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.
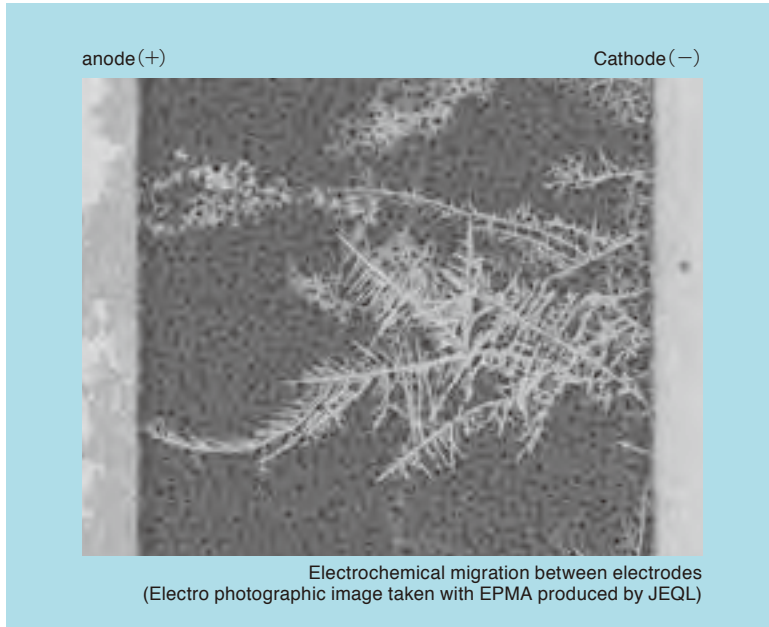
AMI

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

3

Utility

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.)

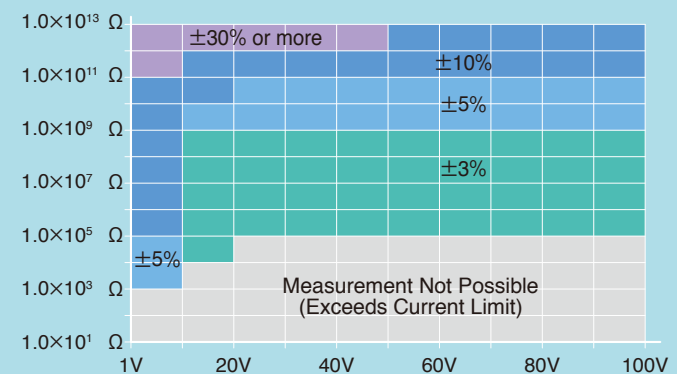### ● Measurement Accuracy Distribution Chart
Distribution of measurement accuracy at end of measurement cable

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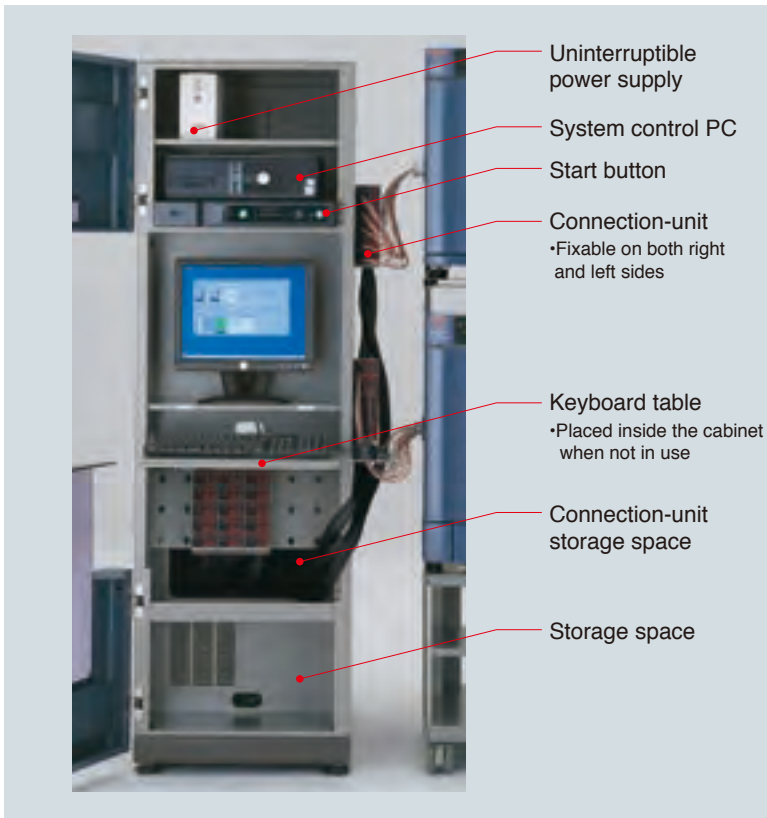Measurement mode: Long   Number of averaging measurements: 4

1.0×10^{13} Ω $\pm$30% or more $\pm$10%
1.0×10^{11} Ω $\pm$5%
1.0×10^{9} Ω
1.0×10^{7} Ω $\pm$3%
1.0×10^{5} Ω
$\pm$5%
1.0×10^{3} Ω Measurement Not Possible (Exceeds Current Limit)
1.0×10^{1} Ω
1V   20V   40V   60V   80V   100V

· 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
- Real-time monitoring of
  temperature and humidity
- Temperature and humidity
  delay-control function
- Safety design guaranteed by
  abnormality detection
- Remote processing of
  the test data (optional)

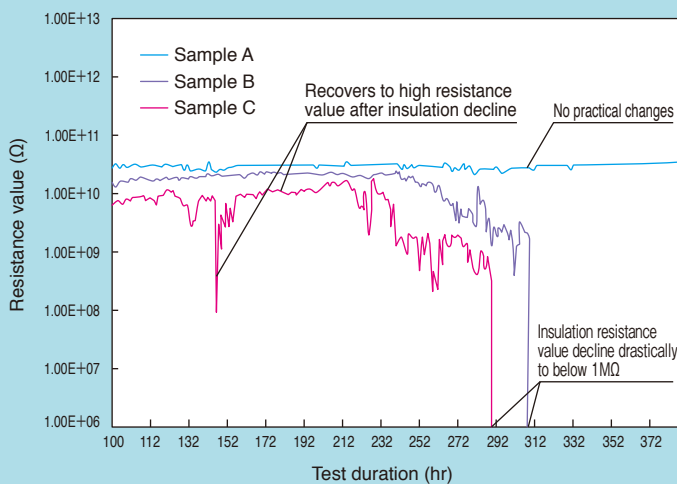Example of AMI connected with a FreeAccess Environmental Chamber

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

Sample A
Sample B
Sample C

Recovers to high resistance value after insulation decline

No practical changes

Insulation resistance value decline drastically to below 1MΩ

Resistance value (Ω)

1.00E+13
1.00E+12
1.00E+11
1.00E+10
1.00E+09
1.00E+08
1.00E+07
1.00E+06

100 112 132 152 172 192 212 232 252 272 292 312 332 352 372

Test duration (hr)

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**
● **Insulation deterioration characteristics testing**

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.
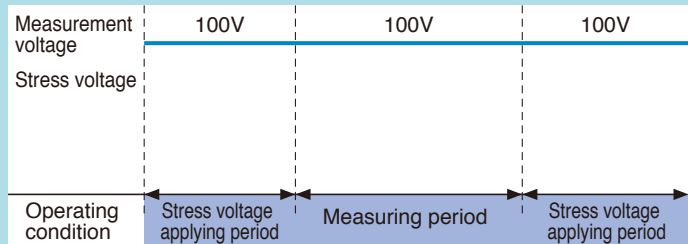
No voltage disruption thanks to a specially designed scanner

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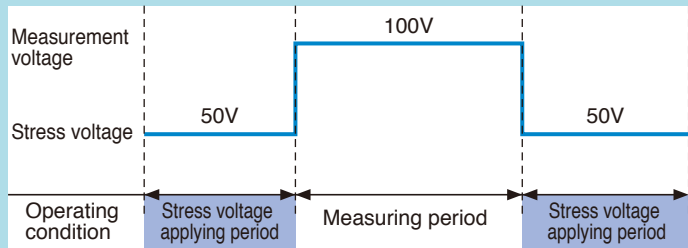
● Voltage migration image obtained by continuous power supply scanner operation technology

● 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

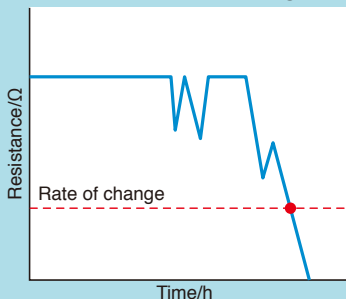▨ Accumulated stress voltage applying time (test time)

There are two recognition methods for all kind of failure.

Limit recognition

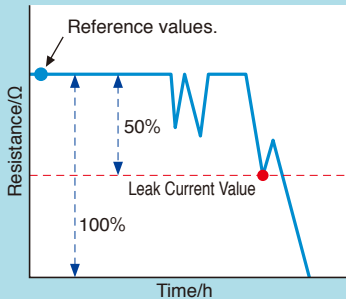By setting an absolute value, a change rate (%), or changing the amount.
These three failure criteria can be used to set the threshold of your test, on each channel.

● **With absolute value setting**

Absolute Value:
Allows you to set an absolute value at which the AMI will recognize a failure.
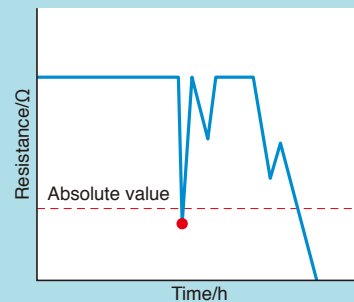
● **With change rate setting**

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**
μ

● **With Leak Touch detection setting**

The Leak Touch detection and recognition instantly detects leakage occurences between samples, and completes the measurement.
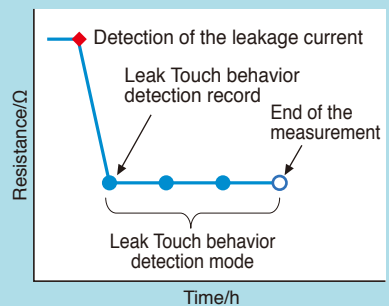
■ **Leak Touch observation mode**
This mode allows to catch the ion migration, and observe the dendrites that appears during conductances.
Measurement criteria can be set, such as the failure detection threshold, number of times for the detection or else the recovery time.
(The leak current can be set between 1 and 500 μ A.)

● **In the case where a failure is detected**

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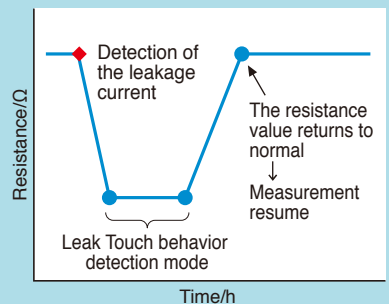
◆ Real-time detection point of leakage current
(detection sensitivity 100μsec/ch)

9

● 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)

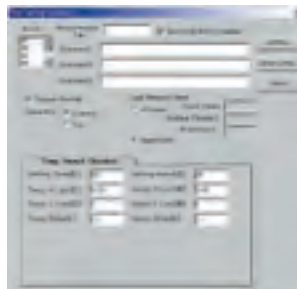* The picture shows AMI-075-U-5.

● Test condition registration

Parameters:
 · Test Duration setting
 · Interval
 · Measurement voltage
 · Limit value...
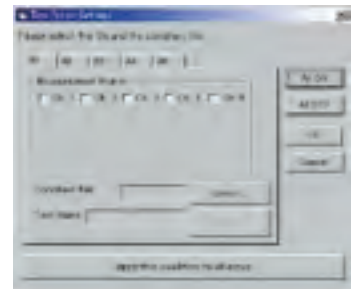Registration in a file.

● Test setting

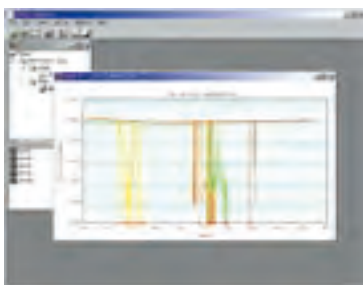On this screen, (image above), test settings can be registered:
 · Test module
 · Files' names setting/ saving
 · Interaction
   (select the chamber which it works with)
 · Text data output option
 · Leak Touch detection mode...

● Test details

Select test channels and conditions. (From test conditions already registered in files)

● Graphic display

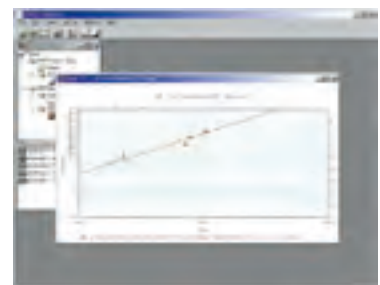Current test data and previous data are displayed on graphs.
Graph can be arranged by selecting the channel, display setting, and cursor display.

● 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 7		Windows 7			
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 to10 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.
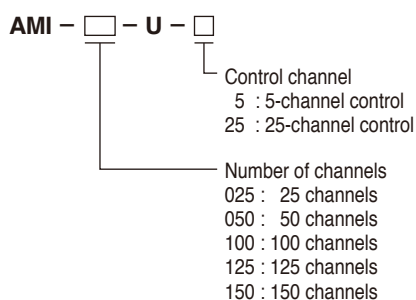　For the measurement accuracy in the whole system, please refer to the Measurement Accuracy Distribution Chart on page 4.
*2 The connection unit for applied high voltage is equipped with 1 kΩ resistors in series on the positive side of the applied voltage.
　A slight voltage drop may occur depending on the current flow through specimens. This voltage drop is not included in the applied voltage accuracy.
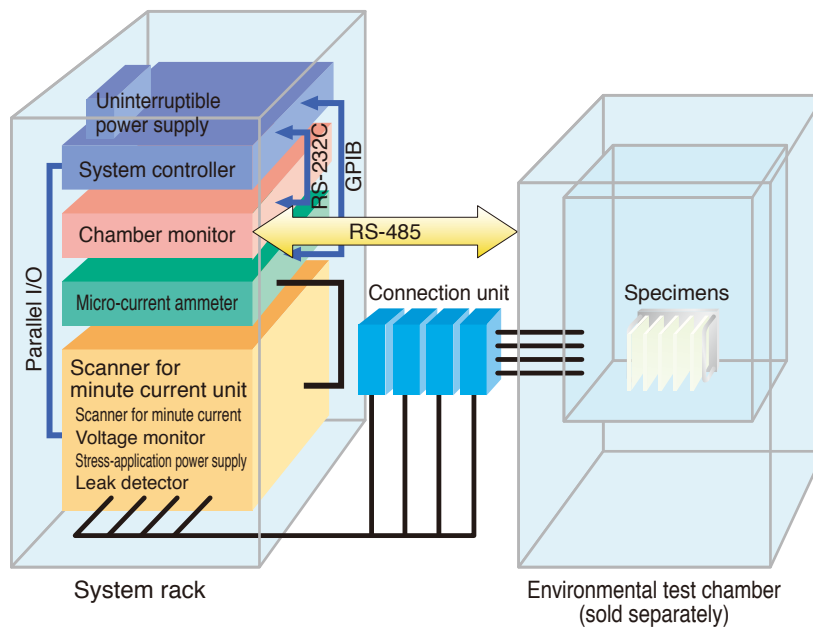*3 The charging time will be zero in the stress voltage full-time measurement mode.

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 rack

Uninterruptible power supply
System controller
Chamber monitor
Micro-current ammeter
Scanner for minute current unit
Scanner for minute current
Voltage monitor
Stress-application power supply
Leak detector

Parallel I/O

RS-232C
GPIB
RS-485

Connection unit
Specimens

Environmental test chamber (sold separately)

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 $1\mu A$ at $400°C$.

■ **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	18
EHS-221(M)	0.020 to 0.196Mpa (0.2kg to 2.0kg/cm^2)	46
EHS-411(M)	+105 to +162.2℃ / 75 to 100% rh	18
	0.020 to 0.392Mpa (0.2kg to 4.0kg/cm^2)	

QMS
JIS Q 9001
JSAQ 004

JAB
CM001

JAB
CM021

ISO 14001
JACO
EC99J2046

UKAS
MANAGEMENT
SYSTEMS
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.

● Specifications are subject to change without notice due to design improvements.
● Corporate names and trade names mentioned in this catalog are trademarks or registered trademarks.