

ESPEC

Electromigration Evaluation System

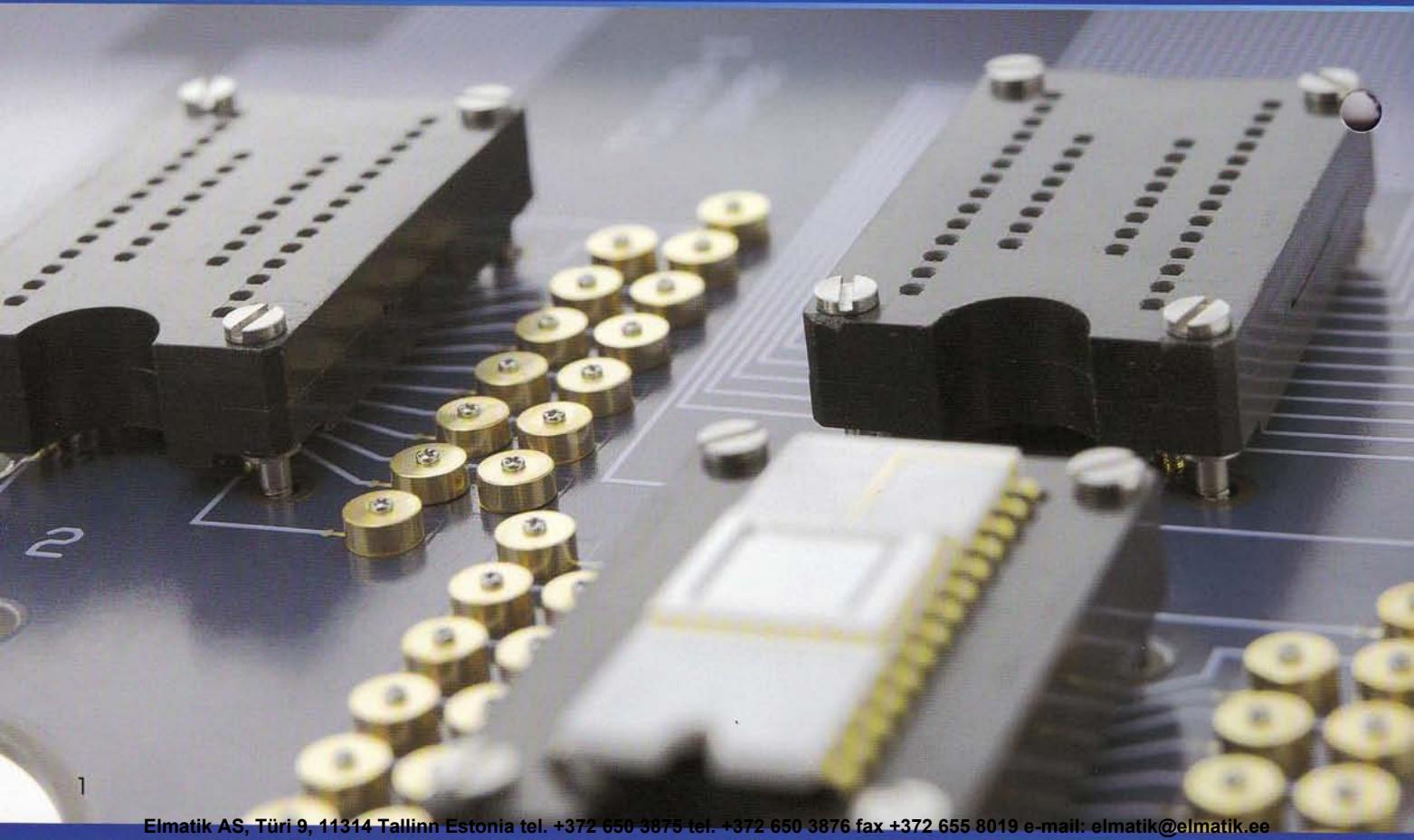
AEM-2000



CAT.NO.E05519

Electromigration testing at $1\mu\text{A}$, 400°C .

Increasing use is being made of microfabrication and new materials in order to increase the levels of performance and integration achieved with semiconductor devices. And as the operating life of devices depends on microfabrication and such new materials, it has become increasingly important to evaluate electromigration under high-precision life-acceleration conditions. High-precision control is used for the temperature (max. 400°C) and current stress that form the main factors in this life acceleration. A Black's model equation and analytical software have been provided to determine product life.



The AEM-2000 Electromigration system is the latest model in the market.
It can meet all of your Electromigration tests requirements and data analysis.
It also contains a lot of considerations from reviewing currently available systems,
including our own AEM-1000.
Easy to handle DUT's, Boards and Ovens.



Special-Features



240ch type

- **Easy operation**

DUT boards can be removed individually during test and at the end of the test. By inserting Dummy boards instead, Oven can maintain test temperature without large disturbance. It enables you to continue the test.

- **Capable of testing up to 240 channels per cabinet**

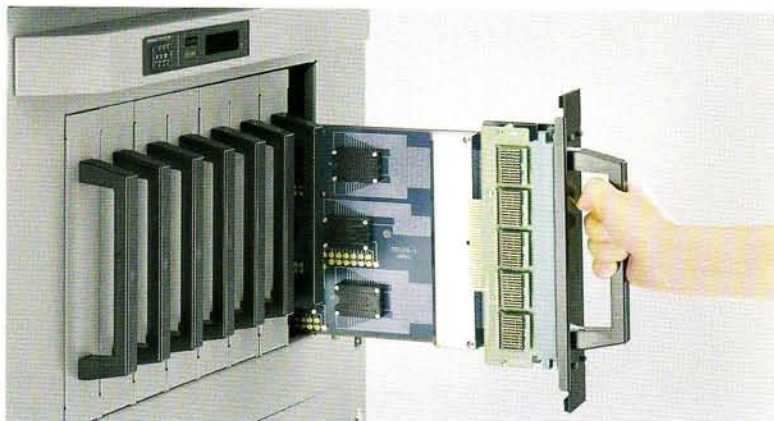
Each oven has 8 DUT Boards. Each DUT board has 5 sockets. Each socket can have 1 or 2 DUTs, thus 80 DUTs total per 1 oven. Test can be performed each 5 DUTs as smallest group so that 16 different tests conditions per oven.

- **Pin-Scramble is available**

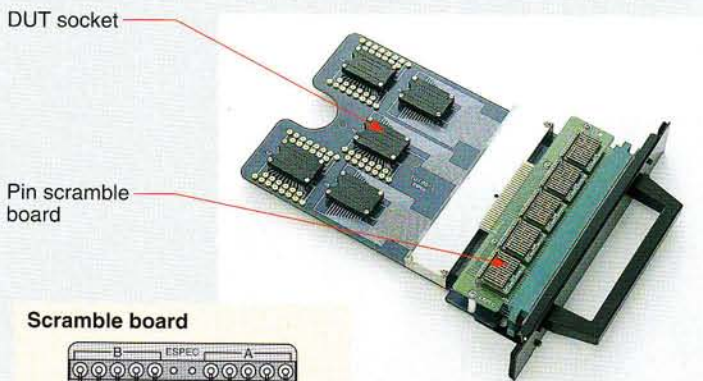
ESPEC DUT Board can accommodate any kind of Pin Assignments. "As you see", inserting various lengths of pins to create all kind of configurations.

- **Newly developed highly reliable Board and Socket**

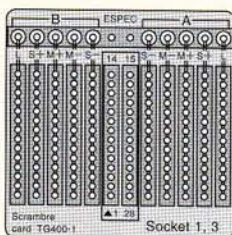
Newly developed highly reliable board and socket have "Double Contact" configuration (patent pending), enabling the connecting parts between the DUT boards and DUT sockets to be fixed firmly. In addition, a unique ESPEC arrangement is used to ensure proper connection between the DUTs and DUT sockets. This new design dramatically reduces faulty contacts at high temperatures and provides low-cost, high-cost-perfor-mance DUT boards capable of conducting testing for longer periods than previously possible.



- **DUT board**



- **Scramble board**



Special-Features

● Low-current stress from 1μA

Stress currents can be applied in a range from 1μA to 50mA in order to accommodate future wire-testing requirements. 1mA to 100mA can be used optionally. Both DIP 28-pin 600-mil and 300-mil sockets are provided.

● High-temperature 400°C high-precision oven

Capable of achieving temperatures of up to 400°C and outstanding precision, with a distribution of ±2.5°C at 350°C. Up to three ovens can be mounted in each cabinet, allowing testing under different temperature conditions each oven.

● Networking capability with PCs

Up to five cabinets can be controlled from a single PC, allowing testing of up to 1,200 DUTs (1,200 channels). This facilitates test monitoring from an office located PC remotely.

● Four types of evaluation testing

This system offers versatility, with electromigration evaluation test and other types of evaluation "stress migration testing" "TCR testing (temperature characteristics)" "Extrusion testing (leakage-current measurement)".

● Cabinet (240ch type)

No.1 Oven

No.2 Oven

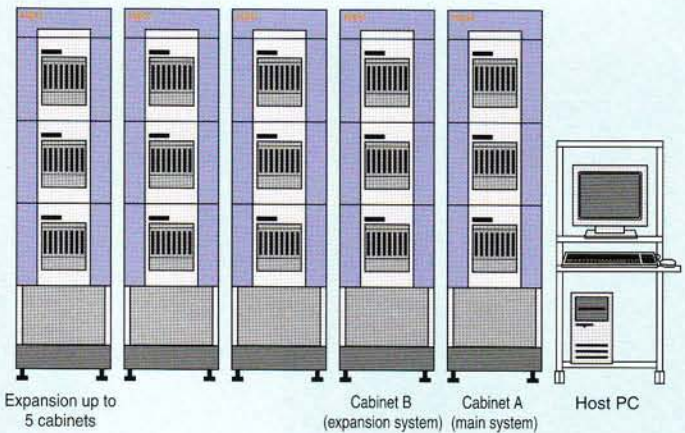
No.3 Oven

Oven

Each oven can be set temperature +65 to +400°C test Max. 80 DUTs

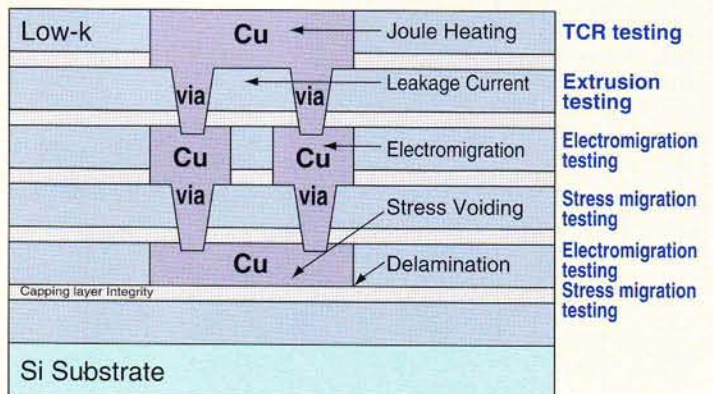


● System configuration (1200ch max)



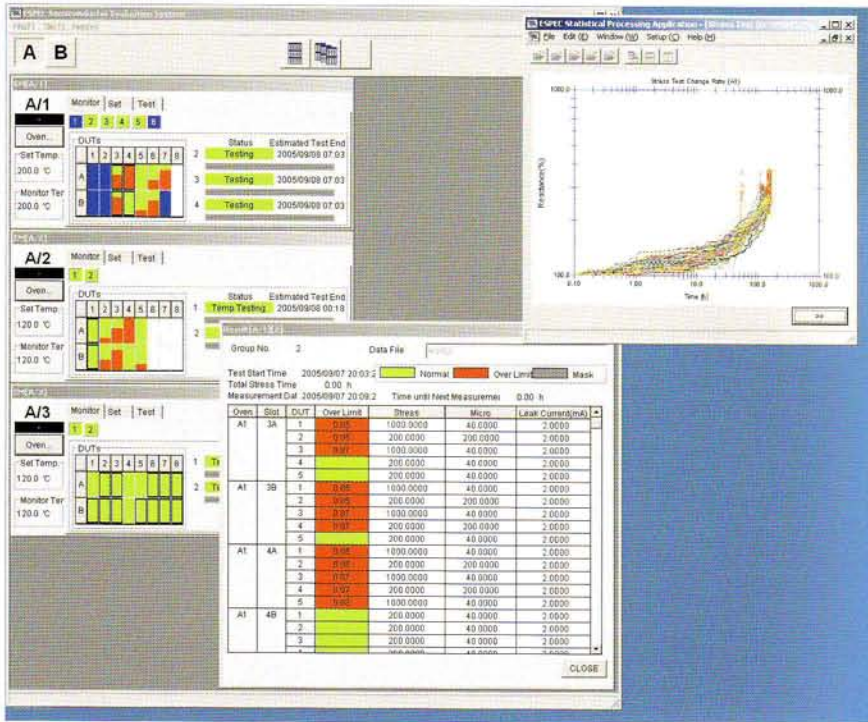
● Reliability concerns for Cu Damascene

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



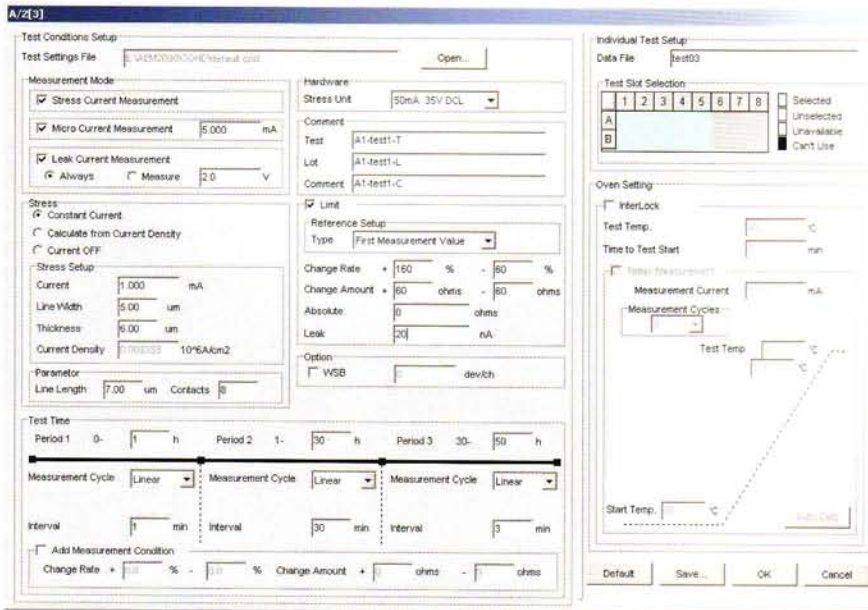
INSTRUMENTATION

● Monitor screen



Monitor Screen can provide all information you need by "Single Screen" at real time with multiple windows. Information is DUT's statuses, Resistances and Change rates with Graphical Interfaces.

● Test condition/ Setup



Engineering Mode: Test condition details can be created easily by "step by step" through this Test Condition Set Up Window. A complicated test program can also be easily created.

Operator Mode: Just pick up the test file already configured and can start the test right away.

ANALYTICAL SOFTWARE

START

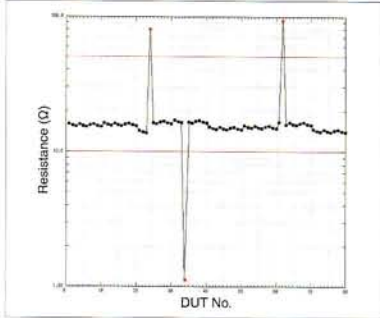
END

Inspect Phase
(Contact Check)

TCR Phase

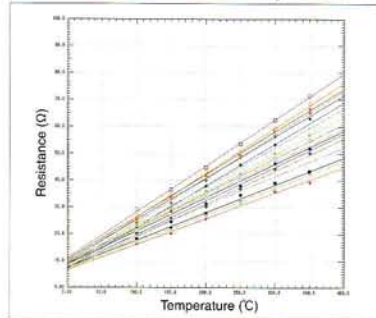
STRESS Phase

● Resistance vs DUT No.



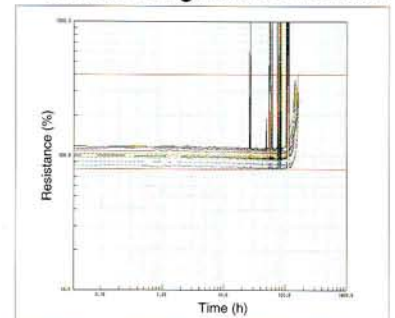
Displays the measured resistance for each DUT in graph form

● Resistance vs Temperature



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

● Relative Degradation vs TIME



Displays the measured resistance for each DUT and time in graph form. Absolute or relative values can be displayed. The wire temperature can be calculated individually from the temperature-characteristic test results.

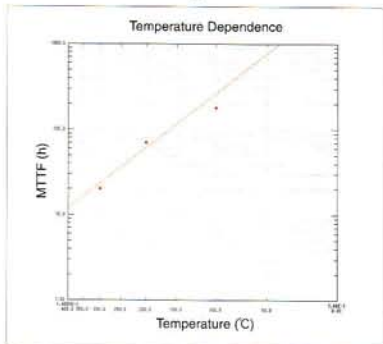
●
●
●

Distribution Plots (Normal/ Log Normal/ Weibull)

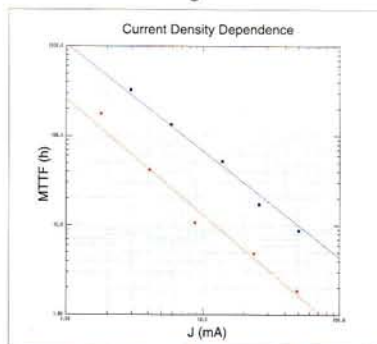
Temperature

Current density

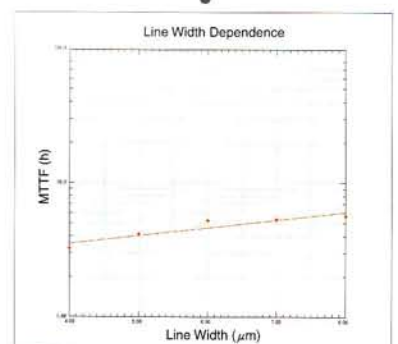
Other Parameters



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.

The linear equation

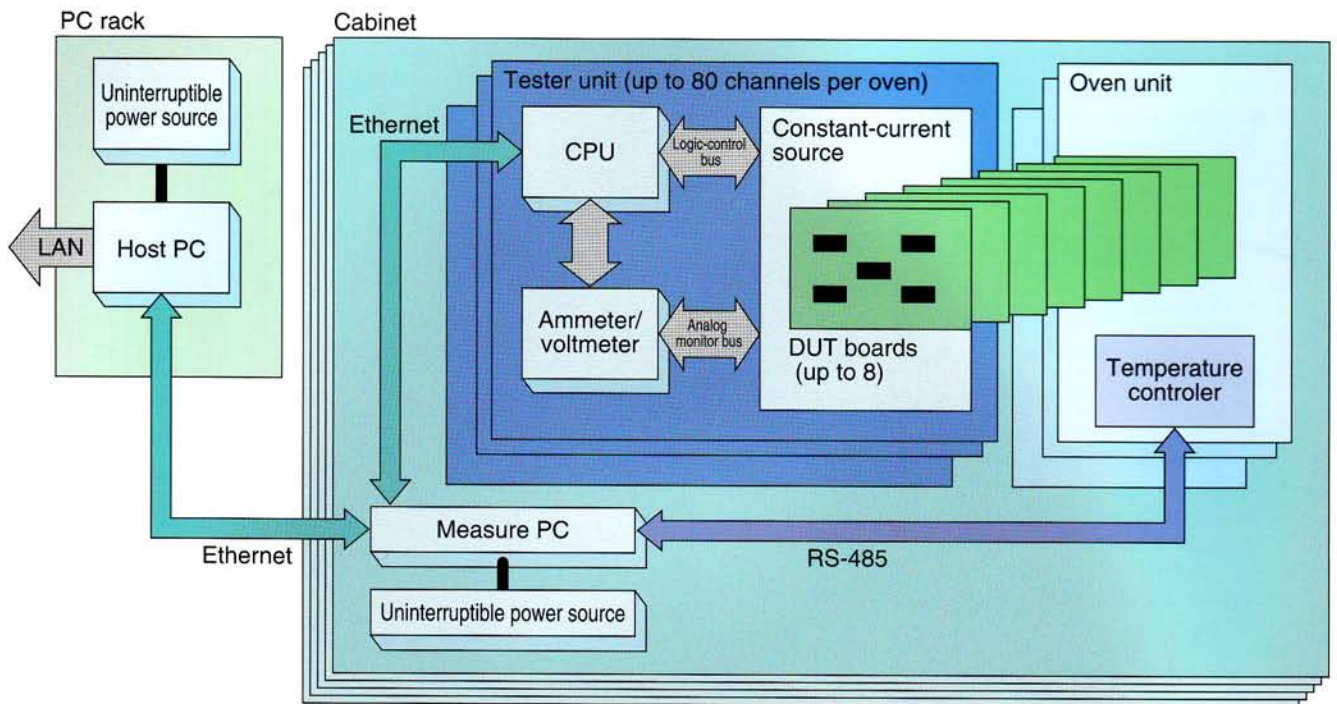
The linear equation

Activation energy (Ea)

Current density exponent

Black's model

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°C

SPECIFICATIONS

Model		AEM-2000		
Number of test channels		240ch	160ch	80ch
Number of ovens		3	2	1
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 (standard): power supply per channel		
	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 setting +20mV)		
Oven	Temperature range	+65 to +400°C		
	Temperature Uniformity	\pm 2.5°C (+50 to +350°C)		
	N ₂ gas inlet	yes		
DUT board	Number of board	24 (8 \times 3 Ovens)	16 (8 \times 2 Ovens)	8 (8 \times 1 Ovens)
	DUT sockets	5 sockets/board (both DIP 28-pin 600 mil and DIP 28-pin 300 mil)		
Cabinet dimensions		W580 \times D1220 \times H1945mm	W580 \times D1220 \times H1490mm	
PC-rack dimensions		W625 \times D632 \times H1386mm		
Power supply		200V AC 3 ϕ 50/60Hz		
Power consumption	Cabinet	Max. 10kW	Max. 7kW	Max. 4kW
	PC unit	550W		

ACCESSORIES

- Dummy DUT boards (4 per oven)
- Pin-scramble jumper pins

SAFETY DEVICES

- Leakage breaker
- Individual overheat protection
- Overheat protection (built inside)
- High and low temperature alarms
- Sensor burn-out

OPTIONS

- WSB testing
- Temp. calibration board/Resistance calibration board
- DUT board rack
- EM module (EMD100E12N10L) 100mA type
- Temperature recorder
- Center-position emergency stop switch (240ch type only)
- Power supply: 230V AC 1 ϕ 50/60Hz
- CE marking
- Step-down transformer(for 380V AC 3 ϕ 4W)

ESPEC CORP. <http://www.espec.co.jp/english>

Head Office

3-5-6, Tenjinbashi, Kita-ku, Osaka 530-8550, Japan

Tel: 81-6-6358-4741 Fax: 81-6-6358-5500

Europe Branch

Tel: 49-0-89-30765661 Fax: 49-0-89-30767573

ESPEC NORTH AMERICA, INC.

Tel: 1-616-896-6100 Fax: 1-616-896-6150

ESPEC EVALUATION & TEST SYSTEMS, INC.

Tel: 1-408-433-2295 Fax: 1-408-433-2296

ESPEC ENVIRONMENTAL EQUIPMENT (SHANGHAI) CO., LTD.

Head Office

Tel: 86-21-58303322 Fax: 86-21-58661781

BEIJING Rep. Office

Tel: 86-10-64627025 Fax: 86-10-64627036

GUANGZHOU Rep. Office

Tel: 86-20-83317826 Fax: 86-20-83317825

SHENZHEN Rep. Office

Tel: 86-755-83674422 Fax: 86-755-83674228

SUZHOU Rep. Office

Tel: 86-512-68664007 Fax: 86-512-68601994

WUXI Rep. Office

Tel: 86-510-2735036 Fax: 86-510-2735039

ESPEC TEST TECHNOLOGY (SHANGHAI) CO., LTD.

Tel: 86-21-68798008 Fax: 86-21-68798088

ESPEC (MALAYSIA) SDN. BHD.

Tel: 60-3-89451377 Fax: 60-3-89451287



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ISO 9001/JIS Q 9001
Quality Management System Assessed
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ISO 14001 (JIS Q 14001)
Environmental Management System Assessed and Registered

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