

Product Datasheet - Technical Specifications



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RIGOL

Data Sheet

DM3058/DM3058E Digital Multimeter

Product Overview

DM3058/DM3058E^[1] is a digital multimeter designed with 5½ digits readings resolution and dual-display especially fitting to the needs of high-precision, multifunction and automatic measurement.

Applications

- Research&Development Laboratory
- Scientific Research and Education
- Detection and Maintenance
- Quality Test
- Automatic Production Test

Main Features

- Real 5½ digits readings resolution
- Up to 123 rdgs/s measurement speed
- True-RMS AC Voltage and AC Current measuring
- Quickly Save or Recall the 10 groups of Preset Configuration
- Preset 10 groups of Standard Sensor Configuration, built-in cold terminal compensation for thermocouple
- Clone the instrument configurations into other DM3058/DM3058E via USB storage device
- The first 5½ digit digital multimeter passing LXI Criterion in industry, which can achieve system integration easily
- With easy, convenient and flexible any sensor measurement control software: UltraSensor
- Standard configuration interface: USB Device, USB Host, LAN (only for DM3058), RS-232, GPIB (only for DM3058)
- Support remote control via commands and compatible with commands of main stream multimeters



Easy to Use Design

- 256×64 LCD
- Support double display, Chinese and English menu
- Built-in help system makes information acquisition more easier
- File management (support for USB-disk and local storage)

Powerful Measurement Functions

➤ Basic Measurement Function

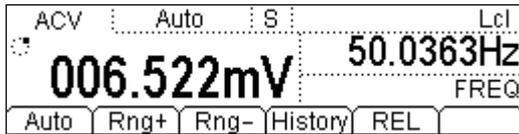
- DC Voltage: 200 mV ~ 1000 V
- DC Current: 200 μA ~ 10 A
- AC Voltage: True-RMS, 200 mV ~ 750 V
- AC Current: True-RMS, 20 mA ~ 10 A
- 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ
- Capacitance Measurement: 2 nF ~ 10000 μF
- Continuity Test: Range is fixed at 2 kΩ
- Diode Test: Range is fixed at 2.0 V
- Frequency Measurement: 20 Hz ~ 1 MHz
- Period Measurement: 1 μs ~ 0.05 s
- Any Sensor Measurement: Support for 6 types of sensor (DCV, DCI, Freq, 2WR, 4WR and TC)

➤ Math Function

Max, Min, Average, Standard Deviation, Pass/Fail, dBm, dB, Relative Measurement and Histogram

Note^[1]: The difference between DM3058 and DM3058E is only that DM3058E doesn't support LAN and GPIB interfaces.

Double Display



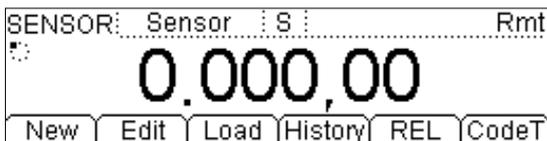
Dual-display function makes your measurements achieve maximum results with little effort. It can display two performances of a signal simultaneously instead of two multimeters or measurements in the past.

Preset Mode



Based on Preset Mode, the worker operation on product line could be greatly simplified. Besides, 10 groups of Preset Configuration are available to be stored and recalled.

Any Sensor Measurement

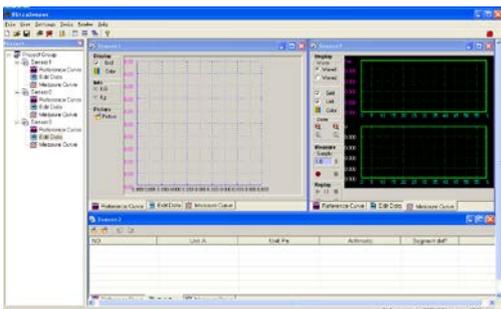


Any sensor measurement is a new conception being forward to meet user's requirements. By this particular function, you can easily connect pressure sensor or flux sensor or temperature sensor.

The multimeter supports 6 kinds of sensor (DCV, DCI, Freq, 2WR, 4WR and TC). Meanwhile, there are 10 groups of standard sensor configuration preset within the instrument.

Thermocouple Cold Terminal compensation is built in the multimeter.

Easy, Convenient and Flexible Control Software



UltraSensor Software Interface

UltraSensor is used to control any sensor. The main functions include:

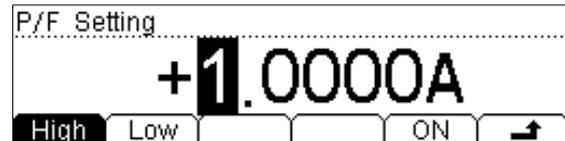
- Create a project for any sensor measurement which can be download to the multimeter;
- Connect with the multimeter to achieve any sensor measurement;
- Monitor the sensor data in real time and show them in the form of figure;
- Enable to save data in the format of CSV and TXT and reference curve in the format of BMP.

Mirror Image Configuration



All the configurations (system and sensor configuration) can be cloned into other DM3058/DM3058E on product line via USB storage device to improve work efficiency.

Pass/Fail



Pass/Fail test function can prompt for signals beyond the range based on specified higher and lower limit, and make test result more obvious.

LXI & Web Control

DM3058 is the first 5½ digit digital multimeter passing LXI Criterion in industry that makes system integration easier.

Remote Control for DM3058 can be achieved by virtual panel from Web page in the same operation way with front panel of instrument.



Specifications

DC Characteristics

| Function | Range ^[2] | Test current or Load voltage | Accuracy ± (% of reading + % of range) ^[1] | |
|---------------------------|--------------------------|------------------------------|---|--|
| | | | 1 Year 23°C ± 5°C | Temperature Coefficient 0°C - 18°C 28°C - 50°C |
| DC Voltage | 200.000 mV | | 0.015 + 0.004 | 0.0015 + 0.0005 |
| | 2.00000 V | | 0.015 + 0.003 | 0.0010 + 0.0005 |
| | 20.0000 V | | 0.015 + 0.004 | 0.0020 + 0.0005 |
| | 200.000 V | | 0.015 + 0.003 | 0.0015 + 0.0005 |
| | 1000.00 V ^[4] | | 0.015 + 0.003 | 0.0015 + 0.0005 |
| DC Current | 200.000 µA | <8 mV | 0.055 + 0.005 | 0.003 + 0.001 |
| | 2.00000 mA | <80 mV | 0.055 + 0.005 | 0.002 + 0.001 |
| | 20.0000 mA | <0.05 V | 0.095 + 0.020 | 0.008 + 0.001 |
| | 200.000 mA | <0.5 V | 0.070 + 0.008 | 0.005 + 0.001 |
| | 2.00000 A | <0.1 V | 0.170 + 0.020 | 0.013 + 0.001 |
| 10.0000 A ^[5] | <0.3 V | 0.250 + 0.010 | 0.008 + 0.001 | |
| Resistance ^[3] | 200.000 Ω | 1 mA | 0.030 + 0.005 | 0.0030 + 0.0006 |
| | 2.00000 kΩ | 1 mA | 0.020 + 0.003 | 0.0030 + 0.0005 |
| | 20.0000 kΩ | 100 µA | 0.020 + 0.003 | 0.0030 + 0.0005 |
| | 200.000 kΩ | 10 µA | 0.020 + 0.003 | 0.0030 + 0.0005 |
| | 2.00000 MΩ | 1 µA | 0.040 + 0.004 | 0.0040 + 0.0005 |
| | 10.0000 MΩ | 200 nA | 0.250 + 0.003 | 0.0100 + 0.0005 |
| | 100.000 MΩ | 200 nA 10 MΩ | 1.75 + 0.004 | 0.2000 + 0.0005 |
| Diode Test | 2.0000 V ^[6] | 1 mA | 0.05 + 0.01 | 0.0050 + 0.0005 |
| Continuity Test | 2000 Ω | 1 mA | 0.05 + 0.01 | 0.0050 + 0.0005 |

Remarks:

- [1] Specifications are for 0.5 hour warm-up, "Slow" measurement rate and calibration temperature 18°C ~ 28°C.
- [2] 20% over range on all ranges except for DCV 1000 V, ACV 750 V, DCI 10 A and ACI 10 A.
- [3] Specifications are for 4-wire measure or 2-wire measure under "REF" operation. ± 0.2 Ω of extra errors will be generated if perform 2-wire measure without "REF" operation.
- [4] Plus 0.02 mV of error per 1 V after the first ±500 VDC.
- [5] 30 seconds OFF after 30 seconds ON is recommend for the continuous current that higher than DC 7 A or AC RMS 7 A.
- [6] Accuracy specifications are only for voltage measuring at input terminal. The typical value of current under measure is 1 mA. Voltage drop at the diode junction may vary with current supply.

| DC Voltage | |
|---|--|
| Input Resistance | 200 mV and 2 V 10 MΩ or >10 GΩ selectable (Input signals that exceed ± 2.5 V in these ranges will pass the 100 kΩ (typical) clamp resistance.) 20 V, 200 V and 1000 V 10 MΩ ± 2% |
| Input Bias Current | <90 pA, 25°C |
| Input Protection | 1000 V on all ranges |
| CMRR (common mode rejection ratio) | 120 dB (For the 1 kΩ unbalanced resistance in LO lead, maximum ± 500 VDC) |
| NMRR (normal mode rejection ratio) | 60 dB at "slow" measurement rate 20 dB are added if open the "AC filter" (Settling time will add 0.35 s while source impedance nears zero) |
| Resistance | |
| Testing Method | 4-wire resistance or 2-wire resistance optional For current source refer to LO input |
| Open-circuit Voltage | P/F in <8 V |
| Maximum Lead Resistance (4-wire resistance) | 10% of ranges, on the range of 200 Ω, 1 kΩ, for each lead 1 kΩ, on all other ranges, for each lead |
| Input Protection | 1000 V, on all ranges |

| DC Current | |
|-------------------------|--|
| Shunt Resistor | 200 μ A sampling voltage < 8 mV 2 mA sampling voltage < 80 mV 1 Ω for 20 mA, 200 mA 0.008 Ω for 2 A, 10 A |
| Input Protection | Rear panel: accessible 10 A, 250 V fast-melt fuse Internal: 12 A, 250 V slow-melt fuse |
| Continuity / Diode Test | |
| Measurement Method | 1 mA \pm 5% constant-current source, < 8 V open-circuit voltage |
| Response Time | 123 samples/sec, with beeper |
| Continuity Threshold | Adjustable between 1 Ω and 2000 Ω |
| Input Protection | 1000 V |
| Setup time Attentions | |

The setup time about voltage measurement is influenced by source resistance and media characteristics of cable as well as input signal.

AC Characteristics

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

| Function | Range ^[2] | Frequency Range | Accuracy \pm (% of reading + % of range) ^[1] | |
|---------------------------------------|--------------------------|------------------|---|---|
| | | | 1 Year 23°C \pm 5°C | Temperature Coefficient 0°C - 18°C 28°C - 50°C |
| True RMS AC Voltage ^[3] | 200.000 mV | 20 Hz – 45 Hz | 1.5 + 0.10 | 0.01 + 0.005 |
| | | 45 Hz – 20 kHz | 0.2 + 0.05 | 0.01 + 0.005 |
| | | 20 kHz – 50 kHz | 1.0 + 0.05 | 0.01 + 0.005 |
| | | 50 kHz – 100 kHz | 3.0 + 0.05 | 0.05 + 0.010 |
| | 2.00000 V | 20 Hz – 45 Hz | 1.5 + 0.10 | 0.01 + 0.005 |
| | | 45 Hz – 20 kHz | 0.2 + 0.05 | 0.01 + 0.005 |
| | | 20 kHz – 50 kHz | 1.0 + 0.05 | 0.01 + 0.005 |
| | | 50 kHz – 100 kHz | 3.0 + 0.05 | 0.05 + 0.010 |
| | 20.0000 V | 20 Hz – 45 Hz | 1.5 + 0.10 | 0.01 + 0.005 |
| | | 45 Hz – 20 kHz | 0.2 + 0.05 | 0.01 + 0.005 |
| | | 20 kHz – 50 kHz | 1.0 + 0.05 | 0.01 + 0.005 |
| | | 50 kHz – 100 kHz | 3.0 + 0.05 | 0.05 + 0.010 |
| | 200.000 V | 20 Hz – 45 Hz | 1.5 + 0.10 | 0.01 + 0.005 |
| | | 45 Hz – 20 kHz | 0.2 + 0.05 | 0.01 + 0.005 |
| | | 20 kHz – 50 kHz | 1.0 + 0.05 | 0.01 + 0.005 |
| | | 50 kHz – 100 kHz | 3.0 + 0.05 | 0.05 + 0.010 |
| 750.000 V | 20 Hz – 45 Hz | 1.5 + 0.10 | 0.01 + 0.005 | |
| | 45 Hz – 20 kHz | 0.2 + 0.05 | 0.01 + 0.005 | |
| | 20 kHz – 50 kHz | 1.0 + 0.05 | 0.01 + 0.005 | |
| | 50 kHz – 100 kHz | 3.0 + 0.05 | 0.05 + 0.010 | |
| True RMS AC Current ^[5] | 20.0000 mA | 20Hz – 45 Hz | 1.5 + 0.10 | 0.015 + 0.015 |
| | | 45 Hz - 2 kHz | 0.50 + 0.10 | 0.015 + 0.006 |
| | | 2 kHz -10 kHz | 2.50 + 0.20 | 0.015 + 0.006 |
| | 200.000 mA | 20 Hz - 45 Hz | 1.50 + 0.10 | 0.015 + 0.005 |
| | | 45 Hz – 2 kHz | 0.30 + 0.10 | 0.015 + 0.005 |
| | | 2 kHz - 10 kHz | 2.50 + 0.20 | 0.015 + 0.005 |
| | 2.00000 A | 20 Hz – 45 Hz | 1.50 + 0.20 | 0.015 + 0.005 |
| | | 45 Hz - 2 kHz | 0.50 + 0.20 | 0.015 + 0.005 |
| | | 2 kHz – 10 kHz | 2.50 + 0.20 | 0.015 + 0.005 |
| | 10.0000 A ^[5] | 20 Hz – 45 Hz | 1.50 + 0.15 | 0.015 + 0.005 |
| | | 45 Hz - 2 kHz | 0.50 + 0.15 | 0.015 + 0.005 |
| | | 2 kHz – 5 kHz | 2.50 + 0.20 | 0.015 + 0.005 |

Additional wave crest factor error (not Sine)^[6]

| Wave crest coefficient | Error (% range) |
|------------------------|-----------------|
| 1 - 2 | 0.05 |
| 2 - 3 | 0.2 |

Remarks:

[1] Specifications are for 0.5 hour warm-up, "Slow" measure and calibration temperature 18°C - 28°C.

[2] 20% over range on all ranges except for DCV 1000 V, ACV 750 V, DCI 10 A and ACI 10 A.

- [3] Specifications are for amplitude of sine wave input >5% of range. 750 V range limited to 8×10^7 Volt-Hz. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range extra error. For 50 kHz to 100 kHz, add 0.13%.
- [4] Specifications are for sine wave input >5% of range. 0.1% errors will be added when the range of input sine wave is 1% ~ 5%.
- [5] 30 seconds OFF after 30 seconds ON is recommend for the continuous current that higher than DC 7 A or AC RMS 7 A.
- [6] For frequency <100 Hz.

| True RMS AC Voltage | |
|------------------------------------|---|
| Measurement Method | AC coupled true RMS measure - up to 1000 V DC bias are permitted on every range |
| Wave Crest Factor | ≤ 3 at full scale |
| Input Impedance | $1 \text{ M}\Omega \pm 2\%$ in parallel with <100 pF on all ranges |
| AC Filter Bandwidth | 20 Hz ~ 100 kHz |
| CMRR (common mode rejection ratio) | 60 dB (For the 1 k Ω imbalance resistance among Lo lead and <60 Hz, maximum ± 500 VDC) |
| True RMS AC Current | |
| Measurement Method | DC coupled to the fuse and shunt; AC coupled the True RMS measurement (measures the AC components only) |
| Wave Crest Factor | ≤ 3 at full scale |
| Maximum Input | The DC + AC current peak value <300% of range. The RMS current including DC current is <10 A |
| Shunt Resistor | 1 Ω for 20 mA, 200 mA 0.008 Ω for 2 A, 10 A |
| Input Protection | Rear panel: accessible 10 A, 250 V fast-melt fuse Internal: 12 A, 250 V slow-melt fuse |

Setup Time Attentions
 Make sure that the RC return at input terminal has been in a stable state completely (higher than 1 s) before accurate measurement;
 Input >300 Vrms (or >5 Arms) will cause the self heating of the signal conditioning component to generate error, this error is included in the characteristics of the instrument. Internal temperature variation results from the self heating will cause additional an error on ac range that is lower than 0.03% of readings, and it will disappear after a few minutes.

Frequency and Period Characteristics

| Function | Range | Frequency Range | Accuracy \pm (% of reading + % of range) ^[1] | |
|------------------|-------------------------------|------------------|---|---|
| | | | 1 Year 23°C \pm 5°C | Temperature Coefficient 0°C - 18°C 28°C - 50°C |
| Frequency/Period | 200 mV - 750 V ^[2] | 20 Hz - 2 kHz | 0.01 + 0.003 | 0.002 + 0.001 |
| | | 2 kHz - 20 kHz | 0.01 + 0.003 | 0.002 + 0.001 |
| | | 20 kHz - 200 kHz | 0.01 + 0.003 | 0.002 + 0.001 |
| | | 200 kHz - 1 MHz | 0.01 + 0.006 | 0.002 + 0.002 |
| | 20 mA - 10 A ^[3] | 20 Hz - 2 kHz | 0.01 + 0.003 | 0.002 + 0.001 |
| | | 2 kHz - 10 kHz | 0.01 + 0.003 | 0.002 + 0.001 |

Remarks:

- [1] Specifications are for 0.5 hour warm-up.
- [2] Except for special marks, the AC input voltage is 15% to 120% of range when <100 kHz and 40% to 120% of range when >100 kHz. 750 V range is limited to 750 VRMS. 200 mV ranges is for full scale or higher. For inputs from 30 mV to 200 mV, multiply total % of reading error by 10.
- [3] For AC input current from 15% to 120% of range except where noted. 20 mA range specifications are for full scale. For inputs from 5 mA to 20 mA, multiply total % of reading error by 10. 10 A range is for AC input current from 25% to 100% of range.

| Frequency and Period |
|--|
| Measurement Method: Reciprocal-counting technique, AC-coupled input, AC voltage or AC current measurement function |
| Measure Attentions |
| Generally, errors are leaded into all frequency counters when measuring low voltage or low frequency signal. Shielding input can extremely help to reduce measuring errors caused by exterior noise. |
| Setup Time Attentions |

If the variational DC components appeared in signals under measure, errors may be caused while measuring period or frequency. Please ensure that the RC loop at input terminal must be stable during exact measuring (higher than 1 sec).

Capacitance Characteristics

| Function | Range ^[2] | Maximum Testing Current | Accuracy ± (% of reading + % of range) ^[1] | |
|-------------|----------------------|-------------------------|---|--|
| | | | 1 Year 23°C ± 5°C | Temperature Coefficient 0°C - 18°C 28°C - 50°C |
| Capacitance | 2.000 nF | 200 nA | 3 + 1.0 | 0.08 + 0.002 |
| | 20.00 nF | 200 nA | 1 + 0.5 | 0.02 + 0.001 |
| | 200.0 nF | 2 µA | 1 + 0.5 | 0.02 + 0.001 |
| | 2.000 µF | 10 µA | 1 + 0.5 | 0.02 + 0.001 |
| | 200 µF | 100 µA | 1 + 0.5 | 0.02 + 0.001 |
| | 10000 µF | 1 mA | 2 + 0.5 | 0.02 + 0.001 |

Remarks:

[1] Specifications are for 0.5 hour warm-up and "REF" operation. Using of non-film capacitor may generate additional errors.

[2] Specifications are for from 1% to 120% on 2 nF range and ranges from 10% to 120% on other ranges.

Capacitance Measuring

| | |
|--------------------|--|
| Measurement Method | Measure the rate of change of voltage generated during the current flowing the capacitance |
| Connection Type | 2-wire |
| Input Protection | 1000 V on all ranges |

Measure Attentions:

Small capacitance is easily influenced by external noise and thus causes errors while measuring, shielding input can extremely help to reduce this kind of errors.

Other Measuring Characteristics

Triggering and Memory

| | | |
|------------------------|-------------------------|--|
| Samples/Trigger | 1 ~ 2000 | |
| Trigger Delay | 8 ms ~ 2000 ms optional | |
| External Trigger Input | Input Level | TTL compatible (High level when left input terminal is hanging in the air) |
| | Trigger Condition | Rising edge/falling edge selectable |
| | Input Impedence | >20 kΩ, in parallel with 400 pF, DC-coupled |
| | Min Pulse | 500 µs |
| VMC Output | Electric Level | TTL compatible (input >=1 kohm loads) |
| | Output Polarity | straight polarity and negative polarity optional |
| | Input Impedance | 200 ohm, typical |

Arbitrary Sensor

Support for multiply types of sensor such as Thermocouple, DC Voltage, DC Current, Resistance (2-wire or 4-wire) and Frequency output; With thermocouple compensation at cold junction.

Output Polarity: straight polarity and negative polarity optional

Preset ITS-90 transform of B, E, J, K, N, R, S and T thermocouple and transform of platinum Pt100, Pt385 resistance temperature sensor

Math Functions

Pass/Fail, REL (RELative), Min/Max/Average, dBm, dB, Hold, Histogram, Standard deviation

History Records

| | |
|--------------------|---|
| Volatile Memory | 2000 readings of history records |
| Nonvolatile Memory | 10 gourps of history records (2000 readings/group); 10 groups of sensor records: (1000 readings/group); 10 groups of setting records of instrument; 10 groups of setting records of arbitrary sensor; support USB-disk external storage |

General Specifications

| Power Supply | |
|-----------------------|---|
| AC 100 V ~ 120 V | 45 Hz ~ 440 Hz |
| AC 200 V ~ 240 V | 45 Hz ~ 66 Hz |
| Consumption | 20 VA peak value |
| Mechanism | |
| Dimension | 107.0 mm×231.6 mm×290.5 mm |
| Weight | 2.5 kg |
| Other Characteristics | |
| Display Screen | LCD display with 256×64 lattices, support for Double display, Menu display, Operating help and English/Chinese bilingual. |
| Operating Environment | Full accuracy from 0°C to 50°C; 80% R.H. and 40°C, non condensing |
| | Storage Temperature: -20°C ~ 70°C |
| | Shock and Vibration: conforming to MIL-T-28800E, III, 5 level (only for sine) |
| | height above sea level: up to 3000 meters |
| Safety | Conforming to IEC61010-1: 2001. Measure CAT I 1000 V/CAT II 600 V Class of pollution: 2 |
| Remote Interface | GPIB (only for DM3058), 10/100Mbit LAN (only for DM3058), USB2.0 Full Speed Device & (USB-disk available), RS-232C |
| Programmer Language | RIGOL 3058 SCPI, FLUKE45, Agilent34401A |
| LXI Compatibility | LXI Class C, Version1.1 (only for DM3058) |
| Warm Up Time | 30 minutes |

Ordering Information

Name of Product

RIGOL DM3058/DM3058E Digital Multimeter

Standard Accessories

- A Power Cord that fits the standard of destination country
- Two Test Leads (black and red)
- Two Alligator Clips (black and red)
- An USB Data Cable
- A Backup Fuse
- A Quick Guide
- User's Guide and Application software (CD-ROM)

Optional Accessories

- Kelvin Test Clips
- RS232 Cable

Warranty

Thank you very much for choosing **RIGOL** products!

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

If a product proves defective within the respective period, **RIGOL** guarantees free replacement or repair of any defective products within a reasonable period of time. To get repair service, please contact with your nearest **RIGOL** sales or service office.

There is no other warranty, expressed or implied, except such as is expressly set forth herein or other applicable warranty card. There is no implied warranty of merchantability or fitness for a particular purpose. Under no circumstances shall **RIGOL** be liable for any consequential, indirect, ensuing or special damages for any breach of warranty in any case.

Chapter 6 Characteristics

General Technical Characteristics

Power Supply:

AC 100V~120V, 45Hz~440Hz

AC 200V~240V, 45Hz~66Hz

Power consumption: 20VA peak value

Mechanical:

Height × Width × Depth: 107.0mm×231.6mm ×290.5mm

Weight: 2.5kg

Display:

256×64 LCD display, support dual display, menu, Chinese and English languages, operation help.

Working Environment:

Precision 0~50°C, 80% R.H. at 40°C, No coagulation

Storage Temperature: -20~70°C

Impact and Shake: According with MIL-T-28800E, III class, 5 Level (Only Sine)

Height above sea level: upper limit 3000m

Safety:

According with IEC61010-1: 2001.

Measure CAT I 1000V, CAT II 600V.

Class of pollution: 2.

Remote Interface:

GPIB (only for DM3058), 10/100Mbit LAN (only for DM3058), USB2.0 Full Speed Device & Host (support USB flash device), RS232.

Programming Language:

RIGOL DM3058 SCPI, Fluke 45, Agilent 34401A.

LXI Compatibility: LXI Class C, Version 1.1 (only for DM3058).

Warm-up Time: 30min.

Electric Technique Characteristics

DC Characteristics

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

| Function | Range ^[2] | Test Current or Burden Voltage | 1 Year 23°C±5°C | Temperature Coefficient 0 °C to 18 °C 28 °C to 55 °C |
|---------------------------------|-------------------------|--------------------------------|--------------------|--|
| DC Voltage | 200.000mV | | 0.015 + 0.004 | 0.0015+0.0005 |
| | 2.00000V | | 0.015 + 0.003 | 0.0010+0.0005 |
| | 20.0000V | | 0.015 + 0.004 | 0.0020+0.0005 |
| | 200.000V | | 0.015 + 0.003 | 0.0015+0.0005 |
| | 1000.00V ^[4] | | 0.015 + 0.003 | 0.0015+0.0005 |
| DC Current | 200.000μA | <8mV | 0.055 + 0.005 | 0.003+0.001 |
| | 2.00000mA | <80mV | 0.055 + 0.005 | 0.002+0.001 |
| | 20.0000mA | <0.05V | 0.095 + 0.020 | 0.008+0.001 |
| | 200.000mA | <0.5V | 0.070 + 0.008 | 0.005+0.001 |
| | 2.00000A | <0.1V | 0.170 + 0.020 | 0.013+0.001 |
| | 10.0000A ^[5] | <0.3V | 0.250 + 0.010 | 0.008+0.001 |
| Resistance^[3] | 200.000Ω | 1mA | 0.030 + 0.005 | 0.0030+0.0006 |
| | 2.00000kΩ | 1mA | 0.020 + 0.003 | 0.0030+0.0005 |
| | 20.0000kΩ | 100μA | 0.020 + 0.003 | 0.0030+0.0005 |
| | 200.000kΩ | 10μA | 0.020 + 0.003 | 0.0030+0.0005 |
| | 2.00000MΩ | 1μA | 0.040 + 0.004 | 0.0040+0.0005 |
| | 10.0000MΩ | 200nA | 0.250 + 0.003 | 0.0100+0.0005 |
| 100.000MΩ | 200nA 10MΩ | 1.75 + 0.004 | 0.2000+0.0005 | |
| Diode Test | 2.0000V ^[6] | 1mA | 0.05 + 0.01 | 0.0050+0.0005 |
| Continuity | 2000Ω | 1mA | 0.05 + 0.01 | 0.0050+0.0005 |

- [1] Specifications are for 30 minute warm-up, "slow" measurement rate and 18 °C ~ 28 °C calibration temperature.
- [2] 20% over range on all ranges, except DCV 1000V, ACV 750V, DCI and ACI 10A range.
- [3] Specifications are for 4-wire resistance function, or 2-wire resistance using REL operation. Without REL operation, add 0.2 Ω additional errors in 2-wire resistance function.
- [4] For each additional 1 volt over ± 500 VDC add 0.02 mV of error.
- [5] For current terminal, > 7A DC or AC RMS for 30 seconds ON and 30 seconds OFF.
- [6] Accuracy specifications are for the voltage measured at the input terminals only. 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction.

DC Voltage

| | | |
|-------------------------------------|---|--|
| Input Resistance: | 200mV and 2V range | 10M Ω or >10G Ω selectable |
| | (Input signals which exceed $\pm 2.5V$ in these ranges will pass the 100k Ω (typical) clamp resistance.) | |
| | 20V, 200V and 1000V range | 10M Ω \pm 2% |
| Input offset current: | <90pA, 25 $^{\circ}$ C | |
| Input Protection: | 1000V on all ranges | |
| CMRR (common mode rejection ratio): | 120dB (For the 1k Ω unbalanced resistance in LO lead, maximum $\pm 500VDC$). | |
| NMRR (normal mode rejection ratio): | 60dB at "slow" measurement rate | |
| | Add 20dB when open the "AC filter" (Settling time adds 0.35s (source impedance near zero)) | |

Resistance

| | |
|-----------------------|--|
| Measurement Method: | Selectable 4-wire or 2-wire. |
| | Current source referenced to LO input. |
| Open-circuit Voltage: | Limit in <8V. |
| Max. Lead Resistance: | 10% of range per lead for 200 Ω , 1k Ω per lead (4-wire ohms) on all other ranges. |
| Input Protection: | 1000V on all ranges. |

DC Current

| | |
|-------------------|--|
| Shunt Resistor: | 200 μ A sampling voltage <8mV |
| | 2mA sampling voltage <80mV |
| | 1 Ω for 20mA, 200mA |
| | 0.01 Ω for 2A, 10A |
| Input Protection: | Externally accessible 10A, 250V fast-melt fuse |
| | Internal 12A, 250V slow-melt fuse |

Continuity / Diode Test

| | |
|-----------------------|---|
| Measurement Method: | 1mA \pm 5% current source, <8V open-circuit voltage |
| Response Time: | 123 samples / sec, with beeper |
| Continuity Threshold: | Adjustable from 1 Ω to 2000 Ω |
| Input Protection: | 1000V |

Setting time attentions:

Settling time in voltage measurement is affected by the source impedance, media characteristics of the cable and input signals.

AC Characteristics

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

| Function | Range ^[2] | Frequency Range | 1 Year 23°C±5°C | Temperature Coefficient 0 °C to 18 °C 28 °C to 55 °C |
|------------------------------------|-------------------------|-----------------|--------------------|--|
| True RMS AC Voltage ^[3] | 200.000mV | 20Hz - 45Hz | 1.5 + 0.10 | 0.01+0.005 |
| | | 45Hz - 20kHz | 0.2 + 0.05 | 0.01+0.005 |
| | | 20kHz - 50kHz | 1.0 + 0.05 | 0.01+0.005 |
| | | 50kHz - 100kHz | 3.0 + 0.05 | 0.05+0.010 |
| | 2.00000V | 20Hz - 45Hz | 1.5 + 0.10 | 0.01+0.005 |
| | | 45Hz - 20kHz | 0.2 + 0.05 | 0.01+0.005 |
| | | 20kHz - 50kHz | 1.0 + 0.05 | 0.01+0.005 |
| | | 50kHz - 100kHz | 3.0 + 0.05 | 0.05+0.010 |
| | 20.0000V | 20Hz - 45Hz | 1.5 + 0.10 | 0.01+0.005 |
| | | 45Hz - 20kHz | 0.2 + 0.05 | 0.01+0.005 |
| | | 20kHz - 50kHz | 1.0 + 0.05 | 0.01+0.005 |
| | | 50kHz - 100kHz | 3.0 + 0.05 | 0.05+0.010 |
| | 200.000V | 20Hz - 45Hz | 1.5 + 0.10 | 0.01+0.005 |
| | | 45Hz - 20kHz | 0.2 + 0.05 | 0.01+0.005 |
| | | 20kHz - 50kHz | 1.0 + 0.05 | 0.01+0.005 |
| | | 50kHz - 100kHz | 3.0 + 0.05 | 0.05+0.010 |
| | 750.000V | 20Hz - 45Hz | 1.5 + 0.10 | 0.01+0.005 |
| | | 45Hz - 20kHz | 0.2 + 0.05 | 0.01+0.005 |
| | | 20kHz - 50kHz | 1.0 + 0.05 | 0.01+0.005 |
| | | 50kHz - 100kHz | 3.0 + 0.05 | 0.05+0.010 |
| True RMS AC Current ^[4] | 20.0000mA | 20Hz-45Hz | 1.5 + 0.10 | 0.015+0.015 |
| | | 45Hz-2kHz | 0.50 + 0.10 | 0.015+0.006 |
| | | 2kHz-10kHz | 2.50 + 0.20 | 0.015+0.006 |
| | 200.000mA | 20Hz-45Hz | 1.50 + 0.10 | 0.015+0.005 |
| | | 45Hz-2kHz | 0.30 + 0.10 | 0.015+0.005 |
| | | 2kHz-10kHz | 2.50 + 0.20 | 0.015+0.005 |
| | 2.00000A | 20Hz-45Hz | 1.50 + 0.20 | 0.015+0.005 |
| | | 45Hz-2kHz | 0.50 + 0.20 | 0.015+0.005 |
| | | 2kHz-10kHz | 2.50 + 0.20 | 0.015+0.005 |
| | 10.0000A ^[5] | 20Hz-45Hz | 1.50 + 0.15 | 0.015+0.005 |
| | | 45Hz-2kHz | 0.50 + 0.15 | 0.015+0.005 |
| | | 2kHz-5kHz | 2.50 + 0.20 | 0.015+0.005 |

Additional wave crest factor error (not Sine)^[6]

| Wave crest coefficient | Error (% range) |
|------------------------|-----------------|
| 1 - 2 | 0.05 |
| 2 - 3 | 0.2 |

- [1] Specifications are for 30 minute warm-up, "slow" measurement rate and 18°C - 28°C calibration temperature.
- [2] 20% over range on all ranges, except DCV 1000V, ACV 750V, DCI and ACI 10A range.
- [3] Specifications are for sine wave input >5% of range. 750V range is limited to 8×10^7 Volt-Hz. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error. For 50 kHz to 100 kHz, add 0.13% of range.
- [4] Specifications are for sine wave input >5% of range. Add 0.1% of the range for the sine wave input is 1%~5% of the range.
- [5] For continuous current which is higher than DC 7A or AC RMS 7A, disconnecting for 30s after 30s connection.
- [6] For frequency <100 kHz. Please refer to the "*Crest Factor Errors (non-sinusoidal inputs)*" section described on Page 5-3 for bandwidth error of other frequency.

True RMS AC Voltage

| | |
|-------------------------------------|--|
| Measurement Method: | AC coupled true-RMS-measure, the DC component of input with up to 1000V on any range. |
| Crest factor: | Crest factor on full range ≤ 3 |
| Input Impedance: | $1\text{M}\Omega \pm 2\%$ in parallel with 100pF on any ranges |
| Input Protection: | 750Vrms on all ranges |
| AC filter bandwidth: | 20Hz~100kHz |
| CMRR (common mode rejection ratio): | 60dB (For the $1\text{k}\Omega$ unbalanced resistance in LO lead and <60Hz, maximum $\pm 500\text{VDC}$). |

True RMS AC Current

| | |
|---------------------|--|
| Measurement Method: | DC coupled to the fuse and shunt. AC coupled true RMS measurement (measures the ac component only) |
| Crest factor: | Crest factor on full range ≤ 3 |
| Max. Input: | The DC + AC current peak value <300% of the range. The RMS current including DC current is <10A. |
| Shunt Resistor: | 0.01 Ω for 2A, 10A 1 Ω for 20mA, 200mA |
| Input Protection: | Externally accessible 10A, 250V fast-melt fuse Internal 12A, 250V slow-melt fuse |

Setting time attentions:

Make sure the RC circuit of input terminal has been completely stable (up to 1s) before accurate measurement.

Input >300Vrms (or >5Arms) will cause the self heating of the signal conditioning component to

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generate error, this error is included in the characteristics of the instrument. Internal temperature variation results from the self heating will cause additional error on ac range, this error is lower than 0.02% reading, and it will disappear after a few minutes.

Frequency/Period Characteristics

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

| Function | Range | Frequency Range | 1 Year 23°C±5°C | Temperature Coefficient 0 °C to 18 °C 28 °C to 55 °C |
|---------------------|---------------------------------|-----------------|--------------------|--|
| Frequency Period | 200mV to 750V ^[2] | 20Hz-2kHz | 0.01+0.003 | 0.002+0.001 |
| | | 2kHz-20kHz | 0.01+0.003 | 0.002+0.001 |
| | | 20kHz-200kHz | 0.01+0.003 | 0.002+0.001 |
| | | 200kHz-1MHz | 0.01+0.006 | 0.002+0.002 |
| | 20mA to 10A ^[3] | 20Hz-2kHz | 0.01+0.003 | 0.002+0.001 |
| | | 2kHz-10kHz | 0.01+0.003 | 0.002+0.001 |

[1] Specifications are for 30 minute warm-up.

[2] Unless otherwise noted, for frequency ≤100 kHz, the specifications are for AC input voltage of 15% to 120% of range. For frequency >100 kHz, the specifications are for AC input voltage of 40% to 120% of range. 750 V range is limited to 750Vrms. 200 mV range is full range input or input that is larger than the full range. For 30 mV to 200 mV inputs, multiply % of reading error by 10.

[3] Unless otherwise noted, the specifications are for AC input current from 15% to 120% of range except where noted. 20mA range specifications are for full scale. For inputs from 5mA to 20mA, multiply total % of reading error by 10. 10A range is for AC input current from 25% to 100% of range.

Measurement Characteristics

Frequency and Period

Measurement Method: Reciprocal-counting technique. AC-coupled input using the ac voltage or ac current measurement function.

Measurement attentions:

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.

Setting time attentions:

Errors will occur when attempting to measure the frequency or period of an input following a dc offset voltage change. The input blocking RC time constant must be allowed to fully settle (up to 1 sec) before the most accurate measurements are possible.

Capacitance Characteristics

Accuracy Specifications (% of reading + % of range)^[1,2]

| Function | Range ^[2] | Test Current | 1 Year 23°C±5°C | Temperature Coefficient 0 °C to 18 °C 28 °C to 55 °C |
|-------------|----------------------|--------------|--------------------|---|
| Capacitance | 2.000nF | 200nA | 3 + 1.0 | 0.08+0.002 |
| | 20.00nF | 200nA | 1 + 0.5 | 0.02+0.001 |
| | 200.0nF | 2µA | 1 + 0.5 | 0.02+0.001 |
| | 2.000µF | 10µA | 1 + 0.5 | 0.02+0.001 |
| | 200µF | 100µA | 1 + 0.5 | 0.02+0.001 |
| | 10000µF | 1mA | 2 + 0.5 | 0.02+0.001 |

NOTE:

- [1] Specifications are for 30 minute warm-up using REL operation. Additional errors may occur for non-film capacitors.
- [2] Specifications are for 1% to 110% of range on 2 nF range and 10% to 110% of range on all other ranges.

Measurement Characteristics

Capacitance

Measurement Method: Current input with measurement of resulting ramp.

Connection Type: 2-wire

Input Protection: 1000V on all ranges

Measurement attentions:

Measurement of small capacitance is easily affected by external noise thus to cause measurement error, disable input will reduce this error.

Other Measurement Characteristics

Triggering and Memory

| | |
|-------------------------|--|
| Samples per Trigger: | 1 to 2,000 |
| Trigger Delay: | 8ms to 2000ms |
| External trigger input: | |
| Input Level: | TTL compatible (High level when left trigger input open) |
| Trigger Condition: | Selectable Rising/Falling edges. |
| Input Impedance: | >20k Ω , in parallel with 400pF, DC-coupled |
| Min Pulse Width: | 500 μ s |
| VMC Output: | |
| Electric Level: | TTL compensate (Input \geq 1k Ω load) |
| Output polarity: | positive, negative(selectable) |
| Output impedance: | 200 Ω , typical |

Arbitrary sensor measurement

Support thermocouple, DC voltage, DC current, resistance (2-wire or 4-wire), capacitance and frequency output type sensors. Build in thermocouple cold side compensate.

Cold junction compensation: $\pm 3^{\circ}\text{C}$.

Preset ITS-90 transform of B, E, J, K, N, R, S and T thermocouple and transform of platinum Pt100, Pt385 resistance temperature sensor.

Math function

Pass/Fail, RELative, Maximum/Minimum/Average, dBm, dB, Hold, Histogram, standard deviation.

History function

Volatile Memory: 2000 reading history record.

Nonvolatile Memory:

10 groups history data storage (2000 readings/group)

10 groups sensor data storage (1000 readings/group)

10 groups instrument settings storage

10 groups sensor settings storage

Support USB flash device external storage extend