



# SPECIFICATIONS

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## 9.1 PERFORMANCE

Resolution (secondary electron image):	1.2 nm guaranteed (at accelerating voltage of 30 kV) 3.0 nm guaranteed (at accelerating voltage of 1 kV) 3.0 nm guaranteed (at accelerating voltage of 15 kV, probe current 5 nA, WD 10 mm)
Magnification:	×10 (WD 40 mm) to 1,000,000
Magnification correction:	Automatic correction for accelerating voltage and WD
Fixed magnification:	Any magnification can be preset for each image mode as a fixed magnification. The fixed magnification is instantly obtainable from any magnification in the mode being used.
Image rotation correction:	Provided for each EOS mode at each WD
Image modes:	SEI (Secondary electron image) COMP (Backscattered-electron image in the composition mode, optional) TOPO (Backscattered-electron image in the topography-image mode, optional)
Accelerating voltage:	SEM mode: 0.5 to 30 kV 10 V steps from 0.5 to 2.9 kV 100 V steps from 2.9 to 30 kV 0.2 to 30 kV (GB-L mode):
Probe current:	$10^{-12}$ to $2 \times 10^{-7}$ A

## 9.2 ELECTRON OPTICAL SYSTEM (EOS)

### ■ Electron Gun

Type:	Schottky field-emission gun
Emitter:	ZrO/W emitter
Alignment:	Mechanical and electromagnetic deflection (No mechanical alignment required by users)

### ■ Lens system

EOS modes:	SEM/GB-L
Condenser lens (CL):	Electromagnetic 2-stage lens
Aperture-angle control lens (ACL):	Electromagnetic lens
Objective lens (OL):	Conical objective lens
Lens clear function:	Provided in CL and OL for hysteresis elimination
Automatic focus:	Provided, manual focus override
Focus link:	Provided for accelerating voltage change
Automatic magnification correction:	Provided for accelerating voltage and/or WD change
Image rotation correction:	Provided for WD and/or EOS mode change
OL aperture:	Click stop type (4 steps) Fine position controllable in X/Y directions

Wobbler:	Provided for OL aperture and stigma center alignment Linked to magnification
Automatic stigmator:	Provided, manual adjustment override
Dynamic focus:	Provided for specimen tilt correction Linked to accelerating voltage, magnification and/or WD
Scanning coil:	Electromagnetic 2-stage deflection
Scan rotation:	Provided with an image rotation correction function in each EOS mode with respect to WD
Image fine shifter:	$\pm 10 \mu\text{m}$ shifts (maximum) in X and Y directions

### 9.3 SPECIMEN STAGE (5 AXIS MOTOR DRIVE STAGE TYPE 1A, SM-71480)

The specimen stage is computer-controlled for five axes (X, Y, R, T and Z). The following functions are available by using the unique graphical user interface and the operation panel.

- The stage automatically moves to the center point that you specified on the observation screen using the mouse (point shoot function).
- A stored image (up to four images can be stored) can be moved in the same way (image shift function).
- You can switch the stage movement and image shift by using the mouse button. So, you can quickly search for the point of interest by switching the coarse movement (stage movement) and the fine movement (image shift).
- You can rotate the specimen about the image center irrespective of the location of the specimen stage center. So, you can easily observe the stereoscopic view by tilting the specimen (eucentric rotation function).
- The trackball rotates in the same direction as the image movement.

Stage type:	Fully eucentric goniometer stage Computer-controlled 5-axis (X, Y, Z, T, R) motor driven with backlash correction.
Specimen movements	X-axis: 70 mm Y-axis: 50 mm Z-axis: 3 to 41 mm (Continuous) Tilt: $-5$ to $70^\circ$ Rotation: $360^\circ$ endless
Specimen-position indications	(X, Y, Z, T, R): On the observation screen and beside each motor
Specimen-position file:	Storing and loading of specimen coordinates (X, Y, Z, T, R)
Coordinate specification:	You can specify the stage coordinates (X, Y, Z, T, R) in absolute or relative values.
Motor drive functions:	Trackball operation (X, Y, Z, or R) and button operation (X, Y, Z, T, R) Mouse operations on the observation screen: Point shoot (move to the center), step movement, holder map movement, image shift, Eucentric rotation with correction function for image moving direction

Specimen holder:	For 12.5 mm (dia.) × 10 mm (height) specimen For 32 mm (dia.) × 20 mm (height) specimen (Specimen holders for such as 100 mm (dia.) × 10 mm (height) specimen are optionally available.)
Selecting specimen holder:	Selectable from the standard holders and optional holders. Addition/deletion of the holders is possible.
Movement limiting function:	Automatic setting with holder selection (X, Y, R, T, Z) Locking/unlocking of moving axis is possible (X, Y, Z, T, R).
Specimen exchange chamber:	Specimen Exchange Chamber Type 2A (SM-71031 SE2A) Airlock, 100 mm(dia.) × 40 mm (height) specimen holder can be handled. In the case of 32 mm dia., up to 50 mm height.
Replacing a specimen:	Single touch chucking
Absorbed-current measure terminal:	Built-in
Specimen protection buzzer:	Built-in
Installing EDS in specimen chamber:	Exclusive-use EDS port (X-ray take-off angle: 35° at WD 10 mm on the specimen stage)
Installing WDS in specimen chamber:	Exclusive-use WDS port (X-ray take-off angle: 35° at WD 10 mm on the specimen stage)
Installing EBSD in specimen chamber:	Exclusive-use EBSD port (EBSD observation possible at WD 15 mm on the specimen stage)

## 9.4 ELECTRON DETECTION SYSTEM

### ■ Secondary Electron Image

Normal detector use:	Consists of collector, scintillator, light guide and photomultiplier tube
Video amplifier control:	Adjustable using the contrast and brightness knobs

## 9.5 SCANNING/DISPLAY SYSTEM

The system displays a high-definition image in real time with 1,280 × 960 pixels in real time using the special-purpose graphical user interface.

You can easily operate the instrument, from setting the observation conditions to observing the images, by operating the operation panel and keyboard.

LCD:	[SM-75061LCD]
Image size:	19 inches
Maximum resolution:	1,280 × 1,024 pixels
SEM Control System	
PC	PC/AT compatible computer (SM-77360PC)
RAM	4 GB or more

- OS: Genuine Windows 7 Professional 32 bit \*
- Operation: Graphical user interface under Windows 7. Operations use the mouse and the operation panel. Keyboard is used for entering characters and other operations.
- Scan and display modes: Indication of observation-screen operations, full-screen display, direct-magnification display, reduced scan, two-segment display (with different magnifications, different image modes), two-segment wide display, four-segment display, addition image, scaler.
- Scan speed: Four speeds can be selected from the following 10 speeds (speeds for 1,280 × 960 pixels scan).

	Horizontal (ms)	Vertical (s)
1	0.213	0.3
2	0.427	0.5
3	0.853	1.0
4	1.71	1.8
5	3.41	3.6
6	6.83	7.0
7	18.03 (15.54)	19 (16)
8	37.44 (32.04)	39 (32)
9	76.37 (65.59)	77 (64)
10	115.4 (114.8)	116 (112)

Numbers in parentheses ( ) are for 60 Hz line frequency.

- Pixels in image display area: 1,280 × 960 pixels
- Image mode: LED, BED-T, BED-C, AUX, ADD
- Monitor display: Menu bar, Observation ON/OFF button, accelerating voltage, emission current/filament current, icons for operations, function switch button, image display section, observation conditions display section, operation display section, observation condition selection section, SEM monitor.
- Text and comment display: Using keyboard
- Monitor data display: Accelerating voltage, detector mode, magnification, WD, micron marker, label, date and time.
- Data display position: Horizontally displayed at the bottom of image.
- Measurement functions: Distance in X, Y, and diagonal directions using cursor. Angle is also displayed.
- Annotation and text display: Symbols can be selected and pasted. Alphanumeric entry from keyboard is possible.

\* Windows 7 is a trademark of Microsoft Corporation.


## 9.6 IMAGE PROCESSING SYSTEM

Functions:	Averaging:	1 to 1,023× accumulation
	Integration	0 to 1,023× accumulation
Color mode:	Gray scale (black and white)	
	Pseudo color (2-color composite image)	
Look up:		
Table:	Look-up table (LUT):	$\gamma$ correction, binary coding, multiple-value coding, histogram
Gray scale	Can be displayed.	
Image processing functions: Sharpening, smoothing, median, Gaussian, edge enhancement		

## 9.7 AUTOMATIC FUNCTIONS

Automatic focusing:	Combination with ACB is also possible.
Automatic stigmator (astigmatism correction):	Combination with ACB is also possible.
Automatic exposure:	Automatic memory of observation image brightness possible.

## 9.8 IMAGE FILING FUNCTION

Displayed items:	Directory and name of the image file, list of saved images in the file, observation conditions of the selected image
Image-file saving data:	Image data (in 8-bit or 16-bit gray level image) and text data (observation conditions)  The image saving of 16 bits is only TIFF format.
File formats:	BMP, JPEG, TIFF
Number of files:	Depends on the disk capacity (1.28 MB/image for the BMP format)
Simple reporting functions:	Pasting images on a report screen (standard format) and outputting pasted images is possible.

## 9.9 VACUUM SYSTEM

Electron gun chamber/intermediate chamber:	Evacuated by an ultrahigh vacuum dry evacuation system with ion pumps
Specimen chamber:	Evacuated by a dry evacuation system (turbo-molecular pump (TMP) evacuation system)
Dry nitrogen gas connector:	Built-in. Automatically stops supplying nitrogen after venting.
Coupler (customer prepared)	ISO 7/1 Rc 1/(JIS B 0203 Rc 1/4)
Ultimate pressure	
Gun chamber:	$10^{-7}$ Pa order (standard configuration)
Specimen chamber:	$10^{-4}$ Pa order (standard configuration)



Gun-chamber isolation valve:	Built-in Pneumatic drive. Linked to accelerating voltage on/off switch and specimen-exchange chamber isolation valve. If an optional RBEI is installed, the valve is linked to in/out switches of RBEI)
Specimen-exchange chamber isolation valve:	Built-in, automatic
Vacuum gauges:	Pirani gauge: 3 For monitoring ion-pump currents (for gun chamber, and intermediate chamber)
Ion pumps:	30 L/s: 1, 20 L/s: 1
Turbo-molecular pump:	240 L/s: 1
Oil rotary pump:	100 L/min (with line trap)
Reservoir tank:	10 L: 1

## 9.10 SAFETY DEVICES

Safety devices are provided to protect against an increase in pressure, water stop, power failure, insufficient nitrogen-gas pressure, and leakage of current. However, a device to maintain ultrahigh vacuum during power failure is not included.

## 9.11 ENERGY SAVING MODE

You can reduce the power consumption of the instrument by the operation system shutdown/the vacuum system shutdown modes. Control of shutdown time and schedule management is possible.

## 9.12 INSTALLATION REQUIREMENTS

Power:	Single-phase, 100 VAC, 50/60 Hz, Max 4 kVA At normal operation: approx 1.1 kVA At energy saving mode (vacuum OFF): approx 0.7 kVA Allowable power fluctuation: $\pm 10\%$ .
Grounding terminal:	100 $\Omega$ or less
Cooling water	
Faucet:	14 mm outside diameter or ISO 7/1 Rc 1/4
Flow rate:	0.3 to 0.5 L/min
Water pressure:	0.05 to 0.25MPa (gauge pressure)
Water temperature:	20 $^{\circ}\pm 5$ $^{\circ}\text{C}$
Drain:	25 mm inside diameter or ISO 7/1 Rc 1/4
Dry Nitrogen Gas:	JIS B 0203 Rc 1/4 (Prepared by customer)
Pressure:	0.45 to 0.55 MPa (gauge pressure)
Installation room:	
Room temperature:	20 $^{\circ}\text{C} \pm 5$ $^{\circ}\text{C}$
Temperature:	60% or less



Stray AC magnetic field:	0.3 $\mu$ T (p-p) or less, (50/60 Hz sine wave, WD 10 mm, accelerating voltage 15 kV) *
Floor vibration:	3 $\mu$ m (p-p) or less* for sine wave frequency of 5 Hz or more.
Acoustic noise:	70 dB or less with flat characteristics*
Floor space:	3,000 mm $\times$ 2,800 mm or more Height 2,300mm or more
Door size:	1,000mm (width) $\times$ 2,000 mm (height) or more.

## Dimensions and masses

	Width (mm)	Depth(mm)	Height(mm)	Mass(kg)
Main Unit	790	1,125	1,800	730
Operation and display system	1,200	1,000	700	252
Oil rotary pump (foreline trap included)	465	180	270	25 (55)

\* These items are the minimum requirements for this specification. The stray magnetic fields, floor vibration and acoustic noise in the installation room should be measured before installation by JEOL personnel to determine the maximum observable magnification.