Ion Migration Evaluation System
AMI-U

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registered in the Quality Management System
based on the International Standard ISO
9001:2008 (JIS Q 9001:2008) through the
Japanese Standards Association (JSA).
Analysis and evaluation of electrochemical migration and evaluation of insulation resistance made more accurate, efficient, and easier

Evaluations of electrochemical migration and insulation resistance are assuming a greater degree of importance as electronic devices are more and more miniaturized and mounted with higher density. The "Ion Migration Evaluation System" allows these evaluations to be performed continuously with a high degree of accuracy and efficiency. Environmental testing has been successfully merged with measurements/evaluations.
Example of AMI connected with a Highly Accelerated Stress Test System (HAST Chamber)

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.

**Main features**

- High precision measurement realized by ESPEC’s unique scanner operation technology supported by continuous power supply and international standards-compatible measurement equipment.
- Stress constant voltage (stress voltage and measurement voltage): 100V, 300V, and 500V. (300V and 500V are optional)
- Electrochemical migration accurately identified in micro second by the Leak Touch detection.
- Real-time measurement enabled using a personal computer. Editing/ browsing of data available during the evaluation process.
- Improved operability and safety achieved by the interaction with the environmental test chambers.

**Evaluation targets**

- Printed circuit boards
- Insulation materials
- Semiconductor materials

**Main applications**

- Flux, Printed circuit boards, Resist, Solder, Resin, Conductive adhesive and other materials related to printed wiring boards and high-density mounting
- BGA, CSP and other fine-pitch pattern, IC packages
- Organic semiconductor related materials (Organic electroluminescence)
- Capacitors, Connectors and other electronic components and materials
- Evaluation of hygroscopic property of insulation materials

**Models**

- 100V, Stress constant voltage: Not applied/ 1 to 100 V DC
- 300V, Stress constant voltage: Not applied/ 1 to 300 V DC
- 500V, Stress constant voltage: Not applied/ 1 to 500 V DC
We have always known how to earn our customers’ confidence
AMI 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)

Measures a wide range of insulation resistance
The unit measures insulation resistances with high accuracy over a wide range from $2 \times 10^3$ to $1 \times 10^{13} \Omega$ at the tip of the measurement cable (3m). The scanner board for the micro-electric current uses an advanced cable arrangement in order to avoid leakage current influences on the printed circuit boards.

From low-voltage to high-voltage tests available
The AMI offers three ranges of applied voltage specifications, for a variety of applications in many fields: for example from low driving voltage device evaluation, to high-voltage automotive device evaluation.
A constant stress voltage of 100V is applied, though 300 V and 500 V are available as additional options.

Multi-channel continuous measurement accurately detects a change in the insulation resistance
Continuously measuring the insulation resistance on multi-channels while applying voltage under a high-temperature and high-humidity environment allows an optimized detection of the decreasing insulation resistance.

Using an international standard traceable precision instrument guarantees the most accurate and compatible measurement data.
Multifunction rack that pursues ease of use to improve the workability.

Control on 5ch and 25ch basis
A control evaluation is possible in each module, independently from the other. We offer two types of modules, 5-channel and 25-channel.

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.

High accurate measurement
AMI employs a single cable (positive side) and a co-axial cable (negative side) to restrict the influence of micro-noises. The circuitry of AMI keeps the impedance remarkably low in order to provide precise evaluations. Cables are coated with Teflon, which guarantees indisputable advantages in terms of resistance to heat, humidity, and voltage.

SIR test coupon type IPC-B-24 and test board rack (optional)
SIR test coupon type IPC-B-24 and test board rack conform to IPC-B-24 as stipulated in ISO 9455-17 for efficient SIR testing. The test board rack can receive up to five PCBs, and allows measurement of up to 20 channels.

Connectors (optional)
We offer connection jigs tailored to the specimen as an option. Connection jigs ease the connection between the specimen and the cable and improve the test efficiency.

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 chambers
- Real-time monitoring of temperature and humidity
- Temperature and humidity delay-control function
- Safety design guaranteed by abnormality detection
- Remote processing of the test data (optional)

Example of AMI connected with a FreeAccess Environmental Chamber
AMI uses a measurement method for insulation resistance that meets multiple types of test requirements; among others can be named the electrochemical migration evaluation, insulation deterioration characteristics evaluation, and so on.

**Example of results obtained from the Ion Migration Evaluation System (AMI)**

Insulation resistance variation characteristics of flux under high-temperature and high-humidity conditions

**Test conditions**
- Temperature and humidity condition: 40°C, 90%rh
- Stress voltage: 50 V DC
- Measurement voltage: 50 V DC
- Measurement intervals: 0.5h

In the example above, the Leak Touch occurs at 291.2 hours and at 311.8 hours after the measurement starts.

*The above test results were obtained from the Ion Migration Evaluation System, and processed under an excel format (spreadsheet software).*
**Continuous measurement mode with stress voltage**

When the stress voltage and the measurement voltage are equivalent, you can perform time-saving test by using this mode. It will use the stress voltage as the measurement voltage, without recharging by the measurement voltage. The test period is defined as the accumulated stressed time. The time for measurement (charge and measure) is not included in the test period.

**One shot charge**

To measure the insulation resistance, the sample(s) must be charged before measurement. The AMI will charge by module (either 5 channels or 25 channels) rather than one by one, this allowing time-saving for testing.

**Individual voltage supply per channel**

A channel with its independent power supply guarantees no voltage weakening, nor any leakage on other channels. Each channel has also its individual voltage monitor to insure the correct voltage is applied to every channel.

**No voltage disruption thanks to a specially designed scanner**

ESPEC designed scanner guarantees no interruption of the applied voltage from stress to measurement process. This is made possible thanks to a control on the voltage supply area. (same for stress and measurement)
There are two recognition methods for all kinds of failure.

**Limit recognition**

By setting an absolute value, a change rate (%), or changing the amount. These three failure criteria can be used to set the threshold of your test, on each channel.

- **With absolute value setting**
  
  ![Absolute Value](image)
  
  Absolute Value: Allows you to set an absolute value at which the AMI will recognize a failure.

- **With change rate setting**
  
  ![Change Rate](image)
  
  Sets the initial resistance measurement as a base value, and thereafter recognizes failure based on a percentage of the initial value.

**Leak Touch detection recognition**

- **“Leak Touch” detection and recognition**

  ![Leak Touch](image)
  
  Leak Touch detection recognition

- **Leak Touch observation mode**

  This mode allows to catch the ion migration, and observe the dendrites that appear during conductances. Measurement criteria can be set, such as the failure detection threshold, number of times for the detection or else the recovery time. (The leak current can be set between 1 and 500 μA.)

- **In the case where a failure is detected**

  ![Failure Detection](image)
  
  The Resistance value returns to normal

- **In the case where the resistance value returns to normal during behavior detection**

  ![Behavior Detection](image)
  
  Real-time detection point of leakage current (detection sensitivity 100μsec/ch)
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 AMI-075-U-5.

● Test condition registration

Parameters:
- Test Duration setting
- Interval
- Measurement voltage
- Limit value...
Registration in a file.

● Test setting

On this screen, (image above), test settings can be registered:
- Test module
- Files' names setting/saving
- Interaction
  (select the chamber which it works with)
- Text data output option
- Leak Touch detection mode...

● Test details

Select test channels and conditions.
(From test conditions already registered in files)

● Graphic display

Current test data and previous data are displayed on graphs.
Graph can be arranged by selecting the channel, display setting, and cursor display.

● Data display

Displays current test data and previous data.

● Weibull Analysis (optional)

Data processing software (with a statistical processing function) enables Weibull analysis of test data, as well as regular probability plotting, and logarithmic probability trend curves.
**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Stress constant voltage 100 V</th>
<th>Stress constant voltage 300 V (optional)</th>
<th>Stress constant voltage 500 V (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel configuration</td>
<td>Standard 25ch. (max. 150ch per rack)</td>
<td>Standard 25ch. (max. 150ch per rack)</td>
<td>Standard 25ch. (max. 150ch per rack)</td>
</tr>
<tr>
<td>Control channel</td>
<td>5ch</td>
<td>25ch</td>
<td>5ch</td>
</tr>
<tr>
<td>Software</td>
<td>Windows 7</td>
<td>Windows 7</td>
<td>Windows 7</td>
</tr>
<tr>
<td>Stress constant voltage</td>
<td>Not applied/ 1 to 100 V DC</td>
<td>Not applied/ 1 to 300 V DC</td>
<td>Not applied/ 1 to 500 V DC</td>
</tr>
<tr>
<td>Min. set voltage resolution</td>
<td>0.1 V (1 to 100 V, individually able to set from the measurement voltage)</td>
<td>0.1 V (set at 1 to 200 V)</td>
<td>0.1 V (set at 1 to 200 V)</td>
</tr>
<tr>
<td>Applied voltage accuracy</td>
<td>0.1fA to 20mA (resolution: 0.1fA)</td>
<td>0.1fA to 20mA (resolution: 0.1fA) *2</td>
<td>0.1fA to 20mA (resolution: 0.1fA) *2</td>
</tr>
<tr>
<td>DC measurement range</td>
<td>500 µA to less than or equal to 10 pA</td>
<td>500 µA to less than or equal to 10 pA</td>
<td>500 µA to less than or equal to 10 pA</td>
</tr>
<tr>
<td>Measurement range</td>
<td>2 × 10^8 to 1 × 10^13 (when applying 1 V)</td>
<td>2 × 10^8 to 1 × 10^13 (when applying 1 V)</td>
<td>2 × 10^8 to 1 × 10^13 (when applying 1 V)</td>
</tr>
<tr>
<td>Measurement time (1 time) ^3</td>
<td>15 sec. + charging time, 80 sec. + charging time</td>
<td>15 sec. + charging time, 80 sec. + charging time</td>
<td>15 sec. + charging time, 80 sec. + charging time</td>
</tr>
<tr>
<td>Leakage detection</td>
<td>Normal 100 µsec / less than or equal to specified number of detections on channel basis</td>
<td>Normal 100 µsec / less than or equal to specified number of detections on channel basis</td>
<td>Normal 100 µsec / less than or equal to specified number of detections on channel basis</td>
</tr>
<tr>
<td>Measurement cable Type</td>
<td>+ side</td>
<td>Single cable</td>
<td>Heat-resistant single cable</td>
</tr>
<tr>
<td></td>
<td>− side</td>
<td>Coaxial cable (one-layer shield)</td>
<td>Coaxial cable (one-layer shield)</td>
</tr>
<tr>
<td>Coated material</td>
<td>Teflon (heat resistance of + 150°C)</td>
<td>Teflon (heat resistance of + 150°C)</td>
<td>Teflon (heat resistance of + 150°C)</td>
</tr>
<tr>
<td>Length</td>
<td>Connects the scanner unit and connection unit: 2.5 m Beyond connection unit : 1.5 m</td>
<td>Connects the scanner unit and connection unit: 2.5 m Beyond connection unit : 1.5 m</td>
<td>Connects the scanner unit and connection unit: 2.5 m Beyond connection unit : 1.5 m</td>
</tr>
<tr>
<td>Connection unit</td>
<td>25-channel connection</td>
<td>25-channel connection</td>
<td>25-channel connection</td>
</tr>
<tr>
<td></td>
<td>+ side: Metallic outlet</td>
<td>− side: Square type coaxial connector</td>
<td>− side: Square type coaxial connector</td>
</tr>
<tr>
<td>Measuring equipment</td>
<td>Model: 6514 (Keithley Instruments, Inc.)</td>
<td>Model: 6514 (Keithley Instruments, Inc.)</td>
<td>Model: 6514 (Keithley Instruments, Inc.)</td>
</tr>
<tr>
<td>External dimension</td>
<td>W530 × H1750 × D940 mm</td>
<td>W530 × H1750 × D940 mm</td>
<td>W530 × H1750 × D940 mm</td>
</tr>
<tr>
<td>Power supply facility</td>
<td>100 V AC, 1φ, 10.0 A</td>
<td>100 V AC, 1φ, 10.0 A</td>
<td>100 V AC, 1φ, 10.0 A</td>
</tr>
<tr>
<td></td>
<td>120 V AC, 1φ, 8.3 A</td>
<td>120 V AC, 1φ, 8.3 A</td>
<td>120 V AC, 1φ, 8.3 A</td>
</tr>
<tr>
<td></td>
<td>220 V AC, 1φ, 4.5 A</td>
<td>220 V AC, 1φ, 4.5 A</td>
<td>220 V AC, 1φ, 4.5 A</td>
</tr>
<tr>
<td></td>
<td>240 V AC, 1φ, 4.2 A</td>
<td>240 V AC, 1φ, 4.2 A</td>
<td>240 V AC, 1φ, 4.2 A</td>
</tr>
<tr>
<td></td>
<td>100 : 100 channels</td>
<td>100 : 100 channels</td>
<td>100 : 100 channels</td>
</tr>
<tr>
<td></td>
<td>125 : 125 channels</td>
<td>125 : 125 channels</td>
<td>125 : 125 channels</td>
</tr>
<tr>
<td></td>
<td>150 : 150 channels</td>
<td>150 : 150 channels</td>
<td>150 : 150 channels</td>
</tr>
</tbody>
</table>

*1 The measurement accuracy and the DC measurement range are only applicable to the measuring equipment.

*2 The connection unit for applied high voltage is equipped with 1 kΩ resistors in series on the positive side of the applied voltage.

A slight voltage drop may occur depending on the current flow through specimens. This voltage drop is not included in the applied voltage accuracy.

*3 The charging time will be zero in the stress voltage full-time measurement mode.

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**ACCESSORIES**

- Measurement cable
- Communication cable (RS-485)
- Setup CD
- User’s manual
SYSTEM CONFIGURATION DIAGRAM

**Micro-current ammeter (0.1fA to 20mA):**
The insulation resistance of a specimen is measured at set intervals.
(Equipped with electrometer 6514 made by Keithley Instruments, Inc.)

**Scanner for minute current:**
Measurement of standard 25 channels at resistance value $10^3$ to $10^{13}$ Ω.

**Voltage monitor:**
The output of each stress-application power supply is monitored.

**Stress-application power supply:**
DC voltage is applied between specimen poles as electric stress.
A power supply is provided for each channel.

**Leak detector:**
Constantly monitors leak current against pre-set limit under applied stress voltage between electrode.

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

**Connection unit:**
Relays the measurement cable.

![System rack diagram](image)

Environmental test chamber (sold separately)

OPTION

**Additional channel (25 channel basis):**
The channels can be added according to the capacity of the system (150 channels at maximum on 25 channels basis).

**Additional Scanner Box:**
Required when adding a total of 100 additional channels or more.

**Extended cable that connects the scanner unit and the connection unit:**
Cables can be lengthened from the standard 2.5 m.
- 1m

**Measurement cable for 25 channel (standard type 1.5m):**
We offer both positive and negative measurement cables in addition to the standard accessories.
- 1.5, 3m

**Test board rack type A:**
Test board rack for SIR test coupon type IPC-B-24.

**SIR test coupon type IPC-B-24:**
Printed circuit boards that comply with IPC-B-24 specified in ISO 9455-17.

**LAN-compatible 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 statistical processing software):**
Weibull analysis is installed in addition to the standard statistical processing software.

**Communication cable:**
RS-485 5, 10m

**Emergency stop switch:**
Stops the system immediately.

**Board holder:**
We offer a variety of jigs for securing samples such as boards. (Connection terminal: screw-type)
Conductor Resistance Evaluation System  **AMR**

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

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

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 1 μA 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)

Temperature (& Humidity) Chamber
Platinous K Series

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Humidity range</th>
<th>Inside capacity (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td>-20 to +100°C</td>
<td>20 to 98% rh</td>
<td>120, 225, 408, 800</td>
</tr>
<tr>
<td></td>
<td>-20 to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL</td>
<td>-40 to +100°C</td>
<td>20 to 98% rh</td>
<td>306, 800</td>
</tr>
<tr>
<td></td>
<td>-40 to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSL</td>
<td>-70 to +100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-70 to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH</td>
<td>+10 to +100°C</td>
<td>60 to 98% rh</td>
<td>120, 225, 408, 800</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FreeAccess Environmental Chamber

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Humidity range</th>
<th>Inside capacity (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFL-3K</td>
<td>-40 to +100°C</td>
<td>20 to 98% rh</td>
<td>306</td>
</tr>
<tr>
<td>PFL-3K</td>
<td>-40 to +150°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bench-Top Type
Temperature (& Humidity) Chamber

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature range</th>
<th>Humidity range</th>
<th>Inside capacity (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH-221</td>
<td>-20 to +150°C</td>
<td></td>
<td>22.5</td>
</tr>
<tr>
<td>SH-241</td>
<td>-40 to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SH-261</td>
<td>-60 to +150°C</td>
<td>30 to 95% rh</td>
<td></td>
</tr>
<tr>
<td>SH-641</td>
<td>-40 to +150°C</td>
<td></td>
<td>64</td>
</tr>
<tr>
<td>SH-661</td>
<td>-60 to +150°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Highly Accelerated Stress Test System
(HAST Chamber)

<table>
<thead>
<tr>
<th>Model</th>
<th>Temp./ humid./ pressure range</th>
<th>Inside capacity (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHS-211(M)</td>
<td>+105 to +142.9°C / 75 to 100% rh</td>
<td>18</td>
</tr>
<tr>
<td>EHS-221(M)</td>
<td>0.020 at 0.179Mpa (0.2kg to 2.0kg/cm²)</td>
<td>46</td>
</tr>
<tr>
<td>EHS-411(M)</td>
<td>+105 to +162.2°C / 75 to 100% rh</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>0.020 at 0.392Mpa (0.2kg to 4.0kg/cm²)</td>
<td></td>
</tr>
</tbody>
</table>
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