With this new IM3570 Impedance Analyzer, an LCR meter and an impedance analyzer capable of measurement frequencies of 4 Hz to 5 MHz and test signal levels of 5 mV to 5 V have been combined into one measuring instrument. Advanced capabilities include LCR measurement with AC signals, resistance measurement with direct current (Rdc), and sweep measurement which continuously changes the measurement frequency and measurement level.

The IM3570 facilitates high-speed continuous measurement under different measurement conditions and measurement modes, so inspection lines which up to now have required multiple measuring instruments can be equipped with just one device.
LCR measurement, Rdc measurement, and Sweep measurement

Continuous Measurement and High-speed Testing Achieved with One Instrument

Measurements recommended with IMPEDANCE ANALYZER IM3570

1. Testing the resonance characteristics of piezoelectric elements

Reduce Equipment Costs with Just 1 Device!

Frequency sweep measurement can be used to measure the resonance frequency and its impedance, and then the peak comparator function can be used to make a pass/fail judgment on the resonance state.

In LCR mode, you can test capacitance by performing C measurement between 1 kHz and 120 Hz.

High Speed and High Accuracy

Frequency sweep measurement (impedance analyzer) and C measurement can be performed continuously with one instrument.

Advantage #1 -- Measurement time shortened

The measurement time has been shortened from previous models, achieving maximum speeds of 1.5ms* (1 kHz) and 0.5ms* (100kHz) in LCR mode. This is a significant increase in speed compared with previous Hioki products (3522-50 and 3532-50 with basic speed of 5ms). Faster speed contributes to an increase in test quantities.

Furthermore, sweep measurement, which requires multiple points to be measured, realizes the quick speed of 0.3ms per point.

* When the display is off (time increases by 0.3 ms when the display is on).
Perfect Impedance Analyzer for Production Lines

2. C-D and low ESR measurement of functional polymer capacitors

C-D (120 Hz) and low ESR (100 kHz) measurement can be performed for functional polymer capacitors.

Advantage #2 -- Low-impedance measurement accuracy improved

A one-digit improvement in repeat accuracy during low-impedance measurement has been achieved compared with previous Hioki products. For example, when the condition is 1 mΩ (1V, 100 kHz) and the measurement speed is MED, stable measurement with a repeat accuracy (variation)* of 0.12% is possible, making this instrument suitable for 100 kHz ESR measurement.

* Repeat accuracy (variation) is calculated based on the difference between the maximum and minimum values.

3. Rdc and L-Q measurement of inductors (coils and transformers)

The instrument can continuously measure L-Q (1 kHz, 1 mA constant current) and Rdc, and display the numerical values on the same screen. Current dependent elements such as coils incorporating cores for which the inductance value varies depending on the applied current can be measured with a constant current (CC). Since there is a one-digit improvement in repeat accuracy during low impedance measurement compared with previous products, stable measurement of Rdc can be expected.

Advantage #3

By improving the measurement accuracy of θ compared with previous Hioki products, measurement with an absolute accuracy and repeat accuracy of one-digit better than before can be performed for high Q and Rs values for which θ is in the vicinity of 90°.

The measurement frequency of a coil differs depending on the application. The wide measurement range of 4 Hz to 5 MHz facilitates the measurement of various coils.

Constant current sweep measurement enables a current characteristic graph to be displayed for current dependent elements.
Features of IM3570

- **Low-capacitance (high-impedance) measurement with improved stability**

There is a one-digit improvement in repeat accuracy during low-capacitance (high-impedance) measurement compared with previous Hioki products. For example, when the condition is 1 pF (1 MHz, 1 V) and the measurement speed is SLOW2, stable measurement with a repeat accuracy (variation)\(^*\) of 0.01% is possible. At the same time, phase repeat accuracy is also improved, which in turn has improved the stability of D measurement during low-capacitance (high-impedance) measurement.

\(^*\) Repeat accuracy (variation) is calculated based on the difference between the maximum and minimum values.

- **Wide setting range for measurement frequency**

IM3570 allows DC or a frequency band within the range of 4 Hz to 5 MHz to be set with five-digit resolution (testing at less than 1 KHz has a 0.01 Hz resolution). This enables the measurement of resonance frequency and measurement and evaluation in a state close to that of actual operating conditions.

- **15 parameters measured**

The following parameters can be measured and selected parameters can be captured by a computer: Z, Y, θ, Rs (ESR), Rp, Rdc (DC resistance), X, G, B, Ls, Lp, Cs, Cp, D (tanδ), and Q.

- **Incorporates contact check function (open-circuit check)**

The contact check function for four-terminal measurement (only for low impedance high accuracy mode) and two-terminal measurement prevents measurement in a state in which a measurement electrode is not in contact with the measurement object.

- **Comparator and BIN functions**

In LCR mode, the instrument allows for Hi, IN, and Lo judgments of two types from the measurement items on one screen. For the judgment method, % setting and ∆% setting are available in addition to absolute value setting. If continuous measurement is used, judgments which span over multiple measurement conditions and measurement items are possible. The BIN function can be used to classify two types of measurement items on one screen into 10 categories and out of range. In analyzer mode, the peak comparator for judging whether resonance points pass or fail can be used.

- **Interval measurement**

Up to 20 segments with a total of up to 801 points can be set for the sweep range. This is effective for evaluating multiple frequency ranges in detail.

- **Memory function**

Up to 32,000 measurement results can be stored in the memory of the instrument. The saved measurement results can be copied to a USB flash drive, and can also be acquired using a communication command.

- **High resolution with up to 7-digit display**

High-resolution measurement with full 7-digit display is possible. The number of display digits can be set from 3 to 7.

- **Four-terminal probe allows for use at DC to 8 MHz**

The L2000 4-terminal probe (option) employs a 4-terminal structure to facilitate 50 Ω characteristic impedance and improved measurement accuracy, and is well suited to the IM3570.

- **Measurement cable extendable to up to 4 meters**

Accuracy is guaranteed at the measurement cable lengths of 0, 1, 2, and 4 meters. This makes wiring automated machinery simple. (The frequency range for which accuracy is guaranteed differs depending on the cable length. The probe needs to be provided by the customer.)

- **Longer stability**

Measurement accuracy is guaranteed for one year. Previous models required calibration every 6 months, but with this model the calibration interval has been extended to one year.

- **Wide setting range for measurement voltage and current**

In addition to normal open-loop signal generation, this instrument enables measurement considering voltage/current dependence in constant voltage and constant current modes. The signal levels can be set over wide ranges, from 5 mV to 5 V, and from 10 μA to 50 mA (up to 1 MHz). (The setting range of measurement signal levels differs depending on the frequency and measurement mode.)

- **DC bias can be generated internally**

Up to a 2.5 V DC bias can be applied and then measurement performed with just the unit. This is reassuring when measuring polar capacitors such as a tantalum capacitor. The charge impedance is 100 Ω. (The DC bias unit required with 3522-50 and 3532-50 is not needed for IM3570 within the bias voltage range of 0 to +2.5V. If a larger bias voltage is required, an external option, which is scheduled to be released in the future, is required.)

- **Wide setting range for measurement frequency and measurement and evaluation in a state close to that of actual operating conditions.**

- **Interval measurement**

In order to, for example, confirm the temporal changes of an element from the response of a sensor, parameter time variations can be measured for up to 801 points at a specified interval (100 μs to 10,000s), and then the data can be displayed in a graph or list.

- **Memory function**

Up to 32,000 measurement results can be stored in the memory of the instrument. The saved measurement results can be copied to a USB flash drive, and can also be acquired using a communication command.
Measurement results and settings can be saved to a commercially available USB flash drive connected to the front panel.

The USB port on the front panel is specifically for a USB flash drive. Batch save all measurement results to a USB flash drive after saving them to the internal memory of IM3570. Some USB flash drives may not be able to be used due to incompatibility issues.

The rear panel is standard equipped with RS-232C, GP-IB, USB and LAN ports. (The USB port on the rear panel is specifically for connecting a PC.)

Various functions of IM3570 can be controlled from a PLC or PC, and measurement results can be acquired. (Excluding turning the power on/off and configuring some interface settings.)

Use of an interface suitable for automated machinery enables you to build the optimal measurement system.
The handler (EXT I/O) interface enables output of an end of measurement signal and measurement result signal, and input of signals such as a measurement trigger signal to control the measuring instrument. Each of the signal lines is isolated from the control circuit, and the structure is designed to protect against noise.

### Example of representative EXT I/O timing

![Timing diagram]

- Contact state: Open
- Chuck: ON → OFF → ON
- INDEX: ON → OFF → ON
- TRIG: ON → OFF
- EOM: ON

### Connectors

Connectors to use (unit side): 37-pin D-SUB female connector with #4–40 inch screws

Compliant connectors: DC-37P-ULR (solder type) and DCSP-JB37PR (insulation-displacement type)

For information on where to obtain connectors, consult your nearest HIOKI distributor.

### IM3570 specifications

*(Accuracy guaranteed for 1 year, Post-adjustment accuracy guaranteed for 1 year)*

#### Measurement modes

- **LCR mode**: Measurement with single condition
- **Analyzer mode**: Sweeps with measurement frequency and measurement level
- **Measurement points**: 1 to 801
- **Measurement method**: normal sweep or segment sweep
- **Display**: List display or graph display
- **Continuous measurement mode**: Measures under saved conditions continuously (maximum of 32 sets)

#### Measurement parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Impedance</td>
</tr>
<tr>
<td>Y</td>
<td>Admittance</td>
</tr>
<tr>
<td>R</td>
<td>Phase angle</td>
</tr>
<tr>
<td>Rs (ESR)</td>
<td>Series-equivalent resistance = ESR</td>
</tr>
<tr>
<td>Rp</td>
<td>Parallel-equivalent resistance</td>
</tr>
<tr>
<td>Rdc</td>
<td>DC resistance</td>
</tr>
<tr>
<td>X</td>
<td>Reactance</td>
</tr>
<tr>
<td>G</td>
<td>Conductance</td>
</tr>
<tr>
<td>B</td>
<td>Susceptance</td>
</tr>
<tr>
<td>Cs</td>
<td>Series-equivalent static capacitance</td>
</tr>
<tr>
<td>Cp</td>
<td>Parallel-equivalent static capacitance</td>
</tr>
<tr>
<td>Ls</td>
<td>Series-equivalent inductance</td>
</tr>
<tr>
<td>Lp</td>
<td>Parallel-equivalent inductance</td>
</tr>
<tr>
<td>D(tan δ)</td>
<td>Loss coefficient = tan δ (δ = delta)</td>
</tr>
<tr>
<td>Q</td>
<td>Q factor (Q = 1/D)</td>
</tr>
</tbody>
</table>

#### Measurement range

- **Impedance (Ω)**: 100 mΩ to 100 MΩ, 12 ranges
- **Admittance (S)**: 10 μS to 10000S
- **Phase angle (°)**: ±0.00° to ±180.00°
- **Reactive resistance (Ω)**: ±0.0000 to ±999999
- **Conductance (S)**: ±0.00000 to ±999999
- **Susceptance (µF)**: ±0.000000 to ±99999999
- **Capacitance (µF)**: ±0.000000 to ±99999999
- **Inductance (µH)**: ±0.000000 to ±99999999

#### Basic accuracy

- **Z**: ±0.08% rdg. ±0.05°

#### Measurement frequency

- **Normal mode**: 4 Hz to 5 MHz (5 digits setting resolution, minimum resolution 10 kHz)

#### Measurement signal level

- **Normal mode**: V mode/CV mode: 5 mV to 5 Vrms (up to 1 MHz), 10 mV to 1 Vrms (1 MHz to 5 MHz), 1 Vrms steps
- **CC mode**: 10 µA to 50 mArms (up to 1 MHz), 10 µA to 10 mArms (1 MHz to 5 MHz), 10 µArms steps
- **Low impedance high accuracy mode**: V mode/CV mode: 5 mV to 1 Vrms (up to 100 kHz), 1 mVrms steps
- **CC mode**: 10 µA to 100 mArms (100 mΩ and 1Ω ranges of up to 100 kHz), 10 µArms steps

#### Output impedance

- **Normal mode**: 10 Ω
- **Low impedance high accuracy mode**: 10 Ω

#### Display

- **5.7-inch color TFT, display can be set to ON/OFF**
- **The number of display digits can be set from 3 to 7** (initial value: 6 digits)

#### No. of display digits setting

- **Measurement time**: 0.5 ms (100 kHz, FAST, display OFF, representative value)

#### Measurement speed

- **Normal mode**: FAST/MED/SLOW/SLOW2
- **Low impedance high accuracy mode**: Normal mode: 0 VDC to 2.50 VDC (10 mV steps)
- **Low impedance high accuracy mode**: Normal mode: 0 VDC to 1.00 VDC (10 mV steps)
- **Low impedance high accuracy mode**: Normal mode: 0 VDC to 2.50 VDC (10 mV steps)
- **Low impedance high accuracy mode**: Normal mode: 0 VDC to 1.00 VDC (10 mV steps)

#### Comparator

- **LCR mode**: Hi/In/Lo for first and third items
- **Analyzer mode**: Area judgment (Hi/IN/Lo for each point)
- **Peak judgment (Hi/IN/Lo for local maximum and local minimum)**

#### BIN measurement

- **10 classifications and out of range for 2 items**

#### Compensation

- **Open/short/load/cable length of 0 and 1 m/correlation compensation**

#### Residual charge protection function

- **V = V/10** (C: Capacity [F] of test sample, V = max. 400 V)

#### Trigger synchronous output function

- Applies a measurement signal during analog measurement only

#### Averaging

- **1 to 256**

#### Interval measurement

- **100 µs to 10,000 s, max. 801 points**

#### Panel loading/saving

- **LCR mode: 30; Analyzer mode: 2; Compensation value: 128**

#### Memory function

- **Stores 32,000 data items to the memory of the instrument**

#### Interfaces

- **EXT I/O (handler), RS-232C, GP-IB, USB (Hi-Speed/Full-Speed), USB flash drive, LAN (10BASE-T/100BASE-TX)**

#### Operating temperature and humidity ranges

- **0°C to 40°C, 80% RH or less, no condensation**

#### Storage temperature and humidity ranges

- **-10°C to 50°C, 80% RH or less, no condensation**

#### Power supply

- **90 to 264 V AC, 50/60 Hz, 150 VA max.**

#### Dimensions and weight

- **Approx. 135 (W) x 119 (H) x 417 (D), approx. 5.8 kg**

#### Accessory

- **Power Cord x 1, Instruction Manual x 1, Communication Instruction Manual (CD) x 1**
### IM3570 measurement accuracy

#### Conditions

Temperature and humidity ranges: 23°C ± 5°C, 80% RH or less (no condensation), at least 60 minutes after power turned on, after performing open and short compensation

#### Basic accuracy (Z, θ) calculation expression

- **Top A:** Basic accuracy of Z (± % rdg.)
  - B is the coefficient for the impedance of the sample

- **Bottom A:** Basic accuracy of θ (± % deg.)
  - B is the coefficient for the impedance of the sample

- **A** is the accuracy of R when DC (± % rdg.)
- **B** is the coefficient for the impedance of the sample

In the 1 kΩ range and above and 300 Ω range and below, the calculation expression of basic accuracy differs as shown below. For details, refer to the following calculation examples.

**1 kΩ range and above:**

Accuracy = \( A + B \times \frac{10 \times Z_x}{Z_x} \)  

**300 Ω range and below:**

Accuracy = \( A + B \times \frac{10 \times Z_x}{Z_x} \)  

\( Z_x \) is the actual impedance measurement value (Z) of the sample.

- **Basic accuracy**
  - **Guaranteed accuracy range (measurement signal level)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Guaranteed accuracy range</th>
<th>DC</th>
<th>4 Hz to 99.9 Hz</th>
<th>100 Hz to 999.99 Hz</th>
<th>1 kHz to 10 kHz</th>
<th>10 kHz to 100 kHz</th>
<th>0.1 kHz to 1 MHz</th>
<th>1 kHz to 5 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100MΩ</td>
<td>8Ω to 200MΩ</td>
<td>A=6</td>
<td>B=2</td>
<td>A=2</td>
<td>A=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
</tr>
<tr>
<td>10MΩ</td>
<td>800Ω to 100MΩ</td>
<td>A=6</td>
<td>B=5</td>
<td>A=2</td>
<td>A=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
</tr>
<tr>
<td>1MΩ</td>
<td>8kΩ to 10MΩ</td>
<td>A=5</td>
<td>B=3</td>
<td>A=2</td>
<td>A=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
</tr>
<tr>
<td>10kΩ</td>
<td>2kΩ to 1MΩ</td>
<td>A=3</td>
<td>B=2</td>
<td>A=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>3kΩ</td>
<td>800Ω to 30kΩ</td>
<td>A=4</td>
<td>B=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>1kΩ</td>
<td>240Ω to 10kΩ</td>
<td>A=3</td>
<td>B=2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>300Ω</td>
<td>8Ω to 300Ω</td>
<td>A=5</td>
<td>B=2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>10Ω</td>
<td>80Ω to 10Ω</td>
<td>A=2</td>
<td>B=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>1Ω</td>
<td>80Ω to 1Ω</td>
<td>A=2</td>
<td>B=1</td>
<td>A=0.8</td>
<td>A=0.2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
<tr>
<td>100mΩ</td>
<td>1Ω to 100Ω</td>
<td>A=3</td>
<td>B=2</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
<td>A=1</td>
</tr>
</tbody>
</table>

- **A** is the accuracy of R when DC (± % rdg.)
- **B** is the coefficient for the resistance of the sample

- **Method of determining basic accuracy**
  - Calculate the basic accuracy from the sample impedance, measurement range, and measurement frequency and the corresponding basic accuracy A and coefficient B from the table above.
  - The calculation expression to use differs for each of the 1 kΩ range and above and 300 Ω range and below.
  - For C and L, obtain basic accuracy A and coefficient B by determining the measurement range from the actual measurement value of impedance or the approximate impedance value calculated with the following expression.

\[ Z_\mathrm{b} (\Omega) = \omega L (\text{H}) \quad (\theta = 90^\circ) \]

\[ R_\mathrm{b} (\Omega) \quad (\omega = 2 \times \pi \times \text{Measurement frequency} \ [\text{Hz}]) \]

- **Guaranteed accuracy range (measurement signal level)**

<table>
<thead>
<tr>
<th>Range</th>
<th>DC</th>
<th>4 Hz to 99.9 Hz</th>
<th>100 Hz to 999.99 Hz</th>
<th>1 kHz to 10 kHz</th>
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<th>0.1 kHz to 1 MHz</th>
<th>1 kHz to 5 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100MΩ</td>
<td>1 V to 2.5 V</td>
<td>0.101 V to 5 V</td>
<td>0.050 V to 5 V</td>
<td>0.101 V to 5 V</td>
<td>0.050 V to 5 V</td>
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<td>0.010 V to 5 V</td>
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<td>0.005 V to 5 V</td>
<td>0.010 V to 5 V</td>
<td>0.005 V to 5 V</td>
</tr>
</tbody>
</table>

The above voltages are the voltage setting values corresponding to when in V mode. For measurements other than Rdc, at 30kΩ range and below above 100kΩ range and above and for measurements other than Rdc:

\[ 1 V \text{ to } 5 V : 1 \]

- **Calculation example**
  - Impedance Zx of sample: 500 Ω (actual measurement value)
  - Measurement conditions: When frequency 10 kHz and range 1 kΩ
  - Impedance Zx of sample: 500 Ω (actual measurement value)

\[ Z_\mathrm{b} (\Omega) = 0.12 + 0.005 \times -1 = 0.12 \text{ (± %rdg.)} \]

\[ R_\mathrm{b} (\Omega) = 0.12 + 0.005 \times -1 = 0.12 \text{ (± %rdg.)} \]

\[ \theta_\mathrm{b} (\text{°}) \quad (\omega = 2 \times \pi \times 10 \text{ kHz}) \]

- **Calculation accuracy:**

\[ Z \text{ basic accuracy} = 0.1 + 0.005 \times 10 \times \frac{Z_\mathrm{b}}{100 \Omega} \times \frac{1}{10 \times 10^4} = 0.12 (\pm \% \text{rdg.}) \]

Similarly, insert coefficient A = 0.08 and coefficient B = 0.002 for the θ basic accuracy, as follows:

\[ \theta \text{ basic accuracy} = 0.08 + 0.002 \times 10 \times \frac{Z_\mathrm{b}}{100 \Omega} \times \frac{1}{10 \times 10^4} = 0.088 (\pm \% \text{deg.}) \]

### Measurement accuracy

- **Basic accuracy**
  - **Guaranteed accuracy range:**

<table>
<thead>
<tr>
<th>Range</th>
<th>DC</th>
<th>4 Hz to 99.9 Hz</th>
<th>100 Hz to 999.99 Hz</th>
<th>1 kHz to 10 kHz</th>
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<tr>
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<td>0.050 V to 5 V</td>
<td>0.005 V to 5 V</td>
</tr>
<tr>
<td>1Ω</td>
<td>0.1 V to 2.5 V</td>
<td>0.010 V to 5 V</td>
<td>0.005 V to 5 V</td>
<td>0.010 V to 5 V</td>
<td>0.005 V to 5 V</td>
<td>0.010 V to 5 V</td>
<td>0.005 V to 5 V</td>
</tr>
</tbody>
</table>

The above voltages are the voltage setting values corresponding to when in V mode.

- **1 Guaranteed accuracy of 10 mΩ or above,** 2 Guaranteed accuracy of 0.101 V to 5 V when DC bias, 3 Guaranteed accuracy of 10 mΩ or above and 1.010 V to 5 V when DC bias

\[ \text{Accuracy} = 0.1 + 0.005 \times 10 \times \frac{Z_\mathrm{b}}{100 \Omega} \times \frac{1}{10 \times 10^4} \]
### Options

**EQUIVALENT CIRCUIT ANALYSIS Firmware IM9000**

(Factory-installed option)

The Equivalent Circuit Analysis Firmware IM9000 is an optional function for the Impedance Analyzer IM3570. The IM9000 is not included in the standard package. If you want to use the IM9000, specify the option upon purchase.

Customers who have purchased the Impedance Analyzer IM3570 can add the Equivalent Circuit Analysis Firmware IM9000 function. Please contact your Hioki distributor.

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### Test Fixtures for SMDs

<table>
<thead>
<tr>
<th>Description</th>
<th>Model No.</th>
<th>Order Code</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMD Test Fixture IM9110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMD Test Fixture IM9150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMD Test Fixture 9663</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PINCHER Probe L2001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Probes and Test Fixtures for Lead Components

<table>
<thead>
<tr>
<th>Description</th>
<th>Model No.</th>
<th>Order Code</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pincher Probe L2001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four-Terminal Probe L2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four-Terminal Probe 9140-10</td>
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### For Electrochemical Measurement

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