The quest for fine pitch pattern and more function

The Electro-Migration Evaluation System AEM Series applies DC current, DC pulsed current, and AC pulsed current under high temperature environment to detect and evaluate the increase of resistance value and leak current caused by electromigration. The system will provide electromigration evaluation indispensable for improving reliability of fine pitched LSIs, flip chip solder ball, and coating material.
MEASUREMENT EVALUATION SYSTEM

- LSI ELECTROMIGRATION EVALUATION SYSTEM
- GMR HEAD ELECTRO-MIGRATION RH EVALUATION SYSTEM
- HIGH FREQUENCY ELECTRO-MIGRATION EVALUATION SYSTEM

- WAFER LEVEL
- PACKAGE LEVEL

- FET (HOT-CARRIER) PROPERTY EVALUATION SYSTEM
- TRANSISTOR PROPERTY EVALUATION SYSTEM

- THROUGH-HOLE CONDUCTOR EVALUATION SYSTEM
- SOLDER-JOINT CONTACT EVALUATION SYSTEM
- BGA, CSP SOLDER JOINT CONTACT EVALUATION SYSTEM
- CONNECTOR CONTACT RESISTANCE EVALUATION SYSTEM
- FPC LIFE EVALUATION SYSTEM
- OTHER INTERCONNECTION MATERIAL CONTACT EVALUATION SYSTEM

- CAPACITOR INSULATION RESISTANCE EVALUATION SYSTEM
- PCB, PWB INSULATION RESISTANCE EVALUATION SYSTEM
- INSULATION RESISTANCE EVALUATION SYSTEM FOR OTHER INSULATION MATERIAL

- CAPACITOR LEAK CURRENT MEASUREMENT SYSTEM
- FET LEAK CURRENT MEASUREMENT SYSTEM
- SEMICONDUCTOR REVERSE BIAS LEAK CURRENT MEASUREMENT SYSTEM

- OPTICAL COMPONENT ENVIRONMENTAL TEST SYSTEM
Six types of stress current
Stress is applied by DC current +, DC current -, DC pulse +, DC pulse -.
Test condition can be selected and set individually per 10 channels.

Three measurement modes
Precision current mode uses precision current generator to measure resistance. Stress-on mode measures resistance while applying stress current. Also equipped with a leak current measurement mode.

One TEG/one constant-current power supply control
The power source for constant-current stress application is provided on each channel (TEG). Failure will be detected individually on each TEG and stops stress application to the failed TEG.

Setup of evaluation condition per each TEG board
Evaluation test for 100 TEGs is allowed per chamber. 10 TEGs can be loaded on 1 TEG board, and 10 TEG boards per chamber. Stress current can be set and applied to each TEG board, thus enabling independent testing with different conditions for each board.

Precise evaluation
Constant current power supply with a stable 3W output, and Kelvin's 4-terminal method realizes high precision measurement.

Designated chamber with high temperature of +400°C
Convection type chamber available with temperatures of +250°C and +400°C.

Multiple chambers with different settings can be controlled from one AEM system controller.
Temperature setting and test can be controlled for each chamber. The system controller can manage and control the test performed on multiple chambers with different settings.

APPLICATION

- Electro-Migration Evaluation
  - Evaluation of LSI fine pitch wiring / copper wiring / aluminum wiring
  - Evaluation of flip chip solder ball / UBM
  - Evaluation of metal materials which are used under high-density current
**System controller**

- Controller:
  - OS Windows® XP (DELL Computer PC)
- Uninterruptable power supply:
  - Backup power supply for controller
- Measure controller:
  - Measurement data acquisition and control
- Precision current generator:
  - Applies constant current during precise resistance measurement
- Digital Multimeter:
  - Measurement of resistance value (Advantest Corp.R-6441C)
- E-BUS:
  - Temperature control of chamber / monitor / alarm control

**Stress unit**

- Stress unit:
  - Consists of a CPU board and 10 stress boards
- CPU board:
  - Controls stress board
- Stress board:
  - Scanner & power source for constant current stress,
  - 10 channels per stress board
  - 1 power source per channel for constant current
- Chamber:
  - High-temperature environment
  - (+250°C / +400°C)
EVALUATION PROCEDURES/ MEASUREMENT MODE

Measurement conditions

- Set Duty ratio range 10% to 90% by 10%
- Set pulse repetition frequency
  1Hz, 10Hz, 100Hz, 1KHz, 10KHz

Caution) Stress board for 20mA, 50mA, 1A are a DC constant current and exclusive board

Measurement items

- Stress ON resistance measurement
  Resistance value is measured while applying stress current. For AC pulse constant current, the larger absolute value is measured. When value reaches the same on both positive and negative side, the positive side is measured.

- Precise resistance measurement
  Resistance value is measured by cutting off stress current and applying precise current.

- Leak current measurement
  Leak current between leak terminal and minus terminal is measured after cutting off stress current. (Voltage is constantly applied between the leak terminal and minus terminal)

Various measurement intervals

- Linear: Measures in equal intervals at setting value by the minute (6 to 9,999 minutes, per 1 minute)

- Log t=0.1: Measured in lapse of 0.1Hr, \(10^{(n-2)}\) Hr \((n=\text{number of times of measurement, n \geq 2})\) from test startup.

- Log t=1: Measured in lapse of 0.1Hr, 1Hr, 10Hr, 100Hr, 1000Hr, 10000Hr from test startup.

- Block setting: Divided into 3 blocks from test startup to finish. Can be set by intervals mentioned above.
<table>
<thead>
<tr>
<th>Model</th>
<th>AEM-1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel configuration</td>
<td>Standard 100 channels (Maximum 900 channels)</td>
</tr>
<tr>
<td>Number of chambers</td>
<td>Controls up to 9 chambers (100 channels per chamber)</td>
</tr>
<tr>
<td>Software</td>
<td>Windows® XP</td>
</tr>
<tr>
<td>Stress board variation</td>
<td></td>
</tr>
<tr>
<td>Measurement interval</td>
<td>Linear (minimum 6 min,/log t = 0.16 log t = 1/3-block setting)</td>
</tr>
<tr>
<td>Open detection</td>
<td>Constant detection of disconnection at least 1 seconds</td>
</tr>
<tr>
<td>Measurement mode</td>
<td></td>
</tr>
<tr>
<td>Range and accuracy of the stress current (0.5%+0.1mA) against set value</td>
<td>DC pulse/AC pulse 50mA 0.1mA to 50mA (0.3%SV + 0.05mA)</td>
</tr>
<tr>
<td>Precise resistance measurement</td>
<td>Applied voltage range -20V to +20V (compatible with DC pulse/AC pulse stress board)</td>
</tr>
<tr>
<td>Leak current measurement</td>
<td>Applied voltage DC -20V to +20V in 0.1V variable steps</td>
</tr>
<tr>
<td>Measurement range</td>
<td>100pA to 31A</td>
</tr>
<tr>
<td>Measurement precision</td>
<td>5% 10mA at 10M ohms or larger</td>
</tr>
<tr>
<td>System external dimensions (for 300-channel specification)</td>
<td>System controller 650W × 1300H × 800Dmm</td>
</tr>
<tr>
<td>Stress unit</td>
<td>570W × 1830H × 900Dmm</td>
</tr>
<tr>
<td>Outside dimension of chamber (excluding protrusions)</td>
<td>+250 type 980W × 550H × 890Dmm</td>
</tr>
<tr>
<td>+ 400 type</td>
<td>1015W × 625H × 880Dmm</td>
</tr>
<tr>
<td>Requested utility (for 300 channels per chamber)</td>
<td>System controller 100VAC 1% 50/60Hz 1A</td>
</tr>
<tr>
<td>Stress unit</td>
<td>200VAC 1% 50/60Hz 50A</td>
</tr>
<tr>
<td>Chamber (+ 250 type spec)</td>
<td>200VAC 1% 50/60Hz 20A</td>
</tr>
</tbody>
</table>

**TEG board**

<table>
<thead>
<tr>
<th>Type</th>
<th>+200 type</th>
<th>+250 type</th>
<th>+400 type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>polyimide substrate</td>
<td>SUS base</td>
<td></td>
</tr>
<tr>
<td>Socket duration</td>
<td>+260</td>
<td>+260</td>
<td>+440</td>
</tr>
<tr>
<td>Socket material</td>
<td>heat-resistant resin</td>
<td>ceramics</td>
<td></td>
</tr>
<tr>
<td>PIN position</td>
<td>flexible</td>
<td>fixed (can be modified for requirements)</td>
<td></td>
</tr>
</tbody>
</table>

Caution: Lifespan of TEG board depends on usage.
The system offers maximum AC pulse at 20MHz/ +350°C temperature performance required for Cu evaluation. Networking and control can be easily applied on Windows® XP.

- Duty ratio can be modified in 10% units
  Offers AC pulse frequency at a maximum 20MHz. The duty ratio can be modified in 10% units between the range of 10 to 90%.

- Current waveform
  AC probe is equipped on the lower part of the TEG socket to check the current waveform. (One AC probe is equipped per DHB chamber)

- Measures resistance by precise constant current power supply
  Resistance is measured by precise constant current power supply. Also equipped with a measurement error improvement mode for further quality performance.

- Linking DHB chambers
  Up to three DHB chambers can be linked to the controller to set test parameters and start operation. One TEG board can be loaded on one chamber (number of TEGs loaded on one board can be either 10 or 20).

- + 350°C temperature performance
  With the Direct Heat Board (DHB), precise temperature stress is applied at +350°C.

- Easy operation with Windows® XP
  Control software is applied on Windows® XP. Setting the test parameters and data statistics processing can be done with simple operation. LAN connection to the production line is also possible.

APPLICATION

- Wiring migration evaluation of semi-conductor process
- Simulation by high frequency application
SYSTEM BLOCK DIAGRAM

E-BUS

System controller

PMS-CA
Volmeter (multi-meter)

· Test control software/user interface
· Statistics processing software/data processing

Host computer Windows®XP

Pattern generator

Measurement controller
· Test schedule management
· Measurement
· Chamber control

Printer

Uninterruptible power supply

Volmeter (multi-meter)

Constant DC current generator

Scanner

Heat board

TEG board: (fixed)
10 to 20 sockets

Stress module 1
Stress module 2
Stress module N

DHB chamber (max. 3)

CURRENT WAVEFORM AND RESISTANCE VALUE

● AC Pulse Constant Current Waveform

1
10ns
15MHz frequency

40mA

Condition
Resistance
Applied current
Repeated frequency

51Ω
40mA
15MHz

● Applied Current and Resistance Value Sample

Maximum applicable voltage = Below graph shows regulation on operable maximum resistance value (Rmax) from 4.5V.
Measured maximum resistance value = 400Ω

Operable max. resistance (Ω)

Applied current (mA)
# SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>AEM-HF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>Windows® XP + Visual Basic</td>
</tr>
</tbody>
</table>
| AC pulse constant current application range| 0.1 mA to 30 mA (at plus/minus)  
Setting resolution of current rate  
3 mA range: 0.01 mA (100μA)  
30 mA range: 0.03 mA (300μA) |
| AC pulse frequency                         | 100 KHz to 20 MHz (minimum pulse width 25 ns) |
| Set DUTY ratio range                       | 10 to 90% (at 10% range setting) |
| Other stress power source                  | DC pulse constant current DC constant current (optional) |
| Measurement precision                      | ±0.2% (applied current 1 mA/ 100°) |
| No. of TEGs                                | 10 or 20 TEGs (for one DHB chamber) / up to 3 chambers |
| Test temperature range                     | +70 to +350 °C (temperature uniformity ±7 °C at +350 °C) |
| Required utility                           | 200 V AC 20 A (for one DHB Chamber)  
100 V AC 15 A (controller rack) |
| Outside dimension of system                | 1066 W x 670 H x 745 Dmm  
530 W x 1800 H x 1100 Dmm |