

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4) OPTION



Fig. 4.7-1 Raster Generator Deflection Unit (RGDU-4A)

Rastering can be added to any electron or ion gun system with 4-pole electrostatic deflection and a separate 8-pin deflection connector on the gun. Rastering involves movement of the beam in a pattern and is used to cover an area of the target region fairly uniformly over time. It is produced by applying cyclical voltages to the X and Y deflection plates in the gun. These voltages are controlled by a separate power supply, the Raster Generator Deflection Unit (RGDU). The system can be used either to center the spot manually as a deflection unit or to raster the beam.



Fig. 4.7-2 Raster cable

4.7.1 INSTALLATION OF RASTER UNIT

	<h2 style="margin: 0;">WARNING</h2>
	<p style="text-align: center;">HIGH VOLTAGE Can cause ELECTRIC SHOCK or BURN</p> <p>Power Supply and vacuum system must be grounded. Use High Voltage precautions. Do not energize Power Supply unless the gun is bolted to chamber with proper high vacuum, and all cables are securely attached. Do not disconnect safety interlocks.</p>

1. Follow the Power Supply and Electron or Ion Gun installation procedures in Sections 2.2 and 2.3. Much of the RGDU installation is the same as that for a standard EGPS or IGPS power supply.
2. For initial set-up and positioning, the spot and raster pattern best can be observed using a phosphor screen in the target area.
3. On the front of the RGDU, the green **POWER** and amber **DEFLECTION ON / OFF** switches should both be off, **O** position.
4. Ground strap: Connect the **E1 GND** screw to a proper earth ground.
5. AC selection: Check the red AC voltage indicator in the fuse holder in the same manner as with the EGPS or IGPS.
6. For optional computer/remote control: Set up and cables are the same as with the EGPS or IGPS, local mode for front panel or serial port control, remote mode for analog control. LabVIEW™ computer programming control is not currently available for the RGDU-4A

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4A) OPTION cont.

INSTALLATION OF RASTER UNIT cont.

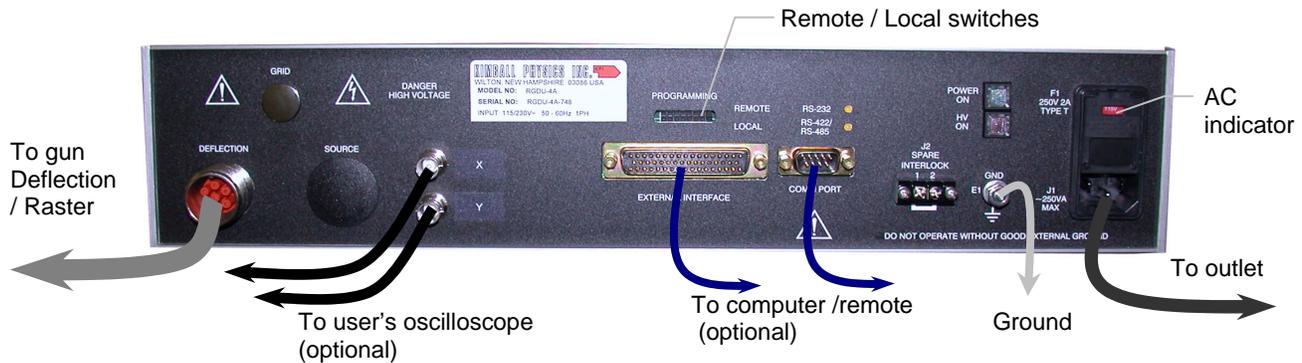


Fig. 4.7-3 Rear panel of RGDU-4A Power Supply, showing cable connections diagrammatically

7. 8-pin Raster cable:
 - a. Plug the orange 7-pin connector of the gray Raster cable into its keyed, mating connector labeled **DEFLECTION** on the back of the RGDU, tightening the ring by hand. Support the cable along its length and do not twist it.
 - b. The 8 pin connector end of the Raster cable will be connected to the Deflection feedthrough on the electron or ion gun in place of the normal Deflection cable, when the gun is installed in vacuum.
 - c. **NOTE: Use the gray raster cable. Although the pinout is the same, do not use the standard black Deflection cable for rastering, as it will not give the proper response.**
8. Optional X and Y outputs:
 - a. If desired, connect the two output BNCs on the back panel labeled **X** and **Y** from the X and Y frequency generators (2 V peak-to-peak signal output) to any user-supplied equipment, such as an oscilloscope.
9. Optional spare interlock: The interlock can be set up in the same manner as with the EGPS or IGPS.
10. Power cord: Connect the power cord to the **J1 ~250VA MAX** outlet on the RGDU and a standard 115 or 230 VAC 50/ 60 Hz power outlet.

WARNING: The power cord must be accessible to disconnect from the AC supply outlet for emergency shut down.

Table 4.7-1 RGDU-4A Power Supply Outputs

Power Supply	Range
X Deflection	-300 V to +300 V
Y Deflection	-300 V to +300 V
X frequency generator (at output BNC)	2 V p-p
Y frequency generator (at output BNC)	2 V p-p

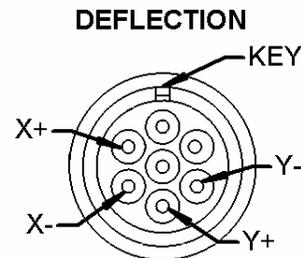


Fig. 4.7-4 Pinout of 7-pin connector on back of RGDU-4A

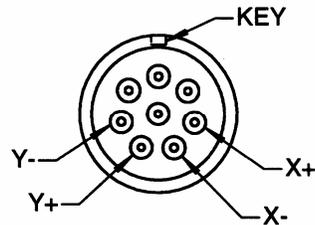


Fig. 4.7-5 Pinout of 8-pin Electron or Ion Gun connector for Raster or Deflection

This completes the Raster Installation Instructions.

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4A) OPTION cont.

4.7.2 DESCRIPTION OF RASTER CONTROLS

RGDU-4A Front Panel Controls

Most of the front panel controls on the raster unit are the same as on the standard EGPS or IGPS power supply unit. Refer to Section 4.1 for descriptions of the POWER switch, INTERLOCK indicator, display screen, gray selector buttons, red function buttons, and the encoder wheel.

On / Off Switch: A red rocker switch labeled **DEFLECTON ON OFF (I / O)** that enables or disables the Deflection and Raster power supplies. The **O** position is OFF, and the **I** position is ON. When off, outputs are grounded, so the deflection plates in the gun are grounded.

Zero LED: An amber LED labeled **ZERO**. This LED is not used with the RGDU-4A.

Power Supply Controls and Meters on Display Screen: For each control/meter label, the value displayed next to it is the actual power supply output. The set of **X CONTROLS** and **Y CONTROLS** operate in the same way to control the beam along arbitrary X and Y axes in the target plane.

CENTER voltage programs the X or Y power supply for deflection in the X or Y direction, controls position of the spot or raster pattern on the target, measured in a $\pm\%$ of full voltage scale. If X and Y FREQ controls are zero, then CENTER controls the beam spot position in the same way as the normal EGPS or IGPS deflection X and Y controls.

SIZE sets the sweep amplitude of the X or Y deflection, controls the size of the raster window, measured in % of the full scale possible window. If the center is offset, the actual window size may be clipped.

FREQ sets the sweep rate of the X or Y deflection, as integer inputs of 0 to 10, which correspond to arbitrary X frequencies (up to 1000 Hz) or Y frequencies (up to 50 Hz). The X and Y frequencies are independent, not synchronized.

RGDU-4A Back Panel Controls

Most of the back panel controls on the raster unit are the same as on the standard EGPS or IGPS power supply unit. Refer to Section 4.1 for descriptions of remote / local PROGRAMMING switches, computer connectors, indicator lights, INTERLOCK terminals, main fuse / AC indicator, ground, and power line input.

Output BNCs: Two output BNCs labeled **X** and **Y** that provide a signal from the X and Y frequency generators (± 1 V peak to peak) to connect user-supplied equipment, such as an oscilloscope.

Gun connector: A keyed 7-pin connector labeled **DEFLECTION** that provides the output voltages for the deflection plates in the gun for rastering or centering deflection, requires a raster cable not the standard deflection cable.

Description of Raster Outputs

The outputs of the RGDU consist of four channels: +X, -X, +Y, and -Y. Figure 5 shows examples of the output wave forms, where the X frequency is set at approximately five times the Y frequency (such as X FREQ=2 and Y FREQ=9), X and Y center are zero, and X and Y size are set at 50% of the full scale ± 300 V. The voltages on the X and Y channels will vary from -150 V to +150 V to produce a square raster pattern centered with zero offset on the X and Y axes. The outputs are independent, not automatically synchronized.

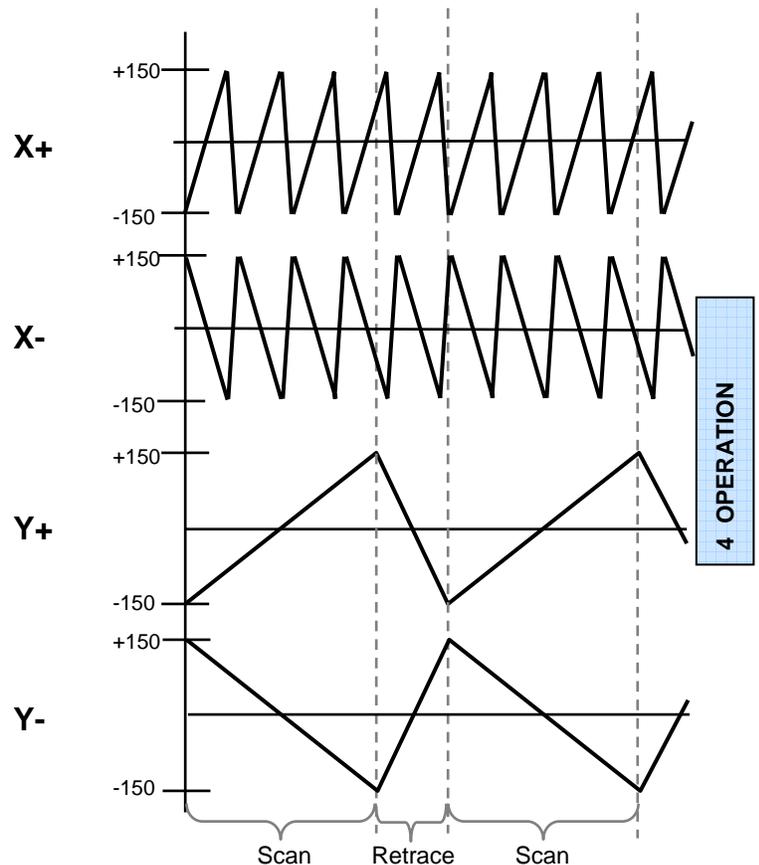


Fig. 4.7-6 Raster Output Wave Forms

NOTE: X and Y are not automatically synchronized

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4A) OPTION cont.

DESCRIPTION OF RASTER CONTROLS cont.

Table 4.7-2 RGDU-4A Controls / Meters and Power Supply Ranges

FlexPanel Control / Meter	Control Setting	Power Supply Range
X CENTER	-100% to +100%	-300 V to +300 V
Y CENTER	-100% to +100%	-300 V to +300 V
X SIZE	0 to +100%	0 to ± 300 V (may be limited if raster off center)
Y SIZE	0 to +100%	0 to ± 300 V (may be limited if raster off center)
X FREQ	0 to 10	0 to 1000 Hz see Table 4.7-3
Y FREQ	0 to 10	0 to 50 Hz see Table 4.7-3
X output BNC (Meter, not a control)	--	2 V p-p (matching X frequency)
Y output BNC (Meter, not a control)	--	2 V p-p (matching Y frequency)

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4A) OPTION cont.

4.7.3 NORMAL OPERATION OF RASTER

1. For initial set-up and positioning, the electron or ion beam spot and raster pattern can best be observed using a phosphor screen in the target area.
2. On the RGDU, the green **POWER** and amber **DEFLECTION ON / OFF** switches should both be off, **O** position. Any remote inputs should also be off initially.
3. Start up the electron or ion gun with the EGPS or IGPS Power Supply according to the instructions in Normal Operation or ECC Operation. When the desired beam current and spot size have been achieved, the beam can be positioned or rastered with the RGDU.
4. Initial energizing of the RGDU:
 - a. Switch the green **POWER** rocker switch on (**I** position). to energize the supplies. The switch and the green **POWER ON** indicator on the back of the unit should light.
 - b. The FlexPanel Control display screen turn on, but do not try to operate yet.
5. Interlocks
 - a. Check that the amber **INTERLOCK** LED is off.
 - b. The LED will illuminate momentarily when the Power Supply is first energized to show that the Interlock circuitry is working.
 - c. If the amber **INTERLOCK** LED stays lighted:
 - i. Switch the green **POWER** switch off (**O** position) to de-energize the Power Supply.
 - ii. Check that the cables are connected tightly.
 - iii. Check that the top and bottom covers of the Power Supply are closed securely.
 - iv. Check that the spare interlock is a closed circuit, either jumpered as shipped, or a closed external loop to the user's system.
 - v. Reenergize the Power Supply after the fault is corrected.
6. Controlling the RGDU:
 - a. Switch the amber **DEFLECTION ON / OFF** rocker switch on (**I** position) to energize the Deflection power supplies. The switch and the red **HV ON** indicator on the back of the unit should light.
 - b. If the **ZERO** LED lights:
 - i. Check that the individual supplies have not been turned up prematurely. Push the small red **SHUTDOWN** button to zero all supplies. With remote control, check that all remote programming signals are zero.
 - ii. If the light does not clear, this indicates a problem with the circuitry or programming.
7. FlexPanel Control display screen:
 - a. All supply meters should read zero initially (or close to zero, due to high sampling speed / resolution of chips and ripple at low end of scale).
8. If the gun has been run previously with the RGDU and all the desired settings have been stored with the manual **STORE** button, the system can be operated with same settings as used previously.
 - a. Press the red **RESUME** function button.
 - b. This will set all power supply controls to the values stored most recently.
 - c. All supplies will automatically be turned on, in an appropriate sequence.
 - d. At this point the gun can simply be run with the given RGDU settings until shutdown, or individual controls can be adjusted as described below in this section.
9. Changing program options with the FlexPanel Controls options (if desired):
 - a. Program options may be changed at any time. Settings are retained when the unit is turned off, and so only need to be set if changes are desired.
 - b. Push the red function button labeled **MENU** to display the list of options, such as screen brightness.
 - c. Using the selector buttons and the encoder wheel as directed on the screen, change the options.
 - d. When finished, push the lower right selector button for **Done** to enter the changes.
10. **For centering / deflection:**
 - a. Set the **X FREQ** and **Y FREQ** to zero.
 - i. With the front panel FlexPanel Controls, select **FREQ** on the display screen with the adjacent gray button.
 - ii. Turn the encoder wheel clockwise until the display reads **10** and then counterclockwise until it reads **0**. This is necessary because the zero displayed at start up may actually be slightly above zero, which will produce some rastering.
 - b. Using the **X CENTER** and **Y CENTER** controls adjust the deflection plate voltages as needed to center or position the beam in the X and Y directions within the target plane.
(Range: -100% to +100% of Full Scale)
 - i. Select **CENTER** on the display screen.
 - ii. Turn the encoder wheel, clockwise to increase the deflection displayed next to the label and move the beam in the positive X or Y direction, counterclockwise to move in the negative direction. Turn more quickly to make larger changes, then turn slowly for fine adjustment.
 - iii. Monitor the **CENTER** position on the display screen meter; it is displayed as a $\pm\%$ of the full scale deflection.
 - iv. Push the button again or push **STORE** when finished.
 - c. The deflection will probably need to be adjusted when other operating parameters are varied. In particular, the deflection voltage required for a constant spot position is often proportional to the beam energy.

4.7 RASTER GENERATOR DEFLECTION UNIT (RGDU-4A) OPTION cont.

NORMAL OPERATION OF RASTER cont.

11. For rastering:

- a. Using the **X CENTER** and **Y CENTER** controls as above, set the position for the center of the raster pattern window within the target area.
(Range: -100% to +100% of Full Scale)
- b. Using the **X SIZE** and **Y SIZE** controls (encoder wheel), set the desired window size of the raster pattern. It is displayed as a % of the possible window size (full scale). If the center is offset, the actual window size may be clipped at one side.
(Range: 0 to +100% of Full Scale)
- c. Using the **X FREQ** and **Y FREQ** controls (encoder wheel), set the sweep rates for X and Y. The frequency is set as an integer from **0** to **10** which corresponds to a value in Hz as shown in Table 4.7-3, up to approximately 1000 Hz for X and 50 Hz for Y. Note that X and Y are not automatically synchronized.
- d. The raster pattern can be observed on a phosphor screen in the target area or with some other user imaging system. The frequencies of the X and Y sawtooth wave forms can be observed with a user-supplied oscilloscope connected to the X and Y output BNCs (2 V peak-to-peak signal output).

12. If deflection or rastering is switched off and then back on with the amber **DEFLECTION ON / OFF** rocker switch while the power is still on, the controls will return to the previously set values to simplify repositioning of the beam. When off, the deflection plates in the gun are grounded.

13. To secure (turn off) the RGDU:

- a. Push the red **SHUTDOWN** button. Wait until all meters read zero.
- a. Switch the amber **DEFLECTION ON / OFF** switch off (**O** position).
- b. Switch the green **POWER** switch off (**O** position).

H.V. WARNING: The red SHUTDOWN button sets all the individual power supply voltages to zero, but does not shut down the entire unit. High Voltage will still be present until the entire sequence is completed. **Before performing any troubleshooting or maintenance on the power supply, ensure that the Power and On / Off switches are off, then disconnect the power cord from the AC main outlet, and wait at least 3 minutes for any voltage to discharge**

Table 4.7-3 Raster Frequency Control Settings and Output

X FREQ setting	X output		Y FREQ setting	Y output	
	Frequency ± 10%	Retrace		Frequency ± 10%	Retrace
0	(spot not rastered)	--	0	(spot not rastered)	--
1	227 Hz	0.53 msec	1	12 Hz	10 msec
2	335 Hz	0.38 msec	2	17 Hz	7.0 msec
3	440 Hz	0.29 msec	3	23 Hz	5.2 msec
4	543 Hz	0.25 msec	4	28 Hz	5.0 msec
5	643 Hz	0.22 msec	5	33 Hz	3.9 msec
6	739 Hz	0.20 msec	6	37 Hz	3.7 msec
7	833 Hz	0.18 msec	7	42 Hz	3.4 msec
8	929 Hz	0.17 msec	8	46 Hz	3.3 msec
9	950 Hz	0.28 msec	9	50 Hz	4.0 msec
10	1090 Hz	0.17 msec	10	53 Hz	3.4 msec

This completes the Normal Raster Operating Instructions.