

RIGOL

Service Guide

DM3068 Digital Multimeter

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RIGOL Technologies, Inc.

Guaranty and Declaration

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RIGOL guarantees this product conforms to the national and industrial standards in China as well as the ISO9001:2008 standard and the ISO14001:2004 standard. Other international standard conformance certification is in progress.

Contact Us

If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

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Safety Requirement

General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injuries or damages 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 by 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 power cord to the Protective Earth terminal before any inputs or outputs.

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.

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 expose to danger of electrical shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

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 qualified service 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 increasing of temperature or damages to the device. So please keep 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 in a humid environment.

Do Not Operate in an Explosive Atmosphere.

In order to avoid damages 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 air, please keep the surface of device clean and dry.

Electrostatic Prevention.

Operate in an electrostatic discharge protective area environment to avoid damages induced by static discharges. Always ground both the internal and external conductors of the cable to release static before connecting.

Handling Safety

Please handle with care during transportation to avoid damages to keys, knob and, interfaces as well as other parts on the panels.

The disturbance tests of all models conform to the P/F values of A based on the standard of EN 61326: 1997+A1+A2+A3 instead of P/F values of B.

Input Terminal Protection Limit

The protection limit is defined for the input terminal:

1. Main input (HI and LO) terminals

HI and **LO** terminals are used for Voltage, Resistance, Capacitance, Continuity, Frequency and Diodes measurements and should be used under the following two conditions:

- 1) **HI-LO** protection: at most 1000 VDC or 750 VAC, this is also the maximum measurable voltage. The limit can be expressed as 1000 Vpk.
- 2) **LO-ground** protection: floating at 500 Vpk (relative) with safety.

Since the HI terminal holds a maximum protection of 1000 Vpk relative to the ground, the sum of the "float" and measured voltages cannot exceed 1000 Vpk.

2. Sampling (HI Sense and LO Sense/200 mA) terminals

HI Sense and **LO Sense/200 mA** terminals are used for 4-wire resistance measurement and should be used under two conditions:

- 1) **HI Sense-LO Sense/200 mA** protection limit: 200 Vpk.
- 2) **LO Sense/200 mA-LO** protection limits: 0.5 Vpk. The current input fuse

on the rear panel provides the current passing through **LO Sense/200 mA** up to 500 mA protection.

3. Current input (10 A and Sense/200 mA) terminals

10 A and **LO** terminals are used for current measurements of 2 A and 10 A. The maximum current going through the **10 A** terminal is limited to 10 A by the internal fuse. **LO Sense/200 mA** and **LO** terminals are used for current measurements ranging from 200 μ A to 200 mA. The maximum current going through the **LO Sense/200 mA** terminal is limited to 500 mA by the internal fuse.

NOTE:

In order to prevent the fuse from blowing out and protect the multimeter, please use the current input terminals according to the following requirements:

- 1) Do not connect the **10 A** and **LO Sense/200 mA** input terminals into the current measuring circuit at the same time.
- 2) Only use **10 A** and **LO** terminals for measurements when the measured current AC+DC RMS value goes within 200 mA and 10 A.
- 3) Select a proper current input terminal according to the estimated current magnitude before connecting the multimeter to AC supplies if you want to use current measurement.
- 4) The current into the **10 A** terminal cannot exceed 13.5 A, otherwise it will blow out the internal fuse; while the current into the **LO Sense/200 mA** terminal cannot exceed 650 mA, otherwise the current input fuse from the rear panel may be blown out.

IEC II Overvoltage Protection

In order to prevent electric shock, DM3068 provides overvoltage protection for line-voltage mains connections meeting both of the following conditions:

1. The HI and LO input terminals are connected to the mains under Measurement Category II conditions defined below.
2. The mains are limited to a maximum line voltage of 300 VAC.

WARNING: IEC II includes electrical devices connected to mains through an outlet from the branch circuit. Such devices include most small appliances, test equipments and other devices inserted into a branch socket.

DM3068 may be used to make measurements with the HI and LO inputs connected to mains in such devices (up to 300 VAC), or to the branch socket. , the HI and LO inputs of DM3068 cannot be connected to mains of permanently installed electrical devices such as a main circuit-breaker panel, sub-panel disconnected box or wired motors. Such devices and circuits are readily to beyond the protection of DM3068.

NOTE: Voltages above 300 VAC may be measured only in circuits that are isolated

from mains. However, a transient overvoltage is also present in such circuits. DM3068 was designed to safely withstand occasional transient overvoltage up to 2500 Vpk. Do not use this device to measure circuits whose transient overvoltage may exceed this level.

Safety Terms and Symbols

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



WARNING

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



CAUTION

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



CAT I (1000V)

IEC Measurement Category I. The maximum voltage can be measured by HI-LO terminal is 1000Vpk.



CAT II (300V)

IEC Measurement Category II. Inputs may be connected to mains (up to 300VAC) in the case of overvoltage in Category II.

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

DANGER indicates an injury or hazard may immediately happen.

WARNING indicates an injury or hazard may be accessible potentially.

CAUTION indicates a potential damage to the instrument or other property might occur.

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



**Hazardous
Voltage**



**Safety
Warning**



**Protective
Earth
Terminal**



**Chassis
Ground**



**Test
Ground**

General Care and Cleaning

General Care:

Do not store or leave the instrument at a place where the instrument will be exposed to direct sunlight for long periods of time.

Cleaning:

Clean the instrument regularly according to its operating conditions. To clean the exterior surface, perform the following steps:

1. Disconnect the instrument from all power sources.
2. Moisten a cloth slightly (using a mild detergent or water) and clean the loose dust on the outside of the instrument. Always take care when you clean the LCD in order to avoid scuffing it.



CAUTION

To avoid damages to the instrument, do not expose them to corrosive liquids.



WARNING

To avoid injury resulting from short circuit, make sure the instrument is completely dry before reconnecting into a power source.

Environmental Considerations

The following symbol indicates that this product complies with the applicable European Union requirements according to Directives 2002/96/EC on waste electrical and electronic equipment (WEEE) and batteries.



Product End-of-Life Handling

The equipment may contain substances that could be harmful to the environment or human health. In order to avoid release of such substances into the environment and harmful to human health, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately. Please contact your local authorities for disposal or recycling information.

Document Overview

Chapter 1 Specifications

This chapter lists specifications and characteristics.

Chapter 2 Performance Test

This chapter introduces how to test the performance of DM3068 so as to know its state well.

Chapter 3 Calibration

This chapter provides information about the calibration of DM3068.

Chapter 4 Disassembly & Assembly

This chapter guides you to disassemble and assemble DM3068 to reach a clearer understanding of its structure.

Chapter 5 Troubleshooting & Maintenance

This chapter guides you to eliminate possible errors caused during the measurement and contains information about routine maintenance.

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Chapter 1 Specifications

1.1 DC Characteristics

Accuracy Specifications: \pm (% of reading + % of range)^[1]

Function	Range ^[2]	Test Current or Burden Voltage	24 Hour ^[3] T _{CAL} °C ±1°C	90 Day T _{CAL} °C ±5°C	1 Year T _{CAL} °C ±5°C	Temperature Coefficient 0°C to (T _{CAL} °C -5°C) (T _{CAL} °C +5°C) to 50°C
DC Voltage	200.0000mV		0.0020 + 0.0020	0.0030 + 0.0025	0.0040 + 0.0025	0.0005 + 0.0005
	2.000000V		0.0015 + 0.0005	0.0020 + 0.0006	0.0035 + 0.0006	0.0005 + 0.0001
	20.00000V		0.0020 + 0.0004	0.0030 + 0.0005	0.0040 + 0.0005	0.0005 + 0.0001
	200.0000V		0.0020 + 0.0006	0.0040 + 0.0006	0.0050 + 0.0006	0.0005 + 0.0001
	1000.000V ^[4]		0.0020 + 0.0006	0.0040 + 0.0010	0.0055 + 0.0010	0.0005 + 0.0001
DC Current	200.0000uA	<0.03V	0.010 + 0.012	0.040 + 0.015	0.050 + 0.015	0.0020 + 0.0030
	2.000000mA	<0.25V	0.007 + 0.003	0.030 + 0.003	0.050 + 0.003	0.0020 + 0.0005
	20.00000mA	<0.07V	0.007 + 0.012	0.030 + 0.015	0.050 + 0.015	0.0020 + 0.0020
	200.0000mA	<0.7V	0.010 + 0.002	0.030 + 0.003	0.050 + 0.003	0.0020 + 0.0005
	2.000000A	<0.12V	0.050 + 0.020	0.080 + 0.020	0.100 + 0.020	0.0050 + 0.0010
	10.00000A ^[5]	<0.6V	0.100 + 0.010	0.120 + 0.010	0.150 + 0.010	0.0050 + 0.0020
Resistance ^[6]	200.0000Ω	1mA	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	0.0006 + 0.0005
	2.000000kΩ	1mA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
	20.00000kΩ	100uA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
	200.0000kΩ	10uA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
	1.000000MΩ	2uA	0.002 + 0.001	0.010 + 0.001	0.012 + 0.001	0.0010 + 0.0002
	10.00000MΩ	200nA	0.015 + 0.001	0.030 + 0.001	0.040 + 0.001	0.0030 + 0.0004
100.0000MΩ	200nA 10MΩ	0.300 + 0.010	0.800 + 0.010	0.800 + 0.010	0.1500 + 0.0002	
Diode Test	2.0000V ^[7]	1mA	0.002 + 0.010	0.008 + 0.020	0.010 + 0.020	0.0010 + 0.0020

Continuity Test	2000.0 Ω	1mA	0.002 + 0.010	0.008 + 0.020	0.010 + 0.020	0.0010 + 0.0020
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- [1] Specifications are for 90-minute warm-up and 100NPLC integration time. For integration time <100NPLC, add the appropriate “RMS Noise Adder” listed in the following table.
- [2] 10% overrange on all ranges except DCV 1000V and DCI 10A range.
- [3] Relative to calibration standards.
- [4] For each additional volt over ± 500 V, add 0.03mV error.
- [5] For continuous current > 7A DC or 7A AC RMS, 30 seconds ON and 30 seconds OFF.
- [6] Specifications are for 4–wire resistance measurement or 2–wire resistance measurement using REL operation. Without REL operation, add 0.2 Ω additional errors in 2-wire resistance measurement.
- [7] Accuracy specifications for the voltage measured at the input terminal only. 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.

Performance Versus Integration Time – 50Hz (60Hz) Power-line Frequency

Integration Time Number of Power line Cycles (NPLC)	Resolution ^[1] (ppm Range)	NMRR ^[2] (dB)	Readings/s ^[3]		RMS Noise Adder ^[4] (% of Range)			
			50Hz	60Hz	DCV 20V	DCV 2V 200V Resistance 2k Ω 20k Ω	DCV 1000V DCI 2mA 200mA	DCV 200mV Resistance 200 Ω DCI 10A
0.006	2.7	0	10000	10000	0.0006	0.0007	0.0015	0.0040
0.02	1.6	0	2500	3000	0.0004	0.0004	0.0008	0.0025
0.06	1	0	833	1000	0.0003	0.0003	0.0006	0.0025
0.2	0.5	0	250	300	0.0001	0.0002	0.0003	0.0015
1	0.22	60	50	60	0	0.0001	0.0002	0.0004
2	0.17	60	25	30	0	0	0.0001	0.0003
10	0.08	60	5	6	0	0	0	0.0002
100	0.035	60	0.5	0.6	0	0	0	0

- [1] Typical value. Resolution is defined as the typical 20V range RMS noise (using auto zero “Once”).
- [2] Normal mode rejection ratio for power-line frequency $\pm 0.1\%$. For power-line frequency $\pm 1\%$, subtract 20dB. For $\pm 3\%$, subtract 30dB.
- [3] Maximum rate for DCV, DCI, 2-wire resistance and 4-wire resistance functions.

- [4] The basic DC accuracy specifications include RMS noise at 100 NPLC. For <100 NPLC, add "**RMS Noise Adder**" to the basic DC accuracy specifications.

SFDR & SINAD^[1]

Function	Range	Spurious-Free Dynamic Range (SFDR)	Signal-to-Noise-and-Distortion (SINAD)
DCV	200mV	81	76
	2V	79	78
	20V	79	75
	200V	83	80
	1000V	86	82
DCI	200uA	89	69
	2mA	86	81
	20mA	88	69
	200mA	81	79
	2A	69	64

- [1] Typical value. -1dBFS, 1kHz single tone. 100us aperture time, zero trigger delay, auto zero off and 4096 samples.

Measuring Characteristics

DC Voltage	
Input Resistance	200mV, 2V, 20V ranges: Selectable 10M Ω or >10G Ω (For these ranges, input beyond $\pm 26V$ are clamped through 106k Ω (typical)) 200V and 1000V ranges: 10M Ω \pm 1%
Input Protection	1000V
Input Offset Current	50pA, at 25 $^{\circ}$ C, typical
CMRR (common mode rejection ratio)	140dB for 1 k Ω unbalance in LO lead, $\pm 500VDC$ peak maximum.
Resistance	
Measurement Method	Selectable 4-wire or 2-wire resistance Current source referenced to LO input
Open-circuit Voltage	Limited to <10V
Max. Lead Resistance (4-wire)	10% of range per lead for 200 Ω , 2 k Ω ranges, 1 k Ω per lead on all other ranges

Input Protection	1000V on all ranges
Offset Compensation	Available on 200 Ω , 2k Ω and 20 k Ω ranges.
DC Current	
Shunt Resistor	100 Ω for 200uA, 2mA
	1 Ω for 20mA , 200mA
	0.01 Ω for 2A, 10A
Input Protection	Externally accessible 500mA, 250V fast blow fuse at the rear panel for 200uA, 2mA, 20mA and 200mA ranges. Internal 10A, 250 V slow blow fuse for 2A and 10A ranges.
Continuity/Diode Test	
Response Time	300 samples/sec, with audible tone
Continuity Threshold	Adjustable from 1 Ω to 2000 Ω
Autozero OFF Operation (typical value)	
Following instrument warm-up at the environment temperature $\pm 1^{\circ}\text{C}$ and <5 minutes, add 0.0001 % range + 2 uV for DCV and 2 m Ω for resistance.	
Settling Time Considerations	
Reading settling times are affected by source impedance, cable dielectric characteristics and input signal changes. The default measurement delay is selected to give first reading right for most measurements.	
Measurement Considerations	
Telon or other high-impedance, low-dielectric absorption wire insulation is recommended for these measurements.	

1.2 AC Characteristics

Accuracy Specifications: \pm (% of reading + % of range)^[1]

Function	Range ^[2]	Frequency Range	24 Hour ^[3] T _{CAL} °C \pm 1°C	90 Day T _{CAL} °C \pm 5°C	1 Year T _{CAL} °C \pm 5°C	Temperature Coefficient 0°C to (T _{CAL} °C -5°C) (T _{CAL} °C +5°C) to 50°C
True RMS AC Voltage ^[4]	200.0000mV	3Hz- 5Hz	1.00 + 0.03	1.00 + 0.04	1.00 + 0.04	0.100 + 0.004
		5Hz-10Hz	0.35 + 0.03	0.35 + 0.04	0.35 + 0.04	0.035 + 0.004
		10Hz-20kHz	0.04 + 0.03	0.05 + 0.04	0.06 + 0.04	0.005 + 0.004
		20kHz-50kHz	0.10 + 0.05	0.11 + 0.05	0.12 + 0.05	0.011 + 0.005
		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
		100kHz- 300kHz	4.00 + 0.50	4.00 + 0.50	4.00 + 0.50	0.20 + 0.02
	2.000000V	3Hz-5Hz	1.00 + 0.02	1.00 + 0.03	1.00 + 0.03	0.100 + 0.003
		5Hz-10Hz	0.35 + 0.02	0.35 + 0.03	0.35 + 0.03	0.035 + 0.003
		10Hz-20kHz	0.04 + 0.02	0.05 + 0.03	0.06 + 0.03	0.005 + 0.003
		20kHz-50kHz	0.10 + 0.04	0.11 + 0.05	0.12 + 0.05	0.011 + 0.005
		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
		100kHz - 300kHz	4.00 + 0.50	4.00 + 0.50	4.00 + 0.50	0.20 + 0.02
	20.00000V	3Hz-5Hz	1.00 + 0.03	1.00 + 0.04	1.00 + 0.04	0.100 + 0.004
		5Hz-10Hz	0.35 + 0.03	0.35 + 0.04	0.35 + 0.04	0.035 + 0.004
		10Hz-20kHz	0.04 + 0.04	0.07 + 0.04	0.08 + 0.04	0.008 + 0.004
		20kHz- 50kHz	0.10 + 0.05	0.12 + 0.05	0.15 + 0.05	0.012 + 0.005
		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
		100kHz-300kHz	4.00 + 0.50	4.00 + 0.50	4.00 + 0.50	0.20 + 0.02
	200.0000V	3Hz-5Hz	1.00 + 0.02	1.00 + 0.03	1.00 + 0.03	0.100 + 0.003
		5Hz-10Hz	0.35 + 0.02	0.35 + 0.03	0.35 + 0.03	0.035 + 0.003
		10Hz-20kHz	0.04 + 0.02	0.07 + 0.03	0.08 + 0.03	0.008 + 0.003
		20kHz-50kHz	0.10 + 0.04	0.12 + 0.05	0.15 + 0.05	0.012 + 0.005

		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
		100kHz-300kHz	4.0 + 0.50	4.0 + 0.50	4.0 + 0.50	0.20 + 0.02
	750.000V ^[5]	3Hz-5Hz	1.00 + 0.02	1.00 + 0.03	1.00 + 0.03	0.100 + 0.003
		5Hz-10Hz	0.35 + 0.02	0.35 + 0.03	0.35 + 0.03	0.035 + 0.003
		10Hz-20kHz	0.04 + 0.02	0.07 + 0.03	0.08 + 0.03	0.008 + 0.003
		20kHz-50kHz	0.10 + 0.04	0.12 + 0.05	0.15 + 0.05	0.012 + 0.005
		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
		100kHz-300kHz	4.0 + 0.50	4.0 + 0.50	4.0 + 0.50	0.20 + 0.02
True RMS AC Current ^[8]	200.0000uA	3Hz-5Hz	1.10 + 0.06	1.10 + 0.06	1.10 + 0.06	0.200 + 0.006
		5Hz-10Hz	0.35 + 0.06	0.35 + 0.06	0.35 + 0.06	0.100 + 0.006
		10Hz-5kHz	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.015 + 0.006
		5kHz-10kHz	0.35 + 0.70	0.35 + 0.70	0.35 + 0.70	0.030 + 0.006
	2.000000mA	3Hz-5Hz	1.00 + 0.04	1.00 + 0.04	1.00 + 0.04	0.100 + 0.006
		5Hz-10Hz	0.30 + 0.04	0.30 + 0.04	0.30 + 0.04	0.035 + 0.006
		10Hz-5kHz	0.12 + 0.04	0.12 + 0.04	0.12 + 0.04	0.015 + 0.006
		5kHz-10kHz	0.20 + 0.25	0.20 + 0.25	0.20 + 0.25	0.030 + 0.006
	20.00000mA	3Hz-5Hz	1.10 + 0.06	1.10 + 0.06	1.10 + 0.06	0.200 + 0.006
		5Hz-10Hz	0.35 + 0.06	0.35 + 0.06	0.35 + 0.06	0.100 + 0.006
		10Hz-5kHz	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.015 + 0.006
		5kHz-10kHz	0.35 + 0.70	0.35 + 0.70	0.35 + 0.70	0.030 + 0.006
	200.0000mA	3Hz-5Hz	1.00 + 0.04	1.00 + 0.04	1.00 + 0.04	0.100 + 0.006
		5Hz-10Hz	0.30 + 0.04	0.30 + 0.04	0.30 + 0.04	0.035 + 0.006
		10Hz-5kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
		5kHz-10kHz	0.20 + 0.25	0.20 + 0.25	0.20 + 0.25	0.030 + 0.006
	2.000000A	3Hz-5Hz	1.10 + 0.06	1.10 + 0.06	1.10 + 0.06	0.100 + 0.006
		5Hz-10Hz	0.35 + 0.06	0.35 + 0.06	0.35 + 0.06	0.035 + 0.006
		10Hz-5kHz	0.15 + 0.06	0.15 + 0.06	0.15 + 0.06	0.015 + 0.006
		5kHz-10kHz	0.35 + 0.70	0.35 + 0.70	0.35 + 0.70	0.030 + 0.006
10.00000A ^[6]	3Hz-5Hz	1.10 + 0.08	1.10 + 0.10	1.10 + 0.10	0.100 + 0.008	

	5Hz-10Hz	0.35 + 0.08	0.35 + 0.10	0.35 + 0.10	0.035 + 0.008
	10Hz-5kHz	0.15 + 0.08	0.15 + 0.10	0.15 + 0.10	0.015 + 0.008

Additional Low Frequency Errors (% of reading)				Additional Crest Factor Errors (non-sinewave) ^[7]	
Frequency	AC Filter			Crest Factor	Error (% of reading)
	Slow	Medium	Fast		
10Hz-20Hz	0	0.74	--	1 - 2	0.05
20Hz-40Hz	0	0.22	--	2 - 3	0.2
40Hz-100Hz	0	0.06	0.73	3 - 4	0.4
100Hz- 200Hz	0	0.01	0.22	4 - 5	0.5
200Hz-1kHz	0	0	0.18		
>1kHz	0	0	0		

[1] Specifications are for 90-minute warm-up, slow ac filter and sinewave input.

[2] 10% overrange on all ranges except ACV 750 V and ACI 10 A ranges.

[3] Relative to calibration standards.

[4] Specifications are for sinewave input >5% of range. For inputs within 1% and 5% of range and <50 kHz, add 0.1% of range additional error. For 50kHz to 100kHz, add 0.13% of range additional error.

[5] ACV 750 range limited to 8×10^7 Volt-Hz. For input over 300V rms, add 0.7mV error for each additional volt.

[6] For continuous current > DC 7A or AC RMS 7A, 30 seconds ON and 30 seconds OFF.

[7] For frequency below 100 Hz, the specification of slow filter is only for sinewave input.

[8] Specifications are for sinewave input >5% of range. For inputs within 1% to 5% of range, add 0.1% of range additional error. Specifications are typical values for 200uA and 2mA, 2A and 10A ranges when frequency >1kHz.

Measuring Characteristics

True RMS AC Voltage	
Measurement Method	AC-coupled True-RMS measurement with up to 400V DC of bias at on any range.
Crest Factor	≤ 5 at full range
Input Impedance	$1M\Omega \pm 2\%$ in parallel with <150pF capacitance on any range
Input Protection	750V rms on all ranges
AC Filter Bandwidth	Slow: 3Hz - 300kHz
	Medium: 20Hz - 300kHz
	Fast: 200Hz - 300kHz

CMRR (common mode rejection ratio)	70 dB, for the 1 k Ω unbalance in LO lead, <60Hz, \pm 500VDC peak maximum.
True RMS AC Current	
Measurement Method	Direct coupled to the fuse and shunt; AC-coupled True RMS measurement (measure the AC component only).
Crest Factor	≤ 3 at full range
Max. Input	DC + AC current peak value <300% of range. The RMS current <10A rms including the DC component.
Shunt Resistor	100 Ω for 200uA, 2mA
	1 Ω for 20mA, 200mA
	0.01 Ω for 2A, 10A
Input Protection	Externally accessible 500mA, 250V fast blow fuse at the rear panel for 200uA, 2mA, 20mA and 200mA ranges. Internal 10A, 250 V slow blow fuse for 2A and 10A ranges.
Settling Time Considerations	
<p>The default measurement delay is selected to give first reading right for most measurements. Make sure the RC circuit of input terminal has been fully settled (about 1s) before accurate measurement.</p> <p>Applying >300Vrms (or >5Arms) will cause self-heating in signal-conditioning components and these error are included in the instrument specifications. Internal temperature changes due to self-heating may cause additional error on lower ac voltage ranges. The additional error will be lower than 0.02% of reading and will generally dissipate within a few minutes.</p>	

1.3 Frequency and Period Characteristics

Accuracy Specifications: \pm (% of reading)^{[1][2]}

Function	Range	Frequency Range	24 Hour ^[3] $T_{CAL} \text{ } ^\circ\text{C} \pm 1^\circ\text{C}$	90 Day $T_{CAL} \text{ } ^\circ\text{C} \pm 5^\circ\text{C}$	1 Year $T_{CAL} \text{ } ^\circ\text{C} \pm 5^\circ\text{C}$	Temperature Coefficient $0^\circ\text{C to } (T_{CAL} \text{ } ^\circ\text{C} - 5^\circ\text{C})$ $(T_{CAL} \text{ } ^\circ\text{C} + 5^\circ\text{C}) \text{ to } 50^\circ\text{C}$
Frequency, Period	200mV to 750V	3 Hz-5 Hz	0.07	0.07	0.07	0.005
		5 Hz-10 Hz	0.04	0.04	0.04	0.005
		10 Hz-40 Hz	0.02	0.02	0.02	0.001
		40 Hz-300 kHz	0.005	0.006	0.007	0.001
		300 kHz-1 MHz	0.005	0.006	0.007	0.001

Additional Low Frequency Errors: (% of reading)

Frequency	Gate Time (Resolution)			
	1 s (0.1ppm)	0.1 s (1ppm)	0.01 s (10ppm)	0.001 s (100ppm)
3 Hz-5 Hz	0	0.12	0.12	0.12
5 Hz-10 Hz	0	0.17	0.17	0.17
10 Hz-40 Hz	0	0.20	0.20	0.20
40 Hz-100 Hz	0	0.06	0.21	0.21
100 Hz-300 Hz	0	0.03	0.21	0.21
300 Hz-1 kHz	0	0.01	0.07	0.07
>1kHz	0	0	0.02	0.02

[1] Specifications are for 90 minutes warm-up, using 1s gate time.

[2] For frequency $\leq 300\text{kHz}$, the specification is the 10% to 110% of range of the AC input voltage. For frequency $> 300\text{kHz}$, the specification is the 20% to 110% of range of the AC input voltage. The maximum input is limited to 750V rms or 8×10^7 Volts-Hz (whichever is less). 200mV range is full range input or input that is larger than the full range. For 20mV to 200mV, multiply % of reading error $\times 10$.

[3] Relative to calibration standards.

Measuring Characteristics

Frequency and Period	
Measurement Method	Reciprocal-counting technique, AC-coupled input using the AC voltage function.
Input Impedance	1M Ω \pm 2% in parallel with <150pF capacitance on any range
Input Protection	750V rms on all ranges
Measurement Considerations	
All frequency counters are susceptible to error when measuring low-voltage, low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors.	
Settling Time Considerations	
Errors will occur when attempting to measure the frequency or period of an input following a dc offset voltage change. Make sure the RC circuit of input terminal has been fully settled (about 1s) before accurate measurement.	

1.4 Capacitance Characteristics

Accuracy Specifications: \pm (% of reading + % of range)^{[1][2]}

Function	Range ^[2]	Test Current	1Year T _{CAL} °C ±5°C	Temperature Coefficient 0°C to (T _{CAL} °C -5°C) (T _{CAL} °C +5°C) to 50°C
Capacitance	2.000nF	200nA	2 + 2.5	0.05+0.05
	20.00nF	2uA	1 + 0.3	0.05+0.01
	200.0nF	10uA	1 + 0.3	0.01+0.01
	2.000uF	100uA	1 + 0.3	0.01+0.01
	20.00uF	1mA	1 + 0.3	0.01+0.01
	200.0uF	1mA	1 + 0.3	0.01+0.01
	2.000mF	1mA	1 + 0.3	0.01+0.01
	20.00mF	1mA	1 + 0.3	0.01+0.01
	100.0mF	1mA	3 + 0.2	0.05+0.02

[1] Specifications are for 90 minutes warm-up and using REL operation. Additional errors may be caused by non-film capacitors.

[2] Specifications are the 1% to 110% of range on 2nF range and 10% to 110% of range on all other ranges.

Measuring Characteristics

Capacitance Measurement	
Measurement Method	Apply constant current into the capacitance, and measure the voltage changing rate.
Connection Type	2-wire
Measurement Considerations	
Since small capacitance measurements are susceptible to the external noise, shielding inputs from external noise pickup is critical for minimizing measurement errors.	

1.5 Temperature Characteristics

Function	Probe Type	Type	Optimum Range	Accuracy Specifications ^[1]	
				1 Year $T_{CAL} \text{ } ^\circ\text{C} \pm 5^\circ\text{C}$	Temperature Coefficient $0^\circ\text{C to } (T_{CAL} \text{ } ^\circ\text{C} - 5^\circ\text{C})$ $(T_{CAL} \text{ } ^\circ\text{C} + 5^\circ\text{C}) \text{ to } 50^\circ\text{C}$
Temperature	RTD ^[2] (R_0 is within 49Ω and $2.1k \Omega$)	$\alpha=0.00385$	$-200^\circ\text{C to } 660^\circ\text{C}$	0.16°C	0.01°C
		$\alpha=0.00389$	$-200^\circ\text{C to } 660^\circ\text{C}$	0.17°C	0.01°C
		$\alpha=0.00391$	$-200^\circ\text{C to } 660^\circ\text{C}$	0.14°C	0.01°C
		$\alpha=0.00392$	$-200^\circ\text{C to } 660^\circ\text{C}$	0.15°C	0.01°C
	Thermal Resistance	$2.2k \Omega$	$-40^\circ\text{C to } 150^\circ\text{C}$	0.08°C	0.002°C
		$3k \Omega$	$-40^\circ\text{C to } 150^\circ\text{C}$	0.08°C	0.002°C
		$5k \Omega$	$-40^\circ\text{C to } 150^\circ\text{C}$	0.08°C	0.002°C
		$10k \Omega$	$-40^\circ\text{C to } 150^\circ\text{C}$	0.08°C	0.002°C
		$30k \Omega$	$-40^\circ\text{C to } 150^\circ\text{C}$	0.08°C	0.002°C
	Thermocouple ^[3]	B	$0^\circ\text{C to } 1820^\circ\text{C}$	0.76°C	0.14°C
		E	$-270^\circ\text{C to } 1000^\circ\text{C}$	0.5°C	0.02°C
		J	$-210^\circ\text{C to } 1200^\circ\text{C}$	0.5°C	0.02°C
		K	$-270^\circ\text{C to } 1372^\circ\text{C}$	0.5°C	0.03°C
		N	$-270^\circ\text{C to } 1300^\circ\text{C}$	0.5°C	0.04°C
		R	$-270^\circ\text{C to } 1768.1^\circ\text{C}$	0.5°C	0.09°C
		S	$-270^\circ\text{C to } 1768.1^\circ\text{C}$	0.6°C	0.11°C
	T	$-270^\circ\text{C to } 400^\circ\text{C}$	0.5°C	0.03°C	

[1] Specifications are for 90 minutes warm-up. Exclusive of sensor error.

[2] Specification is for 4WR sensor measurement or 2WR measurement using REL operation.

[3] Relative to cold junction temperature, accuracy is based on ITS-90. Built-in cold junction temperature refers to the temperature inside the banana jack and its accuracy is $\pm 2.5^\circ\text{C}$.

Measuring Characteristics**Measurement Considerations**

The built-in cold junction temperature tracks the temperature inside the banana jack. The change of the temperature in banana jack might cause additional error. When using the built-in cold junction compensation, connect the sensor terminal of the thermocouple to the banana jack and warm it up for more than 3 minutes to minimize the error.

1.6 Measurement Rate

			Measurement Rate ^[1]
Function	Setting	Integration Time	Readings/s 50Hz (60Hz)
DC Voltage DC Current 2-wire Resistance 4-wire Resistance	0.006 NPLC Integration Time	100(100) us	10000(10000)
	0.02 NPLC	400(333) us	2500(3000)
	0.06 NPLC	1.2(1) ms	833(1000)
	0.2 NPLC	4(3.33) ms	250(300)
	1 NPLC	20(16.7) ms	50(60)
	2 NPLC	40(33.3) ms	25(30)
	10 NPLC	200(167) ms	5(6)
	100 NPLC	2(1.67) s	0.5(0.6)
AC Voltage AC Current ^[2]	3Hz AC Filter		0.2
	20Hz		1.5
	200Hz		10
	200Hz		50 ^[3]
Frequency and Period ^[4]	1s Gate Time		1
	0.1s		10
	0.01s		80
	0.001s		500
Capacitance ^[5]			25

[1] Auto trigger, zero trigger delay, auto zero off, auto range off, math function off and external interface off.

[2] Use the default trigger delay setting.

[3] The maximum rate available when trigger delay is set to 0.

[4] 20V range, fast filter, 1kHz input.

[5] Measure 20nF capacitance on 200nF range. The measurement period changes with the capacitance under test. The maximum measurement period on 100mF is 4s (typical value).

1.7 Other Measurement Characteristics

Triggering and Storage	
Trigger	Pre-trigger or Pos-trigger, Internal Trigger or External Trigger, Rising Edge Trigger or Falling Edge Trigger
Time Base Resolution	33.333us, 0.01% Accuracy
Trigger Delay	0 to 3600s available (about 33μs step size)
Sample Timer	0 to 3600s available (about 33μs step size)
Internal Trigger Level Accuracy	±1% of range
Reading Hold Sensitivity	0.01%, 0.1%, 1% or 10% of reading
Single Trigger Samples	1 to 50000
External Trigger Input	Level: 5V TTL compatible
	Impedance: >30kΩ in parallel with 500pF
	Delay: < 50 μs
	Jitter: < 50 μs (ACV, ACI, FREQ and PREIOD <2ms)
	Polarity: selectable rising edge or falling edge
	Maximum Rate: 300/s Minimum Pulse Width: 2μs
VMC Output	Level: 5V TTL compatible
	Output Impedance: 100Ω, typical
	Output Polarity: Falling Edge
	Pulse Width: about 2μs
History Record and Storage	
Volatile Memory	512k reading history data record
Non-volatile Memory	10 sets history data storage (5000 readings/group)
	5 sets sensor data storage (5000 readings/group)
	10 sets instrument setup storage
	5 sets Anysensor setup storage
	Support USB flash device backup data and setting.

1.8 General Specifications

Display	256×64 LCD, dual display, graphical menu, selectable Chinese or English, online help.
Power Supply	AC 100V - 120V, 45Hz - 440Hz AC 200V - 240V, 45Hz - 66Hz Detect the power-line frequency automatically at power-on, 400Hz defaults to 50Hz
Power Consumption	25 VA Max
Working Environment	Full accuracy for 0°C to 50°C Full accuracy to 40°C, 80% R.H., Non-coagulation
Storage Temperature	-40°C to 70°C
Operation Altitude	Up to 2000m
Safety	IEC 61010-1; EN 61010-1; UL 61010-1; CAN/CSA-C22.2 No. 61010-1 Measurement CAT I 1000V/CAT II 300V Pollution Degree 2
EMC	EN 61326-1
Weight	About 3.2 kg (without package)
Dimension	(h×w×l): 107.0mm×231.6mm×290.5mm
Remote Interface	GPIB, 10/100Mbit LAN, USB 2.0 Full Speed Device & Host (support USB flash device), RS-232C
Programming Language	SCPI
LXI Compatibility	LXI Class C, Version 1.2
Warm-up Time	90 minutes

Chapter 2 Performance Test

2.1 Test Type

The performance test is used to check the measurement performance of the multimeter based on the specifications listed in **User's Guide for DM3068** or "**Specifications**" in this book. The DM3068 supports Self-test, Fast test and Routine Test. Below is the detailed information.

2.1.1 Self-Test

Self-Test is a series of internal calibration tests which can be used reliably to determine the usability of the instrument.

Self-Test Directions:

Step1: Turn on the meter.

Step2: Press `Utility`→`T/C`→`Siftst`→`Run` to start the self-test. When abnormal situation develops during the test, the beeper makes a sound. The screen displays "PASS!" which indicates that the hardware of the instrument is working normally (confidence level>90%) or "FAIL!" when the test completed.

In Remote mode, sending `*TST?` will also start the self-test and query its result. The returned value "0" denotes test passed, while "1" denotes test failed. The whole test process lasts about 18 seconds and appropriate interface timeout period may need to be configured.

Step3: The error information during the test is stored in the error queue and you can obtain them through pressing `Utility`→`T/C`→`Error` (or sending `SYSTEM:ERRor?`).

Table 2-1 List of possible errors

Error Code	Error Information
601	ADC offset too noisy
602	ADC fullscale too noisy
603	ADC gain test failed
604	OHM Common Drive Test
605	DCV Common Drive Test
606	DCI Common Drive Test
607	DC 200V Zero Test
608	DC 1000V Zero Test

609	Input Leakage Test
610	Ohms 0.2uA and DC x1 Test
611	DCV Autozero Test
612	DCI Autozero Test
613	Precharge Offset Test.
614	DC 20V Gain Test
615	AC 200mV Zero Test
616	DC 200V Gain Test
617	DC x10 Gain Test
618	DC 1000V Gain Test
619	Low Current Shunt Test
620	High Current Shunt Test
621	Ohms 2uA Current Source Test
622	Ohms 10uA Current Source Test
623	Ohms 100uA Current Source Test
624	Ohms 1mA Current Source Test
625	AC Gain Test
626	Frequency counter Test
627	Capacitance Function Test
628	FPGA Configuration failed

NOTE

Although the meter automatically cuts off the connection with the input signal while self-testing, ac signals from the input terminal may still enter the meter and causes failure of the self-test. So please do not start the self-test until you have disconnected all input connections.

The meter failed the self-test must be calibrated or repaired before it is put back into use.

2.1.2 Fast Test

Fast test is an easy way to inspect the functions and specifications of the meter with higher confidence level. It contains only a few test points, and can evaluate the accuracy of the meter in normal use rather than to detect an element failure.

Fast Test Directions:

Step1: Run the test.

Step2: Execute the test items marked with "Q" (indicates the optional quick test item) in "**Routine Test**".

NOTE

The fast test does not apply to the units with an abnormality in some certain functions. The meter failed to pass the routine test must be calibrated or repaired before it is put back into use.

2.1.3 Routine Test

A routine test is recommended when you first obtain the meter. Please compare the routine test results with the specifications given in the **1 year** column of **Allowable Error Range** from tables (Table 2-3 to Table 2-7) in "**Routine Test**". Note the meter should be recalibrated once the calibration interval time is up.

NOTE

The meter passed the routine test must be tested again when the test time interval is exceeded.

The meter failed to pass the routine test must be calibrated or repaired before it is put back into use.

2.2 Testing Equipments

The following table lists the equipments recommended for the test. If you do not have such equipments, use others that have the same **Precisions** instead.

Table 2-2 Recommended equipments

Test and Calibrate Items	Recommended Equipments ^[1]	Precision Requirements
Zero Test	None	Pure copper 4-terminal short-circuiter
DC Voltage	Fluke 5520A and Agilent 3458A (contain accessory 002)	<1/5 dmm 24 hour spec.
DC Current	Fluke 5520A and Agilent 3458A (contain accessory 002)	<1/5 dmm 24 hour spec.
Resistance	Fluke 5520A and Agilent 3458A (contain accessory 002)	<1/5 dmm 24 hour spec.
AC Voltage	Fluke 5520A	<1/5 dmm 24 hour spec.
AC Current	Fluke 5520A	<1/5 dmm 24 hour spec.
Frequency	Fluke 5520A	<1/5 dmm 24 hour spec.
Capacitance	Fluke 5520A	<1/5 dmm 24 hour spec.

Remark^[1]: Agilent 3458A (contain accessory 002) characterizes Fluke 5520A.

2.3 Test Conditions

For best performance, we advise following items throughout all testing processes:

1. Always operate the instrument under a proper voltage.
2. Make sure the ambient temperature during the test is stable and within 18 °C and 28 °C.
3. The relative humidity should be less than 80%.
4. Warm up the instrument for at least 90 minutes before testing.
5. Use a copper connector to reduce its thermoelectric potential effect.
6. Use a Teflon insulation shielding paired cable and as short as possible in order to reduce the external interference effect. In the process of capacitance testing, a coaxial cable should be used to minimize the external interference and noise.
7. Ground the shield of both twisted-pair and coaxial-cable, as well as the LO terminal of calibrator (unless otherwise specified).

The DM3068 was designed for high precision, you must be more careful while testing or calibrating in order to avoid errors. In an optimal situation, the accuracy of test and calibration standard source must be four times at least than that of the test instrument.

While performing the gain calibration for DC voltage, DC current and resistance, the "0" output of the calibrator must be correct. In order to reduce the connection errors, enough warm-ups must be done before each reconnection of cable or short-circuiter. 5 minutes is often needed for the warm-up.

2.4 Input Connections

To perform a zero-offset test, you must use a 4-terminal short-circuiter which is made of copper or copper alloy with low thermoemf. A coaxial cable whose shielding layer is connected to the LO terminal should be used for the capacitance test, while a Teflon Shielded Twisted Pair with isolation and as short as possible is available for other kinds of tests. But please note the terminals HI, LO, HI-Sense and LO-Sense must be used through a coaxial cable and the shielding layer must be grounded so as to reduce the influence from low thermoemf and exterior interference.

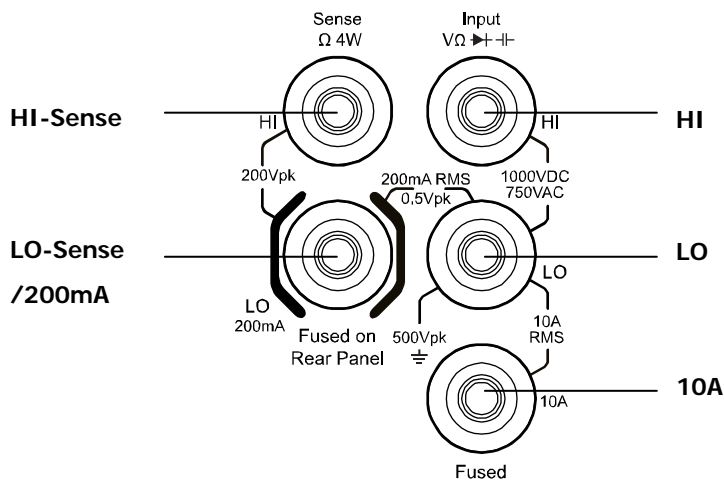


Figure 2-1 Input terminals

2.5 Routine Test

2.5.1 Zero-offset Test

The zero-offset test inspects the meter's offset performance at the point of zero. It is necessary only when a regular offset is occurred to a function or range.

To perform a zero-offset test:

1. Make sure you have carefully read the "Test Conditions".
2. Use a 4-terminal short-circuiter to short connect the HI-LO and Sense HI-LO for DC voltage and resistance measurements (see figure below) and open both 200mA and 10A current input terminals in current measurement.
3. Perform a step-by-step test for the functions under different ranges specified in the following table and set the integration time to 100PLC. Please note that none of the math function is allowable unless otherwise stated.
4. Compare the tested results with the limits in the table.

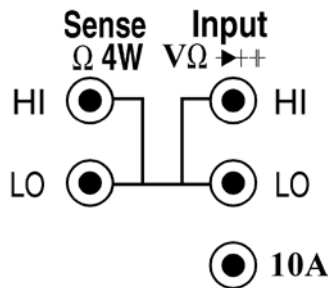


Figure 2-2 Zero-offset test connection

Table2-3 Zero-offset test items

Function ^[1]	Range	Input signal	Quick Test ^[3]	Allowable Error Range		
				24 hours	90 days	1 year
DC Voltage	200.000mV	short	Q	±4μV	±5μV	±5μV
	2.00000V	short		±10μV	±12μV	±12μV
	20.0000V	short		±80μV	±100μV	±100μV
	200.000V	short	Q	±1.2mV	±1.2mV	±1.2mV
	1000.00V	short		±6mV	±10mV	±10mV
DC Current	200.000μA	open	Q	±24nA	±30nA	±30nA
	2.00000mA	open		±60nA	±60nA	±60nA
	20.0000mA	open	Q	±2.4μA	±3μA	±3μA
	200.000mA	open		±4μA	±6μA	±6μA
	2.00000A	open	Q	±400μA	±400μA	±400μA
	10.0000A	open		±1mA	±1mA	±1mA

Resistance ^[2]	200.000Ω	short		±6mΩ	±8mΩ	±8mΩ
	2.00000kΩ	short		±10mΩ	±20mΩ	±20mΩ
	20.0000kΩ	short	Q	±100mΩ	±200mΩ	±200mΩ
	200.000kΩ	short		±1Ω	±2Ω	±2Ω
	1.00000MΩ	short	Q	±10Ω	±10Ω	±10Ω
	10.0000MΩ	short		±100Ω	±100Ω	±100Ω
	100.000MΩ	short		±10kΩ	±10kΩ	±10kΩ

Remarks:

- [1] The integration time is set to 100PLC.
- [2] Specifications are for 4-wire or 2-wire resistance measurement using "REL" operation. If 2-wire resistance measurement is used without REL operation, add 0.2 Ω additional errors.
- [3] Q denotes the optional quick test point.

2.5.2 Gain Test

The gain test inspects the accuracy of the meter under a full range. It is necessary only when a regular gain offset is occurred to a function or range.

1. To test the DC gain:

- (1) Make sure you have carefully read the “**Test Conditions**”.
- (2) Connect your meter with the calibrator.
- (3) Perform a step-by-step test for the functions under different ranges specified in the following table and set the integration time to 100PLC. Please note that none of the math function is allowable unless otherwise stated.
- (4) Input signals in accordance with the table below using the calibrator and compare the results with the limits from the table (make sure the calibrator can adequately output).

Table 2-4 Gain test items

Function ^[1]	Range	Test Signal	Quick Test ^[4]	Allowable Error Range		
				24 hours	90 days	1 year
DC Voltage	200.0000mV	200mV		±8μV	±11μV	±13μV
	200.0000mV	-200mV		±8μV	±11μV	±13μV
	2.000000V	2V	Q	±40μV	±52μV	±82μV
	2.000000V	-2V		±40μV	±52μV	±82μV
	20.00000V	20V	Q	±480μV	±700μV	±900μV
	20.00000V	-20V		±480μV	±700μV	±900μV
	200.0000V	200V	Q	±5.2mV	±9.2mV	±11.2mV
	200.0000V	-200V		±5.2mV	±9.2mV	±11.2mV
	1000.000V	1000V	Q	±26mV	±50mV	±65mV
1000.000V	-1000V		±26mV	±50mV	±65mV	
DC Current ^[2]	200.0000μA	200μA	Q	±44nA	±110nA	±130nA
	200.0000μA	-200μA	Q	±44nA	±110nA	±130nA
	2.000000mA	2mA		±200nA	±660nA	±1.06μA
	2.000000mA	-2mA		±200nA	±660nA	±1.06μA
	20.00000mA	20mA	Q	±3.8μA	±9μA	±13μA
	20.00000mA	-20mA	Q	±3.8μA	±9μA	±13μA
	200.0000mA	200mA		±24μA	±66μA	±106μA
	200.0000mA	-200mA		±24μA	±66μA	±106μA
	2.000000A	2A	Q	±1.4mA	±2mA	±2.4mA
	2.000000A	-2A		±1.4mA	±2mA	±2.4mA
	10.00000A	10A		±11mA	±13mA	±16mA
10.00000A	-10A		±11mA	±13mA	±16mA	
Resistance ^[3]	200.0000Ω	200Ω		±12mΩ	±24mΩ	±28mΩ
	2.000000kΩ	2kΩ		±50mΩ	±180mΩ	±220mΩ
	20.00000kΩ	20kΩ	Q	±500mΩ	±1.8Ω	±2.2Ω
	200.0000kΩ	200kΩ		±5Ω	±18Ω	±22Ω
	1.000000MΩ	1MΩ	Q	±30Ω	±110Ω	±130Ω
	10.00000MΩ	10MΩ		±1.6kΩ	±3.1kΩ	±4.1kΩ

	100.0000MΩ	100MΩ		±310kΩ	±810kΩ	±810kΩ
--	------------	-------	--	--------	--------	--------

Remarks:

- [1] The integration time is set to 100PLC.
- [2] For Continuous current greater than DC 7 A or AC RMS 7 A, 30s on and 30s off.
- [3] Specifications are for 4-wire or 2-wire resistance measurement using "REL" operation. If 2-wire resistance measurement is used without REL operation, add 0.2 Ω additional errors.
- [4] Q denotes the optional quick test point.

2. To test the AC voltage gain:

- (1) Make sure you have carefully read the "Test Conditions".
- (2) Connect your meter with the calibrator.
- (3) Perform a step-by-step test under the ranges specified in the following table, set the filter to Slow and disable math function.
- (4) Input signals in accordance with the table below using the calibrator and compare the results with the limits from the table (make sure the calibrator can adequately output).

Table 2-5 AC voltage gain test items

Range ^[1]	Test Signal	Input Frequency	Quick Test ^[2]	Allowable Error Range		
				24 hours	90 days	1 year
200.000 mV	200mV	10Hz		±760μV	±780μV	±780μV
	200mV	20kHz	Q	±140μV	±180μV	±200μV
	200mV	50kHz		±300μV	±320μV	±340μV
	200mV	100kHz		±1.26mV	±1.36mV	±1.36mV
	200mV	300kHz		±9mV	±9mV	±9mV
2.00000 V	2V	10Hz		±7.4mV	±7.6mV	±7.6mV
	2V	20kHz	Q	±1.2mV	±1.6mV	±1.8mV
	2V	50kHz		±2.8mV	±3.2mV	±3.4mV
	2V	100kHz		±12.6mV	±13.6mV	±13.6mV
	2V	300kHz		±90mV	±90mV	±90mV
	100mV	1kHz		±440μV	±650μV	±660μV
20.0000 V	20V	10Hz		±76mV	±78mV	±78mV
	20V	20kHz	Q	±16mV	±22mV	±24mV
	20V	50kHz		±30mV	±34mV	±40mV
	20V	100kHz		±126mV	±136mV	±136mV
	3.2V	300kHz		±228mV	±228mV	±228mV
200.000 V	200V	45Hz		±120mV	±200mV	±220mV
	200V	20kHz	Q	±120mV	±200mV	±220mV
	200V	50kHz		±280mV	±340mV	±400mV
	200V	100kHz		±1.26V	±1.36V	±1.36V
750.00 V	320V	45Hz		±278mV	±449mV	±481mV
	320V	20kHz	Q	±278mV	±449mV	±481mV
	320V	50kHz		±620mV	±759mV	±855mV
	320V	100kHz		±2.36V	±2.52V	±2.52V
	750V	10kHz	Q	±450mV	±750mV	±825mV

Remarks:

- [1] The AC filter is set to Slow.
 [2] Q denotes the optional quick test point.

3. To test the AC current gain:

- (1) Make sure you have carefully read the "Test Conditions".
- (2) Connect your meter with the calibrator.
- (3) Perform a step-by-step test under the ranges specified in the following table, set the filter to Slow and disable the math function.
- (4) Input signals in accordance with the table below using the calibrator and compare the results with the limits from the table (make sure the calibrator can adequately output).

Table 2-6 AC current gain test items

Range ^[1]	Test Signal	Input Frequency	Quick Test ^[3]	Allowable Error Range		
				24 hours	90 days	1 year
200.0000μA	200μA	1kHz	Q	±420nA	±420nA	±420nA
	200μA	5kHz		±420nA	±420nA	±420nA
	200μA	10kHz		±2.1μA	±2.1μA	±2.1μA
2.000000mA	2mA	1kHz	Q	±3.2μA	±3.2μA	±3.2μA
	2mA	5kHz		±3.2μA	±3.2μA	±3.2μA
	2mA	10kHz		±9μA	±9μA	±9μA
20.00000mA	20mA	1kHz	Q	±42μA	±42μA	±42μA
	20mA	5kHz		±42μA	±42μA	±42μA
	20mA	10kHz		±210μA	±210μA	±210μA
200.0000mA	200mA	1kHz	Q	±280μA	±280μA	±280μA
	200mA	5kHz		±280μA	±280μA	±280μA
	200mA	10kHz		±900μA	±900μA	±900μA
	10mA	10kHz	Q	±520μA	±520μA	±520μA
2.000000A	2A	1kHz	Q	±4.2mA	±4.2mA	±4.2mA
	2A	5kHz		±4.2mA	±4.2mA	±4.2mA
10.00000A ^[2]	10A	1kHz		±23mA	±25mA	±25mA

Remarks:

- [1] The AC filter is set to Slow.
 [2] Continuous current more than DC 7 A or AC RMS 7 A should be 30 seconds Off after 30 seconds On.
 [3] Q denotes the optional quick test point.

4. To test the frequency gain:

- (1) Make sure you have carefully read the "Test Conditions".
- (2) Connect your meter with the calibrator.
- (3) Select range according to table 2-7 and disable the math function.
- (4) Input signals in accordance with the table below using the calibrator and compare the results with the limits from the table (make sure the calibrator

can adequately output).

Table 2-7 Frequency gain test items

Signal Virtual Value	Signal Frequency	Quick Test ^[1]	Range	Allowable Error Range		
				24 hours	90 days	1 year
20mV	98Hz		200 mV	±4.9mHz	±5.88mHz	±6.86mHz
200mV	500kHz	Q	2 V	±25Hz	±30Hz	±35Hz

Remark:

[1] Q denotes the optional quick test point.

5. To test the capacitance gain:

- (1) Make sure you have carefully read the “**Test Conditions**”.
- (2) Switch to Capacitance measurement and select a range listed in the table below.
- (3) Connect one end of a shielded cable to the input terminal of the meter and leave the other end free, then enable the REL operation.
- (4) Connect the other end to the calibrator.
- (5) Input signals in accordance with the table below using the calibrator and compare the results with the limits from the table (make sure the calibrator can adequately output).
- (6) Repeat step 2, 3, 4 and 5 to finish the test.

Table 2-8 Capacitance test items

Range ^[1]	Test Signal	Quick Test ^[2]	Allowable Error Range
			1 year
2.000nF	2nF	Q	±90pF
20.00nF	20nF		±260pF
200.0nF	200nF		±2.6nF
2.000uF	2uF		±26nF
20.00uF	20uF		±260nF
200.0uF	200uF		±2.6μF
2.000mF	2mF		±26μF
20.00mF	20mF	Q	±260μF
100.0mF	100mF		±3.2mF

Remarks:

[1] Specifications under the REL operation.

[2] Q denotes the optional quick test point.

Chapter 3 Calibration

3.1 Calibration Interval

The DM3068 must be periodically calibrated; the calibration interval depends upon the requirements of the measurement accuracy.

For the measurement needs higher accuracy, a 90-day interval is recommended and less than 1 year interval is possible in most situation.

The accuracy will not be guaranteed until you perform a periodical calibration.

An interval higher than 1 year is not recommended under all circumstances.

3.2 Calibration Notice

To ensure accuracy, the meter should be completely recalibrated when the interval is reached whatever interval is chosen.

Even though the meter has passed the performance test, the specifications (see "**Specifications**") cannot be guaranteed unless recalibration is done.

3.3 To Obtain Calibration Service

As the DM3068 does not support user calibration, please send your meter back to us for professional calibration when necessary.

Chapter 4 Disassembly & Assembly

4.1 Disassembly and Assembly Notices

Safety Cautions:

- Do not disassemble the instrument until the necessity arises
- Do not disassemble the instrument unless you are professional
- Cut off the meter power before and during disassembling
- Wear the anti-static hand-ring or take other anti-static measures when disassembling
- Use proper tools and correctly disassemble the meter in sequence below
- Prevent metallic parts from transfiguration and scratch when disassembling metal parts

Tools:

- Club screwdriver T10, T15
- Diagonal cutting pliers



WARNING

Make sure the power is cut off before disassembling.
The operator should have been trained or have related qualification.

4.2 The 3D View of DM3068

Below is the 3D view of the DM3068 which will help you get a primary understanding of the main parts of the instrument before disassembling or assembling. You need to be gentle, follow the steps and be careful not to scratch the surface of the instrument and the PCB when disassembling or assembling the instrument (for details, refer to **Disassembly and Assembly Notices**). The recommended disassembling procedures are as follows:

Handle → Rear Panel → Metallic Shell → Fuse Seat → GPIB PCB → Filter Board and Power Frequency Transformer → Front Panel and LCD → Fan → Mainboard → Keypad PCB

To put above parts in back, reverse the removal procedures.

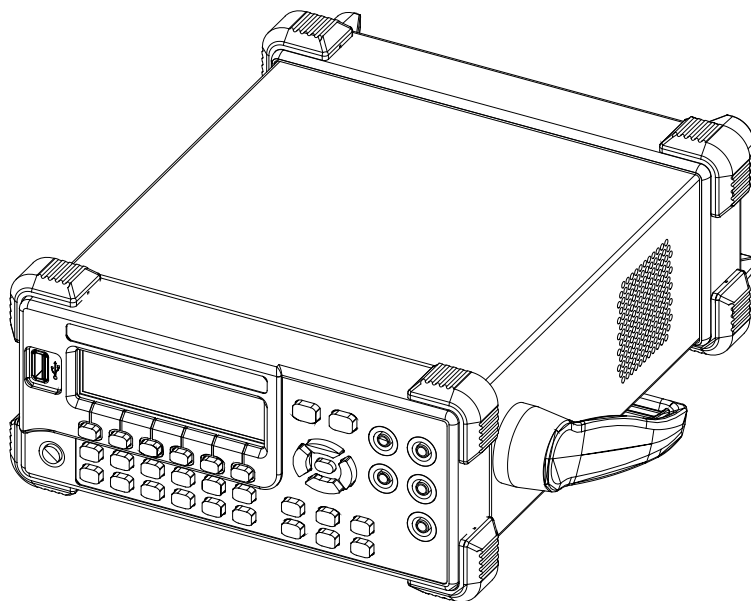


Figure 4-1 Exterior 3D view of DM3068

4.3 To Disassemble and Assemble Handle

To remove the handle, grasp it by the sides and pull outward, then rotate the handle until it is out of the meter body (see figure below).

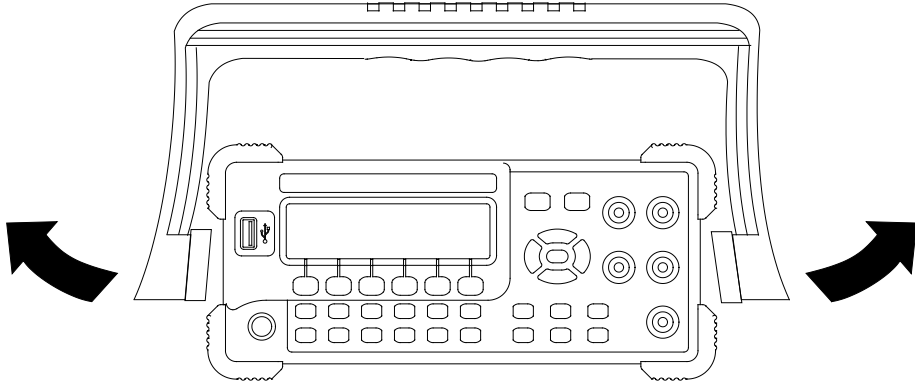


Figure 4-2 To disassemble and assemble handle

4. 4 To Disassemble and Assemble Rear Panel

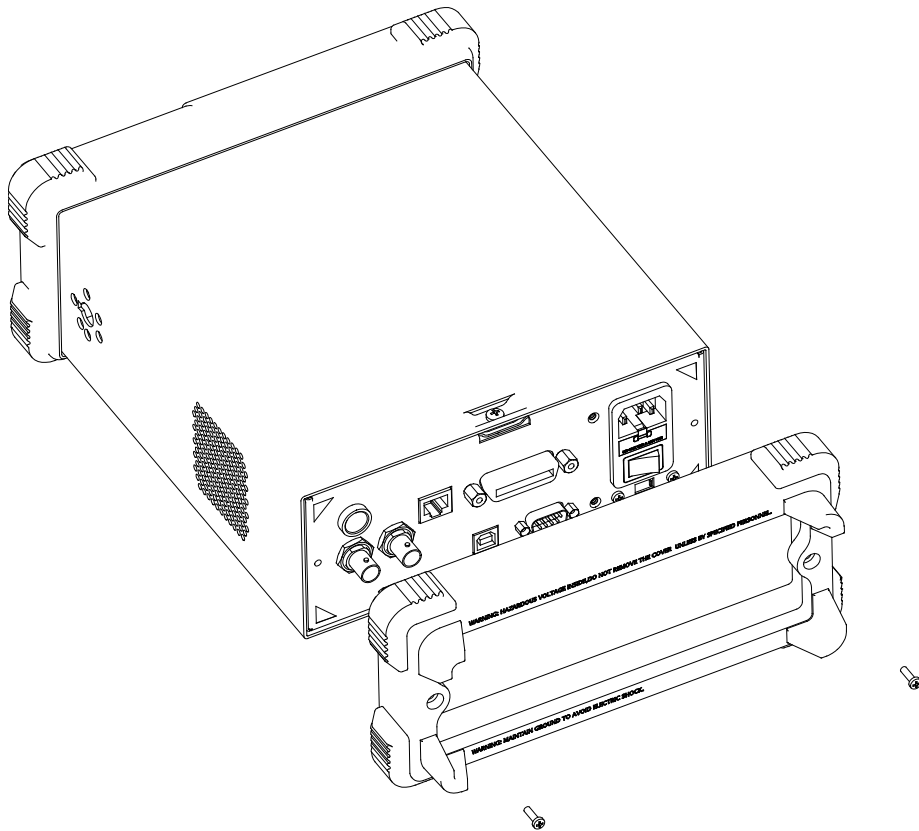


Figure 4-3 To disassemble and assemble rear panel

4.5 To Disassemble and Assemble Metallic Shell

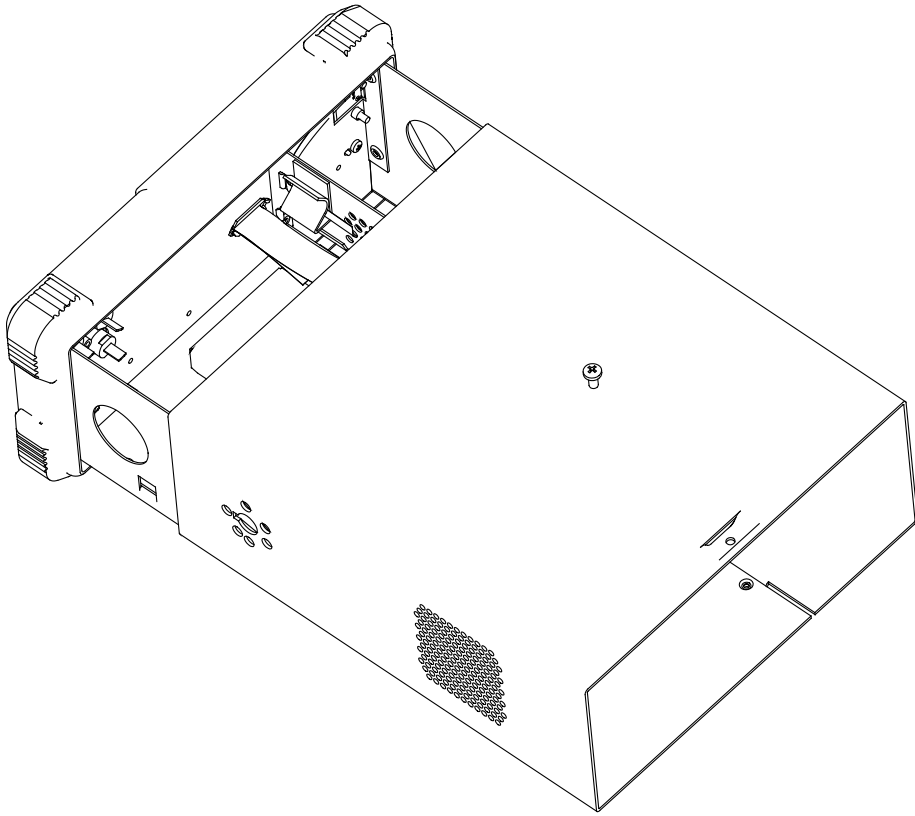


Figure 4-4 To disassemble and assemble metallic shell

4. 6 To Disassemble and Assemble Fuse Seat

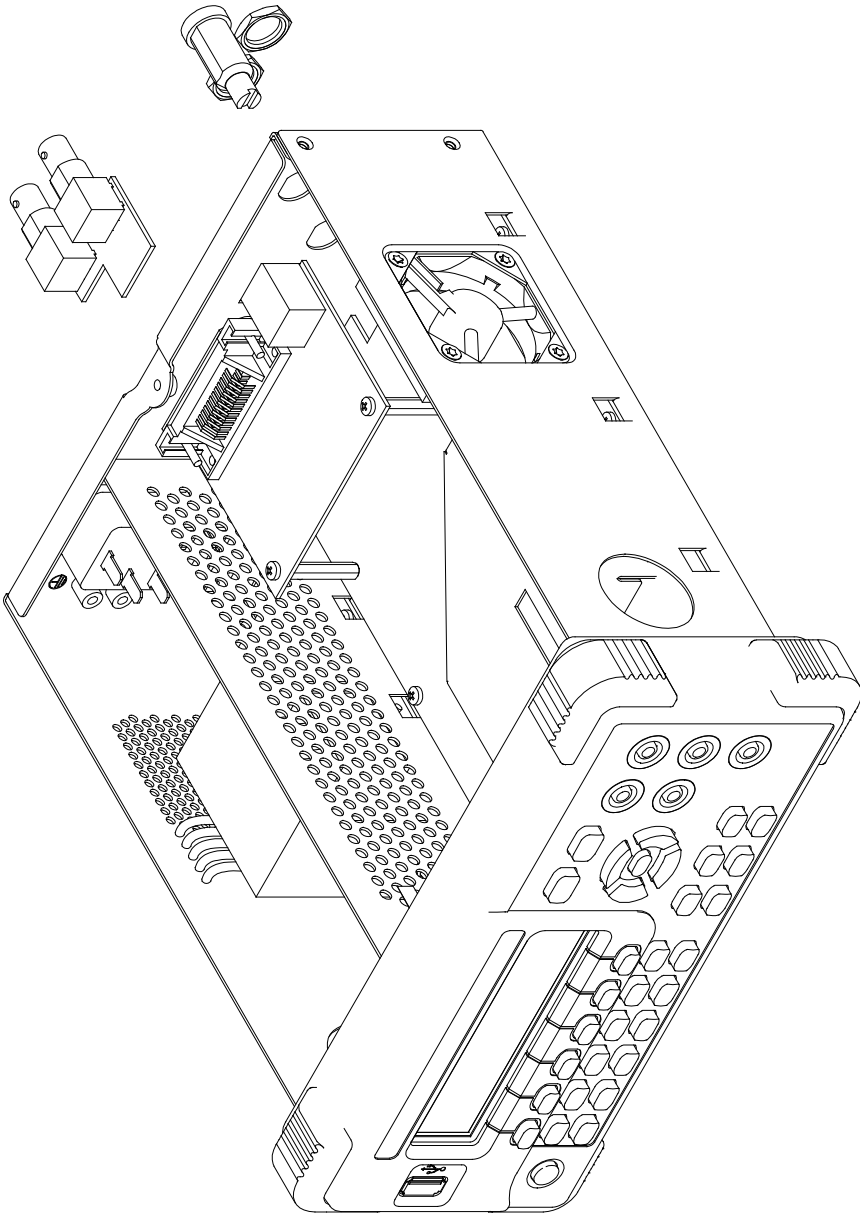


Figure 4-5 To disassemble and assemble fuse seat

4.7 To Disassemble and Assemble GPIB PCB

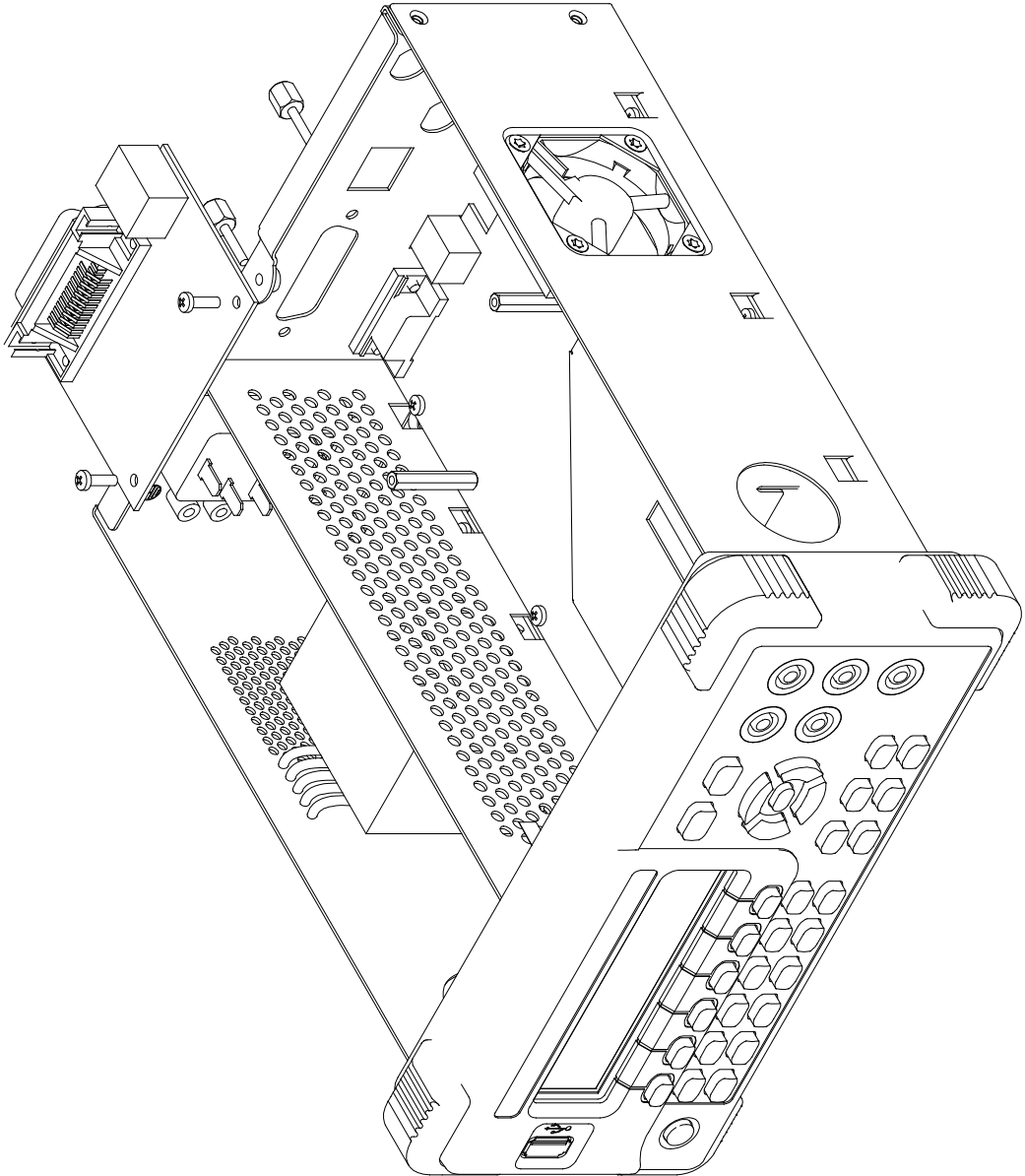


Figure 4-6 To disassemble and assemble GPIB PCB

4. 8 To Disassemble and Assemble Filter Board & Transformer

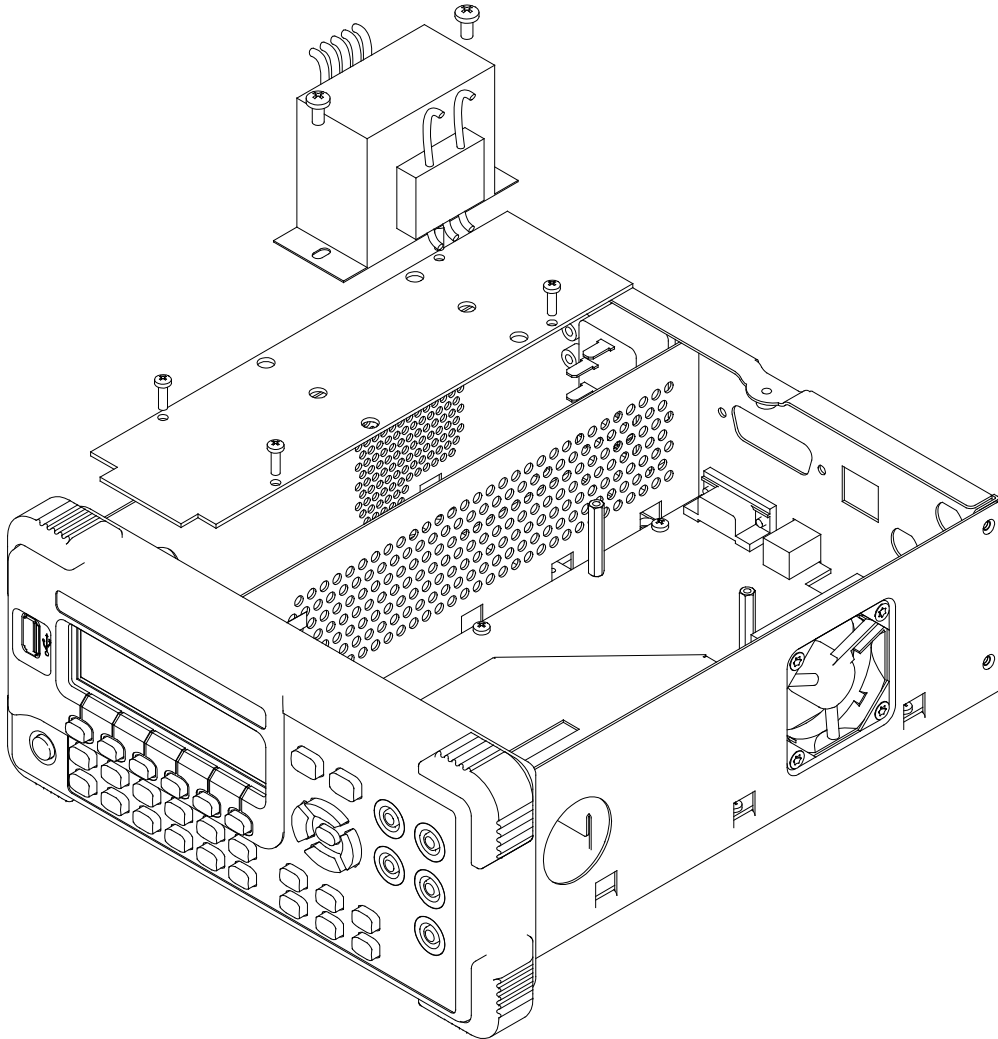


Figure 4-7 To disassemble and assemble filter board & transformer

4.9 To Disassemble and Assemble Front Panel & LCD

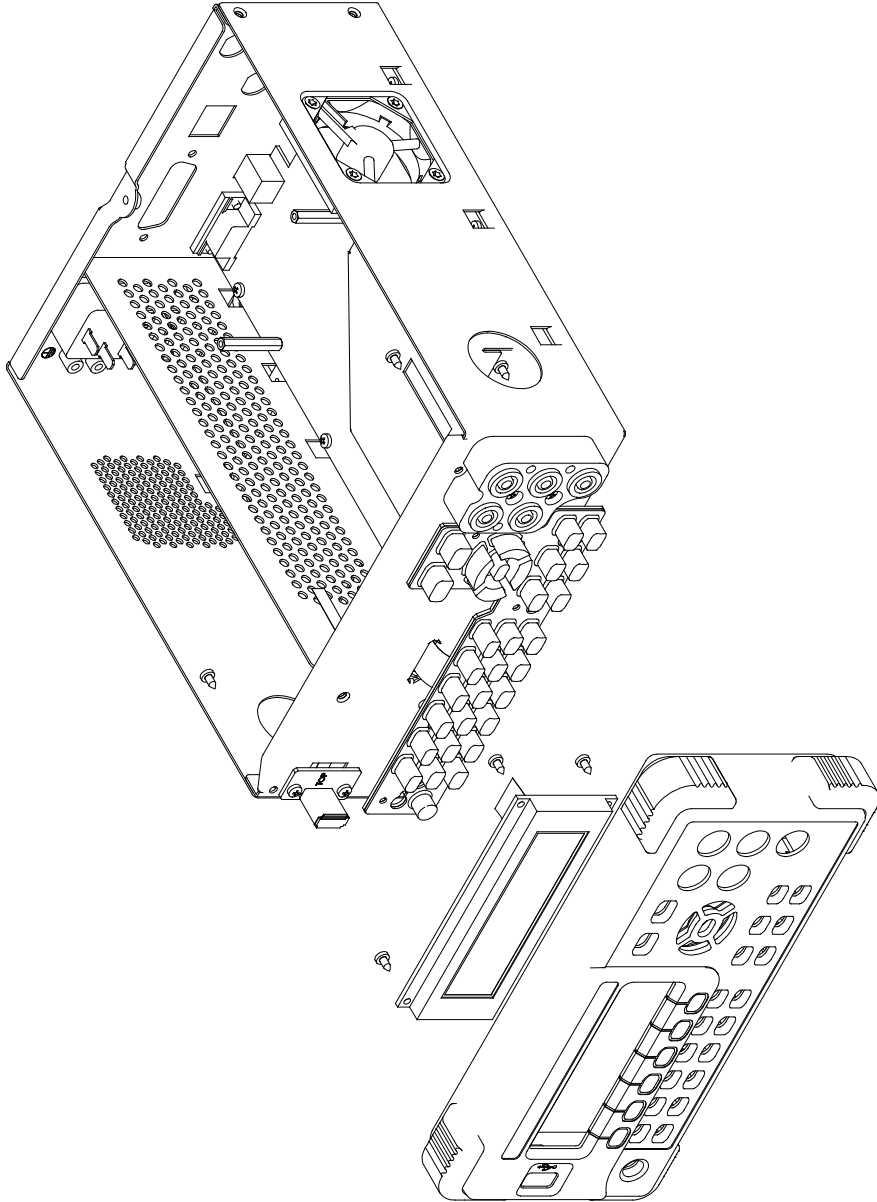


Figure 4-8 To disassemble and assemble front panel & LCD

4. 10 To Disassemble and Assemble the Fan

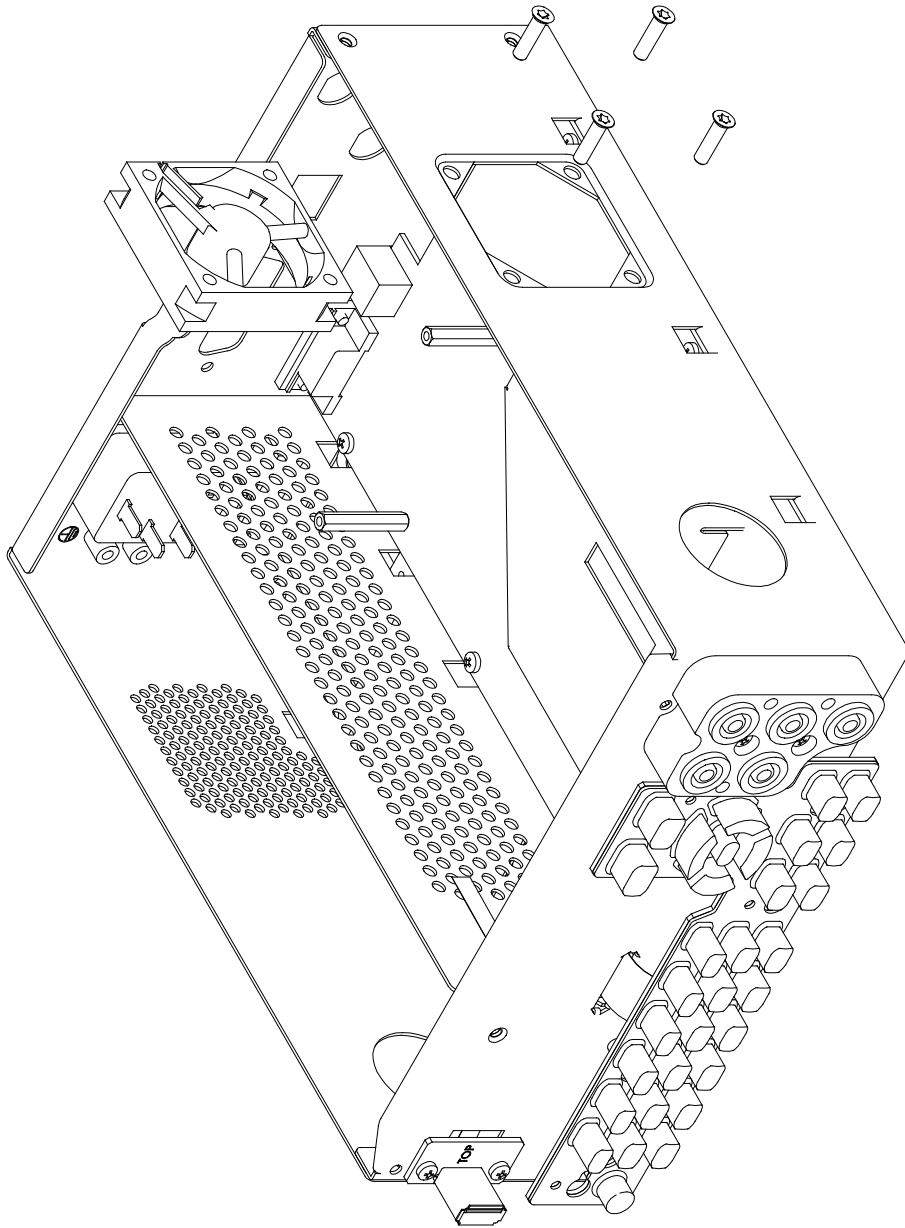


Figure 4-9 To disassemble and assemble the fan

4. 11 To Disassemble and Assemble Mainboard

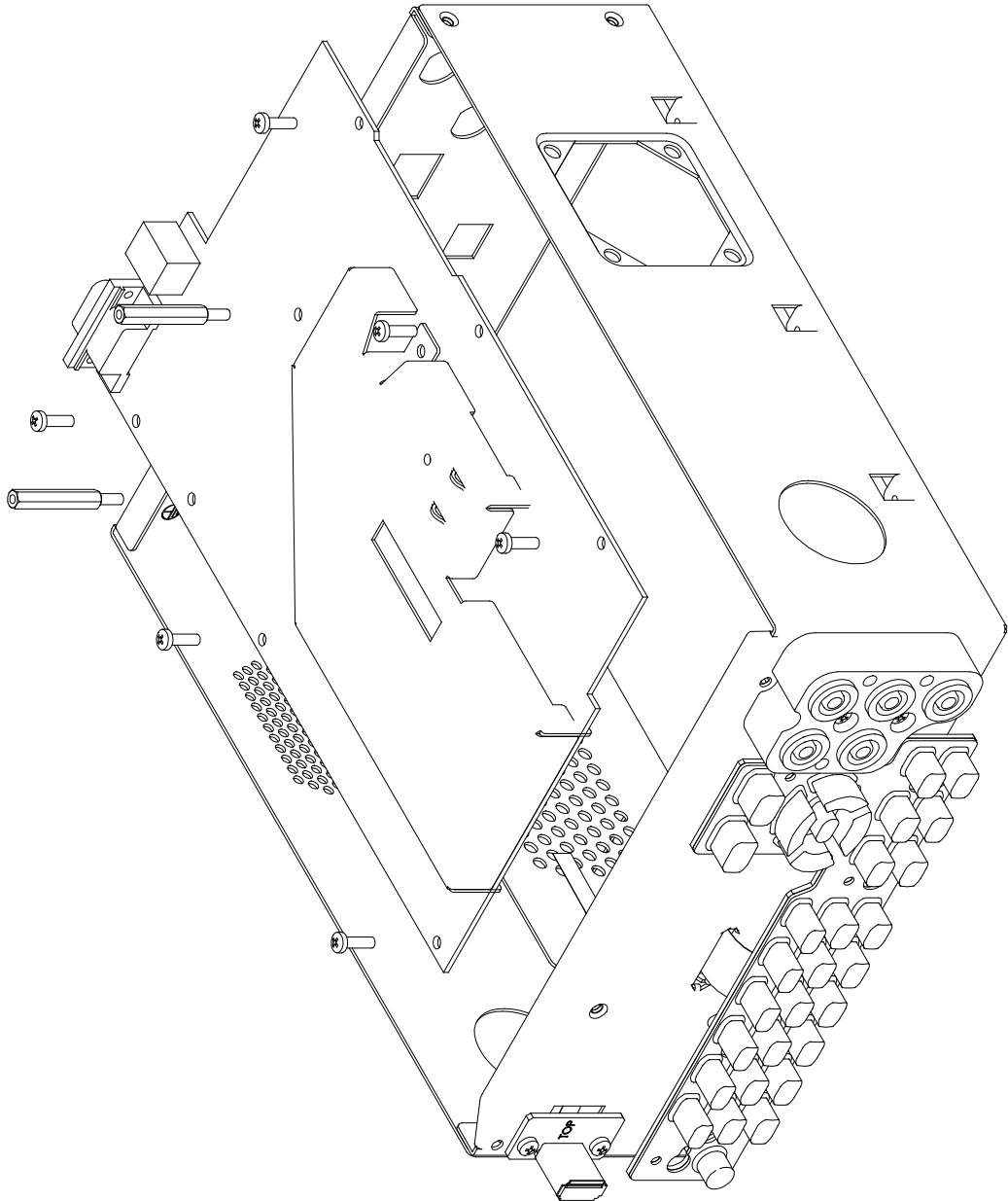


Figure 4-10 To disassemble and assemble mainboard

4. 12 To Disassemble and Assemble Keypad PCB

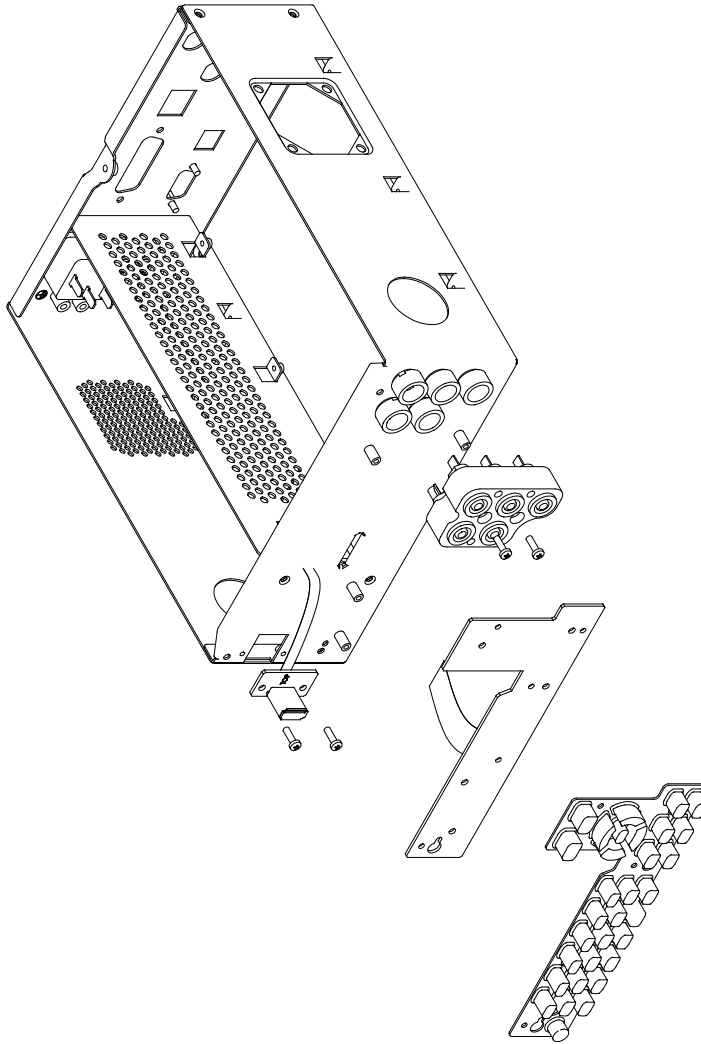


Figure 4-11 To disassemble and assemble keypad PCB

Please try to assemble and disassemble your instrument as above orders or directions to avoid damages to the meter and save time.

Chapter 5 Troubleshooting & Maintenance

5.1 Troubleshooting

1. The multimeter does not start and has no display after power-on:

- (1) Check if the power is correctly connected.
- (2) Check if the power switch on the rear panel has been turned on.
- (3) Check if the power indicator on the front panel is always on.
- (4) Check the power fuse on the back and replace a new one if the fuse is blown out.
- (5) Check if the voltage selector is switched to a right level.
- (6) If the unit still cannot work properly, contact your local **RIGOL** distributor.

Power indicator status

Always on: the meter is working

Flashing: standby mode

Always off: close down

How to replace the fuse?

The power fuse is already installed on the fuse seat of the rear panel before leaving factory, to replace it, please:

Step1: cut off the power supply and use a tool to press the block down (in the arrow direction of the figure below), then pull out the fuse seat.

Step2: replace a new fuse on the seat and insert them into the holder.

Step3: check the voltage scale and ensure a proper level.

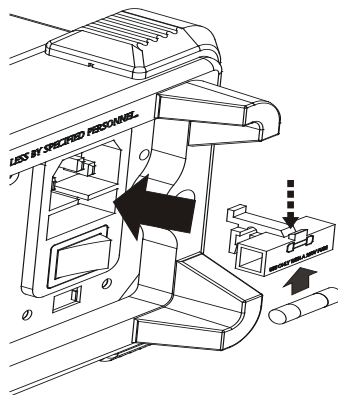


Figure 5-1 Power fuse replace

**CAUTION**

Cut off power connection before replacing the fuse.
The new fuse should meet the specification requirements in this guide.

2. Self-test failed:

- (1) Check the voltage selector if proper scale is selected.
- (2) Disconnect all inputs and restart the self-test. Although the meter automatically cuts off the connection with input signal while self-testing, ac signals from the input terminal may still enter the meter and cause test failure, consequently, manually disconnect all inputs is necessary before self-testing.

3. Readout unstable and large offset is generated from small capacitance measurement:

- (1) Check if a shielded cable is used when measuring small capacitance.
- (2) Disconnect the measured capacitance and use "REL" operation to clear zero offset.

4. Current measurement does not work:

- (1) Check the connections of the current input terminals.
- (2) Check the current input fuse.

5. Readout is stable and non-zero when HI-LO is shorted under voltage measurement:

- (1) Disable all math operations.
- (2) Set the integration time to 100 PLC and enable Autozero.
- (3) Check the voltage selector if proper scale is selected.
- (4) Make sure your meter has been warmed up as requested.

6. Dark in screen backlight:

- (1) Regulate the backlight brightness and contrast.
- (2) Refer to "Screen" in **5.2.4 Replaceable Part list**.

7. Cannot use RS-232 interface to connect with the meter

- (1) Check if the serial ports assigned by both the meter and host are compatible (refer to the **Interface Configurations** of the User's Guide for DM3068).
- (2) Check the connection of the serial cable.
- (3) Check the connections of RXD and TXD terminals of the serial cable.
- (4) Try to disable the print function if a command is desired for the meter control.

8. Cannot connect to the meter through GPIB interface:

- (1) Check if the GPIB address is correct (refer to the **Interface Configurations** of the User's Guide for DM3068).

- (2) Check the connection of the GPIB cable.
- (3) Check if the software edition matches to the used firmware-version.

9. Cannot connect to the meter through LAN interface:

- (1) Make sure you are using the correct network cable and the cable is in good connection.
- (2) Check the network connection indicator, if the indicator is dark, the LAN may have problems.
- (3) Check if the settings of DHCP, IP address and DNS match to the LAN settings.
- (4) Try to turn on the DHCP and AutoIP to enable the network to assign an IP address automatically.
- (5) Check if the browser to be used has the same IP address as your meter.

10. Cannot connect to the meter through USB interface:

- (1) Check the USB connection.
- (2) Check the driver you are using, have a newest from **RIGOL** website if desired.
- (3) Check if the software can correctly identify the meter if multiple USB devices are connected to your PC.

11. Readout becomes slowly or stops during the measurement:

- (1) Check if there is any changes to the auto trigger interval and restore it when this happens.
- (2) Check the indicator of **Single** button; if the indicator always on, press **RUN** to disable the single trigger mode.
- (3) Make sure the external trigger function is disabled.
- (4) Make sure the meter is in Local mode.

12. Cannot enter the measurement interface after switched on:

- (1) Restart the meter after 5 seconds off.
- (2) If the problem persists, disconnect all external devices and restart the meter.

13. In addition, a few problems which may come from other causes, please contact RIGOL if this happens.



WARNING

Case Opening by a person without **RIGOL** authorization will void warrant.

5.2 Maintenance and Cleaning

5.2.1 System Maintenance

In order to ensure the running performance of instrument and extend its service time, you must:

1. Become fully knowledgeable about the meter performance before using it.
2. Do always use and store the meter against dust, shock, humid, magnet and static as well as do not expose it in the sun for a long time as such situation will detract from measurement precision and service life.
3. Do not drive your meter with faults. If a function failure occurs during the operation, please correct the error before continuing on. In addition, test and calibrate the meter within the prescribed time limit to ensure the credibility of the measurement.
4. Put all things away after each use.
5. Keep the accessories for next using.

5.2.2 Principles of Circuit

The DM3068 used a circuit containing a floating, grounding and power circuit.

1. The floating circuit includes the current fuse, signal input end on the front panel (banana socket), measurement analog front-end and the main voltage stabilizing circuits. The measurement analog front-end contains all measurement function circuits such as input protection, function switching, signal transform conditioning, A/D conversion and control interfaces.

The following functional block diagram shows the DM3068 circuit principles. Each box represents an alternative circuit component.

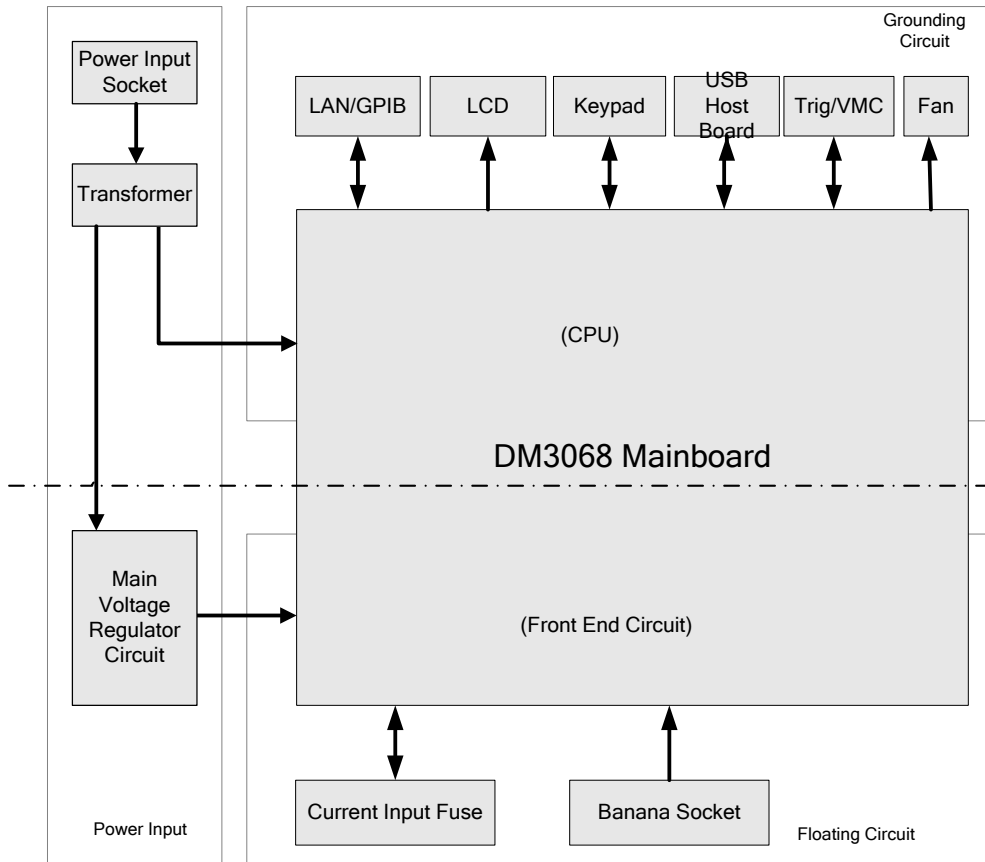


Figure 5-2 DM3068 circuit principles

2. The grounding circuit contains most circuits such as keypad, LCD, USB Host, LAN/GPIB board, Trig/VMC port, fan and CPU.
3. The AC supply enters the meter through the wire and flows through filter board to transformer. The voltage selector provides two voltage scales (one is 115V and the other is 230V). The transformer reduces the ac voltage into multi-path to supply for the floating (9V, one group) and grounding (an 8.5V and two sets of 17V) circuits, respectively. Related rectification circuit and filter circuit as well as voltage-stabilized circuit are contained in both circuits for transforming the low ACV into the stable DCV to supply for each circuit. Note the rectification circuit, filter circuit and most voltage-stabilized circuits from the floating circuit are on the main voltage regulator board.

When measuring, the CPU sends commands to control the analog front-end to switch between function and range and then the analog front-end returns the result from A/D transform or frequency counter to the CPU for correcting. The measured result is then displayed on the screen.

5.2.3 Components Inspection

In this part, you will get more information concerning the fault location for removing advanced malfunction.

1. Fuse

The DM3068 has three types of fuse, which are: power fuse, current input fuse on the rear panel and internal current input fuse on the mainboard, the parameters are as follows:

115V Power fuse: AC, 250V, T250mA, slow- melt, 5x20mm

230V Power fuse: AC, 250V, T125mA, slow- melt, 5x20mm

Replaceable 200mA current input fuse on the rear panel: AC, 250V, F500mA, quick-melt, 5x20mm

Internal 10A current input fuse on the mainboard: AC, 250V, F10A, quick-melt, 6x32mm

Inspection method: Take out the fuse and execute continuity test using the meter. For the internal 10A current input fuse on the mainboard: separately insert the test lead ends into socket HI and 10A and then switch the meter to continuity test; short-circuit the test lead ends, if the testing result is connecting, the fuse is normal, otherwise it may have been blown out.

2. Power Frequency Transformer

The DM3068 is powered by a power frequency transformer. The power socket is equipped with a fuse socket and switch. You can select an input winding for the transformer through the voltage selector in order to accommodate different mains voltage. For countries using 220V voltage as the mains voltage, 230 V is necessary and a T125mA fuse should be installed to protect the meter; while 115V is recommended and a T250mA fuse should be installed if 110 V mains voltage is supplying, otherwise the meter could not be started.

Inspection procedures:

- (1) Cut off the power supply.
- (2) Setup the voltage selector.
- (3) Remove the case.
- (4) Re-power on and keep the power switch in "1".
- (5) Check the voltage of every winding of transformer.
- (6) Cur off the power supply again.
- (7) Remove the fault and fit up the case after re-inspection.



WARNING

Keep all body parts away from the conductors inside the instrument when the meter is powered without case, otherwise you may get electrocuted!

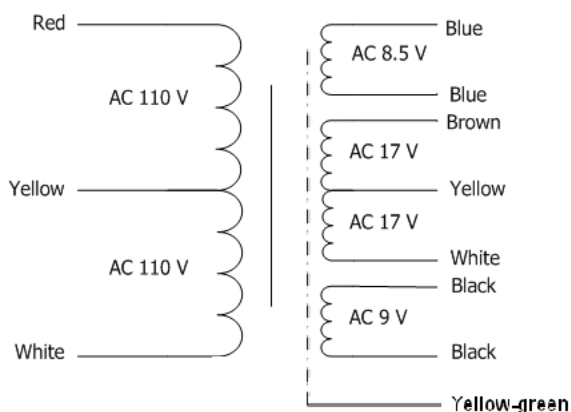


Figure 5-3 Transformer Winding

Compare the measured voltages of each winding with the ones in the following table:

Table 5-1 Check list of voltage selector winding voltage

Windings		Max(Vrms)	Min(Vrms)	Typical (Vrms)
Original	White-Yellow	132	90	110
	White-Red	265	180	220
Vice	Black-Black	10.8	7.3	9
	White-Yellow	21	14	17
	Yellow-Brown	21	14	17
	Blue-Blue	10.3	6.9	8.5
Shielding	Yellow-Green	---	---	---

- (1) If all the winding voltages of originals are 0, the voltage selector or power socket may be problematic.
- (2) If the original voltage is half or double of the typical value, inaccurate location might be selected for the voltage selector.
- (3) If the vice voltage is less than the minimum, the mainboard may have a short circuit, please: remove the vice socket of the transformer from the mainboard (please cut off the electricity before operating) and test the voltage in vice side; if the voltage gets back to levels, short circuit has happened to the mainboard, or else the transformer fails.

3. Screen

DM3068 provides a LCD self-check program for users to inspect the light spot, and dark spot of the LCD, the backlight and the display control circuit.

Inspection method:

Press and hold the second menu key on the left of the front panel and turn on the meter, after about 5 seconds and until you hear a switch sound of relay, the

meter starts testing the screen and a message "Press ·Help· Key to Switch, Hold ·Help· Key to Exit" is shown on the screen.

- If you press **Help**, the screen switches between Full white (all pixels go on) and Full black (all pixels go out). Observe the luminance fluctuation of the LCD and inspect if there is any light spot or dark spot.
- If you press and hold **Help** for about 2 seconds, the display returns to normal measurement state.

If the brightness of LCD is out of control, enter the normal working state and regulate the brightness and contrast under **Utility** to further confirm the fault cause. IF the brightness cannot be adjusted, there may be something wrong about the mainboard. If LCD does not shine, LCD or mainboard may have been damaged.

If bright point or scotoma occurs, the LCD module may be damaged.

Before replacing the parts, please try to pull out the connecting line between LCD and mainboard and reconnect and test to get rid of connectivity failure.

4. Keypad

The DM3068 provides a self-check program to inspect whether the button and backlight from the panel are normal.

Inspection method:

Press and hold the first menu key on the left side and turn on the multimeter, after about 5 seconds and until you hear a sound, the meter starts testing the keypad. The basic measurement keys, parameter keys and trigger control keys are flashing during the test and a status picture is shown on the screen. When you first press a button, the corresponding icon from the picture changes to reverse video and then varies with the button you have pressed.

If no movement happens after you pressed a button, this button or related circuit may have a fault.

If the backlight of some or all buttons does not flash while you execute the self-check, a fault or mistake may occur in that or all backlights or related circuit(s).

Try to pull out the connecting cable between LCD and mainboard and reconnect them to test the connectivity to get rid of connectivity failure before replacing a part.

Replace the keypad and/or rubber button if the problem is proved.

NOTE:

Restoring to factory default may be useful for some problems, for example:

To preclude the possibility of setup error and indeterminate fault:

Press **Utility** → **System** → **Setup** → **Factory** and restart the meter.



WARNING

If a failure occurs, contact **RIGOL** and never disassemble the instrument by yourself to avoid accident or losing.

5.2.4 Replaceable Part list

RIGOL provides some replaceable parts for you to maintain or update the meter, which are:

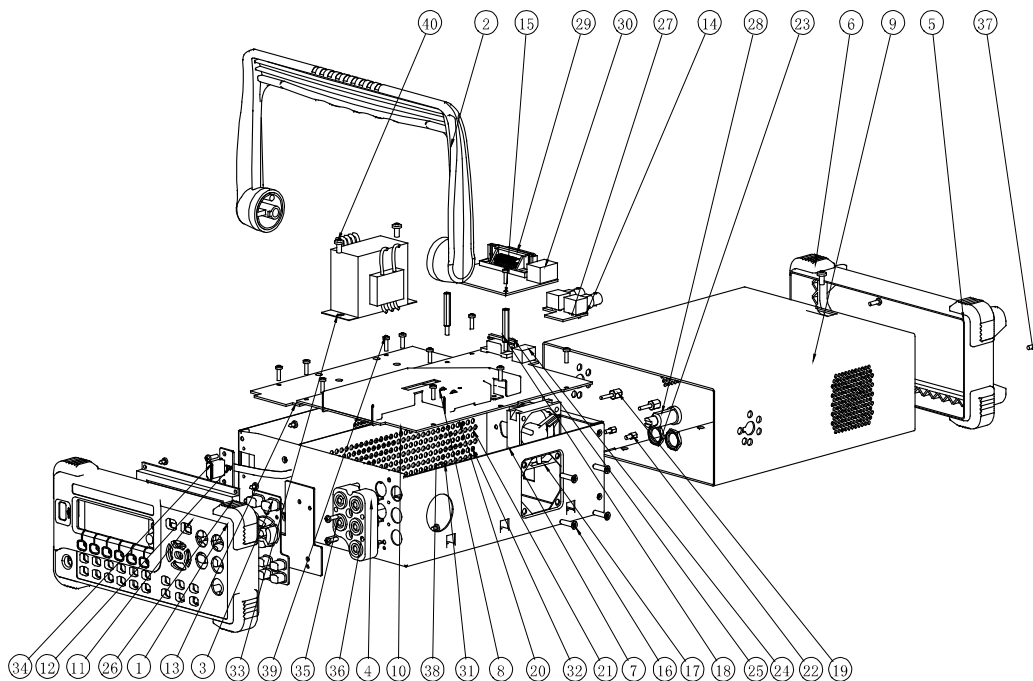


Table 5-2 Replaceable Part List

Part No.	Name	Quantity
1	Front panel	1
2	Handle	1
3	Rubber keypad	1
4	Banana socket	1
5	Rear panel	1
6	Non-slip mat	8
7	Metal shell	1
8	Shielding	1
9	Clapboard	1
10	Mainboard	1
11	Button	1
12	PCB-USB	1

13	PCB cable	1
14	PCB-2BNC	1
15	PCB-GPIB&LAN	1
16	M4 sunk screw (fan)	4
17	Fan	1
18	M3×28+8 Brass stud	2
19	Customized screw (small)	2
20	Power fuse socket	1
21	Power fuse	1
22	DB9 screw	2
23	BNC nut	2
24	USB	1
25	DB9-male	1
26	LCD screen	1
27	BNC (plastic)	2
28	FuseHolder-b02	1
29	GPIB-24PIN-female	1
30	Net interface	1
31	Voltage selector	1
32	Electric outlet	1
33	Transformer	1
34	USB interface-vertical-long	1
35	Banana interface	5
36	Nut for Banana interface	5
37	Cross recessed small pan head screws GB	4
38	Cross recessed pan head tapping screws GB	7
39	Cross recessed pan head screws GB	17
40	Cross recessed pan head screws GB	3

NOTE: For an order of above parts please contact **RIGOL** authorized distributor.

5.2.5 Warranty

RIGOL warrants that its products mainframe and accessories will be free from defects in materials and workmanship within the warranty period.

If a product is proven to be defective within the respective period, **RIGOL** guarantees the free replacement or repair of products which are approved defective. To get repair service, please contact with your nearest **RIGOL** sales and service office.

RIGOL does not provide any other warranty items except the one being provided by this summary and the warranty statement. The warranty items include but not being subjected to the hint guarantee items related to tradable characteristic and any particular purpose. **RIGOL** will not take any responsibility in cases regarding to indirect, particular and ensuing damage.