Electro-Migration Evaluation System
AEM

The quest for fine pitch pattern and more function

The Electro-Migration Evaluation System AEM Series applies
DC current, DC pulsed current, and AC pulsed current under high temperature environment
to detect and evaluate the increase of resistance value and leak current caused by electromigration.
The system will provide electromigration evaluation
indispensable for improving reliability of fine pitched LSIs,
flip chip solder ball, and coating material.

ELECTROMIGRATION EVALUATION SYSTEM

LSI ELECTROMIGRATION EVALUATION SYSTEM
GMR HEAD ELECTRO-MIGRATION RH EVALUATION SYSTEM
HIGH FREQUENCY ELECTRO-MIGRATION EVALUATION SYSTEM

TDDB EVALUATION SYSTEM

WAFER LEVEL
PACKAGE LEVEL

SEMICONDUCTOR PARAMETER AUTOMATIC EVALUATION SYSTEM

FET(HOT-CARRIER) PROPERTY EVALUATION SYSTEM
TRANSISTOR PROPERTY EVALUATION SYSTEM

CONDUCTOR RESISTANCE EVALUATION SYSTEM

THROUGH-HOLE CONDUCTOR EVALUATION SYSTEM
SOLDER-JOINT CONTACT EVALUATION SYSTEM
BGA, CSP SOLDER JOINT CONTACT EVALUATION SYSTEM
CONNECTOR CONTACT RESISTANCE EVALUATION SYSTEM
FPC LIFE EVALUATION SYSTEM
OTHER INTERCONNECTION MATERIAL CONTACT
EVALUATION SYSTEM

ION MIGRATION EVALUATION SYSTEM

INSULATION RESISTANCE EVALUATION SYSTEM

CAPACITOR INSULATION RESISTANCE EVALUATION SYSTEM
PCB, PWB INSULATION RESISTANCE EVALUATION SYSTEM
INSULATION RESISTANCE EVALUATION SYSTEM FOR
OTHER INSULATION MATERIAL

LOW-K INSULATION CHARACTERISTIC EVALUATION SYSTEM

LEAK CURRENT MEASUREMENT SYSTEM

CAPACITOR LEAK CURRENT MEASUREMENT SYSTEM
FET LEAK CURRENT MEASUREMENT SYSTEM
SEMICONDUCTOR REVERSE BIAS LEAK CURRENT
MEASUREMENT SYSTEM

CAPACITOR TEMPERATURE PROPERTY EVALUATION SYSTEM

OPTICAL COMPONENT ENVIRONENTAL TEST SYSTEM

AEM 1000

● Six types of stress current

Stress is applied by DC current , DC current , DC pulse , DC pulse , AC pulse, or AC pulse 0. Test condition can be selected and set individually per 10 channels.

● Three measurement modes

Precision current mode uses precision current generator to measures resistance. Stress-on mode measures resistance while applying stress current. Also equipped with a leak current measurement mode.

● One TEG/one constant-current power supply control

The power source for constant-current stress application is provided on each channel (TEG). Failure will be detected individually on each TEG and stops stress application to the failed TEG.

● Setup of evaluation condition per each TEG board

Evaluation test for 100 TEGs is allowed per chamber. 10 TEGs can be loaded on 1 TEG board, and 10 TEG boards per chamber. Stress current can be set and applied to each TEG board, thus enabling independent testing with different condition for each board.

● Precise evaluation

Constant current power supply with a stable 3W output, and Kelvin's 4-terminal method realizes high precision measurement.

● Designated chamber with high temperature of 400

Convection type chamber available with temperatures of 250 and 400 .

● Multiple chambers with different settings can be controlled from one AEM system controller.

Temperature setting and test can be controlled for each chamber. The system controller can manage and control the test performed on multiple chambers with different settings.
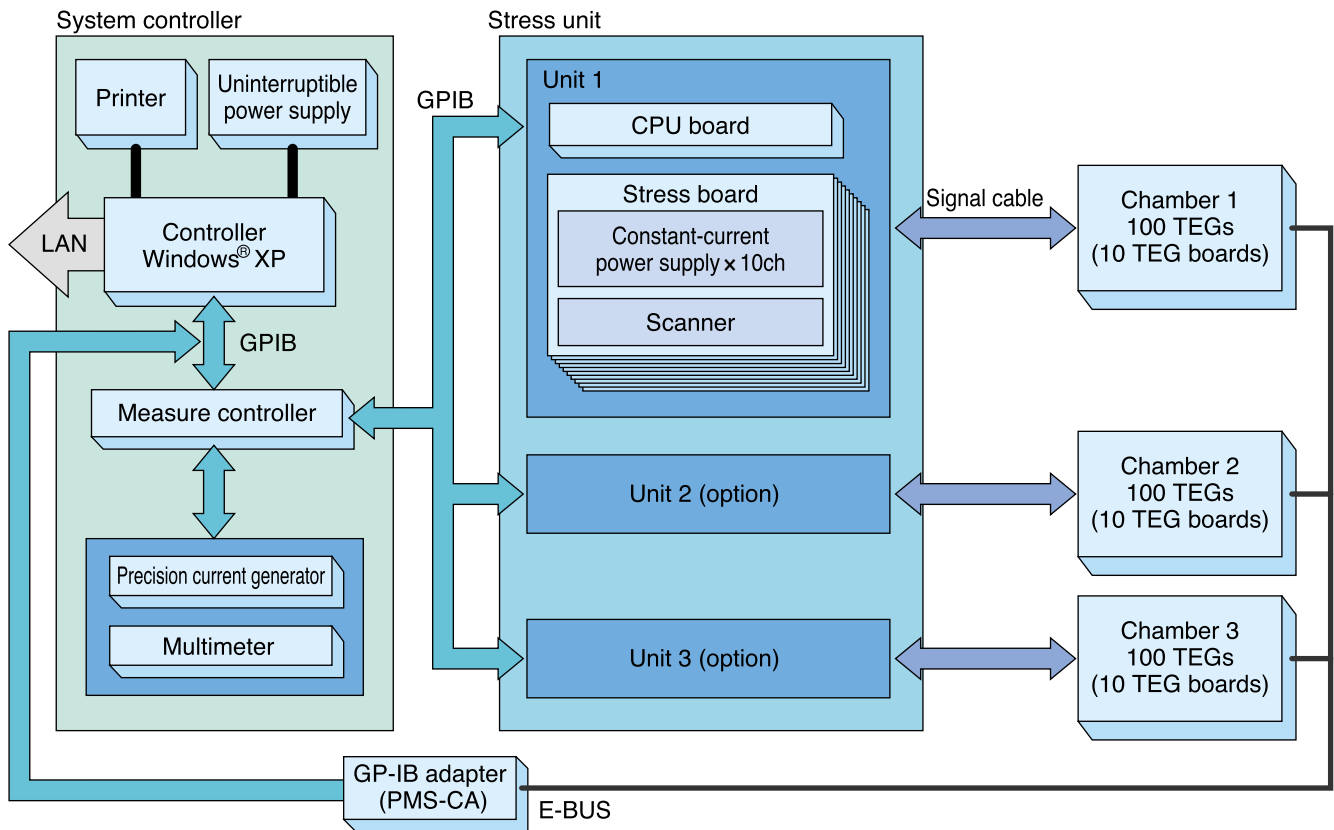

The system is a 100ch. (1 unit) type

APPLICATION

Electro-Migration Evaluation

Evaluation of LSI fine pitched wiring / copper wiring / aluminum wiring

Evaluation of flip chip solder ball / UBM

Evaluation of metal materials which are used under high-density current

SYSTEM BLOCK DIAGRAM

System controller

Stress unit

| Printer | Uninterruptible power supply |

GPIB

Unit 1
- CPU board
- Stress board
  - Constant-current power supply× 10ch
  - Scanner

Signal cable

Chamber 1
100 TEGs
(10 TEG boards)

LAN

Controller Windows® XP

GPIB

Measure controller

Precision current generator

Multimeter

Unit 2 (option)

Chamber 2
100 TEGs
(10 TEG boards)

Unit 3 (option)

Chamber 3
100 TEGs
(10 TEG boards)

GP-IB adapter
(PMS-CA)

E-BUS

System controller

Controller :
  OS Windows® XP (DELL Computer PC)

Uninterruptable power supply :
  Backup power supply for controller

Measure controller :
  Measurement data acquisition and control

Precision current generator :
  Applies constant current during
  precise resistance measurement

Digital Multimeter :
  Measurement of resistance value
  (Advantest Corp.R-6441C)

E-BUS :
  Temperature control of chamber / monitor/ alarm control

Stress unit

Stress unit :
  Consists of a CPU board and 10 stress boards

CPU board :
  Controls stress board

Stress board :
  Scanner & power source for constant current stress,
  10 channels per stress board
  1 power source per channel for constant current

Chamber :
  High-temperature environment
  (　250　/　400　)

Measurement conditions

Set Duty ratio range 10% to 90% by 10%
Set pulse repetition frequency
1Hz, 10Hz, 100Hz, 1KHz, 10KHz

Caution) Stress board for 20mA, 50mA, 1A are a
DC constant current and exclusive board

● Measurement items

Stress ON resistance measurement
Resistance value is measured while applying stress current. For AC pulse constant current, the larger absolute value is measured. When value reaches the same on both positive and negative side, the positive side is measured.

Precise resistance measurement
Resistance value is measured by cutting off stress current and applying precise current.

Leak current measurement
Leak current between leak terminal and minus terminal is measured after cutting off stress current. (Voltage is constantly applied between the leak terminal and minus terminal)
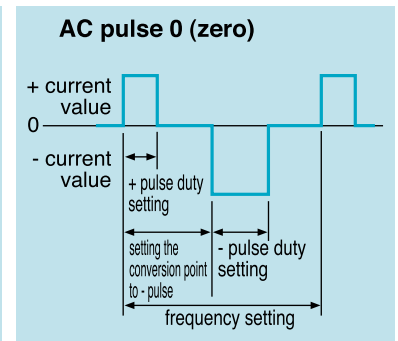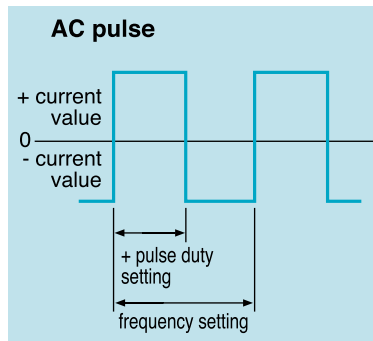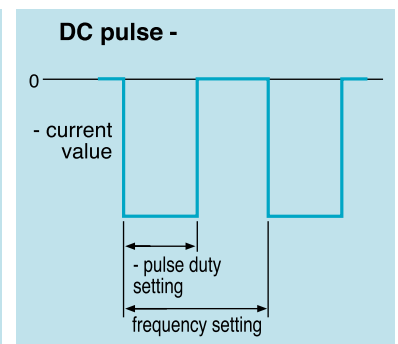
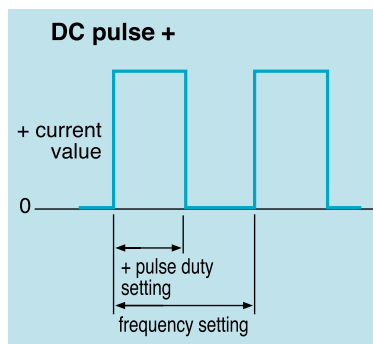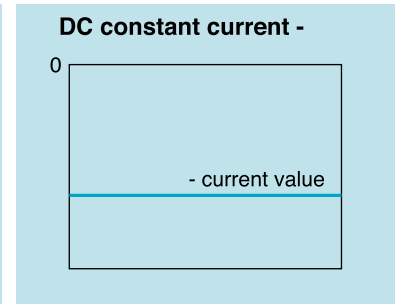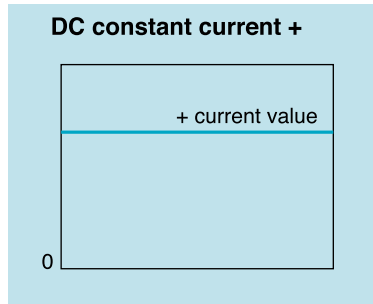## ● Various measurement intervals

Linear: Measures in equal intervals at setting value by the minute
(6 to 9,999minutes, per 1 minute)

Log t=0.1: Measured in lapse of 0.1Hr, $10^{0.1(n-2)}$ Hr (n=number of times of measurement, n 2) from test startup.

Log t=1: Measured in lapse of 0.1Hr, 1Hr, 10Hr, 100Hr, 1000Hr, 10000Hr from test startup.

Block setting: Divided into 3 blocks from test startup to finish. Can be set by intervals mentioned above.

● Current stress application mode

DC constant current +

+ current value

0

DC constant current -

0

- current value

DC pulse +

+ current value

0

+ pulse duty setting

frequency setting

DC pulse -

0

- current value

- pulse duty setting

frequency setting

AC pulse

+ current value

0

- current value

+ pulse duty setting

frequency setting

AC pulse 0 (zero)

+ current value

0

- current value

+ pulse duty setting

setting the conversion point to - pulse

- pulse duty setting

frequency setting

SPECIFICATIONS

| Model	AEM-1000
Channel configuration	Standard 100 channels (Maximum 900 channels)
Number of chambers	Controls up to 9 chambers (100 channels per chamber)
Software	Windows® XP
Stress board variation	AC 50mA / 50V /0.01mA in setting steps (optional) AC 100mA / 50V /0.01mA in setting steps DC pulse AC pulse ± 200mA / 50V / 0.1mA in setting steps DC pulse AC pulse ± 500mA / 30V / 0.1mA in setting steps DC 1A / 20V /0.1mA in setting steps (optional) (restricted to maximum of 3W)
Measurement interval	Linear (minimum 6 min.)/ log t 0.1/log t 1/ 3-block setting
Open detection	Constant detection of disconnection at less than 1 seconds

Measurement mode	Stress ON measurement	Applicable to all stress boards (Able to set stress migration test)
	Precise current resistance measurement	Measurement current setting range 0.01mA to 100mA (up to 1A is optional)
	Leak current measurement	Applied voltage range 20V to 20V (compatible with DC pulse/AC pulse stress board)

Range and accuracy of the stress current (± (0.5%+0.1mA) against set value)	DC pulse/ AC pulse ± 50mA 0.1mA to 50mA ± (0.3%SV 0.05mA) DC pulse/ AC pulse ± 100mA 0.1mA to 100mA ± (0.3%SV 0.04mA) DC pulse/ AC pulse ± 200mA 5mA to 200mA ± (0.5%SV 0.1mA) DC pulse/ AC pulse ± 500mA 5mA to 500mA ± (0.5%SV 0.1mA) DC 1A 10mA to 1A (Positive polarity stress only)
Precise resistance measurement	± 0.2% (1mA current value application, at 100 ohms measurement)

Leak current measurement	Applied voltage	DC 20V to 20V in 0.1V variable steps
	Measurement range	100pA to 3µ A
	Measurement precision	± 5% ± 10nA (at 10M ohms with 20V stress or larger)

System external dimensions (for 300-channel specification)	System controller	650W× 1300H× 800Dmm
	Stress unit	570W× 1830H× 900Dmm
Outside dimension of chamber (excluding protrusions)	250 type	980W× 550H× 890Dmm
	400 type	1015W× 625H× 880Dmm
Required unility (for 100 channels per chamber)	System controller	100V AC± 10% 50/60Hz 15A
	Stress unit	200V AC± 10% 50/60Hz 50A
	Chamber (250 spec)	200V AC± 10% 50/60Hz 20A

TEG board			
Type	200 type	250 type	400 type
Material	polyimide substrate	SUS base	
Socket duration	260	260	440
Socket material	heat-resistant resin		ceramics
PIN position	flexible	fixed (can be modified for requirements)	

Caution: Life span of TEG board depends on usage.

AEM HF
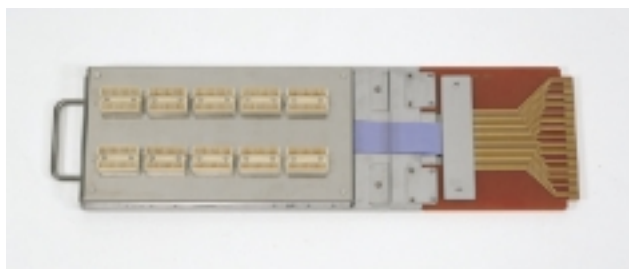
The system offers maximum AC pulse at 20MHz/ +350 temperature performance required for Cu evaluation. Networking and control can be easily applied on Windows® XP.

● Duty ratio can be modified in 10% units

Offers AC pulse frequency at a maximum 20MHz. The duty ratio can be modified in 10% units between the range of 10 to 90%.

● Current waveform

AC probe is equipped on the lower part of the TEG socket to check the current waveform.
(One AC probe is equipped per DHB chamber)

● Measures resistance by precise constant current power supply

Resistance is measured by precise constant current power supply. Also equipped with a measurement error improvement mode for further quality performance.

● Linking DHB chambers

Up to three DHB chambers can be linked to the controller to set test parameters and start operation. One TEG board can be loaded on one chamber (number of TEGs loaded on one board can be either 10 or 20).

● 350 temperature performance

With the Direct Heat Board (DHB), precise temperature stress is applied at +350 .

● Easy operation with Windows® XP

Control software is applied on Windows® XP. Setting the test parameters and data statistics processing can be done with simple operation. LAN connection to the production line is also possible.
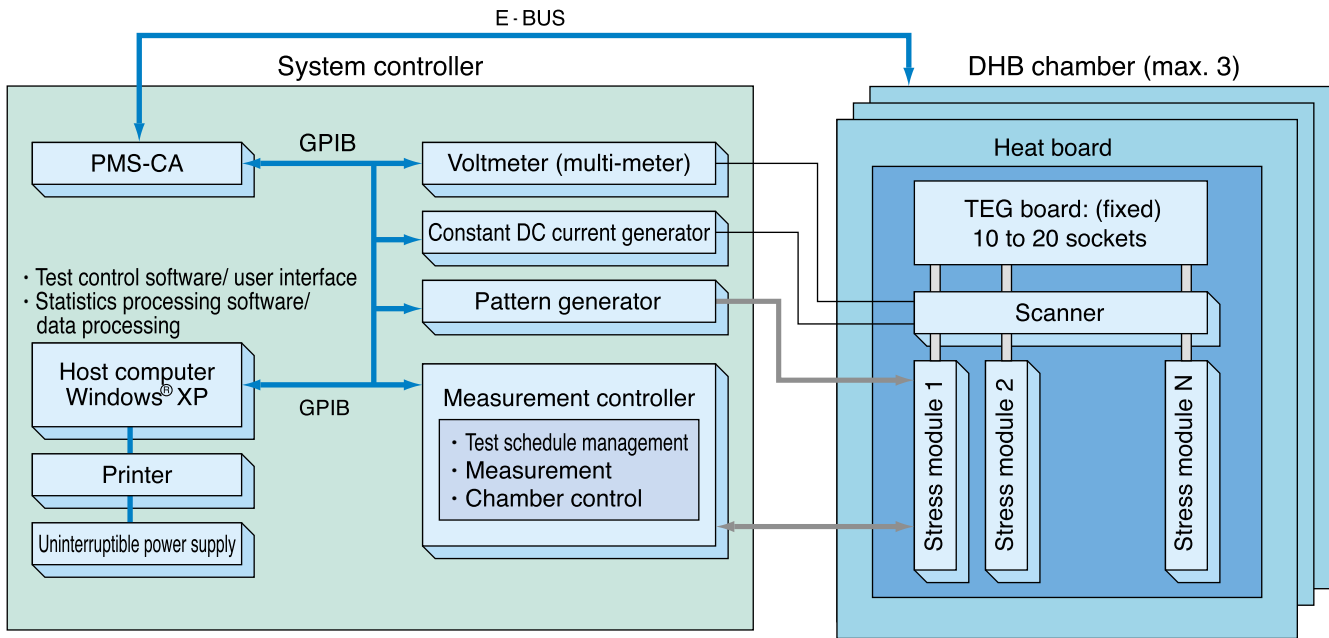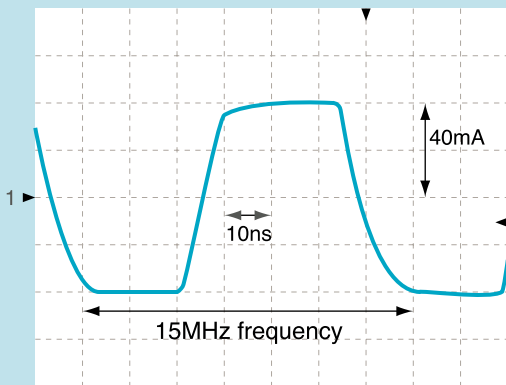
● System Configuration

Controller rack   DHB chamber   DHB chamber
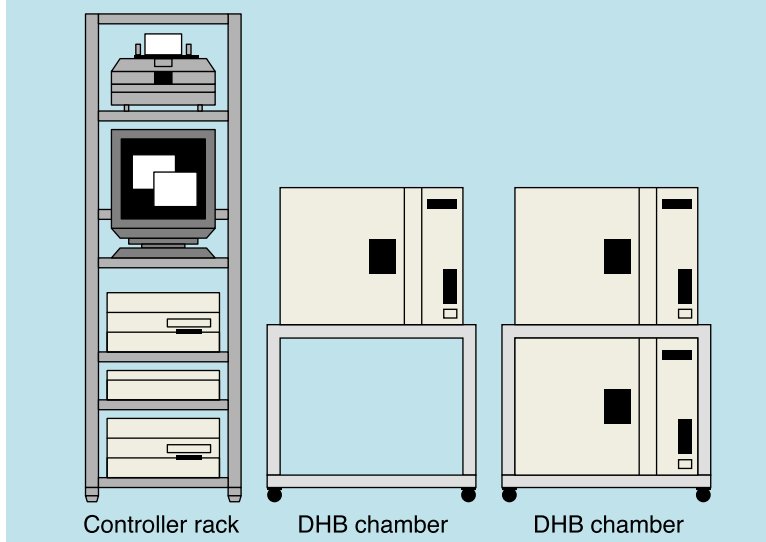
APPLICATION

**Wiring migration evaluation of semi-conductor process
Simulation by high frequency application**

SYSTEM BLOCK DIAGRAM

E BUS

System controller

DHB chamber (max. 3)

PMS-CA

GPIB

Voltmeter (multi-meter)

Constant DC current generator

Test control software/ user interface
Statistics processing software/
data processing

Pattern generator

Host computer
Windows® XP

GPIB

Printer

Uninterruptible power supply

Measurement controller

Test schedule management
Measurement
Chamber control

Heat board

TEG board: (fixed)
10 to 20 sockets

Scanner

Stress module 1

Stress module 2

Stress module N

CURRENT WAVEFORM AND RESISTANCE VALUE

● AC Pulse Constant Current Waveform

40mA

1 ▶

10ns

15MHz frequency

Condition	Resistance	51
	Applied current	40mA
	Repeated frequency	15MHz

● Applied Current and Resistance Value Sample

Maximum applicable voltage = Below graph shows
regulation on operatable maximum resistance value
(Rmax) from 4.5V.
Measured maximum resistance value = 400

Operatable max resistance ( )

400
350
300
250
200
150
100
50
0

10   20   30   40

Applied current (mA)
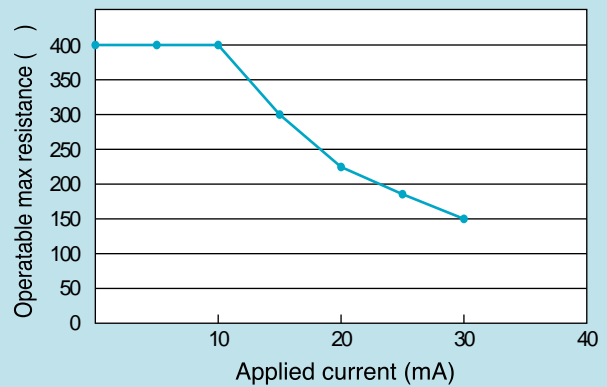
SPECIFICATIONS

Model	AEM-HF
Software	Windows® XP Visual Basic
AC pulse constant current application range	0.1mA to 30mA (at plus/minus) Setting resolution of current rate 3mA range: 0.01mA (10μA) 30mA range: 0.03mA (30μA)
AC pulse frequency	100KHz to 20MHz (minimum pulse width 25ns)
Set DUTY ratio range	10 to 90 % (at 10% range setting)
Other stress power source	DC pulse constant current/ DC constant current (optional)
Measurement precision	± 0.2% (applied currency 1mA/ at 100)
No. of TEGs	10 or 20 TEGs (for one DHB chamber)/ up to 3 chambers
Test temperature range	70 to 350 (temperature uniformity ± 7 at 350)
Required utility	200V AC 20A (for one DHB Chamber) 100V AC 15A (controller rack)
Outside dimension of system	DHB chamber	1066W× 670H× 745Dmm
	System controller	530W× 1800H× 1100Dmm

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JIS Q 9001:2000
JSAQ 004

QMS Accreditation
R001

EMS Accreditation
RE 009

ISO 14001
EC99J2046

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MANAGEMENT
051

ISO 9001/JIS Q 9001
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ISO 14001 (JIS Q 14001)
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