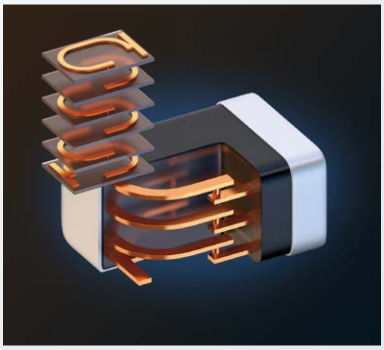
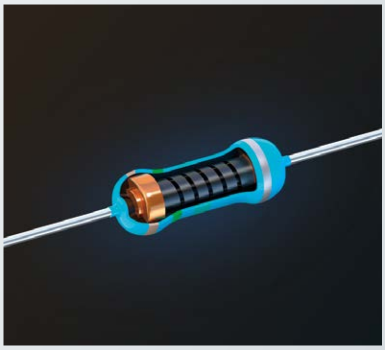
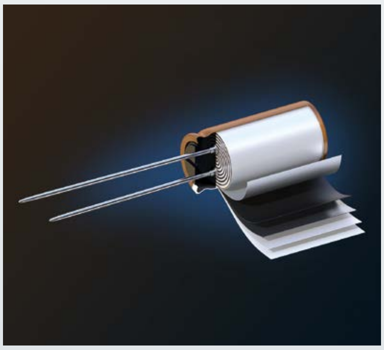
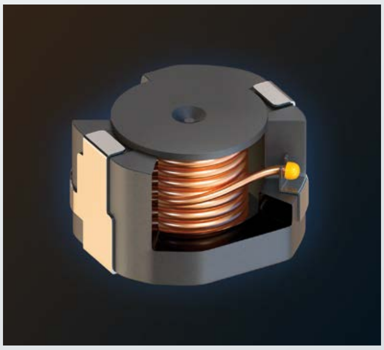
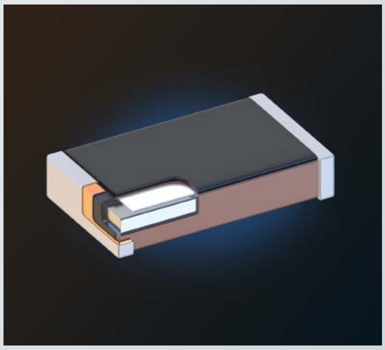
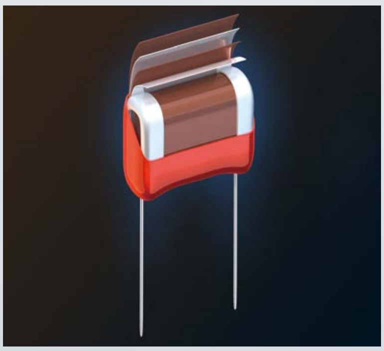
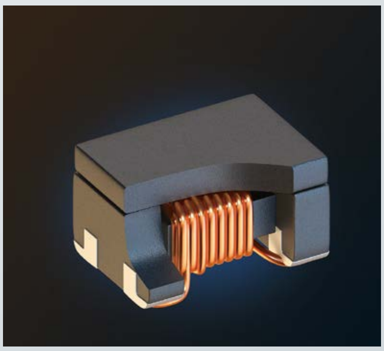
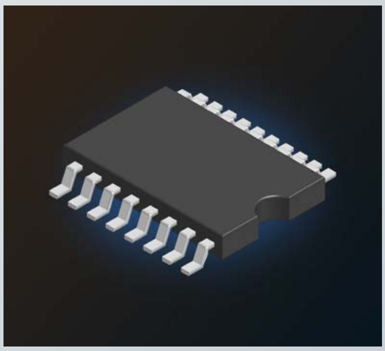
Electronic Component
Measurement Applications

Electrical measurement in electronic component performance evaluation and quality testing

Capacitors	Inductors	Resistors


Increasingly computerized automobiles


Information and communication between cars (V2X)


Smart factories


Automated shipping services


Data centers that support high-capacity communication


Smart houses for efficient use of electricity


Increasingly sophisticated devices


Growing crops using drones

Moving towards a sustainable society with digital technology and 5G

Trends are accelerating towards connecting devices with information and using energy efficiently. Innovations in a variety of core functions of society are taking place due to the combination of fast, high-bandwidth data communications based on 5G networks and advanced digital technologies.

Big data

Energy	Life	Medical	Agriculture	Logistics	Industry

Electronic components that make possible advanced digital technologies

All digital technologies are supported by highly reliable electric circuits. The performance of electronic components exerts a major influence on the operation of the electric circuits they comprise. In recent days, ensuring electronic components deliver a high level of performance is an essential part of satisfying market requirements.

Performance required of electronic components

Low loss	Environmental performance	Noise resistance	Space-saving design

Measuring the performance of electronic components

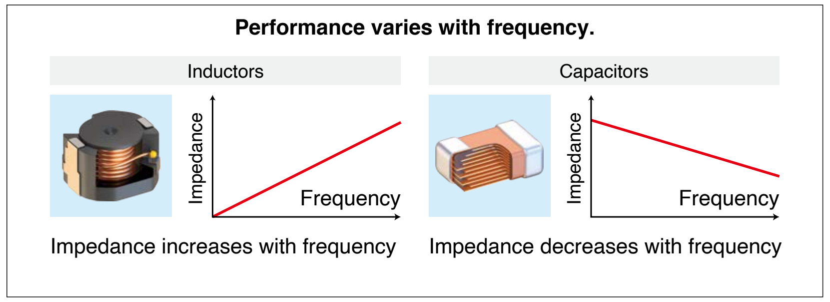
Electric circuits operate properly when electronic components perform as designed.
It is possible to design highly reliable circuits by measuring electronic components to accurately assess their performance.

Assessing the performance of electronic components

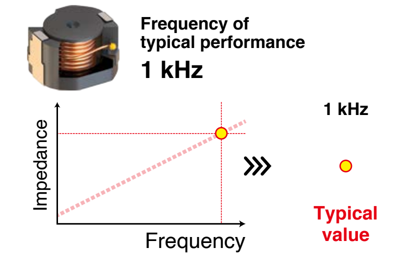
Electricity frequency affects the performance of electronic components to a significant degree. That makes it important to check the performance of electronic components at the frequencies at which they will actually be used.

Assessing changes in the performance by frequency

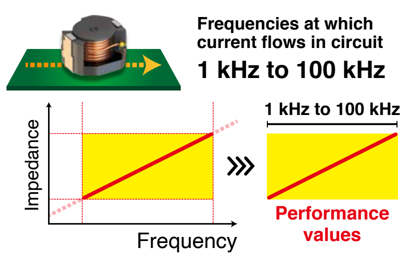
Frequency affects the performance of electronic components to a significant degree. That's why it's important to check how the performance of electronic components changes as the frequency changes.



Observing representative performance

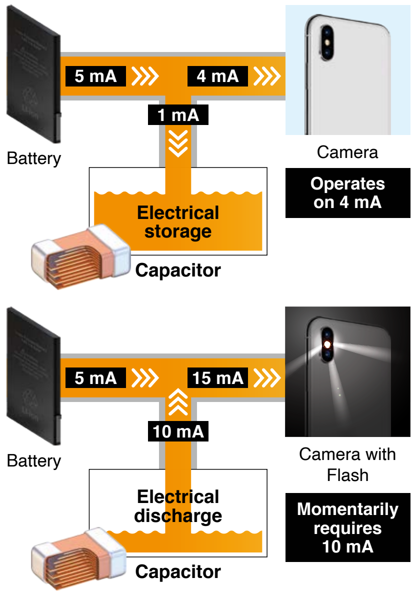


Observing performance under conditions of actual use



Measuring capacitors

Capacitors store and discharge electricity in circuits. The ability to store electricity in this manner is known as capacitance. Various types of capacitors are available, and it's necessary to choose the type that best suits your application.



LCR Meters

Check the performance of electronic components while applying electricity of particular frequencies

Model	Measurement frequency
IM3533	1 mHz to 200 kHz

Model	Measurement frequency
IM3536	4 Hz to 8 MHz

Impedance Analyzers

Check the characteristics of electronic components while varying the frequency and signal magnitude.

Model	Measurement frequency
IM7580A	1 MHz to 300 MHz
IM7581	100 kHz to 300 MHz
IM7583	1 MHz to 600 MHz
IM7585	1 MHz to 1.3 GHz
IM7587	1 MHz to 3 GHz

Model	Measurement frequency
IM3570	4 Hz to 5 MHz

C Meters

Measure the capacitance of capacitors.

Measurement of large C values

Model	Capacitance measurement range
3504-40	0.9400 pF to 20.0000 mF
3504-50	0.9400 pF to 20.0000 mF
3504-60	0.9400 pF to 20.0000 mF

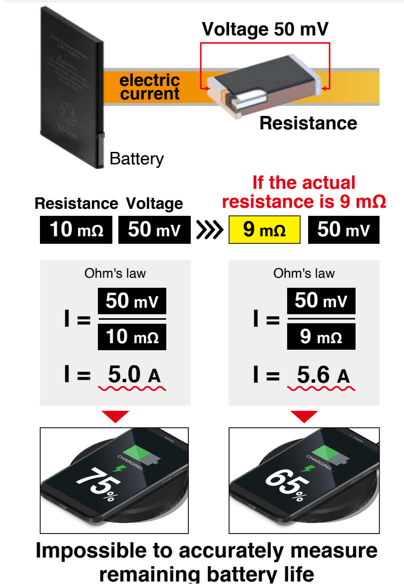
Measurement of low C values

Model	Capacitance measurement range
3506-10	0.001 fF to 15.0000 µF

Measuring resistors

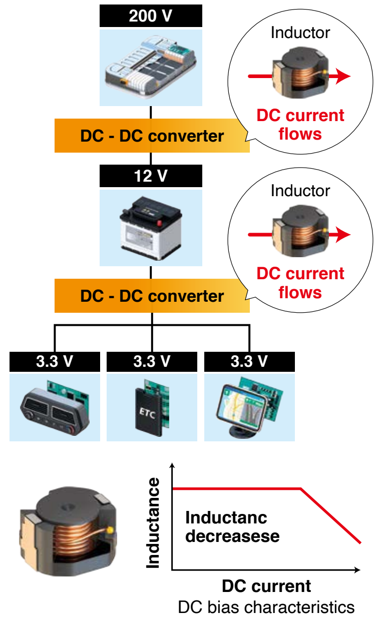
Resistors regulate the amount of electricity flowing in a circuit, and they're used to detect the magnitude of currents. By accurately assessing resistors' resistance value and embedding them in circuits, you can regulate and detect current with a high degree of precision.

Using resistance to detect current



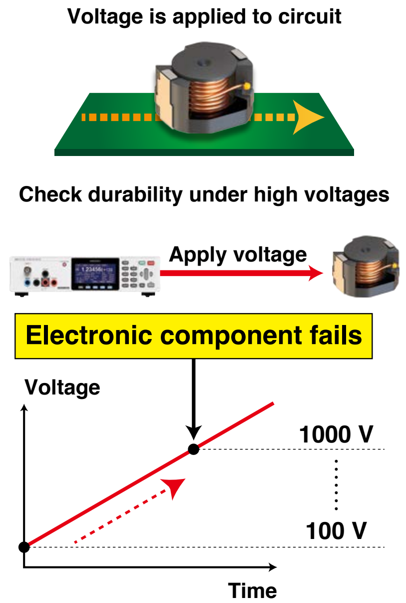
Checking DC bias characteristics

When a DC current flows to a coil, the circuit's inductance may vary. The resulting tendencies are known as DC bias characteristics.



Testing durability

Applying a voltage above a certain level to an electronic component will damage the component and cause the device to fail. That's why it's important to check whether the component can withstand the voltage applied by the designed circuit.



Resistance meters

Measure resistance with a high degree of precision.

Low Rdc measurement

Model	Resistance measurement range
RM3543	0.00000 mΩ to 1200.000 Ω

High Rdc measurement

Model	Resistance measurement range
RM3542A	0.0000 mΩ to 120.0000 MΩ*1

Multichannel pass/fail measurement

4-terminal measurement: 10 ch*2
2-terminal measurement: 21 ch*2

Model	Resistance measurement range
RM3545-02	0.00000 mΩ to 1200.0 MΩ*1

*1: LOW POWER OFF *2: With a Z3003

DC Bias Current Unit LCR Meter

Superpose a DC current from an external power source onto the measurement signal to measure the DC bias characteristics.

Connect between a test fixture and instrument. Maximum applied current: DC 2 A

Model	Measurement frequency
9269-10	40 Hz to 2 MHz

Model	Measurement frequency
IM3536	4 Hz to 8 MHz

Super Megohm Meters Insulation/withstanding Testers

Check an electronic component's durability by applying a gradually increasing voltage to it.

Insulation resistance measurement

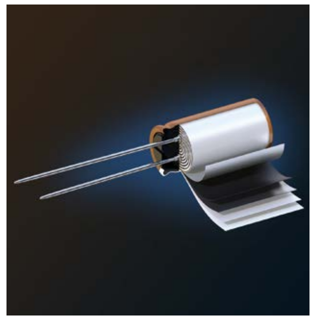
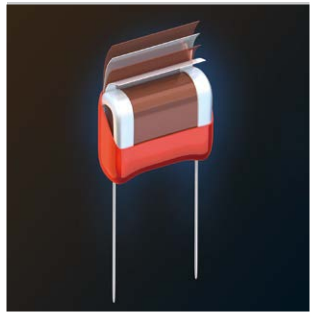
Model	Test voltage (DC)
SM7110	0.1 V to 1000.0 V
SM7120	0.1 V to 2000.0 V

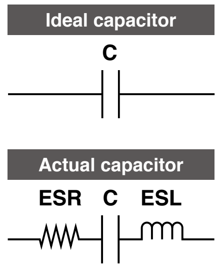
Model	Test voltage (DC)
SM7420	Varies with external power source

Withstand voltage tester

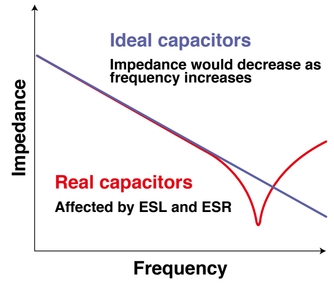
Model	Test voltage (AC/DC)
3153	0.2 kV to 5.00 kV

Capacitor



Simple series equivalent circuit diagram



Frequency characteristics

Equivalent series resistance (ESR) and equivalent series inductance (ESL)

An ideal capacitor would be an element that has only capacitance (C). In reality, however, capacitors have ESR (resistance called Equivalent Series Resistance) caused by losses from the dielectric substance, electrodes, and other factors, as well as parasitic ESL (inductance called Equivalent Series Inductance) caused by electrodes, lead wires, and other factors.

Loss coefficient D (tan δ)

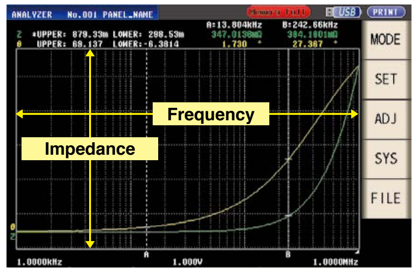
The loss coefficient D (tan δ) expresses the power loss of a capacitor. Smaller values indicate less power loss, and therefore higher-quality capacitors.

IM3570
Measurement frequency: 4 Hz to 5 MHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, Q

Impedance Analyzer

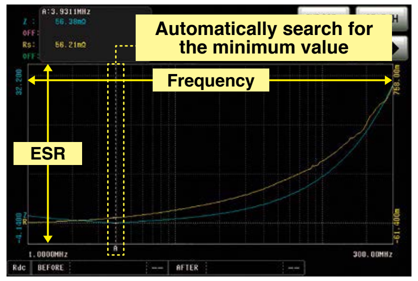
Checking frequency characteristics

Check frequency characteristics by making measurements while sweeping through a range of frequencies. The IM3570 can perform frequency sweep measurement for two parameters simultaneously.



Checking behavior at high frequencies

Check characteristics to determine how parameter values vary by making measurements while sweeping through a range of measurement frequencies.



Evaluating power loss

ESR (Equivalent Series Resistance) is a cause of power loss. Identify the frequency associated with minimum ESR by measuring ESR while sweeping through a range of measurement frequencies.

IM3533
Measurement frequency: 1 mHz to 200 kHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, Q, N, M, ΔL, T

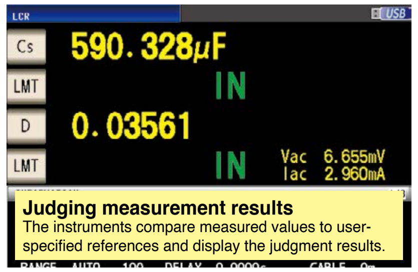
IM3536
Measurement frequency: 4 Hz to 8 MHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, ε, σ

LCR Meters

Measuring C, D, and ESR

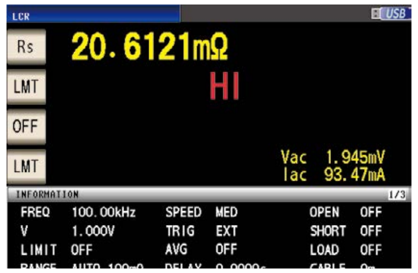
The IM3533 and IM3536 can continuously measure C, D, and ESR, which describe the basic performance of capacitors. The instruments can also compare measured values to user-specified references and display judgment results.

C-D measurement: 120 Hz



Continuous measurement under varying test conditions

ESR measurement: 100 kHz



The panel save function lets you save measurement conditions (for example, "measure C and D at 120 Hz" or "measure ESR at 100 kHz"), while the continuous measurement function lets you perform continuous measurements by combining saved measurement conditions.

3504-40, 3504-50, 3504-60
Measurement frequency: 120 Hz or 1 kHz
Measurement parameters: C, D
Capacitance measurement range:
0.9400 pF to 20.0000 mF

C Meter

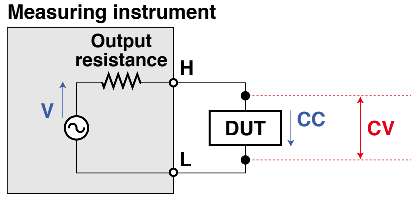
Measuring the C values of high-capacity capacitors

The C values of high-capacity MLCCs that use dielectric substances with high permittivity vary significantly with the applied voltage. The constant-voltage (CV) mode provided by the 3504 series lets you make measurements while applying a defined voltage as the measurement signal.

C measurement range	0.9400 pF to 20.0000 mF
Measurement voltage (open-circuit voltage)	100 mV*, 500 mV, 1 V
Measurement voltage (constant voltage)	100 mV*, 500 mV, 1 V
Measurement frequency	120 Hz, 1 kHz, 1 MHz

*3504-60 only

Measuring instrument



Setting the measurement signal level

Open-circuit voltage (V) mode
Set the voltage produced by the instrument's signal source

Constant-voltage (CV) mode
Set the voltage applied to the DUT
This mode is used when measuring components that exhibit voltage dependency, for example a high-permittivity MLCC

Constant-current (CC) mode*
Set the current that flows to the DUT
This mode is used when measuring devices that exhibit current dependency, for example inductors with cores

*Not available for the 3504 series.

3506-10
Measurement frequency: 1 kHz or 1 MHz
Measurement parameters: C, D, Q
Capacitance measurement range:
0.001 fF to 15.0000 μF

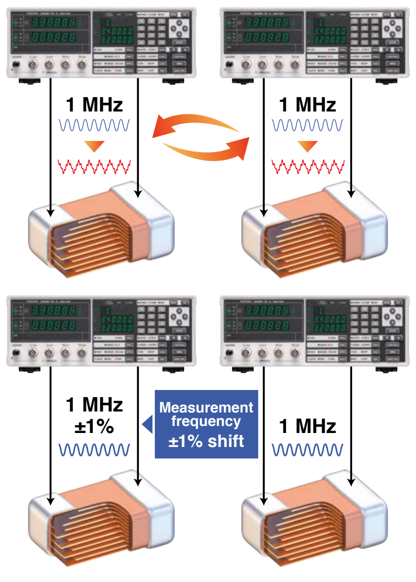
C Meter

Measuring the C values of low-capacitance capacitors

The 3506-10 provides optimal ranges for low-capacitance C measurement.

C measurement range	0.000 fF to 15.0000 μF
Measurement voltage (open-circuit voltage)	500 mV, 1 V
Measurement frequency	1 kHz, 1 MHz

Interference when using multiple instruments



Measurement frequency interference occurs when multiple instruments are used at the same time on a production line. The measurement frequency shift function* (±1%, ±2%) facilitates stable measurement by shifting measurement frequencies.

SM7110
Test voltage: 0.1 V to 1000.0 V

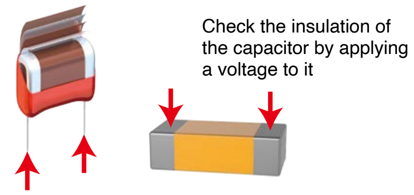
SM7120
Test voltage: 0.1 V to 2000.0 V

SM7420
Test voltage: Varies with external power source

Super Megohm Meters

Evaluating insulation resistance while applying a high voltage

The SM7110 and SM7120 can test insulation at voltages of up to 1000 V or 2000 V, respectively. The SM7420 can shorten insulation test cycle time by using an external power source across 4 channels.

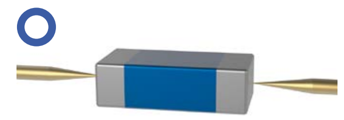


SM7110	SM7120	SM7420
Number of channels		
1 ch	1 ch	4 ch
Test voltage		
0.1 V to 1000.0 V	0.1 V to 2000.0 V	-

Determining the measurement probe contact

The instrument can determine the contact status by measuring capacitance and comparing the result to a previously-set judgment value.

Judgment value setting:
1 pF (can be set as low as 0.2 pF)



Good contact
2 pF (measured value) > 1 pF (judgment value)

Contact error
0.5 pF (measured value) < 1 pF (judgment value)

3153
Test voltage (AC): 0.2 kV to 5.00 kV
Test voltage (DC): 0.2 kV to 5.00 kV

Insulation/withstanding Testers

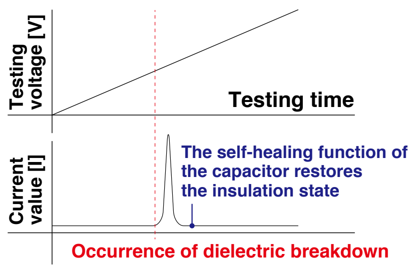
Withstand voltage testing with AC or DC test voltages

The 3153 can automatically perform continuous AC or DC withstand voltage testing. The test voltage's rising and falling times can be set separately. You can check for faulty voltage values by gradually increasing the test voltage.

Test voltage
0.20 kV to 5.00 kV AC 0.20 kV to 5.00 kV DC
Test time
0.1 sec. to 99.9 sec.

Testing the self-healing functions of film capacitors

The self-healing function can be tested by gradually increasing the test voltage.

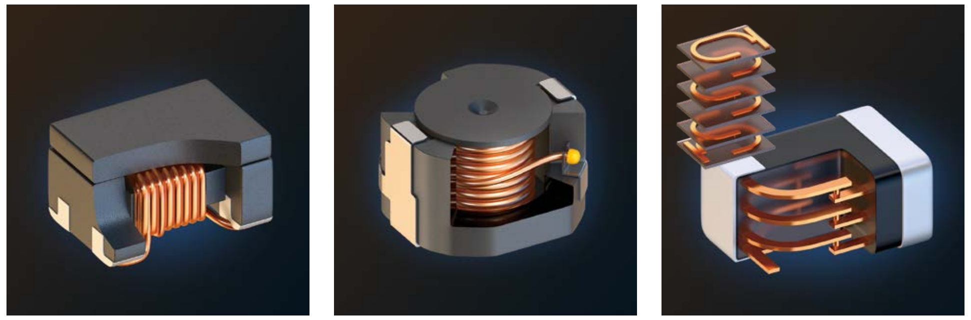


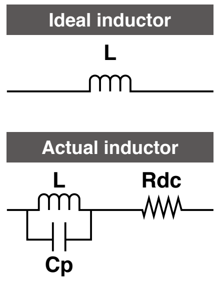
Self-healing function:
Function that instantaneously restores the insulated state, even if the insulation breakdown occurs

Film capacitors are primarily used in power supply circuits to smooth the supply of power. Because the integrity of the insulation in capacitors has a significant impact on component safety, standards such as IEC 60384-14 have been defined to address the risk of fire and electric shock hazards.

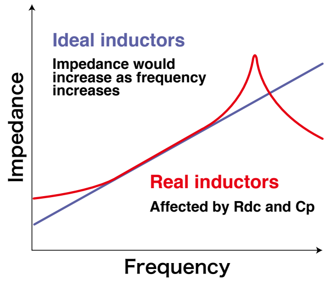
IEC 60384-14: An international standard that outlines safety performance such as the voltage endurance and flame resistance of capacitors connected to commercial power supplies from the perspective of preventing hazards caused by electricity leaks, including fire and electric shock.

Inductors





Simple series equivalent circuit diagram



Frequency characteristics

DC resistance Rdc (DCR)

An ideal coil would be an element that has only inductance (L). In reality however, coils have resistance from the winding wire and coil, Rdc, as well as capacitance between the winding wires, Cp.

Loss coefficient Q (quality factor)

Q is an important quality indicator for high-frequency coils. Larger values indicate less power loss and therefore higher-quality coils.

IM7580s Series

Measurement parameters:
Z, Y, θ , Rs, Rp, X, G, B, Cs, Cp, Ls, Lp, D, Q

IM3570

Measurement parameters:
Z, Y, θ , Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, Q

Impedance Analyzers

Checking frequency characteristics

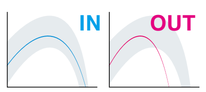
Check frequency characteristics by making measurements while sweeping through a range of frequencies. The IM7580s series and IM3570 can simultaneously perform sweep measurement for two or four parameters, respectively.

Model	Measurement frequency
IM3570	4 Hz to 5 MHz
IM7580A	1 MHz to 300 MHz
IM7581	100 kHz to 300 MHz
IM7583	1 MHz to 600 MHz
IM7585	1 MHz to 1.3 GHz
IM7587	1 MHz to 3 GHz

Generating pass and fail judgments based on user-defined values

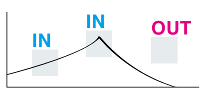
Generate pass and fail judgments based on whether coils satisfy required specifications.

Area judgment



User-specified judgment threshold of the full frequency sweep

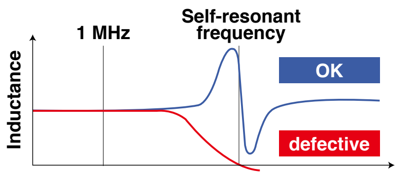
Spot judgment



User-specified judgment thresholds of user-specified frequencies

Detecting minuscule shorts between winding wires and the core

Checking inductance frequency characteristics up to the vicinity of the self-resonant frequency can reveal differences between non-defective parts and parts with shorts.



IM3533

Measurement frequency: 1 mHz to 200 kHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, Q, N, M, ΔL, T

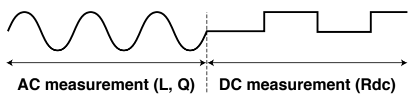
IM3536

Measurement frequency: 4 Hz to 8 MHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, ε, σ

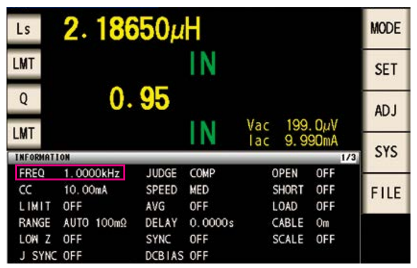
LCR Meters

Measuring L, Q, and Rdc

The IM3533 and IM3536 can make measurements while switching between AC and DC signals. The instruments can measure L and Q using an AC signal and Rdc using a DC signal.

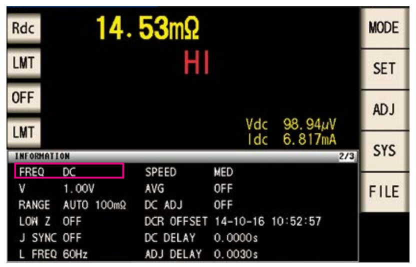


L and Q measurement: 1 kHz



Continuous measurement while switching measurement signals

Rdc measurement: DC



9269-10

Measurement frequency: 40 Hz to 2 MHz
Maximum applied current at frequency: 2 A DC
Connect between fixture and instrument.

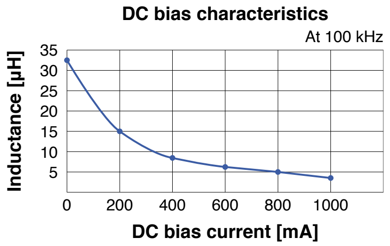
IM3536

Measurement frequency: 4 Hz to 8 MHz
Measurement parameters:
Z, Y, θ, Rs, Rp, X, Rdc, G, B, Cs, Cp, Ls, Lp, D, ε, σ

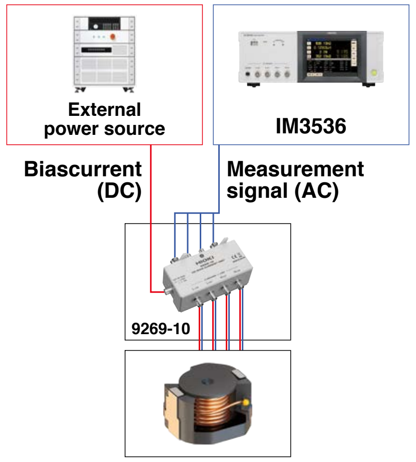
LCR Meters

Measuring DC bias

DC bias can affect L values. The IM3536 and 9269-10 can be used with an external power source to superimpose a DC current on the measurement signal and measure a coil's L value.



DC current superimposed on the measurement signal



RM3542A

Resistance measurement range:
0.0000 mΩ to 120.0000 MΩ (LOW POWER OFF)*
0.000 mΩ to 1200.000 Ω (LOW POWER ON)*
Measurement current: 100 mA DC to 100 nA DC

*When the LOW POWER mode is turned off, a high current is used for measurement, giving stronger resistance to noise. On the other hand, the LOW POWER mode enables measurement of more delicate components.

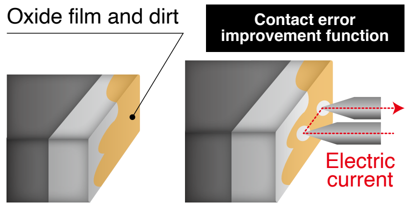
Resistance Meters

Measuring the Rdc of ferrite beads at high speed

The RM3542A can measure the Rdc of ferrite beads in as little as 0.9 ms.

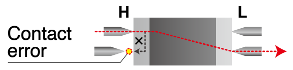
Increasing productivity by addressing contact errors

Oxide film and dirt between the probes and sample can result in incomplete contact, causing a contact error. The RM3542A addresses this issue by applying a current to destroy oxide film and dirt.

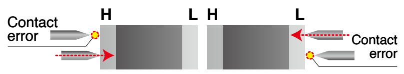


Anticipating changes in ferrite bead characteristics

Applying a current to ferrite (a magnetic material) affects the material's characteristics. The amount of current flowing to the sample can be reduced by alternately applying a current to destroy oxide films and dirt.



Applying a current simultaneously from both ends of the sample causes current to flow to the sample if there is incomplete contact.



The amount of current flowing to the sample is reduced by alternating application of the current.

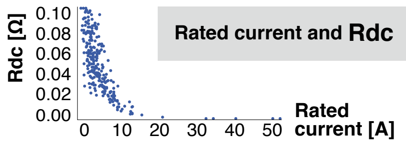
RM3545

Resistance measurement range:
0.00000 mΩ to 1200.0 MΩ
Measurement current: 1 A DC to 100 nA DC

Resistance Meters

Measuring low Rdc at high accuracy

Low-Rdc inductors are becoming more common as a way to reduce energy loss. The RM3545 can measure low Rdc at high accuracy and high resolution.



High-accuracy measurement

Range	Basic accuracy	Measurement current
10 mΩ	±0.060% rdg. + 0.001% f.s.	1 A
100 mΩ	±0.014% rdg. + 0.001% f.s.	1 A, 100 mA
1000 mΩ	±0.008% rdg. + 0.002% f.s.	100 mA, 10 mA
10 Ω	±0.008% rdg. + 0.001% f.s.	10 mA, 1 mA
100 Ω	±0.007% rdg. + 0.001% f.s.	10 mA, 1 mA
1000 Ω	±0.006% rdg. + 0.001% f.s.	1 mA
10 kΩ	±0.007% rdg. + 0.001% f.s.	1 mA
100 kΩ	±0.007% rdg. + 0.001% f.s.	100 μA
1000 kΩ	±0.008% rdg. + 0.001% f.s.	10 μA
10 MΩ	±0.030% rdg. + 0.001% f.s.	1 μA
100 MΩ	±0.200% rdg. + 0.001% f.s.	100 nA, 1 μA or less
1000 MΩ	±1.00% rdg. + 0.02% f.s.	1 μA or less

High resolution

Range	Resolution	Max. display
10 mΩ	10 nΩ	12.000 00 mΩ
100 mΩ	100 nΩ	120.000 0 mΩ
1000 mΩ	1 μΩ	1200.000 mΩ
10 Ω	10 μΩ	12.000 00 Ω
100 Ω	100 μΩ	120.000 0 Ω
1000 Ω	1 mΩ	1200.000 Ω
10 kΩ	10 mΩ	12.000 00 kΩ
100 kΩ	100 mΩ	120.000 0 kΩ
1000 kΩ	1 Ω	1200.000 kΩ
10 MΩ	10 Ω	12.000 00 MΩ
100 MΩ	10 kΩ	120.00 MΩ
1000 MΩ	100 kΩ	1200.0 MΩ

SM7110

Test voltage: 0.1 V to 1000.0 V

SM7120

Test voltage: 0.1 V to 2000.0 V

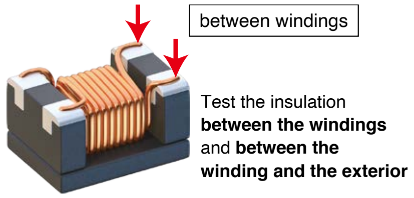
SM7420

Test voltage: varies with external power source

Super Megohm Meters

Evaluating insulation resistance while applying a high voltage

The SM7110 and SM7120 can test insulation at voltages of up to 1000 V or 2000 V, respectively. The SM7420 can test insulation across 4 channels when used with an external power source to shorten test cycle times.

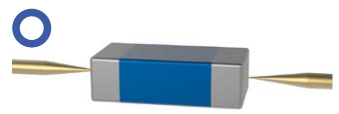


SM7110	SM7120	SM7420
Number of channels		
1 ch	1 ch	4 ch
Test voltage		
0.1 V to 1000.0 V	0.1 V to 2000.0 V	-

Determining the measurement probe contact

The status of contact is determined by measuring capacitance and comparing the result to a previously-set judgment value.

When judgment value is 1 pF (can be set as low as 0.2 pF)



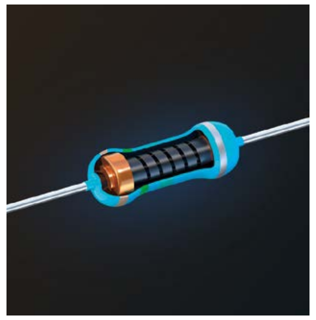
Normal contact

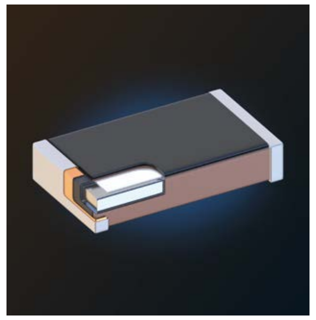
2 pF (measured value) > 1 pF (judgment value)

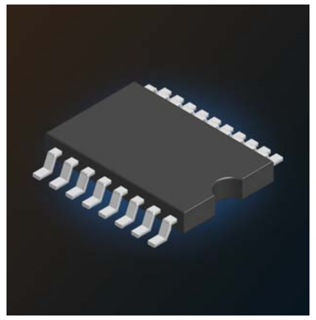
Faulty contact

0.5 pF (measured value) < 1 pF (judgment value)

Resistors







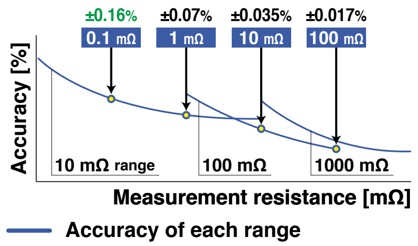
RM3543

Resistance measurement range:
0.00000 mΩ to 1200.000 Ω
Measurement current: 1 A DC to 1 mA DC

Resistance Meters

Measuring low Rdc with high accuracy

The RM3543 can perform measurements with high accuracy (0.1 mΩ ±0.16%) and high resolution (0.01 μΩ).



High-accuracy measurement

Range	Basic accuracy	Measurement current
10 mΩ	±0.060% rdg. +0.001% f.s.*1	1 A
100 mΩ	±0.060% rdg. +0.001% f.s.*2	1 A, 100 mA
1000 mΩ	±0.012% rdg. +0.001% f.s.	100 mA
10 Ω	±0.008% rdg. +0.001% f.s.	10 mA
100 Ω	±0.007% rdg. +0.001% f.s.	10 mA
1000 Ω	±0.006% rdg. +0.001% f.s.	1 mA

*1: With averaging enabled and set to 16 or more iterations
*2: Measurement current: 1 A

High resolution

Range	Resolution	Max. display
10 mΩ	10 nΩ	12.000 00 mΩ
100 mΩ	100 nΩ	120.000 0 mΩ
1000 mΩ	1 μΩ	1200.000 mΩ
10 Ω	10 μΩ	12.000 00 Ω
100 Ω	100 μΩ	120.000 0 Ω
1000 Ω	1 mΩ	1200.000 Ω

RM3542A

Resistance measurement range:
0.0000 mΩ to 120.0000 MΩ
Measurement current: 100 mA DC to 100 nA DC

Special specifications are available to measure resistances of about 100 MΩ with high accuracy (less than 500 ppm)

Resistance Meters

Measuring high Rdc with high accuracy

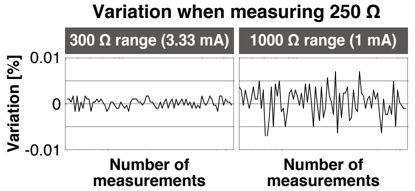
The RM3542A includes a 100 MΩ range that allows accurate measurement of high Rdc.

Range	Basic accuracy	Measurement current
100 mΩ	±0.015% rdg. + 0.002% f.s.	100 mA
1000 mΩ	±0.012% rdg. + 0.001% f.s.	100 mA
3 Ω	±0.012% rdg. + 0.001% f.s.	33.3 mA
10 Ω	±0.008% rdg. + 0.001% f.s.	10 mA
100 Ω	±0.007% rdg. + 0.001% f.s.	10 mA
300 Ω	±0.007% rdg. + 0.001% f.s.	3.33 mA
1000 Ω	±0.006% rdg. + 0.001% f.s.	1 mA
10 kΩ	±0.007% rdg. + 0.001% f.s.	1 mA
30 kΩ	±0.007% rdg. + 0.001% f.s.	333 μA
100 kΩ	±0.007% rdg. + 0.001% f.s.	100 μA
300 kΩ	±0.007% rdg. + 0.001% f.s.	33.3 μA
1000 kΩ	±0.008% rdg. + 0.001% f.s.	10 μA
3 MΩ	±0.008% rdg. + 0.001% f.s.	3.33 μA
10 MΩ	±0.030% rdg. + 0.004% f.s.	1 μA
30 MΩ	±0.030% rdg. + 0.010% f.s.	333 nA
100 MΩ	±0.100% rdg + 0.020% f.s.	100 nA

Using the SLOW measurement speed setting with the LOW POWER mode off

High repeatability

The instrument applies an appropriate measurement current based on the resistance value of the resistor under measurement. The instrument delivers high repeatability and is ideally suited for use in shipping inspections of resistors with low nominal value tolerances.



Z3003

4-terminal measurement: 10 ch
2-terminal measurement: 21 ch

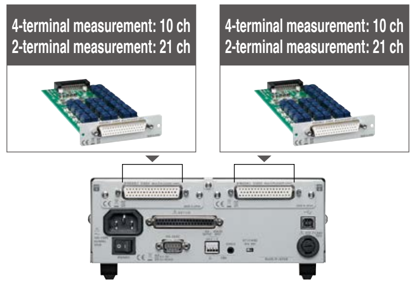
RM3545-02

Resistance measurement range:
0.00000 mΩ to 1200.0 MΩ
Measurement current: 1 A DC to 100 nA DC

Resistance Meters

Generating pass and fail judgments for multiple channels

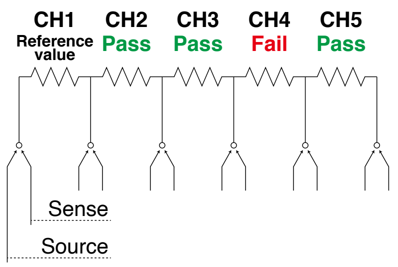
The Z3003 (sold separately) can be installed on the RM3545-02 to increase the number of measurement channels. Additionally, measurement results for channel 1 can be used as reference values to generate pass and fail judgments based on the measurement results for subsequent channels.



Z3003: Two units can be installed

Generating pass and fail judgments for network resistance

Network components are composite components that group multiple resistors together into a single package. One resistor in the network resistance can be used as a reference to generate pass and fail judgments for the other resistors.

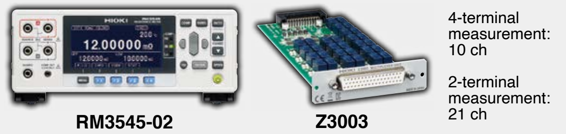


Other electronic components

Thermistors and resettable fuses

Thermistors are characterized by a resistance value that changes in response to temperature variations. Drawing on this characteristic, thermistors are primarily used as temperature sensors.

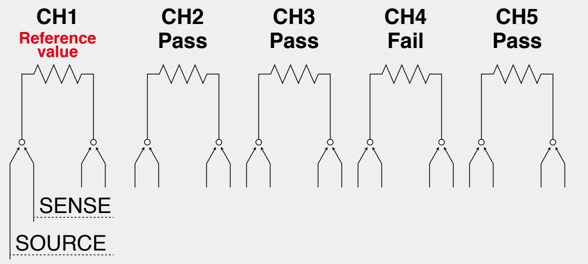
Resistance Meters



Resistance measurement range: 0.00000 mΩ to 1200.0 MΩ
Measurement current: 1 A DC to 100 nA DC

Generating pass and fail judgments without temperature compensation

When used with the Z3003 Multiplexer Unit, The RM3545-02 can use previously measured values as a master reference sample connected to channel 1 to generate pass and fail judgments based on the measurement results for subsequent channels. Since measured values for channel 1 serve as the reference values for generating those judgments, there's no need to perform temperature correction.



Varistors

When a voltage that is equal to or greater than a certain value is applied to a varistor, the varistor's resistance decreases. Drawing on this characteristic, varistors are used to protect circuits by routing electricity to the ground in the event of an abnormal voltage such as a surge voltage or static electricity.

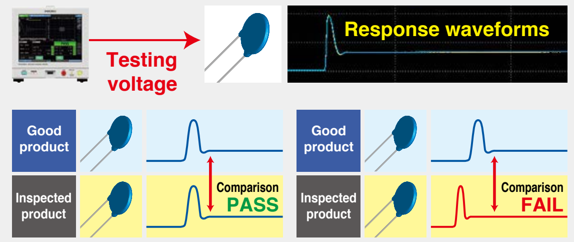
Impulse Winding Testers

ST4030A

Testing voltage: 100 V to 4200 V
Testing voltage: special specifications available for 100 V or less

Impulse testing

Impulse testers can be used to test whether a varistor functions at the defined voltage. The ST4030A can record a response waveform while applying a user-specified voltage. The response waveform from a known-good part can be used as a master/reference waveform to generate pass and fail judgments.



Piezoelectric elements

Applying pressure or vibration to a piezoelectric element generates a voltage. Conversely, applying a voltage causes the piezoelectric material to deform in shape. Drawing on this characteristic, piezoelectric elements are used in vibration sensors and actuators.

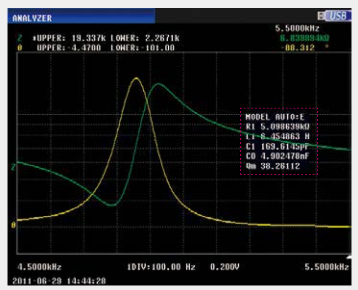
Impedance Analyzers

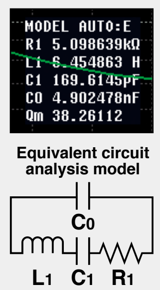
IM7580 Series

IM3570 + IM9000

Analyzing the characteristics of piezoelectric elements

The equivalent circuit analysis function can be used to analyze individual elements in an equivalent circuit model. It can also be used to calculate resonant and antiresonant frequencies.





Equivalent circuit analysis model

Substrate materials

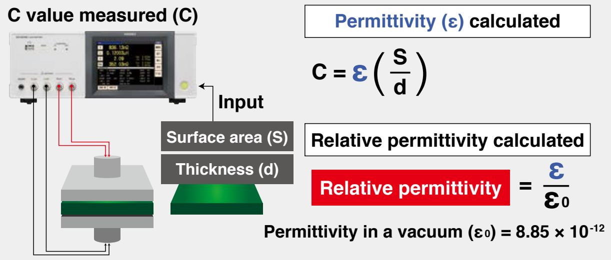
A variety of substrate materials are available. For equipment such as communications components used to exchange information at high speeds, it's essential to use substrate materials with low permittivity so that losses that occur during information transmission can be minimized.

LCR Meters

IM3536

Measuring permittivity

The IM3536 can measure permittivity if the sample's diameter and thickness are specified.



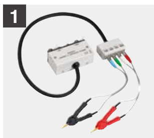
$$C = \varepsilon \left(\frac{S}{d} \right)$$

$$\text{Relative permittivity} = \frac{\varepsilon}{\varepsilon_0}$$

Permittivity in a vacuum (ε_0) = 8.85 × 10^{-12}

Probes and test fixtures for LCR Meters and Impedance Analyzers

	For leaded components			Compatible products
1	4-TERMINAL PROBE	**L2000**	Cable length 1 m (3.28 ft.), DC to 8 MHz, measurable terminal diameter 0.3 to 5 mm (0.012 to 0.19 in.)	IM3533, IM3536, IM3570
2	4-TERMINAL PROBE	**9140-10**	Cable length 1 m (3.28 ft.), DC to 200 kHz, measurable terminal diameter 0.3 to 5 mm (0.012 to 0.19 in.)	IM3533, IM3536, IM3570
3	4-TERMINAL PROBE	**9140**	Cable length 1 m (3.28 ft.), DC to 100 kHz, measurable terminal diameter 0.3 to 5 mm (0.012 to 0.19 in.)	IM3533, IM3536, IM3570
4	4-TERMINAL PROBE	**9500**	Cable length 1 m (3.28 ft.), DC to 1 MHz, measurable terminal diameter 0.3 to 2 mm (0.012 to 0.078 in.)	IM3533, IM3536, IM3570
5	4-TERMINAL PROBE	**9500-10**	Cable length 1 m (3.28 ft.), DC to 200 kHz, measurable terminal diameter 0.3 to 2 mm (0.012 to 0.078 in.)	IM3533, IM3536, IM3570
6	TEST FIXTURE	**9261-10**	Cable length 1 m (3.28 ft.), DC to 8 MHz, measurable terminal diameter 0.3 to 1.5 mm (0.012 to 0.059 in.)	IM3533, IM3536, IM3570
7	TEST FIXTURE	**9261**	Cable length 1 m (3.28 ft.), DC to 5 MHz, measurable terminal diameter 0.3 to 1.5 mm (0.012 to 0.059 in.)	IM3533, IM3536, IM3570
8	TEST FIXTURE	**9262**	Direct connection type, DC to 8 MHz, measurable terminal diameter 0.3 to 2 mm (0.012 to 0.078 in.)	IM3533, IM3536, IM3570

1

L2000

2

9140-10

3

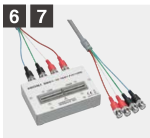
9140

4

9500

5

9500-10

6 7

9261/9261-10

8

9262

	For surface mounting devices (SMD)			Compatible products
1	TEST FIXTURE STAND	**IM9200**	Use with IM9201 and IM9202	IM7580s series
2	TEST FIXTURE	**IM9201**	DC to 3 GHz	IM7580s series
3	TEST FIXTURE	**IM9202**	DC to 600 MHz	IM7580s series
4	ADAPTER	**IM9906**	3.5 (male) to 7 mm (0.138 to 0.276 in.) converter	IM7580s series
5	CALIBRATION KIT	**IM9905**	Set of OPEN, SHORT and LOAD	IM7580s series
6	SMD TEST FIXTURE	**IM9110**	Direct connection type, DC to 1 MHz	IM3533, IM3536, IM3570, IM7580s series
7	SMD TEST FIXTURE	**IM9100**	Direct connection type, DC to 8 MHz, for SMDs with electrode on bottom	IM3533, IM3536, IM3570, IM7580s series
8	SMD TEST FIXTURE	**9699**	Direct connection type, DC to 120 MHz, for SMDs with electrode on bottom	IM3533, IM3536, IM3570
9	SMD TEST FIXTURE	**9677**	Direct connection type, DC to 120 MHz, for SMDs with electrode on side	IM3533, IM3536, IM3570
10	SMD TEST FIXTURE	**9263**	Direct connection type, DC to 8 MHz	IM3533, IM3536, IM3570
11	PINCHER PROBE	**L2001**	Cable length 73 cm (28.74 in.), DC to 8 MHz, includes IM9901	IM3533, IM3536, IM3570
12	CONTACT TIPS	**IM9901**	For L2001 tip conversion	-
13	CONTACT TIPS	**IM9902**	For L2001 tip conversion	-

1

IM9200

2

IM9201

3

IM9202

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IM9906

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IM9905

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IM9110

7

IM9100

8

9699

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9677

10

9263

11

L2001

12

IM9901

13

IM9902

DUT size: Can the DUT size be measured?

***It may not be possible to measure depending on the shape.**

EIA (inch)	JIS (mm)	Lengths (mm)	width (mm)	IM9201	IM9202	IM9110	IM9100	9699	9677	9263	L2001 IM9901	L2001 IM9902
-	0201	0.25	0.125			Yes						
01005	0402	0.40	0.20				Yes					
0201	0603	0.60	0.30	Yes			Yes		Yes*			Yes
0402	1005	1.00	0.50	Yes			Yes		Yes			Yes
0603	1608	1.60	0.80	Yes	Yes			Yes	Yes	Yes*	Yes	Yes
0805	2012	2.00	1.25	Yes	Yes			Yes	Yes*	Yes	Yes	Yes
1206	3216	3.20	1.60	Yes	Yes			Yes*		Yes	Yes	Yes
1210	3225	3.20	2.50	Yes	Yes			Yes*		Yes	Yes	Yes
1812	4532	4.50	3.20		Yes					Yes	Yes	Yes
2220	5750	5.70	5.00		Yes					Yes	Yes	Yes

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