

# SIR 13

*SIR 13 mini*

**New Release!**



## **Insulation Degradation Evaluation System**

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- A reliability evaluation which requires many specimens and characteristics evaluation (an ammeter/voltmeter per specimen) can be simultaneously performed.
- The continuous automatic measurement within the chamber allows accurate detection of the beginning and ending of ion migration.
- The system is designed for 3-way use, namely ion migration detection, insulation resistance measurement, and insulation characteristics evaluation.

**By selecting the necessary measurement boards, the system will perform ion migration detection, insulation resistance measurement, and insulation characteristics evaluation at the same time.**

**The 3-way use evaluation system: ion migration detection, insulation resistance measurement, and insulation characteristics evaluation**

In 1994, ETAC released the industry's first automatic measurement system, "SIR 10" which electrically captures the phenomena of ion migration. Since then, we have been continually improving the system and in 2005, it has evolved into the "SIR 13" and "SIR 13 mini". With the improvement, these systems can now be used for various applications including insulation characteristics evaluation at material development phase, in addition to the measurement of insulation deterioration which is typified by migration phenomenon.



SIR 13 mini  
+  
HAST chamber  
"PLAMOUNT (PM420)"

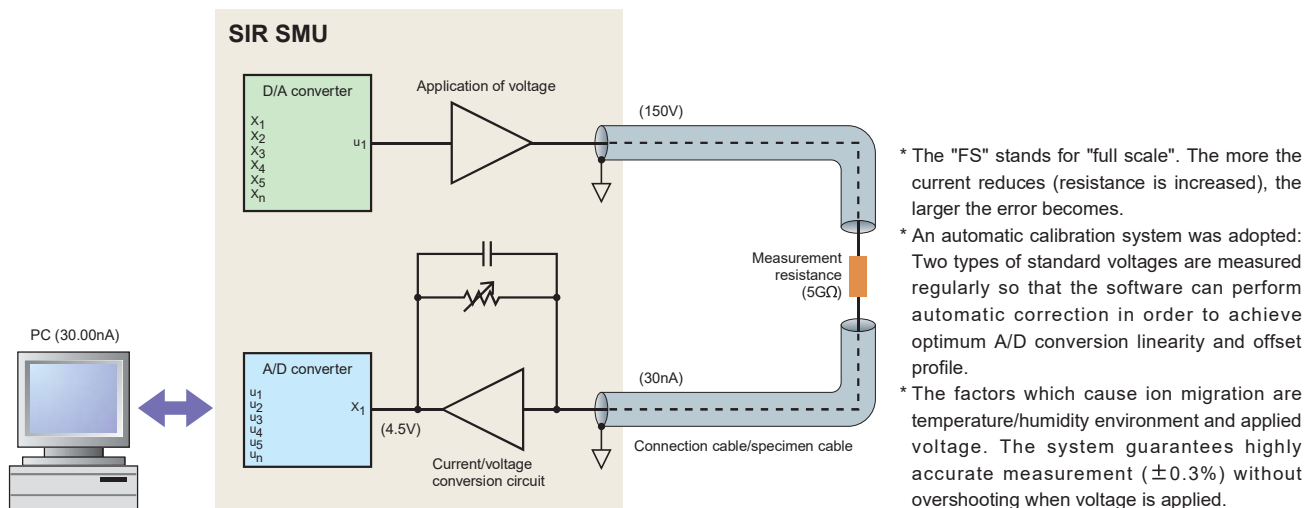
SIR 13 mini  
+  
Temperature/humidity chamber  
"Keyless HIFLEX (TH 402A)"

SIR 13  
+  
Temperature/humidity chamber  
"Keyless HIFLEX (TH 403A)"

## Main features

- 1) New measurement board (120V) which is equipped with a power supply and an ammeter (an ammeter per specimen) per measurement circuit was developed (applied voltage: 120V, with specimen disconnection alarm function based on 8 channels, a four-wire Kelvin bridge method). Test conditions can be changed per channel and multiple tests with different conditions (up to 48 conditions) can be performed at the same time.
- 2) Multiple measurement boards with different applied voltage (120V, 250V, 500V, 1KV) can be simultaneously measured.
- 3) With the improved PC screens switching speed and the development of multi-tasking screen software, the data recording can be speedily performed during the test or after the test.
- 4) The system is designed for 3-way use, namely ion migration detection, insulation resistance measurement, and insulation characteristics evaluation.

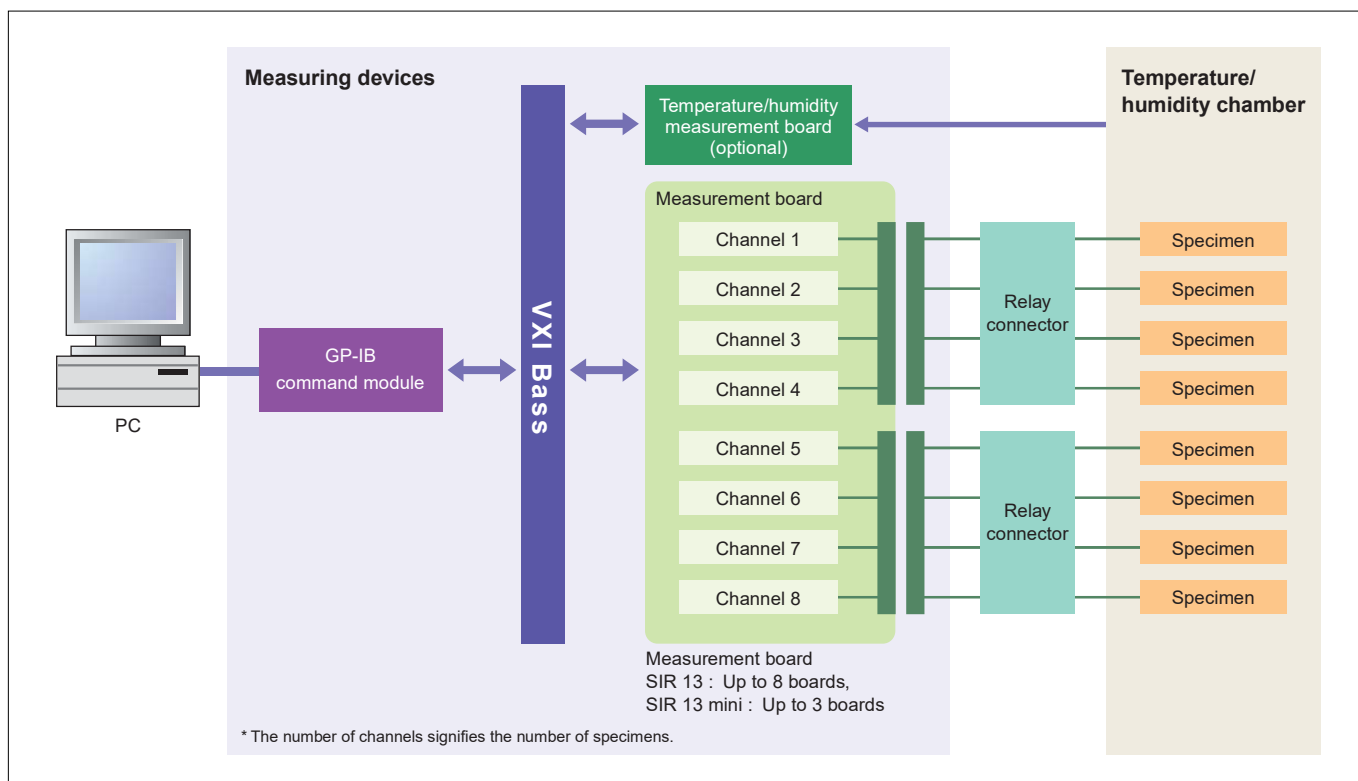
### • Micro current measurement method which achieves the measurement accuracy of $\pm 0.3\%$ (FS)



### • A constant measurement interval of 40msec was achieved regardless of the number of specimens

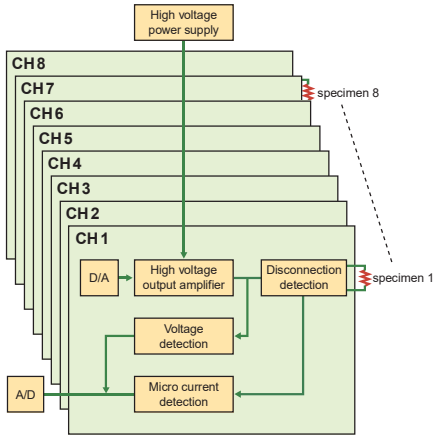
In order to eliminate a humming sound, measurements are carried out 8 times within the 2 power source cycle time (50/60Hz) and the measurement data are obtained by averaging these values. ( $1/50\text{Hz} = 20\text{msec}$ ,  $20\text{msec} \times 2$  power source cycle time = 40msec)  
 Because high-speed voltage/current measurement (A/D conversion) of 8 channels are carried out 8 times each within 40msec, the measurement interval of 40msec is maintained regardless of the number of specimens (8 channels to 128 channels).

## Basic configuration



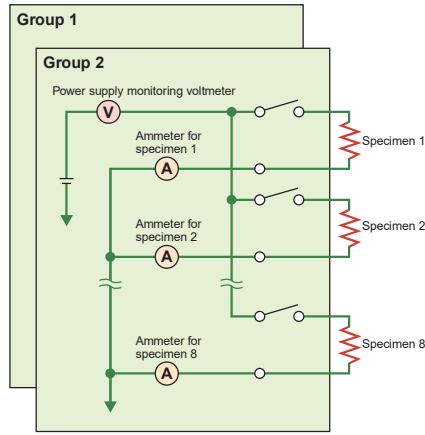
# Types of measurement board and measurement circuit

## • 120V board



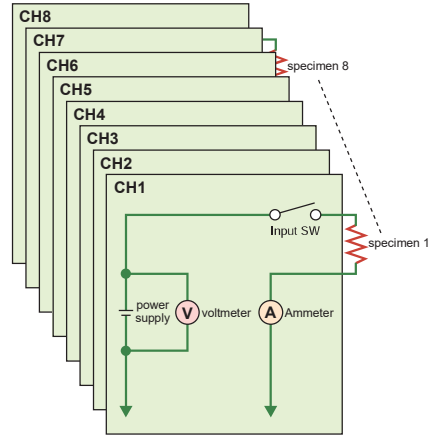
- Maximum 8 channels. A DC voltage generator and a DC ammeter come with every channel. Different test conditions can be set for each channel. Suitable for materials evaluation which requires performing multiple tests with different settings.
- DC four-wire Kelvin bridge method to detect specimen connection error. (Measurement can also be made through two-wire connection.)
- Voltage range: 120.00V/12.00V (set to the best range automatically)
- Current range: 320.00 $\mu$ A/3.2000 $\mu$ A/32.000nA/auto range

## • 250V board



- Maximum 16 channels, 8 channels per group. A DC voltage generator comes with every group and a DC ammeter comes with every channel. Useful for an evaluation of components which need to be tested in large quantity or a certification evaluation, etc.
- Voltage range: 250.00V
- Current range: 320.00 $\mu$ A/3.2000 $\mu$ A/auto range
- \* Because multiple channels in a group share the same power supply, if a current limiter is activated on a certain channel, applied voltage on other channels may be reduced temporarily. However, by specifying the voltage error channel (defective specimen) using the current check function, tests of other channels will be continued without interruption.

## • 500V/1KV board



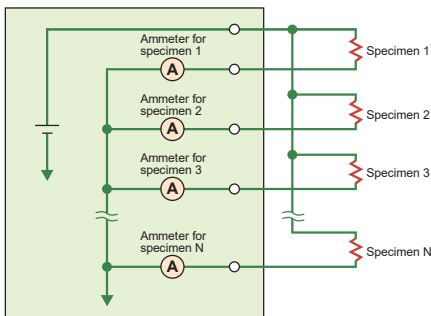
- Maximum 8 channels. Eight channels per group. A DC voltage generator and a DC ammeter come with every channel. Best suited for the test of components which require high voltage applications such as automotive electronics components.
- Voltage range: 500.0V or 1000.0V
- Current range: 320.00 $\mu$ A/3.2000 $\mu$ A/32.000nA/auto range

# Comparison with the scanner measurement (relay) method

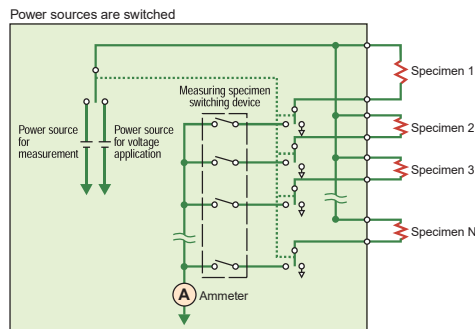
Because the SIR adopted the continuous measurement method which captures every ion migration phenomenon without fail, as compared with the scanner measurement (relay) circuit, the system offers the following advantages.

- 1) Because a power supply and an ammeter is equipped per every channel, there is no need for switching relays and thus, no measurement data will be omitted. (120V, 500V, and 1KV boards only)
- 2) Because of its high-speed measurement sequence, there will be no changes in measurement intervals (40msec) even if the number of specimens is increased. (※See P.2.)
- 3) When the scanner measurement (relay) method is used, the voltage application may be interrupted (0V) when the relays are switched.

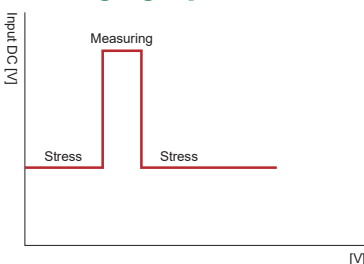
## • SIR's measurement circuit (250V board)



## • Scanner measurement (relay) circuit

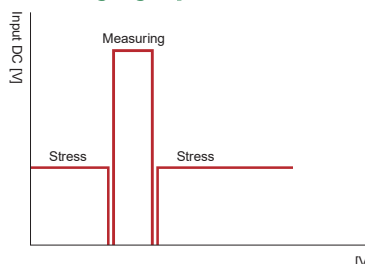


## • Voltage graph of SIR



\* Continuously measured because there is no need to switch the power source.

## • Voltage graph of scanner measurement (relay) circuit



\* The voltage drops to 0V while the scanner boards are switched.

## SIR main body and board configuration



•SIR 13: 8-slot



•SIR 13 mini: 8-slot

### •List of measurement boards with excellent cost performance

Measurement board	Applied voltage	Power supply and ammeter	No. of channels	Setting of test conditions
120V board	0.10~120.00V 0.100~12.000V	1 power supply, 1 ammeter/channel	8 channels	Per channel
250V board Measurement current range: 2-range and 3-range specifications are available	0.1~250.0V	1 power supply/8 channels, 1 ammeter/channel	16 channels	Per 8 channels
500V board	1.0~500.0V	1 power supply, 1 ammeter/channel	8 channels	Per 8 channels
1KV board	1.0~1000.0V			

\* For more detailed specifications, please refer to the Specifications Table in Page 8.

## Temperature/humidity continuous measurement within the chamber provides highly reliable data.

### ... Our effective external noise prevention technique for high resistance, micro current measurement

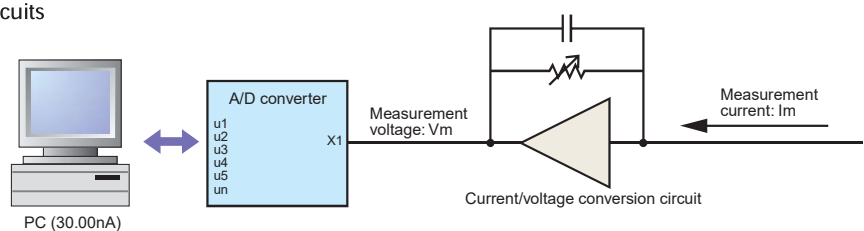
#### 1) Shielded measurement cables



#### • Dedicated specimen cable for the SIR

The measurement cables can be easily affected by external noise due to high impedance and micro measurement current. In order to solve this problem, ETAC provides shielded dedicated cables (measurement cables).

#### 2) Filtering of current-voltage conversion circuits



The system comes with the active low-pass filter that reduces noise of 70Hz to  $-20\text{dB}$  (1/10) and 700Hz to  $-40\text{dB}$  (1/100).

#### 3) Filtering with software

The measurement current converted into voltage is digitally converted with the A/D converter, and the data is accumulated and averaged at every power source cycle time (50/60Hz) with the software installed in the measurement board in order to remove the low frequency noise (humming sound) which is generated at every power source cycle.

# Measurement mode

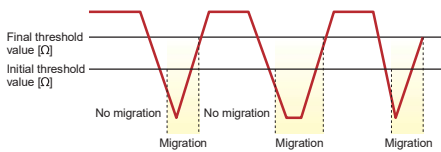
## • Migration measurement mode

<b>Beginning of migration</b>	When the measurement resistance value exceeds the migration initial threshold value, the system will recognize it as the beginning of migration.
<b>Migration in progress</b>	During the migration process, data of up to 151 points per SMU board are collected every 40msec. However, if there are more than 151 points from which data is collected, the recording interval will be doubled and the data to be collected is thinned out.
<b>Ending of migration</b>	When the measurement resistance value exceeds the migration final threshold value, the system will recognize it as the ending of migration.

\* The "SMU" stands for source measurement unit.

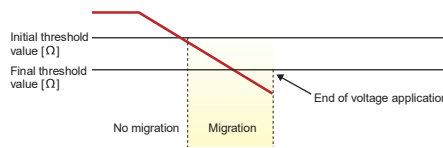
### Time-triggered data collection mode

From the beginning to the end of the test time, voltage is continuously applied even if migration is detected and measurement data is also continuously collected.



### Point-triggered data collection mode

When ion migration occurred, application of voltage is stopped only for the specific channel and the data is collected.



### Group-triggered data collection mode

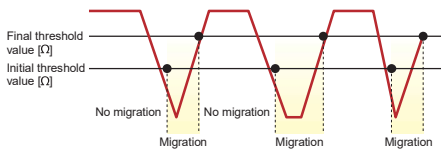
When ion migration occurs, the application of voltage is stopped for the entire group which includes the channel (a "group" is defined as up to 8 specimens connected by the same connector) and the data collection is terminated.

## • Leak check measurement mode

The SIR judges the migration beginning point at high speed (400μ sec/1ch) and the data at the point of time when the migration occurred is recorded in the PC.

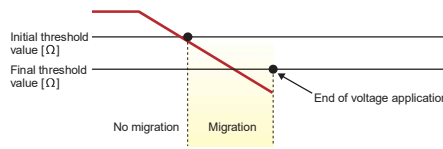
### Time-triggered data collection mode

From the beginning to the end of the test time, voltage is continuously applied even if a migration is detected and the data at the measurement points (●) as indicated in the graph below are collected.



### Point-triggered data collection mode

When an ion migration occurs, the application of voltage is stopped only for the specific channel and the data at the measurement points (●) as indicated in the graph below are collected.

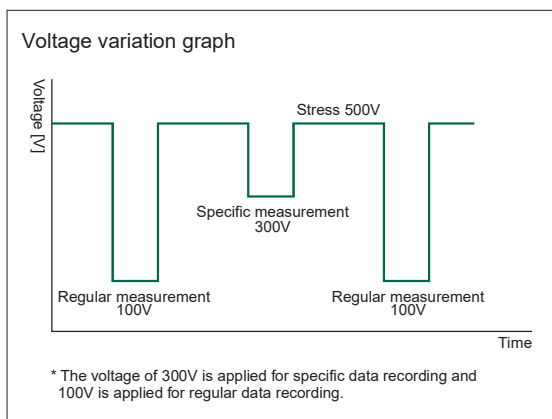


### Group-triggered data collection mode

When ion migration occurs, the application of voltage is stopped for the entire group which includes the channel (a "group" is defined as up to 8 specimens connected by the same connector) and the data collection is terminated.

## • Insulation resistance measurement mode

The stress voltage and the measurement voltage are set separately and the latter is changed at every set time and measurement is made accordingly. While stress voltage is applied, ion migration measurements can be performed at any time. (The system allows ion migration and insulation characteristics evaluations simultaneously.)



- 1) The measurement voltage is applied at preset data recording intervals for measurement. The measurement values are recorded on the PC. Apart from this, stress voltage is applied.
- 2) Judgment: Regardless of whether either stress voltage or measurement voltage is applied, error judgment (absolute value judgment) is made for the measurement.
- 3) While stress voltage is applied, ion migration measurement is performed. The migration measurement is regarded the same as the time-triggered data collection mode of the migration measurement mode and migration evaluation can be made while the stress voltage is applied.
- 4) The minimum measurement and data collection interval is 30 seconds.
- 5) Measurement sequence at insulation resistance measurement mode
  - Usually, the stress voltage is applied to monitor the current value.
  - The measurement values while the stress voltage is applied are not transmitted to the PC unless judged as an error.
  - If the monitored value exceeds the threshold value or voltage is found abnormal, measurement of the channel is ended.
  - The preset voltage is applied during the regular data recording period for measurement.
  - The preset specific data recording voltage is applied during the specific data recording period (2 points~10 points setting) for measurement.

## Functions of temperature/humidity measurement board (optional)

By using an optional temperature/humidity measurement board, temperature/humidity within chamber is measured and recorded after the set temperature/humidity is reached. The sensor is compatible with the T type thermocouple and resistance temperature sensor (Pt100). Up to 3 different temperature/humidity test can be performed simultaneously.

# Application software

- With the dedicated software, a PC can control the entire system (the SIR and temperature/humidity test chamber = Keyless Chamber) simultaneously.
- With the improved screens switching speed and the development of multi-tasking screen software, the data analysis can be speedily performed during the test or after the test.

## System management

System management screen



## Data management

List of past data



Test condition setting screen

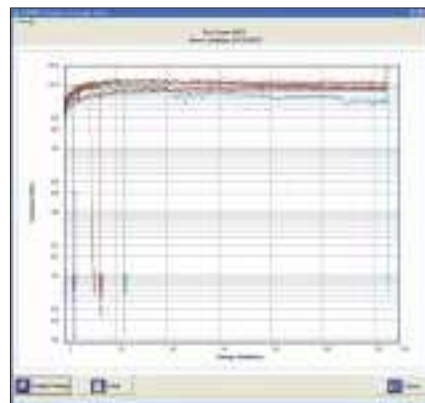


Migration data



- \* The data used to create a graph can be plotted on a log scale.
- \* The collected data is output in ASCII format.
- \* The data processing software is sold separately. Please contact us for more details.
- \* The software operates with Windows 2000 and above.

Data graph



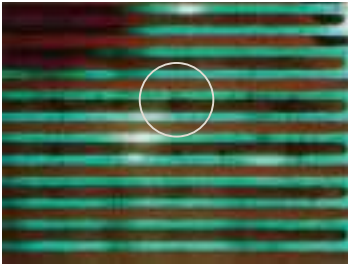
Weibull graph (Optional)



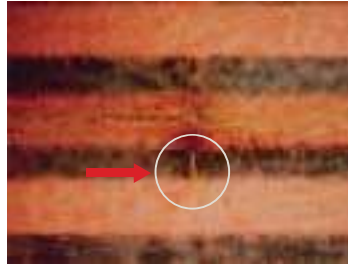
# Evaluation examples

## • Example of printed circuit board ion migration

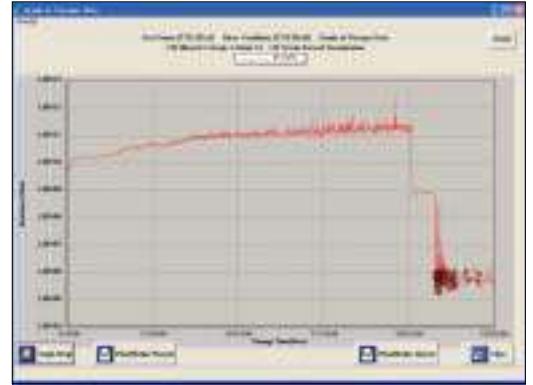
Surface of a substrate



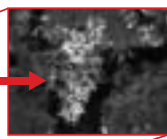
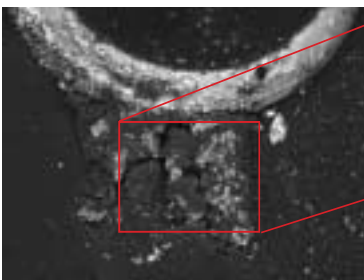
Observation with a dark-field microscope



The arrow (→) shows the location where ion migration occurred.



## • Example of ion migration caused by insufficient application of secondary sealant



Macro photography

The arrow (→) shows the location where ion migration occurred.



## • Example of ion migration caused by a pinhole in the coating film



The arrow (→) shows the location where ion migration occurred.



\* For inquiries on evaluation results or request for a failure analysis, please contact ETAC's "Reliability Clinic" (See Page 10).



# SIR Specifications Table

Product name		Insulation degradation evaluation system					
Model No.		SIR 13					
		120V board	250V board		500V board	1kV board	
Measurement board	Resistance measurement range	320Ω~120TΩ	320Ω~2.5TΩ	320Ω~250TΩ	320Ω~500TΩ	320Ω~1000TΩ	
	No. of measurement channels	8 channels/board	16 channels/board		8 channels/board		
	Connection cable	2 cables/board (connection cable), four-wire Kelvin Bridge method	2 cables/board (connection cable), input voltage measurement cable×2		2 cables/board (connection cable), voltage application cable×1, measurement cable×1		
Application of voltage	Applied voltage	Range 1	0.10~120.00V	0.1~250.0V		1.0~500.0V	1.0~1000.0V
		Range 2	0.100~12.000V	—		—	—
	Resolution	0.01V/0.001V	0.1V				
	Basic accuracy	±0.3%/FS			±0.3%+0.5V/FS		
	Maximum output power	96mW/channel	256mW/8channels		300mW/channel		
	No. of groups to apply voltage	1 group (1 channel/group)	2 groups (8 channels/group)		1 group (8 channels/group)		
	No. of voltage applied ranges	2 ranges	1 range				
	No. of channels to apply voltage	1 channel	8 channels				
	Maximum load carrying capacity	2.0μF/1channel	0.47μF/8channels		3300pF/1channels		
	Voltage monitor	No. of monitoring ranges	2 ranges	1 range			
Monitoring range		Range 1	0.00~120.00V	0.0~250.0V		0.0~500.0V	0.0~1000.0V
		Range 2	0.000~12.000V	—		—	—
Monitoring resolution		0.01V/0.001V	0.1V				
Basic monitoring accuracy		±0.3%/FS			±0.3%+0.5V/FS		
Monitoring unit		1 channel	1 group		1 channel		
Monitoring cycle		40msec/8channels					
No. of monitoring channels		8 channels	16 channels		8 channels		
Measurement of electric current		No. of measurement ranges	3 ranges	2 ranges	3 ranges		
		Measurement range	Range 1	0.00μA~320.00μA			
	Range 2		0.0000μA~3.2000μA				
	Range 3		0.000nA~32.000nA	—	0.000nA~32.000nA		
	Range setting	320.00μA, 3.2000μA, 32.000nA, auto range	320.00μA, 3.2000μA, auto range	320.00μA, 3.2000μA, 32.000nA, auto range			
	Minimum resolution	Range 1	10nA	10nA	10nA		
		Range 2	100pA	100pA	100pA		
		Range 3	1pA	—	1pA		
	Basic measurement accuracy	±0.3%/FS					
	No. of channels	8 channels	16 channels		8 channels		
Recording cycle	Every 30 seconds (minimum)/when ion migration occurs, every 40 msec (minimum)						
Migration measurement speed	40 msec/8 channels						
Leakage current detection	400μsec/channel						
Measuring cycle	8 channels/40 msec						
Other functions	Self diagnosis	An external resistor is connected for diagnosis (optional)					
	Interlock	Automatic measurement interrupt function while the chamber door is open (optional).					
	Detection of disconnection	Terminal disconnection detection function	—				
	Temperature/humidity recording	By adding temperature/humidity measurement boards and by using 3CS・Keyless software, data can be collected from up to 4 chambers (optional)					
	Specimen's temperature recording	By combining with 3CS software, each SMU channel records temperature of a chamber (optional).					
	Maximum No. of channels	SIR 13	64 channels (8 boards)	128 channels (8 boards)		64 channels (8 boards)	
SIR 13 mini		24 channels (3 boards)	48 channels (3 boards)		24 channels (3 boards)		
Control unit	System control PC	Windows XP Pro. SP2 (also compatible with Windows 2000), Pentium III, 500MHz or above, memory: 256Mbyte and above					
	Connection with the measurement unit	GP-IB or Ethernet					
Others	Countermeasures against power failure	The data collected just before power failure is saved to enable continued measurement. *A UPS is necessary (to be purchased separately)					
Measurement board storage unit	Available sizes	SIR 13	SMU 8-slot type External dimensions : W430×H300×D620mm *Do not include projecting parts. Weight : about 30 Kg (when 8 SMU boards are loaded) Consumption current : Less than 5A (when using 100V)				
		SIR 13 mini	SMU 3-slot type External dimensions : W220×H370×D390mm *Do not include projecting parts. Weight : about 20 Kg (when 3 SMU board are loaded) Consumption current : Less than 2A (when using 100V)				
	Noise resistance	1 μsec pulse 2KV 1 minute					
	Insulation resistance	DC500V 100MΩ and above					
	Power source	AC85V~264V 50/60Hz					
	Operating environment	Temperature: +10°C~+40°C, Humidity: 75% RH and below (condensation should not occur)					
	Storage environment	Temperature: -10°C~+60°C					

\* 3CS: The brand name of ETAC's "Environmental test chamber central control and monitoring software".

# Recommended temperature/humidity test chamber

## HIFLEX Keyless series

### Network compatible temperature (humidity) chamber

#### Network compatible Keyless Chamber

This is the industry's first keyless environmental test chamber (settings, operation, and monitoring are performed with a PC) with high performance equivalent to ETAC's standard temperature/humidity test chamber "HIFLEX" which realized space-savings, low price, and flexible system configurations. By using the TH 403A, the economy of space is tripled as up to 3 units can be stacked up to perform different tests individually. Moreover, because the SIR 13 mini can be stored inside a rack which comes with TH 401A and TH 402A, the effectiveness of space management is further enhanced and a complete automatic measurement system can be established within the space.

\* Flexible system configuration:

The measurement cable can be easily connected because the measurement unit can be placed either on right or left side of the chamber according to your needs.



Quick reference for HIFLEX Keyless series model number and basic performance

Temperature/humidity chamber (internal dimensions: mm)	W500×H350×D350	(W500×H350×D350)×2	(W500×H350×D350)×3	W600×H600×D500	(W600×H600×D500)×2
-40°C~+100°C(+150°C) 20%RH.~98%RH.	TH 401A (H)	TH 402A (H)	TH 403A (H)	TH 411A (H)	TH 412A (H)
Temperature chamber (internal dimensions: mm)	W500×H350×D350	(W500×H350×D350)×2	(W500×H350×D350)×3	W600×H600×D500	(W600×H600×D500)×2
-40°C~+100°C(+150°C)	TL 401A (H)	TL 402A (H)	TL 403A (H)	TL 411A (H)	TL 412A (H)

\* The "(H)" indicates that the model is a +150°C maximum temperature specification model.

## PLAMOUNT H series

### Highly accelerated stress test chamber (HAST chamber)

#### The epoch-making, rectangular shape chamber accommodates various needs

We developed an epoch-making, rectangular shape HAST chamber for the first time in Japan in order to completely eliminate the problems caused by the traditional round shape chambers. In addition to unsaturated/saturated operation control functions, various new functions such as the specimen humidified storage function were added to enable more accurate and user-friendly operation. Moreover, because the SIR 13 mini can be stored in the middle space of the rack which comes with PM 220 and PM 420, it contributes further to space saving.



Quick reference for PLAMOUNT H series model number and basic performance

Temperature/humidity and pressure ranges	internal dimensions: mm	W270×H300×D300	W370×H370×D380	W270×H300×D300×2	W370×H370×D380×2
Temperature range: +105°C~+143°C Humidity range : 75%~100%RH Pressure range : 0.2~2.0kg/cm <sup>2</sup> G		PM220	PM250	PM222	PM252
Temperature range: +105°C~+162°C Humidity range : 75%~100%RH Pressure range : 0.2~4.0kg/cm <sup>2</sup> G		PM420	—	PM422	—