

# INSTRUCTIONS

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## T300-BEIS2

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BACKSCATTERED ELECTRON  
DETECTOR

**JEOL**

No. ISMT300BEIS2-2

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 **JEOL LTD. / JEOL TECHNICS LTD.**

Tokyo Japan

## CAUTION

Operation etc. for T220-BEIS is identical to that for T300-BEIS2  
except for the following notes.  
Refer to the T300-BEIS2 instructions.

T220-BEIS

WD: 15~48 mm

T= 0° Only

Specimen movement ranges are in these conditions.  
Refer to the each instruction of specimen holder.

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## 1. GENERAL

The BEIS, used in conjunction with the JSM-T300 Scanning Microscope, detects backscattered electrons from the specimen, and makes it possible to separately observe an image showing element composition of the specimen surface (composition image) and an image showing specimen topography (topographic image).

This detector consists of a detector head having a pair of (left and right) semiconductor detecting elements, a preamplifier, and an operational amplifier. The video signals generated by the two detecting elements are fed to the operational amplifier via the preamplifier, and the signals are added or subtracted. The resultant signal is fed to the CRT. When adding signals, a composition image is obtained; on the other hand, when subtracting signals, a topographic image is obtained.

## 2. SPECIFICATIONS

- |  |   |
|--|---|
| ◦ Backscattered electron detecting elements: | Si p-n junction semiconductor.  |
| ◦ Gain:                                      | Preamplifier...current amplification..<br>1 $\mu$ A $\rightarrow$ 0.1 V.<br><br>Operational amplifier...voltage amplification.. $\times 40$ . |
| ◦ Video output signals:                      | Composition and topographic image signals.  |
| ◦ Bandwidth:                                 | DC to 30 kHz.   |
| ◦ Image polarity:                            | Positive (normal) and negative (inverse).   |
| ◦ Working distance:                          | 8 mm $\sim$ 48 mm.  |
| ◦ Specimen tilt                              | 0°  |
| ◦ Specimen movable range:                    | Confirm to the specimen stage   |
| ◦ Dimensions:                                | Operational amplifier unit<br>35 mm (W) $\times$ 95 mm (H) $\times$ 203 mm (D).   |

*Notes: 1. The IMS is necessary for operating the BEIS.*

*2. Specifications for BEIS2 with FCS is confirmed to "BEIS2 for FCS".*

## 3. COMPOSITION

- Backscattered electron detector complete with preamplifier and flange (built into specimen chamber) ..... 1.
- Operational amplifier unit (built into ATT. BOX) ..... 1.

#### 4. PRINCIPLE

Fig. 1 is a block schematic showing the basic signal flow for forming composition and topographic images. The specimen surface is scanned by an incident electron beam, and as a result, backscattered electrons are emitted, which contain information pertaining to the surface topography and physical and chemical properties of the specimen. These backscattered electrons containing said information are detected from different directions by semiconductor detecting elements A and B and the detected electrons are converted into an electrical signal. The two signals thus obtained are amplified by the preamplifier, and fed into the operational amplifier.

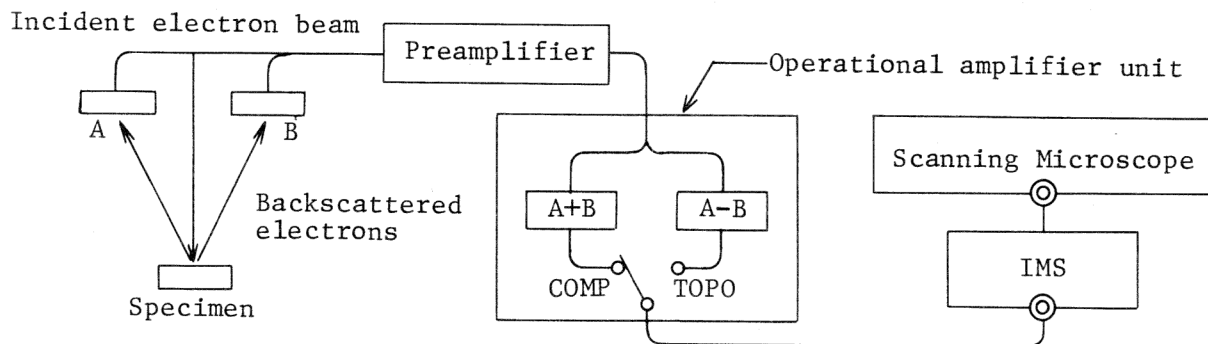


Fig. 1 Block schematic

The operational amplifier further amplifies the two signals, and at the same time, adds or subtracts these signals from detecting elements A and B. The added signal is used as a video signal for displaying the composition image, and the subtracted signal serves as a video signal for displaying the topographic image. The desired video signal is selected by the switch, and is fed to the CRT via the IMS.

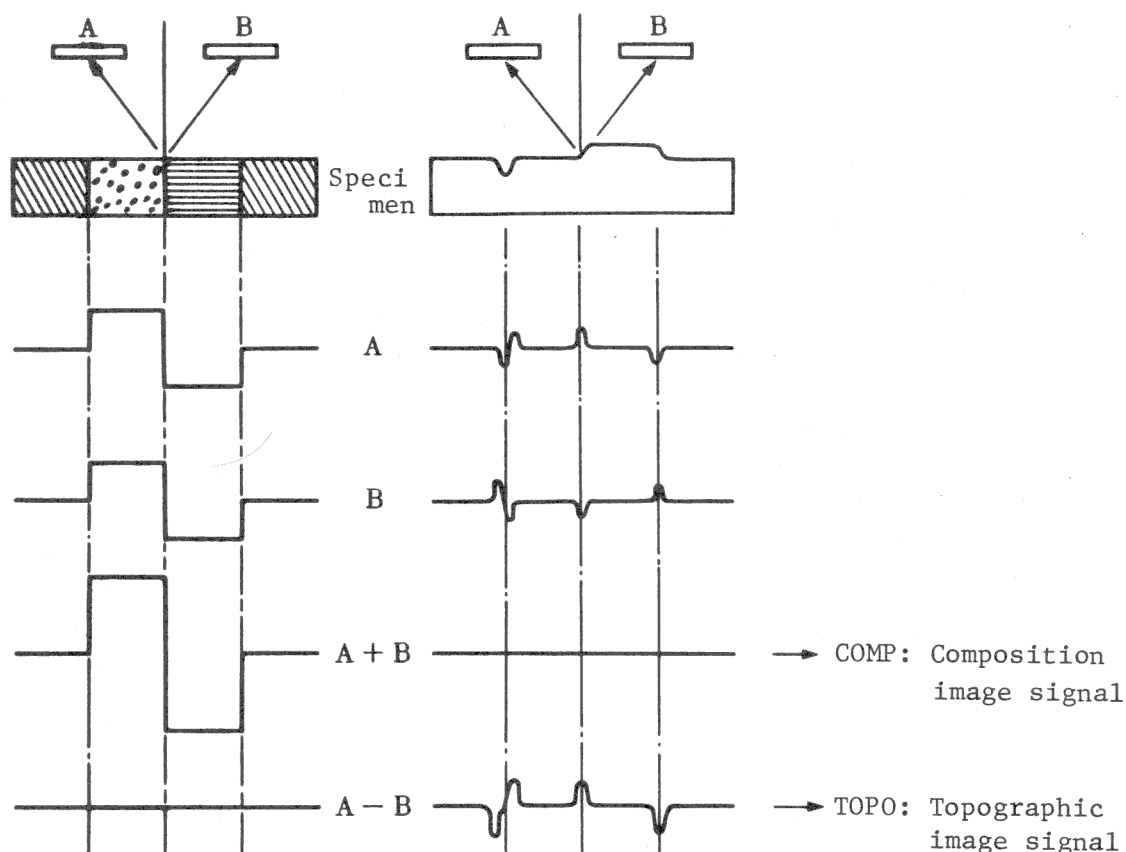


Fig. 2 Signal processing

## 5. PANEL DESCRIPTION

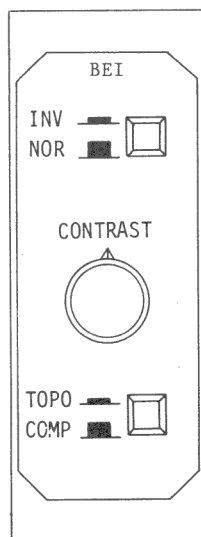


Fig. 3 Operational amplifier unit

### **INV** / **NOR** button

Selects the polarity of the video output signal.

At **INV**, a normal, or positive, image is displayed on the CRT.

At **NOR**, an inversed contrast, or negative, image is displayed on the CRT.

### **CONTRAST** knob

Controls the operational amplifier gain. By turning this knob clockwise, the image contrast is increased.

### **COMP** / **TOPO** button

Selects the video signal.

At **COMP**, the signal from the summing amplifier is selected, and the composition image is displayed on the CRT.

At **TOPO**, the signal from the differential amplifier is selected, and the topographic image is displayed on the CRT.

## 6. OPERATION

### 6.1 Precautions

When observing a backscattered electron image, in general, the following points should be observed:

1. Since the sensitivity of semiconductor elements to detect backscattered electrons is lower than that of scintillators to detect secondary electrons, increase the intensity of the incident electron beam.
2. Since the frequency response of the detecting elements is slow, select "SLOW" if the image has been observed on the TVS screen.
3. Set the specimen stage tilt angle to  $0^\circ$ .
4. A larger working distance will lower the signal detecting efficiency.
5. Be sure to extract the BEI detector from the specimen chamber when not using it. Insertion/extraction of the detector should be done in the VENT state.

*Note: Confirm that the specimen stage tilt angle is  $0^\circ$  before inserting or extracting the backscattered electron detector, and be sure to fasten the securing screw after the insertion/extraction.*

### 6.2 Operation

1. Before observing a backscattered electron image (COMP or TOPO), obtain a secondary electron image (SEI) under the following conditions.

IMS :

JSM-T300 operation panel:

control .....   
 switch .....   
 switch .....   
 control ..... 7 to 9 o'clock position  
 control ..... low magnification

2. Set the controls on the operational amplifier unit panel as follows:

knob ..... fully clockwise  
 /  button .....   
 /  button .....

3. Change the IMS setting to . Further, turn the JSM-T300 operation panel  control knob to the 11 to 12 o'clock position (1 to 3 o'clock position for W.D. 48 mm).
4. Adjust the operational amplifier unit  knob and the JSM-T300 operation panel  knob to their respective optimum positions. Generally, the optimum image contrast can be obtained at the 3 to 5 o'clock position of the  knob.
5. If the operational amplifier button setting is changed to  or , the image brightness on the CRT will change. Adjust the JSM-T300 operation panel  knob to obtain the optimum image brightness.

### 6.3 Photography

1. Similar to secondary electron image photography, use the rapid exposure system. Manipulate the operational amplifier unit **CONTRAST** knob so as to obtain the optimum image contrast.
2. Adjust image brightness with the JSM-T300 operation panel **BRIGHTTNESS** knob. (Refer to "3.7", JSM-300 Scanning Microscope Instructions.)

### 6.4 Miscellaneous

1. The JSM-T300 operation panel **CONTRAST** knob is idle during the back-scattered electron image observation.
2. In a composition image (COMP), the darker areas correspond to the lighter elements, and the brighter areas correspond to the heavier elements.
3. With the topographic image (TOPO), an object appears as if it is lighted from the left side ( in the case of JSM-T300). That is to say, the left edge of each hollow is dark and the right edge is bright. On the other hand, the left edge of each projection is bright and the right edge is dark.



## 7. INSTALLATION

Normally, the BEIS need not be removed when not in use. However, if it has to be removed for cleaning or maintenance, remove and reinstall it by referring to Fig. 4.

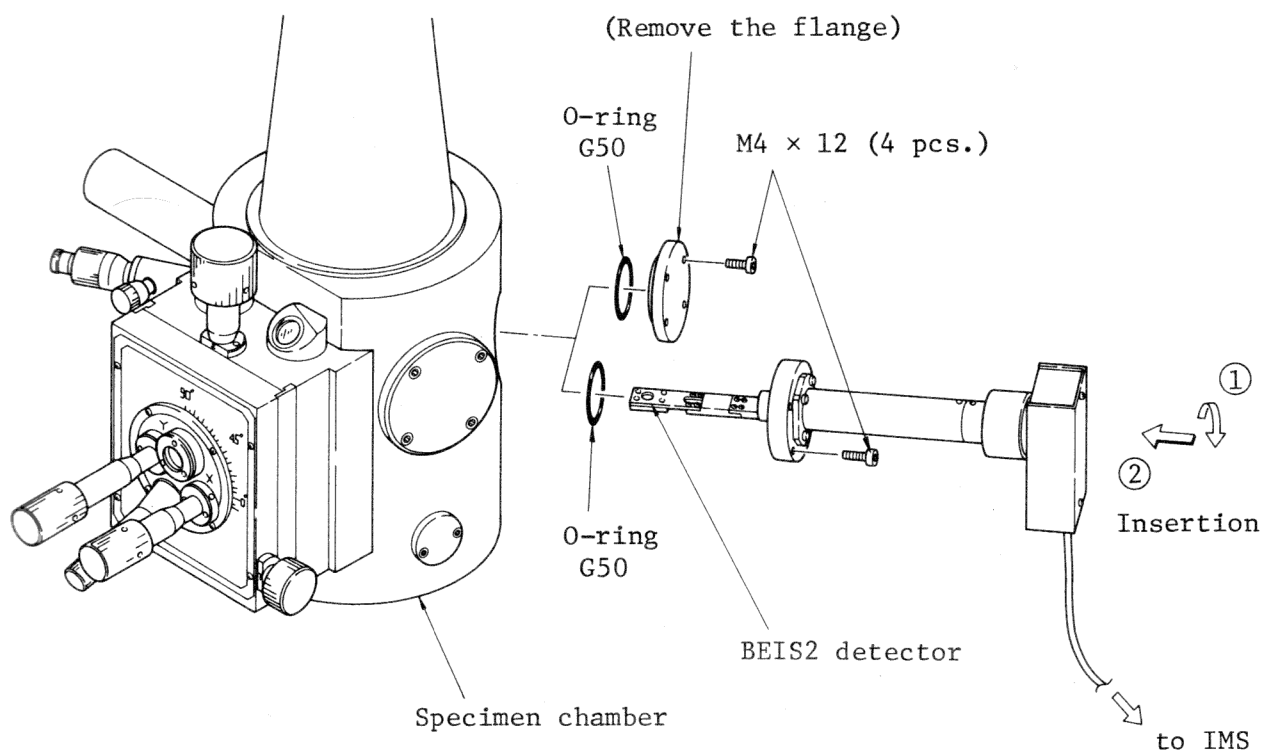
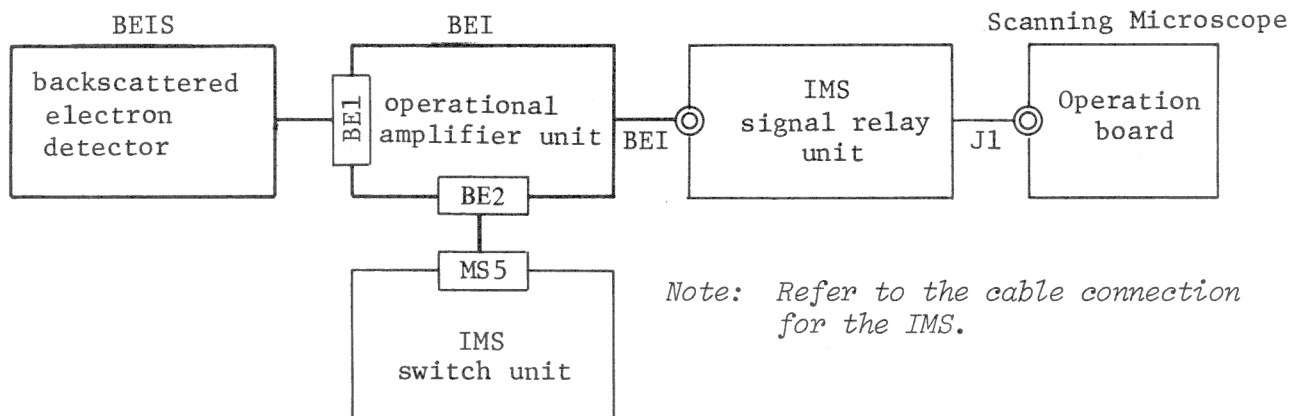


Fig. 4 INSTALLATION

## 8. CABLE CONNECTION



## 9. SIMULTANEOUS USE OF OTHER ATTACHMENTS

AEM	CLD	EDS	HS	IMS	LGSHIC	LGTED	TS	AGS	(SGZ)	(SXA)	(LGS3)
○	○	○	△	⊙	○	△	○	○	○	×	○

\*1

\*1

\*2

⊙ : Must be combined with BEIS2.

○ : Can be used simultaneously with BEIS2.

△ : Can be installed but cannot be used simultaneously with BEIS2.

× : Can be installed simultaneously with BEIS2.

Every attachment other than the above can be installed simultaneously with BEIS2.

(SGZ) : SGZ and the following attachments.

SGZSHL, SGZSHW

(LGS3) : LGS3 and the following attachments.

LG3SHL, LG3SHW

(SXA) : SXA and the following attachments.

FCS, IBS, LNT, OM

\*1 Extract the detector of BEIS2 installed in simultaneously.

\*2 In the case of simultaneous use with FCS, installation etc. should be changed. Confirm the instruction manual of BEIS2(FCS).



