

ESPEC

Electromigration Evaluation System

AEM Series



Electromigration evaluations at stresses of $1 \mu\text{A}$ and 400

Today's more sophisticated, more highly integrated semiconductor devices are the result of ever more advanced microfabrication techniques and the use of new materials.

Since these techniques and materials determine device life, high-precision electromigration evaluations under more rigorous accelerated stress test conditions are becoming increasingly important to developers.

The Electromigration Evaluation System offers high-precision measurement under temperature (up to 400) and current stresses the key conditions for accelerated stress testing.



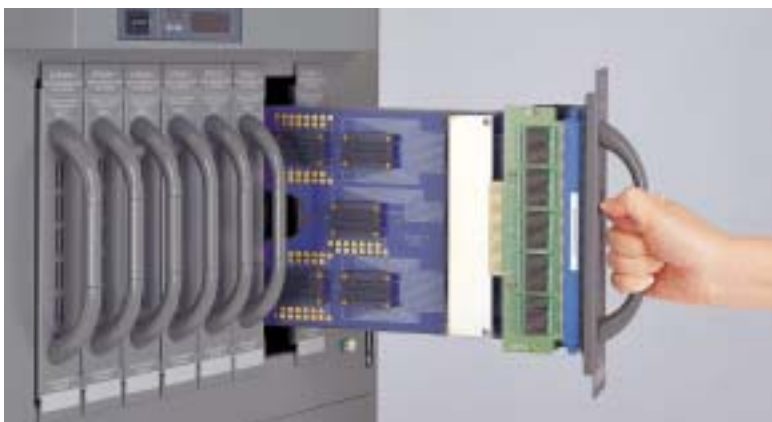
The analysis software provided enables calculations of the parameters needed to determine device life (based on Black's equation).
Offering better operation, reliability and data analysis,
AEM can be used to meet evaluation needs in a wide range of applications,
from cutting-edge evaluations to production management.



Performance



240ch type



■ **DUT board**

IC socket

Pin assignment scramble board

Scramble board

Scramble card TG400-1 Socket 1, 3

- **Test up to 240 channels per cabinet**

Each oven can support up to 80 DUTs(8 DUT boards per oven × 5 sockets per DUT board × 1 or 2 DUTs per socket). Since test groups can have as few as five DUTs, each oven can have up to 16 sets of test conditions.

- **High-temperature (400 max.), high-precision ovens**

AEM's ovens can create test temperatures of up to 400 with outstanding precision (± 2.5 distribution at 350 setting). Up to three ovens can be mounted in each cabinet, and evaluations can use different temperature conditions in each oven.

- **Low current stress (1 μ A min.)**

To support future Copper interconnect evaluation requirements, AEM can apply stress currents of between 1 μ A and 50 mA. Socket can be used for DIP 28-pin 600/300mil type.

- **New high-reliability DUT boards and sockets**

To ensure that components connect securely, DUT board-to-socket connections have been given a double contact structure (patent pending), and an original ESPEC design has been used for DUT-to-socket connections. These structural improvements dramatically reduce contact failure at high temperatures, enabling low-cost, high-cost-performance DUT boards that can withstand longer tests.

- **Pin assignment scrambling**

ESPEC DUT boards support pin assignment scrambling, enabling evaluations of DUTs with different pin assignments.

● PC-driven network

Up to five cabinets can be controlled from a single PC, enabling evaluations of up to 1,200 DUTs (1,200 channels). Evaluations can easily be monitored from a remote office.

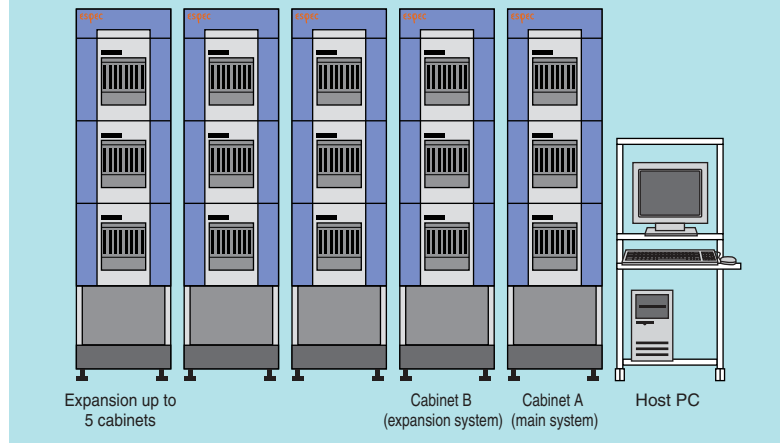
● Four types of electromigration evaluation

AEM is a highly versatile system that supports four types of electromigration evaluation with temperature and current stresses applied: (1) constant-current stress testing (resistance measurement), (2) stress migration testing, (3) TCR (temperature characteristic testing for precise current resistance measurement) testing, and (4) extrusion testing (leak current measurement).

● Space-saving design

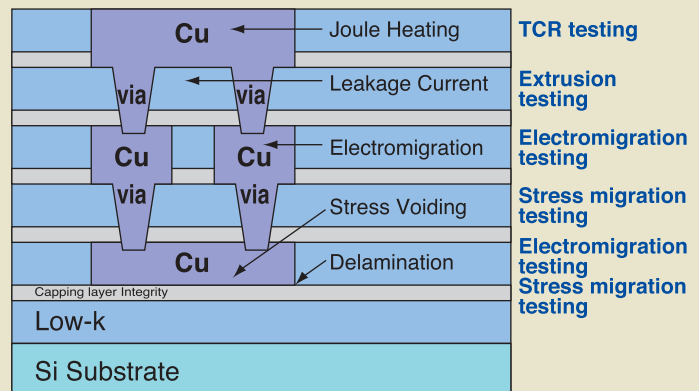
Since the ovens and tester have been combined into a single unit, up to three ovens can be stored in a single cabinet. Up to five cabinets can be controlled from a single PC, greatly reducing the space needed to evaluate large-volume specimens.

System configuration (1200ch max)



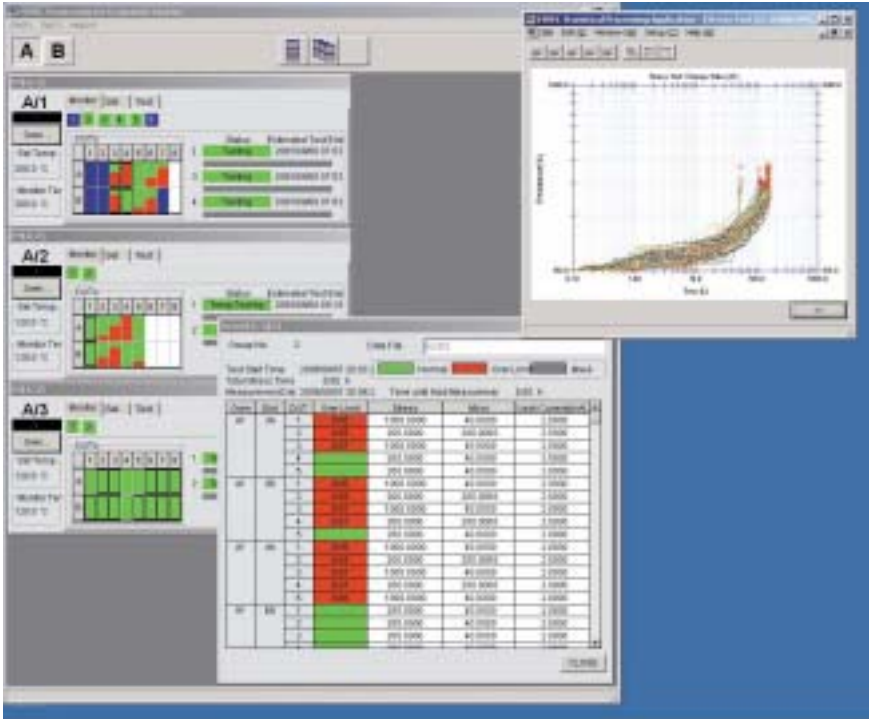
Reliability concerns for Cu Damascene

Cu damascene offers the benefits of low resistance and high reliability, but a wide range of phenomena appear in via structures linking multi-layer interconnect when subjected to thermal stress.



INSTRUMENTATION

■ Monitor screen



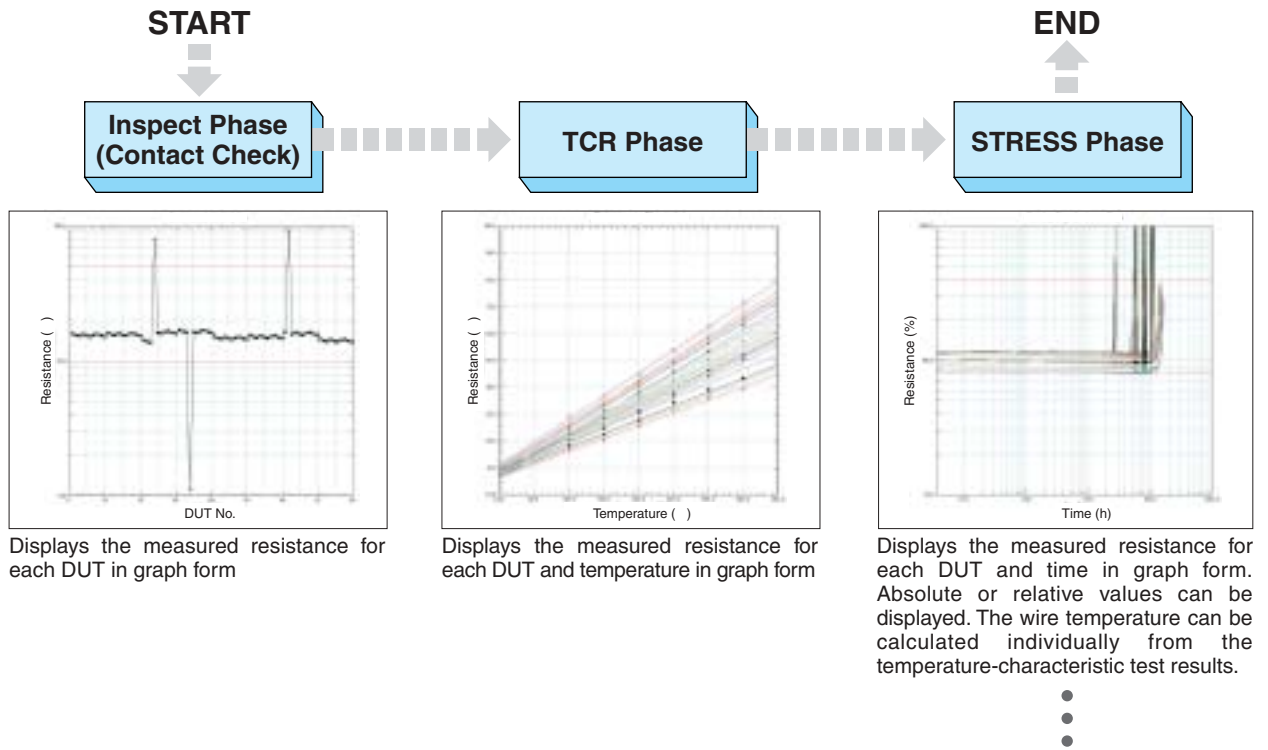
The monitor screen displays all the information needed at a glance, in a single screen in real-time. It contains multiple windows showing items such as the test progress (status) of each DUT, resistance values and rates of change (displayed graphically).

■ Test condition/ Setup

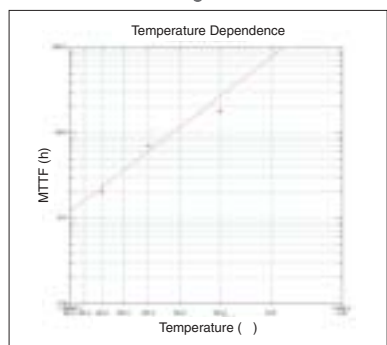
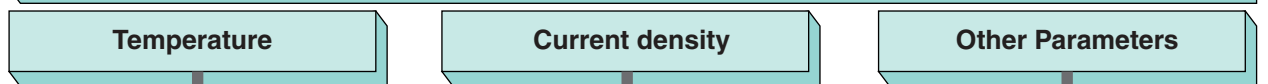


The 'Test Condition Set Up' window lets you enter and check all items in a single screen.

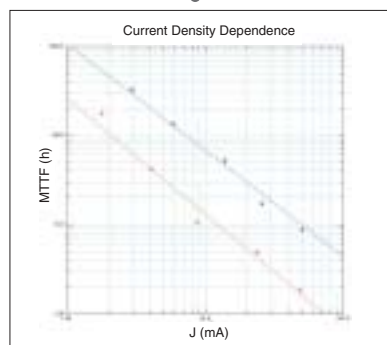
ANALYTICAL SOFTWARE



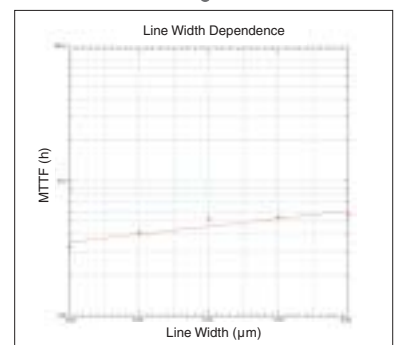
Distribution Plots (Normal/ Log Normal/ Weibull)



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)

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↓

Current density exponent

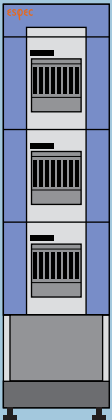
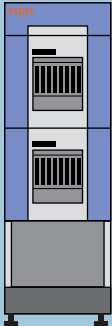
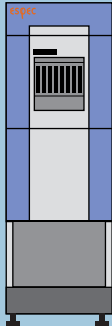
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Black's model

SPECIFICATIONS

Type of evaluation		<ul style="list-style-type: none"> • Electromigration (constant current) testing • Stress migration testing • Extrusion testing • TCR testing
Stress-current	Output range	+ 1 μ A to + 50mA DC
	Accuracy	1 μ A to 1 mA: \pm (0.2% of S.V. + 1 μ A) 1.01mA to 50mA: \pm (0.2% of S.V. + 25 μ A)
	Follow voltage	Max.35V
Extrusion test voltage	Output range	- 10V to + 20V
	Accuracy	\pm (2% of S.V. + 20mV)
Oven	Temperature range	+ 65 to + 400
	Temperature fluctuation	\pm 0.5 (+ 65 to + 350)
	Temperature uniformity	\pm 2.5 (+ 65 to + 350)
	Accessories	N ₂ gas inlet

SYSTEM VARIATION

Model		AEM-240C3 AAA	AEM-160C2 0AA	AEM-080C1 00A
EM module output current	Oven1	50mA	50mA	50mA
	Oven2	50mA	50mA	—
	Oven3	50mA	—	—
Number of test channels		240ch	160ch	80ch
DUT board	Number of board	24 (8 \times 3 Ovens)	16 (8 \times 2 Ovens)	8 (8 \times 1 Oven)
	IC sockets	5 sockets/board (both DIP 28-pin 600 mil and DIP 28-pin 300 mil)		
Power supply	Cabinet	200V AC 3 50/60Hz		
	PC unit	100V AC 1 50/60Hz		
Power consumption	Cabinet	Max. 10kW	Max. 7kW	Max. 4kW
	PC unit	350W		
Cabinet dimensions (mm)		W580 \times D1220 \times H1945	W580 \times D1220 \times H1490	
PC rack dimensions (mm)		W680 \times D640 \times H1260		
Oven configuration				



DANGER

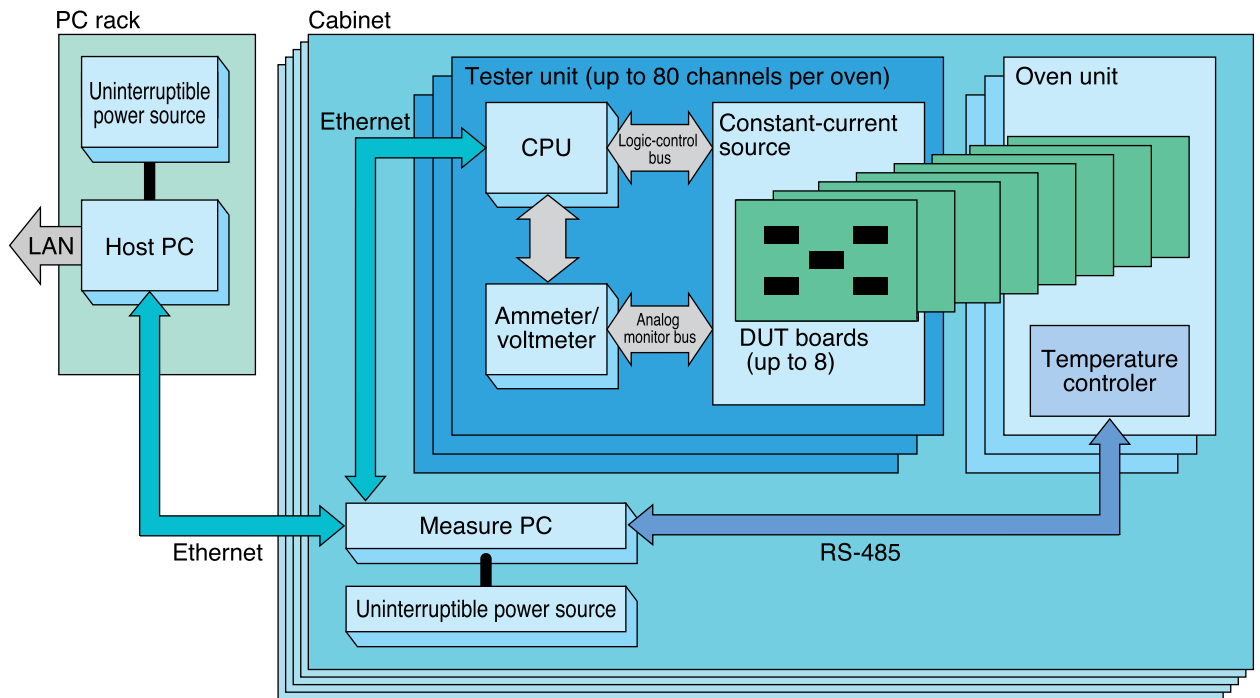
Do not use specimens which are explosive or inflammable, or which contain such substances. To do so could be hazardous, as this may lead to fire or explosion.



CAUTION

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.

SYSTEM BLOCK DIAGRAM



● PC rack

Host PC
 OS: Windows® XP
 Test setting, test monitor control and data analysis
 Uninterruptible power source
 Backup power supply for host PC

● Cabinet

Tester unit
 One constant-current-source supplies per channel which provided for the unit controlling the DUT power supply and DUT resistance measurement
 Measure PC
 Collects measured data and controls measurements
 Uninterruptible power source
 Backup power supply for measure PC
 Oven
 Temperature control range: + 65 to + 400

ACCESSORIES

DUT boards (8 per oven)
 Dummy DUT boards (4 per oven)
 Setup CD
 User's manual

SAFETY DEVICES

Leakage breaker
 Upper and lower temperature limit alarms
 Sensor burn-out detection circuit
 Overheat protector (independent type)
 Overheat protector (built inside)
 Emergency stop switch

OPTIONS

DUT board
 · for + 400 (DIP28-pin 600/ 300mil)
 · for + 250 (DIP28-pin 600mil)
 · for + 250 (DIP16-pin 300mil)
 Dumper board
 Dummy DUT board
 Resistance check board
 DUT boards safekeeping rack
 Additional statistical processing software licenses
 Spaire parts kit1
 Spaire parts kit2
 Host PC less
 Temperature recorder
 Paperless recorder (outside installation type)

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QMS Accreditation
R001



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EMS Accreditation
RE 009



ISO 9001/JIS Q 9001

Quality Management System Assessed
and Registered

ESPEC CORP. has been assessed by and registered in the Quality Management System based on the International Standard ISO 9001:2000 (JIS Q 9001:2000) through the Japanese Standards Association (JSA).

ISO 14001 (JIS Q 14001)

Environmental Management System Assessed and Registered

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ESPEC ENGINEERING CORP.
ESPEC TEST CENTER CORP.

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