Model SVTA-DF-4.5"
Dual Filament Effusion Cell Manual

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Table of Contents

SVT Associates, Inc.

Introduction

SVT Associates, Inc. Dual Filament Effusion Cells are designed for operation in an UHV environment. They are available for mounting in a standard 4.50" conflat (CF) flange. It is available with 16, 40, 50, 60 and 80 cc crucibles. This effusion cell has a maximum system diameter of 2.30" and a standard length of 12 inches. Custom lengths are also available upon request.

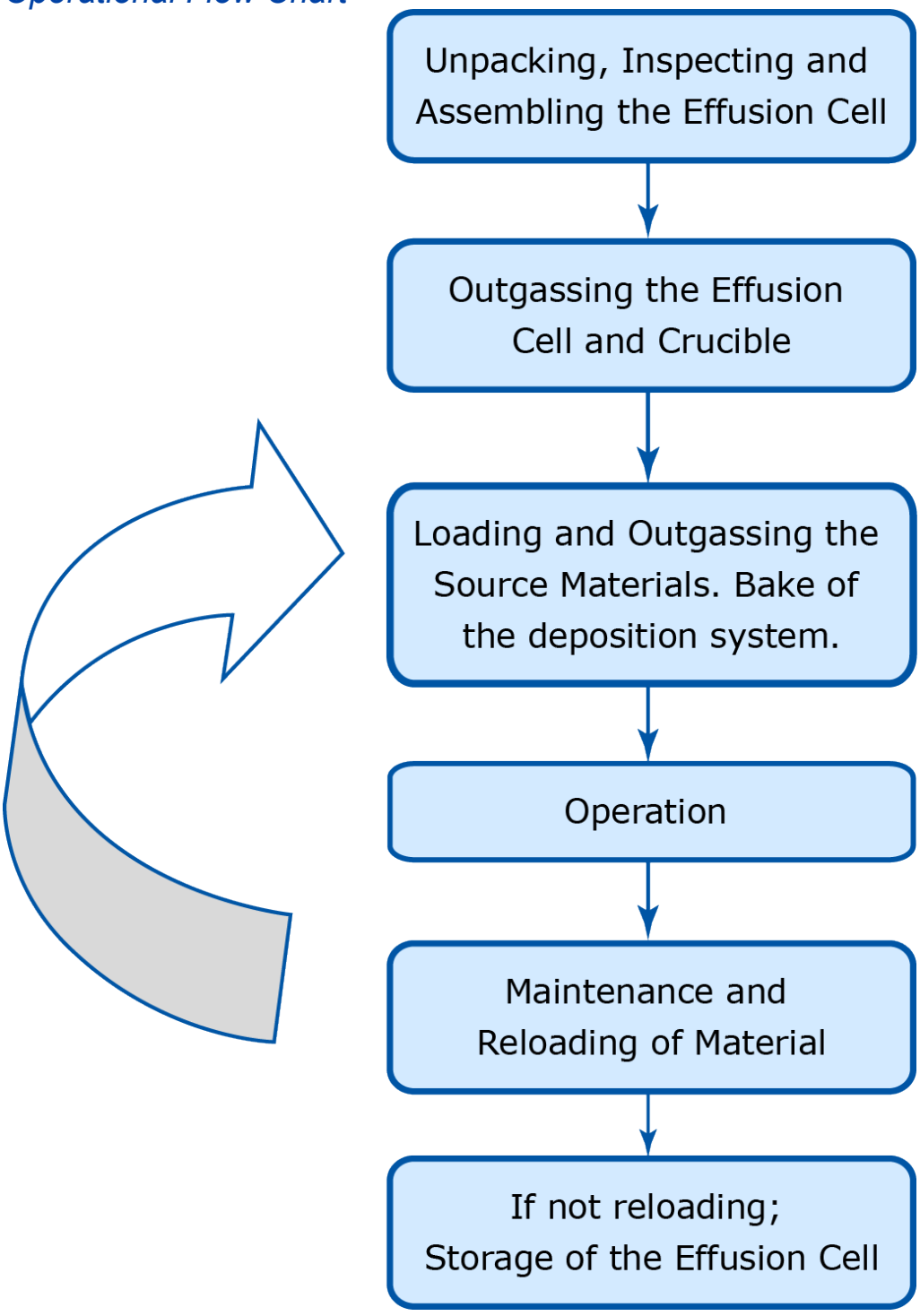
The dual filament effusion cell requires one crucible, one power cable, two temperature controllers and two heater power supplies to be fully operable. The effusion cells and crucibles are outgassed after assembly and all of the components are thoroughly tested and characterized before shipment.

Precaution

- Review the entire manual prior to installation and operation of the effusion cell.
- All SVT Associates' Effusion Cells are engineered for optimum performance and reliability. Any modification of the equipment or operation of the equipment outside the prescribed conditions in this manual will void the warranty and may result in damage of the equipment.
- Before installing and operating your newly delivered effusion cell, inspect the shipping container inside and out and note any visible damage. Notify SVT Associates immediately, if any damage is noticeable. Please send an email to support@svta.com.
- Observe all warning and material handling instructions listed in the MSDS documentation for all materials that are to be used in the effusion cell. Keep in mind that if toxic substances are to be used they may form on the exterior of sources or other in-vacuum equipment.
- SVT Associates should be contacted to make arrangements to have any equipment returned for repair or replacement. ***(Do not discard any packing material as if it is necessary to ship the source back for repair or replacement we request the use of the original packing material).***
- All items included in this equipment package are fragile. Improper handling may damage this product. Handle with care.
- Safety must be used when dealing with electrical equipment. Please refer to the power supply and temperature controller manuals for the correct safety handling procedures. Be certain that all power is turned off before connecting or disconnecting any electrical equipment.

SVT Associates, Inc.

Operational Flow Chart



SVT Associates, Inc.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Unpacking and Assembly

SVT Associates' equipment is packaged with the utmost care in an effort to eliminate damage due to shipping. Inspect all shipping containers and equipment for visual damage. Any damage noticed should be reported to SVT Associates immediately. Also be sure to inspect all contents of the package and compare to the packing list. Report any missing items to SVT Associates.

SVT Associates' Effusion Cells are shipped fully assembled and ready for operation. Only the crucible with cap will need to be installed. The effusion cell is clean and the crucible has been outgassed and tested in a UHV system. It is recommended that you outgas the source and crucible before filling the crucible with material. Refer to *Outgassing the Effusion Cell and Crucible* on page 9.

SVT Associates' Effusion Cells are constructed of high purity materials in a clean room environment. When handling the effusion cell, wear cleanroom gloves and appropriate cleanroom gowning to prevent contaminants from coming into contact with the effusion cell and crucible.

Carefully remove the effusion cell from its shipping container. Remove the bolts holding the stainless steel shipping tube in place. Carefully slide the source out of the shipping tube and place it in an appropriate holder. SVT Associates recommends using a vertical stand. Do not place the cell on its side or use the furnace to mechanically support the source. Visually inspect the effusion cell for any possible loose setscrews that hold the barrel connectors and support rods in place that may have loosened during shipping. See Figure 1 for the connections. Save the stainless steel shipping container and all packaging materials in case the effusion cell has to be returned or is stored outside the vacuum system for any reason. Remove the crucible from its box and inspect it for any possible shipping damage. Use a light source to inspect the crucible for any cracks or chips. If there are any defects in the crucible, please contact SVT Associates.

Figure 1

SVT Associates, Inc.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Continuity Test

Once the source has been unpacked, perform a continuity test to verify that the filaments and thermocouple have not been damaged during shipping. See Figure 2.

Using an ohmmeter, measure the following resistances:

- Measure the resistance across each filament and across each thermocouple.
- Compare these readings to the original values listed on the Component Data Sheet provided with the source.
- Measure the resistance to ground (the side of the flange as well as the outer heat shield of the source) for each filament and thermocouple lead. Compare the readings to the original values listed on the Component Data Sheet provided with the source. Both the filament and the thermocouple should be read as an open circuit to ground.
- Note: MΩ resistance is acceptable for all open circuits.
- Check the continuity between the filament and the thermocouple to confirm they are not touching. This should read as an open circuit.

If any of these checks indicate a problem, contact SVT Associates technical support at support@svta.com.

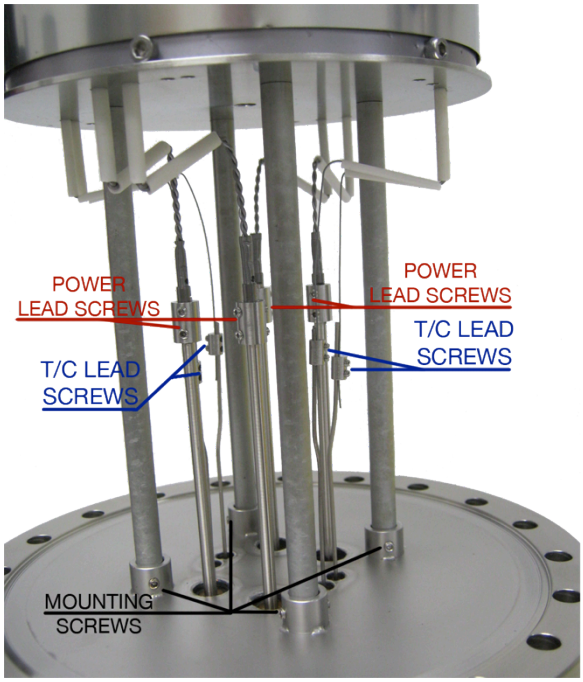


Figure 2

SVT Associates, Inc.

The Effusion Cell

The dual filament 4.5" CF effusion cell is shown schematically in Figure 4. To install the crucible, carefully slide the crucible into the opening of the effusion cell until the lip of the crucible is resting against the top of the furnace. Note that the crucible is made of ceramic and is fragile. It must be handled with the highest level of care.

If a crucible retaining cap was supplied, the cap should be placed over the crucible and slid between the heat shields as shown in Figure 3. This will secure the crucible to the heater assembly. Add the enclosed copper CF flange gasket to the effusion cell and the assembly process is complete. SVT Associates recommends that only copper or gold-coated copper gaskets be used to ensure long term integrity of the knife edge. The effusion cell is now ready for installation into the vacuum system.

Note: See Crucible Insert Assembly instructions in the Common Materials Section of this manual if your crucible needs an insert.

Figure 3

Effusion Cell Diagram

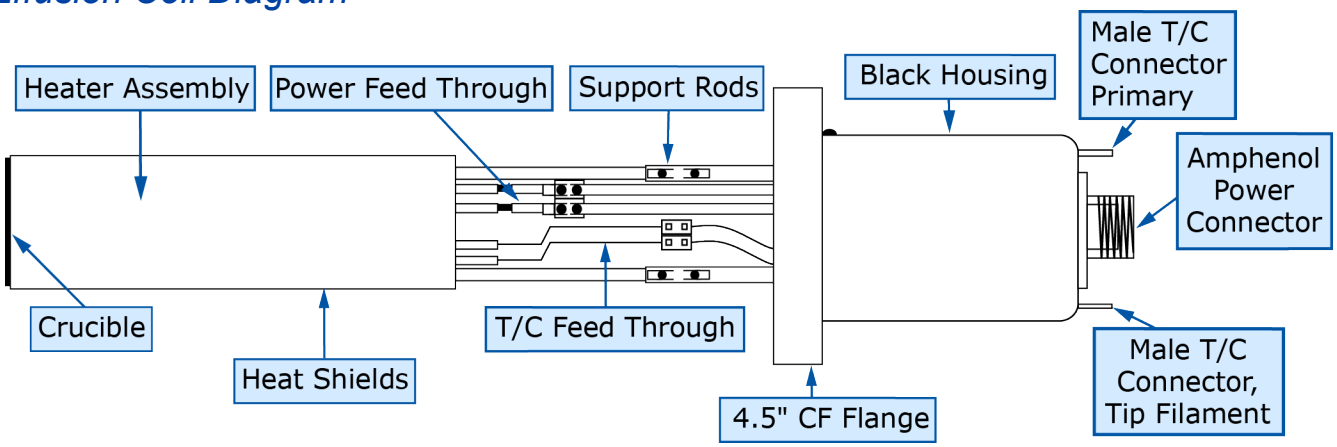


Figure 4

SVT Associates, Inc.

Installing The Effusion Cell Into The Chamber

The dual filament effusion cell mounts on a standard 4.5" conflat (CF) flange. Before adding any materials to the crucible, we recommend you outgas the effusion cell and crucible to remove any impurities absorbed during shipping. See *Outgassing the Effusion Cell and Crucible* on page 9. If outgassing of the effusion cell and crucible is not going to be performed, then the crucible should be installed and the desired material should be added before installing the effusion cell into the vacuum chamber. Carefully insert the effusion cell into the corresponding vacuum system flange using the copper gasket provided and bolt into place. Be sure the gasket stays in the placement groves of the flange as the cell is moved into position. No further alignment of the effusion cell is required. Install the mounting bolts finger tight first, then tighten the bolts evenly and sequentially around the flange.

The Power Cable

The power cable has a metal Amphenol circular connector and two Omega sub-miniature thermocouple connectors on one end of the cable attach this end to the effusion cell. See Figure 5. The connecters are keyed and can only be installed one way. The opposite end of the cable has four terminals that are to be connected to the heater power supplies and two more Omega sub-miniature connectors to attach to the temperature controllers. Refer to pages 12-14 and Figure 7 for these connections.

CAUTION: The thermocouple feedthrough on the effusion cell is extremely delicate and can easily break if twisted or bent. (See the power supply and temperature controller manuals for proper attachment). The cable has been assembled and tested in operation before shipment.

Connecting The Power Cable

Be sure no power is being applied to the cable. Identify the end of the cable with the Amphenol circular connector and attach this connector to the effusion cell. Locate the slotted key (see Figure 5) on the effusion cell and align it with the key slot of the cable connector. (See Figure 6) Firmly push the connector onto the receptacle of the effusion cell and tighten the threaded coupler until it is hand tight. Next, attach the thermocouple type C (or K) connector to the effusion cell. Note that there is a larger and smaller pin. The larger pin is the negative terminal and will connect to the corresponding slot of the omega connector. When connecting the thermocouple connector, DO NOT bend or force the connector onto the pins. This connector can only go on one way.

Connect the power cable terminal ends to the power supply, and then connect the male end of the omega connectors to the temperature controllers. The polarity of the power cable is irrelevant and can be connected interchangeably. However, pay attention to the terminal ends for each filament zone! If utilizing SVT Associates' Effusion Cell Controller package, refer to pages 12–16 of this manual.

SVT Associates, Inc.

Effusion Cell Power and Thermocouple Connection

Effusion Cell

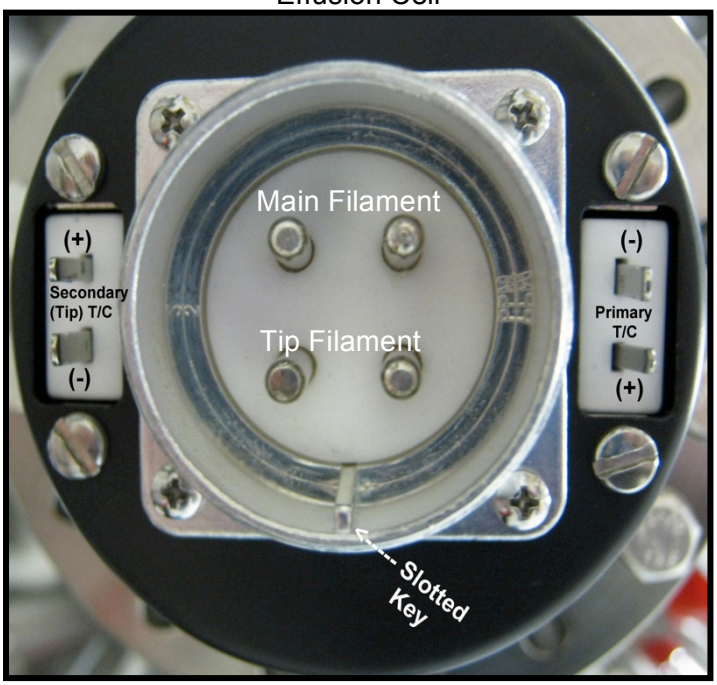


Figure 5

Effusion Cell Power Cable

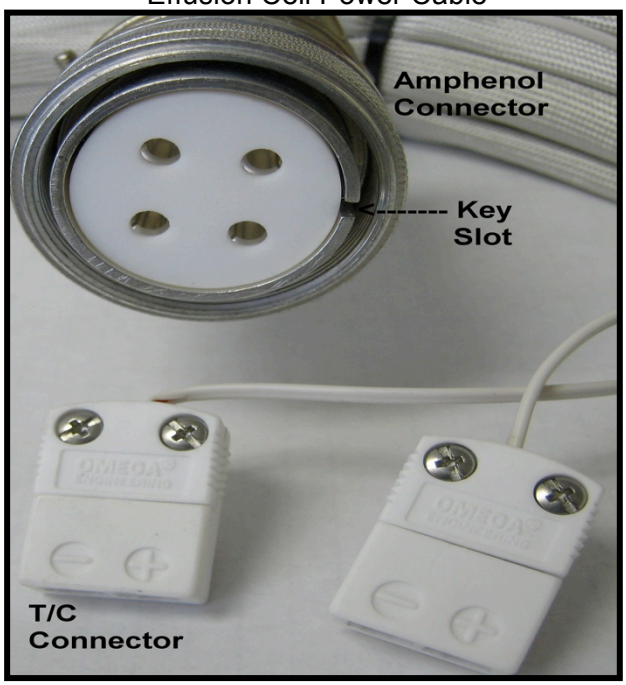


Figure 6

Outgassing the Effusion Cell and Crucible

Even though the effusion cell and crucible have been fully degassed before shipping, it is recommended the process be repeated in the customer's vacuum chamber before placing the effusion cell into service. SVT Associates recommends the following procedure:

1. Wear cleanroom approved gloves and appropriate cleanroom apparel when handling the effusion cell and crucible.
2. Install a new copper (CF) gasket every time the effusion cell is to be installed.
3. Do not install the crucible at this time.
4. Carefully load the effusion cell into the vacuum chamber as described in the *Installation* section on page 8.
5. Tighten the effusion cell to the vacuum chamber port and pump down the vacuum system.
6. Make sure that the power supply is off before connecting the cable. Connect the power cable to the effusion cell.
7. Connect the thermocouple wire from the power cable to the effusion cell.

SVT Associates, Inc.

8. Do not apply power to the effusion cell until the pressure of the vacuum system has reached a maximum pressure of $1.0x10^{-7}$ Torr. Begin by placing the temperature controller into manual control mode, by pressing the auto/man button on the front of the Eurotherm 2408 module. See *Eurotherm 2408 Operation* on page 15 for additional details. Adjust the applied power by using the arrow up/down keys on the front panel of the controller. Apply 2 amps of current to each filament (keep in mind that power is measured in percent of the total power available in manual mode, cautiously raise the setting in small increments). After the temperature of the effusion cell begins to rise and stabilize, apply another 1 amp of current each, wait for the temperature of the effusion cell to stabilize before increasing the current. Continue to follow this pattern until you have reached the maximum outgassing temperature.
9. Typically, SVT Associates will outgas effusion cells at 1400 °C. (1000 °C for low temperature effusion cells and 600 °C for ultra low temperature effusion cells). Once you have reached your desired outgassing temperature, leave the source at this setting for a minimum of (2) hours. It is recommended to outgas as long as possible up to (48) hours. Ensure the current and voltage limits are set appropriately so additional power cannot be added to the source. See *Eurotherm 2408 operation* on page 15 for these settings.
10. After you have finished the outgassing process, begin ramp down of the source in the exact opposite order of ramp up. Decrease the power in 1 amp increments until the source temperature reaches 200–300 °C. Shut off the power supplies and let the source cool down on its own. Make sure the source temperature is below 100 °C before you vent the system for removal of the source.
11. To outgas the crucible, follow the same pattern for outgassing the effusion cell.

Operation

Load the crucible with the appropriate material and install the effusion cell into the vacuum chamber. It is recommended that the crucible not be filled more then 50% of the crucible height. Pump down the vacuum chamber to a maximum base pressure of $1x10^{-7}$ Torr before applying power to the effusion cell.

Once this vacuum is achieved, you can begin the temperature ramp up process. Follow the same ramping procedure explained in *Outgassing the Effusion Cell and Crucible* on page 9. If PID temperature control is to be utilized, it is recommended that the temperature ramp up process start manually first, slowly ramping up the heater power supply until the effusion cell reaches a minimum temperature of 200 °C before switching over to PID control. Refer to pages 16–17 for details on using PID control.

Caution: PID (Automatic) control at lower temperatures will cause the power supply to operate at maximum current and may cause damage to the filament.

If manual operation is to be utilized continue the temperature ramping process until the desired operating temperature is reached. See the accompanying *Component Data Sheet* for voltage, current and power ratings to produce a given temperature. Refer to the *Eurotherm Controller* and *Sorenson Power Supply* manuals for complete details of their operation.

To turn off the source, slowly ramp down the effusion cell heater as explained in *Outgassing the Effusion Cell and Crucible* on page 9 and then either turn it off completely or leave it at an idle temperature as necessary for the material being used. Refer to *common materials* on page 17 for further instructions.

SVT Associates, Inc.

Maintenance

Effusion Cells are relatively maintenance free; however, it will be necessary to change the crucible occasionally. This is also a good time to visually inspect the cell for any deterioration or mechanical damage. Check all electrical connections for continuity and ensure all setscrews are tight.

Before removing the cell from the vacuum system, make sure it has been cooled down to room temperature. Please follow the recommendations for ramp down found in step 10 of *Outgassing the Effusion Cell and Crucible* on page 10. Remove the old crucible by pulling the crucible retaining cap (if provided) out of the heat shields and slide it out of the end of the cell with a tool such as a needle nose pliers. Clean any parts of the effusion cell, which may have become contaminated. Carefully slide **(do not drop)** in a new crucible as described in *Installing the Effusion Cell* on page 8. Be very careful when loading the crucible into the source as the ceramic material of the crucible and the filament supports are fragile.

Replace the crucible retaining cap by sliding it over the crucible and fitting it between the heat shields (See Figure 3). The effusion cell is now ready to install into the vacuum system. See *Installing the Effusion Cell* on page 8 for reinstallation instructions. Begin the outgassing procedure as described in *Outgassing the Effusion Cell and Crucible* on page 9.

SVT Associates, Inc.

Specifications

Dual Filament Effusion Cell:

Mounting Flange	4.50" CF
Length	12.0" *custom lengths also available*
Interior Diameter	2.30" (maximum)
Capacity	16, 40, 50, 60, 80 cc
Continuous Operating Temperature Range	See Attached Datasheet
Power Range	See Attached Datasheet
Source Temperature Stability	± 0.1 °C
Source Temperature Reproducibility	± 0.1 °C
Thermocouple	Type C
Electrical Connectors	Filament: Amphenol Circular Thermocouple: Omega Submini

Options

- Integral Manual Shutter
- Integral Pneumatic Shutter
- Water Cooling Shroud

See *Appendix* for complete details of available options if ordered with the effusion cell.

Effusion Cell Controller Package

The Effusion cell controller package consists of the following:

- Eurotherm temperature controller unit
- Sorensen power supply
- Control interface cable
- Power input cables
- Power and thermocouple cable for the source

Refer to Figure 7 on page 14.

SVT Associates, Inc.

Eurotherm Controller Connections:

The controller contains the Eurotherm controller and the interface connections needed to operate each filament zone. Located on the back of the unit:

- Main AC electrical input power is connected to J1.
- The power supply control cable is connected to J1-1.
- The thermocouple input from the effusion cell cable is connected to JTC-1.
- The Power On/Off switch is located at SW1.
- A 2A slow blow fuse is located at F1.
- The Unit is equipped with RS485 communication capability through J2 and J3.
- The Pin outs for the RS485 are as follows:
  - Pin 1 = Ground
  - Pin 4 = Positive (+)
  - Pin 7 = Negative (-)
- The current limit potentiometer is located directly above the thermocouple connection. This is a ten-turn potentiometer with each turn representing 10% of the total power available.

Power Supply Connections:

The Eurotherm controller unit controls the Sorensen power supply; which supplies power to the effusion cell. The effusion cell power cable leads are connected to the DC output on the rear of the power supply. The polarity of the power cable is irrelevant and can be connected interchangeably. Electrical power is applied at the input receptacle.

Control Cable:

The control cable is connected between the Eurotherm controller (J1-1) and the remote input connector on the power supply.

Effusion Cell Power Cable:

This cable is connected to the thermocouple input (JTC-1) on the Eurotherm controller and the DC output terminals on the power supply. Refer to page 9 for connecting the cable to the effusion cell.

Power Input Cables:

Both the Eurotherm controller and Sorensen power supply each have a wide range of power input to be connected to a power source capable of 100–240 VAC and 15A service.

A complete manufacture's manual will be supplied for the Eurotherm controller and the Sorensen power supply if they were purchased with the effusion cell.

SVT Associates, Inc.

Figure 7 – Front View

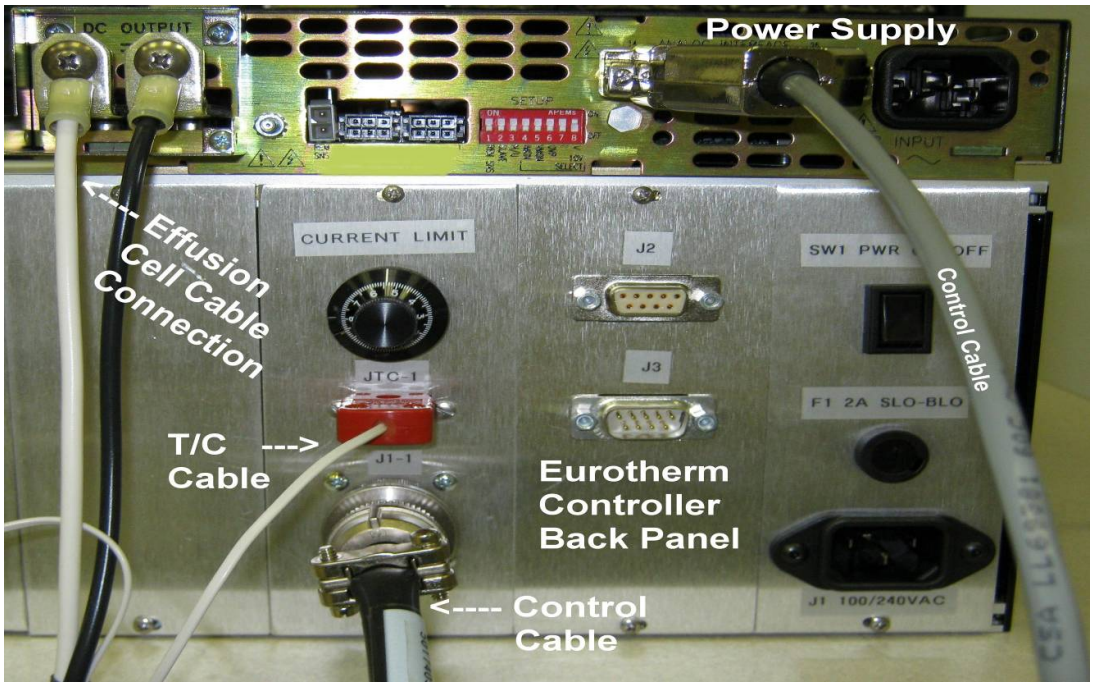


Figure 8 – Back View

SVT Associates, Inc.

Eurotherm 2408 Operation

The Eurotherm 2408 controls the Sorensen Power Supply by using a 0–10V signal to the supply. It can control the power supply (and therefore the temperature) by either 'auto' or 'manual' mode. The controller is initially set to power up in auto mode, which will control by temperature. By moving the arrow keys up and down, the temperature can be changed and the power supply will power the filament to maintain the set point temperature. The controller also has a ramp rate, called **SP.rr** in the list, which has a default rate of 20 °C per minute. For example, if the heater is set to go to 300 °C from room temperature, it will take 15 minutes. Refer to the Eurotherm control manual for complete details.

Caution: Watch the display and make all changes before you see it flash. The flash will occur approximately 1 second after the last up or down arrow change. The user should observe this flash at low temperatures as a guide for normal operation. After the temperature begins to ramp, then the arrows should not be adjusted until the *'run'* icon disappears and the temperature ramp has finished and stabilized.

The other mode of operation is '*manual*' mode. In this mode the power supply is controlled only by percent output of the total power available and the temperature follows accordingly. Typical operation does not utilize *manual* mode.

Power supply limiting is done by the current control potentiometer on the power supply. The current limit LED (above the potentiometer) will be illuminated when the current limit has been reached. Increase the current limit potentiometer slightly to allow for the LED to go dark and the Eurotherm 2408 controller will regain control. During all modes of operation, the current limit potentiometer should be set to just slightly higher than the required setting for operation. If the current limit LED lights during *'auto'* mode, then the PID settings will not be allowed to fully control the temperature in a stable state.

Ramping

When the PID's have been set they should maintain stability in a steady state, and also maintain an actual temperature that is close to the set point temperature as the heater is being ramped between temperatures. Refer to the Eurotherm control manual for complete details.

Default ramp rates are typically set to 20 °C per minute both up and down. These are general guidelines for all heaters, and are safe values for all filaments. Some materials require much lower ramp rates to protect the crucible and heater. Further detailed rates can be established for different materials and at different temperature ranges. For specific materials and heater applications, contact SVT Associates for support on ramp rates and limits.

SVT Associates, Inc.

Quick PID instructions

These guidelines offer more detailed instructions based on the same manual method as shown in the Eurotherm Operators Manual. In general, SVT Associates does not recommend auto tuning to be performed on any of the heater and power supply/controller combinations we provide. Auto tuning applies excess power to the filament, which can result in excessive wear on the heater.

Under *'Manual'* control of the Eurotherm, increase the percent output slowly until the heater temperature reaches 300 °C (*100* °C *for low temperature materials*). Follow this procedure: Apply 2 amps of current initially to the filament, after the temperature of the effusion cell begins to rise and begins to stabilize, apply another 1 amp of current, wait for the temperature of the effusion cell to stabilize before increasing the current. Continue to follow this pattern until you have reached the appropriate temperature.

Turn the current limit potentiometer up slightly when the effusion cell reaches the temperatures stated above. This will insure the limit will be reached when in *'Auto'* mode.

Change the Eurotherm control to *'Auto'* mode. The power supply will probably reach the current limit, as the lower display changes from percent output to set point temperature, which will match when first changed to auto.

Generally the PID's for our non-contact thermocouples will fall into the following estimates: P=30–40, I=30–40, and D=7–12. Start by turning P=50 to 60, I=off, and D=off

Temperature and power will probably fluctuate wait until they stabilize. If the temperature is not changing, watch the power supply for stability. Consider it stable if the voltage or current are not oscillating more than a value of +/- 0.5 (V/A). Make sure when you consider the heater stabilized that the current is not being limited because this will not allow for proper tuning.

Now lower the P value by 3–5 points. Again, the power supply will probably reach the current limit for a short time, but as the oscillations get smaller, it should no longer limit. Wait for the oscillations to get *'stable'* (small V or I change). It may take 10–15 min before it reaches this *'stability'*.

Continue dropping the P value in the 3–5 point range (with I and D still off), until the heater and power supply doesn't reach this 'stability' after several minutes. As you get to numbers that P~40 and below, decrease the P closer to the 2–3 point range.

After you have gotten to the point where the heater and power supply are not moving toward smaller oscillations and stability, you can record the time periods of oscillations and set the actual PID settings. Measure the time it takes from high point to high point of the oscillation. This may be based on the high and low point of the oscillation on the V and I on the power supply; the actual temperature may not change on the controller.

Change the P to 2 times the value. (If P=22, then new P=44) Set the I to half the period of oscillation. (If period is 64 seconds, then I=32) Set the D to ¼ to ⅓ of the I.
(If I=32, then D=8–11)

Allow the system to stabilize again after the three values have been applied. And again, give it a little bit of room before it hits the current limit. In practice it is a good idea to always keep the current limit set just slightly above what is necessary for the heater operation.

SVT Associates, Inc.

Appendix
Common Materials Sheet

Attention: Please check the effusion cell datasheet provided with the effusion cell manual for details regarding the specific effusion cell being utilized. The maximum upper temperature limit of the effusion cell is 1350 °C and must never be exceeded.

Gallium (Ga)

16, 40–60 cc Hot Lip Effusion Cell

Outgassing without materials loaded:
With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp the effusion cell temperature to 1250 °C at a rate of 10 °C per minute. Hold the temperature at 1250 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

Outgassing with materials loaded:
Never fill the crucible to capacity. No more then 50% of the crucibles height should be filled with Gallium. With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp the effusion cell temperature to 1000 °C at a rate of 10 °C per minute. Hold the temperature at 1000 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

Typical MBE growth rates for Gallium are in the range of 900–1050 °C

Indium (In)

16, 40–60cc Hot Lip Effusion Cell

Outgassing without materials loaded:
With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp the effusion cell temperature to 1250 °C at a rate of 10 °C per minute. Hold the temperature at 1250 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

Outgassing with materials loaded:
Never fill the crucible to capacity. No more then 50% of the crucibles height should be filled with Indium. With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp up the effusion cell temperature to 900 °C at a rate of 10 °C per minute. Hold at 900 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

SVT Associates, Inc.

Magnesium (Mg)

16–40 cc Low Temperature Effusion Cell

Outgassing without materials loaded:
With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp the effusion cell temperature to 1250 °C at 10 °C per minute. Hold the temperature at 1250 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

Outgassing with materials loaded:
Never fill the crucible to capacity. No more then 50% of the crucibles height should be filled with Magnesium. With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp up the effusion cell temperature to 550 °C at a rate of 10 °C per minute. Hold the temperature at 550 °C for 2 minutes. Continue to ramp down the temperature to 550 °C at a rate of 10 °C per minute. Hold this temperature for 20 minutes. Ramp down the temperature to 150 °C at a rate of 10 °C/min for bake and idle.

Important Note:
Magnesium melts at 650 °C. Magnesium has a very high vapor pressure at 550 °C, so outgas at this temperature for only a short time. Typical cell temperature for doping Magnesium is > 400 °C.

Zinc (Zn)

16–40 cc Low Temperature Effusion Cell

Outgassing without materials loaded:
With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp the effusion cell temperature to 1250 °C at 10 °C per minute. Hold the temperature at 1250 °C for 1–3 hours. Ramp down the temperature to 300 °C at a rate of 10 °C per minute.

Outgassing with materials loaded:
Never fill the crucible to capacity. No more then 50% of the crucibles height should be filled with Zinc. With liquid nitrogen flowing through the cryo panel and pressure < 10^{-7} Torr, ramp up the effusion cell temperature to 350 °C at 10 °C per minute. Hold the temperature at 350 °C for 2 minutes. Continue to ramp down the temperature to 300 °C at a rate of 10 °C per minute. Hold this temperature for 20 minutes. Ramp down the temperature to 100 °C at 10 °C/min for bake and idle.

Important Note:
Zinc melts at 420 °C. Zinc has a very high vapor pressure at 350 °C, so outgas at this temperature for only a short time. Typical cell temperature for Zinc doping is < 300 °C.

SVT Associates, Inc.

Evaporation Guide (Temperatures in °C)

Pressure/Torr	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	Melting T
Ga	677	742	817	907	1007	1132	30
In	xxx	597	664	742	837	947	157
Mg	214	246	282	327	377	439	650
Zn	147	177	209	247	292	344	420

Crucible Filling:

It is recommended to fill crucibles for materials that sublime up to 75%.
It is recommended to fill crucibles for materials that melt up to 50%.
In case of Aluminum, filling should not exceed 15%.

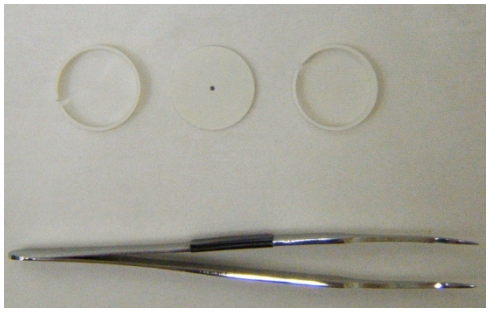
For specific materials and heater applications, contact SVT Associates for support on ramp rates and limits.

Crucible Insert Assembly Instructions

Description: For high vapor pressure material (e.g. Zn) a crucible insert is provided that allows better flux control and reduces oxidation of the source material charge. Please follow below instructions for reassembly of the insert.

Note: Crucible insert assemblies are made of PBN, Alumina, Pyrolytic Graphite, Tantalum, or a combination of these, depending on the application. PBN and Graphite are very delicate to handle. Handle with care to prevent potential damage. Observe proper clean room etiquette to prevent contamination.

Figure 1 shows the necessary parts for assembly; they are from left to right, top ring, aperture, and bottom ring*. Use a clean tweezers to help with insertion and removal.



- Insert the bottom ring into the crucible. The ring has a small cut-out for spring tension. If your crucible is tapered skip this step. (Figure 2a)
- Place the aperture on top of the bottom ring. If the aperture has a taper on it, place taper side down. (Figure 2b)

SVT Associates, Inc.

- Place the top ring to secure the aperture. This ring also has spring tension. Hold the crucible against a light source to make sure that the aperture is sitting flat inside. (Figure 2c)

*Note: Effusion Cells with a tapered crucible will only use the aperture and top ring.

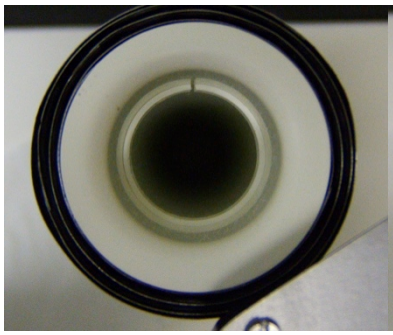


Figure 2a: Bottom ring

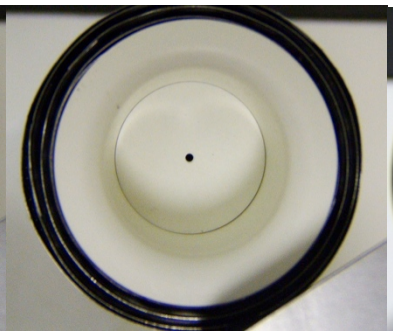


Figure 2b: Aperture

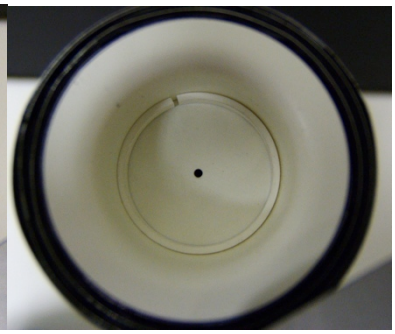


Figure 2c: Top ring

This completes assembly of the insert. For further assistance please contact support@svta.com.

Spare Parts List

Crucibles

Size	Model	Material	SVTA Part#
16 cc Crucible	SVTA-16CC	PBN	5004051
16 cc Crucible	SVTA-16CC-ALO	Alumina	5020564
16 cc Crucible	SVTA-16CC-PG	Pyrolytic Graphite	5019421
40 cc Crucible	SVTA-40CC	PBN	6000274
40 cc Crucible	SVTA-40CC-ALO	Alumina	5013043
40 cc Crucible	SVTA-40CC-PG	Pyrolytic Graphite	5020608
40 cc Crucible	SVTA-40CC-DW	Double Wall PBN	5026826
40 cc Crucible	SVTA-40CC-TA	Tantalum	5024007
50 cc Crucible	SVTA-50CC	PBN	5012248
50 cc Crucible	SVTA-50CC-ALO	Alumina	5013837
60 cc Crucible	SVTA-60CC	PBN	6000042
60 cc Crucible	SVTA-60CC-ALO	Alumina	5013047
60 cc Crucible	SVTA-60CC-Q	Quartz	5021825

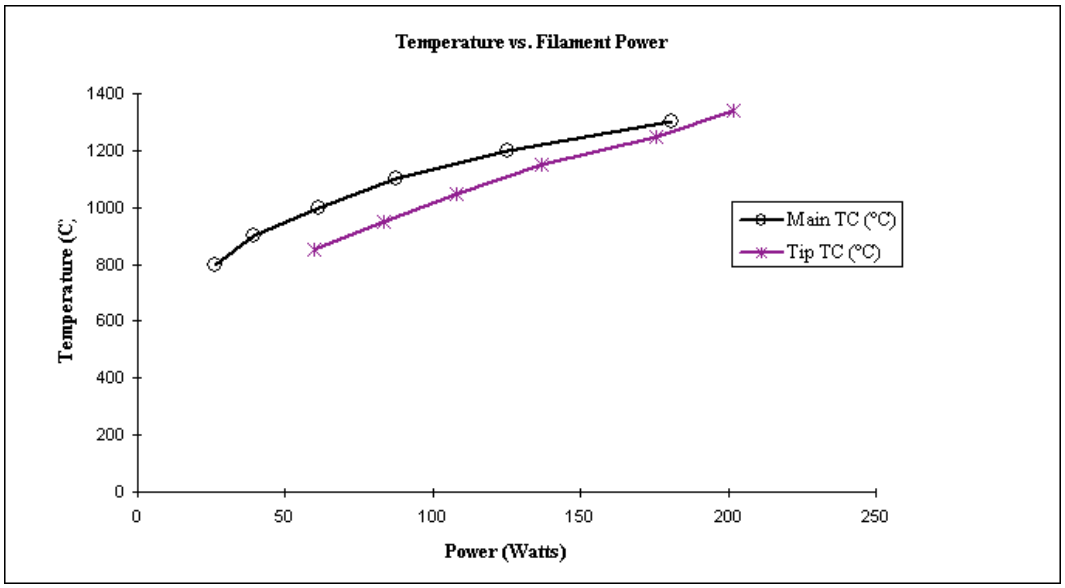
Miscellaneous Parts

SVT Associates, Inc.

SVT Associates, Inc.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Component Data Sheet



Date	5/22/14	Job Number	XXXX
Data Sheet Number	XXX	PO Number	System
Customer Name			

Cell Type	40 cc Dual Filament w/Cap	Serial Number	5023445-XXX
Flange Size	4.50" CF	T/C Type	C
Crucible	PBN	Length	12"

Main Filament Resistance at Room Temperature (Ohms)	1.3
Main T/C Resistance at Room Temperature (Ohms)	0.8
Tip Filament Resistance at Room Temperature (Ohms)	0.5
Tip T/C Resistance at Room Temperature (Ohms)	0.9

Main Filament			
Amps	Volts	Watts	Main T/C (°C)
5.7	31.7	181	1300
4.9	25.5	125	1200
4.2	20.8	87	1100
3.6	17.1	62	1000
3.0	13.1	39	900
2.5	10.5	26	800

Tip Filament			
Amps	Volts	Watts	Tip T/C (°C)
10.3	19.6	202	1340
9.8	17.9	175	1250
8.8	15.5	137	1150
8.0	13.5	108	1050
7.2	11.6	84	950
6.3	9.5	60	850

Source was outgassed at 1400 °C w/o crucible (22.1V/11.3A Tip, 38.7V/6.6A Main)

SVT Associates, Inc.

Warranty and Limitations of Remedies

SVT Associates warrants that all equipment manufactured by it shall be free from defects in materials and workmanship under normal use and service for a period of twelve (12) months from the date of shipment from SVT Associates manufacturing facility. This warranty is subject to SVT Associates equipment being installed, maintained, and operated in accordance with the operating and maintenance instructions accompanying each item manufactured by SVT Associates. Warranty shall be void if SVT Associates equipment is modified by the CUSTOMER or used in other than the recommended manner or applications. Purchased equipment incorporated into any item supplied by SVT Associates will be covered by said manufacturer's warranty.

SVT Associates warrants that, at the time of delivery, any other products processed or manufactured and sold by it hereunder are free of defects in material and workmanship and conform to COMPANY specifications. No warranty is provided by SVT Associates for products sold hereunder which are not manufactured or processed by SVT Associates, but the manufacturer's warranty for such products, if any, shall be assigned to the CUSTOMER without recourse to SVT Associates The foregoing warranties are in lieu of and exclude all other warranties not expressly set forth herein, whether expressed or implied by law or otherwise, including without limitation any warranty of merchantability or fitness for a particular purpose. In no event will SVT Associates be liable for any consequential damages.

IN THE EVENT OF SVT ASSOCIATES LIABLITY, WHETHER BASED ON CONTRACT, TORT (INCLUDING BUT NOT LIMITED TO NEGLIGENCE AND STRICT LIABLITY) OR OTHERWISE, THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDY WILL BE LIMITED; SVT ASSOCIATES HAS THE FOLLOWING OPTIONS; TO REPAIR OR REPLACEMENT (F.O.B. SVT ASSOCIATES MANUFACTURING PLANT) BY THE COMPANY OF ANY NON-CONFORMING ITEM FOR WHICH CLAIM IS MADE BY THE CUSTOMER OR TO REPAYMENT OF THE PORTION OF THE PURCHASE PRICE PAID BY THE CUSTOMER ATTRIBUTABLE TO THE NON-CONFORMING ITEM. SVT ASSOCIATES WILL NOT BE LIABLE FOR ANY OTHER DAMAGES, WHETHER DIRECT, INCIDENTAL, CONSEQUENTIAL OR OTHERWISE.

Return Policy

Any request by the CUSTOMER for return of standard products other than for warranty claims under warranty hereof, for all or any part of purchase order accepted by SVT Associates, shall be subject to the following conditions:

A. The CUSTOMER must make notification to SVT Associates within thirty (30) days of original shipping date.
B. A "RETURN GOODS AUTHORIZATION" number must be assigned to and accompany all goods or materials being returned by the CUSTOMER to SVT Associates. SVT Associates must assign said number prior to any and all returns. Goods not accompanied by a "RETURN GOODS AUTHORIZATION" number will be refused by SVT Associates and returned at the CUSTOMER'S expense.
C. CUSTOMER shall prepay shipping charges for products being returned to SVT Associates.
D. Products being returned to SVT Associates should be properly crated for shipment, and the CUSTOMER shall bear the risk of loss until delivered to SVT Associates.
E. Products being returned to SVT Associates must be returned in the condition originally received by the CUSTOMER and free from damage, use, or modification, which would render the product unusable for resale, by SVT Associates.

SVT Associates, Inc.

F. All applicable taxes, duties, insurance, and shipping charges shall be the sole responsibility of the CUSTOMER.

G. Goods being returned for other than warranty repair shall be subject to a restocking charge of twenty (20) percent of the original sales price of the returned item.

Returning Equipment for Repair or Servicing

Before shipping equipment for repair or servicing, obtain a Return Authorization Number assigned by SVT Associates.

Liability Disclaimer

SVT Associates, Inc. takes steps to assure that its published specifications and manuals are correct; however, errors do occur. SVT Associates, Inc. reserves the right to correct any such errors and disclaims liability resulting therefrom.

No Liability for Consequential Damage

In no event shall SVT Associates, Inc. or anyone else involved in the creation, production, or delivery of the accompanying product (including hardware and software) be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or the results of use of or inability to use such product, even if SVT Associates, Inc. has been advised of the possibility of such damages.

SVT Associates, Inc.