HIOKI

High-precision portable RESISTANCE METER

measures from μΩ to MΩ

New

RM3548

■ Features

- ■ High-precision specs in a portable package(high accuracy of 0.02% rdg.)
- ■ Design is ideal for maintenance and testing/measurement of large equipment.
- ■ No warmup period or zero adjustment required.
- ■ Dramatically improved overvoltage resistance (protection up to 70 V DC)

■ High-precision specs in a portable package

● **Expansive range options**

Measure from 0.0 μΩ to 3.5000 MΩ

0.1μΩ max. resolution, 0.02% basic accuracy

Max.measurable current of 1A

● **Continuity and resistance measurement in large transformers, motors, and power supply equipment**

The RM3548 uses a high current of 1 A to measure lower resistance values more reliably at a resolution of 0.1 μΩ in applications including measuring resistance in large transformers and motors as well as wiring, busbars and connections in power supply equipment.
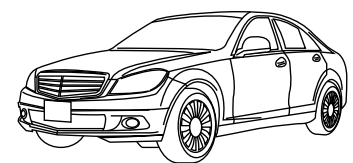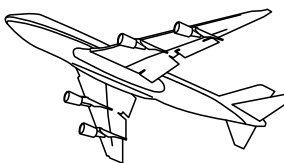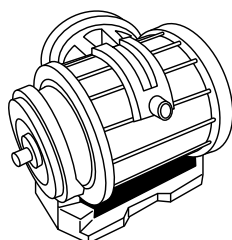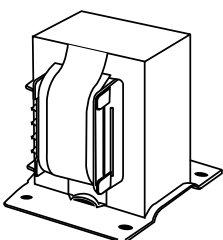
● **Verification of continuity of ground lines in automobiles and fuselage welds and caulking in aircraft**

The RM3548 can be used to check ground connections* in automobiles and fuselage welds and caulking in aircraft using a measurement current of 300 mA (300 mΩ range).

CE

■ Portable, easy to use, and easy to understand

### ● Design is ideal for maintenance and testing/measurement of large products

The included strap can be looped around the neck to support the instrument, leaving the operator's hands free to hold probes for measurement. The meter uses eight AA alkaline batteries, which provide enough power for approximately 10 hours of testing under normal operating conditions. (Operating times vary with measurement conditions.)

● Auto-hold and auto-memory functionality

The RM3548 features auto-hold and auto-memory functionality to automatically hold and record data simply by placing the probes in contact with the desired measurement location. This functionality allows measured values to be recorded automatically as soon as they stabilize without the need for the user to operate any switches.

● LED COMPARATOR ATTACHMENT

By installing the LED COMPARATOR ATTACHMENT close to a probe, you can capture judgment results without moving your eyes away from the measurement location and probe.
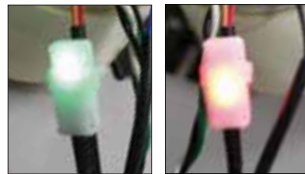
Green light
IN state

Red light
HI/LO state

● Offset Voltage Compensation(OVC)

Thermal EMF occurs at the contact point of different metals. This voltage affects measurements, and if large enough, can cause measurement errors. The offset voltage compensation function minimizes the effect of thermal EMF to maintain measurement accuracy. Particularly when measuring low resistances where the detection voltage is small, and during low-power resistance measurements, OVC is essential to maintain accuracy.

● Length conversion function

By setting a resistance value per meter, it is possible to convert resistance values into lengths. This capability is useful when managing cable inventory or estimating PCB pattern lengths.

● No zero adjustment

Accuracy is defined without any need to perform zero-adjustment. Measurement can be performed as soon as the instrument is turned on.

● Dramatically improved overvoltage resistance

Protection is provided against overvoltage input of up to 70 V, preventing damage caused by connecting the instrument to an electrical charge or by the effects of the counter-EMF from inductance.

PrtCt

Circuit protection detection state
(Alerts the operator to overvoltage input with a screen display and an audible warning.)

● Acquire measured values recorded in the instrument's memory over a USB connection

By connecting the RM3548 to a computer with a USB cable*, you can download measured values stored in the instrument's memory.
*Since the RM3548 provides a mass storage class (read-only) USB interface, there is no need to install special driver software on the computer

■ Temperature conversion function and interval measurement: Useful in temperature-rise testing

Temperature increase (Δt) is obtained and displayed by converting resistance measurements and ambient temperature. The maximum temperature increase needs to be determined when current is applied especially for verifying motor windings or transformers. The interval measurement function can be used to take measurements at a user-specified interval from the start of measurement. Since measured values can be recorded in the instrument's memory, the maximum temperature can be easily estimated.

The temperature conversion function cannot be used simultaneously with the temperature correction function and length conversion function.

① When a motor or coil has thermally stabilized at room temperature, measure the resistance (r_0) and ambient temperature (t_0) before applying current.

② Excite the coil, and when the temperature increase appears to saturate, remove the excitation.

③ After removing excitation, determine the temperature (Δt_1 to Δt_n) from the resistance (r_t) measured at each specific time (t), and the ambient temperature.

④ Project the curve through the collected temperature data (Δt_1 to Δt_n) to estimate the maximum temperature increase (Δt).
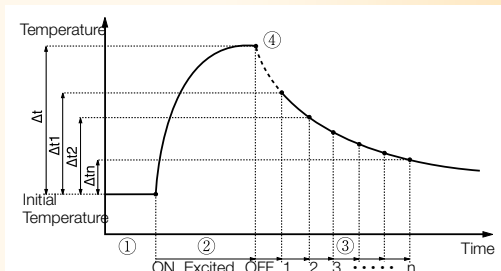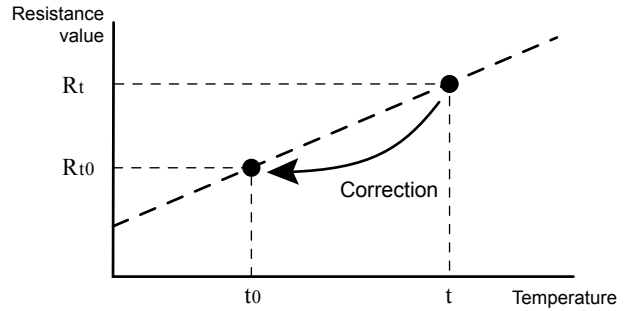
■ Temperature correction

Generally, the resistance of cooper wiring changes with temperature by 0.4% per degree Celsius. The RM3544/RM3544-01/RM3548 provides a temperature correction function to convert the observed resistance value R_t at the current temperature t to the resistance value R_{t0} at the reference temperature t_0.
Requires temperature sensor (Z2001 or Z2002).

Reference temperature setting range : -10 °C to 99.9 °C
Temperature coefficient setting range : -9,999 ppm to +9,999 ppm

■ Measurement accuracy

■ Resistance measurement accuracy
● Conditions of guaranteed accuracy

- Temperature & humidity: 23 °C ±5 °C, 80% rh or less (non-condensating)
- Guaranteed Accuracy Period: 1 year
- From 0°C to 18°C and from 28°C to 40°C, add (temperature coefficient ±[1/10 measurement accuracy] / °C).

● RM3548

Accuracy = ±(% rdg. + % f.s.)
(f.s. = calculated 30,000 dgt., where 0.010% f.s. = 3 dgt.)

(Example) 0.020 + 0.007 . ..... 0.020% rdg. + 0.007% f.s.

Range	Max. measurement display[4],[5]	Accuracy[6]	Measurement Current[7]	Open-Circuit Voltage
3mΩ	3.500 0 mΩ	0.100 + 0.200 (0.100 + 0.020)	1A	
30mΩ	35.000 mΩ	0.100 + 0.020 (0.100 + 0.010)		
300mΩ	350.00 mΩ	0.100 + 0.010 (0.100 + 0.010)	300mA	
		0.020 + 0.020 (0.020 + 0.010)	100mA	
3Ω	3.500 0 Ω	0.020 + 0.007 (0.020 + 0.007)	100mA	
30Ω	35.000 Ω	0.020 + 0.007 (0.020 + 0.007)	10mA	
300Ω	350.00 Ω	0.020 + 0.007 (0.020 + 0.007)	1mA	5.5Vmax.
3kΩ	3.500 0 kΩ	0.020 + 0.007		
30kΩ	35.000 kΩ	0.020 + 0.007	100μA	
300kΩ	350.00 kΩ	0.040 + 0.007	5μA	
3MΩ	3.500 0 MΩ	0.200 + 0.007	500nA	

[4] For negative values, to -10% f.s.
[5] The maximum display range is the same as the maximum measurement range.
[6] Measurement accuracy values assume offset voltage correction (OVC) is ON.
[7] Measurement current accuracy is ±5%.

* *During temperature correction, the value calculated below is added to the rdg. error for resistance measurement accuracy:*

$$\frac{-\alpha_{t0}\Delta t}{1 + \alpha_{t0} \times (t + \Delta t - t_0)} \times 100 \quad [\%]$$

t_0 : Reference temperature. [°C]
t : Ambient temperature. [°C]
Δt : Temperature. measurement accuracy
α_{t0} : Temperature. coefficient at t_0 is [1/°C]

● Temperature measurement accuracy

- Temperature Sensor Z2001 (for RM3544/RM3544-01)
- Temperature Sensor Z2002 (for RM3548)

Range of guaranteed accuracy	-10.0 to 99.9 °C
Display refresh rate	Approx. 2 s
Guaranteed accuracy period	1 year

- Temperature Sensor Z2001 and RM3544/RM3544-01 combined accuracy
- Temperature Sensor Z2002 and RM3548 combined accuracy

t: Temperature measurement values [°C]

Temperature	Accuracy
-10.0 °C to 9.9 °C	± (0.55 + 0.009 × |t-10|) °C
10.0 °C to 30.0 °C	± 0.50 °C
30.1 °C to 59.9 °C	± (0.55 + 0.012 × |t-30|) °C
60.0 °C to 99.9 °C	± (0.92 + 0.021 × |t-60|) °C

Standalone instrument accuracy: ± 0.2 °C

■ RM3544/RM3544-01/RM3548 Specifications

Product warranty: 1 year

	RM3544/RM3544-01	RM3548
Measurement types	Resistance measurement: 0.000mΩ (30mΩ range) to 3.500 0MΩ (3MΩ range), 9 ranges Temperature measurement (thermistor): -10.0 to 99.9°C	Resistance measurement: 0.0000mΩ (3mΩ range) to 3.500 0MΩ (3MΩ range), 10 ranges Temperature measurement (thermistor): -10.0 to 99.9°C
Measurement method	4-terminal direct current (constant current), banana plug,with guard terminal	4-terminal direct current (constant current), banana plug
Range switching	Auto or Manual	
Temperature correction	Reference temperature setting range: -10°C to 99.9°C, Temperature coefficient setting range: -9,999 ppm/°C to +9,999 ppm/°C	
Zero-adjustment	Within -3% to 50% f.s. of each range. (f.s.= 30,000 dgt.)	Within ±3% f.s. of each range (f.s.= 30,000 dgt.)
Trigger	RM3544: Internal trigger, RM3544-01: Internal or external	Internal trigger
Measurement speed	FAST (50Hz:21 ms, 60Hz:18 ms) / MED (101 ms) / SLOW (401 ms)	Fixed
Display refresh rate	N/A	Without OVC: approx. 100ms, With OVC: approx. 230ms
Delay	N/A	Internal fixed value: / 10 to 1000ms (7 settings)
Functions	Temperature correction, comparator (ABS/REF%), key-lock (OFF, menu lock, all lock), display digit count selection function (5 digits/4 digits), automatic power supply frequency settings (AUTO/50Hz/60Hz), scaling, judgment sound setting, auto hold	Temperature correction, temperature conversion, offset voltage compensation (OVC), comparator (ABS/REF%), length conversion, judgment sound setting, auto hold, auto power save (APS)
Measurement fault detection functions	Over-range detection, current fault detection, fuse trip detection	Over-range detection, current fault detection, circuit protection detection function, fuse trip detection
Averaging	OFF, 2 to 100 averaging iterations (variable in 1-iteration steps)	OFF, 2/5/10/20 averaging iterations
Panel store, panel load	10 Panel save parameters: resistance measurement ranges, measurement speed, average, comparator, judgment sound, scaling, temperature correction(TC), auto hold, zero-adjust	9
Memory storage	N/A	Manual, Auto memory, interval memory Number of blocks: 10 Number of recordable data points: (manual/auto) Up to 1,000, (interval) Up to 6,000 Interval: 0.2 to 10.0s (0.2s steps) Acquisition of data from memory: display, USB mass storage (CSV, TXT files)
Interfaces	RM3544-01: EXT I/O, Communication interface	Communication interface
Communication interfaces	RM3544-01: Select from RS-232C, PRINTER(RS-232C), or USB	USB
Communication function	Remote function, communications monitor function, data output function	N/A
RS-232C	Bit rates: 115,200 / 38,400 / 19,200 / 9,600 bps	N/A
USB	Class: CDC (COM mode), HID (USB keyboard mode)	Class: USB mass storage class (read-only)
Printer	Operation: Prints at PRINT signal or PRINT key input. Printed data: Resistance measurement values, temperature measurement values, judgment results, measurement conditions Interval: ON/OFF Interval times: 1 to 3,600 s (variable in 1 s steps) Number of print columns per row: 1 or 3	N/A

■ General specifications

	RM3544/RM3544-01	RM3548
Operating temperature and humidity	0 to 40°C, 80% rh or less (non-condensating)	
Storage temperature and humidity	–10 to 40°C, 80% rh or less (non-condensating)	
Operating environment	Indoors, Pollution Degree 2, up to 2,000 m ASL	
Power supply	Rated supply voltage: 100 to 240 VAC ±10% Rated supply frequency: 50/60 Hz	DC1.5V × 8 (LR6 alkaline battery × 8)
Continuous operating time	N/A	1 s measurements over 10 s in 3 mΩ range: Approx. 10 hours (when using new alkaline batteries)
Rated power consumption	15 VA	5 VA
Insulation withstand potential	1.62 kV AC for 1 min. (with 10 mA cutoff current) between all mains supply terminals and protective ground, interfaces, and measurement jacks	N/A
Dimensions	Approx. 215W × 80H × 166D mm (8.46"W × 3.15"H × 6.54"D) (without projections)	Approx. 192W × 121H × 55D mm (7.56"W × 4.76"H × 2.17"D) (without projections)
Mass	RM3544: Approx. 0.9 kg (31.7 oz) RM3544-01:Approx. 1.0 kg (35.3 oz)	Approx. 0.77 kg (27.2 oz.)
Accessories	RM3544: Power cord ×1, CLIP TYPE LEAD L2101 ×1, instruction manual ×1, extra fuse ×1 RM3544-01: Power cord ×1, CLIP TYPE LEAD L2101 ×1, male EXT I/O connector ×1, instruction manual ×1, application disc ×1, USB cable (A-to-B type) ×1, extra fuse ×1	CLIP TYPE LEAD 9287-01 ×1, TEMPERATURE SENSOR Z2002 ×1, LR6 alkaline battery ×8, instruction manual ×1, USB cable(A-to-mini B type) ×1, strap ×1, extra fuse ×1
Applicable standards	Safety: EN61010 EMC: EN61326, EN61000-3-2, EN61000-3-3	Safety: EN61010 EMC: EN61326

RESISTANCE METER RM3544

(Accessories: Power cord ×1, CLIP TYPE LEAD L2101 ×1, instruction manual ×1, extra fuse ×1)

RESISTANCE METER RM3544-01

(EXT I/O, with communication interface)

(Accessories: Power Cord ×1, CLIP TYPE LEAD L2101 ×1, male EXT I/O connector ×1, instruction manual ×1, applications disc ×1, USB cable (A-to-B type) ×1, extra fuse ×1)
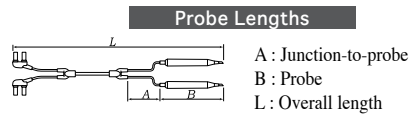
RESISTANCE METER RM3548

(Accessories : CLIP TYPE LEAD 9287-10 ×1, TEMPERATURE SENSOR Z2002 ×1, LR6 alkaline battery ×8, instruction manual ×1, USB cable (A-to-mini B type) ×1, strap ×1, extra fuse ×1)
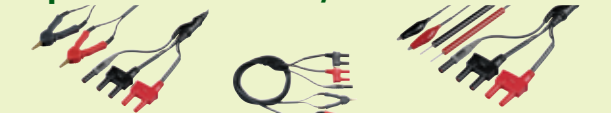
● Shared option

LED COMPARATOR ATTACHMENT L2105
2 m (6.56 ft.)

Probe Lengths
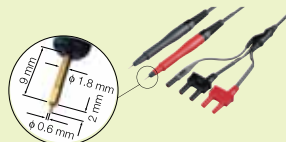
A : Junction-to-probe
B : Probe
L : Overall length

*Since the L2101 to L2104 leads can be separated into two units, length A is not noted

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● Options for RM3544/RM3544-01

CLIP TYPE LEAD L2101
(Bundled accessory)
B:83 mm (3.27 in.), L:1.5 m (4.92 ft.)

(Whole image)

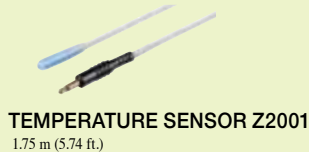**4 -TERMINAL LEAD L2104**
B:118 mm (4.65 in.), L:1.5 m (4.92 ft.)

PIN TYPE LEAD L2102
B:140 mm (5.51 in.), L:1.5 m (4.92 ft.)

PIN TYPE LEAD L2103
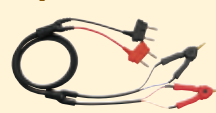B:138 mm (5.43 in.), L:1.5 m (4.92 ft.)

TEMPERATURE SENSOR Z2001
1.75 m (5.74 ft.)

PC Communication (for RM3544-01)

RS-232C CABLE 9637
for PC connection, 9pin - 9pin, cross, 1.8 m (5.91 ft.)

RS-232C CABLE 9638
for PC connection, 9pin - 25pin, cross, 1.8 m (5.91 ft.)

● Options for RM3548

CLIP TYPE LEAD 9287-10
(Bundled accessory)
A:130 mm (5.12 in.), B:83 mm (3.27 in.), L:1.1 m (3.61 ft.)

FOUR TERMINAL LEAD 9453
A:280 mm (11.02 in.), B:118 mm (4.65 in.), L:1.36 m (4.46 ft.)

PIN TYPE LEAD 9465-10
A: 80 mm (3.15 in.) (Red), 140 mm (5.51 in.) (Black, Max. 550 mm (21.65 in.)),
B: 121 mm (4.76 in.), L: 1.88 m (6.17 ft.)

PIN TYPE LEAD 9772
A: 80 mm (3.15 in.) (Red), 140 mm (5.51 in.) (Black, Max. 550 mm (21.65 in.)),
B: 118 mm (4.65 in.), L: 1.78 m (5.84 ft.)

TEMPERATURE SENSOR Z2002
(Bundled accessory)
100 mm (3.94 in.)

LARGE CLIP TYPE LEAD 9467
Not CE marked
φ29 mm (1.14 in.)
A:300 mm (11.81 in.), B:116 mm (4.57 in.), L:1.36 m (4.46 ft.)

(Storage Example)
CARRYING CASE C1006

ZERO ADJUSTMENT BOARD 9454
for 9465-10

HIOKI

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All information correct as of Jan. 15, 2013. All specifications are subject to change without notice.