Electromigration Evaluation System
AEM Series
Electromigration evaluation at 350°C

As the miniaturization of semiconductor devices progresses, evaluating electromigration under excessively severe conditions is becoming essential.

The AEM Series Electro-Migration Evaluation System offers accurate measurements based on temperature and current stress — two major factors affecting a device’s service life — and analysis software for determining the necessary parameters for judging the life of a device.

Designed to meet a wide range of evaluation needs, from cutting-edge evaluations to production management, the AEM Series offers enhanced operability, superior reliability, and simplified data analysis.
240-channel evaluation testing over 3 oven in a single cabinet

2 channels (DUTs) = 1 Socket
5 Sockets = 1 DUT Board
8 DUT boards = 1 Oven
3 Ovens = 1 Cabinet
Maximum of 80 channels or DUTs can be tested in a single oven, makes it 240 channels per cabinet. The host PC, however, can control up to 1,200 channels or five fully-loaded cabinets.

High-accuracy temperature control up to 350°C

The oven are capable of testing temperatures of up to 350°C and offer highly accurate temperature distributions of ±3.5°C at 300°C. Each oven comes with an independent controller for separate temperature settings.

Current stress application up to 200 mA

The AEM Series is capable of applying stress currents between 0.1 mA and 200 mA.

Highly reliable dual-contact board structure (Patent No. 4304189)

The DUT boards and socket connections feature a dual-contact structure for a stronger hold. ESPEC’s proprietary design also prevents the DUTs from disconnecting. This structure design ensures greater reliability for long-term evaluations at high temperatures.

*350°C model sockets (300 mil and 600 mil) equipped as standard. 250°C models (600 mil only) are also available (optional).

DUT board
Size: 220 (W) × 465 (H) × 460 (D) mm
Weight: About 1.6 kg
Connection board
The pin assignment scramble function makes it possible to evaluate ESPEC DUT boards even using DUTs with different pin layouts.

Four test modes
The AEM Series is capable of performing four different tests by measuring resistance while stressing temperature and current: Electromigration, Stress migration, Temperature characteristic (TCR), and Extrusion.

Reliability concerns for Cu damascene
Cu damascene offers the benefits of low resistance and high reliability, but a wide range of phenomena appear in via structures linking multi-layer wiring when subjected to thermal stress.
**Monitor screen**

The monitor screen offers real-time information on the test progress, resistance, and rate of change of all DUTs at a glance.

**Condition setting screen**

Electrical parameters and time settings can be configured for each DUT.

Temperature characteristic testing parameters and stress testing temperature settings can also be configured.
Displays the measured resistance for each DUT in graph form.

Displays the measured resistance for each DUT and temperature in graph form.

Displays the measured resistance for each DUT and time in graph form. Absolute or relative values can be displayed.

Density dependence plots (Normal/ Log Normal/ Weibull)

Temperature dependence

Current density dependence

Other parameters dependencies

Displays the temperature-dependence in graph form based on the life (MTTF/median) calculated from the distribution plot. (Arrhenius plot)

Displays the current density dependence in graph form based on the life (MTTF/median) calculated from the distribution plot.

Displays in graph form the dependence on wire length, wire width, thickness and number of contacts.

Activation energy (Ea)

Current density index

Black's model
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Evaluation item</th>
<th>• Electromigration testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Stress migration testing</td>
</tr>
<tr>
<td></td>
<td>• Temperature characteristic (TCR) testing</td>
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<tr>
<td></td>
<td>• Extrusion testing</td>
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<table>
<thead>
<tr>
<th>Stress current source</th>
<th>Output range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ DC, 0.1 mA to 200 mA</td>
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</tbody>
</table>

| Accuracy                | 0.1 to 200 mA: ± (0.3% of set point + 50 μA) |

| Following voltage       | 35V                       |

<table>
<thead>
<tr>
<th>Extrusion test voltage</th>
<th>Output range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>−10.0 to −1.0 V / 1.0 to 20.0 V</td>
</tr>
</tbody>
</table>

| Accuracy                | ± (2% of set point + 20 mV) |

<table>
<thead>
<tr>
<th>Oven</th>
<th>Temperature control range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+65 to +350°C</td>
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</tbody>
</table>

| Temperature fluctuation | ±0.5°C (+65 to +350°C)    |

| Temperature uniformity  | ±1.0°C (+100°C), ±2.0°C (+200°C), ±3.5°C (+300°C) |

### SYSTEM VARIATION

<table>
<thead>
<tr>
<th>Model</th>
<th>AEM–240C3 AAA</th>
<th>AEM–160C2 9AA</th>
<th>AEM–080C1 00A</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM module output current</td>
<td>Oven 1</td>
<td>200mA</td>
<td>200mA</td>
</tr>
<tr>
<td></td>
<td>Oven 2</td>
<td>200mA</td>
<td>200mA</td>
</tr>
<tr>
<td></td>
<td>Oven 3</td>
<td>200mA</td>
<td>–</td>
</tr>
<tr>
<td>Number of evaluation channels</td>
<td>240ch</td>
<td>160ch</td>
<td>80ch</td>
</tr>
<tr>
<td>DUT board</td>
<td>Number of installed units</td>
<td>24 (8 × 3 oven)</td>
<td>16 (8 × 2 oven)</td>
</tr>
<tr>
<td></td>
<td>IC socket</td>
<td>5 each per board (DIP 28-pin, 600 mil and 300 mil)</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>200 V AC, 3-pole, 50/60 Hz (controller), AC 100 V, 1-pole, 50/60 Hz (PC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker capacity</td>
<td>200 V (Test unit + Oven unit)</td>
<td>75A (25kVA)</td>
<td>60A (17kVA)</td>
</tr>
<tr>
<td></td>
<td>100 V (Host PC)</td>
<td>6.5A (650VA)</td>
<td></td>
</tr>
<tr>
<td>Oven unit dimensions (mm) *1 *2</td>
<td>1080 (1131) (W)</td>
<td>1990 (H)</td>
<td>580 (W)</td>
</tr>
<tr>
<td></td>
<td>1955 (D)</td>
<td>1360 (H)</td>
<td>1220 (D)</td>
</tr>
<tr>
<td></td>
<td>Test unit dimensions (mm) *2</td>
<td>580 (W) × 1942 (2217) (H) × 1210 (1302) (D)</td>
<td></td>
</tr>
</tbody>
</table>

*1 Including stand  
*2 Dimensions in parentheses include protrusions

### Safety precautions

- Do not use specimens which are explosive or inflammbale, or which contain such substances. To do so could be hazardous, as this may lead to fire or explosion.
- Vapor from specimens that accumulates in tanks or exhaust ducts may ignite and cause fires, so the equipment must be cleaned periodically. Vapor that seeps into and accumulates in equipment insulating layers may cause more serious fires.
**Host PC**
- **Host PC**
  - Software: Windows OS
  - Test settings and test monitoring management and data analysis
- **Uninterruptible power supply**
  - For host PC

**Test unit**
- **EM module**
  - For DUT power control and DUT resistance measurement
  - 1 constant power source supply per channel
- **PC for measurements**
  - Measurement data aggregation and measurement control
- **Uninterruptible power supply**
  - For measurement PC

**Oven unit**
- **Oven**
  - Temperature range: +65 to +350°C
- **Connection board**
  - For DUT board connection;
  - Includes DUT pin scrambling function.

**OPTIONS**
- **DUT board** (8 boards per oven)
- Setup CD
- User's manual
- Resistance check board (1 board)

**ACCESSORIES**
- DUT board (8 boards per oven)
- Setup CD
- User’s manual
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**SAFETY DEVICES**
- Leakage breaker
- High-low temperature limit alarm
- Burn-out detection circuit
- Stand-alone overheat protector
- PC freeze detection using watchdog timer
- Status indicator light 3 level
- Emergency stop switch (test unit)