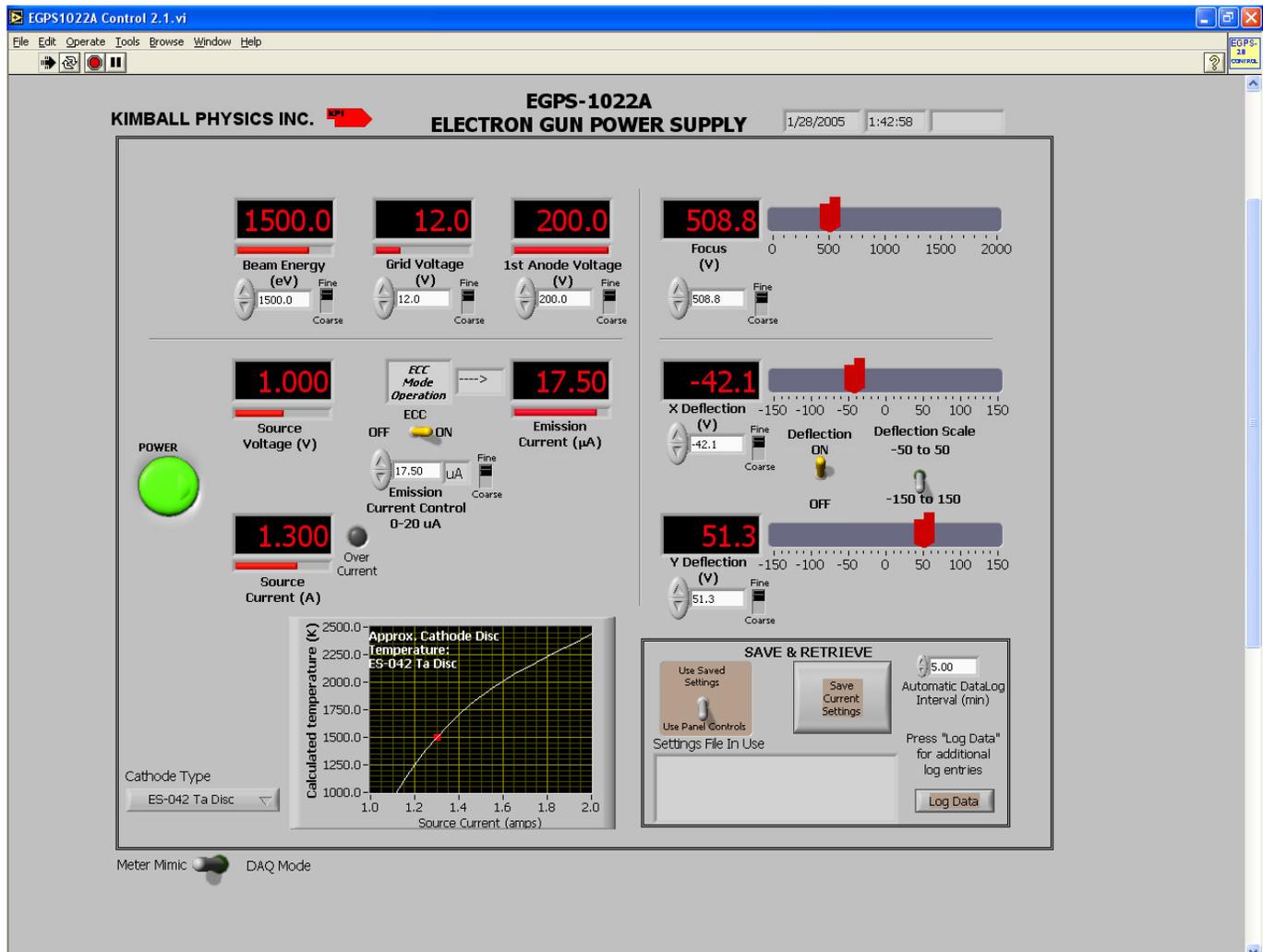


4.1 DESCRIPTION OF CONTROLS cont.

EGPS-1022 Power Supply Remote Control Computer Panel



(ADDITIONAL CONTROLS AND INDICATORS BELOW MAIN PANEL)

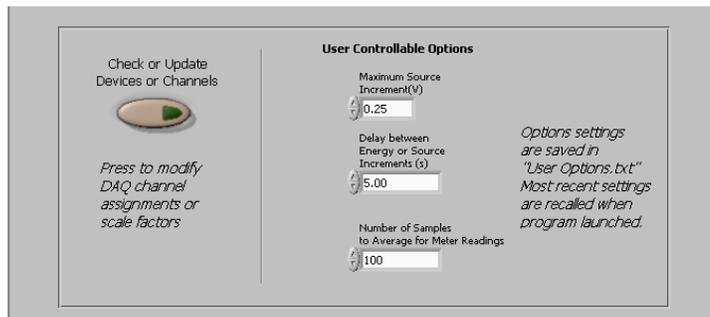


Fig. 4.1-4 Screen captures of LabVIEW™ program for EGPS-1022 Power Supply System remote control

4.1 DESCRIPTION OF CONTROLS cont.



Fig. 4.1-5 Virtual Panel of a typical LabVIEW program for computer remote control and metering (Particular controls may vary with gun model)

EGPS-1022 Power Supply Remote Control Computer Panel

The following is a description of the function of the controls in the LabVIEW™ computer remote programming of the EGPS-1022 Power Supply.

Power Button: A pushbutton labeled **POWER** with a green arrow that lights when on. It is used to start or stop the LabVIEW™ program, after the Power switches on the EGPS-1022 have been physically turned on. Although switching the computer Power button to off sets all program voltages to zero, **this button does not energize or shut down the power supplies.**

ENERGY, GRID VOLTAGE, 1st ANODE VOLTAGE, SOURCE/ ECC, FOCUS, DEFLECTION X and Y

Digital Controls: Program input controls that voltage program the associated power supplies in the same way as the EGPS-1022 front panel potentiometers (see above). Labels below the control give the supply range. **It is strongly recommended that Beam Energy and Source be turned up gradually.** If too large an increase is entered, the program will automatically make the change in a more gradual series of steps. The **Fine/Coarse** slide switch changes the input increments controlled by the up/down arrow switches by a factor of ten. For example with Energy on Fine, one click gives a 0.1 keV increase or decrease, and on Coarse, one click gives 1 keV.

Thumb Slide Controls: (Focus and Deflection only)

Program input controls that voltage program the associated power supplies in the EGPS-1022. The large slide controls with the red arrows have the same effect as the digital input controls but allow easier adjustment for alignment.

Digital Indicators: Digital meters that display the meter signals out of the associated supplies in the EGPS-1022 (see above). The indicator may not be linear with the input digital control, as it displays the actual output.

Horizontal Fill Slides: Horizontal slide bars that display the meter signals out of the associated supplies in the EGPS-1022. They display more visually the same data as the digital indicators.

ECC (Emission Current Control) Switch: A toggle switch labeled **ECC ON / OFF**. When the switch is in the **Off** position (Source mode), it allows the user to set the desired Source voltage directly. When the switch is in the **On** position (ECC mode), it allows the user to set the desired emission current. The default is Off for Source mode.

Note that in ECC mode, the **Source Control** is labeled **Emission Current Control** and is used to set the desired emission current. The Source Voltage will then be varied automatically by the emission feedback circuitry to maintain the set emission current. **Source mode must be used when pulsing.**

Deflection On/Off switch: A toggle switch labeled **Deflection ON / OFF**. When On, the deflection supplies are voltage programmed by the controls. When Off, a control voltage of 0 V is sent to the deflection supplies, regardless of the control settings. Note that this switch does not ground the deflection plates in the way that the physical DEF ON/OFF rocker switch on the EGPS does; that is the computer switch does not control a relay within the power supply. If switched off and then back on, the controls will return to the previously set values.

Deflection scale range toggle switch sets the range of the X and Y Deflection controls.

4.1 DESCRIPTION OF CONTROLS cont.

EGPS-1022 Computer Panel cont.

SAVE & RETRIEVE

Settings Toggle Switch: A two position toggle switch labeled **Use Saved Settings / Use Panel Settings**. In the Panel Settings mode, all the controls on the virtual panel can be controlled by the user. When the switch is moved to the Use Saved Settings position, a dialog box allows the user to choose a previously saved file of parameter values. The saved settings will then be entered as the supply controls, and the file will be shown in the box labeled **Settings File In Use**. The toggle switch will return to the Use Panel Controls position to allow settings to be changed by the user.

Save Settings Pushbutton: A pushbutton labeled **Save Current Settings** that brings up a dialog box to save the current parameter values in a file for future use.

Data Log File: A tab-delimited text file labeled DataLog.txt that automatically records the values of all the controls and meters at a user controllable time interval while the program is running.

Automatic Data Log Interval sets how often the data (all the control settings and meter readings) is recorded in the DataLog.txt file.

The **Log Data** pushbutton records an additional set of all values at the time it is pushed.

CATHODE GRAPH: A graph that tracks the Calculated Cathode True Temperature vs Source Current in real time as the Source Control is varied. The appropriate cathode type must be selected in the user-controllable options below.

Cathode type: A pull-down list to select the type of cathode installed in the gun (Ta disc, LaB₆, etc.). The temperature calculation used in the cathode graph, and the Source overcurrent warning limit depend on this setting.

Warning Messages:

A window with a reminder to change toggle switches on the EGPS to remote will be displayed when the program is opened initially.

A warning message will be displayed if the Energy or Source, is increased in too large a step; the program will then gradually bring the supply to that setting.

A warning message will be displayed if the system is in ECC mode and a settings file in Source mode is chosen. The Source will go to zero automatically and then need to be turned up again. A similar warning will occur if the system is in Source mode and an ECC file is chosen.

A yellow overcurrent button will light up if the source current exceeds the recommended maximum operating current. **Running the Source current this high greatly reduces the cathode lifetime.** For this warning to be correct, the appropriate cathode type, corresponding to the one installed in the gun, must be chosen in the Cathode Type pull-down list.

METER MIMIC/DAQ MODE SWITCH: A toggle switch that sets the operating mode of the computer program. When in Meter Mimic, program does not address DAQ boards. Useful for testing program on computer without DAQ boards installed. Program will make some very SIMPLE calculations to roughly mimic cathode behavior. When in DAQ mode, program addresses DAQ boards. An error message will be generated if DAQ boards are not present or are inconsistent with those expected by program.

User Controllable Program Options: A number of program variables that can be set by the user, but will probably not be changed frequently. This area is viewed by scrolling down below the usual operating panel. These options are stored in "user options.txt" file. When the program is started, the most recent user options are recalled. If an option is changed, the new value can be saved. These preference settings include:

Max Source increment sets the size of steps by which the controls for these high voltage elements can be changed. If a new settings file or operator enters too large change, the program will bring the supply up in smaller steps. The **Delay between increments** control sets the time interval for these steps.

Number of samples to average for meter readings

The settings with which the program is shipped are ones Kimball Physics recommends:

Max Source increment = 0.25 V

Delay = 5 sec

Number of samples to average = 100

Check or Update Devices or Channels: A pushbutton below the panel that brings up an array showing the ranges of all the controls and meters in the LabVIEW program. The values should only be changed if the DAQ boards or EGPS-1022 power supplies are physically modified.

Troubleshooting indicators (hidden): An additional set of indicators of program operation that were used during program development, but are not normally displayed. If needed for program troubleshooting, contact Kimball Physics.

4.4 REMOTE ACCESS: METERING / PROGRAMMING OF POWER SUPPLIES

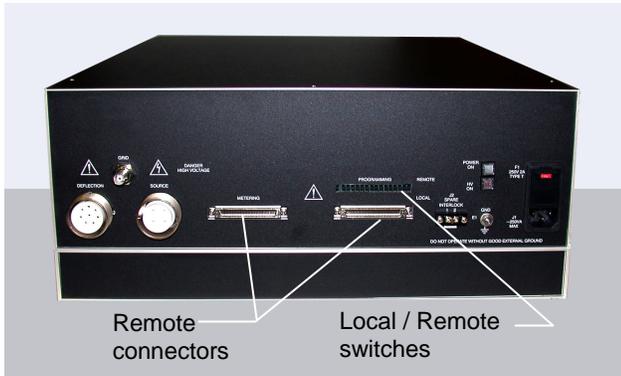


Fig. 4.4-1 A typical power supply with computer remote access connectors for metering and programming.

The Power Supply provides two types of remote access: (1) remote monitoring of all meters, and (2) remote programming control of all individual power supplies.

Remote metering allows any digital or analog meter on the front panel be read using a digital voltmeter or a computer with a data acquisition board. For example, the Emission Current meter signal can be connected to a computer, so that emission data can be recorded directly. Remote metering also permits a more sensitive reading than is possible visually on an analog meter face used in some Power Supplies.

Remote programming allows the operation of the gun to be somewhat automated. The programming voltage signal can be obtained from any source, such as a simple analog supply or a computer with a digital to analog converter. For example, a computer program can be used to control the output of an individual power supply (such as Energy or Focus) and increase that parameter in systematic small steps. Note that when a supply is in the remote mode, it can not be controlled manually with the front panel controls (potentiometers or an encoder wheel).

The remote access uses two D-sub connectors labeled **METERING** and **PROGRAMMING** on the back of the Power Supply (Fig. 4.4-1). In addition, the remote programming has individual Local/ Remote slide switches for each supply to be programmed. These switches are accessed from the back of the Power Supply. The meter signals that can be monitored and the supplies that can be programmed depend on the particular gun model and are listed in the tables below. Note that there may be extra pins and switches which are not used with a particular gun. On some systems there may be a single D-sub connector for both metering and programming.

Separate, optional Power Supply units, such as a stand-alone Rastering unit, may also have supplies that can be controlled remotely in a similar manner.



Fig. 4.4-2 Typical computer set up running LabVIEW™ program for remote programming and metering written by Kimball Physics

A National Instruments LabVIEW™ computer program written by Kimball Physics is available for remote computer control (Fig. 4.4-2). The program provides the user with a virtual panel similar to the front panel on the main Power Supply for controlling and metering all supplies.

The programming input uses standard LabVIEW™ controls such as pushbuttons, toggle switches, and digital controls with increment/decrement buttons. The digital controls have the same effect as the physical front panel controls. Using a numerical input on the digital control can cause the supply to immediately jump to that input value. This could be a problem with some critical supplies, in particular Energy and Source, which should be brought up gradually, so the program will automatically increase them in a series of steps. However, care must still be taken with these supplies. For lower voltage supplies, such as Grid or Raster size, either numerical input or increment/decrement buttons may be used.

For remote metering, the Kimball Physics program uses both LabVIEW™ digital indicators and horizontal fill slides. These virtual meters display the meter signal out of the individual supplies. The horizontal fill slide provides a more visual representation, similar to an analog meter. With the fill slide, it can be seen from a distance whether a supply is turned halfway or all the way up. Details of the control panel for a particular gun are given in Section 4.1.

Other computer programs may be designed by the user to control the power supplies in particular ways or to collect data from the supply meters.

4.4.1 REMOTE METERING

N. I. LabVIEW™ Program by Kimball Physics

1. Set up the power supplies, DAQ boards and cables as described in Power Supply Installation Section 2.2.
2. If the program is not already installed, install the National Instruments LabVIEW™ program file written by Kimball Physics on the computer. Either LabVIEW or LabVIEW Runtime (included with the installer on the disc) is required.
3. After the Power Supplies have been turned on physically as described in Normal Start-Up Procedure, start the program by clicking the arrow in the menu bar and then the **POWER** button. The button should turn all green, and the digital indicator meters show 000. Note that this power button does not energize or shut down the power supplies.
4. As the gun is operated, the digital indicators and horizontal fill slides will display the meter signals out of each supply.
5. To shut down:
 - a. Turn off supplies as described in the Normal Shut Down Procedure.
 - b. Turn off the program by clicking **POWER** button. The green button light and digital readouts should go off. **Do not just close the window** as the program voltages may remain at the values set before the window was closed.
 - c. Then the program window can be closed and the computer shut down.
 - d. An **EMERGENCY STOP** button is provided on some systems. This button is for an emergency situation only and should not be used under normal circumstances. It immediately turns off all Power Supplies.
6. Proceed to the remote programming instructions below.

User-designed Remote Metering

1. Set up a user-supplied system (computer program, DAQ boards etc.) to monitor the meters.
2. Ensure that all Power Supplies are **OFF** before making electrical connections.
3. The meter output signal maps linearly onto supply-dependant ranges shown in Table 4.4-1.
 - a. **For meters with a range of 0 to X** (most supplies): The output signal is 0 to +2 V. For example, with a 0 to 500 μ A Emission meter, a +2 V signal represents 500 μ A, and a +1 V signal represents 250 μ A.
 - b. **For meters with a range of -X to +X** (Deflection or Alignment): The output signal is -2 V to +2 V. For example, with a -150 V to +150 V Deflection supply, a -2 V signal represents -150 V, a +1 V signal represents +75 V, and a 0 V signal represents no deflection.
 - c. Refer to Table 4.4-1 and Fig. 4.4-4 below for the pinout of the **METERING** connector. For each meter, there are a pair of pins: (1) signal output to connect to the output measuring device and (2) common to reference the system to ground.
4. Connect a user-supplied cable from the monitoring system to the D-sub connector labeled **METERING** on the back of the Power Supply to the computer system.
5. Remote metering does not require Remote/ Local switches, and does not affect the use of the front panel controls or meters.
6. Proceed to the remote programming instructions below.

Table 4.4-1 EGPS-1022 Remote Metering Equivalency Table (connector NI 6034E)

Meter Output	DAQ Input Channel		Meter Signal	Meter Range
	Signal (pin#)	Ground (pin#)		
Energy Voltage	ACH 0 (68)	AIGND (67)	0 to 2 V	0 to -2 keV
Source Voltage	ACH 1 (33)	AIGND (67)	0 to 2 V	0 to 2.0 V
Grid Voltage	ACH 2 (65)	AIGND (64)	0 to 2 V	0 to -50 V
1st Anode Voltage	ACH 3 (30)	AIGND (64)	0 to 2 V	0 to +200 V
Focus Voltage	ACH 4 (28)	AIGND (27)	0 to 2 V	0 to +2 kV
X Deflection Voltage	ACH 8 (34)	AIGND (67)	-2 V to +2 V	-150 V to +150 V
Y Deflection Voltage	ACH 9 (66)	AIGND (67)	-2 V to +2 V	-150 V to +150 V
Emission Current	ACH 10 (31)	AIGND (32)	0 to 2 V	0 to 20 μ A
Source Current	ACH 11 (63)	AIGND (64)	0 to 2 V	0 to 2.0 A

4.4.2 REMOTE PROGRAMMING

N. I. LabVIEW™ Program by Kimball Physics

1. Set up the power supplies and cable connections as described in Power Supply Installation Section 2.2.
2. If the program is not already installed, install the National Instruments LabVIEW™ executable program file written by Kimball Physics on the computer. Either LabVIEW or LabVIEW Runtime is required.
3. On the back of the main Power Supply, set the small local/ remote slide switches labeled **PROGRAMMING** to the **REMOTE** position (up) for each supply that is to be remotely controlled. Individual supplies can be run in either local or remote mode. (Fig. 4.4-3)
NOTE: Once in the Remote mode, the individual power supply is not controllable by the front panel controls (potentiometers or encoder wheel). Front panel meters are not affected by these switches.
(Some Power Supplies do not have any front panel potentiometers/ meters and are always controlled remotely by computer; thus these “black box” units do not have any local/ remote slide switches.)
4. After the Power Supplies have been turned on physically as described in Normal Start-Up Procedure, start the program by clicking the arrow in the menu bar and then the **POWER** button. The button should turn all green, and the digital indicator meters should show 000. Note that this power button does not energize or shut down the power supplies.
5. Operate the gun as described in the Normal Start Up or ECC Procedures, using the toggle switches and digital controls on the virtual panel instead of those on the Power Supply front panel.

CAUTION: For critical supplies, such as Energy and Source, it is strongly recommended that the supplies be turned up gradually..

6. To shut down:
 - a. Turn off supplies as described in the Normal Shut Down Procedure.
 - b. Turn off the program by clicking the **POWER** button. The green button light and digital readouts should go off. **Do not just close the window** as the program voltages may remain at the values set before the window was closed.
 - c. Then the program window can be closed and the computer shut down.
 - d. An **EMERGENCY STOP** button is provided on some systems. This button is for an emergency situation only and should not be used under normal circumstances. It immediately turns off all Power Supplies. If the **EMERGENCY STOP** button has been used, it must be reset by clicking reset on the button, before any supplies can be turned on.

User-designed Remote Programming Control

1. Set up a user-supplied system (computer program, DAQ boards etc.) to provide a source for controlling the individual power supplies.
2. Ensure that all Power Supplies are **OFF** before making electrical connections.
3. The voltage source signal maps linearly onto the supply-dependant range shown in Table 4.4-2 below.
 - a. **For supplies with a range of 0 to X** (most supplies): Provide a voltage source that produces a 0 to +10 V signal.
For example, with a 0 to –5 keV Energy power supply, a +10 V signal supplies –5000 eV, and a +5 V signal supplies –2500 eV.
 - b. **For supplies with a range of ±X** (Deflection or Alignment): Provide a voltage source that produces a –10 V to +10 V signal.
For example, with a –150 V to +150 V Deflection power supply, a -10 V signal supplies –150 V, a +5 V signal supplies +75 V, and a 0 V signal supplies no deflection.
 - c. **For toggle switches:** Provide an on/off, +5 V or 0 V signal. For example, with the Source/ECC switch, +5 V sets the switch to ECC, and 0 V sets it to Source mode.
 - d. Refer to Table 4.4-2 and Fig. 4.4-4 for the pinout of the **PROGRAMMING** connector. For each supply, there are a pair of pins: (1) signal program to connect to the voltage programming signal and (2) common to reference the system to ground.
4. On the Power Supply front panel, turn all controls (potentiometers or encoder wheel) fully counterclockwise, to avoid problems due to unexpected settings if the unit is switched back to local mode.
5. On the Power Supply front panel, preset any toggle switches that are not controlled by the remote programming, such as PULSE or HIGH/ LOW switches.
7. On the back of the main Power Supply, set the small local/ remote slide switches labeled **PROGRAMMING** to the **REMOTE** position (up) for each supply that is to be remotely controlled. Individual supplies can be run in either local or remote mode. (Fig. 4.4-3)
NOTE: Once in the Remote mode, the individual power supply is not controllable by the front panel controls (potentiometer or encoder wheel). Front panel meters are not affected by these switches.
6. Connect a user-supplied cable from the programming control system to the D-sub connector labeled **PROGRAMMING** on the back of the Power Supply to the computer system.
7. Follow the Normal Start Up Procedure to energize the system and operate the controls that are not programmed remotely. Front panel pushbuttons or rocker switches need to be on (lighted) for the remote programmed supplies to operate.

4.4 REMOTE ACCESS: METERING / PROGRAMMING OF POWER SUPPLIES cont.

4.4.2 REMOTE PROGRAMMING cont.

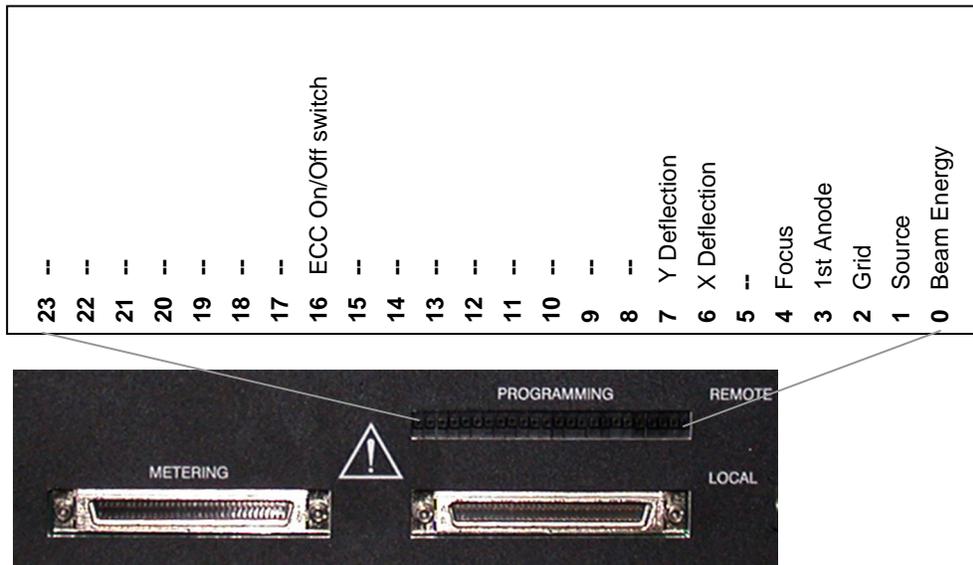


Fig. 4.4-3 Local / Remote Switches on the back of the EGPS-1022 (not all 24 switches are used)

Table 4.4-2 EGPS-1022 Remote Programming Equivalency Table (connector NI 6703)

Power Supply Controls	DAQ Output Channel		Control Type	Control Signal	Power Supply Range
	Signal (pin#)	Ground (pin#)			
Beam Energy	VCH 0 (34)	AGND 0 (68)	Variable	0 to +10 V	0 to -2000 V
Source In ECC mode	VCH 1 (66)	AGND 1 (33)	Variable	0 to +10 V 0 to +10 V	0 to 2.0 V 0 to 20 μ A
Grid	VCH 2 (31)	AGND 2 (65)	Variable	0 to +10 V	0 to -50 V
1st Anode	VCH 3 (63)	AGND 3 (30)	Variable	0 to +10 V	0 to +200 V
Focus	VCH 4 (28)	AGND 4 (62)	Variable	0 to +10 V	0 to +2 kV
X Deflection	VCH 6 (25)	AGND 6 (59)	Variable	-10 V to +10 V	-150 V to +150 V
Y Deflection	VCH 7 (57)	AGND 7 (27)	Variable	-10 V to +10 V	-150 V to +150 V
ECC On / Off	DIO0 (2)	DGND (36)	Switch (TTL)	0 V = Source +5 V = ECC	--

4.4 REMOTE ACCESS: METERING / PROGRAMMING OF POWER SUPPLIES cont.

4.4.2 REMOTE PROGRAMMING cont.

NOTE: With the ELG-2 / EGPS-1022, pulsing is always controlled directly, not by the computer program.

With a **Pulse Junction Box**, a user supplied pulse generator controls the voltage and rate.

With optional **Dual Grid Pulsing**, a user-supplied external TTL input controls the rate.

EGPS METERING CONNECTOR PIN OUT (Device 1)

ACH8	34	68	ACH0
ACH1	33	67	AIGND
AIGND	32	66	ACH9
ACH10	31	65	ACH2
ACH3	30	64	AIGND
AIGND	29	63	ACH11
ACH4	28	62	AISENSE
AIGND	27	61	ACH12
ACH13	26	60	ACH5
ACH6	25	59	AIGND
AIGND	24	58	ACH14
ACH15	23	57	ACH7
DAC0OUT*	22	56	AIGND
DAC1OUT*	21	55	AOGND*
EXTREF*	20	54	AOGND*
DIO4	19	53	DGND
DGND	18	52	DIO0
DIO1	17	51	DIO5
DIO6	16	50	DGND
DGND	15	49	DIO2
+5 V	14	48	DIO7
DGND	13	47	DIO3
DGND	12	46	SCANCLK
PFI0/TRIG1	11	45	EXTSTROBE*
PFI1/TRIG2	10	44	DGND
DGND	9	43	PFI2/CONVERT*
+5 V	8	42	PFI3/GPCTR1_SOURCE
DGND	7	41	PFI4/GPCTR1_GATE
PFI5UPDATE*	6	40	GPCTR1_OUT
PFI6/WFTRIG	5	39	DGND
DGND	4	38	PFI7/STARTSCAN
PFI9/GPCTR0_GATE	3	37	PFI8/GPCTR0_SOURCE
GPCTR0_OUT	2	36	DGND
FREQ_OUT	1	35	DGND

*Not available on AT-AI-16XE-10, PCI-6032E, DAQCard-AI-16E-4, DAQCard-AI-16XE-50

I/O CONNECTOR for NI 6034

(NI 6070E, NI 6060E, NI 6062E, NI 6041E, NI 6040E, NI6036E, NI 6035, and NI 6034E)

EGPS PROGRAMMING CONNECTOR PINOUT (Device 2)

+5 V	1	35	DGND
DIO0	2	36	DGND
DIO1	3	37	DGND
DIO2	4	38	RFU
DIO3	5	39	DGND
DIO4	6	40	RFU
DIO5	7	41	DGND
DIO6	8	42	DGND
DIO7	9	43	AGND
ICH31*	10	44	VCH15
AGND15/AGND31	11	45	ICH30*
VCH14	12	46	AGND14/AGND30
ICH29*	13	47	VCH13
AGND13/AGND29	14	48	ICH28*
VCH12	15	49	AGND12/AGND28
ICH27*	16	50	AGND11/AGND27
VCH11	17	51	ICH26*
AGND10/AGND26	18	52	VCH10
AGND	19	53	ICH25*
AGND9/AGND25	20	54	VCH9
ICH24*	21	55	AGND8/AGND24
VCH8	22	56	AGND
ICH23*	23	57	VCH7
AGND5/AGND21	24	58	ICH22*
VCH6	25	59	AGND6/AGND22
ICH21*	26	60	VCH5
AGND7/AGND23	27	61	ICH20*
VCH4	28	62	AGND4/AGND20
ICH19*	29	63	VCH3
AGND3/AGND19	30	64	ICH18*
VCH2	31	65	AGND2/AGND18
ICH17*	32	66	VCH1
AGND1/AGND17	33	67	ICH16*
VCH0	34	68	AGND20/AGND16

*No connect on NI 6703

I/O CONNECTOR for NI 6703

(NI 670x Family)

4 OPERATION

Fig. 4.4-4 Pin outs of 68-pin DAQ (Data Acquisition) cable connectors, as seen from outside the unit. NI 6034E for metering and NI 6703 for programming

4.4 REMOTE ACCESS: METERING / PROGRAMMING OF POWER SUPPLIES cont.

File Saving for the EGPS-1022 Remote Control Program

SAVE CURRENT SETTINGS saves the following in a tab-delimited file.			
These values are called up if USE SAVED SETTINGS is chosen.			
70 items saved			
Index	Item Saved	Units	Notes
0	Energy	V	
1	Source / ECC in Source mode	V	If in ECC mode when saved, this is set to 0
2	Source / ECC in ECC mode	μ A	If in Source mode when saved, this is set to 0
3	Grid	V	
4	1st Anode	V	
5	Focus	V	
6	X Deflection	V	
7	Y Deflection	V	
8-29	unused		Even though 8-29 and 32-69 are unused, they exist in the file and the positions are filled with zeros
30	Source / ECC mode switch	0 or 1	Switch state 0 = Source, 1 = ECC
31	Deflection switch	0 or 1	Switch state 0 = Off, 1 = On,
32-69	unused		

LOG DATA saves the following in a tab-delimited file.			
These values cannot be called up by the program. Purpose is for data-logging.			
23 items saved in Desktop\Subvis&Data\DataLog.txt. or in same directory as program			
This file can be opened, data copied and pasted to other files, data deleted if desired.			
Index	Item Saved	Units	
<i>TIME MARKERS</i>			
0	Date		
1	Time		
2	Operator's name		Entered when program starts, optional
<i>CONTROL SETTINGS</i>			
3	Energy	eV	
4	Source / ECC in Source mode	V	Depends on switch position
5	Source / ECC in ECC mode	μ A	Depends on switch position
6	Grid	V	
7	1st Anode	V	
8	Focus		
9	X Deflection		
10	Y Deflection	V	
11	Source / ECC Switch	0 or 1	Switch state 0 = Source, 1 = ECC
12	Deflection switch	0 or 1	Switch state 0 = Off, 1 = On
<i>METER READINGS</i>			
13	Energy	eV	
14	Emission Current	μ A	
15	Source Voltage	V	
16	Source Current	A	
17	Grid	V	
18	1st Anode	V	
19	Focus		
20	X Deflection		
21	Y.Deflection	V	
<i>OTHER</i>			
22	Cathode Temperature	K	Temperature calculated from source current