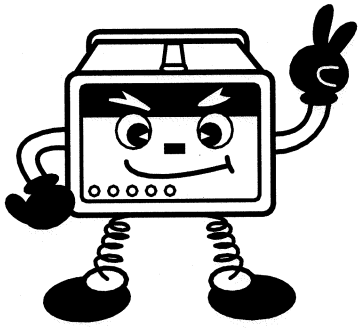
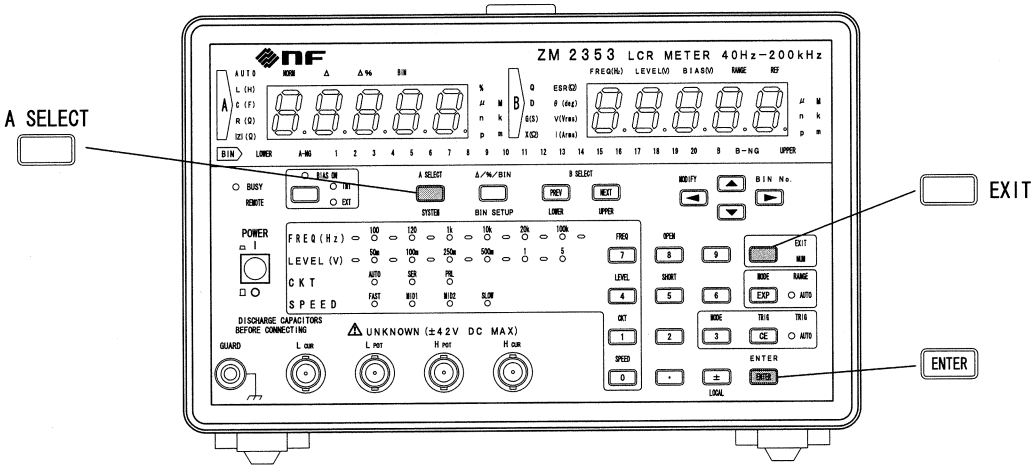
7 System menu



System menu

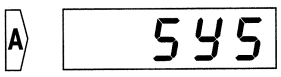
System menu functions are ready for user to make settings within the ZM2353/ZM2354 as well as setting items concerning the handler interface



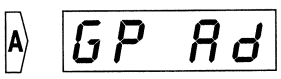
Entry to system menu mode

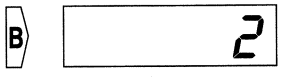
1. While pressing [ENTER] in a measuring state, press [A SELECT], and the control enters into the system menu mode.

2. When the system menu is entered, [SyS] appears on Display A for two seconds.



3. Then, setting items of GPIB address appear.

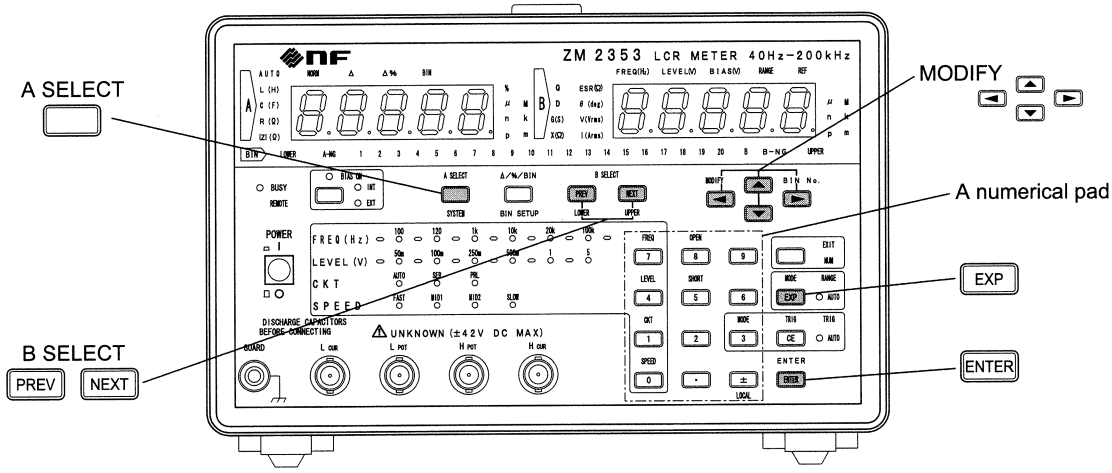




Exit from system menu mode

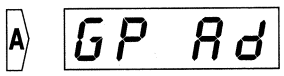
1. Press [EXIT], and the control quits the system menu mode and enters into the measurement mode.

Items of system menu



GPIB address [GP Ad]

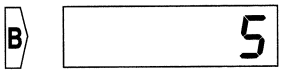
1. Press A SELECT, or MODIFY several times to show [GP Ad] on Display A.



2. Using the numerical pad, make setting of GPIB address.

   Example: If the address is 5:

   Press 5 and ENTER.

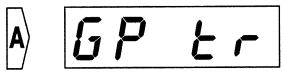


Note

A GPIB address is the ZM2353/ZM2354's address used for communications made with computer through GPIB. The address is a number ranging from 0 to 30. It is set to 2 when the ZM2353/ZM2354 is shipped.

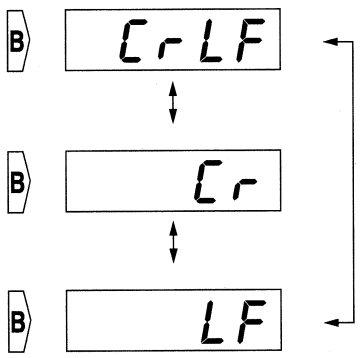
GPIB terminator [GP tr]

1. Press A SELECT, or MODIFY several times to show [GP tr] on Display A.



2. Press B SELECT PREV NEXT or and * to select a GPIB terminator.

   * Every press on the buttons will change the indication of terminators as shown below.

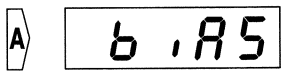


Note

The GPIB terminator will be the ZM2353/ZM2354's terminator (a separator between messages) when communications are made with computer through GPIB.
"CrLF" is selected when the product is shipped.

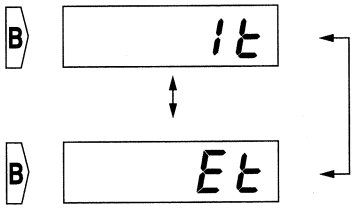
Selection of internal/external for DC bias voltage [biAS]

1 Press A SELECT , or MODIFY several times to show [biAS] on Display A.



2 Press B SELECT PREV NEXT or and * to select a DC bias volt.

* Every press on the buttons will change the indication of DC bias voltages as shown below.



Be careful!

The external DC bias should be set within the range of ±35 V.

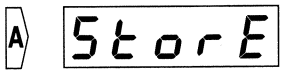
Note

It: Internal DC bias voltage is used.
The DC bias voltage set by the ZM2353/ZM2354 will be output when DC BIAS is ON.

Et: External DC bias voltage is used.
The voltage of DC bias source connected to the rear panel DC BIAS will be output.

Store memory [StorE]

1. Press A SELECT, or MODIFY ◄ ► several times to show [StorE] on Display A.



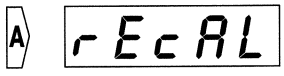
2. Set desirable measurement conditions for storage, and enter the memory number from the numerical pad.
Example:To store the current measurement conditions in Memory No. 4:
Press 4 and ENTER.

Note

Memory numbers range from 1 to 9.

Recall memory [rEcAL]

1. Press A SELECT, or MODIFY ◄ ► several times to show [rEcAL] on Display A.



2. From the numerical pad, enter the number of memory in which your desired measurement conditions are stored.
Example: To call the measurement conditions in Memory No. 3:
Press 3 and ENTER.

Note

Memory numbers range from 1 to 9.
Memory No. 0 stores the measurement conditions just before power is turned off.

Note

[Items to be stored in one memory number]

- Display A parameter
- Display B parameter
- Comparator mode
- Measurement frequency
- Measurement level
- Measurement equivalent circuit
- Measuring speed
- Measurement range
- Measurement trigger
- Internal DC bias level
- Reference value
- Upper and lower limit values of comparator.

ON/OFF of DC bias is not contained in the setting conditions of the memory.

* Whenever a memory number is called, the DC bias setting becomes OFF.

Trigger delay [dELAy]

1 Press A SELECT, or MODIFY ◄ ► several times to show [dELAy] on Display A.

2 From the numerical pad, enter the value of delay time from trigger input to measurement start.

Example: If the delay time is 5.12 seconds:

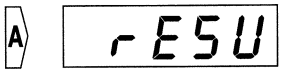
Press 5 • 1 2 and ENTER.

Note

Delay time should be 0 s or any value between 10 ms and 199.99 s, where resolution is 10 ms.

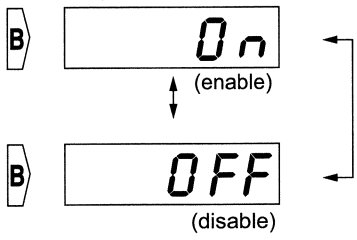
Resume function [rESU]

1 Press A SELECT, or MODIFY ◄ ► several times to show [rESU] on Display A.



2 Press B SELECT PREV NEXT or ▲ ▼ and * to select whether to enable or disable the resume function.

* Every press on the buttons will toggle the indication as follows:



Note

If the resume function is enabled, power energizing of the ZM2353/ZM2354 retrieves the settings just before the last power turning off.
At the same time, also the zero correction value (OPEN/SHORT correction value) is retrieved.

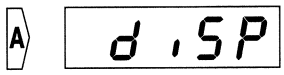
However, ON/OFF of DC bias will not be retrieved; DC bias will be OFF whenever the power switch is turned on.

[Items to be retrieved]

- Display A parameter
- Display B parameter
- Comparator mode
- Measurement frequency
- Measurement level
- Measurement equivalent circuit
- Measuring speed
- Measurement range
- Measurement trigger
- Internal DC bias level
- Reference value
- Upper and lower limit values of comparator
- Selection of internal/external of DC bias voltage
- Trigger delay time
- Indications on Displays A and B when comparator is used
- Beep when comparator is used
- Width of strobe signal
- Polarity of output signal of handler interface
- Length of measurement cable
- Zero correction value (OPEN/SHORT correction value)

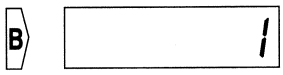
Selection of indication when comparator is used [diSP]

1 Press A SELECT, or MODIFY ◄ ► several times to show [diSP] on Display A.



2 Press B SELECT PREV NEXT or ▲ ▼ and * to select indications on Displays A and B.

[Indication of 1]



* Every press on the buttons will toggle the indication as follows:

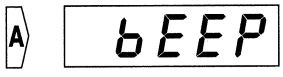
0 Displays A and B will show the measurement.
↓
1 Displays A and B will show the upper and lower limit values of BIN number

Note

If the parameter is set to 1, the indication of the upper and lower limit values of the BIN number will be the indications of BIN number of the upper and lower limit values for Display A. Indication of the upper and lower limit values for Display B is not available.

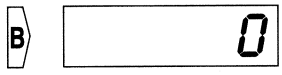
Selection of beep when comparator is used [bEEP]

1 Press A SELECT, or MODIFY ◄ ► several times to show [bEEP] on Display A.



2 Press B SELECT PREV NEXT or ▲ ▼ and * to select whether or not to sound beep according to the result of judgment when the comparator is used.

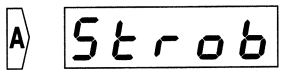
[Indication of 0]



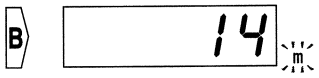
0 Do not sound a beep
↓
1 Sound a beep in low tone (2 kHz) for BIN 1 to 20
↓
2 Sound a beep in high tone (4 kHz) for BIN A NG
↓
3 Sound a beep for every case

Specification of strobe signal width [Strob]

1. Press A SELECT, or MODIFY several times to show [Strob] on Display A.



2. From the numerical pad, enter the value of the strobe signal pulse width of the handler interface.
Example: If the pulse width is 14 ms:
Press 1 4 and then press EXP to light up (m) for the units.



3. Press ENTER.

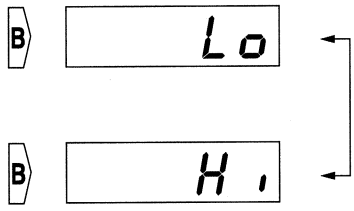
Note

The setting value should be any value between 1 ms and 19.999 s, where resolution is 1 ms.
When the handler interface is used, change the pulse width of strobe signal according to the pulse response time of the handler.
If this strobe signal is active, a trigger signal cannot be input (Any trigger signal will be neglected).
This setting is not significant because the ZM2353 has been installed but is not equipped with a handler interface. Set 1 ms (default value) to prevent slowing of measurement speed.

Selection of output signal polarity of handler interface [HAndL]

1. Press A SELECT, or MODIFY several times to show [HAndL] on Display A.

2. Press B SELECT PREV NEXT or and * to select the polarity of output judgment result when the comparator is used.
* Every press on the buttons will toggle the indication as follows:



Note

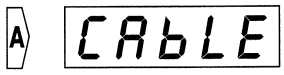
Lo: Lo (low level) if output is active
Hi (high level) if output is inactive
Hi: Hi (high level) if output is active
Lo (low level) if output is inactive

The user can change the polarity by the signal input of the handler to be connected.

This setting is not significant because the ZM2353 has been installed but is not equipped with a handler interface.

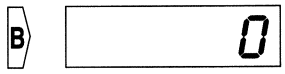
Selection of connection cable length [CAbLE]

1 Press A SELECT [ ], or MODIFY [◄] [►] several times to show [CAbLE] on Display A.



2 Press B SELECT [PREV] [NEXT] or [▲] [▼] and * to select the length of the cable to be connected to the UNKNOWN terminal.

[Indication of 0]



* Every press on the buttons will toggle the indication as follows:

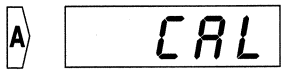
→ 0 Cable length of 0 m
↓
1 Cable length of 1 m
↓
2 Cable length of 2 m
↓
4 Cable length of 4 m

Note

Select the value nearest to the length of the practical cable to be connected.
For description of cable length settings for our company's test fixtures and test leads, see the "Guide to Text Figures and Test Leads".

Gain correction [CAL]

1 Press A SELECT [ ], or MODIFY [◄] [►] several times to show [CAL] on Display A.



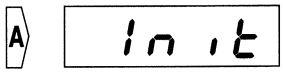
2 Press [ENTER] to start internal gain correction.

Note

This gain correction function corrects the internal circuit.
Do not connect anything to the UNKNOWN terminal when executing gain correction.
If gain correction is not conducted properly, "Err26" will appear when the unit is powered.
If this error is fixed, measurement will be available, however the precision will not be guaranteed.

Initial settings [Init]

1 Press A SELECT, or MODIFY ◄ ► several times to show [Init] on Display A.



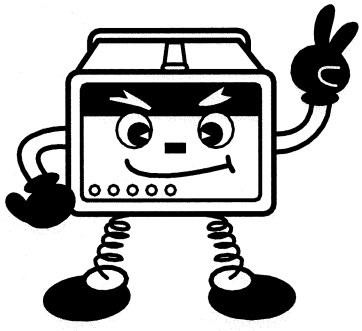
2 Press ENTER and the initial settings will be the measurement conditions.

Note

Items	Initially set values
Display A	AUTO
Display B	As per Display A
Comparator mode	NORM
Measurement frequency	1 kHz
Measurement level	1 Vrms
Measurement equivalent circuit	AUTO
Measuring speed	MID2
Measurement range	AUTO
Measurement trigger	AUTO
Internal DC bias level	0, mV
Reference value	0
Upper and lower limit values of comparator	Upper limit value: 0, lower limit value: 0
Selection of internal/external of DC bias voltage	Internal
DC bias	OFF
Trigger delay time	0 s
Indications on Displays A and B when comparator is used	Measurement
Beep when comparator is used	Do not sound
Width of strobe signal	1 ms
Polarity of output signal of handler interface	LO
Length of measurement cable	0 m
Zero correction value (OPEN/SHORT correction value)	Do not correct (default)

For the GPIB address and terminator, the initial settings will be effective at any time.

Measurement 8



Connection of test piece

Measurement terminal

The ZM2353/ZM2354 adopts a four-terminal pair measurement technique, which provides most high precision in measurement. The measurement terminals labeled "UNKNOWN" include BNC connectors for test piece connection and a guard terminal as follows:

HCUR: Drive signal output terminal
HPOT: Voltage detection terminal (High)
LPOT: Voltage detection terminal (Low)
LCUR: Current detection terminal
G: Grounding terminal for guard

The grounding terminal for guard is connected to the enclosure of the ZM2353/ZM2354.

The current supplied from the HCUR terminal flows through the test piece and reaches the LCUR terminal, and thus the current value is measured. In addition, the voltage across the HPOT and LPOT terminals is measured as the voltage applied to the test piece. The guard terminal, G, is used to lessen the induction noise from AC power supply and other sources by shielding jigs and test pieces.

With the four-terminal pair measurement technique, the measurement current that has flowed from HCUR to LCUR through the core conductor of the current cable returns to the signal source, HCUR via the same cable.

The automatic bridge incorporated in the ZM2353/ZM2354 unit functions so that the potential detected by the LPOT will be zero in order to minimize the error current that flows to the ground to an almost zero level. Therefore, the external conductor of four connection cables must be connected altogether near the test piece.

Any test piece that has a grounded terminal cannot be measured by the ZM2353/ZM2354 because of the principle of measurement.

☞ See Fig. 1 "Four-terminal Pair Connection".

Be careful!

Pay attention to the following instructions when connecting a test piece:

- Be sure to connect the voltage terminal to the DUT side (inner side) than the current terminal.
- Connect four external conductors (i.e., shield wires) altogether to the measurement terminal.

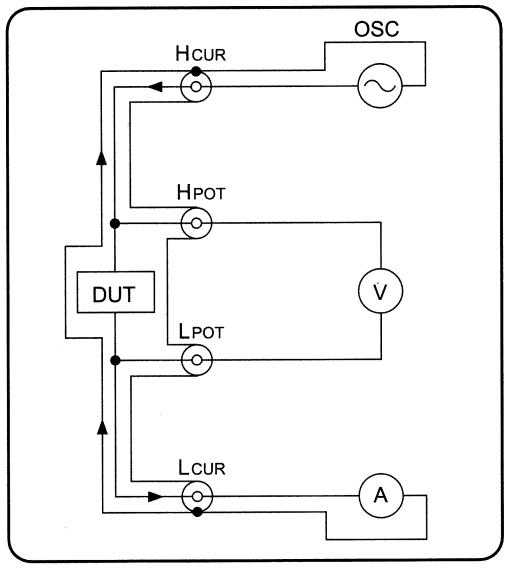


Fig. 1 Four-terminal Pair Connection

If the test piece (DUT) and the voltage and current terminals are to be connected separately with each independent cable, observe the following instructions:

- Be sure to connect the voltage detection terminal to the test piece side (inner side) than the current terminal.
- Use as short a coaxial cable as practicable.
- If the user's cable is rather long, twist the voltage cables (V) and the current cables (I) so that four wires will be intertwined with a V opposing another V and an I opposing another I.
- Connect four external conductors (i.e., shield wires) altogether to the measurement end.

If the system is experiencing any noise induction, wrap and guard the test piece with the external conductor of the voltage cable or the conductive material that is connected to the guard terminal "G". Just a shield board will be effective if it is placed under the test piece as shown in Fig. 2 "Connection of Test Piece".

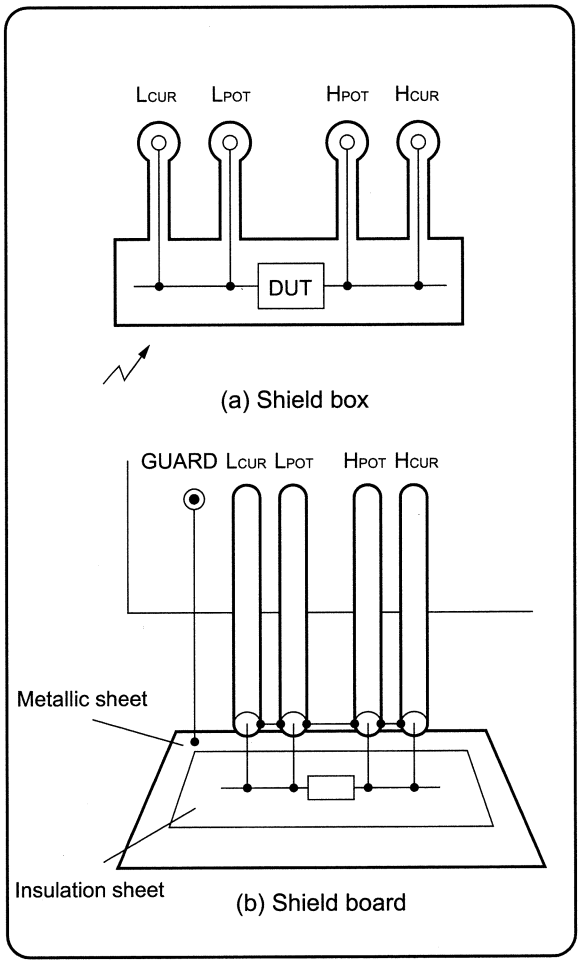


Fig. 2 Connection of Test Piece

Extension cable

If the user wants to extend the measuring terminal, the four-terminal pair structure should be maintained up to the tip as much as possible. Use coaxial cables and bundle and twist them as shown in Fig. 3 "Extension Cable". If it is hard to twist all four wires together, then twist two current cables and two voltage cables separately. Keep the cable within a length of 4 meters. The shorter the cable is, the less will be the error.

Zero correction of OPEN and SHORT should be carried out in a condition as near to the practical condition of use as possible.

In the cable length of the ZM2353/ZM2354 system menu, specify a value near to the length of the actual extension cable.

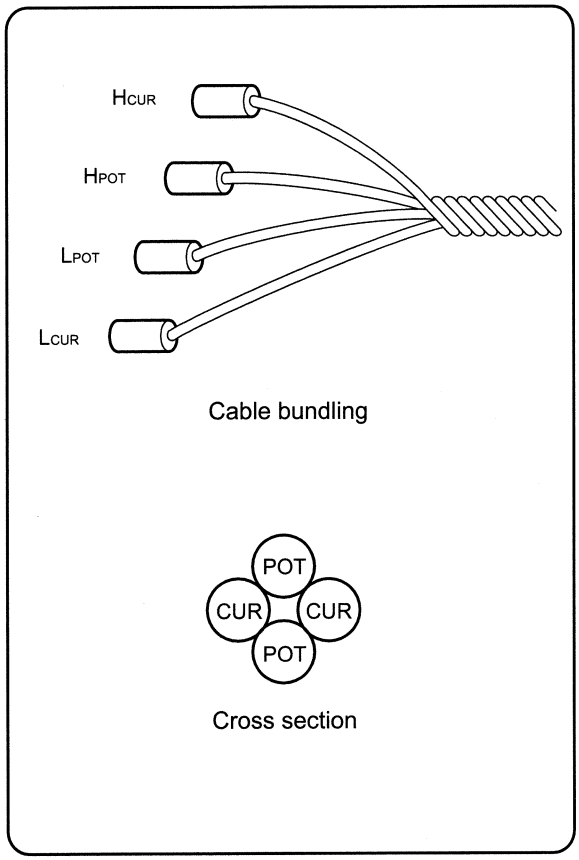


Fig. 3 Extension Cable

Test fixture and test lead (optional)

Test fixtures and test leads are ready for users option.

Select according to the application, as described in the "Guide to Text Figures and Test Leads".

Scanner

When a scanner is used to measure a number of test pieces by switching, it often happens that long cables are connected to the measurement terminals. As a result, various problems are likely to take place. The following sections provide some effective instructions. will be effective if it is placed under the test piece as shown in Fig. 2 "Connection of Test Piece".

Restraint on cable length

● Keep the effective cable length within 4 m or so. With too long cables, not only the precision in measurement lowers but also it may become too unstable to continue measurement. In the case of long cables, change the measurement conditions or ambient temperature to check and see if operation is sufficiently stabilized and necessary precision is secured.

● Measurement error becomes higher with longer cables.
Particularly the influential factor is the capacity (electrostatic capacity of central and external conductors) of the connection cable on the Low side (LCUR and LPOT). Therefore, take proper measures such as to minimize the total length of the cables connected to the Low side during measurement, and also to limit the floating capacity to the ground such as switches as much as possible.
Avoid a configuration such that the ends of all test pieces are connected to the Low side.

These measures are effective also for prevention of noise induction.

● Difference in cable length by channels would result in a variation of errors produced. Therefore, keep to a certain length of cables connected to test pieces during measurement. However, the floating capacity on High side (HCUR and HPOT) is not so influential.

Noise induction

If a number of cables are used for connection of test pieces, the system is prone to noise induction.
Use shielded connection cables and connect the scanner casing to the guard terminal, G of "UNKNOWN", in order to prevent noise induction as much as possible.

Error caused by floating capacity

If a number of shielded cables are used, higher errors are produced due to the cable capacity of the cables.
In particular, error becomes greater if measurement is made with higher frequency. In such cases, use cables with low capacity, and calibrate the measurement by measuring the standard element. To calibrate the measurement, determine the impedance and phase of the test piece.
In the case of frequency ≤ 10 kHz, let the measured impedance be Z, and the true impedance Zx will be given by the following equation:

$$Zx = K \bullet Z$$

where the constant K is calculated by using the value of Zm resulting from measurement of standard element Zstd, as follows:

$$K = Zstd / Zm$$

Here, all of Z, Zx, Zstd, Zm and K are complex numbers.

The value of K depends on the frequency and the reference resistance (measurement range) inside the ZM2353/ZM2354. If the impedance of measured test piece is too high, or too low, this correction method cannot correct the measurement properly.

Operations on power energizing

Power turning-on

☞ See "Measurement in auto mode" in Chapter 4 "How to Measure".

⚠CAUTION

Should the user notices the fan not running, immediately turn off the power, and contact the NF Corporation or distributors. Use of the ZM2353/ZM2354 with the fan not working would expand the damage, resulting in an unrepairable condition.

Before turning on the power switch, wait for three seconds or longer after the last power turning-off. If the unit is energized immediately after the power switch is turned off, the ZM2353/ZM2354 may not work normally.

Self-check

Self-check is conducted in the order of memory check, indicator lamp check, version display and internal circuit check.

Memory check

CPU-based ROM and RAM are checked.

Indicator lamp check

All lamps are lit up. Also for 7-segment numeral indicators, all segments in all places, including decimal points, will be turned on. Confirm that every lamp is lighting.

Indication of version number and setting conditions for startup

After all indication lamps are lit, the version number (e.g., "1.20") is shown on Display A, and the measurement condition settings (resume function and settings when comparator is used) after energization are shown on Display B.

On display B, "r0_c0" or similar indication appears, indicating the condition of setting when resume and comparator are used.

The following items and their descriptions are shown in display B.

Display B Resume setting	Resume setting	Comparator setting
r0_c0	Resume function OFF	Handler I/F output Lo Indication Measurement
r0_c1	Resume function OFF	Handler I/F output Hi Indication Measurement
r0_c2	Resume function OFF	Handler I/F output Lo Indication Upper/lower limit value
r0_c3	Resume function OFF	Handler I/F output Hi Indication Upper/lower limit value
r1_c0	Resume function ON	Handler I/F output Lo Indication Measurement
r1_c1	Resume function ON	Handler I/F output Hi Indication Measurement
r1_c2	Resume function ON	Handler I/F output Lo Indication Upper/lower limit value
r1_c3	Resume function ON	Handler I/F output Hi Indication Upper/lower limit value

Resume function: Changes the settings of measurement conditions back to those just before power turning-off.
Handler I/F output: Shows the polarity of output signal of handler interface. (Valid for the ZM2354 only.)
Indication: Shows the condition of indication on Displays A and B when comparator is used.

Internal circuit check

After showing the version number and setting conditions for startup, the internal circuit will be checked.

Now, "SEtUP" is shown on Display A while countdown is conducted on Display B.

Display A	Display B
SEtUP	07 to 01

Settings of measurement conditions

If self-check detects no anomaly, the settings of ZM2353/ZM2354 will be made the initial values if resume function is disabled.
However, the GPIB address and terminator, the polarity of output signal of handler interface, and the indication items on Displays A and B when comparator is used will be the settings just before the last power turning-off.

Initial setting items when power switch is turned on

Display A	AUTO
Display B	(AUTO)
Deviation indication	NORM
Measurement frequency	1 kHz
Measurement level	1 Vrms
Equivalent circuit	AUTO
Measuring speed	MED2
DC bias	OFF
DC bias (INT/EXT)	INT
DC bias level	0 mV
Measurement range	AUTO
Trigger	AUTO
Trigger delay time	0.00 s
Reference value	0
Comparator upper/lower limit value	0 for all
Cable length	0 m
Beep	OFF
Strobe signal width	1 ms
Zero correction (OPEN/SHORT)	No correction

Items in which the settings just before last power turning-off is retrieved

GPIB address and terminator
Polarity of output signal of handler interface□
Indication items on Displays A and B when comparator is used (Measurement/Upper and lower limit values)

If the resume function is enabled and the LOCK signal of handler interface (ZM2354 only) is activated (low level), then the ZM2353/ZM2354 settings will be set to the settings just before last power turning-off.
On this occasion, also the zero correction value (OPEN/SHORT correction value) will be set to the value just before last power turning-off.

Should the setting data be lost due to memory backup error, "Err21" appears. When the error is fixed (pressing any button releases the error), the initial settings are retrieved.
Then, the GPIB address, the polarity of handler interface, and the indication items when comparator is used will be as follows: induction as much as possible.

GPIB address and terminator	Address 2 Terminator CRLF
Polarity of handler interface	Lo (low level)
Indication items when comparator is used	Measurement

Should the gain correction value be lost due to memory backup error

Should the gain correction value be lost due to memory backup error
"Err26" appears.
When the error is fixed (pressing any button releases the error), a temporary value is assigned to the gain correction value in order to resume measurement. However the precision of measurement cannot be guaranteed. In such cases, carry out gain correction (CAL) in system mode.

Indication of measurements

Selection of measurement parameter

Display A

AUTO: Automatic selection of parameters for Displays A and B and equivalent circuit from the measured test piece
L: Self-inductance (H)
C: Electrostatic capacity (F)
R: Resistance (Ω)
|Z|: Magnitude of impedance (Ω)

Display B

Q: Quality factor
D: Dissipation factor (= tan δ = 1/Q)
G: Parallel conductance (S)
X: Serial reactance (Ω)
ESR: Equivalent series resistance (Ω)
θ: Phase angle of impedance (deg)
V: Voltage monitor value (Vrms)
I: Current monitor value (Arms)
FREQ: Measurement frequency (Hz)
LEVEL: Measurement signal level (Vrms)
BIAS: Internal DC bias level (V)
RANGE: Measurement range
REF: Reference value

Indication format for parameter and range for indication

● |Z|, R, ESR, X

Format	Exponential expression
Resolution	4-1/2 digits (maximum 19999) Minimum resolution = 0.1 mΩ
Range of indication	0.0 m, ±(0.1 m to 19.999 M) Ω

● C

Format	Exponential expression
Resolution	4-1/2 digits (maximum 19999)
Range of indication	0.000 p, ±(0.001 p to 199.99 m) F

|C| ranges differently by frequency as follows:
For 40 to 150 Hz: 0.0 p to 199.99 mF
For 160 to 1.5 kHz: 0.00 p to 19.999 mF
For 1.6k to 15 kHz: 0.000 p to 1.9999 mF
For 16k to 159 kHz: 0.000 p to 199.99 μF
For 160k to 200 kHz: 0.000 p to 19.999 μF

● L

Format	Exponential expression
Resolution	4-1/2 digits (maximum 19999)
Range of indication	0.00 n, ±(0.01 n to 19.999 k) H

|L| ranges differently by frequency as follows:
For 40 to 150 Hz: 0.0 μ to 19.999 kH
For 160 to 1.5 kHz: 0.00 μ to 1.9999 kH
For 1.6k to 15 kHz: 0.000 μ to 199.99 H
For 16k to 159 kHz: 0.0 n to 19.999 H
For 160k to 200 kHz: 0.00 n to 1.9999 H

● Q, D

Format	Floating-point expression
Resolution	4-1/2 digits (maximum 19999)
Range of indication	.0000, ±(.0001 to 19999)

● G

Format	Exponential expression
Resolution	4-1/2 digits (maximum 19999)
Range of indication	0.0 n, ±(0.01 n to 199.99) S

● θ

Format	Floating-point expression
Resolution	0.01 deg
Range of indication	–180.00 to +179.99 deg

● V

Format	Exponential expression
Resolution	3-1/2 digits (maximum 1999)
Range of indication	0.0 m to 19.99 Vrms
Practical indication is shown only up to 5 V or so due to the output level.	

● I

Format	Exponential expression
Resolution	3-1/2 digits (maximum 1999)
Range of indication	0.0 μ to 19.99 mArms
Practical indication is shown only up to 50 mA or so due to the output level. In addition, resolution is limited by the measurement range as follows: 1 μA and more for reference resistance of 100 Ω 0.1 μA and more for reference resistance of 1 kΩ 0.01 μA and more for reference resistance of 10 k, 50 kΩ	

● Special indication

OF	Value is too great for indication.
UF	Value is too small for indication.
OU	Operation range of internal circuit is exceeded, disallowing normal measurement.

If any of the above indication appears, check the indication range, setting of range, condition of test piece connection, and noise induction.

● Others

For R, ESR and G, measurement range and resolution will be more limited with the phase angle θ being farther away from 0° or –180° (+180°).

For L, C and X, measurement range and resolution will be more limited with the phase angle θ being farther away from +90° or –90°.

The characteristic is indicated by the following lamps:
p for –12th power, n for –9th power, μ for –6th power, m for –3rd power.
k for 3rd power, M for 6th power.
A positive (+) sign is not shown.

Measurement conditions

Measurement frequency

☞ See "Setting the measurement frequency" in Chapter 4 "How to Measure".

Measurement signal level

☞ See "Setting the measurement frequency" in Chapter 4 "How to Measure".

When V or I is shown:

When you are selecting V or I for parameter on Display B by the B SELECT [PREV] [NEXT] buttons:

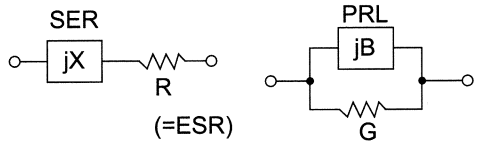
Press the [▲] and [▼] buttons of the MODIFY [◄] [▲] [▼] [►] buttons to change the value with the signal level being in minimum resolution.

Equivalent circuit

Selection of equivalent circuit

Even if an identical test piece is measured under the same measurement conditions, the resulting measurement is different depending on whether it was measured in series or in parallel.

This is because of the dissipation factor of the test piece.



$Z = R+jX$ $\quad Y = \frac{1}{Z} = G+jB$

$$\therefore \quad G+jB = \frac{1}{R+iX} = \frac{R}{R^2+X^2} - j\frac{X}{R^2+X^2}$$

If series resistance (R) and conductance (G) do not exist, the relation of Cs = Cp (Ls = Lp) holds.

For practical test piece measurement, however, they cannot be neglected, so the relation is Cs ≠ Cp (Ls ≠ Lp).

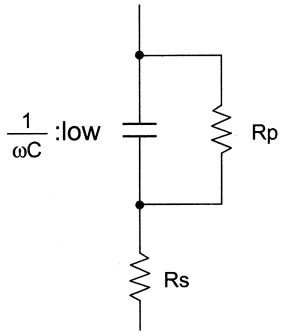
☞ See the following table titled "Dissipation Factor and Equivalent Circuit Conversion".

Dissipation Factor and Equivalent Circuit Conversion

Equivalent circuit		Dissipation factor	Conversion into another equivalent circuit
C	PRL	$D = \frac{G}{\omega Cp} = \frac{1}{Q}$	$Cs = (1+D^2)\,Cp,\ R = \frac{D^2}{1+D^2} \cdot \frac{1}{G}$
	SER	$D = \omega CsR = \frac{1}{Q}$	$Cp = \frac{1}{1+D^2}Cs,\ G = \frac{D^2}{1+D^2} \cdot \frac{1}{R}$
L	PRL	$D = \omega LpG = \frac{1}{Q}$	$Ls = \frac{1}{1+D^2}Lp,\ R = \frac{D^2}{1+D^2} \cdot \frac{1}{G}$
	SER	$D = \frac{R}{\omega Ls} = \frac{1}{Q}$	$Lp = (1+D^2)\,Ls,\ G = \frac{D^2}{1+D^2} \cdot \frac{1}{R}$
R	PRL	$D = \frac{1}{\omega CpRp} = \frac{\omega Lp}{Rp}$	$Rs = \frac{D^2}{1+D^2}\,Rp$
	SER	$D = \omega CsRs = \frac{Rs}{\omega Ls}$	$Rp = \frac{1+D^2}{D^2}\,Rs$

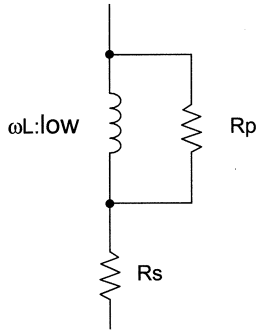
When in AUTO (automatic selection) mode, the impedance of the test piece selects SER or PRL at the border point of 1 kΩ. The reason for this is described below.

● If reactance is low:
Under conditions of low reactance, the circuit is as shown below.



Rp : Effect is low on $\frac{1}{\omega C}$.

Rs : Effect is high on $\frac{1}{\omega C}$.

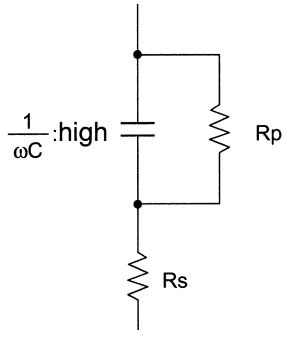


Rp : Effect is low on ωL.

Rs : Effect is high on ωL.

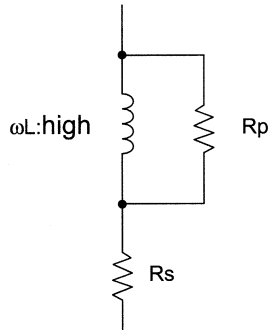
Therefore, measurement is conducted in SER (series).

● If reactance is high:
Under conditions of high reactance, the circuit is as shown below.



Rp : Effect is high on $\frac{1}{\omega C}$.

Rs : Effect is low on $\frac{1}{\omega C}$.



Rp : Effect is high on ωL.

Rs : Effect is low on ωL.

Therefore, measurement is conducted in PRL (parallel).

Measuring speed

☞ See "Selection of measuring speed" in Chapter 4 "How to Measure".

Measurement time

Measurement time depends on the frequency and range. The following are a broad time for guideline.

- Frequency is 1 kHz.
- Impedance of measured test piece is 1 kΩ/ (fixed to 1 kΩ range)

FAST	25 ms (typ)
MED1	64 ms (typ)
MED2	150 ms (typ)
SLOW	480 ms (typ)

Trigger

☞ For automatic trigger, see "Trigger mode" in Chapter 4 "How to Measure".

Manual trigger (manual trigger signal)

Once a trigger signal is accepted, measurement will be started.

When the measurement is finished, next measurement will not be started until a trigger signal is supplied.

The user can input a trigger signal using on the panel, through the GPIB, or by means of the handler interface (ZM2354 only).

When the system is in automatic trigger mode, reception of a trigger signal will change the mode from automatic trigger to manual trigger and measurement is triggered.

- The TRIG button, TRIG/CE

Every press on TRIG/CE will execute one measurement.

This button is activated only when it is local and the LOCK signal is inactive.

- Trigger-response command of GPIB (GET, "TG")

Activated only when it is remote. It will not be inactivated by LOCK signal.

- TRIG input of handler interface (ZM2354 only)

A trigger signal is supplied from the TRIG input terminal of the handler interface.

At the fall from high level to low level, the trigger signal will be effective, executing one measurement.

Trigger delay time

Using a manual trigger, the user can specify the time period from the reception of the trigger signal to the start of measurement.

This delay time should be set in the trigger delay item of the system menu.

The value must be in the range from 0.00 s to 199.99 s (with resolution of 10 ms).

During the time from the reception of trigger signal to the end of measurement that allows the test piece removal, the BUSY lamp keeps lighting.

DC bias

During measurement of a capacitor or another measurement can be conducted with a DC bias voltage applied.

The ZM2353/ZM2354 has a built-in 0 V to +2.5 V DC power source and it can also use an external DC power supply to apply DC bias voltage ranging from 0 to ±35 V to the test piece in order to execute measurement.

Setting of internal DC bias voltage

☞ See "Application of internal DC bias" in Chapter 4 "How to Measure".

⚠CAUTION

If DC bias is not used, set the internal DC bias voltage to 0 V.

External DC bias

Connect a DC power supply to the EXT BIAS IN terminal on the rear panel.
A red terminal (Hi) will be connected to the cable conductor part of the HCUR terminal of the UNKNOWN terminal on the front panel, and a white terminal (Lo) to the external conductor of the HCUR terminal.

If nothing is connected to the UNKNOWN terminal, the white terminal (Lo) of EXT BIAS IN is not connected to the housing. If a test fixture or test lead is connected to the UNKNOWN terminal, the white terminal (Lo) is connected to the housing.

If the user wants to connect an external DC power supply to the unit, set the voltage of the DC power supply to 0 V, and turn off the output of the DC power supply before connection.

⚠CAUTION

Only apply a voltage ranging 0 to ±35 V to the EXT BIAS IN terminal. Otherwise the ZM2353/ZM2354 failure or fire may be caused.

Use a DC power supply that is sufficiently low in ripple and noise (1 mVrms or lower). High ripple or noise may cause variation in measurements or disable measurement.

If the user wants to give a 10 V or higher voltage change, gradually change the voltage at the rate of 10 V/s or less.

Switching of internal DC bias/external DC

☞ See "Contents of system menu" in □ Chapter 7 "System Menu".

Measurement

Specify C or |Z| for parameter indication on Display A.

⇩

Connect a test piece.

⚠CAUTION

- For polar parts, pay extreme attention to the polarity.
- Be sure to discharge any charged capacitor before connect it to the unit.

By pressing ○BIAS ON, the user can turn on or off the DC bias. If the DC bias is turned on, the BIAS ON lamp lights up.

If the parameter on Display A is anything (including AUTO) other than C or |Z|, pressing ○BIAS ON will not turn on the DC bias, and an error message will appear.

⇩

If an external DC bias voltage has been selected, slowly raise the volt from 0 V, and when the measurement is finished, slowly lower the voltage to 0 V.

⇩

Take off the test piece.

MEMO

- If parameter of Display A is altered midway:
- If the mode is changed to system mode or bin setup mode:
- If zero correction is started:

⇩

The DC bias will be turned OFF automatically. It is necessary to turn on the DC bias again.

Bias stabilization time

When bias is turned on or off, or if the bias voltage is changed, it takes a certain period of time before the bias voltage becomes stabilized, disallowing measurement.

The time until normal measurement is available is broadly as follows:

Stabilization time = (6 + 0.015C) s

where C is the electrostatic capacity of the test piece (μF)

Measurement range

☞ See "Setting of measurement range" in Chapter 4 "How to Measure"

Measurement range for each range

☞ See the table below.

Setting frequency: 40 to 20 kHz

Range	Standard resistance	Lower limit extension	Applied impedance range (Ω)		
			Lower limit	Upper limit	Upper limit extension
1*	100 Ω	---	0	7	14
2	100 Ω	0.7	7	1.4 k	14 k
3	1 kΩ	700	1.4 k	14 k	140 k
4	10 kΩ	7 k	14 k	140 k	1.4 M
5	50 kΩ	40 k	140 k	1.4 M	∞
6*	50 kΩ	400 k	1.4 M	∞	--

Setting frequency: 21 k to 200 kHz

Range	Standard resistance	Lower limit extension	Applied impedance range (Ω)		
			Lower limit	Upper limit	Upper limit extension
1*	100 Ω	---	0	7	14
2	100 Ω	0.7	7	1.4 k	14 k
3	1 kΩ	700	1.4 k	14 k	140 k
4	10 kΩ	7 k	14 k	140 k	1.4 M
5	10 kΩ	70 k	140 k	1.4 M	∞
6*	10 kΩ	700 k	1.4 M	∞	--

MEMO

An asterisked range means an extension range.

The measurement range for each range is a value containing residual impedance and floating admittance effects rather than the impedance of the test piece itself.

In the case of automatic range, control determines it as the optimal range if it is within the range between the lower and upper limits of each range.

In the case of manual range, control shows the measurement as being in the range between the

Zero correction

The user can beforehand measure the floating admittance and residual impedance of test fixture, test lead and other measuring jigs and the connection cable. Thus, by using the obtained result, the user can make correction by that degree during measurement to seek the correct impedance of the test piece and to view the value.

Be careful!

- Result of zero correction is held in the backup memory, and if resume function is enabled, or if the LOCK signal of the handler interface is active, then the correction result will be read when the unit is powered and the system will return to the original correction state. Otherwise, the system will be in the state without zero correction when it is powered.
- During measurement for zero correction, the measurement signal level will be 1 V.
- Carry out zero correction whenever test fixture or test lead has been replaced.

Correction and abortion of correction

☞ See "Measurement in AUTO mode" in Chapter 4 "How to Measure".

OPEN: measurement of floating admittance

This measures the terminal-to-terminal capacity etc. when measurement terminals are released.

Press OPEN 8 and ENTER to start measurement of floating admittance, then control will show Display A "OP" and the countdown until the ending. In addition, Display B shows a value corresponding to the floating admittance.

When floating admittance has been measured, control returns to measurement state, although the indication of measurement remains blank until the measurement ends.

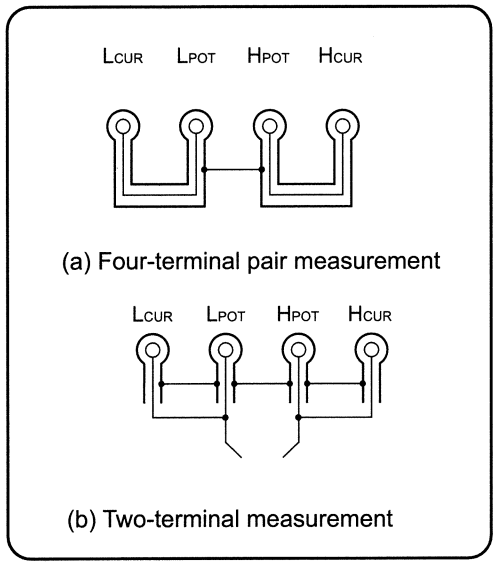


Fig. 4 OPEN Measurement

Be careful!

Always connect LCUR to LPOT and HPOT to HCUR. Connect four external conductors together at the measurement end. Take the same action over both OPEN and SHORT for connection of external conductor.OSC

SHORT: Measurement of residual impedance

This measures the resistance etc. when measurement terminals are short-circuited.

Press SHORT 5 and ENTER to start measurement of residual impedance, then control will show Display A "SH" and the countdown until the ending. In addition, Display B shows a value corresponding to the residual impedance

When the residual impedance has been measured, control returns to measurement state, although the indication of measurement remains blank until the measurement ends.

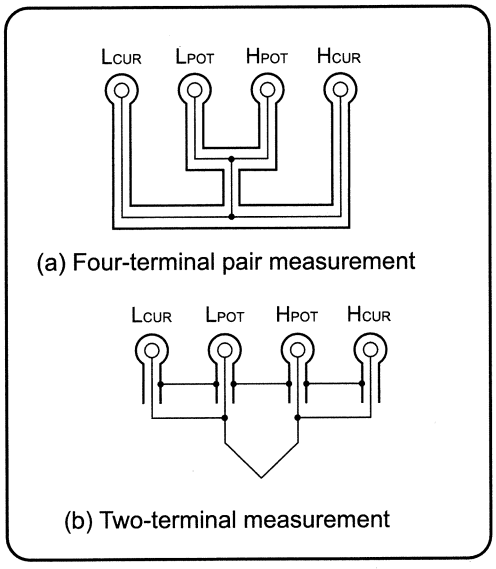


Fig. 5 SHORT Measurement

Abortion of correction

During execution of OPEN measurement, or during execution of SHORT measurement, the user can abort zero correction by pressing EXIT.

Also pressing any other button can abort the correction.

When OPEN or SHORT measurement is complete, the user can get the accurate measurement of the test piece being measurement by correcting the floating capacity and residual impedance of the test fixture, test lead and other measurement jigs and connection cables.

☞For zero correction when test fixture or test lead is used, see the manual for that test fixture or test lead.

Equivalent circuit of measurement system

The ZM2353/ZM2354 determines the residual impedance and floating admittance, calculates the true impedance using the equation below and shows the value of impedance provided that the state of measurement can be depicted by the circuit as shown below.

$$Zx = 1/(Ym - Ypp) - Zss$$

☞ See Fig 6 "Equivalent Circuit of Measurement System".

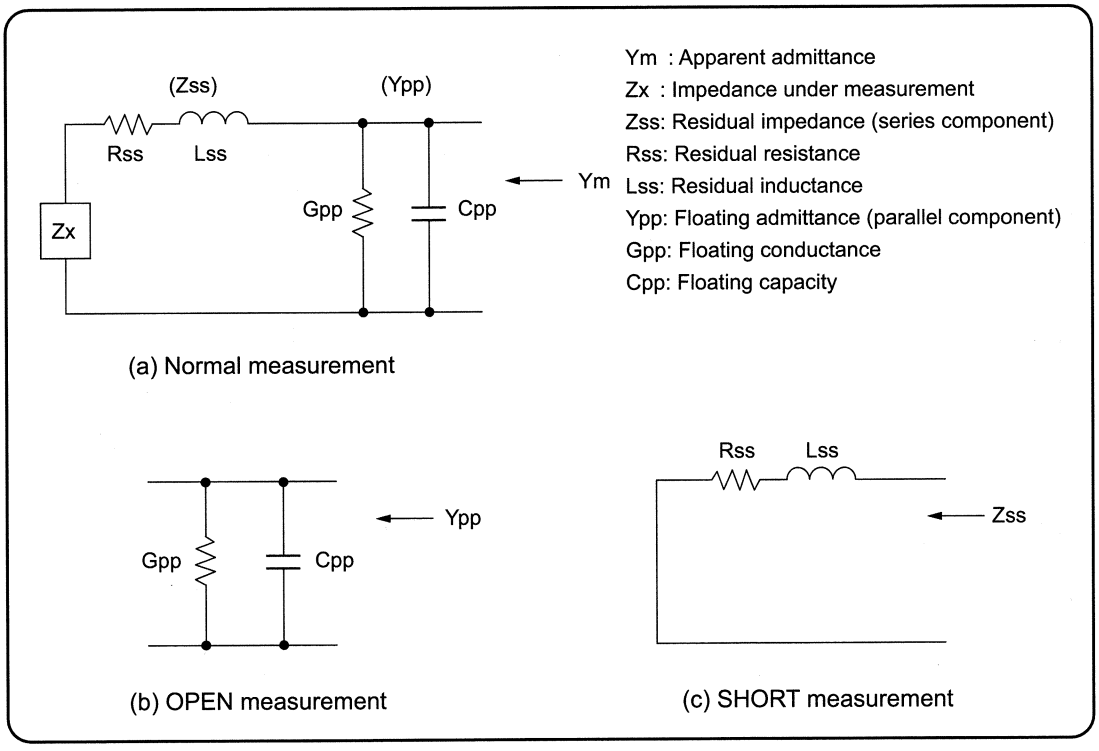


Fig. 6 Equivalent Circuit of Measurement System

Range for possible correction

The range for possible correction of floating admittance and residual impedance during OPEN or SHORT measurement is described below.

● Floating admittance

|Ypp| < 100 μS: Rpp > 10 kΩ (Rpp = 1/Gpp)
Cpp < ca. 160 pF at 100 kHz

● Residual impedance

|Zss| < $\sqrt{}$1000 Ω = ca. 31.623 Ω: Rss < ca. 30 Ω
Lss < ca. 50 μH at 100 kHz

Exceeding the above range for possible correction will cause an error, showing an error message "Err22".
Correction factor (value of zero) does not change.

Note that the ZM2353/ZM2354 measures the overall impedance that contains the floating admittance and residual impedance, and then corrects the floating admittance and residual impedance by calculation. Therefore, if the magnitude of the floating admittance and/or the residual impedance approaches (or further, exceeds) the magnitude of the impedance under measurement, the measurement precision will lower.

In the above case, calibration by means of external standard is required.

An error message "Err23" may appear if there is any problem in the reliability of zero correction value obtained through attenuation of the measurement signal level due to poor contact of the measurement terminals or other factors.

Comparator functions

The ZM2353/ZM2354 is provided with 20 bins (BINs 1 to 20) that correspond to Display A and another bin (BIN B) that corresponds to Display B.

Judgment of bin

Bin judgment starts with BIN 1. The system determines for each bin whether or not the value shown on Display A falls in the range between the upper and lower limit values. If it determines the value does not fall in the range for one bin, then it goes to the next bin and determines the value again.

If the upper limit value is equal to or lower than the lower limit value for a bin, the system does not make judgment for that bin, showing indication of "A NG", and it will not go further to the next bin number.

For BIN B, the system check if the value shown on Display B falls in the range between the upper and lower limit values set for BIN B.

If the upper limit value is equal to or lower than the lower limit value, the system does not make judgment for BIN B. If the parameter on Display B is FREQ, LEVEL, BIAS, RANGE, or REF, the system does not make judgment for BIN B either.

☞ See Fig. 8 "Example of Range Setting".

☞ See Fig. 7 "Bin Judgment".

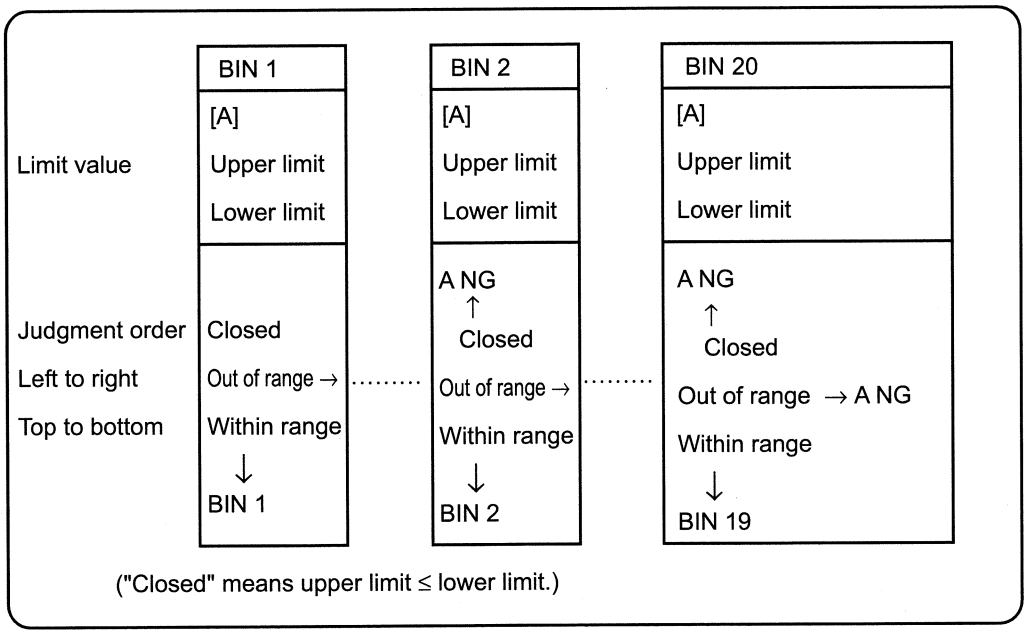
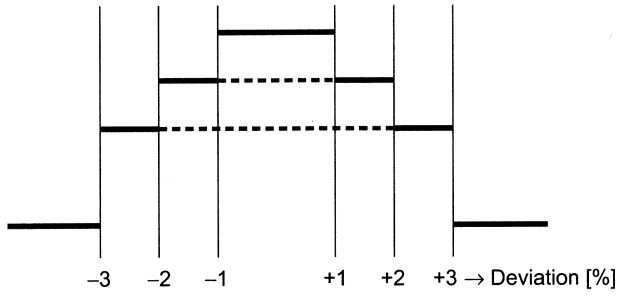


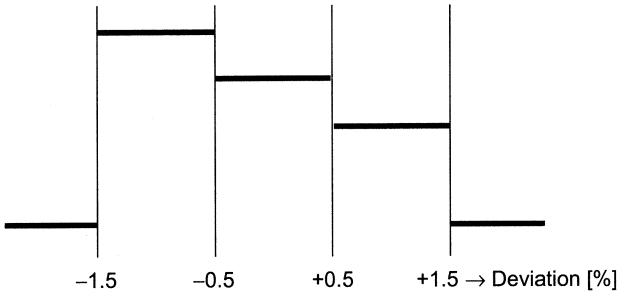
Fig. 7 Bin Judgment

BIN 1 : ±1%
BIN 2 : ±2%
BIN 3 : ±3%
A NG



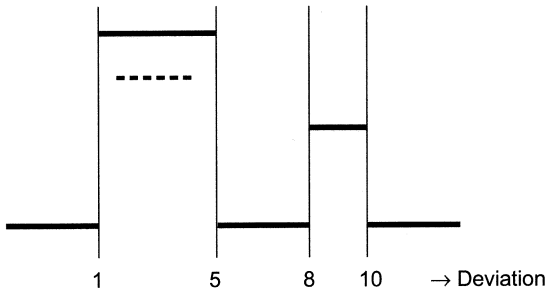
(a) Ranges overlapping each other

BIN 1 : –1.5 to –0.5%
BIN 2 : –0.5 to +0.5%
BIN 3 : +0.5 to +1.5%
A NG



(b) Consecutive ranges

BIN 1 : 1 to 5
BIN 2 : 2 to 4
BIN 3 : 8 to 10
A NG



(c) Specific setting

Note: A solid line ——— means the range to judge the value coming into the bin.
A dotted line - - - - means an invalid range due to overlapping.

Fig. 8 Example of Range Setting

Method of measurement (judgment)

● First, decide the parameter for judgment.
Parameters for Display A include L, C, R and |Z|.
For judgment on Display B, also decide the parameter for judgment out of Q, D, G, X, ESR, θ, V and I.
In this case, bin judgment is possible even if an AUTO parameter is set for Display A. However, it will be easier if parameters on Display A and B are fixed to execute measurement (judgment).

● For Display A judgment, decide whether to judge by measurement or to judge by deviation of percentage.
If the user wants to use deviation or percentage, enter the reference value (REF).
☞ See "Show deviation data" in Chapter 5 "Operation of Comparator Functions".

● Enter the upper limit value and the lower limit value for each bin number.
☞ See "Setting of comparator mode" in Chapter 5 "Operation of Comparator Functions".
To do this, enter the indication parameter of Display A or B and the measure for deviation or percentage.

Example: For C measurement, setting a range from 9 μF to 11 μF for judgment of 10 m μF:
- To judge by measurement, the range will be:
  Lower limit value of 9.000 μ, upper limit value of 11.000 μ
- To judge by deviation, the range will be:
  Lower limit value of –1.000 μ, upper limit value of 1.000 μ
- To judge by percentage, the range will be:
  Lower limit value of –10.000, upper limit value of 10.000

●Quit the bin setup mode, and press Δ/%/BIN to bring the system into a bin measurement state.
Select measurement (BIN), deviation (Δ BIN) or percentage (Δ %BIN) according to your intended setting range.

●Measurement (judgment)
Start measurement. The system determines if the measurement falls in the range defined by the upper and lower limit values for the first bin (BIN 1). If the measurement is judged to be in the range, control turns on the bin display lamp that corresponds to that bin number. Or else, control moves to the next bin (BIN 2), and repeat the above until the last bin is reached, if applicable.

If the measurement judged to be outside the range at the last bin, or if the judgment results in OF, UF or OU indication, then the A NG lamp will be turned on.

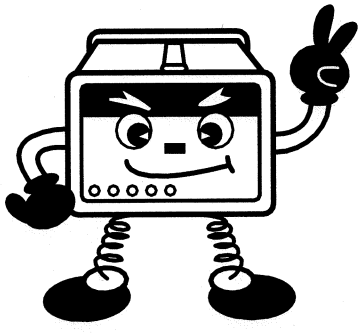
Gain correction

The system menu contains a CAL function, which carries out gain correction.

This function corrects the circuit inside the ZM2353/ZM2354. The user does not have to mind this function in normal measurement.
Before using this product in a hot environment (about 40°C) or a cold environment (about 5°C), adjust the gain correction (CAL) so that the measured value approximates room temperature (23°C ±5°C).

If an error message "Err26" appears when the ZM2353/ZM2354 is powered, the gain correction value is lost, which means the measurement precision (accuracy) is not guaranteed. Carry out gain correction before starting measurement.
Perform a warm-up run for at least 30 minutes before adjusting the gain.

Maintenance and Calibration 9



Outline

The following maintenance is required to keep the ZM2353/ZM2354 in the best condition for use.

- Operation check and performance test

Check if the ZM2353/ZM2354 is functioning properly, and its ratings are met.

- Fault detection

If the ratings are not met, the system seeks the cause for failure and defective parts.

- Fault repair

This instruction manual contains only the items of operation check that the user can carry out easily and the procedure of performance test. For advanced inspection, calibration and fault repair, contact NF Corporation or NF representatives.

⚠CAUTION

Never open the case when the power cord is connected to the ZM2353/ZM2354 except for those service technicians who have sufficient knowledge of electrical safety and the ZM2353/ZM2354 construction. High voltage is live at the power supply part of the ZM2353/ZM2354, contact to which may cause electric shock.

Prepare the following measuring instruments and standards for maintenance of ZM2353/ZM2354.

- Frequency counter: Precision of ±5ppm; reciprocal system is preferable (to measure 1 kHz).
- AC voltmeter: Precision of ±1.0%, 10 mV to 1 Vrms, 40 Hz to 100 kHz
  ±4.0%, 10 mV to 1 Vrms, 101 k to 200 kHz
- DC voltmeter: Precision of ±0.5%,
- Oscilloscope: Band of 10 MHz or higher
- Standard resistor: 10, 100, 1 k, 10 k, 100 kΩ
- Standard capacitor: 10 p, 100 p, 1 n, 10 n, 100 n, 1 μF
- Standard inductor: 1 mH, 10 mH, 100 mH, 1 H

The precision of calibration for the standard should be set within 1/3 of the guaranteed precision for the ZM2353/ZM2354 (0.03% at the best).

Prepare a standard with as excellent frequency characteristics as practicable.

Use a standard resistor with known equivalent series inductance and equivalent parallel capacitance.

Operation check and performance test

Confirmation of operation environment

The following maintenance is required to keep the ZM2353/ZM2354 in the best condition for use.

- Power supply voltage: The voltage set by the power voltage selector switch ±10%
- Ambient temperature and humidity: 23 ±5°C, 5 to 85%RH
  provided that the condition must meet the requirements for the standard and measuring instruments used.

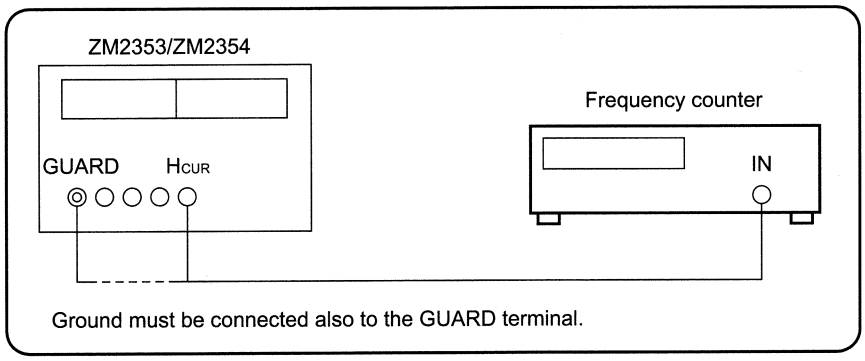
Check of driving signal source

- Precision of frequency (±0.01%)

  Measurement signal level = 1 Vrms

  DC bias = OFF

  Frequency = 1 kHz



Check of frequency

- Measurement signal level (1 V ±(10% + 3 mV), 50 mV ±(10% + 3 mV))

  Frequency = 1 kHz

  DC bias = OFF

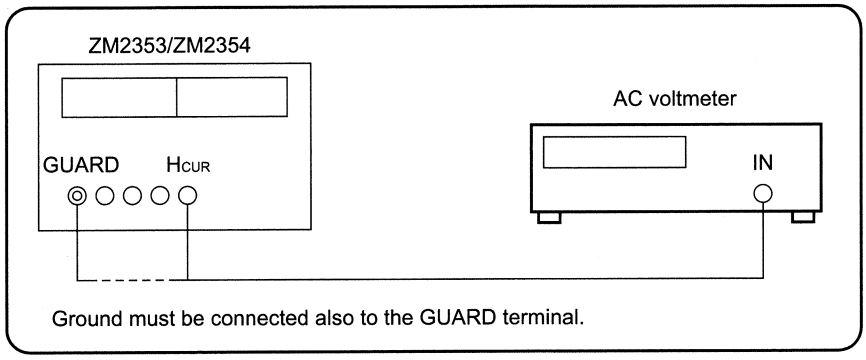
  Measurement signal level = 1 V, 50 mV

- Level frequency characteristics (up to 100 kHz: ±(10% + 3 mV); 101 kHz to 200 kHz: ±(15% + 5 mV))

  Measurement signal level = 1 V

  DC bias = OFF

  Frequency = 40, 100, 120, 200, 1k, 2k, 10k, 20k, 100k, 200k [Hz]



Check of Measurement Signal Level and Frequency Characteristics

- Internal DC bias (if ON: 2 V ±(5% ±10 mv), if OFF: ±10 mV)

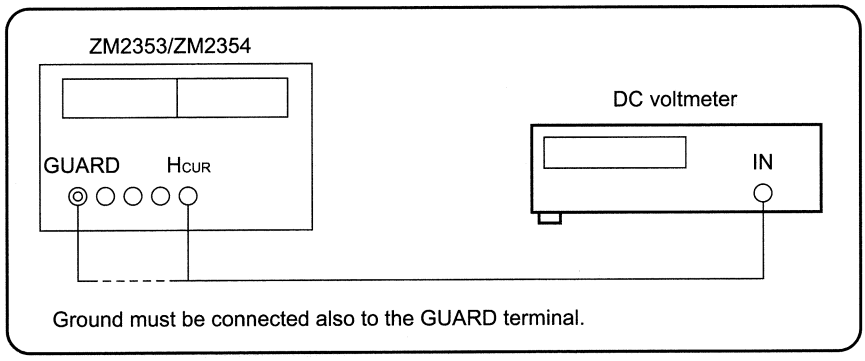
  Frequency = 1 kHz

  Measurement signal level = 50 mV

  Internal DC bias level = 2 V

  DC bias = ON (internal bias power supply is used)

  OFF

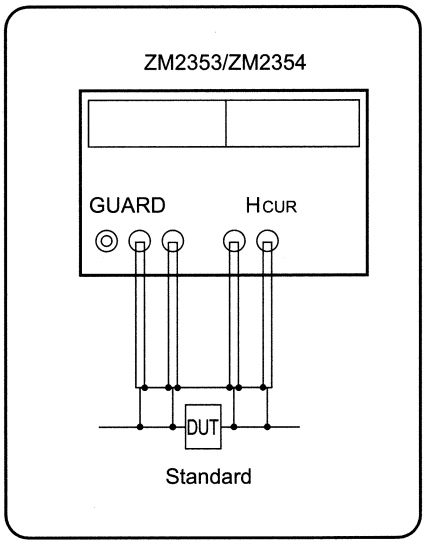


Check of DC Bias

Check of measurement accuracy

☞ For the accuracy of the ZM2353/ZM2354, see "Table of Basic Accuracy" in Chapter 12 "Ratings".

- If the conditions meet following two equations, then the specifications are completely met.
  The guaranteed accuracy of the ZM2353/ZM2354 > The accuracy of calibration of the standard
  |Measurement − Calibration value of the standard| < The guaranteed accuracy − The accuracy
- of calibration of the standard
  Conversely, if the conditions meet the following equation, then the specifications are not met at all.



Use preferably a four-terminal connection pair.
Use as short a connection cable as possible.
Heat run for 30 minutes or longer.
Carry out zero correction.
Set AUTO for the range.
Indication must be |Z| – θ.
Connect four external conductors of the cables together near the standard. inductance or equivalent parallel capacitance.

Check of Measurement Accuracy

- R

R [Ω]	40	100	120	200	500	1 k	2 k	5 k	10 k	20 k	50 k	100 k
10												
100												
1 k												
10 k												
100 k												

If the equivalent series inductance and equivalent parallel capacitance of the standard are known, then first calculate the impedance at each frequency from these values and the calibrated value of DC resistance. If the equivalent series inductance or equivalent parallel capacitance is unknown, then use it in the range that allows usage by the user discernment from the frequency characteristics of the standard. If the user has a 1 MHz impedance meter, it is possible to determine the broad value of the equivalent series inductance or equivalent parallel capacitance.

- C

C [Ω]	Frequency [Hz]											
	40	100	120	200	500	1 k	2 k	5 k	10 k	20 k	50 k	100 k
10 p												
100 p	--	--	--	--	--							
1 n												
10 n												
100 n												
1 μ												

Calculate the impedance at each frequency from the calibration values. "C" and "D" may be used for calibration.

Use it within the guaranteed frequency range of the standard

- L

L [H]	Frequency [Hz]											
	40	100	120	200	500	1 k	2 k	5 k	10 k	20 k	50 k	100 k
1 m	--	--	--	--	--							
10 m												
100 m												
1												

Calculate the impedance at each frequency from the calibration values. "L" and "Q" may be used for calibration.

Use it within the guaranteed frequency range of the standard. Since a wire-wound resistor of standard inductance is prone to temperature change, a great change will be caused in impedance at such low frequency that a change of only 0.5 decrease "Q". Therefore, we recommend the user to calibrate only the Ls value at a frequency that would produce a "Q > 1" condition even in a normal room although it may be just a simple method. Incidentally, the ZM2353/ZM2354 cannot measure a dummy inductor consisting of C and R because of the low impedance between the LCUR terminal and the ground. Therefore, do not use a dummy inductor for calibration.