

INSTRUCTION MANUAL

3535

LCR HiTESTER

HIOKI E. E. CORPORATION

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Introduction

- The Quick Start Manual is supplied with your 3535 LCR HiTESTER. Refer to the manual for information on pre-operation procedures, connecting to peripheral devices, basic measurements, and maintenance.
- This Instruction Manual provides detailed information on settings procedures for individual screens, operational applications, interfaces, specifications, and accuracy.

Symbols



Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.



Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument.



Advisory items related to performance or correct operation of the instrument.



Indicates the reference.



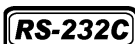
Indicates quick references for operation and remedies for troubleshooting.



Indicates terminology explained at the bottom of the page.



Indicates descriptions relating to the GP-IB only.



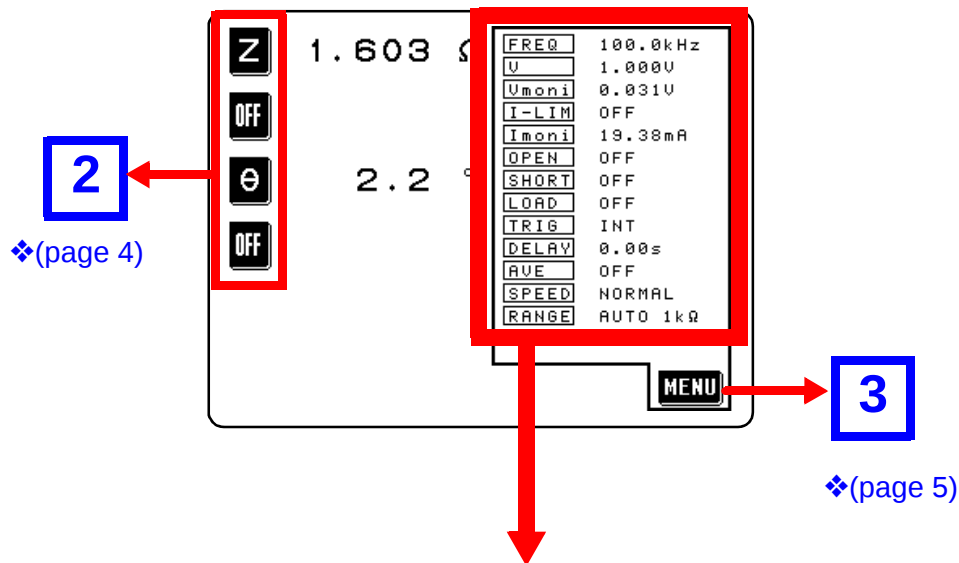
Indicates descriptions relating to the RS-232C only.

Screen Configuration

Chapter 1

1 Initial Screen

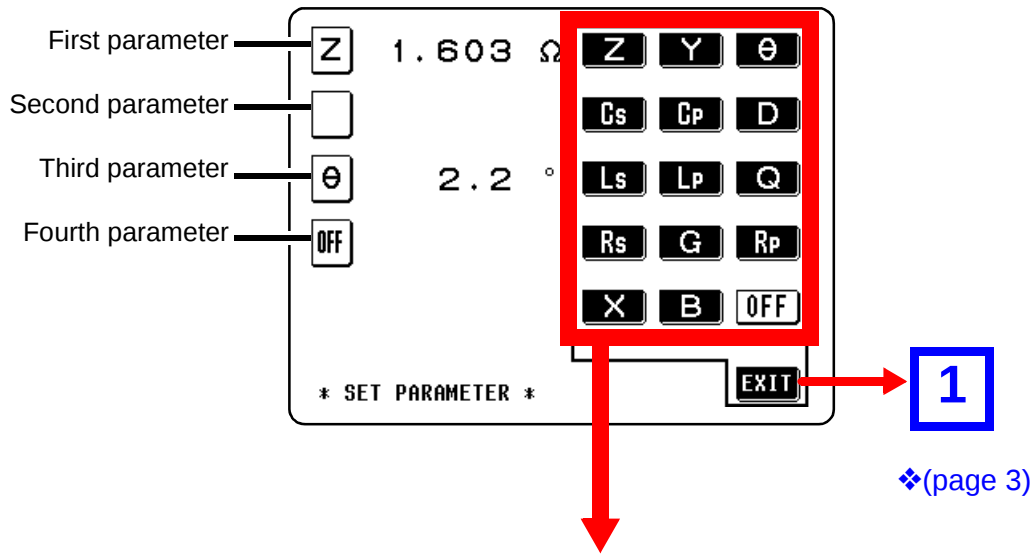
2.1, "Initial Screen" (page 7)



		Section (page)
FREQ	Measurement frequency	❖ 3.1 (page 9)
U	Measurement signal level	❖3.2 (page 12)
Umoni	Voltage value between the terminals	❖(page 15)
I-LIM	Measurement current limit value	❖3.3 (page 16)
Imoni	Current value flowing through the measurement sample	❖(page 15)
OPEN	Open-circuit compensation setup	❖3.4 (page 18)
SHORT	Short-circuit compensation setup	❖3.5 (page 22)
LOAD	Load compensation setup	❖3.6 (page 26)
TRIG	Trigger mode	❖3.7 (page 31)
DELAY	Setting value for the trigger delay	❖3.8 (page 33)
AVE	Number of times for averaging	❖3.9 (page 34)
SPEED	Measurement speed	❖3.10 (page 36)
RANGE	Measurement range	❖3.11 (page 37)

2 Parameter Setting Screen

2.2, "Selecting Parameters" (page 7)



Z	Impedance (Ω)
Y	Admittance (S)
θ	Impedance phase angle ($^{\circ}$) * 1
Cs	Static capacitance in series-equivalent circuit mode (F) ❖(page 191)
Cp	Static capacitance in parallel-equivalent circuit mode (F) ❖(page 191)
D	Dissipation factor = $\tan\delta$
Ls	Inductance in series-equivalent circuit mode (H)
Lp	Inductance in parallel-equivalent circuit mode (H)
Q	Q factor
Rs	Effective resistance in series-equivalent circuit mode = ESR (Ω)
Rp	Effective resistance in parallel-equivalent circuit mode (Ω)
G	Conductance (S)
X	Reactance (Ω)
B	Susceptance (S)
OFF	Display no measurement parameter in the chosen position

All parameters excluding the impedance phase angle θ is displayed as absolute value. To check the polarity, confirm the impedance phase angle θ .

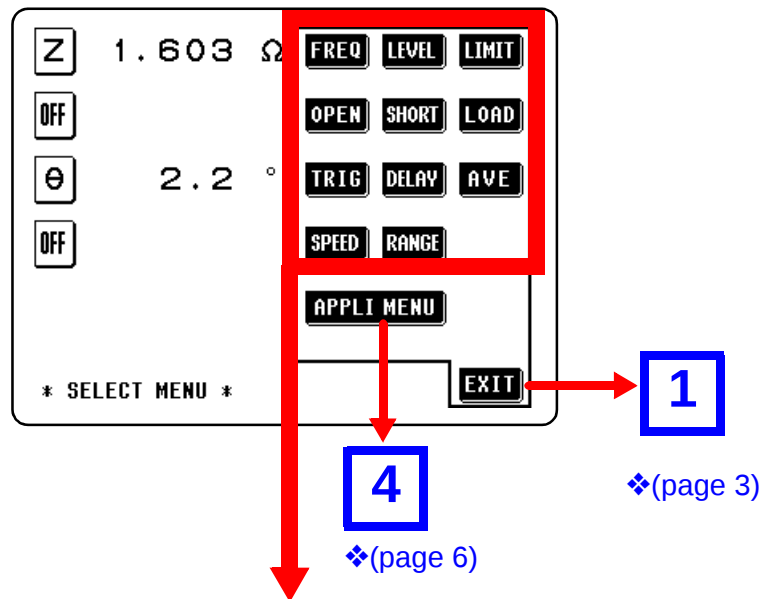
*1: The phase angle θ is shown based on the impedance Z. When measuring based on the admittance Y, the sign of the phase angle θ must be reversed.

❖ Parameters and Calculation Equations(page 182)

❖ Measurement Range and Accuracy(page 186)

3 Menu Screen

Chapter 3, "Setting the Menu Screen" (page 9)

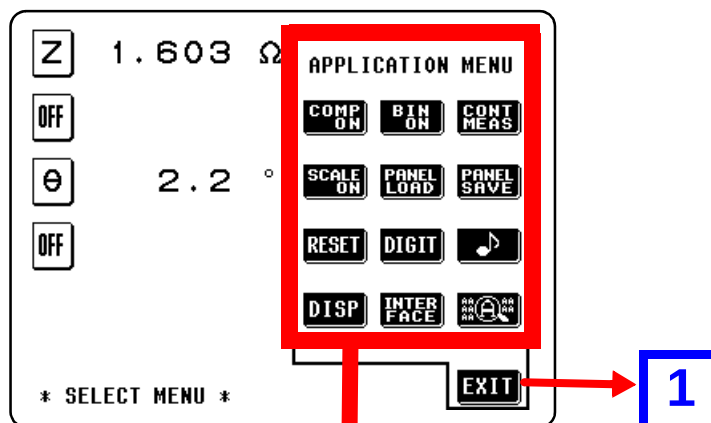


FREQ	Measurement frequency setting	❖ (page 9)
LEVEL	Measurement signal level setting	❖ (page 12)
LIMIT	Limit setting	❖ (page 16)
OPEN	Open-circuit compensation setting	❖ (page 18)
SHORT	Short-circuit compensation setting	❖ (page 22)
LOAD	Load compensation setting	❖ (page 26)
TRIG	Trigger setting.....	❖ (page 31)
DELAY	Trigger delay function	❖ (page 33)
AVE	Averaging setting.....	❖ (page 34)
SPEED	Measurement speed setting	❖ (page 36)
RANGE	Measurement range setting.....	❖ (page 37)

Press the corresponding key to switch to the screen for setting measurement conditions.

4 Application Menu Screen

Chapter 4, "Setting the Application Menu Screen" (page 41)



❖(page 3)

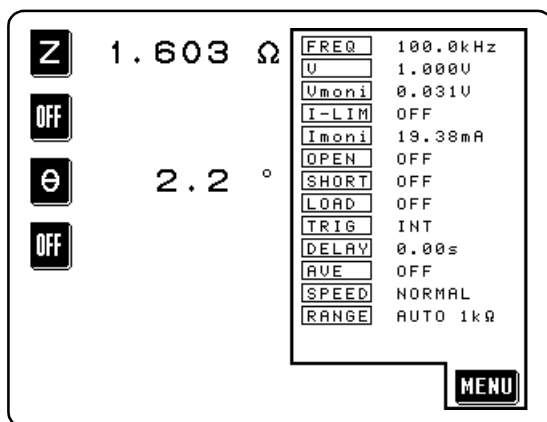
COMP ON	COMP OFF	Comparator function	❖ (page 41)
BIN ON	BIN OFF	BIN (classification) measurement function.....	❖ (page 47)
SCALE ON	SCALE OFF	Scaling function	❖ (page 52)
CONT MEAS		Continuous measurement function	❖ (page 67)
PANEL LOAD		Panel load function	❖ (page 59)
PANEL SAVE		Panel save function	❖ (page 56)
RESET		System reset.....	❖ (page 65)
DIGIT		Display digits setting	❖ (page 71)
		Beep sound setting	❖ (page 61)
DISP		Display setting	❖ (page 73)
INTER FACE		Interface setting	❖(page 89)/ (page 98)
		Zoom display function.....	❖ (page 63)

Press the corresponding key to switch to the screen for setting measurement conditions.

Setting the Initial Screen

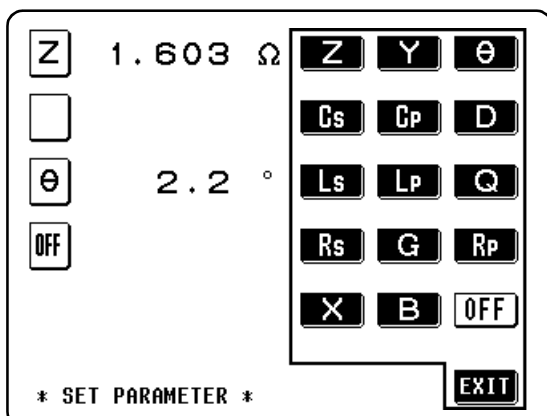
Chapter 2

2.1 Initial Screen



This screen is displayed first after the power is turned on.

2.2 Selecting Parameters



Parameter Setting Screen

On the Parameter Setting Screen, you can set any parameters (such as L, C, and R) or check the measurement conditions. Up to four parameters can be defined.

1. Press any parameter key on the Initial Screen.
2. Select the parameter to be measured.

When you press the desired key, the selected parameter is set and the Initial Screen is automatically displayed.

To return to the Initial Screen without setting a parameter, press **EXIT**.

❖ 7.2, "Parameters and Calculation Equations" (page 182)



Setting the Menu Screen

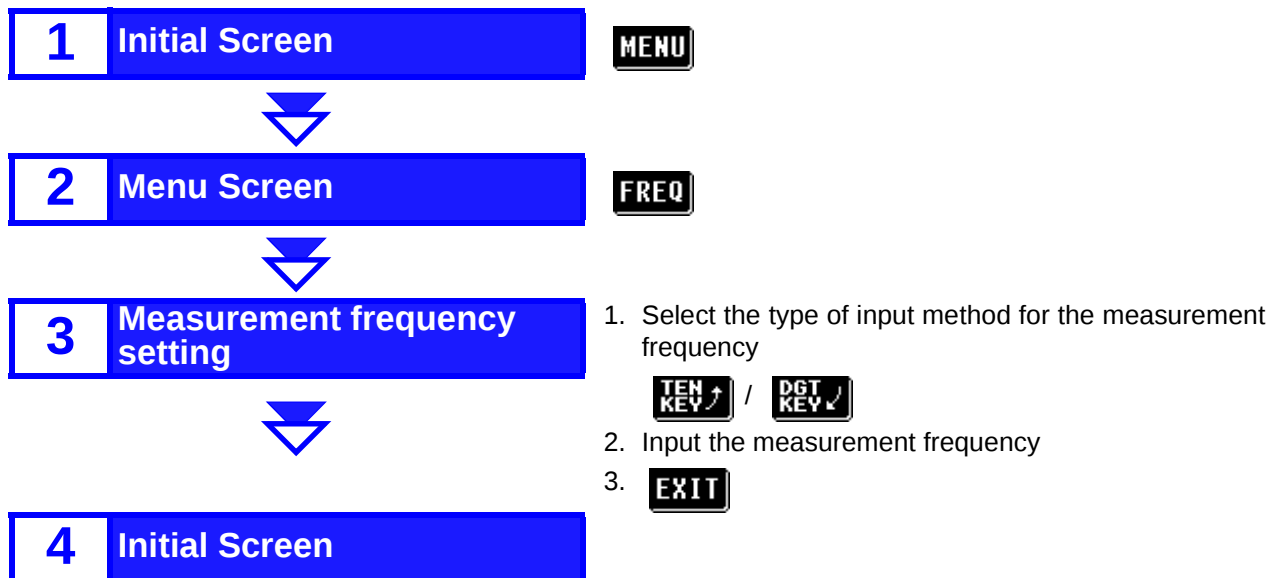
Chapter 3

For basic operating procedures, see the Quick Start Manual.

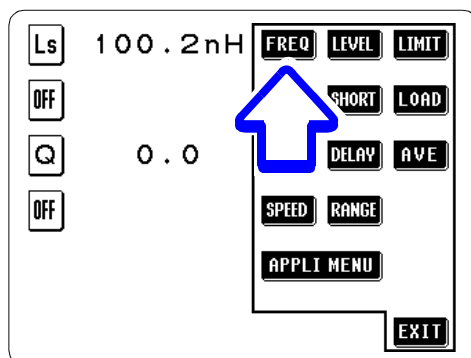
3.1 Setting the Measurement Frequency

The measurement frequency may vary depending on the frequency range of the sample.

Control Screen Sequence



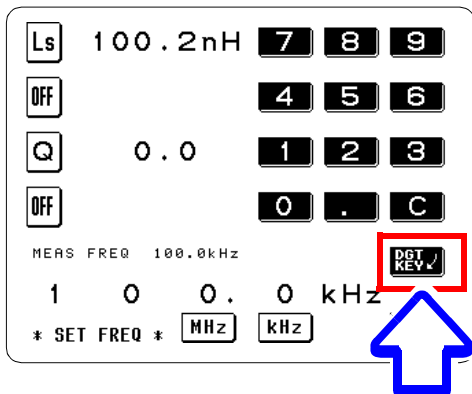
Setting Method



Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **FREQ**
Display the Frequency Setting Screen.

3.1 Setting the Measurement Frequency



3. Select the type of input method for the measurement frequency.



Enter the numeric value directly.

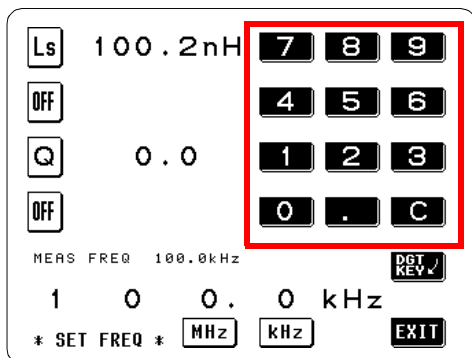


Set the numeric value for each digit.

4. Set the measurement frequency.

Settable range: 100.0 kHz to 120 MHz

❖ Explanation of the Screens TEN KEY/ DGTKEY (page 11)



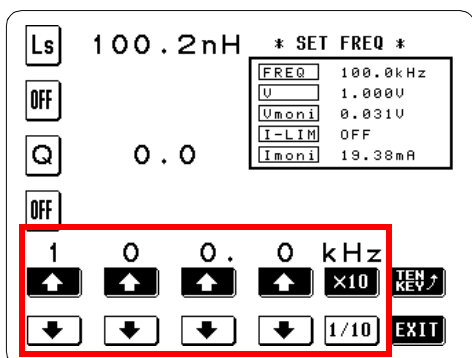
Frequency Setting Screen
Using the numeric keypad

- **TEN KEY** Using the keypad _____

- 1) Enter the frequency using the keypad.
If you make a mistake during input:
press **C** to cancel the input and start again.
- 2) After entering the numerical value, select the unit
and confirm it. (**MHz** or **kHz**)

NOTE

- If you change the screen before confirmation, the measurement frequency will not have been changed.
- The unit keys are disabled until the numerical value has been entered.
- If a value in excess of 120 MHz is entered, the measurement frequency will automatically set to 120 MHz.
- If a value less than 100 kHz is entered, the measurement frequency will automatically set to 100 kHz.



Frequency Setting Screen
Using the digit keys

- **DGT KEY** Using the digit keys _____

- 1) Enter the frequency, one digit at a time, with the digit keys.
Holding down a digit key increases or decreases the number continuously. When the frequency reaches the upper or lower limit, the digit keys are highlighted.
- 2) Select the position of the decimal point and the unit. (**×10** or **1/10**)

5. **EXIT**

Return to the Initial Screen.

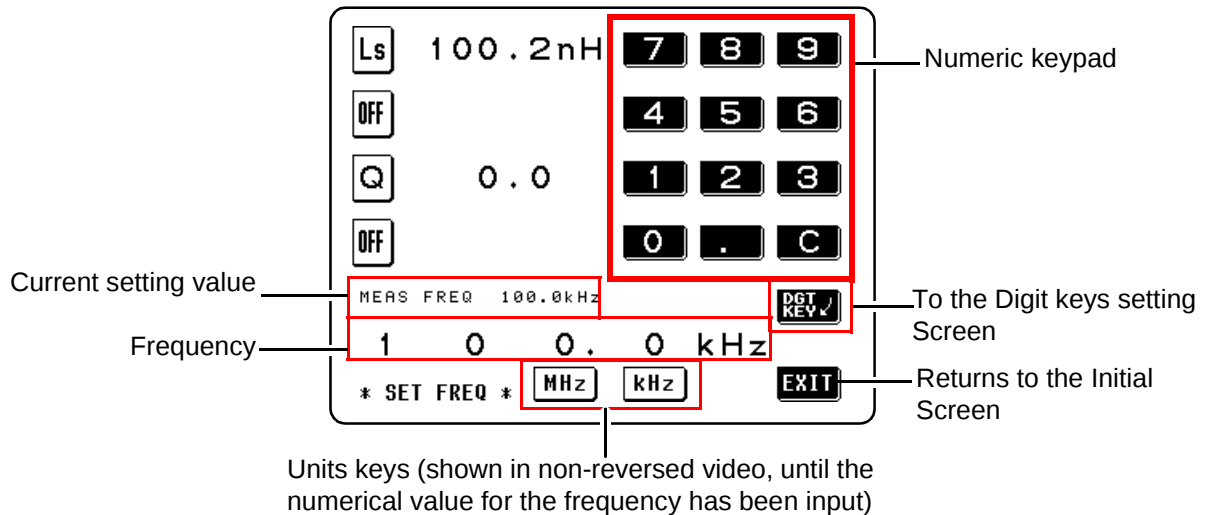
Explanation of the Screens TEN KEY/ DGTKEY

Two measurement frequency input methods are available. You can select the desired method by toggling between the input screens.



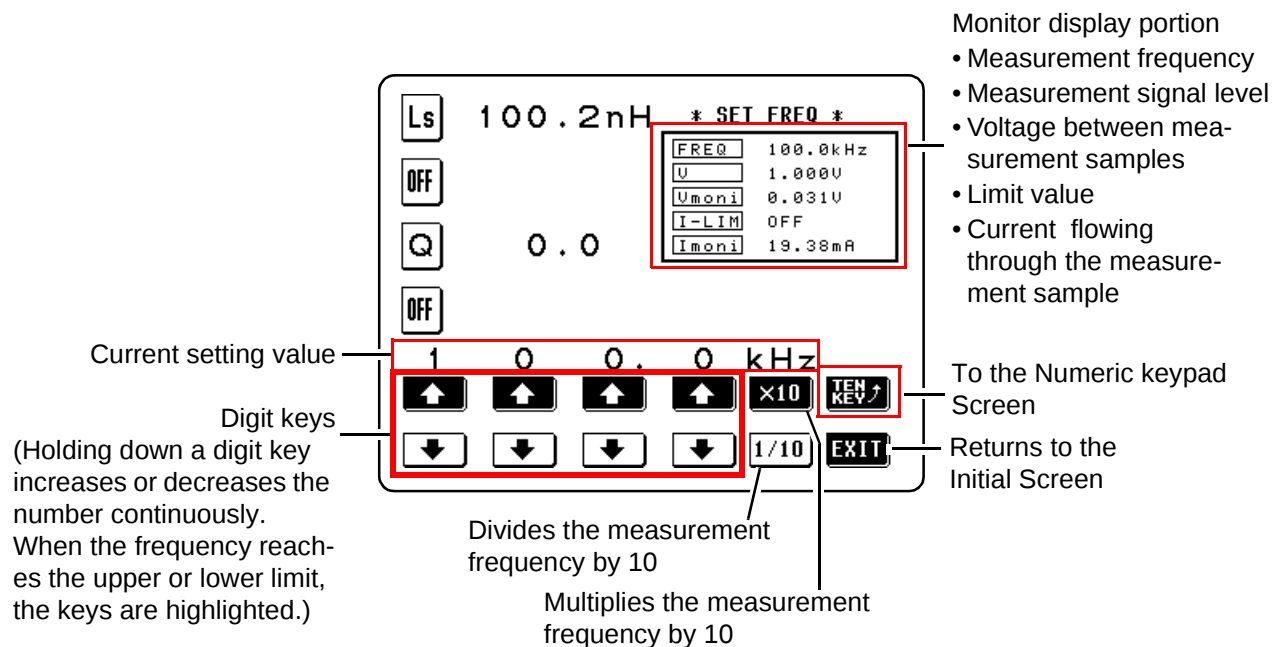
Numeric Keypad Setting Screen

Enter the new measurement frequency directly using the numeric keypad.



Digit Keys Setting Screen

Enter the digits of the measurement frequency with the digit keys.



NOTE

When the measurement signal frequency exceeds 10 MHz, the maximum open circuit voltage level is 0.5 V. When the input value exceeds 0.5 V, the voltage is automatically set to 0.5 V.

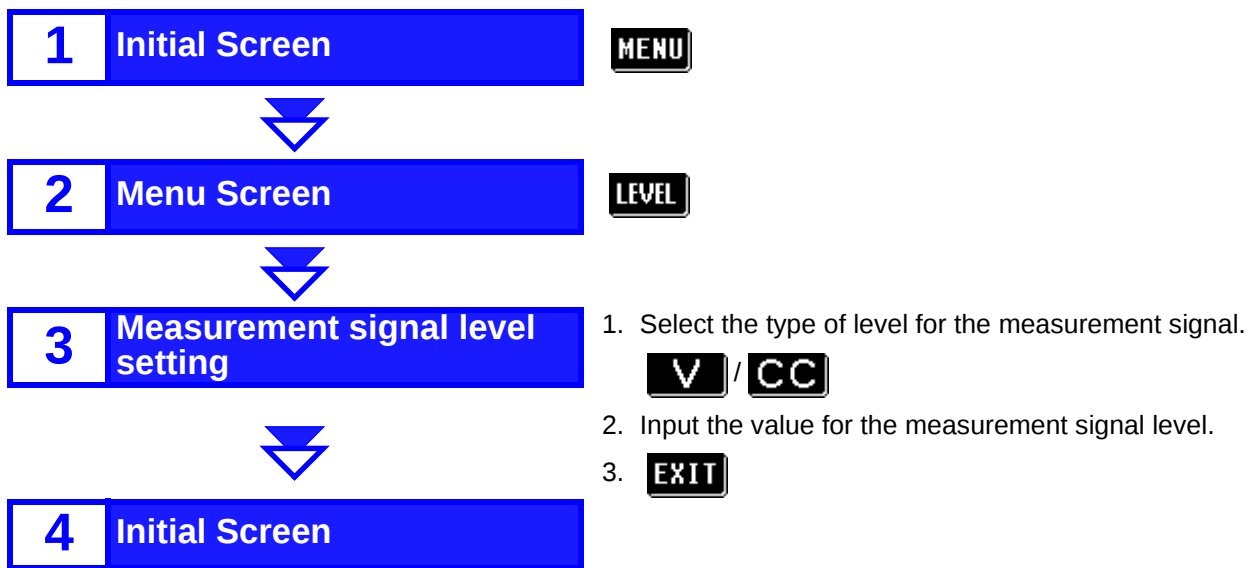
3.2 Setting the Measurement Signal Level

The value of the measurement signal level may change according to the sample which is being measured.

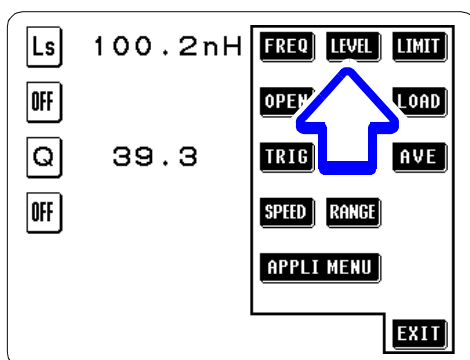
Measurement signal level:

- Open-circuit voltage setting (V)
The value of the open-circuit voltage is set.
- Constant current setting (CC)
The value of the current flowing through the object under measurement is set.

Control Screen Sequence



Setting Method



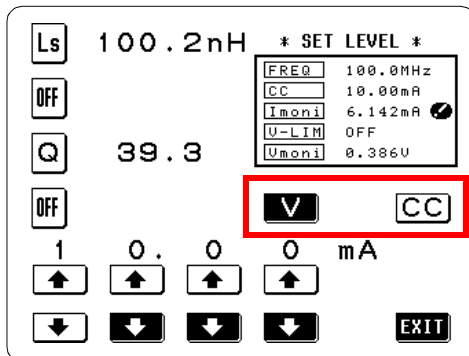
Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **LEVEL**
Display the Measurement Level Setting Screen.



Be absolutely sure not to change over between **V** and **CC** with the measurement terminals still connected to the sample to be measured. Doing so may damage the measurement sample.



Measurement Signal Level
Selecting Screen

3. Select the method of control for the measurement signal level.



The value of the open-circuit voltage is set.



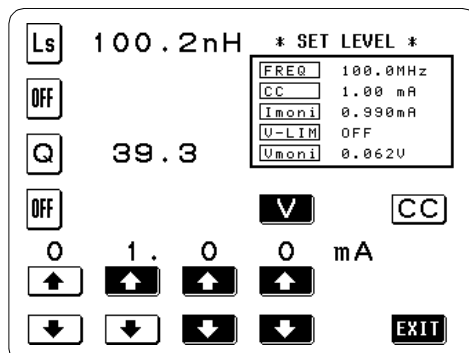
The value of the current flowing through the object under measurement is set.

The accuracy of measurement varies according to the measurement signal level.

- ❖ 7.4, "Measurement Range and Accuracy" (page 186)
- ❖ Explanation of the Screens V/ CC (page 15)

NOTE

When the measurement frequency exceeds 10 MHz, the maximum open circuit voltage is limited to 0.5 V.



When the CC (constant current)
setting

4. Set the voltage or current value.



Setting the open-circuited voltage _____

Change the open-circuited voltage value using the digit keys.



Setting the constant current _____

Change the constant current value using the digit keys.

5. **EXIT**

Return to the Initial Screen.



When is displayed:

When a set current cannot flow in constant current (CC) setting, this symbol is displayed.

Action:

Change the constant current level to a value not more than the value being shown as Imoni.

- ❖ For more details; "Reference: Measurable range of constant current (Im)" (page 14)

Reference: Measurable range of constant current (Im)

When  appears during the measurement of constant current, the measurable range can be calculated with the following equation.

$$I_m = V_o / |Z_m'|$$

Z_m' : impedance from the generator

V_o : generator output

(Example)

When a 10 μ H impedance (L) is measured at 100 kHz:

$$Z_m' = R_o + Z_m \quad (R_o : \text{output resistance (50 } \Omega))$$

$$= R_o + (R_m + jX_m) \quad (X_m : 2 \pi fL)$$

$$= 50 \Omega + (0 \Omega + j6.28 \Omega)$$

$$= 50 \Omega + j6.28 \Omega \quad (Z_m' = \sqrt{(R_o + R_m)^2 + X_m^2})$$

$$= 50.39 \Omega$$

$$V_o = 5 \text{ mV to } 1 \text{ V} \quad (\text{the generator output voltage range at 100 kHz})$$

$$I_m = V_o / 50.39 \Omega$$

$$= 99.22 \mu\text{A to } 19.84 \text{ mA}$$

Explanation of the Screens

VI CC

There are two options to flexibly change the measurement signal level applied to the sample.



Open-circuit voltage (V) setting

The value of the open-circuit voltage is set.



Constant current (CC) setting

The value of the current flowing through the object under measurement is set.

Current value

Digit keys

Holding down a digit key increases or decreases the number continuously. When the value reaches the upper or lower limit, the keys are highlighted.

Open-circuit voltage (V) setting

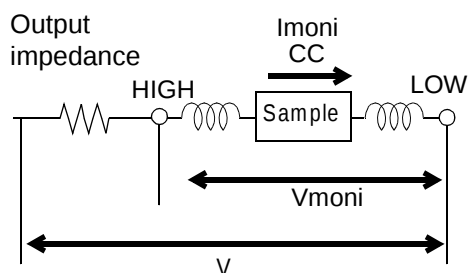
Constant current (CC) setting

Monitor display portion

- Measurement frequency
- Measurement signal level
- Voltage between terminals
- Limit value
- Current flowing through the measurement sample

The current status can be checked on the monitor screen.

The measurement signal level and Monitor value



- Open-circuit voltage level (V)
Voltage applied between the terminals of an open circuit where output impedances are connected to the sample in series
- Constant current level (CC)
The setting where the current flow in the sample is constant
- Current monitor (Imoni)
For current flow in the sample
- Voltage monitor (Vmoni)
The voltage applied between the HIGH and LOW terminals

3.3 Setting the Voltage/Current Limit

Depending on the measurement signal level, in some cases it is possible to damage the sample which is being measured by applying to it a voltage or a current greater than its rated value.

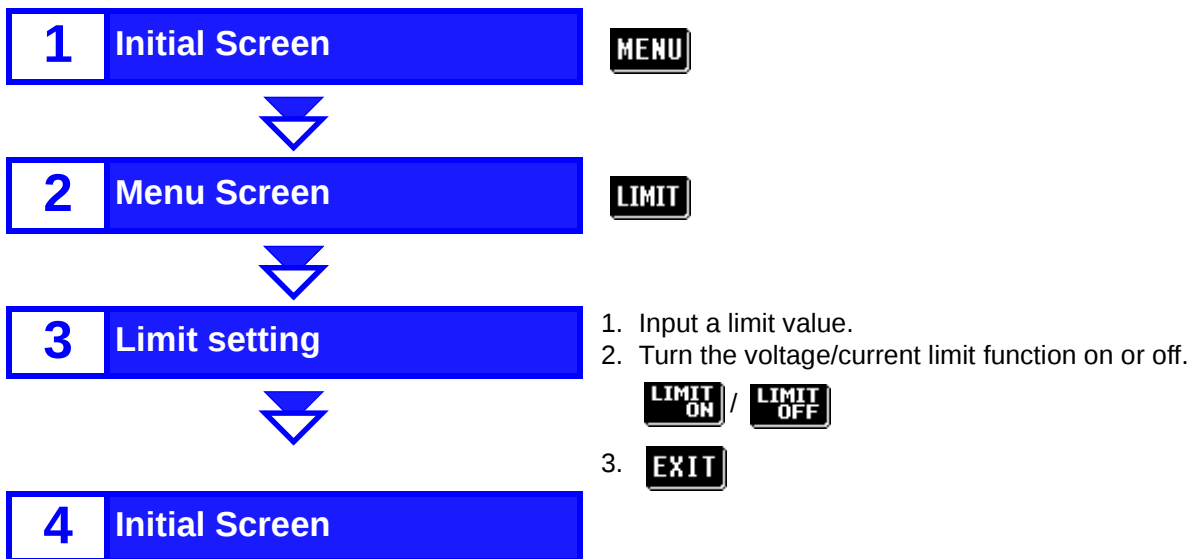
Using the voltage/current limit function, it is possible to set a limit value which the voltage applied to the sample under measurement, or alternatively the current flowing through it, should not exceed; and thereafter the 3535 unit will limit the voltage, or current, so as keep it below this specified limit value.

The voltage/current limit setting is changed automatically according to the measurement signal level in use. Therefore, specify the measurement signal level before entering the voltage and current limits.

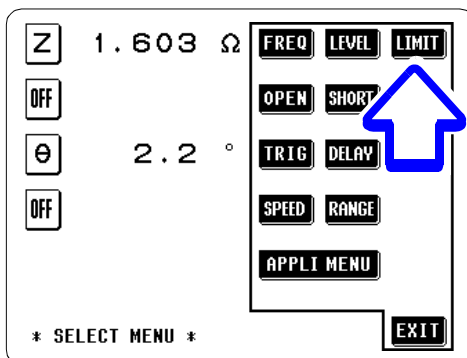
❖3.2, "Setting the Measurement Signal Level" (page 12)

- When open-circuit voltage (V) is set: a current limit can be set.
- When constant current (CC) is set: a voltage limit can be set.

Control Screen Sequence



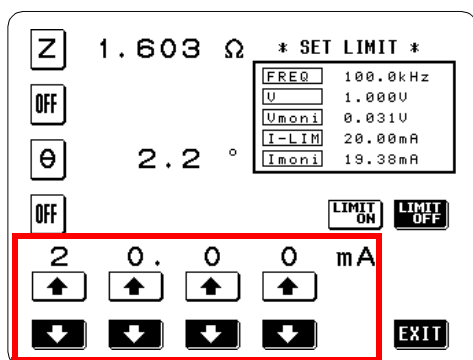
Setting Method



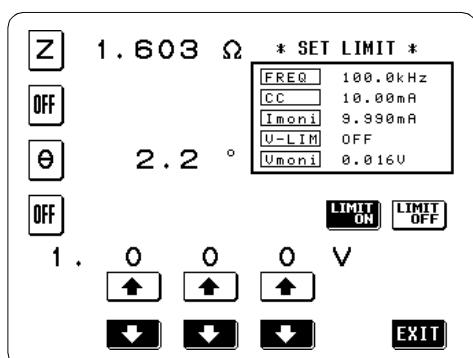
Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **LIMIT**
Display the Limit Setting Screen.

3.3 Setting the Voltage/Current Limit



Current Limit Setting Screen



Voltage Limit Setting Screen

3. Input the limit value using the digit keys.

The ranges within which the limit values can be set.

Measurement signal control level	Limit set	Setting range
V	Current limit	0.20 mA to 20.00 mA
CC	Voltage limit	0.005 V to 1.000 V

When the voltage or current reaches the upper or lower limit, the digit keys are highlighted.

4. Turn the voltage/current limit function on.



The limit function is turned on.



The limit function is turned off.

The current settings can be checked on the monitor screen.

5. EXIT

Return to the Initial Screen.



When **limit** / is displayed:

When the limit function has been turned on, and either of the following occurs, the associated symbol is displayed.



If the measurement signal level which is being applied to the sample under measurement exceeds the limit value. Then the measurement signal level is stopped changing.

At this time, the voltage or current which exceeds the limit value is not being applied to the sample under measurement. You should change the measurement signal level so that it does not exceed the limit value.



If the voltage or current which is applied to the sample under measurement exceeds the limit value (the current exceeding the limit value flows through the sample even when the open-circuit voltage is set to minimum value.)

3.4 Open Circuit Compensation

With open-circuit compensation, it is possible to reduce the influence of the floating impedance of the test fixtures and test cables, and thereby to enhance the accuracy of measurement. It is effective for measurement samples whose impedance is relatively high.

Open-circuit compensation may be performed according to either of two methods:

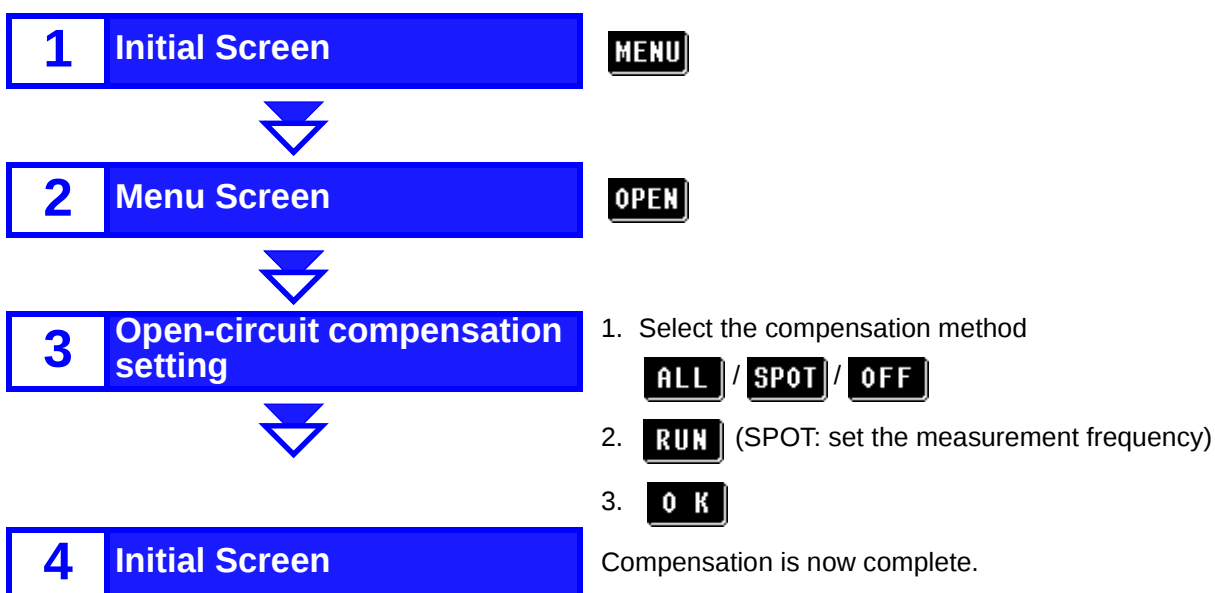
- ALL compensation (ALL)
Compensation is performed at all the measurement frequencies.
- SPOT compensation (SPOT)
Compensation is performed for one specified measurement frequency only.
- OFF
The open-circuit compensation data are cleared.

NOTE

- The measurement accuracy specified in the specification of this unit assumes that open-circuit compensation and short-circuit compensation is being performed, as appropriate.
- Whenever the test fixtures or the HEAD AMP UNIT is changed, re-execute the open circuit compensation. If the previous compensation conditions remain, test results will be inaccurate.
- For SPOT compensation, the open circuit compensation will be valid only when the measurement frequency agrees with the SPOT compensation frequency.

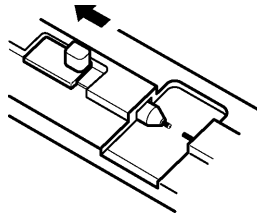
Control Screen Sequence

Before setting up the screens, ensure that the test fixtures have been adequately prepared and that both the HIGH and LOW terminals are open.

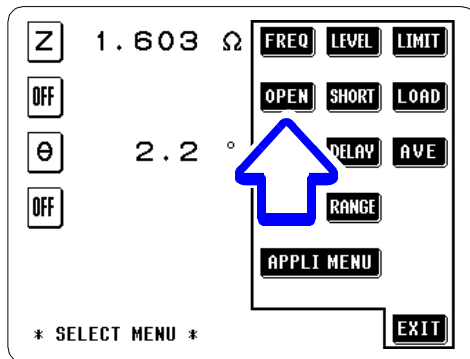


Setting Method

(Example)
When using
the 9677



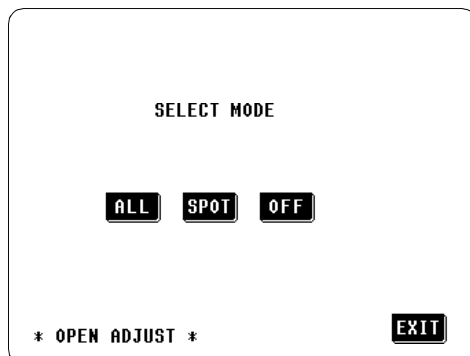
Open both terminals before carrying out measurement with the 3535.



Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **OPEN**
Display the Open Circuit Compensation Screen.



Open Circuit Compensation Screen

3. Select the open-circuit compensation method.

- ALL** The compensation values are obtained for all measurement frequencies.
- SPOT** The compensation values are obtained at the set measurement frequency only.
- OFF** The open-circuit compensation data are cleared.

Compensation time (from start to acquisition of compensation value)

ALL About 5 minutes

SPOT About 5 seconds

4. Set the compensation.

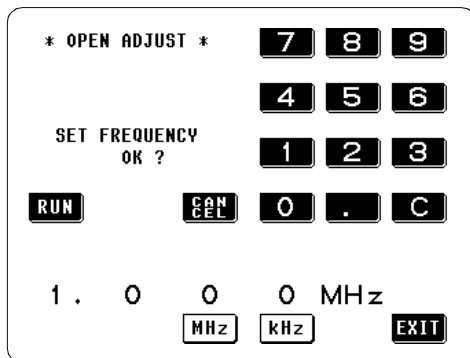


When ALL is selected

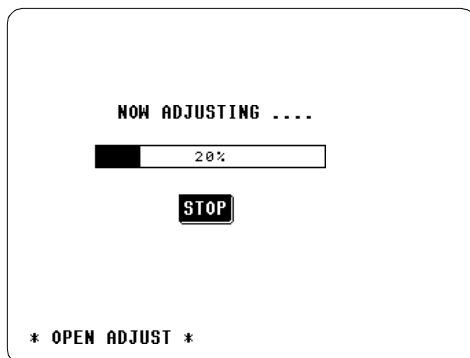
- **ALL** _____
A Confirmation Screen will appear for confirmation.

Check that both the terminals are open.

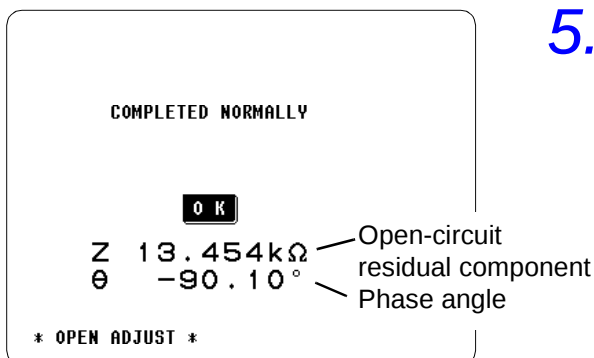
- RUN** Continue. (ALL compensation starts)
- CANCEL** Cancel (return to the Open Circuit Compensation Screen)



When SPOT is selected



Compensation is underway



Compensation is completed

SPOT

A numeric keypad is displayed for input of the frequency. Until one of these keys is pressed for input of a numerical value, the previous frequency for which SPOT compensation was performed is displayed.

Check that both the terminals are open.

RUN

SPOT compensation for the same frequency as previously

CANCEL

Cancel
(return to the Open Circuit Compensation Screen)

SPOT compensation for some new frequency:

- 1) Input the frequency for compensation using the numeric keypad.

Settable range: 100 kHz to 120 MHz)

NOTE

- If a value in excess of 120 MHz is entered, the measurement frequency will automatically set to 120 MHz.
 - If a value less than 100 kHz is entered, the measurement frequency will automatically set to 100 kHz.
 - If you make a mistake during input:
press **C** to cancel the input and start again.
- 2) Select the unit and confirm it.
The unit keys are disabled until the numerical value has been entered.
 - 3) Press **RUN** (SPOT compensation starts)

Interrupting the SPOT compensation process:

STOP

The compensation process will stop and the display will return to the Initial Screen.

At this time, the previous open circuit compensation data will remain.

❖When an error message appears(page 21)

5.

Check the compensated values and press

OK

When compensation has been completed correctly, the open circuit residual and phase angle are displayed on the screen. (The values displayed are for the cable measured under 120 MHz (ALL) or the set measurement frequency (SPOT).

❖Open-circuit compensation and Short-circuit compensation(page 192)



**When an error
message appears**

Press **OK** to terminate the compensation process.

The open circuit compensation is now turned off.

Open circuit compensation is susceptible to influence by external or induced noise, so conduct the following examinations and re-execute.

- Check that fixtures or test cables are connected correctly.
- Check that measurement terminals are open. (Open circuit compensation and sample measurement cannot be performed simultaneously.)
- Check that, as far as is practically possible, open circuit compensation was executed with all fixtures and test cables adjusted according to actual conditions of use.
- Do not touch the fixtures or test cables or move your hands near them during compensation.



**To clear the
compensation data**

Press **OFF** on the Open circuit compensation screen.

The display will return to the Initial Screen with the compensation data cleared.

3.5 Short Circuit Compensation

With short-circuit compensation, it is possible to reduce the influence of the residual impedance of the test fixtures and test cables, and thereby to enhance the accuracy of measurement. It is effective for measurement samples whose impedance is relatively low.

Short-circuit compensation may be performed according to either of two methods:

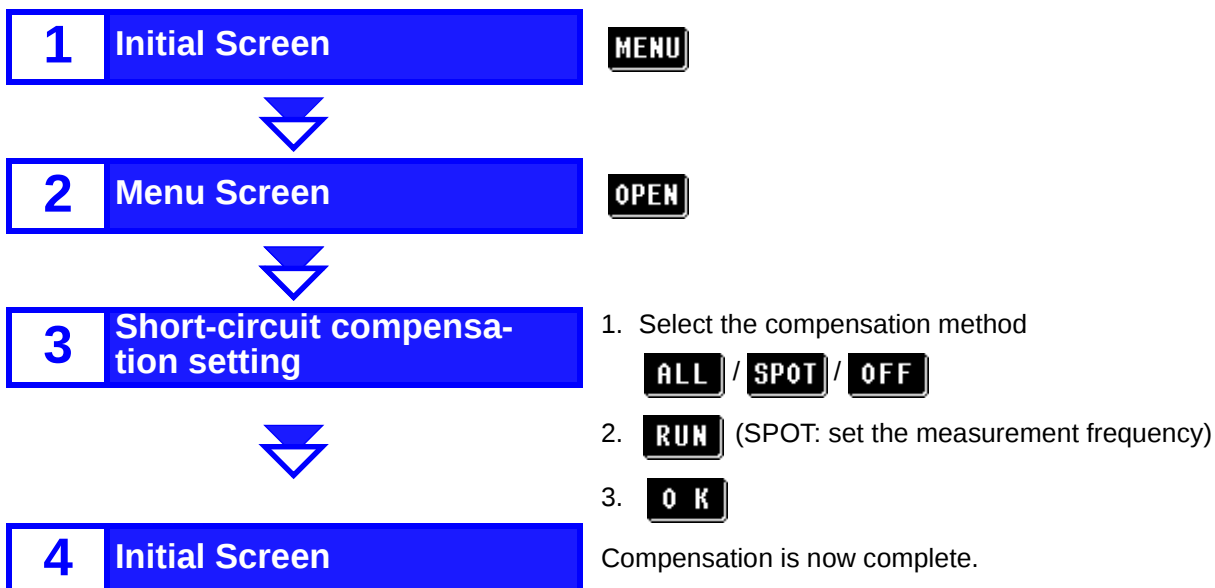
- ALL compensation (ALL)
Compensation is performed at all the measurement frequencies.
- SPOT compensation (SPOT)
Compensation is performed for one specified measurement frequency only.
- OFF
The short-circuit compensation data are cleared.

NOTE

- The measurement accuracy specified in the specification of this unit assumes that open-circuit compensation and short-circuit compensation is being performed, as appropriate.
- Whenever the test fixtures or the HEAD AMP UNIT is changed, re-execute the short circuit compensation. If the previous compensation conditions remain, test results will be inaccurate.
- For SPOT compensation, the short circuit compensation will be valid only when the measurement frequency agrees with the SPOT compensation frequency.

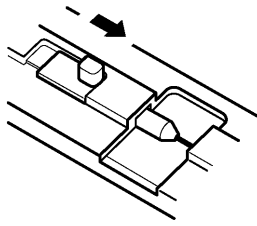
Control Screen Sequence

Before setting up the screens, ensure that, as far as is practically possible, all test fixtures have been adequately prepared, and then short-circuit both the HIGH and LOW terminals.

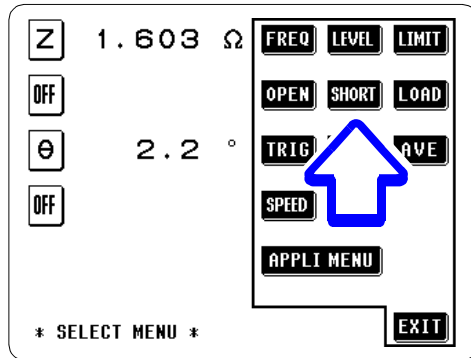


Setting Method

(Example)
When using
the 9677



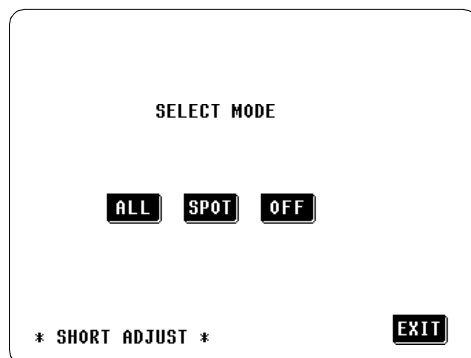
Before setting up the screens, ensure that, as far as is practically possible, the test fixture has been adequately prepared, and then short-circuit both the HIGH and LOW terminals.



Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **SHORT**
Display the Short Circuit Compensation Setting Screen.



Short Circuit Compensation Setting Screen

3. Select the short-circuit compensation method.

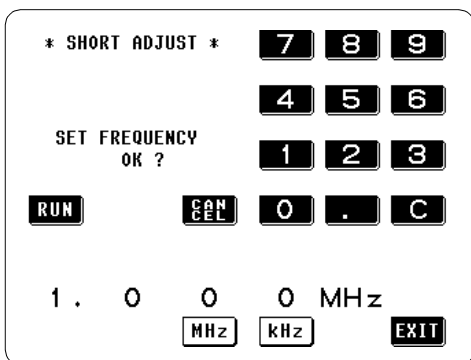
- ALL** The compensation values are obtained for all measurement frequencies.
- SPOT** The compensation values are obtained at the set measurement frequency only.
- OFF** The short-circuit compensation data are cleared.

Compensation time (from start to acquisition of compensation value)

- ALL About 5 minutes
- SPOT About 5 seconds



When ALL is selected



When SPOT is selected

4. Set the compensation.

- **ALL** _____
A Confirmation Screen will appear for confirmation.
Check that both the measurement terminals are short-circuited.

RUN Continue. (ALL compensation starts)
CAN CEL Cancel (return to the Short Circuit Compensation Screen)

- **SPOT** _____
A numeric keypad is displayed for input of the frequency. Until one of these keys is pressed for input of a numerical value, the previous frequency for which SPOT compensation was performed is displayed.
Check that both the measurement terminals are short-circuited.

RUN SPOT compensation for the same frequency as previously
CAN CEL Cancel (return to the Short Circuit Compensation Screen)

SPOT compensation for some new frequency:

- 1) Input the frequency for compensation using the numeric keypad.

Settable range: 100 kHz to 120 MHz)

NOTE

- If a value in excess of 120 MHz is entered, the measurement frequency will automatically set to 120 MHz.
- If a value less than 100 kHz is entered, the measurement frequency will automatically set to 100 kHz.
- If you make a mistake during input:
press **C** to cancel the input and start again.

- 2) Select the unit and confirm it.
The unit keys are disabled until the numerical value has been entered.

- 3) Press **RUN** (SPOT compensation starts)

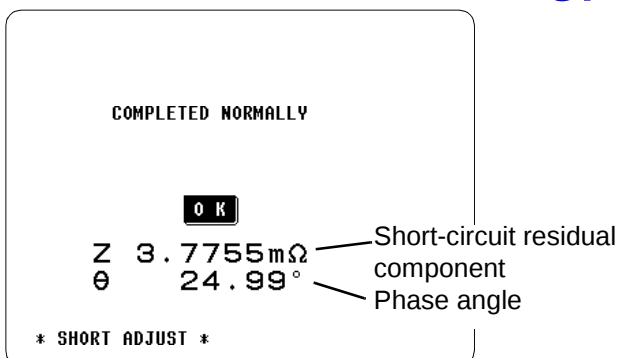


Compensation is underway.

Interrupting the SPOT compensation process: **STOP**

The compensation process will stop and the display will return to the Initial Screen.

At this time, the previous short circuit compensation data will remain.



Compensation is completed.

5. Check the compensated values and press **OK**.

When compensation has been completed correctly, the short circuit residual and phase angle are displayed on the screen. (The values displayed are for the cable measured under 120 MHz (ALL) or the set measurement frequency (SPOT).)

❖ Open-circuit compensation and Short-circuit compensation (page 192)



When an error message appears

Press **OK** to terminate the compensation process.

The short circuit compensation is now turned off. Short circuit compensation is susceptible to influence by external or induced noise, so conduct the following examinations and re-execute.

- Check that fixtures and test cables are connected correctly.
- Check that both the measurement terminals are short-circuited. (Short circuit compensation and sample measurement cannot be performed simultaneously.)
- Check that, as far as is practically possible, short circuit compensation was executed with all fixtures and test cables adjusted according to actual conditions of use.
- Do not touch the fixtures or test cables or move your hands near them during compensation.



To clear the compensation data

Press **OFF** on the Short circuit compensation screen.

The display will return to the Initial Screen with the compensation data cleared.

3.6 Load Compensation Function

With load compensation it is possible to calculate the compensation coefficient by measuring a reference sample with known data and perform the compensation for the test data obtained from the target sample. This function provides the compatibility with the test data.

Load compensation can be performed at up to five measurement frequencies, and the reference for each measurement frequency can be set independently.

The following four compensation conditions should be set for each measurement frequency:

- Compensation frequency
Define the measurement frequency used to measure and compensate the reference sample.
- Reference input mode
Specify what parameters are assigned to References 1 and 2.
- Reference 1
Define the reference values for Z, Cs, Cp, Rs, Ls, or Lp selected in the input mode.
- Reference 2
Define the reference values for θ , D, X, or Q selected in the input mode.

The compensation coefficient is computed from the reference values of Z and θ obtained from the set values and the actual data acquired from the reference sample at each of the compensation frequencies.

$$\text{Compensation coefficient of Z} = \frac{\text{Reference value of Z}}{\text{Actual data of Z}}$$

$$\text{Compensation coefficient of } \theta = (\text{Reference value of } \theta) - (\text{Actual data of } \theta)$$

The measured values of Z and θ are first compensated using the following equations, and then individual parameters from the compensated Z and θ values are employed.

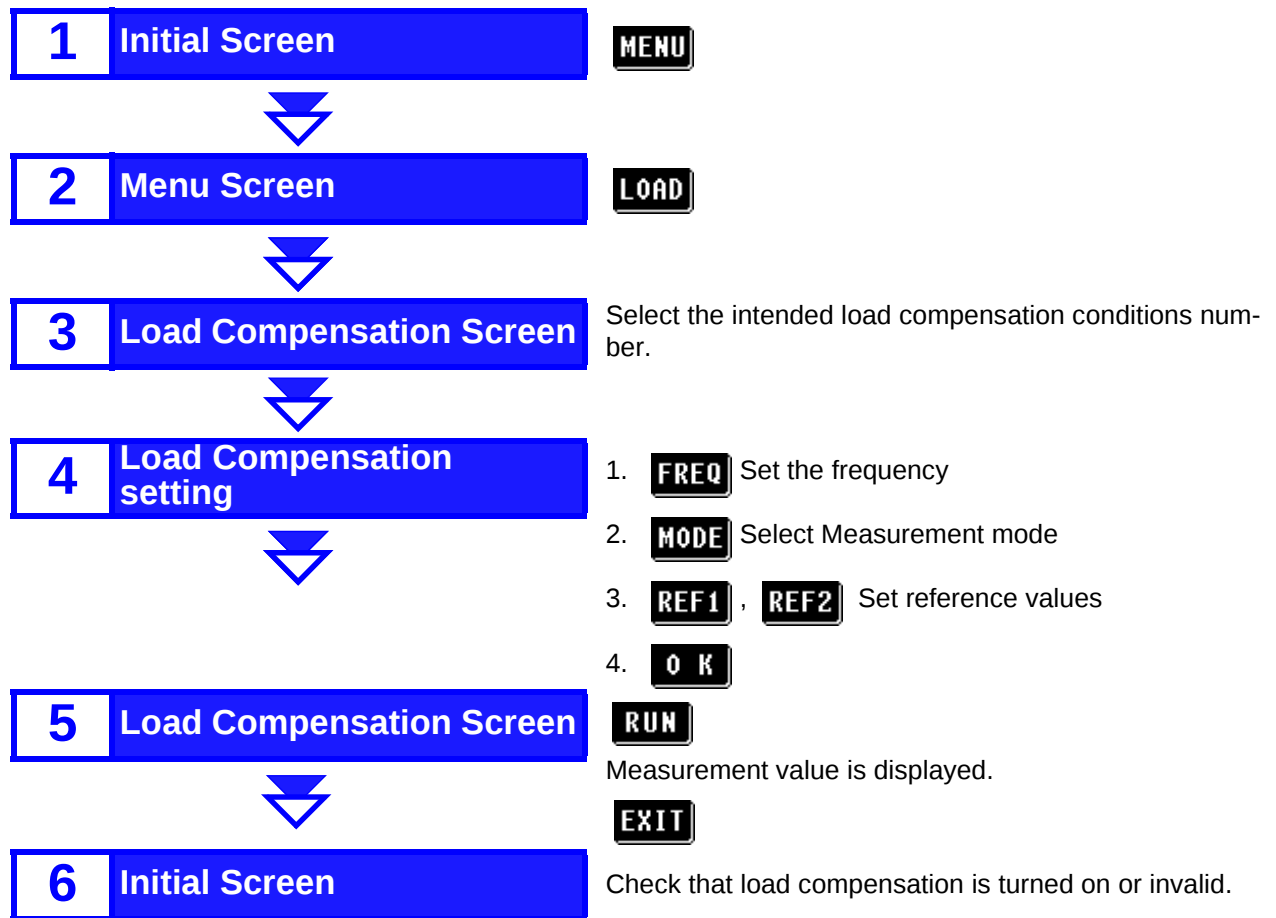
$$Z = (Z \text{ before compensation}) \times (Z \text{ after compensation})$$

$$\theta = (\theta \text{ before compensation}) + (\theta \text{ after compensation})$$

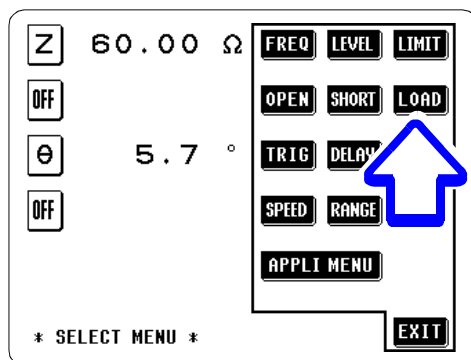
NOTE

- The load compensation is valid only when the measurement frequency agrees with the compensation frequency specified in the load compensation conditions. (When the load compensation is valid for the current measurement conditions, LOAD ON is observed on the Initial Screen.)
- When the OPEN or SHORT compensation is valid, the load compensation is performed for Z and θ processed by the OPEN or SHORT compensation.
- In acquiring load compensation data (i.e., reference sample measurement), the OPEN/SHORT compensation settings, that were defined before entry into the Load Compensation Screen, are valid.

Control Screen Sequence

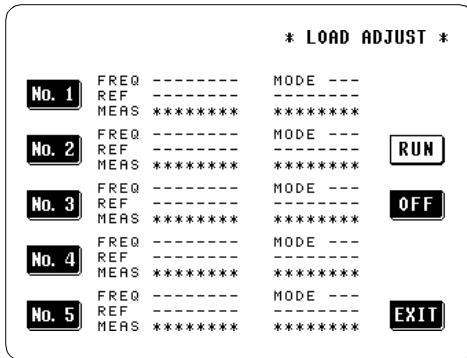


Setting Method

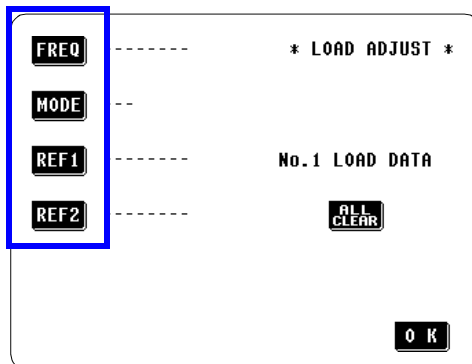


Menu Screen

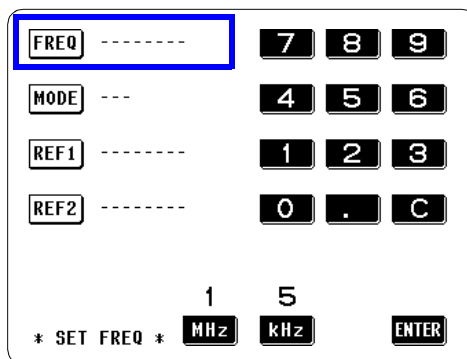
1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **LOAD**
Display the Load Compensation Screen.



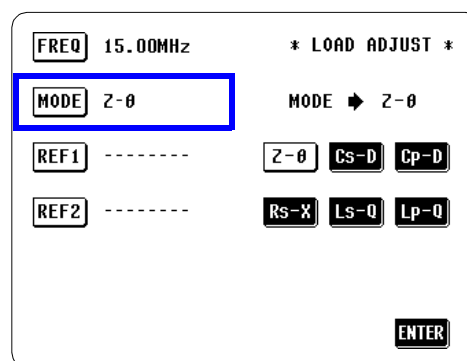
Load Compensation Screen



Compensation Conditions Setting Screen



Frequency setting



Parameter mode setting

3. Select the load compensation conditions number to be set.

The Load Compensation setting screen appears.

4. Select the load compensation conditions to be set.

- FREQ** Set the compensation frequency.
(Define the test frequency used to measure and compensate the reference sample.)
- MODE** Select the reference parameter input mode to be set.
(Specify what parameters are assigned to References 1 and 2.)
- REF1** Set Reference 1.
(Define the reference values for Z, Cs, Cp, Rs, Ls, or Lp selected in the input mode.)
- REF2** Set Reference 2.
(Define the reference values for θ , D, X, or Q selected in the input mode.)
- ALL CLEAR** Delete all set compensation conditions.

- **FREQ** Compensation frequency setting _____

1) Enter the numerical value using the keypad.

2) Select the unit. (**MHz** or **kHz**)

3) **ENTER** Confirm the setting.

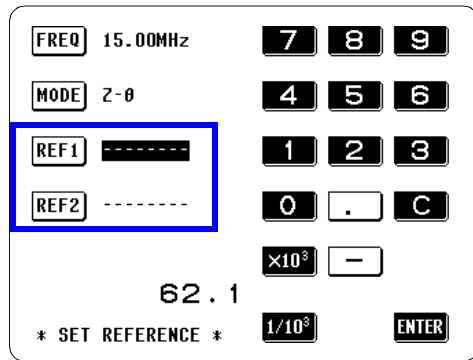
The display returns to the Compensation condition setting screen.

- **MODE** Reference parameter input mode setting _

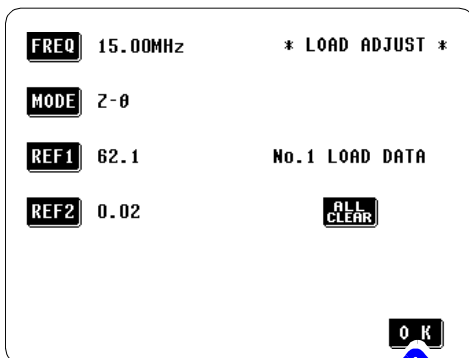
The selected parameters are assigned to REF1 and REF2.

	REF1	REF2	REF1	REF2
Z-θ	Z	θ	Cs-D	Cs D
Cp-D	Cp	D	Rs-X	Rs X
Ls-Q	Ls	Q	Lp-Q	Lp Q

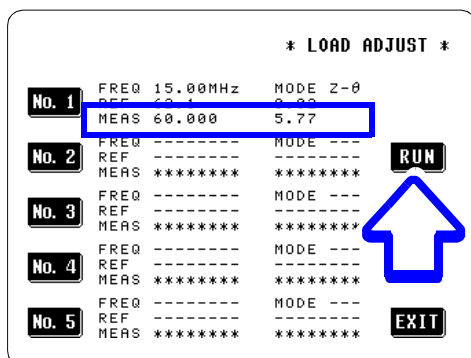
After setting, press **ENTER** .



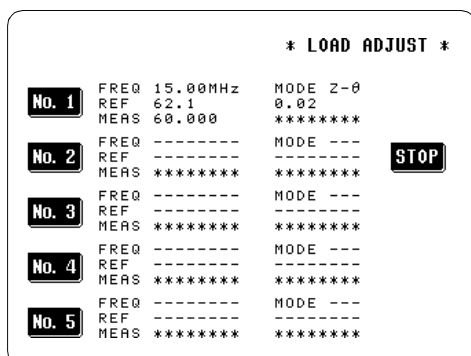
Reference value 1 setting



Compensation Conditions Setting Screen



Load Compensation Screen



Acquisition of compensation data

- **REF1** Reference values of the parameters ____
 - 1) Enter the numerical value using the keypad.
 - 2) Select the unit. ($1/10^3$ or $\times 10^3$)
 - 3) **ENTER** Confirm the setting.

Set the reference values for **REF2**.

NOTE

If the compensation frequency, input mode or reference values are incorrectly set, the load compensation cannot be executed.

5.



Confirm the compensation conditions.

The display returns to the Load Compensation Screen.

NOTE

Attach the reference sample to the test fixtures.

6.



Start acquiring compensation data.

When data acquisition is completed, the reference sample compensation data is displayed on the screen.

NOTE

- When an error occurs during data acquisition, a “beep” sound is generated and the compensation data is invalidated.
- If even one of the load compensation conditions is changed following data acquisition, the acquired compensation data is invalidated.

To cancel the data acquisition process:

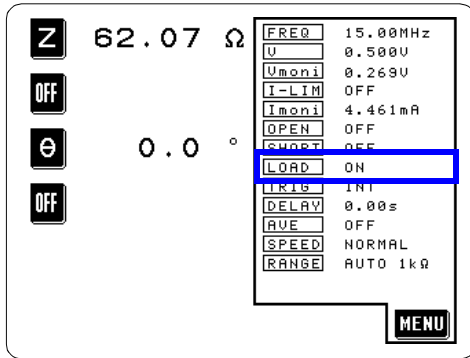
press **STOP**

7.



Return to the Initial Screen.

3.6 Load Compensation Function



Initial Screen

When the load compensation is valid for the set measurement conditions, ON appears on the LOAD parameter in the Initial Screen.

NOTE

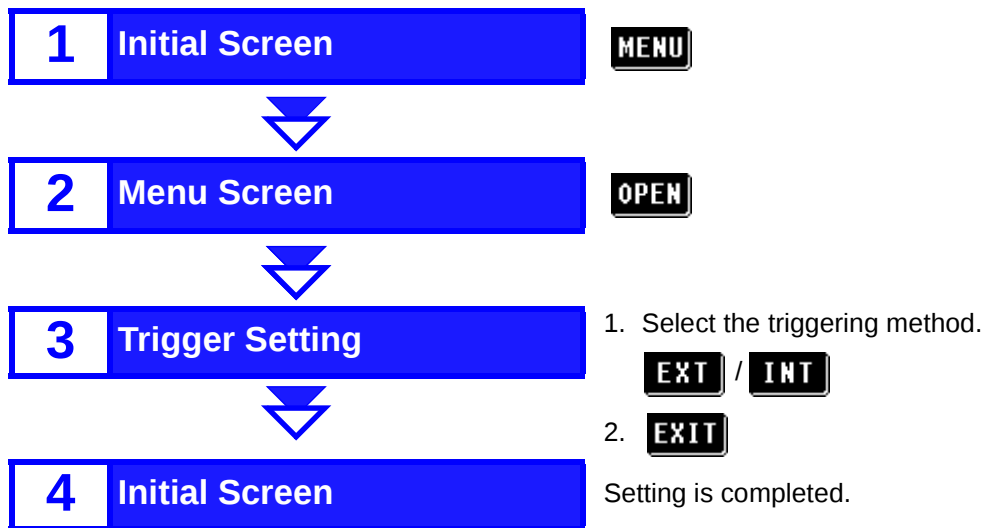
- When the same compensation frequency has been set to multiple load compensation groups, only the group with the smallest number will be valid.
- When the current measurement frequency does not agree with the load compensation frequency, the load compensation will be invalid and ON will not appear.

3.7 Setting the Trigger

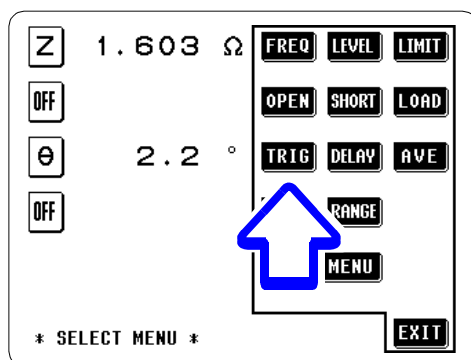
You can select one of two trigger types: internal trigger or external trigger.

- External trigger
For measurement, the trigger signal is either automatically or manually introduced from outside the 3535. (Manual/ EXT I/O/ interface)
- Internal trigger
To perform continuous measurement, the trigger signal is automatically generated within the 3535.

Control Screen Sequence

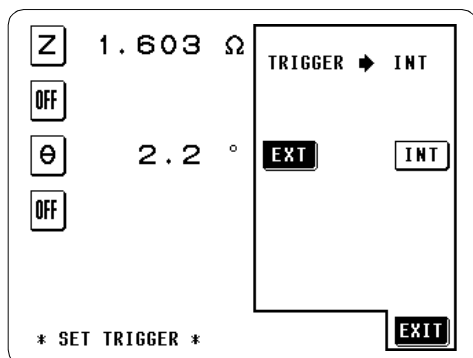


Setting Method

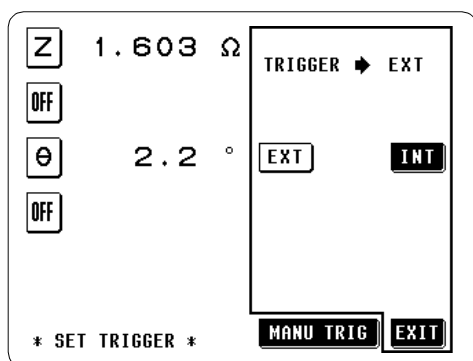


Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **TRIG**
Display the Trigger Setting Screen.



Trigger Setting Screen (INT)



Trigger Setting Screen (EXT)

3. Select the type of trigger.

EXT

External trigger:
The trigger is input manually, via EXT I/O,
or via interface.

INT

Internal trigger
Measurement is performed continuously.

- **INT** _____
Measurement is performed continuously in automatic mode.

- **EXT** _____

When inputting the trigger manually:

MANU TRIG

Measurement is performed once.

When inputting the trigger signal through the EXT I/O connector:

Measurement is performed once, each time a negative sense pulse signal is supplied to the EXT I/O connector on the rear panel of the unit.

❖ 5.3, "Measurements Using EXT I/O" (page 80)

When inputting the trigger signal through the interface:

Measurement is performed once, when the "*TRG" command is transferred from the interface.

❖ 6.6, "Message Reference" (page 121)

4.

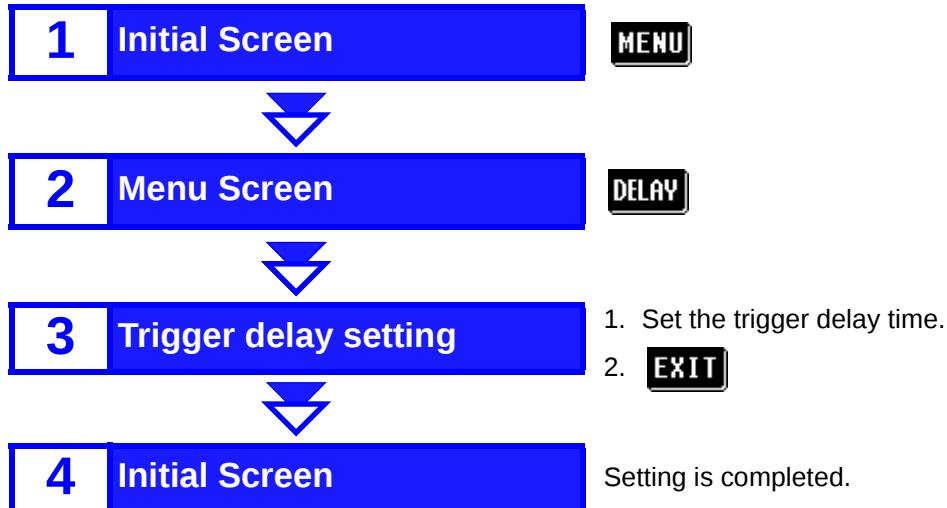
EXIT

Return to the Initial Screen.

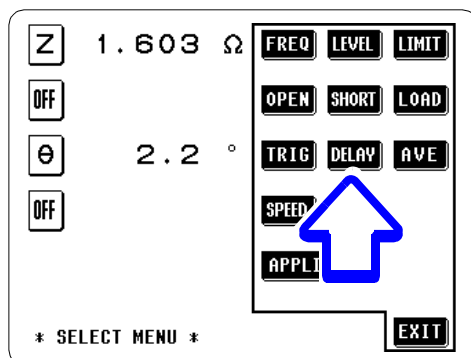
3.8 Setting the Trigger Delay

The delay time period from input of the trigger signal to reading of the measurement data can be set. The value of the trigger delay period can be set from 10 ms to 9.99 s, with a resolution of 10 ms. With this function it is possible to ensure that measurement is started after the connection condition of the object being measured and the test fixtures or test cables has stabilized.

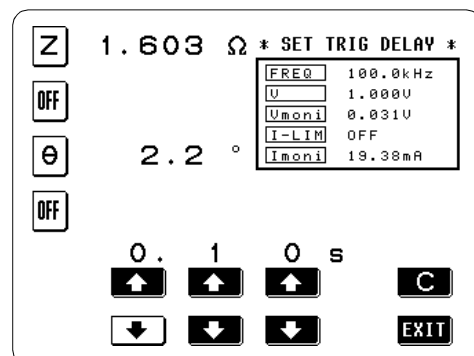
Control Screen Sequence



Setting Method



Menu Screen



Trigger Delay Setting Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **DELAY**
Display the Trigger Delay Setting Screen.
3. Set the delay time period using the digit keys.
Settable range: 10 ms to 9.99 s, with a resolution of 10 ms
Holding down a digit key increases or decreases the number continuously. When the delay time reaches the upper or lower limit, the keys are highlighted.
4. **EXIT**
Return to the Initial Screen.

To cancel the trigger delay function:

Press **C** to set the trigger delay period to 0.00 s. This will cancel the trigger delay function.

3.9 Setting Averaging

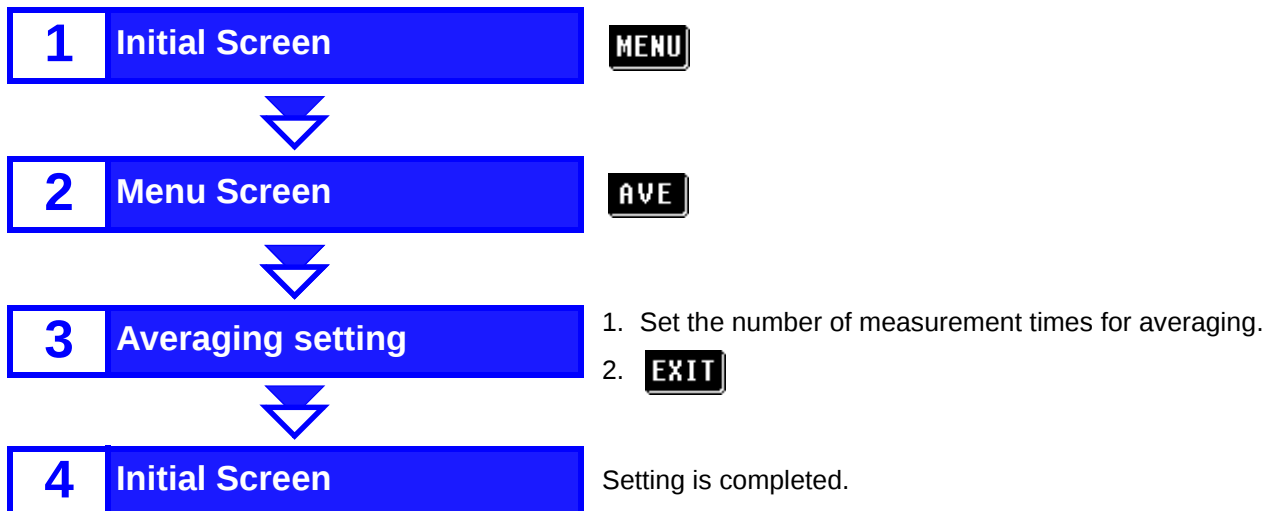
With the averaging function, the measured values can be averaged. Using this function, it is possible to reduce fluctuations in the measured value display.

The averaging can be performed over OFF, 2, 4, 8, 16, 32, or 64 times that measurement is performed.

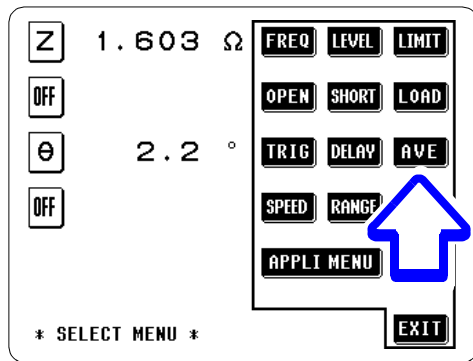
The way in which averaging is performed varies, depending upon the trigger setting.

- With internal trigger:
A rolling average of the measured values over the set number of times for averaging is always calculated backwards from the present. (When the sample to be measured is changed over, it takes a little time for a certain stabilization time period until the results is reliable.)
- With external trigger:
An average of the measurement values is calculated over the set number of times for averaging forwards from when the trigger is input.

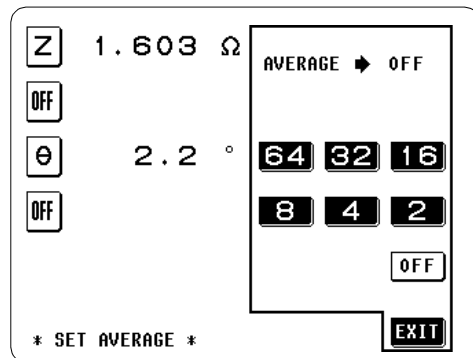
Control Screen Sequence



Setting Method



Menu Screen



Averaging Setting Screen

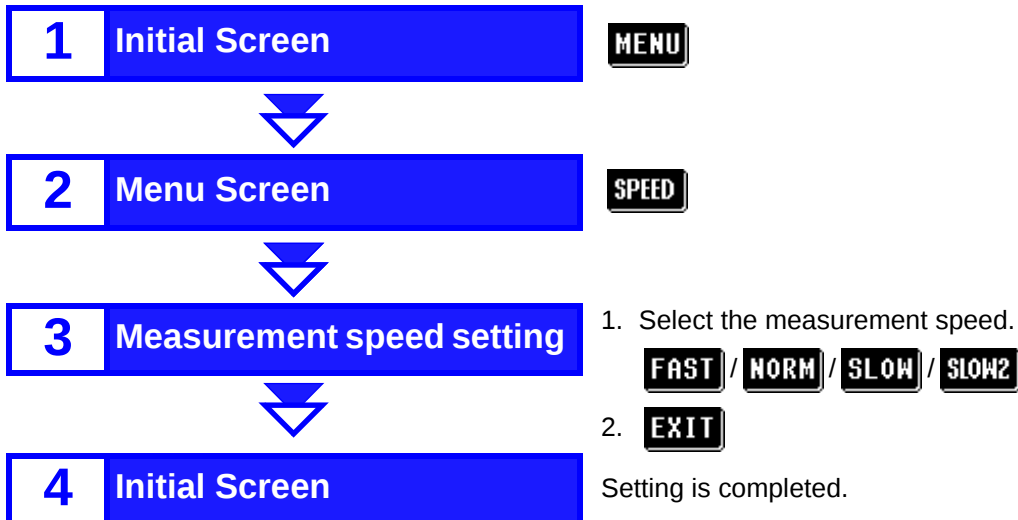
1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **AVE**
Display the Averaging Setting Screen.
3. Set the number of times for averaging
Settable range: OFF/ 2/ 4/ 8/ 16/ 32/ 64
The key which is pressed goes into non-reversed video, and this number is set as the number of times for averaging.

To stop the averaging function : **OFF**
the averaging function will be terminated.
4. **EXIT**
Return to the Initial Screen.

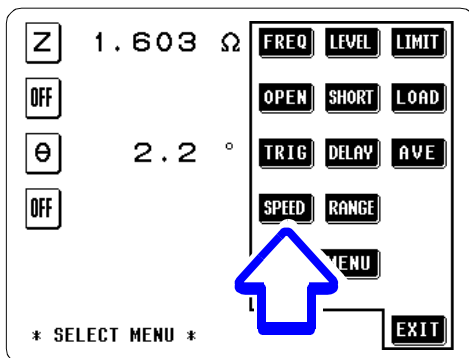
3.10 Setting the Measurement Speed

The measurement speed can be set. The slower the measurement speed is, the more accurate are the results.

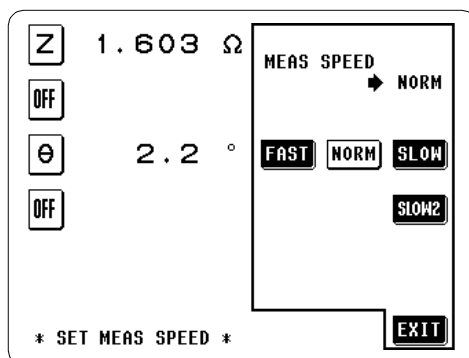
Control Screen Sequence



Setting Method



Menu Screen



Measurement Speed Setting Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **SPEED**
Display the Measurement Speed Setting Screen.
3. Select the measurement speed.

FAST	Low accuracy measurement at high speed	(6 ms±1 ms)
NORM	This speed used for normal measurement	(8 ms±1 ms)
SLOW	High accuracy slow measurement	(55 ms±1 ms)
SLOW2	High accuracy slow measurement	(668 ms±1 ms)

(): typical, in the case of |Z| only being displayed
The selected key is highlighted.

The measurement speed varies according to the number of parameters being displayed, and according to their type.

❖ 7.3, "Measurement Time" (page 184)

4. **EXIT** Return to the Initial Screen.

3.11 Setting the Measurement Range

Select the measurement range. Available settings are AUTO for automatic range selection, or HOLD, 1 kΩ, 10 kΩ and 100 kΩ fixed ranges. When measuring large variations in frequency-dependent impedance values or unknown objects, the optimum range can be selected by using the AUTO setting. However, measurement time is delayed slightly whenever the measurement range changes. For high-speed measurement of objects having an impedance within a known range, select a fixed range.

Measurement ranges

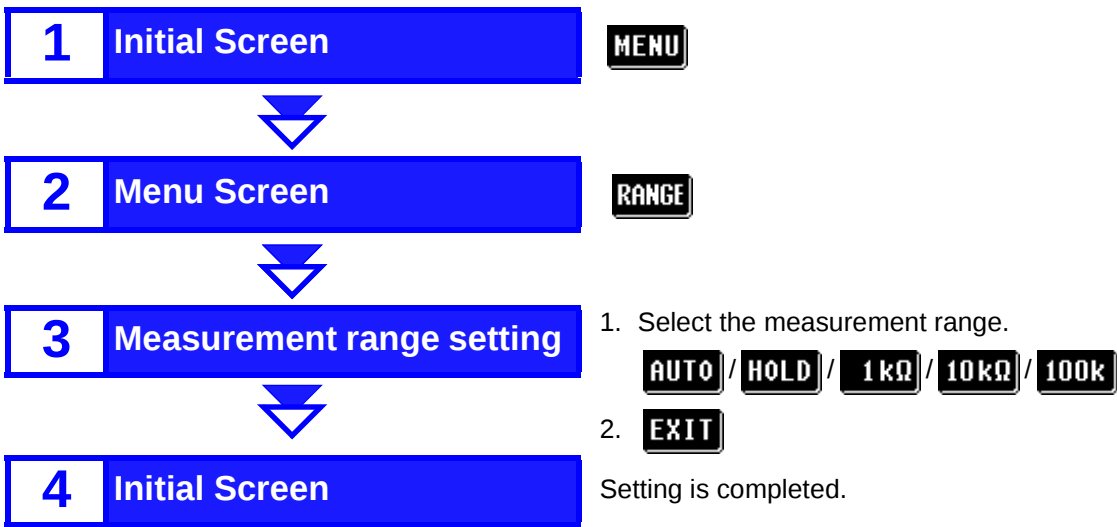
Range	Measurable range (accuracy assured range)
1 kΩ	100 mΩ to 2 kΩ
10 kΩ	1 kΩ to 20 kΩ
100 kΩ	10 kΩ to 300 kΩ

NOTE

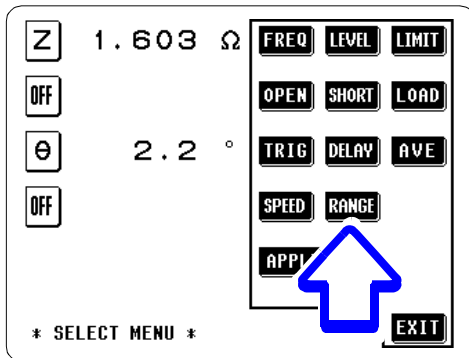
The appropriate measurement range to use is impedance dependent. Therefore, to determine the fixed range to use for measuring a parameter other than impedance, first take one measurement using AUTO ranging to determine the optimum range, or otherwise convert the parameter to an equivalent impedance to determine the measurement range.

❖7.2, "Parameters and Calculation Equations" (page 182)

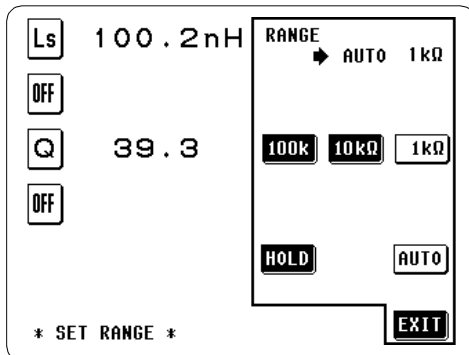
Control Screen Sequence



Setting Method



Menu Screen



Measurement Range Setting Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **RANGE**
Display the Measurement Range Setting Screen.
3. Select the measurement range setting method or measurement range.

AUTO	Automatically select the most suitable range.
HOLD	Fix (hold) the currently selected measurement range.
1 kΩ	1 kΩ range is selected. (HOLD setting)
10 kΩ	10 kΩ range is selected. (HOLD setting)
100 k	100 kΩ range is selected. (HOLD setting)

The currently selected range is indicated by the range key (1 kΩ, 10 kΩ or 100 kΩ) displayed in reverse (white).
4. **EXIT** Return to the Initial Screen.



When "OVERFLOW" is displayed

The object impedance exceeds the upper limit of the current measurement range. Use the AUTO setting to select the optimum range, or select a higher range.

If OVER FLOW is displayed with the 100 kΩ range selected, the measurement cannot be made with this instrument under the current conditions (although measurement may still be possible under different conditions, such as by changing the measurement frequency to lower the object impedance).



When "UNDERFLOW" is displayed

The object impedance is below the lower limit of the current measurement range. Use the AUTO setting to select the most suitable range, or select a lower range.



When **reference value**
is displayed:

When the set current value is not within the assured accuracy range and the measurement data is displayed as a reference, this message appears. This is due to one of the following reasons.

- The set value exceeds the measurable range (accuracy assured range).
❖ 7.4, "Measurement Range and Accuracy" (page 186)

Action:

Select the most suitable range.

- The system being measured is unstable.
❖ Appendix 2, "Measurement Principle" (page 194)

Action:

The constant current cannot be measured under the current measurement conditions. Use the measured data as a reference only. Changing the measurement frequency or voltage may allow measurement of the current.

Setting the Application Menu Screen

Chapter 4

4.1 Setting and Activating the Comparator

Using the comparator function an upper limit value and a lower limit value can be set, and the result of measurement then can be compared with these two limit values.

Result of measurement

- HI (greater than the upper limit value)
- IN (between the lower limit value and the upper limit value)
- LO (less than the lower limit value)

Appropriate signals are also output from the EXT I/O terminal on the rear panel.

The following setting methods are available on the comparator:

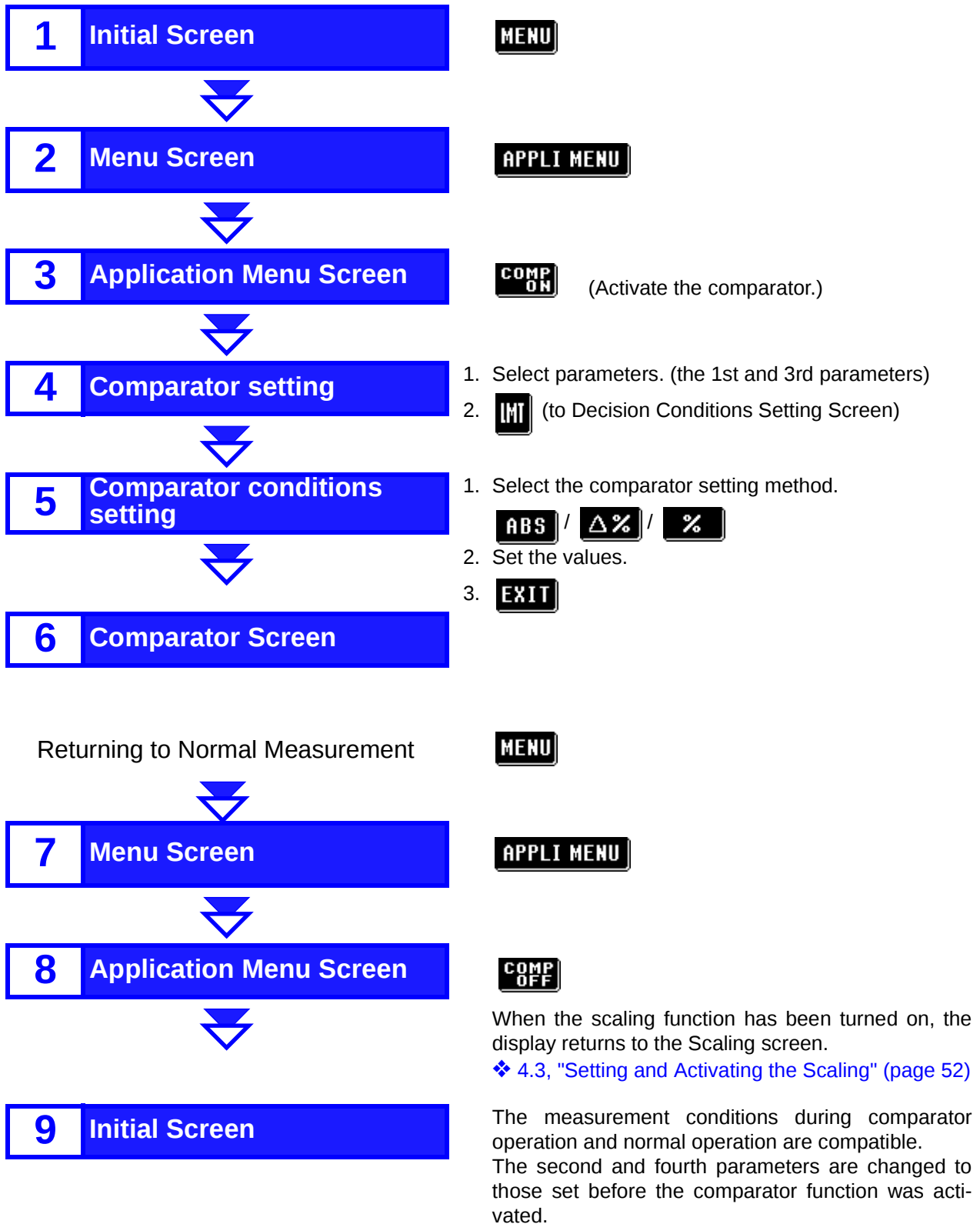
- Absolute value setting method (ABS)
The upper limit value and the lower limit value are set as absolute numerical values.
The measurement values displayed are the same as those of the measurement parameters.
- Percentage setting method (%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.
The measurement values displayed are the same as those of the measurement parameters.
- Setting of the deviation percentage ($\Delta\%$)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.
The measurement values are displayed in deviations ($\Delta\%$) from the reference value.

The comparator can deal with two measurement values at the most. "ABS", "%", and " $\Delta\%$ " can be selected for each of these values individually.

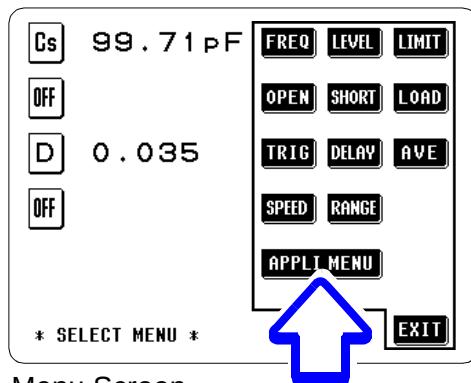
NOTE

- After powering off on the Comparator Setting Screen, the same screen is displayed when the power is turned on again.
- The measurement conditions during comparator operation and normal operation are compatible.
- When the trigger is internal, measurement starts at the time point at which the comparator mode is started, and the results of the decisions will be output through the EXT I/O terminal.
- It is not possible to perform comparator measurement and BIN measurement simultaneously.

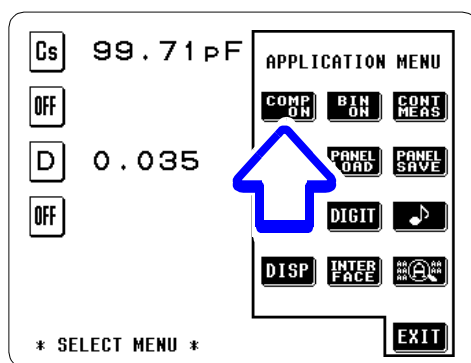
Control Screen Sequence



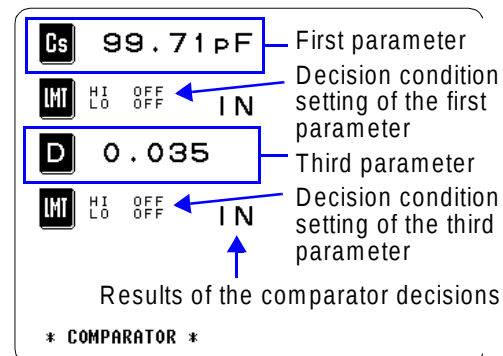
Setting Method



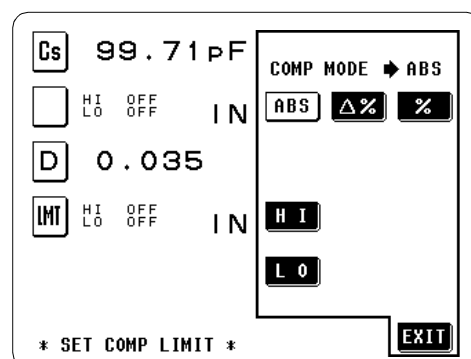
Menu Screen



Application Menu Screen



Comparator Screen



Comparator Setting Method Setting Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.

3. **COMP ON**
Display the Comparator Screen.

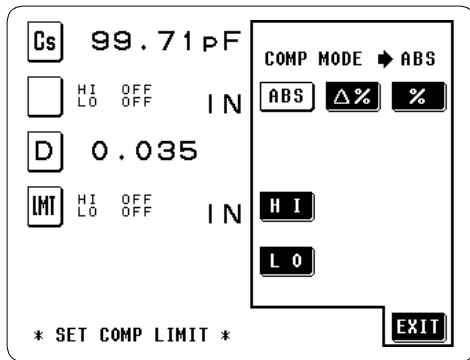
In the internal trigger mode, the comparator function is also activated.

4. Set the test parameters to be set to the first and third parameter keys.
❖2.2, "Selecting Parameters" (page 7)

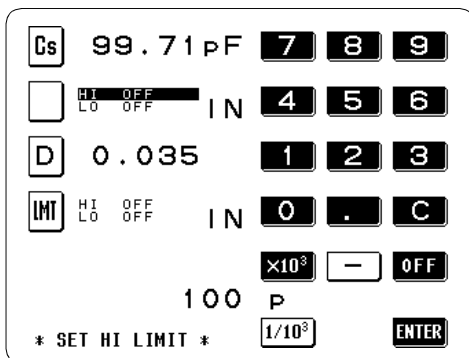
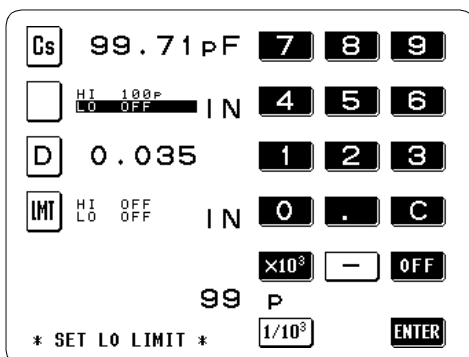
5. **INT**
Display the condition setting screen.

6. Select the comparator setting method.

- ABS** Absolute value setting method (ABS)
The upper limit value and the lower limit value for the measurement parameter are set as absolute numerical values. The measurement values displayed are the same as those of the measurement parameters.
- Δ%** Setting of the deviation percentage (Δ%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value. The measurement values are displayed in deviations (Δ%) from the reference value.
- %** Percentage setting method (%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value. The measurement values displayed are the same as those of the measurement parameters.



ABS setting

Upper limit value setting -
ABS modeLower limit value setting -
ABS mode

7. Set the values.

- **ABS** mode _____

Set the upper and lower limit values as absolute numerical values (ABS). The measurement values displayed are the same as those of the measurement parameters.

- 1) **H I** Display the upper limit setting screen.

- 2) Enter the upper limit using the keypad.
Settable range: -200.00M to 200.00M

OFF Delete the limit values.

C Cancel

NOTE

When you press **C** and **ENTER** in this order, the display returns to the previous screen without changing the set values.

- 3) Select the unit.

$\times 10^3$ Step the units up

$1/10^3$ Step the units down

← Down Up →
p/ n/ μ / m/ none/ k/ M

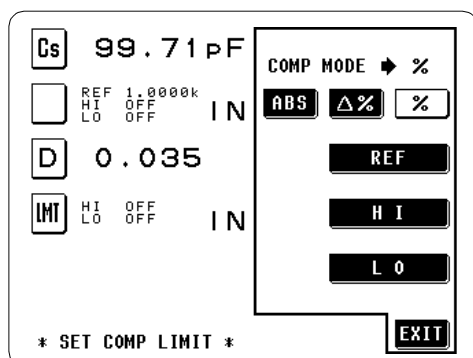
- 4) **ENTER** Confirm the upper limit.
(The display returns to the condition setting screen.)

- 5) **L 0** The lower limit is set in the same way as the upper limit.
Settable range: -200.00M to 200.00M

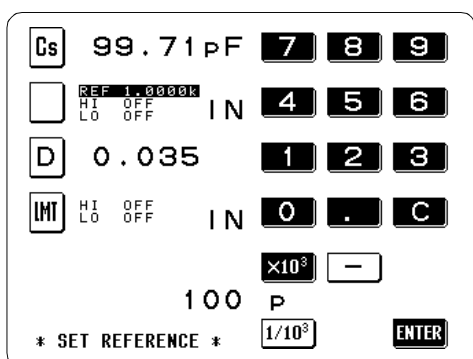
- 6) After the upper and lower limits have been set, press **EXIT** on the setting screen to return to the Comparator screen.

❖ [Comparator decisions \(page 46\)](#)

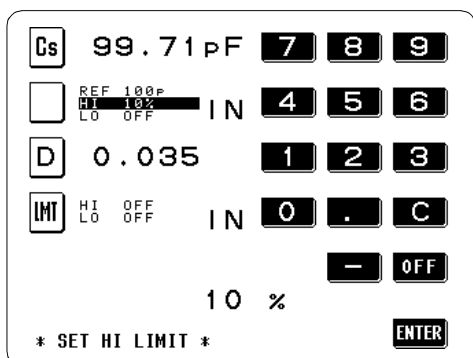
4.1 Setting and Activating the Comparator



% setting



Reference value setting - % mode



Upper limit value setting - % mode

The actual internal operation consists of calculating the upper-limit value of comparison using the equation given below, and comparing it to the measurement value to enable a decision to be made.

Upper/lower-limit comparison value = Reference value + |Reference value | x Percentage set value/100

| | : Denotes an absolute value

If a value smaller than the reference value is to be set, the percentage set value must be an absolute value.

- **% mode** _____
Set a reference value, and the upper-limit and lower-limit values as percentages relative to the reference value.

- 1) **REF** Display the reference value setting screen.
- 2) Enter the reference value necessary for the percentage setting using the keypad.

Settable range: -200.00M to 200.00M

NOTE

When you press **C** and **ENTER** in this order, the display returns to the previous screen without changing the set values.

- 3) Select the unit.

x10³ Step the units up

1/10³ Step the units down

← Down Up →
p/ n/ μ/ m/ none / k/ M

- 4) **ENTER** Confirm the reference value. (The display returns to the condition setting screen.)
- 5) **H I** Display the upper limit setting screen.
- 6) Use the numeric keypad to input the upper limit value as a percentage relative to the reference value and then press **ENTER** to confirm the setting.

Settable range: -999.99% to 999.99%

OFF No upper limit value

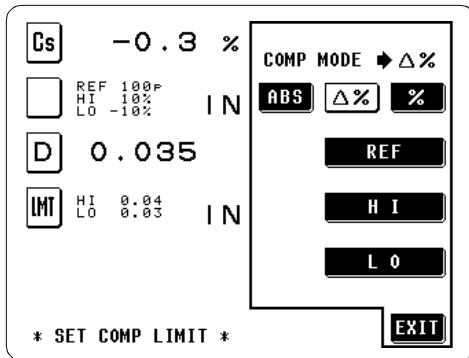
C Cancel

NOTE

When you press **C** and **ENTER** in this order, the display returns to the previous screen without changing the set values.

- 7) **L 0** The lower limit is set in the same way as the upper limit.
Settable range: -999.99% to 999.99%
- 8) After the upper and lower limits have been set, press **EXIT** on the condition setting screen to return to the Comparator screen.

❖ [Comparator decisions \(page 46\)](#)



Δ% setting

The Δ% value is calculated using the following equation:

$$\Delta\% = \frac{(\text{Measurement value} - \text{Reference value})}{|\text{Reference value}|} \times 100$$

| | : Denotes an absolute value

● mode _____

Set a reference value, and the upper-limit and lower-limit values as percentages relative to the reference value.

The measurement values are displayed in deviations (Δ%) from the reference value.

The reference value and upper- and lower-limit values are set in the same manner as in the percentage mode.

Settable range: -999.99% to 999.99%

If the result of the calculation exceeds 999.99, "999.99" will be indicated, and if the result is less than -999.99, "-999.99" will be displayed.

❖ [Comparator decisions \(page 46\)](#)

Comparator decisions _____

Judgment criteria	Display
1 If the measured value is "OVERFLOW" If the measured the value is "UNDERFLOW"	HI LO
2 If it is judged whether the measured value is higher than a lower-limit value and the result is NG.	LO
3 If it is judged whether the measured value is lower than an upper-limit value and the result is NG.	HI
4 If both 2 and 3 give an affirmative result	IN

No measurement is performed in order to ensure that the upper limit value is greater than the lower limit value. Therefore no error message will be displayed even if you mistakenly interchange the settings for the desired upper limit value and the desired lower limit value. However, be careful that the decision process will not operate properly.

4.2 BIN Measurement Function

With the BIN measurement function, it is possible to compare the test data to up to ten sets of upper and lower limit values (BIN1 to BIN10) in one test operation and display the results. The first and third parameters are subject to this comparison.

The result is transformed into appropriate signals and output from the EXT I/O terminal on the rear panel.

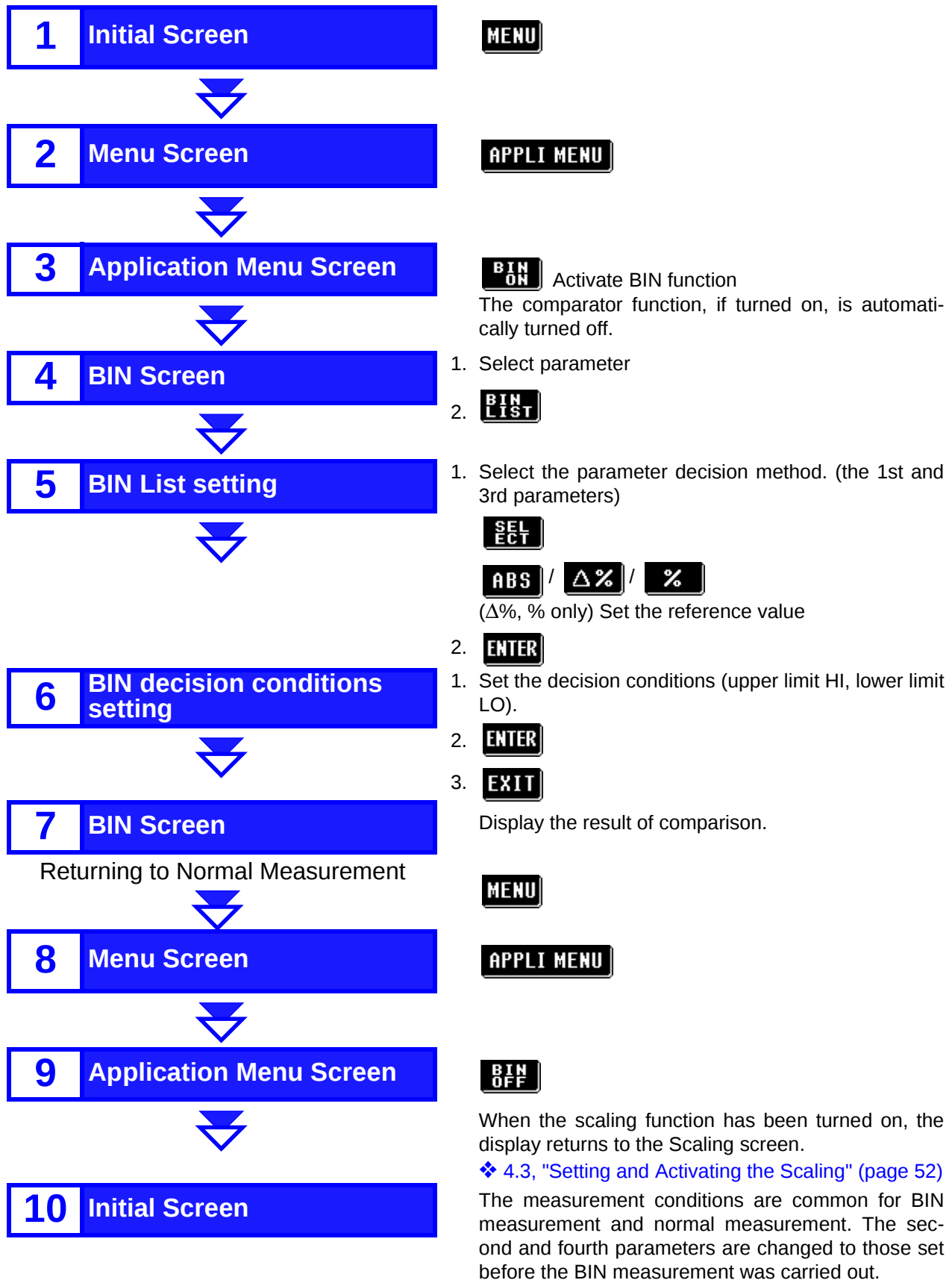
The upper and lower limit values can be set with either of the following three methods, just like the comparator function.

- **Absolute value setting method (ABS)**
The upper limit value and the lower limit value are set as absolute numerical values.
The measurement values displayed are the same as those of the measurement parameters.
- **Percentage setting method (%)**
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.
The measurement values displayed are the same as those of the measurement parameters.
- **Setting of the deviation percentage ($\Delta\%$)**
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.
The measurement values are displayed in deviations ($\Delta\%$) from the reference value.

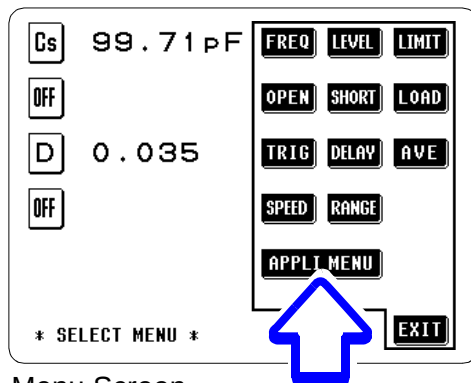
NOTE

- After powering off on the BIN Screen, the same screen is displayed when the power is turned on again.
- The measurement conditions during BIN operation and normal operation are compatible.
- When the trigger is internal, measurement starts at the time point at which the BIN mode is started, and the results of the decisions will be output through the EXT I/O terminal.
- The reference value and upper and lower limit values are common in the percentage setting method (%) and deviation percentage setting method ($\Delta\%$). Only one reference value is set for the first and third parameters.
- It is not possible to perform comparator measurement and BIN measurement simultaneously.
- The comparison of test data and BIN upper and lower limit values starts from the BIN with the smallest effective number. The first BIN number whose test data falls within the range is displayed as a test result.

Control Screen Sequence

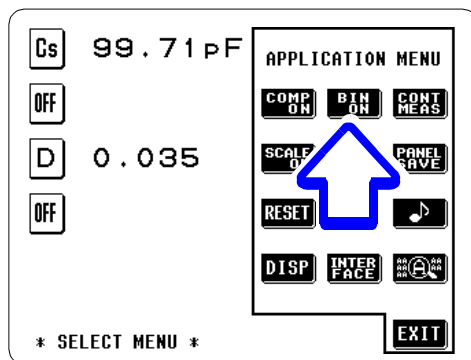


Setting Method



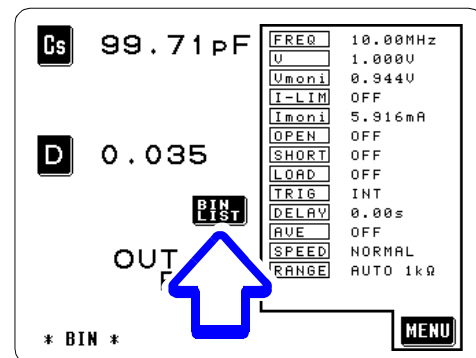
Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.



Application Menu Screen

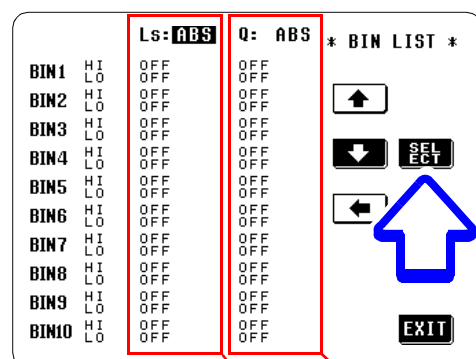
3. **BIN ON**
Display the BIN Screen.



BIN Screen

4. Select parameter.
❖2.2, "Selecting Parameters" (page 7)
5. **BIN LIST**
Display the BIN List screen.

6. Select the parameter decision method.



BIN List Screen

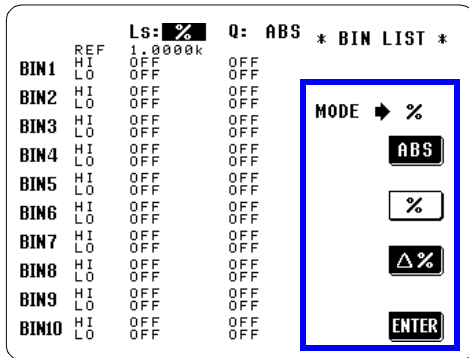
Decision conditions for third parameter

Decision conditions for first parameter

1) Move the cursor to the parameter decision method.

2) Press **SELECT**

The decision method selection screen is displayed.



Decision method setting

3) Select the parameter decision method.

ABS

Absolute value setting method (ABS)
The upper limit value and the lower limit value for the measurement parameter are set as absolute numerical values.

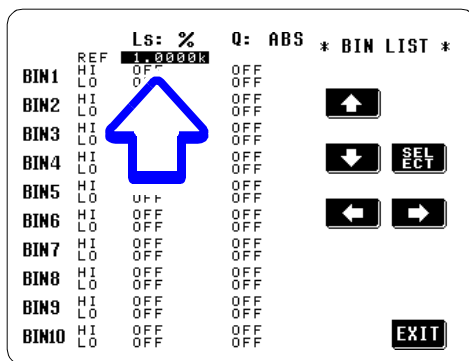
%

Percentage setting method (%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.

Δ%

Setting of the deviation percentage (Δ%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value.

4) **ENTER** Confirm the setting.



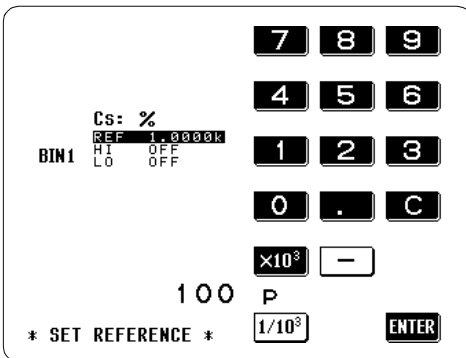
Reference value setting

● **%**, **Δ%** mode _____

Set the reference value.

1) Move the cursor to REF, the reference value setting field.

2) **SELECT** Display the Reference value setting screen.



Reference value setting

3) Enter the numerical value using the keypad.

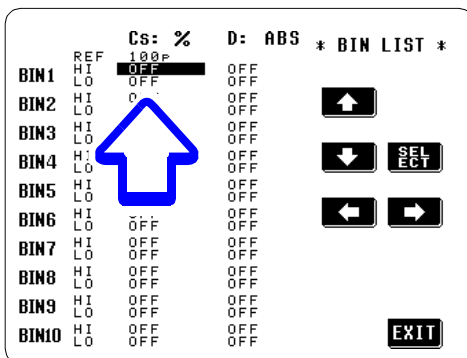
4) **1/10³** / **×10³** Select the unit.

5) **ENTER** Confirm the setting.

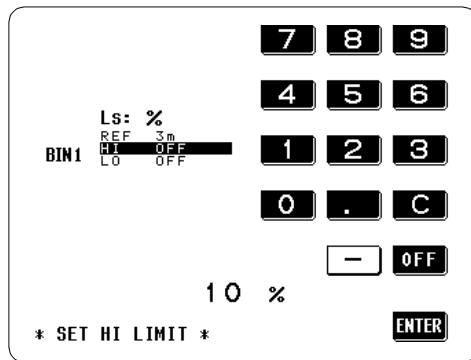
7. Set the upper and lower limit values.

1) Move the cursor to the HI or LO setting field.

2) **SELECT** Display the upper/lower limit setting screen.



Upper/lower limit value setting



Upper/lower limit value setting

3) Enter the numerical value using the keypad.

4) Select the unit.(during ABS setting)

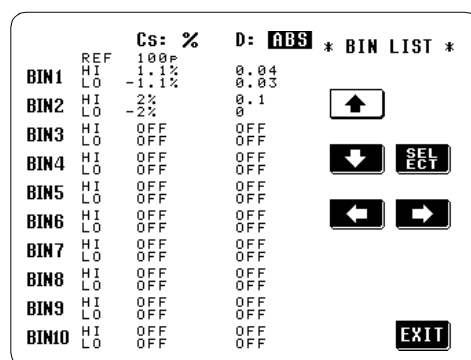
5) **ENTER** Confirm the setting.

Return to the BIN List screen.

8.

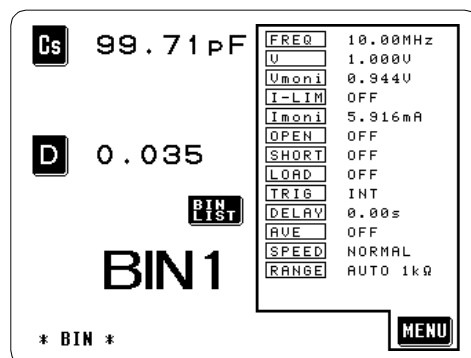
EXIT

Return to the Initial Screen.



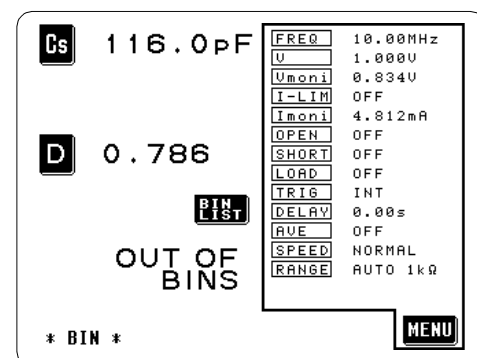
BIN List Screen

The BIN test result is displayed.

BIN measurement result
(within set BIN1 range)

NOTE

- The BIN tests are performed one by one, beginning with BIN1, and when the test data falls within the set range the BIN number is displayed.
- To specify multiple-decision conditions, start with the conditions group that has the narrowest range.



BIN measurement result (out of set range)

4.3 Setting and Activating the Scaling

Scaling applies a compensation function to the measurement value. This function can be used to provide compatibility among measurement devices.

Set the compensation coefficients a and b for the measurement values of the first and third parameters to compensate by the following expression.

$$\text{Compensated value} = a \times \text{Measurement value} + b$$

Compensated value: the last measurement value

Measurement value: the first or third parameter measurement value

a: integration value of the measured value

b: the value added to measured value

When the first or third parameter is either D or Q, the scaling is applied to θ as follows:

$$\theta' = a \times \theta + b$$

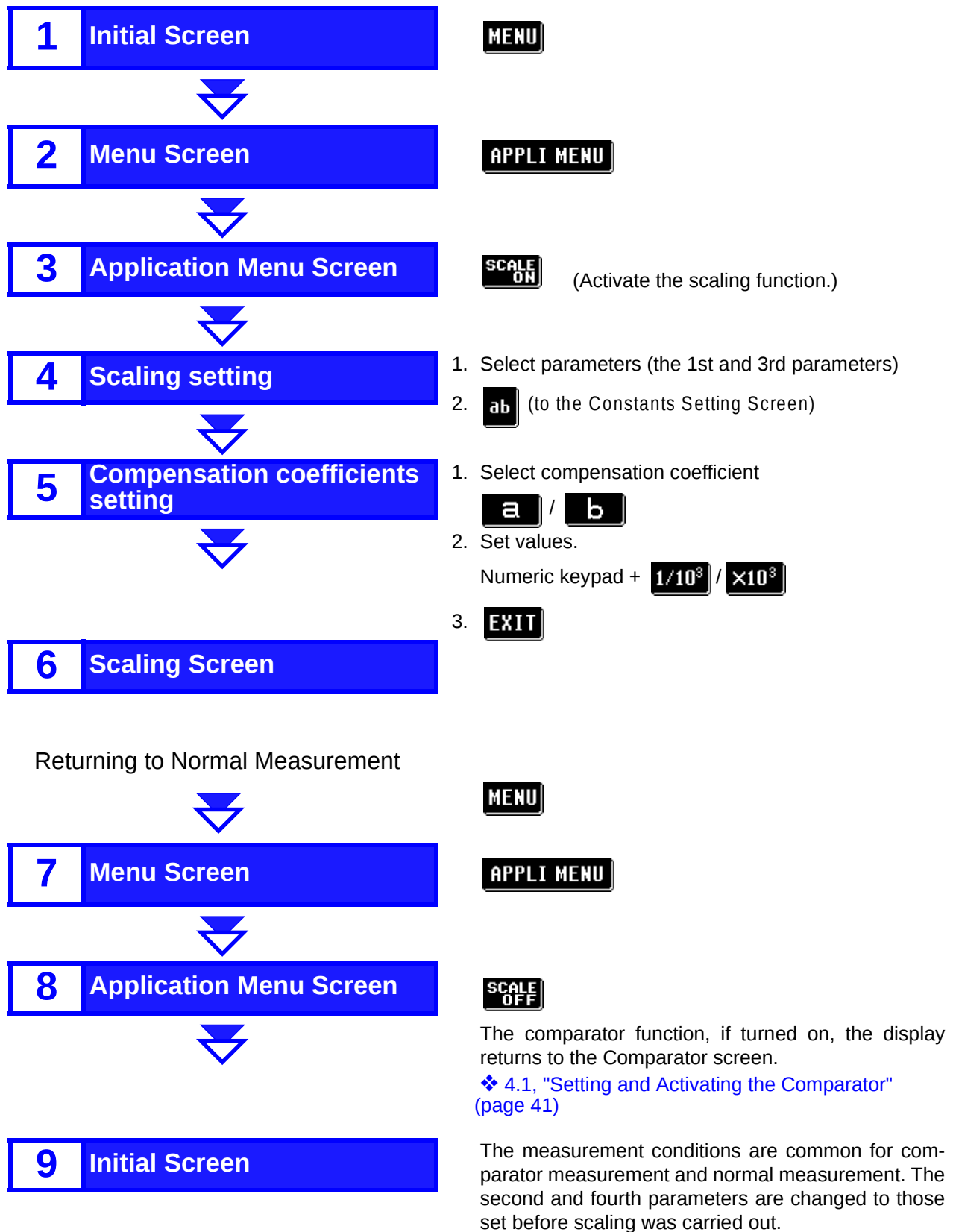
This gives a new value θ' , from which D or Q is obtained.

NOTE

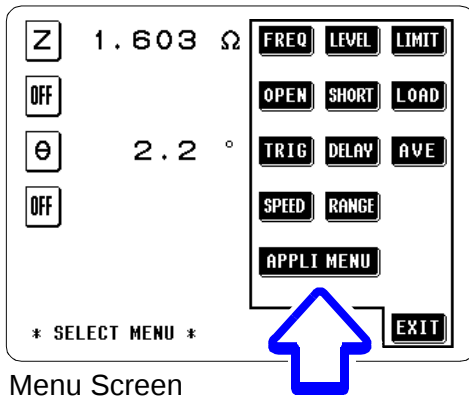
- After powering off on the Scaling Screen, the same screen is displayed when the power is turned on again.
- You can also access the Comparator Scaling screen or BIN Scaling screen from the Scaling screen. In this case, the comparator measurement or BIN measurement is performed on the scaled test data.

❖ [Comparator function: 4.1, "Setting and Activating the Comparator" \(page 41\)](#)

Control Screen Sequence



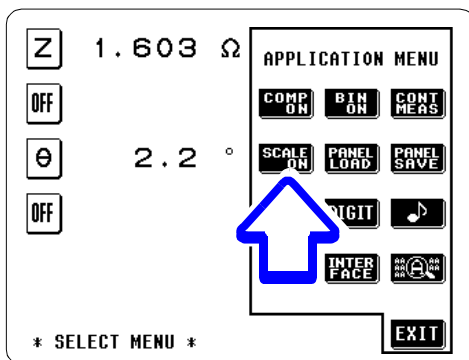
Setting Method



Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.

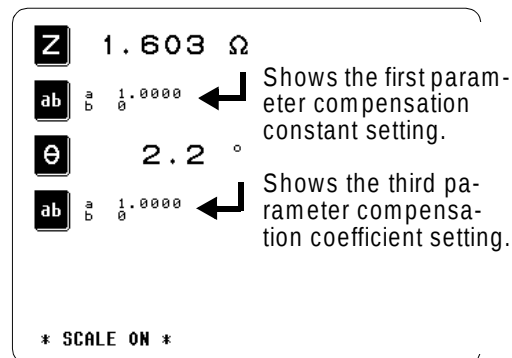
2. **APPLI MENU**
Display the Application Menu Screen.



Application Menu Screen

3. **SCALE ON**
Display the Scaling screen.

The scaling function is now activated.



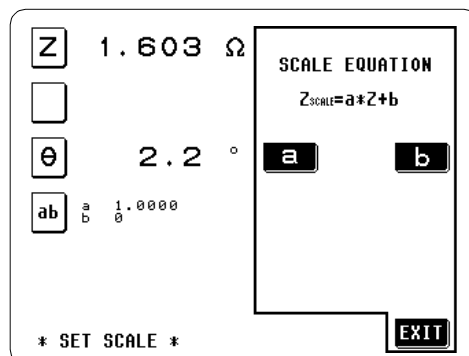
Scaling Screen

4. Set the test parameters to be set to the first and third parameter keys.

❖ 2.2, "Selecting Parameters" (page 7)

5. **ab**
Display the Compensation coefficient selection screen.

6. Select the compensation coefficients to be set.

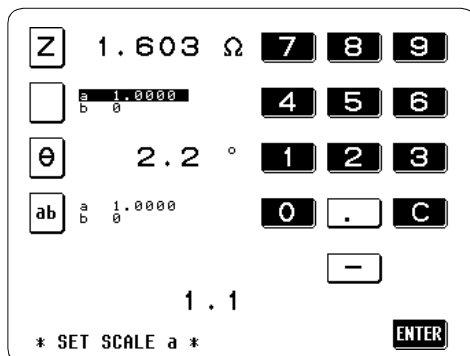


Compensation Coefficient Setting

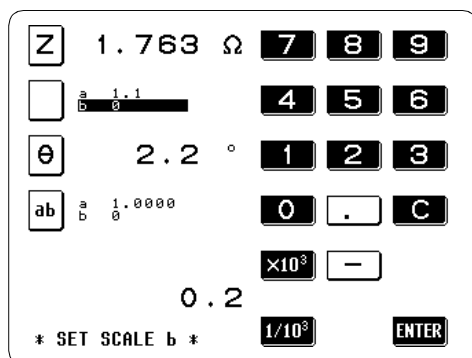
a The setting screen for the compensation coefficient a is displayed.

b The setting screen for the compensation coefficient b is displayed.

7. Set the numerical value.



Compensation coefficient a



Compensation coefficient b

• **a** _____

Use the numeric keypad to input the desired value.

Settable range:-999.99 to 999.99

Cancel: **C**

NOTE

When you press **C** and **ENTER** in this order, the display returns to the previous screen without changing the set values.

• **b** _____

- 1) Set the compensation coefficient 'b' in the same way to coefficient 'a,' using the keypad.
Settable range:-200.00M to 200.00M

- 2) Select the unit.

×10³ Step the units up

1/10³ Step the units down

←Down Up→
p/ n/ μ/ m/ none/ k/ M

- 3) **ENTER** Confirm the setting.

8. **EXIT**

Return to the Scaling screen.

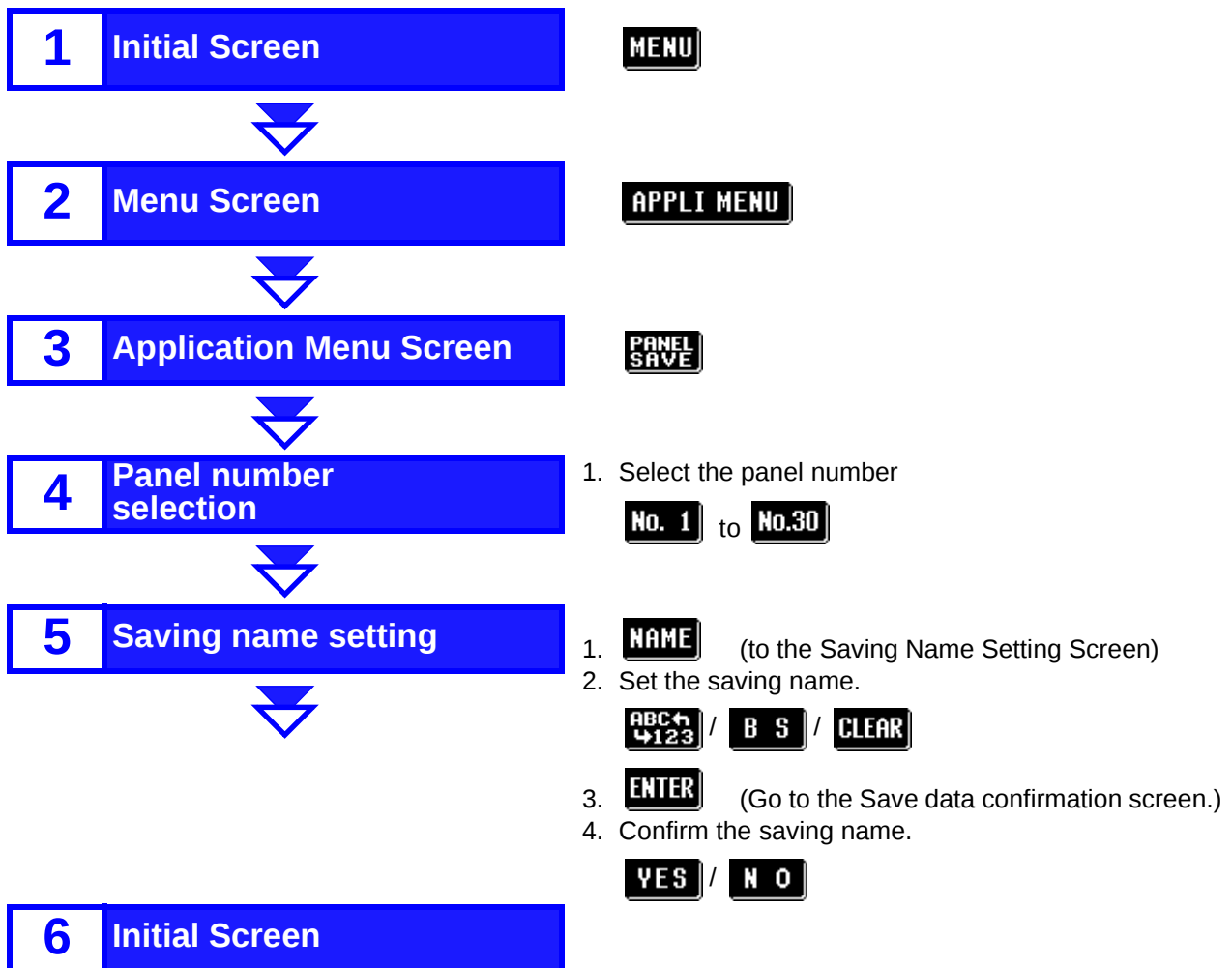
NOTE

- The scaled measurement value has no effect on other measurement values. Therefore, even if the same parameter is set for the first and third parameters, the scaling is carried out with the respective compensation coefficients.
- The calculation result of scaling for θ is as follows.
When exceeding 180° , " 180.00° " is displayed.
When below -180° , " -180.00° " is displayed.

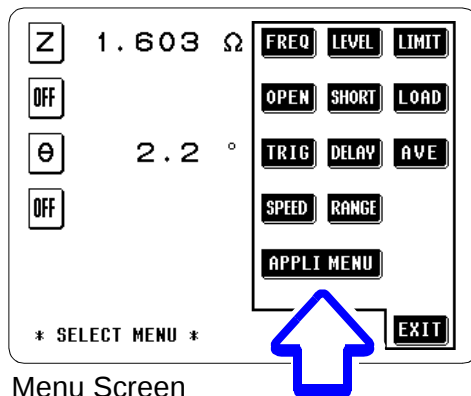
4.4 Panel Save Function

With the Panel Save function, it is possible to save all the measurement conditions, except for the interface setting conditions, and up to thirty different types of OPEN/SHORT/LOAD compensation values.

Control Screen Sequence



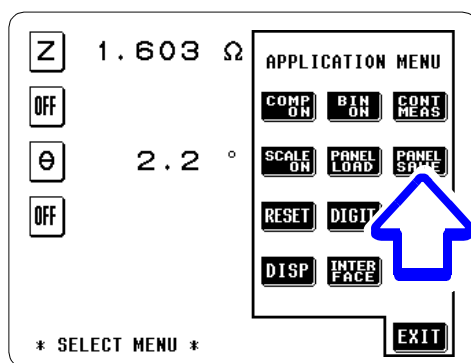
Setting Method



Menu Screen

1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **APPLI MENU**
Display the Application Menu Screen.

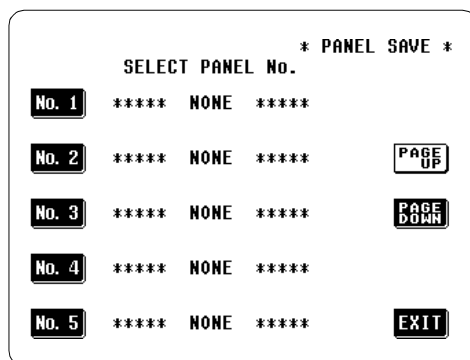


Application Menu Screen

3. **PANEL SAVE**
Display the Panel number selection screen.

To cancel the saving:

EXIT (the display returns to the Initial Screen.)

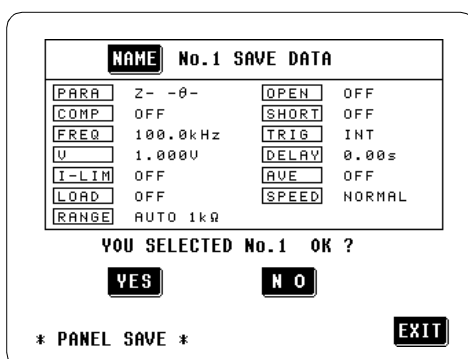


Panel Number Selection Screen

PAGE UP / **PAGE DOWN**: change the position of the panel number (up to No.30)

NONE means that nothing is saved.

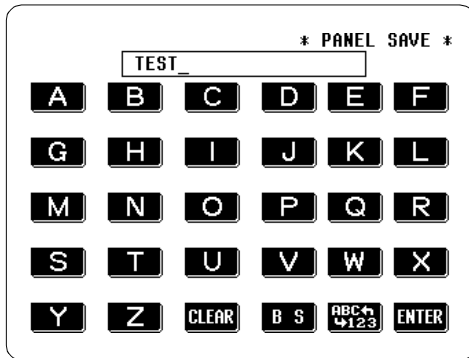
4. Press the panel number to be saved.



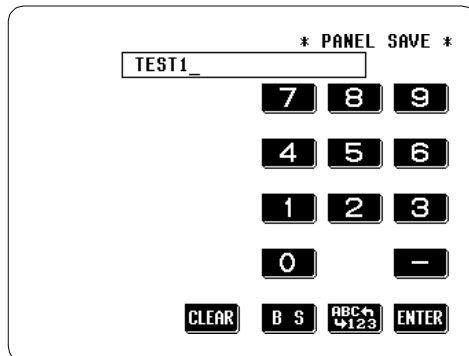
Save data confirmation screen

The Save data confirmation screen is displayed. The measurement conditions to be saved are displayed under the saving name.

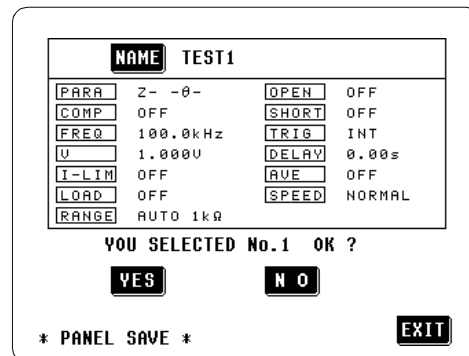
5. **NAME**
Display the Saving name input screen.



Saving Name Setting Screen
(Roman type)



(Numerical keypad)



Save Data Confirmation Screen

6. Enter the saving name.
(up to 20 characters)



Toggles between the alphabet input screen and numerical input screen.



Back space



Clears the input character.

7. Press **ENTER** to return to the Save Data Confirmation Screen.

8. Confirm the data to be saved.



Saves the measurement conditions under the name displayed and automatically returns to the Initial Screen.



Returns to the previous screen.

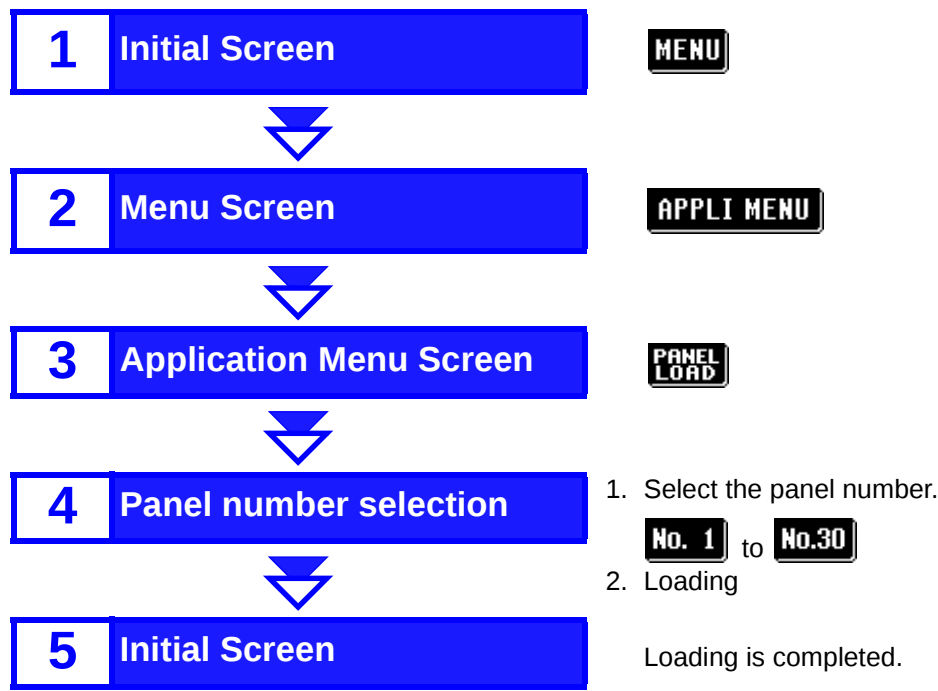
NOTE

- If the comparator mode is set, then when the measurement conditions are saved, as well as the saved measurement conditions, the **COMP** mark is displayed.
- If the BIN mode is set, then when the measurement conditions are saved, as well as the saved measurement conditions, the **BIN** mark is displayed.
- Under normal conditions of use, the average life of the backup battery is about 5 years.
- If the internal battery becomes exhausted, it is no longer possible to save the measurement conditions. You should have the battery changed by an approved HIOKI service facility (which is chargeable).

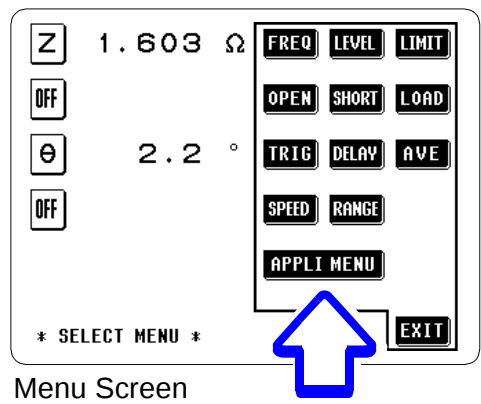
4.5 Panel Load Function

Using the panel load function, saved measurement conditions can be loaded.
All the measurement conditions, except for the interface setting conditions, and the OPEN/SHORT/LOAD compensation values are loadable.

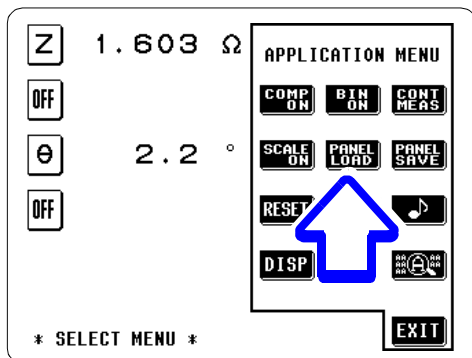
Control Screen Sequence



Setting Method



1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.



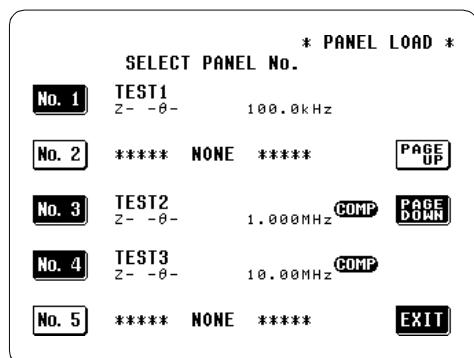
Application Menu Screen

3.



Display the Panel Number Selection Screen.

For each panel number, some of the values currently saved are shown on the screen.



Panel Number Selection Screen

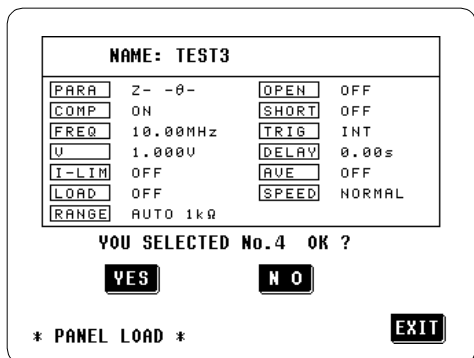
4.

Select the panel number to be loaded.

To cancel the panel load process: **EXIT**
(the display will return to the Initial Screen.)

PAGE UP / **PAGE DOWN** : change the position of the panel number (up to No.30)

The Panel Load Confirmation Screen appears.



Panel Load Confirmation Screen

5.

Confirm loading.



Loads the measurement conditions with the selected panel number and automatically returns to the Initial Screen.



Returns to the previous screen.

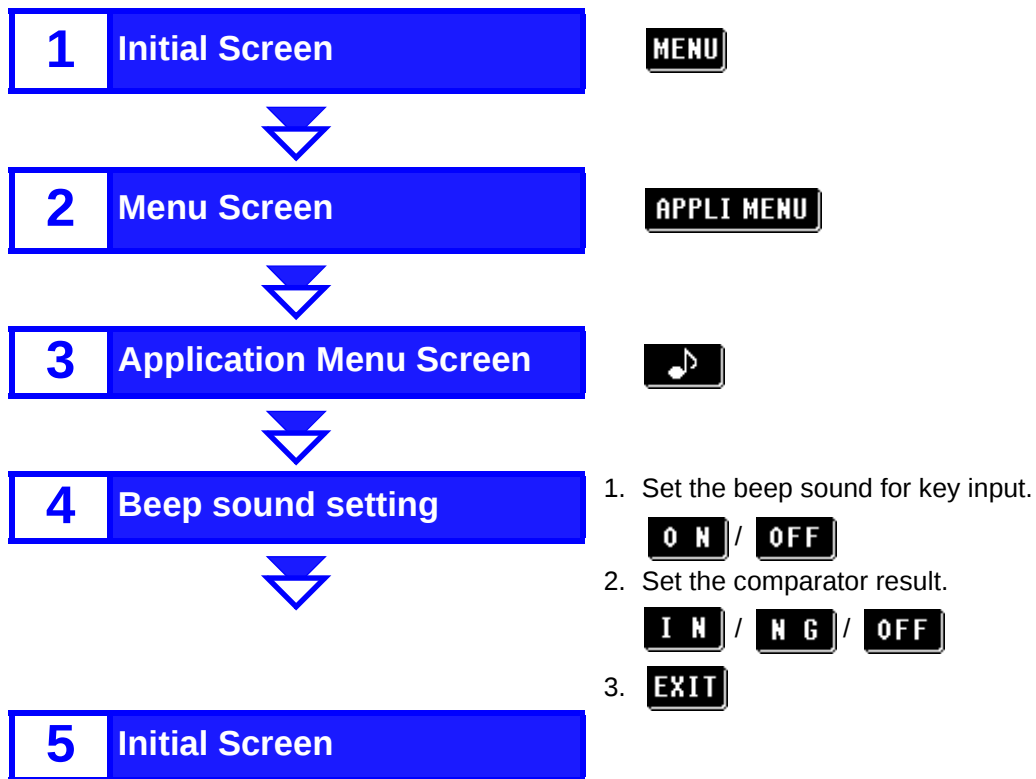
NOTE

- If the comparator mode is set, then when the measurement conditions are saved, as well as the saved measurement conditions, the **COMP** mark is displayed.
- If the BIN mode is set, then when the measurement conditions are saved, as well as the saved measurement conditions, the **BIN** mark is displayed.
- Under normal conditions of use, the average life of the backup battery is about 5 years.
- If the internal battery becomes exhausted, it is no longer possible to save the measurement conditions. You should have the battery changed by an approved HIOKI service facility (which is chargeable).

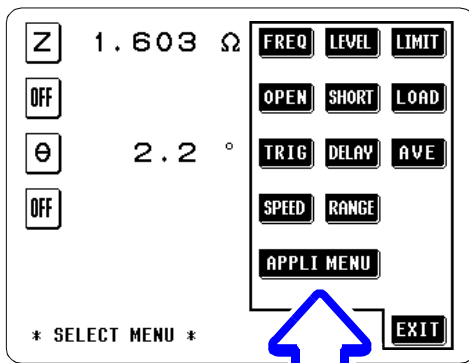
4.6 Setting the Beep Sound

The beep sound which is produced each time that a soft key is pressed, and the beep sound which is produced when the comparator makes decisions, can be turned on and off individually.

Control Screen Sequence



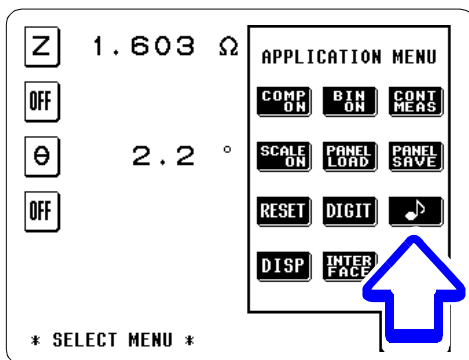
Setting Method



Menu Screen

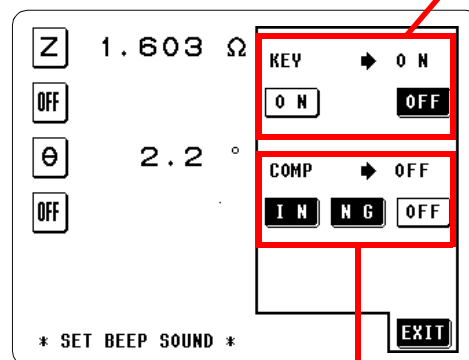
1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **APPLI MENU**
Display the Application Menu Screen.



Application Menu Screen

3. **MUSIC**
Display the Beep Setting Screen.



Beep Setting Screen

4. Set whether or not the beep sound is generated when the key-input is executed.

- ON** A beep sound for key input is emitted.
- OFF** No beep sound for key input is emitted.

5. Set the beep sound generation in the comparator decision.

- When the comparator makes a single decision:

- IN** When the comparator result is IN, a beep sound is emitted.
- NG** When the comparator result is LO or HI, a beep sound is emitted.
- OFF** No beep sound is emitted when the comparator operates.

- When the comparator makes two decisions:

- IN** When both of these comparator results are IN, a beep sound is emitted.
- NG** When either of these comparator result is LO or HI, a beep sound is emitted.
- OFF** No beep sound is emitted when the comparator operates.

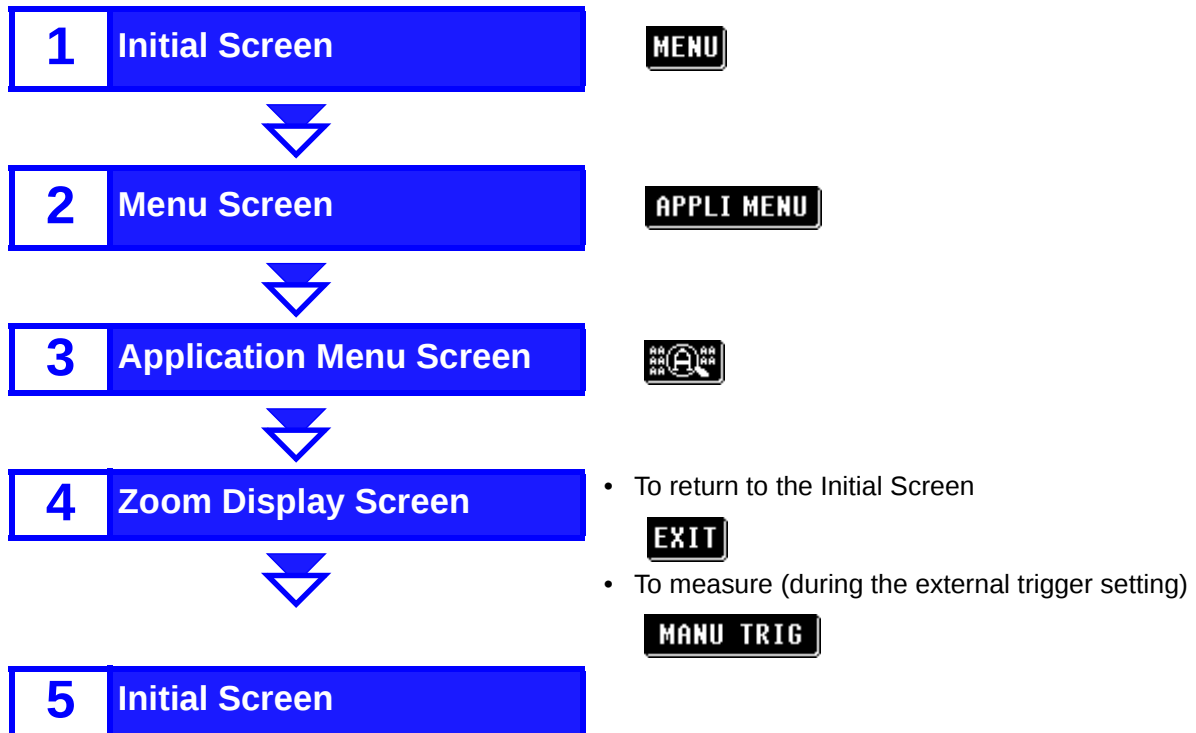
6. **EXIT**
Return to the Initial Screen.

4.7 Zoom Display of Measurement Values

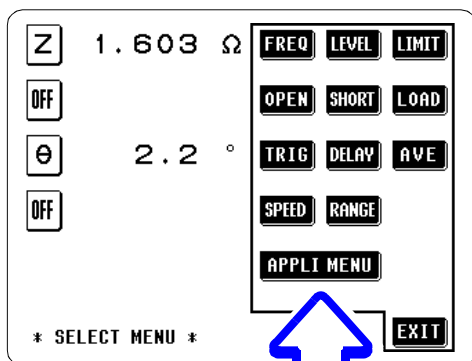
The measurement values and comparator decision results can be displayed in enlarged form. This function is convenient when the unit is used under constant measurement conditions.

After powering off on the Zoom Display Screen, the same screen is displayed when the power is turned on again.

Control Screen Sequence



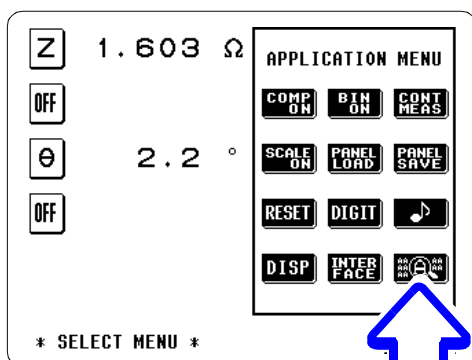
Setting Method



Menu Screen

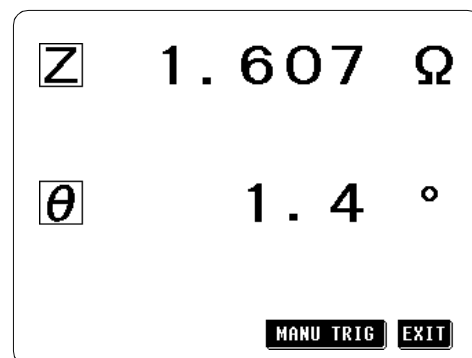
1. **MENU** (on the Initial Screen)
Display the Menu Screen.

2. **APPLI MENU**
Display the Application Menu Screen.



Application Menu Screen

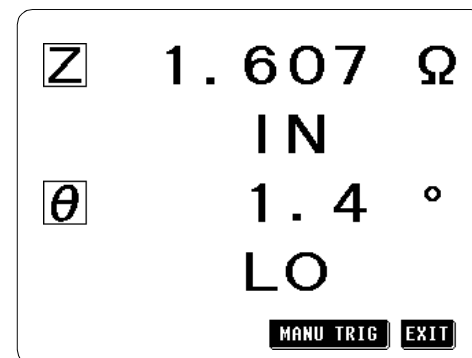
3. 
Display the Zoom Display Screen.

Zoom Display Screen
(Normal Screen)

4. **EXIT**
Return to the Initial Screen.

When the external trigger mode has been set and a single sample test is required press

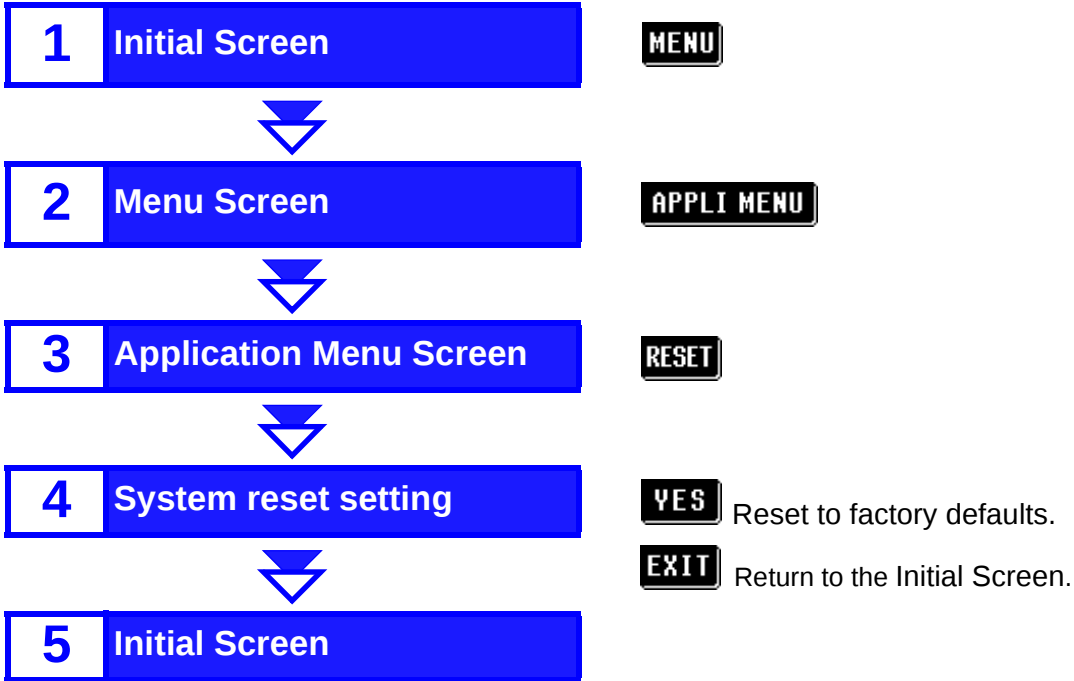
MANU TRIG .

Zoom Display Screen
(Comparator Screen)

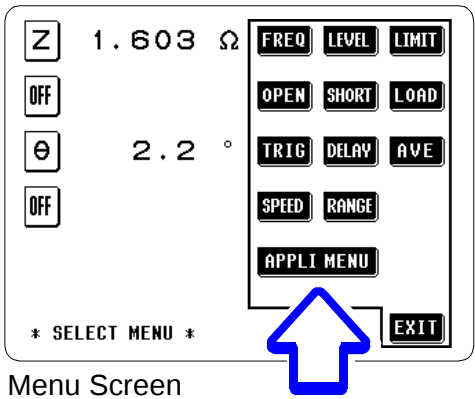
4.8 System Reset

All of the settings will revert to the factory original settings.

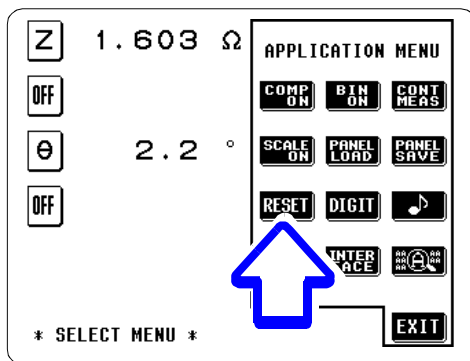
Control Screen Sequence



Setting Method



1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.



Application
Menu Screen



System Reset Screen

The settings established at the factory:

Measurement parameters	Z , θ
Measurement frequency	1 MHz
Measurement signal level	Open-circuit voltage (V) setting
Open-circuit voltage (V) set value	1.000 V
Constant current (CC) set value	10.00 mA
Limit function	OFF
Voltage limit set value	1.000 V
Current limit set value	20.00 mA
Open-circuit compensation	OFF
Short-circuit compensation	OFF
Load compensation	OFF
Trigger setting	Internal trigger
Trigger delay setting	0 s
Measurement speed setting	NORMAL
Measurement range	AUTO
Beep sound setting	ON for key input OFF for comparator
Panel save	All contents clear

3.

RESET

Display the System Reset Screen.

4.

YES

Reverts to the factory settings and the Initial Screen is displayed.

To cancel the system reset:

EXIT

Return to the Initial Screen.

Comparator (both first and third parameters):	
Comparator setting	Absolute value setting
Absolute value setting	Upper and lower limit values both OFF
Percent set values	
First parameter	Reference value: 1000 Upper and lower limit: OFF
Third parameter	Reference value: 10 Upper and lower limit: OFF
BIN mode (both first and third parameters):	
Mode setting	Absolute value setting
Absolute value setting	Upper and lower limit: OFF
Percent set values	
First parameter	Reference value: 1000 Upper and lower limit: OFF
Third parameter	Reference value: 10 Upper and lower limit: OFF
Scaling setting value (compensation coefficient a for the first and third parameters):	
a: 1.0000, b: 0	
Display digits setting (First to 4th parameters)	
All four digits	
Display setting	
LCD display: ON Voltage and Current monitor: ON	
Interface setting	
RS-232C, 9600bps, CR+LF	

4.9 Continuous Measurement Function

It is possible to read in order measurement conditions which have been saved using the panel save function, and to perform continuous measurement.

Up to five panel numbers can be selected in a page for the continuous measurement.

Panel numbers for each page

Page	Panel numbers
1	No.1 to No.5
2	No.6 to No.10
3	No.11 to No.15
4	No.16 to No.20
5	No.21 to No.25
6	No.26 to No.30

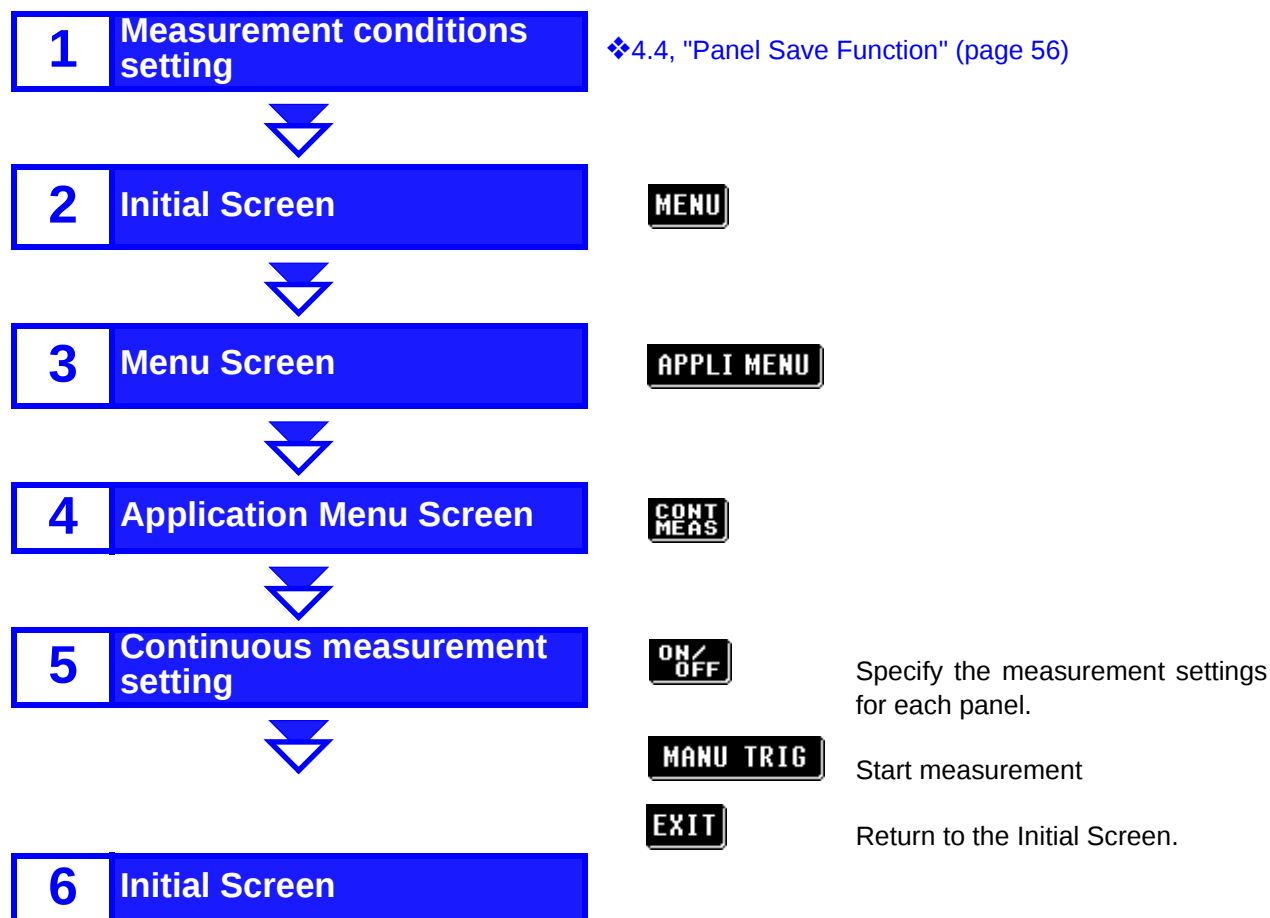
After powering off on the Continuous Measurement Screen, the same screen is displayed when the power is turned on again.

When different measurement conditions (measurement frequencies and measurement signal levels) are assigned to respective panel numbers, it is possible to simply evaluate characteristics of the test sample.

NOTE

When the measurement conditions assigned to the panel number are intended for the BIN measurement mode, normal measurement is performed instead of BIN measurement.

Control Screen Sequence



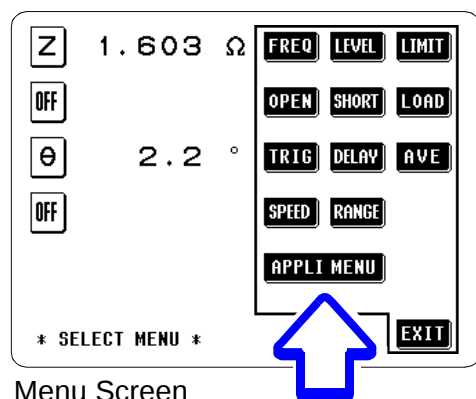
Setting Method

1. With the panel save function, save the measurement conditions.
❖4.4, "Panel Save Function" (page 56)

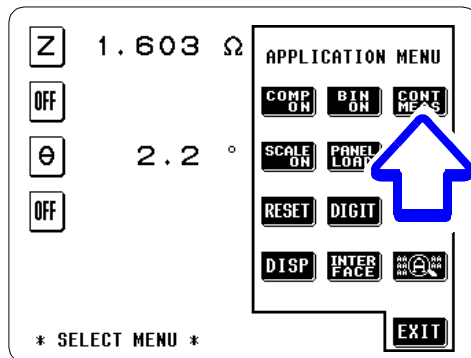
The continuous measurement is performed for the first and third parameters which have been saved.

2. **MENU** (on the Initial Screen)
Display the Menu Screen.

3. **APPLI MENU**
Display the Application Menu Screen.



Setting Method

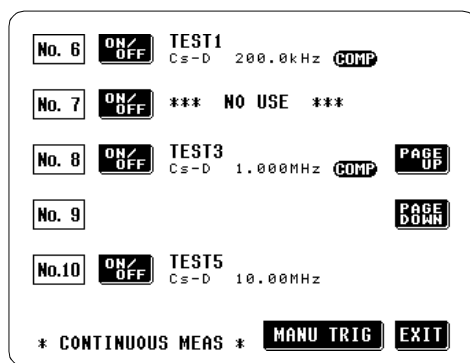


Application Menu Screen

4.



Display the Continuous Test setting screen.



Continuous Measurement Setting Screen

5.

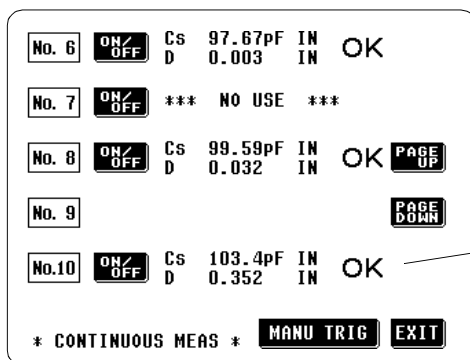


Set whether measurement of each panel number is executed or not.



PAGE UP / **PAGE DOWN**: Scroll the panel numbers in a vertical direction.

- When a continuous measurement is executed:
The panel save conditions or previous test results are displayed.
- When a continuous measurement is not executed:
NO USE is displayed.
The panel numbers which are not saved or which are invalid even if saved (when the both first and third parameters are off) are not displayed.



Continuous Measurement
Result Screen

6.

MANU TRIG

Press this key to start measurement.

The measurement result is displayed when the measurements of each panel numbers are terminated.

When the comparator measurement, individual decision result and AND result are displayed.

When BIN measurement, only the test data obtained from the first and third parameter settings are displayed. (The BIN measurement is not performed.)

If the displaying page is switched to other page after measurement completed, the displays of the measurement result are disappear.

When **EXIT** is pressed during a continuous test, the measurement is canceled and the display returns to the Initial Screen.

7.

EXIT

Return to the Initial Screen.

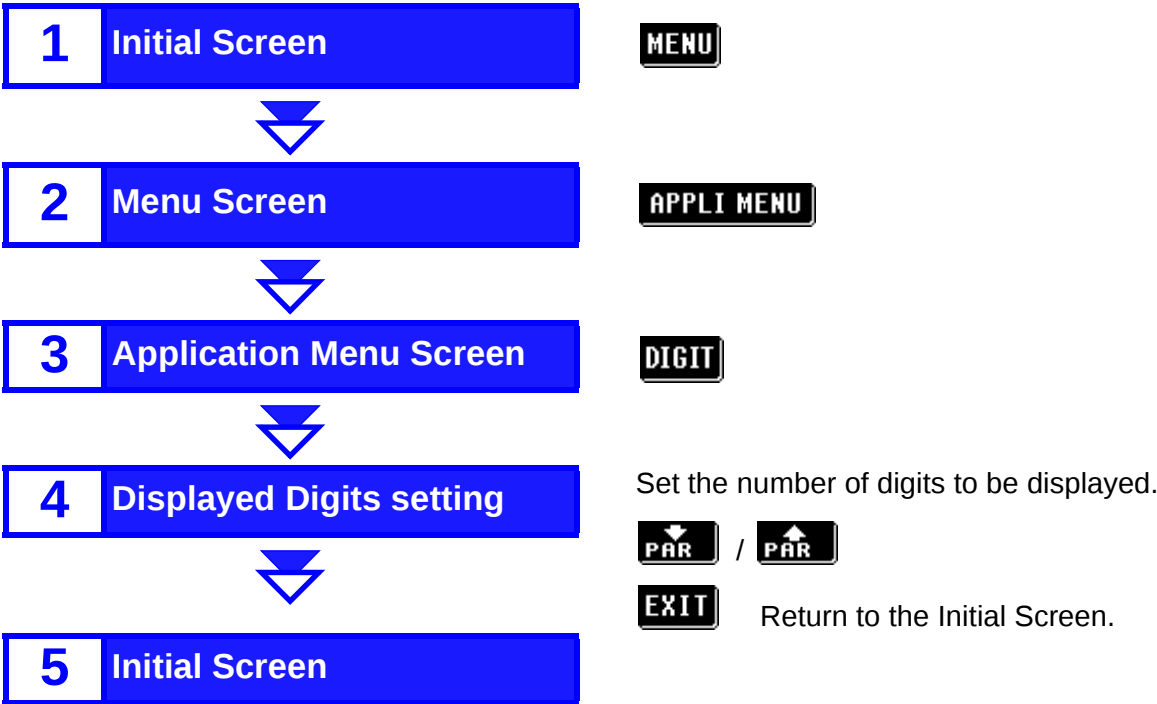
The continuous measurement can be executed from the EXT I/O connector.

❖5.3, "Measurements Using EXT I/O" (page 80)

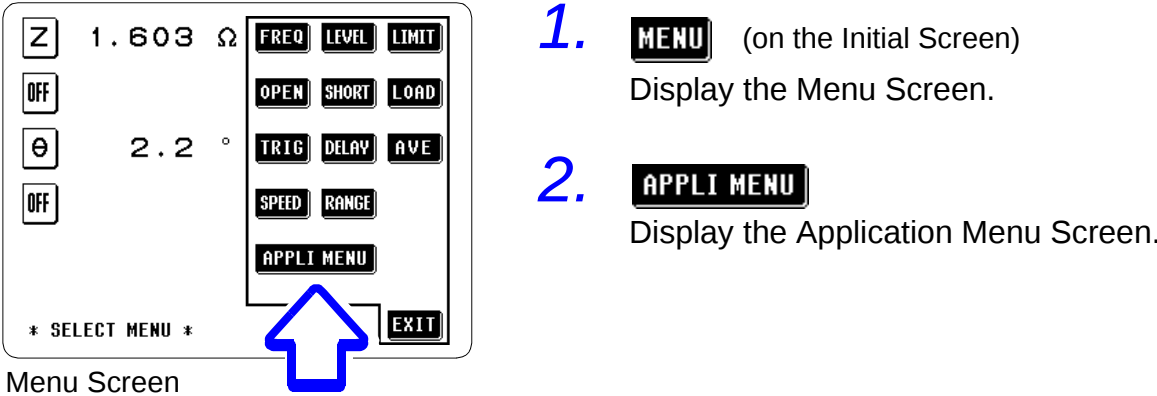
4.10 Setting the Number of Displayed Digits

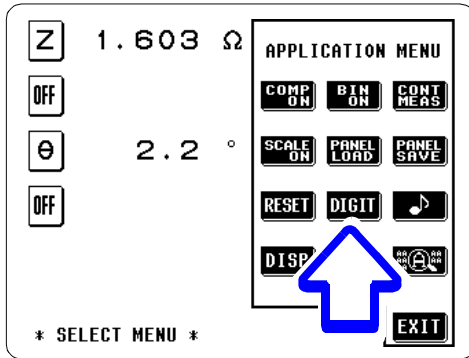
The number of effective digits for measurement can be set on a parameter-by-parameter basis.

Control Screen Sequence



Setting Method



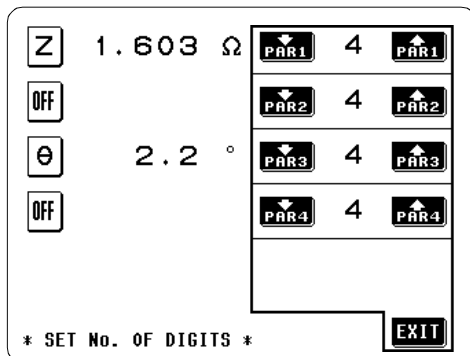


Application
Menu Screen

3.

DIGIT

Display the Displayed Digits Setting Screen.



Displayed Digits Setting Screen

4.

PAR / **PAR**

Set the number of displayed digits for each parameter.

Settable range: 3 to 5 digits

Note that the decimal point is displayed in different ways according to the parameter type.

- Normal measurement mode, Comparator mode, and BIN measurement mode (excluding Δ%):

Setting value	Parameters		
	θ, Q	D	Others
5	XXX.XX	X.XXXX	Up to 5 digits
4	XXX.X	X.XXX	Up to 4 digits
3	XXX	X.XX	Up to 3 digits

- Δ% setting in Comparator and BIN mode

Setting value	All parameters
5	XXX.XX %
4	XXX.X %
3	XXX %

5.

EXIT

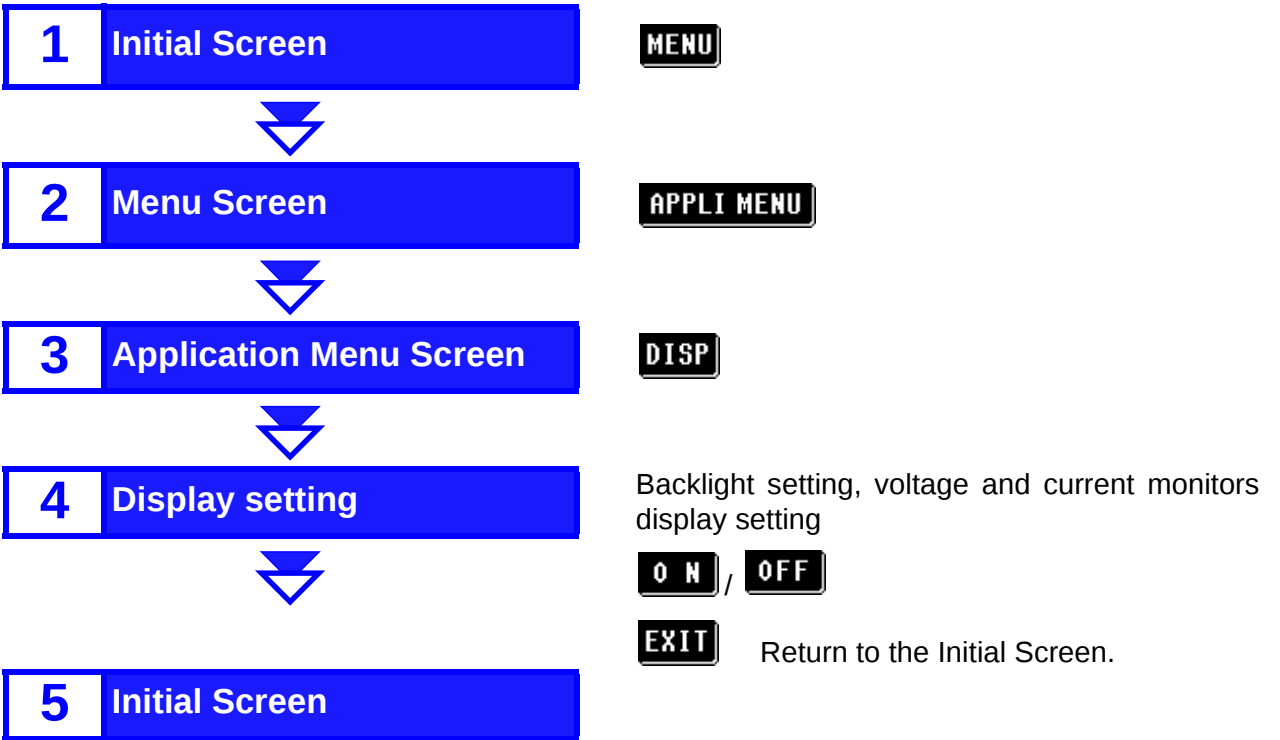
Return to the Initial Screen.

4.11 Setting for Display

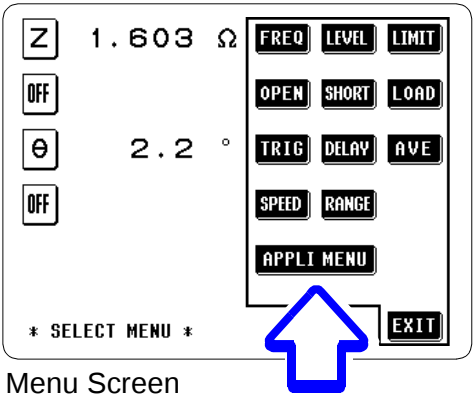
In some applications, such as on a production line or where EXT I/O or interfaces are used, it may not be necessary to display measurement values. This unit allows ON/OFF settings of the display and voltage/current monitors (Vmoni, Imoni) to be made.

- Turning off the LCD display helps save power, as the LCD display and backlight remain off. Moreover, the measurement time is reduced due to the fact that measurement values and Vmoni and Imoni indications need not be displayed.
- When the voltage and current monitors are turned off, the measuring time is also reduced due to the fact that the Vmoni and Imoni indications are not required.

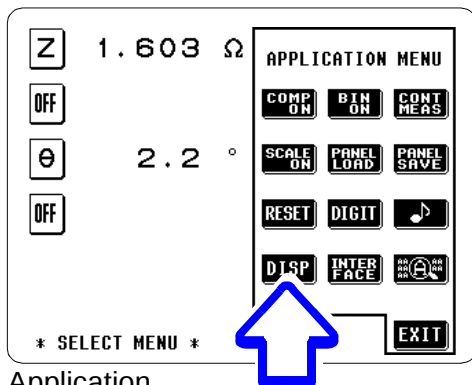
Control Screen Sequence



Setting Method



1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.

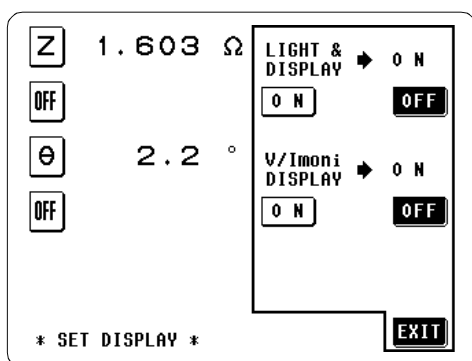


Application
Menu Screen

3.

DISP

Display the Display setting screen.



Display Setting Screen

4.

Set the display.

- Setting for backlight (LIGHT&DISPLAY)

ON

The backlight remain on permanently.

OFF

The backlight remain off permanently.
The backlight go out approximately 5 seconds after the touch panel is last touched. When the backlight are off, the measurement time is reduced, as Vmoni and Imoni do not display indications.

Turning on the backlight again

When the touch panel is touched after the display and backlight have gone out, they will come on again.

- Setting for Voltage and Current Monitors (Vmoni, Imoni) (V/Imoni DISPLAY)

ON

The voltage and current monitors display indications.

OFF

The voltage and current monitors do not display indications.

The measurement time is reduced, as Vmoni and Imoni do not display indications.

❖ Measurement time: 7.3, "Measurement Time" (page 184)

5.

EXIT

Return to the Initial Screen.

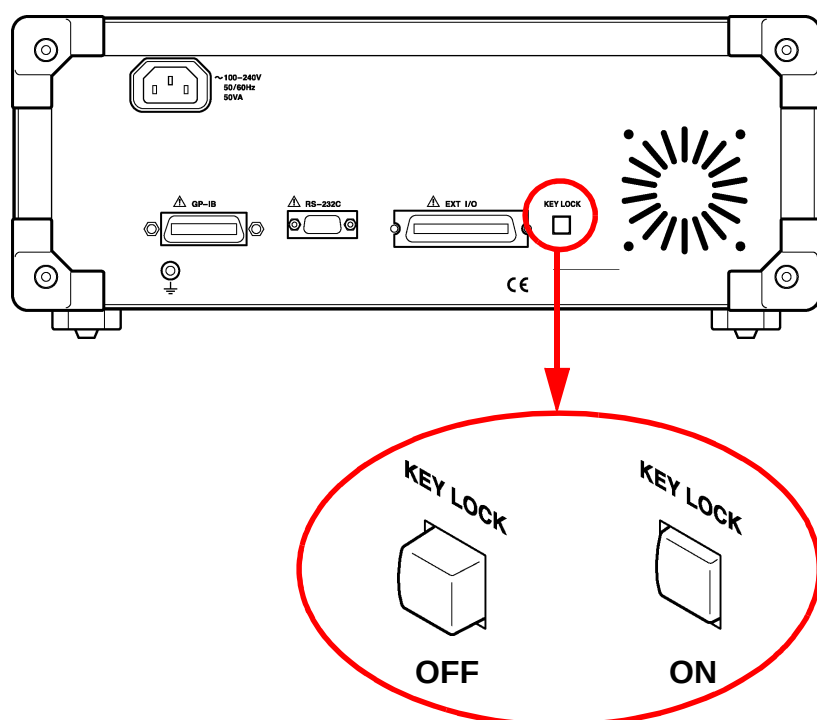
4.12 Key Lock Function

When the key lock function is turned on, all of the keys become inoperative, so that no control via the touch panel is possible, and the values of the settings are all frozen and preserved.

Turning the Key Lock On and Off

This function is activated using the key lock switch on the rear panel of the unit.

The key lock function can only be used when the screen is displaying the Initial Screen, Comparator Screen, BIN Screen, Scaling Screen, Zoom Display Screen, or Continuous Measurement Screen.



NOTE

- In the case of external triggering, the key lock does not apply to the **MANU TRIG** key.
- Even if the power supply is interrupted, the key lock function is not canceled.

Applications Chapter 5

5.1 Comparator Decision

This chapter describes two comparator decision methods as applications.

- Making decisions for two items simultaneously
- Sorting a single item into five bands

Making decisions for two items simultaneously (ABS and % settings).

Example

Parameters	Comparator	Setting value	
First parameter: static capacitance (Cs)	ABS	Upper limit value	110 nF
		Lower limit value	100 nF
Third parameter: phase angle (θ)	%	Reference value	-85°
		Upper limit value	5% (-80.75°)
		Lower limit value	-5% (-89.25°)

The results of the decisions

First parameter		Comparator decisions		
Upper limit value (110 nF)	HI	HI/ LO	HI/ IN	HI/ HI
	IN	IN/ LO	IN/ IN	IN/ HI
Lower limit value (100 nF)	LO	LO/ LO	LO/ IN	LO/ HI
		LO	IN	HI
		Lower limit value (-5%) Upper limit value (5%)		
		Third parameter		

In this manner, two decisions can be made simultaneously. Further, it is possible to check the decision results for two different parameters at the same time, and thereby to determine what quality zone the object which is being measured falls into.

Sorting a single item into five bands (% setting).

Two decisions can be made relating to the same item, so as to obtain five different combinations of results.

Example

Parameter	Setting value	
First parameter : Impedance (Z)	Reference value	300 Ω
	Upper limit value	10%
	Lower limit value	5%
Third parameter : Impedance (Z)	Reference value	300 Ω
	Upper limit value	-5%
	Lower limit value	-10%

The results of the decisions

		Comparator decisions	
		First parameter	Third parameter
First parameter	Band 1 Upper limit value 10% (330 Ω)	HI	HI
	Band 2 Lower limit value 5% (315 Ω)	IN	HI
Third parameter	Band 3 Upper limit value -5% (285 Ω)	LO	HI
	Band 4 Lower limit value -10% (270 Ω)	LO	IN
Band 5		LO	LO

It is possible to sort the objects under measurement into five bands according to the results of the decisions relating to the first and the third parameter. (This can also be done using the ABS setting.)

Various other possibilities can be used for the settings, according to requirements.

5.2 External Interference

This unit is designed to be resistant to errors caused by interference from the power supply line. However, if the level of the interference is particularly large, this can cause measurement errors or faulty operation.

Refer to the examples given below for examples of countermeasures which can be taken against interference which has caused faulty operation etc.

Countermeasures Against Interference from the Power Supply Line

If noise is present in the power supply line, its influence can be moderated by the following countermeasures:

Grounding by using a protective ground wire

The unit is constructed so as to be provided with protective grounding via the ground lead in the power cord.

This protective grounding serves the important function, not only of avoiding the possibility of electric shock to the operator, but also of eliminating noise from the power supply line by the provision of an internal filter.

Be sure to connect the unit to a properly 3-wire power supply socket, using the grounded power cord which is supplied with the unit.

Inserting a noise filter in the power supply line

Any excessive noise present in the power supply line can be suppressed by purchasing a socket type noise filter (generally available commercially) which can be inserted into the power supply socket, with the unit connected to the output of the noise filter.

Various types of such socket type noise filters are readily available from specialist manufacturers.

Fitting an anti-interference ferrite core on the power cord

Pass the power cord through a commercially available anti-interference ferrite core, and fix it on the power cord as close as possible to the AC power inlet of the unit, so as to suppress noise from the power supply line. Further benefit can often be obtained by fitting another anti-interference ferrite core on to the power cord at its other end, as close as possible to the plug which connects to the power supply outlet.

Moreover, if the internal diameter of the ferrite core allows, winding the power cord several times around the ferrite core may further reduce the amount of noise. Various types of such anti-interference ferrite cores or ferrite beads are readily available in the market from specialist manufacturers.

5.3 Measurements Using EXT I/O



5.3.1 EXT I/O Connector

The EXT I/O connector has the following functions.

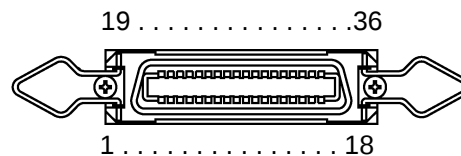
- To output signals containing the comparator result
- To output the end of measurement (EOM) signal
- To receive an external trigger signal
- To select the panel number to be loaded
- To display the result of BIN sorting

Connector used

- 57RE-40360-730B (D29) (made by DDK)

Compatible connector

- 57-30360 (solder cup connector without rib, made by DDK)
- 57-30360R (solder cup connector with rib, made by DDK)
- RC30-36P (made by HIROSE ELECTRIC CO.,LTD.)



Pinouts for the EXT I/O Connector

Pin number	Signal line name	I/O	Pin number	Signal line name	I/O
1	TRIG	Input	19	LD1	Input
2	LD2	Input	20	LD3	Input
3	LD4	Input	21	LD5	Input
4	M-HI	Output	22	M-IN	Output
5	M-LO	Output	23	S-HI	Output
6	S-IN	Output	24	S-LO	Output
7	AND	Output	25	EOM	Output
8	BIN1	Output	26	BIN2	Output
9	BIN3	Output	27	BIN4	Output
10	BIN5	Output	28	BIN6	Output
11	BIN7	Output	29	BIN8	Output
12	BIN9	Output	30	BIN10	Output
13	OUT OF BINS	Output	31	Unused	—
14	Unused	—	32	Unused	—
15	EXT.DCV	Input	33	INT.DCV	Output
16	EXT.DCV	Input	34	INT.DCV	Output
17	EXT.COM	Input	35	INT.GND	Output
18	EXT.COM	Input	36	INT.GND	Output

Signal Lines for the EXT I/O Connector

All input and output signals are all negative logic.

$\overline{\text{M-HI}}$, $\overline{\text{M-IN}}$, $\overline{\text{M-LO}}$

Output signal of comparator result
These lines output the comparator result for the first parameter.

$\overline{\text{S-HI}}$, $\overline{\text{S-IN}}$, $\overline{\text{S-LO}}$

Output signal of comparator result
These lines output the comparator result for the third parameter.

$\overline{\text{AND}}$

Output signal of comparator result
This signal is used to comprehensively evaluate the decision results for the first and third parameters.
This signal is output only if both the first parameter comparator result and the third parameter comparator result are IN.

$\overline{\text{BIN1 to BIN10}}$,
 $\overline{\text{OUT OF BINS}}$

Output of BIN test result
LO is sent to the signal line associated with the result of the BIN measurement.

$\overline{\text{EOM}}$

End of measurement signal
This signal is continuously output during measurement. When this signal is HI, the most recent comparator result is used for the evaluation. The next trigger signal can also be input.

$\overline{\text{EXT.DCV}}$,
 $\overline{\text{EXT.COM}}$

These are terminals for supplying a power supply voltage from an external device. This enables the unit to be connected to an external device while maintaining the isolation. The range of power voltage which can be connected is from +5 to +24 volts DC.

$\overline{\text{INT.DCV}}$, $\overline{\text{INT.GND}}$

These lines output +5 VDC and COM from the unit.

$\overline{\text{TRIG}}$

Trigger signal
When the external trigger is enabled for the 3535, measurement is begun when this signal is input.

$\overline{\text{LD1 to LD5}}$

Panel load signal
This signal is used to select panel numbers stored using the panel save function. When a panel number has been selected using this signal at the input of a trigger signal, the 3535 loads the measurement conditions for the panel number and then begins measurement. The table below shows the selectable panel numbers.

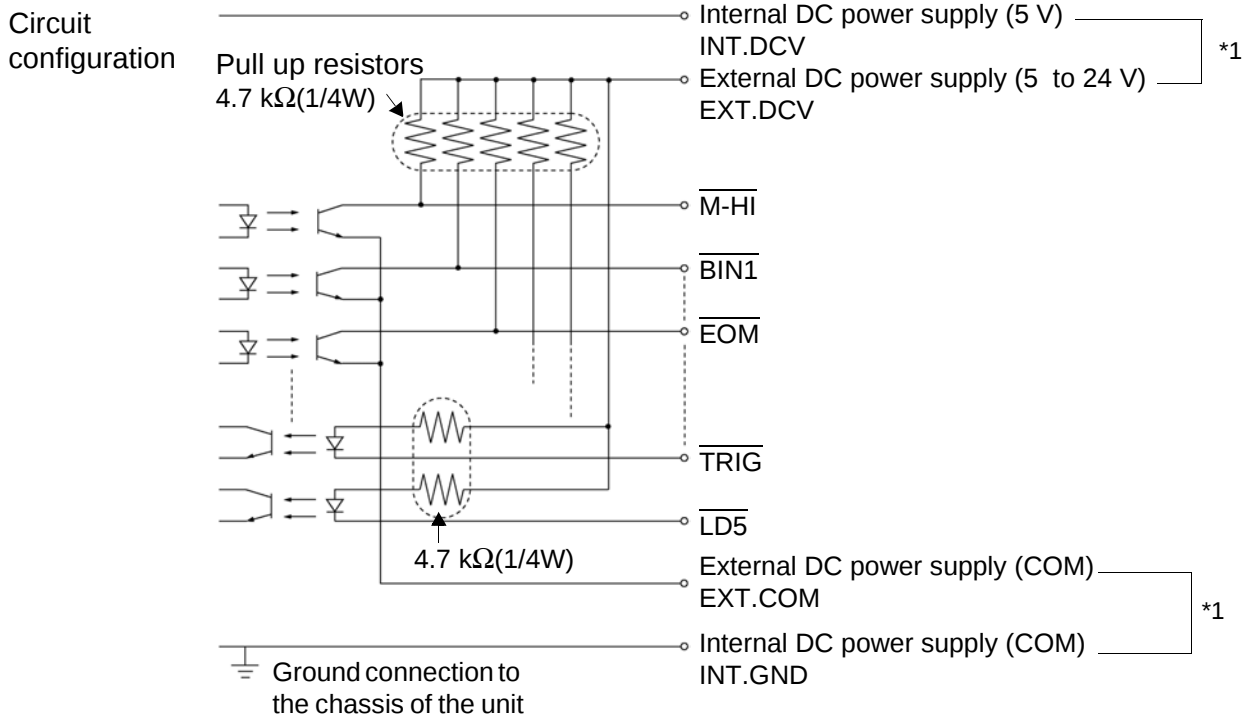
Panel number	LD1	LD2	LD3	LD4	LD5	Panel number	LD1	LD2	LD3	LD4	LD5	Panel number	LD1	LD2	LD3	LD4	LD5
1	L	H	H	H	H	11	L	L	H	L	H	21	L	H	L	H	L
2	H	L	H	H	H	12	H	H	L	L	H	22	H	L	L	H	L
3	L	L	H	H	H	13	L	H	L	L	H	23	L	L	L	H	L
4	H	H	L	H	H	14	H	L	L	L	H	24	H	H	H	L	L
5	L	H	L	H	H	15	L	L	L	L	H	25	L	H	H	L	L
6	H	L	L	H	H	16	H	H	H	H	L	26	H	L	H	L	L
7	L	L	L	H	H	17	L	H	H	H	L	27	L	L	H	L	L
8	H	H	H	L	H	18	H	L	H	H	L	28	H	H	L	L	L
9	L	H	H	L	H	19	L	L	H	H	L	29	L	H	L	L	L
10	H	L	H	L	H	20	H	H	L	H	L	30	H	L	L	L	L
L: LOW level input / H: HIGH level input												Invalid	H	H	H	H	H
													L	L	L	L	L

5.3.2 Circuit Construction and Connections for the EXT I/O Connector

The circuit construction for the EXT I/O connector is shown in the figure. Except for the power supply lines, all of the input and output signal lines are insulated by photocouplers.

CAUTION

- The insulation of the signal lines is for eliminating mutual influences between the signals. Any device which is connected to the 3535 unit should always be properly protectively grounded. If proper connection to a protective ground is not established, there is a danger of damage to the insulation.
- The voltage of the external DC power supply to be connected to the EXT DCV and EXT COM terminals should be from 5 V to 24 V. Do not supply DC voltage greater than 24 V. If you do, there is a danger of damage to the unit. Moreover, for driving the circuitry, connect any device which is capable of providing an output current of more than 200 mA.
- Do not connect unused pins (pins 14, 31, and 32).



*1: Connect when using the internal 5 V power supply

NOTE

- The internal DC power supply of 5 VDC is provided between INT DCV and INT GND. The maximum current capacity is 100 mA. Do not connect any external circuit whose current consumption is greater than 100 mA.
- INT GND is grounded to the chassis of the 3535 unit.
- When using the EXT I/O connector, be sure always to supply power to the external DC power supply.
- The output signal low level output current is a maximum of 60 mA. If a current greater than this is required, you should connect a transistor circuit using a current amplifier driven by an external power source or the like externally.

5.3.3 Electrical Characteristics of the Output Signals

The output signals are the collector outputs of the photocouplers, and are connected to the external DC power supply (EXT. DCV) via 4.7 kΩ pull-up resistors provided internally to the 3535 unit.

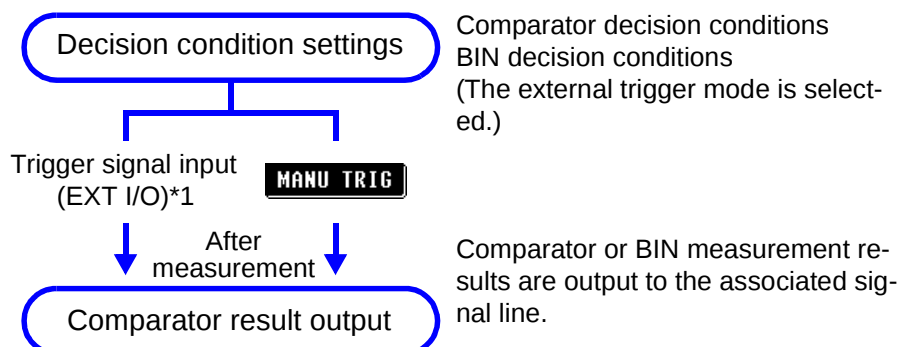
The relationship between the external DC power supply voltage, the voltage of the output signals, and the current, is as shown in the following table:

External DC power supply voltage [V]	Output signals (internal pull-up resistors 4.7 kΩ [V])			
	High level	Low level (Output current)		
		(10 mA)	(40 mA)	(60 mA max)
5	5	0.9	1.1	1.2
12	12			
24	24			

Direct connection of a circuit whose input voltage V_{IL} is regulated to a maximum of 0.8 V or the like is not possible.

In such a case, keep V_{IL} below 0.8 V by incorporating a transistor or a drive capable buffer circuit or the like.

5.3.4 I/O Signal Timing

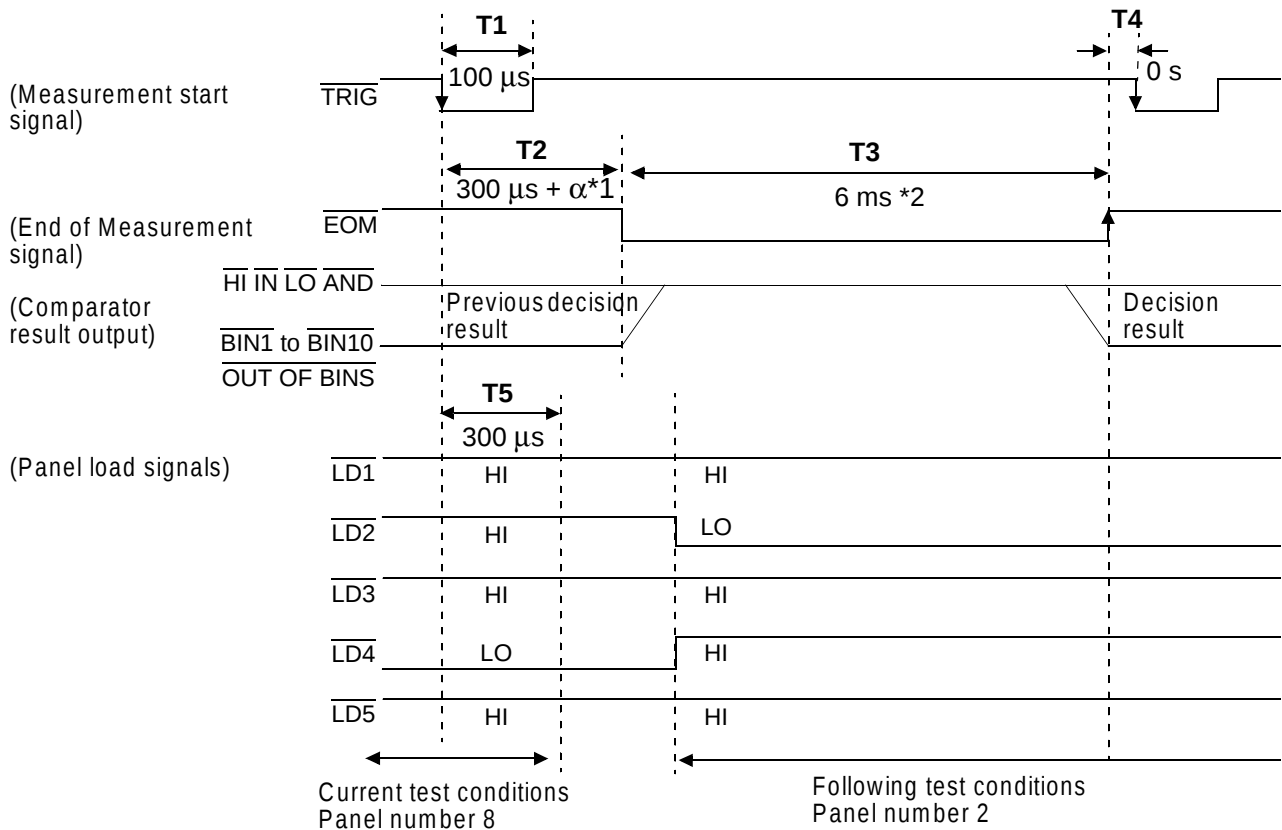


*1: When the panel number has been selected by the panel load signal and the trigger signal is received from the EXT I/O connector, the measurement conditions of the panel number are loaded before measurement.

❖ Example of measurement timing (Approx.)(page 84)

Example of measurement timing

(Approx.)



*1: α depends on the component and the trigger delay

*2: Reference value with FAST measurement speed, Averaging OFF and Z measurement selected.

T1 Minimum time period for trigger signal recognition

T2 Time period from trigger to circuit response

T3 Time period for measurement

T4 Minimum time period from end of measurement to next trigger

T5 Time period from trigger input to panel load signal recognition. After this length of time has elapsed, the LD signal can be changed.

❖ 7.3, "Measurement Time" (page 184)

NOTE

When the selected panel number falls under either of the following conditions, the 3535 begins measurement without loading the measurement conditions:

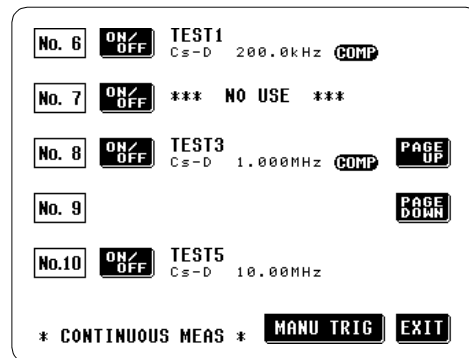
- The selected panel number is not stored.
- Both the first and third parameters are set to OFF.

When the measurement conditions are loaded, the external trigger is always set.

5.3.5 Measurement on the Continuous Measurement Screen

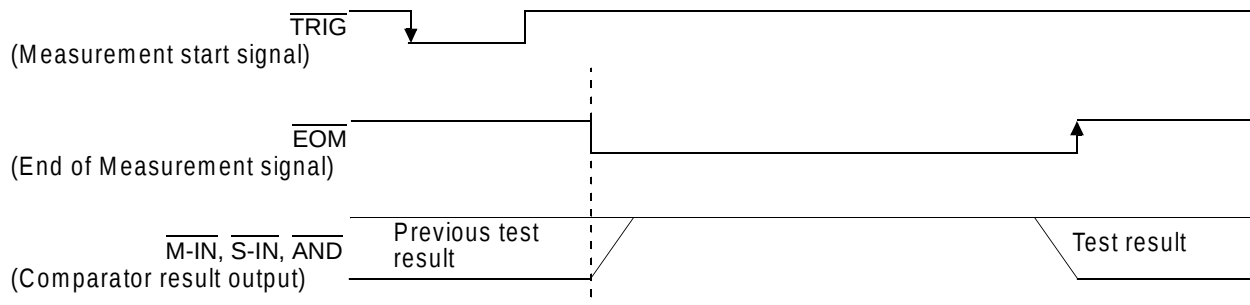
On the Continuous Measurement Screen, when a trigger signal is input via the EXT I/O connector, or when the **MANU TRIG** key on the screen is pressed, then the decision result is output on the comparator result output signal line of the EXT I/O connector after measurement is completed for all the panel numbers that must be measured on the screen according to the setting.

When performing continuous measurement with panel numbers 6, 8, and 10 for example.



Continuous Measurement Screen

Example of measurement timing



$\overline{\text{AND}}$

If all of the decision results are IN, then LO is output.

$\overline{\text{M-IN}}$

If all of the decision results of the first parameters are IN, then LO is output.

$\overline{\text{S-IN}}$

If all of the decision results of the third parameters are IN, then LO is output.

$\overline{\text{M-HI}}, \overline{\text{M-LO}},$

No output

$\overline{\text{S-HI}}, \overline{\text{S-LO}}$

NOTE

On the Continuous Measurement Screen, the panel load signals ($\overline{\text{LD1}}$ to $\overline{\text{LD5}}$) cannot be used.

❖ Continuous test: 4.9, "Continuous Measurement Function" (page 67)

5.4 Using the 9442 Printer (option)

Using with the optional 9442 PRINTER and 9444 CONNECTION CABLE, the measurement values and screen display copy can be printed out.

5.4.1 Preparation before Connection

Necessary items

- 9442 PRINTER (DPU-414 Seiko Instruments Inc.)
- 9443-01 AC ADAPTER(for Japan) PW-4007-J1 Seiko Instruments Inc.
- 9443-02 AC ADAPTER (for EU) PW-4007-E1 Seiko Instruments Inc.
- 9443-03 AC ADAPTER(for America) PW-4007-U1 Seiko Instruments Inc.
- 1196 RECORDING PAPER

To connect the main unit and printer:

- 9444 CONNECTION CABLE

Setting of the 9442 PRINTER

Change the settings of the software dip switches (DIP SW) to use the 9442 for the 3535.

- The 9442 is shipped with the function settings for use with the HIOKI 3166 CLAMP ON POWER HiTESTER. Before using, always change the settings of the DIP switches.
- For details on the operations and handling of the printer, refer to the operation manual supplied to the printer.
- For the printer, use the 1196 RECORDING PAPER (thermal paper, 10 rolls) or an equivalent.

Procedure

1. Turn off the power of the 9442.
2. Turn on the power while pressing the ON LINE button. Release the button after a list of the current settings starts printing out.

The print out of the current settings is followed by the prompt:

Continue? :Push 'On-line SW'

Write? :Push 'Paper feed SW'

3. Press the ON LINE button to change the settings.

"Dip SW-1" is printed to make a settings for DIP SW 1.

4. For switches one to eight of the DIP SW1, set the ON/OFF status as shown in the table below.

To set to ON, press the ON LINE button once and to set to OFF, press the FEED button once.

The setting is printed out after the **ON LINE** or **FEED** button is pressed to allow to confirm the new setting.

To change the settings, repeat from step 1.

 : Use these settings for the 3535

Software DIP SW 1 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Input method	Parallel	Serial
2	Printing speed	High	Low
3	Auto loading	Enable	Off
4	CR function	Carriage return and line feed	Carriage return
5	Setting command	Enable	Disable
6	Printing density (set to 100%)		OFF
7		ON	
8		ON	

After switch eight is set, the following messages are printed out.

Continue? :Push 'On-line SW'

Write? :Push 'Paper feed SW'

5. Press the ON LINE button and provide the following settings for DIP SW2 and DIP SW3.

Software DIP SW 2 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Print mode	Normal printing (40 columns)	Condensed printing (80 columns)
2	User-defined characters back-up	Enable	Disable
3	Character type	Ordinary characters	Special characters
4	Zero font	0	Ø
5	International character set	ON	
6		ON	
7		ON	
8		ON	

Software DIP SW 3 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Data bit length	8 bits	7 bits
2	Parity permission	Without	With
3	Parity condition	Odd	Even
4	Flow control	H/W BUSY	XON/XOFF
5	Baud rate (19200bps)		OFF
6		ON	
7		ON	
8			OFF

6. After setting for the switch number 8 of DIP SW 3 is made, press the ON LINE or FEED switch to complete settings.

The following message is printed out.

Dip SW setting complete!!

5.4.2 Connection Method



WARNING

To avoid electrocution, turn off the power to all devices before plugging or unplugging any cables or peripherals.

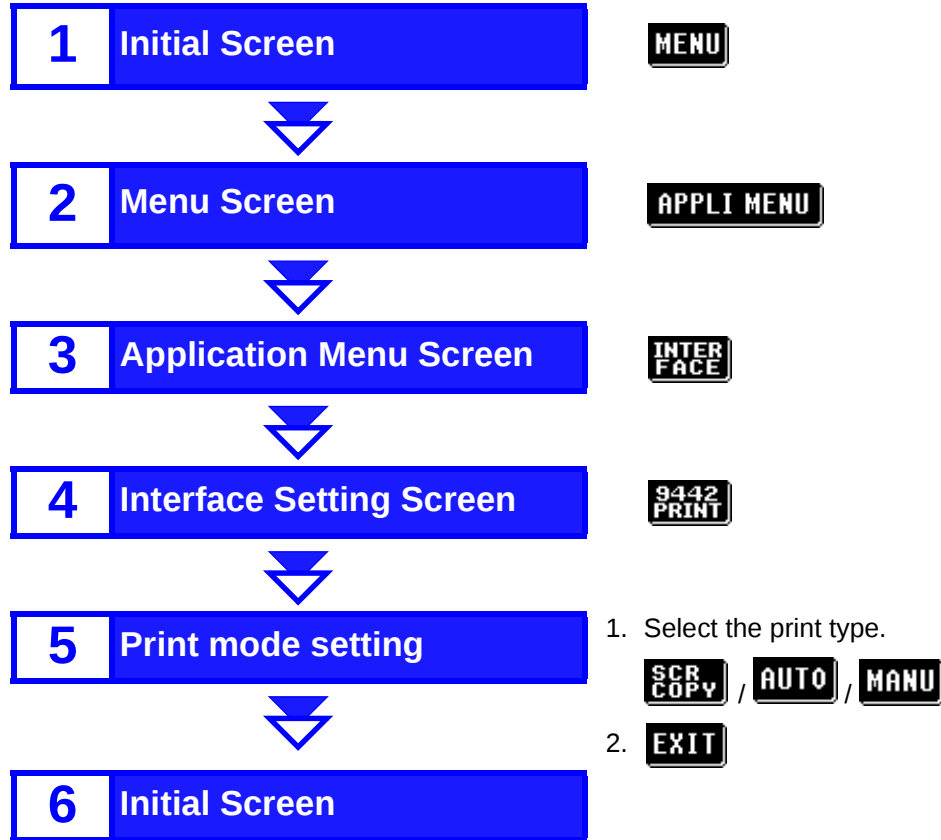
Connect the 9442 PRINTER to the RS-232C connector of the 3535. Before connection, complete any necessary settings on both the printer and the 3535.

Procedure

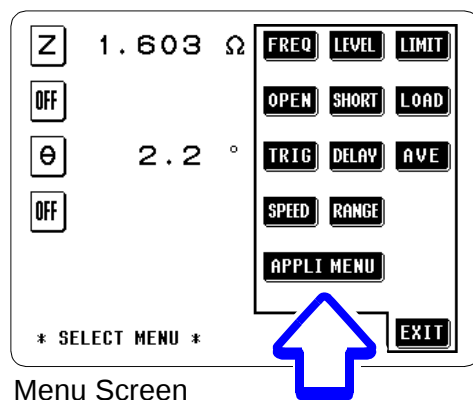
1. Turn off the power of the main unit and printer.
2. Connect the 9444 CONNECTION CABLE between the main unit and the printer.
3. After turning on the power of the main unit, turn on the power of the printer.

5.4.3 Print Mode Setting and Printout

Control Screen Sequence

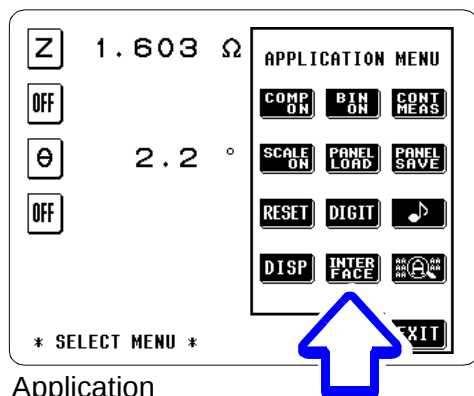


Setting Method



1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.

5.4 Using the 9442 Printer (option)

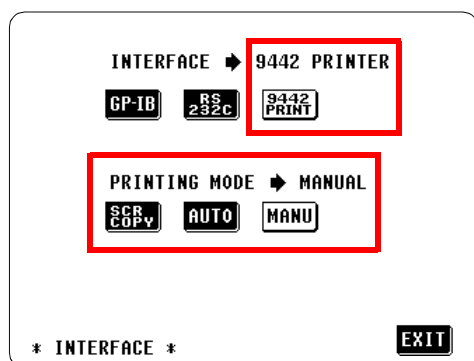


Application Menu Screen

3.



Display the Interface setting screen.



Print Mode Setting Screen

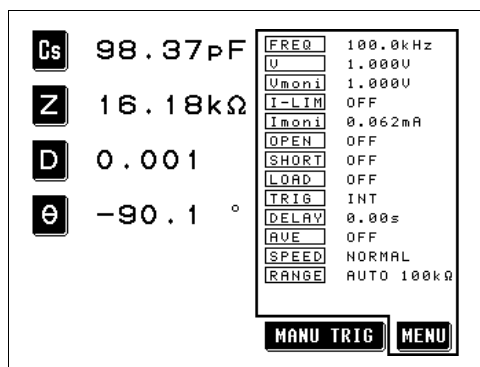
4.



Display the Print mode selection screen.

5.

Select the print mode.

Screen copy printing
Prints out the Initial Screen copy.Auto printing
Prints out the measurement values after measurement.Manual printing
Prints out the measurement values only when **PRINT** on the Initial Screen is pressed.

Example of printing: Screen copy



Screen Copy Mode _____

Press **PRINT** on the Initial Screen to start printing.
During printing, **PRINT** is not displayed, and all keys are invalid.

Example of printing: Auto printing

1. Normal measurement

Cs	97.61p	F		Z	16.31k	ohm
D	0.013			PH	-90.8	deg

2. Comparator executing

Cs	98.41p	F HI		D	0.001	LO
----	--------	------	--	---	-------	----

3. BIN measurement

Cs	98.36p	F		D	0.001	BIN2
----	--------	---	--	---	-------	------

4. Continuous measurement

PANEL No.6: TEST1						
Cs	97.82p	F IN		D	0.002	LO
PANEL No.8: TEST3						
Cs	99.73p	F IN		D	0.033	IN
PANEL No.10: TEST5						
Cs	103.4p	F IN		D	0.353	IN

● **AUTO** Auto Print Mode _____

The measurement values are printed out when the measurement is completed.

When the continuous measurement is performed, the measurement values are printed out when each measurement for the panel number is completed.

When automatic printing is selected, the external trigger mode is enabled.

When automatic printing is selected and a computer is connected to the 3535 instead of the 9442 PRINTER, test data can be transmitted to the computer.

The following RS-232C communication settings should be made on the computer.

- Baud rate: 19200bps
- Data length: 8 bits
- Parity: none
- Stop bit: 1 bit
- Flow control: none

Example of printing: Manual printing

1. Normal measurement

Cs	97.61p	F		Z	16.31k	ohm
D	0.013			PH	-90.8	deg

2. Comparator executing

Cs	98.41p	F HI		D	0.001	LO
----	--------	------	--	---	-------	----

3. Continuous measurement

Cs	98.36p	F		D	0.001	BIN2
----	--------	---	--	---	-------	------

● **MANU** Manual Print Mode _____

Regardless of the trigger settings, the measurement values are printed out when **PRINT** on the Initial Screen is pressed.

- When the measurement value is not stabilized because of changing the range by auto-ranging, "OVERFLOW" may be printed out.

Press **PRINT** after the measurement value is stabilized.

- The examples of the output results are same as 1 and 2 of the auto print mode.

6. **EXIT** Return to the Initial Screen.

GP-IB/RS-232C Interface

Chapter 6

This chapter contains information relating to the GP-IB and RS-232C interfaces, and uses the following symbols to identify which information is relevant to each interface. Sections without these symbols pertain to both interfaces.

GP-IB : GP-IB only

RS-232C : RS-232C only

Before Use

- Always be sure to secure the GP-IB/ RS-232C cable to the interface connector by tightening up the fixing screws.
- It is vital that the proper data format is used when inputting commands with data values to the 3535.

6.1 Overview and Features

All of the functions of the 3535 unit, except for powering on and off, can be controlled via the GP-IB/ RS-232C interface.

- The beeper sound can be turned on and off.
- The unit can be reset.

RS-232C

- The test result can be printed out by connecting the 3535 to the optional 9442 PRINTER.

GP-IB

- IEEE 488.2-1987 standard (essential) commands can be used.
- This unit is compliance with the following standard.
Compliance standard : IEEE 488.1-1987
- This unit is designed with reference to the following standard:
Reference standard : IEEE 488.2-1987
- If the output queue becomes full, it is cleared and a query error is generated. This differs from the IEEE 488.2 specification, which only stipulates the clearing of the output queue and the outputting of a query error when a deadlock state occurs, that is, when both the input buffer and the output queue have become full, and continuation of processing has become impossible.

6.2 Specifications

6.2.1 Specifications of RS-232C

RS-232C

Transfer system	Communication: Full duplex Synchronization: Start-stop synchronization
Baud rate	9600, 19200 bps
Data length	8 bits
Parity	none
Stop bit	1 bit
Message terminator (delimiter)	CR+LF, CR
Flow control	none
Electrical characteristic	Input voltage levels 5 to 15 V ON -15 to -5 V OFF Output voltage levels 5 to 9 V ON -9 to -5 V OFF
Connector	RS-232C Interface Connector Pin Assignments ❖ 6.3.1 "Attaching the Connector" (page 96) (D-sub miniature 9Pin male connector with M2.6 set screws) The connector is for terminal (DTE). Recommended cable: • 9637 RS-232C CABLE (for PC/AT machines) • 9638 RS-232C CABLE (for PC98 series)

6.2.2 Specifications of GP-IB



Interface Functions

SH1	All source handshake functions
AH1	All acceptor handshake functions
T6	Basic talk functions Serial poll function No talk-only mode The talker cancellation function with MLA (My Listen Address)
L4	Basic listener functions No listen-only mode The listener cancellation function with MTA (My Talk Address) is provided.
SR1	All service request functions
RL1	All remote/local functions
PP0	No parallel polling function
DC1	All device clear functions
DT1	All device trigger functions
C0	No controller function

ASCII codes are used.

6.3 Connection and Setting

6.3.1 Attaching the Connector



! WARNING

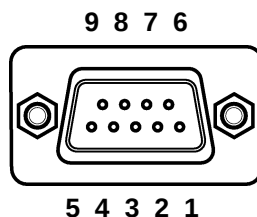
- To avoid electrocution, turn off the power to all devices before plugging or unplugging any of the interface connectors.
- To avoid damage to the instrument, do not short-circuit the terminal and do not input voltage to the terminal.

! CAUTION

The mounting screws must be firmly tightened or the unit may not perform to specifications, or may even fail.

RS-232C

RS-232C connector



D-sub 9Pin male connector
with M2.6 set screws

Connect the RS-232C cable.

To connect the 3535 to the controller (DTE), use a crossing cable compatible with the connectors on both the 3535 and the controller.

The I/O connector is designed for the terminal (DTE).

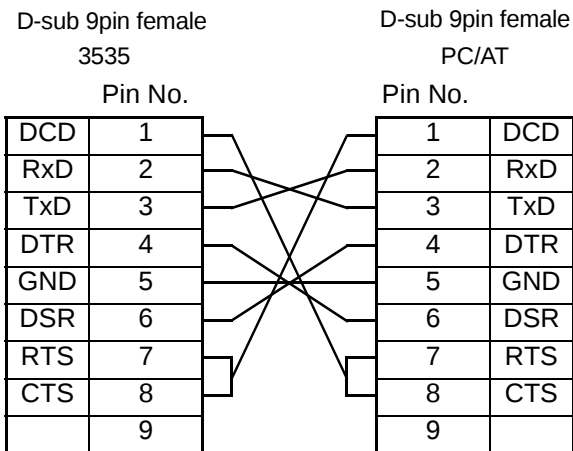
Pin No.	Functions	CCITT	EIA	JIS	Signal Name
		Circuit No.	Code Addr.	Code Addr.	
1	(Unused)				
2	Receive Data	104	BB	RD	RxD
3	Send Data	103	BA	SD	TxD
4	Data Terminal Ready	108/2	CD	ER	DTR
5	Signal Ground	102	AB	SG	GND
6	(Unused)				
7	Request to Send	105	CA	RS	RTS
8	Clear to Send	106	CB	CS	CTS
9	(Unused)				

RS-232C

When connecting the 3535 and PC/AT (DOS/V)

Use a crossing cable comprising two D-sub 9Pin female connectors.

Cross connection



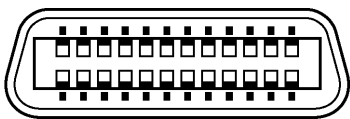
Recommended
cable:

HIOKI
9637 RS-232C
CABLE (1.8 m)

GP-IB

GP-IB connector

Connect the GP-IB cable.

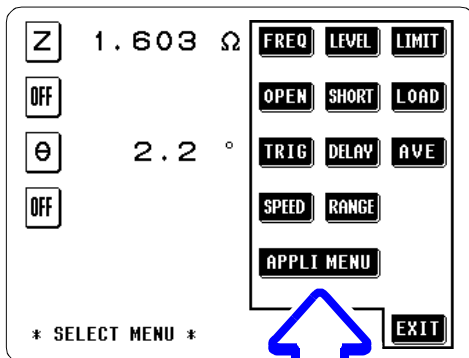


Recommended cable:

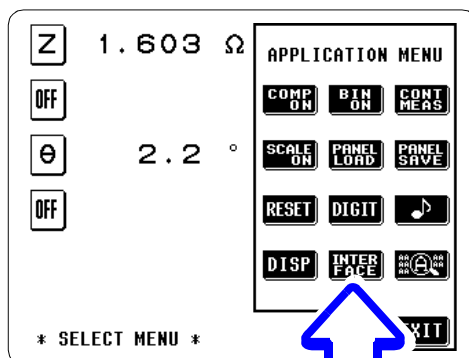
HIOKI
9151-02 GP-IB CONNECTOR CABLE (2 m)
9151-04 GP-IB CONNECTOR CABLE (4 m)

6.3.2 Setting the Communication Conditions

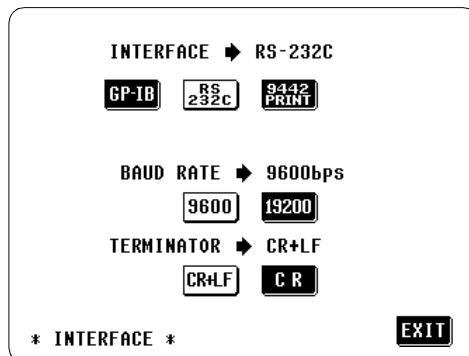
Setting Method



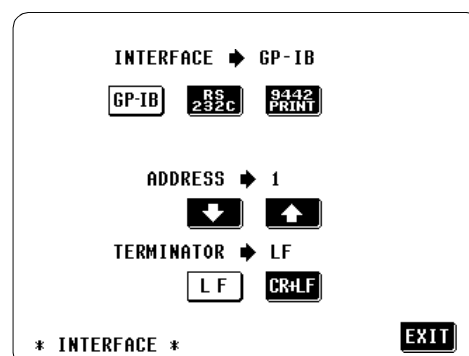
Menu Screen



Application Menu Screen



RS-232C interface setting



GP-IB interface setting

1. **MENU** (on the Initial Screen)
Display the Menu Screen.
2. **APPLI MENU**
Display the Application Menu Screen.
3. **INTER FACE**
Display the Interface Setting Screen.
4. Select the interface to be used.

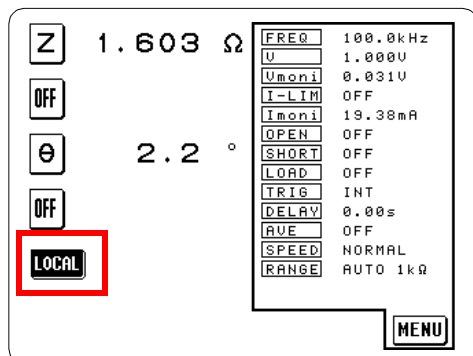
RS 232C RS-232C interface is used.

GP-IB GP-IB interface is used.

9442 PRINT Printer is used.

 - **RS 232C**
Set the baud rate and terminator.
Provide the same settings as for the PC to be connected.
 - **GP-IB**
Set the address and terminator.
 - **9442 PRINT**
❖ 5.4 "Using the 9442 Printer (option)" (page 86)
5. **EXIT**
Return to the Initial Screen.

6.3.3 Screen Display



During communications (in the remote state), the LOCK key to release the remote state is displayed on the screen.

Press this key to resume the normal state (local state).

During communications, the Initial Screen is forcibly displayed excluding the following conditions.

- When executing OPEN/SHORT/LOAD compensation or sending the execution command (compensation execution screen appears).
- When the Zoom Display Screen appears.

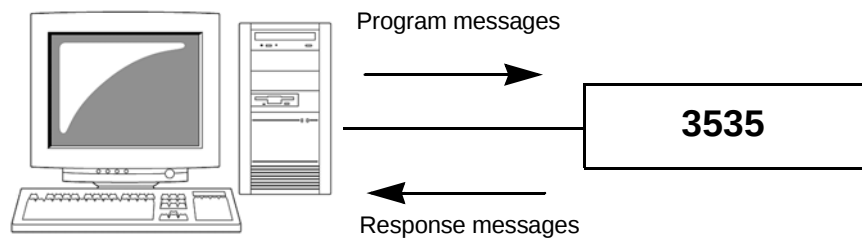
GP-IB

This key is disabled if the GP-IB controller has put the unit into the local lock out state. (Pressing the key has no effect.)

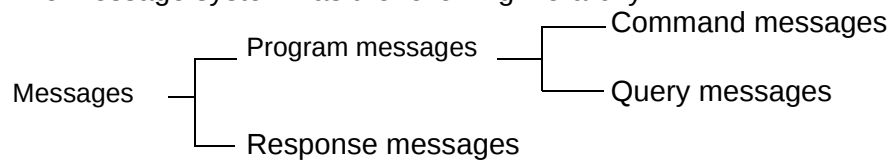
6.4 Communication Methods

Various messages are supported in order to control the 3535 through the interface.

Messages are divided into program messages, which are sent to the 3535 from the PC, and response messages, which are sent to the PC from the 3535.



The message system has the following hierarchy.



6.4.1 Message Format

Program Message

Program messages can be divided into either command messages or query messages.

- **Command Message**
Orders for controls of the unit, such as for making measurement condition settings or for reset or the like.
(example)
Command message which sets the frequency
:FREQUENCY 1000000

↑
↑
↑

Header portion
Space
Data portion

- **Query Message**
Orders for responses relating to results of operation, results of measurement, or the state of device settings.
(example)
Queries the current frequency
:FREQUENCY?

↑
↑

Header portion
Question mark

❖ For details: [Headers](#)(page 101), [Separators](#)(page 102), [Data Formats](#) (page 103)

Response messages

After a query message has been received, a response message is produced the moment that its syntax has been checked. Whether or not headers are prefixed to response messages is set by the "HEADer" command.

Header ON **:FREQUENCY 1000000**
 Header OFF **1000000**
 (Current frequency is 1 MHz)

After power-on, Header OFF is selected as a default setting. If an error occurs when the query message is received, the query does not produce response message.

Command Syntax

The names of commands for the 3535 are as far as possible mnemonic. Furthermore, all commands have a long form, and an abbreviated short form.

In command references in this manual, the short form is written in upper case letters, and then this is continued in lower case letters so as to constitute the long form.

Either of these forms will be accepted during operation, but intermediate forms will not be accepted. Further, during operation both lower case letters and upper case letters will be accepted without distinction.

DISPlay OK (long form)
DISP OK (short form)
DISPL Error
DIS Error

Response messages generated by the 3535 are in long form and in upper case letters.

Headers

It is essential to prefix headers to program messages.

(1) Command program headers

There are three types of command: simple commands, compound commands, and standard commands.

- Simple command header
 This header is a sequence of letters and digits.
:HEADer
- Compound command header
 This header is made up from a plurality of simple command type headers marked off by colons " :".
:BEEPer:KEY
- Standard command header
 This header begins with an asterisk " *", and continues with a standard command stipulated by IEEE 488.2.
***RST**

(2) Query program headers

These are for commands used for interrogating the unit about the results of operations, about measured values, or about the current states of settings for the unit. As shown by the following examples, they can be recognized as queries by a question mark "?" appearing after the program header.

:MEASure?

:MEASure:ITEM?

Message Terminators

The 3535 supports the following message terminators.



- LF
- CR+LF
- EOI
- LF with EOI



- CR
- CR+LF

The following response message terminators can be selected depending on the interface setting.



- LF with EOI (initial setting)
- CR + LF with EOI



- CR
- CR + LF (initial setting)

❖ [Setting of the interface: 6.3.2 "Setting the Communication Conditions" \(page 98\)](#)

Separators

(1) Message unit separator

A semicolon ";" is used as a message unit separator when it is desired to set out several messages on a single line.

:BEEP:KEY ON;*IDN?

When messages are combined in this way, if a syntax error occurs, all subsequent messages up to the next terminator will be ignored.

(2) Header separator

In a message which has a header and data, a space " " is used as the header separator to separate the header from the data.

:LEVel V

(3) Data separator

If a message has several data items, commas are required as data separators for separating these data items from one another.

:MEASure:ITEM 53,18

Data Formats

The main unit uses character string data and decimal numeric data, and the type used varies according to the command in question.

(1) Character data

Character string data must always begin with an alphabetic character, and the following characters can be either alphabetic characters or numerals. Although in character data either upper case letters or lower case letters are accepted, response messages output by the main unit are always in upper case letters.

```
:LEVel CC
```

(2) Decimal data

The numeric data values are all represented in decimal, in three formats identified as NR1, NR2 and NR3, and each of these can appear as either a signed number or an unsigned number. Unsigned numbers are taken as positive.

Further, if the accuracy of a numerical value exceeds the range with which the main unit can deal, it is rounded off. (5 and above is rounded up; 4 and below is rounded down).

- NR1 integer data (examples: +12, -23, 34)
- NR2 fixed point numbers (examples: +1.23, -23.45, 3.456)
- NR3 floating point numbers . (examples: +1.0E-2, -2.3E+4)

The term "NRf format" includes all these three formats. When the main unit is receiving it accepts NRf format.

For the response data, the format is specified for each commands and the data in specified format is transmitted.

```
:AVERaging 2
:PHASE -88.05
:Z 31.981E+00
```



- The 3535 does not completely support IEEE 488.2. Use the data shown in Section 6.5 "Command Reference" (page 112) as far as possible, but be warned that the input buffer or output queue may overflow by a single command.
- When the numerical data is converted into 3535 settings, the conversion error is ± 1 dgt.

Abbreviation of Compound Commands

When several compound commands have a common head portion, for example **:BEEPer:KEY** and **:BEEPer:COMParator**, then, when and only when writing them directly following on from one another, this common portion (**:BEEPer:** in this example) can be omitted from each command.

This common portion is called "the current path", by analogy with the general concept of the current directory in the directory structure of UNIX or MS-DOS, and until it is cleared the analysis of following commands is performed by deeming them to be preceded by the current path which has been curtailed in the interests of brevity. This manner of using the current path is shown in the following example:

Normal expression

:BEEPer:KEY ON;:BEEPer:COMParator NG

Abbreviated expression

:BEEPer:KEY ON;COMParator NG

↑
This becomes the current path, and can be curtailed from the following messages.

The current path is cleared when the power is turned on, when a colon ":" appears at the start of a command, and when a message terminator is detected.

Messages of standard command form can be executed without relation to the current path. Further, they have no effect upon the current path.

It is not necessary to prefix a colon ":" at the start of headers of simple commands and compound commands. However, in order to prevent confusion with abbreviated forms and mistakes in operation, it is recommended practice always to prefix ":" to headers.

On the 3535, the current paths are as follows (common in GP-IB and RS-232C).

:APPLication:DISPlay:
:BEEPer:
:BIN:FLIMit:
:BIN:SLIMit:
:COMParator:FLIMit:
:COMParator:SLIMit:
:CORRection:
:CORRection:LOAD:
:LEVel:
:LIMiter:
:MEASure:
:MEMory:
:PARAmeter#: (# =1/ 2/ 3/ 4)
:SCALE:
:TRIGger:
:USER:

6.4.2 Output Queue and Input Buffer

Output Queue

Response messages accumulate in the output queue and are read out as data and cleared by the controller. The output queue is also cleared in the following circumstances:

RS-232C

- When the power is turned off and turned on again.

GP-IB

- When a device clear is issued.
- When the power is turned off and turned on again.
- When a query error is generated.

The 3535 has an output queue of 10 K bytes capacity. If the response messages overflow this limit of 10 K bytes, a query error is generated, and the output queue is cleared. Further, if a new message is received while the output queue still contains data, the output queue is cleared, and a query error is generated.

Input Buffer

The 3535 has an input buffer of 10 K bytes capacity.

Messages which are received are put into this buffer and executed in order. If the data accumulated in this buffer exceeds 10 K bytes the buffer becomes full, and until a space again becomes available in the buffer the GP-IB interface bus goes into the waiting state.

The RS-232C does not accept data in excess of 10 K bytes.

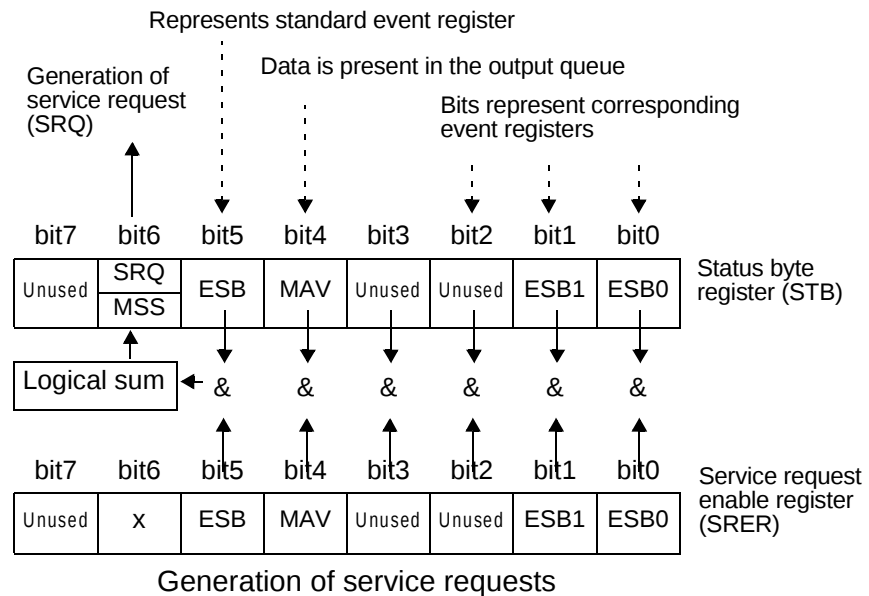
NOTE

The length of a single command should be less than 10 K bytes.

6.4.3 Status Byte Register



In its implementation of the serial polling function using service requests, the 3535 employs the status model specified by IEEE 488.2. The term "event" refers to any phenomenon which generates a service request.



The status byte register holds information relating to the event registers and the output queue. It is further possible to use the service request enable register as a mask to select the items required. If any of the bits selected by the mask becomes 1, bit 6 (MSS; the master summary status) is also set to 1, an SRQ message is generated, and this generates a service request.

Status byte register (STB)

The status byte register is an 8-bit register whose contents are output from the main unit to the controller, when serial polling is being performed.

If even only one bit in the status byte register has changed from 0 to 1 (provided that it is a bit which has been set in the service request enable register as a bit which can be used), then the MSS bit is set to 1. Simultaneously with this the SRQ bit is set to 1, and a service request is generated.

The SRQ bit is synchronized with service requests, and is read out and simultaneously cleared when serial polling is being performed. Although the MSS bit is only read out on an "*STB?" query, on a "*CLS" command for example it is not cleared until the event is cleared.

Bit 7	Unused
Bit 6 SRQ MSS	Set to 1 when a service request is dispatched. Logical sum of the other bits of the status byte register
Bit 5 ESB	Standard event summary (logical sum) bit Shows a logical sum of the standard event status register.
Bit 4 MAV	Message available Indicates that there is at least one message in the output queue.
Bit 3	Unused
Bit 2	Unused
Bit 1 ESB1	Event summary bit 1 Bitwise logical sum of event status register 1
Bit 0 ESB0	Event summary bit 0 Bitwise logical sum of event status register 0

Service request enable register (SRER)

This register masks the status byte register. Setting a bit of this register to 1 enables the corresponding bit of the status byte register to be used.

6.4.4 Event Registers

Standard event status register (SESR)

The standard event status register is an 8-bit register.



It is possible to determine the status of the unit by reading these registers.



If any bit in the standard event status register is set to 1 (after masking by the standard event status enable register), bit 5 (ESB) of the status byte register is set to 1.

❖ [Standard event status register \(SESR\) and Standard event status enable register \(SESER\)\(page 109\)](#)

The standard event status register is cleared in the following situations:

- When a "*CLS" command is received.
- When an "*ESR?" query is received.
- When the unit is powered on.

Standard event status enable register (SESR)

Bit 7	PON	Power on flag. When the power is turned on, or on recovery from a power cut, this bit is set to 1.
Bit 6		User request. Unused
Bit 5	CME	Command error. (The command to the message terminator is ignored.) When a command which has been received contains a syntactic or semantic error, this bit is set to 1. • There is a mistake in a program header. • The number of data parameters is wrong. • The format of the parameters is wrong. • Unsupported commands are received.
Bit 4	EXE	Execution error. When for some reason a command which has been received cannot be executed, this bit is set to 1. • The designated data value is outside the set range. • The designated data value is not acceptable. • Some other function is being performed
Bit 3	DDE	Device dependent error. When a command cannot be executed due to some cause other than a command error, a query error, or an execution error, this bit is set to 1. • Execution is impossible due to an abnormality inside the main unit. • During open or short-circuit compensation or load compensation, valid data cannot be obtained.
Bit 2	QYE	Query error. (output queue is cleared) This bit is set to 1 when a query error is detected by the output queue control. • When an attempt has been made to read the output queue when it is empty. (GP-IB only) • When the data overflows the output queue. • When data in the output queue has been lost.
Bit 1		Unused

Standard event status enable register (SESR)

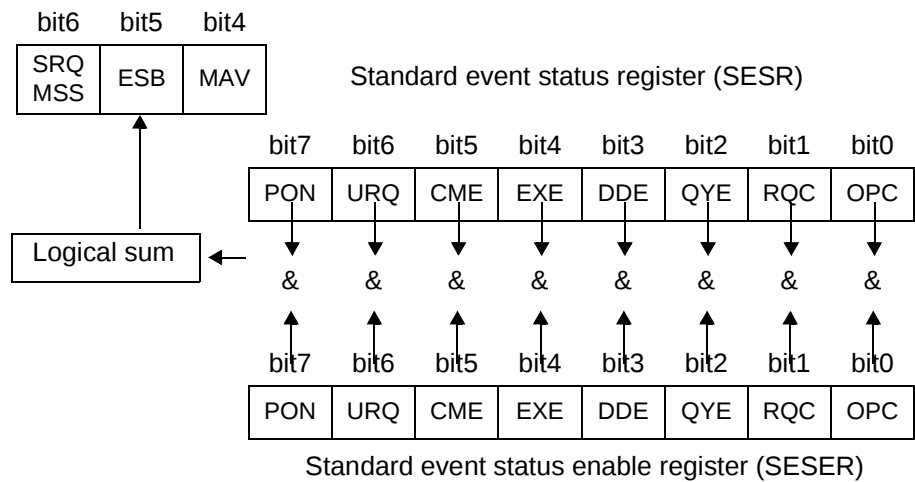
Bit 0	OPC	Operation terminated. (GP-IB only) This bit is set to 1 when an "*OPC" command is executed When the operation of all the messages up to the "*OPC" command has been completed.
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Standard event status enable register (SESER)

GP-IB

Setting any bit of the standard event status enable register to 1 enables the corresponding bit of the standard event status register to be accessed.

Standard event status register (SESR) and Standard event status enable register (SESER)



Event status registers specific to the 3535 (ESR0, ESR1)

The 3535 has two event status registers.
The event status registers are each 8-bit registers.

RS-232C

It is possible to determine the status of the unit by reading these registers.

GP-IB

If any bit in one of these event status registers is set to 1 (after masking by the corresponding event status enable register), the following happens:

- For event status register 0, bit 0 of the status byte register (ESB0) is set to 1.
- For event status register 1, bit 1 of the status byte register (ESB1) is set to 1.

Event status register 0 and event status register 1 are cleared in the following three situations:

- When a "*CLS" command is received.
- When an "*ESR0?" query (for event status register 0) or "*ESR1?" query (for event status register 1) is received.
- When the unit is powered on.

Event Status Register 0 (ESR0)

Bit 7		Unused
Bit 6	COF	Constant current overflow
Bit 5	LOF	Limits overflow
Bit 4	IOF	Impedance overflow
Bit 3	IUF	Impedance underflow
Bit 2		Unused
Bit 1	EOM	Measurement completed
Bit 0	CEM	Compensation data measurement completed

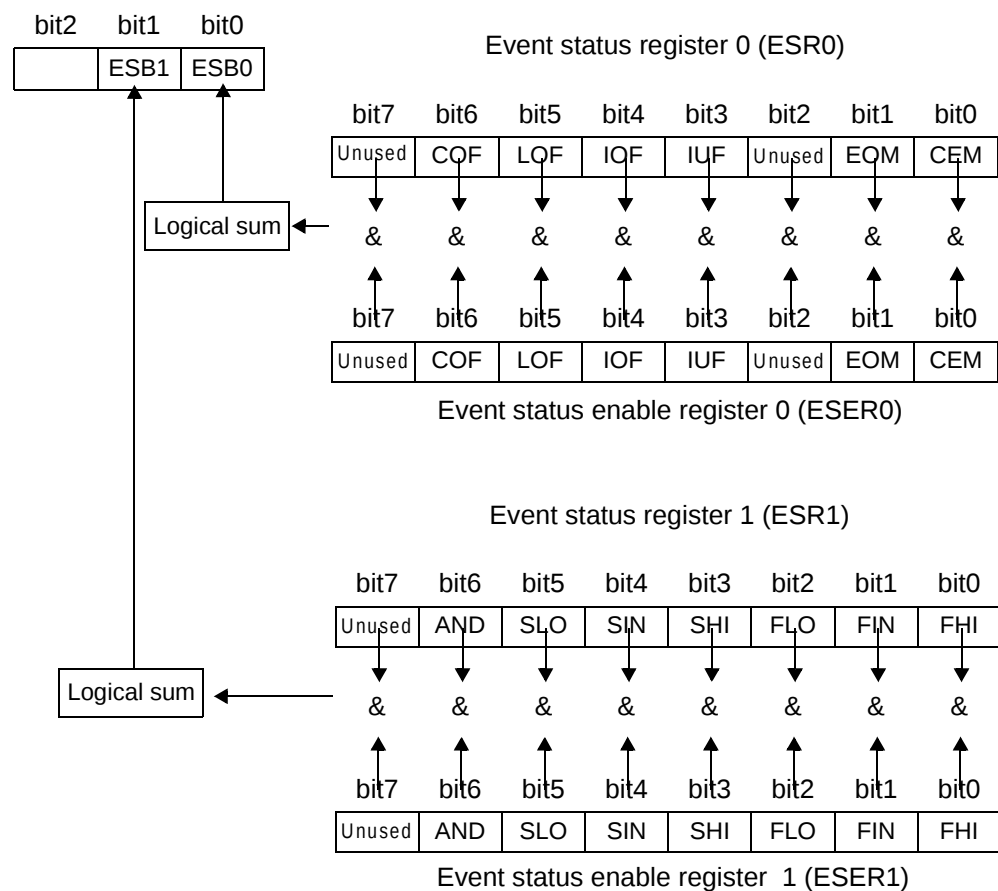
Event Status Register 1 (ESR1)

Bit 7		Unused
Bit 6	AND	Logical product (AND bit1 and bit 4) of comparison re- sults
Bit 5	SLO	Third parameter below lower limit
Bit 4	SIN	Third parameter within limits
Bit 3	SHI	Third parameter above upper limit
Bit 2	FLO	First parameter below lower limit
Bit 1	FIN	First parameter within limits
Bit 0	FHI	First parameter above upper limit



Event status registers 0 (ESR0), 1 (ESR1) and event status enable registers 0 (ESER0), 1 (ESER1)

Status byte register (STB)



Summary of commands for writing and reading each of the registers

GP-IB

Register	Read	Write
Status byte register	*STB?	—
Service request enable register	*SRE?	*SRE
Standard event status register	*ESR?	—
Standard event status enable register	*ESE?	*ESE
Event status register 0	:ESR0?	—
Event status enable register 0	:ESE0?	:ESE0
Event status register 1	:ESR1?	—
Event status enable register 1	:ESE1?	:ESE1

GP-IB Commands

The following commands are used for performing interface functions:

Command	Function
GTL	Go To Local The remote state is canceled, and the system goes into the local state.
LLO	Local Lock Out All keys, including the LOCAL key, become inoperable.
DCL	Device CLear Clears the input buffer and the output queue.
SDC	Selected Device Clear Clears the input buffer and the output queue.
GET	Group Execute Trigger During the external trigger, performs single-shot sampling processing.

6.5 Command Reference

The command specific to RS-232C or GP-IB interface is identified with  or  .

Common commands

Command		Data format (For query, response data is used.)	Explanation	Error	Ref page
*CLS			Clears event register.	*1	124
*ESE		0 to 255 (NR1)	Sets the standard event status enable register (SESR).	*4	125
*ESE?		0 to 255 (NR1)	Queries the standard event status enable register (SESR).	*2	125
*ESR?		0 to 255 (NR1)	Queries the standard event status register.	*2	125
*IDN?		<Manufacturer's name>,<Model name>,0,<Software version>	Queries device ID.	*2	122
*OPC		—————	Issues service request after execution completion.	*1	123
*OPC?		1	Queries execution completion.	*2	123
*RST		—————	Queries the initial setting.	*1	122
*SRE		0 to 255 (NR1)	Sets the service request enable register.	*4	126
*SRE?		0 to 255 (NR1)	Reads the service request enable register.	*2	126
*STB?		0 to 255 (NR1)	Reads the status byte register.	*2	126
*TRG		—————	Performs sampling once.	*1,3,5	127
*TST?		0 to 15 (NR1)	Queries the result of the self-test.	*2, 3	123
*WAI		—————	Waits until sampling is fully completed.	*1	124

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Command error ____ If the data parameters are set after this command.
- *2 Query error ____ If the response message is longer than 10 K bytes.
- *3 Execution error ____ If the command is executed while the open or short circuit or load compensation is performed.
- *4 Execution error ____ If the command is not set using the specified character or numerical data.
- *5 Execution error ____ If the command is executed in internal trigger mode

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
Display function				
:APPLication:DISPlay:LIGHt	ON/ OFF	Setting for backlight.	*2, 3	127
:APPLication:DISPlay:LIGHt?		Queries the setting for backlight.	*1	127
:APPLication:DISPlay:MONItor	ON/ OFF	Setting for voltage and current monitors.	*2, 3	127
:APPLication:DISPlay:MONItor?		Queries the setting for voltage and current monitors.	*1	127
Averaging function				
:AVERaging	OFF/ 2/ 4/ 8/ 16/ 32/ 64 (NR1)	Sets the number of measurement times for averaging.	*2, 3	128
:AVERaging?		Queries the number of measurement times for averaging.	*1	128
Beep sound function				
:BEEPPer:COMParator	IN/ NG/ OFF	Sets the beep sound for the comparator.	*2, 3	128
:BEEPPer:COMParator?		Queries the beep sound for the comparator.	*1	128
:BEEPPer:KEY	ON/ OFF	Sets the beep sound for key input.	*2, 3	129
:BEEPPer:KEY?		Queries the beep sound for key input.	*1	129
BIN function				
:BIN	ON/ OFF	Enables and disables the BIN function.	*2, 3	129
:BIN?		Queries the BIN function enablement.	*1	129
:BIN:FLIMit:ABSolute	<BIN#>, <lower limit value>, <upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>, <upper limit value>= OFF/ numerical value (NR3)	Sets the lower and upper limit values of the first parameter for the BIN function in absolute value mode.	*2, 3	130
:BIN:FLIMit:ABSolute?	<BIN#>	Queries the lower and upper limit values of the first parameter for the BIN function in absolute value mode.	*1	130
:BIN:FLIMit:DEViation	<BIN#>, <lower limit value>, <upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>, <upper limit value>= OFF/ numerical value (NR2)	Sets the lower and upper limit values of the first parameter for the BIN function in deviation percentage mode ($\Delta\%$).	*2, 3	131
:BIN:FLIMit:DEViation?	<BIN#>	Queries the lower and upper limit values of the first parameter for the BIN function in deviation percentage mode ($\Delta\%$).	*1	131

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
:BIN:FLIMit:REfERENCE	<reference value> <reference value>= numerical value (NR3)	Sets the reference value of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).	*2, 3	132
:BIN:FLIMit:REfERENCE?		Queries the reference value of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).	*1	132
:BIN:FLIMit:MODE	<characters> <characters>=ABSolute/ PERcent/ DEViation	Sets the first parameter setting mode for the BIN function.	*2, 3	132
:BIN:FLIMit:MODE?		Queries the first parameter setting mode for the BIN function.	*1	132
:BIN:FLIMit:PERcent	<BIN#>,<lower limit value>,<upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>,<upper limit value> = OFF/ numerical value (NR2)	Sets the lower and upper limit values of the first parameter for the BIN function in percentage mode (%).	*2, 3	131
:BIN:FLIMit:PERcent?	<BIN#>	Queries the lower and upper limit values of the first parameter for the BIN function in percentage mode (%).	*1	131
:BIN:SLIMit:ABSolute	<BIN#>,<lower limit value>,<upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>,<upper limit value> = OFF/ numerical value (NR3)	Sets the lower and upper limit values of the third parameter for the BIN function in absolute value mode.	*2, 3	133
:BIN:SLIMit:ABSolute?	<BIN#>	Queries the lower and upper limit values of the third parameter for the BIN function in absolute value mode.	*1	133
:BIN:SLIMit:DEViation	<BIN#>,<lower limit value>,<upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>,<upper limit value> = OFF/ numerical value (NR2)	Sets the lower and upper limit values of the third parameter for the BIN function in deviation percentage mode ($\Delta\%$).	*2, 3	134
:BIN:SLIMit:DEViation?	<BIN#>	Queries the lower and upper limit values of the third parameter for the BIN function in deviation percentage mode ($\Delta\%$).	*1	134
:BIN:SLIMit:REfERENCE	<reference value> <reference value>= numerical value (NR3)	Sets the reference value of the third parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).	*2, 3	135
:BIN:SLIMit:REfERENCE?		Queries the reference value of the third parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).	*1	135

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
:BIN:SLIMit:MODE	<characters> <characters>=ABSolute/ PERcent/ DEVIation	Sets the third parameter setting mode for the BIN function.	*2, 3	135
:BIN:SLIMit:MODE?		Queries the third parameter setting mode for the BIN function.	*1	135
:BIN:SLIMit:PERcent	<BIN#>, <lower limit value>, <upper limit value> <BIN#>=1 to 10(NR1) <lower limit value>, <upper limit value> = OFF/ numerical value (NR2)	Sets the lower and upper limit values of the third parameter for the BIN function in percentage mode (%).	*2, 3	134
:BIN:SLIMit:PERcent?	<BIN#>	Queries the lower and upper limit values of the third parameter for the BIN function in percentage mode (%).	*1	134

Comparator function

:COMParator	ON/ OFF	Enables and disables the comparator function.	*2, 3	136
:COMParator?		Queries the comparator function enablement.	*1	136
:COMParator:FLIMit:ABSolute	<lower limit value>, <upper limit value> <lower limit value>, <upper limit value>=OFF/ numerical value (NR3)	Sets the lower and upper limit values for the first comparator parameter in absolute value mode.	*2, 3	136
:COMParator:FLIMit:ABSolute?		Queries the lower and upper limit values for the first comparator parameter in absolute value mode.	*1	136
:COMParator:FLIMit:DEVIation	<reference value>, <lower limit value>, <upper limit value> <reference value>= numerical value (NR3) <lower limit value>, <upper limit value>=OFF/ numerical value (NR2)	Sets the reference value and lower and upper limit values for the first comparator parameter in deviation percentage mode ($\Delta\%$).	*2, 3	137
:COMParator:FLIMit:DEVIation?		Queries the reference value and lower and upper limit values for the first comparator parameter in deviation percentage mode ($\Delta\%$).	*1	137
:COMParator:FLIMit:MODE	ABSolute/ PERcent/ DEVIation	Set the first parameter setting mode for the comparator.	*2, 3	137
:COMParator:FLIMit:MODE?		Queries the setting mode of the first parameter for the comparator.	*1	137
:COMParator:FLIMit:PERcent	<reference value>, <lower limit value>, <upper limit value> <reference value>= numerical value (NR3) <lower limit value>, <upper limit value>=OFF/ numerical value (NR2)	Sets the reference value and lower and upper limit values for the first comparator parameter in percentage mode (%).	*2, 3	138

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
:COMParator:FLIMit:PERcent?		Queries the reference value and the lower and upper limit values for the first comparator parameter in percentage mode (%).	*1	138
:COMParator:SLIMit:ABSolute	<lower limit value>,<upper limit value> <lower limit value>,<upper limit value>=OFF/ numerical value (NR3)	Sets the lower and upper limit values for the third comparator parameter in absolute value mode.	*2, 3	139
:COMParator:SLIMit:ABSolute?		Queries the lower and upper limit values for the third comparator parameter in absolute value mode.	*1	139
:COMParator:SLIMit:DEViation	<reference value>,<lower limit value>,<upper limit value> <reference value>= numerical value (NR3) <lower limit value>,<upper limit value>=OFF/ numerical value (NR2)	Sets the reference value and lower and upper limit values for the third comparator parameter in deviation percentage mode ($\Delta\%$).	*2, 3	140
:COMParator:SLIMit:DEViation?		Queries the reference value and lower and upper limit values for the third comparator parameter in deviation percentage mode ($\Delta\%$).	*1	140
:COMParator:SLIMit:MODE	ABSolute/ PERcent/ DEViation	Set the third parameter setting mode for the comparator.	*2, 3	140
:COMParator:SLIMit:MODE?		Queries the setting mode of the third parameter for the comparator.	*1	140
:COMParator:SLIMit:PERcent	<reference value>,<lower limit value>,<upper limit value> <reference value>= numerical value (NR3) <lower limit value>,<upper limit value>=OFF/ numerical value (NR2)	Sets the reference value and lower and upper limit values for the third comparator parameter in percentage mode (%).	*2, 3	141
:COMParator:SLIMit:PERcent?		Queries the reference value and the lower and upper limit values for the third comparator parameter in percentage mode (%).	*1	141

Open and short-circuit compensation function

:CORRection:OPEN	OFF/ ALL/ numerical value (NR1) (100000 to 120000000)	Enables and disables the open-circuit compensation function.	*2, 3	142
:CORRection:OPEN?		Queries the open-circuit compensation function enablement.	*1	142
:CORRection:SHORT	OFF/ ALL/ numerical value (NR1) (100000 to 120000000)	Enables and disables the short-circuit compensation function.	*2, 3	143
:CORRection:SHORT?		Queries the short-circuit compensation function enablement.	*1	143

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
Load compensation function				
:CORRection:LOAD	ON/OFF	Enables and disables the load compensation function.	*2, 3	144
:CORRection:LOAD?		Queries the load compensation function enablement.	*1	144
:CORRection:LOAD:FREQuency	<LOAD compensation number>,<frequency> <LOAD compensation number>= 1 to 5(NR1) <frequency>= OFF/ numerical value (NR1)	Turns the load compensation conditions (frequency) on or off.	*2, 3	145
:CORRection:LOAD:FREQuency?		Queries the on/off status of the load compensation conditions (frequency).	*1	145
:CORRection:LOAD:REFeRence	<LOAD compensation number>,<mode>, <reference value1>, <reference value2> <LOAD compensation number>=1 to 5(NR1) <mode>=Z/CS/CP/LS/LP/Rs(characters) <reference value1>= numerical value (NR3) <reference value2>= numerical value (NR2/NR3)	Sets the reference values for the load compensation condition.	*2, 3	146
:CORRection:LOAD:REFeRence?		Queries the reference values for the load compensation condition.	*1	146
Monitor function				
:DISPlay:MONItor?	<voltage monitor value>,<current monitor value>	Queries the monitored voltage and current.	*1	147
Event register				
:ESE0	 0 to 255 (NR1)	Sets event status enable register 0.	*3	147
:ESE0?		Queries event status enable register 0.	*1	147
:ESE1	 0 to 255 (NR1)	Sets event status enable register 1.	*3	148
:ESE1?		Queries event status enable register 1.	*1	148
:ESR0?	0 to 255 (NR1)	Queries event status register 0.	*1	148
:ESR1?	0 to 255 (NR1)	Queries event status register 1.	*1	149
Measurement frequency function				
:FREQuency	100000 to 120000000 (NR1)	Sets the measurement frequency.	*2, 3	149
:FREQuency?		Queries the measurement frequency.	*1	149
Headers				
:HEADer	ON/ OFF	Enables and disables headers for the response message.	*2, 3	150
:HEADer?		Queries headers enablement.	*1	150

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
Measurement signal level function				
:LEVel	V/ CC	Sets the measurement signal level.	*2, 3	150
:LEVel?		Queries the measurement signal level.	*1	150
:LEVel:CCURRent	0.2E-03 to 20.00E-03 (100 kHz to 10.00 MHz) 0.2E-03 to 10.00E-03 (10.01 MHz to 120.0 MHz) (NR3)	Sets the constant current level value.	*2, 3	151
:LEVel:CCURRent?		Queries the constant current level value.	*1	151
:LEVel:VOLTage	0.005 to 1.000 (100 kHz to 10.00 MHz) 0.005 to 0.500 (10.01 MHz to 120.0 MHz) (NR2)	Sets the open-circuit voltage level value.	*2, 3	151
:LEVel:VOLTage?		Queries the open-circuit voltage level value.	*1	151
Limit function				
:LIMiter	ON/ OFF	Enables and disables the limit setting function.	*2, 3	152
:LIMiter?		Queries the limit setting function enablement.	*1	152
:LIMiter:CURRent	0.01E-03 to 99.99E-03 (NR3)	Sets the current limit value.	*2, 3	152
:LIMiter:CURRent?		Queries the current limit value.	*1	152
:LIMiter:VOLTage	0.010 to 1.000 (NR2)	Sets the voltage limit value.	*2, 3	153
:LIMiter:VOLTage?		Queries the voltage limit value.	*1	153
Panel load function				
:LOAD	1 to 30 (NR1)	Transfers the specified panel number.	*2, 3, 4	153
Normal measurement				
:MEASure?		Queries the data item.	*1, 2, 5	154
:MEASure:ITEM	<MR0>,<MR1> <MR0>,<MR1>= 0 to 255 (NR1)	Sets measurement parameter.	*3	156
:MEASure:ITEM?		Queries measurement parameter.	*1	156
Test data memory function				
:MEMory?	<contents of first memory><message terminator> ...<contents of n'th memory>	Queries the test data that has been stored in the memory with the test data memory function.	*1, 2	157
:MEMory:CLEar		Clears the memory controlled by the test data memory function.	*2	158

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
:MEMory:COUNT?	0 to 200(NR1)	Queries the number of test data sets stored in the memory with the test data memory function.	*1,2	158
Parameter settings (#: 1 to 4)				
:PARAmeter#	Z/ Y/ PHASE/ CS/ CP/ D/ LS/ LP/ Q/ RS/ G/ RP/ X/ B/ OFF	Sets displayed parameters.	*2,3	158
:PARAmeter#?		Queries displayed parameters.	*1	158
:PARAmeter#:DIGit	3 to 5 (NR1)	Sets the number of displayed digits.	*2,3	159
:PARAmeter#:DIGit?		Queries the number of displayed digits.	*1	159
Measurement range settings				
:RANGe	1 to 3(NR1)	Sets the measurement range.	*2,3	159
:RANGe?		Queries the measurement range.	*1	159
:RANGe:AUTO	ON/OFF	Sets the measurement auto-range.	*2,3	160
:RANGe:AUTO?		Queries the measurement auto-range.	*1	160
Panel saving function				
:SAVE	<No.>,<Name> <No.>=1 to 30 (NR1) <Name>=1 to 20 characters	Saves the measurement conditions in specified panel number.	*2,3	160
:SAVE?	<No.>	Queries the panel number in which data is saved.	*1	160
Scaling function				
:SCALE	ON/ OFF	Enables and disables the scaling function.	*2,3	161
:SCALE?		Queries the scaling function enablement.	*1	161
:SCALE:FVALue	<a>, <a>,=numerical value (NR3)	Sets the first parameters (a and b) in the scaling function.	*2,3	161
:SCALE:FVALue?		Queries the first parameters (a and b) in the scaling function.	*1	161
:SCALE:SVALue	<a>, <a>,=numerical value (NR3)	Sets the third parameters (a and b) in the scaling function.	*2,3	162
:SCALE:SVALue?		Queries the third parameters (a and b) in the scaling function.	*1	162
Measurement speed function				
:SPEED	FAST/ NORMAl/ SLOW/ SLOW2	Sets the measurement speed.	*2,3	162
:SPEED?		Queries the measurement speed.	*1	162
Trigger function				
:TRIGger	INTernal/ EXTernal	Sets the type of trigger.	*2,3	163
:TRIGger?		Queries the trigger setting.	*1	163

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

Commands Specific to the 3535

Command	Data format	Explanation	Error	Ref page
:TRIGger:DELAy	0.00 to 9.99 (NR2)	Sets the trigger delay time.	*2,3	163
:TRIGger:DELAy?		Queries the trigger delay time.	*1	163
ID function				
:USER:IDENTity	<ID> <ID>= user ID code	Sets the user ID.	*3	164
:USER:IDENTity?		Queries the user ID.	*1	164

Description of errors (An error occurs when the message is sent in any of the following cases.)

- *1 Query error _____ If the response message is longer than 10 K bytes.
- *2 Execution error _____ If the command is executed while the open or short circuit or load compensation is performed.
- *3 Execution error _____ If the command is not set using the specified character or numerical data.
- *4 Execution error _____ If the panel number in which the settings have not been saved is selected.
- *5 Execution error _____ During comparator measurement, BIN, and scaling measurement, if parameters both first and third are set to OFF

NOTE: Any typographical mistakes in the message will result in a command error.

6.6 Message Reference

Shows the command message that contains numerical or character parameters.

<numerical value>: Numeric data values

- (NR1) integer data
- (NR2) fixed point numbers
- (NR3) floating point numbers
- (NRf) format that contains NR1, NR2, and NR3

<characters>: Character string data

Shows the command description.

Enables and disables headers for the response message

Describes the message syntax.

Syntax Command :HEADer <ON/ OFF>
Query :HEADer?
Response <ON/ OFF>

Explains the command data or response message.

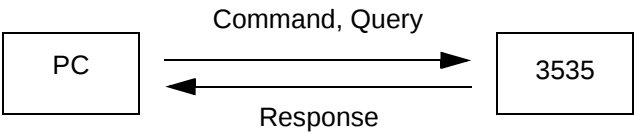
ON :Headers are prefixed to response messages.
OFF:No header is affixed to the response message.

Explains the message.

Function Command Sets whether or not the 3535 will prefix headers to its response messages.
When powering on, OFF is initially set.

Illustrates the actual command application. (Generally, the explanation is directed to the "HEADER ON" case, except for the HEADER command.)

Query Returns the setting of headers for the response messages as ON or OFF.
Example Command :HEADer ON
Headers are prefixed to response messages.
Query :HEADer?
Response :HEADER ON (Headers: ON)
OFF (Headers: OFF)



6.6.1 Standard Command

The message specific to RS-232C or GP-IB interface is identified with the corresponding symbol.

(1) System data command

Queries device ID.

Syntax Query *IDN?
 Response <Manufacturer's name >,<Model name >,0,<Software version>

Example HIOKI,3535,0,V01.01

(2) Internal operation command

Initializes the settings.

Syntax Command *RST
Function Resets the 3535 unit.

Measurement parameters	Z , θ	Comparator (Both first and third parameters)	
Measurement frequency	1 MHz	Comparator setting mode	ABS (absolute value setting)
Measurement signal level	Open-circuit voltage mode (V mode)	Absolute value set values	Upper and lower limit values: OFF
V mode set value	1.000 V	Percent set values	
CC mode set value	10.00 mA	First parameter	Reference value: 1000 Upper and lower limit values: OFF
Limit function	OFF	Third parameter	Reference value: 10 Upper and lower limit values: OFF
Voltage limit set value	1.000 V		
Current limit set value	20.00 mA		
Open-circuit compensation	OFF	BIN measurement (Both first and third parameters)	
Short-circuit compensation	OFF	Setting mode	ABS (absolute value setting)
Load compensation	OFF	Absolute value set values	Upper and lower limit values: OFF
Trigger setting	Internal trigger	Percent set values	
Trigger delay time	0 s	First parameter	Reference value: 1000 Upper and lower limit values: OFF
Measurement speed setting	NORMAL	Third parameter	Reference value: 10 Upper and lower limit values: OFF
Measurement range	AUTO		
Beep sound setting	Key input: ON Comparator: OFF	Scaling	
Panel saving	All clear	(compensation coefficient a/ b of the first and third parameters)	a: 1.0000, b: 0
Number of displayed digits (First to forth parameters)	All 4 digits		
Display setting	LCD display: ON Voltage/current monitor: ON		

Function	Performs the self test of the 3535, and returns the result thereof as a numerical value in NR1 format. No header is affixed to the response message.
-----------------	---

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
unused	unused	unused	unused	Interrupt error	I/O error	RAM error	ROM error

After all action has been completed during execution, sets the OPC of
SESR.

After execution is completed, replies with ASCII [1].

Syntax	Query *OPC? Response 1
Function	When the command preceding the *OPC command completes execution, the response of ASCII [1] is made.

After all execution is completed, subsequently performs the following command.

Syntax	Command *WAI
Example	A;B;*WAI;C After execution of commands A and B has been completed, the command C that follows the *WAI command is executed. If the frequency is set to 100 kHz: - When not using the *WAI command Transmission :FREQuency 1E+6;:MEASure? The response for :MEASure? is the measurement value at frequency of 100 kHz. - When using the *WAI command Transmission :FREQuency 1E+6;*WAI;:MEASure? The response for :MEASure? is the measurement value of frequency at 1 MHz.

(4) Status and event control command

Clears the status byte and associated queues (except for the output queue).

Syntax	Command *CLS
Function	Clears all the event registers associated with the bits of the status byte register. Accordingly, also clears the status byte register.
Note	 This has no effect upon the output queue.  This has no effect upon the output queue, the various enable registers, or bit 4 (the MAV bit) of the status byte register.

GP-IB

Function	Command	Sets the mask pattern of the standard event status enable register (SESER) to a value (0 to 255). When the power is turned on, the data is reinitialized to 0.
	Query	The contents of SESER as set by the *ESE command as a numerical value in NR1 format between 0 and 255.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Reads out and clears the contents of the standard event status register (SESR).

Function	Returns the contents of the standard event status register (SESR) as a numerical value in NR1 format from 0 to 255, and then clears standard event status register. No header is affixed to the response message.
-----------------	---

RS-232C

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	Unused	CME	EXE	DDE	QYE	Unused	Unused

GP-IB

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Example 32 Bit 5 of SESR has been set to 1.

Write and reads the service request enable register (SRER).



Syntax Command ***SRE** <numerical value>

Query ***SRE?**

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function Command Sets a mask pattern if SRER to a value in the range 0 to 255. The setting of unused bits (bits 2,3, and 7) and bit 6 are disregarded. When the power is turned on, the data is reinitialized to zero.

Query Returns the set contents of the service request enable register (SRER) set by the *SRE command as a numerical value in NR1 format between 0 and 255. The values of bit 6 and unused bits (bit 2, 3, 7) are always 0.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	X	ESB	MAV	Unused	Unused	ESE1	ESE0

Example Command ***SRE 34**

Bits 1 and 5 of SRER is set to 1.

Query ***SRE?**

Response ***SRE 34** (Headers: ON)

34 (Headers: OFF)

Bits 1 and 5 of SRER is set to 1.

Reads the status byte and MSS bit.



Syntax Query ***STB?**

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function Returns the set contents of the status byte register (STB) as a numerical value in NR1 format (0 to 3, 16 to 19, 32 to 35, 48 to 51, 64 to 67, 80 to 83, 96 to 99, 112 to 115). No header is affixed to the response message.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	MSS	ESB	MAV	Unused	Unused	ESE1	ESE0

Example Query ***STB?**

Response **16**

Bit 4 of STB has been set to 1.

Request for sampling

Syntax	Command *TRG
Function	In external trigger mode, performs measurement once.
Example	:TRIGger EXTernal;*TRG*;MEASure?

6.6.2 Commands Specific to the 3535

Sets and queries the LCD display.

Syntax	Command	:APPLication:DISPlay:LIGHt <ON/ OFF>
	Query	:APPLication:DISPlay:LIGHt?
	Response	<ON/ OFF>
		ON The backlight remains on permanently. OFF The backlight remains off permanently.
Function	Command	Sets for display backlight. When OFF is selected, the backlight goes out approximately 5 seconds after the touch panel is last touched.
	Query	Returns the setting for backlight as ON or OFF.

Sets and queries the voltage and current monitors.

Syntax	Command	:APPLication:DISPlay:MONItor <ON/ OFF>
	Query	:APPLication:DISPlay:MONItor?
	Response	<ON/ OFF>
		ON The voltage and current monitors display indications. OFF The voltage and current monitors do not display indications.
Function	Command	Sets for voltage and current monitors
	Query	Returns the setting for voltage and current monitors as ON or OFF.

Sets and queries the number of measurement times for averaging.

Syntax	Command	:AVERaging <OFF/ numerical value>
	Query	:AVERaging?
	Response	<OFF/ numerical value> <OFF/ numerical value> = 2/ 4/ 8/ 16/ 32/ 64 (NR1) or OFF
Function	Command	Sets the desired number of times for averaging. The numerical value can be in NRf format, but any digits after the decimal point will be rounded.
	Query	Returns the current setting of the number of times for averaging as OFF or numerical value in NR1 format.
Example	Command	:AVERaging 32 The count for averaging is set to 32.
	Query	:AVERaging?
	Response	:AVERAGING 32 (Headers: ON)
		32 (Headers: OFF)

Sets and queries the beep sound for the comparator.

Syntax	Command	:BEEPer:COMParator <characters>
	Query	:BEEPer:COMParator?
	Response	<characters> <characters> = IN/ NG/ OFF IN When the comparator result is within limits, a beep sound is emitted. NG When the comparator result is out of limits, a beep sound is emitted. OFF No beep sound is emitted.
Function	Command	Sets the beep sound produced when the comparator makes decisions.
	Query	Returns the beep sound setting for when the comparator makes decision as character data.
Example	Command	:BEEPer:COMParator NG When the value is out of limits, a beep sound is emitted.
	Query	:BEEPer:COMParator?
	Response	:BEEPER:COMPARATOR NG (Headers: ON)
		NG (Headers: OFF)

Enables and disables the beep sound for key input.

Syntax	Command	:BEEPer:KEY <ON/ OFF>
	Query	:BEEPer:KEY?
	Response	<ON/ OFF> ON A beep sound is emitted. OFF No beep sound is emitted.
Function	Command	Sets the beep sound produced each time a key is pressed.
	Query	Returns the beep sound setting for when a key is pressed as ON or OFF.
Example	Command	:BEEPer:KEY ON When a key is pressed, a beep sound is emitted.
	Query	:BEEPer:KEY?
	Response	:BEEPER:KEY ON (Headers: ON) ON (Headers: OFF)

Enables and disables the BIN function.

Syntax	Command	:BIN <ON/ OFF>
	Query	:BIN ?
	Response	<ON/ OFF> ON The BIN measurement is started. OFF The BIN measurement is stopped.
Function	Command	Turns the BIN measurement function on or off. When the “:BIN ON” command is sent during the comparator measurement, the current measurement is automatically terminated and the BIN measurement is started.
	Query	Returns the setting of the BIN measurement function as ON or OFF.
Example	Command	:BIN ON The BIN measurement function is enabled.
	Query	:BIN?
	Response	:BIN ON (Headers: ON) ON (Headers: OFF)

Sets and queries the lower and upper limit values of the first parameter for the BIN function in absolute value mode.

Syntax	Command	:BIN:FLIMit:ABSolute <BIN#>,<lower limit value>,<upper limit value>
	Query	:BIN:FLIMit:ABSolute? <BIN#>
	Response	<BIN#>,<lower limit value>,<upper limit value> <BIN#> = 1 to 10 (NR1) <lower limit value> = OFF/ numerical value (NR3) <upper limit value> = OFF/ numerical value (NR3)
Function	Command	Sets the lower and upper limit values of the first parameter for the specified BIN number in absolute value mode. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values of the first parameter for the specified BIN number in absolute value mode in the order of BIN number, lower limit value, and upper limit value.
Example	Command	:BIN:FLIMit:ABSolute 1,0.2345E-03,1.2345 The lower and upper limit values of the first parameter for BIN1 are set to 0.2345E-03 (lower limit) and 1.2345 (upper limit), respectively, in absolute value mode.
	Query	:BIN:FLIMit:ABSolute? 1
	Response	:BIN:FLIMIT:ABSOLUTE 1,0.2345E-03,1.2345 (Headers: ON) 1,0.2345E-03,1.2345 (Headers: OFF)
Note		The 3535 memorizes the lower and upper limit value for the absolute value mode and those for the percentage mode separately.

Sets and queries the lower and upper limit values of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).

Syntax	Command	<code>:BIN:FLIMit:DEViation <BIN#>,<lower limit value>,<upper limit value></code> <code>:BIN:FLIMit:PERcent <BIN#>,<lower limit value>,<upper limit value></code>
	Query	<code>:BIN:FLIMit:DEViation? <BIN#></code> <code>:BIN:FLIMit:PERcent? <BIN#></code>
	Response	<code><BIN#>,<lower limit value>,<upper limit value></code> <code><BIN#></code> = 1 to 10 (NR1) <code><lower limit value></code> = OFF/ numerical value (NR2) <code><upper limit value></code> = OFF/ numerical value (NR2)
Function	Command	Sets the lower and upper limit values of the first parameter for the specified BIN number in percentage mode (%) or deviation percentage mode ($\Delta\%$). The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values of the first parameter for the specified BIN number in percentage mode (%) or deviation percentage mode ($\Delta\%$).
Example	Command	<code>:BIN:FLIMit:DEViation 1,-10.0,10.0</code> The lower and upper limit values of the first parameter for BIN1 are set to -10% (lower limit) and 10% (upper limit), respectively, in deviation percentage mode.
	Query	<code>:BIN:FLIMit:DEViation? 1</code>
	Response	<code>:BIN:FLIMIT:DEVIATION 1,-10.0,10.0</code> (Headers: ON) <code>1,-10.0,10.0</code> (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually. The reference value and lower and upper limit values are common in percentage mode (%) and deviation percentage mode ($\Delta\%$).

Sets and queries the reference value of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).

Syntax	Command	:BIN:FLIMit:REFErence <reference value>
	Query	:BIN:FLIMit:REFErence?
	Response	<reference value> <reference value> = numerical value (NR3)
Function	Command	Sets the reference value of the first parameter in percentage mode (%) or deviation percentage mode ($\Delta\%$). The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the reference value of the first parameter in percentage mode (%) or deviation percentage mode ($\Delta\%$) as a numerical value in NR3 format.
Example	Command	:BIN:FLIMit:REFErence 1.2345E-6 The reference value of the first parameter is set to 1.2345E-6 in percentage mode (%) or deviation percentage mode ($\Delta\%$).
	Query	:BIN:FLIMit:REFErence?
	Response	:BIN:FLIMIT:REFERENCE 1.2345E-06 (Headers: ON) 1.2345E-06 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually. The reference value and lower and upper limit values are common in percentage mode (%) and deviation percentage mode ($\Delta\%$).

Sets and queries the first parameter setting mode for the BIN function.

Syntax	Command	:BIN:FLIMit:MODE <characters>
	Query	:BIN:FLIMit:MODE?
	Response	<characters> <characters> = ABSolute/ PERcent/ DEVIation ABSolute Absolute value setting mode PERcent Percentage value (%) setting mode DEVIation Deviation percentage value ($\Delta\%$)setting mode
Function	Command	Sets the first parameter setting mode for the BIN function.
	Query	Returns the current setting mode for the first parameter for the BIN function as character data.
Example	Command	:BIN:FLIMit:MODE PERcent The percentage setting mode is selected.
	Query	:BIN:FLIMit:MODE?
	Response	:BIN:FLIMIT:MODE PERCENT (Headers: ON) PERCENT (Headers: OFF)

Sets and queries the lower and upper limit values of the third parameter for the BIN function in absolute value mode.

Syntax	Command	:BIN:SLIMit:ABSolute <BIN#>,<lower limit value>,<upper limit value>
	Query	:BIN:SLIMit:ABSolute? <BIN#>
	Response	<BIN#>,<lower limit value>,<upper limit value> <BIN#> = 1 to 10 (NR1) <lower limit value>= OFF/ numerical value (NR3) <upper limit value> = OFF/ numerical value (NR3)
Function	Command	Sets the lower and upper limit values of the third parameter for the specified BIN number in absolute value mode. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values of the third parameter for the specified BIN number in absolute value mode in the order of BIN number, lower limit value, and upper limit value.
Example	Command	:BIN:SLIMit:ABSolute 1,0.2345E-03,1.2345 The lower and upper limit values of the third parameter for BIN1 are set to 0.2345E-03 (lower limit) and 1.2345 (upper limit), respectively, in absolute value mode.
	Query	:BIN:SLIMit:ABSolute? 1
	Response	:BIN:SLIMIT:ABSOLUTE 1,0.2345E-03,1.2345 (Headers: ON) 1,0.2345E-03,1.2345 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually.

Sets and queries the lower and upper limit values of the third parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).

Syntax	Command	:BIN:SLIMit:DEViation <BIN#>,<lower limit value>,<upper limit value> :BIN:SLIMit:PERcent <BIN#>,<lower limit value>,<upper limit value>
	Query	:BIN:SLIMit:DEViation? <BIN#> :BIN:SLIMit:PERcent? <BIN#>
	Response	<BIN#>,<lower limit value>,<upper limit value> <BIN#> = 1 to 10 (NR1) <lower limit value> = OFF/ numerical value (NR2) <upper limit value> = OFF/ numerical value (NR2)
Function	Command	Sets the lower and upper limit values of the third parameter for the specified BIN number in percentage mode (%) or deviation percentage mode ($\Delta\%$). The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values of the third parameter for the specified BIN number in percentage mode (%) or deviation percentage mode ($\Delta\%$).
Example	Command	:BIN:SLIMit:DEViation 1,-10.0,10.0 The lower and upper limit values of the third parameter for BIN1 are set to -10% (lower limit) and 10% (upper limit), respectively, in deviation percentage mode.
	Query	:BIN:SLIMit:DEViation? 1
	Response	:BIN:SLIMIT:DEVIATION 1,-10.0,10.0 (Headers: ON) 1,-10.0,10.0 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually. The reference value and lower and upper limit values are common in percentage mode (%) and deviation percentage mode ($\Delta\%$).

Sets and queries the reference value of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode ($\Delta\%$).

Syntax	Command	:BIN:SLIMit:REFeRence <reference value>
	Query	:BIN:SLIMit:REFeRence?
	Response	<reference value> <reference value> = numerical value (NR3)
Function	Command	Sets the reference value of the third parameter in percentage mode (%) or deviation percentage mode ($\Delta\%$). The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the reference value of the third parameter in percentage mode (%) or deviation percentage mode ($\Delta\%$) as a numerical value in NR3 format.
Example	Command	:BIN:SLIMit:REFeRence 1.2345E-6 The reference value of the first parameter is set to 1.2345E-6 in percentage mode (%) or deviation percentage mode ($\Delta\%$).
	Query	:BIN:SLIMit:REFeRence?
	Response	:BIN:SLIMIT:REFERENCE 1.2345E-06 (Headers: ON) 1.2345E-06 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually. The reference value and lower and upper limit values are common in percentage mode (%) and deviation percentage mode ($\Delta\%$).

Sets and queries the third parameter setting mode for the BIN function.

Syntax	Command	:BIN:SLIMit:MODE <characters>
	Query	:BIN:SLIMit:MODE?
	Response	<characters> <characters>= ABSolute/ PERcent/ DEViation ABSolute Absolute value setting mode PERcent Percentage value (%) setting mode DEViation Deviation percentage value ($\Delta\%$) setting mode
Function	Command	Sets the third parameter setting mode for the BIN function.
	Query	Returns the current setting mode for the third parameter for the BIN function as character data.
Example	Command	:BIN:SLIMit:MODE PERCent The percentage setting mode is selected.
	Query	:BIN:SLIMit:MODE?
	Response	:BIN:SLIMIT:MODE PERCENT (Headers: ON) PERCENT (Headers: OFF)

Enables/disables and queries the comparator function.

Syntax	Command	:COMParator <ON/ OFF>
	Query	:COMParator?
	Response	<ON/ OFF>
Function	Command	Enables and disables the comparator function.
	Query	Returns the current enablement state of the comparator function as ON or OFF.
Example	Command	:COMParator ON
		The comparator function is turned on.
	Query	:COMParator?
	Response	:COMPARATOR ON (Headers: ON) ON (Headers: OFF)

Sets and queries the lower and upper limit values for the first comparator parameter in absolute value mode.

Syntax	Command	:COMParator:FLIMit:ABSolute <lower limit value>,<upper limit value>
	Query	:COMParator:FLIMit:ABSolute?
	Response	<lower limit value>,<upper limit value> <lower limit value> = OFF/ numerical value (NR3) <upper limit value> = OFF/ numerical value (NR3)
Function	Command	Sets the lower and upper limit values for the first comparator parameter as absolute numerical values. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values which are set as absolute values for the first comparator parameter as character data or numerical value in order (lower limit, upper limit).
Example	Command	:COMParator:FLIMit:ABSolute 1.1234E-06,1.2345E-06
		The lower limit value is set to 1.1234E-06 and the upper limit value is set to 1.2345E-06.
	Query	:COMParator:FLIMit:ABSolute?
	Response	:COMPARATOR:FLIMIT:ABSOLUTE 1.1234E-06,1.2345E-06 (Headers: ON) 1.1234E-06,1.2345E-06 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually.

Sets and queries the reference value and lower and upper limit values for the first comparator parameter in deviation percentage mode ($\Delta\%$).

Syntax	Command	:COMPARATOR:FLIMIT:DEVIATION <reference value>,<lower limit value>,<upper limit value>
	Query	:COMPARATOR:FLIMIT:DEVIATION?
	Response	<reference value>,<lower limit value>,<upper limit value> <reference value> = numerical value (NR3) <lower limit value> = OFF/ numerical value (NR2) <upper limit value> = OFF/ numerical value (NR2)
Function	Command	Sets the reference value and the lower and upper limit values for the first comparator parameter as deviation percentage relative to a reference value.
	Query	Returns the reference value and the lower and upper limit values which are set as deviation percentage for the first comparator parameter as <reference value>,<lower limit value>,<upper limit value> in order.
Example	Command	:COMPARATOR:FLIMIT:DEVIATION 1.2345E-6, -10.0,10.0 The reference value is set to 1.2345E-06, the lower limit value is set to -10%, and the upper limit value is set to 10%.
	Query	:COMPARATOR:FLIMIT:DEVIATION?
	Response	:COMPARATOR:FLIMIT:DEVIATION 1.2345E-6, -10.0,10.0 (Headers: ON) 1.2345E-6, -10.0,10.0 (Headers: OFF)
Note		The reference value and lower and upper limit values are common in percentage mode and deviation percentage mode. Therefore, this command and the “:COMPARATOR:FLIMIT:PERCENT” command perform the same action.

Sets and queries the first parameter setting mode for the comparator function.

Syntax	Command	:COMPARATOR:FLIMIT:MODE <characters>
	Query	:COMPARATOR:FLIMIT:MODE?
	Response	<characters> <characters> = ABSolute/ PERcent/ DEVIation ABSolute Absolute value setting mode PERcent Percentage value (%) setting mode DEVIation Deviation percentage value ($\Delta\%$)setting mode
Function	Command	Sets the first parameter setting mode for the comparator function.
	Query	Returns the current setting mode for the first parameter for the comparator function as character data.
Example	Command	:COMPARATOR:FLIMIT:MODE PERcent The percentage setting mode is selected.
	Query	:COMPARATOR:FLIMIT:MODE?
	Response	:COMPARATOR:FLIMIT:MODE PERCENT (Headers: ON) PERCENT (Headers: OFF)

Sets and queries the reference value and lower and upper limit values for the first comparator parameter in percentage mode (%).

Syntax	Command	:COMPARATOR:FLIMIT:PERcent <reference value>,<lower limit value>,<upper limit value>
	Query	:COMPARATOR:FLIMIT:PERcent?
	Response	<reference value>,<lower limit value>,<upper limit value> <reference value> = numerical value (NR3) <lower limit value> = OFF/ numerical value (NR2) <upper limit value> = OFF/ numerical value (NR2)
Function	Command	Sets the reference value and the lower and upper limit values for the first comparator parameter as percentage relative to a reference value. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place. The reference value cannot be set to OFF.
	Query	Returns the reference value and the lower and upper limit values which are set as percentage for the first comparator parameter as <reference value>,<lower limit value>,<upper limit value> in order.
Example	Command	:COMPARATOR:FLIMIT:PERcent 1.2345E-06, -20,20 The reference value is set to 1.2345E-06, the lower limit value is set to -20%, and the upper limit value is set to 20%.
	Query	:COMPARATOR:FLIMIT:PERcent?
	Response	:COMPARATOR:FLIMIT:PERCENT 1.2345E-06, -20,20 (Headers: ON) 1.2345E-06, -20,20 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually.

Sets and queries the lower and upper limit values for the third comparator parameter in absolute value mode.

Syntax	Command	:COMParator:SLIMit:ABSolute <lower limit value>,<upper limit value>
	Query	:COMParator:SLIMit:ABSolute?
	Response	<lower limit value>,<upper limit value> <lower limit value> = OFF/ numerical value (NR3) <upper limit value> = OFF/ numerical value (NR3)
Function	Command	Sets the lower and upper limit values for the third comparator parameter as absolute values. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the lower and upper limit values which are set as absolute numerical values for the third comparator parameter as character data or numerical value in order (<lower limit value>, <upper limit value>).
Example	Command	:COMParator:SLIMit:ABSolute 1.1234E-06,1.2345E-06 The lower limit value is set to 1.1234E-06, and the upper limit value is set to 1.2345E-06.
	Query	:COMParator:SLIMit:ABSolute?
	Response	:COMPARATOR:SLIMIT:ABSOLUTE 1.1234E-06,1.2345E-06 (Headers: ON) 1.1234E-06,1.2345E-06 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually.

Sets and queries the reference value and lower and upper limit values for the third comparator parameter in deviation percentage mode ($\Delta\%$).

Syntax	Command	:COMParator:SLIMit:DEVIation <reference value>,<lower limit value>,<upper limit value>
	Query	:COMParator:SLIMit:DEVIation?
	Response	<reference value>,<lower limit value>,<upper limit value> <reference value> = numerical value (NR3) <lower limit value> = OFF/ numerical value (NR2) <upper limit value> = OFF/ numerical value (NR2)
Function	Command	Sets the reference value and the lower and upper limit values for the third comparator parameter as deviation percentage relative to a reference value.
	Query	Returns the reference value and the lower and upper limit values which are set as deviation percentage for the third comparator parameter as <reference value>,<lower limit value>,<upper limit value> in order.
Example	Command	:COMParator:SLIMit:DEVIation 1.0000E-3,OFF,5 The reference value is set to 1.0000E-3, the lower limit value is set to OFF, and the upper limit value is set to 5%.
	Query	:COMParator:SLIMit:DEVIation?
	Response	:COMPARATOR:SLIMIT:DEVIATION 1.0000E-3,OFF,5 (Headers: ON) 1.0000E-3,OFF,5 (Headers: OFF)
Note		The reference value and lower and upper limit values are common in percentage mode and deviation percentage mode. Therefore, this command and the “:COMParator:SLIMit:PERcent” command perform the same action.

Sets and queries the third parameter setting mode for the comparator.

Syntax	Command	:COMParator:SLIMit:MODE <characters>
	Query	:COMParator:SLIMit:MODE?
	Response	<characters> <characters>= ABSolute/ PERcent/ DEVIation ABSolute Absolute value setting mode PERcent Percentage value (%) setting mode DEVIation Deviation percentage value ($\Delta\%$) setting mode
Function	Command	Sets the third parameter setting mode for the comparator function.
	Query	Returns the current setting mode for the third parameter for the comparator function as character data.
Example	Command	:COMParator:SLIMit:MODE PERcent The percentage setting mode is selected.
	Query	:COMParator:SLIMit:MODE?
	Response	:COMPARATOR:SLIMIT:MODE PERCENT (Headers: ON) PERCENT (Headers: OFF)

Sets and queries the reference value and lower and upper limit values for the third comparator parameter in percentage mode (%).

Syntax	Command	:COMPARATOR:SLIMIT:PERCENT <reference value>,<lower limit value>,<upper limit value>
	Query	:COMPARATOR:SLIMIT:PERCENT?
	Response	<reference value>,<lower limit value>,<upper limit value> <reference value> = OFF/ numerical value (NR3) <lower limit value> = OFF/ numerical value (NR2) <upper limit value> = OFF/ numerical value (NR2)
Function	Command	Sets the reference value and the lower and upper limit values for the third comparator parameter as percentage relative to a reference value. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place. The reference value cannot be set to OFF.
	Query	Returns the reference value and the lower and upper limit values which are set as percentage for the third comparator parameter as <reference value>,<lower limit value>,<upper limit value> in order.
Example	Command	:COMPARATOR:SLIMIT:PERCENT 1.2345E-06,-20,20 The reference value is set to 1.2345E-06, the lower limit value is set to -20%, and the upper limit value is set to 20%.
	Query	:COMPARATOR:SLIMIT:PERCENT?
	Response	:COMPARATOR:SLIMIT:PERCENT 1.2345E-06,-20,20 (Headers: ON) 1.2345E-06,-20,20 (Headers: OFF)
Note		The upper and lower limit values which are set as absolute values, and which are set as percentage values are stored individually.

Enables/disables and queries the open-circuit compensation function.

Syntax	Command	:CORRection:OPEN <characters/ numerical values>
	Query	:CORRection:OPEN?
	Response	<characters/ numerical values>
		<characters/ numerical values> = OFF/ ALL/ numerical value (NR1) (100000 to 120000000)
Function		OFF The open-circuit compensation is not performed.
		ALL The open-circuit compensation is performed at all the measurement frequencies.
		Numerical data
		The open-circuit compensation is performed at the set measurement frequency only (spot compensation).
Function	Command	Enables and disables the open-circuit compensation function. The numerical value can be in NRf format.
	Query	Returns the current setting of open-circuit compensation function enablement as character data or a numerical value in NR3 format.
Example	Command	:CORRection:OPEN 1000000
		The open-circuit compensation function at 1 MHz is set to ON.
	Query	:CORRection:OPEN?
	Response	:CORRECTION:OPEN 1000000 (Headers: ON) 1000000 (Headers: OFF)
Note		The open-circuit compensation at 1 MHz has been enabled.
		When the compensation is performed at all the measurement frequencies, about 5 minutes compensation is required. Executing the command which changes measurement settings during compensation is performed at all the measurement frequencies generates an execution error. Be sure not to execute commands other than commands for checking each status registers such as *ESR? and :ESR0?.

Enables/disables and queries the short-circuit compensation function.

Syntax	Command	:CORRection:SHORT <characters/ numerical values>
	Query	:CORRection:SHORT?
	Response	<characters/ numerical values> <characters/ numerical values>= OFF/ ALL/ numerical value (NR1) (100000 to 120000000) OFF The short-circuit compensation is not performed. ALL The short-circuit compensation is performed at all the measurement frequencies. Numerical data The short-circuit compensation is performed at the set measurement frequency only (spot compensation).
Function	Command	Enables and disables the short-circuit compensation function. The numerical value can be in NRf format.
	Query	Returns the current setting of the short-circuit compensation enablement as character data or a numerical value in NR3 format.
Example	Command	:CORRection:SHORT 1000000 The short-circuit compensation function at 1 MHz is enabled.
	Query	:CORRection:SHORT?
	Response	:CORRECTION:SHORT 1000000 (Headers: ON) 1000000 (Headers: OFF) The short-circuit compensation function at 1 MHz has been enabled.
Note		When the compensation is performed at all the measurement frequencies, about 5 minutes compensation is required. Executing the commands which changes measurement settings during compensation for all frequency generate an execution error. Be sure not to execute commands other than that of checking each status registers such as *ESR? and :ESR0?.

Enables/disables and queries the load compensation function

Syntax	Command	:CORRection:LOAD <ON/ OFF>
	Query	:CORRection:LOAD?
	Response	<ON/ OFF>
	ON	The acquisition of load compensation data is started and the load compensation is enabled.
	OFF	The load compensation is not performed.
Function	Command	Enables and disables the load compensation function. When ON is selected, the acquisition of load compensation data is started according to the current load compensation conditions. When the acquisition of load compensation data is completed normally, the load compensation is enabled, and when the load compensation is not completed normally, the load compensation is disabled. When OFF is selected, the load compensation is disabled.
	Query	Returns the current setting of load compensation function enablement as ON or OFF. The header is not returned.
Example	Command	:CORRection:LOAD ON The load compensation will be enabled.
	Query	:CORRection:LOAD?
	Response	ON The load compensation has been enabled.
Note		When the compensation is performed, about 6 seconds compensation is required for each load compensation. Executing the commands which changes measurement settings during compensation generate an execution error. Be sure not to execute commands other than that of checking each status registers such as *ESR? and :ESR0?.

Sets and queries the compensation frequency of the load compensation conditions.

Syntax	Command	:CORRection:LOAD:FREQuency <LOAD compensation number>,<OFF/ numerical value>
	Query	:CORRection:LOAD:FREQuency? <LOAD compensation number>
	Response	<LOAD compensation number>,<OFF/ numerical value> <LOAD compensation number> =1 to 5 (NR1) <OFF/ numerical value> = OFF/ numerical value (NR1) (frequency: 100000 to 120000000)
Function	Command	Sets any of five different compensation condition groups in the load compensation. The load compensation conditions specified with <LOAD compensation number> are enabled or disabled. To disable the load compensation conditions, enter OFF. To enable the load compensation conditions, specify the test frequency to be compensated in numerical values. When disabled status is selected, all the compensation conditions for the specified load compensation number become undefined.
	Query	Returns the enabled/disabled status of the specified load compensation conditions (measurement frequency) as character or numerical data.
Example	Command	:CORRection:LOAD:FREQuency 1,1000000 The load compensation condition group 1 is enabled and the compensation frequency is set to 1 MHz.
	Query	:CORRection:LOAD:FREQuency? 1
	Response	:CORRECTION:LOAD:FREQUENCY 1,1000000 (Headers: ON) 1,1000000 (Headers: OFF) The current load compensation condition group 1 has been enabled and the compensation frequency has been set to 1 MHz.
Note		This command sets whether the measurement frequencies in five different compensation condition groups will be used or not, or the load compensation conditions will be used for the load compensation data. Therefore, the command is not designed to start acquisition of load compensation data. To enable the load compensation, specify the load compensation conditions with both the ":CORRection:LOAD:FREQuency" and ":CORRection:LOAD:REFeRence" commands, and then execute the ":CORRection:LOAD ON" command.

Sets and queries the reference values for the load compensation conditions.

Syntax	Command	:CORRection:LOAD:REFeRence <LOAD compensation number>,<mode>,<reference value 1>,<reference value 2>																					
	Query	:CORRection:LOAD:REFeRence? <LOAD compensation number>																					
	Response	<LOAD compensation number>,<mode>,<reference value1>,<reference value2> <LOAD compensation number> =1 to 5 (NR1) <mode>=Z/CS/CP/LS/LP/Rs/OFF (characters) <reference value1> = OFF/ numerical value (NR3) <reference value2> = OFF/ numerical value (NR2)/(NR3)																					
Function	Command	Sets five different compensation condition groups in the load compensation. The reference values for the load compensation conditions specified with <LOAD compensation number> are set. Specify what parameter should be characterized by the value defined with <mode>, and enter reference values for <reference value 1> and <reference value 2>. The table below shows the relationship between <mode>, <reference value 1>, and <reference value 2>.																					
		<table><thead><tr><th><mode></th><th><reference value1></th><th><reference value2></th></tr></thead><tbody><tr><td>Z</td><td>Reference value of Z</td><td>Reference value of θ</td></tr><tr><td>CS</td><td>Reference value of Cs</td><td>Reference value of D</td></tr><tr><td>CP</td><td>Reference value of Cp</td><td>Reference value of D</td></tr><tr><td>LS</td><td>Reference value of Ls</td><td>Reference value of Q</td></tr><tr><td>LP</td><td>Reference value of Lp</td><td>Reference value of Q</td></tr><tr><td>Rs</td><td>Reference value of Rs</td><td>Reference value of X</td></tr></tbody></table>	<mode>	<reference value1>	<reference value2>	Z	Reference value of Z	Reference value of θ	CS	Reference value of Cs	Reference value of D	CP	Reference value of Cp	Reference value of D	LS	Reference value of Ls	Reference value of Q	LP	Reference value of Lp	Reference value of Q	Rs	Reference value of Rs	Reference value of X
	<mode>	<reference value1>	<reference value2>																				
Z	Reference value of Z	Reference value of θ																					
CS	Reference value of Cs	Reference value of D																					
CP	Reference value of Cp	Reference value of D																					
LS	Reference value of Ls	Reference value of Q																					
LP	Reference value of Lp	Reference value of Q																					
Rs	Reference value of Rs	Reference value of X																					
Query	Returns the reference values for the specified compensation conditions in the order of LOAD compensation number, mode, <reference value 1>, and <reference value 2>. When the mode and reference values for the specified compensation conditions are not set, OFF is returned against these items.																						
Example	Command	:CORRection:LOAD:REFeRence 2,CS,1.2345E-06,0.1234 The reference values for the load compensation condition group 2 are specified with Cs and D, and defined as “Cs=1.2345E-06” and “D=0.1234.”																					
	Query	:CORRection:LOAD:REFeRence? 2																					
	Response	:CORRECTION:LOAD:REFERENCE 2,CS,1.2345E-06,0.1234 (Headers: ON) 2,CS,1.2345E-06,0.1234 (Headers: OFF)																					

Sets and queries the voltage and current monitored parameters.

Syntax	Query	:DISPlay:MONItor?
	Response	<voltage monitored value>,<current monitored value> <voltage monitored value>: numerical value (NR2) <current monitored value>: numerical value (NR3)
Function	Query	Returns the monitored parameters as <voltage monitored value> and <current monitored value> in order.
Example	Query	:DISPlay:MONItor?
	Response	:DISPLAY:MONITOR 1.23,0.12E-03 (Headers: ON) 1.23,0.12E-03 (Headers: OFF)

Sets and queries the event status enable register 0 (ESER0).



Syntax	Command	:ESE0 <numerical value>
	Query	:ESE0?
	Response	<numerical value> <numerical value> = 0 to 255 (NR1)
Function	Command	Sets the mask pattern of the event status enable register 0 (ESER0) to a value (0 to 255). The numerical value can be in NRf format, but any digits after the decimal point will be rounded. When the power is turned on, the data is reinitialized to 0.
	Query	Returns the value of event status enable register 0 (ESER0) as a numerical value in NR1 format as a numerical value in NR1 format between 0 and 255.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	COF	LOF	IOF	IUF	Unused	EOM	CEM

Example	Command	:ESE0 20
		Bits 2 and 4 of ESE0 are set to 20.

Sets and queries the event status enable register 1 (ESER1).



Syntax Command **:ESE1** <numerical value>

Query **:ESE1?**

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function Command Sets the mask pattern of the event status enable register 1 (ESER1) to a value (0 to 255).

The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

When the power is turned on, the data is reinitialized to 0.

Query Return the contents of the event status enable register 1 (ESER1) as a numerical value in NR1 format between 0 and 255.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	AND	SLO	SIN	SHI	FLO	FIN	FHI

Example Command **:ESE0 20**

Bits 2 and 4 of ESER0 are set to 20.

Queries the event status register 0 (ESR0).

Syntax Query **:ESR0?**

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function Query Returns the value of event status register 0 (ESR0) as a numerical value in NR1 format from 0 to 255, and then clears event status register 0.

No header is affixed to the response message.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	COF	LOF	IOF	IUF	Unused	EOM	CEM

Example Query **:ESR0?**

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Bit 2 of ESR0 has been set to 1.

Queries event status register 1 (ESR1).

Syntax	Query	:ESR1?																							
	Response	<numerical value> <numerical value> = 0 to 255 (NR1)																							
Function	Query	Returns the value of event status register 1 (ESR1) as a numerical value in NR1 format from 0 to 255, and then clears event status register 1. No header is affixed to the response message.																							
		<table><tr><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr><tr><td>bit 7</td><td>bit 6</td><td>bit 5</td><td>bit 4</td><td>bit 3</td><td>bit 2</td><td>bit 1</td><td>bit 0</td></tr><tr><td>Unused</td><td>AND</td><td>SLO</td><td>SIN</td><td>SHI</td><td>FLO</td><td>FIN</td><td>FHI</td></tr></table>	128	64	32	16	8	4	2	1	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Unused	AND	SLO	SIN	SHI	FLO	FIN
128	64	32	16	8	4	2	1																		
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0																		
Unused	AND	SLO	SIN	SHI	FLO	FIN	FHI																		
Example	Query	:ESR1? 64																							
		Bit 6 of ESR1 has been set to 1.																							

Sets and queries the measurement frequency.

Syntax	Command	:FREQuency <numerical value>
	Query	:FREQuency?
	Response	<numerical value> <numerical value>= 100000 to 120000000 (NR1)
Function	Command	Sets the measurement frequency. The numerical value can be in NRf format.
	Query	Returns the currently measurement frequency as a numerical value in NR1 format.
Example	Command	:FREQuency 1000000 The measurement frequency is set to 1 MHz.
	Query	:FREQuency?
	Response	1000000 (Headers: OFF) The measurement frequency has been set to 1 MHz.
Note		When the measurement frequency exceeds 10 MHz, the measurement level is limited. If the measurement level exceeds the limitation as the result of a change in the measurement frequency, the maximum level is automatically set.

Enables/disables and queries headers for the response message

Syntax	Command	:HEADer <ON/ OFF>
	Query	:HEADer?
	Response	<ON/ OFF>
		ON : Headers are prefixed to response messages. OFF: No header is affixed to the response message.
Function	Command	Sets whether or not the 3535 will prefix headers to its response messages. When the power is turned on, the data is initially set to OFF.
	Query	Returns the setting of headers for the response messages as ON or OFF.
Example	Command	:HEADer ON Headers are prefixed to response messages.
	Query	:HEADer?
	Response	:HEADER ON (Headers: ON) OFF (Headers: OFF)

Sets and queries the measurement signal level.

Syntax	Command	:LEVel <characters>
	Query	:LEVel?
	Response	<characters> <characters>= V/ CC V Open-circuit voltage level CC Constant current level
Function	Command	Sets the measurement signal level to open-circuit voltage level or constant current level.
	Query	Returns the measurement signal level as character data.
Example	Command	:LEVel CC The measurement signal level is set to constant current.
	Query	:LEVel?
	Response	:LEVEL CC (Headers: ON) CC (Headers: OFF) The measurement signal level has been set to constant current.

Sets and queries the constant current value.

Syntax	Command	:LEVel:CCURRent <numerical value>
	Query	:LEVel:CCURRent?
	Response	<numerical value> <numerical value>= numerical value (NR3) 0.2E-03 to 20.00E-03 (frequency: 100 kHz to 10.00 MHz) 0.2E-03 to 10.00E-03 (frequency: 10.01 MHz to 120.0 MHz)
Function	Command	Sets the value of the constant current. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the value of the constant current as a numerical value in NR3 format.
Example	Command	:LEVel:CCURRent 10.00E-03 The constant current value is set to 10 mA.
	Query	:LEVel:CCURRent?
	Response	:LEVEL:CCURRENT 10.00E-03 (Headers: ON) 10.00E-03 (Headers: OFF)
		The constant current value has been set to 10 mA.

Sets and queries the open-circuit voltage value.

Syntax	Command	:LEVel:VOLTage <numerical value>
	Query	:LEVel:VOLTage?
	Response	<numerical value> <numerical value>= numerical value (NR2) 0.005 to 1.000 (frequency: 100 kHz to 10.00 MHz) 0.005 to 0.500 (frequency: 10.01 MHz to 120.0 MHz)
Function	Command	Sets the open-circuit voltage value. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the open-circuit voltage value as a numerical value in NR2 format.
Example	Command	:LEVel:VOLTage 0.5 The open-circuit voltage value is set to 0.5 V.
	Query	:LEVel:VOLTage?
	Response	:LEVEL:VOLTAGE 0.5 (Headers: ON) 0.5 (Headers: OFF)
		The open-circuit voltage level has been set to 0.5 V.

Enables/disables and queries the limit value setting function.

Syntax	Command	:LIMiter <ON/ OFF>
	Query	:LIMiter?
	Response	<ON/ OFF>
Function	Command	Enables and disables the limit value setting function.
	Query	Returns the current setting of the limit value setting function enablement as ON or OFF.
Example	Command	:LIMiter ON
		The limit value setting function is enabled.
	Query	:LIMiter?
	Response	:LIMITER ON (Headers: ON) ON (Headers: OFF)

Sets and queries the current limit value.

Syntax	Command	:LIMiter:CURRent <numerical value>
	Query	:LIMiter:CURRent?
	Response	<numerical value> <numerical value> = 0.20E-03 to 20.00E-03 (NR3)
Function	Command	Sets the current limit value.
	Query	Returns the current limit value as a numerical value in NR3 format.
Example	Command	:LIMiter:CURRent 20.00E-03
		The current limit value is set to 20 mA.
	Query	:LIMiter:CURRent?
	Response	:LIMITER:CURRENT 20.00E-03 (Headers: ON) 20.00E-03 (Headers: OFF) The current limit value has been set to 20 mA.

Sets and queries the voltage limit value.

Syntax	Command	:LIMiter:VOLTage <numerical value>
	Query	:LIMiter:VOLTage?
	Response	<numerical value> <numerical value> = 0.010 to 1.000 (NR2)
Function	Command	Sets the voltage limit value. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the voltage limit value as a numerical value in NR2 format.
Example	Command	:LIMiter:VOLTage 0.5 The voltage limit value is set to 0.5 V.
	Query	:LIMiter:VOLTage? :LIMITER:VOLTAGE 0.5 (Headers: ON) 0.5 (Headers: OFF) The voltage limit value has been set to 0.5 V.

Loads the measurement conditions of the specified panel number.

Syntax	Command	:LOAD <numerical value> <numerical value> = 1 to 30 (NR1)
Function	Command	Sets the panel number which you wish to load. The numerical value can be in NRf format, but any digits after the decimal point will be rounded.
Example	Command	:LOAD 2 The measurement conditions which are saved in panel number 2 is loaded.

Queries measured data.

Syntax	Query	:MEASure?
	Response	- During normal measurement <parameter>,<measurement value>,, - During comparator measurement <logical product of comparison result>,<measurement value of the first parameter>,<comparison result of first parameter>,<measurement value of the third parameter>,<comparison result of third parameter> Comparison result= 0/ 1/ -1 0: Within limits or logical product limits 1: Above the upper limit or out of logical product limits -1: Below the lower limit - During BIN measurement <result of BIN measurement>,<measurement value of the first parameter>,<measurement value of the third parameter> <result of BIN measurement> = -1, 1 to 10 - During scaling measurement <measurement value of the first parameter>,<measurement value of the third parameter>
Function	Query	Returns the measured value that is valid at the reception of command as a numerical value in NR2 and 3 format.
		- During normal measurement Returns the measured value of the parameter that bits of MR0 (measurement register 0) and MR1 (measurement register 1) have been set to 1 in the following order; impedance (Z), admittance (Y), phase angle (PHASE), series capacitance (CS), parallel capacitance (CP), dissipation factor (D), series inductance (LS), parallel inductance (LP), Q factor (Q), series resistance (RS), conductance (G), parallel resistance (RP), reactance (X), and susceptance (B). When powering on, the measurement parameters are initially set to impedance (Z) and phase angle (θ). The contents of MR0 and MR1 are set with the :MEASure:ITEM command. - During comparator measurement Returns the measured values of the first and third parameters which have been set and the comparator result. - During BIN measurement Returns the measured values of the first and third parameters which have been set and the BIN measurement result. Returns -1 when the test data deviates from the set BIN range (OUT OF BINS). - During scaling measurement Returns the measured values of the first and third parameters in order. - During comparator, BIN, or scaling measurement, sets the first parameter with the ":PARAmeter1" command, and sets the third parameter with the ":PARAmeter3" command. When the parameter is set to OFF, the data is not returned.

Queries measured data.

Example

- During normal measurement
When querying the measured values for impedance (Z), phase angle (θ), parallel capacitance (Cp), dissipation factor (D):

Query `:MEASure:ITEM 53,0;:TRIGger EXTernal
*TRG;:MEASure?`

Response `Z 31,981E+03,PHASE -88.05,CP 4.9736E-09,D
0.03405` (Headers: ON)
`31,981E+03,-88.05,4.9736E-09,0.03405` (Headers: OFF)

- During comparator measurement
When comparator measurement for impedance (Z) and phase angle (θ).

Command `:PARAmeter1 Z;:PARAmeter3 PHASe
:COMParator ON`

Query `:TRIGger EXTernal
*TRG;:MEASure?`

Response `1,Z 31,981E+03,0,PHASE -88.05,-1` (Headers: ON)
`1,31,981E+03,0,-88.05,-1` (Headers: OFF)
The decision result of the first parameter is within limits, and that of the third parameter is below the lower limit.

- During BIN measurement
When BIN measurement for impedance (Z) and phase angle (θ).

Command `:PARAmeter1 Z;:PARAmeter3 PHASe
:BIN ON`

Query `:TRIGger EXTernal
*TRG;:MEASure?`

Response `BIN1,Z 31,981E+03,PHASE -88.05` (Headers: ON)
`BIN1,31,981E+03,-88.05` (Headers: OFF)

- During scaling measurement
When comparator measurement for impedance (Z) and phase angle (θ).

Command `:PARAmeter1 Z;:PARAmeter3 PHASe
:SCALE ON`

Query `:TRIGger EXTernal
*TRG;:MEASure?`

Response `Z 31,981E+03,PHASE -88.05` (Headers: ON)
`31,981E+03,-88.05` (Headers: OFF)

Sets and queries the measurement parameter for response of the :MEASure? query during normal measurement.

Syntax

Command :MEASure:ITEM <MR0>,<MR1>
 Query :MEASure:ITEM?
 Response <MR0>,<MR1>
 <MR0>,<MR1> = 0 to 255 (NR1)
 MR: measurement register (see the table below)

Function

Command Specifies the measurement parameters for response of the :MEASure? query during normal measurement with bits.
 When the power is turned on, the measurement parameter is set to impedance (Z) and phase angle (θ) that is; <MR0> is 5 and <MR1> is 0.
 The numerical value can be in NRf format, but any digits after the decimal point will be rounded.

Query Returns the measurement parameter to response the :MEASure? query during normal measurement as bits <MR0> and <MR1>.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Lp	Ls	D	Cp	Cs	θ	Y	Z

Measurement Register 0 (MR0)

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Unused	Unused	B	X	Rp	G	Rs	Q

Measurement Register 1 (MR1)

Example

Command :MEASure:ITEM 53,18
 The measurement parameters for response are set to impedance (Z), phase angle (θ), equivalent parallel circuit capacitance (Cp), dissipation factor (D), series resistance (Rs), reactance (X).

Query :MEASure:ITEM?
 Response :MEASURE:ITEM 53,18 (Headers: ON)
 53,18 (Headers: OFF)
 The measurement parameters to response have been set to impedance (Z), phase angle (θ), parallel capacitance (Cp), dissipation factor (D), series resistance (Rs), reactance (X).

Queries the test data saved in the memory controlled by the test data memory function.

Syntax	Query	:MEMory?
	Response	<contents of first memory><message terminator><contents of second memory><message terminator>...<contents of n'th memory><message terminator> n: up to 200
Function	Query	• Returns all the latest test data saved in the memory controlled by the test data memory function. • Up to 200 entries of the latest test data are saved in the memory. To clear the memory, use the “:MEMory:CLEar” command. • Four test results connected to the displayed parameters are saved in the memory regardless of “:MEAS:ITEM” status existing. • The formats of the memory contents are the same as the response data formats for the query “:MEASure?” and a detailed format description is included in the outline of the query “:MEASure?” (page 154). When the displayed parameter set to OFF, 0 is always set as test data. • A message terminator is assigned between memories. • The query “:MEMory:COUNt?” confirms the number of data sets currently saved in the memory. • When the internal trigger source has been selected, the number of data sets obtained with the query “:MEMory:COUNt?” may differ from n. To use this query “:MEMory:COUNt?”, select the external trigger source.
	Response	
Example	Query	:MEMory?
	Response	Z 31.981E+00,OFF 0,PHASE 88.05,OFF 0 (Headers: ON) 31.981E+00,0,88.05,0 (Headers: OFF)

Clears the memory controlled by the test data memory function.

Syntax	Command	:MEMory:CLEar
Function	Command	Clears all the test data saved in the memory controlled by the test data memory function. After this command is sent, the subsequent test data will be saved from the beginning of the memory.
Example	Command	:MEMory:CLEar All the test data saved in the memory is cleared.

Queries the number of test data sets saved in the memory controlled by the test data memory function.

Syntax	Query	:MEMory:COUNT?
	Response	<numerical value> <numerical value> = 0 to 200 (NR1)
Function	Query	Returns the number of data sets saved in the memory controlled by the test data memory function as a numerical value in NR1 format.
Example	Query	:MEMory:COUNT? :MEMORY:COUNT 1 (Headers: ON) 1 (Headers: OFF)

Sets and queries the displayed parameters

Syntax	Command	:PARameter1(or 2/ 3/ 4) <characters>
	Query	:PARameter1(or 2/ 3/ 4)?
	Response	<characters> <characters> = displayed parameter: Z/ Y/ PHASe(phase angle)/ CS/ CP/ D/ LS/ LP/ Q/ RS/ G/ RP/ X/ B/ OFF
Function	Command	Sets the displayed parameters.
	Query	Returns the displayed parameters as character data.
Example	Command	:PARameter1 Z;:PARameter3 PHASe The first parameter is set to impedance (Z), and the third parameter is set to phase angle (PHASe).
	Query	:PARameter2?
	Response	:PARAMETER2 PHASE (Headers: ON) PHASE (Headers: OFF) The second parameter has been set to phase angle (PHASe).

Sets and queries the number of displayed digits for the measurement parameters.

Syntax	Command	:PARAmeter1(or 2/ 3/ 4):DIGit <numerical value>
	Query	:PARAmeter1(or 2/ 3/ 4):DIGit?
	Response	<numerical value> <numerical value> = 3 to 5 (NR1)
Function	Command	Sets the number of displayed digits for the first to fourth parameters. The response message for the ":MEASure?" query is always returned in 5 digits.
	Query	Returns the number of displayed digits for the first to fourth parameters as a numerical value in NR1 format .
Example	Command	:PARAmeter1:DIGit 4 The number of displayed digits for the first parameter is set to 4.
	Query	:PARAmeter1:DIGit?
	Response	:PARAMETER1:DIGIT 4 (Headers: ON) 4 (Headers: OFF)
		The number of displayed digits for the first parameter has been set to 4.

Sets and queries the measurement range.

Syntax	Command	:RANGe <numerical value>										
	Query	:RANGe?										
	Response	<numerical value> <numerical value> = 1 to 3(NR1)										
<table border="1"> <tr> <td>Range No.</td><td>1</td><td>2</td><td>3</td></tr> <tr> <td>Range</td><td>1 kΩ</td><td>10 kΩ</td><td>100 kΩ</td></tr> </table>					Range No.	1	2	3	Range	1 kΩ	10 kΩ	100 kΩ
Range No.	1	2	3									
Range	1 kΩ	10 kΩ	100 kΩ									
Function	Command	Sets the measurement range. The numerical value can be in NRf format, but any digits after the decimal point will be rounded. Executing this command automatically switches the :RANGe:AUTO setting to OFF.										
	Query	Returns the setting of the measurement range as a numerical value in NR1 format (1 to 3)										
Example	Command	:RANGe 1 The measurement range is set to 1 kΩ.										
	Query	:RANGe?										
	Response	:RANGe 1 (Headers: ON) 1 (Headers: OFF) The measurement range has been set to 1 kΩ.										

Sets and queries the auto-range.

Syntax	Command	:RANGe:AUTO <ON/ OFF>
	Query	:RANGe:AUTO?
	Response	<ON/ OFF>
Function	Command	Enable or disable automatic range selection.
	Query	Returns the auto-range setting as ON or OFF.
Example	Command	:RANGe:AUTO ON Enable automatic range selection.
	Query	:RANGe:AUTO?
	Response	:RANGe:AUTO ON (Headers: ON) ON (Headers: OFF) Automatic range selection is enabled.

Executes and queries the panel save function.

Syntax	Command	:SAVE <No.>,<Name>
	Query	:SAVE? <No.> <No.>: 1 to 30 (NR1) <Name>: 1 to 20 characters
	Response	0/ 1 0: The test data has not been saved. 1: The test data has been saved.
Function	Command	Saves the measurement conditions in specified panel number with name to be saved. The numerical value can be in NRf format, but any digits after the decimal point will be rounded. The capital letters, numbers, and hyphen can be used. If 21 or more characters are entered, the first 20 characters are used.
	Query	Returns 1 when the measurement conditions are saved in specified panel number, and returns 0 when not saved. The numerical value can be in NRf format, but any digits after the decimal point will be rounded. No header is affixed to the response message.
Example	Command	:SAVE 3,TEST1 The measurement condition is saved as a name "TEST1" in panel number 3.
	Query	:SAVE? 3
	Response	1 The measurement condition is saved in panel number 3.

Enables/disables and queries the scaling function.

Syntax	Command	:SCALE <ON/ OFF>
	Query	:SCALE?
	Response	<ON/ OFF>
Function	Command	Enables and disables the scaling function.
	Query	Returns the setting of scaling function enablement as ON or OFF.
Example	Command	:SCALE ON Enables the scaling function.
	Query	:SCALE?
	Response	:SCALE ON (Headers: ON)
		ON (Headers: OFF)

Sets and queries the first parameters (a and b) in the scaling function.

Syntax	Command	:SCALE:FVALue <a>,
	Query	:SCALE:FVALue?
	Response	<a>, <a>, = numerical value (NR3)
Function	Command	Sets the first parameters (a and b values) in the scaling function. ❖4.3 "Setting and Activating the Scaling" (page 52)
	Query	Returns the setting of the first parameters (a and b values) in the scaling function as a numerical value in NR3 format.
Example	Command	:SCALE:FVALue 2.0000E+00,1.0000E+00 Sets a value to 2.0000, and b value to 1.0000.
	Query	:SCALE:FVALue?
	Response	:SCALE:FVALUE 2.0000E+00,1.0000E+00 (Headers: ON) 2.0000E+00,1.0000E+00 (Headers: OFF)

Sets and queries the third parameters (a and b) in the scaling function.

Syntax	Command	:SCALE:SVALue <a>,
	Query	:SCALE:SVALue?
	Response	<a>, <a>, =numerical value (NR3)
Function	Command	Sets the third parameters (a and b values) in the scaling function. ❖ 4.3 "Setting and Activating the Scaling" (page 52)
	Query	Returns the setting of the third parameters (a and b values) in the scaling function as a numerical value in NR3 format.
Example	Command	:SCALE:SVALue 2.0000E+00,1.0000E+00 Sets a value to 2.0000, and b value to 1.0000.
	Query	:SCALE:SVALue?
	Response	:SCALE:SVALUE 2.0000E+00,1.0000E+00 (Headers: ON)
		2.0000E+00,1.0000E+00 (Headers: OFF)

Sets and queries the measurement speed.

Syntax	Command	:SPEED <characters>
	Query	:SPEED?
	Response	<characters> <characters> = FAST/ NORMAl/ SLOW/ SLOW2
Function	Command	Sets the measurement speed.
	Query	Returns the setting of measurement speed as character data.
Example	Command	:SPEED NORMAl
	Query	:SPEED?
	Response	:SPEED NORMAL (Headers: ON) NORMAL (Headers: OFF)

Sets and queries the type of trigger.

Syntax	Command	:TRIGger <characters>
	Query	:TRIGger?
	Response	<characters> <characters> = INTernal/ EXTernal INTernal Internal trigger mode EXTernal External trigger mode
Function	Command	Sets the type of trigger.
	Query	Returns the trigger setting as character data.
Example	Command	:TRIGger INTernal The trigger mode is set to internal trigger.
	Query	:TRIGger?
	Response	:TRIGGER INTERNAL (Headers: ON) INTERNAL (Headers: OFF) The trigger mode has been set to internal triggering.

Sets and queries the trigger delay time.

Syntax	Command	:TRIGger:DELAy <numerical value>
	Query	:TRIGger:DELAy?
	Response	<numerical value> <numerical value> = 0.00 to 9.99 (NR2)
Function	Command	Sets the trigger delay time. The numerical value can be in NRf format, but rounding is performed for figures beyond the last valid decimal place.
	Query	Returns the current setting of trigger delay time as a numerical value in NR2 format from 0.00 to 9.99.
Example	Command	:TRIGger:DELAy 0.05 The trigger delay time is set to 50 ms.
	Query	:TRIGger:DELAy?
	Response	:TRIGGER:DELAY 0.05 (Headers: ON) 0.05 (Headers: OFF) The trigger delay time has been set to 50 ms.

Sets and queries the user ID.

Syntax	Command	:USER:IDENTity <ID>
	Query	:USER:IDENTity?
	Response	<ID> <ID> = user ID code (exaple:AB-1234) up to seven characters A to Z, a to z, 0 to 9, -(hyphen) can be used.
Function	Command	The user can set an identity code. The ID is backed up in the same way as the main unit settings. If an ID of 11 or more characters is entered, the first 10 characters are used.
	Query	Returns a user ID as character data or a numerical value.
Example	Command	:USER:IDEN AB-1234 This sets the user ID to "AB-1234"
	Query	:USER:IDENTity?
	Response	:USER:IDENTITY AB-1234 (Headers: ON) AB-1234 (Headers: OFF)

6.6.3 Response Format for Queries as Numerical Value

1. Measurement value

|Z| , |Y|, Cs, Cp, Ls, Lp, Rs, G, Rp, X, B <in NR3 format>

□ . □ □ □ □ E ± □ □	1: Mantissa	Five digits and decimal point
1 2	2: Exponent	Two digits

When the value is overflow or underflow, the following value is displayed.
Overflow: 99999E+99
Underflow: -99999E+99

θ (phase angle) <in NR2 format>

(-) □ □ □ . □ □	1: Sign	Only when the value is negative, minus (-) is prefixed.
(-) □ □ . □ □	2: Numerical	Up to the second decimal point
1 2		

When the value is overflow or underflow, the following value is displayed.
Overflow: 999.9
Underflow: -999.9

D (dissipation factor) <in NR2 format>

□ . □ □ □ □ Up to the forth decimal point

When the value is overflow or underflow, the following value is displayed.
Overflow: 99999
Underflow: -99999

Q (Q factor) <in NR2 format>

□ . □ □	Up to the second decimal point
□ □ . □ □	
□ □ □ . □ □	

When the value is overflow or underflow, the following value is displayed.
Overflow: 9999
Underflow: -9999

2. Frequency <in NR1 format>

□ □ □ □ □ □	100 kHz to 999.999 kHz
□ □ □ □ □ □ □	1MHz to 9.999999 MHz
□ □ □ □ □ □ □ □	10 MHz to 99.999999 MHz
□ □ □ □ □ □ □ □ □	100 MHz to 120 MHz

3. Voltage <in NR2 format>

□.□□□ Four digits and decimal point

4. Current <in NR3 format>

□.□□□E±□□ 1: Mantissa Four digits and decimal point
 2: Exponent Two digits

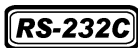
5. Trigger delay <in NR2 format>

□.□□ Three digits and decimal point

6. Reference value (percentage value), upper and lower limit values (absolute value), scaling compensation coefficients for comparator <in NR3 format>

(-)□.□□□□E±□□ 1: Sign When the value is negative, minus (-) is prefixed.
 (-)□□.□□□□E±□□ 2: Mantissa Five digits and decimal point
 (-)□□□□.□E±□□ 3: Exponent Two digits

6.6.4 Initialization Items



●: initialized / ×: not initialized

Item	Initialization method	Power on	*RST command	*CLS command
Device specific functions (ranges etc.)		×	●	×
Output queue		●	×	×
Input buffer		●	×	×
Event registers		● *1	×	●
Current path		●	×	×
Headers on/off		●	●	×
Measurement resistor		●	●	×

*1 Except the PON bit (bit 7).



●: initialized / ×: not initialized

Initialization method Item	Power on	*RST command	Device clear	*CLS command
Device specific functions (ranges etc.)	×	●	×	×
Output queue	●	×	●	×
Input buffer	●	×	●	×
Status byte register	●	×	× *1	● *2
Event register	● *3	×	×	●
Enable register	●	×	×	×
Current path	●	×	●	×
Headers on/off	●	●	×	×
Measurement resister	●	●	×	×

*1 Only the MAV bit (bit 4) is cleared.

*2 All bits except the MAV bit are cleared.

*3 Except the PON bit (bit 7).

6.7 Creating Programs

This section describes the method by which the 3535 is controlled from the PC via the RS-232C, and retrieves and saves the test data using Visual Basic 6.0 or the Windows' programming language for software development.

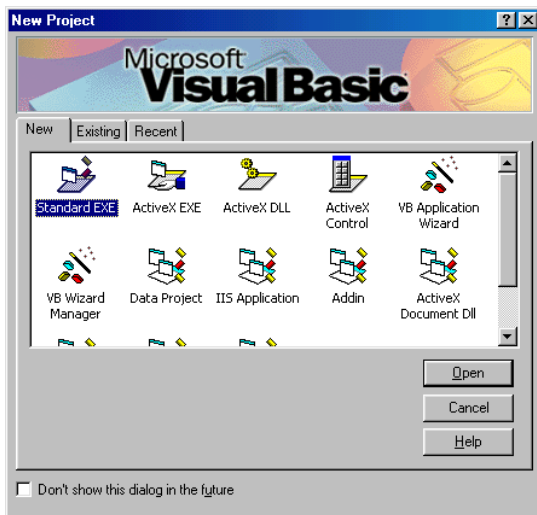
Windows, Visual Basic 6.0 is a registered trademark of Microsoft Corporation.

6.7.1 Development Method

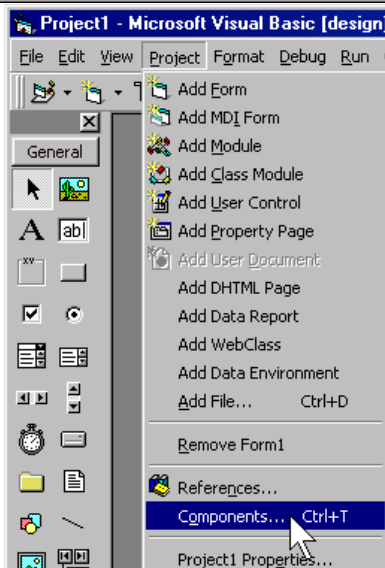
This subsection describes how to create a program with Visual Basic 6.0. Visual Basic is hereinafter referred to as "VB."

NOTE

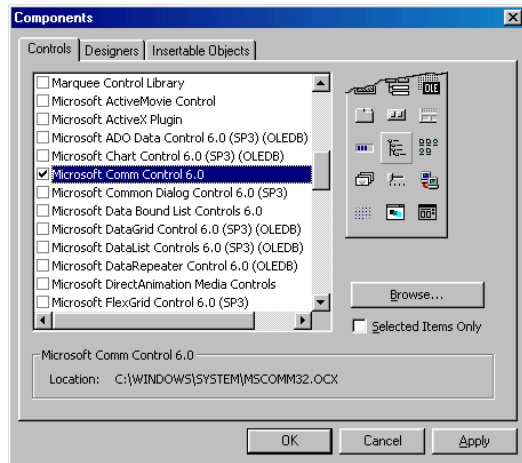
The descriptions may vary slightly depending on the settings and version of the PC or VB. For detailed operation of VB, refer to its instruction manual or on-line HELP.



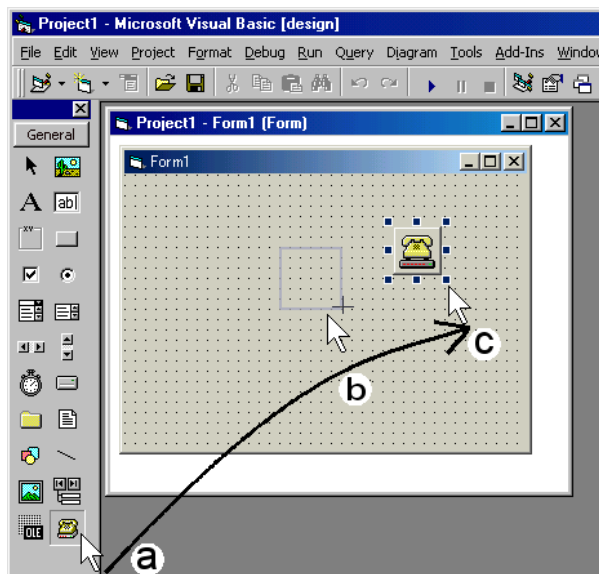
1. Boot VB, and select [Standard EXE] from the New tab and click **Open**.



2. Select [Project]-[Components] from the Menu Bar.

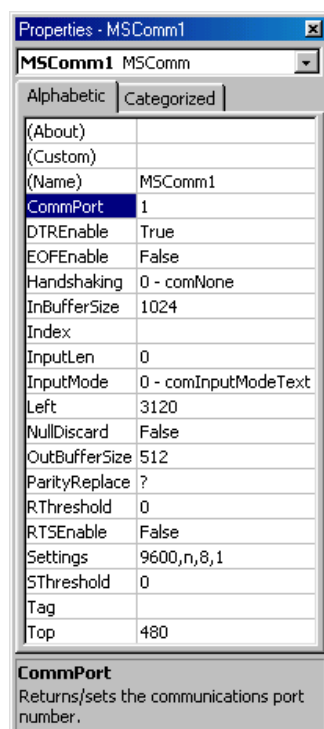


3. Click “**Microsoft Comm Control 6.0**” on the Controls tab of the Components window, and click **OK**.



4. Click the icon  (telephone) on the Toolbox. (a)
On the Form designer window, draw a square with the left mouse button held down and, upon completion, release the button. (b)

Now, the icon  (telephone) is displayed on the Form designer window. (c)



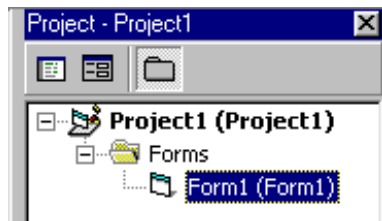
The window shown left is the object with which the telephone icon created in Step 4 will use the RS-232C port for VB. This object, when created, acquires the name “MSComm1” and in the following steps this “MSComm1” is used to access the RS-232C from VB.

5. With the icon  (telephone) selected, change the settings in the Properties window according to the 3535's communication conditions and the PC's operating conditions.
In particular, be sure to provide the following settings.

CommPort Port number used on the PC
(Example: specify “1” when COM1 is used.)

Handshaking 0-comNone

Settings 9600,n,8,1

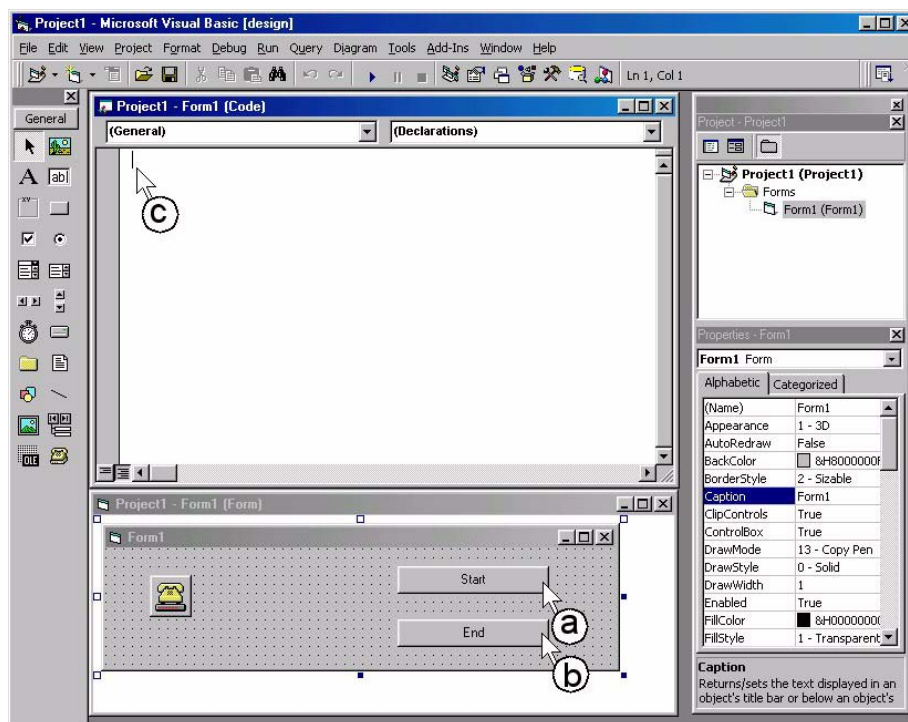


6. Select "Form1" in the Project window with the mouse, and click  to display the code window for it.

The window will have changed, as shown below.

* The screen layout may differ depending on settings and version.

After the window is displayed, display buttons (a) and (b) on "Form1" and write the program statements on the window indicated with (c). Then, execute the created program using VB's execution command.



6.7.2 Sample Programs

This subsection describes the sample program created with VB. This program is designed to allow the 3535 to communicate via the RS-232C, retrieve test data, and save it to a file.

The following rules are used to describe the sample program.

Description in Subsection 6.7.1 "Development Method" (page 168)	Statements in sample program
RS-232C object	MSComm1
Command button created for commencing the test (Start button)	Command1
Command button created for quitting the application (End button)	Command2

The programs shown herein are all described as codes for "Form1"

1. Program used to control the RS-232C

Program Code

```

Private Sub COMOpen()
    MSComm1.PortOpen = True ..... '(a)
End Sub

Private Sub COMClose()
    MSComm1.PortOpen = False ..... '(b)
End Sub

Private Sub COMCommand(CommandData As String) ..... '(c)
    MSComm1.Output = CommandData & Chr(&HD) & Chr(&HA) ..... '(d)
End Sub

Private Function COMQuery(QueryData As String) As String ..... '(e)
    Dim strbuf As String
    Dim a As String
    Dim i As Integer, j As Integer, k As Integer
    COMCommand (QueryData) ..... '(f)
    strbuf = ""
    Do While MSComm1.InBufferCount = 0 ..... '(g)
    Loop
    For i = 0 To 10000
        If MSComm1.InBufferCount > 0 Then
            strbuf = strbuf & MSComm1.Input ..... '(h)
            If Asc(Right(strbuf, 1)) = &HA Then
                COMQuery = ""
                For j = 1 To Len(strbuf) ..... '(i)
                    a = Mid(strbuf, j, 1)
                    If Asc(a) > 32 Then COMQuery = COMQuery & a
                Next j
            End If
        End If
    Next i
    COMQuery = "COMERROR"
End Function

```

Description of program statements

- (a) Enables the RS-232C port.
- (b) Disables the RS-232C port.
- (c) This function sends the character string CommandData to the 3535.
- (d) Adds CR and LF to the character string CommandData, and sends the resulting string to the 3535.
- (e) This function sends the command (query) character string CommandData that contains the response data, and saves the response character string returned to the PC from the 3535 to COMCuery.
- (f) Sends the character string CommandData to the 3535.
- (g) Waits until the response character string is returned from the 3535.
- (h) Retrieves the response character string to the variable strbuf.
- (i) Picks up the character string, except for the message terminator (CR+LF), when the retrieved character string ended with LF (line feed code), and saves the net character string to COMCuery.

2. Setting the 3535 Program Code

```
Private Sub SendSetting()
    COMCommand (":LEV V")
    COMCommand (":LEV:VOLT 0.5")
    COMCommand (":FREQ 10000000")
    COMCommand (":TRIG EXT")
    COMCommand (":PAR1 Cs;:PAR2 OFF;:PAR3 D;:PAR4 OFF")
    COMCommand (":MEAS:ITEM 40,0")
    COMCommand (":RANGE:AUTO ON")
End Sub
```

Description of program statements

These statements set the following test conditions for the 3535
 Signal level : Open-circuit voltage (V), 500 mV
 Measurement frequency : 10 MHz
 Trigger : External trigger
 Display parameter : Cs, OFF, D, OFF
 Response data of : MEAS? : Cs, D
 Measurement range: AUTO

3. Retrieving the test data from the 3535 and saving it to a file Program Code

```
Private Sub Command1_Click() ..... '(a)
    Dim strbuf As String
    Dim i As Integer
    Command1.Enabled = False ..... '(b)
    Command2.Enabled = False
    COMOpen
    SendSetting
    Open "data.csv" For Output As #1 ..... '(c)
    For i = 1 To 10
        strbuf = COMQuery("*TRG;:MEAS?") ..... '(d)
        Print #1, Str(i) & "," & strbuf ..... '(e)
    Next i
    Close #1
    COMClose
    Command1.Enabled = True
    Command2.Enabled = True
End Sub

Private Sub Command2_Click()
    Unload Me
End Sub
```

Description of program statements

- (a) When the command button Command1, created to start the test, is clicked, this function sets the test conditions for the 3535, tests the sample ten times, and saves the test data to a "data.csv" file. (This is a comma-delimiter type text file.)
- (b) Disables both the Start and End buttons during communication.
- (c) Opens the "data.csv" file. When a file with an identical name is already existent, the existing file "data.csv" is deleted and a new file is created.
- (d) Sends the command that "executes the test once and returns the test data to the PC" to the 3535, and retrieves the test data to the variable strbuf.
- (e) Separates the data number and the retrieved test data with a comma and saves the resulting character string to the file opened with statement (b).

6.8 Troubleshooting

When the 3535 is malfunctioning, attempt checking and troubleshooting according to the instructions shown below.

The causes/treatments without marks (**GP-IB** / **RS-232C**) are common to both the RS-232C and GP-IB.

Symptom	Cause / Treatment
The RS-232C/ GP-IB has stopped working completely.	• Are the cables properly connected? • Are all the devices powered on? • Are correct cables used? • Has the communication condition been correctly set? RS-232C • Is the device address for the 3535 set correctly? GP-IB • Does some other device have the same device address? GP-IB
Communication failure with RS-232C/GP-IB.	• Do the 3535 and PC have the same settings (baud rate, data length, parity, and stop bit)? RS-232C • Ensure the message terminators (delimiters) for the controller are set. GP-IB ❖ "Message Terminators" (page 102)
After transmission on the RS-232C/ GP-IB bus, the keys on the 3535 freeze up and have no effect.	• Press the LOCAL key on the front panel of the 3535 to release the remote state. • Has a LLO (Local Lock-Out) command been transmitted? Transmit a GTL command to put the 3535 into the local state. GP-IB
When attempting to read data using a BASIC INPUT statement, the RS-232C bus hangs. RS-232C	• Be sure to transmit one query before each INPUT statement. • Have any of these transmitted queries resulted in an error?
When attempting to read data using a HP-Basic ENTER statement, the GP-IB bus hangs. GP-IB	• Be sure to transmit one query before each ENTER statement. • Have any of these transmitted queries resulted in an error?
Although a command has been transmitted, nothing has happened.	• Using the *ESR? query, inspect the standard event status register, and check what type of error has occurred. • Using the *ERR? query, and check whether transmission error occurred on the RS-232C. RS-232C
Sending several queries, produces only one response.	• Has an error occurred? • Send the queries one at a time, and read the responses individually. When you want to read them in all at once, try doing so by putting them all on one line separated by the message separator character. • Have you used the *IDN? query? GP-IB
The response message to a query differs from the display on the front panel.	• Due to the response message being produced at the instant that the 3535 receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.

Symptom	Cause / Treatment
Sometimes service requests are not generated. 	• Have the service request enable register and the various event status enable registers been correctly set? • Clear all the event registers at the end of SRQ processing subroutines by using the *CLS command. If an event bit is not cleared, no service request will be generated for that event.
Beeper sounds when *TRG command is transferred.	• Is the trigger is set to internal trigger? • *TRG command can be used for the external trigger setting. For the internal trigger setting, an execution error occurs.

6.9 Device Compliance Statement



“Information on compliance to standards” based on the IEEE 488.2 standard

- (1) IEEE 488.1 interface functions
These are detailed in 6.2.2 "Specifications of GP-IB" (page 95)
- (2) Operation with a device address other than 0 through 30
The bus is disabled.
- (3) Timing of changed device address recognition
A change of address is recognized immediately after changing.
- (4) Device settings at power on.
The status information is cleared, and all other items are preserved. However, the header on/off setting, and response message separator and terminator are all reinitialized.
- (5) List of message exchange options
 - Input buffer capacity and operation
These are detailed in "Input Buffer" (page 105)
 - Queries to which multiple response message units are returned

:BIN:FLIMit:ABSolute?	3
:BIN:FLIMit:DEViation?	3
:BIN:FLIMit:PERcent?	3
:BIN:SLIMit:ABSolute?	3
:BIN:SLIMit:DEViation?	3
:BIN:SLIMit:PERcent?	3
:COMParator:FLIMit:ABSolute?	2
:COMParator:FLIMit:DEViation?	3
:COMParator:FLIMit:PERcent?	3
:COMParator:SLIMit:ABSolute?	2
:COMParator:SLIMit:DEViation?	3
:COMParator:SLIMit:PERcent?	3
:CORRection:LOAD:REFerence?	4
:DISPlay:MONItor?	2
:MEASure:ITEM?	2
:MEASure?	 1 to 14
:MEMory?	1 to 200
:SCALE:FVALue?	2
:SCALE:SVALue?	2

- Queries producing responses as syntax checking is performed:
All queries produce responses when syntax checking is performed.
- Whether any queries produce responses when read:
There are no queries which produce response messages at the instant they are read in by the controller.
- Whether any commands are coupled:
There are no relevant commands.

- (6) Summary of functional elements for use when constructing device specific commands, and whether compound commands or program headers can be used:
The followings can be used
- Program message
 - Program message terminator
 - Program message unit
 - Program message unit separator
 - Command message unit
 - Query message unit
 - Command program header
 - Query program header
 - Program data
 - Character program data
 - Decimal program data
 - Compound commands and program headers
- (7) Buffer capacity limitations for block data
Block data is not used.
- (8) Summary of program data elements used in expressions, and deepest nesting level allowable in sub-expressions, including syntax restrictions imposed by the device.
Sub-expressions are not used. Character data and decimal data are the only program data elements used.
- (9) Response syntax for queries
Response syntax is detailed in [6.6 "Message Reference" \(page 121\)](#).
- (10) Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages
There are no device to device messages.
- (11) Response capacity for block data
Block data does not appear in responses.
- (12) Summary of standard commands and queries used
This appears in [6.5 "Command Reference" \(page 112\)](#)
- (13) Device state after a calibration query has been completed without any problem
The "*CAL?" query is not used.
- (14) Existence/nonexistence of "*DDT" command
When using the "*DDT" command, the maximum length of block used in a trigger macro definition
The "*DDT" command is not used.

- (15) Existence/nonexistence of macro command
When a macro command is being executed, the maximum length of macro label, the maximum length of block for defining a macro, and how echoing is managed when expanding a macro
Macros are not used.
- (16) For queries related to identification, explanation of the response to the "*IDN?" query
This is detailed in [6.6 "Message Reference" \(page 121\)](#).
- (17) Capacity of the user data storage area reserved for when the "*PUD" command and the "*PUD?" query are being executed
The "*PUD" command and the "*PUD?" query are not used. Further, there is no user data storage area.
- (18) Resources when the "*RDT" command and the "*RDT?" query are being used
The "*RDT" command and the "*RDT?" query are not used.
- (19) Conditions which are influenced when "*RST", "*LRN?", "*RCL?", and "*SAV" are used
"*LRN?", "*RCL?", and "*SAV" are not used. The "*RST" command returns the unit to its initial state.
❖ [6.6.1 "Standard Command" \(page 122\)](#), [6.6.4 "Initialization Items" \(page 166\)](#)
- (20) Scope of the self-testing executed as a result of the "*TST?" query
[This is detailed in 6.6.1 "Standard Command"; *TST?\(page 123\)](#)
- (21) Additional organization of the status data used in a device status report
[This is detailed in 6.4.4 "Event Registers" \(page 108\)](#)
- (22) Whether commands are overlap or sequential type
All the commands except :MEASure? command are sequential commands.
- (23) Criterion relating to the functions required at the instant that the termination message is produced, as a response to each command
Termination occurs when the command has been parsed.

Specification

Chapter 7

7.1 General Specification

Measurement Parameters	• Z Impedance • Y Admittance • Rs Series-equivalent resistance, ESR • Rp Parallel-equivalent resistance • G Conductance • X Reactance • B Susceptance • θ Phase angle • Ls Series-equivalent inductance • Lp Parallel-equivalent inductance • Cs Series-equivalent static capacitance • Cp Parallel-equivalent static capacitance • Q Q factor • D Dissipation factor $\tan\delta$
Measurement Frequency	Range 100 kHz to 120 MHz Resolution 4 digits (by front panel setting) 100.0 kHz to 1.000 MHz (100-Hz steps) 1.000 MHz to 10.00 MHz (1-kHz steps) 10.00 MHz to 100.0 MHz (10-kHz steps) 100.0 MHz to 120.0 MHz (100-kHz steps) 1-Hz resolution with GP-IB or RS-232C interface Accuracy Less than $\pm 0.005\%$ of setting value
Output Impedance	50 Ω $\pm$ 10 Ω (at 100 kHz)
Measurement Signal Levels	
Open-circuit voltage (V) mode	Range 5 mV to 1 V, 20 mA max. (up to 10.00 MHz) 5 mV to 500 mV, 10 mA max. (above 10.01 MHz) Resolution 1 mV steps Accuracy $\pm(5\% + 5 \text{ mV}) \times (2 + \log f)$, where f is in MHz
Constant current (CC) mode	Range 200 μ A to 20 mA, 1 V max. (up to 10.00 MHz) 200 μ A to 10 mA, 0.5 V max. (above 10.01 MHz) Resolution 10 μ A step Accuracy $\pm(10\% + 50 \mu\text{A}) \times (2 + \log f)$, where f is in MHz
Monitor Function	
Voltage monitor	(voltage between HIGH and LOW terminals of the 3535 unit) Range 0.000 V to 1.000 V Accuracy $\pm(5\% + 5 \text{ mV}) \times (2 + \log f)$, where f is in MHz
Current monitor	Range 0.000 mA to 20.00 mA Accuracy $\pm(10\% + 50 \mu\text{A}) \times (2 + \log f)$, where f is in MHz

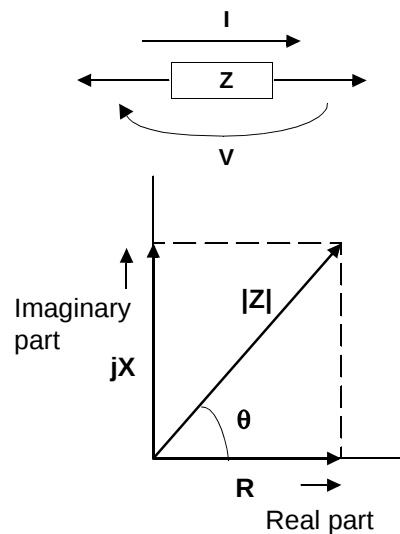
Limit Function	
Current limit (during V setting)	Range 0.20 mA to 20.00 mA Accuracy $\pm(10\% + 50 \mu\text{A}) \times (2 + \log f)$, where f is in MHz
Voltage limit (during CC setting)	(voltage between HIGH and LOW terminals of the 3535 unit) Range 0.005 V to 1.000 V Accuracy $\pm(10\% + 10 \text{ mV}) \times (2 + \log f)$, where f is in MHz
Ranges	3 ranges, AUTO or HOLD setting 1 k Ω range 100 m Ω to 2 k Ω 10 k Ω range 1 k Ω to 20 k Ω 100 k Ω range 10 k Ω to 300 k Ω
Measurement Ranges	Z: 100.00 m Ω to 300.00 k Ω (5-digit display) θ : -180.00° to 180.00° (0.01° resolution)
Measurement Time	6 ms $\pm$ 1 ms (nominal) Actual time depends on measurement conditions, such as measurement speed and averaging.
Measurement Speed	FAST, NORMAL, SLOW, and SLOW2 The number of waveform averaging cycles depends on the measurement speed.
Average	OFF, 2, 4, 8, 16, 32, and 64
Trigger Function	Internal and external trigger sources can be selected Trigger delay function: 0.01 s to 9.99 s with 0.01 s resolution
Zero Compensation	Open/ short-circuit compensation ALL and SPOT compensations are available.
Load Compensation	Measure a standard component to establish a compensation value for subsequent measurements.
Key Lock Function	Temporarily disable touch panel operation using rear panel switch.
Comparator	Compares two measurement items. Upper and lower limit values setting: Input either the absolute value, percentage of standard value or its deviation percentage ($\Delta\%$). For $\Delta\%$, the measurement value is displayed as the percentage of deviation from the standard value.
BIN (classification) Measurement	Ranks two measurement items into ten classifications
Correlation Compensation Function	Constants a and b are entered to compensate displayed values (compensated value) = a x (measurement value) + b
Panel Save and Load Function	Memory Capacity: 30 Sets Load Method: Front panel key operation, external I/O connector, GP-IB, RS-232C
Measurement Value Storage	Memory Capacity: up to 200 values Measurement values are stored in the main unit and transferred as a batch
Zoom display function	Enlarge the display of measurement data and comparator results.
Continuous Measurements	Measurements are made continuously per conditions (up to five) saved on the screen
Audible Beeper	Beeping can be set ON/OFF for key entry and comparator results (IN or NG)
Numerical Display Digit Setting Function	Measurement values can be set to display as 3, 4 or 5 digits. Available settings depend on the parameter.
Display Setting Functions	Backlight and voltage/current monitor display can be set ON/OFF
Printer Functions	Hard copy printout of measurement values and screens Requires 9442 and 9444

Interfaces	GP-IB, RS-232C, and EXT.I/O (standard)	
Accuracy guarantee for temperature and humidity	23±5°C, 80%RH or less	
Operating Environment	Indoors, altitude up to 2000 m (6562-ft.)	
Power Supply	Rated supply voltage	100 to 240 VAC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.)
	Rated supply frequency	50/60 Hz
	Maximum rated power	50 VA
Operating Temperature and Humidity	10 to 40°C (50 to 104°F), 80%RH or less, no condensation	
Storage Temperature and Humidity	-10 to 55°C (14 to 131°F), 80%RH or less, no condensation	
Dimensions and Mass	Approx. 360 W × 130 H × 360 D mm (14.17" W × 5.12" H × 14.17" D) Approx. 8.3 kg (292.8 oz.)	
Applicable Standards	EMC	EN61326:1997+A1:1998+A2:2001+A3:2003 EN61000-3-2:2000 EN61000-3-3:1995+A1:2001
	Safety	EN61010-1:2001 Pollution Degree 2
Dielectric Strength	1.39 kV AC for 15s, between power and ground	
Accessories	• Quick Start Manual • Instruction Manual • Power cord	
Options	Fixture • 9677 SMD TEST FIXTURE (no CE marking) • 9699 SMD TEST FIXTURE	
	HEAD AMP UNITs • 9700-10 HEAD AMP UNIT (1 kΩ to 100 kΩ range)	
	Connecting cables • 9678 CONNECTION CABLE • 9151-02 GP-IB CONNECTOR CABLE(2 m) • 9151-04 GP-IB CONNECTOR CABLE(4 m) • 9637 RS-232C CABLE(1.8 m, 9pin-9pin) • 9638 RS-232C CABLE(1.8 m, 9pin-25pin)	
	Printer • 9442 PRINTER (DPU-414 Seiko Instruments Inc.) • 9443-01 AC ADAPTER (for printer, for Japan) (PW-4007-J1 Seiko Instruments Inc.) • 9443-02 AC ADAPTER (for printer, for EU) (PW-4007-E1 Seiko Instruments Inc.) • 9443-03 AC ADAPTER (for printer, for America) (PW-4007-U1 Seiko Instruments Inc.) • 9444 CONNECTION CABLE • 1196 RECORDING PAPER	

7.2 Parameters and Calculation Equations

Normal circuit elements etc. are assessed with regard to their characteristics in terms of their impedance Z .

The 3535 sends AC signals to a sample and measures the impedance Z and the phase angle θ of the measurement frequency based on the prescribed measurement principle (see Appendix 2, "Measurement Principle"(page 194)). When the impedance Z is displayed on the complex plane, the following quantities can be obtained.



$$Z = R + jX = |Z| \angle \theta$$

$$\theta = \tan^{-1} \frac{X}{R}$$

$$|Z| = \sqrt{R^2 + X^2}$$

Z : impedance (Ω)

θ : phase angle (deg)

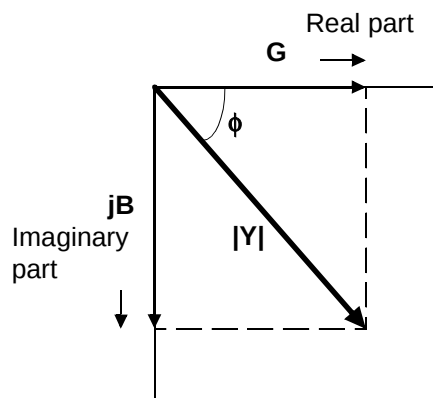
R : resistance (Ω)

X : reactance (Ω)

$|Z|$: absolute value of impedance (Ω)

Moreover, it is possible to use the admittance Y , which as a characteristic of a circuit component is the reciprocal of the impedance Z .

By displaying the admittance Y upon the complex plane (just as was done for the impedance Z) the following quantities can be obtained:



$$Y = G + jB = |Y| \angle \phi$$

$$\phi = \tan^{-1} \frac{B}{G}$$

$$|Y| = \sqrt{G^2 + B^2}$$

Y : admittance (S)

ϕ : phase angle (deg) = $-\theta$

G : conductance (S)

B : susceptance (S)

$|Y|$: absolute value of admittance (S)

The 3535 calculates the necessary components using the equations listed below.

NOTE

The phase angle θ is shown based on the impedance Z . When measuring based on the admittance, the sign of the phase angle θ must be reversed.

Calculation Equations

[$\omega = 2 \pi f$]

	Series-equivalent circuit mode	Parallel-equivalent circuit mode
Z	$ Z = \frac{V}{I} (= \sqrt{R^2 + X^2})$	
Y	$ Y = \frac{1}{ Z } (= \sqrt{G^2 + B^2})$	
R	$R_s = ESR = Z \cos \theta $	$R_p = \left \frac{1}{ Y \cos \phi} \right (= \frac{1}{G})$ *1
X	$X = Z \sin \theta $	_____
G	_____	$G = Y \cos \phi $ *1
B	_____	$B = Y \sin \phi $ *1
L	$L_s = \frac{X}{\omega}$	$L_p = \frac{1}{\omega B}$
C	$C_s = \frac{1}{\omega X}$	$C_p = \frac{B}{\omega}$
D	$D = \left \frac{1}{\tan \theta} \right $	
Q	$Q = \tan \theta (= \frac{1}{D})$	

*1: ϕ phase angle of admittance Y ($\phi = -\theta$)

LS, RS, CS: The measured values of L, C, and R in series-equivalent circuit mode.

Lp, Rp, Cp: The measured values of L, C, and R in parallel-equivalent circuit mode.

7.3 Measurement Time

The time taken for testing varies according to the measurement conditions.

NOTE

The following values may be used for reference.

The measurement time is defined by the following equation.

$$T3 = (A) + (B) + (C) + (D) + (E) + (F)$$

T3: Measurement time

(A): Influence value for measurement speed and displayed parameter settings

(B): Influence value for backlight setting

(C): Influence value for open/ short-circuit compensation and load compensation

(D): Influence value for comparator measurement and BIN measurement

NOTE

When the averaging is not set to OFF:

The measurement time = $T3 \times (\text{average setting})$

When the measurement range is set to AUTO:

Since the optimum range is selected by using the AUTO setting, the measurement time is delayed slightly.

Items (A) to (D) are defined as follows.

- (A) Influence value for measurement speed and displayed parameter settings

When the monitor display setting is OFF

Display parameters	Measurement speed setting			
	FAST	NORM	SLOW	SLOW2
Z	6.0 ms	8.0 ms	55 ms	668 ms
Z, θ	6.5 ms	8.5 ms	56 ms	668 ms
Cp, D	7.0 ms	9.0 ms	56 ms	668 ms
Z, θ , Cp	7.5 ms	9.5 ms	57 ms	668 ms
Z, θ , Cp, D	8.0 ms	10.0 ms	58 ms	668 ms

(Allowance $\pm 1\text{ms}$)

NOTE

- Since calculations are based on $|Z|$ and θ , other parameters prolong the measurement time.

❖ 7.2, "Parameters and Calculation Equations"(page 182)

- When the measurement signal level setting is CC or voltage and current limitations are enabled, up to five tests are performed internally to automatically adjust the open circuit voltage. Therefore, the parameter values in (A) may become up to five times as large as those provided above.

7.3 Measurement Time

(B) Influence value for backlight setting

Backlight setting	
ON	OFF
0 ms	-0.5ms (for a parameter)

(Allowance $\pm 0.5\text{ms}$)

(C) Influence value for open/ short-circuit compensation and load compensation

No compensation	Compensation
0 ms	0.3 ms

(Allowance $\pm 0.2\text{ms}$)

(D) Influence value for comparator measurement and BIN measurement

Measurement mode		
Normal	Comparator	BIN
0 ms	0.2ms (for a parameter)	0.2ms (for a parameter and 1 BIN)

(Allowance $\pm 0.5\text{ms}$)

Wait Time

When the measurement conditions are changed, the time taken for the internal processing is necessary before testing.

When the measurement signal level is changed:

The range of the measurement signal level is divided into five categories, as shown below.

Wait time: 10 ms

Range	Measurement signal level [V]
1	0.005 to 0.012
2	0.013 to 0.037
3	0.038 to 0.111
4	0.112 to 0.333
5	0.334 to 1.000

NOTE

When the measurement signal level setting is CC or voltage and current limitations are enabled, the measurement signal level is automatically changed. Up to five changes are executed per test.

7.4 Measurement Range and Accuracy

Warm-up time: 60 minutes

Accuracy levels are defined in both Z and θ , and those for other parameters are calculated from Z and θ .

Accuracy of impedance Z

Z accuracy = Basic accuracy $\times$ C $\times$ D $\times$ E $\times$ F $\times$ G [%]

C: Frequency constant, D: Level constant, E: Measurement speed constant, F: Cable length constant, G: Temperature constant

Basic accuracy

 Upper end of range: Basic accuracy = $A + B \times \left| \frac{Z_m \times 10}{\text{range}} - 1 \right|$

 Lower end of range: Basic accuracy = $A + B \times \left| \frac{\text{range}}{Z_m \times 10} - 1 \right|$

Z_m : Measurement value

range: Range of the HEAD AMP UNIT(1 k Ω / 10 k Ω / 100 k Ω)

Guaranteed accuracy period	Measurement range	Range (detection resistance)		
		1 kΩ range	10 kΩ range	100 kΩ range
6 months	10 kΩ to 100 kΩ	_____	_____	A = 2.00% B = 0.20%
	5 kΩ to 10 kΩ	_____	A = 1.00% B = 0.10%	
	1 kΩ to 5 kΩ	_____		_____
	500 Ω to 1 kΩ	A = 0.50% B = 0.10%		_____
	100 Ω to 500 Ω	A = 0.50% B = 0.10%	_____	_____
	100 mΩ to 100 Ω	A = 0.50% B = 0.10%	_____	_____
1 year	10 kΩ to 100 kΩ	_____	_____	A = 3.00% B = 0.30%
	5 kΩ to 10 kΩ	_____	A = 1.50% B = 0.15%	
	1 kΩ to 5 kΩ	_____		_____
	500 Ω to 1 kΩ	A = 0.75% B = 0.15%		_____
	100 Ω to 500 Ω	A = 0.75% B = 0.15%	_____	_____
	100 mΩ to 100 Ω	A = 0.75% B = 0.15%	_____	_____

C Frequency constant

$f \leq 10 \text{ MHz}$	$f > 10 \text{ MHz}$
$\log f + 2$	$10 \times \log f - 7$

f [MHz]

D Level constant

$$10 - 3 \times \log V \quad V [\text{mV}]$$

E Measurement speed constant

FAST	NORMAL	SLOW	SLOW2
$5 + 150/V$	$3 + 100/V$	$1.5 + 30/V$	1

V [mV]

F Cable length constant

0 m	2 m (9678)
1	2

G Temperature constant

$$1 + 0.1 \times |T [^{\circ}\text{C}] - 23 [^{\circ}\text{C}]| \quad T: \text{Operating temperature } [^{\circ}\text{C}]$$

Accuracy of phase angle θ

$$\theta \text{ accuracy} = Z \text{ accuracy} \times 0.6 [^{\circ}]$$

Other accuracy levels are obtained by referring to the Calculation Equations (page 183) defined in Subsection 7.2.

Method of Acquiring Measurement Accuracy

(Example) Obtaining the basic accuracy Cs of a 100 p = capacitor.
Measurement value: $Z = 159.12$, $\theta = -89.12^\circ$ when measuring with the following conditions.

- Measurement frequency 10 MHz
- Measurement speed SLOW2
- Measurement signal level 500 mV
- Measurement range 1 k Ω range
- Cable length 0 m
- Temperature 24°C

1.

Acquire Z constants A and B from the basic accuracy table, and calculate the basic accuracy of Z.

Basic accuracy

$$= A + B \times \left| \frac{Z_m \times 10}{\text{range}} - 1 \right|$$

❖ Basic accuracy (page 186)

From the basic accuracy table, the constants A and B are $A = 0.50$ and $B = 0.10$ (when guaranteed accuracy period is six months)

$$Z \text{ basic accuracy} = 0.50 + 0.10 \times \left(\frac{159.12 \times 10}{1000} - 1 \right) = \pm 0.55912 \%$$

2.

Acquire the other constants from the measurement conditions.

$$\text{Frequency constant} = \log(10) + 2 = 3$$

$$\text{Level constant} = 10 - 3 \times \log(500) \approx 1.90309$$

$$\text{Measurement speed constant} = 1$$

$$\text{Cable length constant} = 1$$

$$\text{Temperature constant} = 1 + 0.1 \times |24 - 23| = 1.1$$

3.

Acquire the accuracy of Z.

Z accuracy [%] = basic accuracy $\times$ frequency constant $\times$ level constant $\times$ measurement speed constant $\times$ cable length constant $\times$ temperature constant

$$Z \text{ accuracy} = 0.55912 \times 3 \times 1.90309 \times 1 \times 1 \times 1.1 \approx \pm 3.51138 \%$$

4.

Calculate the basic accuracy of θ from the basic accuracy of Z.

θ accuracy = Z accuracy $\times$ 0.6
[°]

$$\theta \text{ accuracy} = 3.51138 \times 0.6 = \pm 2.106828^\circ$$

5.

The range of possible values for Z, θ , and $|\sin\theta|$ is acquired from the basic accuracy.

$Z_{\min} = Z_m \times (1 - Z \text{ accuracy } [\%])$
 $Z_{\max} = Z_m \times (1 + Z \text{ accuracy } [\%])$
 Z_m : measurement value of Z

$$Z_{\min} = 159.12 \times \left(1 - \frac{3.51138}{100} \right) \approx 153.53269 \Omega$$

$$Z_{\max} = 159.12 \times \left(1 + \frac{3.51138}{100} \right) \approx 164.70731 \Omega$$

$\theta_{\min} = \theta_m - \theta \text{ accuracy } [^\circ]$
 $\theta_{\max} = \theta_m + \theta \text{ accuracy } [^\circ]$
 θ_m : measurement value of θ

$$\theta_{\min} = -89.12 - 2.106828 \approx -91.226828^\circ$$

$$\theta_{\max} = -89.12 + 2.106828 \approx -87.013172^\circ$$

Since the absolute value of $\sin\theta$ ($|\sin\theta|$) is maximized at $\sin 90^\circ$ or $\sin -90^\circ$, the range is defined as follows.

$$\sin\theta_{\min} = |\sin - 87.013172| \approx 0.99864$$

$$\sin\theta_{\max} = |\sin - 90| = 1$$

6.

The range of possible values for Cs is acquired from the range of Z and sinθ.

❖ Calculation Equations: (page 183)

$$C_s = \frac{1}{\omega \times |Z| |\sin\theta|}$$

$$= \frac{1}{2\pi f \times |Z| |\sin\theta|}$$

$\omega = 2 \times \pi \times f$

f: frequency [Hz]

Minimum value of Cs (Csmin):

$$C_{smin} = \frac{1}{2\pi f \times Z_{max} \times \sin\theta_{max}} = \frac{1}{2\pi f \times 164.70731 \times 1} \approx 96.6289 \text{ pF}$$

Maximum value of Cs (Csmax):

$$C_{smax} = \frac{1}{2\pi f \times Z_{min} \times \sin\theta_{min}} = \frac{1}{2\pi f \times 153.53269 \times 0.99864} \approx 103.8031 \text{ pF}$$

Minimum value of the basic accuracy of Cs

$$= \frac{C_{smin} - C_m}{C_m} \times 100 = \frac{96.6289 - 100}{100} \times 100 = -3.37110 \%$$

Maximum value of the basic accuracy of Cs

$$= \frac{C_{smax} - C_m}{C_m} \times 100 = \frac{103.8031 - 100}{100} \times 100 = 3.80310 \%$$

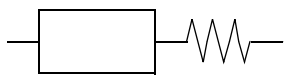
Cm: measurement value of Cs = 100pF

Therefore, the basic accuracy of Cs is -3.37110% to 3.80310%.

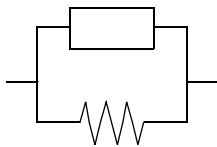
Appendix

Appendix 1 Terminology

Series-Equivalent Circuit Mode and Parallel-Equivalent Circuit Mode



Series-equivalent circuit



Parallel-equivalent circuit

The 3535 unit analyses the test sample in terms of a pure inductive component (L), an equivalent circuit construction composed of a pure capacitive component (C), and a pure resistive component (R), and calculates as though these components were connected in series, or alternatively connected in parallel. Therefore, it is possible for the user to select either a series-equivalent circuit mode or a parallel-equivalent circuit mode for this conceptual connection together of these L, C, and R components.

When the impedance of the sample being measured is relatively high, L_p , C_p , and R_p for the parallel-equivalent circuit mode should be selected manually, and when the impedance of the sample being measured is relatively low, L_s , C_s , and R_s for the series-equivalent circuit mode should be selected manually.

Generally, for a device such as an electrolytic capacitor or the like with a high D value (i.e., a low Q value), the test values obtained when testing using series-equivalent circuit mode differ from those obtained when testing using parallel-equivalent circuit mode. The greater the resistance component in the sample being measured, the more this difference in the test values appears.

For example, the test values for capacitors of the same capacitance which have different values of D in series-equivalent circuit mode and in parallel-equivalent circuit mode may be as follows:

3535 displayed value		
D	Cs	Cp
0	C'	C'
0.1	1.005C'	0.995C'
0.5	1.118C'	0.8944C'

C' : Static capacitance (nominal value)

Cs: Static capacitance in series-equivalent circuit mode

Cp: Static capacitance in parallel-equivalent circuit mode

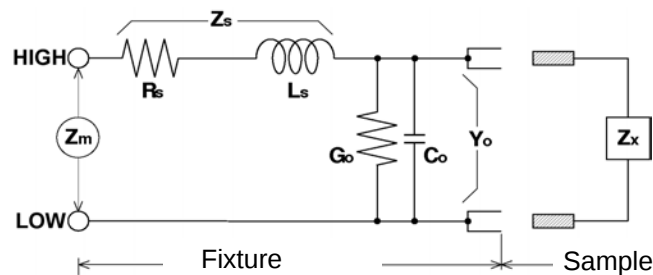
D: Dissipation factor

Therefore it is necessary for the user clearly to understand the setting of this test mode, in order properly to assess test samples.

In general, parallel-equivalent circuit mode should be used for elements which have relatively low capacitance and high impedance such as film capacitors and ceramic capacitors, since parallel resistance can cause great loss in this case; while series-equivalent circuit mode should be used for elements which have relatively high capacitance and low impedance such as electrolytic capacitors, since series resistance can cause great loss in this case.

Open-circuit compensation and Short-circuit compensation

The residual impedance component of the test fixture can be considered in terms of an equivalent circuit as shown in the figure.



Further, because the measured value Z_m for impedance includes this residual component, therefore, in order to obtain the genuine impedance value, it is necessary to compensate the measured value in terms of the open-circuit impedance residual component and the short-circuit residual component, which accordingly must be obtained.

$$\text{Measurement value } Z_m = Z_s + 1/(Y_o + 1/Z_x)$$

Z_x : true value

R_s : residual resistance

L_s : residual inductance

G_o : residual conductance

C_o : floating capacitance value

Z_s : short-circuit residual component

Y_o : open-circuit residual component

Z_m : test value

The residual components can be determined in the following manner:

- Open-circuit compensation

The terminals of the test fixture are left separated (open-circuited). Because the short-circuit residual component Z_s is now zero, therefore the open-circuit residual component Y_o can be determined.

- Short-circuit compensation

The terminals of the test fixture are connected together (short-circuited). Because the open-circuit residual component Y_o is now zero, therefore the short-circuit residual component Z_s can be determined.

These residual components thus obtained are recorded as compensation values, and the compensation process may then be performed by substituting them into the above equation.

NOTE

The determination of test range is performed according to the measured value Z_m for impedance. Therefore it may happen that testing cannot be performed, when HOLD is on, if the test range is determined merely according to the value of impedance of the sample under test. In this case, you should set the test range in consideration both of the impedance of the test sample and also of the residual impedance components of the test fixture.

Deviations in the measured values can become comparatively large in the following cases:

- If only short-circuit compensation has been performed.
With short-circuit compensation only having been performed, since no compensation can be performed in terms of the open-circuit residual component Y_o (which is not available), thereby deviation in the resultant values will become large if the value of that open-circuit residual component Y_o is relatively large.
- If only open-circuit compensation has been performed.
With open-circuit compensation only having been performed, since no compensation can be performed in terms of the short-circuit residual component Z_s (which is not available), thereby deviation in the resultant values will become large if the value of that short-circuit residual component Z_s is relatively large.

In order to avoid this sort of thing, be sure always to perform both short-circuit compensation and also open-circuit compensation.

Appendix 2 Measurement Principle

The 3535 incorporates an automatically balanced bridge circuit with digital control.

The measurement signal is generated by a primary oscillator and applied to the component (DUT: Device Under Test). The LOW terminal voltage is measured and used to control the phase and amplitude of a secondary oscillator so as to maintain a balanced condition (LOW terminal voltage being zero). The impedance Z and phase angle θ of the DUT are determined according to the amplitude and phase required to maintain the secondary oscillator in its balanced condition.

$$|Z| = |Z_f| \times A_1/A_2$$

$$\theta = \theta_f + \theta_1 - \theta_2 + 180$$

Z : Impedance of the DUT

θ : Phase angle of the DUT

Z_f : Impedance of detection resistance

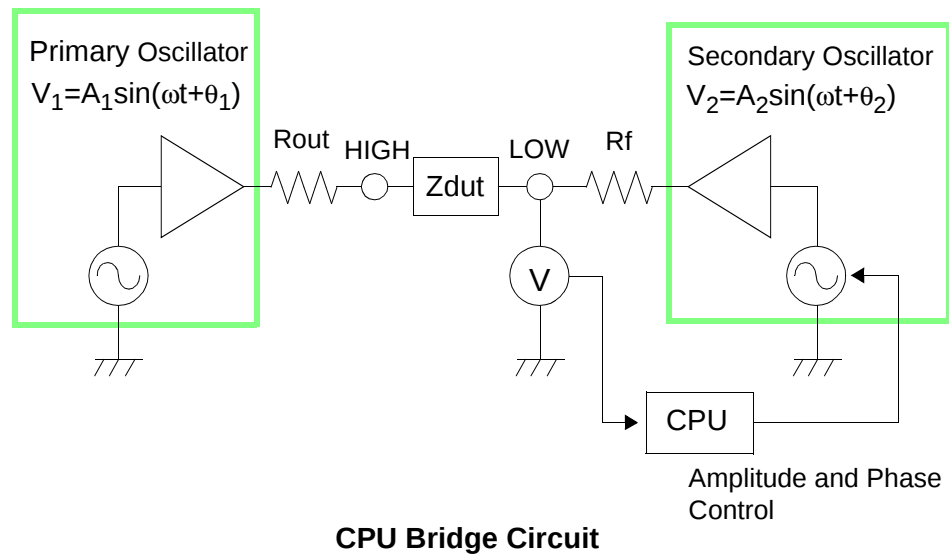
θ_f : Phase angle of detection resistance

A_1 : Voltage of the primary oscillator

θ_1 : Phase angle of the primary oscillator

A_2 : Voltage of the secondary oscillator

θ_2 : Phase angle of the secondary oscillator



NOTE

Since a voltage twice as large as the measurement signal voltage may be applied to the DUT in an unbalanced condition, the most care must be shown when dealing with a low-voltage type DUT.

DECLARATION OF CONFORMITY

Manufacturer's Name: HIOKI E.E. CORPORATION
Manufacturer's Address: 81 Koizumi, Ueda, Nagano 386-1192, Japan
Product Name: LCR HiTESTER
Model Number: 3535
Options: 9700-10 HEAD AMP UNIT
9699 SMD TEST FIXTURE
9678 CONNECTION CABLE
9151-02 GP-IB CONNECTOR CABLE
9151-04 GP-IB CONNECTOR CABLE
9637 RS-232C CABLE
9638 RS-232C CABLE

The above mentioned products conform to the following product specifications:

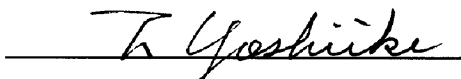
Safety: EN61010-1:2001
EMC: EN61326:1997+A1:1998+A2:2001+A3:2003
ClassB equipment
Minimum immunity test requirement
EN61000-3-2:2000
EN61000-3-3:1995+A1:2001

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

HIOKI E.E. CORPORATION

15 September 2006


Tatsuyoshi Yoshiike
President

3535A999-04

HIOKI 3535 LCR HiTESTER
Instruction Manual

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- All reasonable care has been taken in the production of this manual, but if you find any points which are unclear or in error, please contact your supplier or the International Sales and Marketing Department at HIOKI headquarters.
 - In the interests of product development, the contents of this manual are subject to revision without prior notice.
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HIOKI

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