

# **RIGOL**

## **Performance Verification Guide**

### **DM3058/DM3058E Digital Multimeter**

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RIGOL Technologies, Inc.



# Guaranty and Declaration

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Website: [www.rigol.com](http://www.rigol.com)

# Safety Requirement

## General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injury or damage to the instrument and any product connected to it. To prevent potential hazards, please use the instrument only specified by this manual.

### **Use Proper Power Cord.**

Only the power cord designed for the instrument and authorized for use within the local country could be used.

### **Ground the Instrument.**

The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, it is essential to connect the earth terminal of the power cord to the Protective Earth terminal before connecting any inputs or outputs.

### **Connect the Probe Correctly.**

If a probe is used, do not connect the ground lead to high voltage since it has isobaric electric potential as the ground.

### **Observe All Terminal Ratings.**

To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting the instrument.

### **Use Proper Overvoltage Protection.**

Make sure that no overvoltage (such as that caused by a thunderstorm) can reach the product, or else the operator might be exposed to the danger of electrical shock.

### **Do Not Operate Without Covers.**

Do not operate the instrument with covers or panels removed.

### **Do Not Insert Anything Into the Holes of Fan.**

Do not insert anything into the holes of the fan to avoid damaging the instrument.

### **Use Proper Fuse.**

Please use the specified fuses.

### **Avoid Circuit or Wire Exposure.**

Do not touch exposed junctions and components when the unit is powered.

### **Do Not Operate With Suspected Failures.**

If you suspect damage occurs to the instrument, have it inspected by **RIGOL**

authorized personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or accessories must be performed by **RIGOL** authorized personnel.

**Keep Well Ventilation.**

Inadequate ventilation may cause an increase of instrument temperature which would cause damage to the instrument. So please keep the instrument well ventilated and inspect the intake and fan regularly.

**Do Not Operate in Wet Conditions.**

In order to avoid short circuiting to the interior of the device or electric shock, please do not operate the instrument in a humid environment.

**Do Not Operate in an Explosive Atmosphere.**

In order to avoid damage to the device or personal injuries, it is important to operate the device away from an explosive atmosphere.

**Keep Product Surfaces Clean and Dry.**

To avoid the influence of dust and/or moisture in the air, please keep the surface of the device clean and dry.

**Electrostatic Prevention.**

Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

**Proper Use of Battery.**

If a battery is supplied, it must not be exposed to high temperature or in contact with fire. Keep it out of the reach of children. Improper change of battery (note: lithium battery) may cause explosion. Use **RIGOL** specified battery only.

**Handling Safety.**

Please handle with care during transportation to avoid damage to buttons, knob interfaces and other parts on the panels.

## Safety Terms and Symbols

**Terms Used in this Manual.** These terms may appear in this manual:

**WARNING**

Warning statements indicate conditions or practices that could result in injury or loss of life.

**CAUTION**

Caution statements indicate conditions or practices that could result in damage to this product or other property.

**Terms Used on the Product.** These terms may appear on the product:

**DANGER** It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.

**WARNING** It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.

**CAUTION** It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

**Symbols Used on the Product.** These symbols may appear on the product:



**Hazardous  
Voltage**



**Safety  
Warning**



**Protective  
Earth  
Terminal**



**Chassis  
Ground**



**Test  
Ground**

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## Allgemeine Sicherheits Informationen

Überprüfen Sie die folgenden Sicherheitshinweise sorgfältig um Personenschäden oder Schäden am Gerät und an damit verbundenen weiteren Geräten zu vermeiden. Zur Vermeidung von Gefahren, nutzen Sie bitte das Gerät nur so, wie in diesem Handbuch angegeben.

### **Um Feuer oder Verletzungen zu vermeiden, verwenden Sie ein ordnungsgemäßes Netzkabel.**

Verwenden Sie für dieses Gerät nur das für ihr Land zugelassene und genehmigte Netzkabel.

### **Erden des Gerätes.**

Das Gerät ist durch den Schutzleiter im Netzkabel geerdet. Um Gefahren durch elektrischen Schlag zu vermeiden, ist es unerlässlich, die Erdung durchzuführen. Erst dann dürfen weitere Ein- oder Ausgänge verbunden werden.

### **Anschluss eines Tastkopfes.**

Die Erdungsklemmen der Sonden sind auf dem gleichen Spannungspegel des Instruments geerdet. Schließen Sie die Erdungsklemmen an keine hohe Spannung an.

### **Beachten Sie alle Anschlüsse.**

Zur Vermeidung von Feuer oder Stromschlag, beachten Sie alle Bemerkungen und Markierungen auf dem Instrument. Befolgen Sie die Bedienungsanleitung für weitere Informationen, bevor Sie weitere Anschlüsse an das Instrument legen.

### **Verwenden Sie einen geeigneten Überspannungsschutz.**

Stellen Sie sicher, daß keinerlei Überspannung (wie z.B. durch Gewitter verursacht) das Gerät erreichen kann. Andernfalls besteht für den Anwender die Gefahr eines Stromschlages.

### **Nicht ohne Abdeckung einschalten.**

Betreiben Sie das Gerät nicht mit entfernten Gehäuse-Abdeckungen.

### **Betreiben Sie das Gerät nicht geöffnet.**

Der Betrieb mit offenen oder entfernten Gehäuseteilen ist nicht zulässig. Nichts in entsprechende Öffnungen stecken (Lüfter z.B.)

### **Passende Sicherung verwenden.**

Setzen Sie nur die spezifikationsgemäßen Sicherungen ein.

### **Vermeiden Sie ungeschützte Verbindungen.**

Berühren Sie keine unisolierten Verbindungen oder Baugruppen, während das Gerät in Betrieb ist.

**Betreiben Sie das Gerät nicht im Fehlerfall.**

Wenn Sie am Gerät einen Defekt vermuten, sorgen Sie dafür, bevor Sie das Gerät wieder betreiben, dass eine Untersuchung durch **RIGOL** autorisiertem Personal durchgeführt wird. Jedwede Wartung, Einstellarbeiten oder Austausch von Teilen am Gerät, sowie am Zubehör dürfen nur von **RIGOL** autorisiertem Personal durchgeführt werden.

**Belüftung sicherstellen.**

Unzureichende Belüftung kann zu Temperaturanstiegen und somit zu thermischen Schäden am Gerät führen. Stellen Sie deswegen die Belüftung sicher und kontrollieren regelmäßig Lüfter und Belüftungsöffnungen.

**Nicht in feuchter Umgebung betreiben.**

Zur Vermeidung von Kurzschluß im Geräteinneren und Stromschlag betreiben Sie das Gerät bitte niemals in feuchter Umgebung.

**Nicht in explosiver Atmosphäre betreiben.**

Zur Vermeidung von Personen- und Sachschäden ist es unumgänglich, das Gerät ausschließlich fernab jedweder explosiven Atmosphäre zu betreiben.

**Geräteoberflächen sauber und trocken halten.**

Um den Einfluß von Staub und Feuchtigkeit aus der Luft auszuschließen, halten Sie bitte die Geräteoberflächen sauber und trocken.

**Schutz gegen elektrostatische Entladung (ESD).**

Sorgen Sie für eine elektrostatisch geschützte Umgebung, um somit Schäden und Funktionsstörungen durch ESD zu vermeiden. Erden Sie vor dem Anschluß immer Innen- und Außenleiter der Verbindungsleitung, um statische Aufladung zu entladen.

**Die richtige Verwendung des Akku.**

Wenn eine Batterie verwendet wird, vermeiden Sie hohe Temperaturen bzw. Feuer ausgesetzt werden. Bewahren Sie es außerhalb der Reichweite von Kindern auf. Unsachgemäße Änderung der Batterie (Anmerkung: Lithium-Batterie) kann zu einer Explosion führen. Verwenden Sie nur von **RIGOL** angegebenen Akkus.

**Sicherer Transport.**

Transportieren Sie das Gerät sorgfältig (Verpackung!), um Schäden an Bedienelementen, Anschlüssen und anderen Teilen zu vermeiden.



## Sicherheits Begriffe und Symbole

**Begriffe in diesem Guide.** Diese Begriffe können in diesem Handbuch auftauchen:



### **WARNING**

Die Kennzeichnung WARNING beschreibt Gefahrenquellen die leibliche Schäden oder den Tod von Personen zur Folge haben können.



### **CAUTION**

Die Kennzeichnung Caution (Vorsicht) beschreibt Gefahrenquellen die Schäden am Gerät hervorrufen können.

**Begriffe auf dem Produkt.** Diese Bedingungen können auf dem Produkt erscheinen:

- DANGER** weist auf eine Verletzung oder Gefährdung hin, die sofort geschehen kann.
- WARNING** weist auf eine Verletzung oder Gefährdung hin, die möglicherweise nicht sofort geschehen.
- CAUTION** weist auf eine Verletzung oder Gefährdung hin und bedeutet, dass eine mögliche Beschädigung des Instruments oder anderer Gegenstände auftreten kann.

**Symbole auf dem Produkt.** Diese Symbole können auf dem Produkt erscheinen:



**Gefährliche  
Spannung**



**Sicherheits-  
Hinweis**



**Schutz-erde**



**Gehäusemasse**



**Erde**

# Document Overview

This manual guides users to correctly test the performance specifications of **RIGOL** DM3058/DM3058E digital multimeter. For the operation methods mentioned during the test process, refer to the User's Guide of this product.

## The Main topics of this manual:

### Chapter 1 Test Overview

This chapter introduces the preparations before performing the performance verification test.

### Chapter 2 Performance Verification Test

This chapter introduces the routine test methods of DM3058/DM3058E performance verification test.

### Appendix Test Record Form

The appendix provides a test record form for users to record the test results so as to determine whether the performance specifications meet the requirements.

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# Chapter 1 Test Overview

## Test Type

The performance verification test is used to test the measurement performance of the instrument. You can select from two levels of verification tests (quick test and routine test).

### Quick Test

The quick test is an easy way to inspect the functions and specifications of the multimeter with higher confidence level. It contains only a few test points and can evaluate the accuracy drift of the multimeter in normal use; however, it cannot detect abnormal element failures.

For the quick test, you only need to test the items marked with "Q" in "**Chapter 2 Performance Verification Test**".

**Tip**

The quick test is not applicable to instruments with abnormalities in some certain functions. The multimeter that fails to pass the quick test must be calibrated or repaired before it is put back into use.

### Routine Test

It is recommended that you perform routine test when you obtain the multimeter for the first time and please compare the routine test results with the values of the "1-year Test Limit" in Table 2-1 to Table 2-6 in "**Chapter 2 Performance Verification Test**". After that, you can verify the performance of the instrument at the end of each calibration interval. It is recommended that you calibrate the instrument at the end of each calibration interval.

**Tip**

The multimeter that passes the test must be tested again when the test time interval expires. The multimeter that fails to pass the test must be calibrated or repaired before it is put back into use.

## Test Devices

You are recommended to use the devices listed in Table 1-1 to test DM3058/DM3058E digital multimeter. If you do not have these devices, please use other devices that can meet the "**Precision Requirement**" in the table below.

Table 1-1 Recommended Device List

| Item        | Recommended Device | Precision Requirement                           |
|-------------|--------------------|---|
| Zero Offset | None               | Pure copper 4-terminal short-circuiter          |
| DC Voltage  | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| DC Current  | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| Resistance  | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| AC Voltage  | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| AC Current  | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| Frequency   | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |
| Capacitance | Fluke 5520A        | <1/5 of the 1-year parameters of the instrument |

## Test Conditions

For the optimum performance, all the procedures should comply with the following recommendations.

1. Provide proper working voltage for the device.
2. Make sure the environment temperature is stable and between 18°C and 28°C. Ideally, the calibration should be performed at 23°C ±2°C.
3. Make sure the environment relative humidity is lower than 80%.
4. Make sure that the instrument has been warmed up for more than 1 hour before the test or calibration.
5. Use copper connectors to reduce the effect of thermoelectric potential.
6. Use Teflon shielded twisted pair (as short as possible) to reduce the effect of external interference. When making capacitance verification, use coaxial cable to minimize the external interference and noise.
7. Ground the shield of the twisted pair and the shield of the coaxial cable. Unless otherwise noted, ground the LO terminal of the calibrator.

As DM3058/DM3058E digital multimeter is a high-precision measuring instrument, special care should be paid during the verification to avoid causing additional error. Ideally, the accuracy of the standard source of the verification should be more than 5

times higher than the accuracy specification of the test instrument.

When performing the DC voltage, DC current and resistance gain calibrations, the "0" output of the calibrator must be correct. To reduce the error caused by the connecting cable, the connecting cable must be adequately warmed up (for about 5 minutes) each time when the connecting cable or the short-circuiter is re-connected.

## Input Connection

For the zero offset verification, please use copper or copper alloy low thermoelectric potential 4-terminal short-circuiter. For the capacitance verification, please use coaxial cable and connect its shielding layer with the LO terminal. For the verifications of the other functions, please use Teflon shielded twisted pair (as short as possible) to connect the multimeter and calibrator; the HI and LO terminals must be connected with twisted pair; the HI-Sense and LO-Sense terminals must be connected with the twisted pair. The shielding layer of the cable must be connected to the reference ground. This kind of connection can reduce the effect of the thermoelectric potential and external interference.

## Test Result Record

Record and keep the test result of each test. In "**Appendix Test Record Form**" of this manual, a test result record form of DM3058/DM3058E digital multimeter which lists all the test items and their corresponding performance specification limits as well as spaces for users to record the test results, is provided.

### Tip

It is recommended that users photocopy the test record form before each test and record the test results in the copy so that the form can be used repeatedly.

## Specifications

The test limits of each test item, calculated based on the technical specifications of DM3058/DM3058E, is provided in chapter 2. For the technical specifications of DM3058/DM3058E, refer to *DM3058/DM3058E User's Guide* or *DM3058/DM3058E Data Sheet* (can be downloaded from [www.rigol.com](http://www.rigol.com)).





## Chapter 2 Performance Verification Test

This chapter introduces the routine test methods of DM3058/DM3058E performance verification test and the quick test methods are also contained.

### Zero Offset Verification

The zero offset verification inspects the zero offset performance of the multimeter. It is necessary only when a regular offset occurs to a function and range.

**The zero offset verification procedures are as follows.**

1. Make sure you have carefully read the "Test Conditions".
2. Use a 4-terminal short-circuiter to short-circuit the Input HI-LO and Sense HI-LO terminals and open the current input terminal, as shown in Figure 2-1.
3. Test the functions under different ranges specified in Table 2-1 one by one. Set the reading rate to "Slow" and turn off all the math operations.
4. Compare the test results with the test limits in the table.

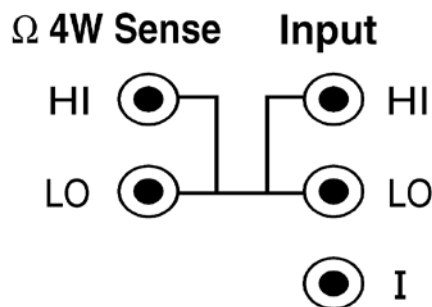


Figure 2-1 Short-circuit the Input HI-LO and Sense/Ref HI-LO Terminals

Table 2-1 Zero Offset Verification Table

| Function <sup>[1]</sup>   | Range      | Input signal | Quick Test       | 1-year Test Limit |             |
|---------------------------|------------|--------------|------------------|-------------------|-------------|
|                           |            |              |                  | Upper Limit       | Lower Limit |
| DC Voltage                | 200.000 mV | short        | Q <sup>[3]</sup> | 8 μV              | -8 μV       |
|                           | 2.00000 V  | short        |                  | 60 μV             | -60 μV      |
|                           | 20.0000 V  | short        |                  | 800 μV            | -800 μV     |
|                           | 200.000 V  | short        |                  | 6 mV              | -6 mV       |
|                           | 1000.00 V  | short        |                  | 30 mV             | -30 mV      |
| DC Current                | 200.000 μA | open         | Q                | 10 nA             | -10 nA      |
|                           | 2.00000 mA | open         |                  | 100 nA            | -100 nA     |
|                           | 20.0000 mA | open         | Q                | 4 μA              | -4 μA       |
|                           | 200.000 mA | open         |                  | 16 μA             | -16 μA      |
|                           | 2.00000 A  | open         |                  | 400 μA            | -400 μA     |
|                           | 10.0000 A  | open         |                  | 1 mA              | -1 mA       |
| Resistance <sup>[2]</sup> | 200.000 Ω  | short        | Q                | 10 mΩ             | -10 mΩ      |
|                           | 2.00000 kΩ | short        |                  | 60 mΩ             | -60 mΩ      |
|                           | 20.0000 kΩ | short        |                  | 600 mΩ            | -600 mΩ     |

|  |                    |       |   |              |               |
|--|--------------------|-------|---|--------------|---------------|
|  | 200.000 k $\Omega$ | short |   | 6 $\Omega$   | -6 $\Omega$   |
|  | 2.00000 M $\Omega$ | short | Q | 80 $\Omega$  | -80 $\Omega$  |
|  | 10.0000 M $\Omega$ | short |   | 300 $\Omega$ | -300 $\Omega$ |
|  | 100.000 M $\Omega$ | short |   | 4 k $\Omega$ | -4 k $\Omega$ |

**Note**<sup>[1]</sup>: The reading rate is set to "Slow".

**Note**<sup>[2]</sup>: Specifications are for the 4-wire resistance function or the 2-wire resistance function using "REL" operation. If the 2-wire resistance function is used without "REL" operation, add 0.2  $\Omega$  additional errors.

**Note**<sup>[3]</sup>: Q marks the optional quick test points.

## Gain Verification

The gain verification inspects the accuracy of the multimeter under full range. It is necessary only when a regular gain offset occurs to a function and range.

### 1. The DC gain verification procedures

- (1) Make sure you have carefully read the "Test Conditions".
- (2) Connect the input terminals of the multimeter with the calibrator.
- (3) Test the functions under different ranges specified in Table 2-2 one by one. Set the reading rate to "Slow" and turn off all the math operations. For the DC voltage and DC current measurement functions, turn off the "Filter".
- (4) Input the signals specified in Table 2-2 using the calibrator and compare the test results with the test limits in the table (make sure the output of the calibrator is built adequately).

Table 2-2 Standard Device DC Gain Error

| Function <sup>[1]</sup>   | Range           | Test Signal  | Quick Test       | 1-year Test Limit |                  |
|---------------------------|-----------------|--------------|------------------|-------------------|------------------|
|                           |                 |              |                  | Upper Limit       | Lower Limit      |
| DC Voltage                | 200.000 mV      | 200 mV       |                  | 200.038 mV        | 199.962 mV       |
|                           | 200.000 mV      | -200 mV      |                  | -199.962 mV       | -200.038 mV      |
|                           | 2.00000 V       | 2 V          | Q <sup>[5]</sup> | 2.00036 V         | 1.99964 V        |
|                           | 2.00000 V       | -2 V         | Q                | -1.99964 V        | -2.00036 V       |
|                           | 20.0000 V       | 20 V         | Q                | 20.0038 V         | 19.9962 V        |
|                           | 20.0000 V       | -20 V        | Q                | -19.9962 V        | -20.0038 V       |
|                           | 200.000 V       | 200 V        |                  | 200.036 V         | 199.964 V        |
|                           | 200.000 V       | -200 V       |                  | -199.964 V        | -200.036 V       |
|                           | 1000.00 V       | 1000 V       |                  | 1000.19 V         | 999.81 V         |
| 1000.00 V                 | -1000 V         |              | -999.81 V        | -1000.19 V        |                  |
| DC Current <sup>[2]</sup> | 200.000 $\mu$ A | 200 $\mu$ A  | Q                | 200.120 $\mu$ A   | 199.880 $\mu$ A  |
|                           | 200.000 $\mu$ A | -200 $\mu$ A | Q                | -199.880 $\mu$ A  | -200.120 $\mu$ A |
|                           | 2.00000 mA      | 2 mA         |                  | 2.00120 mA        | 1.99880 mA       |
|                           | 2.00000 mA      | -2 mA        |                  | -1.99880 mA       | -2.00120 mA      |
|                           | 20.0000 mA      | 20 mA        | Q                | 20.0230 mA        | 19.9770 mA       |
|                           | 20.0000 mA      | -20 mA       | Q                | -19.9770 mA       | -20.0230 mA      |
|                           | 200.000 mA      | 200 mA       |                  | 200.156 mA        | 199.844 mA       |
|                           | 200.000 mA      | -200 mA      |                  | -199.844 mA       | -200.156 mA      |
|                           | 2.00000 A       | 2 A          | Q                | 2.00380 A         | 1.99620 A        |
| 2.00000 A                 | -2 A            |              | -1.99620 A       | -2.00380 A        |                  |

|                           |                           |        |   |            |            |
|---------------------------|---------------------------|--------|---|------------|------------|
|                           | 10.0000 A                 | 10 A   |   | 10.0260 A  | 9.9740 A   |
|                           | 10.0000 A                 | -10 A  |   | -9.9740 A  | -10.0260 A |
| Resistance <sup>[3]</sup> | 200.000 Ω                 | 200 Ω  |   | 200.070 Ω  | 199.930 Ω  |
|                           | 2.00000 kΩ                | 2 kΩ   | Q | 2.00046 kΩ | 1.99954 kΩ |
|                           | 20.0000 kΩ                | 20 kΩ  |   | 20.0046 kΩ | 19.9954 kΩ |
|                           | 200.000 kΩ                | 200 kΩ |   | 200.046 kΩ | 199.954 kΩ |
|                           | 2.00000 MΩ                | 2 MΩ   | Q | 2.00088 MΩ | 1.99912 MΩ |
|                           | 10.0000 MΩ                | 10 MΩ  |   | 10.0253 MΩ | 9.9747 MΩ  |
|                           | 100.000 MΩ <sup>[4]</sup> | 100 MΩ |   | 101.754 MΩ | 98.246 MΩ  |

**Note<sup>[1]</sup>:** The reading rate is set to "Slow".

**Note<sup>[2]</sup>:** For continuous currents greater than DC 7A or AC RMS 7A, close the circuit for 30 s and then open the circuit for 30 s.

**Note<sup>[3]</sup>:** Specifications are for the 4-wire resistance function or the 2-wire resistance function using "REL" operation. If the 2-wire resistance function is used without "REL" operation, add 0.2 Ω additional errors.

**Note<sup>[4]</sup>:** Use the 2-wire resistance function.

**Note<sup>[5]</sup>:** Q marks the optional quick test points.

## 2. The AC voltage gain verification procedures

- (1) Make sure you have carefully read the "**Test Conditions**".
- (2) Connect the input terminals of the multimeter with the calibrator.
- (3) Test the ranges specified in Table 2-3 one by one. Set the reading rate to "Slow" and turn off all the math operations.
- (4) Input the signals specified in Table 2-3 using the calibrator and compare the test results with the test limits in the table (make sure the output of the calibrator is built adequately).

Table 2-3 AC Voltage Gain Verification Table

| Range <sup>[1]</sup> | Test Signal | Input Frequency | Quick Test       | 1-year Test Limit |             |
|----------------------|-------------|-----------------|------------------|-------------------|-------------|
|                      |             |                 |                  | Upper Limit       | Lower Limit |
| 200.000 mV           | 10 mV       | 100 kHz         | Q <sup>[2]</sup> | 10.660 mV         | 9.340 mV    |
|                      | 200 mV      | 20 Hz           |                  | 203.200 mV        | 196.800 mV  |
|                      | 200 mV      | 45 Hz           |                  | 200.500 mV        | 199.500 mV  |
| 200.000 mV           | 200 mV      | 20 kHz          | Q                | 200.500 mV        | 199.500 mV  |
|                      | 200 mV      | 50 kHz          |                  | 202.100 mV        | 197.900 mV  |
|                      | 200 mV      | 100 kHz         |                  | 206.100 mV        | 193.900 mV  |
| 2.00000 V            | 100 mV      | 100 kHz         |                  | 0.10660 V         | 0.09340 V   |
|                      | 2 V         | 20 Hz           | Q                | 2.03200 V         | 1.96800 V   |
|                      | 2 V         | 45 Hz           | Q                | 2.00500 V         | 1.99500 V   |
|                      | 2 V         | 20 kHz          | Q                | 2.00500 V         | 1.99500 V   |
|                      | 2 V         | 50 kHz          | Q                | 2.02100 V         | 1.97900 V   |
| 20.0000 V            | 2 V         | 100 kHz         | Q                | 2.06100 V         | 1.93900 V   |
|                      | 1 V         | 100 kHz         |                  | 1.0660 V          | 0.9340 V    |
|                      | 20 V        | 20 Hz           |                  | 20.3200 V         | 19.6800 V   |
|                      | 20 V        | 45 Hz           |                  | 20.0500 V         | 19.9500 V   |
|                      | 20 V        | 20 kHz          | Q                | 20.0500 V         | 19.9500 V   |
| 200.000 V            | 20 V        | 50 kHz          |                  | 20.2100 V         | 19.7900 V   |
|                      | 20 V        | 100 kHz         |                  | 20.6100 V         | 19.3900 V   |
|                      | 10 V        | 100 kHz         |                  | 10.660 V          | 9.340 V     |

|          |        |         |   |           |           |
|----------|--------|---------|---|-----------|-----------|
|          | 200 V  | 20 Hz   |   | 203.200 V | 196.800 V |
|          | 200 V  | 45 Hz   |   | 200.500 V | 199.500 V |
|          | 200 V  | 20 kHz  | Q | 200.500 V | 199.500 V |
|          | 200 V  | 50 kHz  |   | 202.100 V | 197.900 V |
|          | 200 V  | 100 kHz |   | 206.100 V | 193.900 V |
| 750.00 V | 37.5 V | 100 kHz |   | 39.98 V   | 35.03 V   |
|          | 320 V  | 20 Hz   |   | 325.55 V  | 314.45 V  |
|          | 320 V  | 45 Hz   |   | 321.02 V  | 318.99 V  |
|          | 320 V  | 20 kHz  | Q | 321.02 V  | 318.99 V  |
|          | 320 V  | 50 kHz  |   | 323.58 V  | 316.43 V  |
|          | 320 V  | 100 kHz |   | 329.98 V  | 310.03 V  |
|          | 750 V  | 1 kHz   | Q | 751.88 V  | 748.13 V  |

**Note<sup>[1]</sup>**: The reading rate is set to "Slow".

**Note<sup>[2]</sup>**: Q marks the optional quick test points.

### 3. The AC current gain verification procedures

- (1) Make sure you have carefully read the "Test Conditions".
- (2) Connect the input terminals of the multimeter with the calibrator.
- (3) Test the ranges specified in Table 2-4 one by one. Set the reading rate to "Slow" and turn off all the math operations.
- (4) Input the signals specified in Table 2-4 using the calibrator and compare the test results with the test limits in the table (make sure the output of the calibrator is built adequately).

Table 2-4 AC Current Gain Verification Table

| Range <sup>[1]</sup>     | Test Signal | Input Frequency | Quick Test       | 1-year Test Limit |             |
|--------------------------|-------------|-----------------|------------------|-------------------|-------------|
|                          |             |                 |                  | Upper Limit       | Lower Limit |
| 20.0000 mA               | 1 mA        | 1 kHz           | Q <sup>[3]</sup> | 1.0450 mA         | 0.9550 mA   |
|                          | 20 mA       | 20 Hz           |                  | 20.3200 mA        | 19.6800 mA  |
|                          | 20 mA       | 45 Hz           |                  | 20.1200 mA        | 19.8800 mA  |
|                          | 20 mA       | 2 kHz           | Q                | 20.1200 mA        | 19.8800 mA  |
|                          | 20 mA       | 10 kHz          |                  | 20.5400 mA        | 19.4600 mA  |
| 200.000 mA               | 10 mA       | 1 kHz           |                  | 10.430 mA         | 9.570 mA    |
|                          | 200 mA      | 20 Hz           | Q                | 203.200 mA        | 196.800 mA  |
|                          | 200 mA      | 45 Hz           | Q                | 200.800 mA        | 199.200 mA  |
|                          | 200 mA      | 2 kHz           | Q                | 200.800 mA        | 199.200 mA  |
|                          | 200 mA      | 10 kHz          | Q                | 205.400 mA        | 194.600 mA  |
| 2.00000 A                | 100 mA      | 1 kHz           |                  | 0.10650 A         | 0.09350 A   |
|                          | 2 A         | 20 Hz           |                  | 2.03400 A         | 1.96600 A   |
|                          | 2 A         | 45 Hz           |                  | 2.01400 A         | 1.98600 A   |
|                          | 2 A         | 2 kHz           | Q                | 2.01400 A         | 1.98600 A   |
|                          | 2 A         | 10 kHz          |                  | 2.05400 A         | 1.94600 A   |
| 10.0000 A <sup>[2]</sup> | 500 mA      | 1 kHz           |                  | 0.5275 A          | 0.4725 A    |
|                          | 10 A        | 20 Hz           |                  | 10.1650 A         | 9.8350 A    |
|                          | 10 A        | 45 Hz           |                  | 10.0650 A         | 9.9350 A    |
|                          | 10 A        | 2 kHz           | Q                | 10.0650 A         | 9.9350 A    |
|                          | 10 A        | 5 kHz           |                  | 10.2700 A         | 9.7300 A    |

**Note<sup>[1]</sup>**: The reading rate is set to "Slow".

**Note<sup>[2]</sup>**: For continuous currents greater than DC 7A or AC RMS 7A, close the circuit for 30 seconds

and then open the circuit for 30 seconds.

**Note<sup>[3]</sup>**: Q marks the optional quick test points.

#### 4. The frequency gain verification procedures

- (1) Make sure you have carefully read the "**Test Conditions**".
- (2) Connect the input terminals of the multimeter with the calibrator.
- (3) Select the manual 200 mV range of the frequency measurement function and turn off all the math operations.
- (4) Input the signals specified in Table 2-5 using the calibrator and compare the test results with the test limits in the table (make sure the output of the calibrator is built adequately).

Table 2-5 Frequency Gain Verification Table

| Signal Effective Value | Signal Frequency | Quick Test       | Range  | 1-year Test Limit |             |
|------------------------|------------------|------------------|--------|-------------------|-------------|
|                        |                  |                  |        | Upper Limit       | Lower Limit |
| 200 mV                 | 20 Hz            |                  | 200 mV | 20.0620Hz         | 19.9380Hz   |
| 200 mV                 | 1 MHz            | Q <sup>[1]</sup> | 200 mV | 1.00016MHz        | 0.99984MHz  |

**Note<sup>[1]</sup>**: Q marks the optional quick test point.

#### 5. Capacitance gain verification procedures

- (1) Make sure you have carefully read the "**Test Conditions**".
- (2) Switch to the capacitance measurement function and select a range listed in Table 2-6.
- (3) Connect one end of the shielded cable to the input terminal of the multimeter and leave the other end unconnected; then, execute "REL" operation.
- (4) Connect the end of the shielded cable hang in the air to the calibrator.
- (5) Input the signals specified in Table 2-6 using the calibrator and compare the test results with the test limits in the table (make sure the output of the calibrator is built adequately).
- (6) Repeat steps (2), (3), (4) and (5) to finish the capacitance gain verification.

Table 2-6 Capacitance Gain Verification Table

| Range <sup>[1]</sup> | Test Signal   | Quick Test       | 1-year Test Limit |               |
|----------------------|---------------|------------------|-------------------|---------------|
|                      |               |                  | Upper Limit       | Lower Limit   |
| 2.000 nF             | 2 nF          | Q <sup>[2]</sup> | 2.080 nF          | 1.920 nF      |
| 20.00 nF             | 20 nF         |                  | 20.30 nF          | 19.70 nF      |
| 200.0 nF             | 200 nF        |                  | 203.0 nF          | 197.0 nF      |
| 2.000 $\mu$ F        | 2 $\mu$ F     | Q                | 2.030 $\mu$ F     | 1.970 $\mu$ F |
| 200.0 $\mu$ F        | 200 $\mu$ F   |                  | 203.0 $\mu$ F     | 197.0 $\mu$ F |
| 10000 $\mu$ F        | 10000 $\mu$ F |                  | 10250 $\mu$ F     | 9750 $\mu$ F  |

**Note<sup>[1]</sup>**: Specifications are obtained under "REL" operation.

**Note<sup>[2]</sup>**: Q marks the optional quick test points.



# Appendix Test Record Form

## Zero Offset

| Function <sup>[1]</sup>   | Range              | Input signal | Quick Test       | 1-year Test Limit |                 | Test Result |
|---------------------------|--------------------|--------------|------------------|-------------------|-----------------|-------------|
|                           |                    |              |                  | Upper Limit       | Lower Limit     |             |
| DC Voltage                | 200.000 mV         | short        | Q <sup>[3]</sup> | 8 $\mu$ V         | -8 $\mu$ V      |             |
|                           | 2.00000 V          | short        |                  | 60 $\mu$ V        | -60 $\mu$ V     |             |
|                           | 20.0000 V          | short        |                  | 800 $\mu$ V       | -800 $\mu$ V    |             |
|                           | 200.000 V          | short        |                  | 6 mV              | -6 mV           |             |
|                           | 1000.00 V          | short        |                  | 30 mV             | -30 mV          |             |
| DC Current                | 200.000 $\mu$ A    | open         | Q                | 10 nA             | -10 nA          |             |
|                           | 2.00000 mA         | open         |                  | 100 nA            | -100 nA         |             |
|                           | 20.0000 mA         | open         | Q                | 4 $\mu$ A         | -4 $\mu$ A      |             |
|                           | 200.000 mA         | open         |                  | 16 $\mu$ A        | -16 $\mu$ A     |             |
|                           | 2.00000 A          | open         |                  | 400 $\mu$ A       | -400 $\mu$ A    |             |
|                           | 10.0000 A          | open         |                  | 1 mA              | -1 mA           |             |
| Resistance <sup>[2]</sup> | 200.000 $\Omega$   | short        | Q                | 10 m $\Omega$     | -10 m $\Omega$  |             |
|                           | 2.00000 k $\Omega$ | short        |                  | 60 m $\Omega$     | -60 m $\Omega$  |             |
|                           | 20.0000 k $\Omega$ | short        |                  | 600 m $\Omega$    | -600 m $\Omega$ |             |
|                           | 200.000 k $\Omega$ | short        |                  | 6 $\Omega$        | -6 $\Omega$     |             |
|                           | 2.00000 M $\Omega$ | short        | Q                | 80 $\Omega$       | -80 $\Omega$    |             |
|                           | 10.0000 M $\Omega$ | short        |                  | 300 $\Omega$      | -300 $\Omega$   |             |
|                           | 100.000 M $\Omega$ | short        |                  | 4 k $\Omega$      | -4 k $\Omega$   |             |

**Note<sup>[1]</sup>:** The reading rate is set to "Slow".

**Note<sup>[2]</sup>:** Specifications are for the 4-wire resistance function or the 2-wire resistance function using "REL" operation. If the 2-wire resistance function is used without "REL" operation, add 0.2  $\Omega$  additional errors.

**Note<sup>[3]</sup>:** Q marks the optional quick test points.

## DC Gain

| Function <sup>[1]</sup>           | Range              | Test signal    | Quick Test         | 1-year Test Limit  |                    | Test Result |
|-----------------------------------|--------------------|----------------|--------------------|--------------------|--------------------|-------------|
|                                   |                    |                |                    | Upper Limit        | Lower Limit        |             |
| DC Voltage                        | 200.000 mV         | 200 mV         |                    | 200.038 mV         | 199.962 mV         |             |
|                                   | 200.000 mV         | -200 mV        |                    | -199.962 mV        | -200.038 mV        |             |
|                                   | 2.00000 V          | 2 V            | Q <sup>[5]</sup>   | 2.00036 V          | 1.99964 V          |             |
|                                   | 2.00000 V          | -2 V           | Q                  | -1.99964 V         | -2.00036 V         |             |
|                                   | 20.0000 V          | 20 V           | Q                  | 20.0038 V          | 19.9962 V          |             |
|                                   | 20.0000 V          | -20 V          | Q                  | -19.9962 V         | -20.0038 V         |             |
|                                   | 200.000 V          | 200 V          |                    | 200.036 V          | 199.964 V          |             |
|                                   | 200.000 V          | -200 V         |                    | -199.964 V         | -200.036 V         |             |
|                                   | 1000.00 V          | 1000 V         |                    | 1000.19 V          | 999.81 V           |             |
| 1000.00 V                         | -1000 V            |                | -999.81 V          | -1000.19 V         |                    |             |
| DC Current <sup>[2]</sup>         | 200.000 $\mu$ A    | 200 $\mu$ A    | Q                  | 200.120 $\mu$ A    | 199.880 $\mu$ A    |             |
|                                   | 200.000 $\mu$ A    | -200 $\mu$ A   | Q                  | -199.880 $\mu$ A   | -200.120 $\mu$ A   |             |
|                                   | 2.00000 mA         | 2 mA           |                    | 2.00120 mA         | 1.99880 mA         |             |
|                                   | 2.00000 mA         | -2 mA          |                    | -1.99880 mA        | -2.00120 mA        |             |
|                                   | 20.0000 mA         | 20 mA          | Q                  | 20.0230 mA         | 19.9770 mA         |             |
|                                   | 20.0000 mA         | -20 mA         | Q                  | -19.9770 mA        | -20.0230 mA        |             |
|                                   | 200.000 mA         | 200 mA         |                    | 200.156 mA         | 199.844 mA         |             |
|                                   | 200.000 mA         | -200 mA        |                    | -199.844 mA        | -200.156 mA        |             |
|                                   | 2.00000 A          | 2 A            | Q                  | 2.00380 A          | 1.99620 A          |             |
|                                   | 2.00000 A          | -2 A           |                    | -1.99620 A         | -2.00380 A         |             |
|                                   | 10.0000 A          | 10 A           |                    | 10.0260 A          | 9.9740 A           |             |
| 10.0000 A                         | -10 A              |                | -9.9740 A          | -10.0260 A         |                    |             |
| Resistance <sup>[3]</sup>         | 200.000 $\Omega$   | 200 $\Omega$   |                    | 200.070 $\Omega$   | 199.930 $\Omega$   |             |
|                                   | 2.00000 k $\Omega$ | 2 k $\Omega$   | Q                  | 2.00046 k $\Omega$ | 1.99954 k $\Omega$ |             |
|                                   | 20.0000 k $\Omega$ | 20 k $\Omega$  |                    | 20.0046 k $\Omega$ | 19.9954 k $\Omega$ |             |
|                                   | 200.000 k $\Omega$ | 200 k $\Omega$ |                    | 200.046 k $\Omega$ | 199.954 k $\Omega$ |             |
|                                   | 2.00000 M $\Omega$ | 2 M $\Omega$   | Q                  | 2.00088 M $\Omega$ | 1.99912 M $\Omega$ |             |
|                                   | 10.0000 M $\Omega$ | 10 M $\Omega$  |                    | 10.0253 M $\Omega$ | 9.9747 M $\Omega$  |             |
| 100.000 M $\Omega$ <sup>[4]</sup> | 100 M $\Omega$     |                | 101.754 M $\Omega$ | 98.246 M $\Omega$  |                    |             |

**Note<sup>[1]</sup>:** The reading rate is set to "Slow".

**Note<sup>[2]</sup>:** For continuous currents greater than DC 7A or AC RMS 7A, close the circuit for 30 s and then open the circuit for 30 s.

**Note<sup>[3]</sup>:** Specifications are for the 4-wire resistance function or the 2-wire resistance function using "REL" operation. If the 2-wire resistance function is used without "REL" operation, add 0.2  $\Omega$  additional errors.

**Note<sup>[4]</sup>:** Use the 2-wire resistance function.

**Note<sup>[5]</sup>:** Q marks the optional quick test points.



## AC Voltage Gain

| Range <sup>[1]</sup> | Test Signal | Input Frequency | Quick Test       | 1-year Test Limit |             | Test Result |
|----------------------|-------------|-----------------|------------------|-------------------|-------------|-------------|
|                      |             |                 |                  | Upper Limit       | Lower Limit |             |
| 200.000 mV           | 10 mV       | 100 kHz         | Q <sup>[2]</sup> | 10.660 mV         | 9.340 mV    |             |
|                      | 200 mV      | 20 Hz           |                  | 203.200 mV        | 196.800 mV  |             |
|                      | 200 mV      | 45 Hz           |                  | 200.500 mV        | 199.500 mV  |             |
| 200.000 mV           | 200 mV      | 20 kHz          | Q                | 200.500 mV        | 199.500 mV  |             |
|                      | 200 mV      | 50 kHz          |                  | 202.100 mV        | 197.900 mV  |             |
|                      | 200 mV      | 100 kHz         |                  | 206.100 mV        | 193.900 mV  |             |
| 2.00000 V            | 100 mV      | 100 kHz         |                  | 0.10660 V         | 0.09340 V   |             |
|                      | 2 V         | 20 Hz           | Q                | 2.03200 V         | 1.96800 V   |             |
|                      | 2 V         | 45 Hz           | Q                | 2.00500 V         | 1.99500 V   |             |
|                      | 2 V         | 20 kHz          | Q                | 2.00500 V         | 1.99500 V   |             |
|                      | 2 V         | 50 kHz          | Q                | 2.02100 V         | 1.97900 V   |             |
| 20.0000 V            | 2 V         | 100 kHz         |                  | 2.06100 V         | 1.93900 V   |             |
|                      | 1 V         | 100 kHz         |                  | 1.0660 V          | 0.9340 V    |             |
|                      | 20 V        | 20 Hz           |                  | 20.3200 V         | 19.6800 V   |             |
|                      | 20 V        | 45 Hz           |                  | 20.0500 V         | 19.9500 V   |             |
|                      | 20 V        | 20 kHz          | Q                | 20.0500 V         | 19.9500 V   |             |
|                      | 20 V        | 50 kHz          |                  | 20.2100 V         | 19.7900 V   |             |
| 200.000 V            | 20 V        | 100 kHz         |                  | 20.6100 V         | 19.3900 V   |             |
|                      | 10 V        | 100 kHz         |                  | 10.660 V          | 9.340 V     |             |
|                      | 200 V       | 20 Hz           |                  | 203.200 V         | 196.800 V   |             |
|                      | 200 V       | 45 Hz           |                  | 200.500 V         | 199.500 V   |             |
|                      | 200 V       | 20 kHz          | Q                | 200.500 V         | 199.500 V   |             |
|                      | 200 V       | 50 kHz          |                  | 202.100 V         | 197.900 V   |             |
| 750.00 V             | 200 V       | 100 kHz         |                  | 206.100 V         | 193.900 V   |             |
|                      | 37.5 V      | 100 kHz         |                  | 39.98 V           | 35.03 V     |             |
|                      | 320 V       | 20 Hz           |                  | 325.55 V          | 314.45 V    |             |
|                      | 320 V       | 45 Hz           |                  | 321.02 V          | 318.99 V    |             |
|                      | 320 V       | 20 kHz          | Q                | 321.02 V          | 318.99 V    |             |
|                      | 320 V       | 50 kHz          |                  | 323.58 V          | 316.43 V    |             |
|                      | 320 V       | 100 kHz         |                  | 329.98 V          | 310.03 V    |             |
| 750 V                | 1 kHz       | Q               | 751.88 V         | 748.13 V          |             |             |

**Note<sup>[1]</sup>:** The reading rate is set to "Slow".

**Note<sup>[2]</sup>:** Q marks the optional quick test points.

## AC Current Gain

| Range <sup>[1]</sup>     | Test Signal | Input Frequency | Quick Test       | 1-year Test Limit |             | Test Result |
|--------------------------|-------------|-----------------|------------------|-------------------|-------------|-------------|
|                          |             |                 |                  | Upper Limit       | Lower Limit |             |
| 20.0000 mA               | 1 mA        | 1 kHz           | Q <sup>[3]</sup> | 1.0450 mA         | 0.9550 mA   |             |
|                          | 20 mA       | 20 Hz           |                  | 20.3200 mA        | 19.6800 mA  |             |
|                          | 20 mA       | 45 Hz           |                  | 20.1200 mA        | 19.8800 mA  |             |
|                          | 20 mA       | 2 kHz           | Q                | 20.1200 mA        | 19.8800 mA  |             |
|                          | 20 mA       | 10 kHz          |                  | 20.5400 mA        | 19.4600 mA  |             |
| 200.000 mA               | 10 mA       | 1 kHz           |                  | 10.430 mA         | 9.570 mA    |             |
|                          | 200 mA      | 20 Hz           | Q                | 203.200 mA        | 196.800 mA  |             |
|                          | 200 mA      | 45 Hz           | Q                | 200.800 mA        | 199.200 mA  |             |
|                          | 200 mA      | 2 kHz           | Q                | 200.800 mA        | 199.200 mA  |             |
|                          | 200 mA      | 10 kHz          | Q                | 205.400 mA        | 194.600 mA  |             |
| 2.00000 A                | 100 mA      | 1 kHz           |                  | 0.10650 A         | 0.09350 A   |             |
|                          | 2 A         | 20 Hz           |                  | 2.03400 A         | 1.96600 A   |             |
|                          | 2 A         | 45 Hz           |                  | 2.01400 A         | 1.98600 A   |             |
|                          | 2 A         | 2 kHz           | Q                | 2.01400 A         | 1.98600 A   |             |
|                          | 2 A         | 10 kHz          |                  | 2.05400 A         | 1.94600 A   |             |
| 10.0000 A <sup>[2]</sup> | 500 mA      | 1 kHz           |                  | 0.5275 A          | 0.4725 A    |             |
|                          | 10 A        | 20 Hz           |                  | 10.1650 A         | 9.8350 A    |             |
|                          | 10 A        | 45 Hz           |                  | 10.0650 A         | 9.9350 A    |             |
|                          | 10 A        | 2 kHz           | Q                | 10.0650 A         | 9.9350 A    |             |
|                          | 10 A        | 5 kHz           |                  | 10.2700 A         | 9.7300 A    |             |

**Note<sup>[1]</sup>:** The reading rate is set to "Slow".

**Note<sup>[2]</sup>:** For continuous currents greater than DC 7A or AC RMS 7A, close the circuit for 30 seconds and then open the circuit for 30 seconds.

**Note<sup>[3]</sup>:** Q marks the optional quick test points.

## Frequency Gain

| Signal Effective Value | Signal Frequency | Quick Test       | Range  | 1-year Test Limit |             | Test Result |
|------------------------|------------------|------------------|--------|-------------------|-------------|-------------|
|                        |                  |                  |        | Upper Limit       | Lower Limit |             |
| 200 mV                 | 20 Hz            |                  | 200 mV | 20.0620 Hz        | 19.9380 Hz  |             |
| 200 mV                 | 1 MHz            | Q <sup>[1]</sup> | 200 mV | 1.00016 MHz       | 0.99984 MHz |             |

**Note<sup>[1]</sup>:** Q marks the optional quick test point.

## Capacitance Gain

| Range <sup>[1]</sup> | Test Signal   | Quick Test       | 1-year Test Limit |               | Test Result |
|----------------------|---------------|------------------|-------------------|---------------|-------------|
|                      |               |                  | Upper Limit       | Lower Limit   |             |
| 2.000 nF             | 2 nF          | Q <sup>[2]</sup> | 2.080 nF          | 1.920 nF      |             |
| 20.00 nF             | 20 nF         |                  | 20.30 nF          | 19.70 nF      |             |
| 200.0 nF             | 200 nF        |                  | 203.0 nF          | 197.0 nF      |             |
| 2.000 $\mu$ F        | 2 $\mu$ F     | Q                | 2.030 $\mu$ F     | 1.970 $\mu$ F |             |
| 200.0 $\mu$ F        | 200 $\mu$ F   |                  | 203.0 $\mu$ F     | 197.0 $\mu$ F |             |
| 10000 $\mu$ F        | 10000 $\mu$ F |                  | 10250 $\mu$ F     | 9750 $\mu$ F  |             |

**Note<sup>[1]</sup>:** Specifications are obtained under "REL" operation.

**Note<sup>[2]</sup>:** Q marks the optional quick test points.