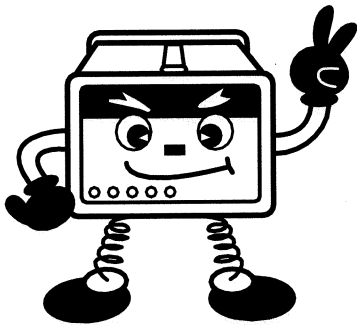


Error Messages

11





Error messages

The following sections describe major error messages.

If any message that is not described here appears (e.g., "FFFFF" on A, "66666" on B), malfunction may have been caused by a strong external noise. In such cases, first turn off the power, wait three seconds or so, and then turn on the power again.

If it often occurs, the ZM2353/ZM2354 may have some failure. Contact the NF Corporation or its sales representative.

The ZM2353/ZM2354 has possibility for errors to take place in the following conditions:

- During self-check (on power turning-on, OPEN and SHORT zero correction and gain correction)
- When setting is made from panel
- Setting or query through GPIB
- Selection of comparator from the handler interface (ZM2354 only)

In addition to the above, "OF", "UF" and "OU" may appear during measurement.



Note

Error numbers are shown on Display B.

Some errors entail an auxiliary status shown on Display A.

Error during self-check

Error messages that appear during self-check include two types: ROM/RAM check errors and other errors due to anomaly in hardware excepting the memory.

Either of the above cannot be released.

If an error message appears, try again to turn on the switch.

If any of these error messages often appears, it is suspected that the ZM2353/ZM2354 is not functioning properly.

ROM/RAM check error

Display A	Display B	Description
EEEE	9999	ROM error
EEEE	7777 to 4444	RAM error
EEEE	3333	Model identification error
EEEE	2222	Calibration data error

Errors due to anomaly in hardware excepting the memory

Display A	Display B	Description
Auxiliary status	Err50 to Err79	Attributable to anomaly in hardware



Errors on setting from panel and setting through GPIB

Errors on setting are caused by wrong operation.

These errors can be released.

When setting

Display A	Display B	Description
--	Err12	Entered value exceeded the specified range.
--	Err14	Trial was made to turn on DC bias when Display A is AUTO, L or R. DC bias can be turned on only when AUTO is released on Display A or when Display A is C or Z .
--	Err15	Trial was made to change parameter setting by B SELECT button when settings on Displays A and B are indication of upper/lower limit values for use of comparator.

When Executing

Display A	Display B	Description
--	Err21	Battery backup error. When anomaly is detected in the memory (setting of measurement conditions, zero correction, gain correction) that backups the battery, this error message appears. In addition, the memory in which the anomaly has been detected will be reset to the initial setting state (default values). (Similarity for GPIB address)
Auxiliary status	Err22	Zero correction value exceeds the allowable range. During zero correction, after completion of self-check is complete, when residual impedance or floating admittance is measured, if the value for each frequency exceeds the range of correctable values, this error message appears. The range of correctable values is as follows: $ Z_{ss} < \sqrt{1000} \Omega = \text{ca. } 31.623 \Omega$: $R_{ss} < \text{ca. } 30 \Omega$ $L_{ss} < \text{ca. } 50 \mu\text{H at } 100 \text{ kHz}$ $ Y_{pp} < 100 \mu\text{S}$: $R_{pp} > 10 \text{ k}\Omega$ ($R_{pp} = 1/G_{pp}$) $C_{pp} < \text{ca. } 160 \text{ pF at } 100 \text{ kHz}$ If the value is outside the above range at each measurement frequency, an error message appears range and stops execution of correction for that frequency and more.

Display A	Display B	Description
--	Err23	<p>During zero correction, the voltage applied to the test piece or the flowing current is extremely low.</p> <p>If the measurement signal level is not normal when measuring at each frequency during zero correction, this error message appears. When this takes place, check the measurement signal level, and check if a normal measurement signal is supplied.</p>
Auxiliary status	Err25	<p>During gain correction (when doing CAL), the value of gain is sharply different.</p> <p>When doing CAL (during gain correction), if the gain correction value cannot be determined in a normal way, this error message appears. If this error takes place when doing CAL (during gain correction), remove the error and return to the initial value.</p>
--	Err26	<p>Gain correction value is not changed from the initial value.</p> <p>When checking the memory that is backed up, if the gain correction value remains the initial one, this error message appears.</p> <p>When this takes place, carry out gain correction (CAL) of system mode, then start measurement.</p> <p>If the gain correction value is the initial one, the measurement precision cannot be guaranteed.</p>



Errors in GPIB

Display A	Display B	Description
--	Err31	Reception buffer is overflowed. The program code was too long to be put in the reception buffer. (All program codes will become invalid.)
--	Err32	Illegal header A undefined header was received.
--	Err33	Illegal header Query was tried when only setting was allowed. Setting was tried when only query was allowed.
--	Err34	Illegal parameter No parameter is found when parameter is needed.
--	Err35	Illegal parameter No delimiter "," to separate parameters is found. Shortage of parameters



Releasing errors

Errors during self-check

Errors that arise during self-check cannot be released in principle.

Effects of disturbance noise and anomaly in the internal circuit of the main unit are suspected. Try to turn on the power again to remove the error.

If the error arises again when the power is turned on, the ZM2353/ZM2354 is suspected to have some defects.

Releasing errors during panel setting and errors in GPIB

These errors can be removed by pressing any buttons on the panel, and by Device Clear from GPIB.

When any panel button is pressed to remove the error, this pressing does not execute its proper function.

If the message indicates a GPIB setting error, any GPIB command will not be executed unless Device Clear is issued or any panel button is pressed to remove the error.



Errors during measurement

Errors may be indicated by "OF", "UF" or "OU" when measurement is executed.

These errors are caused by abnormal completion of measurement or measurement data exceeding the range of indication.

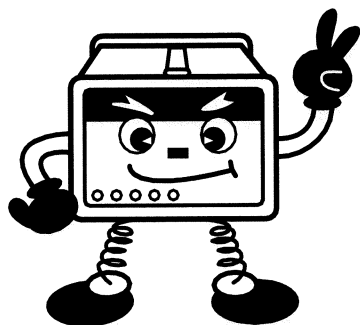
OF: shown when measurement data is greater than the selected indication range.

UF: shown when measurement data is smaller than the selected indication range.

OU: shown when measurement data was not obtained in the normal procedure.

Rating

12





Indication parameters

Types of parameters

● Main parameters (on Display A)

AUTO	Automatically selects main parameter, sub parameter, and equivalent circuit.
L	Self inductance (units: H, henry)
C	Electrostatic capacity (units: F, farad)
R	Resistance (units: Ω , ohm)
Z	Magnitude of impedance (units: Ω , ohm) Each of L, C, and R contains series and parallel.

● Sub parameters (on Display B)

Sub parameters include measurement parameters and setting parameters.

Measurement parameters:

Q	Quality factor (excellence of circuit)
D	Dissipation factor ($= \tan \delta = 1/Q$)
ESR	Equivalent series resistance (units: Ω , ohm)
G	Parallel conductance (units: S, siemens)
X	Serial reactance (units: Ω , ohm)
θ	Phase angle of impedance (units: degree)
V	Voltage monitor (Effective (r.m.s.) value of fundamental wave of measurement signal applied to the test piece, units: Vrms)
I	Current monitor (Effective (r.m.s.) value of fundamental wave of measurement signal flowing through the test piece, units: Arms)

Setting parameters:

FREQ	Measurement frequency (units: Hz)
LEVEL	Measurement signal level (units: Vrms)
BIAS	DC bias (units: V)
RANGE	Measurement range
REF	Reference value for measurement shown as the main parameter

● Equivalent circuit

AUTO	Automatic selection
SER	Series
PRL	Parallel

● Indication of deviation

Δ	Indication of main parameter deviation (indication range: $\pm 100\%$ or more of the reference value)
$\Delta\%$	Indication of main parameter deviation in percentage (indication range: $\pm 199.99\%$)

Indication of sub parameter deviation and its percentage cannot be shown.

- Automatic selection of parameters

The phase angle of impedance switches the parameters.

$\theta = +90 \pm 30^\circ$	→	L - Q
$\theta = 0 \pm 30^\circ$	→	R - Q
$\theta = -90 \pm 30^\circ$	→	C - D
$\theta = \text{Other than the above}$	→	$ Z - \theta$

- Automatic selection of equivalent circuit

Selection will be made by combination of parameters and the value and the phase angle of impedance.

Conditions to select series:

L, C, R, $ Z $	- ESR, X
L, C ($ Z \leq 1 \text{ k}\Omega$)	- Q, D, θ , V, I, setting parameter
R ($\theta \geq 0$)	- Q, D, θ , V, I, setting parameter
$ Z $	- Q, D, θ , V, I, setting parameter

Conditions to select parallel

L, C, R, $ Z $	- G
L, C ($ Z > 1 \text{ k}\Omega$)	- Q, D, θ , V, I, setting parameter
R ($\theta < 0$)	- Q, D, θ , V, I, setting parameter

Resolution of indication

- 4-1/2 digits (19999 max)
 - Maximum resolution of D and Q: 0.0001
 - Resolution of θ : 0.01°

- 3-1/2 digits (1999 max)
 - Maximum resolution of V: 0.1 mV
 - Maximum resolution of I:
 - 1 μ A (at reference resistance of 100 Ω)
 - 0.1 μ A (at reference resistance of 1 k Ω)
 - 0.01 μ A (at reference resistance of 10 k Ω and 50 Ω)

Measurement (indication) range

R, Z , ESR, X:	0.0 m Ω to 19.999 M Ω
C:	0.000 pF to 199.99 mF
	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 μ F
	For 160k to 200 kHz: 0.000 p to 19.999 μ F
L:	0.00 nH to 19.999 kH
	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:	0.000 to 19999
G:	0.0 nS to 199.99 S
θ :	-180.00° to +179.99°
V:	0.0 mVrms to 19.99 Vrms
	(Actual measurement range is around 5.00 Vrms.)
I:	0.00 μ Arms to 199.9 mArms
	(Actual measurement range is around 50.0 mArms.)



Accuracy

- Conditions for guaranteed accuracy

Heat run:	30 minutes or longer
Ambient temperature and humidity:	23 ±5°C, 5 to 80%RH
Gain correction:	Gain correction (CAL) is executed before measurement.
Zero correction:	Executed when the above conditions have been met.
Term:	For 12 months after shipment or after calibration

Accuracy for $|Z| - \theta$

- Condition of measurement

Measurement signal level:s	1 Vrms
Measuring speed:	MED2 or SLOW
Cable length:	0 m (the measurement terminal on the front panel)
Refer to Table, "Table of Basic Accuracy".	

Supplement 1

In the vicinity of the power supply frequency (50 Hz, 60 Hz) and 3 times and 5 times that frequency, the variance of measurement may go beyond the range of accuracy due to the induction from the power supply.

Supplement 2

For practical measurement accuracy, add ±1/2 count of the indication.

Supplement 3

This does not include any additional errors due to test fixtures and test leads.

Table of Basic Accuracy

Impedance $ Z (\Omega)$	Frequency									
	40~190	200~490	500~990	1k	1.1k~5k	5.1k~10k	11k~20k	21k~50k	51k~100k	101k~200k
$0S \leq Y \leq 50nS^{*1}$	2.7n	1.8n	1.2n	0.6n	1.2n	2.1n	2.5n	7.5n	12.0n	—
$20M > Z \geq 10M$	4.5 2.3°	3.0 1.5°	2.0 1.0°	1.0 0.8°	2.5 2.0°	3.5 2.0°	4.0 3.0°	14.0 8.0°	20.0 12.0°	—
$10M > Z \geq 5M$	2.4 1.5°	1.5 0.9°	1.1 0.7°	0.7 0.5°	1.2 0.8°	1.8 1.1°	2.0 1.3°	7.0 4.0°	10.0 6.0°	—
$5M > Z \geq 2M$	1.2 0.8°	0.9 0.6°	0.7 0.5°	0.5 0.35°	1.0 0.6°	1.2 0.7°	1.5 0.9°	4.0 2.5°	7.0 4.0°	14.0 8.0°
$2M > Z \geq 1M$	0.7 0.4°	0.45 0.3°	0.35 0.2°	0.3 0.15°	0.6 0.35°	0.7 0.4°	1.0 0.6°	1.6 1.0°	3.0 2.0°	6.0 4.0°
$1M > Z \geq 130k$	0.45 0.3°	0.35 0.2°	0.25 0.15°	0.2 0.12°	0.27 0.2°	0.3 0.25°	0.4 0.3°	1.0 0.6°	2.0 1.2°	4.0 2.4°
$130k > Z \geq 13k$	0.3 0.18°	0.2 0.12°	0.15 0.09°	0.1 0.04°	0.2 0.12°	0.25 0.15°	0.3 0.2°	0.6 0.4°	1.0 0.7°	2.0 1.5°
$13k > Z \geq 1.3k$	0.3 0.18°	0.2 0.12°	0.12 0.05°	0.1 0.03°	0.12 0.06°	0.15 0.08°	0.2 0.12°	0.4 0.3°	0.7 0.5°	1.0 0.7°
$1.3k > Z \geq 10$	0.4 0.25°	0.25 0.15°	0.15 0.09°	0.1 0.03°	0.11 0.08°	0.13 0.1°	0.17 0.15°	0.4 0.25°	0.7 0.5°	1.0 0.7°
$10 > Z \geq 2$	0.8 0.5°	0.5 0.3°	0.3 0.18°	0.15 0.07°	0.2 0.12°	0.32 0.2°	0.5 0.3°	0.8 0.4°	1.5 0.8°	2.0 1.5°
$2 > Z \geq 1$	1.4 0.9°	1.0 0.6°	0.6 0.3°	0.3 0.18°	0.4 0.25°	0.5 0.3°	0.7 0.4°	1.0 0.6°	1.5 1.0°	3.0 2.0°
$1 > Z \geq 0.5$	3.0 2.0°	1.6 1.0°	1.0 0.6°	0.6 0.36°	0.7 0.4°	0.8 0.5°	1.2 0.7°	1.7 1.0°	3.3 2.0°	6.6 4.0°
$0.5 > Z \geq 0.2$	6.0 4.5°	3.5 2.5°	2.0 1.5°	1.3 0.8°	1.4 0.9°	1.6 1.0°	1.8 1.1°	2.7 1.6°	5.5 3.0°	11.0 6.0°
$0.2 > Z \geq 0^{*2}$	9.0 1.2m	7.0 0.6m	4.0 0.3m	2.5 0.2m	3.3 0.2m	3.7 0.3m	4.0 0.6m	6.0 1.5m	7.0 3.0m	13.0 6.0m

Accuracy of $|Z|$: The value in the upper field; in \pm (percentage of reading) excepting those values less than 0.2 Ω .

Accuracy of θ : The value in the lower field, in \pm degree.

The accuracy of impedance value of 5 M Ω or higher is not specified at frequency of 101 kHz or higher.

*1. The accuracy for the case of $|Y| \leq 50$ nS ($|Z| \geq 20$ M Ω) is defined as follows:

Magnitude: Specified by the \pm deviation (S) of admittance $|Y|$.

Phase: (phase accuracy of 10 M Ω to 20 M Ω) x ($|Z| / 20$ M Ω)

* 2. The accuracy for the case of $|Z| < 0.2$ Ω is defined as follows:

Magnitude: \pm [Percentage of reading (the value in the upper field)] + [Impedance deviation in Ω (the value in the lower field)]

Phase: (The value in the upper field x 0.7) x (0.2 $\Omega / |Z|$)

Additional error due to measurement conditions

In practical measurement, determine the accuracy ACC of $|Z|$ and θ from "Table of Basic Accuracy" based on the obtained measurement, and multiply that ACC by the factors shown below as follows:

Accuracy of actual $|Z|$ and $\theta = \pm(\text{ACC} \times K_{lv} \times K_{sp} \times K_{cb} \times K_{tp})$

- K_{lv}: The factor defined by the measurement signal level
- K_{sp}: The factor defined by the measuring speed
- K_{cb}: The factor defined by the cable length
- K_{tp}: The factor defined by the ambient temperature

(1) Additional error by the measurement signal level

Multiply the value with the following factor according to the setting of measurement signal level.

Measurement signal level (V)	Factor (K _{lv})
5.00 ~ 1.41	3.0
1.40 ~ 1.21	2.0
1.20 ~ 801m	1.0
800m ~ 471m	2.0
470m ~ 141m	3.0
140m ~ 48m	6.0
47m ~ 10m	12.0

Supplement 1

When measurement signal level is set to 140 mV or lower, if the measurement frequency is 21 kHz or higher and the impedance value is 1 MΩ or higher ($|Z| \geq 1 \text{ M}\Omega$), then accuracy is not guaranteed.

Supplement 2

When measurement signal level is set to 140 mV or lower, if the impedance value is lower than 0.2 Ω ($|Z| < 0.2 \Omega$), then accuracy is not guaranteed.

Supplement 3

When measurement signal level is set to 140 mV or lower, if the impedance value is 10 MΩ or higher ($|Z| \geq 10 \text{ M}\Omega$), then accuracy is not guaranteed.

(2) Additional error due to measuring speed

Multiply the value with the following factor according to the setting of measuring speed.

Measuring speed	Factor (K _{sp})
SLOW, MID2	1.0
MID1	2.0
FAST	4.0

(3) Additional error by the cable length

Multiply the value with the following factor according to the length of cable.

Cable length	Factor (Kcb)
0m	1.0
1m	1.5
2m	2.0
4m	4.0

Supplement 1

With the cable length set to 2 m, accuracy is not guaranteed for impedance less than 0.2Ω ($|Z| < 0.2 \Omega$) or equal to or greater than $10 \text{ M}\Omega$ ($|Z| \geq 10 \text{ M}\Omega$).

Supplement 2

With the cable length set to 4 m, accuracy is not guaranteed for impedance less than 0.2Ω ($|Z| < 0.2 \Omega$) or equal to or greater than $10 \text{ M}\Omega$ ($|Z| \geq 10 \text{ M}\Omega$).

Supplement 3

With the cable length set to 4 m, accuracy is not guaranteed if the measurement

(4) Additional error by ambient temperature

Multiply the value with the following factor according to the ambient temperature.

Ambient temperature	Factor (Ktp)
$5^\circ\text{C} \leq \text{Ambient temperature} < 18^\circ\text{C}$	2.0
$18^\circ\text{C} \leq \text{Ambient temperature} \leq 28^\circ\text{C}$	1.0
$28^\circ\text{C} < \text{Ambient temperature} \leq 40^\circ\text{C}$	2.0

Supplement

Accuracy is not guaranteed for the ambient temperature that is outside the above range.

Accuracy of R, ESR and G

If $Q < 0.1$ ($D > 10$), apply the accuracy of $|Z|$.

$$R: |Z| = |R|$$

$$\text{ESR: } |Z| = |\text{ESR}|$$

$$G: |Z| = 1/|G|$$

For practical measurement accuracy, add $\pm 1/2$ count of the indication.

Accuracy of L, C and X

If $Q > 10$ ($D > 0.1$), apply the accuracy of $|Z|$.

$$L: |Z| = |2\pi f L|$$

$$C: |Z| = |1/(2\pi f C)|$$

$$X: |Z| = |X|$$

"f" stands for frequency [Hz].

For practical measurement accuracy, add $\pm 1/2$ count of the indication.

Accuracy of Q and D

If $D \ll 1$ ($Q \gg 1$), apply the following equation,

$$\text{Accuracy of } D = \pm(0.0175 \times \text{Phase accuracy(deg)})$$

$$\text{Accuracy of } Q = \pm(0.0175 \times \text{Phase accuracy(deg)} \times Q^2)$$

For practical measurement accuracy, add $\pm 1/2$ count of the indication.

Accuracy of V and I

$$\text{Accuracy of } V \text{ and } I = \pm(10\% + \text{Measurement accuracy of impedance } |Z|)$$

However, accuracy is not guaranteed for the frequency of 101 kHz or higher.

For practical measurement accuracy, add $\pm 1/2$ count of the indication.

Accuracy of other items

Procedure of determining the accuracy for parameters other than $|Z|$ and θ where accuracy of $|Z|$ is not applicable

(1) Measure $|Z|$ and θ . Or otherwise, calculate them from other parameters.

$Q = 1/D$ $= 2\pi f \cdot L_s/ESR$ $= 1/(2\pi f \cdot C_s \cdot ESR)$ $= 2\pi f \cdot C_p/G$ $= 1/(2\pi f \cdot L_p \cdot G)$	$ \theta = \arctan Q $ $ Z = 2\pi f \cdot L_s/\sin \theta $ $= 1/(2\pi f \cdot C_s \cdot \sin \theta) $ $= \sin \theta/(2\pi f \cdot C_p) $ $= 2\pi f \cdot L_p \cdot \sin \theta $
---	--

"f" stands for frequency [Hz]. Suffix "s" denotes a serial equivalent circuit while suffix "p" denotes a parallel equivalent circuit.

(2) Determine the accuracy of $|Z|$ and θ from "Table of Basic Accuracy" and additional errors.

(3) From the measurement and accuracy of $|Z|$ and θ , determine the maximum and minimum of $|Z|$ and θ .

$$|Z|_{\max, \min} = \text{Measurement of } |Z| \times (1 \pm \text{Accuracy of } |Z| [\%] / 100)$$

$$\theta_{\max, \min} = \text{Measurement of } \theta \pm \text{Accuracy of } \theta \text{ (degree)}$$

(4) In the calculation equation for each parameter, seek the maximum and minimum out of four combinations of maximum and minimum of $|Z|$ and θ .

$R_s = Z \cos \theta$ $ESR = Z \cos \theta$ $X = Z \sin \theta$ $L_s = X/(2\pi f)$ $C_s = -1/(2\pi f \cdot X)$ $Q = \sin \theta /\cos \theta$	$R_p = Z /\cos \theta$ $G = (1/ Z)\cos \theta$ $B = -(1/ Z)\sin \theta$ $L_p = -1/(2\pi f \cdot B)$ $C_p = B/(2\pi f)$ $D = \cos \theta / \sin \theta $
---	---

B is the susceptance (the imaginary part of admittance).

(5) Add the error for 1/2 count of the indication value to |Maximum – Measurement| or |Minimum – Measurement|, whichever is greater, and the sum will be the accuracy.

How to determine actual accuracy

This does not include any additional errors due to test fixtures and test leads.

- What will be the accuracy when $R = 33 \text{ k}\Omega$ is measured at 10 kHz and 1 V?
(where $Q < 0.1$, measuring speed is MID2, cable length is 0 m, and ambient temperature is 23°C)
 - (1) From "Table of Basic Accuracy", determine the accuracy for frequency of 10 kHz and segment of $|Z|$ (13 k to 130 k Ω).
 - (2) From the additional error, determine the factor for measurement signal level, K_{lv} , the factor for measuring speed, K_{sp} , the factor for cable length, K_{cb} , and the factor for ambient temperature, K_{tp} .
 - (3) Multiply the accuracy of "Table of Basic Accuracy" by K_{lv} , K_{sp} , K_{cb} and K_{tp} to seek the actual accuracy (in this case, all factors are 1).
 - (4) Add $\pm 1/2$ count of the indication.

- What will be the accuracy when $C = 10 \mu\text{F}$ is measured at 1 kHz and 50 mV (under the condition of $D < 0.1$)?
 - (1) Determine $|Z|$ from "LC \rightarrow $|Z|$ Conversion Graph".
Locate the intersection of the falling line of $C = 10 \mu\text{F}$ and the vertical line of frequency = 1 kHz.
From the intersection point, extend a horizontal line until it reaches the impedance $|Z|$, where read the value of $|Z|$ (ca. 16 Ω). Or otherwise, carry out the calculation of $|Z| = |1 / (2\pi fc)|$.
 - (2) From "Table of Basic Accuracy", determine the accuracy for frequency of 1 kHz and segment of $|Z|$ (10 to 1.3 k Ω).
 - (3) From the measurement conditions, determine the factor for measurement signal level, which is the additional error, K_{lv} , the factor for measuring speed, K_{sp} , the factor for cable length, K_{cb} , and the factor for ambient temperature, K_{tp} .
(In this case, the measurement signal level factor, K_{lv} is 6.0)
 - (4) Multiply the accuracy of "Table of Basic Accuracy" by K_{lv} , K_{sp} , K_{cb} and K_{tp} to seek the actual accuracy.
 - (5) Add $\pm 1/2$ count of the indication.

- What will be the accuracy when $L = 100 \text{ mH}$ is measured at 10 kHz (provided that $Q > 10$)?
 - (1) Determine $|Z|$ from "LC \rightarrow $|Z|$ Conversion Graph".
Locate the intersection of the rising line of $L = 100 \text{ mH}$ and the vertical line of frequency = 10 kHz. From the intersection point, extend a horizontal line until it reaches the impedance $|Z|$, where read the value of $|Z|$ (ca. 6.3 k Ω). Or otherwise, carry out the calculation of $|Z| = |2\pi fL|$.
 - (2) From "Table of Basic Accuracy", determine the accuracy for frequency of 10 kHz and segment of $|Z|$ (1.3 k to 13 k Ω).
 - (3) From the measurement conditions, determine the factor for measurement signal level, which is the additional error, K_{lv} , the factor for measuring speed, K_{sp} , the factor for cable length, K_{cb} , and the factor for ambient temperature, K_{tp} .
 - (4) Multiply the accuracy of "Table of Basic Accuracy" by K_{lv} , K_{sp} , K_{cb} and K_{tp} to seek the actual accuracy.
 - (5) Add $\pm 1/2$ count of the indication.

Measurement signal

Frequency

Range:	40 Hz to 200 kHz	
Resolution:	40 Hz to 99 kHz:	Two digits resolution
	100 kHz to 200 kHz:	Three digits resolution
Accuracy:	±0.01%	

Signal level (the voltage when drive terminal H_{CUR} is open)

Range:	10 mVrms to 5 Vrms	
Resolution:	10 mVrms to 999 mVrms:	1 mV resolution
	1 Vrms to 5 Vrms:	10 mV resolution
Accuracy:	±(10% + 3 mV) when 40 Hz to 100 kHz	
	±(15% + 5 mV) when 101 kHz to 200 kHz	

However, abnormal operation may occur when voltage exceeding 5 V or current exceeding 50 mA is actually applied to the device under testing.

DC bias

Internal	Range:	0 mV to 2.5 V	
	Resolution:	0 mV to 999 mV:	1 mV resolution
		1 V to 2.5 V:	10 mV resolution
	Accuracy:	±(5% + 10 mV)	
External	Range:	0 V to ±35 V	
	Input terminal:	Binding post on rear panel	

Measurement range

Number of ranges:	6 (Reference resistor: 100 Ω, 1 kΩ, 10 kΩ, 50 kΩ, two up/down extension ranges)
Switching:	Automatic and manual

Measuring speed (for reference)

Measurement time (fixed range, automatic trigger)

FAST:	25 ms (typ) for measurement at 1 kHz and 1 k Ω
MED1:	64 ms (typ) for measurement at 1 kHz and 1 k Ω
MED2:	150 ms (typ) for measurement at 1 kHz and 1 k Ω
SLOW:	480 ms (typ) for measurement at 1 kHz and 1 k Ω

Automatic range selection time (per range)

The value is almost equal to the measurement time.

If the frequency is 500 Hz or lower and the impedance is 1 M Ω or higher, it may take some time until stable measurement is obtained. For test pieces of which impedance varies with the measurement signal level, it may take some time until the value of the test piece stabilizes.

Level-change stabilizing time

200 ms to 4 s

The time varies with test pieces.

This stabilizing time becomes longer when a diode or other nonlinear element is measured, or when voltage is switched from 5 V to 50 mV.

This time is necessary for measurement to stabilize, excluding the time for change in test piece.

DC bias stabilizing time

$(6 + 0.015C)$ s, where C is the electrostatic capacity [μ F] of the test piece

The time varies with test pieces.

This time is necessary for measurement to stabilize, excluding the time for change in test piece.

Frequency-change stabilization time

150 ms to 4 s

It takes longer time if the frequency is changed from high to low (e.g., 100 kHz to 100 Hz).

The time also varies with test pieces.

This time is necessary for measurement to stabilize, excluding the time for change in test piece.

Trigger

Trigger mode: Automatic (repetition) and manual
Trigger delay time: 0 s to 199.99 s (minimum resolution of 0.01 s)

Measurement terminal

Four terminals (BNC-R) + one guard terminal

Residual charge protection (for reference)

Maximum protection voltage $V = \sqrt{16/C}$

However, $V \leq 250$ V and C is the capacitance (F) of the device under testing

This maximum protection voltage value is only a reference value; it is not guaranteed.

Comparator function

Number of classes: Maximum 21
Main parameter judgment: Upper and lower limits can be set for judgment for 1 to 20 bins.
Sub parameter judgment: Conformity judgment for one pair of upper and lower limits.

Setting memory (Battery backup)

Number of memories: 10 (One of ten memories stores the last data just before the power is turned off.)
Battery life: Three years or longer after shipping provided that it is stored at 40°C or lower.

Handler interface (ZM2354 only)

Connector

50-pin multi-connector (DDK 57-40500 or equivalent)

Output signal

BIN 1 to BIN 20:	Main parameter (display A) bin judgment signal
BIN B:	Sub parameter (display B) judgment signal
A NG:	Main parameter (display A) defective
B NG:	Sub parameter (display B) defective
STROBE:	Judgment complete pulse
EOM:	Measurement complete pulse
BUSY:	Under measurement flag

Input signal

TRIG:	Start measurement trigger
LOCK:	Disable panel operation
SET 0 to SET 3:	Select memory

Signal level

TTL level negative logic
Output can be reversed to positive logic.

Signal ground

Signal ground of the handler interface is isolated from the enclosure.
Voltage across the grounds must be within ± 42 Vdc.

Beeper

The user can select to issue beep on measurement completion.
Beep on/off can be changed.

Strobe signal width

The pulse width of strobe signal can be modified.
Setting range: 1 ms to 19.999 s with resolution of 1 ms
The width of actually issued strobe is about ± 1 ms to the set value.

GPIB

Specification: Conforms to IEEE-488.1-1987
Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0

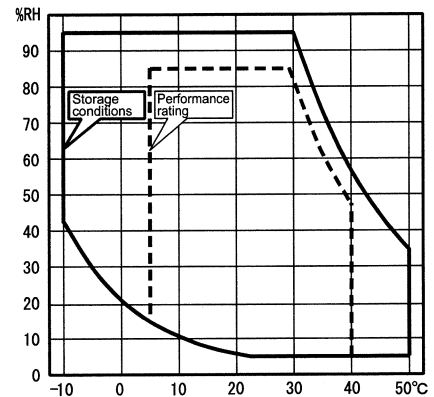
General matters

Power supply

Voltage: 100/115/230 V AC $\pm 10\%$
Frequency: 50/60 Hz ± 2 Hz
Power consumption: 50 VA or less

Range of temperature and humidity to guarantee the performance

+5 to +40°C, 5 to 85%RH
(Absolute humidity: 1 to 25 g/m³, no condensation)
For specifications for some parts, further restriction may exist on the range of temperature and humidity.



Range of temperature and humidity for storage

-10 to +50°C, 5 to 95%RH (no dew condensation)
(Absolute humidity: 1 to 29 g/m³, no condensation)

Outside dimensions

216(W) x 132.5 (H) x 330 (D) mm (projections not included)

Mass

Approximately 4.7 kg (only main unit, excluding accessories)

WARRANTY

NF Corporation certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period of, **NF** will, at its option, either will repair the defective product without any charge for the parts and labor, or either repair or replace products which prove to be defective. For repair service under warranty, the product must be returned to a service center designated by **NF**. Purchaser shall prepay all shipping cost, duties, and taxes for the product to **NF** from another country, and **NF** shall pay shipping charge to returned the product to purchaser.

This warranty shall not apply to any defect, failure or damage caused by improper use, improper or inadequate maintenance and care or modified by purchaser or personnel other than **NF** representatives.

NF Corporation

If there are any misplaced or missing pages, we will replace the manual. Contact the sales representative.

NOTES:

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

Copyright 2005, **NF Corporation**

ZM2353/ZM2354 LCR METER Instruction Manual

NF Corporation

6-3-20 Tsunashima Higashi, Kohoku-ku. Yokohama
223-8508, JAPAN

Phone: +81-45-545-8111 Fax: +81-45-545-8191

