thermionics laboratory, inc.

SVA SERIES

E-GUN™ (ELECTRON BEAM) POWER SUPPLY

INSTRUCTION MANUAL

TABLE OF CONTENTS

1 INTRODUCTION 7

1.1 INTENDED PURPOSE 7

1.2 USER RESPONSIBILITY 7

1.3 SYSTEM DESCRIPTION 8

1.3.1 The High Voltage Power Supply 8

1.3.2 The Filament Output Transformer 8

1.3.3 The SVA Controller 8

1.3.4 The Handheld Controller (Optional) 8

1.4 LIABILITIES AND WARRANTY 9

1.5 SAFETY 9

1.5.1 Personnel Qualifications 9

1.5.2 General Safety Instructions 9

1.5.3 Illustrations of Risks and Hazards 9

1.5.4 General Safety Concerns 11

1.5.5 High Voltage Safety 12

2 SPECIFICATIONS 15

2.1 SVA POWER SUPPLY MODELS 15

2.2 MECHANICAL SPECIFICATIONS 16

2.2.1 The High Voltage Power Supply 16

2.2.2 The SVA Filament Output Transformer 17

2.2.3 The SVA Controller/SVA Sub-Controller 18

2.2.4 The Handheld (Optional) 19

2.3 ELECTRICAL SPECIFICATIONS 20

2.4 ENVIRONMENTAL 21

2.5 STANDARDS 21

2.6 USE AND OPERATING MODES 21

2.7 INTERFACES 22
2.7.1 Interlocks (Required) 22
2.7.2 Remote I/O (Optional).....22

3 INSTALLATION 23

3.1 UNPACKING.....23
3.1.1 Component Lists 24
3.2 RACK INSTALLATION.....28
3.3 GROUNDING.....29
3.4 CONNECTING THE SVA POWER SUPPLY.....31
3.4.1 HVPS Connections, Round Input Connector.....34
3.4.2 Filament Output Transformer Connections.....36
3.4.3 SVA Controller Connections.....37
3.4.4 SVA Sub-Controller Connections 37
3.4.5 SYSTEM INTERCONNECTION.....38
3.4.6 Mains Connection.....39
3.5 INTERLOCK I/O.....41
3.5.1 High Voltage Power Supply Interlock I/O.....41
3.5.2 SVA Controller Interlock I/O 42
3.5.3 SVA Sub-Controller Interlock I/O.....42

4 STANDARD OPERATION 45

4.1 HVPS FUNCTIONS AND INDICATORS 45
4.2 SVA CONTROLLER FUNCTIONS AND INDICATORS.....47
4.2.1 High Voltage Functions.....48
4.2.2 Control Select Functions.....49
4.2.3 Source Functions.....50
4.3 OPERATION 51
4.3.1 Initial Start-Up.....51
4.3.2 Standard Operation 52
4.3.3 Handheld Operation 53

5 REMOTE OPERATION.....55

5.1 REMOTE USER I/O PINOUTS 56

6 MAINTENANCE AND STORAGE 61

6.1 PREVENTIVE MAINTENANCE 61
6.2 STORAGE AND DISPOSAL 62
6.2.1 Packaging 62
6.2.2 Storage 62
6.2.3 Disposal 62
6.2.4 WEEE 62
7 TROUBLESHOOTING 63
7.1 BASIC TROUBLESHOOTING 63
7.1.1 HV Overvoltage Fault 63
7.1.2 HV Overcurrent Fault 63
7.1.3 HV Out of Regulation 64
7.1.4 Arc Counter Fault 64
7.1.5 Rail Current Fault 65
7.1.6 Step Start Fault 65
7.2 CONTACTING SERVICE 66
8 WARRANTY CONDITIONS 67
8.1 LIMITED WARRANTY 67
9 ADDENDUM 69

TABLE OF FIGURES

Figure 1-1, Keep Foreign Material Out of the SVA Power Supply 11
Figure 1-2, Examples of High Voltage warning labels 14
Figure 2-1, SVA HVPS Reference Dimensions 16
Figure 2-2, SVA Filament Transformer Dimensions 17
Figure 2-3, SVA Controller Dimensions 18
Figure 2-4, SVA Sub-Controller Dimensions 19
Figure 2-5, Handheld 19
Figure 3-1, SVA Power Supply Component List 24
Figure 3-2, Cable Kit Components, Round Input Power 25
Figure 3-3, Cable Kit 208V Components, Square Input Power 26
Figure 3-4, SVA Cable Kit 400V, Square Input Power 27
Figure 3-5, Suggested Grounding Connections 30
Figure 3-6, Interconnections for the SVA Power Supply 32
Figure 3-7, Interconnections for the SVA Power Supply, 2 source 33
Figure 3-8, HVPS Rear Panel Connections, Round Input 34
Figure 3-9, HVPS Rear Panel Connections, Square Input 35
Figure 3-10, Filament Output Transformer Connections to HVPS 36
Figure 3-11, SVA Controller Rear Panel Connections 37
Figure 3-12, SVA Sub-Controller Rear Panel Connections 37
Figure 3-13, MAIN POWER, Circular Line Input 40
Figure 3-14, MAIN POWER, Square Line Input 40
Figure 3-15, Square Connector Wire Installation 41
Figure 3-16, EPO Connections 41
Figure 3-17, Interlock Pinouts 42
Figure 3-18, Interlock Pinouts 42
Figure 4-1, HVPS Front Panel Functions 45

Figure 4-2, HVPS Rear Panel Functions 46
Figure 4-3, Controller Front Panel 47
Figure 4-4, Sub-Controller Front Panel 47
Figure 4-5, High Voltage Control Functions 48
Figure 4-6, Control Select Functions 49
Figure 4-7, Source Control Functions 50
Figure 5-1, Controller Remote I/O Pinout, Top Row 57
Figure 5-2, Controller Remote I/O Pinout, Bottom Row 58
Figure 5-3, Sub-Controller Remote I/O Pinout 59
Figure 6-1, WEEE Symbol 62
Figure 9-1, Connections SVA series 208VAC Round Version 70
Figure 9-2, Connections SVA series 400VAC Round Version 71
Figure 9-3, , Connections SVA series 208VAC Square Version 72
Figure 9-4, Connections SVA series 400VAC Square Version 73
Figure 9-5, J4 Remote User I/O Connector 74
Figure 9-6, J4 Remote User I/O Connector 75

LIST OF TABLES

Table 2-1, SVA Power Supply Part Numbers 15
Table 2-2, SVA Electrical Specifications 20
Table 3-1, High Voltage Power Supply Model Part Numbers 24
Table 3-2, Grounding Recommendation 30

1 INTRODUCTION

This user manual contains important information about the installation, functionality, start-up, and operations of the SVA Series High Voltage Electron Beam Power Supply. Read this manual carefully to ensure correct installation and operating conditions are met for its intended use.

1.1 INTENDED PURPOSE

The SVA High Voltage Electron Beam Power Supply is a constant voltage, high frequency, switching power supply intended to deliver power to a single Electron Beam (EB) source which uses electro-magnetic deflection or a combination of permanent magnet and electro-magnetic focusing.

Typically, it is used with other Electron Beam equipment such as an Electron Beam Sweep Generator, a Crucible Indexer, and/or a Deposition Process Controller or the user's PLC system. The SVA High Voltage Electron Beam Power Supply delivers up to -10kV (-8kV for SVA-4) voltage output with a maximum emission current depending on model specifications and configuration. (See chapter 2.3 for more info.)

The SVA High Voltage Electron Beam Power Supply will be referred to as the SVA Power Supply for the remainder of this manual.

1.2 USER RESPONSIBILITY

The user is responsible for proper operation and ordinary maintenance of the equipment, following procedures described in this manual, including reference documents. Upon inspection of incoming equipment contact factory for replacement of any broken or missing parts. Proper operation includes timely replacement of parts that

are lost, broken or plainly worn. If the user has a reasonable doubt about understanding the use or installation of a component, Service should be contacted.

It is vitally important that the user properly install the equipment as described in Chapter 3 (Installation) of this manual.

The warranty will be void if the equipment is improperly installed and/or improperly grounded.

Alteration of the design or any function of the equipment will void the warranty and is entirely the responsibility of the user.

1.3 SYSTEM DESCRIPTION

The SVA Power Supply is comprised of three main units: The High Voltage Power Supply, the Filament Output Transformer, and the SVA Controller.

1.3.1 The High Voltage Power Supply

The High Voltage Power Supply (usually abbreviated HVPS) produces the High Voltage and Filament Current outputs. It also controls the power and regulation of these outputs for use in Electron Beam deposition applications. It receives the control values from the SVA Controller and produces the desired outputs to be joined at the Filament Output Transformer for use with the Electron Beam source emitter assembly.

1.3.2 The Filament Output Transformer

The Filament Output Transformer (usually abbreviated FOT) uses the line voltage filament control output and steps down the voltage to increase the output current for use with the emitter assembly filament. It also joins the negative polarized High Voltage DC output of the SVA Power Supply to the high current output of the Filament Output Transformer and sends the combined outputs through High Voltage Feed-throughs mounted in the chamber wall to the Electron Beam source emitter to produce the desired emission rate.

1.3.3 The SVA Controller

The SVA Controller serves as an interface for the common modes of operation of the SVA Power Supply. It converts the inputs from one of three separate input modes (Local, Handheld, and Remote) and sends that information to the High Voltage Power Supply to produce the desired outputs.

1.3.4 The Handheld Controller (Optional)

The Handheld controller offers more freedom of movement while controlling the SVA Power Supply output. The Handheld Controller allows the user to view the source

operation directly and control High Voltage and Emission output without having to move back and forth to the SVA Controller installed in the instrument rack.

1.4 LIABILITIES AND WARRANTY

Thermionics is not liable for damages resulting from improper use of the device and any guarantees expire, if the user, or a third party:

- ignores information contained in this manual
- utilizes the product in a manner inconsistent with the intended purpose
- makes any modification or alteration to the product
- uses any unauthorized accessories with the product

Thermionics reserves the right to make changes without prior notice.

1.5 SAFETY

TLI is concerned for your general welfare and safety. Please follow these safety guidelines below to ensure you have a safe and productive operation of your SVA Power Supply.

1.5.1 Personnel Qualifications

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience.

1.5.2 General Safety Instructions

For all work performed on this product, be sure to adhere to all the applicable safety regulations and local and regional Electrical Codes. Observe all safety notices given in this documentation and forward this information to all other users of the product.

1.5.3 Illustrations of Risks and Hazards

This Instruction Manual illustrates safety notes concerning risks and hazards as follows:

Indicates important information that must be adhered to.

Indicates risk of exposure to electrically energized components.

DANGER Information on preventing any kind of physical injury.

WARNING Information on preventing extensive equipment and environmental damage.

CAUTION Information on correct handling or use. Disregarding safety notes can lead to malfunctions or equipment damage.

NOTE: Indicates particularly important, but not safety-relevant information.

1.5.4 General Safety Concerns

Pay attention to the following safety notes:

DANGER

Foreign Objects:

Contact with electrically energized parts is extremely hazardous when any objects are introduced, or any liquids penetrate the device.

Make sure that no objects enter the device. Keep the device dry.

Figure 1-1, Keep Foreign Material Out of the SVA Power Supply

WARNING

Improper use:

Improper use can damage the SVA Power Supply.

Use the SVA Power Supply only as intended.

WARNING

Improper installation and operation:

Improper installation and operation may damage the SVA Power Supply.

Strictly adhere to the installation and operational guidelines.

1.5.5 High Voltage Safety

This power supply operates at a high enough voltage and possesses sufficient stored energy to be capable of killing a person!

DO NOT TAKE SAFETY FOR GRANTED!

Pay strict attention to safety information and warnings in this manual.

This power supply produces extremely high voltages. DO NOT attempt to adjust any load connection with High Voltage on. DO NOT attempt to open the power supply enclosure unless the manual has been thoroughly reviewed and the internal layout is understood. Never reach into the enclosure unless the power has been disconnected, lock outs/tag outs applied, and the output is fully discharged. Be certain safety ground connections are in place and secured.

DO NOT rely on the power supply's instrumentation or controls to determine that the output is safely discharged. The sensors and indicator LEDs are driven by amplifiers, which are powered by an internal low voltage power supply. There may be dangerous voltages present on the output, even if the unit appears "OFF".

Assuming that High Voltage is always ON is the best way to avoid hazard to personnel. Always shut off the supply circuit breaker(s) and follow an appropriate grounding procedure to discharge the output before touching any exposed connections.

The High Voltage output is automatically discharged internally when HV is turned off. Although redundancy is designed into the discharge circuit, in the unlikely event of component failure the output may remain charged long after power is disconnected if it is not manually discharged!

DO NOT allow anyone who has not reviewed this manual to perform any part of the installation process or attempt servicing of the power supply. Any questions must be brought to the attention of Thermionics' service personnel.

DO NOT obstruct the cooling inlets or outlets. Overheating can result, which may damage the power supply.

Use decals or other warning labels on the High Voltage shield, at the front of the E-beam chamber and on the door(s) to the room(s) housing the chamber and power supply to provide a warning that lethal voltages are present.

Do not put any part of the body under a chamber while a source is running.

Always use a grounding hook as a matter of habit before touching any potentially High Voltage area, even when the power supply is off.

Always keep one hand in a pocket.

Always maintain a respectful fear of high voltages: familiarity does not make high voltages safe.

Examples of High Voltage warning labels include, but are not limited to:

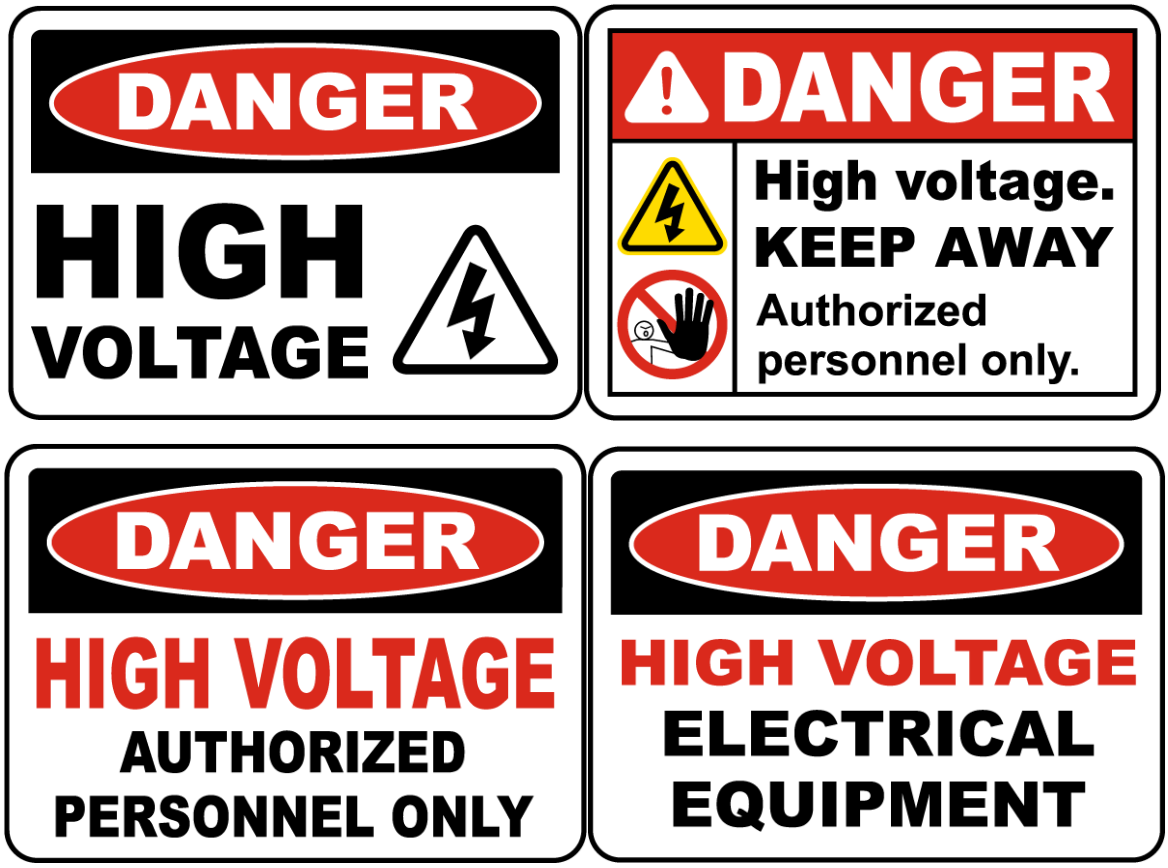


Figure 1-2, Examples of High Voltage warning labels

2 SPECIFICATIONS

2.1 SVA POWER SUPPLY MODELS

Description	Output HV and Emission ranges
SVA-4 Power Supply, 2 Source, 208V	HV: 0 to -8kV; Emission: 0 to 500mA
SVA-4 Power Supply, 2 Source, 400V	HV: 0 to -8kV; Emission: 0 to 500mA
SVA-6 Power Supply, 2 Source, 208V	HV: 0 to -8kV; Emission: 0 to 750mA
SVA-6 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 600mA
SVA-6 Power Supply, 2 Source, 400V	HV: 0 to -8kV; Emission: 0 to 750mA
SVA-6 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 600mA
SVA-8 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 800mA
SVA-8 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 800mA
SVA-10 Power Supply, 1 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 1 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-12 Power Supply, 1 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 1 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1200mA

2.2 MECHANICAL SPECIFICATIONS

2.2.1 The High Voltage Power Supply

The High Voltage Power Supply (**See Figure 2-1**) occupies a standard 5U-19” rack compartment.

Physical dimensions are:

Height: 8.73” (222mm)

Width: 19.00” (483mm)

Length: 25.79” (655mm) Overall, 24.19” (614mm) from rack face

Net Weight: 60 lb. (27.2kg)

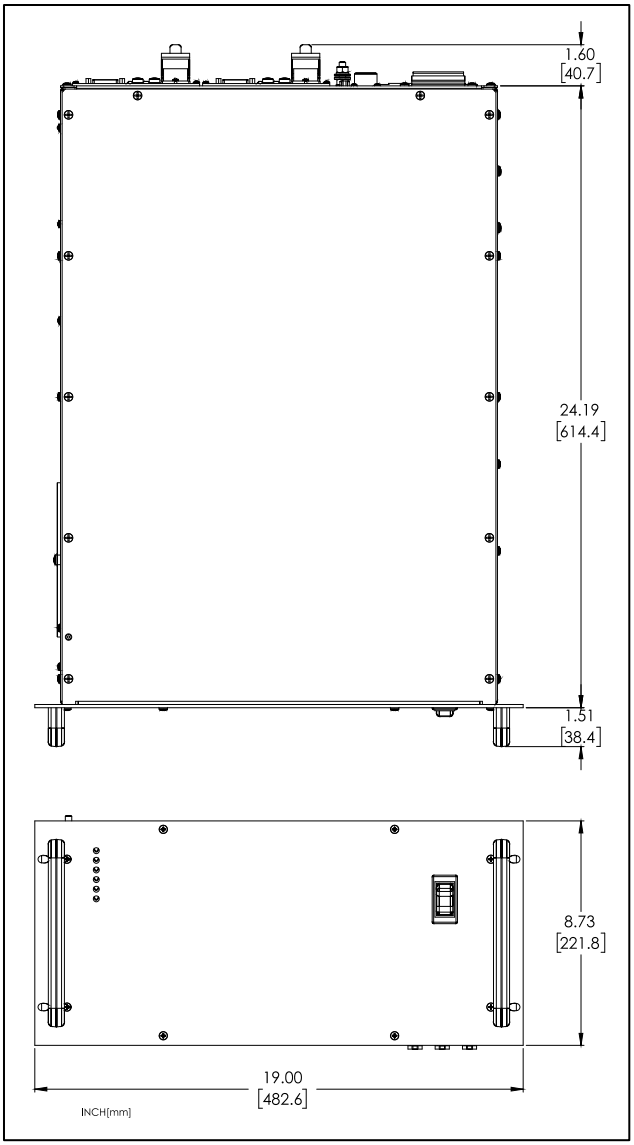


Figure 2-1, SVA HVPS Reference Dimensions

2.2.2 The SVA Filament Output Transformer

The SVA Filament Transformer (See Figure 2-3) is placed at a point between the Power Supply and the HV feedthroughs. It is usually placed or mounted below the deposition chamber with the interconnecting cables routed to the High Voltage Power Supply in the instrument rack.

Physical dimensions are:

Height: 8.68” (220mm)

Width: 7.25” (184mm)

Length: 11.00” (279mm) not including cable length to HV feedthrough.

Net Weight: 29 lb. (13.2kg)

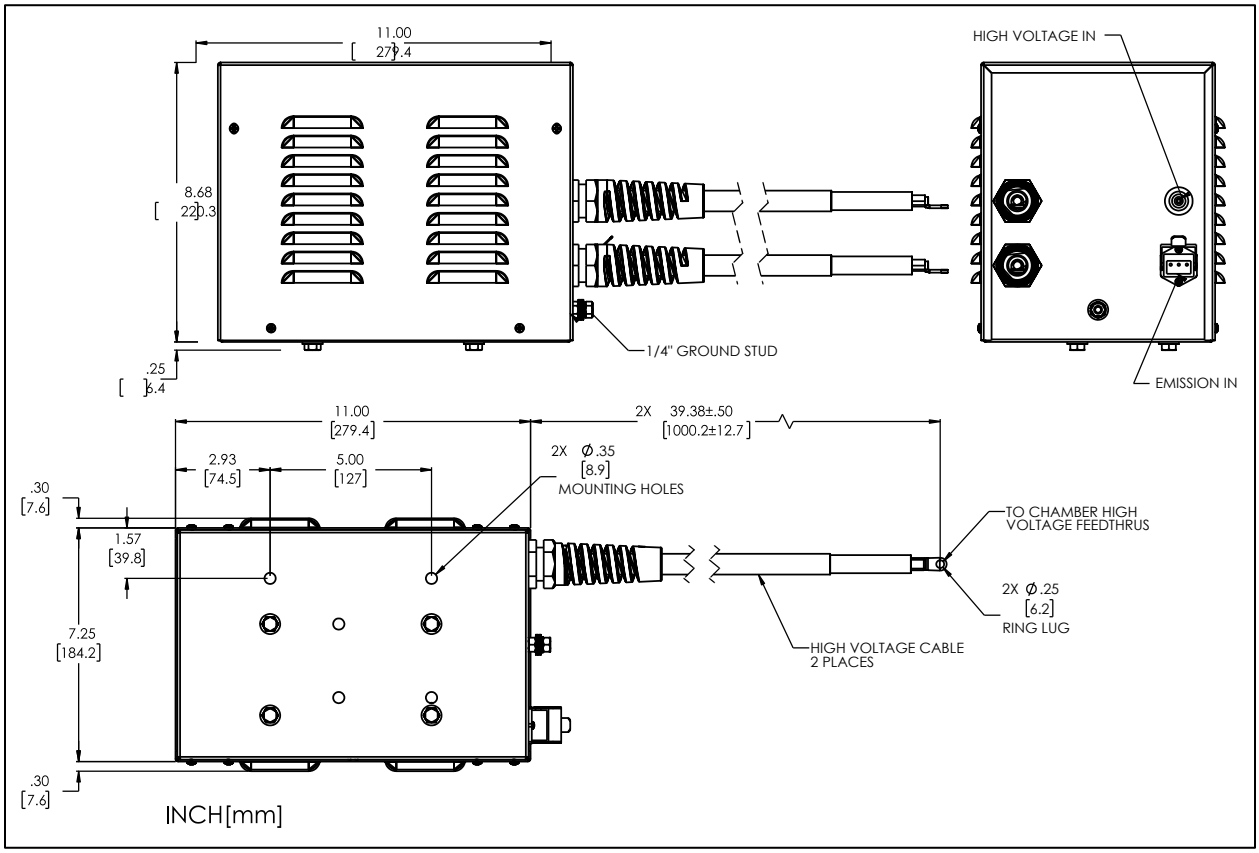


Figure 2-2, SVA Filament Transformer Dimensions

2.2.3 The SVA Controller/SVA Sub-Controller

The SVA Controller (See Figure 2-4) provides external controls for the operation of the SVA Power Supply. SVA Sub-Controller (See Figure 2-5) It occupies a standard 1U 19” rack compartment.

Physical dimensions are:

Height: 1.72” (43.7mm)

Width: 19.00” (483mm)

Length: 9.13” (232mm) Overall, 8.11” (206mm) from rack face

Net Weight: 4 lb. (1.8kg)

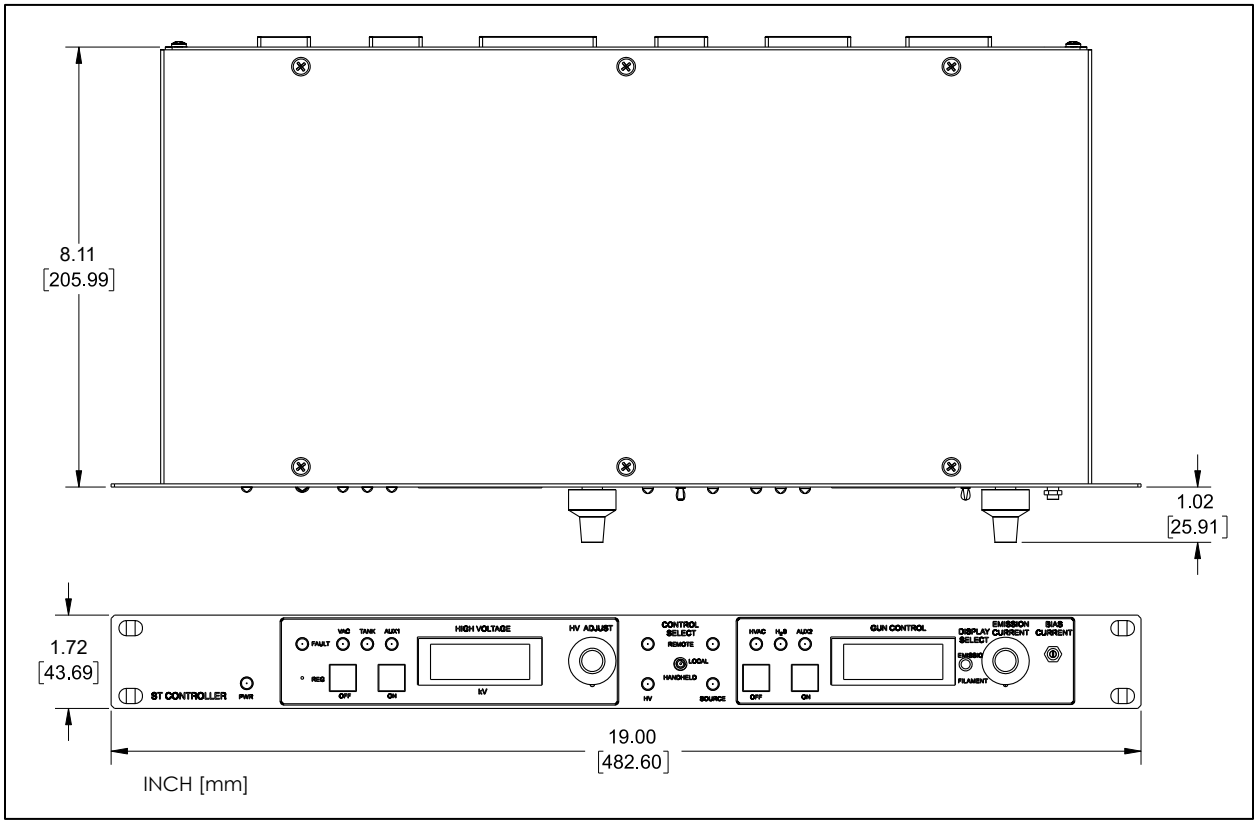


Figure 2-3, SVA Controller Dimensions

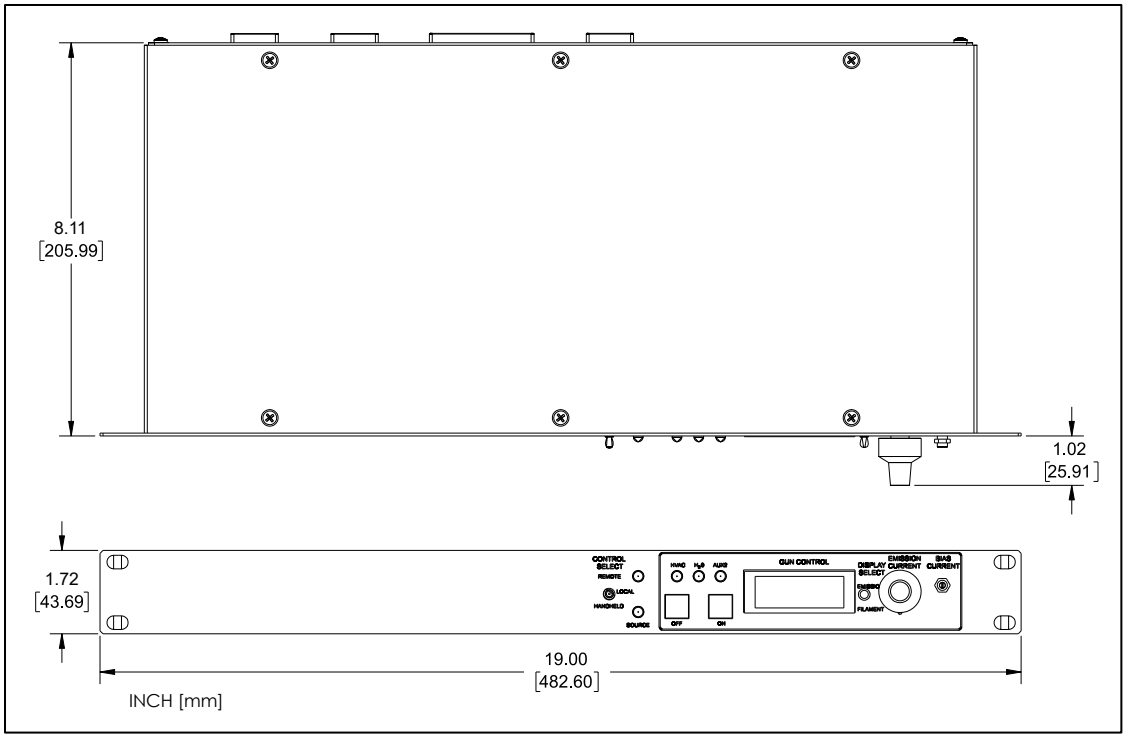


Figure 2-4, SVA Sub-Controller Dimensions

2.2.4 The Handheld (Optional)

The Handheld controller offers more freedom of movement while controlling the SVA Power Supply output. Comes with 15ft cable.

Physical dimensions are:

Height: 1.94” (49.3mm)

Width: 3.49” (88.7mm)

Length: 5.9” (150mm)

Net Weight: 1 lb. (0.45kg)

Figure 2-5, Handheld

2.3 ELECTRICAL SPECIFICATIONS

Parameter	SVA-4 208VAC	SVA-4 400VAC	SVA-6 208VAC	SVA-6 400VAC	SVA-8 208VAC	SVA-8 400VAC
Line Voltage	198-220VAC	380-420VAC	198-220VAC	380-420VAC	198-220VAC	380-420VAC
Line Frequency	50/60Hz	50/60Hz	50/60Hz	50/60Hz	50/60Hz	50/60Hz
Line Current	16A	9A	23A	12A	30A	15A
Output Voltage	0 to -8kV	0 to -8kV	0 to -10kV (optional 0 to -8kV)	0 to -10kV (optional 0 to -8kV)	0 to -10kV	0 to -10kV
Max Output Ripple	0.5%rms	0.5%rms	0.5%rms	0.5%rms	0.5%rms	0.5%rms
Voltage Regulation	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Emission Current	500mA	500mA	600mA (-8kV option is 0 to -750mA)	600mA (-8kV option is 0 to -750mA)	800mA	800mA
Filament Current *	0 to 40A	0 to 40A	0 to 40A	0 to 40A	0 to 40A	0 to 40A

Parameter	SVA-10 208VAC	SVA-10 400VAC	SVA-12 208VAC	SVA-12 400VAC
Line Voltage	198-220VAC	380-420VAC	198-220VAC	380-420VAC
Line Frequency	50/60Hz	50/60Hz	50/60Hz	50/60Hz
Line Current	37A	20A	39A	22A
Output Voltage	0 to -10kV	0 to -10kV	0 to -10kV	0 to -10kV
Max Output Ripple	0.5%rms	0.5%rms	0.5%rms	0.5%rms
Voltage Regulation	0.2%	0.2%	0.2%	0.2%
Emission Current	1000mA	1000mA	1200mA	1200mA
Filament Current *	0 to40A	0 to 40A	0 to40A	0 to 40A

Table 2-2, SVA Electrical Specifications

Specifications subject to change without notice

NOTE: The above specified line currents are average maximum currents at full load and at lowest specified line voltage.

It is considered good practice to select slow blow circuit breakers (or fuses) with at least one step up in current rating (e.g. +5A). Line feed cable size must be chosen accordingly.

2.4 ENVIRONMENTAL

The SVA Power Supply

Temperature Storage:	-20…+60 °C
Operation Temperature:	+5…+40 °C
Relative Humidity:	Max. 80 % (up to 31 °C), decreasing to max. 50 % (above 40 °C)
Use indoor only	
Altitude:	max. 2000 m n.p.m.
The degree of dust standard:	II
Humidity resistance:	IP20

2.5 STANDARDS

Conformity with the Directive relating to electrical equipment designed for use within certain voltage limits 73/23/EWG

Conformity with the Directive relating to electromagnetic compatibility 89/336/EWG

Harmonized and international/national standards and specifications:

EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use)

EN 61000-6-2 (Electromagnetic compatibility generic immunity standard)

EN 61000-6-3 (Electromagnetic compatibility generic emission standard)

2.6 USE AND OPERATING MODES

There are three common modes for the operation of the SVA Power Supply:

Manual “**Local Mode**” control, using the ON and OFF pushbuttons and setpoint dials on the SVA Controller, or

PLC/Hardware “**Remote Mode**” control using the I/O interface connector (J4) on the rear of the SVA Controller, or

Via the optional Handheld controller in “**Handheld Mode**” control.

These modes are activated by switching the “**CONTROL SELECT**” toggle into the corresponding position on the front of the SVA Controller.

2.7 INTERFACES

The SVA Power Supply interfaces to the Process Chamber controls via two D-Subminiature interface connections. One is required for interlock status and safety, and one is optional for Remote Process Control.

2.7.1 Interlocks (Required)

15pin D-Sub connector (J6) on the rear of the SVA Controller.

15pin D-Sub connector (J6) on the rear of the SVA Sub-Controller (2 Source supplies only).

4pin Amphenol EPO cable connection or provided jumper on the rear of the SVA Power Supply (J5).

(See Chapter 3.5 for pinout information)

2.7.2 Remote I/O (Optional)

37 pin D-Sub connector (J4) on the rear of the SVA Controller.

(See Chapter 5.1 for pinout information)

3 INSTALLATION

3.1 UNPACKING

1. Before unpacking, visually inspect the transport packaging for signs of external damage.

2. Unpack the SVA Power Supply components and place the packaging material aside.

NOTE: Keep the packaging material for future use! The SVA Power Supply must be stored and transported in the original packaging material only.

3. Examine the contents and verify that all components, cables, and accessories are present. (See Figures 3-1 and 3-2, 3-3, 3-4)

4. Visually inspect the SVA Power Supply for any signs of damage.

Never Power Damaged Product.

Putting a damaged product into operation can be extremely dangerous.

Never attempt to put a damaged product into operation. Secure the damaged product from unintended operation. Send a damage report to the transport company or the insurer.

3.1.1 Component Lists

The following is a comprehensive list of the components included with the SVA Power Supply System.

Qty	Description	Photo
1	High Voltage Power Supply (HVPS)	
1	Filament Transformer Box	
1	Control Module	
1	Sub-Control Module (2 Source supplies only)	
1	Cable Kit, SVA	(See Figure 3-3, 3-4, or 3-5)

Figure 3-1, SVA Power Supply Component List

Description	Output HV and Emission ranges
SVA-4 Power Supply, 2 Source, 400V	HV: 0 to -8kV; Emission: 0 to 500mA
SVA-4 Power Supply, 2 Source, 400V	HV: 0 to -8kV; Emission: 0 to 500mA
SVA-6 Power Supply, 2 Source, 208V	HV: 0 to -8kV; Emission: 0 to 750mA
SVA-6 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 600mA
SVA-6 Power Supply, 2 Source, 400V	HV: 0 to -8kV; Emission: 0 to 750mA
SVA-6 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 600mA
SVA-8 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 800mA
SVA-8 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 800mA
SVA-10 Power Supply, 1 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 1 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-10 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1000mA
SVA-12 Power Supply, 1 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 1 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 2 Source, 208V	HV: 0 to -10kV; Emission: 0 to 1200mA
SVA-12 Power Supply, 2 Source, 400V	HV: 0 to -10kV; Emission: 0 to 1200mA

Table 3-1, High Voltage Power Supply Model Part Numbers

Cable Kit Components, Round Power Connector

Dual Source Qty	Description	Photo
2	15pin D-Sub, Control Cable, M-F, 10 feet	
1	25pin D-Sub, Control Cable, F-F, 10 feet	
1	25pin D-Sub, Control Cable, M-M, 10 feet	
2	SVA Filament Power Cable, M-F, 15 feet	
2	SVA HV Output Coax Cable, 15 feet	
2	Interlock Connector Kit, D-Sub, 15pin, Male	
2	Remote I/O Connector Kit, D-Sub, 37pin, Male	
1	Input Power Connection Kit, Round	

Figure 3-2, Cable Kit Components, Round Input Power

208V Cable Kit Components, Square Power Connector

208V Single Source Qty	208V Dual Source Qty	Description	Photo
1	2	15pin D-Sub, Control Cable, M-F, 10 feet	
1	1	25pin D-Sub, Control Cable, F-F, 10 feet	
1	1	25pin D-Sub, Control Cable, M-M, 10 feet	
1	2	SVA Filament Power Cable, M-F, 15 feet	
1	2	SVA HV Output Coax Cable, 15 feet	
1	2	Interlock Connector Kit, D-Sub, 15pin, Male	
1	2	Remote I/O Connector Kit, D-Sub, 37pin, Male	
1	1	Input Power Connection Square Kit, 208V	

Figure 3-3, Cable Kit 208V Components, Square Input Power

400V Cable Kit Components, Square Power Connector

400V Single Source Qty	400V Dual Source Qty	Description	Photo
1	2	15pin D-Sub, Control Cable, M-F, 10 feet	
1	1	25pin D-Sub, Control Cable, F-F, 10 feet	
1	1	25pin D-Sub, Control Cable, M-M, 10 feet	
1	2	SVA Filament Power Cable, M-F, 15 feet	
1	2	SVA HV Output Coax Cable, 15 feet	
1	2	Interlock Connector Kit, D-Sub, 15pin, Male	
1	2	Remote I/O Connector Kit, D-Sub, 37pin, Male	
1	1	Input Power Connection Square Kit, 400V	

Figure 3-4, SVA Cable Kit 400V, Square Input Power

3.2 RACK INSTALLATION

The SVA Power Supply is designed to be mounted in a standard 19-inch electronic instrument rack. Any suitable place on a vacuum system that has a standard 19-inch-wide opening may be used.

The SVA Controller could, for example, be set directly on a system cabinet top for easy access or be mounted in a 19-inch, 1U high, electronic instrument rack. The HVPS requires an opening that is 5U high.

For maximum operating ease, the controller should be mounted at approximately eye level. The HVPS should be placed at the bottom of the 19-inch rack.

If the HVPS is mounted in a rack containing other heat generating equipment, care should be taken that there is adequate ventilation to assure that the ambient temperature does not exceed the SVA Power Supply's temperature rating.

The temperature of the environment.
Exceeding the allowable temperature of the device may damage the unit. Chassis supports must not block air passages located on the unit's side panels. A fan located on the left side panel pulls air in through a heatsink located on the right-side panel. Intake air temperature must stay below 30°C/86°F!

Make sure that the maximum permissible ambient temperature is not exceeded, and that air can circulate freely through the ventilation slots.

The HVPS must be placed in a level 19-inch rack or other suitable cabinet that can support a minimum of 70 lbs. (32kg.). The module(s) must be secured in the cabinet before electrical connections are made.

3.3 GROUNDING

Proper grounding is the single most important aspect of the installation of the e-Gun. During arcing events, RF noise is generated that must be properly driven to ground to avoid interference/damage. For this reason, the e-Gun ground must be separate from the electronics rack ground and ideally as short as possible.

Improper grounding can lead to poor performance, interference with other equipment, damage to e-Gun electronics or other equipment, or even shock potential.

NOTE: Do not depend on water pipes for the system ground connection. Because of multiple joints and sealing compounds, water pipes typically do not make a good Earth Ground. Keep in mind this is a high frequency return as well as a DC ground.

Regardless of the method of grounding, the first point of connection for the ground cable/strap is always the e-Gun chamber. There should be a specially designed ground bar welded to the chamber for this purpose. The strap, if used, should be "sandwiched" between two bars to ensure a broad area connection.

Connecting to Building Steel:

The best method known for grounding the E-Gun is to tie the ground bar to building steel as close as possible using the appropriate grounding strap (varies based on the distance - see figure 3-5). One must verify that the building steel has a good connection to ground for this to be a viable solution. Be sure to remove any paint, rust, etc. from under the connection point to the building steel.

Because the connection is for an RF ground, surface area is more important than cross-sectional area. It is critical to have a wide surface area of connection between the grounding strap and the building steel.

When in doubt, always go with the larger ground connection. You can never have too good of a connection!

Do not use braided wire. Be sure that the connection is made to clean metal.

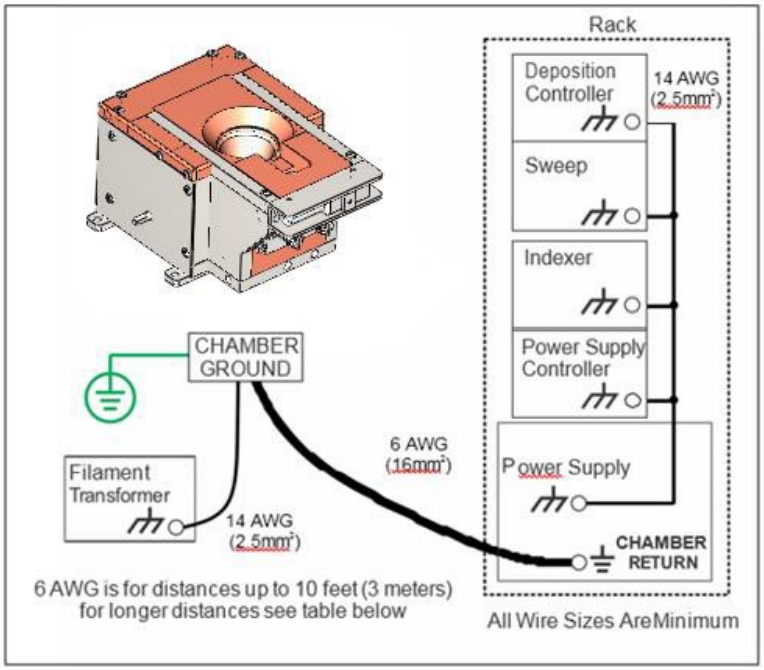


Figure 3-5, Suggested Grounding Connections

Distance Between E-Beam Chamber and Grounding Point	Minimum Recommended Strap/Cable
< 10 Feet « 3 meters)	#6 Gauge (16mm^2) or larger copper cable
10-20 Feet (3-6 meters)	#4 Gauge (25mm^2) or larger copper cable
20-60 Feet (6-18 meters)	2-inch x .035 inch (50mm x 1mm) thick copper strap
> 60 Feet (> 18 meters)	Contact Thermionics for recommendations

Table 3-2, Grounding Recommendation

In addition to the critical building (Earth) ground described above, there are 3 other ground leads that will be attached to the ground bar on the e-Gun chamber:

1. Filament Output Transformer - connected using 14 AWG (2.5mm^2) wire
2. Safety cover over high voltage feedthroughs - connected using 12 AWG (4mm^2) wire
3. E-beam power supply - connected using 6 AWG (16mm^2) wire

There are also 4 ground connections to be maintained between the rack-installed instruments and the HVPS but **not directly to chamber ground**:

1. SVA-Controller - connected using 14 AWG (2.5mm^2) wire.
2. Sweep controller - connected using 14 AWG (2.5mm^2) wire.
3. Indexer controller - connected using 14 AWG (2.5mm^2) wire.
4. Deposition Controller – connected using 14 AWG (2.5mm^2) wire.

These connections can either be “daisy-chained” from one unit to the next and then to the HVPS chassis ground or maintain their own individual connections to the HVPS chassis ground.

There is not a required order for the above. Ensure connections are secure prior to turning on the power to the E-beam. Operating without one or more grounds properly connected may cause damage to equipment or even harm to the operator.

3.4 CONNECTING THE SVA POWER SUPPLY

Here we will discuss the interconnections between the High Voltage Module (HVPS), the Filament Output Transformer, The Controller, and Input Power.

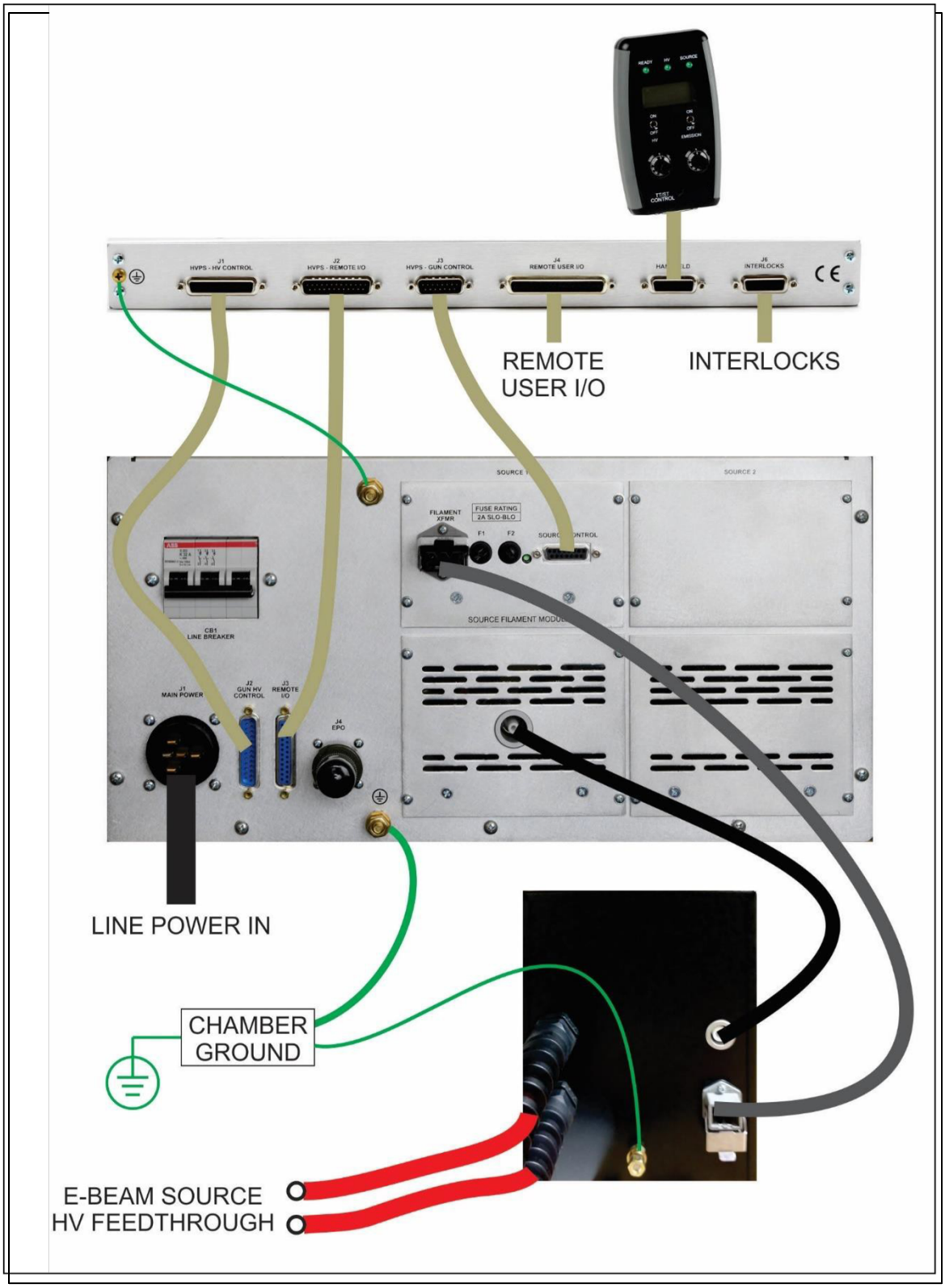


Figure 3-6, Interconnections for the SVA Power Supply

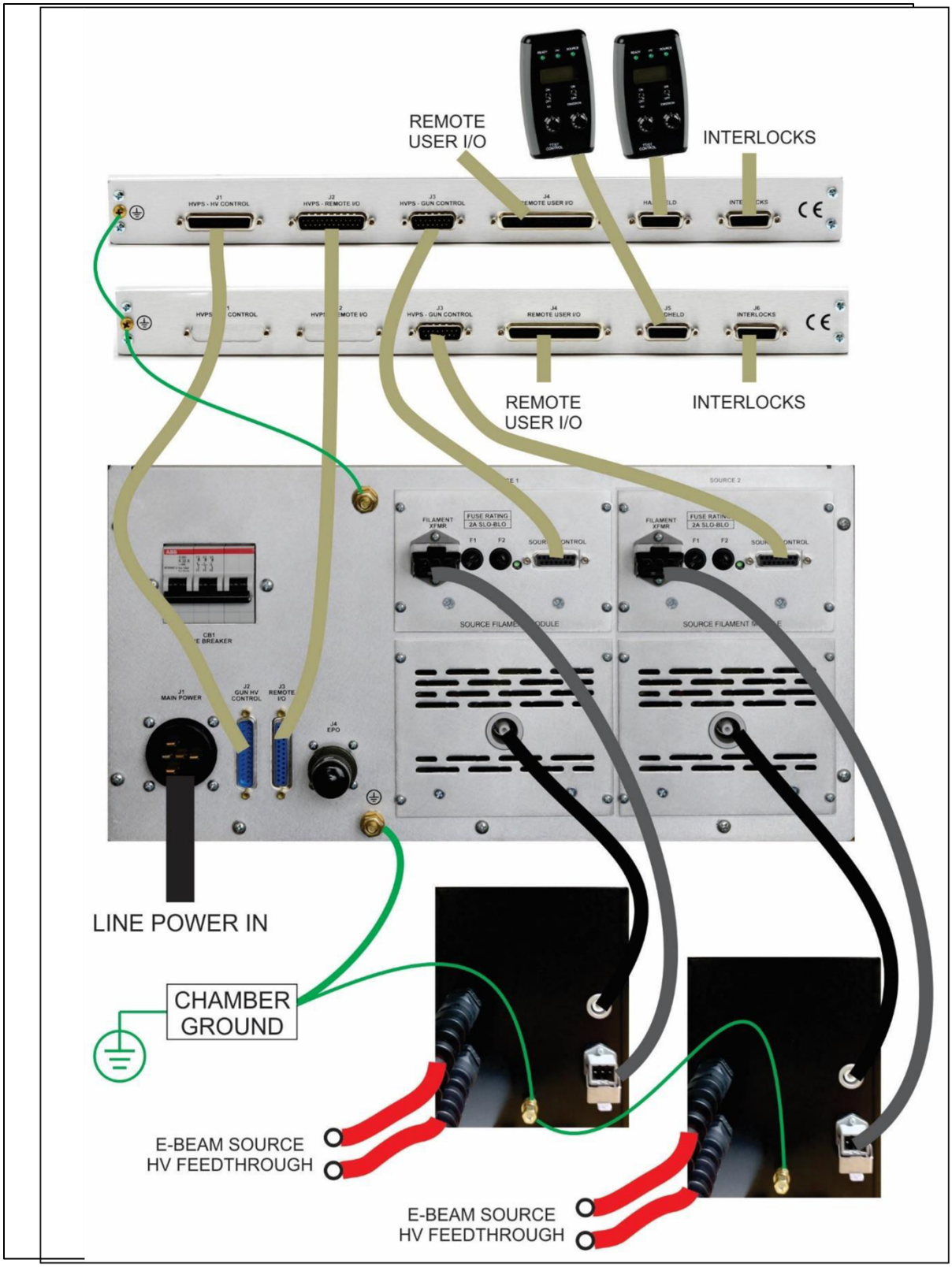


Figure 3-7, Interconnections for the SVA Power Supply, 2 source

3.4.1 HVPS Connections, Round Input Connector

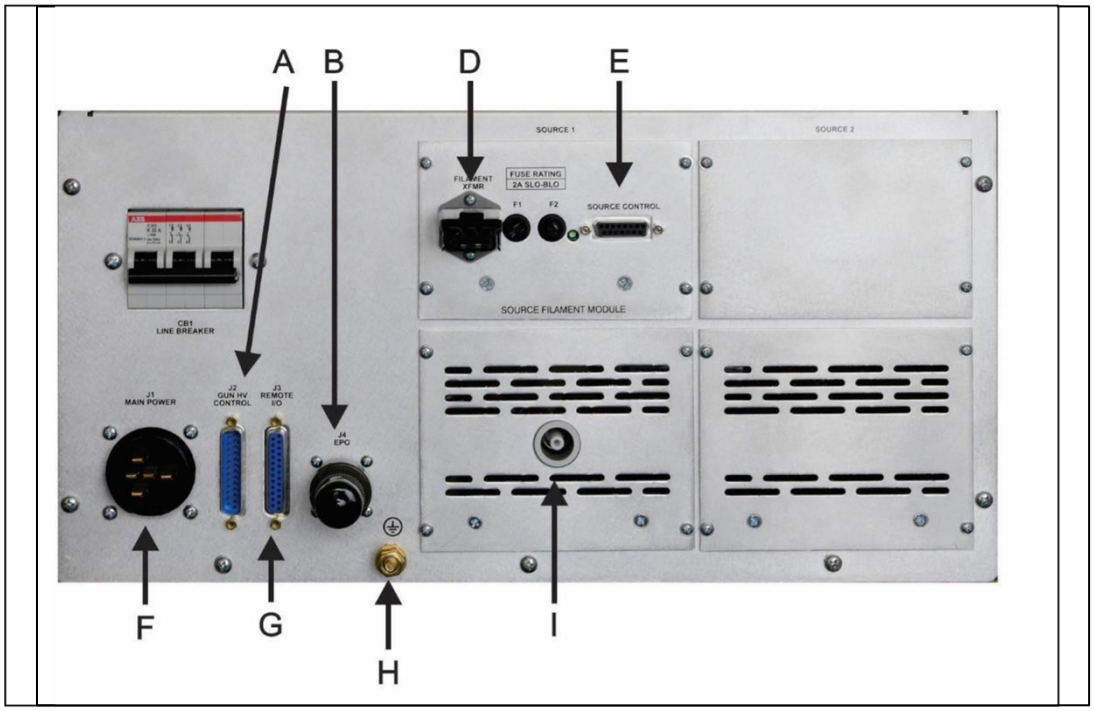


Figure 3-8, HVPS Rear Panel Connections, Round Input

A – J2 HV CONTROL - connects to J1 of Controller

B – J4 EPO - Jumpered or connected to system EPO.

D - FILAMENT OUTPUT - connects to J2 of Filament Transformer

E – SOURCE CONTROL - connects to J3 of Controller

F – J1 MAIN POWER - “Mains” Line Input Power

G – J3 INTERFACE I/O - connects to J2 of Controller

H ⏚ CHAMBER RETURN

I – HV OUTPUT - connects to J1 of Filament Transformer

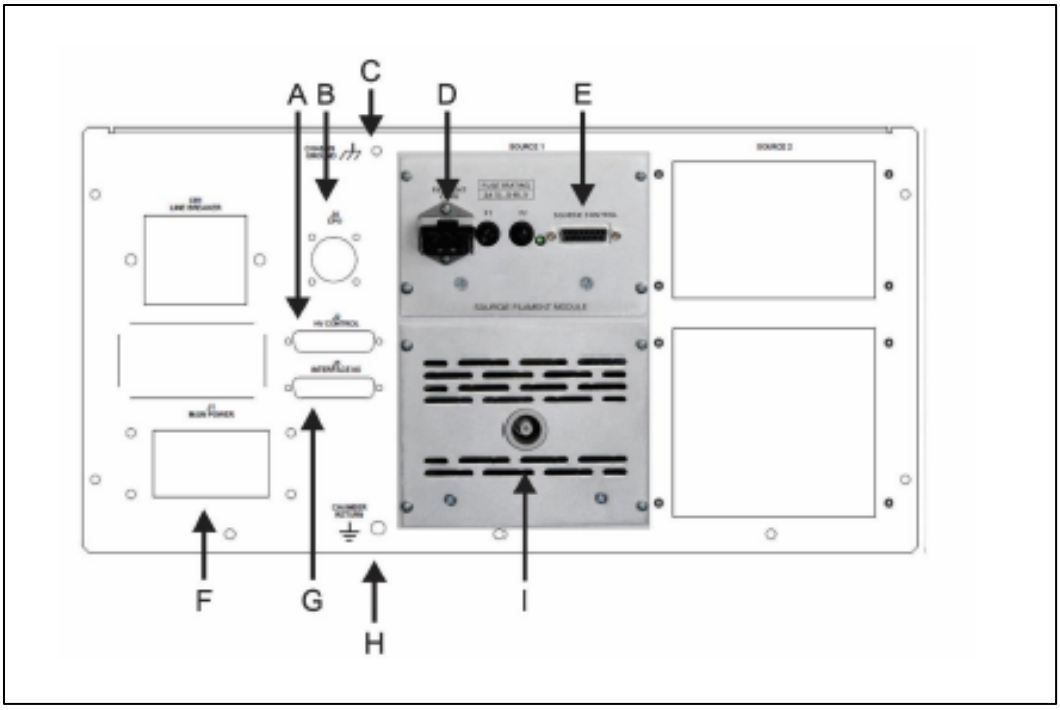


Figure 3-9, HVPS Rear Panel Connections, Square Input

A – J2 HV CONTROL - connects to J1 of Controller

B – J4 EPO - Jumpered or connected to system EPO.

C - ⏚ CHASSIS GROUND (Top) - (see chapter 3.3 for details)

D - FILAMENT OUTPUT - connects to J2 of Filament Transformer

E – SOURCE CONTROL - connects to J3 of Controller

F – J1 MAIN POWER - “Mains” Line Input Power

G – J3 INTERFACE I/O - connects to J2 of Controller

H ⏚ CHAMBER RETURN (Bottom)

I – HV OUTPUT - connects to J1 of Filament Transformer

3.4.2 Filament Output Transformer Connections

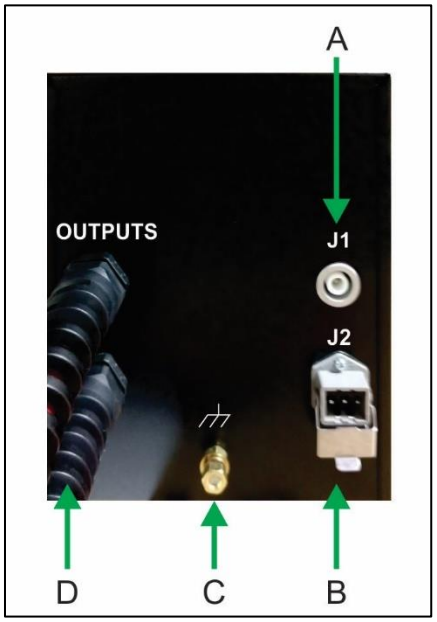


Figure 3-10, Filament Output Transformer Connections to HVPS

A – HV INPUT - connects to HVPS HV Output

B – FILAMENT INPUT - connects to HVPS Filament Output

C – CHAMBER GROUND - (see chapter 3.3 for details**)**

D – HV POWER OUTPUT - Connect to HV feedthroughs

3.4.3 SVA Controller Connections

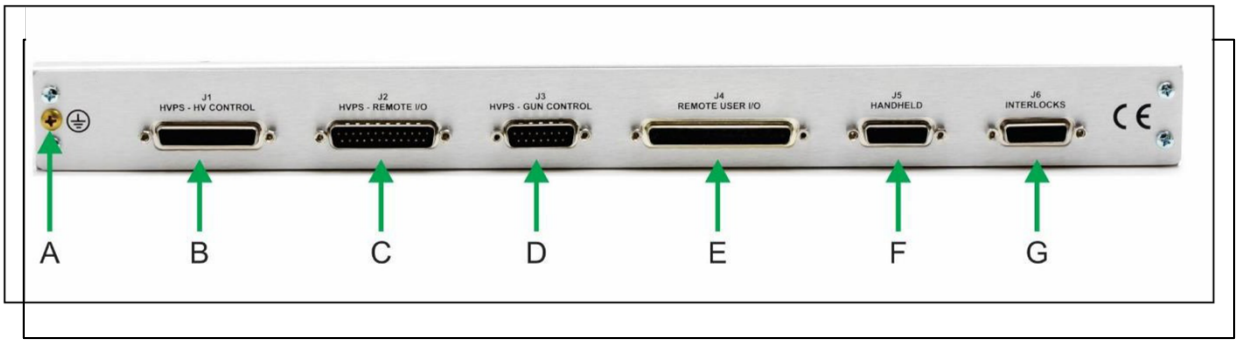


Figure 3-11, SVA Controller Rear Panel Connections

A – **CHASSIS GROUND** - (see chapter 3.3 for details**)**

B – **J1 – HVPS HV CONTROL** - connects to J1 of HVPS

C – **J2 – HVPS INTERFACE I/O** - connects to J2 of HVPS

D – **J3 – HVPS - SOURCE CONTROL** - connects to J3 of HVPS

E – **J4 – REMOTE USER I/O** - connects to Customer I/O (see chapter 5.1)

F – **J5 – HANDHELD** - connects to Handheld

G – **J6 – INTERLOCKS** - connects to Customer I/O (see chapter 3.5)

3.4.4 SVA Sub-Controller Connections

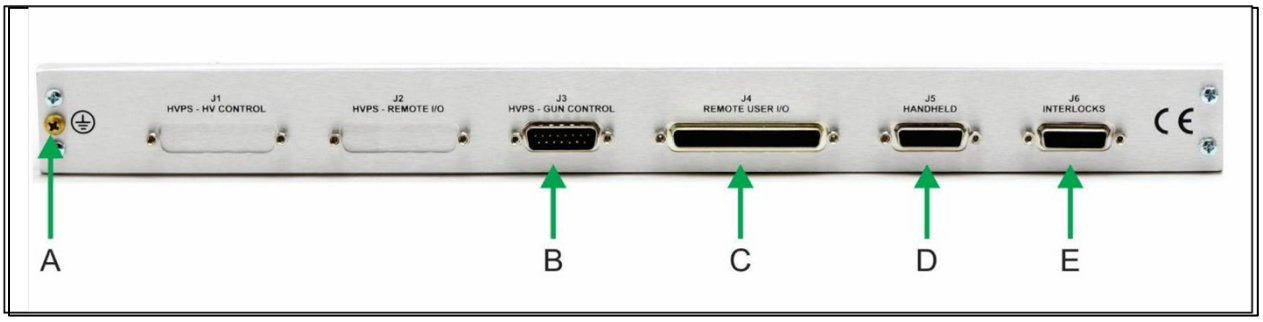


Figure 3-12, SVA Sub-Controller Rear Panel Connections

A – **CHASSIS GROUND** - (see chapter 3.3 for details**)**

B – **J3 – HVPS - SOURCE CONTROL** - connects to J3 of HVPS

C – **J4 – REMOTE USER I/O** - connects to Customer I/O (see chapter 5.1)

D – **J5 – HANDHELD** - connects to Handheld

E – **J6 – INTERLOCKS** - connects to Customer I/O (see chapter 3.5)

3.4.5 SYSTEM INTERCONNECTION

Turn OFF all front and rear panel circuit breakers.

Connect the bottom ground stud on the rear panel of the HVPS chassis to a common ground on the vacuum system. See Figure 3-5 for Grounding information, wire gauges, and connections. This vacuum system ground must be the common point of all ground connections.

Ground the SVA Controller directly to the top HVPS ground stud.

Connect the supplied 25pin Sub-D M-M cable between J1 on the HVPS and J1 on the Controller.

Connect the supplied 25pin Sub-D F-F cable between J2 on the HVPS and J2 on the Controller.

Connect the supplied 15 pin Sub-D M-F cable between J3 on the HVPS and J3 on the Controller.

Connect the supplied HV Output cable (RG Coax) between J4 on the HVPS and J4 on the supplied Filament Output Transformer (see Figure 3-10). It is good practice to keep the HV cable away from sharp objects, machinery, and high traffic areas. This will minimize the possibility of damage to the cable.

Connect the supplied Filament Power cable between HVPS filament output and J2 on the Filament Output Transformer (see Figure 3-10).

The ends of the red HV cables need to be custom configured to connect to the High Voltage Feedthroughs for the e-Gun Source.

Connect the safety interlocks to J6 of the SVA controller as described in Chapter 3.6, according to the connection diagrams in Figure 9-1(208V) or Figure 9-2 (400V).

With input AC line voltage **OFF**, and a lockout/tag out in place, terminate the AC line feed wires with the supplied terminals (P/N 124-1440-1), connector shell (P/N 124-1441-1), and cable clamp (P/N 124-1442-1). It is mandatory to use 600V insulated, stranded wire of sufficient gauge (10AWG (6mm²) for 208VAC, 12AWG (4mm²) for 400VAC). Strip about 0.4 inch (~10mm) of insulation from the wires before crimping them to the terminals. Refer to the pinout in Chapter 3.4.5 for proper insertion connections.

Connect the completed connector assembly to J1 on the HVPS.

When all connections have been double checked, remove any lockout/tag outs, and apply AC power from the AC line input. Turn both rear panel circuit breakers ON. The unit is now ready for operation.

3.4.6 Mains Connection

The Main Power connection is designed for a mains cable which contains the mating connector (included with your SVA Power Supply) for the input on the HVPS side. A suitable mains cable will have the following characteristics:

Four-conductor (3P+G) 10AWG (6 mm2) for 208V models, or

Five-conductor (3P+N+G) 12AWG (4 mm2) for 400V models.

Minimum 600V rating

Recommended: Flame-retardant, with resistances to abrasion, chemicals, oil, sunlight and weather.

Input Voltage Selection.

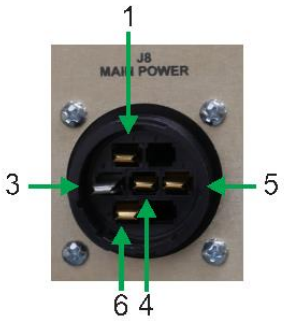
Before the HVPS may be installed, it is critical that the input AC line voltage being supplied to it conforms to the marking on the rear panel. No neutral connection is required for 208VAC units. The HVPS is not sensitive to phase rotation. Double check your power line wiring configuration before proceeding with the installation.

Mains power.

Improperly grounded devices can be extremely dangerous in the event of a fault. Use three-wire mains or extension cables with protective ground only. Hookup the mains cable into wall sockets with protective ground only

1. Connect the power connector to the mains cable.
2. Connect the cable connector to the power supply.
3. Connect the cable to the mains outlet.

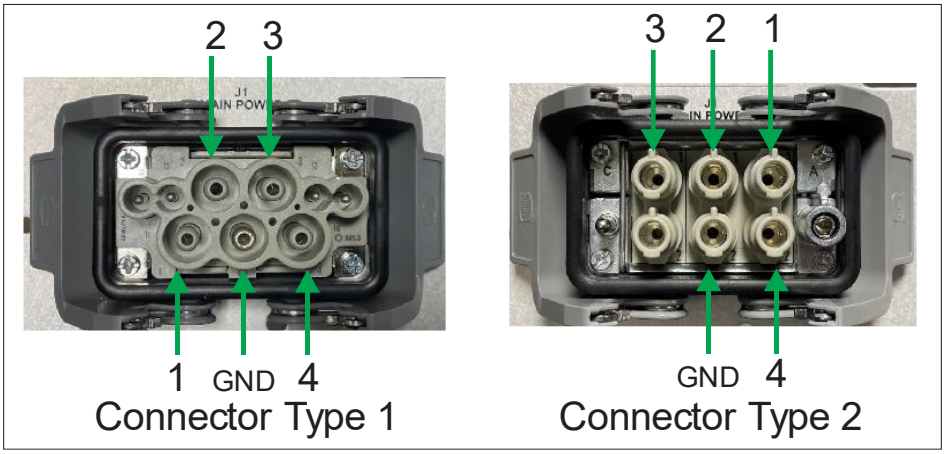
MAIN POWER, Line Input (Amphenol 7-pin F circular power)



Pin#	Name	Description
1	P1	AC Phase 1
3	GND	AC Ground / Physical Earth
4	N	AC Neutral, **(400V models only.)**
5	P2	AC Phase 2
6	P3	AC Phase 3

Figure 3-13, MAIN POWER, Circular Line Input

MAIN POWER, Line Input (Square)



Pin#	Name	Description
1	P1	AC Phase 1
2	P2	AC Phase 2
3	P3	AC Phase 3
4	N	AC Neutral, **(400V models only.)**
GND	GND	AC Ground / Physical Earth

Figure 3-14, MAIN POWER, Square Line Input

Notes for Square Connector

Use a 2.5mm Allen wrench from the pin side to tighten wire to connector. See figure 3-15 for wire installation.

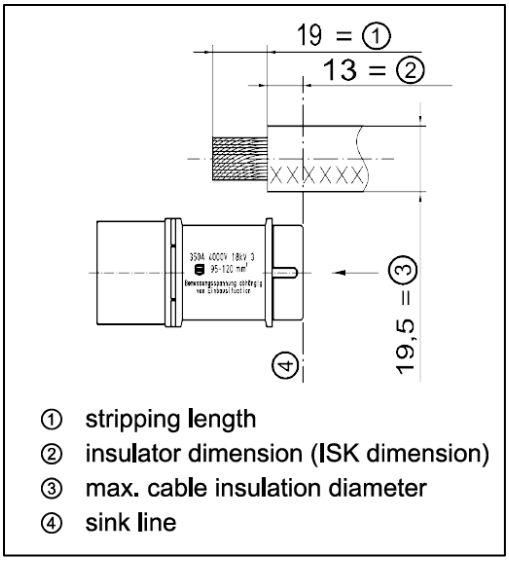


Figure 3-15, Square Connector Wire Installation

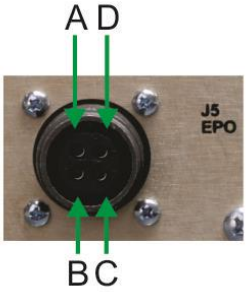
3.5 INTERLOCK I/O

It is extremely important for operator and equipment safety that the external interlocks are appropriately installed (see Chapter 9, connection diagrams Figures 10-1 and 10-2).

3.5.1 High Voltage Power Supply Interlock I/O

J5 – EPO – Emergency Power Off (Amphenol 4-pin M circular) leave jumpered or connect to system EPO.

An open between pins C and D will disable the HV interlock chain and shut down HV output.

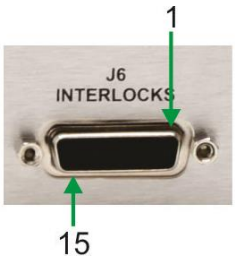


Pin#	Name	Description
A	External Interlock A	External interlock (Internally jumpered to B) Can be used to verify Power Supply is connected.
B	External Interlock B	External Interlock Return (Internally jumpered to A) Returns signal input to Pin A.
C	EPO A	Contact closure to pin D to enable HVPS, open will disable HVPS
D	EPO B	Contact closure to pin C to enable HVPS, open will disable HVPS

Figure 3-16, EPO Connections

3.5.2 SVA Controller Interlock I/O

J6 – INTERLOCKS – External Safety Interlocks (15pin Sub-D M)

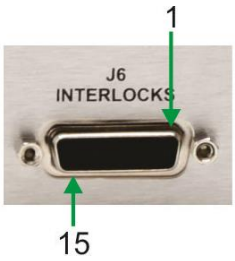


Pin #	Name	Function Description	Power
1	VAC Interlock Return	Return for pin 2	GND
2	VAC Interlock	Contact closure to pin 1	+15VDC
3	TANK Interlock Return	Return for pin 4	GND
4	TANK Interlock	Contact closure to pin 3	+15VDC
5	AUX1 Interlock Return	Return for pin 6	GND
6	AUX1 Interlock	Contact closure to pin 5	+15VDC
7	HVAC Interlock Return	Return for pin 8	GND
8	HVAC Interlock	Contact closure to pin 7	+15VDC
9	H20 Interlock Return	Return for pin 10	GND
10	H20 Interlock	Contact closure to pin 9	+15VDC
11	AUX2 Interlock Return	Return for pin 12	GND
12	AUX2 Interlock	Contact closure to pin 11	+15VDC
13	-	-	-
14	-	-	-
15	-	-	-

Figure 3-17, Interlock Pinouts

3.5.3 SVA Sub-Controller Interlock I/O

J6 – INTERLOCKS – External Safety Interlocks (15pin Sub-D M)



Pin #	Name	Function Description	Power
1	-	-	-
2	-	-	-
3	--	-	-
4	-	-	-
5	-	-	-
6	-	-	-
7	HVAC Interlock Return	Return for pin 8	GND
8	HVAC Interlock	Contact closure to pin 7	+15VDC
9	H20 Interlock Return	Return for pin 10	GND
10	H20 Interlock	Contact closure to pin 9	+15VDC
11	AUX2 Interlock Return	Return for pin 12	GND
12	AUX2 Interlock	Contact closure to pin 11	+15VDC
13	-	-	-
14	-	-	-
15	-	-	-

Figure 3-18, Interlock Pinouts

NOTE: In the case that **interlock inputs need to be paralleled** (e.g. only one safety switch is available for two interlock inputs), it must be made sure that the Contact closure pins (+15VDC) are wired together and the Return pins (GND) are wired together (or only one Return pin used). Failure to do so will compromise correct functioning of the interlocks (always satisfied).

Example: One safety switch to be used for VAC and HVAC interlocks: Connect one side of contact to pins 2 and 8 and the other side to pins 1 and 7 (or to only one of the two).

4 STANDARD OPERATION

This chapter covers the standard operation of the SVA Power Supply. It will familiarize the user with the basic functions and indicators of the HVPS and the SVA Controller and instruct the user in the best operating practices.

4.1 HVPS FUNCTIONS AND INDICATORS

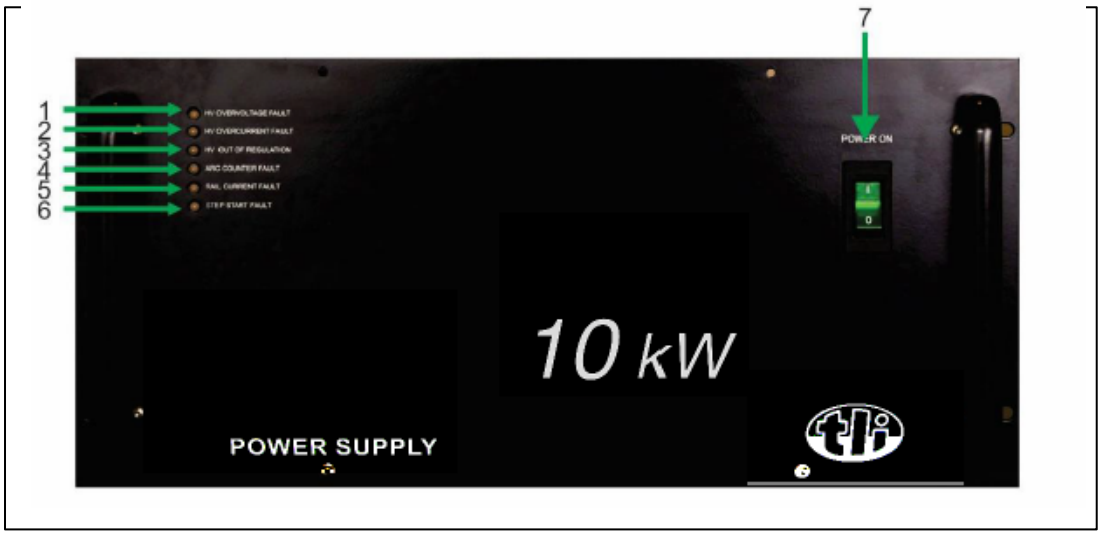


Figure 4-1, HVPS Front Panel Functions

1 – **HV OVERVOLTAGE** fault indicator

2 – **HV OVERCURRENT** fault indicator

3 – **HV OUT OF REGULATION** fault indicator

4 – **ARC COUNTER** fault indicator

5 – **RAIL CURRENT** fault indicator

6 – **STEP START** fault indicator

7 – **ON/OFF ILLUMINATED SWITCH**

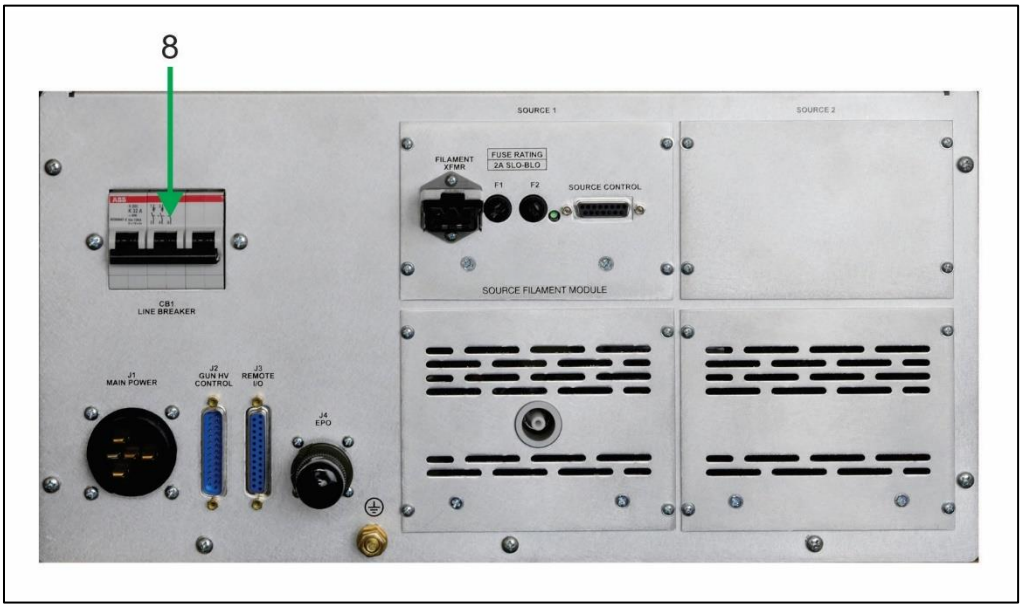


Figure 4-2, HVPS Rear Panel Functions

8 – **MAIN CIRCUIT BREAKER** Turns the unit on and off. Prevents excessive input current.

4.2 SVA CONTROLLER FUNCTIONS AND INDICATORS

The SVA Controller front panel includes a power on indicator is divided into 3 functional areas:

Local High Voltage Control, Control Input Selection, and Local Source Control

Figure 4-3, Controller Front Panel

1. **Controller Power** - Green LED that is lit when the HVPS is turned on and input power is applied.
2. **Local High Voltage Control** - This area provides local controls and displays the High Voltage Output on an LCD Display.
3. **Control Input Selection** – This area lets the user choose which method of input control to use. (Local, Handheld, or Remote Input via PLC or Process controller)
4. **Local Source Control** – This area provides local controls and displays the Source Emission and Source Filament Outputs on an LCD Display.

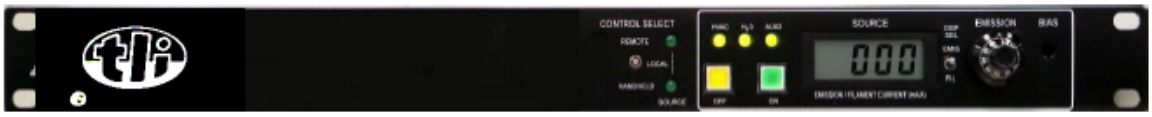


Figure 4-4, Sub-Controller Front Panel

1. **Control Input Selection** – This area lets the user choose which method of input control to use. (Local, Handheld, or Remote Input via PLC or Process controller)
2. **Local Source Control** – This area provides local controls and displays the Source Emission and Source Filament Outputs on an LCD Display.

4.2.1 High Voltage Functions

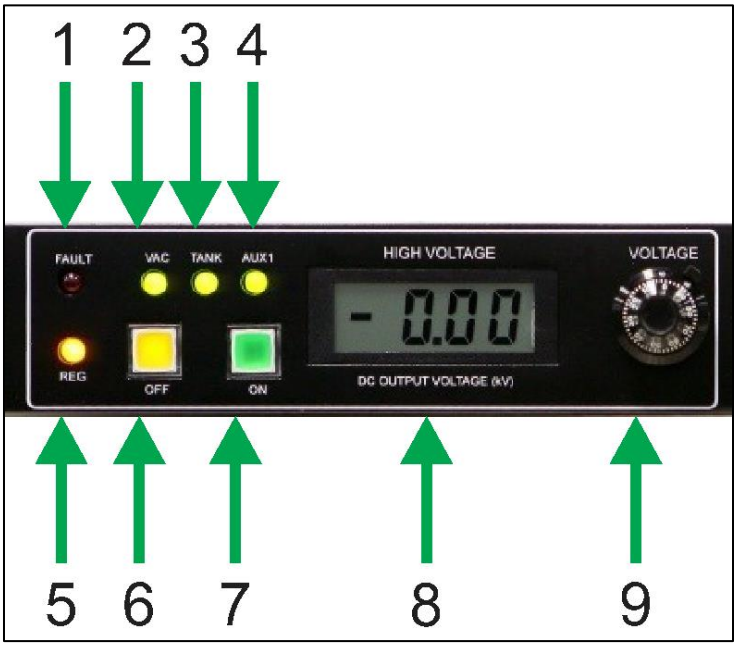


Figure 4-5, High Voltage Control Functions

Ref	Name	Type	Function
1	FAULT Indicator	Red LED	Lit when HVPS Fault is present. (check HVPS front panel indicators)
2	VAC Interlock Indicator	Green LED	Lit when VAC interlock is satisfied.
3	TANK Interlock Indicator	Green LED	Lit when TANK interlock is satisfied.
4	AUX1 Interlock Indicator	Green LED	Lit when AUX1 interlock is satisfied.
5	REG Indicator	Amber LED	Lit when HV current is out of regulation
6	OFF Button	Yellow Pushbutton	Press to turn HV off. Illuminated when HV is off, and all HV interlocks are satisfied.
7	ON Button	Green Pushbutton	Press to turn HV on. Illuminated when HV is on.
8	DC Output Voltage Display	3.5-digit LCD Display	High Voltage Output Display (in -kV)
9	VOLTAGE Dial	10-turn Potentiometer	Sets HV output setpoint in Local Mode. (And in Remote Mode, if selected. See Chapter 5)

4.2.2 Control Select Functions

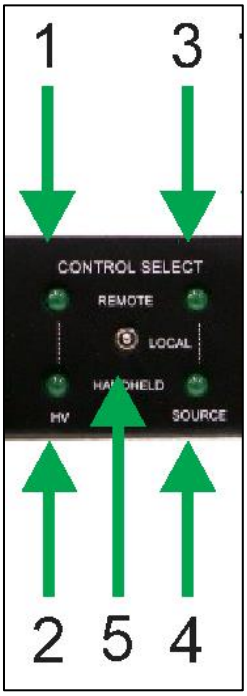


Figure 4-6, Control Select Functions

Ref	Name	Type	Function
1	Control Indicator – HV Remote	Green LED	Lit when HV is being controlled via Remote.
2	Control Indicator – HV Handheld	Green LED	Lit when HV is being controlled via Handheld.
3	Control Indicator – Source Remote	Green LED	Lit when Source is being controlled via Remote.
4	Control Indicator – Source Handheld	Green LED	Lit when Source is being controlled via Handheld.
5	Control Switch	3-Position switch	Selects input control for both HV and Source operation. May select Local (SVA Controller front panel), Handheld (optional Pendant), or Remote (PLC or Process controller)

4.2.3 Source Functions

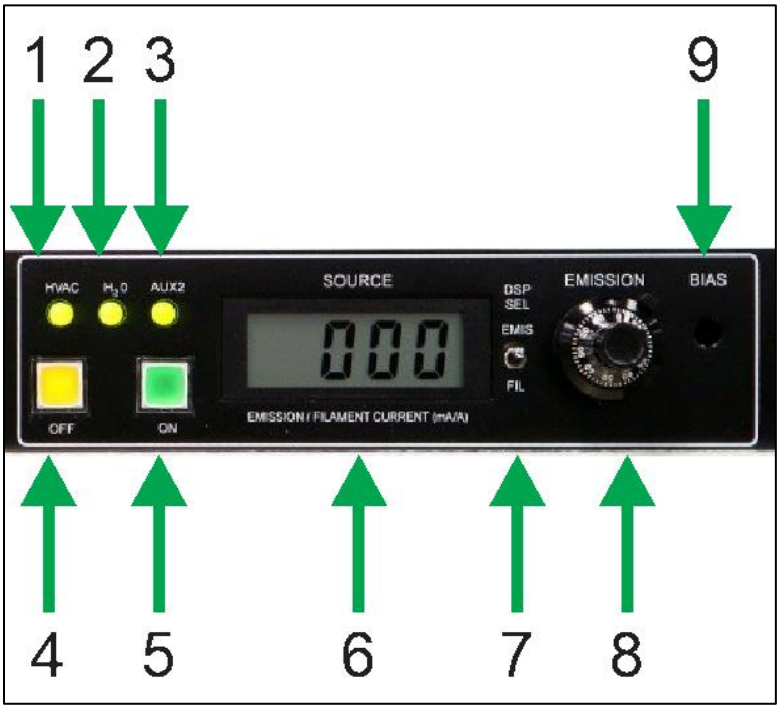


Figure 4-7, Source Control Functions

Ref	Name	Type	Function
1	HVAC Interlock Indicator	Green LED	Lit when HVAC interlock is satisfied.
2	H20 Interlock Indicator	Green LED	Lit when H20 interlock is satisfied.
3	AUX2 Interlock Indicator	Green LED	Lit when AUX2 interlock is satisfied.
4	OFF Button	Yellow Pushbutton	Press to turn Source off. Illuminated when Source is off, and all Source interlocks are satisfied.
5	ON Button	Green Pushbutton	Press to turn Source on. Illuminated when Source is on.
6	Emission/Filament Current Display	3.5-digit LCD Display	Emission current (in mA) or Filament current (in Amps) display. (Set by DSP SEL)
7	Display Select (DSP SEL)	2-Position switch	Selects between Emission or Filament current for LCD display.
8	EMISSION Dial	10-turn Potentiometer	Sets Emission output setpoint in Local Mode.
9	BIAS	10-turn Trim-pot	Sets Filament “Pre-heat” bias current.

4.3 OPERATION

Here we will discuss the proper Initial Start-up and Standard Operation procedures for the SVA Power Supply.

4.3.1 Initial Start-Up

When all connections have been made as described in Chapter 3 – INSTALLATION, the power supply is ready for use.

Make sure that the “CONTROL SELECT” toggle switch is in center “LOCAL” position and both “VOLTAGE” and “EMISSION” potentiometers are turned all the way down at 0 (zero).

Ensure both rear panel breakers are turned on, then apply mains power to the HVPS. Turn on the main breaker on the front panel of the HVPS. The fan will come on, which can be heard, the green power LED (PWR) on the controller will light up, the yellow REG LED (Regulation) will light up, and the green interlock LEDs (for the interlocks that are satisfied) will be lit. The two LCD meters will also turn on.

Let fan come up to speed (~10-15 seconds).

Once all interlocks are satisfied, both amber (yellow) OFF push buttons for HV and Source will be lit which indicates the power supply is in the “Stand By” or "Ready" state.

NOTE: If the HV OFF button is still not illuminated, double check that the SVA HVPS external EPO (J5 on rear panel) is satisfied or has the provided jumper plug installed.

When HV is ready (amber/yellow OFF push button illuminated), HV can be turned on by pressing the green ON push button. After a short delay of less than one second the green push button will be illuminated, indicating that HV is on.

The “REG” LED will turn off.

NOTE: If the “REG” LED is still illuminated, stop the start-up procedure. Power off the HVPS and doublecheck all connections to the Vacuum Chamber.

Slowly dial up the “VOLTAGE” potentiometer, watching the DC Output Voltage LCD meter. Keep increasing HV up to the source’s operational voltage, paying attention to

any arcing that may occur in the vacuum chamber (this can be seen by instability of the HV meter reading or flashing of the “REG” LED).

When HV is stable at source operational voltage, leave potentiometer in this position, this HV level is appropriate for most e-beam applications. Should a lower HV level be desired (e.g. for dielectric materials), turn down potentiometer to reduce HV to that level.

Turn off HV.

Set the “DSP SEL” (Display Select) toggle switch next to the Source LCD meter to “FIL” (Filament).

Turn on the Source by pressing the green ON push button, this will light up, indicating that power is supplied to the filament. After a several seconds the Source meter will read a stable bias (preheat) filament current of around 18A. (The meter reads Amps in the Filament mode)

Wait for about 15 to 30 seconds (to allow for filament preheating).

NOTE: A good range for setting the bias for e-Gun sources is between 17 to 21A, settings for other sources need to be determined by trial and error (yellow glow of the filament, but still a few amps below emission point) but should be very similar.

Turn on HV.

Flip “DSP SEL” toggle switch to “EMIS” (Emission), slowly turn up the “EMISSION” potentiometer, watching the Source meter (reads mA in the Emission mode), until a beam spot is visible in the crucible pocket. Check for correct position of the beam in the pocket, then bring up emission further to heat the material to evaporation point.

Turn down the “EMISSION” potentiometer to zero, then turn off the Source and HV.

This completes the initial test of the power supply.

Turn off the front panel main breaker of the HVPS.

The power supply is now ready for use.

4.3.2 Standard Operation

When operating the power supply, it is considered good practice to ***first*** turn on the source filament (Source ON) and allow it to heat up to preheat level (bias) for at least 15 to 30 seconds, and ***only then*** to turn on High Voltage (HV ON).

This procedure will extend the filament lifetime, allow for more precise control in the low emission current range, and prevent initial rate spikes from emission current overshoot on evaporation materials requiring very low power levels. (Such as subliming materials.)

NOTE: It is acceptable, and safe, to turn on and off HV with the potentiometer set at the desired HV operating level. The potentiometer has a physical locking mechanism that may be set to prevent accidental adjustment to the desired setpoint.

After turning on HV, slowly turn up the “EMISSION” potentiometer to the desired Emission setpoint for the process application. Once the process is complete, turn down the “EMISSION” potentiometer to zero, then turn off the Source and HV. Give the SVA Power Supply a few minutes to exhaust excess heat, then turn off the front panel main breaker of the HVPS.

4.3.3 Handheld Operation

An optional Handheld Controller is available for convenient operation of the power supply while standing in front of the vacuum system.

To operate the power supply from the Handheld, the “CONTROL SELECT” toggle switch needs to be switched to the “HANDHELD” position.

Apply the same procedures for (Chapter 4.3.2 Standard Operation), except that the ON/OFF toggle switches and potentiometers on the Handheld will be used instead of the functions on the SVA Controller.

5 REMOTE OPERATION

Remote Operation (from Process Controller or PLC)

Switching the Control Select toggle to the Remote position hands over all controls and voltage setpoints for HV and Emission to connector J4 (Remote I/O) on the rear panel of the SVA Controller.

In this mode, HV and Emission can be turned on and off remotely from a Process Controller or PLC. The HV output of the power supply may be set by the remote I/O or locally from the SVA Controller front panel (bypassing the Remote command). The Emission output is set via a Process or a Deposition Controller.

The digital control signals can either be "active", i.e. an external (isolated) voltage source or "passive", that is via dry contacts by using the internal +24VDC at pin 1 as a voltage source.

If the Process Controller is not only to remotely control emission current but also set the HV level, then a jumper needs to be installed on pins 7 & 8, otherwise HV level setting will always be from the front panel potentiometer.

The green LEDs left and right of the Control select switch indicate which of the settings are remotely controlled (illuminated = active).

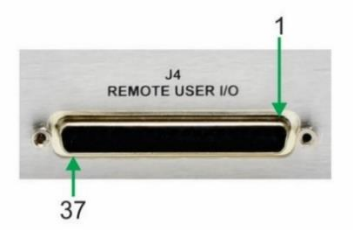
For an operation from a Deposition Controller (Rate Controller) where no digital ON/OFF signals are available, the ON/OFF push buttons on the front panel can be enabled in the Remote mode by installing a jumper on J4 pins 12 & 13.

NOTE: For safety reasons the OFF pushbuttons, both HV and Source, are always enabled regardless of the Control mode selection.

J4 also provides several status and analog signal feedbacks to the Process Controller for complete process control. See Chapter 10: Figure 9-5, J4 Remote User I/O Connector and Figure 9-6, J4 Remote User I/O Connector for more details.

5.1 REMOTE USER I/O PINOUTS

J4 – REMOTE USER I/O (Sub-D 37pin), *see also Figures 9-3 and 9-4*



Top Row Pins

Pin#	Name	In, Out, Power	Signal Range	Function Description
1	User +24VDC	Power	+24VDC	Source for user +24VDC control (200mA max output)
2	HV Ready/OFF Indicator	Output (O.C.)*	0 to +VCC	Low = HV ready/off High = HV not ready
3	Out-of-Regulation Indicator	Output (O.C.)*	0 to +VCC	Low = HV out of regulation High = HV regulating
4	Sum Fault Indicator	Output (O.C.)*	0 to +VCC	Low = HVPS Fault High = no HVPS Fault
5	HV ON Indicator	Output (O.C.)*	0 to +VCC	Low = HV is on High = HV is off
6	Source ON Indicator	Output (O.C.)*	0 to +VCC	Low = Source is on High = Source is off
7	Voltage Reference Select	Input	Jumper only, do not apply voltage	Open = always front panel pot GND = kV reference selected by Control Select switch
8	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34
9	HV ON Control	Input	0 to +24VDC	+5 to +24VDC = HV ON 0VDC = HV OFF
10	Source ON Control	Input	0 to +24VDC	+5 to +24VDC = Source ON 0VDC = Source OFF
11	Not Connected	N/A	N/A	Unused
12	F.P. ON in Remote	Input	Jumper only, do not apply voltage	Open = ON signals from PLC GND = F.P. ON switches are active in remote mode
13	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34
14	Remote Voltage Reference	Input	0 to +10VDC	0 to +10VDC = 0 to 10kV 0 to +8VDC = 0 to 8kV
15	Remote Emission Current Reference	Input	0 to +10VDC	0 to +10VDC = 0 to max. current (500 / 600 / 800 / 1000mA) (SVA-4)
16	Isolated GND (GND_ISO)	Power		Reference for pins 2 thru 6, 9, 10, 24, 31 (isolated from GND)
17	Isolated GND (GND_ISO)	Power		Reference for pins 2 thru 6, 9, 10, 24, 31 (isolated from GND)
18	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34
19	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34

Figure 5-1, Controller Remote I/O Pinout, Top Row

Bottom Row Pins

Pin #	Name	Input/ Output/ Power	Signal Range	Function Description
20	Not Connected	N/A	N/A	Unused
21	Not Connected	N/A	N/A	Unused
22	Not Connected	N/A	N/A	Unused
23	Not Connected	N/A	N/A	Unused
24	All Interlocks OK Indicator	Output (O.C.) *	0 to +VCC	Low = All Interlocks satisfied High = Not all Interlocks satisfied
25	Not Connected	N/A	N/A	Unused
26	Source Ready/OFF Indicator	Output (O.C.)*	0 to +VCC	Low = Source is ready/off High = Source is not off
27	Not Connected	N/A	N/A	Unused
28	Not Connected	N/A	N/A	Unused
29	User +10VDC (Emission)	Power	+10VDC	Source (if used) for remote Emission reference input (2mA maximum output)
30	User +10VDC (kV)	Power	+10VDC	Source (if used) for remote kV reference input (2mA maximum output)
31	+VCC	Input	+5 to +24VDC	External user isolated control power (for output clamping)
32	Voltage Monitor	Output	0 to +10VDC	0 to +10VDC = 0 to -10kV 0 to +8VDC = 0 to -8kV (ST-4)
33	Emission Current Monitor	Output	0 to +10VDC	0 to +5 / 6 / 8 / 10VDC = 0 to 500 / 600 / 800mA / 1000mA
34	Filament Current Monitor	Output	0 to +10VDC	0 to +5VDC = 0 to 50A
35	Isolated GND (GND_ISO)	Power		Reference for pins 2 thru 6, 9, 10, 24, 31 (isolated from GND)
36	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34
37	Digital GND (GND)	Power		Reference for pins 1, 7, 12, 14, 15, 30, 32, 33, 34

Figure 5-2, Controller Remote I/O Pinout, Bottom Row

Pin#	Name	Input/ Output/ Power	Signal Range	Function Description
1	User +24VDC	Power	+24VDC	Source for user +24VDC control (200mA max output)
6	Source ON Indicator	Output (O.C.)*	0 to +Vcc	Low = Source is on High = Source is off
8	Digital GND (GND)	Power		Reference for pins 1, 12, 15, 33, 34
10	Source ON Control	Input	0 to +24VDC	+5VDC to +24VDC = Source ON 0VDC = Source OFF
12	F.P. ON in Remote	Input	Jumper only, do not apply voltage	Open = ON signals from PLC GND = F.P. ON switches are active in remote mode
13	Digital GND (GND)	Power		See pin 8
15	Remote Emission Current Reference	Input	0 to +10VDC	0 to +10VDC = 0 to 100% current
16	Isolated GND (GND_ISO)	Power		Reference for pins 6, 10, 24, 31 (isolated from GND)
17	Isolated GND	Power		See pin 16
18	Digital GND (GND)	Power		See pin 8
19	Digital GND (GND)	Power		See pin 8
24	All Interlocks OK Indicator	Output (O.C.)*	0 to +Vcc	Low = All Interlocks satisfied High = Not all Interlocks satisfied
26	Source Ready/OFF Indicator	Output (O.C.)*	0 to +Vcc	Low = Source is ready/off High = Source is not off
29	User +10VDC (Emission)	Power	+10VDC	Source (if used) for remote Emission reference input (2mA maximum output)
31	+Vcc	Input	+5 to +24VDC	External user isolated digital control power (clamping)
33	Emission Current Monitor	Output	0 to +10VDC	0 to +10VDC = 0 to 100% current
34	Filament Current Monitor	Output	0 to +10VDC	0 to +5VDC = 0 to 50A
35	Isolated GND	Power		See pin 16
36	Digital GND (GND)	Power		See pin 8
37	Digital GND (GND)	Power		See pin 8

Figure 5-3, Sub-Controller Remote I/O Pinout

*** O.C. :** Denotes Open Collector

Note 1: Open Collector outputs require external pull-up resistors. When connecting “User +24VDC” to pull-up resistors, their resistance value must not be lower than 2kOhm.

Note 2: When using “User +24VDC” as control supply voltage for pins 2-6, 9, 10, 24 and 26, then GND and GND_ISO **must be shorted externally** (for example pins 17 and 36).

Note 3: When using "User +24VDC" for inductive loads (e.g. relays) on pins 2-6, 24 and 26, then "User +24VDC" **must be connected** to "+VCC" (pin 1 to pin 31).

In the case of incorrect connection in accordance with Figure 5-1 there is a danger of damage to the controller. Make sure to check correct pin connection prior to applying power.

6 MAINTENANCE AND STORAGE

6.1 PREVENTIVE MAINTENANCE

Preventive maintenance is to be done with main power turned off and locked out/tagged out, following your company's safety program.

- Check and confirm power supply earth ground is clean and secure at power supply ground terminal and at the facility earth ground point.
- For cleaning the outside of the device, a slightly moistened cloth will usually do. Do not use any aggressive or abrasive cleaning agents.
- Check that the power supply vents are clean of any buildup of dust or dirt. Vacuum out/ blow out main cabinet of power supply to remove this build up.
- Check and confirm all electrical wires, connections and contactors in the main power supply cabinet are clean and showing no sign of overheating or other damage. If there are signs of overheating, contact Thermionics Service and Support. Check all mechanical connections and terminal block connections, to assure they are clean, and connections are tight.
- Confirm the High Voltage connection in the power supply is clean and tight. Clean any oxidation, as needed, and tighten connection.
- Confirm the mechanical connections at the filament source transformer are clean and tight and free of oxidation. This is located, in most cases, under the chamber, near the high voltage feedthroughs. Also confirm connections of the cables to the high voltage feedthroughs are tight and secure.
- Confirm the power supply controller cables are secure and screw terminals are tight. Confirm the earth ground is connected to the provided ground point. Confirm ground point is clean and secure.

Replace all covers which were removed and secure with proper screws.

Confirm all components are safe and remove the lock out / tag out lock, before turning power back on to system.

6.2 STORAGE AND DISPOSAL

6.2.1 Packaging

Please keep the original packaging. The packaging is required for storing the SVA Power Supply and for shipping it to a Thermionics service center if required.

6.2.2 Storage

The SVA Power Supply may only be stored in a dry room. The following requirements must be met:

Ambient temperature: -20….+60 °C

Humidity: As low as possible. Preferably in an air-tight plastic bag with a desiccant.

6.2.3 Disposal

The product must be disposed of in accordance with the relevant local regulations for the environmentally safe disposal of systems and electronic components.

6.2.4 WEEE

The use of the Waste Electrical and Electronic Equipment (WEEE) symbol (see Figure 16-1) indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly you will protect the environment. Recycling information of this product can be obtained at the place of sale, your household waste disposal service provider, or local authority.

Figure 6-1, WEEE Symbol

7 TROUBLESHOOTING

7.1 BASIC TROUBLESHOOTING

Whenever the SVA Power Supply enters a latched fault condition, one of the several fault condition LEDs on the front panel of the HVPS, as well as the red Fault LED on the SVA Controller, will light up.

High Voltage operation will be shut off and the red Fault LED will remain active until the fault is cleared.

The fault condition can normally be cleared by pressing the HV OFF pushbutton on the SVA Controller if the condition for the fault is no longer present. Otherwise, the unit will re-enter the fault condition and the fault LED will remain active.

7.1.1 HV Overvoltage Fault

This is a “Latched Fault” and will shut down HV operation.

An HV Overvoltage Fault will occur when the HVPS detects the HV output voltage has exceeded 5% above the maximum factory calibration setpoint for the Power Supply.

Possible causes for this fault include:

Emitter assembly malfunction inside the vacuum chamber resulting in a heavy arc condition or emitter short.

Component failure inside the HVPS resulting in loss of calibration.

7.1.2 HV Overcurrent Fault

This is a “Latched Fault” and will shut down HV operation.

An HV Overcurrent Fault will occur when the HVPS detects the HV output emission current has exceeded 5% above the maximum factory calibration setpoint for the Power Supply.

Possible causes for this fault include:

Emitter assembly malfunction inside the vacuum chamber resulting in a heavy arc condition or emitter short.

Process material may have found its way between the Emitter assembly and the crucible source, or in between the High Voltage feedthrough and grounded cover.

Component failure inside the HVPS resulting in loss of calibration.

7.1.3 HV Out of Regulation

This is a non-latching “Soft Fault” and will serve to alert the operator to an unsatisfactory condition, yet it will try to maintain operation of HV.

This condition will occur when the HVPS detects that the HV output voltage has exited the specified operating range as set by the SVA Controller and it cannot regulate the output voltage back into that set range. The Power Supply will enter a “Rollback” where it will momentarily cut power to the output for 200uS and then try to re-establish a beam at the specified set output. This will continue repeatedly until the HVPS either re-establishes the beam or determines that to many attempts have passed in a set amount of time and enters an Arc Counter Fault.

Possible causes for this fault include:

Process arcing inside the chamber

Intermittent shorting between HV leads and grounded chamber components due to operation at higher pressures.

Intermittent shorting of HV in crushed or cut cables (e.g. between conductor and shielding) or other points where HV can arc to Ground.

Failure of internal components required to produce HV.

NOTE: The “REG” LED on the SVA Controller is also tied to this fault and responds to the same conditions but for another reason. The “REG” LED is active when the HVPS detects that the HV output emission current has exited the specified operating range as set by the SVA Controller and it cannot regulate the output emission current back into that set range.

7.1.4 Arc Counter Fault

This is a “Latched Fault” and will shut down HV operation.

An Arc Counter Fault will occur when there are too many continuous arcing events detected within a specified amount of time as set by the factory.

Possible causes for this fault include:

Process arcing inside the chamber.

Intermittent shorting of HV to Ground.

7.1.5 Rail Current Fault

This is a “Latched Fault” and will shut down HV operation.

A Rail Current Fault will occur when the SVA Power Supply detects too much current passing through the DC Rails (and/or the Neutral line in 400V models) and onto the HV power switches.

Possible causes for this fault include:

Input voltage to the SVA Power Supply is too low during power on or has become low during operation.

Emitter shorted to Ground.

Damaged or degraded components on the Inverter PCB regulating the production of HV.

7.1.6 Step Start Fault

This is a “Latched Fault” and will shut down HV operation.

The Step Start Fault will occur when the DC Rail cannot be charged when attempting to turn on High Voltage.

Possible causes for this fault include:

Blown input fuse on the Inverter PCB.

Damaged or degraded DC Rail capacitors.

DC Rails shorted (or shorted to Neutral, 400V models only)

Component failure in the Step Start charging circuit.

7.2 CONTACTING SERVICE

If service or repair is required for your unit, please contact Thermionics Service and Support. We can be reached via the following:

Phone: +1 (510) 225-6975 EXT. 100

Please provide the serial number when contacting Thermionics. Please request an RMA number before sending anything back to Thermionics .

Email: sales@thermionics.com

8 WARRANTY CONDITIONS

8.1 LIMITED WARRANTY

The Thermionics SVA Electron Beam Power Supply is guaranteed against faulty materials, function, and workmanship for a period of 12 months after delivery from Thermionics. Components which are purchased by Thermionics from other manufacturers will be guaranteed for any lesser time that such manufacturer warrants its products to Thermionics. This warranty is valid only for normal use where regular maintenance is performed as instructed. This warranty shall not apply if repair has been performed or an alteration made by anyone other than an authorized Thermionics representative or if a malfunction occurs through abuse, misuse, negligence, or accident. No charge will be made for repairs made under warranty at Thermionics' facilities. Freight costs both ways will be at customer’s expense. Thermionics reserves the right for final warranty adjustment.

9 ADDENDUM

- Figure 9-1 Connections SVA-4/6/8/10/12, Round Connector,
- Figure 9-2 208VAC Connections SVA-4/6/8/10/12, Round
- Figure 9-3 Connector, 400VAC Connections SVA-4/6/8/10/12,
- Figure 9-4 Square Connector, 208VAC Connections
- Figure 9-5 SVA-4/6/8/10/12, Square Connector, 400VAC J4
- Figure 9-6 Remote User I/O Connector

  J4 Typical Remote User I/O Connections

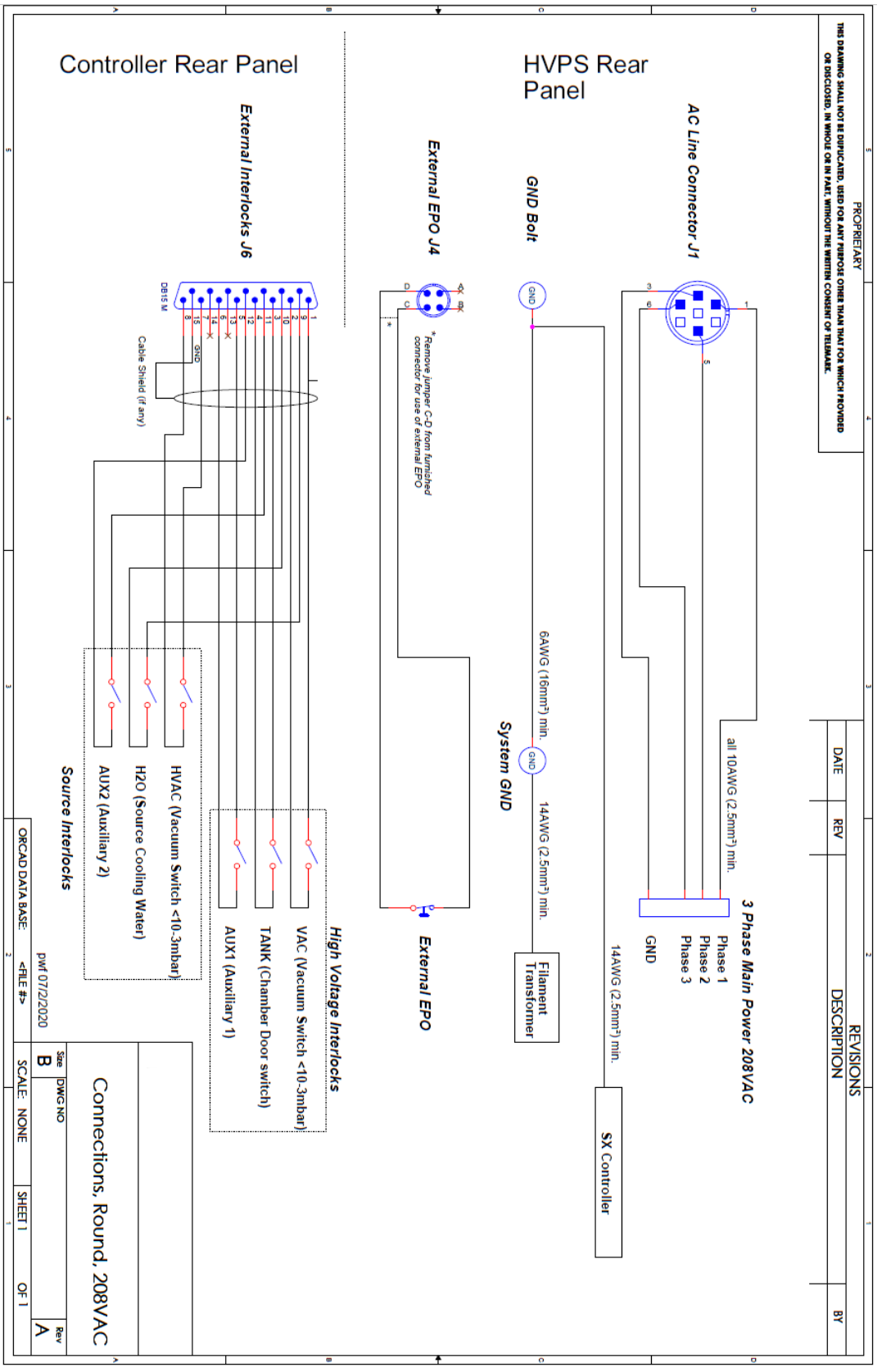


Figure 9-1, Connections SVA series 208VAC Round Version

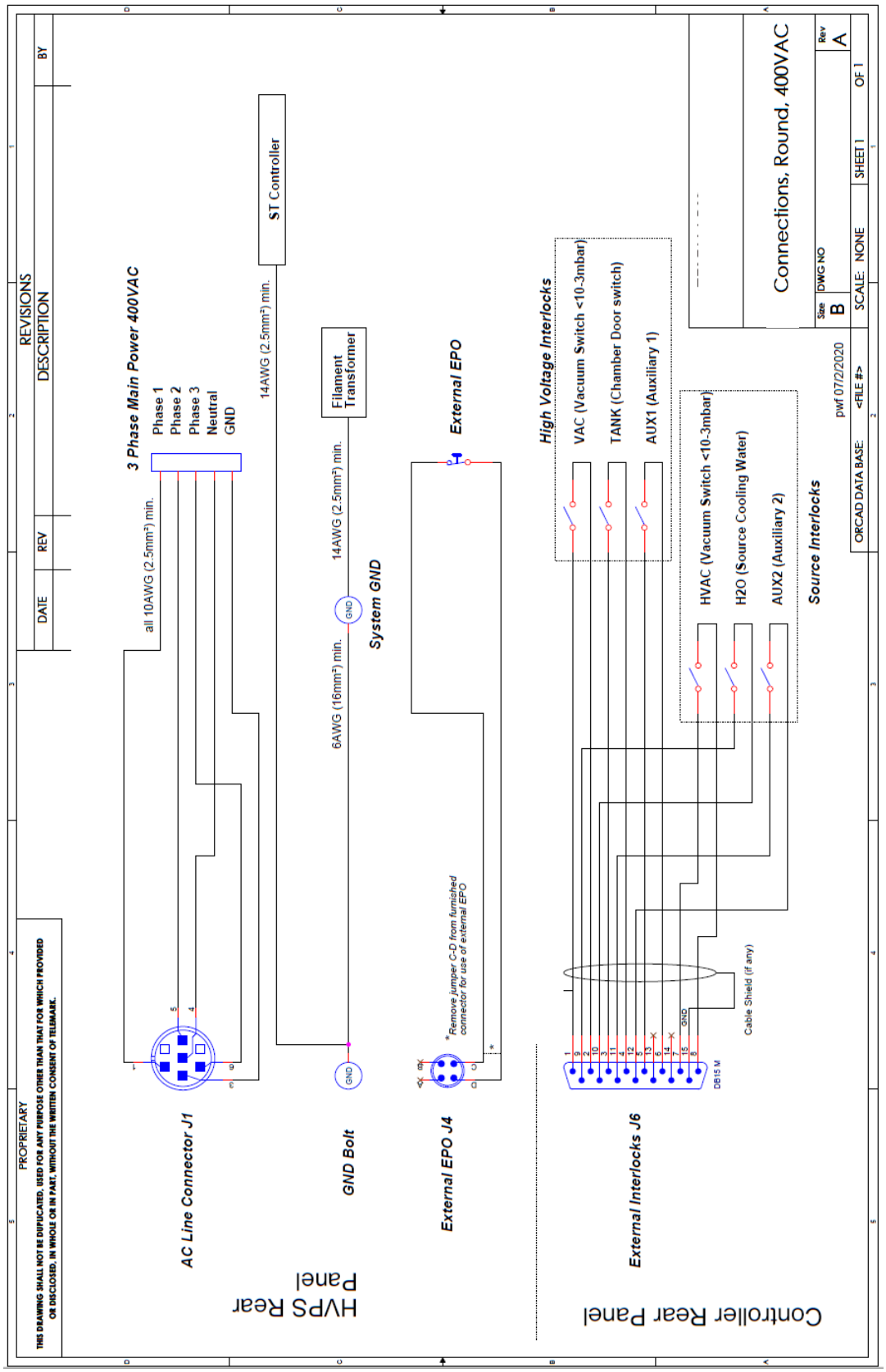


Figure 9-2, Connections SVA series 400VAC Round Version

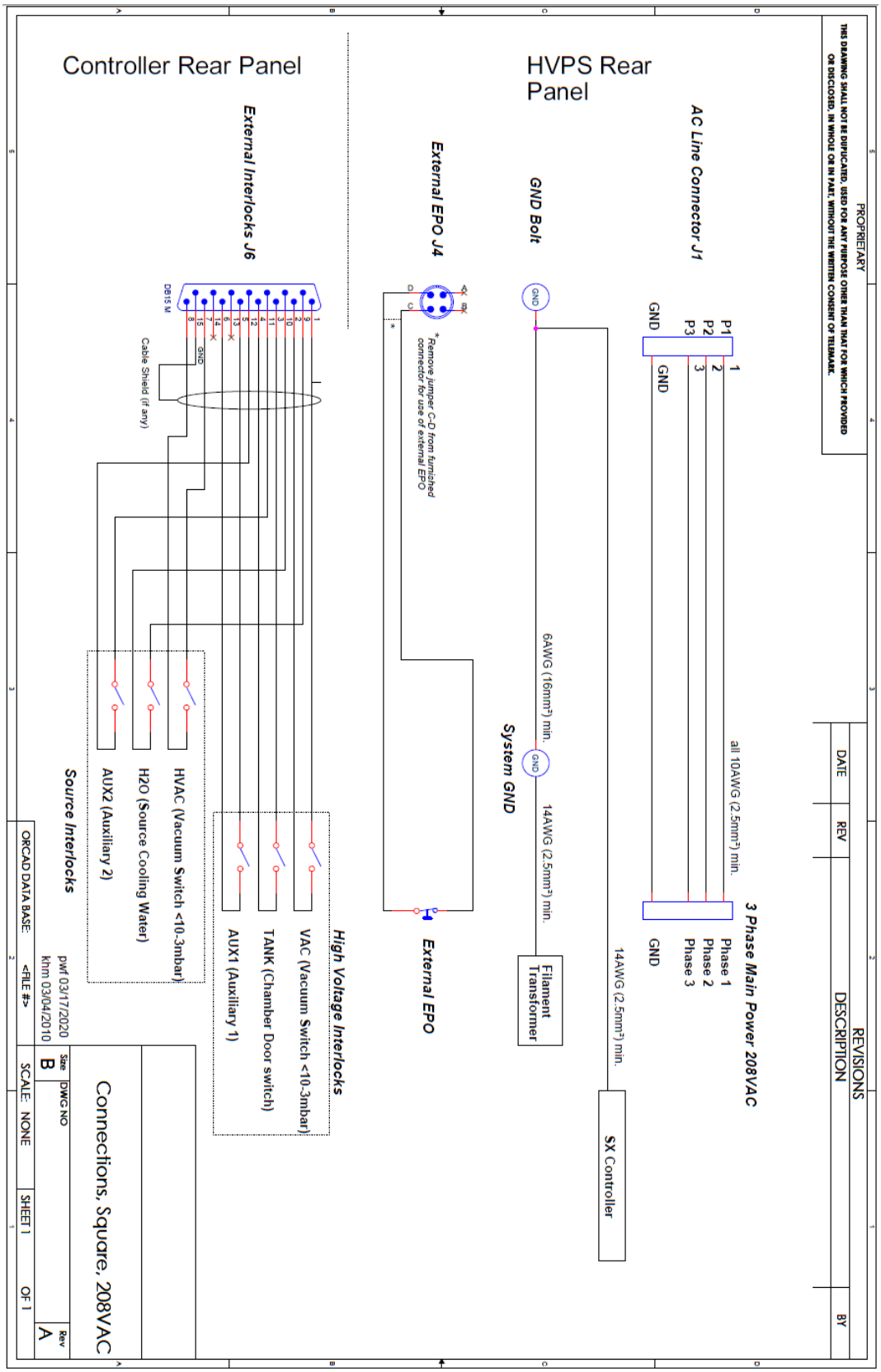


Figure 9-3, , Connections SVA series 208VAC Square Version

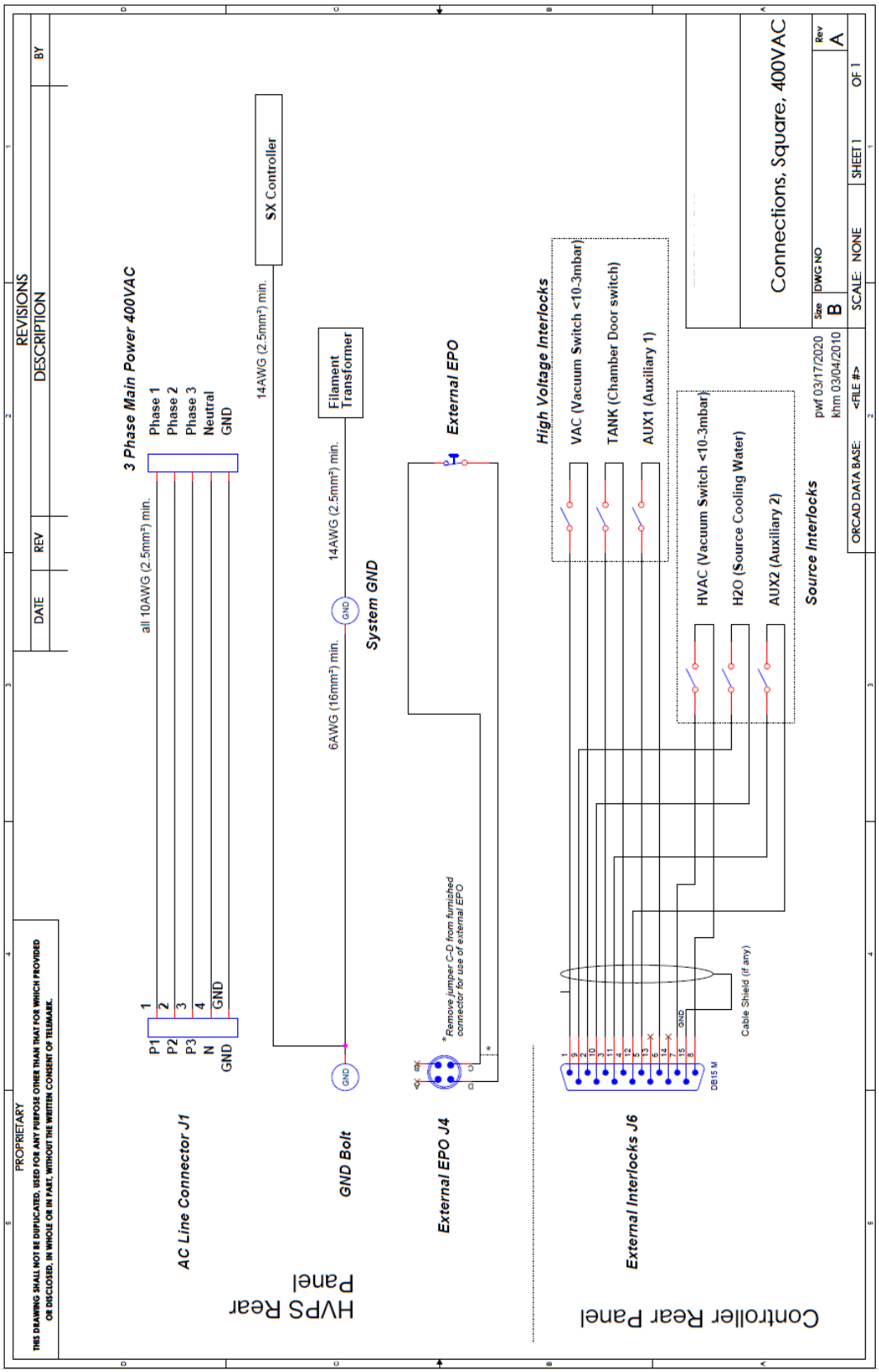


Figure 9-4, Connections SVA series 400VAC Square Version

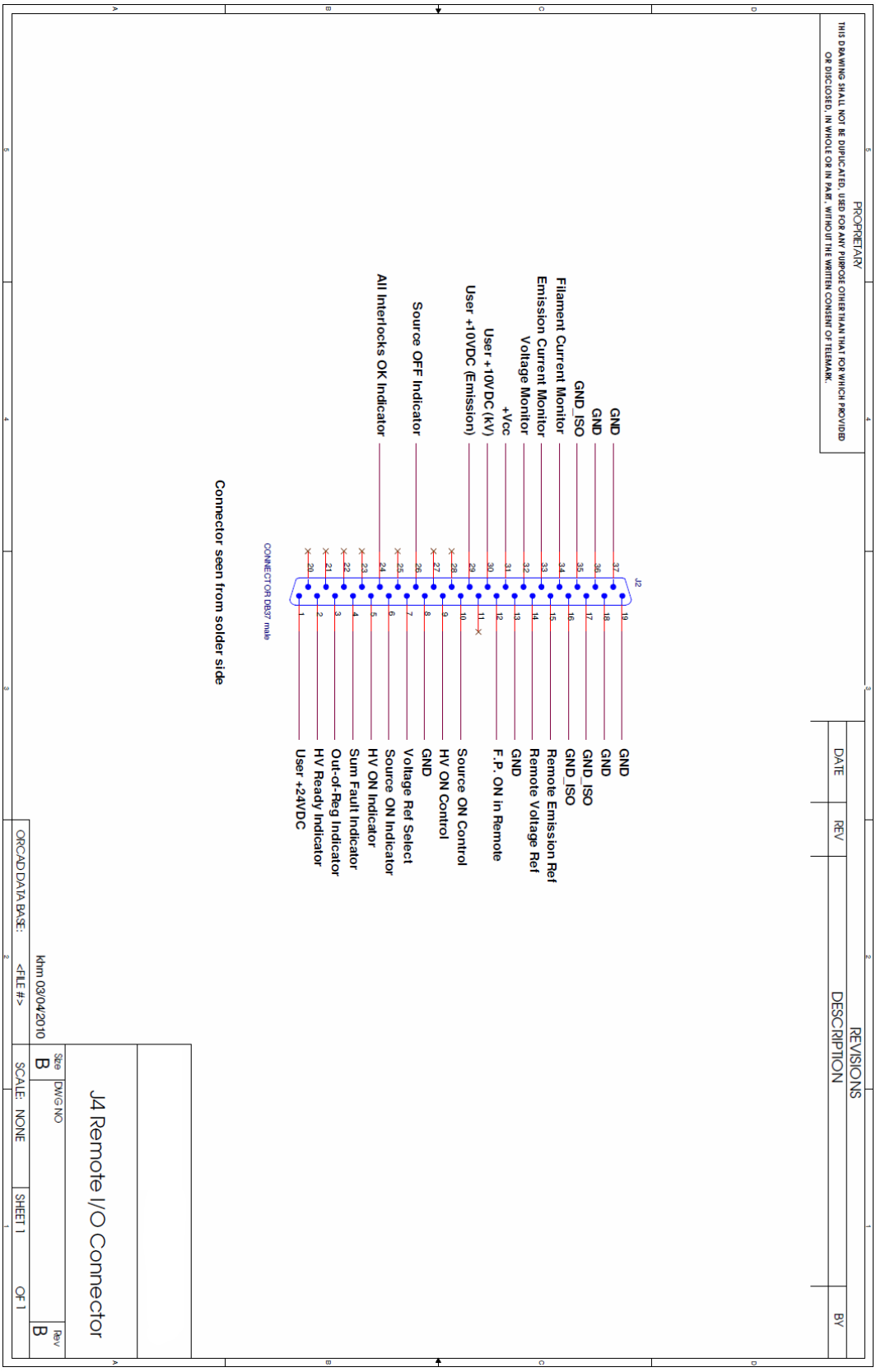


Figure 9-5, J4 Remote User I/O Connector

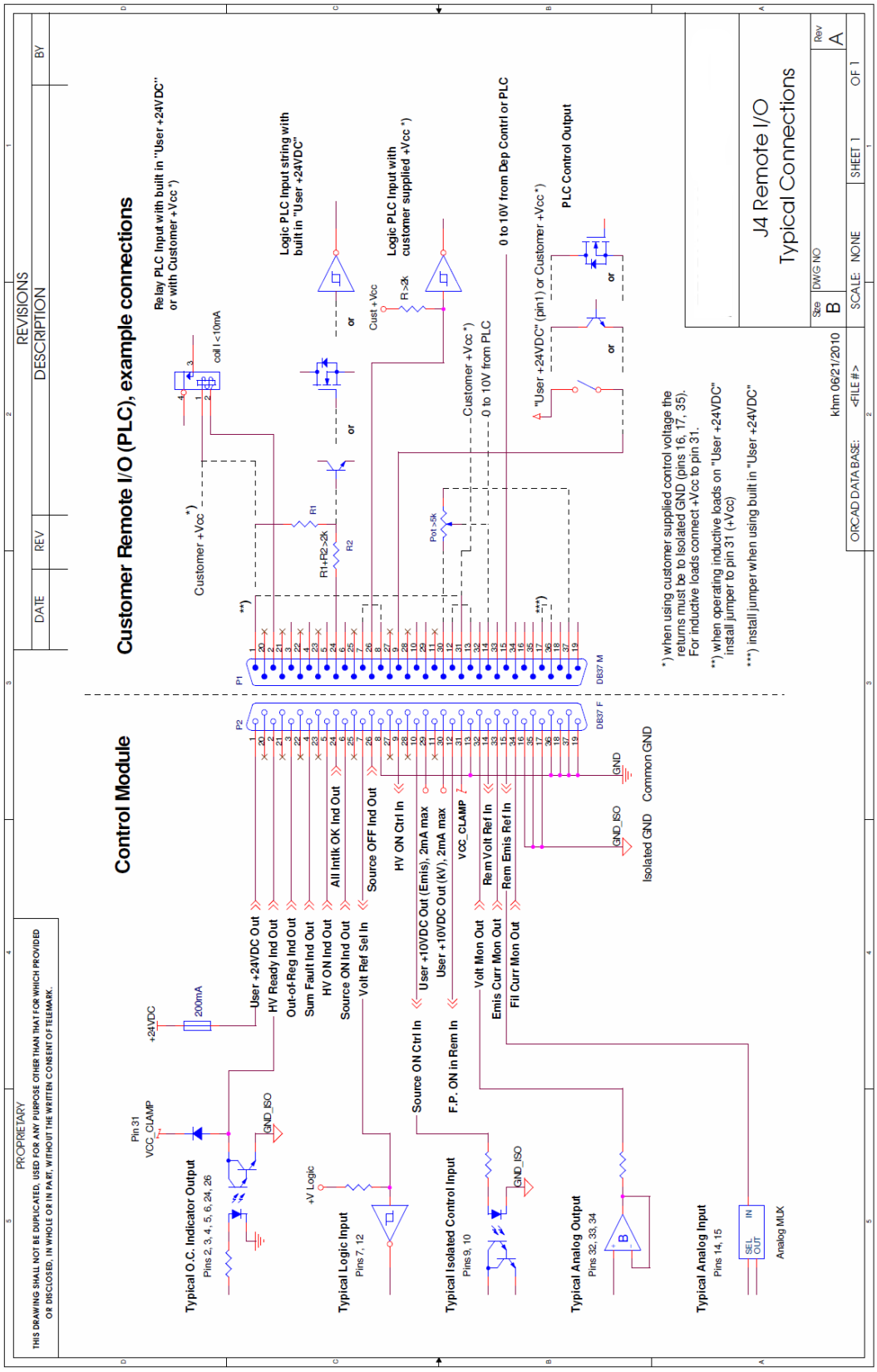


Figure 9-6, J4 Remote User I/O Connector