Continuous measurement of micro resistance in solder joint and connector contact areas. Accurate evaluation of the reliability of connections

The Conductor Resistance Evaluation System enables continuous measurement of resistance changes under high and low temperature cycles. Automatic measurement, data storage and processing are operated systematically with a PC. The system realizes accurate and effective contact reliability evaluations.
Accurately detects minute cracks in semiconductor packages and electronic component junctions. Automatic measurement and chamber integration allow improved efficiency in test schedule management.

**Main features**
- Unique multi-scan and international standards-compatible measurement equipment.
- Both direct and alternating current application available.
- Absolute value and changing rate evaluation available.
- Real time measurement enabled using a personal computer.
- Editing/browsing of data available during the evaluation process.
- Test efficiency dramatically improved by thermal shock chamber’s interaction with the AMR.

**Evaluation targets**
- Printed circuit boards
- Semiconductor underfill

**Main applications**
- Through-hole conductor evaluation
- Solder-joint contact evaluation
- BGA, CSP solder joint contact evaluation
- Connector contact resistance evaluation
- Fpc life evaluation
- Contact resistance evaluation of switches, Relays, etc.
- Lead-free solder joints evaluation
- Contact resistance evaluation of Connectors, etc.
- Conductive adhesives and anisotropic conductive films evaluation
- Other interconnection material contact evaluation

**Models**
- With DC application (AMR-UD)
  - Resistance measurement range: $10^3$ to $10^6$
  - Minimum resolution: 100
- With AC application (AMR-UA)
  - Resistance measurement range: $10^3$ to $10^4$
  - Minimum resolution: 10
We have always known how to earn our customers’ confidence

AMR is equipped with highly reliable measurement equipment and an ammeter for micro-electric current both designed to meet international standards. This, to obtain most reliable measurement data. We offer a calibration service to maintain the equipment’s accuracy. (ISO / IEC 17025 compliant)

We offer two equipments allowing all possibilities

We offer two micro electric current applications, the DC (AMR-UD) and the AC (AMR-UA), which are used to flow current to specimens when measuring the conductor resistance.

We offer a wide range of resistance measurement; From $10^{-3}$ to $10^6\Omega$

Conductor resistance values ranging from $10^{-3}$ to $10^6\Omega$ (AMR-UD) and from $10^{-3}$ to $10^4\Omega$ (AMR-UA) can be precisely determined at the tip of a measuring cable, using a four terminal sensing.

We offer multi-channel evaluations, thus increasing time-saving and test accuracy

Channels can be added in 40-channel blocks from the standard 40 channels up to 280 channels (optional) depending on the tests and the number of chambers to be connected.
Multifunction rack that pursues ease of use improve the workability.

- **Connection unit**
  Installing the connection unit facilitates the measurement cable connection. The connection unit can be installed in front of the rack, or either on the left or right side of the rack according to the work environment.

- **Optimum characteristics cable**
  The cable supplied is made from Teflon, which guarantees an excellent resistance to noises, as well as heat. Moreover, it enables an optimum/accurate measurement of micro resistances. The end of the cable is designed to facilitate the connection to a specimen.

- **Global environmental issues**
  Components are fixed with lead-free soldering. Furthermore, power consumption has been reduced by 24% (compared to the previous model) in consideration of global environmental protection.
  *except for purchased items such as PCs and measuring instruments.
Tests simplified by the interaction of the measurement system with various environmental test chambers.

- **Interaction with the environmental test chamber**
  The AMR can be connected to three environmental test chambers for testing. Interaction with the environmental test chamber enables temperature and humidity monitoring, management of the time schedule, and it displays an alarm when a failure is detected.

- **Real-time monitoring of temperature and humidity**
  AMR monitors and records the temp. and humid. inside the environmental test chamber. Data are recorded simultaneously with the measurement carried out by the AMR. The statistics processing software displays the recorded data in synchronization with the data of the resistance tests.

- **Safety design guaranteed by abnormality detection**
  If a failure occurs with the environmental test equipment or the AMR, the test will stop immediately. Resetting will resume the test from where it stopped.

- **Remote processing of the test data (optional)**
  LAN-compatible software enables remote test checking and data processing, for example from a distant office. Additionally, we offer software licenses according to the number of users so that multiple PC monitoring is possible.

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<table>
<thead>
<tr>
<th>Function</th>
<th>Interaction with the thermal shock chamber (TSA Series)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature monitoring</td>
<td>Loads temperature data for each measurement are processed by the AMR. Data are saved on a CSV format.</td>
</tr>
<tr>
<td>Cycle count</td>
<td>Analyzes the cycles performed by the chamber, by counting and failure occurrences listing.</td>
</tr>
<tr>
<td>Start of the test</td>
<td>The AMR starts the test automatically, as soon as the chamber parameters has been set.</td>
</tr>
<tr>
<td>Halt of the test</td>
<td>The AMR automatically stops operations of both itself and the chamber, after being exposed to high temperature.</td>
</tr>
<tr>
<td>Resumption of the test</td>
<td>Automatically resumes the halted cycle of the test as it is. The halt history is saved in the measurement data.</td>
</tr>
<tr>
<td>Completion of the test</td>
<td>Test automatically ends when the test is completed.</td>
</tr>
<tr>
<td>Work temperature monitoring</td>
<td>The AMR take temperature measures in the chamber (randomly), up to 16 channels. Data are saved in CSV format.</td>
</tr>
<tr>
<td>Chamber failure detection</td>
<td>When a failure occurs in the chamber or the measuring equipment fails to operate properly, the test automatically stops.</td>
</tr>
<tr>
<td>Data processing</td>
<td>Checks the obtained temperature data against the data of resistance values based on the number of cycles.</td>
</tr>
</tbody>
</table>
DC or AC measurement can be selected according to your test requirements.

- **Example: reliability evaluation of BGA and CSP solder ball connections (Daisy chain evaluation)**

  - **DC and AC application evaluation**
    Case in which signals between measured channels do not interfere with each other (communication between channels is independent from each other)

  - **DC application only (AMR-UD only)**
    Case in which the measured signals interfere with each other between channels

  * Compatible model differs depending on the daisy chain design for BGA and CSP evaluations.

- **DC Measurement (AMR-UD)**
  Using DC current resistance to measure small voltage change and detect up to 1MΩ of resistance. It is suitable for the observation of large changes of conductive resistance, such as Daisy Chain of BGA in semiconductor applications.

- **AC Measurement (AMR-UA)**
  Using AC micro current to measure small voltage changes without being affected by thermal electromotive force. It is suitable for the observation of changes in conductive resistance evaluations.

### Evaluated item

<table>
<thead>
<tr>
<th>Evaluated item</th>
<th>DC application (AMR-UD)</th>
<th>AC application (AMR-UA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-free solder joints</td>
<td>☺</td>
<td>☺</td>
</tr>
<tr>
<td>Reliability of BGA and CSP solder ball connections</td>
<td>☺</td>
<td>☺</td>
</tr>
<tr>
<td>Contact resistance of connectors, etc.</td>
<td>☺</td>
<td>☺</td>
</tr>
<tr>
<td>Contact resistance of switches, relays, etc.</td>
<td>☒</td>
<td>☀</td>
</tr>
<tr>
<td>Conductive adhesive and anisotropic conductive films</td>
<td>☒</td>
<td>☀</td>
</tr>
</tbody>
</table>
Two failure recognition methods can be performed to detect the failure in conductive resistance of the joint parts.

**Failure recognition using the absolute value**

The data obtained at measurement intervals are evaluated using the preset absolute value. It will detect small changes of conductive resistance due to micro-cracks, and will do so until total opening of the crack. Absolute value can be set in hot condition and cold condition to have separate identifications from both temperature ends. The AMR will terminate the test once that failure is identified on the channel. (It can be set to resume the test too.)

**Failure recognition using the change rate (%)**

This method can be used to detect small changes of conductive resistance in BGA and CSP. It will compare the initial value at the starting point of the test with the actual one, and will use the % of difference to detect the failure. It can be set on both ends of hot and cold conditions.
SOFTWARE

● Main window*

- Test monitoring
- Real time display of the resistance value, temperature inside the chamber, channel on which a failure occurs
- Auto link to the data processing software
- Control commands (start, stop, pause, and restart)

* The picture shows AMR-280-UD.

● Test condition registration

Setting of:
- Duration, nb. of cycles of a test
- Duration of the measurement
- Voltage measurement
- Stress application voltage
- Limit values

These settings can be saved in a file that can be use subsequently; numerous test conditions can be saved for different tests and specimens.

● Test setting

Parameters:
- Selection of a module
- Specification of the data file name and the connected chamber
- Text documents output
- Selection /unselection of the leak-touch action mode
- Comments input
- Selection of the channel for the testing
- Test conditions' specifications
  (Test conditions selected from a saved file)

● Graphic display

The graph can be arranged by selecting the channel displayed, the settings and the cursor.
Graphs can be copied on a clipboard and opened in another software.

The sample graph displays a resistance value with the temperature in the thermal shock chamber at the same time.

● Cursor function

Quick confirmation of measurement data and channel number is available, thanks to the cursor function displayed on the graphic.

● Weibull Analysis (Optional)

This data-processing software (with a statistic processing function) enables a Weibull analysis of test data, as well as regular probability plotting, and logarithmic probability trend curves.
• System controller:
  PC and LCD monitor for system control. Measurement, data processing, chamber control.

• Uninterruptible power supply:
  Backup power supply for the system controller. Automatically interrupts the test in case of power cut. When power recovers, the test restarts from where it was stopped. (does not resume automatically)

• Chamber monitor:
  Allows temperature control, monitoring, alarm control of the chamber from the system controller.

• Micro-resistance measurement unit:
  Precisely measures resistance by 4-wire (resistance) measurements.
  UD type: Equipped with 34420A made by Agilent Technologies
  UA type: Equipped with 4338B made by Agilent Technologies

• Scanner unit for minute resistance measurement:
  40 standard channels
  (Optionally, up to 280 channels can be added)

• Connection unit:
  Relays the measurement cable.
SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>AMR-040-UD</th>
<th>AMR-040-UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current application</td>
<td>DC application</td>
<td>AC application</td>
</tr>
<tr>
<td>Channel configuration</td>
<td>Standard 40ch. (max. 280ch per rack)</td>
<td></td>
</tr>
<tr>
<td>Control channel</td>
<td>A unit of 10 channels</td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Windows® XP</td>
<td></td>
</tr>
<tr>
<td>Measuring intervals</td>
<td>Minimum 3 seconds (10 channels), Variable in 3-sec. steps</td>
<td></td>
</tr>
<tr>
<td>Resistance measurement range</td>
<td>$1 \times 10^{-3}$ to $1 \times 10^6 \Omega$</td>
<td>$1 \times 10^{-3}$ to $1 \times 10^4 \Omega$</td>
</tr>
<tr>
<td>Minimum resolution</td>
<td>$100\mu\Omega$</td>
<td>$10\mu\Omega$</td>
</tr>
<tr>
<td>Measurement accuracy *1</td>
<td>10 mΩ Measured value of $\pm5%$ or less</td>
<td></td>
</tr>
<tr>
<td>Measurement range</td>
<td>1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, 1MΩ, and AUTO</td>
<td>10mΩ, 100mΩ, 1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, and AUTO</td>
</tr>
<tr>
<td>Type</td>
<td>Heat-resistant flat cable</td>
<td></td>
</tr>
<tr>
<td>Coated material</td>
<td>Teflon (Temperature for continuous duty: $+200^\circ\text{C}$ *2)</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>Beyond connection unit: 1.5m</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Non heat-resistant measurement cable</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>Between scanner unit and connection unit: 2.0m</td>
<td></td>
</tr>
<tr>
<td>Connection unit</td>
<td>One connection unit has 40-channel connection.</td>
<td></td>
</tr>
<tr>
<td>External dimension</td>
<td>530W $\times$ 1750H $\times$ D940D mm</td>
<td></td>
</tr>
<tr>
<td>Power supply facility</td>
<td>100V AC, 1φ, 10.0A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>120V AC, 1φ, 8.3A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>220V AC, 1φ, 4.5A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>240V AC, 1φ, 4.2A</td>
<td></td>
</tr>
</tbody>
</table>

*1 Value guaranteed at end of measurement cable of a standard system.

*2 The solder used for connections has to be chosen by the customer, regarding its temperature resistance.

MODEL

**AMR-**

- **D**: DC application
- **A**: AC application

- **U**

Number of channels
- 040: 40 channels
- 080: 80 channels
- 120: 120 channels
- 160: 160 channels
- 200: 200 channels
- 240: 240 channels
- 280: 280 channels

ACCESSORIES

- Measurement cable
- Communication cable (RS-485)
- Setup CD
- User’s manual
**OPTIONS**

<table>
<thead>
<tr>
<th>Specimen temperature monitor</th>
<th>Emergency stop switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen temperature monitor measures the surface temperature of the specimen and saves the specimen surface temperature and the measured data simultaneously. The following two types are available.</td>
<td></td>
</tr>
<tr>
<td>· 8 points measurement type</td>
<td></td>
</tr>
<tr>
<td>· 16 points measurement type</td>
<td></td>
</tr>
<tr>
<td>Stops the system immediately.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication cable</th>
</tr>
</thead>
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<tr>
<td>RS-485 5, 10m</td>
</tr>
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<td>Stops the system immediately.</td>
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<th>LAN-compatible software</th>
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</thead>
<tbody>
<tr>
<td>LAN-compatible software enables remote test checking and data processing, such as from a distant office.</td>
</tr>
<tr>
<td>* License for multiple PC monitoring requires an additional cost.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data processing software (with statistic processing software)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weibull analysis is installed in addition to the standard statistic processing software.</td>
</tr>
</tbody>
</table>

**Additional channel (40 channel basis)**

The channels can be added according to the capacity of the system (280 channels at maximum on 40 channel basis).

**Heat-resistant measurement cable**

Identical to the heat-resistant measurement Teflon cable included as a standard accessory.

- 1.5 m
- 2.5 m
- 3.5 m
* Can be extended in 1 meter increments upon request at the time of purchase.

**Colored heat-resistant cable**

Provides different colored cables for each channel.

- 1.5 m
* Can be extended in 1 meter increments upon request at the time of purchase.

**Non heat-resistant measurement cable (extension)**

Extensions offered according to the equipment installation conditions.

- 3 m
- 6 m
* If the cable length is changed from that of the initial shipment, default setting offset needs to be changed, so data will need to be re-corrected.
Ion Migration Evaluation System **AMI**

Makes stress evaluations and insulation resistance evaluations by electrochemical migration efficient and easy, and covers a broad spectrum, from low-voltage to high-voltage tests.

**Evaluation Targets**
- Printed circuit boards
- Insulation materials
- Semiconductor materials

Semiconductor Parametric Test System **AMM**

Supports cutting-edge device evaluation and offers highly-reliable data acquisition, collection, and analysis over a wide range of evaluation conditions from reliability evaluations to test/characteristic evaluations.

**Evaluation Targets**
- Semiconductor transistors
- Low-k materials
- High-k materials

Electromigration Evaluation System **AEM**

Space-saving all-in-one system, the AEM is the only product of its kind in the industry to offer electromigration evaluation of 1μA at 400°C.

**Evaluation Targets**
- Semiconductor wiring patterns
- Solder bumps

Flash Memory Endurance Cycling System **RBM-LCT**

A Monitored Burn-in System for evaluation testing of non-volatile memory, such as Flash memory or FeRAM. This testing/evaluation equipment is suited to a variety of uses from R&D to mass production.

**Evaluation Targets**
- Flash memory (FeRAM and MRAM)
VARIOUS ENVIRONMENTAL TEST CHAMBERS (SOLD SEPARATELY)

Thermal Shock Chamber  TSA Series

TSA series is the series that reduces the temperature recovery time, temperature heat-up time, and temperature pull-down time. TSA series has HFC refrigerant and a touch-panel that facilitates operation setting changes. TSA Series is presented as environment-friendly series.

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Inside dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSA–71S</td>
<td>High temp. chamber: +60 to +200°C Low temp. chamber: −70 to 0°C</td>
<td>W410×H460×D370</td>
</tr>
<tr>
<td>TSA–101S</td>
<td></td>
<td>W650×H460×D370</td>
</tr>
<tr>
<td>TSA–201S</td>
<td></td>
<td>W650×H460×D670</td>
</tr>
<tr>
<td>TSA–41L</td>
<td></td>
<td>W240×H460×D370</td>
</tr>
<tr>
<td>TSA–71L</td>
<td>High temp. chamber: +60 to +200°C Low temp. chamber: −65 to 0°C</td>
<td>W410×H460×D370</td>
</tr>
<tr>
<td>TSA–101L</td>
<td></td>
<td>W650×H460×D370</td>
</tr>
<tr>
<td>TSA–301L</td>
<td></td>
<td>W970×H460×D670</td>
</tr>
</tbody>
</table>

Thermal Shock Chamber  TSD-100

TSD-100 is a thermal shock chamber with two zones that conforms to Japanese and international test standards such as MIL-STD-883, JIS C 0025 and JASO-D001. With excellent temperature distribution performance, this chamber applies uniform temperature stress to specimens. Furthermore, by monitoring specimen temperature with the STT function, this chamber starts counting exposure time and switches to the next step immediately after the specimen temperature reaches a preset value, thus enabling highly accurate tests. In the temperature range between 60 and 150, this chamber has a short return time of 15 minutes, allowing a reduction of the total test time. This chamber can be used in a variety of purposes, from research and development to inspection and production.

<table>
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<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Inside dimensions (mm)</th>
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<tbody>
<tr>
<td>TSD–100</td>
<td>High temp. chamber: +60 to +200°C Low temp. chamber: −65 to 0°C</td>
<td>W710×H345×D410</td>
</tr>
</tbody>
</table>