HIOKI

Instruction Manual

# 3535

# LCR HiTESTER

HIOKI E. E. CORPORATION

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*60002217A*

# Contents

# 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

| | |
|---|---|
| ⚠WARNING | Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user. |
| ⚠CAUTION | Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument. |
| NOTE | 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. |
| GP-IB | Indicates descriptions relating to the GP-IB only. |
| RS-232C | Indicates descriptions relating to the RS-232C only. |

# Usage Notes

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

## Handling this device

⚠WARNING

- **To avoid electric shock, do not allow the instrument to get wet, and do not use it when your hands are wet.**
- **Never modify the instrument. Only a Hioki service engineer can disassemble or repair the instrument. Failure to observe these precautions may result in fire, electric shock, or injury.**
- **Do not use the instrument where it may be exposed to corrosive or combustible gases. The instrument may be damaged or cause an explosion.**

**⚠CAUTION**

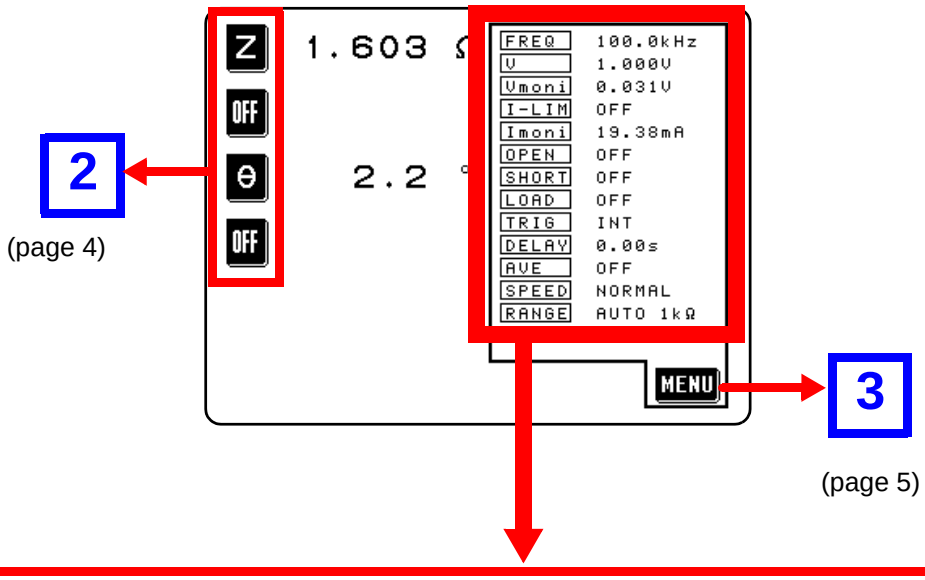
- To avoid damage to the instrument, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- Do not use excessive force on the touch panel, and do not use sharp objects that could damage the touch screen.
- Before using the instrument, make sure that the insulation on the cables is undamaged and that no bare conductors are improperly exposed. Using the instrument under such conditions could result in electrocution. Replace the cables specified by HIOKI.
- If anything unusual happens during operation of the unit, turn off the power switch immediately and contact any HIOKI service facility for help, advice and service.
- Do not connect or disconnect the 9700-10 HEAD AMP UNIT or 9678 CONNECTION CABLE with the power turned on. This may cause a malfunction.
- Do not apply any voltage to the measurement terminals. This may cause a malfunction in the unit.

# Screen Configuration

# Chapter 1

## 1 Initial Screen

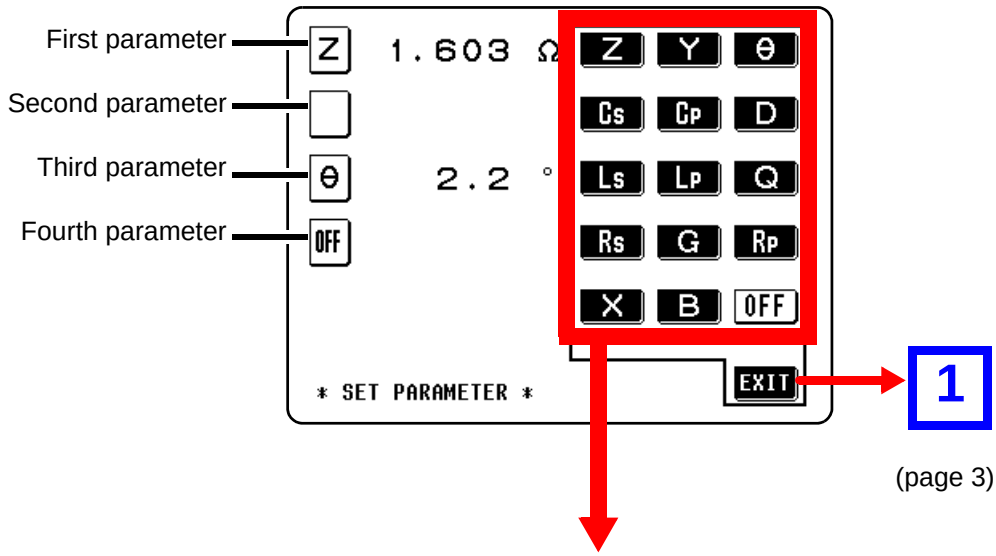
2.1, "Initial Screen" (page 7)




| | | Section (page) |
|---|---|---|
| FREQ | Measurement frequency | 3.1 (page 9) |
| V | Measurement signal level | 3.2 (page 12) |
| Vmoni | 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)




(page 3)

| | |
|---|---|
| Z | Impedance (Ω) |
| Y | Admittance (S) |
| θ | Impedance phase angle (°) * 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 = tanδ |
| 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 |

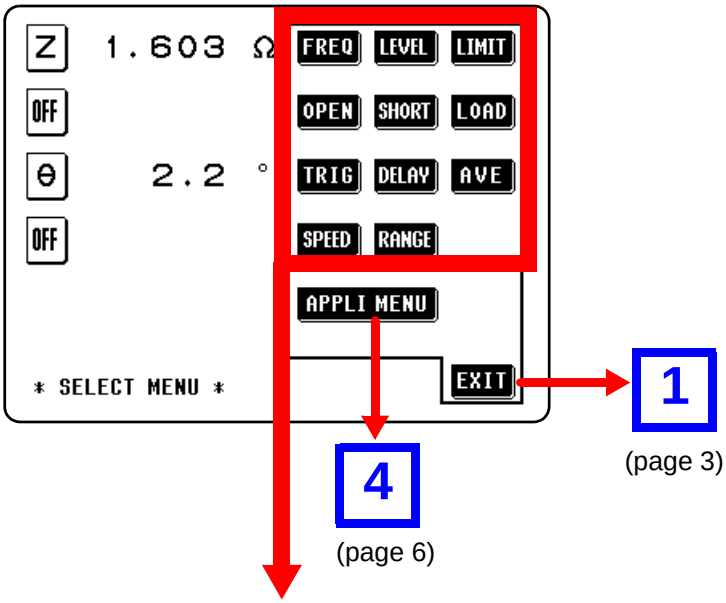
All parameters excluding the impedance phase angle θ is displayed as absolute value. To check the polarity, confirm the impedance phase angle θ.

*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)

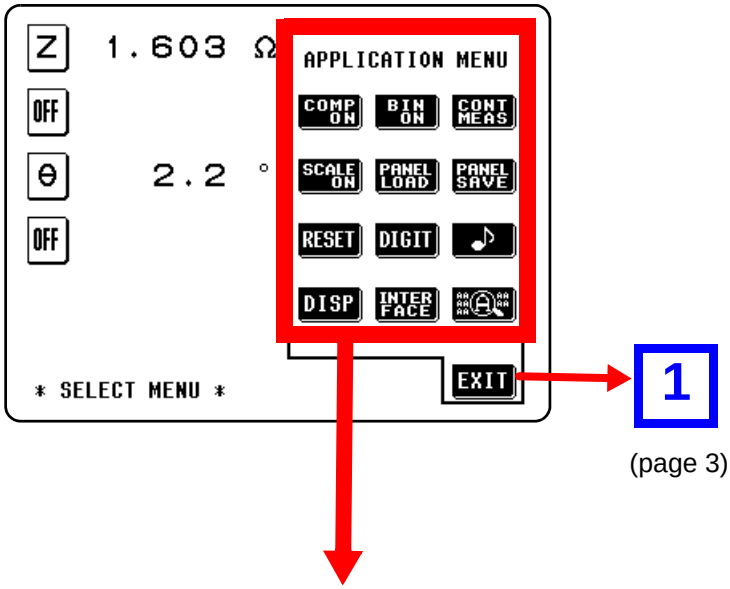



| | | |
|---|---|---|
| FREQ | Measurement frequency setting | (page 9) |
| LEVEL | Measurement signal level setting | (page 12) |
| LIMIT | Limit setting | (page 16) |
| OPEN | Open-circuit compensation setting | (page 18) |
| SHORT | Short-circuit compensation setting | (page 22) |
| LOAD | Load compensation 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)

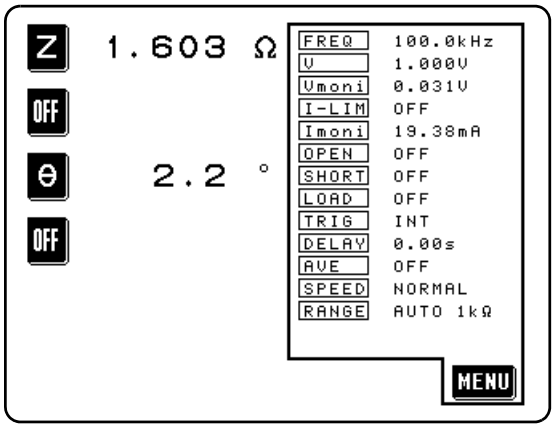
| | | |
|---|---|---|
| COMP ON / COMP OFF | Comparator function | (page 41) |
| BIN ON / BIN OFF | BIN (classification) measurement function | (page 47) |
| SCALE ON / SCALE OFF | Scaling function | (page 52) |
| CONT MEAS | Continuous measurement function | (page 67) |
| PANEL LOAD | Panel load function | (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

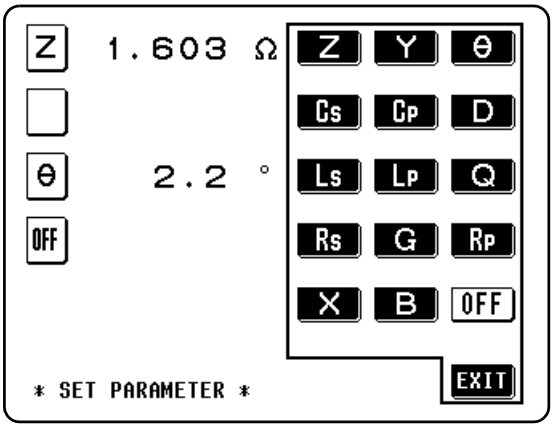
# Chapter 2

## 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

1 Initial Screen — MENU

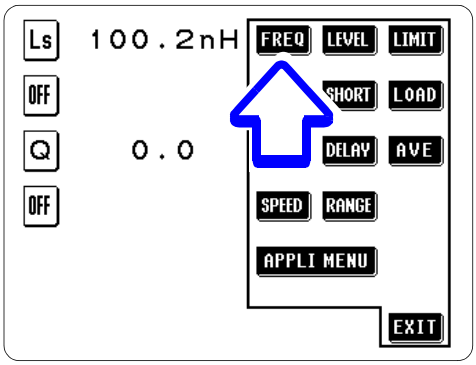
2 Menu Screen — FREQ

3 Measurement frequency setting

1. Select the type of input method for the measurement frequency
   TEN KEY / DGT KEY
2. Input the measurement frequency
3. EXIT

4 Initial Screen

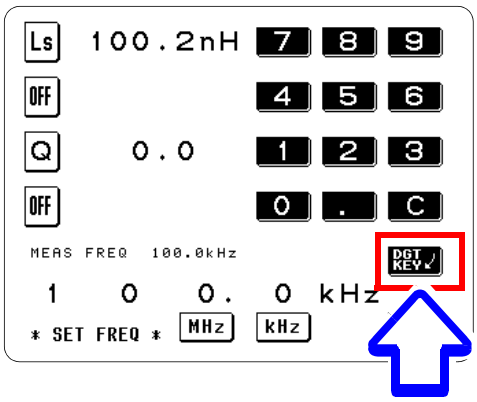
### Setting Method




Menu Screen

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

*2.* FREQ
Display the Frequency Setting Screen.



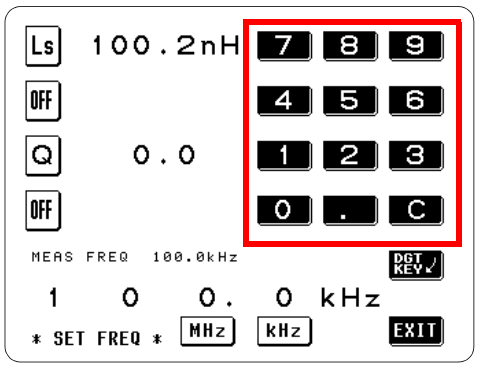

## 3. Select the type of input method for the measurement frequency.

| | |
|---|---|
| TEN KEY | Enter the numeric value directly. |
| DGT KEY | 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

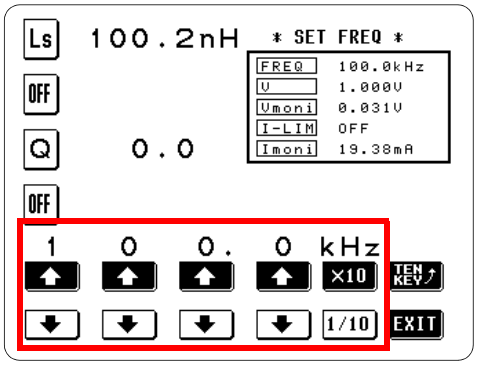
### l TEN KEY Using the keypad

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

### l 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

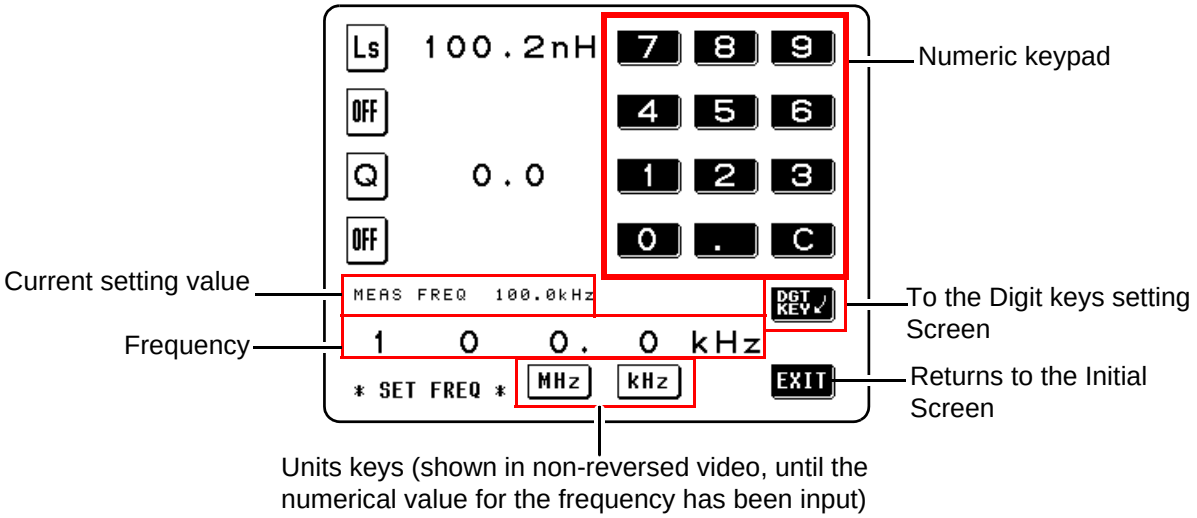
Return to the Initial Screen.

## 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.

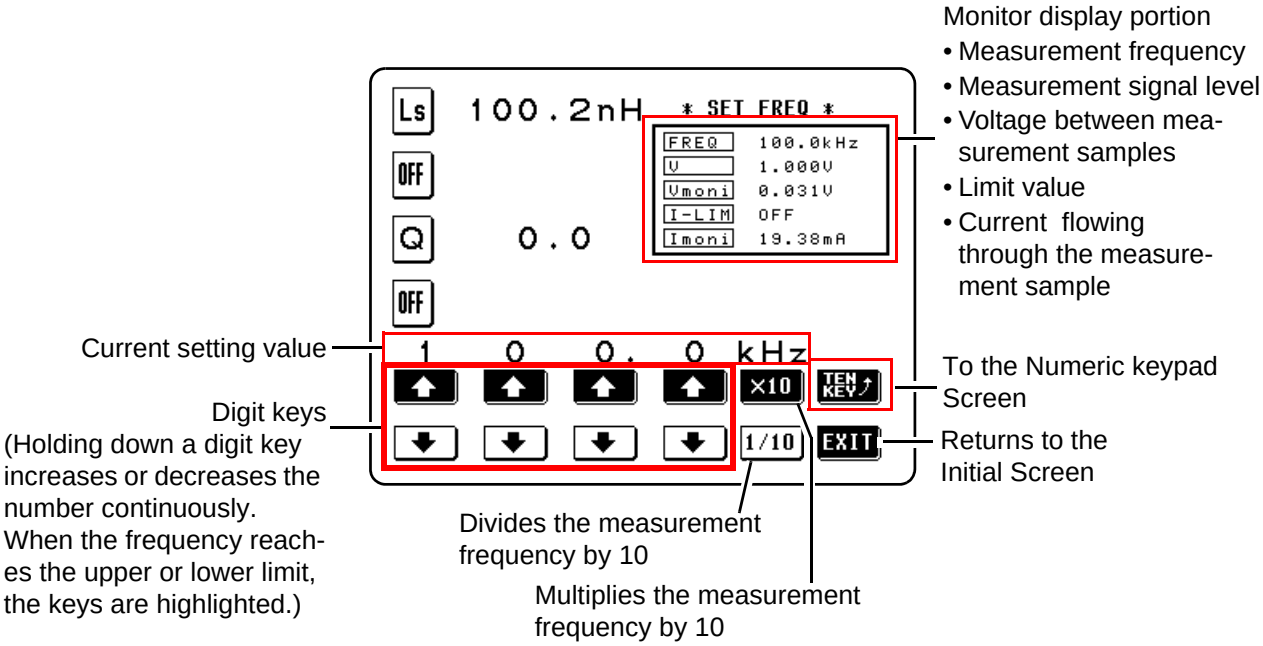
### Numeric Keypad Setting Screen

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

**1** Initial Screen — MENU

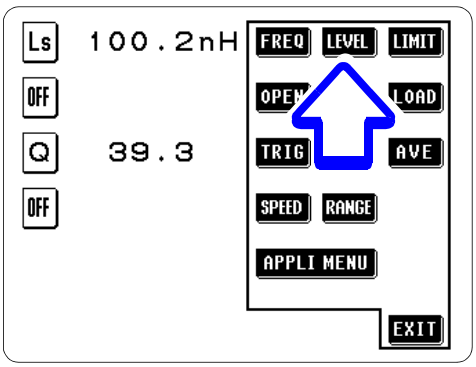
**2** Menu Screen — LEVEL

**3** Measurement signal level setting

1. Select the type of level for the measurement signal.
   V / CC
2. Input the value for the measurement signal level.
3. EXIT

**4** Initial Screen

## Setting Method



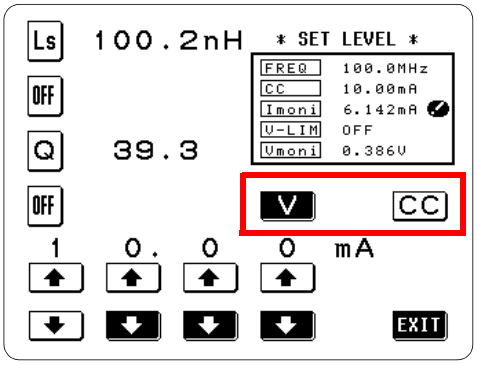
Menu Screen

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

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

**CAUTION**

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.

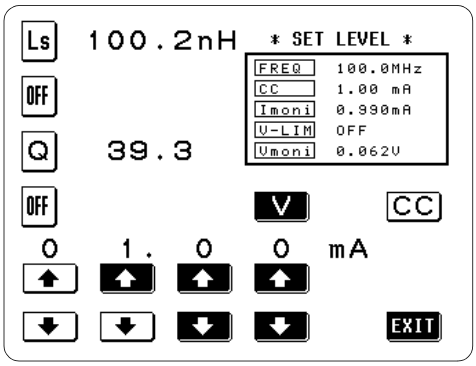
| | |
|---|---|
| V | The value of the open-circuit voltage is set. |
| CC | The value of the current flowing through the object under measurement is set. |

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.

l V Setting the open-circuited voltage _____

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

l CC 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.

**Im = Vo/|Zm'|**

Zm': impedance from the generator
Vo: generator output

(Example)
When a 10 μH impedance (L) is measured at 100 kHz:

Zm' = Ro + Zm (Ro : output resistance (50 Ω)
= Ro + (Rm + jXm ) (Xm : 2 πfL)
= 50 Ω + (0 Ω + j6.28 Ω)
= 50 Ω + j6.28 Ω (Zm' = $\sqrt{(Ro + Rm)^2 + Xm^2}$ )
= 50.39 Ω
Vo = 5 mV to 1 V (the generator output voltage range at 100 kHz)
Im = Vo / 50.39 Ω
= 99.22 μA to 19.84 mA

## Explanation of the Screens V/ CC

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

V

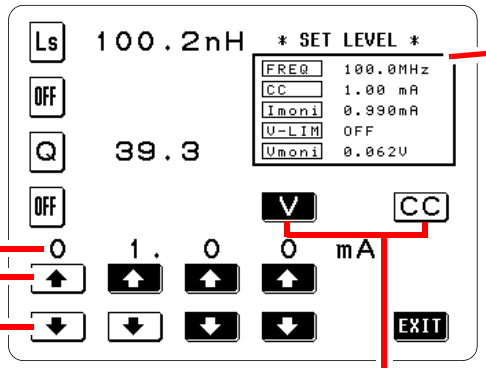
**Open-circuit voltage (V) setting**

The value of the open-circuit voltage is set.

CC

**Constant current (CC) setting**

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




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.

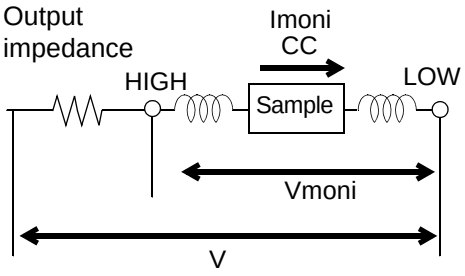
Current value

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

## 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

**1 Initial Screen** — MENU

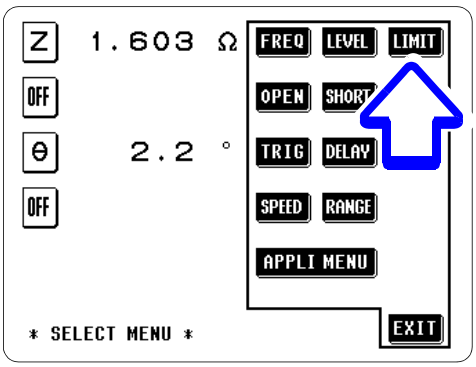
**2 Menu Screen** — LIMIT

**3 Limit setting**

1. Input a limit value.
2. Turn the voltage/current limit function on or off.
   LIMIT ON / LIMIT OFF
3. EXIT

**4 Initial Screen**

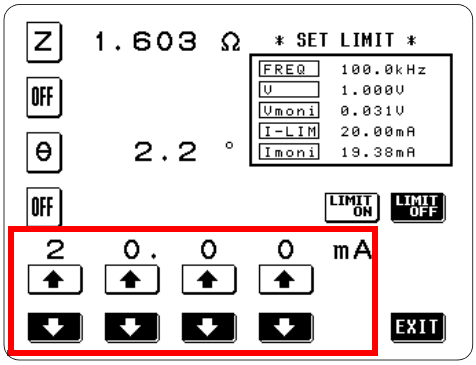
## Setting Method



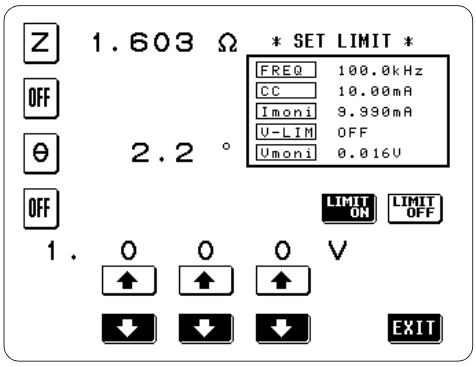
Menu Screen

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

*2.* LIMIT
Display the Limit Setting Screen.




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.

| Measure-ment 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.

| | |
|---|---|
| LIMIT ON | The limit function is turned on. |
| LIMIT OFF | 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.

limit

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.
- When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
  ex. Servo Motor, switching power source, high-voltage cable and etc.
- Perform compensation in the state as close as possible to the actual one in which the test sample will be measured.
- The compensated value is preserved in the memory of the main unit even when power is turned off.

## 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.

**1 Initial Screen** — MENU

**2 Menu Screen** — OPEN

**3 Open-circuit compensation setting**

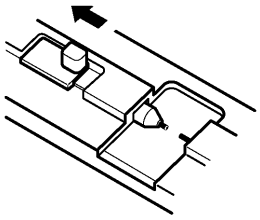
1. Select the compensation method
   ALL / SPOT / OFF
2. RUN (SPOT: set the measurement frequency)
3. OK

**4 Initial Screen**

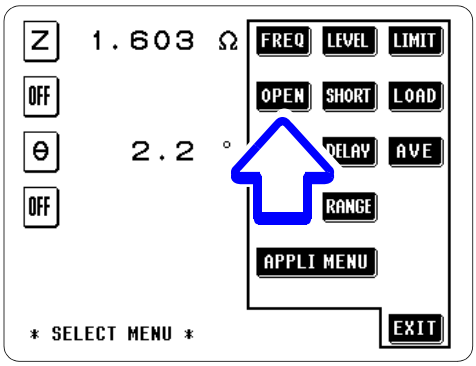
Compensation is now complete.

## Setting Method

(Example)
When using
the 9677



Open both terminals before carrying out measurement with the 3535.



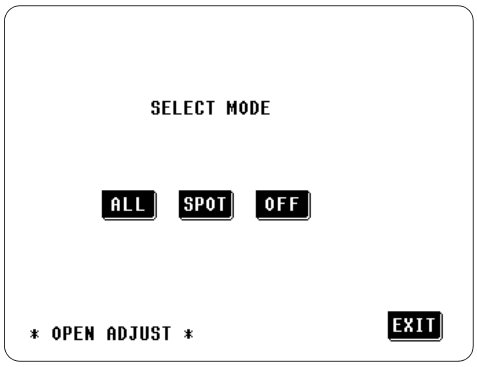

Menu Screen

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

Display the Menu Screen.

**2.** **OPEN**

Display the Open Circuit Compensation Screen.



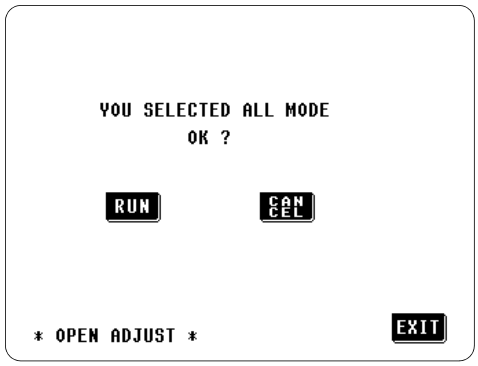

Open Circuit Compensation Screen

**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 |



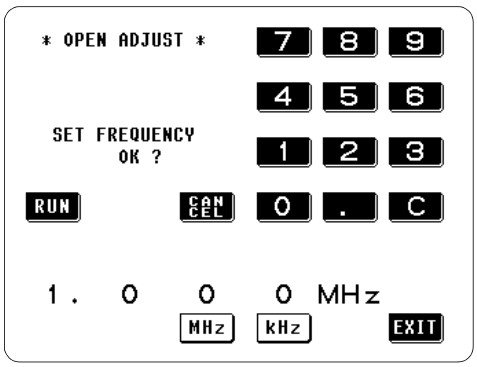

When ALL is selected

**4.** Set the compensation.

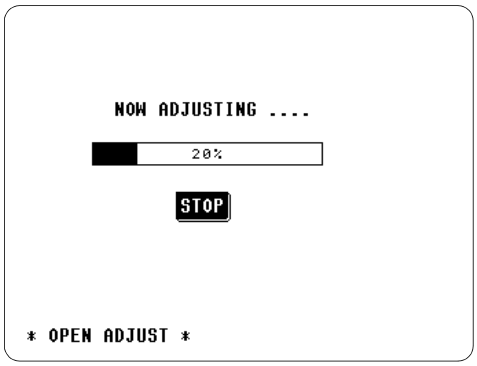
l **ALL**

A Confirmation Screen will appear for confirmation.
Check that both the terminals are open.

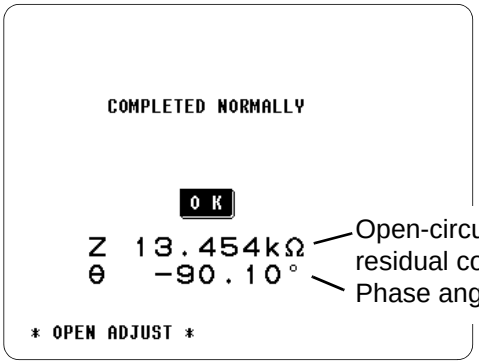
| | |
|---|---|
| **RUN** | Continue. (ALL compensation starts) |
| **CANCEL** | Cancel (return to the Open Circuit Compensation Screen) |




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 [ O K ] 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.
- When performing compensation, make sure that there is no noise source nearby. Noise may cause an error when performing compensation.
  ex. Servo Motor, switching power source, high-voltage cable and etc.
- Perform compensation in the state as close as possible to the actual one in which the test sample will be measured.
- The compensated value is preserved in the memory of the main unit even when power is turned off.

## 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.

**1 Initial Screen** — MENU

▼

**2 Menu Screen** — OPEN

▼

**3 Short-circuit compensation setting**

1. Select the compensation method
   ALL / SPOT / OFF
2. RUN (SPOT: set the measurement frequency)
3. O K

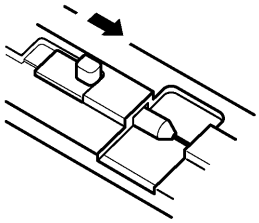
▼

**4 Initial Screen**

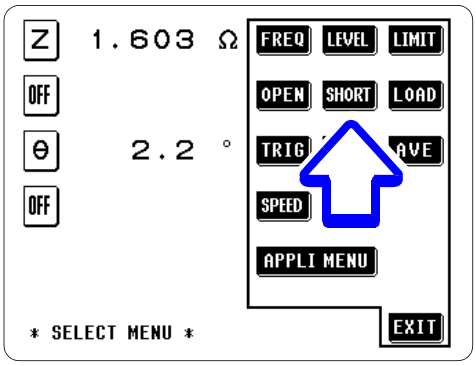
Compensation is now complete.

## 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.



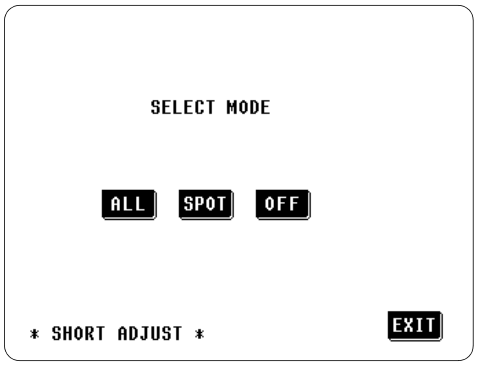

Menu Screen

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

Display the Menu Screen.

*2.* **SHORT**

Display the Short Circuit Compensation Setting Screen.



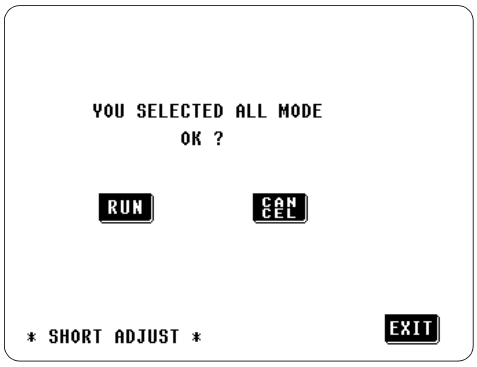

Short Circuit Compensation Setting Screen

*3.* Select the short-circuit compensation method.

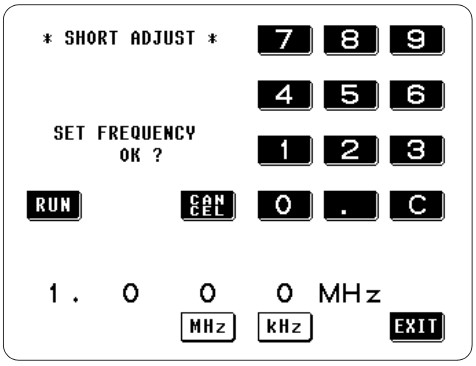
| | |
|---|---|
| **ALL** | The compensation values are obtained for all measurement frequencies. |
| **SPOT** | The compensation values are obtained at the set measurement frequency only. |
| **OFF** | The short-circuit compensation data are cleared. |

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.

l **ALL** _____

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

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

l **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 |
| CANCEL | Cancel (return to the Short Circuit Compensation Screen) |

**SPOT compensation for some new frequency:**

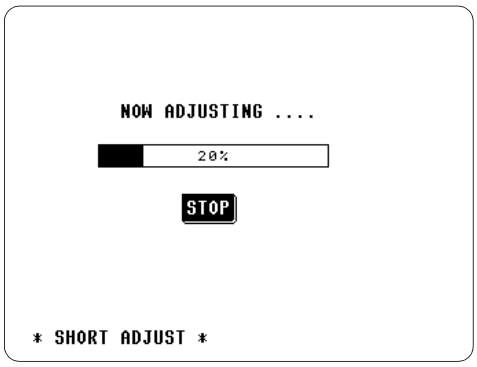
1 ) Input the frequency for compensation using the numeric keypad.
Settable range: 100 kHz to 120 MHz)

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.

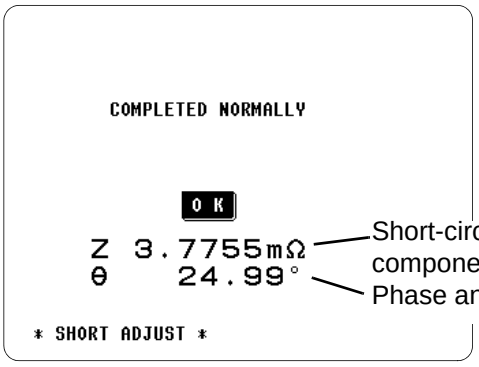
3 ) Press RUN (SPOT compensation starts)




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.

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

Compensation coefficient of θ = (Reference value of θ) - (Actual data of θ)

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 before compensation) × (Z after compensation)
θ = (θ before compensation) + (θ 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

**1 Initial Screen** — MENU

**2 Menu Screen** — LOAD

**3 Load Compensation Screen** — Select the intended load compensation conditions number.

**4 Load Compensation setting**

1. FREQ Set the frequency
2. MODE Select Measurement mode
3. REF1 , REF2 Set reference values
4. O K

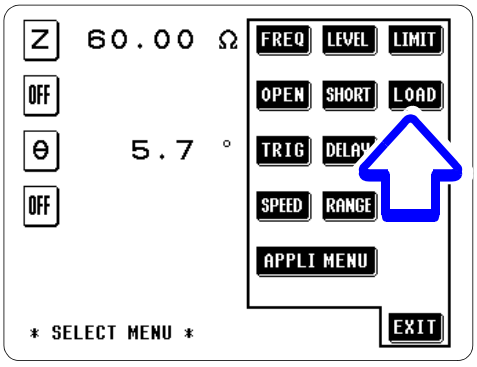
**5 Load Compensation Screen** — RUN

Measurement value is displayed.

EXIT

**6 Initial Screen** — Check that load compensation is turned on or invalid.

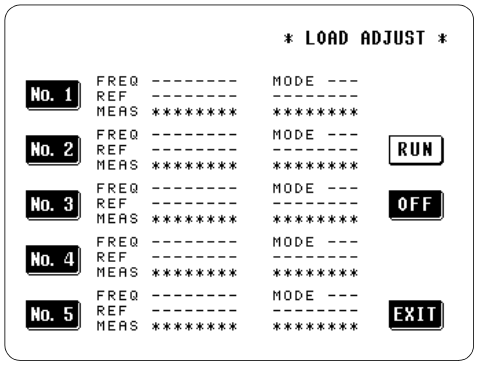
## Setting Method



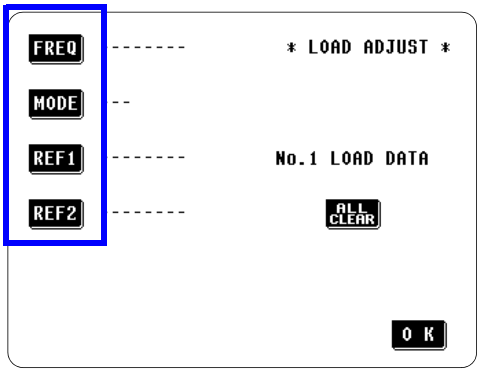

Menu Screen

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

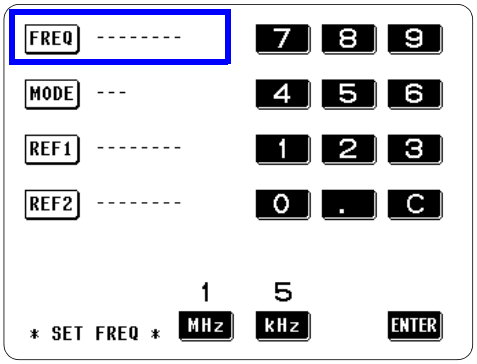
*2.* LOAD
Display the Load Compensation Screen.



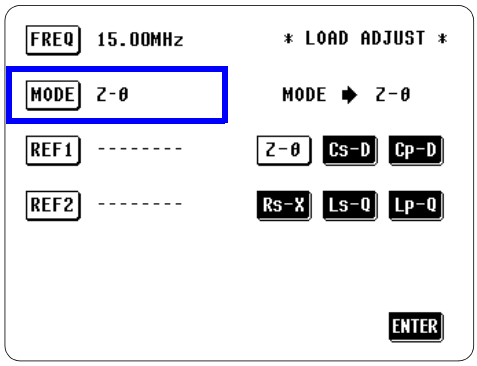

Load Compensation Screen




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.) Delete all set compensation conditions. |
| ALL CLEAR | Delete all set compensation conditions. |

l **FREQ** Compensation frequency setting _____

1 ) Enter the numerical value using the keypad.

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

3 ) **ENTER** Confirm the setting.

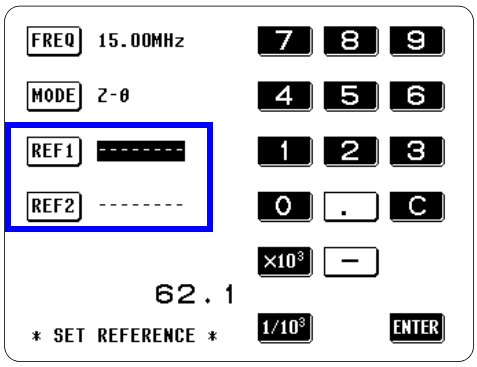
The display returns to the Compensation condition setting screen.

l **MODE** Reference parameter input mode setting_

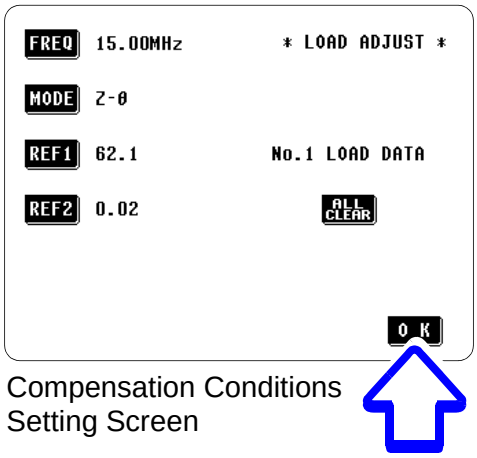
The selected parameters are assigned to REF1 and REF2.

| | 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 |

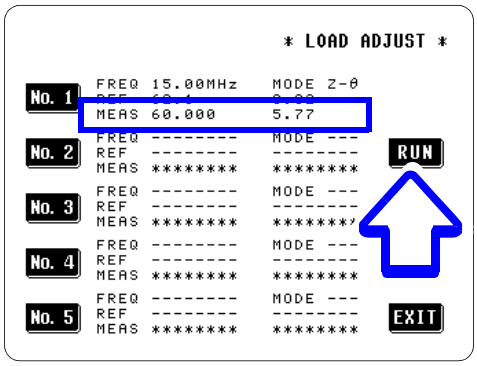
After setting, press **ENTER** .



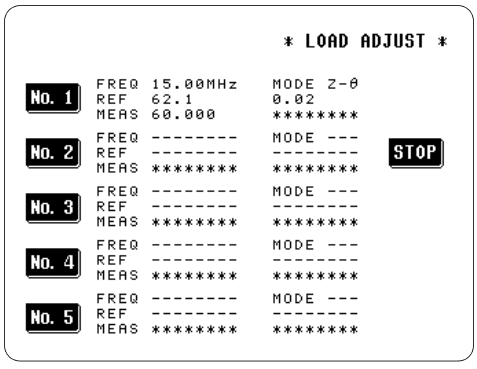

Reference value 1 setting




Compensation Conditions Setting Screen




Load Compensation Screen




Acquisition of compensation data

l **REF1** Reference values of the parameters ____

1 ) Enter the numerical value using the keypad.

2 ) Select the unit. (**1/10³** or **×10³**)

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. **O K**

Confirm the compensation conditions.

The display returns to the Load Compensation Screen.

**NOTE**

Attach the reference sample to the test fixtures.

## 6. **RUN**

Start acquiring compensation data.

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

**NOTE**

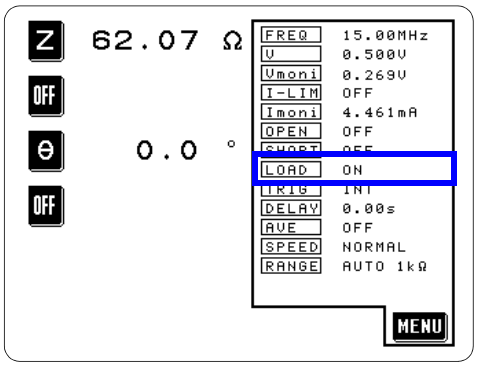
- When an error occurs during data acquisition, a “beep” sound is generated and the compensation data is invalidated.
- If even one of the load compensation conditions is changed following data acquisition, the acquired compensation data is invalidated.

**To cancel the data acquisition process:**

press **STOP**

## 7. **EXIT**

Return to the Initial Screen.



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

**1 Initial Screen** — MENU

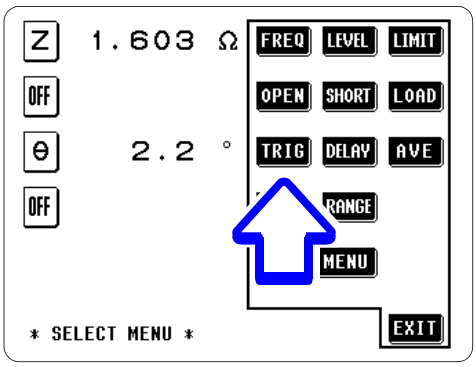
**2 Menu Screen** — OPEN

**3 Trigger Setting**

1. Select the triggering method.
   EXT / INT
2. EXIT

**4 Initial Screen** — Setting is completed.

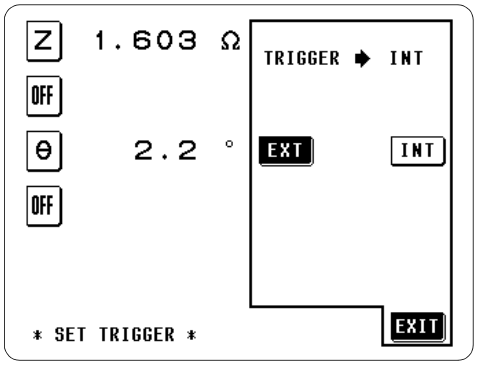
## Setting Method



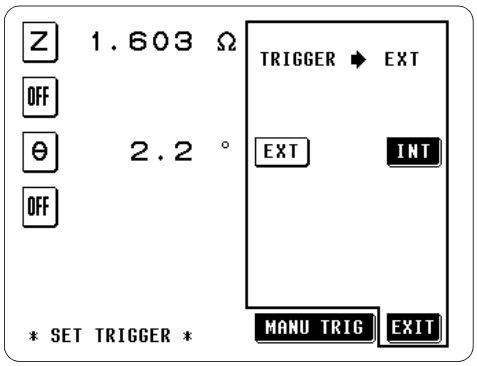

Menu Screen

*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.

l **INT**

Measurement is performed continuously in automatic mode.

l **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.

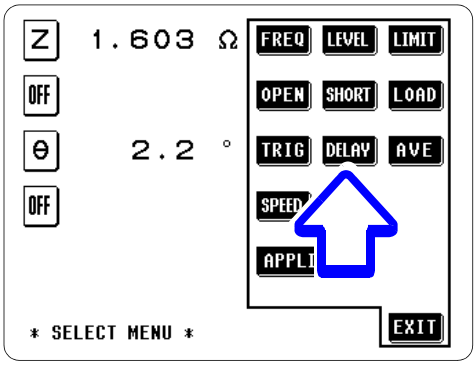
# 3.8 Setting the Trigger Delay

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.

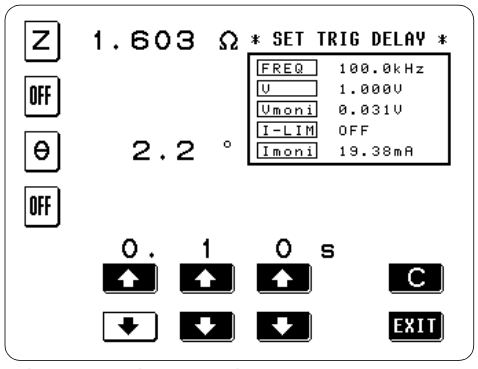
## Control Screen Sequence

| | |
|---|---|
| 1 Initial Screen | MENU |
| 2 Menu Screen | DELAY |
| 3 Trigger delay setting | 1. Set the trigger delay time.<br>2. EXIT |
| 4 Initial Screen | Setting is completed. |

## 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.

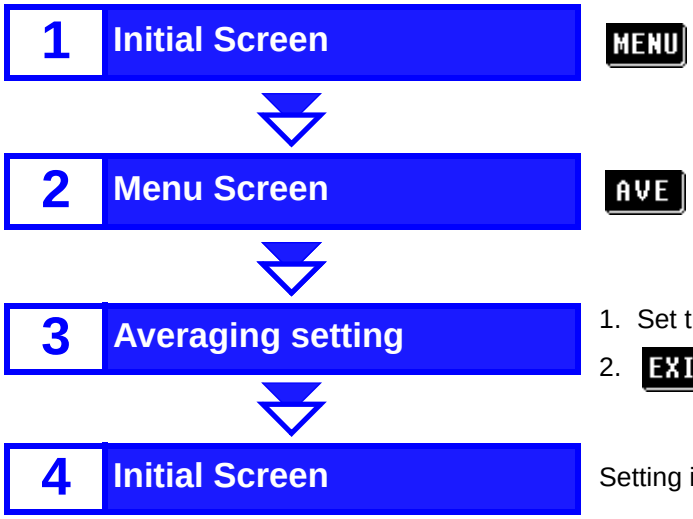
# 3.9 Setting Averaging

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.

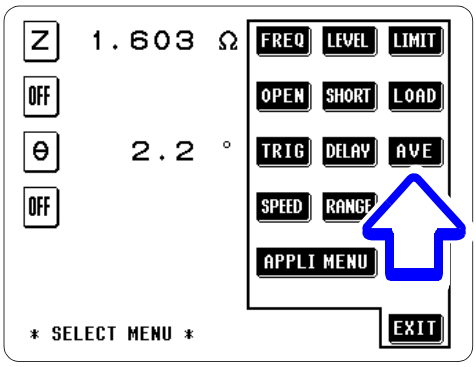
## Control Screen Sequence



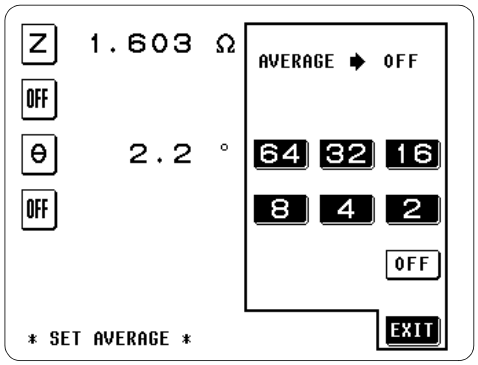

1. Set the number of measurement times for averaging.
2. EXIT

Setting is completed.

## 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

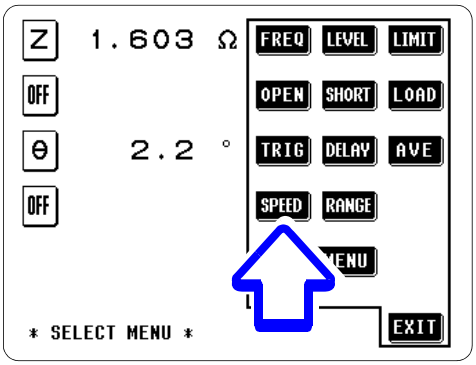
1 Initial Screen — MENU

2 Menu Screen — SPEED

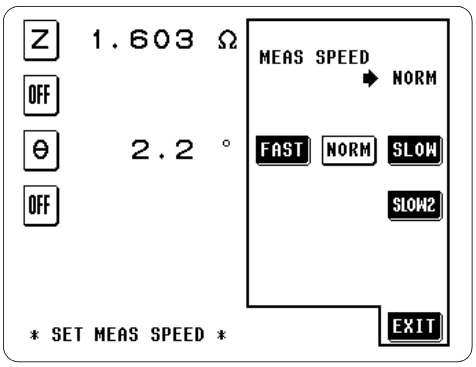
3 Measurement speed setting
1. Select the measurement speed.
   FAST / NORM / SLOW / SLOW2
2. EXIT

4 Initial Screen — Setting is completed.

## 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

**1 Initial Screen** — MENU

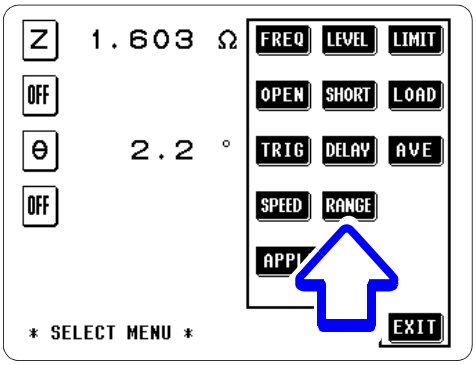
**2 Menu Screen** — RANGE

**3 Measurement range setting**

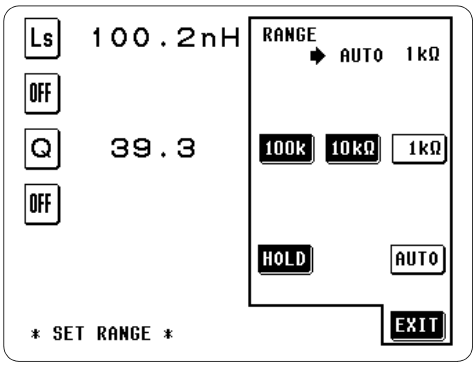
1. Select the measurement range.
   AUTO / HOLD / 1kΩ / 10kΩ / 100k
2. EXIT

**4 Initial Screen** — Setting is completed.

## 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. |
| **1kΩ** | 1 kΩ range is selected. (HOLD setting) |
| **10kΩ** | 10 kΩ range is selected. (HOLD setting) |
| **100k** | 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.

# Chapter 4 Setting the Application Menu Screen

## 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 (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.

The comparator can deal with two measurement values at the most. "ABS", "%", and "Δ%" 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

**1 Initial Screen**

MENU

**2 Menu Screen**

APPLI MENU

**3 Application Menu Screen**

COMP ON (Activate the comparator.)

**4 Comparator setting**

1. Select parameters. (the 1st and 3rd parameters)
2. LMT (to Decision Conditions Setting Screen)

**5 Comparator conditions setting**

1. Select the comparator setting method.
   ABS / Δ% / %
2. Set the values.
3. EXIT

**6 Comparator Screen**

Returning to Normal Measurement

MENU

**7 Menu Screen**

APPLI MENU

**8 Application Menu Screen**

COMP OFF

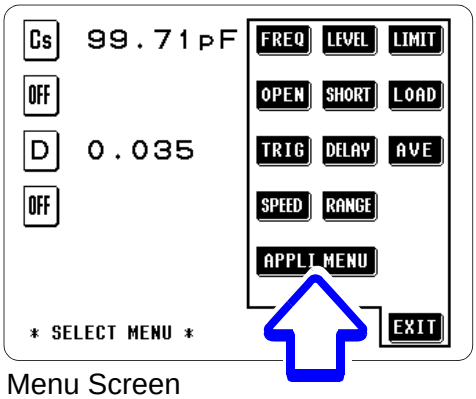
When the scaling function has been turned on, the display returns to the Scaling screen.

❖ 4.3, "Setting and Activating the Scaling" (page 52)

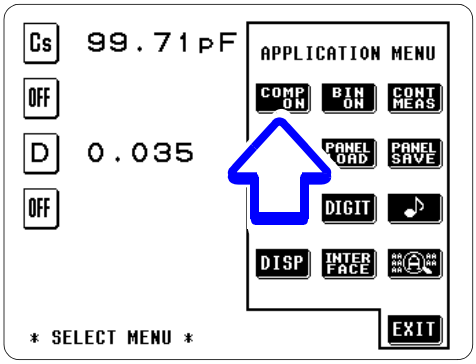
**9 Initial Screen**

The measurement conditions during comparator operation and normal operation are compatible.
The second and fourth parameters are changed to those set before the comparator function was activated.

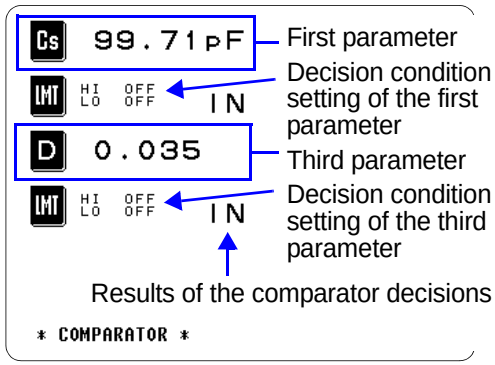
## Setting Method



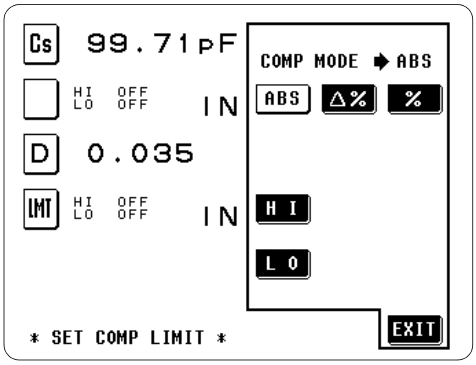

Menu Screen




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)

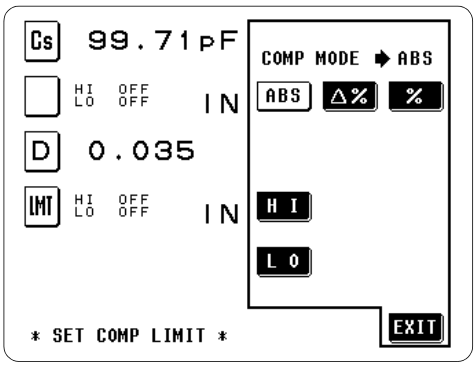
5. **LMT**
Display the condition setting screen.

6. Select the comparator setting method.

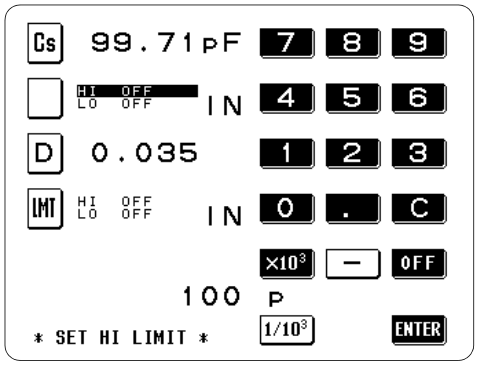
**ABS** Absolute value setting method (ABS)
The upper limit value and the lower limit value for the measurement parameter are set as absolute numerical values. The measurement values displayed are the same as those of the measurement parameters.

**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.

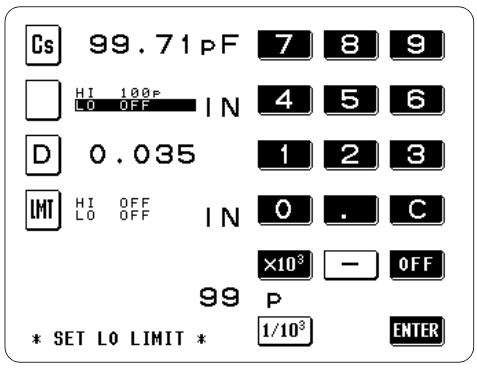
**%** Percentage setting method (%)
A reference value is input, and the upper-limit and lower-limit values are set as percentages relative to the reference value. The measurement values displayed are the same as those of the measurement parameters.




ABS setting




Upper limit value setting-
ABS mode




Lower limit value setting -
ABS mode

## 7. Set the values.

### 1 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 ) **HI** 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.

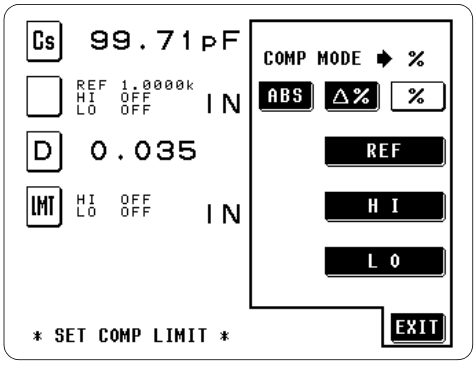
| | |
|---|---|
| **×10³** | Step the units up |
| **1/10³** | Step the units down |

←Down Up →
p/ n/ μ/ m/ none/ k/ M

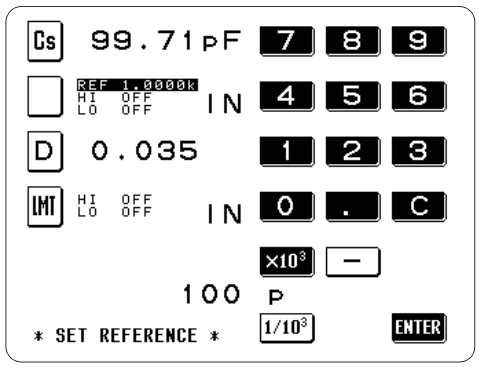
4 ) **ENTER** Confirm the upper limit.
(The display returns to the condition setting screen.)

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

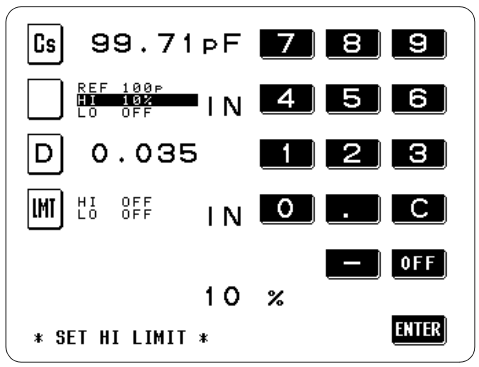
6 ) After the upper and lower limits have been set, press **EXIT** on the setting screen to return to the Comparator screen.
❖ Comparator decisions(page 46)




% 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.

## l [%] 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.

| | |
|---|---|
| [×10³] | 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**

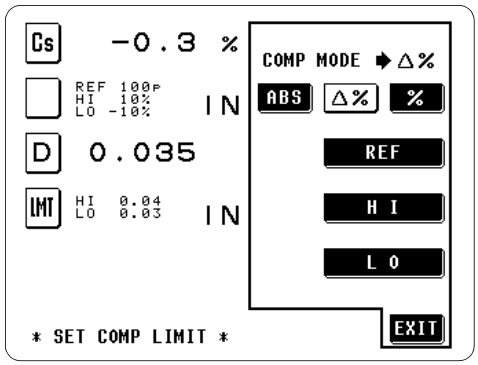
When you press [C] and [ENTER] in this order, the display returns to the previous screen without changing the set values.

7 ) [L O] 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:

**Δ% = (Measurement value - Reference value)/ |Reference value| x 100**

| | : Denotes an absolute value

### Δ% 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"<br>If the measured the value is "UNDERFLOW" | **HI**<br>**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 (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.

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 (Δ%). 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

**1 Initial Screen**

MENU

**2 Menu Screen**

APPLI MENU

**3 Application Menu Screen**

BIN ON Activate BIN function
The comparator function, if turned on, is automatically turned off.

**4 BIN Screen**

1. Select parameter
2. BIN LIST

**5 BIN List setting**

1. Select the parameter decision method. (the 1st and 3rd parameters)

   SELECT

   ABS / Δ% / %

   (Δ%, % only) Set the reference value
2. ENTER

**6 BIN decision conditions setting**

1. Set the decision conditions (upper limit HI, lower limit LO).
2. ENTER
3. EXIT

**7 BIN Screen**

Display the result of comparison.

Returning to Normal Measurement

MENU

**8 Menu Screen**

APPLI MENU

**9 Application Menu Screen**

BIN OFF

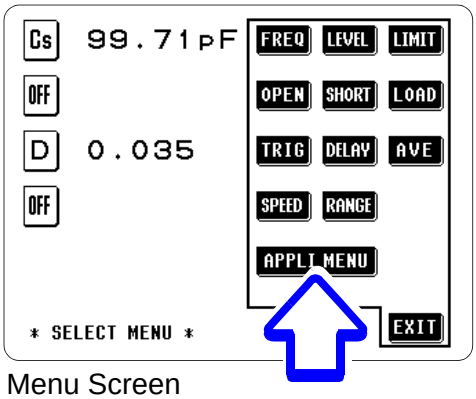
When the scaling function has been turned on, the display returns to the Scaling screen.

❖ 4.3, "Setting and Activating the Scaling" (page 52)

**10 Initial Screen**

The measurement conditions are common for BIN measurement and normal measurement. The second and fourth parameters are changed to those set before the BIN measurement was carried out.

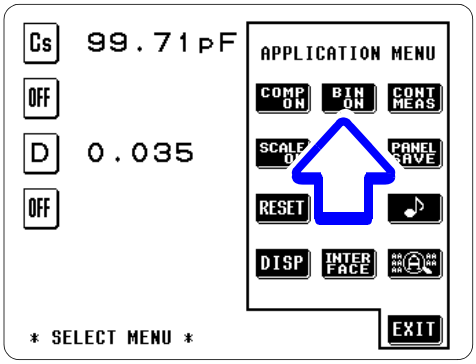
## Setting Method




Menu Screen

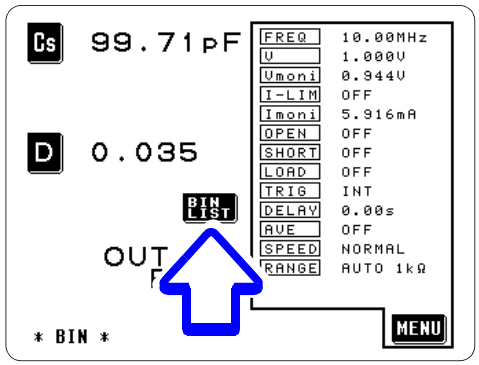
1. **MENU** (on the Initial Screen)
Display the Menu Screen.

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)

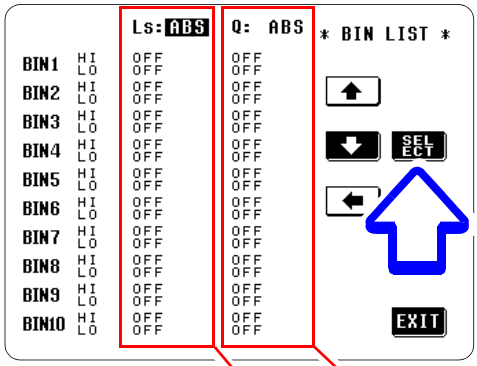
5. **BIN LIST**
Display the BIN List screen.

6. Select the parameter decision method.

1) Move the cursor to the parameter decision method.

2) Press **SELECT**

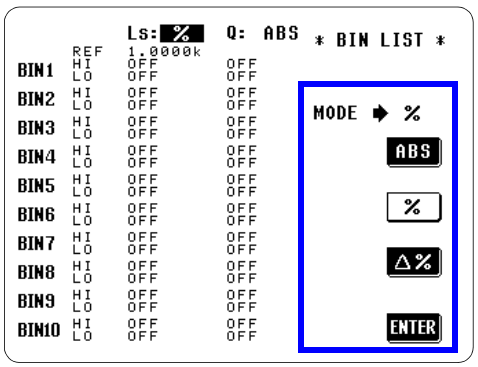
The decision method selection screen is displayed.




BIN List Screen

Decision conditions for third parameter

Decision conditions for first parameter

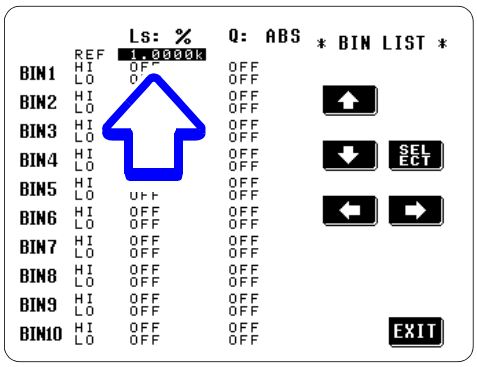



Decision method setting

3 ) Select the parameter decision method.

| | |
|---|---|
| ABS | Absolute value setting method (ABS)<br>The upper limit value and the lower limit value for the measurement parameter are set as absolute numerical values. |
| % | Percentage setting method (%)<br>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%)<br>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.



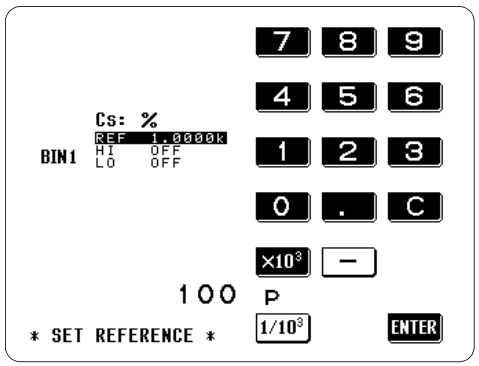

Reference value setting

l % , Δ% mode_____

Set the reference value.

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

2 ) SEL ECT Display the Reference value setting screen.

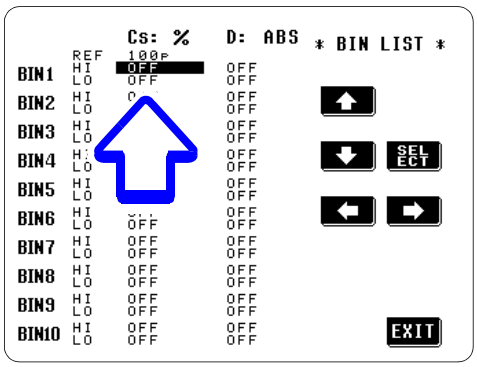



Reference value setting

3 ) Enter the numerical value using the keypad.

4 ) 1/10³ / ×10³ Select the unit.

5 ) ENTER Confirm the setting.

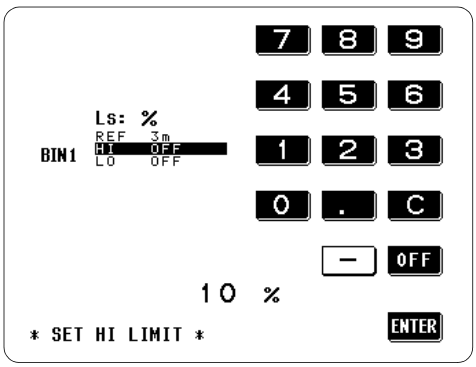



Upper/lower limit value setting

## 7. Set the upper and lower limit values.

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

2 ) SEL ECT Display the upper/lower limit setting screen.



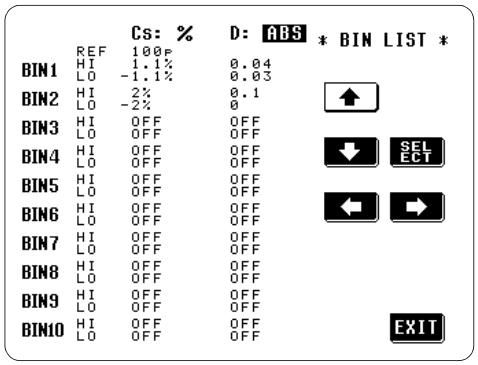

Upper/lower limit value setting

3 ) Enter the numerical value using the keypad.

4 ) Select the unit.(during ABS setting)

5 ) ENTER Confirm the setting.

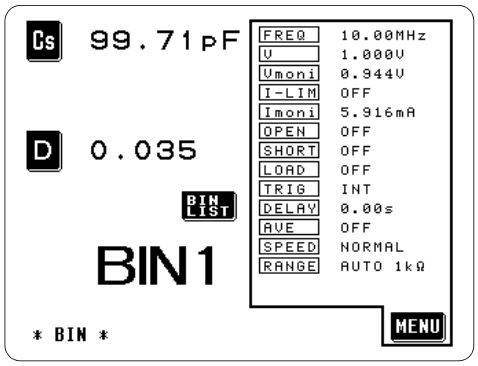
Return to the BIN List screen.




BIN List Screen

## 8. EXIT

Return to the Initial Screen.

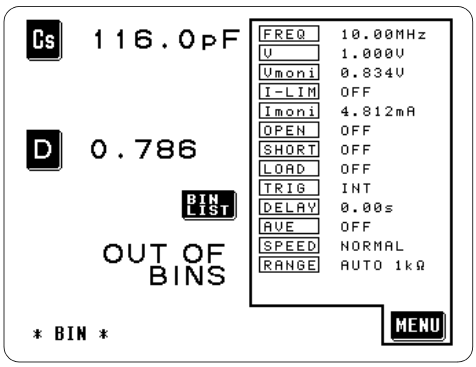



BIN measurement result
(within set BIN1 range)

The BIN test result is displayed.

**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.

**Compensated value = a × 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:

**θ' = a × θ + 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

**1 Initial Screen**

MENU

**2 Menu Screen**

APPLI MENU

**3 Application Menu Screen**

SCALE ON (Activate the scaling function.)

**4 Scaling setting**

1. Select parameters (the 1st and 3rd parameters)
2. ab (to the Constants Setting Screen)

**5 Compensation coefficients setting**

1. Select compensation coefficient
   a / b
2. Set values.
   Numeric keypad + 1/10³ / ×10³
3. EXIT

**6 Scaling Screen**

Returning to Normal Measurement

MENU

**7 Menu Screen**

APPLI MENU

**8 Application Menu Screen**

SCALE OFF

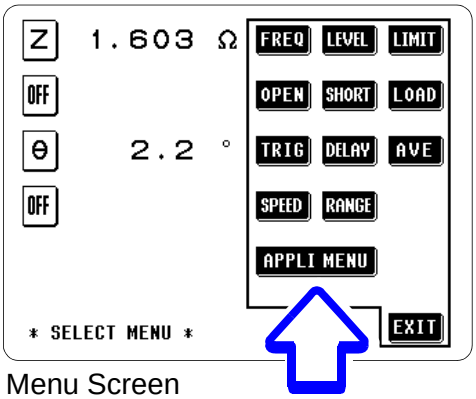
The comparator function, if turned on, the display returns to the Comparator screen.

❖ 4.1, "Setting and Activating the Comparator" (page 41)

The measurement conditions are common for comparator measurement and normal measurement. The second and fourth parameters are changed to those set before scaling was carried out.

**9 Initial Screen**

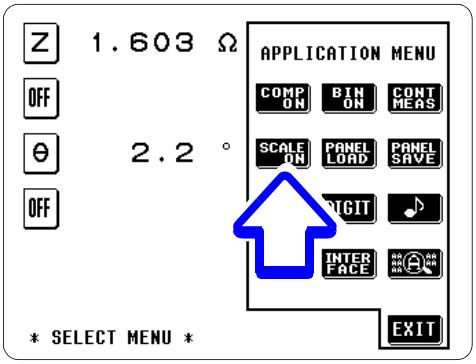
## Setting Method



Menu Screen

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

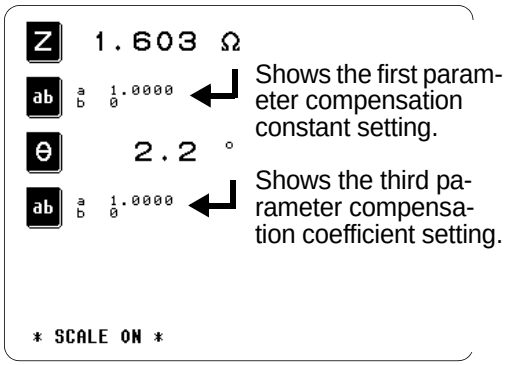
2. **APPLI MENU**
Display the Application Menu Screen.



Application
Menu Screen

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

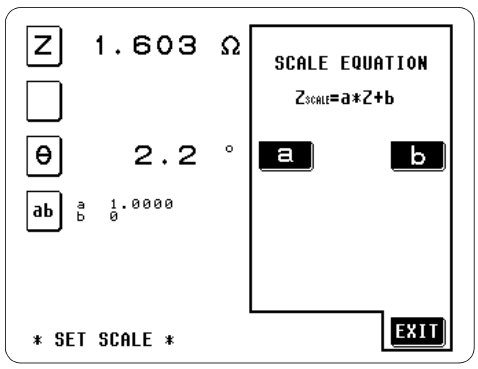
The scaling function is now activated.



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.

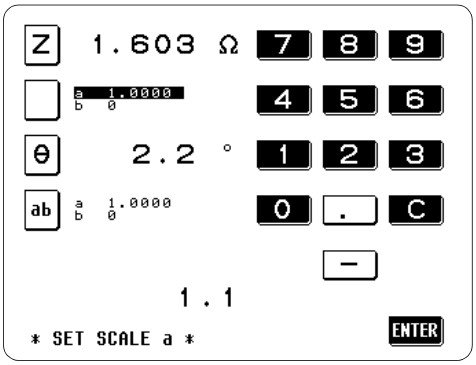


Compensation Coefficient Setting

6. Select the compensation coefficients to be set.

| | |
|---|---|
| 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

l **a** _____

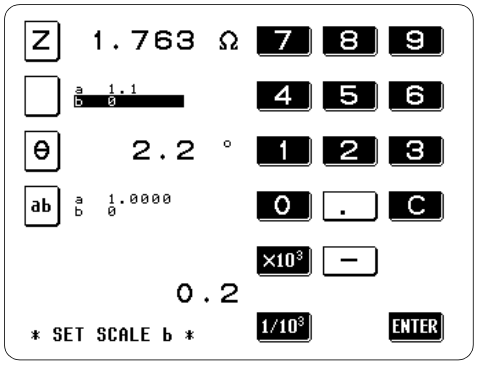
Use the numeric keypad to input the desired value.

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.



Compensation coefficient b

l **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

**1 Initial Screen**

MENU

**2 Menu Screen**

APPLI MENU

**3 Application Menu Screen**

PANEL SAVE

**4 Panel number selection**

1. Select the panel number

No. 1 to No.30

**5 Saving name setting**

1. NAME (to the Saving Name Setting Screen)
2. Set the saving name.

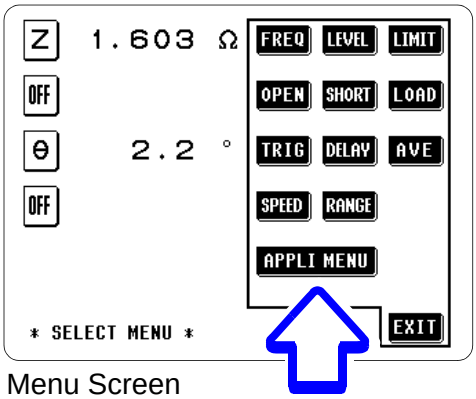
ABC↵123 / B S / CLEAR

3. ENTER (Go to the Save data confirmation screen.)
4. Confirm the saving name.

YES / N O

**6 Initial Screen**

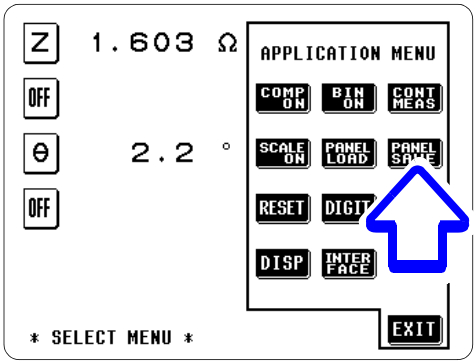
## Setting Method




Menu Screen

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

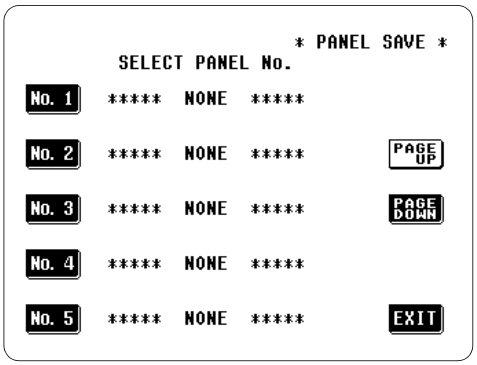
2. **APPLI MENU**
Display the Application Menu Screen.




Application Menu Screen

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

**To cancel the saving:**
**EXIT** (the display returns to the Initial Screen.)

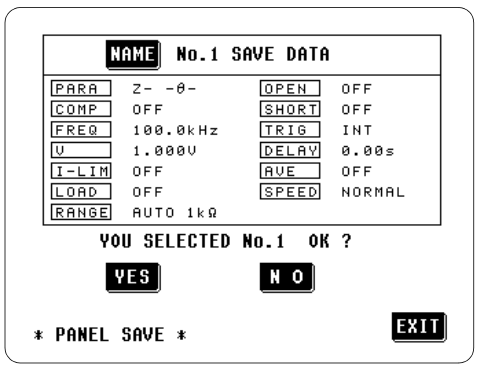



Panel Number Selection Screen

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

***NONE*** means that nothing is saved.

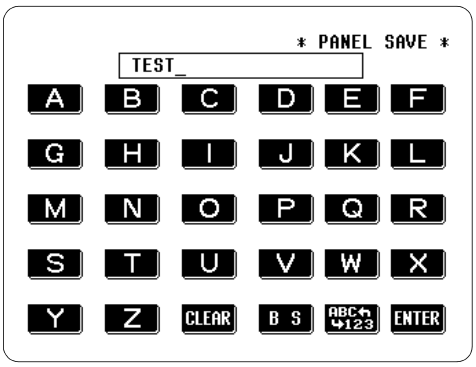
4. Press the panel number to be saved.



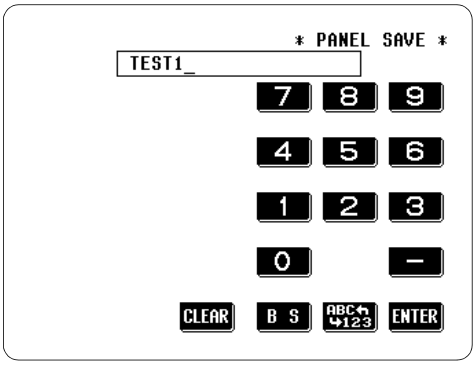

Save data confirmation screen

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

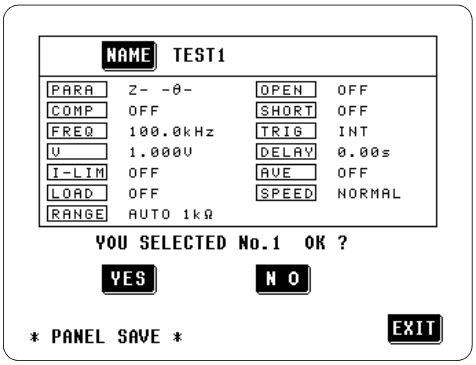
5. **NAME**
Display the Saving name input screen.




Saving Name Setting Screen(Roman type)




(Numerical keypad)




Save Data Confirmation Screen

## 6. Enter the saving name.

(up to 20 characters)

| | |
|---|---|
| ABC 123 | Toggles between the alphabet input screen and numerical input screen. |
| B S | Back space |
| CLEAR | Clears the input character. |

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

## 8. Confirm the data to be saved.

| | |
|---|---|
| YES | Saves the measurement conditions under the name displayed and automatically returns to the Initial Screen. |
| NO | 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).

CALIFORNIA, USA ONLY
This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

# 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

1 Initial Screen — MENU

2 Menu Screen — APPLI MENU

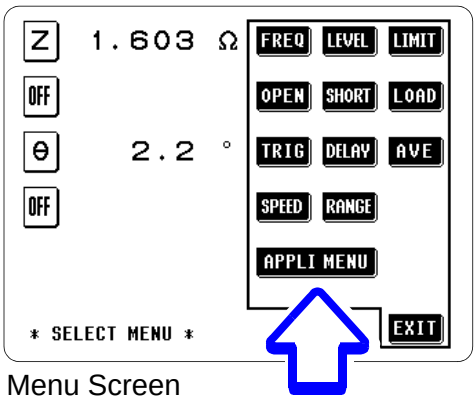
3 Application Menu Screen — PANEL LOAD

4 Panel number selection

1. Select the panel number.
   No. 1 to No.30
2. Loading

5 Initial Screen — Loading is completed.

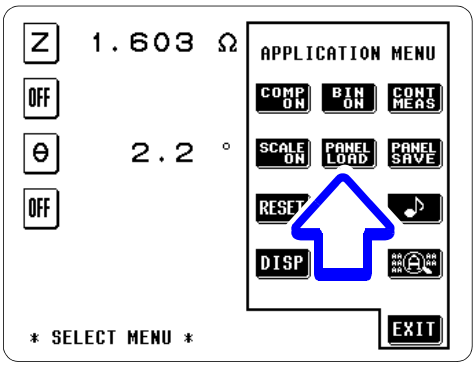
## Setting Method



Menu Screen

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

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



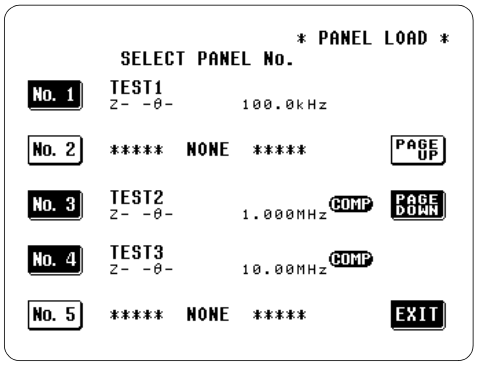

Application Menu Screen

## 3.

PANEL LOAD

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

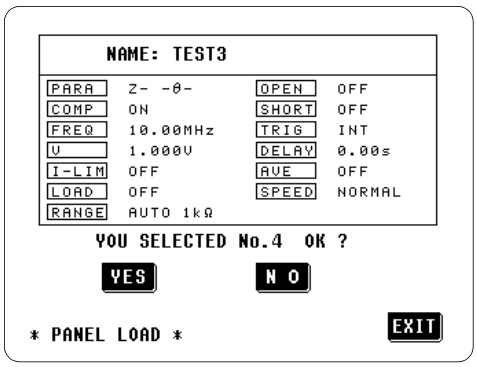
## 4.

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.

| | |
|---|---|
| YES | Loads the measurement conditions with the selected panel number and automatically returns to the Initial Screen. |
| NO | 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

**1** Initial Screen — MENU

**2** Menu Screen — APPLI MENU

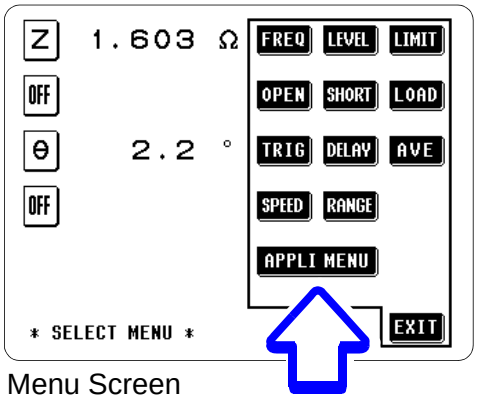
**3** Application Menu Screen — ♪

**4** Beep sound setting

1. Set the beep sound for key input.
   ON / OFF
2. Set the comparator result.
   IN / NG / OFF
3. EXIT

**5** Initial Screen

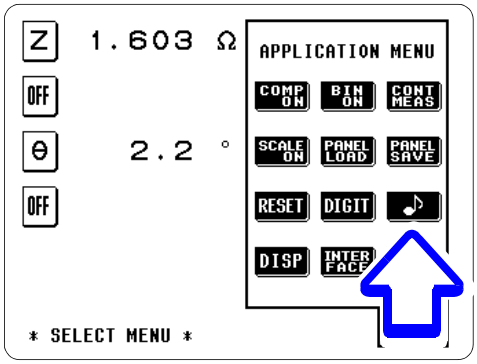
## Setting Method



Menu Screen

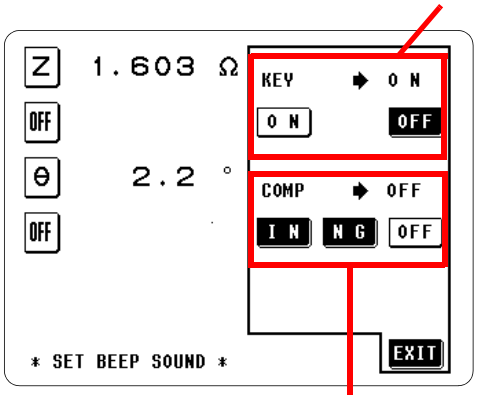
**1.** **MENU** (on the Initial Screen)
Display the Menu Screen.

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



Application
Menu Screen

**3.** ♪
Display the 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

**1 Initial Screen**

MENU

**2 Menu Screen**

APPLI MENU

**3 Application Menu Screen**

**4 Zoom Display Screen**

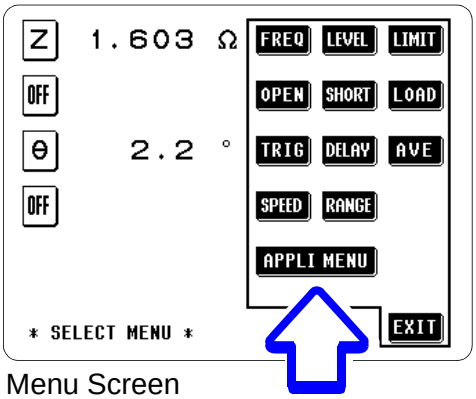
- To return to the Initial Screen

  EXIT
- To measure (during the external trigger setting)

  MANU TRIG

**5 Initial Screen**

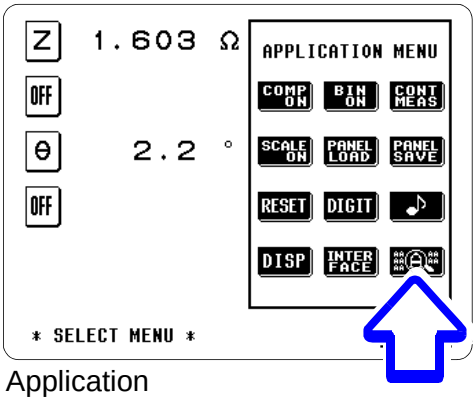
## Setting Method




Menu Screen

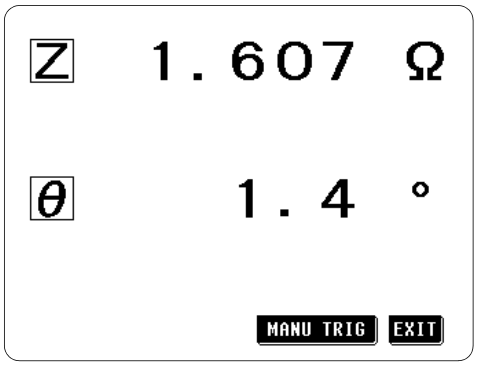
1. **MENU** (on the Initial Screen)
Display the Menu Screen.

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

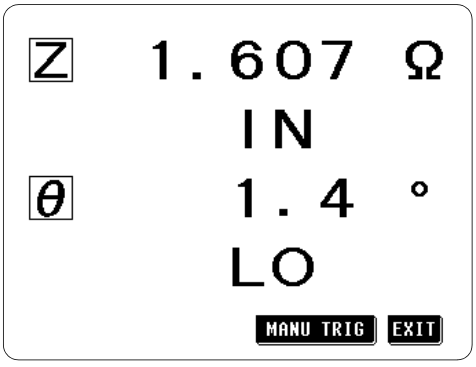



Application
Menu Screen

3. 
Display the Zoom Display Screen.




Zoom Display Screen
(Normal Screen)




Zoom Display Screen
(Comparator 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** .

# 4.8 System Reset

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

## Control Screen Sequence

1 Initial Screen — MENU

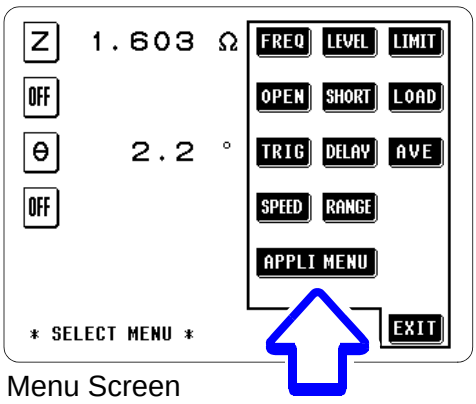
2 Menu Screen — APPLI MENU

3 Application Menu Screen — RESET

4 System reset setting — YES Reset to factory defaults. / EXIT Return to the Initial Screen.

5 Initial Screen

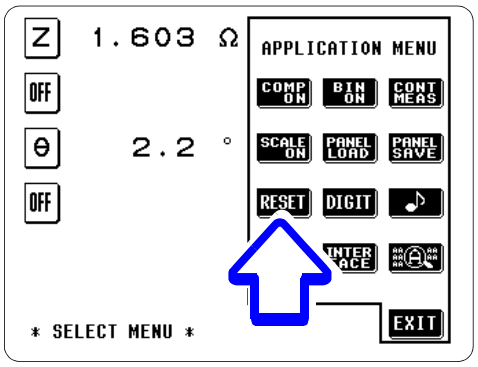
## Setting Method



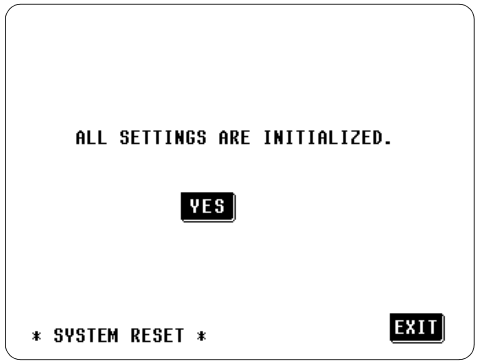
Menu Screen

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

2. APPLI MENU
Display the Application Menu Screen.




Application Menu Screen




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<br>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<br>Upper and lower limit: OFF |
| Third parameter | Reference value: 10<br>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<br>Upper and lower limit: OFF |
| Third parameter | Reference value: 10<br>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<br>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

**1** Measurement conditions setting
❖ 4.4, "Panel Save Function" (page 56)

↓

**2** Initial Screen
MENU

↓

**3** Menu Screen
APPLI MENU

↓

**4** Application Menu Screen
CONT MEAS

↓

**5** Continuous measurement setting
ON/OFF — Specify the measurement settings for each panel.
MANU TRIG — Start measurement
EXIT — Return to the Initial Screen.

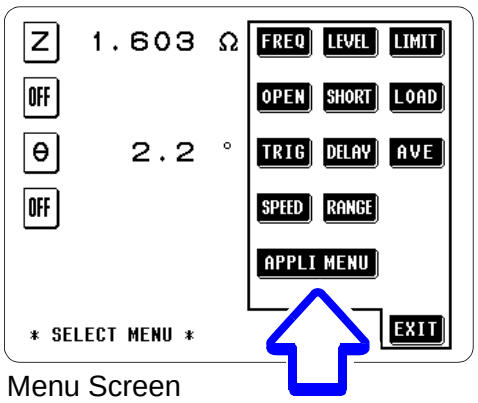
↓

**6** Initial Screen

## 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.

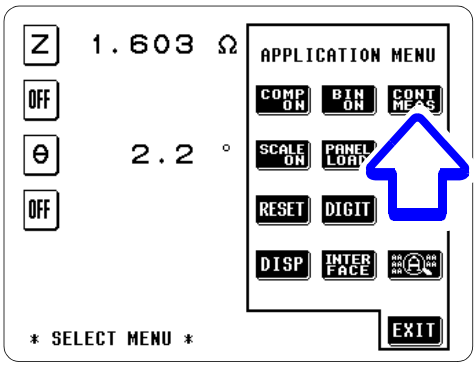


Menu Screen

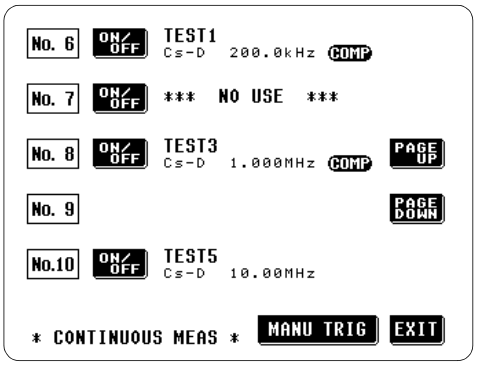
*2.* MENU (on the Initial Screen)
Display the Menu Screen.

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

## Setting Method




Application Menu Screen




Continuous Measurement Setting Screen

*4.* CONT MEAS

Display the Continuous Test setting screen.

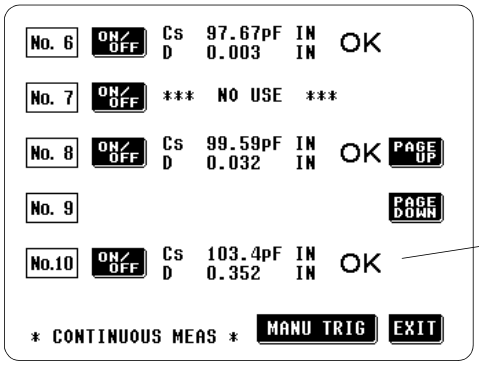
*5.* ON/OFF

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

1 Initial Screen

MENU

2 Menu Screen

APPLI MENU

3 Application Menu Screen

DIGIT

4 Displayed Digits setting

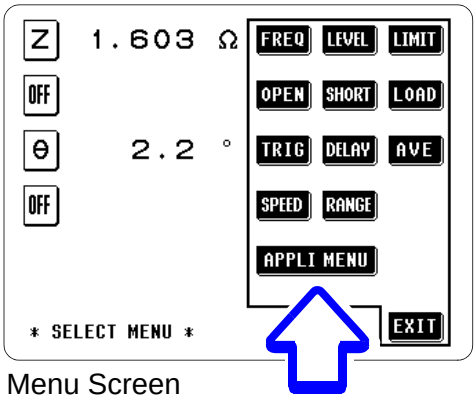
Set the number of digits to be displayed.

PAR / PAR

EXIT Return to the Initial Screen.

5 Initial Screen

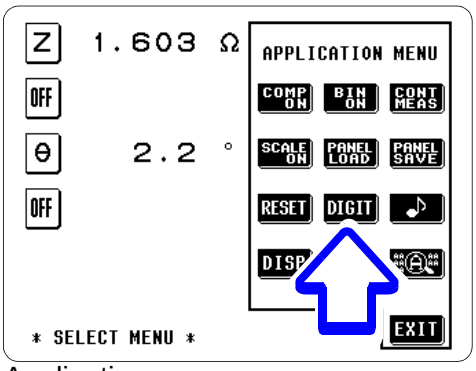
## Setting Method



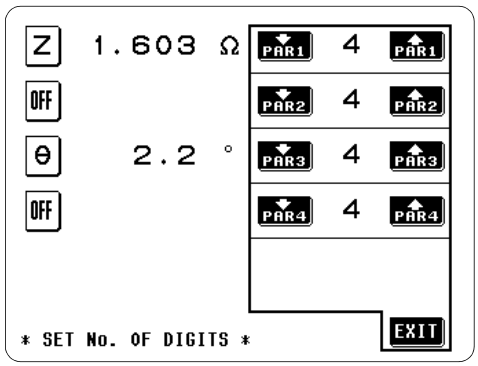

Menu Screen

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

2. APPLI MENU
Display the Application Menu Screen.




Application
Menu Screen




Displayed Digits Setting Screen

## 3. DIGIT

Display the Displayed Digits Setting Screen.

## 4. PAR / PAR

Set the number of displayed digits for each parameters.

Settable range:3 to 5 digits
Note that the decimal point is displayed in different ways according 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

**1 Initial Screen** — MENU

**2 Menu Screen** — APPLI MENU

**3 Application Menu Screen** — DISP

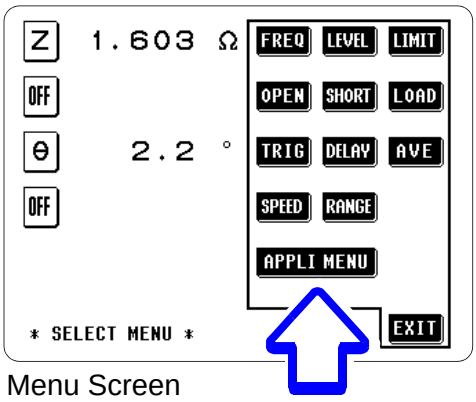
**4 Display setting** — Backlight setting, voltage and current monitors display setting

ON / OFF

EXIT Return to the Initial Screen.

**5 Initial Screen**

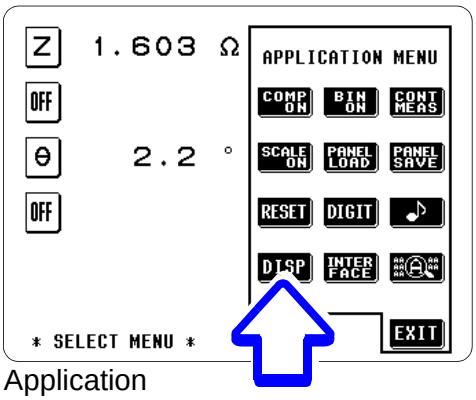
## Setting Method



Menu Screen

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

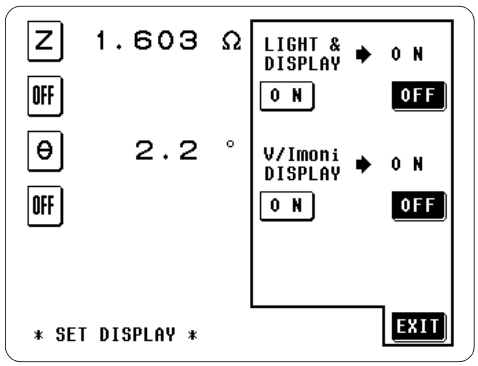
2. APPLI MENU
Display the Application Menu Screen.



Application Menu Screen

## 3. DISP

Display the Display setting screen.



Display Setting Screen

## 4. Set the display.

l 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.

l 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.<br><br>The measurement time is reduced, as Vmoni and Imoni do not display indications. |

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

## 5. EXIT

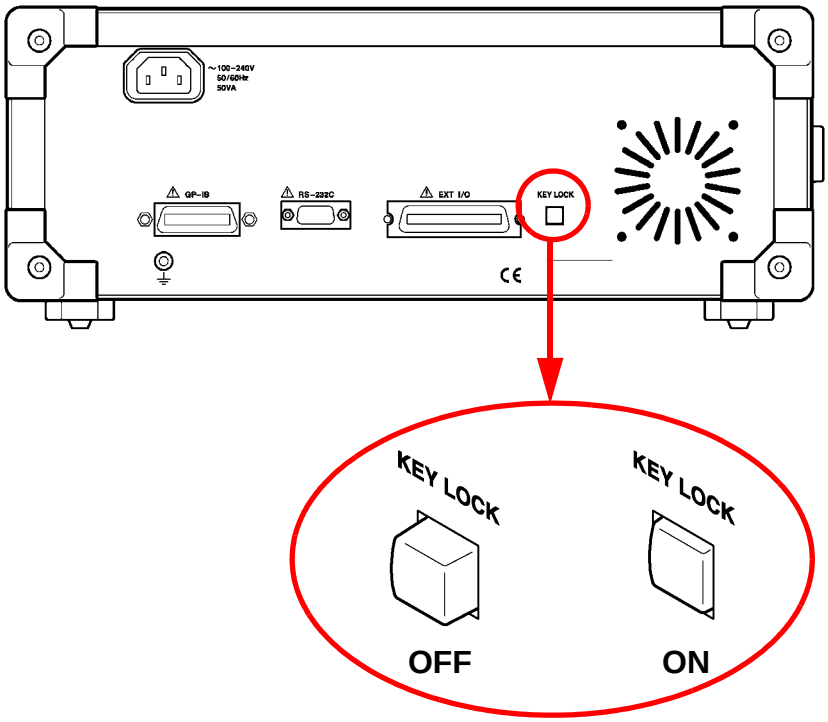
Return to the Initial Screen.

# 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.

# Chapter 5 Applications

## 5.1 Comparator Decision

This chapter describes two comparator decision methods as applications.

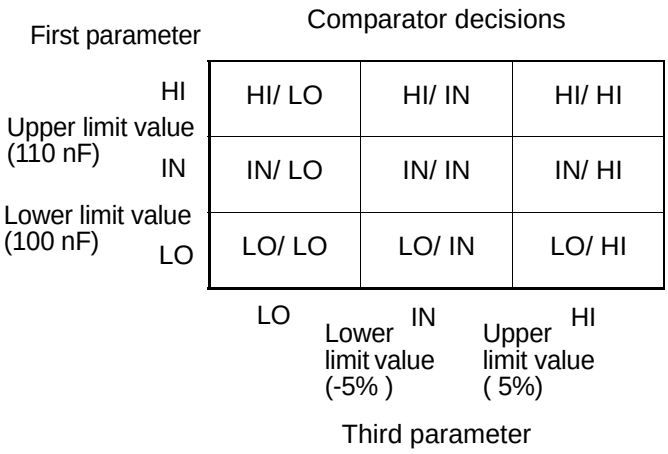
- Making decisions for two items simultaneously
- Sorting a single item into five bands

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

**Example**

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

**The results of the decisions**




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).

**Example**

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

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

**The results of the decisions**

Comparator decisions

| | | First parameter | Third parameter |
|---|---|---|---|
| First parameter | Band 1<br>Upper limit value<br>10% (330 Ω) | HI | HI |
| First parameter | Band 2<br>Lower limit value<br>5% (315 Ω) | IN | HI |
| Third parameter | Band 3<br>Upper limit value<br>-5% (285 Ω) | LO | HI |
| Third parameter | Band 4<br>Lower limit value<br>-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

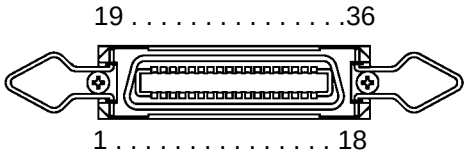
## 5.3.1 EXT I/O Connector

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 | $\overline{\text{TRIG}}$ | Input | 19 | $\overline{\text{LD1}}$ | Input |
| 2 | $\overline{\text{LD2}}$ | Input | 20 | $\overline{\text{LD3}}$ | Input |
| 3 | $\overline{\text{LD4}}$ | Input | 21 | $\overline{\text{LD5}}$ | Input |
| 4 | $\overline{\text{M-HI}}$ | Output | 22 | $\overline{\text{M-IN}}$ | Output |
| 5 | $\overline{\text{M-LO}}$ | Output | 23 | $\overline{\text{S-HI}}$ | Output |
| 6 | $\overline{\text{S-IN}}$ | Output | 24 | $\overline{\text{S-LO}}$ | Output |
| 7 | $\overline{\text{AND}}$ | Output | 25 | $\overline{\text{EOM}}$ | Output |
| 8 | $\overline{\text{BIN1}}$ | Output | 26 | $\overline{\text{BIN2}}$ | Output |
| 9 | $\overline{\text{BIN3}}$ | Output | 27 | $\overline{\text{BIN4}}$ | Output |
| 10 | $\overline{\text{BIN5}}$ | Output | 28 | $\overline{\text{BIN6}}$ | Output |
| 11 | $\overline{\text{BIN7}}$ | Output | 29 | $\overline{\text{BIN8}}$ | Output |
| 12 | $\overline{\text{BIN9}}$ | Output | 30 | $\overline{\text{BIN10}}$ | Output |
| 13 | $\overline{\text{OUT OF BINS}}$ | 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.

**M-HI, M-IN, M-LO** — Output signal of comparator result
These lines output the comparator result for the first parameter.

**S-HI, S-IN, S-LO** — Output signal of comparator result
These lines output the comparator result for the third parameter.

**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.

**BIN1 to BIN10, OUT OF BINS** — Output of BIN test result
LO is sent to the signal line associated with the result of the BIN measurement.

**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.

**EXT.DCV, 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.

**INT.DCV, INT.GND** — These lines output +5 VDC and COM from the unit.

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

**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 |

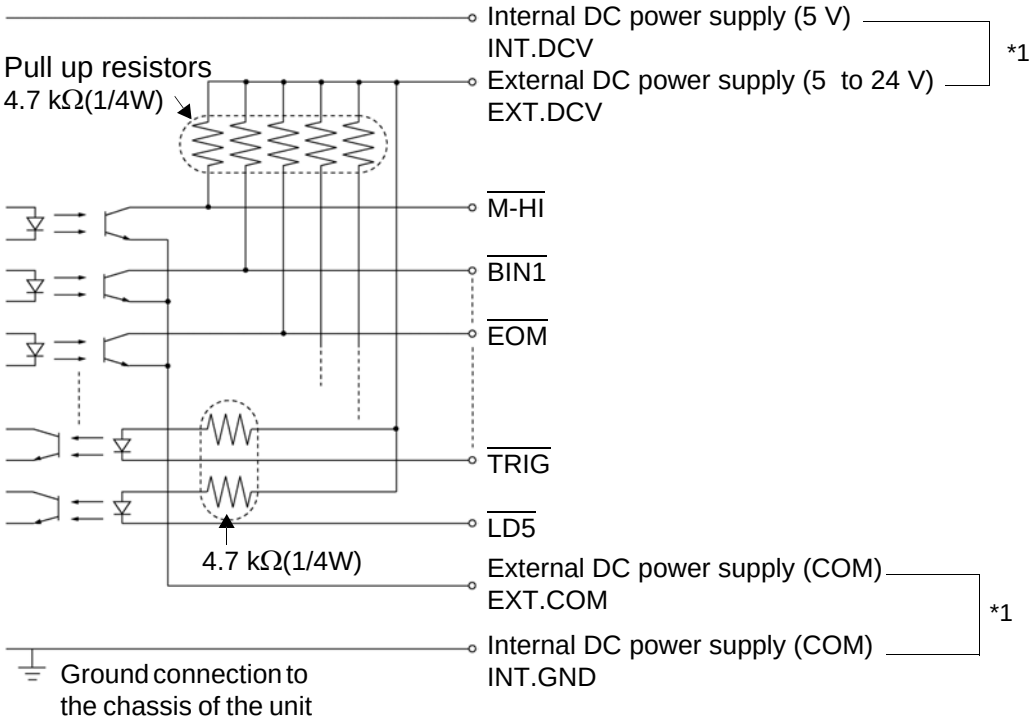
# 5.3.2 Circuit Construction and Connections for the EXT I/O Connector

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).

Circuit configuration




*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 30 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.

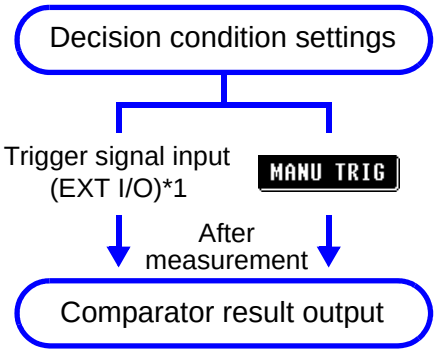
## 5.3.3 Electrical Characteristics of the Output Signals

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) | (30 mA) |
| 5 | 5 | 0.9 | 1.1 |
| 12 | 12 | | |
| 24 | 24 | | |

The above value is for reference only, and not a guaranteed value.
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




Comparator decision conditions
BIN decision conditions
(The external trigger mode is selected.)

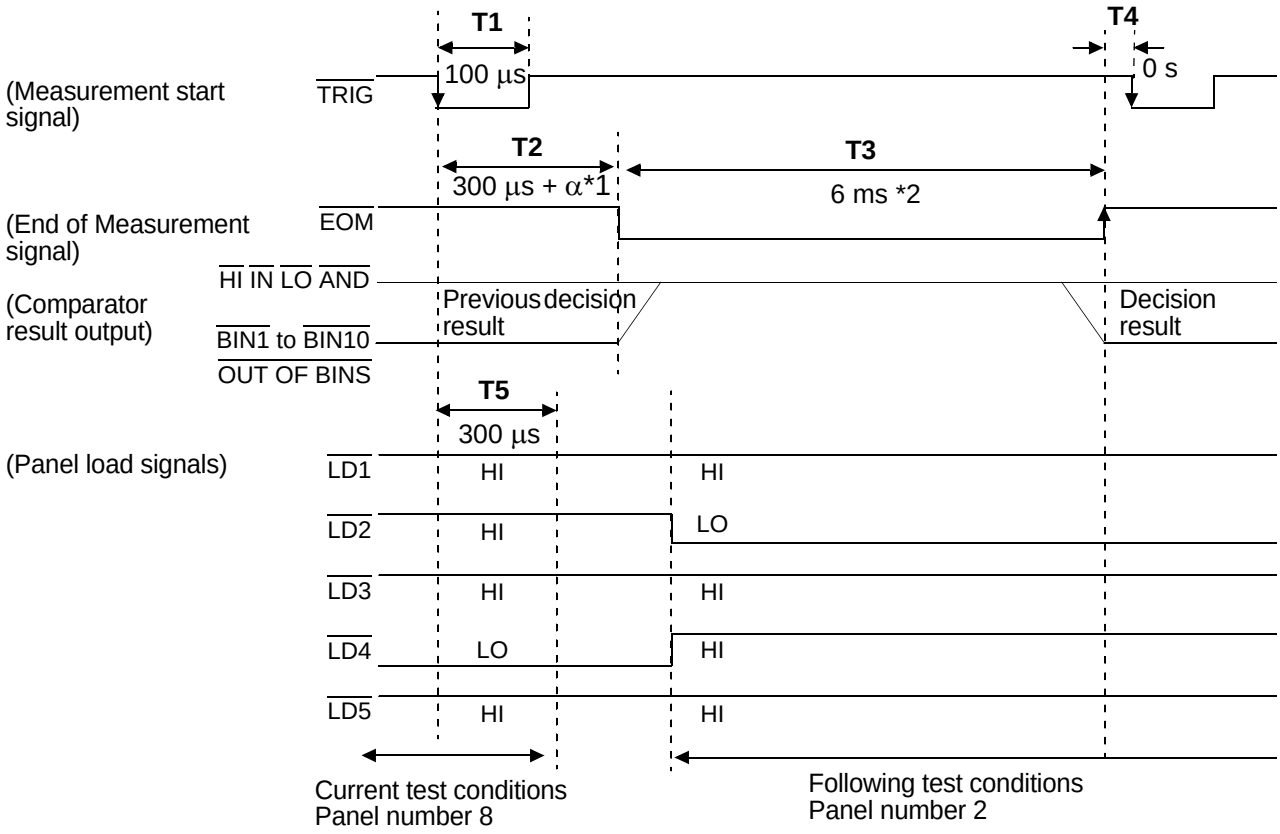
Comparator or BIN measurement results are output to the associated signal line.

*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:

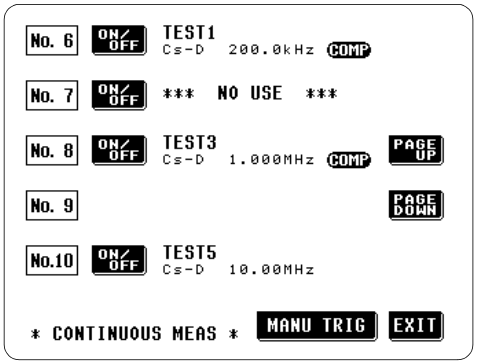
- The selected panel number is not stored.
- Both the first and third parameters are set to OFF.

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

# 5.3.5 Measurement on the Continuous Measurement Screen

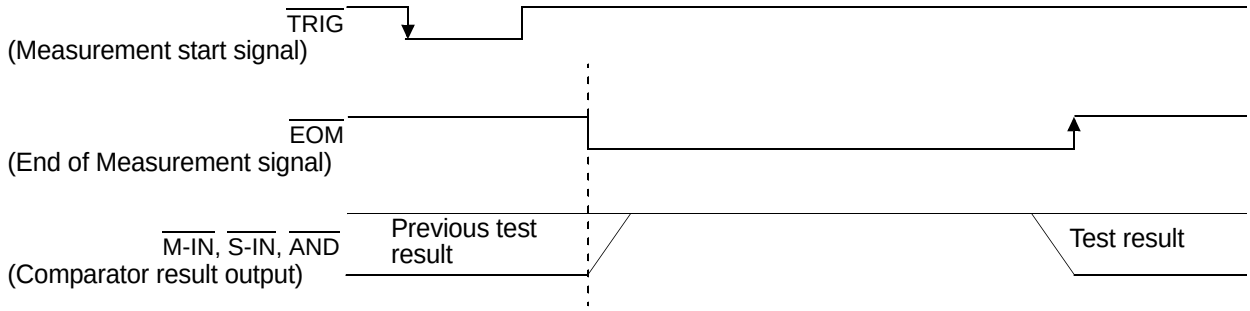
On the Continuous Measurement Screen, when a trigger signal is input via the EXT I/O connector, or when the MANU TRIG key on the screen is pressed, then the decision result is output on the comparator result output signal line of the EXT I/O connector after measurement is completed for all the panel 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. |
| $\overline{\text{M-HI}}$, $\overline{\text{M-LO}}$, $\overline{\text{S-HI}}$, $\overline{\text{S-LO}}$ | No output |

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
- 9443-01 AC ADAPTER (for Japan)
  9443-02 AC ADAPTER (for EU)
- 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

1 Initial Screen — MENU

↓

2 Menu Screen — APPLI MENU

↓

3 Application Menu Screen — INTER FACE

↓

4 Interface Setting Screen — 9442 PRINT

↓

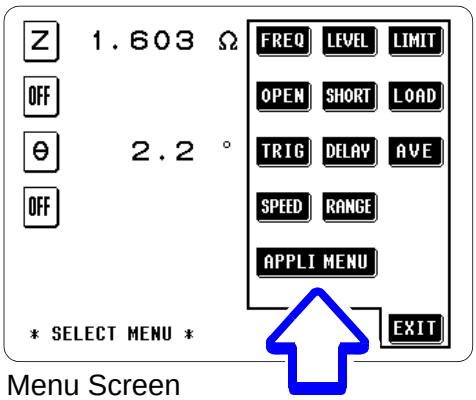
5 Print mode setting

1. Select the print type.
   SCR COPY / AUTO / MANU
2. EXIT

↓

6 Initial Screen

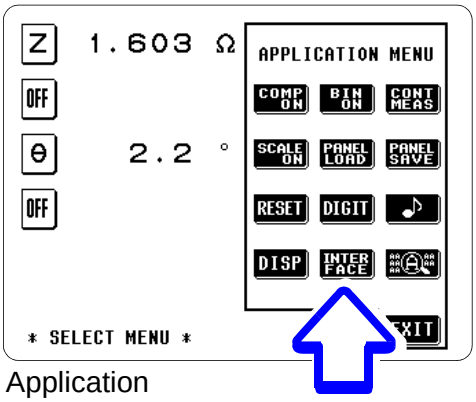
## Setting Method



Menu Screen

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

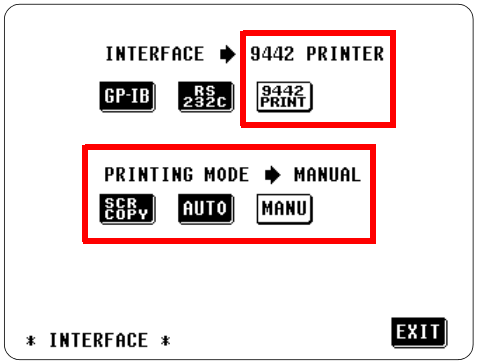
*2.* APPLI MENU
Display the Application Menu Screen.




Application Menu Screen

**3.** INTER FACE

Display the Interface setting screen.



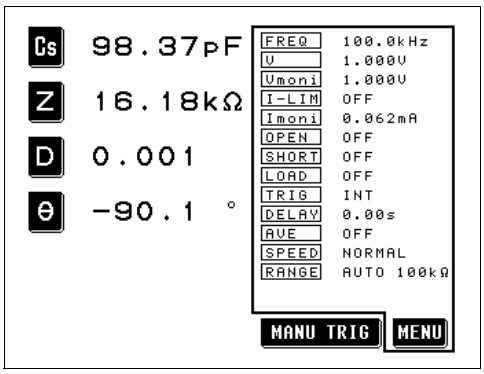

Print Mode Setting Screen

**4.** 9442 PRINT

Display the Print mode selection screen.

**5.** Select the print mode.

| | |
|---|---|
| SCR COPY | Screen copy printing<br>Prints out the Initial Screen copy. |
| AUTO | Auto printing<br>Prints out the measurement values after measurement. |
| MANU | Manual printing<br>Prints out the measurement values only when PRINT on the Initial Screen is pressed. |




Example of printing: Screen copy

l SCR 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 |

l 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 |

l 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.

*1.* 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

- 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<br>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<br>5 to 15 V ON<br>-15 to -5 V OFF<br><br>Output voltage levels<br>5 to 9 V ON<br>-9 to -5 V OFF |
| Connector | RS-232C Interface Connector Pin Assignments<br>❖ 6.3.1 "Attaching the Connector" (page 96)<br>(D-sub 9Pin male connector with #4-40 inch screws)<br>The connector is for terminal (DTE).<br>Recommended cable:<br>• 9637 RS-232C CABLE (for PC/AT machines)<br>• 9638 RS-232C CABLE (for PC98 series) |

# 6.2.2 Specifications of GP-IB

GP-IB

## Interface Functions

| | |
|---|---|
| SH1 | All source handshake functions |
| AH1 | All acceptor handshake functions |
| T6 | Basic talk functions<br>Serial poll function<br>No talk-only mode<br>The talker cancellation function with MLA<br>(My Listen Address) |
| L4 | Basic listener functions<br>No listen-only mode<br>The listener cancellation function with MTA<br>(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.**

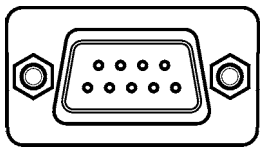
⚠CAUTION

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

RS-232C

### RS-232C connector

9 8 7 6



5 4 3 2 1

D-sub 9Pin male connector
with #4-40 inch 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

| D-sub 9pin female 3535 Pin No. | | D-sub 9pin female PC/AT Pin No. | |
|---|---|---|---|
| DCD | 1 | 1 | DCD |
| RxD | 2 | 2 | RxD |
| TxD | 3 | 3 | TxD |
| DTR | 4 | 4 | DTR |
| GND | 5 | 5 | GND |
| DSR | 6 | 6 | DSR |
| RTS | 7 | 7 | RTS |
| CTS | 8 | 8 | CTS |
| | 9 | 9 | |

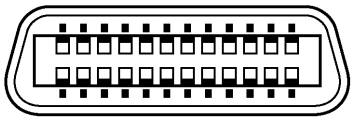
Recommended cable:

HIOKI
9637 RS-232C CABLE (1.8 m)

GP-IB

## GP-IB connector

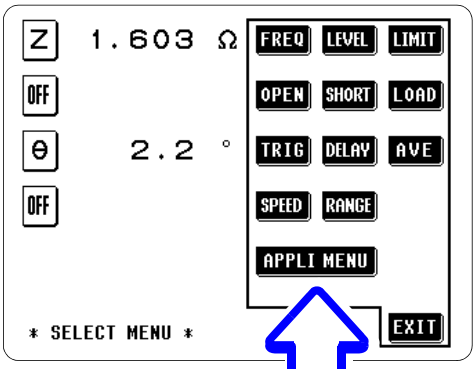
Connect the GP-IB cable.



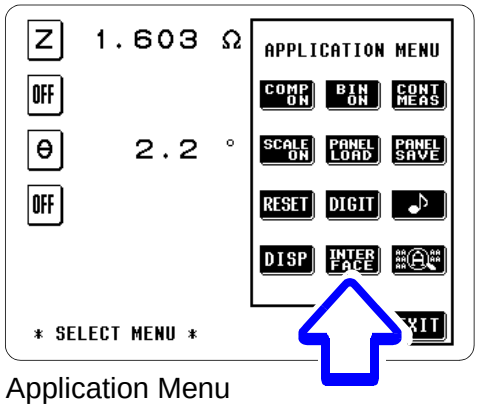
Recommended cable:
HIOKI
9151-02 GP-IB CONNECTOR CABLE (2 m)
9151-04 GP-IB CONNECTOR CABLE (4 m)

# 6.3.2 Setting the Communication Conditions

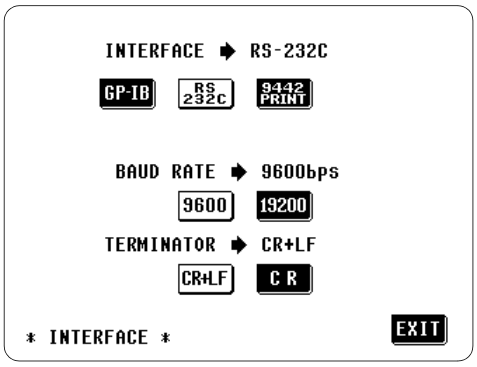
## Setting Method



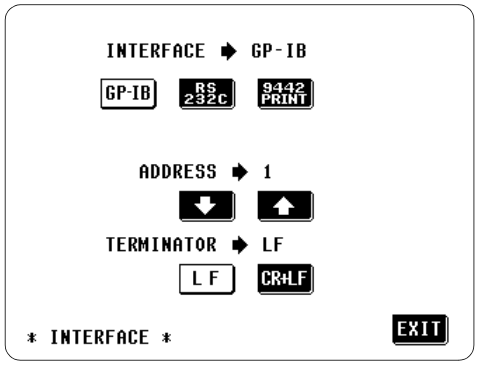

Menu Screen




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. |

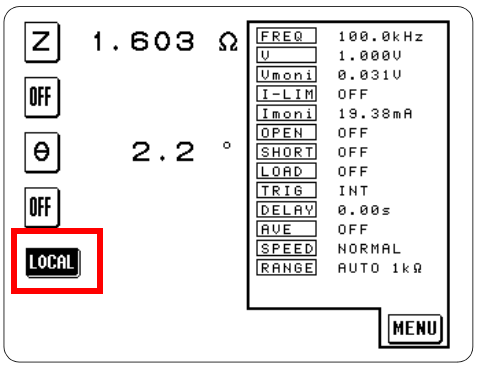
l RS 232C
Set the baud rate and terminator.
Provide the same settings as for the PC to be connected.

l GP-IB
Set the address and terminator.

l 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.

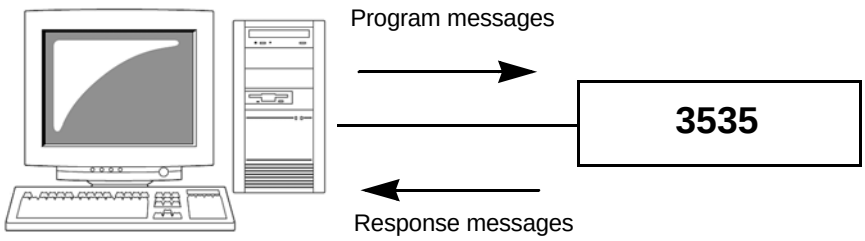
- When executing OPEN/SHORT/LOAD compensation or sending the execution command (compensation execution screen appears).
- When the Zoom Display Screen appears.

GP-IB

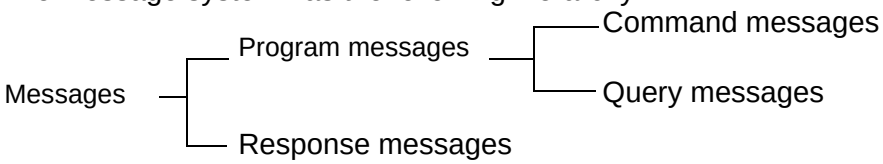
This key is disabled if the GP-IB controller has put the unit into the local lock out state. (Pressing the key has no effect.)

# 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.

GP-IB

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

RS-232C

- CR
- CR+LF

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

GP-IB

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

RS-232C

- 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
```

GP-IB

- 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.

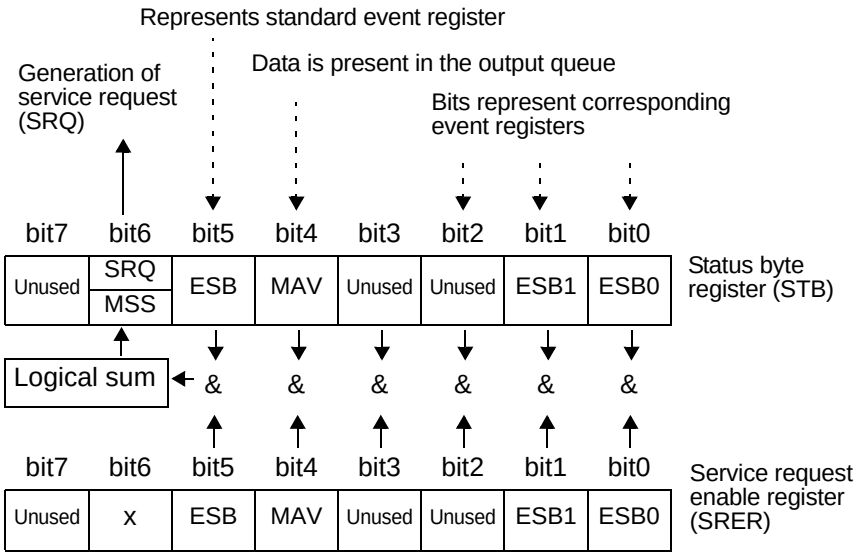
NOTE

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

# 6.4.3 Status Byte Register

GP-IB

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.




Generation of service requests

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

RS-232C

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

GP-IB

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

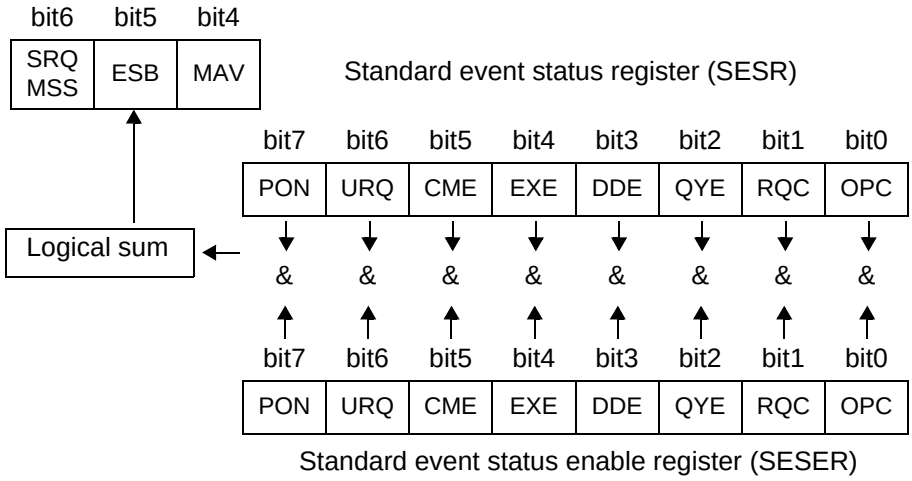
| Standard event status enable register (SESR) | | |
|---|---|---|
| Bit 0 | OPC | Operation terminated. (GP-IB only)<br>This bit is set to 1 when an "∗OPC" command is executed<br>• When the operation of all the messages up to the "∗OPC" command has been completed. |

## 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:

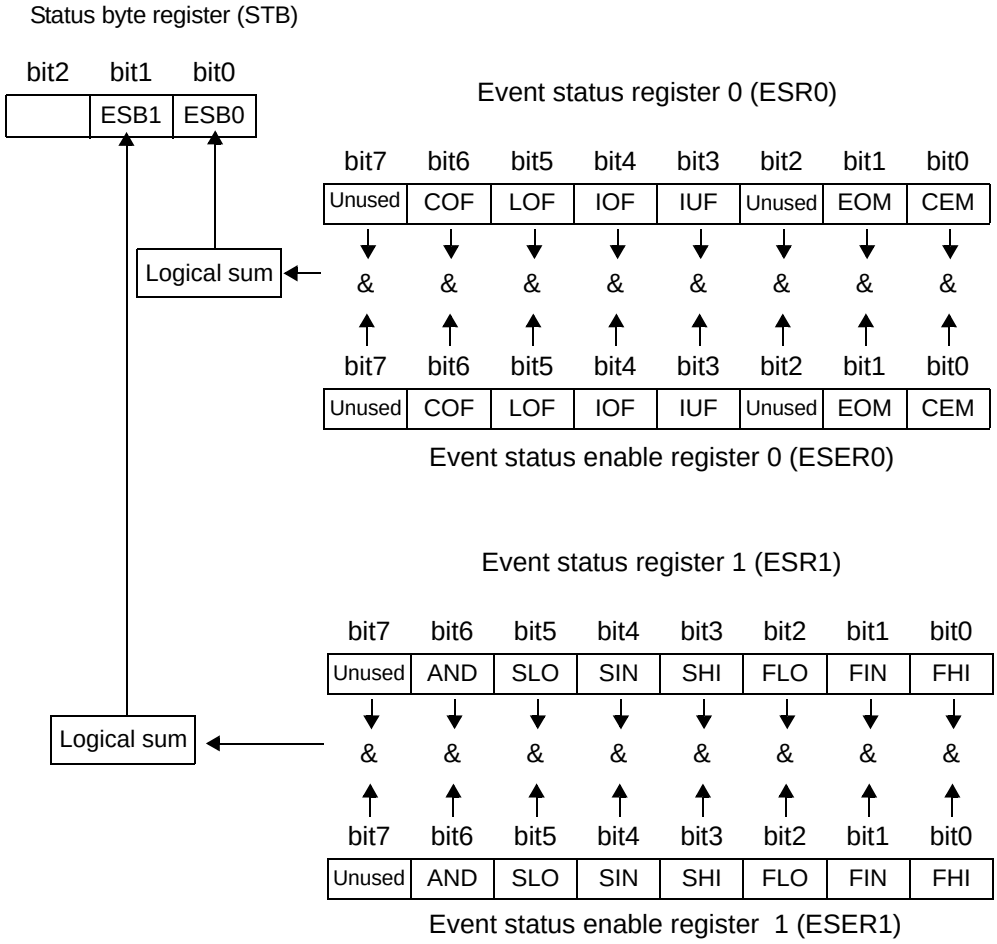
- When a "∗CLS" command is received.
- When an "∗ESR0?" query (for event status register 0) or "∗ESR1?" query (for event status register 1) is received.
- When the unit is powered on.

| 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 results |
| 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 |

GP-IB

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



## 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<br>The remote state is canceled, and the system goes into the local state. |
| LLO | Local Lock Out<br>All keys, including the LOCAL key, become inoperable. |
| DCL | Device CLear<br>Clears the input buffer and the output queue. |
| SDC | Selected Device Clear<br>Clears the input buffer and the output queue. |
| GET | Group Execute Trigger<br>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 RS-232C or GP-IB .

## Common commands

| Command | | Data format (For query, response data is used.) | Explanation | Error | Ref page |
|---|---|---|---|---|---|
| ∗CLS | | | Clears event register. | *1 | 124 |
| ∗ESE | GP-IB | 0 to 255 (NR1) | Sets the standard event status enable register (SESR). | *4 | 125 |
| ∗ESE? | GP-IB | 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 | GP-IB | ———— | Issues service request after execution completion. | *1 | 123 |
| ∗OPC? | GP-IB | 1 | Queries execution completion. | *2 | 123 |
| ∗RST | | ———— | Queries the initial setting. | *1 | 122 |
| ∗SRE | GP-IB | 0 to 255 (NR1) | Sets the service request enable register. | *4 | 126 |
| ∗SRE? | GP-IB | 0 to 255 (NR1) | Reads the service request enable register. | *2 | 126 |
| ∗STB? | GP-IB | 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** | | | | |
| :BEEPer:COMParator | IN/ NG/ OFF | Sets the beep sound for the comparator. | *2, 3 | 128 |
| :BEEPer:COMParator? | | Queries the beep sound for the comparator. | *1 | 128 |
| :BEEPer:KEY | ON/ OFF | Sets the beep sound for key input. | *2, 3 | 129 |
| :BEEPer: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><br><BIN#>=1 to 10(NR1)<br><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><br><BIN#>=1 to 10(NR1)<br><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 (Δ%). | *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 (Δ%). | *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><br><reference value>= numerical value (NR3) | Sets the reference value of the first parameter for the BIN function in percentage mode (%) or deviation percentage mode (Δ%). | *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 (Δ%). | *1 | 132 |
| :BIN:FLIMit:MODE | <characters><br><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><br><BIN#>=1 to 10(NR1)<br><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><br><BIN#>=1 to 10(NR1)<br><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><br><BIN#>=1 to 10(NR1)<br><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 (Δ%). | *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 (Δ%). | *1 | 134 |
| :BIN:SLIMit:REFerence | <reference value><br><reference value>= numerical value (NR3) | Sets the reference value of the third parameter for the BIN function in percentage mode (%) or deviation percentage mode (Δ%). | *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 (Δ%). | *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><br><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><br><BIN#>=1 to 10(NR1)<br><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><br><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><br><reference value>= numerical value (NR3)<br><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 (Δ%). | *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 (Δ%). | *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><br><reference value>= numerical value (NR3)<br><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><br><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><br><reference value>= numerical value (NR3)<br><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 (Δ%). | *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 (Δ%). | *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><br><reference value>= numerical value (NR3)<br><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><br><LOAD compensation number>= 1 to 5(NR1)<br><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><br><LOAD compensation number>=1 to 5(NR1)<br><mode>=Z/CS/CP/LS/LP/Rs(characters)<br><reference value1>= numerical value (NR3)<br><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 GP-IB | 0 to 255 (NR1) | Sets event status enable register 0. | *3 | 147 |
| :ESE0? GP-IB | | Queries event status enable register 0. | *1 | 147 |
| :ESE1 GP-IB | 0 to 255 (NR1) | Sets event status enable register 1. | *3 | 148 |
| :ESE1? GP-IB | | 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 |

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 |
|---|---|---|---|---|
| :HEADer? | | Queries headers enablement. | *1 | 150 |
| **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 (10.01MHz 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><br><No.>=1 to 30 (NR1)<br><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>,<b><br><a>,<b>=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>,<b><br><a>,<b>=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><br><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.

Describes the message syntax.

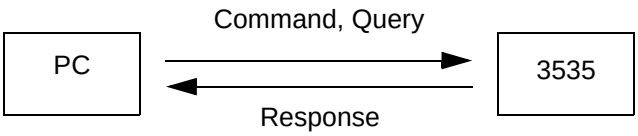
Explains the command data or response message.

Explains the message.

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

Enables and disables headers for the response message

| | | | |
|---|---|---|---|
| Syntax | Command | :HEADer <ON/ OFF> | |
| | Query | :HEADer? | |
| | Response | <ON/ OFF> | |
| | | ON :Headers are prefixed to response messages.<br>OFF:No header is affixed to the response message. | |
| Function | Command | Sets whether or not the 3535 will prefix headers to its response messages.<br>When powering on, OFF is initially set. | |
| | Query | Returns the setting of headers for the response messages as ON or OFF. | |
| Example | Command | **:HEADer ON**<br>Headers are prefixed to response messages. | |
| | Query | **:HEADer?** | |
| | Response | **:HEADER ON** (Headers: ON)<br>**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 |
| Measurement frequency | 1 MHz |
| Measurement signal level | Open-circuit voltage mode (V mode) |
| V mode set value | 1.000 V |
| CC mode 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 time | 0 s |
| Measurement speed setting | NORMAL |
| Measurement range | AUTO |
| Beep sound setting | Key input: ON<br>Comparator: OFF |
| Panel saving | All clear |
| Number of displayed digits<br>(First to forth parameters) | All 4 digits |
| Display setting | LCD display: ON<br>Voltage/current monitor: ON |

| | |
|---|---|
| Comparator (Both first and third parameters) | |
| Comparator setting mode | ABS (absolute value setting) |
| Absolute value set values | Upper and lower limit values: OFF |
| Percent set values | |
| First parameter | Reference value: 1000<br>Upper and lower limit values: OFF |
| Third parameter | Reference value: 10<br>Upper and lower limit values: OFF |
| BIN measurement (Both first and third parameters) | |
| Setting mode | ABS (absolute value setting) |
| Absolute value set values | Upper and lower limit values: OFF |
| Percent set values | |
| First parameter | Reference value: 1000<br>Upper and lower limit values: OFF |
| Third parameter | Reference value: 10<br>Upper and lower limit values: OFF |
| Scaling | |
| (compensation coefficient a/b of the first and third parameters) | a: 1.0000, b: 0 |

### Requests execution of, and queries the result of, the self test.

**Syntax**

Query ∗**TST?**

Response <numerical value>

<numerical value> = 0 to 15 (NR1)

**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<br>bit 7 | 64<br>bit 6 | 32<br>bit 5 | 16<br>bit 4 | 8<br>bit 3 | 4<br>bit 2 | 2<br>bit 1 | 1<br>bit 0 |
|---|---|---|---|---|---|---|---|
| unused | unused | unused | unused | Interrupt error | I/O error | RAM error | ROM error |

**Example**

Query ***TST?**

Response **6**

A RAM error (bit 1) and an I/O error (bit 2) have occurred.

## (3) Synchronous command

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

GP-IB

**Syntax**

Command ∗**OPC**

**Function**

Sets bit 0 (the OPC bit) of the standard event status register (SESR) to 1 at the instant the previous commands which is on the same line with *OPC have been completed.

**Example**

```
A;B;*OPC;C
```

After the execution of the commands A and B is completed, the OPC of SESR is set.

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

GP-IB

**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**

RS-232C This has no effect upon the output queue.

GP-IB This has no effect upon the output queue, the various enable registers, or bit 4 (the MAV bit) of the status byte register.

## Writes and reads the standard event status enable register (SESER).

GP-IB

**Syntax**

Command ∗**ESE** <numerical value>
Query ∗**ESE?**
Response <numerical value>

<numerical value> = 0 to 255 (NR1)

**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 |

**Example**

Command ***ESE 36**

Bits 5 and 2 of SESER are set to 36.

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

**Syntax**

Query ∗**ESR?**
Response <numerical value>

<numerical value> = 0 to 255 (NR1)

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

GP-IB

| 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 |

**Example**

**32**

Bit 5 of SESR has been set to 1.

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

GP-IB

**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.

GP-IB

**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 (Δ%).

**Syntax**

Command
**:BIN:FLIMit:DEViation** <BIN#>,<lower limit value>,<upper limit value>
**:BIN:FLIMit:PERcent** <BIN#>,<lower limit value>,<upper limit value>

Query
**:BIN:FLIMit:DEViation?** <BIN#>
**:BIN:FLIMit: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 first parameter for the specified BIN number in percentage mode (%) or deviation percentage mode (Δ%).
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 (Δ%).

**Example**

Command
```
:BIN:FLIMit:DEViation 1,-10.0,10.0
```
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
```
:BIN:FLIMit:DEViation? 1
```
Response
```
:BIN:FLIMIT: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 (Δ%).

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

**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 (Δ%).
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 (Δ%) 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 (Δ%).

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 (Δ%).

## 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 (Δ%)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 (Δ%).

**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 (Δ%).
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 (Δ%).

**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 (Δ%).

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

**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 (Δ%).
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 (Δ%) 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 (Δ%).

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 (Δ%).

## 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 (Δ%) 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 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 (Δ%).

**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 (Δ%)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 (Δ%).

**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 (Δ%) 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)
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)
The open-circuit compensation 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 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>.

| <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).

GP-IB

**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).

GP-IB

**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?**
**4**

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.

| 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 ($\theta$).
  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.

**Example**

The impedance should be set to the first parameter while the phase angle should be set to the third parameter.

When the first parameter is set to Z, the third parameter is set to θ, both the second and fourth parameters are set to OFF on the displayed parameter setting screen, and the data from a single normal test has been saved in the memory:

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)

| 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>,<b>
Query **:SCALe:FVALue?**
Response <a>,<b>
<a>,<b> = 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>,<b>
Query **:SCALe:SVALue?**
Response <a>,<b>
<a>,<b> =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 2

1: Mantissa Five digits and decimal point
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 2

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

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

1 2

### 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±□ □
(-)□ □ .□ □ □ E±□ □
(-)□ □ □ .□ □ E±□ □
(-)□ □ □ □ .□ E±□ □

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

1 2 3

## 6.6.4 Initialization Items

RS-232C

l: initialized / ×: not initialized

| Item \ Initialization method | Power on | ∗RST command | ∗CLS command |
|---|---|---|---|
| Device specific functions (ranges etc.) | × | l | × |
| Output queue | l | × | × |
| Input buffer | l | × | × |
| Event registers | l *1 | × | l |
| Current path | l | × | × |
| Headers on/off | l | l | × |
| Measurement resister | l | l | × |

*1 Except the PON bit (bit 7).

GP-IB

l: initialized / ×: not initialized

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

*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.

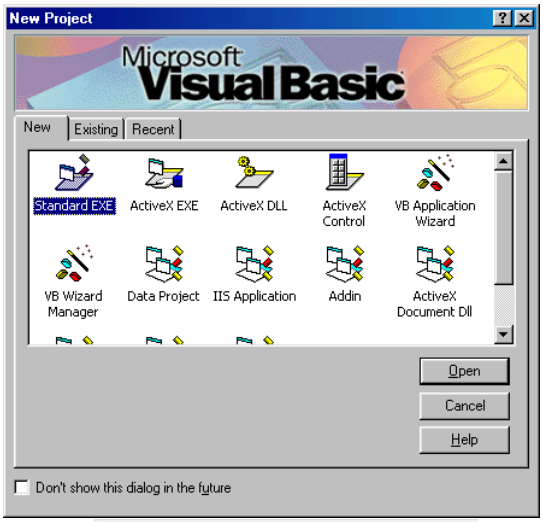
Windows, Visual Basic 6.0 is a registered trademark of Microsoft Corporation.

## 6.7.1 Development Method

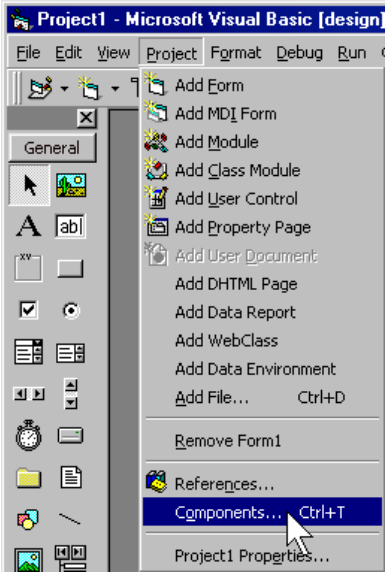
This subsection describes how to create a program with Visual Basic 6.0. Visual Basic is hereinafter referred to as "VB."

NOTE

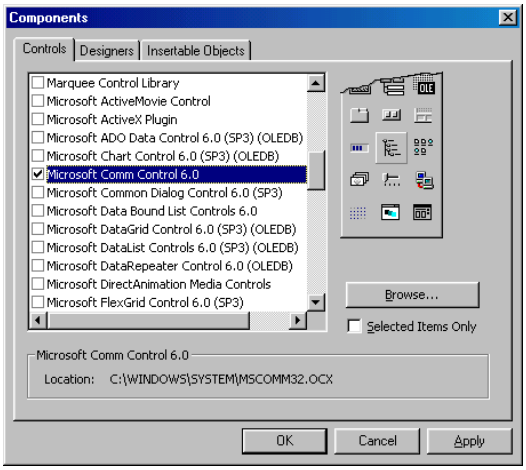
The descriptions may vary slightly depending on the settings and version of the PC or VB. For detailed operation of VB, refer to its instruction manual or on-line HELP.



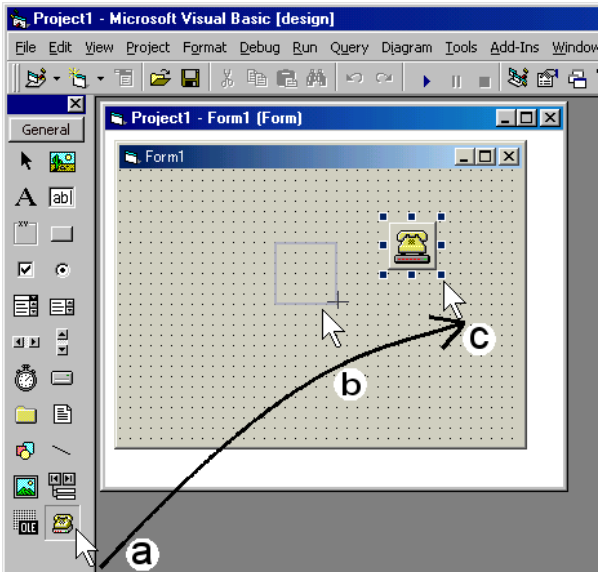

1. Boot VB, and select [**Standard EXE**] from the New tab and click **Open**.




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

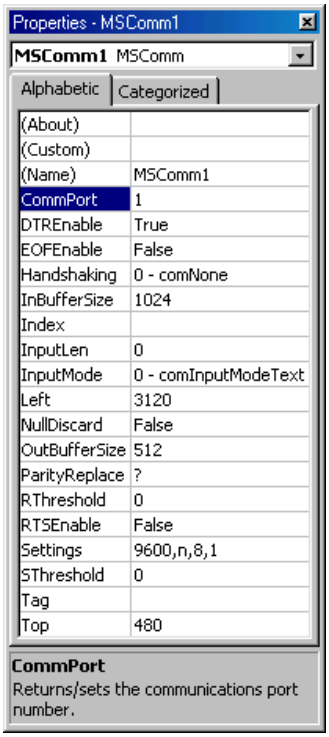



**3.** Click "**Microsoft Comm Control 6.0**" on the Controls tab of the Components window, and click **OK**.




**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)

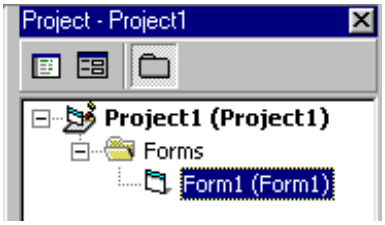
Now, the icon  (telephone) is displayed on the Form designer window. (c)




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.

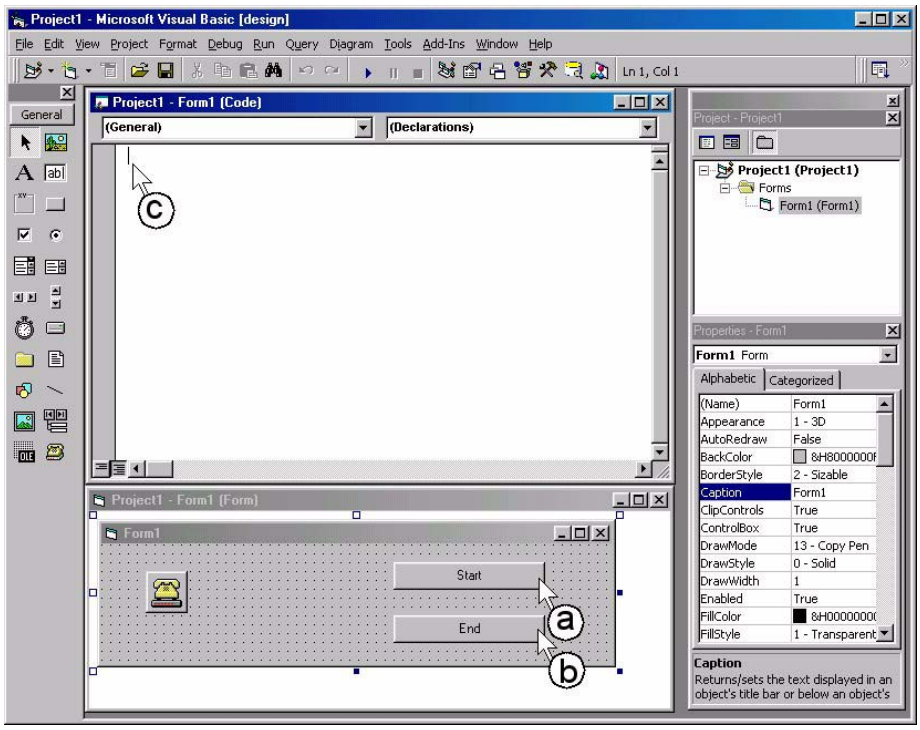
**5.** With the icon  (telephone) selected, change the settings in the Properties window according to the 3535's communication conditions and the PC's operating conditions.
In particular, be sure to provide the following settings.

| | |
|---|---|
| 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
        Exit Function
      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?<br>• Are all the devices powered on?<br>• Are correct cables used?<br>• Has the communication condition been correctly set? RS-232C<br>• Is the device address for the 3535 set correctly? GP-IB<br>• 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<br>• Ensure the message terminators (delimiters) for the controller are set. GP-IB<br>❖ "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.<br>• 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.<br>• Have any of these transmitted queries resulted in as 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.<br>• 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.<br>• 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?<br>• 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.<br>• 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. GP-IB | • Have the service request enable register and the various event status enable registers been correctly set?<br>• 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?<br>• ∗TRG command can be used for the external trigger setting. For the internal trigger setting, an execution error occurs. |

# 6.9 Device Compliance Statement

GP-IB

"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

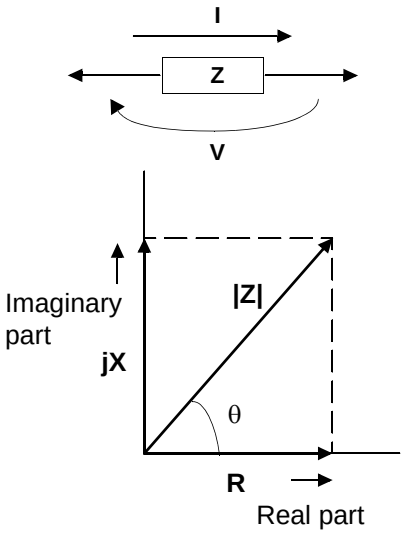
| | | |
|---|---|---|
| Measurement Parameters | • Z | Impedance |
| | • Y | Admittance |
| | • Rs | Series-equivalent resistance, ESR |
| | • Rp | Parallel-equivalent resistance |
| | • G | Conductance |
| | • X | Reactance |
| | • B | Susceptance |
| | • θ | Phase angle |
| | • Ls | Series-equivalent inductance |
| | • Lp | Parallel-equivalent inductance |
| | • Cs | Series-equivalent static capacitance |
| | • Cp | Parallel-equivalent static capacitance |
| | • Q | Q factor |
| | • D | Dissipation factor tanδ |
| Measurement Frequency | Range | 100 kHz to 120 MHz |
| | Resolution | 4 digits (by front panel setting)<br>100.0 kHz to 1.000 MHz (100-Hz steps)<br>1.000 MHz to 10.00 MHz (1-kHz steps)<br>10.00 MHz to 100.0 MHz (10-kHz steps)<br>100.0 MHz to 120.0 MHz (100-kHz steps)<br>1-Hz resolution with GP-IB or RS-232C interface |
| | Accuracy | Less than ±0.005% of setting value |
| Output Impedance | 50 Ω±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)<br>5 mV to 500 mV, 10 mA max. (above 10.01 MHz) |
| | Resolution | 1 mV steps |
| | Accuracy | ±(5% + 5 mV) × (2 + logf), where f is in MHz |
| Constant current (CC) mode | Range | 200 μA to 20 mA, 1 V max. (up to 10.00 MHz)<br>200 μA to 10 mA, 0.5 V max. (above 10.01 MHz) |
| | Resolution | 10 μA step |
| | Accuracy | ±(10% + 50 μA) × (2 + logf), 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 | ±(5%+ 5 mV) × (2 + logf), where f is in MHz |
| Current monitor | Range | 0.000 mA to 20.00 mA |
| | Accuracy | ±(10% + 50 μA) × (2 + logf), where f is in MHz |

| | |
|---|---|
| Limit Function | |
| Current limit (during V setting) | Range 0.20 mA to 20.00 mA<br>Accuracy ±(10% + 50 μA) × (2 + logf), where f is in MHz |
| Voltage limit (during CC setting) | (voltage between HIGH and LOW terminals of the 3535 unit)<br>Range 0.005 V to 1.000 V<br>Accuracy ±(10%+ 10 mV) × (2 + logf), where f is in MHz |
| Ranges | 3 ranges, AUTO or HOLD setting<br>1 kΩ range 100 mΩ to 2 kΩ<br>10 kΩ range 1 kΩ to 20 kΩ<br>100 kΩ range 10 kΩ to 300 kΩ |
| Measurement Ranges | Z: 100.00 mΩ to 300.00 kΩ (5-digit display)<br>θ: -180.00° to 180.00° (0.01° resolution) |
| Measurement Time | 6 ms±1 ms (nominal)<br>Actual time depends on measurement conditions, such as measurement speed and averaging. |
| Measurement Speed | FAST, NORMAL, SLOW, and SLOW2<br>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<br>Trigger delay function: 0.01 s to 9.99 s with 0.01 s resolution |
| Zero Compensation | Open/ short-circuit compensation<br>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.<br>Upper and lower limit values setting: Input either the absolute value, percentage of standard value or its deviation percentage (Δ%).<br>For Δ%, 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<br>(compensated value) = a x (measurement value) + b |
| Panel Save and Load Function | Memory Capacity: 30 Sets<br>Load Method: Front panel key operation, external I/O connector, GP-IB, RS-232C |
| Measurement Value Storage | Memory Capacity: up to 200 values<br>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.<br>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<br>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.), Pollution Degree 2 |
| Power Supply | Rated supply voltage 100 to 240 VAC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.)<br>Rated supply frequency 50/60 Hz<br>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)<br>Approx. 8.3 kg (292.8 oz.) |
| Guaranteed Accuracy Period | 6 months |
| Applicable Standards | EMC EN61326<br>EN61000-3-2<br>EN61000-3-3<br>Safety EN61010 |
| Dielectric Strength | 1.62 kV AC for 60s, between power and ground |
| Accessories | • Quick Start Manual<br>• Instruction Manual<br>• Power cord |
| Options | Fixture<br>• 9677 SMD TEST FIXTURE (no CE marking)<br>• 9699 SMD TEST FIXTURE<br><br>HEAD AMP UNITs<br>• 9700-10 HEAD AMP UNIT (1 kΩ to 100 kΩ range)<br><br>Connecting cables<br>• 9678 CONNECTION CABLE<br>• 9151-02 GP-IB CONNECTOR CABLE (2 m)<br>• 9151-04 GP-IB CONNECTOR CABLE (4 m)<br>• 9637 RS-232C CABLE (1.8 m, 9pin-9pin)<br>• 9638 RS-232C CABLE (1.8 m, 9pin-25pin)<br><br>Printer<br>• 9442 PRINTER<br>• 9443-01 AC ADAPTER (for printer, for Japan)<br>• 9443-02 AC ADAPTER (for printer, for EU)<br>• 9444 CONNECTION CABLE<br>• 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.



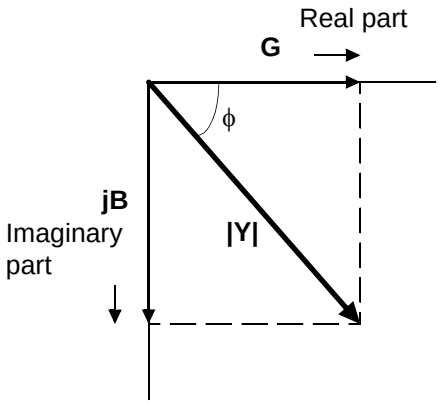

$$Z = R + jX = |Z| \angle \theta$$

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

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

*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) = -*θ*
*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 | $R_s = ESR = \|Z\|\|\cos\theta\|$ | $R_p = \left\|\frac{1}{\|Y\|\cos\phi}\right\|\left(= \frac{1}{G}\right)$ *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 | $Q = \|\tan\theta\left(= \frac{1}{D}\right)$ | |

*1: $\phi$ 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 x (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 ±1ms)

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.

**(B)** Influence value for backlight setting

| Backlight setting | |
|---|---|
| ON | OFF |
| 0 ms | -0.5ms (for a parameter) |

(Allowance ±0.5ms)

**(C)** Influence value for open/ short-circuit compensation and load compensation

| No compensation | Compensation |
|---|---|
| 0 ms | 0.3 ms |

(Allowance ±0.2ms)

**(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 ±0.5ms)

## 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 × C × D × E × F × 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 $= A + B \times \left| \frac{Zm \times 10}{range} - 1 \right|$

Lower end of range: Basic accuracy $= A + B \times \left| \frac{range}{Zm \times 10} - 1 \right|$

Zm: Measurement value
range: Range of the HEAD AMP UNIT(1 kΩ/ 10 kΩ/ 100 kΩ)

| 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%<br>B = 0.20% |
| | 5 kΩ to 10 kΩ | _____ | A = 1.00%<br>B = 0.10% | |
| | 1 kΩ to 5 kΩ | _____ | | _____ |
| | 500 Ω to 1 kΩ | A = 0.50%<br>B = 0.10% | | _____ |
| | 100 Ω to 500 Ω | | _____ | _____ |
| | 100 mΩ to 100 Ω | A = 0.50%<br>B = 0.10% | _____ | _____ |
| 1 year | 10 kΩ to 100 kΩ | _____ | _____ | A = 3.00%<br>B = 0.30% |
| | 5 kΩ to 10 kΩ | _____ | A = 1.50%<br>B = 0.15% | |
| | 1 kΩ to 5 kΩ | _____ | | _____ |
| | 500 Ω to 1 kΩ | A = 0.75%<br>B = 0.15% | | _____ |
| | 100 Ω to 500 Ω | | _____ | _____ |
| | 100 mΩ to 100 Ω | A = 0.75%<br>B = 0.15% | _____ | _____ |

### C Frequency constant

| f ≤ 10 MHz | f > 10 MHz | |
|---|---|---|
| log f + 2 | 10 × log f – 7 | f [MHz] |

### D Level constant

| | |
|---|---|
| 10 – 3 ×logV | V [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 x \| T [°C] - 23 [°C] \| | T: Operating temperature [°C] |

## Accuracy of phase angle θ

**θ accuracy = Z accuracy x 0.6 [°]**

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, θ = -89.12° when measuring with the following conditions.

- Measurement frequency ..... 10 MHz
- Measurement speed ..... SLOW2
- Measurement signal level ..... 500 mV
- Measurement range ..... 1 kΩ 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(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)

Basic accuracy $= A + B \times \left| \frac{Zm \times 10}{range} - 1 \right|$

Z 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.

Frequency constant = log(10) + 2 = 3
Level constant = 10 - 3 × log(500) ≈ 1.90309
Measurement speed constant = 1
Cable length constant = 1
Temperature constant = 1 + 0.1 × | 24 - 23 | = 1.1

**3.** Acquire the accuracy of Z.

Z accuracy [%] = basic accuracy × frequency constant × level constant × measurement speed constant × cable length constant × temperature constant

Z accuracy = 0.55912 × 3 × 1.90309 × 1 × 1 × 1.1 ≈ ±3.51138%

**4.** Calculate the basic accuracy of θ from the basic accuracy of Z.

θ accuracy = Z accuracy × 0.6 [°]

θ accuracy = 3.51138 × 0.6 = ±2.106828°

**5.** The range of possible values for Z, θ, and |sinθ| is acquired from the basic accuracy.

Z min =Zm × (1 - Z accuracy [%])
Z max =Zm × (1+Z accuracy [%])
Zm: measurement value of Z

$Zmin = 159.12 \times \left(1 - \frac{3.51138}{100}\right) \approx 153.53269\Omega$

$Zmax = 159.12 \times \left(1 + \frac{3.51138}{100}\right) \approx 164.70731\Omega$

θmin = θm − θ accuracy [°]
θmax = θm + θ accuracy [°]
θm: measurement value of θ

θmin = -89.12 - 2.106828 ≈ -91.226828°

θmax = -89.12 + 2.106828 ≈ -87.013172°

Since the absolute value of sinθ (|sinθ|) is maximized at sin 90° or sin -90°, the range is defined as follows.

sinθmin = |sin - 87.013172| ≈ 0.99864
sinθmax = |sin - 90| = 1

*6.* The range of possible values for Cs is acquired from the range of Z and sinθ.

❖ Calculation Equations: (page 183)

$$Cs = \frac{1}{\omega \times |Z||\sin\theta|} = \frac{1}{2\pi f \times |Z||\sin\theta|}$$

$\omega = 2 \times \pi \times f$
f: frequency [Hz]

Minimum value of Cs (Csmin):

$$Csmin = \frac{1}{2\pi f \times Zmax \times \sin\theta max} = \frac{1}{2\pi f \times 164.70731 \times 1} \approx 96.6289\,pF$$

Maximum value of Cs (Csmax):

$$Csmax = \frac{1}{2\pi f \times Zmin \times \sin\theta min} = \frac{1}{2\pi f \times 153.53269 \times 0.99864} \approx 103.8031\,p$$

Minimum value of the basic accuracy of Cs

$$= \frac{Csmin - Cm}{Cm} \times 100 = \frac{96.6289 - 100}{100} \times 100 = -3.37110\,\%$$

Maximum value of the basic accuracy of Cs

$$= \frac{Csmax - Cm}{Cm} \times 100 = \frac{103.8031 - 100}{100} \times 100 = 3.80310\,\%$$

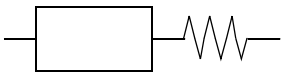
Cm: measurement value of Cs = 100pF

Therefore, the basic accuracy of Cs is -3.37110% to 3.80310%.

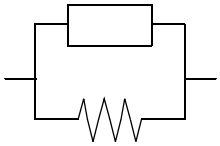
# Appendix

# Appendix 1 Terminology

## Series-Equivalent Circuit Mode and Parallel-Equivalent Circuit Mode



Series-equivalent circuit



Parallel-equivalent circuit

The 3535 unit obtains the impedance Z and the phase angle θ by measuring the current and voltage across the test sample. The other measurement parameters, like an inductive component L, a capacitive component C, a resistive component R, etc. are calculated based on the Z and θ.
A series-equivalent circuit mode is the mode in which the calculation is performed assuming that resistive components are connected in series to C (or L), while a parallel-equivalent circuit mode is the calculation assuming that resistive components are connected in parallel.
The appropriate selection of the equivalent circuit modes will enable the more accurate calculation results.

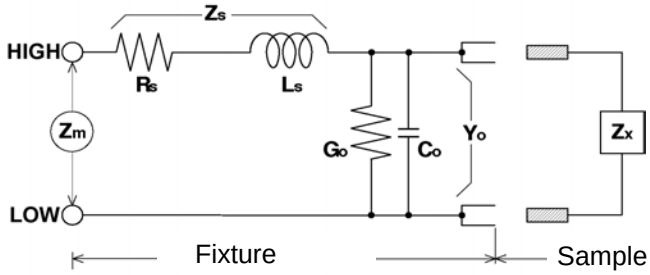
Generally, for measurement of a low impedance device (approx. less than 100 Ω) like a large capacitance capacitor or a low inductance, a series-equivalent circuit mode will be selected. While, for a high impedance device (approx. more than 10 kΩ) like a small capacitance capacitor or a high inductance, a parallel-equivalent circuit mode will be selected.
When you are not sure about selection of circuit mode, please ask the parts maker. (ex. a impedance approx. between 100 Ω and 10 kΩ)

NOTE

Because measurement value in each equivalent circuit mode is obtained through calculation, measurement values of both modes can be displayed. However, please note that the appropriate equivalent circuit depends on the test sample.

## 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 Zm 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.

Measurement value $Zm = Zs + \dfrac{1}{Yo + \dfrac{1}{Zx}}$

Zx: true value
Rs: residual resistance
Ls: residual inductance
Go: residual conductance
Co: floating capacitance value
Zs: short-circuit residual component
Yo: open-circuit residual component
Zm: 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 Zs is now zero, therefore the open-circuit residual component Yo can be determined.
- Short-circuit compensation
  The terminals of the test fixture are connected together (short-circuited). Because the open-circuit residual component Yo is now zero, therefore the short-circuit residual component Zs 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 Zm 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 Yo (which is not available), thereby deviation in the resultant values will become large if the value of that open-circuit residual component Yo 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 Zs (which is not available), thereby deviation in the resultant values will become large if the value of that short-circuit residual component Zs 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.

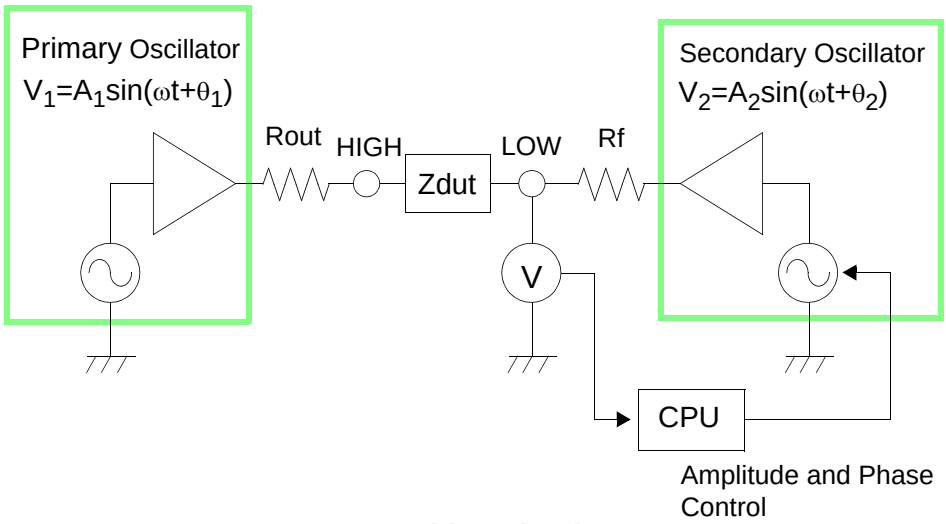
# Appendix 2 Measurement Principle

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.

$|Z| = |Zf| \times A1/A2$
$\theta = \theta f + \theta 1 - \theta 2 + 180$

| | |
|---|---|
| Z: Impedance of the DUT | θ: Phase angle of the DUT |
| Zf: Impedance of detection resistance | θf: Phase angle of detection resistance |
| A1: Voltage of the primary oscillator | θ1: Phase angle of the primary oscillator |
| A2: Voltage of the secondary oscillator | θ2: Phase angle of the secondary oscillator |




**CPU Bridge Circuit**

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.

HIOKI

HIOKI E. E. CORPORATION

**Headquarters**
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 FAX +81-268-28-0568 E-mail: os-com@hioki.co.jp
URL http://www.hioki.com/
(International Sales and Marketing Department)

**HIOKI USA CORPORATION**
6 Corporate Drive, Cranbury, NJ 08512, USA
TEL +1-609-409-9109 FAX +1-609-409-9108 E-mail: hioki@hiokiusa.com
URL http://www.hiokiusa.com

**HIOKI (Shanghai) Sales & Trading Co., Ltd.**
1608-1610, Shanghai Times Square Office 93 Huaihai Zhong Road Shanghai,
P.R.China POSTCODE: 200021
TEL +86-21-63910090 FAX +86-21-63910360 E-mail: info@hioki.com.cn
URL http://www.hioki.cn

**HIOKI INDIA PRIVATE LIMITED**
Khandela House, 24 Gulmohar Colony Indore 452 018 (M.P.), India
TEL +91-731-6548081 FAX +91-731-4020083 E-mail: info@hioki.in
URL http://www.hioki.in

**HIOKI SINGAPORE PTE. LTD.**
33 Ubi Avenue 3, #03-02 Vertex Singapore 408868
TEL +65-6634-7677 FAX +65-6634-7477 E-mail: info@hioki.com.sg

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