BS-64010SCT

SCAN CONTROLLER

BS-64061SCT-E1-08

Printed in Japan

JEOL
Serving Advanced Technology

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SAFETY PRECAUTIONS

For the proper use of the instrument, be sure to read the following safety precautions prior to starting operation or maintenance. They contain important information related to safety. Contact your JEOL service office whenever you are unclear about any operation or maintenance.

The signs for safety precautions and their meanings used in this instruction manual are as follows:

⚠ WARNING: A potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION: A potentially hazardous situation which, if not avoided, could result in minor or moderate injury. Also could mean a potentially hazardous situation which could result in serious damage to facilities and acquired data.

Use the instrument in a proper manner and within the scope of the purposes and usage contained in the brochures and instruction manuals. Never make modifications such as removing protective parts, exchanging component parts, and defeating safety measures.

Be sure to read the “Safety Precautions” given in the instruction manuals of the optional attachments for information about the attachments of this instrument.

⚠ CAUTIONS

- When you use the SCAN CONTROLLER unit, set X Limit, Y Limit, Scan XS/Limit, and Scan YS/Limit properly in advance. If the electron beam moves off the limits or beyond the object to be irradiated, the electron gun or other parts might be damaged.
- Do not use the connector pins other than those designated for external control purposes. Doing so might cause the electron gun power supply unit or other units to be damaged.
- When SP-EXT and P-TUNING are in use, make sure that external control signals are input. If they are not, the electron gun power supply unit or other units might be damaged.
- When SP-EXT and P-TUNING are in use, observe the beam position and make sure that the beam is within the permissible movement range. If the electron beam moves off the limits or beyond the object to be irradiated, the electron gun or other parts might be damaged.
- When you use the SCAN CONTROLLER unit, make sure that memory data selection signals(range from 1 to 15) are input. If they are not, the SCAN CONTROLLER does not function normally, and the electron gun power supply unit or other units might be damaged.

1 General

In the electron beam scan signal of the F series electron gun power supply unit, various correction functions are available.

● Specifications

1) Waveform generation mode	4
2) Number of channels	2
3) Number of stored settings	15 for each channel
4) PC interface	RS232C (D-Sub9pin pin connector, inch screw)

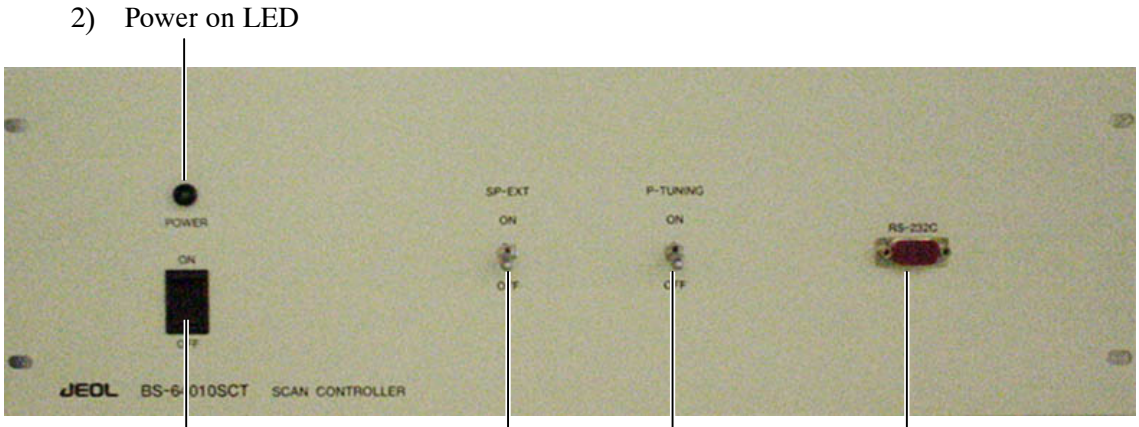
● Customer provided

1) PC communication cable	RS232C cross cable
2) PC	Resolution: 1024 × 768 or better
3) OS	Windows 2000, XP
4) Input power	AC 90 to 240V 50/60Hz 70VA

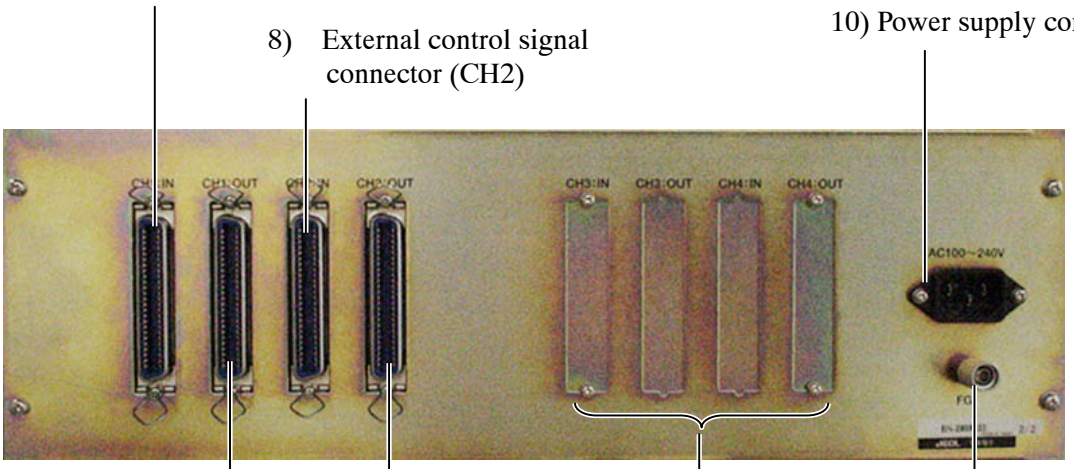
● Accessories

1)Line cable (3 m)	1
2)Grounding cable (3 m)	1
3)50 pin communication cable (1 m)	2 (CH1 OUT, CH2 OUT)

2 Unit description



Front panel



Rear panel

1) Power switch
   Turns on and off the SCAN CONTROLLER unit
2) Power on LED
   Lights when the SCAN CONTROLLER unit is on.
3) RS232C communication connector
   Connected to the PC.
4) SP-EXT switch
   Switches from the position and scanning gain signals of the SCAN CONTROLLER to the external control signal.
   ✍ When you turn on the SP-EXT switch, make sure that the external control signal has been input. Otherwise, the electron gun power supply unit or other units might function erroneously.
5) P-TUNING switch
   Superimposes the external control signal on the position signals of the SCAN CONTROLLER. This external signal is used to compensate the SCAN CONTROLLER position signal.
   ✍ When you turn on the P-TUNING switch, make sure that the external control signal has been input. Otherwise, the electron gun power supply unit or other units might function erroneously.

6) External control signal connector (CH1)
Used for the selections of stored settings and external control signals.
7) JST-F series power supply signal interface (CH1)
Connected to the F series power supply.
8) External control signal connector (CH2)
Used for the selections of stored settings and external control signals.
9) JST-F series power supply signal interface (CH2)
Connected to the F series power supply.
10) Power supply connector
Connected to the power line, AC 90 V to 240 V, 50/60 Hz.
11) Grounding terminal
Used to ground the system. For the purpose of safety and protection, it is mandatory that the equipment be grounded.
12) CH3, CH4 External control signal connectors and JST-F series power supply signal interfaces (Optional, supplied to order)
These connectors are provided on an optional 4-channel equipment.

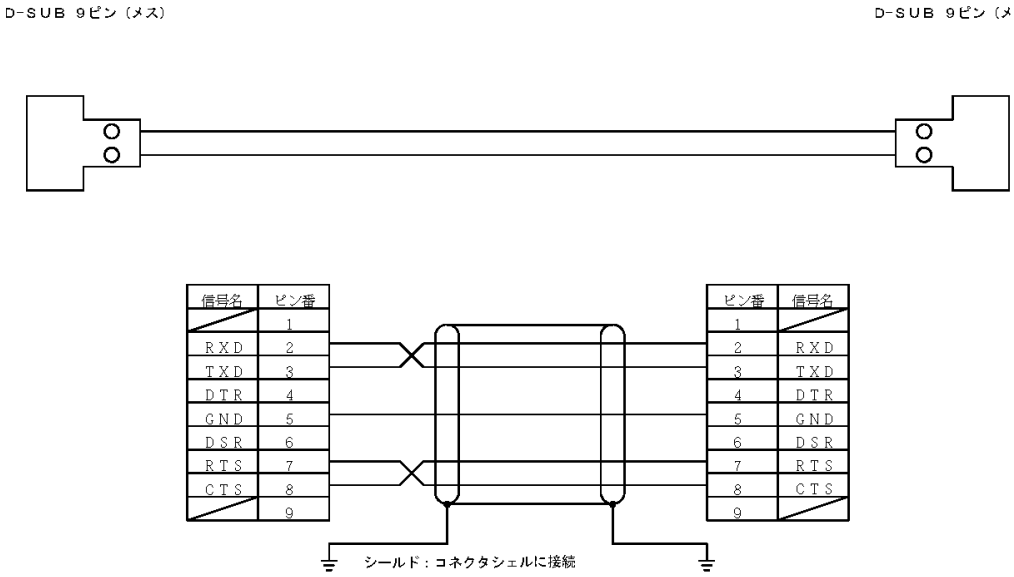
3 Installation

3.1 Connection

Power supply	AC 90 V to 240 V 50/60 Hz No harmonic component included.
Ground	10 Ω or less

✍ In AC 200 V system, use an AC cable suitable for the power rating and receptacle.

1. For safety reasons, it is imperative to ground the unit by connecting the ground terminal at the back of the unit to the grounding provision at the installation site using the supplied cable.
2. Connect the F series power supply with the signal line using the supplied 50-pin cable by connecting the power supply EXT II connector to CH1 to CH2 OUT.
3. Connect the external control signal cable to the IN connector, as necessary.
   ✍ Also, make necessary connections for stored setting selection signals.
   ✍ Use the F series power supply EXT II dummy connector as the IN signal connector.
4. Connect the PC to the RS232C connector on the front panel using the RS232C cross cable.
5. Install the SCAN CONTROLLER control program in the PC. To do this, insert the setup disk into the PC disk drive; execute the SETUP.EXE command; then follow the instructions shown on the window.
6. As a preparatory step, turn on only the SCAN CONTROLLER unit and PC and input data so that the beam position and scan width are set to zero for each of the 15 internal memories (XP•ADJ = 0, YP•ADJ = 0, SCAN WIDTH = 0).



Connection of PC interface cable (RS232C cross cable)

Depending on the PC conditions, it might be necessary to specify the RS232C port number in the SCAN CONTROLLER program. If it is so, specify it as follows:

7. Open the **Scanning.imi** file in the SCAN CONTROLLER program file (for example, in the directory C:¥Program File¥Scanning).

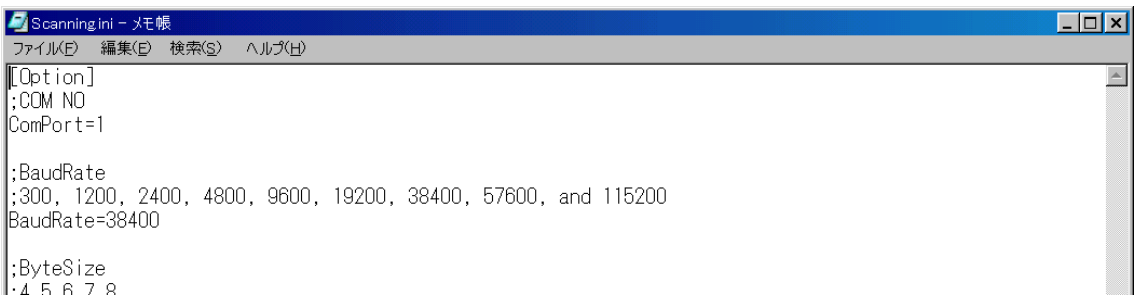
8. Input the port number using alphanumeric characters, following after "**ComPort=**" in the third line.

- Com Port No. to be connected to the SCAN CONTROLLER can be confirmed by Control Panel System Information.
- The default is ComPort=1.
- Do not change the other parameters.

9. Save the setting and close the file.

Modification of the F series power supply

In order that the SCAN CONTROLLER functions properly, the circuit board must be modified. For information on the modification, consult JEOL service personnel.



- **BS-64061OPE DeviceNet operation unit**

  ☞ Refer to the BS-64061OPE instruction manual about connection, setting, and operation.

  ✍ SCAN CONTROLLER signal connectors for external control and F power supply are both connected with BS-64061OPE. So SCAN CONTROLLER 's external signals are controlled by BS-64061OPE.

3.2 External control signals

The following external signals are used to control the SCAN CONTROLLER and to indicate its operating conditions.

a. Memory data (15 sets) selection signal

This signal (binary code signal, contact point: open/close) calls one of the 15 data sets stored in the SCAN CONTROLLER. If all of the contact points are open (no input), the SCAN CONTROLLER does not function.

⚠ CAUTION

When you use the SCAN CONTROLLER unit, make sure that memory data selection signals(range from 1 to 15) are input. If they are not, the SCAN CONTROLLER does not function normally, and the electron gun power supply unit or other units might be damaged.

b. S•P EXT

This contact point is closed when the F series power supply is set to the external control for beam position and scan width. When you use the SCAN CONTROLLER, this contact point must be closed.

✍ The function of the SP-EXT switch on the front panel of the SCAN CONTROLLER is different.

c. SC POWER ON

This contact point is closed when:

- The 10F power supply is on.
- The SCAN CONTROLLER power supply is on.
- One of the 15 data sets is selected.

d. Analog output signals for confirming XP, XS, YP, and YS positions and scan widths

These signals are output from the F series power supply when the optional ST-EXTSIG board is provided. The signal gain varies depending on the initial settings of the F series power supply and SCAN CONTROLLER. Listed below are the typical variable ranges.

XP	-10 V to 10 V

XS	0 V to 10 V
YP	-10 to 10 V
YS	0 V to 10 V

e. Analog input signals for setting XP, XS, YP, and YS positions and scan widths

The operation changes according to the settings of the SP-EXT and P-TUNING switches on the SCAN CONTROLLER front panel. Also, the signal gain varies depending on the initial settings of the F series power supply. Control should be carried out while observing the electron beam spot. The operation mode changes as follows:

- When SP-EXT and P-TUNING are off, the external signals cannot be used.
- When SP-EXT and P-TUNING are on or when SP-EXT is on and P-TUNING is off, the beam position and scan width can be controlled by the external control signals. In this mode, the correction for balance, tilt, p-form, and others cannot be applied to the beam position. The scan width changes only its magnitude while keeping the conditions (the shape and the time during which the beam dwells in a certain place) specified by the SCAN CONTROLLER unchanged. Listed below are the typical variable ranges.

XP	-10 V to 10 V
XS	0 V to 10 V
YP	-10 to 10 V
YS	0 V to 10 V

- When SP-EXT is off and P-TUNING is on, the settings of the SCAN CONTROLLER is applied to the scan width and the external control signals cannot be used. The external control signal is added to the position signal output of the SCAN CONTROLLER. In this mode, however, the SCAN CONTROLLER position correction for limits, balance, tilt, p-form, and others) cannot be applied to the external control signal. The input voltage range depends on the settings of the SCAN CONTROLLER X Limit and Y Limit and varies as follows:

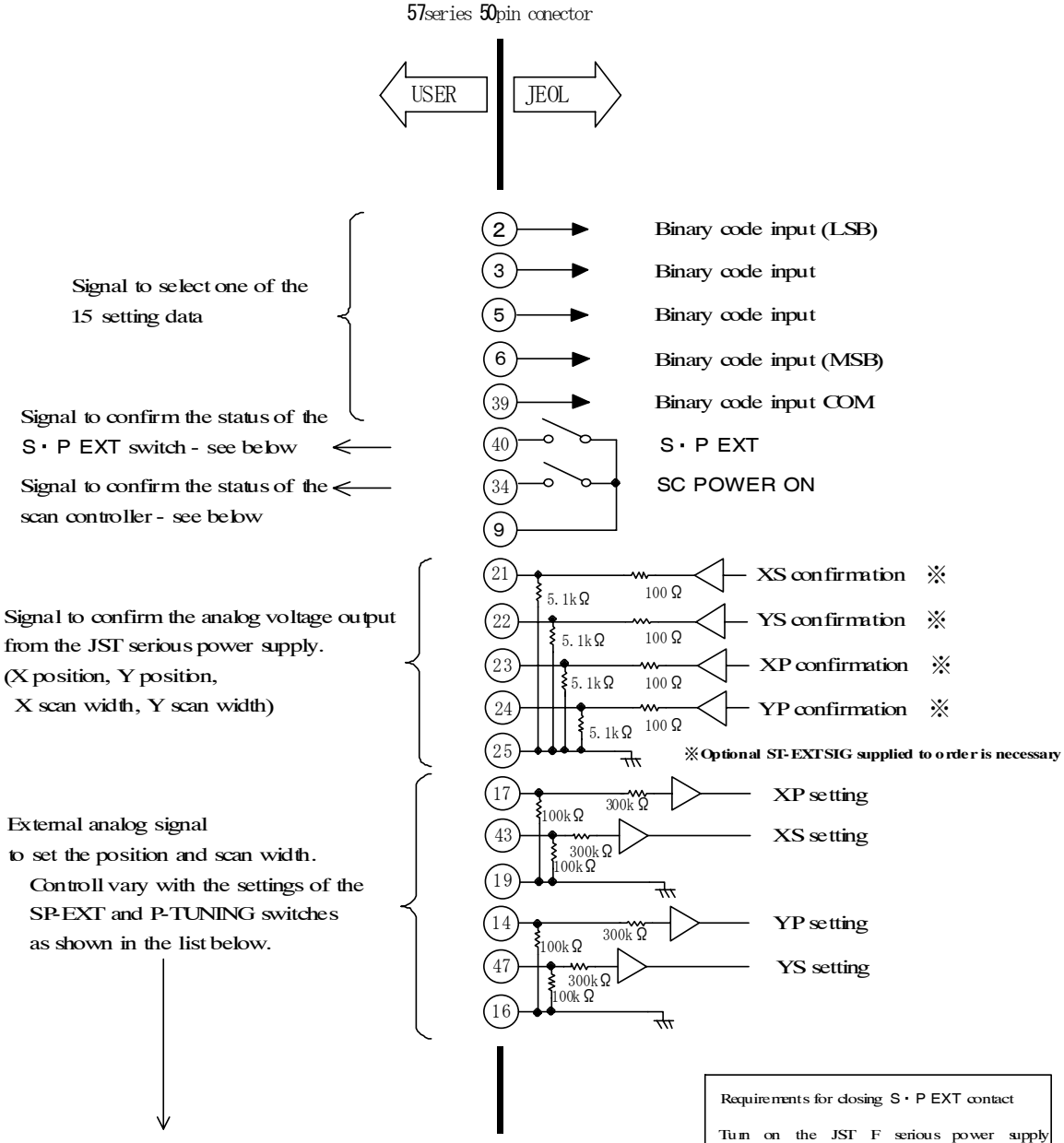
XP	-10+10×(X Limit/99) to +10-10× (X Limit/99)
XP	-10+10×(Y Limit/99) to +10-10× (Y Limit/99)

⚠ CAUTION

When SP-EXT and P-TUNING are in use, make sure that external control signals are input. If they are not, the electron gun power supply unit or other units might be damaged.

When SP-EXT and P-TUNING are in use, observe the beam position and make sure that the beam is within the permissible movement range. If the electron beam moves off the limits or beyond the object to be irradiated, the electron gun or other parts might be damaged.

Scan controller IN connector



Scan controller Front panel switches	S・P EXT :OFF P-TURNNING :OFF	S・P EXT :OFF P-TURNNING :ON	S・P EXT :ON P-TURNNING :OFF
Position control	By the scan controller	Scan controller output is superimposed on external input	By the external signals
Scan width control	By the scan controller	By the scan controller	By the external signals

Requirements for closing S・P EXT contact

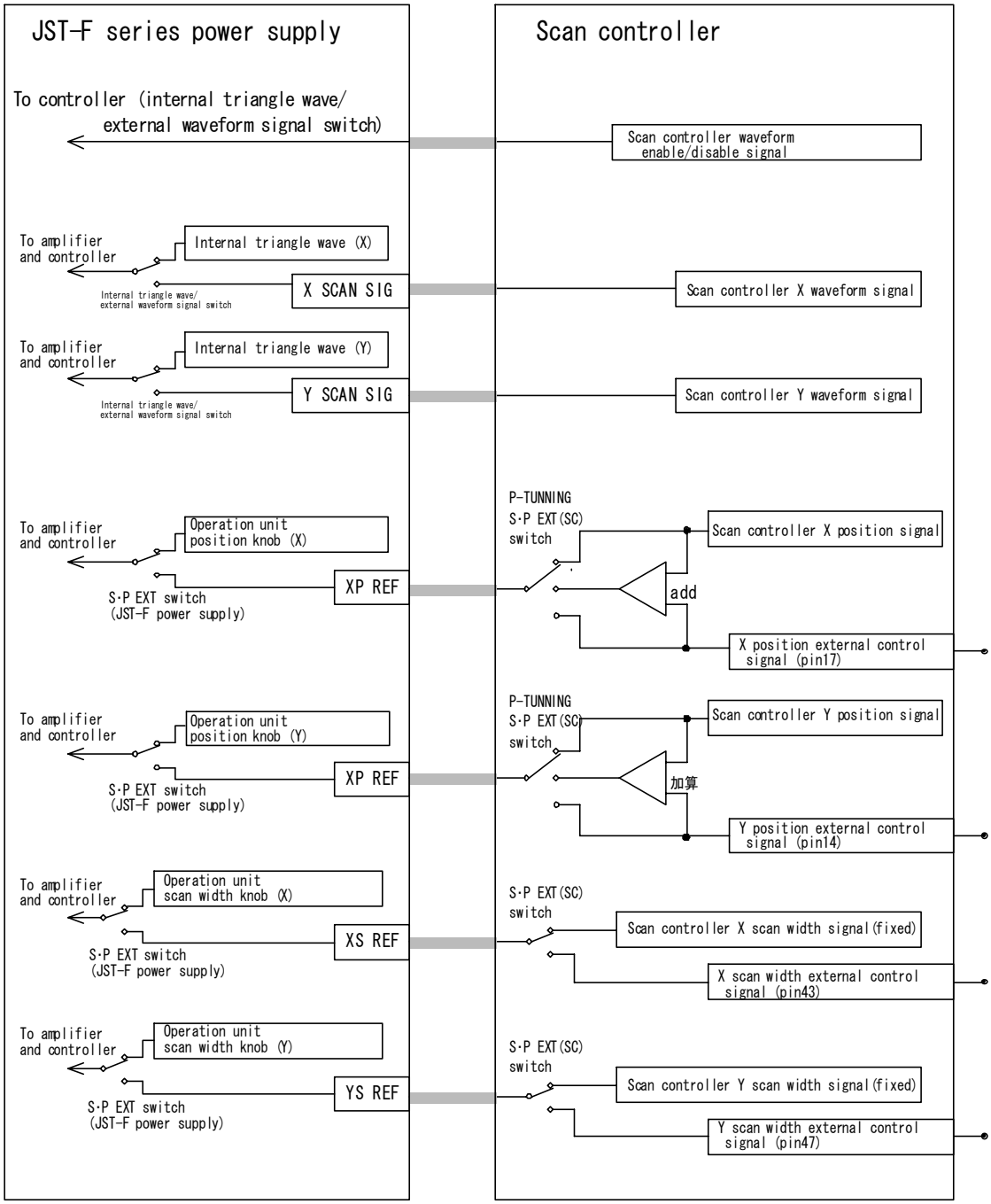
Turn on the JST F serious power supply POWER switch.
& Set the INT/EXT switch to INT
& Set the S・P EXT switch to on(close).

Requirements for closing SC POWER ON contact

Turn on the JST power supply POWER switch.
&Turn on the scan controller.
&Input a setting selection signal(close)

3.3 JST-F series power supply connection diagram (principle of operation)

The figure below shows the schematic illustration of signal connection.



The signals sent from the SCAN CONTROLLER to the F series power supply consist of the X and Y ‘wave-form signal’, X and Y ‘position signal’, and X and Y ‘scan width signal’. The ‘wave-form signal’ is the basic scan wave form, the ‘position signal’ determine the beam center, and the ‘scan width signal’ determine the scanning

magnitude (gain). Normally, the SCAN CONTROLLER outputs the fixed maximum ‘scan width signal’ (+10V) and the actual scan width is controlled by changing the amplitude of the ‘wave-form signal’. The SCAN CONTROLLER ‘position signals’ and ‘scan width signals’ are turned on and off by the SP-EXT and P-TUNING switches. When both the SP-EXT and P-TUNING switches are off, the signals are generated from the SCAN CONTROLLER and the external signals cannot be used. When the P-TUNING switch is turned on, the external ‘position signal’ that is input from the IN connector is added to the SCAN CONTROLLER ‘position signal’. When the SP-EXT switch is on, the beam position and scan width can be controlled by the external control signal.

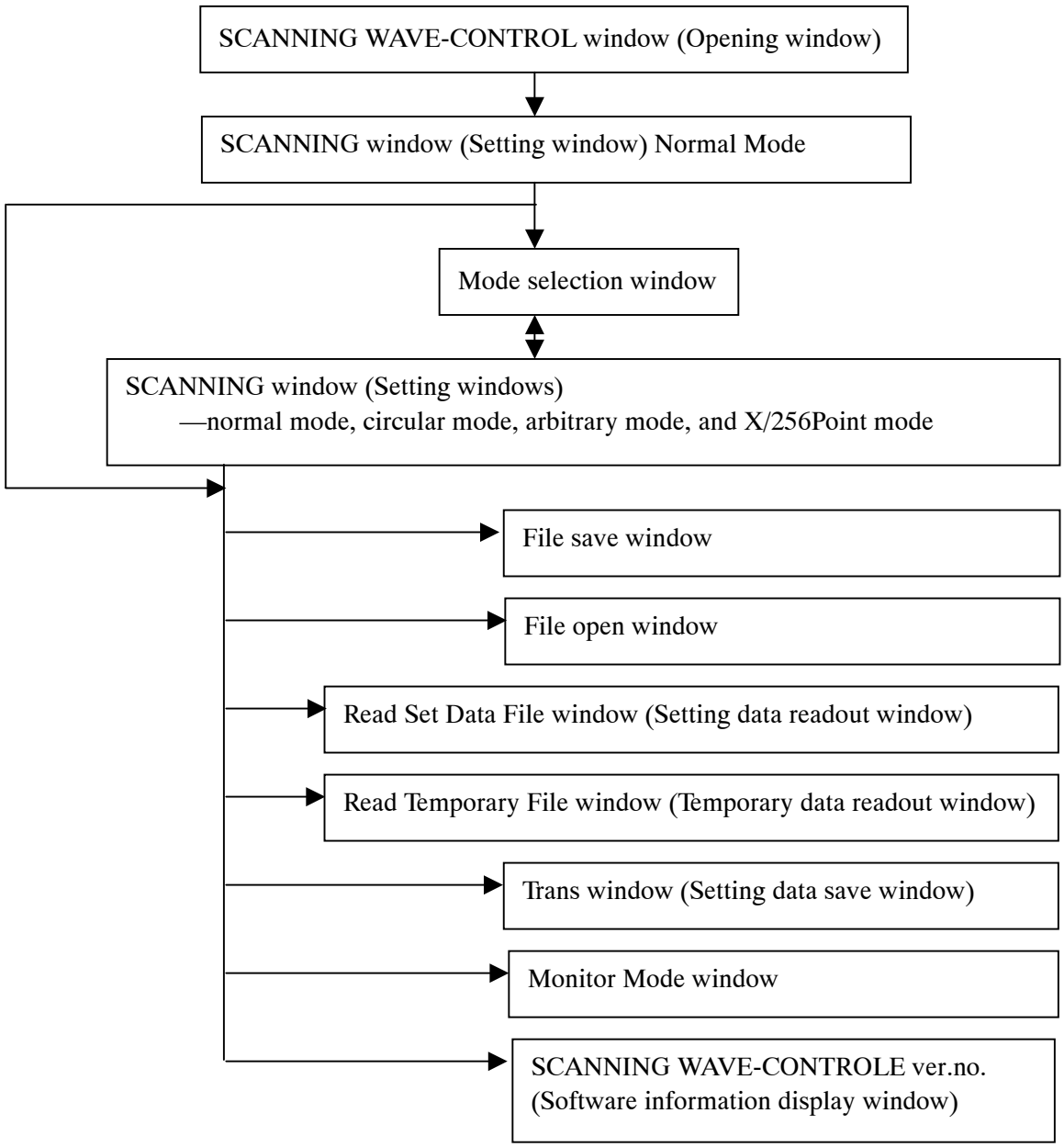
There are switches also on the F series power supply to select whether to enable the signals from the SCAN CONTROLLER or not. The SCAN CONTROLLER automatically selects the SCAN CONTROLLER wave-form signal when the SCAN CONTROLLER (POWER) is on and the setting selection signal has been input. When the INT/EXT switch on the F series power supply operation panel is set to EXT and the S・P EXT switch to ON, the position and scan width signals from the SCAN CONTROLLER is selected.

⚠ CAUTION

Do not use the connector pins other than those designated for external control purposes; otherwise the electron gun power supply or other parts might be damaged.

4 Software

4.1 Windows

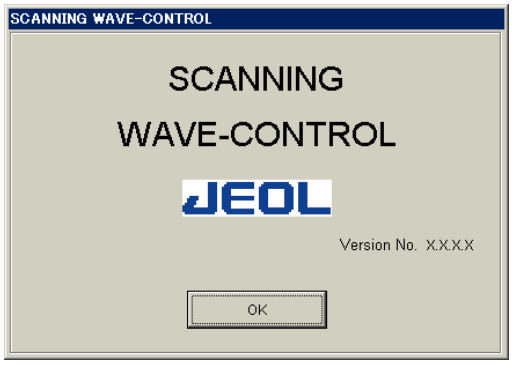


4.2 Operation

Operations common to all of the scanning modes

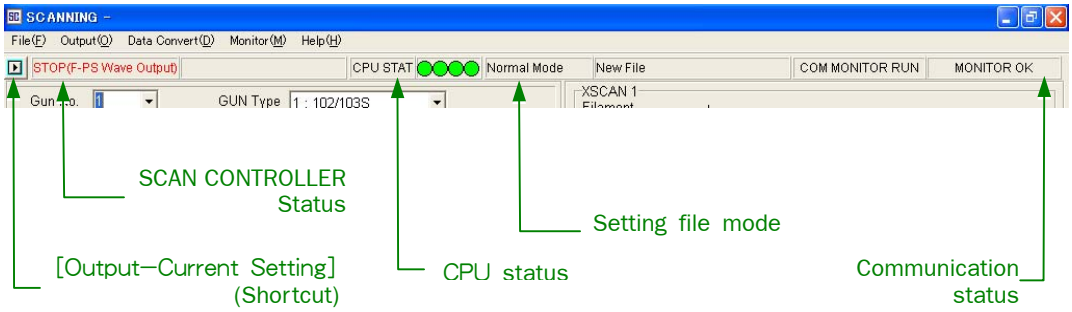
4.2.1 Initial opening window

This window opens when the software starts.



OK — Clicking on this button opens the SCANNING window (Normal mode setting).

4.2.2 Menu bar and icons



◆ File(F) menu

- New(N)
  Clicking on this button opens the SCANNING window.
- Open(O)
  Clicking on this button opens the File readout window.
- Save As(S)
  Clicking on this button opens the file entry window.
  (The file is named and saved.)
- Save
  Clicking on this button rewrite and save the file.

◆ Output(O) menu

These commands are for changing SCAN CONTROLLER output signals.

This button functions only when the PC is in communication with the SCAN CONTROLLER.

- Current Settings ([Run] command at previous software version)

Clicking on this command transmits the present settings and executes the temporary mode. SCAN CONTROLLER status indicates “SC Output” / “Selected Memory No.[Invalid]”.

- Once the power is turned off, the transmitted data become invalid.
- The setting data will not be output unless the setting selection signal has been input.
- When executing this command, SCAN CONTROLLER runs as temporary mode, and memory selection signal is invalid. To execute the stored setting data selected by memory selection signal again, turn off SCAN CONTROLLER once, or change memory selection signal once, or execute [Output-Selected Memory No.] command.

• Selected Memory No.

Clicking on this command executes the stored setting data selected by memory selection signal. SCAN CONTROLLER status indicates “SC Output” / “Selected Memory No.[**]”. (** means the selected number.)

• F-PS Wave (STOP) ([STOP] command at previous software version)

Clicking on this command interrupts the operation of the SCAN CONTROLLER. Scanning wave form change to triangle wave which is made by F power supply. SCAN CONTROLLER status indicates “STOP (F-PS Wave Output)”.

◆ Data Convert(D) menu

These commands are for sending or receiving the SCAN CONTROLLER setting data.

- Do not turn off the SCAN CONTROLLER power supply nor remove the communication cable while SCAN CONTROLLER is communicating.
- This button functions only when the PC is in communication with the SCAN CONTROLLER.

• Trans

Clicking on this button opens the Setting Data Store window and saves the setting data in the SCAN CONTROLLER memory.

• Read Active Setting ([Read Temporary File] command at previous software version)

You can read out the setting data which SCAN CONTROLLER outputs at present.

• Read Set Data File

You can read the data stored in the SCAN CONTROLLER memory.

◆ Monitor(M)

Clicking on this button opens the Monitor Mode window.

◆ Help(H)

Clicking on this button opens the SCANNING WAVE-CONTROL ver.no. (Software information display window).

◆ CPU status

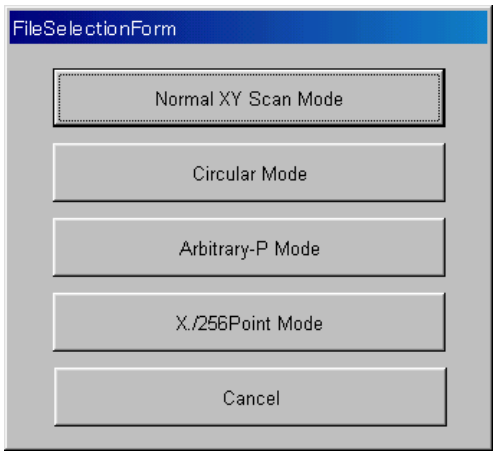
The green indicator is lit up when the CPU is normal. When the red indicator is lit up, the CPU is abnormal and SCAN CONTROLLER interrupts the operation

⚠ CAUTION

When you execute [OUTPUT] command, observe the beam position and make sure that the beam is within the permissible position movement range. In some SCAN CONTROLLER or power supply setting conditions, the beam moves impermissible position, and the electron gun or other parts might be damaged.

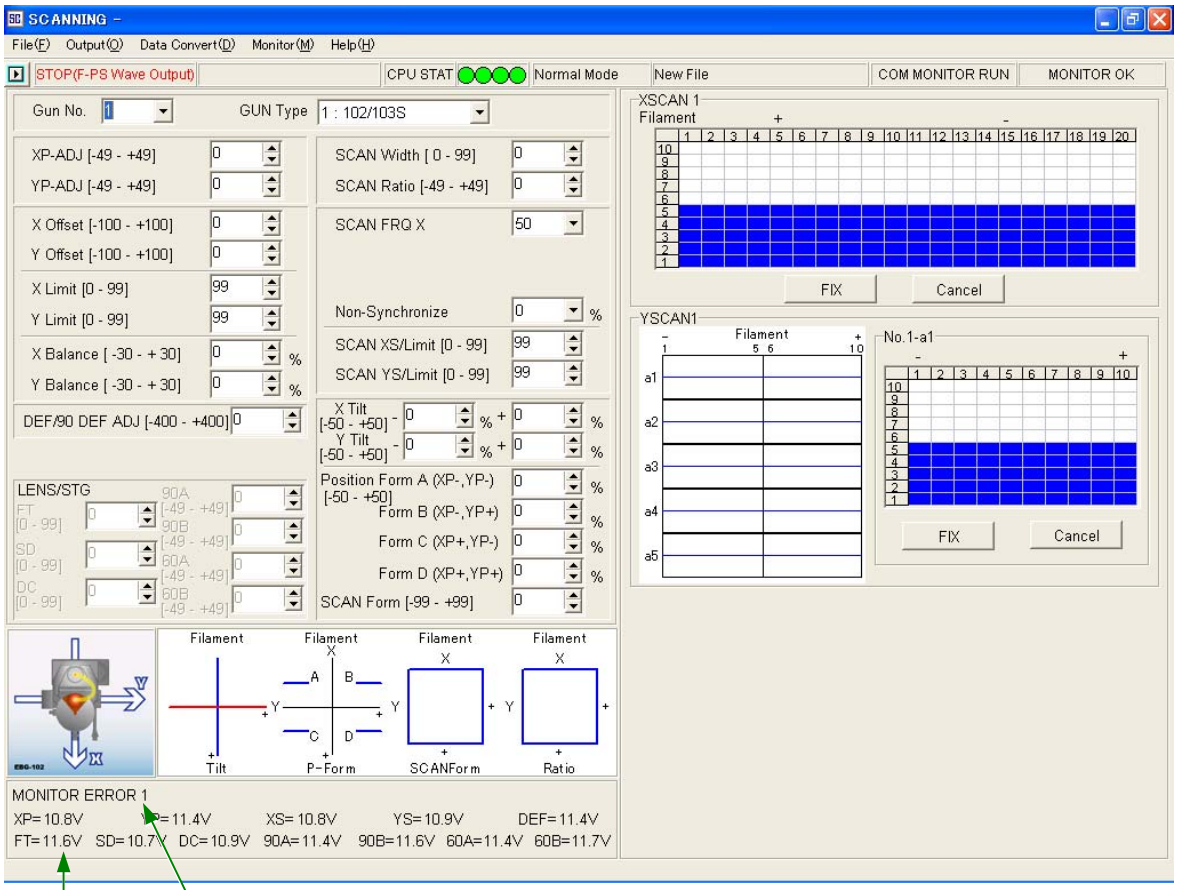
4.2.3 Mode selection window

Clicking on the New(N) button in the File menu opens the SCANNING window, containing the following buttons:



Normal XY Scan Mode	Opens the SCANNING (Normal Mode) window.
Circular Mode	Opens the SCANNING Circular Mode window.
Arbitrary-P Mode	Opens the SCANNING Arbitrary Mode window.
X/256Point Mode	Opens the SCANNING X/256Point Mode window.
Cancel	Cancels the created file.

4.2.4 Setting window



Communication status

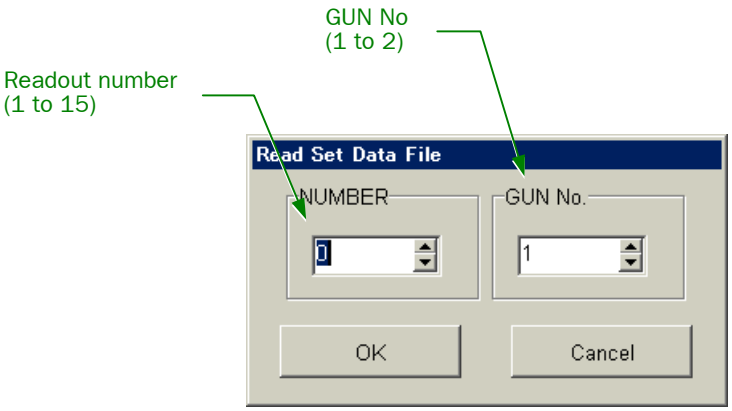
MONITOR RUN # : Normal operation
(#: BCD setting number)
MONITOR STOP : Operation at a normal stop
MONITOR ERR 1 : No program
MONITOR OFF LINE : Not connected

Monitor changes by GUN NO.

- To enable the monitor, the optional supplied to order is necessary.
- A numeral is displayed when ST-EXTSIG is not provided.

4.2.5 Stored data readout window

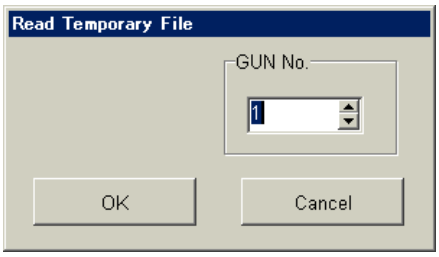
You can read the data stored in the SCAN CONTROLLER memory. Note that SCAN CONTROLLER output signals don't change.



OK	Clicking this button reads out the data.
Cancel	Clicking on this button returns to the previous window without reading out the data.

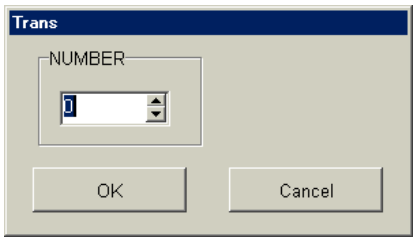
4.2.6 Active data readout window

You can read out the setting data which SCAN CONTROLLER outputs at present. Note that SCAN CONTROLLER output signals don't change.



OK	Clicking this button reads out the temporary data.
Cancel	Clicking on this button returns to the previous window without reading out the temporary data.

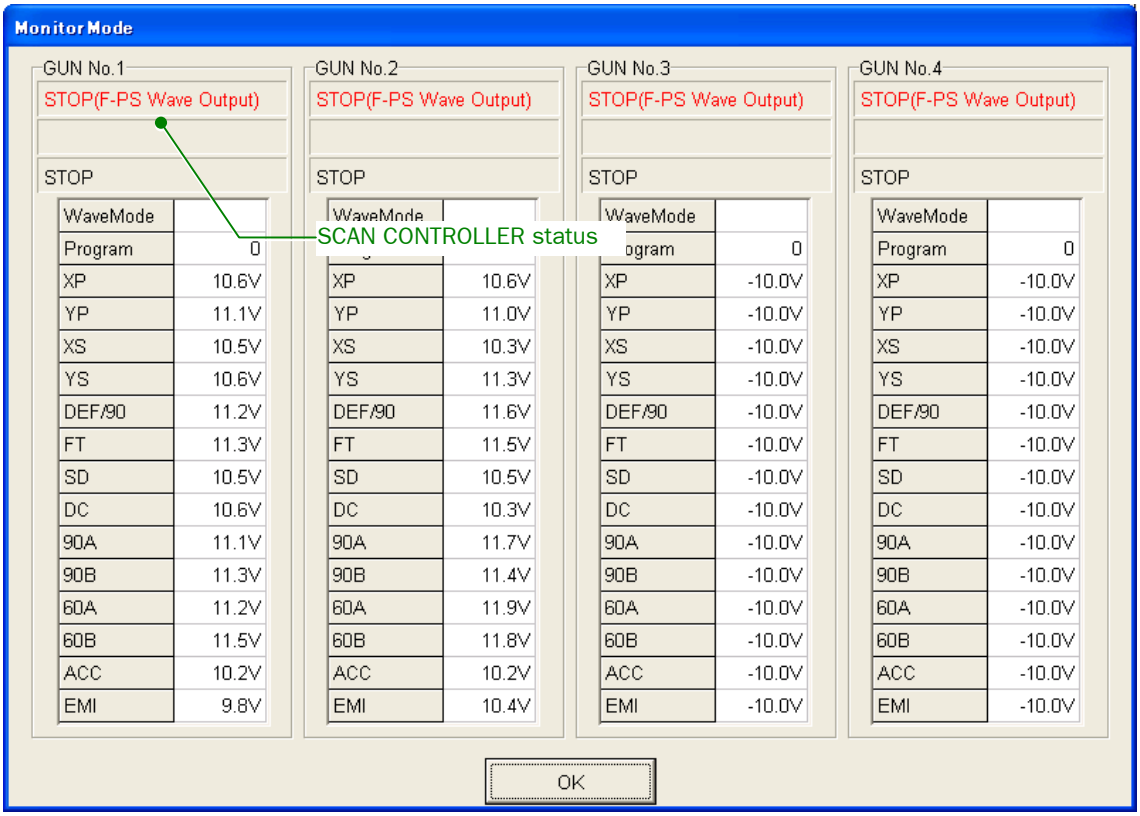
4.2.7 Setting data store window



OK	Clicking this button stores the data in the SCAN CONTROLLER memory.
Cancel	Clicking on this button returns to the previous window without storing the data.

4.2.8 Monitor window

In online, you can monitor the scanning status. Optional ST-EXTSIG supplied to order is necessary.



There are 3 type statuses in the SCAN CONTROLLER

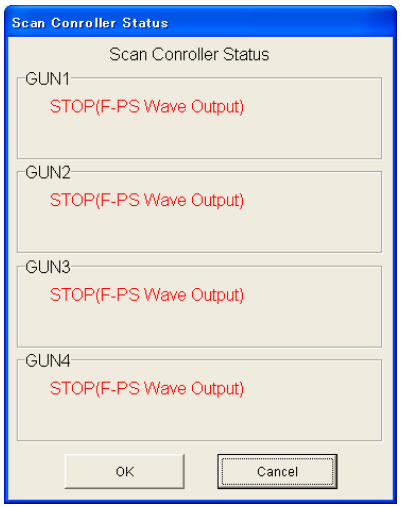
- "SC Output" / "Selected Memory No.[Invalid]"
  SCAN CONTROLLER outputs scanning signals, which is not the setting data selected by the memory selection signal. For instance, signal output by executing [Output]-[Current Setting] command makes this state.
- "SC Output" / "Selected Memory No.[**]". (** means the selected number.)
  SCAN CONTROLLER outputs scanning signals, which is the setting data selected by the memory selection signal. [Memory number] indicates the memory selection number.
- "STOP (F-PS Wave Output)"
  SCAN CONTROLLER doesn't output the scanning signal. Scanning wave form is triangle wave made by F series power supply.

4.2.9 Software information window

Information on the software is displayed. The software information varies with the OS version.

4.2.10 Ending window

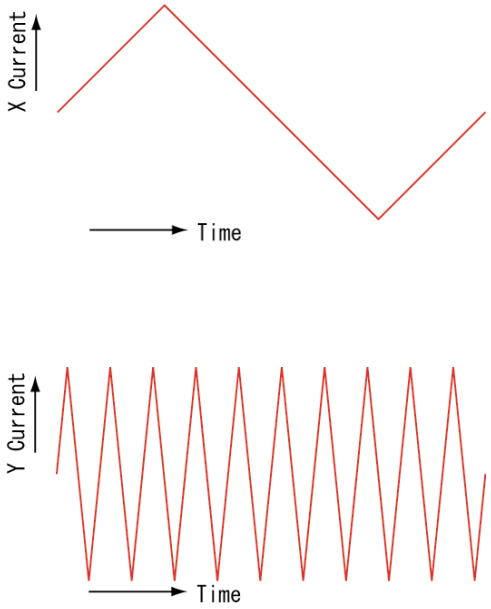
This window opens when the software are closed. SCAN CONTROLLER statuses are displayed.

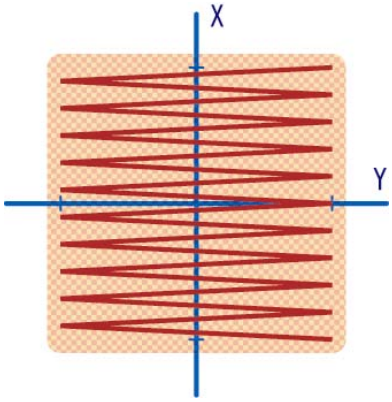


4.3 Scanning operation

4.3.1 Scanning waveform

The electron beam can be scanned by means of the magnetic field generated by the X and Y scanning coils through which respective currents flow. The standard JST-10F power supply produces and outputs the triangle wave currents, thereby enabling the electron beam to scan in the shape of a square. The SCAN CONTROLLER further modulates these currents, providing various scanning shapes.

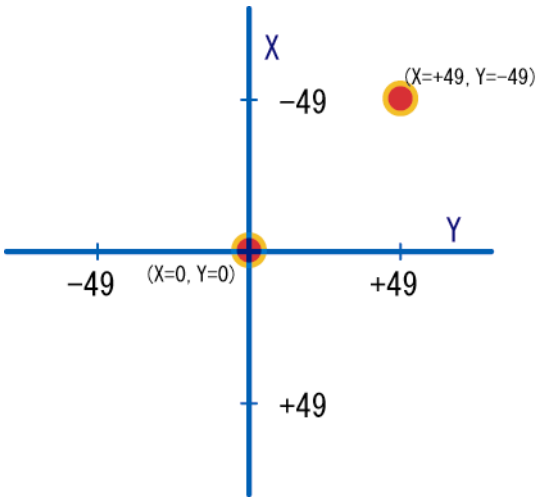




4.3.2 Position, offset, limits

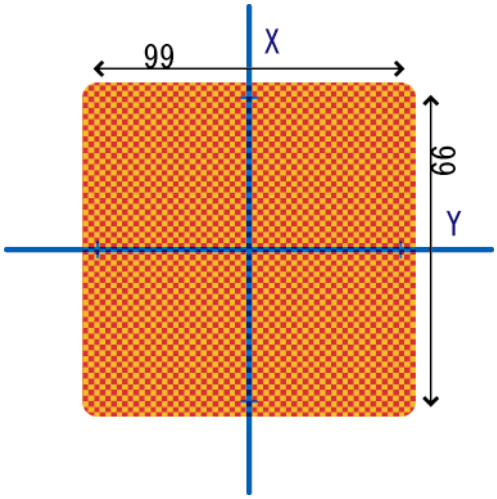
In the SCAN CONTROLLER, the electron beam position and all other parameters are denoted by the value with the X and Y components—the direction of the line that connects the electron gun and the crucible is X and the direction perpendicular to the line is Y.

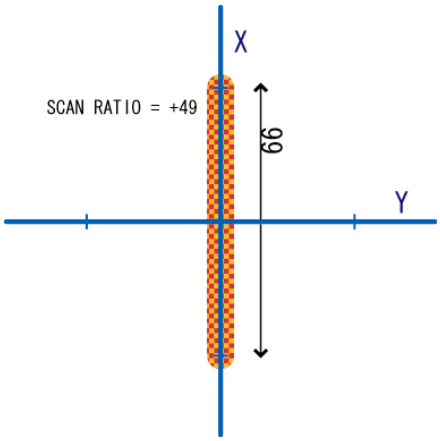
The range of beam position setting is -49 to +49 and can be adjusted using the XP-ADJ and YP-ADJ controls. When the position is set to ±49, the maximum beam movement is restricted by the X Limit and the Y Limit. It should be noted that the effectiveness of beam correction might vary according to the beam position. Therefore, the adjustment of the XP-ADJ and YP-ADJ controls is considered to be crucial for operation. When the position is set to 0, the beam position is changed by the X Offset and Y Offset settings.

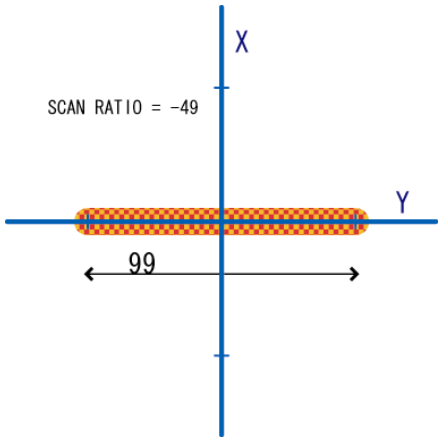


4.3.3 Scan ratio and scan limits

Scanning widen around the position set in Section 4.3.2. The magnitude of scanning can be changed by the Scan Width setting ranging from 1 to 99 and it is restricted by the XS Limit and YS Limit settings at the maximum setting 99 in the X and Y directions respectively. The “Limit” settings are selected at the initial stage. In order to change the X and Y scanning ratio, select an appropriate Scan Ratio setting. When +49 is selected, the scan width in the Y direction becomes 0 and when -49 is selected, the scan width in the X direction becomes 0.

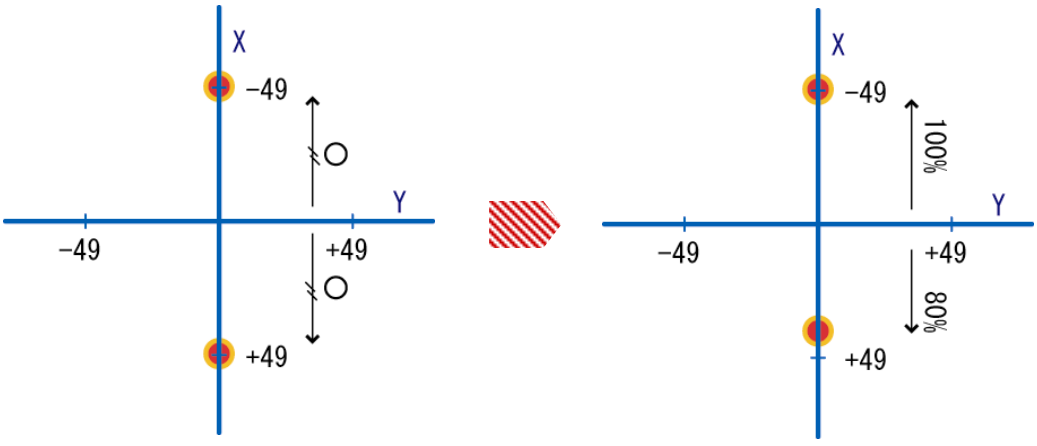






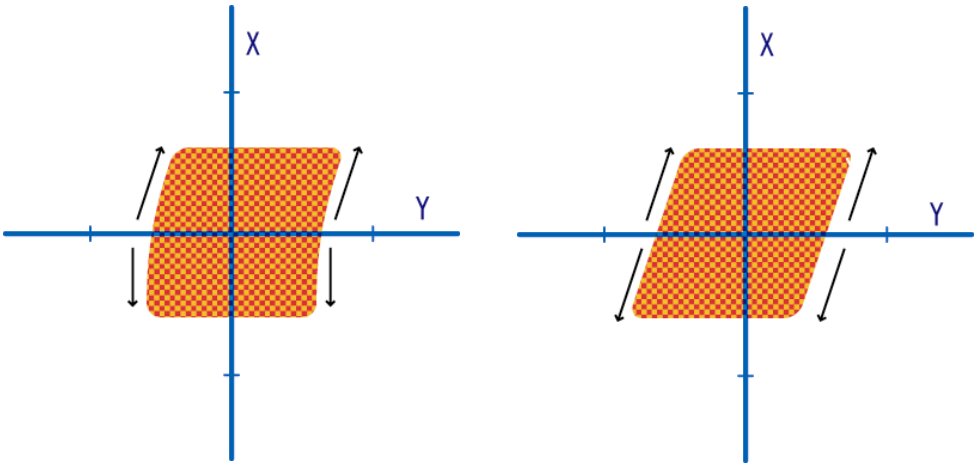
4.3.4 Balance

This function reduces the amount of movement at the same distance in the plus and minus directions with the beam position set at 0. For instance, when X Balance is set to -20, the amount of movement in the minus X direction is reduced by 20% and therefore the total amount of movement becomes 80 %.



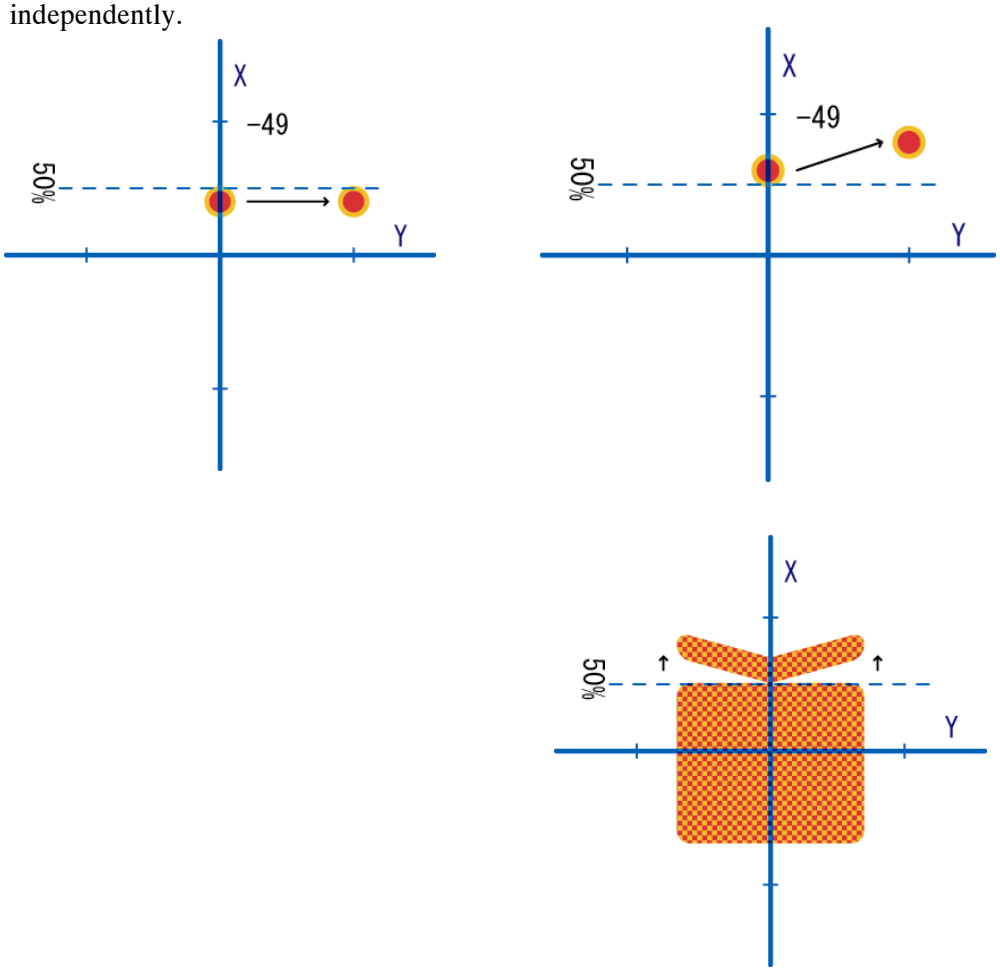
4.3.5 Tilt

The electron beam can be tilted in the X (plus or minus) and Y (plus or minus) directions.



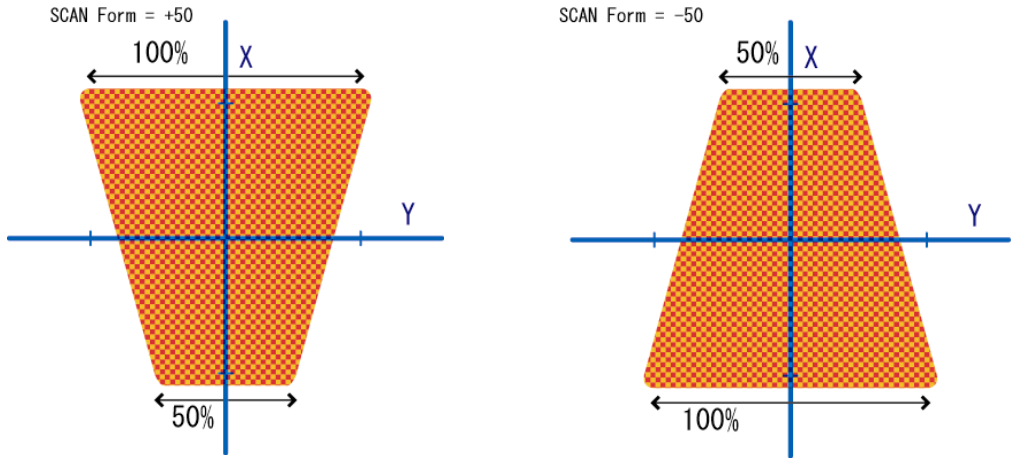
4.3.6 Position form

The outer region of the beam moving area undergoes correction. When this correction function is specified, up to ±50% of the total amount of beam movement and the scan width in the X direction is the same as usual but in the region more than 50%, the beam moves or scans obliquely. This correction is possible in all the X and Y quadrants independently.



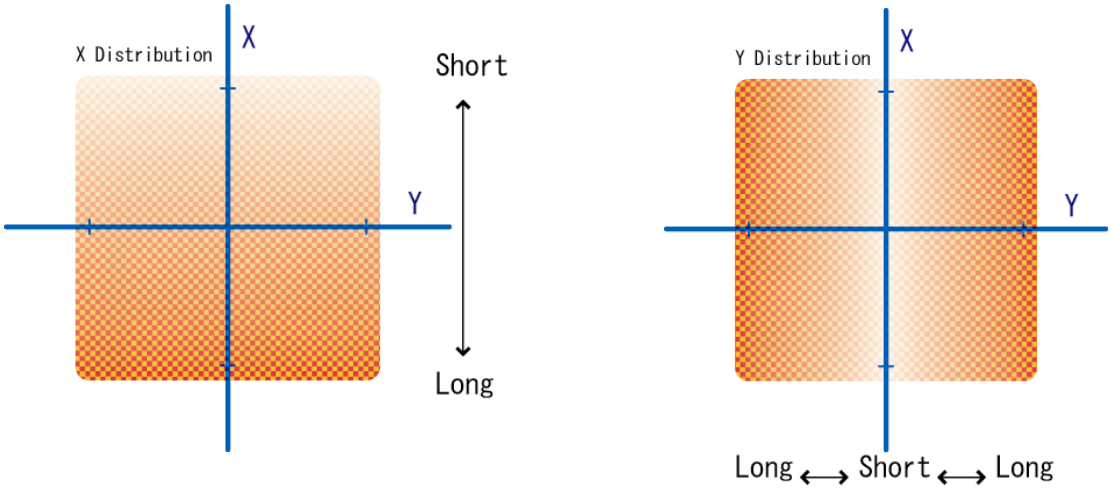
4.3.7 Scan form

With this correction, the scan widths in the X-axis plus and minus directions can be changed.



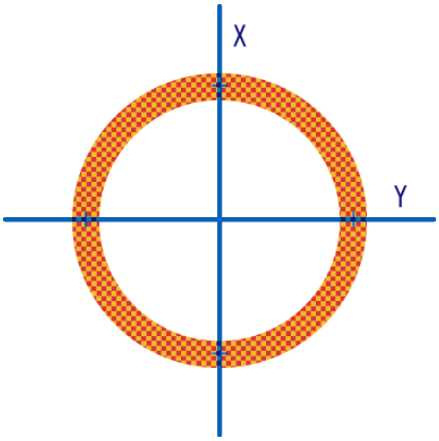
4.3.8 Beam dwelling time in normal mode

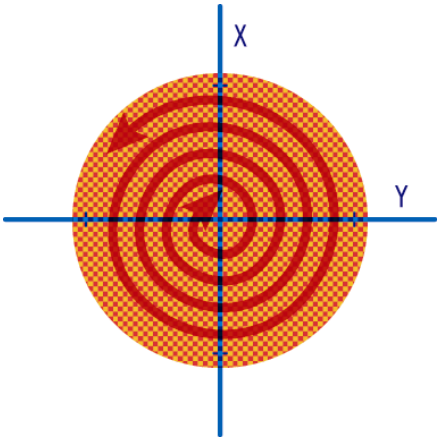
In this correction, the maximum scan width is divided into 16 divisions, and the ratio of the time during which the electron beam stays can be changed at each division. The maximum scan width is divided into 20 divisions in the X direction and 10 divisions (when the scan width in the X direction is divided into 10 divisions) in the Y direction and the ratio of the time during which the electron beam stays can be changed at each division.



4.3.9 Circular mode scanning

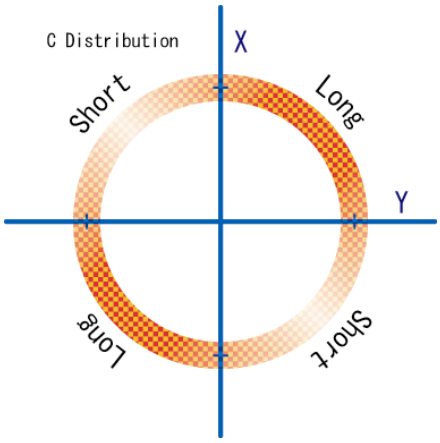
When a sinusoidal wave current is supplied to the X and Y scan coils, the beam can be scanned in the shape of a circle. In this mode, the SCAN CONTROLLER enables the beam to scan in the circumferential or spiral direction.

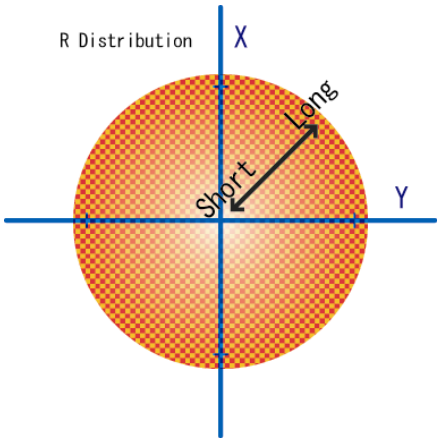




4.3.10 Beam dwelling time in circular mode

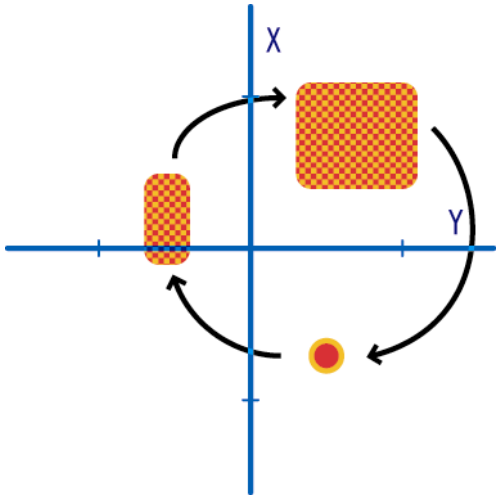
In this correction, the maximum scan width is divided into 16 divisions in the circumferential direction and 10 divisions (when Spiral is on) in the radial direction and the ratio of the time during which the electron beam stays can be changed at each division.





4.3.11 Arbitrary mode scanning

Up to a maximum of 20 scan areas can be selected by specifying the X and Y coordinates. The beam position and scan width are switched together and scans each area sequentially, with the scan ratio and the dwelling time preset.



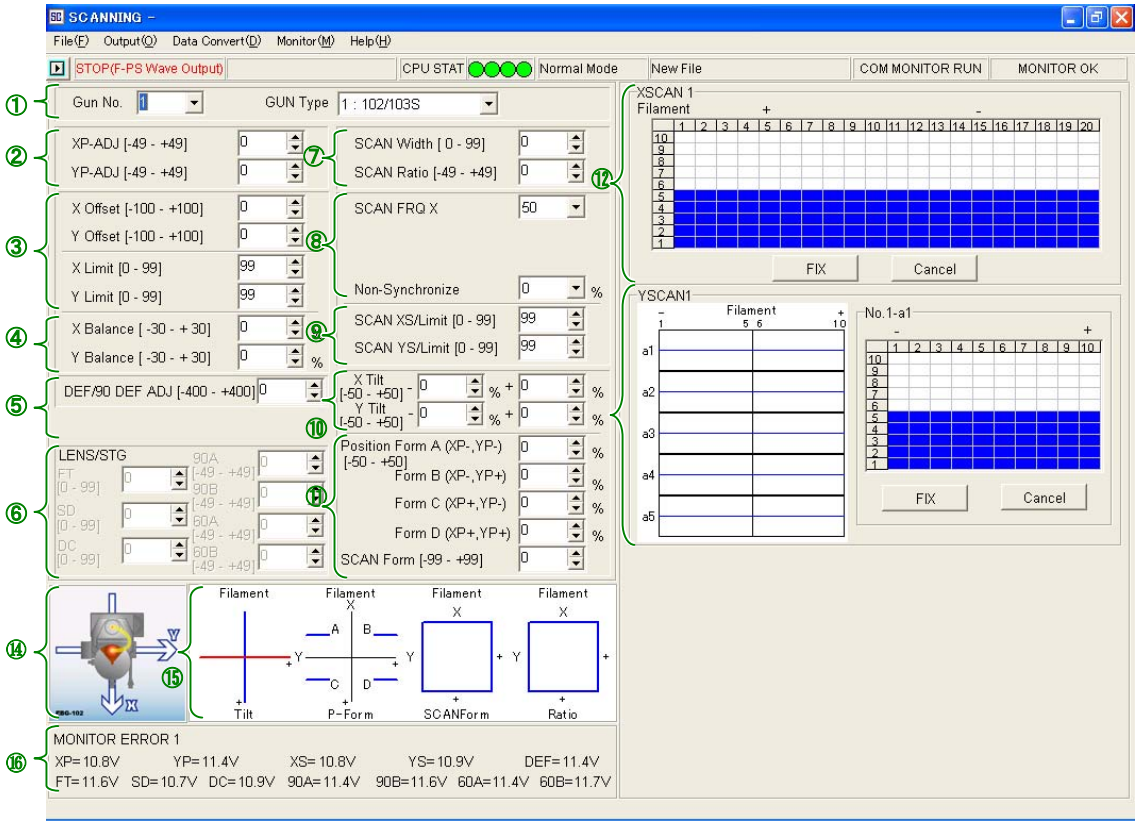
4.3.12 X256Point mode scanning

The scan width in the X direction is divided into 16 divisions for tilt correction and into 256 divisions for setting the dwelling time for each division.

4.4 Normal mode (SCANNING-) window

In normal mode, the beam is scanned in the shape of a square using a triangle wave.

4.4.1 General



① Basic setting

Gun No.	Selects one of the electron guns when multiple electron guns (Nos. 1 to 2) are used.
Gun Type	Selects the type of gun to be used from 102/103S, 103/203/303, 163, Straight GUN, and 102/103E/Scan coil.

② Position setting

XP-ADJ	Adjusts the X position of the beam. Range: -49 to +49
YP-ADJ	Adjusts the Y position of the beam. Range: -49 to +49

③ Position initial setting

X Offset, Y Offset	Set the referrence X and Y beam positions. Range: -100 to +100
X Limit, Y Limit	Set the maximum possible movable X and Y ranges. Range: 0 to 99

④ Plus and minus balance correction

X Balance, Y Balance — Perform correction for the beam position and scan width (plus and minus directions with respect to the beam axis).
Range: -30 to +30

⑤ Deflection coil intensity adjustment

DEF ADJ — Adjusts the Deflection coil current. This command is just used for deflection current adjustable EB sources.

⑥ Lens intensity adjustment — Not used

⑦ Scanning

Scan width — Selects the scanning magnitude.
Range: 0 to 99

Scan ratio — Adjusts the X and Y scanning ratio.
Range: -49 to +49

⑧ Scanning frequency

Scan FRQ X — Selects the X scanning frequency. The Y scanning frequency is automatically set to ten times the X scanning frequency.
Range: 5, 10, 15, 20, 30, 35, 40, 45, 50, 1, 0.5, 0.33, 0.25, 0.2, 0.17, 0.14, 0.12, 0.11, and 0.1 Hz

Non-Synchronize — Changes the X scanning frequency.
Range: (0), 2, 4, 6, 8, and 10%

⑨ Scanning initial setting

Scan XS/Limit — Establishes the upper limit of the X scan width.
Range: 0 to 99

Scan YS/Limit — Establishes the upper limit of the Y scan width.
Range: 0 to 99

⑩ Tilt correction

X Tilt — Corrects the X tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Y Tilt — Corrects the Y tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑪ Form correction

Position Form — The beam moves or scans obliquely in the region more than 50% of the X scan width limit. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Scan Form — The Y scan width is changed gradually in the X-axis directions. (The schematic diagram is displayed in the lower section of the window.)
Range: -99 to +99%

⑫ Setting the beam dwelling time in the X direction

The maximum scan width is divided into 20 divisions in the X direction and the ratio of the time during which the electron beam stays can be changed at each division. The larger the number of blocks in the graph in the window, the longer the

beam dwelling time. The number of blocks can be changed by clicking on a cell and then clicking on the FIX button.

⑬ Setting the beam dwelling time in the Y direction

The maximum scan width is divided into 10 divisions in the Y direction. The ratio of the time during which the electron beam stays can be changed at each division. This correction is implemented in the 5 regions in the X direction. The X region is selected by clicking on the area (a1 to a5) in the graph on the left side. The larger the number of blocks, the longer the beam dwelling time. The number of blocks can be changed by clicking on a block and then clicking on the FIX button.

⑭ Electron gun axis polarity

Schematic of axis polarity of the EBG-102 electron gun.

In some type of EB guns, and cable connection, the polarity doesn't correspond to the picture.

⑮ Schematic illustration

Tilt	Axis tilt
P-Form	Position form correction
Scan Form	Scan form correction
Scan ratio	X and Y scan ratio

⑯ Signal output monitor

This monitors the confirmation current signal for each coil. To do this, the optional ST-EXTSIG unit for the F series power supply is required.

4.4.2 Principle of operation

The output signals from the SCAN CONTROLLER are detailed below. In the main, the output signals consist of an 'X position signal', 'Y position signal', 'X scanning signal', and 'Y scanning signal'. The 'X and Y position signals' are DCs and the 'X and Y scanning signals' are triangle (or quasi triangle) waveform currents (ACs).

① XP-ADJ, YP-ADJ, X Limit, Y Limit, X Offset, Y Offset

The upper and lower limits of the position signals can be determined by X Limit and Y Limit. For instance, the X position signal is expressed by

X position signal = maximum X position signal output (10 V) × X Limit/99 × XP-ADJ/49 + maximum X position signal output (10 V) × X Offset/100

② Scan Width, Scan Ratio, Scan XS/Limit, Scan YS/Limit

XS/Limit and YS/Limit determine the upper limit of the scanning amplitude with the Scan Ratio set to 0 at the maximum Scan Width. For instance, the X scanning (Scan Width) signal is expressed by

X scan width signal = maximum Scan width (5 Vp-p) × Scan XS/Limit/99 × Scan Width/99

When the scan ratio is set to a plus value, the X scan width is multiplied by
1− Scan Ratio/49
As a result, the scanning amplitude in the X direction attenuates. On the other hand, when the scan ratio is set to a minus value, the Y scan width is multiplied by

1− Scan Ratio/49
As a result, the scanning amplitude in the Y direction attenuates.

③ X Balance, Y Balance

When the X Balance is set to a plus value and the X position signal or the X scanning signal is plus, “X output signal (before correction) × X Balance/100” is subtracted from the X signal output. When the X Balance is set to a minus value and the X signal is minus, “X output signal (before correction) × X Balance/100” is added to the X signal output (the absolute value becomes small).

④ X/Tilt, Y/Tilt

When X/Tilt is set to a minus value, X tilt correction is implemented in the X signal minus region. Under these conditions, the beam is tilted so that the Y signal equals to “maximum Y signal × X/Tilt” at the maximum minus X signal that is defined by the Limit setting.

⑤ SCAN FRQ X, Non-synchronize

SCAN FRQ X is used to set the X scan triangle waveform frequency. The Y scan frequency is automatically set to 10 times the frequency of the X scan. When the Y frequency is an integral multiple of the X frequency, the beam scans the same position repeatedly. To avoid this, set Non-Synchronize. Doing this decreases the X frequency by the specified percent.

⑥ Position Form A, B, C, and D

These commands change the shape of a scanning signal. A, B, C, and D represent the X and Y coordinate four quadrants, namely “-X -Y”, “-X+Y”, “+X-Y”, “+X+Y” respectively. The scanning has a tilt from the midway of the X upper(lower) limits in such a way that the “X Limit value × Set value” is added to the X value at the Maximum Y.

⑦ Scan Form

Scan Form changes the shape of the scanning signals. The Y scan width gradually varies with a change in the X signal. When a plus value is given to the Scan Form, the larger the X position signal, the smaller the Y scan width signal.

⑧ Beam dwelling time in the X direction

The maximum scan width (defined by setting Limit) is divided into 20 divisions in the X direction. You can allocate each block a ratio of the time during which the electron beam stays. The dwelling time for a certain region per scan cycle is given by

1/f × Number of sections in a certain region × Total number of sections

⑨ Beam dwelling time in the Y direction

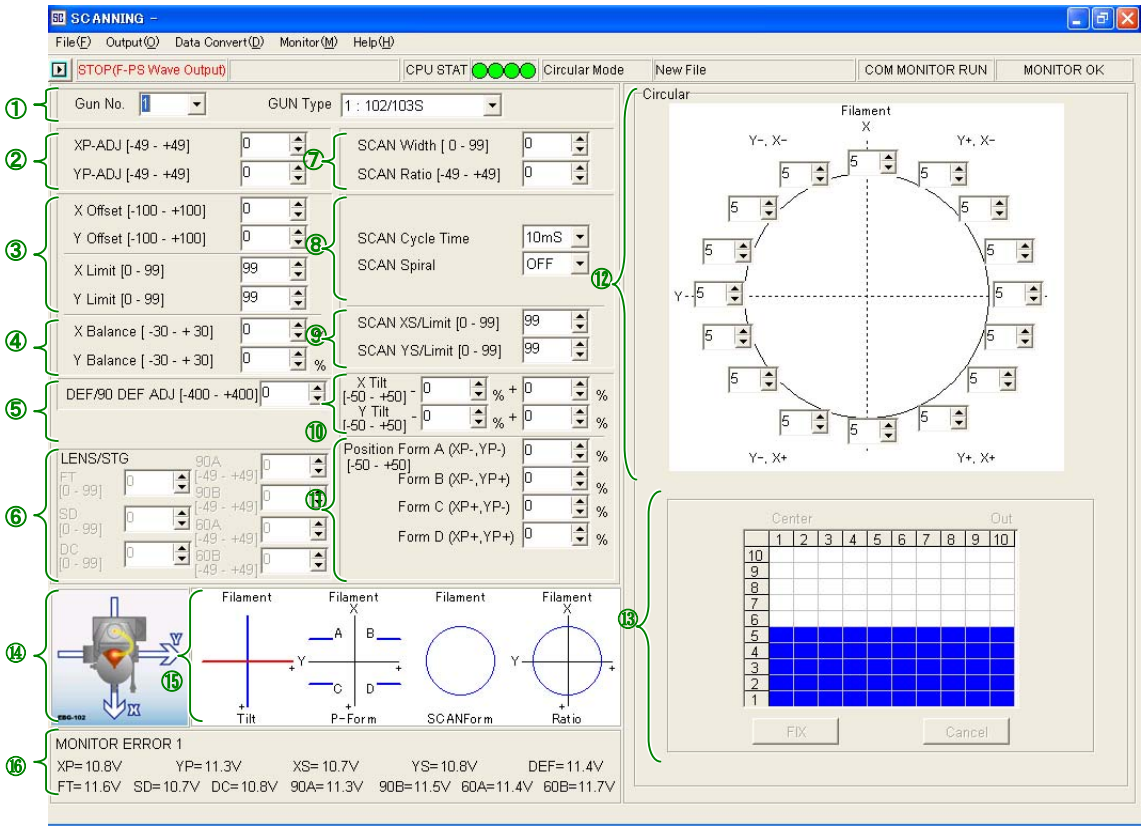
The maximum scan width is divided into 5 divisions (a1, a2, a3, a4, and a5) in the X direction. You can allocate each division a ratio of the time during which the electron beam stays. The dwelling time for a certain region per scan cycle is given by

1/f × Number of sections in a certain region × Total number of sections

4.5 Circular mode (SCANNING-Circular(inst).SCA window

In circular mode, the beam scans in the shape of a circle using a sine or cosine wave.

4.5.1 General



① Basic setting

Gun No. — Selects one of the electron guns when multiple electron guns (Nos. 1 to 2) are used.

Gun Type — Selects the type of gun to be used from 102/103S, 103/203/303, 163, Straight GUN, and 102/103E/Scan coil.

② Position setting

XP-ADJ — Adjusts the X position of the beam.
Range: -49 to +49

YP-ADJ — Adjusts the Y position of the beam.
Range: -49 to +49

③ Position initial setting

X Offset, Y Offset — Set the referrence X and Y beam positions.
Range: -100 to +100

X Limit, Y Limit — Set the maximum possible movable X and Y ranges.
Range: 0 to 99

④ Plus and minus balance correction

X Balance, Y Balance — Perform correction for the beam position and scan width (plus and minus directions with respect to the beam axis).
Range: -30 to +30

⑤ Deflection coil intensity adjustment

DEF ADJ — Adjusts the Deflection coil current. This command is just used for deflection current adjustable EB sources.

⑥ Lens intensity adjustment — Not used

⑦ Scanning

Scan width — Selects the scanning magnitude.
Range: 0 to 99

Scan ratio — Adjusts the X and Y scanning ratio.
Range: -49 to +49

⑧ Scanning frequency

SCAN Cycle Time — Sets the time for which the beam goes around the periphery of a circle. When SCAN Spiral is on, a cycle time which the beam goes from the periphery through the center back to the periphery is 20 times the SCAN Cycle time.
Select 10 min, 20 min, 30 min, 40 min, 50 min, 60 min, 70 min, 80 min, 90 min, 100 min, 1 s, 2 s, 3 s, 4 s, 5 s, 6 s, 7 s, 8 s, 9 s or 10 s.

SCAN Spiral — The beam scans not only the periphery but also the central region. Select ON or OFF from the selection box.

⑨ Scanning initial setting

Scan XS/Limit — Establishes the upper limit of the X scan width.
Range: 0 to 99

Scan YS/Limit — Establishes the upper limit of the Y scan width.
Range: 0 to 99

⑩ Tilt correction

X Tilt — Corrects the X tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Y Tilt — Corrects the Y tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑪ Form correction

Position Form — The beam moves or scans obliquely in the region more than 50% of the X scan width limit. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Scan Form — The Y scan width is changed gradually in the X-axis directions. (The schematic diagram is displayed in the lower section of the window.)
Range: -99 to +99%

⑫ Setting the beam dwelling time ratio in the direction tangential to the circumference

The maximum scan width is divided into 16 divisions. The ratio of the time during which the electron beam stays at each section can be changed. The larger the number, the longer the beam dwelling time.

Range: 1 to 10

⑬ Setting the beam dwelling time ratio in the radial direction

This functions when SCAN Spiral is on.

The maximum scan width is divided into 10 divisions. The ratio of the time during which the electron beam stays can be changed at each section. The number of blocks in the graph can be changed by clicking on one of the blocks and then clicking on the FIX button. The larger the number of blocks, the longer the beam dwelling time.

⑭ Electron gun axis polarity

Schematic of axis polarity of the EBG-102 electron gun

⑮ Schematic illustration

Tilt	Axis tilt
P-Form	Position form correction
Scan Form	Scan form correction
Scan ratio	X and Y scan ratio

⑯ Signal output monitor

This monitors the confirmation current signal for each coil. To do this, the optional ST-EXTSIG unit for the F series power supply is required.

4.5.2 Principle of operation

The X and Y position signals are DCs. The X and Y scanning signals are a sine or cosine waveform current (AC).

① XP-ADJ, YP-ADJ, X Limit, Y Limit, X Offset, Y Offset, Scan Width, Scan Ratio, Scan XS/Limit, Scan YS/Limit, X Balance, Y Balance, X/Tilt, Y/Tilt, Position Form A, B, C, and D

Refer to Section “Principle of operation” of the Normal Mode.

② SCAN Cycle Time, SCAN Spiral

SCAN Cycle Time determines the scanning frequency in the direction of the periphery. When SCAN Spiral is on, the frequency in the radial direction becomes a tenth of that of the periphery.

③ Beam dwelling time ratio in the direction tangential to the circumference in the X direction

The maximum scan width (defined by setting Limit on the periphery) is divided into 16 blocks. You can allocate each block a ratio of the time during which the electron beam stays. Setting is carried out by a numerical input. The larger the number, the longer the dwelling time becomes. The dwelling time for a certain region per scan cycle is given by

1/f × Number of sections in a certain region × Total number of sections

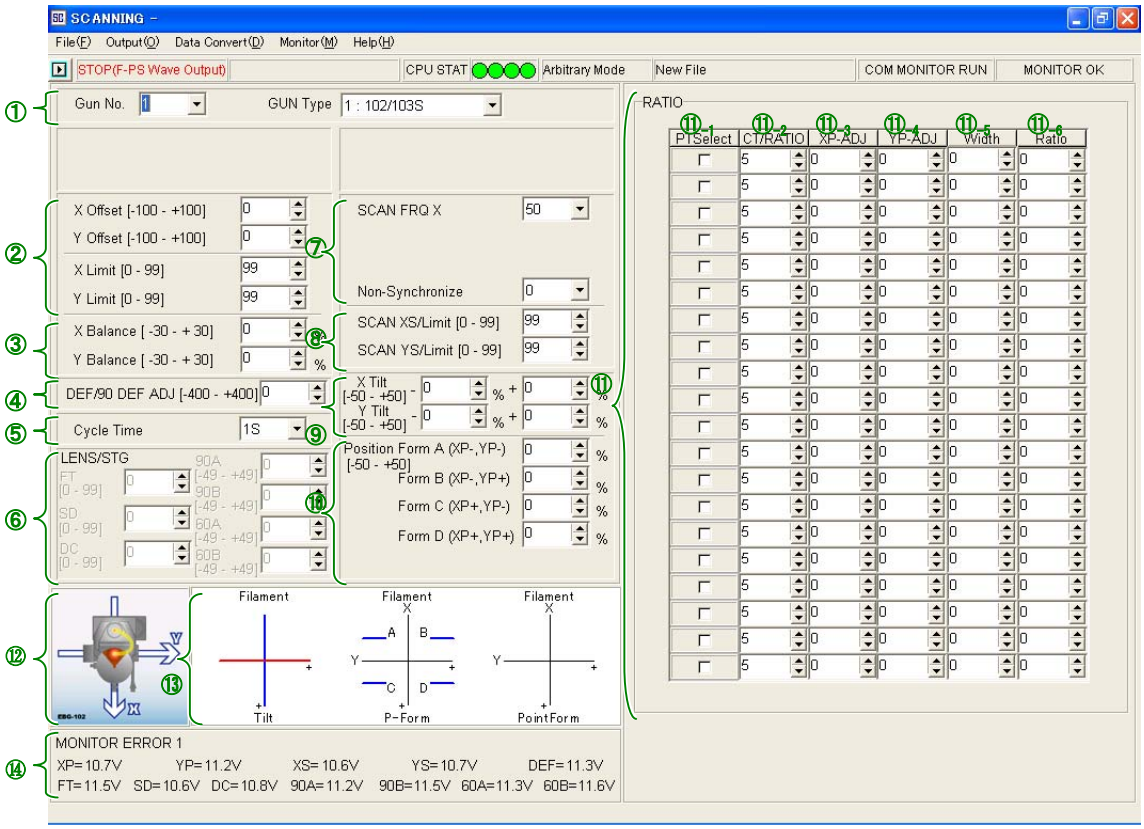
④ Beam dwelling time in the radial direction

The radial scan width is divided into 10 blocks. You can allocate each block a ratio of the time during which the electron beam stays. The dwelling time for a certain region per scan cycle is given by
1/f $\times$ Number of sections in a certain region $\times$ Total number of sections

4.6 Arbitrary Mode (SCANNING-arbitrary(inst).SCA) window

In this mode, up to 20 scan areas can be selected by specifying the X and Y coordinates. The beam scans each area sequentially in the shape of a square.

4.6.1 General



① Basic setting

Gun No. — Selects one of the electron guns when multiple electron guns (Nos. 1 to 2) are used.

Gun Type — Selects the type of gun to be used, 102/103S, 103/203/303, 163, Straight GUN, or 102/103E/Scan coil.

② Position initial setting

X Offset, Y Offset — Set the referrence X and Y beam positions.
Range: -100 to +100

X Limit, Y Limit — Set the maximum possible movable X and Y ranges.
Range: 0 to 99

③ Plus and minus balance correction

X Balance, Y Balance — Perform correction for the beam position and scan width (plus and minus directions with respect to the beam axis).
Range: -30 to +30

④ Deflection coil intensity adjustment

DEF ADJ — Adjusts the Deflection coil current. This command is just used for deflection current adjustable EB sources.

⑤ Position cycle time

Cycle Time — Sets the time for which the beam goes around the up to 20 positions. Select 1 s, 2 s, 3 s, 4 s, 5 s, 6 s, 7 s, 8 s, 9 s, 10 s, 11 s, 12 s, 14 s, 14 s, 15 s, 16 s, 17 s, 18 s, 19 s, 20 s, 21 s, 22 s, 23 s, 24 s, 25 s, 26 s, 27 s, 28 s, 29 s, 30 s, 5 min, or 10 min.

⑥ Lens intensity adjustment — Not used

⑦ Scanning frequency

Scan FRQ X — Selects the X scanning frequency. The Y scanning frequency is automatically set to ten times the X scanning frequency.
Range: 5, 10, 15, 20, 30, 35, 40, 45, 50, 1, 0.5, 0.33, 0.25, 0.2, 0.17, 0.14, 0.12, 0.11, and 0.1 Hz

Non-Synchronize — Changes the X scanning frequency.
Range: (0), 2, 4, 6, 8, and 10%

⑧ Scanning initial setting

Scan XS/Limit — Establishes the upper limit of the X scan width.
Range: 0 to 99

Scan YS/Limit — Establishes the upper limit of the Y scan width.
Range: 0 to 99

⑨ Tilt correction

X Tilt — Corrects the X tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Y Tilt — Corrects the Y tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑩ Form correction

Position Form — The beam moves or scans obliquely in the region more than 50% of the X scan width limit. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑪ Setting 20 Points

(1) Valid/Invalid — Specify whether each of the 20 point settings is valid or not (ON: valid, OFF: invalid).

(2) CT/RATIO — Specifies the dwelling time ratio in the selected point.
Range: 1 to 10

(3) XP-ADJ — Specifies the beam position in the X direction.
Range: -49 to +49

(4) YP-ADJ — Specifies the beam position in the Y direction.

(5) Width — Specifies the scan width.
Range: 0 to 99

(6) Ratio — Specifies the scanning X/Y ratio at each point.
Range: -49 to +49

⑫ Electron gun axis polarity

Schematic of axis polarity of the EBG-102 electron gun

⑬ Schematic illustration

Tilt	Axis tilt
P-Form	Position form correction
Point Form	Layout of 20 setting points

⑭ Signal output monitor

This monitors the confirmation current signal for each coil. To do this, the optional ST-EXTSIG unit for the F series power supply is required.

4.6.2 Principle of operation

The X and Y position signals are DCs. The X and Y scanning signals are triangle (or quasi triangle) waveform currents (ACs). The “Ratio” settings in the SCANNING-arbitrary window apply to each respective specified point. The settings other than these apply to all of the points up to 20.

① XP-ADJ, YP-ADJ, X Limit, Y Limit, X Offset, Y Offset, Scan Width, Scan Ratio, Scan XS/Limit, Scan YS/Limit, X Balance, Y Balance, X/Tilt, Y/Tilt, Position Form A, B, C, and D

Refer to Section 40402, “Principle of operation” of the Normal Mode.

② Cycle Time, PtSelect, CT/RATIO

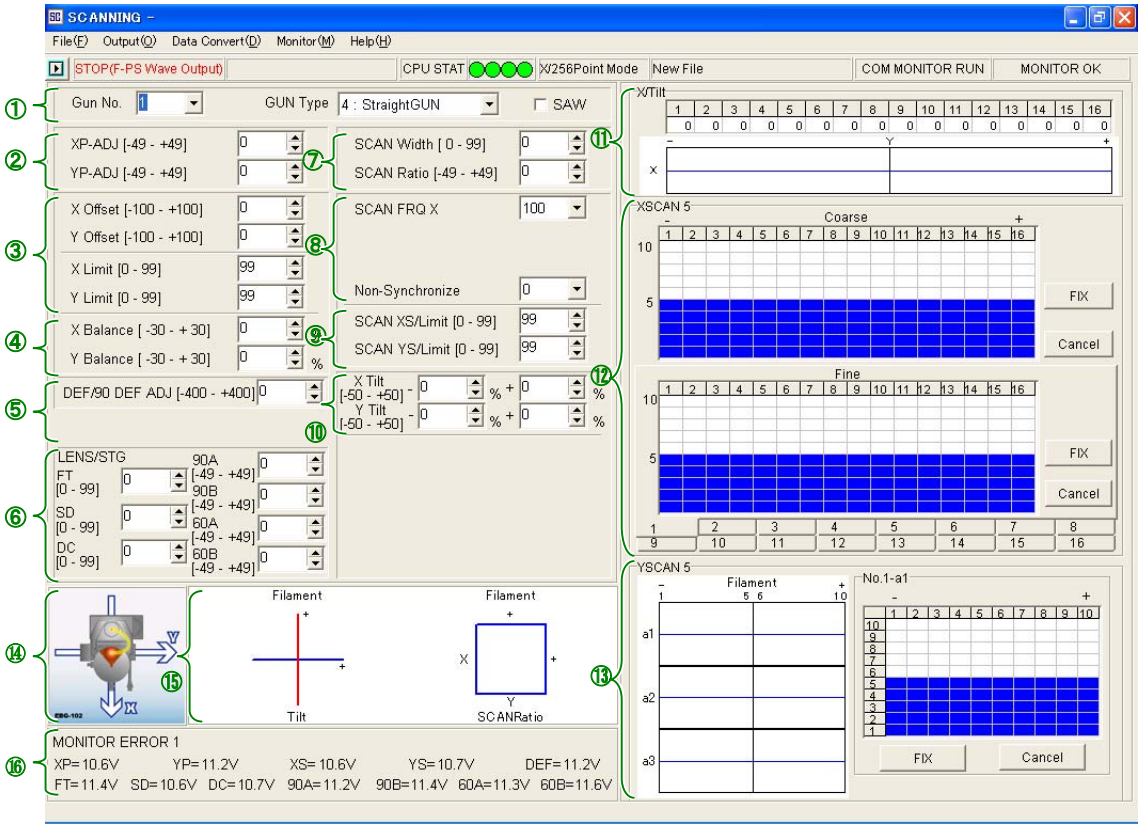
Cycle Time is the time for scanning the areas which are specified by the points which are, in turn, specified by clicking on the corresponding PtSelect check boxes. The time allocated to each point is determined by the ratio specified by CT/Ratio. For instance, the beam dwelling time at a certain point A is written as

Cycle Time × CT/RATIO at point A / the sum of CT/Ratio values of the selected points

4.7 X/256Point Mode (SCANNING-) window

The scan width in the X direction is divided into 16 sections for tilt correction and into 256 sections for setting the dwelling time for each section.

4.7.1 General



① Basic setting

Gun No.	Selects one of the electron guns when multiple electron guns (Nos. 1 to 2) are used.
Gun Type	Selects the type of gun to be used—Straight GUN.
SAW	Choose a triangle or saw-tooth waveform signal.

② Position setting

XP-ADJ	Adjusts the X position of the beam. Range: -49 to +49
YP-ADJ	Adjusts the Y position of the beam. Range: -49 to +49

③ Position initial setting

X Offset, Y Offset	Set the referrence X and Y beam positions. Range: -100 to +100
X Limit, Y Limit	Set the maximum possible movable X and Y ranges. Range: 0 to 99

④ Plus and minus balance correction

X Balance, Y Balance — Perform correction for the beam position and scan width (plus and minus directions with respect to the beam axis).
Range: -30 to +30

⑤ Deflection coil intensity adjustment

DEF ADJ — Adjusts the Deflection coil current. This command is just used for deflection current adjustable EB sources.

⑥ Lens intensity adjustment — Not used

⑦ Scanning

Scan width — Selects the scanning magnitude.
Range: 0 to 99

Scan ratio — Adjusts the X and Y scanning ratio.
Range: -49 to +49

⑧ Scanning frequency

Scan FRQ X — Selects the X scanning frequency. The Y scanning frequency is automatically set to five times the X scanning frequency.
Range: 100, 150, and 200 Hz

Non-Synchronize — Changes the X scanning frequency.
Range: (0), 2, 4, 6, 8, and 10%

⑨ Scanning initial setting

Scan XS/Limit — Establishes the upper limit of the X scan width.
Range: 0 to 99

Scan YS/Limit — Establishes the upper limit of the Y scan width.
Range: 0 to 99

⑩ Tilt correction

X Tilt — Corrects the X tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

Y Tilt — Corrects the Y tilt axis. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑪ X axis tilt correction at each division

The maximum X scan width is divided into 16 divisions. Axis tilt correction is performed for each division. (The schematic diagram is displayed in the lower section of the window.)
Range: -50 to +50%

⑫ Setting the beam dwelling time ratio in the X direction

Coarse — The maximum scan width is divided into 16 divisions in the X direction. The ratio of the time during which the electron beam stays can be changed at each section. The larger the number of blocks, the longer the beam dwelling time. The number of blocks can be changed by clicking on a cell and then clicking on the FIX button.

Fine — A scan width divided by Coarse is further divided into 16 sections. You can set the ratio of the beam dwelling time finely.

⑬ Setting the beam dwelling time ratio in the Y direction

The maximum scan width is divided into 10 divisions in the Y direction. The ratio of the time during which the electron beam stays can be changed at each division. The larger the number of blocks, the longer the beam dwelling time. This correction is implemented in the region of up to 3 divisions in the X direction. The time can be set by clicking on the area for the 5 blocks (a1 to a5) in the graph on the left side. The number of blocks can be changed by clicking on a block and then clicking on the FIX button.

⑭ Electron gun axis polarity

Schematic of axis polarity of the EBG-102 electron gun

⑮ Schematic illustration

Tilt	Axis tilt
Scan ratio	X and Y scan ratio

⑯ Signal output monitor

This monitors the confirmation current signal for each coil. To do this, the optional ST-EXTSIG unit for the 10F power supply is required.

4.7.2 Principle of operation

The X and Y position signals are DCs. The X and Y scanning signals are triangle or saw-tooth waveform AC currents.

① XP-ADJ, YP-ADJ, X Limit, Y Limit, X Offset, Y Offset, Scan Width, Scan Ratio, Scan XS/Limit, Scan YS/Limit, X Balance, Y Balance, X/Tilt, Y/Tilt, Position Form A, B, C, and D

Refer to Section 40402, “Principle of operation” of the Normal Mode.

② X/Tilt (Divided)

The maximum X position movement and scan width (defined by the Limit setting) is divided into 16 divisions. Tilt of the X axis can be changed at each division. For instance, when an X/Tilt value is entered into the 9th division, the beam is tilted so that the Y signal equals to “maximum Y signal × X/Tilt” at the position of one eighth of the maximum X position movement and scan width.

③ Setting the beam dwelling time ratio in the X direction

Coarse	The maximum scan width is divided into 16 divisions in the X direction. The ratio of the time during which the electron beam stays can be changed at each division. The dwelling time for a certain region per scan cycle is given by 1/f × Number of blocks in a certain region × Total number of blocks in the Coarse graph
Fine	A scan width divided by Coarse is further divided into 16 sections. You can set the ratio of the beam dwelling time finely at each section. The dwelling time is given by 1/f/16 × Number of blocks in a certain region × Total number of blocks in the Coarse graph

④ Beam dwelling time in the Y direction

The maximum scan width is divided into 3 divisions in the X direction. You can allocate each of the 10 divisions in the Y direction a ratio of the time during which the electron beam stays. The dwelling time is given by

1/f × Number of blocks in a certain region × Total number of blocks

⑤ SCAN FRQ X, Non-synchronize

SCAN FRQ X is used to set the X scan frequency. The Y scan frequency is automatically set to 5 times the frequency of the X scan. When the Y frequency is an integral multiple of the X frequency, the beam scans the same position repeatedly. To avoid this, set Non-Synchronize. Doing this decreases the X frequency by the specified percent.

5 Operation

5.1 Setting the initial conditions

1. Connect the PC that the SCAN CONTROLLER operation program is installed to the SCAN CONTROLLER using the RS232C cross cable.
2. Turn on the circuit breaker switch and POWER switch on the JST-F series power supply console; then turn on the PC and SCAN CONTROLLER. The F series power supply system is set to the external wave signal mode and outputs the selected waveform signal of SCAN CONTROLLER. (The position and scan width signals remain the same as those set from the operation panel of the operation unit.)
   - ✍ If there is no selection signal in the SCAN CONTROLLER memory, the SCAN CONTROLLER will not function at this stage.
   - ✍ For information on the JST-F series power supply system, refer to the appropriate instruction manual of the electron gun and power supply.
3. Set the S•P EXT switch (with a red cap that exposes when the cover plate on the operation panel is removed) up; then set the INT/EXT switch on the operation panel to EXT. (The position and scan width signals now switched to those from the SCAN CONTROLLER.)
4. Start up the SCAN CONTROLLER control program from the PC; click on File in the menu bar; click on the New; then select Normal XY Scan Mode, Circular Mode, Arbitrary-P Mode, or X/256Poin Mode from the window.
5. Select the desired gun number and scanning frequency from the Gun No. and SCAN FRQ X popup windows.
   - ✍ The Y scanning frequency is automatically selected.
6. Enter the following parameters.
   - ✍ Primary settings are [X Offset], [Y Offset], [X Limit], [Y Limit], [Scan XS/Limit], [Scan YS/Limit]. To adjust these contents, turn on the beam at a comparatively low emission current to observe the beam spot location. The effect of settings is easily checked by executing [Output-Current Setting] command (Temporary mode).

   a. X Offset, Y Offset

   Align the beam with the center of the object to be irradiated, crucible, or the optical axis of the electron gun.

   b. X Limit, Y Limit

   Set XP ADJ and YP ADJ to +49 or -49 and increase the X Limit and Y Limit values (0 to 99) gradually until the beam reaches the edge of the object to be irradiated or the maximum beam movement width in the electron gun specifications.

   c. Scan XS/Limit, Scan YS/Limit

   Set Scan Width to 99 and Scan Ratio to 0 or +49 (-49 in the case of the Y direction) and increase the Scan XS Limit and Scan YS Limit values (0 to 99) gradually until the beam reaches the width of the object to be irradiated or the maximum beam movement width in the electron gun specifications.
   - ✍ With these settings, you can confirm output immediately by executing the Output command (Temporary Mode). But these settings cannot be stored in the PC or SCAN CONTROLLER memory.

- To execute the Output command, one of the memory selection signals (1 to 15) must have already been input.
- When executing this command, SCAN CONTROLLER runs as temporary mode, and memory selection signal is invalid. To execute the stored setting data selected by memory selection signal again, turn off SCAN CONTROLLER once, or change memory selection signal once, or execute [Output-Selected Memory No.] command.

7. Enter the desired values into the X Tilt, Y Tilt, X Balance, and Y Balance parameter input boxes, as necessary.
8. Enter the beam dwelling time you want.
9. To store the settings in the PC, click on File; click on Save As; enter a name of a file, and then store the file. To store the settings in the SCAN CONTROLLER memory, execute the [Data Convert-Trans] command.

⚠ CAUTION

Before you use the scan controller, set X Limit, Y Limit, Scan XS/Limit, and Scan YS/Limit to the appropriate values. Otherwise, the beam goes outside the object to be irradiated or the range in the electron gun specifications, causing the elec-tron gun or other parts to be damaged.

⚠ CAUTION

When you execute [OUTPUT] command, observe the beam position and make sure that the beam is within the permissible position movement range. In some SCAN CONTROLLER or power supply setting conditions, the beam moves impermissible position, and the electron gun or other parts might be damaged.

- When the accelerating voltage or beam focus is changed, the range of beam movement also changes. Readjust the SCAN CONTROLLER from the beginning.
- When the SCAN FRQ X frequency is changed, the actual beam scan width also changes. Readjust Scan XS/Limit, and Scan YS/Limit.
- Due to the settings of X Tilt and Y Tilt, the irradiation of the beam might extend outside the area specified by Limit. Therefore, each time you change the Tilt parameters, check to make sure that the beam does not go outside the limits or the range in the electron gun specifications.
- In general, parameters interfere to each other, so when one parameter is changed, there might be cases where the other parameters need to be readjusted.

5.2 PC online operation

Presented below is the procedure for operating the system using the SCAN CONTROLLER control program installed in the online PC.

✍ Finish the initial settings according to the section 5.1 before proceeding regular operation.

1. Connect the PC with the SCAN CONTROLLER control program installed to the SCAN CONTROLLER using the RS232C cross cable.
2. Turn on the circuit breaker switch and POWER switch on the JST-F series power supply console; then turn on the PC and SCAN CONTROLLER. The F series power supply system is set to the external wave signal mode and outputs the selected waveform signal of SCAN CONTROLLER. (The position and scan width signals remain the same as those set from the operation panel of the operation unit.)
   - ✍ If there is no selection signal in the SCAN CONTROLLER memory, the SCAN CONTROLLER will not function at this stage.
   - ✍ For information on the JST-10F power supply system, refer to the appropriate instruction manual of the electron gun and power supply.
3. Set the S•P EXT switch (with a red cap that exposes when the cover plate on the operation panel is removed) up; then set the INT/EXT switch on the operation panel to EXT. (The position and scan width signals now switched to those from the SCAN CONTROLLER.)
4. Start up the SCAN CONTROLLER control program from the PC.
5. Enter the necessary parameters as in the case of Section 5.1, “Setting the initial conditions”. When these parameters are stored in the PC or SCAN CONTROLLER, you can retrieve and load them by executing the File and Open commands (for the PC) and the File and Read Set Data File commands (for the SCAN CONTROLLER).
6. Click on the [Output-Current Setting] command to execute the settings of the SCAN CONTROLLER. (The settings are executed in temporary mode.)
   - ✍ The settings in this mode are volatile. Once the system is turned off, they will be lost. When the system is turned on again, stored information with the selected memory number takes effect.
   - ✍ When executing this command, SCAN CONTROLLER runs as temporary mode, and memory selection signal is invalid. To execute the stored setting data selected by memory selection signal again, turn off SCAN CONTROLLER once, or change memory selection signal once, or execute [Output-Selected Memory No.] command.

5.3 PC offline operation

Presented below is the procedure for operating the system without using the SCAN CONTROLLER control program installed in the PC. Before operating the SCAN CONTROLLER, necessary information should be stored in the SCAN CONTROLLER memory.

1. Turn on the circuit breaker switch and POWER switch on the JST-F series power supply console; then turn on the PC and SCAN CONTROLLER. The F series power supply system is set to the external wave signal mode and outputs the selected waveform signal of SCAN CONTROLLER. (The position and scan width signals remain the same as those set from the operation panel of the operation unit.)

✍ If there is no memory selection signal in the SCAN CONTROLLER, the SCAN CONTROLLER will not function at this stage.

✍ For information on the F series power supply system, refer to the appropriate instruction manual of the electron gun and power supply.

2. Set the S•P EXT switch (with a red cap that exposes when the cover plate on the F series power supply operation panel is removed) up; then set the INT/EXT switch on the operation panel to EXT. (The position and scan width signals now switched to those from the SCAN CONTROLLER.)
3. To execute one of the setting data (1 to 15) in the memory, externally select the desired memory selection signal.

✍ After executing [Output-Current Setting] command in the PC, SCAN CONTROLLER runs as temporary mode, and memory selection signal is invalid. To execute the stored setting data selected by memory selection signal again, turn off SCAN CONTROLLER once, or change memory selection signal once, or execute [Output-Selected Memory No.] command.

✍ After executing [Output-F-PS Wave (STOP)] command in the PC, SCAN CONTROLLER stops to operate. Scanning wave form change to triangle wave that is made by F power supply. To execute the stored setting data selected by memory selection signal again, turn off SCAN CONTROLLER once, or change memory selection signal once, or execute [Output-Selected Memory No.] command.

5.4 Scan signal switching between the SCAN CONTROLLER and JST-F series power supply

The scanning signal from the SCAN CONTROLLER can be switched to the signal from the JST-F series power supply as follows;

1. Turn off the electron gun and then turn off the SCAN CONTROLLER.

✍ Since the position and scan width signal from the SCAN CONTROLLER becomes 0 when the SCAN CONTROLLER is turned off, never fail to turn off the electron gun in advance.

2. Set the INT/EXT switch on the F series power supply operation panel to the INT position (with the S•P EXT switch up). The settings for the position and scan width signals from the F series power supply console now take effect, and then the power supply outputs the scanning signal consisting of a triangle waveform current.

✍ To return to the SCAN CONTROLLER, repeat the above steps with the INT/EXT switch set to EXT. And turn off the SCAN CONTROLLER.

5.5 Position and scan width external control

The SP-EXT and P-TUNING switches on the SCAN CONTROLLER front panel enable the beam position and scan width to be controlled by external analog signals. In this event, however, the Balance, Tilt, P-Form, and other corrections which vary with the XP ADJ or YP ADJ values are not applicable. The position signal output is linearly proportional to the voltage of the external analog signal. The scan width signal output is also linearly proportional to the voltage of the external analog signal under the same conditions (shape, beam dwelling time, etc) as those set in the SCAN CONTROLLER. The external signals input into IN connector pins 17, 43, 19, 47, and 16.

When the SP-EXT switch is on, the external signal controls the beam position and scanning width. In scan width, the relative size of waveform output is controlled. The scanning area is determined by the external signals and the SCAN CONTROLLER's Width parameter.

For instance, when the let the scan width be 100%. If the scan width external signal is 10 V with the SP-EXT switch off, a 100% scan width is output. When the SP-EXT switch is off and there is no scan width signal (Width = 0), the SCAN CONTROLLER will not output any scanning signal even if the SP-EXT switch is on and the scan width external signal is input.

When the P-TUNING switch is on, the external position signals are superimposed onto the SCAN CONTROLLER X and Y position signals. The beam position signal ranges from -10 V to +10 V and the scan width signal from 0 to +10 V. The magnitude of beam movement and scan width when the maximum voltages are input is determined by the settings of the SCAN CONTROLLER and the initial settings of the JST-F series power supply (beam position—initial settings of the JST-F series power supply, scan width—initial settings of the JST-10F power supply plus SCAN CONTROLLER Width parameter). Depending upon the nature of the operation, the beam might irradiate the area outside the permissible range or power exceeds its capacity. Consequently, when you turn on the SP-EXT and P-TUNING switches, turn on the beam and make sure that the beam position and scan width is within the permissible ranges.

⚠ CAUTION

When SP-EXT and P-TUNING are in use, make sure that external control signals are input. If they are not, the electron gun power supply unit or other units might be damaged.

When SP-EXT and P-TUNING are in use, observe the beam position and make sure that the beam is within the permissible movement range. If the electron beam moves off the limits or beyond the object to be irradiated, the electron gun or other parts might be damaged.

5.6 Summary of operations (Normal mode)

● Position and scan width

XP-ADJ	Changes the beam position in the X direction.
YP-ADJ	Changes the beam position in the Y direction.
Width	Changes the beam scan width.
Ratio	Changes the X/Y ratio of the scanning range.

● Corrections

X Offset	Adjusts the beam X-axis scanning center at XP-ADJ=0.
Y Offset	Adjusts the beam Y-axis scanning center at YP-ADJ=0.
X Limit	Adjusts the beam X podition movement range.
Y Limit	Adjusts the beam Y position movement range.
XS Limit	Adjusts the beam X scan width range.
YS Limit	Adjust the beam Y scan width range.
X Tilt/Y Tilt	Correct the tilts due to XP-ADJ and YP ADJ.
X Balance/Y Balance	Correct the difference between the movements in the plus and minus directions due to XP-ADJ and YP ADJ.
Scan FRQ X/Non Synchronize	Changes the X scanning frequency. The Y scanning frequency automatically changes by 10 times the X frequency. Non Synchronize: for fine adjustment
Position Form A, -X, -Y Position Form B, -X, +Y Position Form C, +X, -Y Position Form D, +X, +Y	Adjust the scanning distortion in the outer scanning region.
Scan Form	Adjusts the scan width in the Y direction at both X scanning ends on the plus and minus side.

● Beam dwelling time

XSCAN/ YSCAN	Adjusts the dosage of the beam when, for instance, melting surface is not uniform.

6 Inspection and maintenance

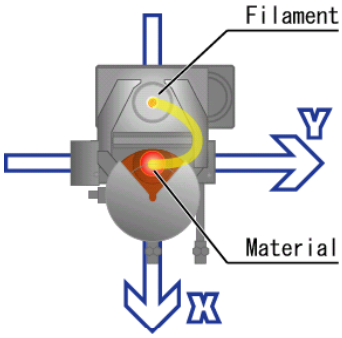
As a daily checkup, when you turn on the equipment, check to make sure that

- No abnormal odor emits from the inside of the equipment.
- The LED on the front panel lights normally.

FOOTNOTE

■ The polarity of the EB source

In some of the electron guns, the polarity of the electron gun Y axis is opposite to that of the SCAN CONTROLLER. When installing the SCAN CONTROLLER, set YP-ADJ to a plus and make sure that the polarity of the Y axis coincides with that shown below. If it does not, either you accept the situation or change the connections of the electron gun low-voltage feedthrough leads following the procedure presented below. After the lead connections are exchanged, however, the beam moves in the opposite direction even in any other control.



Direction X
Filament Material to be irradiated

Direction Y
Perpendicular to the X axis
(Three o'clock direction)

SCAN CONTROLLER coordinates

● To reverse the direction of the electron gun Y axis

1. Turn off the electron gun power supply circuit breaker switch.
2. Remove the electron gun low-voltage feedthrough cover.
3. Connect the blue low-voltage feedthrough to the yellow Y scanning coil wire and the yellow low-voltage feedthrough to the blue Y scanning coil wire.
4. The above procedure completes the reversal of the electron gun Y axis.

■ Variable ACC (acceleration voltage) EB power supply [BS-Z050412UNIT]/ [BS-Z06111TUNIT]

Variable ACC EB power supply has a function for adjusting the deflection coil current by the external voltage signal. The signal pin number is 18 (GND: 19) of F power supply's EXT2 connector, and in case of using SCAN CONTROLLER, this voltage is controlled by [DEF/90 DEF ADJ] command. Output voltage of 18-pin is set from +10V to –10V when [DEF/90 DEF ADJ] is set from –400 to 400.