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.
Espec measuring products in the reliability evaluation of the electronic device market

**Semiconductor manufacturer/foundry**

- **Wafer manufacturing process (pre-processing)**
  - Wiring process
  - Inspection process
  - FOWLP

- **Packaging (post-processing)**
  - Assembly process
  - Screening process

- **Reliability test**
  - Insulation resistance evaluation test (electro-chemical migration) AMI
  - TDDB evaluation test (package evaluation) AMM-TDDB-C AMI
  - Burn-in test RBC RBS RBM MBI
  - Electromigration evaluation test AEM
  - Reverse bias test (power device) HTRB HTGB H3TRB AMI
  - Power cycle test (power device) RBS-PST

- **Conductor resistance evaluation test (joint reliability test) AMR

- **Assembly manufacturer**
  - PC manufacturer/mobile phone manufacturer/in-vehicle component manufacturer/communication device manufacturer

- **Electronic component manufacturer**
  - Capacitor/inductor/resistor/sensor

- **Composite manufacturer**
  - Sealing material/substrate/insulation material/solder material/multi-layer board

**Wafer manufacturer**

- TDDB evaluation test (wafer evaluation) AMM-TDDB-W

**Material manufacturer**

- Sealing material/substrate/insulation material/solder material/multi-layer board

**Insulation resistance evaluation test AMI (electro-chemical migration)**

**Conductor resistance evaluation test AMR (joint reliability test)**

**Product shipment**

- **Insulation resistance evaluation test AMI (electro-chemical migration)**
- **Conductor resistance evaluation test AMR (electro-chemical migration)**

**Conductor resistance evaluation test AMR (joint reliability test)**

- Leakage current measurement AMI evaluation test
- Capacitor temperature characteristic AMQ evaluation test
- Inductor evaluation test AEM
- Sensor burn-in RBS
AMR

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

Example of AMR connected with a Thermal shock chamber

Changes in Electronic Device and Joint Reliability Evaluations
https://youtu.be/UuRWrRpiyzQ
*Audio available
Using an international standard traceable precision instrument guarantees the most accurate and compatible measurement data.

**Models**
- With DC specification (AMR-UD)
  Resistance measurement range:
  \[1\text{m}\Omega \text{ to } 100\text{M}\Omega\]
- With AC specification (AMR-UA)
  Resistance measurement range:
  \[1\text{m}\Omega \text{ to } 3\text{k}\Omega\]

**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 a wide range of resistance measurement; From \(1 \times 10^{-3}\) to \(1 \times 10^{8}\Omega\)**
Conductor resistance values ranging from \(1 \times 10^{-3}\) to \(1 \times 10^{8}\Omega\) (AMR-UD) and from \(1 \times 10^{-3}\) to \(3 \times 10^{3}\Omega\) (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 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.

- **Addressing global environmental concerns**
  Electronic boards and components used in our equipment are designed to reduce the burden on the global environment. Additionally, products intended for the EU market are compliant with RoHS Directive, and have the CE marking.
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
AMR monitors and records the temp. 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 (option)
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.

<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.

### DC Measurement (AMR-UD)

Using DC current resistance to measure small voltage change and detect up to 100MΩ 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.

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

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

**• Case in which the measured signals interfere with each other between channels**

- **DC application only (AMR-UD only)**

**• Case in which signals between measured channels do not interfere with each other (communication between channels is independent from each other)**

- **DC and AC application evaluation**

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* Accurate measurements cannot be performed when the current applied during measurement is shared with other measurement wiring.

* In certain cases measurements cannot be performed due to the capacity of the capacitor.
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.

**Acceptance test standard**

The failure definition would be an increase of 20% above nominal resistance.
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
- 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
- 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.
- **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)

- **System controller**: 
  - PC and LCD monitor for system control.
  - Measurement, data processing, chamber control.

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

- **Micro-resistance measuring unit**: Precisely measures resistance by 4-wire (resistance) measurements.

- **Scanner unit for minute resistance measurement**: 
  - 40 standard channels
  - (up to 280 channels can be added)

- **Connection unit**: 
  - Relays the measurement cable.
## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>AMR-<em>-</em>-UD</th>
<th>AMR-<em>-</em>-UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement current</td>
<td>DC specification</td>
<td>AC specification</td>
</tr>
<tr>
<td>Channel configuration</td>
<td>40ch to 280ch per rack</td>
<td></td>
</tr>
<tr>
<td>Control channel</td>
<td>A unit of 10 channels</td>
<td></td>
</tr>
<tr>
<td>System controller</td>
<td>Windows OS</td>
<td></td>
</tr>
<tr>
<td>Measurement range</td>
<td>10mΩ, 100mΩ, 1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, 1MΩ, 10MΩ, 100MΩ, and Auto</td>
<td></td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>3mΩ, 30mΩ, 300mΩ, 3Ω, 30Ω, 300Ω, 3kΩ and Auto</td>
<td></td>
</tr>
<tr>
<td>Measurement cable</td>
<td>Heat-resistant flat cable</td>
<td></td>
</tr>
<tr>
<td>Coated material: Teflon (Temperature for continuous duty: +200°C) Beyond connection unit: 1.5m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection cable</td>
<td>Non heat-resistant measurement cable Between scanner unit and connection unit</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 × 1750H × 940D 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 Windows operating system version requirements are subject to change based on version changes in Windows. Please ask for current supported operating system version.

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

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

## MODEL

AMR-*-*-

- Measurement unit
  - UD: DC application
  - UA: AC application
- 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
### 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.

### Specimen temperature monitor

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.
- 8 points measurement type
- 16 points measurement type

### Emergency stop switch

Stops the system immediately.

### LAN-support software

LAN-compatible software enables remote test checking and data processing, such as from a distant office.
* License for multiple PC monitoring requires an additional cost.

### Colored heat-resistant cable

Provides different colored cables for each channel.
- 1.5 m
* Can be extended in 1 meter increments upon request at time of purchase.

### Data processing software (with statistic processing software)

Weibull analysis is installed in addition to the standard statistic processing software.
* License for multiple PC monitoring requires an additional cost.

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

Extensions offered according to the equipment installation conditions.
- 3 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.
Electrochemical 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 350°C.

- Evaluation Targets
  - Semiconductor wiring patterns
  - Solder bumps

Capacitor Temperature Characteristic Evaluation System  AMQ

Capacitors/inductors essential to IoT, 5(6)G communications are used under a variety of different temperature conditions. An AMQ is a device needed to obtain frequency and voltage characteristics under a broad range of temperature conditions.

- Evaluation Targets
  - MLCC capacitor
  - Aluminum electrolytic capacitor
  - Inductor, etc.
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-73EH/ES</td>
<td>High temp. chamber: +60°C to +200°C</td>
<td>W410 × H460 × D370</td>
</tr>
<tr>
<td></td>
<td>Low temp. chamber: −70°C to 0°C</td>
<td>W650 × H460 × D370</td>
</tr>
<tr>
<td>TSA-103ES</td>
<td>High temp. chamber: +60°C to +200°C</td>
<td>W240 × H460 × D370</td>
</tr>
<tr>
<td></td>
<td>Low temp. chamber: −70°C to 0°C</td>
<td>W410 × H460 × D370</td>
</tr>
<tr>
<td>TSA-203ES</td>
<td>High temp. chamber: +60°C to +200°C</td>
<td>W650 × H460 × D670</td>
</tr>
<tr>
<td>TSA-43EL</td>
<td>High temp. chamber: +60°C to +200°C</td>
<td>W970 × H460 × D670</td>
</tr>
</tbody>
</table>

Thermal Shock Chamber  TSD

TSD-101 is a thermal shock chamber with two zones that conforms to Japanese and international test standards such as MIL, IEC and JASO. With excellent temperature distribution performance, this chamber applies uniform temperature stress to specimens. 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>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Inside dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSD-101-W</td>
<td>High temp. chamber: +60°C to +200°C</td>
<td>W710 × H345 × D410</td>
</tr>
<tr>
<td></td>
<td>Low temp. chamber: −77°C to 0°C</td>
<td>W370 × H345 × D410</td>
</tr>
</tbody>
</table>

Rapid-rate Thermal Cycle Chamber  TCC

This chamber enables rapid specimen temperature changes, covering a wide range of applications from JEDEC and IEC tests standard to screening. The chamber applies uniform temperature stress to specimens with excellent temperature distribution performance. Two control modes offered: Temperature Ramp Control mode that enables ramp control at a specimen temperature change rate of 15°C/min., and Air Temperature Non-ramp Control mode that enables temperature cycle testing and thermal shock testing.

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Inside dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCC-151W</td>
<td>−70°C to +180°C</td>
<td>W800 × H500 × D400</td>
</tr>
</tbody>
</table>
Conductor Resistance Evaluation System

Specifications are subject to change without notice due to design improvements.

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