ESPEC

Conductor Resistance Evaluation System
## AMR‒U

Continuous measurement of micro resistance in solder joint and connector contact areas. Accurate evaluation of the reliability of connections
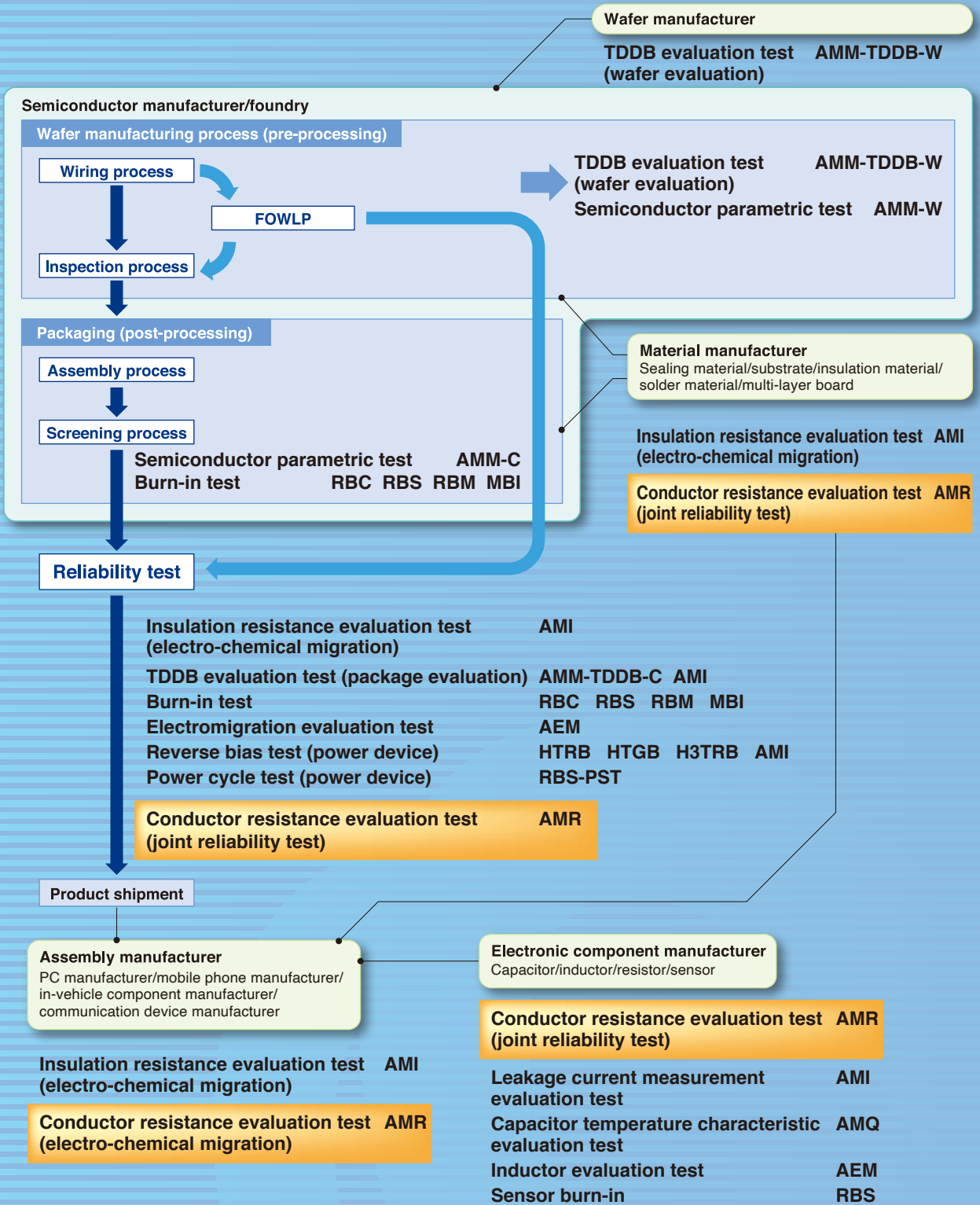
The Conductor Resistance Evaluation System enables continuous
measurement of resistance changes under high and low temperature cycles.
Automatic measurement, data storage and processing are operated systematically with a PC.
The system realizes accurate and effective contact reliability evaluations.
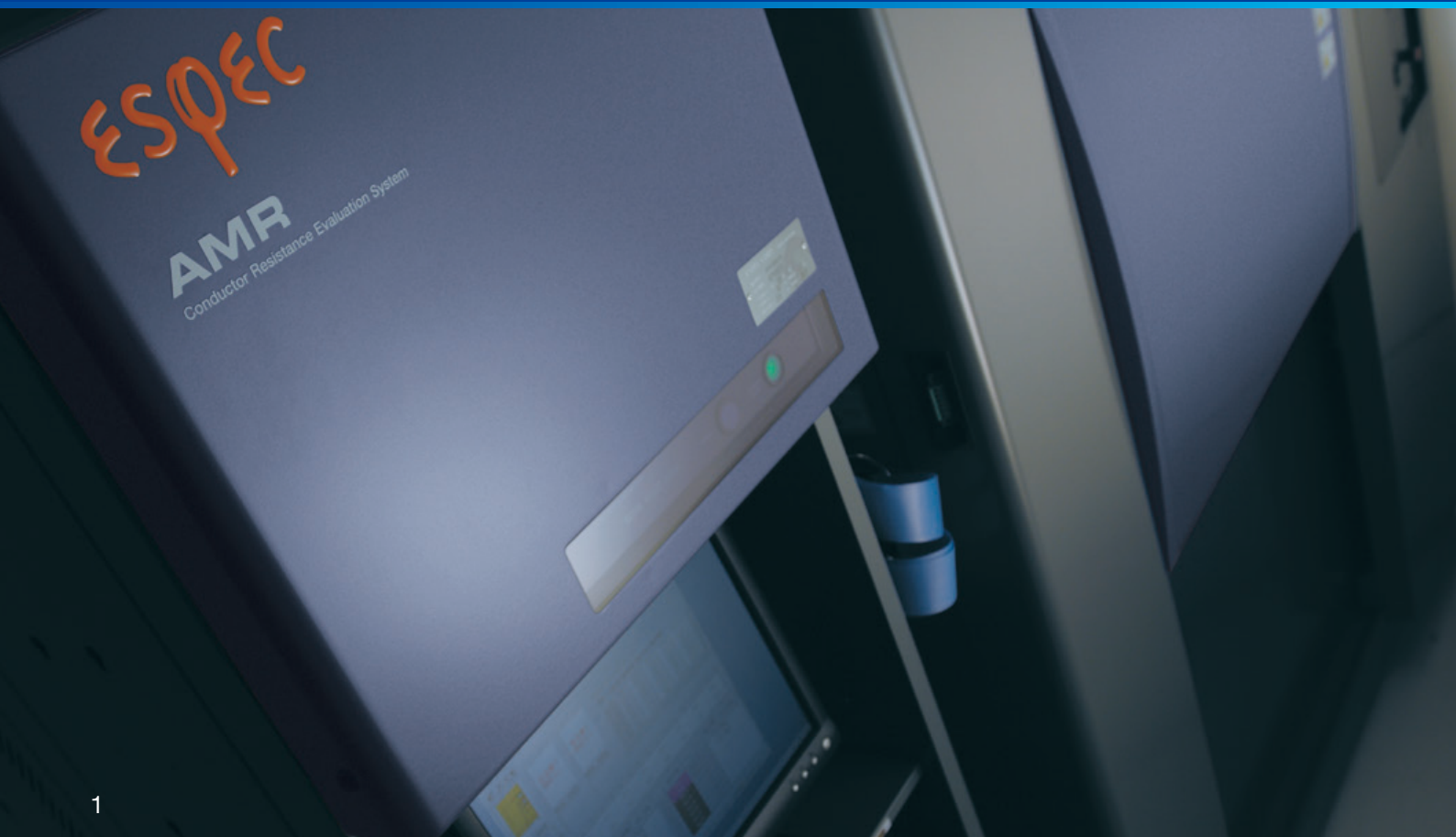
Espec measuring products in the reliability evaluation of the electronic device market

Wafer manufacturer

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

Semiconductor manufacturer/foundry

Wafer manufacturing process (pre-processing)

Wiring process

FOWLP

Inspection process

→ TDDB evaluation test   AMM-TDDB-W
(wafer evaluation)
Semiconductor parametric test   AMM-W

Packaging (post-processing)

Assembly process

Screening process

Semiconductor parametric test   AMM-C
Burn-in test   RBC RBS RBM MBI

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)

Reliability test

Insulation resistance evaluation test   AMI
(electro-chemical migration)

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   AMR
(joint reliability test)

Product shipment

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

Insulation resistance evaluation test   AMI
(electro-chemical migration)

Conductor resistance evaluation test AMR
(electro-chemical migration)

Electronic component manufacturer
Capacitor/inductor/resistor/sensor

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

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AMR

Accurately detects minute cracks in semiconductor packages and electronic component junctions. Automatic measurement and chamber integration allow improved efficiency in test schedule management.

● Solder crack progression
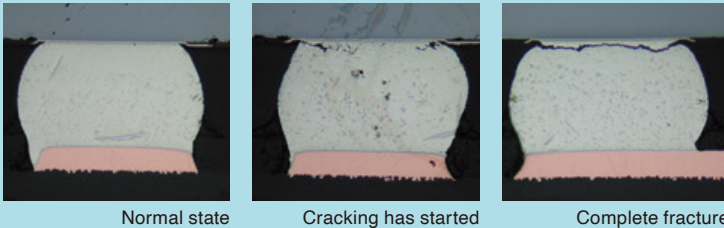
| Normal state | Cracking has started | Complete fracture |

Example of AMR connected with a Thermal shock chamber

Changes in Electronic Device and Joint Reliability Evaluations
https://youtu.be/UuRWlRpizdQ
*Audio available

● 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

Features

Using an international standard traceable precision instrument guarantees the most accurate and compatible measurement data.

● Models

- With DC specification (AMR-UD)
  Resistance measurement range:
  $1m\Omega$ to $100M\Omega$
- With AC specification (AMR-UA)
  Resistance measurement range:
  $1m\Omega$ to $3k\Omega$

● 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 1×10^{-3} to $1 \times 10^{8}\Omega$

Conductor resistance values ranging from 1×10^{-3} to $1 \times 10^{8}\ \Omega$ (AMR-UD) and from 1×10^{-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.
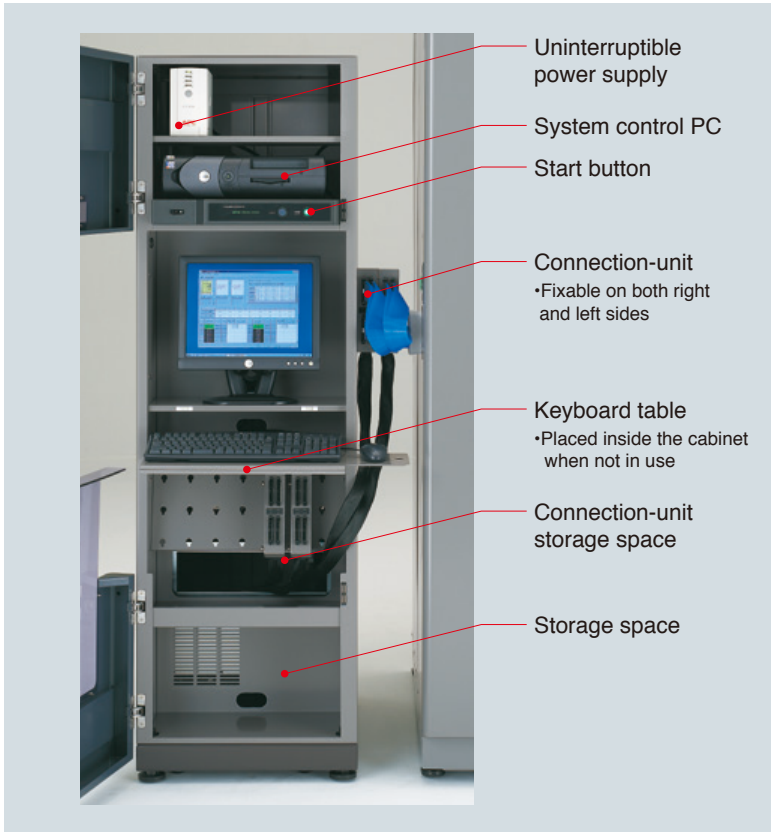

AMR
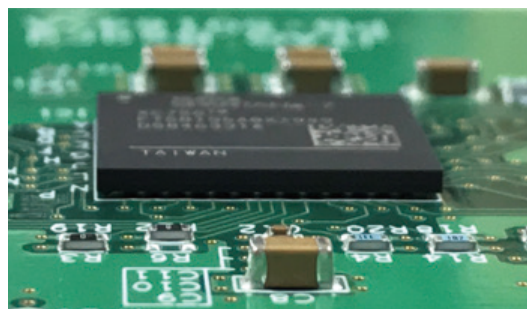
BGA mounting board

Features

Multifunction rack that pursues ease of use improve the workability.

Uninterruptible power supply

System control PC

Start button

Connection-unit
•Fixable on both right and left sides

Keyboard table
•Placed inside the cabinet when not in use

Connection-unit storage space

Storage space

System rack

● 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.

Connection unit

Measurement cable (Chamber sold separately)

Features

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

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.

Example of AMR connected with two Thermal shock chambers

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

● Network

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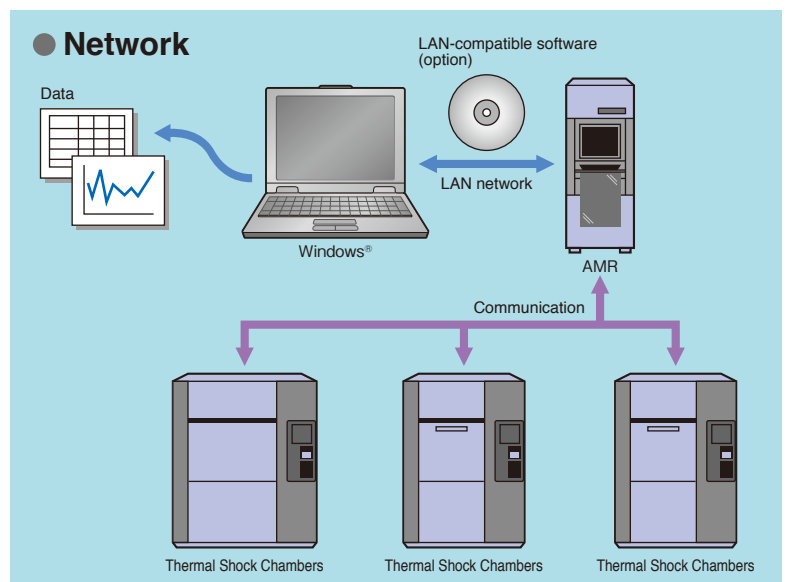
Evaluation

DC or AC measurement can be selected according to your test requirements.

Evaluation item	DC Measurement (AMR-UD)	AC Measurement (AMR-UA)
Evaluation of solder joints	○	○*1
Reliability of BGA and CSP solder ball connections	○	△*1
Conductive adhesive and anisotropic conductive films	○	○*1
Capacitor (surface mounting/built-in on board) joint reliability	×	△*2

*1 Accurate measurements cannot be performed when the current applied during measurement is shared with other measurement wiring.
*2 In certain cases measurements cannot be performed due to the capacity of the capacitor.

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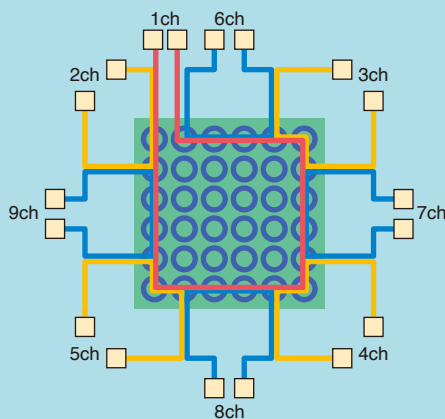
● Case in which signals between measured channels do not interfere with each other (communication between channels is independent from each other

➡ DC and AC application evaluation
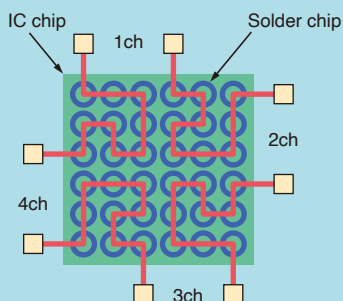
* Compatible model differs depending on the daisy chain design for BGA and CSP evaluations.

● **DC Measurement (AMR-UD)**

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

Evaluation

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 date 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.
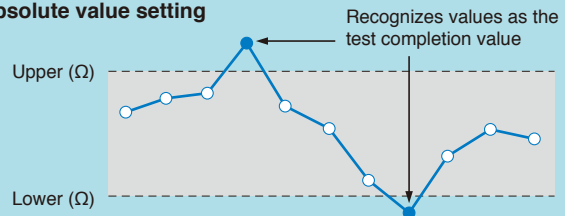
● Acceptance test standard

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

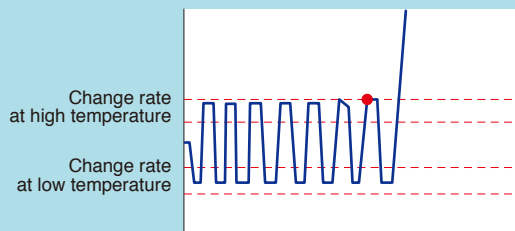### ● Evaluation with absolute value

Upper absolute value

Lower absolute value
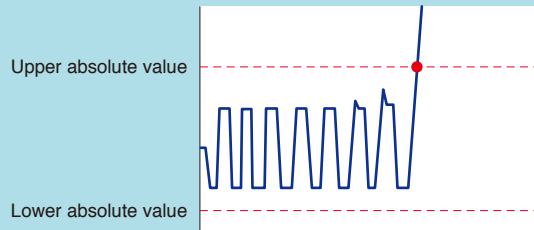
· Evaluation of the measured data using the absolute value.

■ Absolute value setting

Recognizes values as the test completion value

Upper (Ω)

Lower (Ω)

● Evaluation with the change rate

Change rate at high temperature

Change rate at low temperature

· Evaluation of the measured data using the change rate.

■ Change rate setting

Recognizes the values as the change rate reference values.

High temperature side

Upper (Ω)

Lower (Ω)

Low temperature side

Upper (Ω)

Lower (Ω)

Decision waiting period   Stabilization period   Stabilization period   Decision waiting period
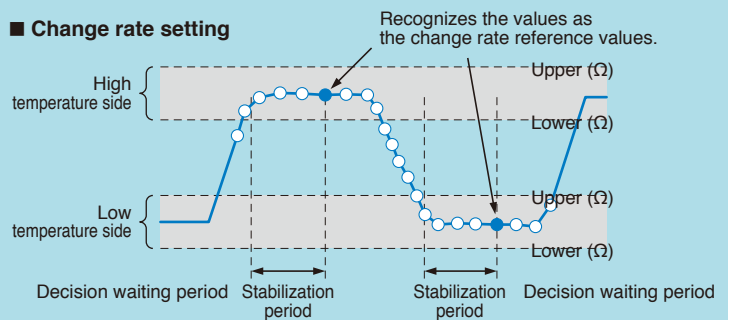
● Main window*
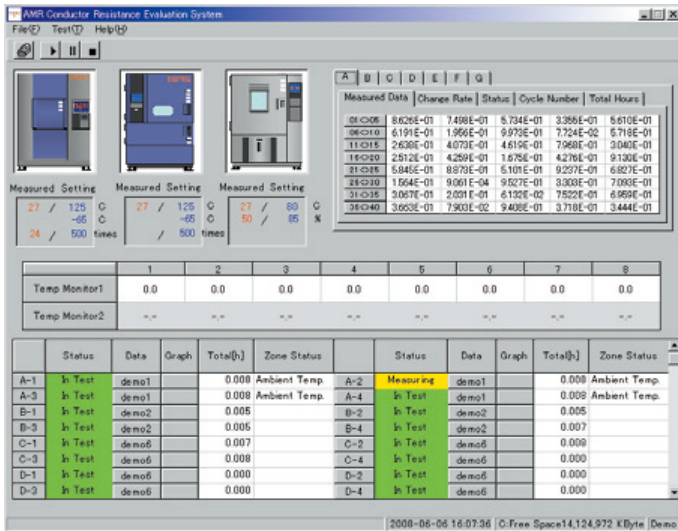
· Test monitoring

· 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
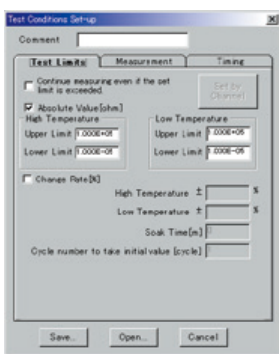
Setting of:
 · Duration, nb. of cycles of a test
 · Duration of the measurement
 · Limit values
These settings can be saved in a file that can be use subsequently; numerous test conditions can be saved for different tests and specimens.
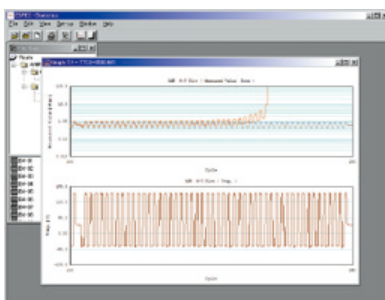
● Test setting

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)
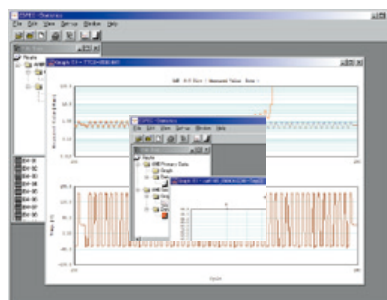
● Graphic display

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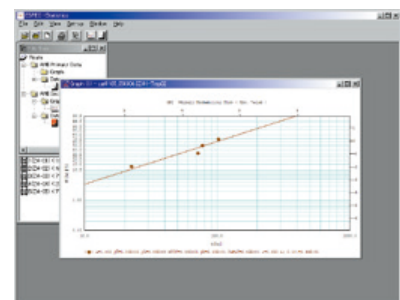Graphs can be copied on a clipboard and opened in another software.

(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.

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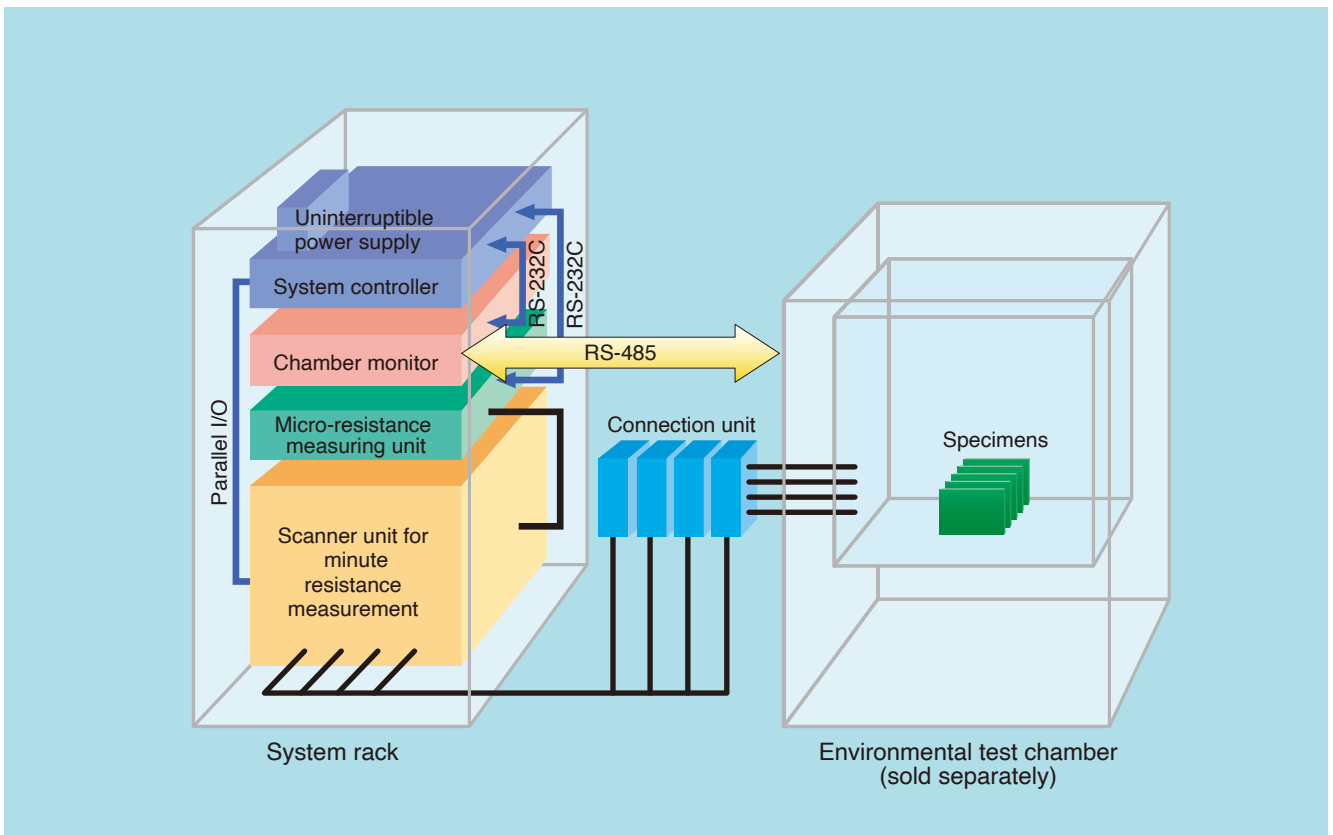
- Uninterruptible power supply :
  Backup power supply for the system controller.
  Automatically interrupts the test in case of power cut.
  When power recovers, the test restarts from where it was stopped. (does not resume automatically)

- 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

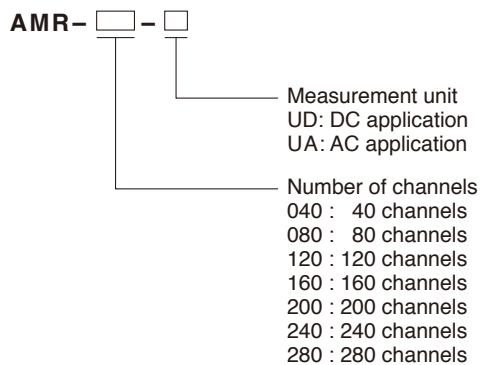| Model		AMR-∗∗-UD	AMR-∗∗-UA
Measurement current		DC specification	AC specification
Channel configuration		40ch to 280ch per rack	
Control channel		A unit of 10 channels	
System controller [1]		Windows OS	
Measuremen	Resistance measurement range	$1 \times 10^{-3}\Omega$ to $1 \times 10^{8}\Omega$ (1mΩ to 100MΩ)	$1 \times 10^{-3}\Omega$ to $1 \times 10^{3}\Omega$ (1mΩ to 3kΩ)
	Measurement accuracy [2]	10 mΩ Measured value of $\pm$1% or less, 100 mΩ Measured value of $\pm$0.5% or less	
	Measurement range	10mΩ, 100mΩ, 1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, 1MΩ, 10MΩ, 100MΩ, and Auto	3mΩ, 30mΩ, 300mΩ, 3Ω, 30Ω, 300Ω, 3kΩ and Auto
Measurement cable		Heat-resistant flat cable Coated material: Teflon (Temperature for continuous duty: $+200℃$ [3]) Beyond connection unit: 1.5m	
Connection cable		Non heat-resistant measurement cable Between scanner unit and connection unit	
Connection unit		One connection unit has 40-channel connection.	
External dimension		530W $\times$ 1750H $\times$ D940D mm	
Power supply facility		100V AC, 1ϕ, 10.0A 120V AC, 1ϕ, 8.3A 220V AC, 1ϕ, 4.5A 240V AC, 1ϕ, 4.2A	

[1] Windows operating system version requirements are subject to change based on version changes in Windows.
   Please ask for current supported operating system version.
[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– ☐ – ☐

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

OPTIONS

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 time of purchase.

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.

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

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.

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.

Emergency stop switch

Stops the system immediately.

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℃.

■ **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.

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.

Model	Temperature range	Inside dimensions (mm)
TSA-73EH/ES	High temp. chamber: +60°C to +200°C Low temp. chamber: −70°C to 0°C	W410×H460×D370
TSA-103ES		W650×H460×D370
TSA-203ES		W650×H460×D670
TSA-43EL	High temp. chamber: (ambient temp. +50°C) to +200°C Low temp. chamber: −65°C to 0°C	W240×H460×D370
TSA-73EL		W410×H460×D370
TSA-103EL		W650×H460×D370
TSA-203EL		W650×H460×D670
TSA-303EL		W970×H460×D670

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.

Model	Temperature range	Inside dimensions (mm)
TSD-101-W	High temp. chamber: +60°C to +205°C Low temp. chamber: −77°C to 0°C	W710×H345×D410

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.

Model	Temperature range	Inside dimensions (mm)
TCC-151W	−70°C to +180°C	W800×H500×D400

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ISO 9001 (JIS Q 9001)
**Quality Management System Assessed
and Registered**

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＊**The organization of these certificates is
ESPEC CORP. Japan.**

QMS
JIS Q 9001
JSAQ 004

MS
CM001

ISO 27001 (JIS Q 27001)
**Quality Management System Assessed
and Registered**

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ISMS
JIS Q 27001
JSAI 165

ISMS-AC
ISMS ISR006

ISO 14001 (JIS Q 14001)
**Environmental Management System Assessed
and Registered**

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MS
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