ESPEC

Ion Migration Evaluation System
AMI−U

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.
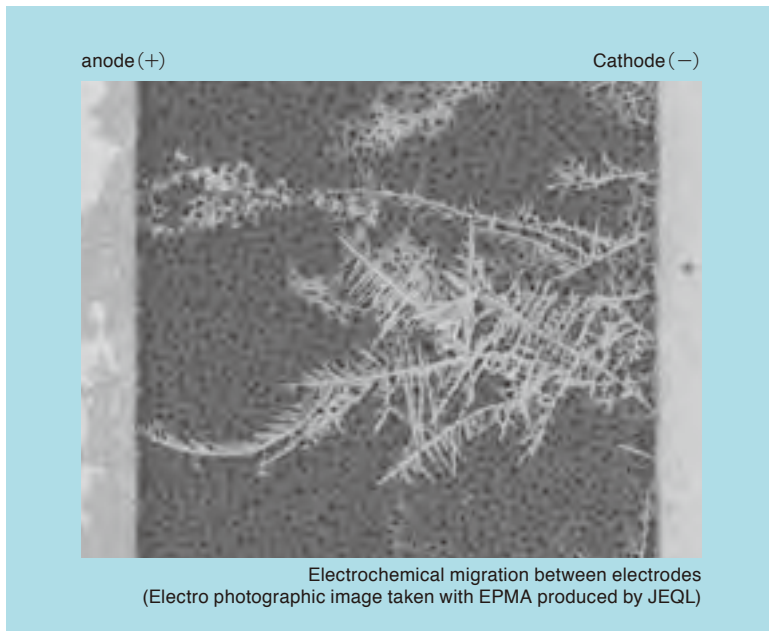
AMI

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.

anode(+)   Cathode(−)

Electrochemical migration between electrodes
(Electro photographic image taken with EPMA produced by JEQL)

Example of AMI connected with a Highly Accelerated Stress Test System (HAST Chamber)

● 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

Using an international standard traceable precision instrument guarantees the most accurate and compatible measurement data.

● 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 2×10^3 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.

AMI

Measurement equipment (Keithley Instruments, Inc.)

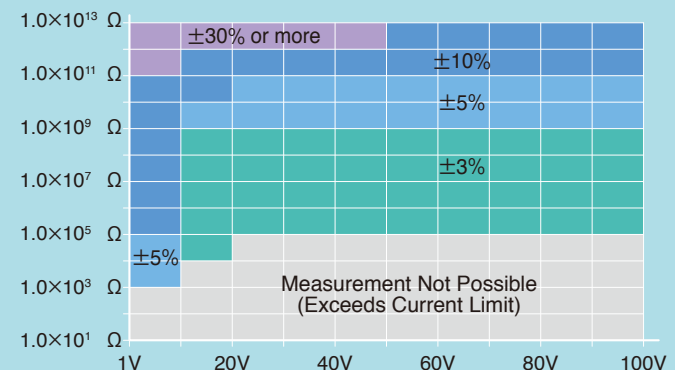### ● Measurement Accuracy Distribution Chart

Distribution of measurement accuracy at end of measurement cable

Outside temperature: Room temperature
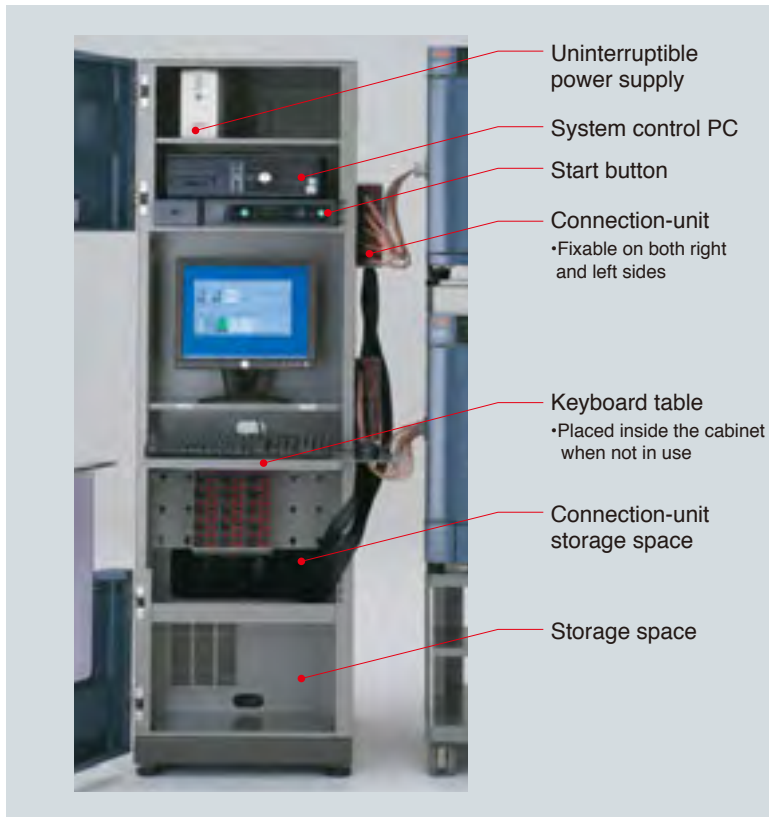Measurement mode: Long
Measurement range: AUTO
Number of averaging measurements: 4

· Values on boundary lines are either lower accuracy measurements or accuracy measurements that cannot be measured.
· The above measurement results are provided for the purposes of example. You may not be able to obtain the above measurement accuracy results depending on your system installation environment.

□ In such a small range (100fA to 5pA), interferences might appear during measurement.

Multifunction rack that pursues ease of use to improve the workability.

- Uninterruptible power supply
- System control PC
- Start button
- Connection-unit
  ·Fixable on both right and left sides
- Keyboard table
  ·Placed inside the cabinet when not in use
- Connection-unit storage space
- Storage space

System rack

Connection unit

SIR test coupon type IPC-B-24 and test board rack type A (optional)

● 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

Interaction with the environmental test chambers enables accurate measurement and makes the best use of it. AMI can be connected to up to three environmental test chambers.

● Real-time monitoring of temperature and humidity

AMI monitors and records the temp. and humid. inside the environmental test chamber. Data are recorded simultaneously with the measurement carried out by the AMI. The statistics processing software displays the recorded data in synchronization with the data of the resistance tests.

● Temperature and humidity delay-control function

When interacting with the environmental test chambers, rapidly increasing the humid. at the beginning of the test could generate dew condensation on the surface of the specimen. The temp. and humid. delay-control function, prevents the effects of the dew condensation on the specimen. Test scheduling is also available. (start, pause, and stop)

● Safety design guaranteed by abnormality detection

If a failure occurs in the environmental test chamber or inside the AMI during the test, the network system will protect the specimen against stress voltage and will save the data until the failure is found.

● Remote processing of the test data (optional)

LAN-compatible software enables remote test checking and data processing, for example from a distant office.
Additionally, we offer software licenses according to the number of users so that multiple PC monitoring is possible.

Example of AMI connected with a FreeAccess Environmental Chamber
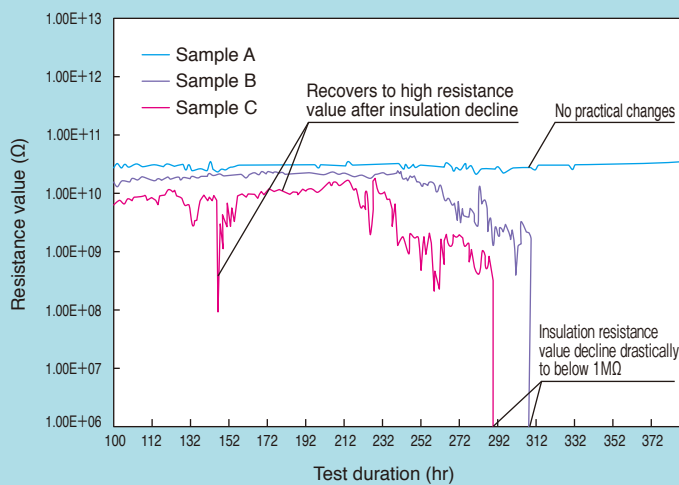
Evaluation

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℃, 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).

● Electrochemical migration test

Before starting, a preset measurement cycle (six min. minimum) is realized by the AMI, on the insulation resistance of every channel. The AMI works by one-time charging channels' voltage, thus allowing a subsequent save of time and ease of operation.

● Insulation deterioration characteristics testing

The stress voltage and measurement voltage can be set individually. The stress voltage impression and the measurement voltage can be set separately. Then after having applied the voltage at a given time, the charging time can also be determined. If no stress voltage (0V) is selected in the test conditions settings, it is possible to measure the insulation resistance of the voltage impressed at the specified time.

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Evaluation

● 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.
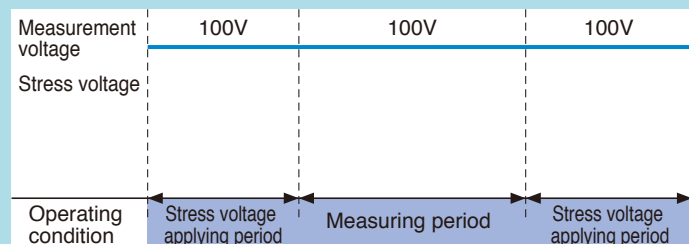
● No voltage disruption thanks to a specially designed scanner

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)
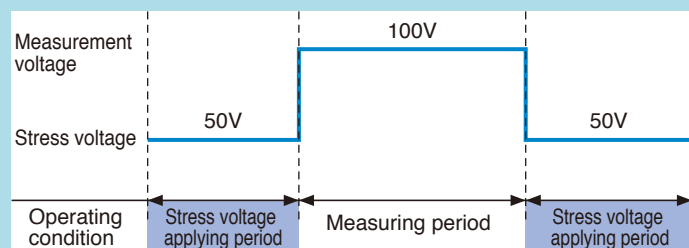
● Voltage migration image obtained by continuous power supply scanner operation technology

● Stress voltage (100V), measurement voltage (100V)
In the measuring mode of continuously applied stress voltage

Measurement voltage	100V	100V	100V
Stress voltage			
Operating condition	Stress voltage applying period	Measuring period	Stress voltage applying period

● Stress voltage (50V), measurement voltage (100V)

Measurement voltage		100V	
Stress voltage	50V		50V
Operating condition	Stress voltage applying period	Measuring period	Stress voltage applying period

—— Voltage that is actually applied onto the specimen

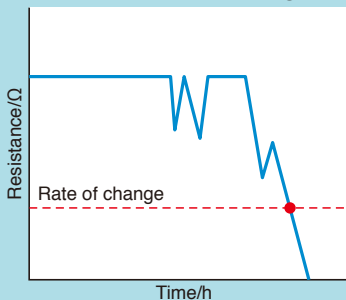▨ Accumulated stress voltage applying time (test time)

There are two recognition methods for all kind of failure.

Limit recognition

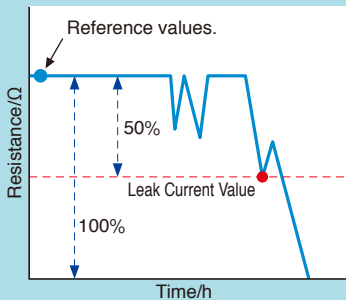By setting an absolute value, a change rate (%), or changing the amount.

These three failure criteria can be used to set the threshold of your test, on each channel.

● **With absolute value setting**

Absolute Value:
Allows you to set an absolute value at which the AMI will recognize a failure.

● **With change rate setting**

Sets the initial resistance measurement as a base value, and thereafter recognizes failure based on a percentage of the initial value.
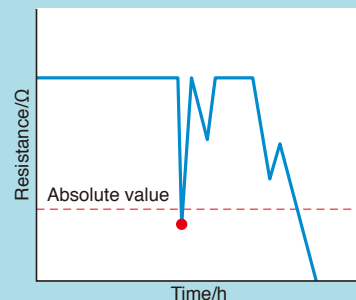
Leak Touch detection recognition

■ **"Leak Touch" detection and recognition**

Between the measurement interval, the leak detector can identifies any small leak on each sample by their stress voltage. You can set any amount of leak current that AMI will then recognize as a failure. It is a circuitry totally apart from the measurement.

(The evaluation is performed using a separate circuit from the one used for periodic measurement. The leak current can be set between 1 and 500 μA.)

● **With Leak Touch detection setting**

The Leak Touch detection and recognition instantly detects leakage occurences between samples, and completes the measurement.

■ **Leak Touch observation mode**

This mode allows to catch the ion migration, and observe the dendrites that appears 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.)

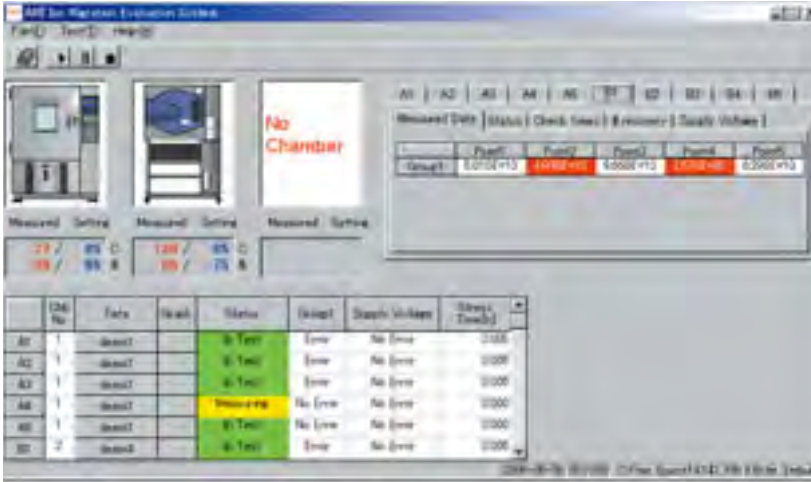● **In the case where a failure is detected**
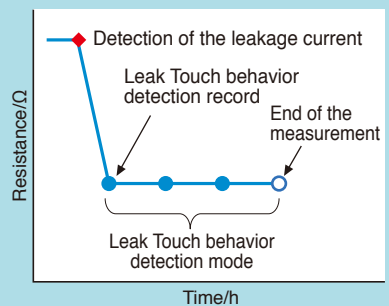
● **In the case where the resistance value returns to normal during behavior detection**
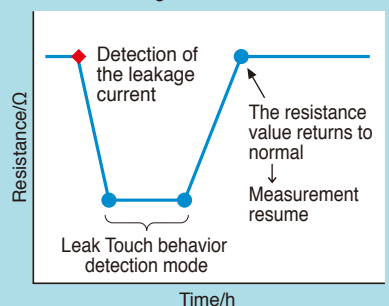
◆ Real-time detection point of leakage current
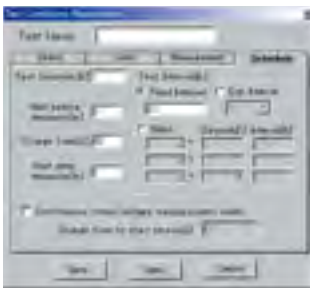(detection sensitivity 100μsec/ch)

● **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
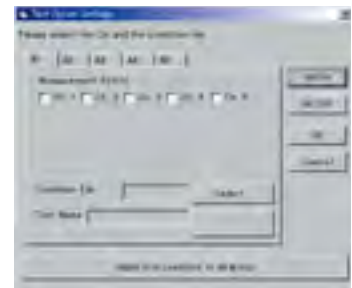 ・Limit value...
Registration in a file.

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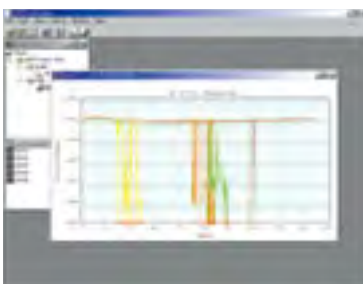
Current test data and previous data are displayed on graphs.
Graph can be arranged by selecting the channel, display setting, and cursor display.

● **Data display**

Displays current test data and previous data.

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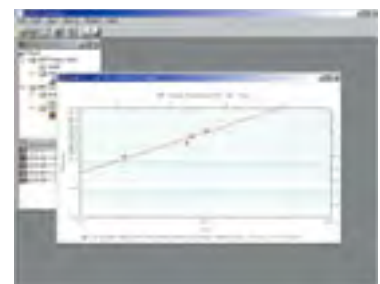
Data-processing software (with a statistical processing function) enables Weibull analysis of test data, as well as regular probability plotting, and logarithmic probability trend curves.

SPECIFICATIONS

Type			Stress constant voltage 100 V		Stress constant voltage 300 V (optional)		Stress constant voltage 500 V (optional)	
Channel configuration			Standard 25ch. (max. 150ch per rack)		Standard 25ch. (max. 150ch per rack)			
Control channel			5ch	25ch	5ch	25ch	5ch	25ch
Software			Windows® XP		Windows® XP			
Measurement	Resistance evaluation and measurement time	Stress power supply — Stress constant voltage	Not applied/ 1 to 100 V DC		Not applied/ 1 to 300 V DC		Not applied/ 1 to 500 V DC	
		Min. set voltage resolution	0.1 V (1 to 100 V, individually able to set from the measurement voltage)		0.1 V (set at 1 to 200 V) 1.0 V (set at 200 to 300 V)		0.1 V (set at 1 to 200 V) 1.0 V (set at 200 to 500 V)	
		Applied voltage accuracy	0.1fA to 20mA (resolution: 0.1fA)		0.1fA to 20mA (resolution: 0.1fA) *2			
		DC measurement range *1	500 μA to less than or equal to10 pA		500 μA to less than or equal to 10 pA			
		Resistance measurement range	2×10^5 to 1×10^{13} (when applying 100 V) 2×10^3 to 1×10^{11} (when applying 1 V)		2×10^5 to 1×10^{13} (when applying 300 V) 2×10^3 to 1×10^{11} (when applying 1 V)		2×10^5 to 1×10^{13} (when applying 500 V) 2×10^3 to 1×10^{11} (when applying 1 V)	
		Measurement accuracy *1	$\pm$1.015% (20pA range, full scale)		$\pm$1.015% (20pA range, full scale)			
		Measurement voltage	1 to 100 V DC (0.1 V step)		1 to 300 V DC (1 to 200 V DC: 0.1 V step) (200 to 300 V DC: 1.0 V step)		1 to 500 V DC (1 to 200 V DC: 0.1 V step) (200 to 300 V DC: 1.0 V step)	
		Measurement time (1 time) *3	15 sec. + charging time	80 sec. + charging time	15 sec. + charging time	80 sec. + charging time	15 sec. + charging time	80 sec. + charging time
	Leak Touch detection		Normal 100 μ sec / less than or equal to specified number of detections on channel basis		Normal 100 μ sec / less than or equal to specified number of detections on channel basis			
Measurement cable	Type	+side	Single cable		Heat-resistant single cable			
		−side	Coaxial cable (one-layer shield)		Coaxial cable (one-layer shield)			
	Coated material		Teflon (heat resistance of + 150℃)		Teflon (heat resistance of + 150℃)			
	Length		Connects the scanner unit and connection unit: 2.5 m Beyond connection unit : 1.5 m		Connects the scanner unit and connection unit: 2.5 m Beyond connection unit : 1.5 m			
Connection unit			25-channel connection Coaxial connector		25-channel connection +side: Metallic outlet −side: Square type coaxial connector			
Measuring equipment			Model: 6514 (Keithley Instruments, Inc.)		Model: 6514 (Keithley Instruments, Inc.)			
External dimension			W530 × H1750 × D940 mm		W530 × H1750 × D940 mm			
Power supply facility			100 V AC, 1ϕ, 10.0 A 120 V AC, 1ϕ, 8.3 A 220 V AC, 1ϕ, 4.5 A 240 V AC, 1ϕ, 4.2 A		100 V AC, 1ϕ, 10.0 A 120 V AC, 1ϕ, 8.3 A 220 V AC, 1ϕ, 4.5 A 240 V AC, 1ϕ, 4.2 A			

*1 The measurement accuracy and the DC measurement range are only applicable to the measuring equipment.
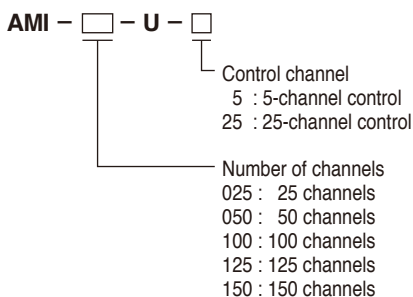 For the measurement accuracy in the whole system, please refer to the Measurement Accuracy Distribution Chart on page 4.
*2 The connection unit for applied high voltage is equipped with 1 kΩ resistors in series on the positive side of the applied voltage.
 A slight voltage drop may occur depending on 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.

MODEL

AMI − ☐ − U − ☐

└ Control channel
  5 : 5-channel control
  25 : 25-channel control

└ Number of channels
  025 : 25 channels
  050 : 50 channels
  100 : 100 channels
  125 : 125 channels
  150 : 150 channels

ACCESSORIES

• Measurement cable
• Communication cable (RS-485)
• Setup CD
• User's manual

SYSTEM CONFIGURATION DIAGRAM

System rack

Environmental test chamber
(sold separately)
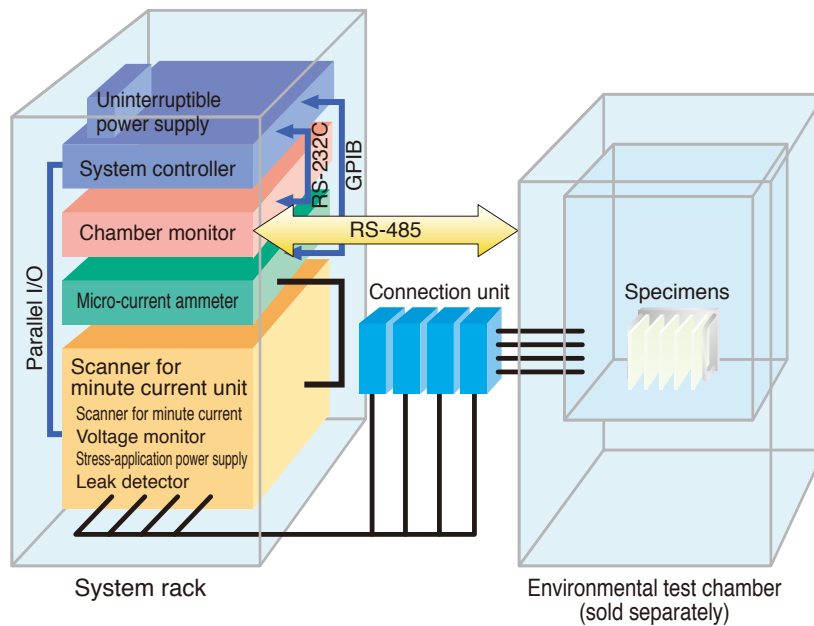
OPTION

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.

Board holder

We offer a variety of jigs for securing samples such as boards. (Connection terminal: screw-type)

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.

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 1μA at 400℃.

■ **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)

Temperature (& Humidity) Chamber
Platinous K Series

Model	Temperature range	Humidity range	Inside capacity (L)
PR	−20 to +100℃	20 to 98%rh	120、225、408、800
	−20 to +150℃		
PL	−40 to +100℃		
	−40 to +150℃		
PSL	−70 to +100℃		306、800
	−70 to +150℃		
PH	+10 to +100℃	60 to 98%rh	120、225、408、800

FreeAccess Environmental Chamber

Model	Temperature range	Humidity range	Inside capacity (L)
PFL-3K	−40 to +100℃	20 to 98%rh	306
PFL-3KH	−40 to +150℃		

Bench-Top Type
Temperature (& Humidity) Chamber

Model	Temperature range	Humidity range	Inside capacity (L)
SH-221	−20 to +150℃	30 to 95%rh	22.5
SH-241	−40 to +150℃		
SH-261	−60 to +150℃		
SH-641	−40 to +150℃		64
SH-661	−60 to +150℃		

Highly Accelerated Stress Test System
(HAST Chamber)

Model	Temp./ humid./ pressure range	Inside capacity (L)
EHS-211(M)	+105 to +142.9℃ / 75 to 100%rh 0.020 to 0.196Mpa (0.2kg to 2.0kg/cm^2)	18
EHS-221(M)		46
EHS-411(M)	+105 to +162.2℃ / 75 to 100%rh 0.020 to 0.392Mpa (0.2kg to 4.0kg/cm^2)	18

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

ESPEC NORTH AMERICA, INC.
Tel : 1-616-896-6100   Fax : 1-616-896-6150

ESPEC EUROPE GmbH
Tel : 49-89-1893-9630   Fax : 49-89-1893-96379

ESPEC ENVIRONMENTAL EQUIPMENT (SHANGHAI) CO., LTD.
Head Office
Tel : 86-21-51036677   Fax : 86-21-63372237
BEIJING Branch
Tel : 86-10-64627025   Fax : 86-10-64627036
TIANJIN Branch
Tel : 86-22-26210366   Fax : 86-22-26282186
GUANGZHOU Branch
Tel : 86-20-83317826   Fax : 86-20-83317825
SHENZHEN Branch
Tel : 86-755-83674422 Fax : 86-755-83674228
SUZHOU Branch
Tel : 86-512-68028890 Fax : 86-512-68028860

ESPEC TEST TECHNOLOGY (SHANGHAI) CO., LTD.
Tel : 86-21-68798008   Fax : 86-21-68798088

ESPEC (MALAYSIA) SDN. BHD.
Tel : 60-3-8945-1377   Fax : 60-3-8945-1287

QMS
JIS Q 9001
JSAQ 004

JAB
CM001

JAB
CM021

ISO 14001
JACO
EC99J2046

UKAS
ENVIRONMENTAL
MANAGEMENT
051

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 9001:2008 (JIS Q 9001:2008) through the Japanese Standards Association (JSA).

ISO 14001 (JIS Q 14001)
Environmental Management System Assessed and Registered
ESPEC CORP.

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