Materials/chemicals/pharmaceuticals/battery materials

Evaluation of material characteristics and properties, R&D, experimentation

Measuring volume resistivity and surface resistivity of conductive materials using the four-point probe method

The four-point probe method can be used to measure volume resistivity, surface resistivity, and conductivity.

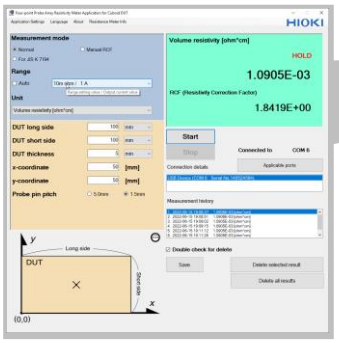
The four-point probe method is the four-terminal measurement using four-point array probes and with RCF calculation.
It can be used to calculate volume resistivity and surface resistivity (sheet resistance). Four-point probe resistivity measurement is made possible by the Resistance Meter RM3545, four-point array probes, and PC application software.

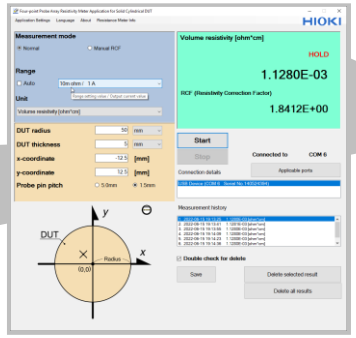
Highlights

・Hioki provides four-point array probes in two variants with probe spacing of 5.0 mm and 1.5 mm.
・Hioki provides two types of PC application software: for cuboid DUTs and for solid cylindrical DUTs.
・Measured parameters include volume resistivity, surface resistivity, and conductivity. Resistance values can also be chosen as a reference value.
・The application displays RCF (Resistivity Correction Factor) calculated based on the entered DUT dimensions and measurement position coordinates.
・The application provides convenient functionality of a probing position guide, a measurement history, and outputting measurement results as a CSV file.
・Low resistance values are measured with basic accuracy of 0.006% and a maximum resolution of 0.01 μΩ (as per the RM3545's specifications), allowing volume resistivity to be calculated with a high degree of precision.

System components

PC apps that come with the probes
(for cuboid DUTs or solid cylindrical DUTs)



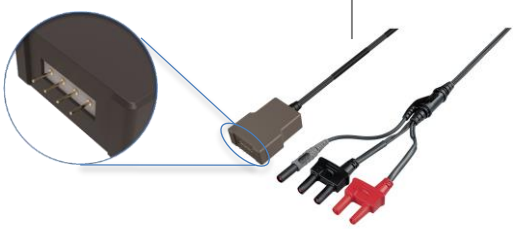


OS: Windows 10 Pro
*Customer is responsible for providing a PC

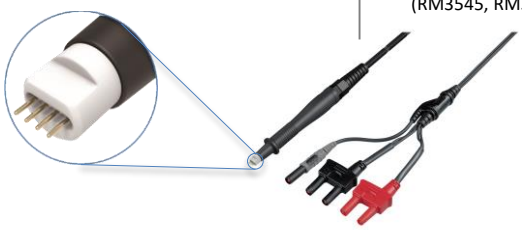
USB connection

Resistance Meter RM3545
(RM3545, RM3545-01, RM3545-02)

Four-point array probe
Model: RM9010-01, RM9010-02



Model: RM9010-01
Four-point array probe with 5.0 mm
spacing between adjacent probes



Model: RM9010-02
Four-point array probe with 1.5 mm
spacing between adjacent probes

Execution Run-time/Environment:
.NET Framework 4.6.1 or one of the versions compatible with .NET Framework 4.6.1

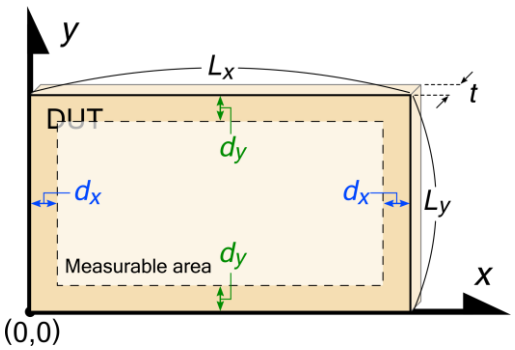
Note: Download and install .NET Framework from Microsoft's support website.

Four-point Probe Array Resistivity Meter Application

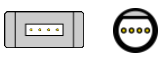
Recommended operating environment :

Supported Operating system	Windows 10 Pro (32 bits/64 bits)
CPU	Intel(R) Core(TM) i7, 2.4 GHz, 4 threads or better (recommended)
Memory	8 GB or more recommended (4 GB or more available RAM recommended)
Display	1050 × 1050 pixels or more recommended, 32768 colors or more recommended
Hard disk	Free capacity 2 GB or more recommended
Communication interface	USB 2.0 (virtual COM port)
Application run-time execution environment	.NET Framework 4.6.1 or one of the versions compatible with .NET Framework 4.6.1 Note: Download and install .NET Framework from Microsoft's support website.

Measurement conditions for cuboid DUT application (measurement mode: Normal)



Probe Head Orientation



Place the probe head on the sample so that the four tips are aligned on a straight line parallel to the x-axis.

The coordinates of the measurement position represent the center coordinate of the probe head.

L_x : 18 mm ~ 2000 mm L_y : 2.0 mm ~ L_x t : 10^{-9} mm ~ 30 mm d_x : 8.5 mm ~ d_y : 1.0 mm ~	L_x : 6.0 mm ~ 2000 mm L_y : 1.5 mm ~ L_x t : 10^{-9} mm ~ 30 mm d_x : 3.0 mm ~ d_y : 0.75 mm ~
 Model RM9010-01: four-point array Probe with 5.0 mm spacing pins	 Model RM9010-02: four-point array probe with 5.0 mm spacing pins

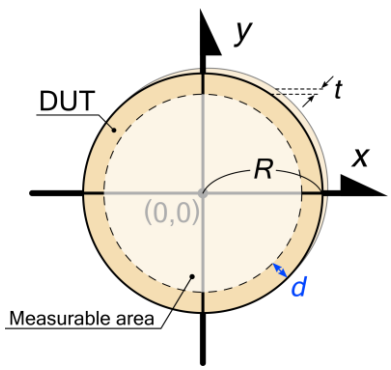
Set the DUT dimensions and probe conditions. The setting value has 5 significant digits and up to 2 decimal places.

1. DUT length

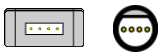
Enter the DUT length of the longs side.
Settable range
RM9010-01: 18 mm to 2000 mm
RM9010-02: 6.0 mm to 2000 mm

2. DUT width
Enter the DUT width of the short side.
Settable range
RM9010-01: 2.0 mm to the length above
RM9010-02: 1.5 mm to the length above
3. DUT thickness
Enter the DUT thickness.
Settable range
RM9010-01: 10^{-9} mm to 30 mm
RM9010-02: 10^{-9} mm to 30 mm
4. x-coordinate
Enter the x-coordinate of the probing position. Enter the center coordinate of the probing head.
Settable range
RM9010-01: Enter a coordinate within the DUT and 8.5 mm or more inward from its short side.
RM9010-02: Enter a coordinate within the DUT and 3.0 mm or more inward from its short side.
5. y-coordinate
Enter the y-coordinate of the probing position. Enter the center coordinate of the probing head.
Settable range
RM9010-01: Enter a coordinate within the DUT and 1.0 mm or more inward from its long side.
RM9010-02: Enter a coordinate within the DUT and 0.75 mm or more inward from its long side.

Measurement conditions for solid cylindrical DUT application (measurement mode: Normal)



Probe Head Orientation



Place the probe head on the sample so that the four tips are aligned on a straight line parallel to the x-axis.

The coordinates of the measurement position represent the center coordinate of the probe head.

R : 8.5 mm ~ 500 mm t : 10^{-9} mm ~ 30 mm d : 8.0 mm ~	R : 3.0 mm ~ 500 mm t : 10^{-9} mm ~ 30 mm d : 3.0 mm ~
 Model RM9010-01: four-point array Probe with 5.0 mm spacing pins	 Model RM9010-02: four-point array probe with 5.0 mm spacing pins

Set the DUT dimensions and probe conditions. The setting value has 5 significant digits and up to 2 decimal places.

1. DUT radius
Enter the DUT radius.
Settable range
RM9010-01: 8.5 mm to 500 mm
RM9010-02: 3.0 mm to 500 mm

2. DUT thickness
Enter the DUT thickness.
Settable range
RM9010-01: 10^{-9} mm to 30 mm
RM9010-02: 10^{-9} mm to 30 mm
3. (x, y) coordinates
Enter the (x, y) coordinates of the probing position. Enter the center coordinate of the probing head.
Settable range
RM9010-01: Enter (x, y) coordinates which exist 8.0 mm or more inward from the edge of the DUT.
RM9010-02: Enter (x, y) coordinates which exist 3.0 mm or more inward from the edge of the DUT.

Settable resistance range and applied current with the application software

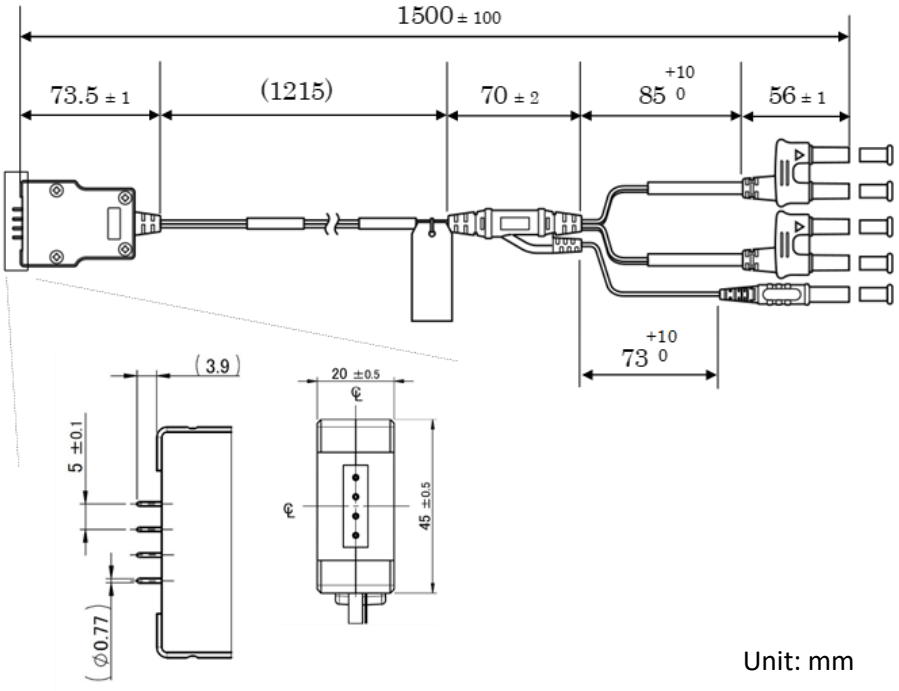
10 MΩ/1 uA	1000 kΩ/10 uA	100 kΩ/100 uA	10 kΩ/1 mA	1000 Ω/1 mA
100 Ω/1 mA	10 Ω/1 mA	1000 mΩ/10 mA	100 mΩ/100 mA	10 mΩ/1 A

Four-point array probe model RM9010-01, RM9010-02

Model RM9010-01: specifications

Probe material	Base material: Beryllium copper Plating: Gold (primary nickel plating)
Probe diameter	Approx. 0.77 mm
Probe tip shape	Spherical
Probe array	Collinear
Spacing between adjacent probes	5.0 mm ±0.1 mm (with every probe thrust against an object)
Insulation resistance between adjacent probes	10 GΩ or more for an applied voltage of 25 V at an ambient temperature of 23°C and relative humidity of 35% RH (reference value)
Probe spring force (per spring)	1.25 N ±0.25 N (with every probe thrust against an object)
Maximum rated terminal-to-ground voltage	30 V AC rms or less, 42.4 V AC peak or less, 60 V DC or less
Rated current	3 A AC/DC continuous
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	-10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Operating environment	Indoors, pollution degree 2, operating altitude: up to 2000 m (6562 ft.)
Dimensions	About 1500 mm (59.06″)
Weight	About 200 g (7.1 oz.)

Model RM9010-01: outline drawing

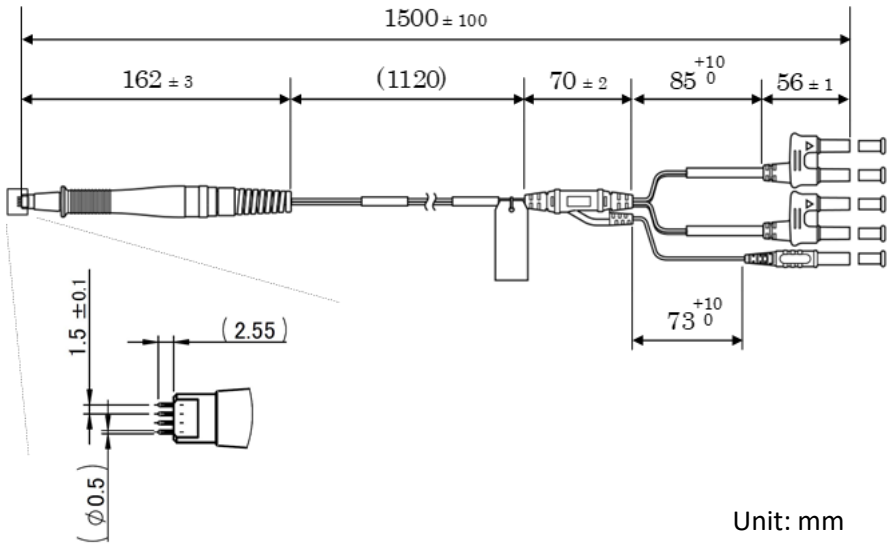


Unit: mm

Model RM9010-02: specifications

Probe material	Base material: Beryllium copper Plating: Gold (primary nickel plating)
Probe diameter	Approx. 0.5 mm
Probe tip shape	Spherical
Probe array	Collinear
Spacing between adjacent probes	1.5 mm ±0.1 mm (with every probe thrust against an object)
Insulation resistance between adjacent probes	10 GΩ or more for an applied voltage of 25 V at an ambient temperature of 23°C and relative humidity of 35% RH (reference value)
Probe spring force (per spring)	About 0.85 N (with every probe thrust against an object)
Maximum rated terminal-to-ground voltage	30 V AC rms or less, 42.4 V AC peak or less, 60 V DC or less
Rated current	1.5 A AC/DC continuous
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	-10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Operating environment	Indoors, pollution degree 2, operating altitude: up to 2000 m (6562 ft.)
Dimensions	About 1500 mm (59.06″)
Weight	About 150 g (5.3 oz.)

Model RM9010-02: outline drawing



Unit: mm

Please contact Hioki via the following web site:

HIOKI E. E. CORPORATION https://www.hioki.com/global