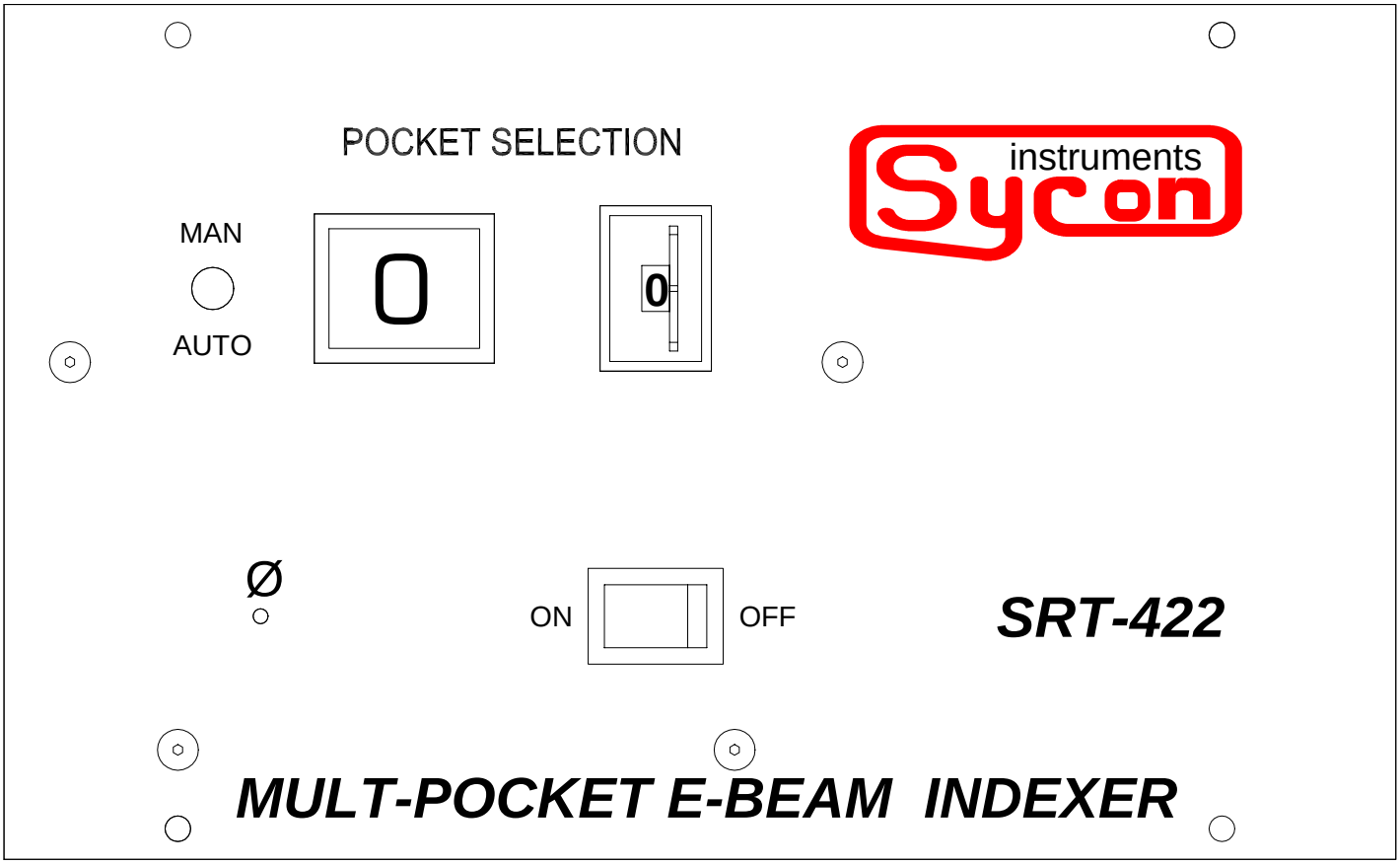
SRT-422

E-Beam Source Indexer



User's Manual

518-034 Revision A, January 2004

SRT-422

Operators Manual

Preface

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Warranty

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Sycon Instruments, Inc.
6757 Kinne Street
Syracuse, New York
13057-1215

P (315) 463-5297
F (315) 463-5298
www.sycon.com

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EC Declaration of Conformity

We,
Sycon Instruments
6757 Kinne Street
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Declare under sole responsibility that the

SRT-422, E-beam source indexer

Meets the intent of Directive 89/336/EEC as amended by 92/31/EEC and 93/68/EEC for Electromagnetic Compatibility and the 72/23/EEC Low Voltage Directive for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 50081-1:1992 Emissions

EN 5022	Class B Radiated and Conducted Emissions
EN 6100-3-2	AC Power Line Harmonic Current Emissions

EN 50082-1: 1995 Immunity

IEC 1000-4-2	Electrostatic Discharge Immunity
IEC 1000-4-3	RF Electromagnetic Field Immunity
IEC 1000-4-4	Electrical Fast Transient/Burst Immunity
IEC 1000-4-5	Power Line Surge Immunity
IEC 1000-4-11	Power Line Dips and Interrupts

EN 61010-1: 1993 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

SECTION 1

GENERAL INFORMATION

Section 1
General Information & Specifications

Section 1.1: Introduction

The Source Rotation Indexer (SRT-422) is a stepping motor driver unit with optical encoding for the positioning and rotation of multi-pocket electron beam sources. The SRT-422 is unique to other rotation controllers because the motor is small and compact separate from the driver, and control electronics.. The unit is designed to attach to the input shaft (air side) of a rotary vacuum feedthrough. For ease of installation, complete installation packages are available which include either a 1" bolt Rotary Feedthrough or a 2 ¾" Del Seal Rotary Feedthrough.

The Indexer can be controlled manually from a remote control panel, or automatically from STC I/O Input or the RS 232 computer interface. It can control a 3, 4, 6 or 8 pocket source in either a unidirectional or bi-directional manner. (the bi-directional mode, takes the shortest path to the next selected pocket). The unit can be used to rotate a continuous trough source at one of seven selected rotation speeds. For the multi-pocket UHV source, it has the capability of limiting rotation to 270 degrees (3 pockets) from the pocket 1 position. Three variations of 3 pocket source rotation control are provided (2 Standard pockets, 1 'banana' pocket) which allow for different retrograde motion of the banana pocket (120°, 135° and 145° sweep). Five rotational speeds are available for sweeping the 'banana' pocket. In addition, custom firmware can be added to control other variations of sources.

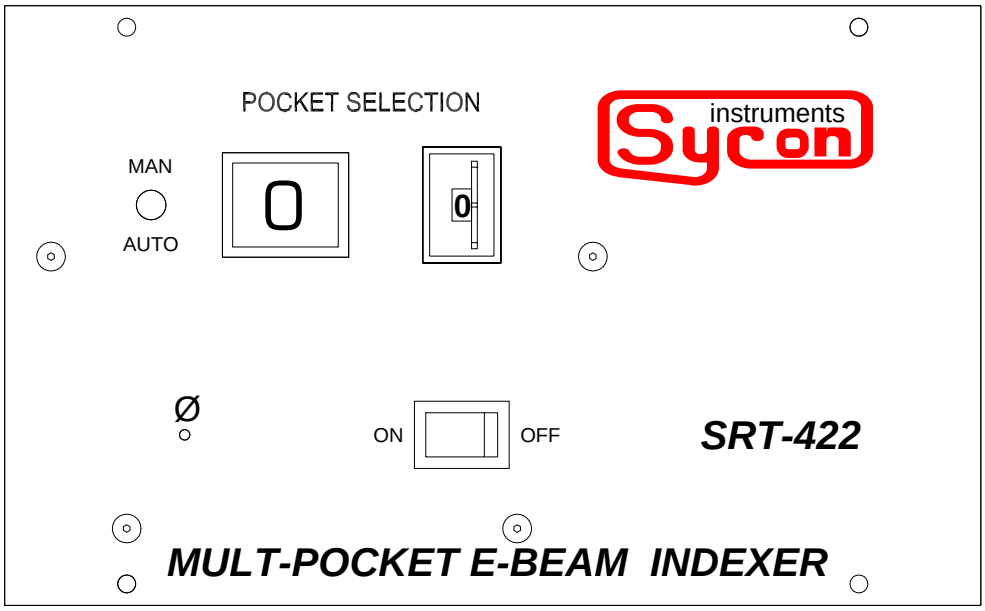

Figure 1.1: SRT-422 Front Panel

Section 1.2: Unpacking

When opening the shipping package, you should find the following items:

- SRT-422 Source Rotation Indexer
- 600-004 Power Cord (IEC 110 Volt)
- 514-004 RS232 / I/O Connector Kit
- 518-XXX SRT-422 User's Manual

The following optional items will be additionally included if they have been purchased:

- 500-074 1" Bolt Rotary Feedthrough and Adapter
- 500-075 2 ¾" Del Seal Rotary Feedthrough and Adapter

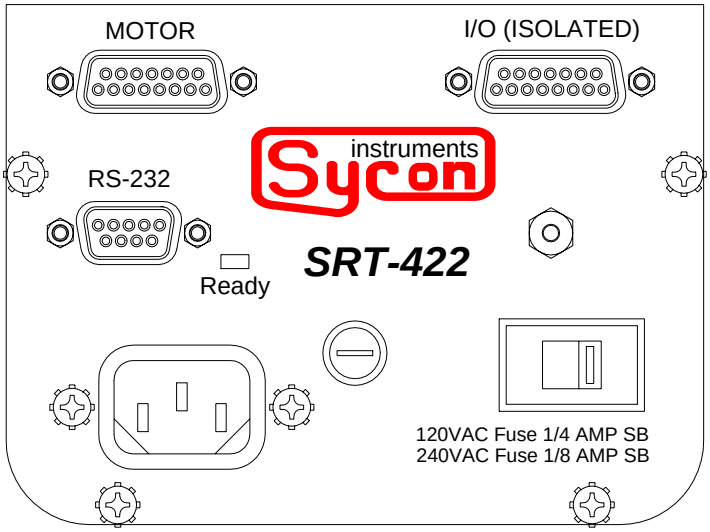

Figure 1.2: SRT-422 Rear Panel

Section 1.3: Specifications

Specifications	Description
Rotational Ability	•4,6 or 8 Pocket Source (Uni or Bi-direction) •Continuous Trough Source (1 of 8 speeds) •UHV 4 pocket source (limited rotation) •3 - 3 pocket 'banana' types
Rotational Speed	•Shaft speeds of up to 12 rpm
Path Finding	•Quickest path (CW, CCW) for multi-pocket source
Torque	•120 in-oz. at output shaft
Repeatability	•3° resolution and repeatability
Data Interface	•RS-232
Relay Interface	•Allows control from system or deposition
Manual Control	•Inputs/outputs for Remote Manual Control Panel
Safety Interlocks	•Disallows rotation with beam power applied
Pocket Good Indication	•Indicated selected pocket is reached or retrograde motion is in progress.
Size	•5.0w x 5.0h x 4.5d plus 1" shaft extensions
Weight	•3.5 lbs.
Power	•Input power 115/230 Volts ac/10 watts

Table 1.1: Specifications

SECTION 2

OPERATION

Section 2
Operation

The SRT-422 can be controlled remotely by the output relays of our STC-2002 and STC-2000A Thin Film Deposition Controllers, or any other system controller. Additionally, it can be controlled by a remote panel Manual Pocket Selection Switch or through either of two standard computer interfaces. An Interlock input is provided to assure that rotation of multi-pocket sources *cannot* occur while deposition power is being applied to the source.

Section 2.1: Automatic Operation

With the Auto/Man toggle switch in the Auto position (DOWN), the Indexer will be controlled through the STC I/O Port or the RS232 Computer Interface. The Binary code applied to the STC I/O port will direct the Indexer to the proper position. Signals are available which indicate correct pocket position along with the safety interlock described above.

Section 2.2: Stalled Motor Indication on 7-Segment Display

In addition to indicating the current pocket location the 7-segment LED provides a stall or jammed source indication. This is done by alternately flashing the 7-segment display between the current pocket location and zero. (The green LED on the back panel of the Indexer will also blink if the condition occurs). This flashing indicates the load on the Indexer has exceeded the torque capacity of the Indexer and it is unable to move to the new desired position. This usually means that an excess amount of material has accumulated on the source such that it cannot rotate freely.

Section 2.3: Section overview

This section describes the operation of the SRT-422 with a variety of source hearth types. The specific sections are

Control/Display Features
Clockwise vs. Counterclockwise Pocket Numbering
Indexer Operation With Standard Multipocket Sources
Indexer Operation with 4-pocket UHV Sources
Indexer Operation With 3-pocket Sources That Have One Banana-Shaped Pocket
Indexer Operation With Continuous-Trough Hearths
Phase Adjustment
Rotation Speed and Torque Selection

Section 2.4: Control/display features

All of the indexer's control/display features are on the control unit's front panel, which is illustrated in Figure below.

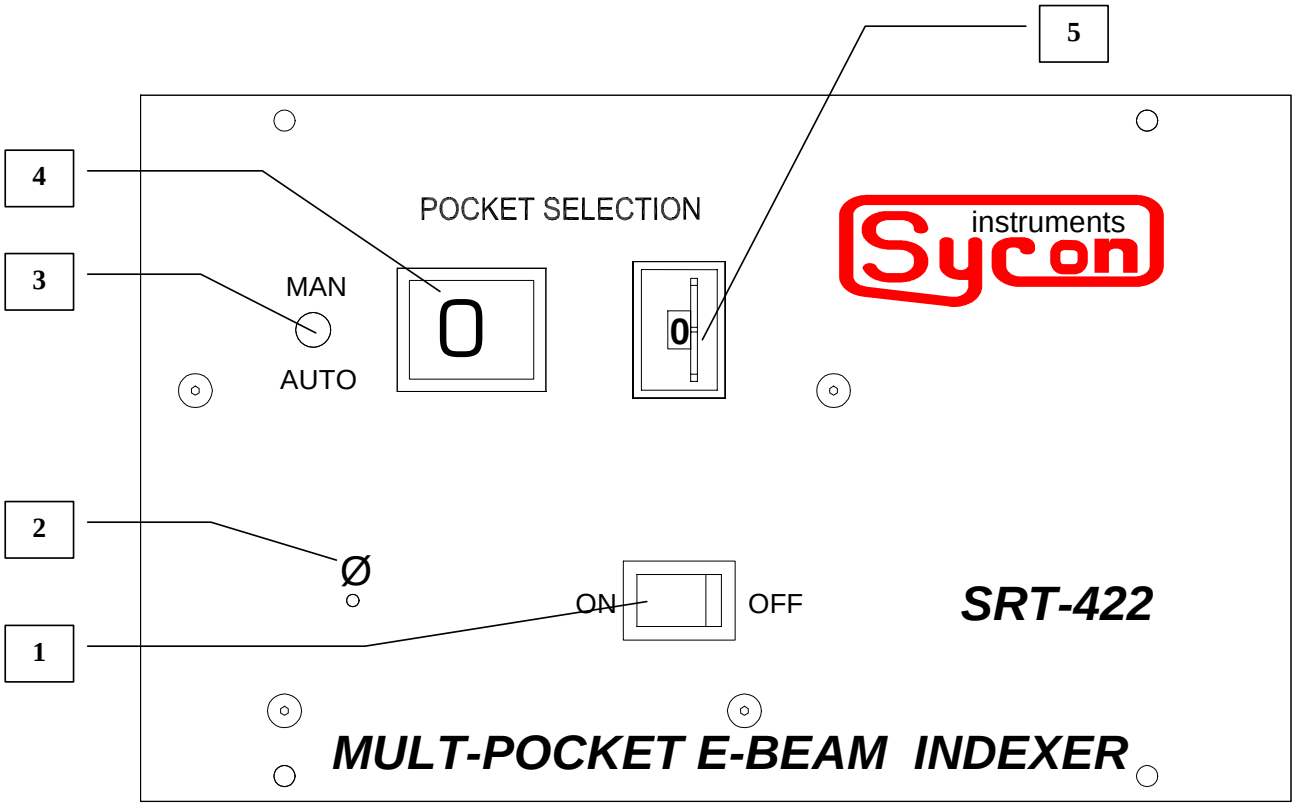

Figure 2.1: Control / display features on the control unit's front panel

1. *ON/OFF switch*. This switch controls the input power to the unit.
2. *Phase-adjustment switch*. This spring-loaded pushbutton is mounted inside a hole below the Greek letter ph ø. See the instructions on using this switch to recalibrate the home position of pocket 1.
3. *MANual/AUTO mode switch*. When this switch is set toward MAN, the position of the thumbwheel (feature *5)* controls the following functions:
   • Pocket selection in all multipocket modes.
   • Rotation speed in continuous mode and oscillation speed in "banana" mode.
   When the switch is set toward AUTO, these functions are controlled by signals from a host computer, deposition controller, or other remote device. These signals are input via either the RS-232 port or the I/O (ISOLATED) connector, both of which are on the control unit's rear panel.
   Note that this switch has a spring-loaded locking feature. You must pull the switch all the way out and hold it out while changing its position.
4. *LED pocket-position indicator.* This 7-segment LED displays the numerals 0 through 7 to indicate the current pocket position. The LED also flashes between zero and the number of the current pocket position to indicate a stalled-motor condition, which usually results from the buildup of material along the edges of the cutout in the top of the source.
5. *Pocket/speed selection thumbwheel*. When the MAN/AUTO switch is set to MANual, this thumbwheel controls pocket selection and rotation/oscillation speed.

Section 2.5: Clockwise vs. counterclockwise pocket numbering

When planning multipocket deposition—with the indexer in either unidirectional or bidirectional mode, bear in mind that the orientation of pocket numbering is determined by the setting of internal DIP switch *5.* This means that the direction of "forward" rotation (i.e., rotation "upward" through the pocket numbers) depends on whether DIP switch *5* is set for clockwise or counterclockwise rotation. The Figure below shows what this means for indexer operation with a standard 4-pocket source. The pockets of such a source must be thought of as being numbered 1-4 in a counterclockwise direction when DIP switch *5* is on and 1-4 in a clockwise direction when switch *5* is off. The same principle applies to all multipocket sources.

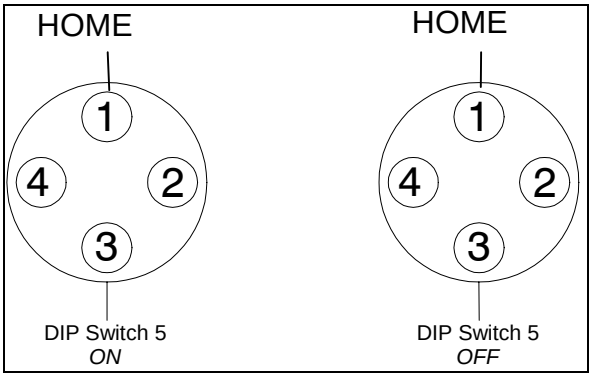

Figure 2.2: How the orientation of pocket numbering depends on the setting of DIP switch *5.*

Section 2.6: Indexer operation with standard multipocket sources

The SRT-422 operates any standard 3-, *4-, 5-, 6-,* or 8-pocket source that has internal 4:1 gear reduction. When the internal DIP switches are configured for one of these source types, operation of the indexer is straightforward. After the pocket selection has been changed either manually via the front-panel thumbwheel or automatically by a remote device, the indexer rotates the hearth to that pocket position at a constant rotational speed and then stops.

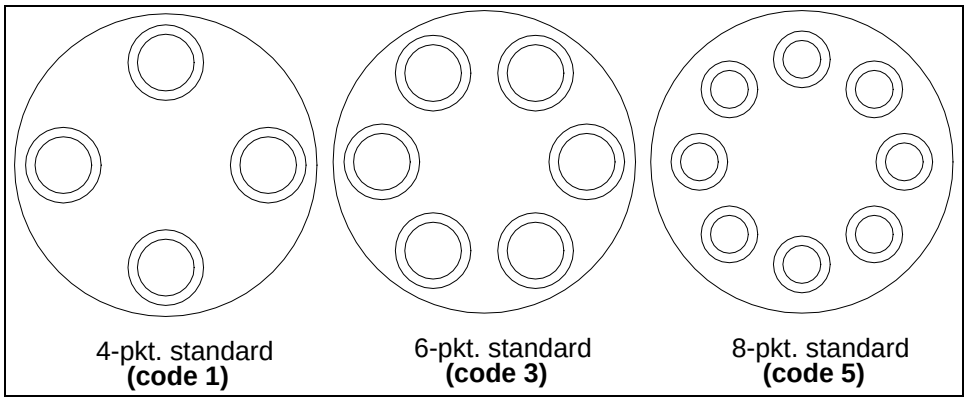

Figure 2.3: Standard 4-, 6-, and 8-pocket hearths

Source rotation can be either uni- or bidirectional if you select unidirectional rotation, you can also select clockwise or counterclockwise rotation. If you select bidirectional rotation, the unit will index to the selected pocket by the shortest path, whether that means rotating clockwise or counterclockwise. Bear in mind that both uni- and bidirectional modes, the orientation of pocket numbering depends on whether clockwise or counterclockwise rotation is selected.

Notes on This Operating Mode

1. When the indexer is configured for a standard 4-pocket source, selecting pocket positions 1-4 moves the hearth to pockets 1-4, respectively. In addition,
   Selecting pocket *5* moves the hearth to pocket 1, as indicated by the LED
   Selecting pocket 6 moves the hearth to pocket 2, as indicated by the LED
   Selecting pocket 7 moves the hearth to pocket 3, as indicated by the LED
   Selecting pocket 8 moves the hearth to pocket 4, as indicated by the LED.
2. When the indexer is configured for a standard 6-pocket source, selecting pocket positions 1-6 moves the hearth to pockets 1 -6, respectively. In addition, selecting either pocket 7 or pocket S moves the hearth to pocket 1 , as indicated by the LED.
3. When the indexer is configured for a standard 8-pocket source, selecting pocket positions 1 -8 moves the hearth to pockets 1-8, respectively. However, note that the LED displays a zero rather than an *8* when the hearth is at pocket 8.

Section 2.7: Indexer operation with 4-pocket UHV sources

The distinguishing operating characteristic of the indexer in this mode is that it will not move directly in either direction between pocket 1 and the pocket 90° counterclockwise from pocket 1. (The unit's software may be thinking of the latter pocket as either pocket *2* or pocket 4. depending on the primary rotation direction. This 'software barrier" prevents damage to the special bellows that is attached in this location to the hearth of a 4-pocket UHV source. Consequently, the indexer rotates 270° to go between these two pockets in either direction. However, because this operating mode requires the indexer to be set for bidirectional rotation, it follows the shortest path in moving between any other pair of pockets.

CAUTION!

The indexer MUST be configured for bidirectional rotation when it is controlling a UHV 4-pocket source. Damage to the source and/or its bellows is likely to occur if the unit is configured for unidirectional motion. There are no limits programmed for unidirectional motion in UIIV mode, as there are for bidirectional motion in UHV mode.

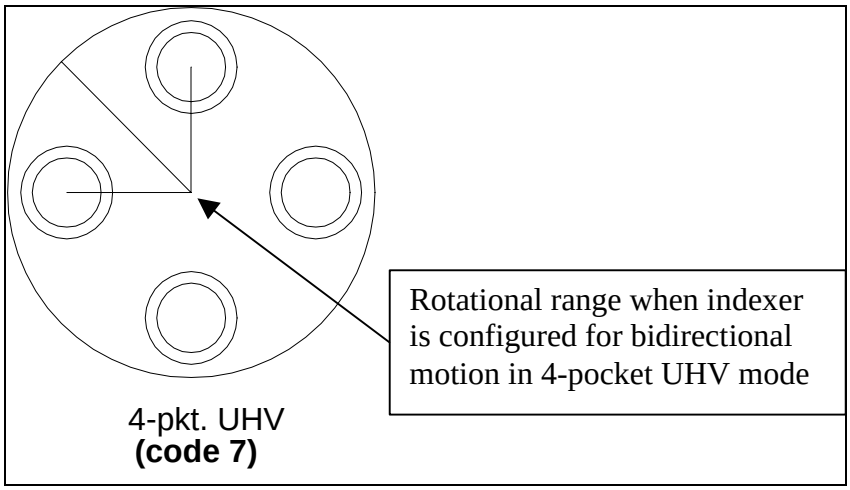

Figure 2.4: Illustration of a 4-pocket UHV source, indicating the position of the "software barrier" implemented in this mode to prevent damage to the bellows attached to UHV hearths in this area.

Section 2.8: Indexer operation with three-pocket sources that have one banana shaped pocket

The SRT-422 can be configured to operate three-pocket sources that have two conventional circular pockets 90º apart and one banana-shaped pocket, which can be either 12O°, 1*35°,* or 1*45*° in arc length or a source which has pockets 6O° apart and one 180° banana*.*

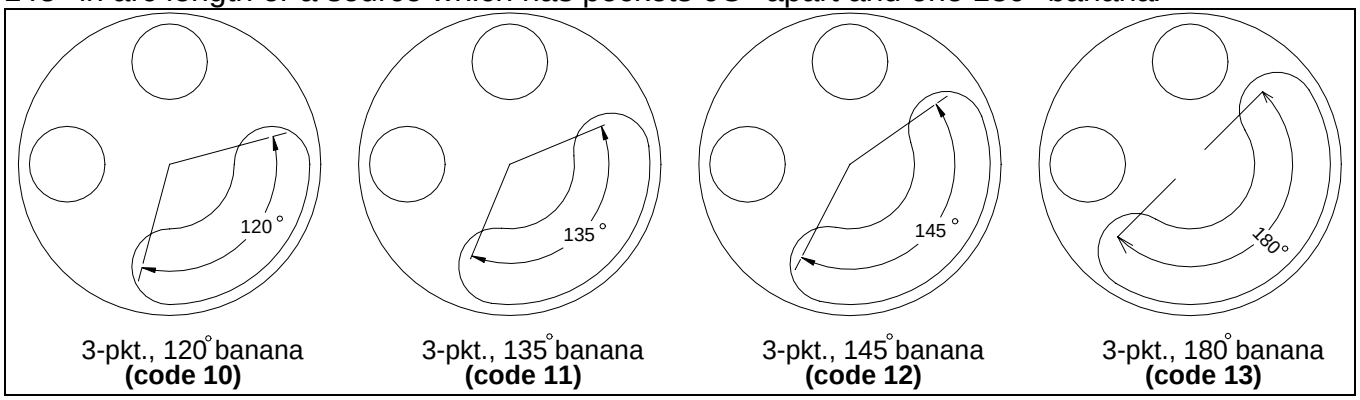

Figure 2.5: Three-pocket hearths with one banana-shaped pocket

When the indexer is properly configured to operate in this mode, selecting either pocket 1 or pocket 2 causes the indexer to rotate the hearth to one of the conventional circular pockets. However, in this mode, the pocket-select codes for pockets 3-8 all select the banana-shaped pocket. When the indexer receives any of these six pocket-select codes — either from a remote device or from the front-panel thumbwheel — it first rotates the midpoint of the "banana" to the home position. If the pocket-select code received by the indexer is one those for pockets 3 through 7, the indexer then begins to oscillate the hearth in such a way that the electron beam will sweep from one end of the "banana" to the other end. This oscillation continues until the pocket selection is changed or until indexer rotation stops. Either because

of interlock action or because the indexer has been switched off. As Table 3-i shows, the speed of this oscillating motion depends on which of the pocket-select codes between 3 and 7 is received. The pocket-select code for pocket 8 causes the hearth to rotate the midpoint of the banana to the home position and then stop. Note that this means that the electron beam will be focused on the same point continuously until it is switched off or until another pocket is selected.

How the speed of oscillating hearth motion in “banana” mode varies depending on the pocket number selected

Pocket Selected	Hearth Rotation Speed
3	.630 RPM
4	.515 RPM
5	.405 RPM
6	.295 RPM
7	.187 RPM
8	0 RPM

Table 2.1: Speed of Hearth in Banana Mode.

NOTE
When the indexer is configured for “banana” mode operation, internal DIP switch *5* MUST be set for bidirectional motion. If unidirectional motion is selected, the indexer will not move the banana-shaped pocket correctly.

Section 2.9: Indexer operation with continuous trough hearths

The SRT-422 operates in a continuous-rotation mode to support the use of full-circle evaporant carousels (see Figure 3-6). When the indexer is properly configured for operation in this mode, the hearth rotates continuously at any of 7 speeds in the direction determined by internal D[P switch *#5.* (See section 2.3 for instructions on setting the internal DIP switches.) As the hearth rotates, the LED displays the numerals 1-4 successively and then begins again with 1. These numerals indicate motion relative to what would be the home position of pocket 1 on a 4-pocket source.

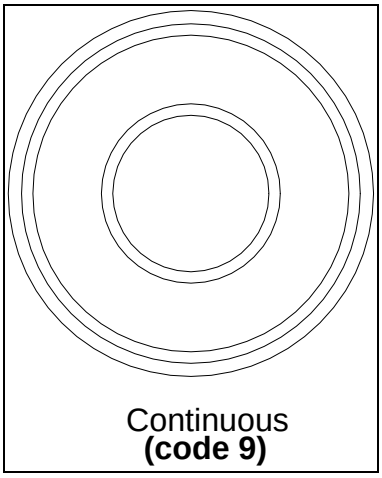

Figure 2.6: Illustration of a continuous-trough hearth

In this mode, the pocket-select codes whether issued via the front-panel thumbwheel or by a remote device determine the hearth's rotation speed. As the table below indicates, the pocket-select codes for pockets 1 through 7 select rotation speeds ranging from .187 RPM to *.845* RPM, and the pocket-select code for pocket 8 stops or prevents hearth rotation. Speed changes can be made while the hearth is rotating.

Pocket Selected	Hearth Rotation Speed
0	0 RPM
1	.845 RPM
2	.732 RPM
3	.630 RPM
4	.515 RPM
5	.405 RPM
6	.295 RPM
7	.187 RPM
8	0 RPM

Table 2.2: Hearth rotation speed in continuous mode.

Section 2.10: phase adjustment

A unique front-panel feature of the SRT-422 makes it easy to reset the home position when hearth rotation is out of phase (i.e., when the home position is no longer centered within the cutout in the top of the source). This phase adjustment can be accomplished in either of two ways, both of which are described in detail below. The electromechanical method necessitates breaking vacuum and lowering and swinging out the source tray. However, this method allows extremely precise phase adjustment. The electronic method lets you reset the home position using front panel controls alone. However, it may prove difficult to achieve the desired accuracy with this method, as it entails judging the accuracy of the phase adjustment while observing the source at an angle through a view port.

Electromechanical Method

DANGER: HIGH VOLTAGE

Observe all applicable high-voltage precautions in performing the following procedure. These precautions include making sure that the high-voltage is OFF and using a properly connected grounding rod to neutralize any residual charge on the structures on and around the source tray.

STEP NO. PROCEDURE

1 Make sure that the high-voltage power supply is switched OFF.

2 If the power supply is equipped with a key lock, remove it and keep it in your pocket while you complete this procedure.

3 Lower the source tray, open the vacuum enclosure ' s access doors, and swing

the source tray away from the enclosure.

4 Using a properly connected grounding hook, touch the source tray and the frame of the vacuum enclosure in several places to neutralize any residual high-voltage charge.

5 Make sure the MAN/AUTO switch on the control unit's front panel is set to MAN.

6 Use the thumbwheel on the control unit's front panel to select pocket 1

7 Switch on the indexer, if it is not already on. After going through some rotation involved in its initialization routine, the indexer will rotate the hearth to the factory-set home position for pocket 1.

8 If pocket 1 is not correctly centered within the cutout in the top of the source, switch off the indexer.

9 Turn the hearth by hand until pocket 1 is precisely centered within the cutout.

10 Using the end of a paper clip or some other small-diameter probe, push in the spring-loaded phase adjustment pushbutton and keep it depressed as you switch on the indexer and as the hearth goes through its initialization routine. (This routine involves what may appear to be random rotation.) Release the pushbutton only after the hearth has returned to the new home position for pocket 1 and stopped. If this is not the correct home position, switch off the indexer and repeat steps 9 and 10.

11 Use the pocket selection thumbwheel to change pockets several times, checking to see that each pocket goes to the correct home position. If the hearth does not remain properly in phase, return to pocket 1 and repeat steps 9 - 11.

Electronic Method

STEP NO.	PROCEDURE
1	Make sure the MAN/AUTO switch on the control unit's front panel is set to MAN.
2	Use the thumbwheel on the control unit's front panel to select pocket 1.
3	Switch on the indexer, if it is not already on. After going through some rotation involved in its initialization routine, the indexer will rotate the hearth to the factory-set home position for pocket 1.
4	If pocket 1 is not correctly centered within the cutout in the top of the source, switch off the indexer.
5	Switch the indexer on and off rapidly, watching the hearth move a small amount each time you do so. When pocket 1 is centered in the cutout, leave the indexer switched off.
6	Using the end of a paper clip or some other small-diameter probe, push in the spring-loaded phase adjustment pushbutton and keep it depressed as you switch on the indexer and as the hearth goes through its initialization routine. (This routine involves what may appear to be random rotation.) Release the pushbutton only after the hearth has returned to the new home position for pocket 1 and stopped. If this is not the correct home position, switch off the indexer and repeat steps 5 and 6.
7	Use the pocket selection thumbwheel to change pockets several times, checking to see that each pocket goes to the correct home position. If the hearth does not remain properly in phase, return to pocket 1 and repeat steps *5-7.*

Section 2.11: Rotation speed and torque selection for pocket seeking

The SRT-422 provides the ability to select between three speed/torque relationships by configuring the internal DIP switches. There is a four to one gear reduction within the source, which produces the reduced speed and increased torque at the Hearth.

	Rotation Speed			**Rotation Torque**			
Setting	**Indexer**	**Hearth**		**Indexer**		**Hearth***	
High Speed	9.25 rpm	2.31	rpm	120	In-oz.	480	In-oz.
Mid Speed	7.0 rpm	1.75	rpm	156	In-oz.	625	In-oz.
Low Speed	5.0 rpm	1.25	rpm	180	In-oz.	720	In-oz.

Table 2.3: Rotation Speed and Torque

The high speed/low torque setting is desired when you want the indexer to get to the next pocket as soon as possible, or when you want the indexer to stop rotating in the event that evaporant material build up is starting to causing mechanical interference between the hearth and the cover. The low speed/high torque setting may be desired when the drive feedthrough mechanism is producing a lot or resistance to rotation. It is also desirable when you do not want the indexer to stop rotation (i.e. during a process sequence) in the event that the evaporant material build up is starting to cause mechanical interference between the hearth and the cover. In any case, if a significant amount or resistance is created by either excessive material build-up or improperly aligned drive components, the indexer will stop rotating and signal a stall. If a stall occurs, the pocket-position LED flashes between zero and the number of the current pocket position. A stall can occasionally be cleared temporarily by cycling power to the indexer, however the cause of the stall should be addressed as soon as possible. Changing the speed torque setting affects the torque and speed when the indexer is seeking out a new pocket, however it does not affect the speed or torque when oscillating within a banana pocket or while in the continuous-rotation mode. While using these modes, the torque will be greater than 180 in-oz (at the indexer) due to the slow rotation speeds.

*The value for rotation torque at the hearth in the table above does not include friction losses or gear efficiency. The actual value would be less, and will depend on the amount of loss within the drive system.

SECTION 3

INSTALLATION

Section 3

Installation

Section 3.1: Introduction

The Indexer is shipped from the factory with an assigned home position for pocket #1. In general, it will be difficult to install the Indexer in such a manner that home position of pocket #1 of the Indexer correspond exactly to the actual center of pocket 1 of the source. The need to adjust the phase between the Indexer and the E-Beam Source will generally occur after the initial mechanical installation. There are two ways to accomplish this phase adjustment mechanically or electronically.

The SRT-422 Motor drive is packaged in a compact case. A ¼" shaft with flat, provides the output drive.

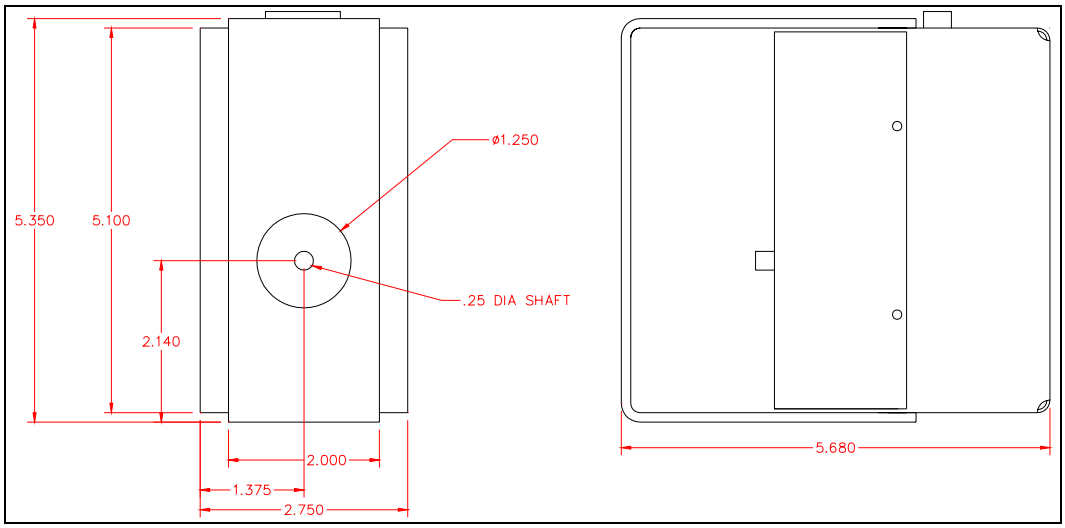

Figure 3.1: SRT-422 Motor Drive unit.

Section 3.2: Electrical Connections and Descriptions

Line Voltages

Unit is capable of running on both 230 Volts and 115 Volts. There is a switch located on the connector panel of the unit to select for the proper voltage requirements.

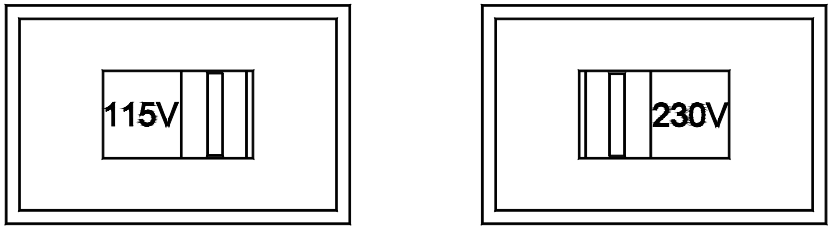

Figure 3.2: Line Voltage Selection Switch

The SRT-422 is supplied with an IEC type power cord for 115 Volt operation. If 230 Volt operation is required, use the proper IEC power cord and change fuse to 1/8 amp SB.

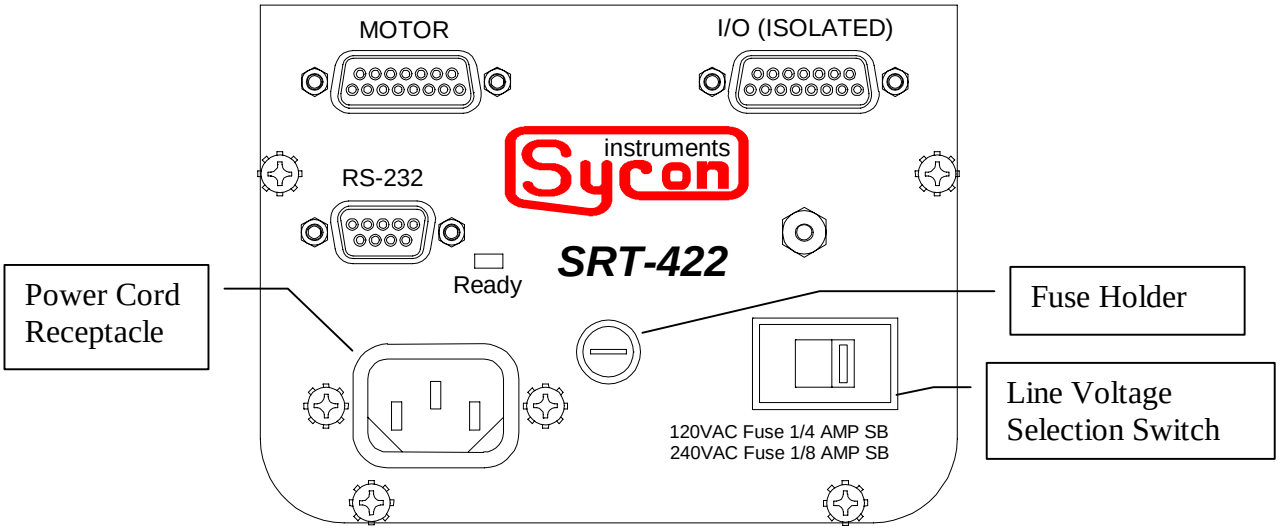

Figure 3.3: SRT-422 Rear Panel

WARNING! Operating with incorrect line selection will damage unit!

Section 3.3: Internal Configuration Switches

The SRT-422 is capable of controlling several different types of multi-pocket E-Beam Sources (4 Pocket, 6 Pocket, 4 Pocket UHV, and Continuous Trough). It can also be configured to rotate in a uni or bi-directional manner. In addition, a RS232 Serial Computer Line at set baud rate can access it serially. The control unit contains eight internal DIP switches that enable you to configure the unit to support your application. Four of these DIP switches configure the indexer for use with a specific source type.

Caution! DIP switches 1-6 MUST be set properly

Internal DIP switches 1-6 MUST be set properly to configure the indexer for the type of hearth it will be controlling. Failure to set these switches correctly will lead to improper operation and may

result in damage to the source.

Section 3.4: setting the configuration dip switches

The control unit contains eight internal DIP switches that enable you to configure the unit to support your application. Three of these DIP switches configure the indexer for use with a specific source type. The other switches allow you to select uni- or bidirectional motion, the rotation direction, RS -232 communications enabled/disabled, and the baud rate for RS-232 communications.

WARNING!

Procedures involving the controller's internal circuitry may be hazardous if attempted with the AC power cord connected.

Before attempting to change any DIP switch settings, it is essential to ensure that the AC power is not connected to the controller. If the unit has been in use, first use the front-panel switch to power down the unit. Then disconnect the unit's AC power cord.

To gain access to the DIP switches, you must slide back the control unit's top cover. To do so, first insert a thin, flat-bladed screwdriver beneath the rear edge of the cover and pry it up enough so that the retainer dimple in its rear edge clears the top edge of the controller's rear panel. Then you can easily slide the cover back by applying thumb pressure to it and pushing rearward. When you have finished setting the DIP switches, slide the cover forward until the retainer snaps into place, firmly securing the cover. The switch block containing the DIP switches is mounted along the front edge of the controller's main printed circuit board. If you look at the board from a position above the front panel, you will see the switch block near the right-hand edge of the board. The DIP switches are on the side of the switch block that faces the front panel. Note that they are numbered I through 8 from left to right, as viewed from the front end of the control unit.

The figure below illustrates the eight DIP switches from this point of view and lists the effects of their settings in tabular form. Note that these switches slide rather than rock up and down to change position and that the ON position is up.

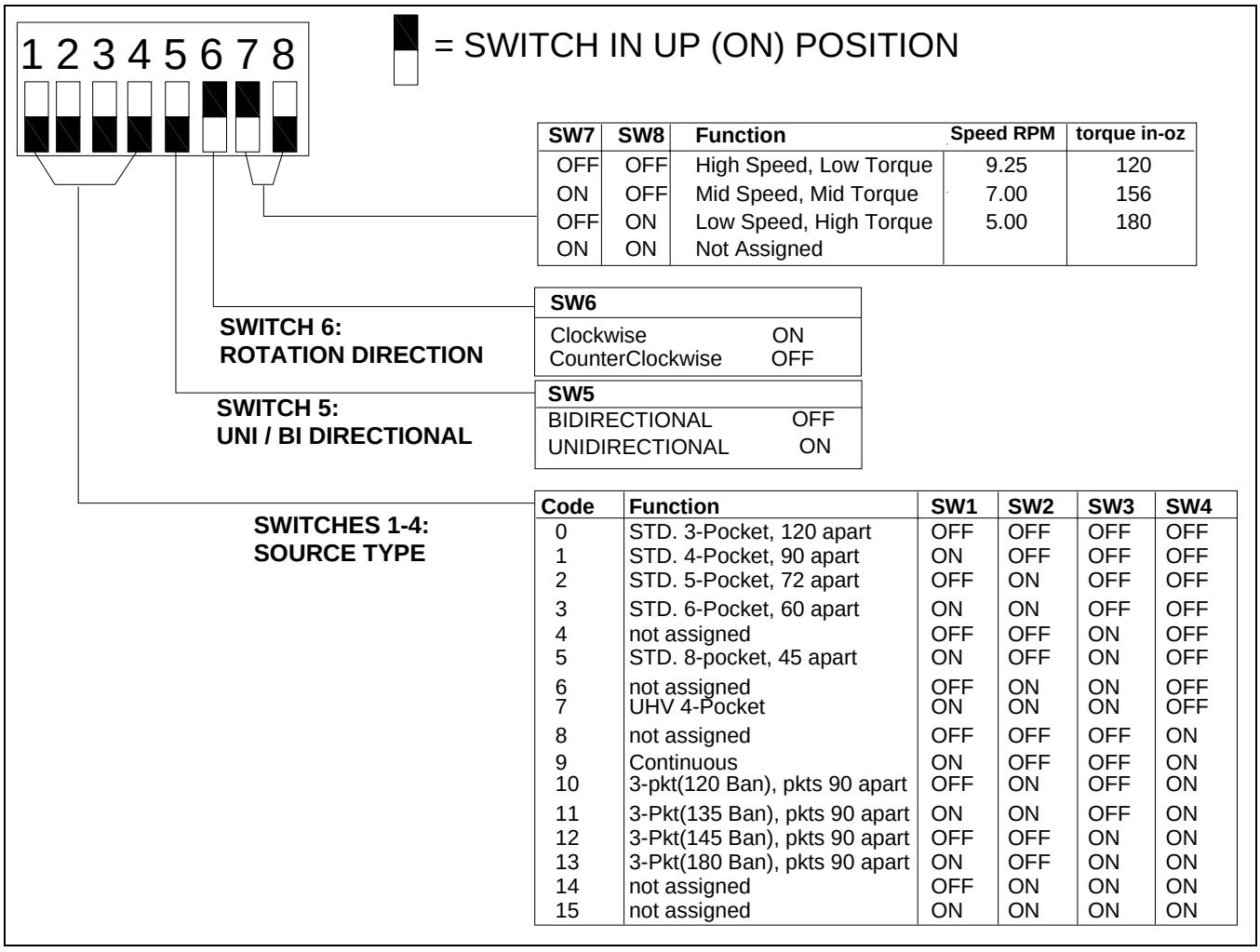

Figure 3.4: Configuration Switch

Internal switches select all the above modes or functions. An eight-position dipswitch is located at the top end of the main control printed circuit board within the SRT-422. To access this switch, first disconnect any line power. Remove the six socket head cap screws, which hold the bottom connector panel to the side extrusions. Slide out the back panel and PC Boards until this switch is accessible. Make the desired configuration settings and reassemble the unit.

Section 3.5: Description of Configuration Switches

SW1, SW2, SW3, SW4 -- The first four switches are used to match the Indexer to the type of source being controlled.

SW5 -- Rotation Type. Controls whether the Indexer moves in a single direction or a bi-directional path. (Bi-directional should be selected if shortest path operation is desired). Switch 5 allows you to select uni- directional or bi-directional rotation. If uni-directional rotation is selected (switch 5 ON), the direction of rotation is determined by the setting of switch 6. If bidirectional rotation is selected (switch 5 OFF), the indexer will employ shortest-path indexing in moving between the pockets of rnultipocket sources.

SW6 -- This switch defines the relationship between pocket 1 and pocket 2 of the source. It should be set at the same sense, which the Indexer should rotate to move the source between pocket 1 and pocket 2, e.g. clockwise or counter clockwise. The setting of switch 6 determines the direction of hearth rotation in unidirectional mode and the primary rotation direction in bidirectional mode. For both uni- and bidirectional operation, the orientation of pocket numbering (i.e., which direction is “forward” or upward though the pocket numbers) also changes depending on the setting of DIP switch 6. The figure below illustrates this in the case of a 4-pocket source. When DIP switch 6 is on, the indexer will operate such a source as if its pockets were numbered 1-4 counterclockwise (hearth rotates clockwise). When this switch is off, the indexer will operate the same source as if its pockets are numbered 1-4 clockwise (hearth rotates counterclockwise). The same principle applies to all other source types.

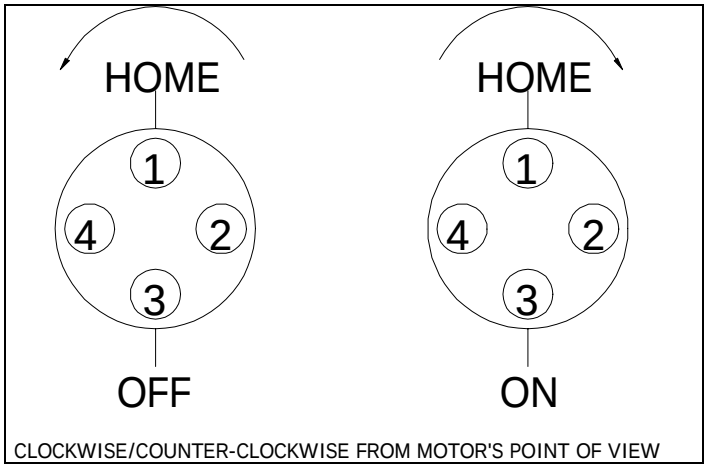

Figure 3.5: Orientation of pocket numbering changes depending on the setting of DIP switch 6

(Note: The output shaft of the index drive unit rotates counterclockwise when D/P switch 5 is on and clockwise when this switch is off. Because of the effect of the internal gears in the sources supported by the SRT-422, output shaft rotation is in the opposite direction from hearth rotation.)

NOTE

When planning for multipocket deposition, it is critical to bear in mind that the setting of switch 6 determines the orientation of pocket numbering. The pockets of a 4-pocket source must be thought of as being numbered 1-4 in a clockwise direction when switch 6 is on and 1-4 in a counterclockwise direction when switch 6 is off.

SW7, SW8 -- Rotation Speed and Torque As shown, Switch 7 and 8 allow you to select between three speed and torque settings. If high speed is selected (switch 7 and 8 OFF) the indexer will seek out the next pocket, when commanded, at the highest speed rate. If mid-speed is selected (switch 7 OFF and switch 8 ON) the indexer will seek out the next pocket at an intermediate speed and torque. If low-speed is selected (switch 7 OFF, switch 8 ON) the indexer will produce the highest torque while seeking out the next pocket, however it will be at a Lower speed.

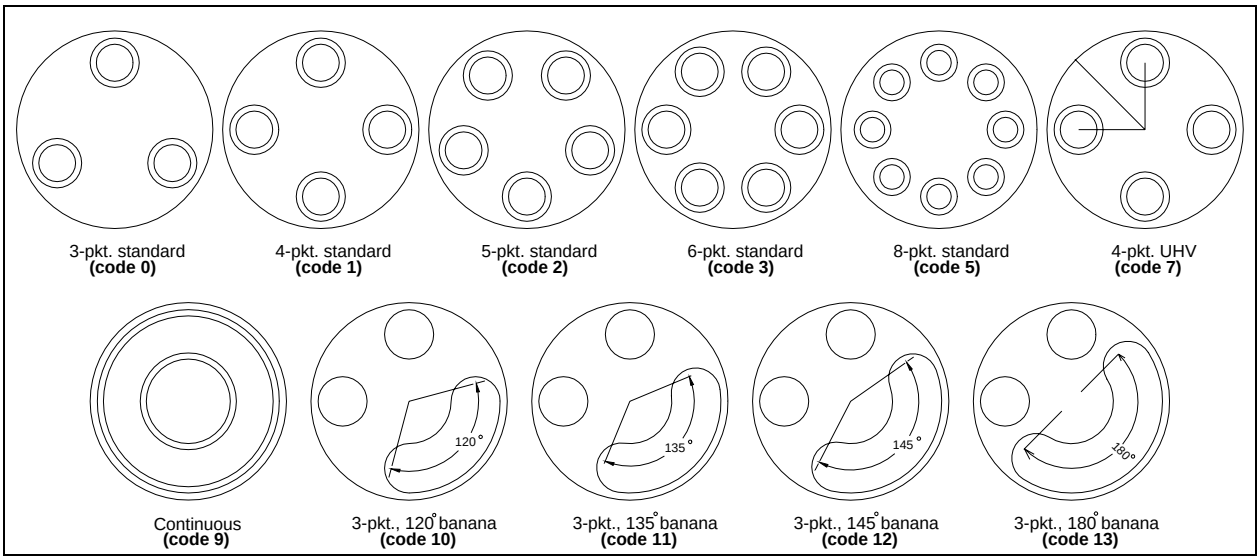

Figure 3.6: Source types supported by the SRT-422

Standard Multi-pocket Sources (Codes 0-5)

When switches 1-4 are set for code 1, the unit is configured to operate a standard 4-pocket source. When these switches are set for code 3, the unit is configured to operate a standard 6-pocket source. When these switches are set for code 5, the unit is configured to operate a standard 8-pocket source. The switch positions that select these codes are:

Code Number	DIP SW1	DIP SW2	DIP SW3	DIP SW4
Code 0	OFF	OFF	OFF	OFF
Code 1	ON	OFF	OFF	OFF
Code 2	OFF	ON.	OFF	OFF
Code 3	ON	ON	OFF	OFF
Code 5	ON	OFF	ON	OFF

Table 3.1: Codes 0 – 5 DIP Switches settings.

UHV 4-Pocket Sources (Code 7)

If the SRT-422 is to be used with a UHV 4-pocket source, switches 1-4 must be set for code 7. In addition, switch 5 must be set for bidirectional motion. The switch positions that select code 7 are:

Code Number	DIP SW1	DIP SW2	DIP SW3	DIP SW4
Code 7	ON	ON	OFF	OFF

Table 3.2: Code 7 DIP switch settings

CAUTION!

Switches 1-5 MUST he set as described above when the SRT-422 is controlling a UHV 4-pocket source. Damage to the source and / or its bellows are likely to occur if switches 1-4 are set for a UHV source and switch 5 is set for unidirectional rotation There are no limits programmed for unidirectional motion in UHV mode, as there are for bidirectional rotation in that mode.

This mode has a programmed "software barrier" that prevents the hearth from rotating in either direction between pocket 1 and the pocket next to it in the counterclockwise direction. This programming serves to prevent damage to the special bellows attached to the hearth in that location on UHV sources. To move the hearth between these two pockets, the indexer does not simply rotate the hearth 90° along the shortest path. Instead, the hearth is rotated 270° in the opposite direction. The indexer employs shortest-path rotation when rotating the hearth between any two other pockets.

Three-Pocket Hearths with One Banana-Shaped Pocket (Codes 10-13)

When switches 1 - 4 are set to codes 10, 11, 12 and 13, the indexer is configured for hearths with two conventional pockets 90° apart and one banana-shaped pocket. These three codes configure the indexer to support "bananas" of differing arc lengths.

- Code 10 sets the indexer for a three-pocket hearth with a "banana" covering 120° of arc.
- Code 11 sets the indexer for a three-pocket hearth with a "banana" covering 135° of arc.
- Code 12 sets the indexer for a three-pocket hearth with a "banana" covering 145° of arc.
- Code 13 sets the indexer for a three-pocket hearth with a 'banana" covering 180° of arc.

The switch positions that select these codes are:

Code Number	DIP SW1	DIP SW2	DIP SW3	DIP SW4
Code 10	OFF	ON	OFF	ON
Code 11	ON	ON	OFF	ON
Code 12	OFF	OFF	ON	ON
Code 13	ON	OFF	ON	ON

Table 3.3: Codes 10 – 13 DIP switch settings

NOTE

When switches 1-4 are set to any of these FOUR codes, switch 5 MUST be set for bidirectional motion. If unidirectional motion is selected, the indexer will not move the "banana" correctly.

In any of these "banana" modes, the indexer moves pockets 1 and 2 to the home position when it receives the pocket-select codes for those pockets. When the

indexer receives any of the pocket-select codes for pockets 3 through 7, it moves the banana-shaped pocket to the home position and then begins oscillating the hearth in such a way that the e-beam sweeps from one end of the “banana” to the other. Pocket select codes 3-7 determines the speed of the oscillating motion, as the Table below indicates. When the indexer receives the pocket-select code for pocket 8, it moves the midpoint of the “banana” to the home position and stops.

Hearths with Full-Circle Evaporant Troughs (Code 2)

If switches 1-3 are set for this type of hearth (code 2), the hearth will rotate continuously in the direction set via switch 5. The setting of switch 4 has no effect on rotation in this mode. The switch settings that select code 2 is in this mode, the pocket-select codes for pockets through 7 determine the hearth’s rotation speed, as indicated in the table below. The pocket-select code for pocket 8 stops or prevents hearth rotation.

Pocket Selected	Hearth Rotation Speed
1	.845 RPM
2	.732 RPM
3	.630 RPM
4	.515 RPM
5	.405 RPM
6	.295 RPM
7	.187 RPM
8	0 RPM

Table 3.4: Hearth rotation in continuous mode .

Section 3.6: configuring the opto-isolator pc board for 24-vdc I/Os

The control unit's opto-isolated I/Os are factory configured to operate on 9 V dc supplied by an internal power supply. However, the control unit's opto-isolator board can also be configured to operate on +24 V dc supplied by an external source. Follow the steps described below to accomplish this reconfiguration.

STEP NO. PROCEDURE

1 Make sure the power cord is not connected to the control unit.

2 Remove the four screws that secure the control unit's rear panel (see Figure Below).

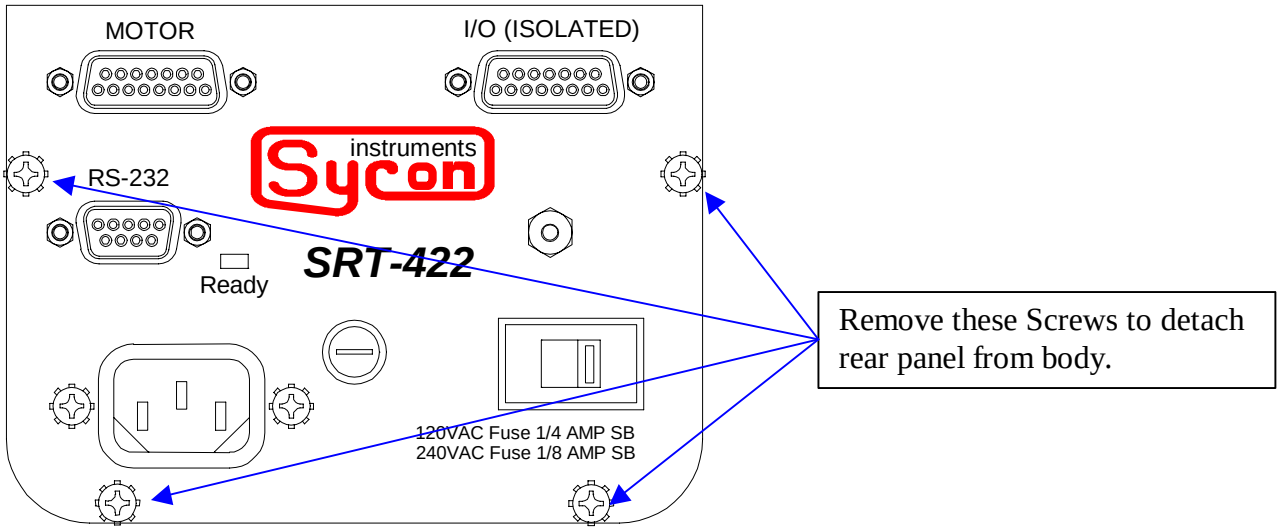

Figure 3.7: Locations of screws that secure the control unit's rear panel to its body

3 Grasp the rear panel and pull it backwards until it is approximately an inch away from the body of the controller.

4 The jumper blocks to be reconfigured are mounted on the underside of the opto-isolator PC board, which is the topmost board in the unit. Turn the control unit upside down and find the legend JP1 on the underside of this board. You will find this legend near the rear of the board and along the edge of the board that is closest to the rear-panel connector labeled I/O (ISOLATED). Jumper block JPI is just behind the legend JP1 (or just to the right of this legend, if you are looking at it from the side of the controller).

5 The pins on jumper block JPI are numbered from left to right as you face the side of the controller that the jumper block is on. From that point of view, pin 1 is on your left, pin 2 is in the middle, and pin 3 is on your right. The jumper across this jumper block is factory installed so that it covers pins 1 and 2, leaving pin 3 exposed. Remove the jumper and replace it so that it covers pins 2 and 3, leaving pin 1 exposed.

7 JP2 is behind and at right angles to JP1 (i.e., behind JP1 with respect to the controller's front panel). On this jumper block, pin 1 is the pin nearest the edge of the board; pin 2 is in the center, and pin 3 is nearest to the center of the board. Like

JP1 , this jumper block is factory configured so the jumper covers pins 1 and 2, leaving pin 3 exposed. Remove the jumper and replace it so it covers pins 2 and 3, leaving pin 1 exposed.

8 Grasp the controller' s rear panel and slide it forward until it is in contact with the body of the controller. As you do so, take care that the green ground wire connected to the inside of the rear panel does not get pinched between the rear panel and the controller's body.

9 Replace the four screws that secure the rear panel to the body of the controller.

Section 3.7: Initial Bench Test

After the configuration dipswitch has been set to the desired pocket type and the unit is reassembled it is useful to confirm the setting by running the unit on the test bench. To do this first connect the 15-pin Remote Selection Panel cable to the Indexer. Attach the power cord and plug in to appropriate voltage. (See line voltage selection Refer to Section 3.2). Turn on power switch on bottom of Indexer. Place remote panel Auto/Man switch the manual mode . Select the different pocket number using the thumbwheel switch and observe the rotation of the output shaft of the Indexer. Remember this model of the Indexer is design for 4 to 1 reduction between the Indexer and the rotatable hearth. This means the Indexer will turn 360 degrees for a 90-degree rotation of the hearth.

It is a good idea to bench test the indexer after the control unit is configured for your application. Follow the steps described below in performing this test.

STEP NO. PROCEDURE

1 Find the motor cable. This is the 25-foot cable supplied to connect the control unit to the index drive unit.

2 The motor cable has a 1 5-pin 'D' connector on each end. Plug the male 'D' connector on one end of the cable into the socket labeled MOTOR on the control unit's rear panel.

3 Plug the female 'D' connector on the other end of the motor cable into the 15-pin male connector on the end of the index drive unit.

4 Make sure the input power selection switch is set for the correct voltage

WARNING

Operating the SRT-422 with incorrect line voltage selected will damage the unit.

5 Make sure the power switch on the control unit's front panel is OFF.

6 Plug the correct power cable for the local AC power into the three-pronged plug on the control unit's rear panel. Plug the other end of this cable into an AC power socket.

7 Make sure the MAN/AUTO toggle switch on the control unit's front panel is set to

MAN. Note that this switch has a locking feature. To change its position, you must first pull the locking collar out toward you.

8 Set the front-panel thumbwheel to position 1, if it is not already at that position.

9 Using the ON/OFF switch on the control unit's front panel, switch on the indexer. If the internal DIP switches are set for a full circle evaporant carousel, the drive unit's output shaft will begin rotating continuously at its highest speed. If the DIP switches are set for any other type of source, the indexer will stop at the factory-set home position for pocket 1 after proceeding through various rotations involved in its initialization routine.

10 Change thumbwheel setting to select pocket 2. The indexer rotates to the pocket -2 position after going through rotations that vary depending on the settings of DIP switches 1-5.

11 Use the thumbwheel to select other pockets and observe the rotation of the output shaft.

12 When you have completed the bench-test, switch off the control unit, disconnect the AC power cable from the rear panel, and disconnect the motor cable from both the control unit and the index drive unit.

Section 3.8: System Installation

The standard unit is designed to be used with the E-Beam source, which has a 4 to 1 reduction within the source or a 4 to 1 reduction between the Indexer output shaft and the source. Thus 360 degrees of rotation of the Indexer shaft will cause a 4 pocket source to rotate 90°.

The most cost effective system installation is accomplished by the purchase of either the 1" or 2 ¾" Rotary Feedthrough Indexer and Adapter Kits from Sycon. If system configuration of space does not allow the use of these standard items, the Indexer should be rigidly mounted and the Indexer drive shaft be appropriately attached (minimum slop and backlash) to the airside of the Rotary Feedthrough.

A one-to-one directed connector is needed between the output shaft of the Indexer and the airside of the Rotary Vacuum Feedthrough. Sycon stocks the following items to assist in making the Mechanical connection from the output shaft of the Indexer to the air side of the Rotary Vacuum Feedthrough:

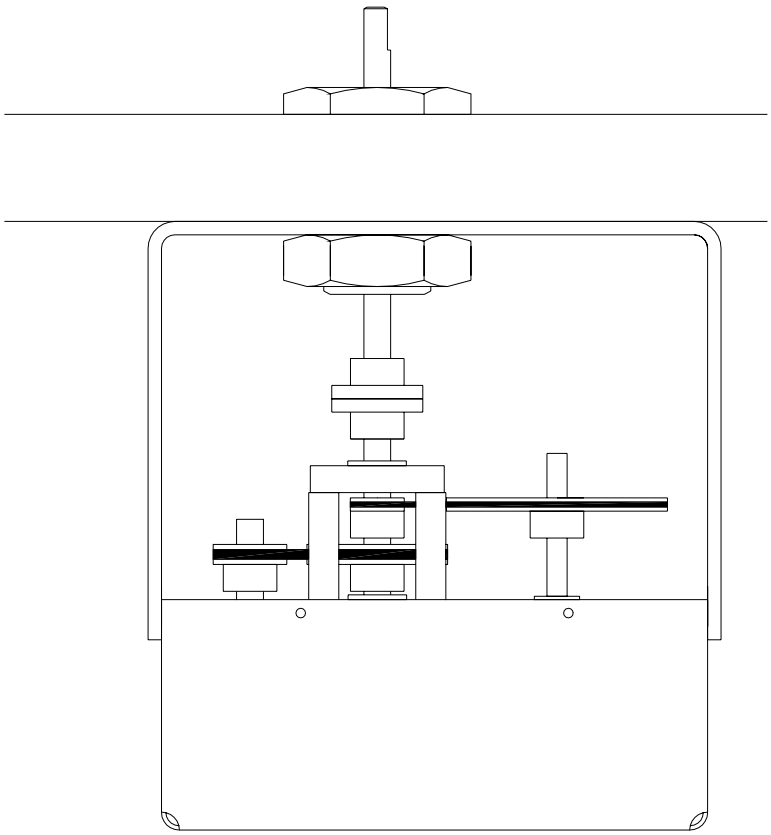

Figure 3.8: Motor Drive Unit

Section 3.9: Installing the Index-Drive Unit

The Figure above shows the index-drive unit properly installed on the underside of the source tray. The drive unit is held in place by the large nut on the underside of the 1 -inch-dia. rotary feedthrough.

DANGER: HIGH VOLTAGE

If a high-voltage power supply is installed in the vacuum system in which the SRT-422 is to be installed, observe all applicable high-voltage precautions in performing the following procedure. These precautions include making sure that the high-voltage is OFF and using a properly connected grounding rod to neutralize any residual charge on the structures on and around the source tray.

Follow the procedure described below in installing the drive unit.

STEP NO.	PROCEDURE
1	Perform the following sub steps only if a high-voltage power supply is connected to the vacuum system in which the SRT-422 is being installed. Otherwise, proceed to step 2.

(a) Make sure that the high-voltage power supply is switched OFF.
(b) If the power supply is equipped with a keylock, remove it and keef, it in your pocket while you complete this procedure.

2 Lower the source tray, open the vacuum enclosure's access doors, and swing the source tray out from the enclosure.

3 (This step may be skipped if a high-voltage power supply has not been connected to the vacuum system in which you are installing the SRT-422.) Using a properly connected grounding hook, touch the source tray and the frame of the vacuum enclosure in several places to neutralize any residual high-voltage charge.

4 Remove the attachment nut and flat washer (see Fig. 2-7) from the rotary feedthrough.

5 Put coupling PN 9015-0121-01 in place over the feedthrough input shaft and secure the coupling to that shaft with the coupling's upper set screw.

WARNING

To prevent binding during source rotation and to minimize alignment problems, it is essential to use the same type of flexible coupling to connect the feedthrough output shaft to the source's drive shaft.

6 Place the index-drive unit against the underside of the source tray so that the feedthrough threaded shaft extends through the hole in the yoke that spans the top of the drive unit. Make sure that the drive unit's output shaft fits up into the coupling.

7 Lower the index drive unit enough to put the flat washer and attachment nut back in place around the threaded portion of the feedthrough. Then restore the drive unit to the position described in step 6.

8 Screw the attachment nut all the way on, tightening it to approximately 10 ft-lbs.

9 Secure the coupling to the drive unit by tightening the coupling's lower set screw against the drive unit's output shaft.

10 Connect the female 'D' connector on one end of the motor cable to the 'D' connector on the index-drive unit, securing the connection with the screws on the 'D' connector.

Section 3.10: Installing the Control Unit

Follow the procedure described below in mounting the control unit in a standard 1 9-inch electronics rack.

STEP NO. PROCEDURE

1 Disconnect any cables that have been connected to the control unit's rear panel.

2 Put the half-with control unit in place a 5-1/4-in-high space in the electronics rack.

3 Secure the front panel to the rack with the four screws and cup washers provided.

4 Connect the input power cable to the plug on the control unit's rear panel.

5 Plug the other end of the power cable into a wall socket.

6 Make sure that the line voltage selection switch is set correctly (see Fig. 2-2)..

WARNING

Operating the SRT-422 with incorrect line voltage selected will damage the unit.

7 Connect the male 'D' connector on one end of the motor cable to the MOTOR connector on the control unit's rear panel. Use the screws provided on the 'D' connector to secure it to the MOTOR connector.

Section 3.11: Indexer and System Grounding

A grounding stud is provided on the control unit's rear panel. Use a 16-gauge or larger wire to ground this stud to the electronics rack. Because the rack as a whole is likely to be subject to RF interference, it is strongly recommended that a low-impedance ground be provided for the system. The figure below shows a method of setting up such a ground.

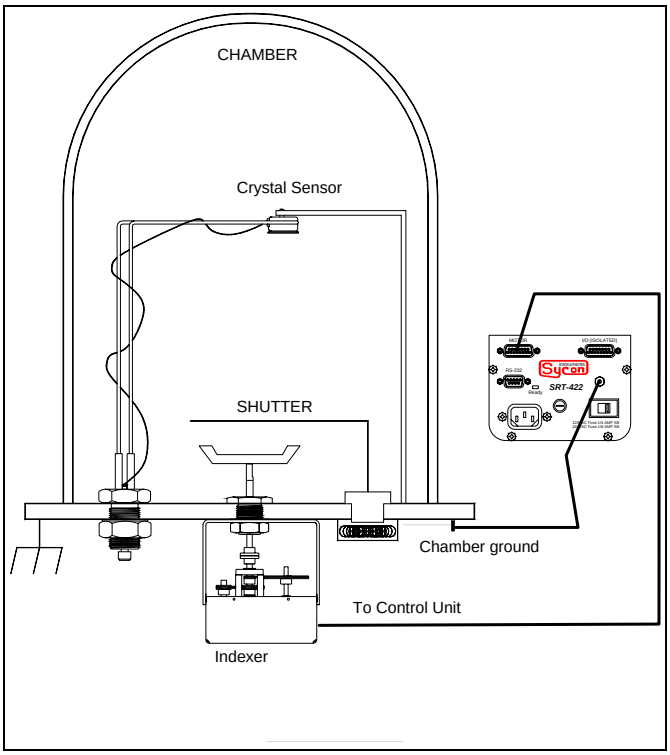

Figure 3.9: SRT-422 Grounding

Section 3.12: initial phase adjustment

The home position will almost certainly have to be reset after the indexer is installed. This initial phase adjustment can be accomplished in either of two ways, both described in detail below. The electromechanical method necessitates breaking vacuum and lowering and swinging out the source tray. However, this method allows extremely precise phase adjustment. The electronic method lets you reset the home position using front panel controls alone. However, it may prove difficult to achieve the desired accuracy with this method, as it entails judging the accuracy of the phase adjustment while observing the source at an angle through a view port.

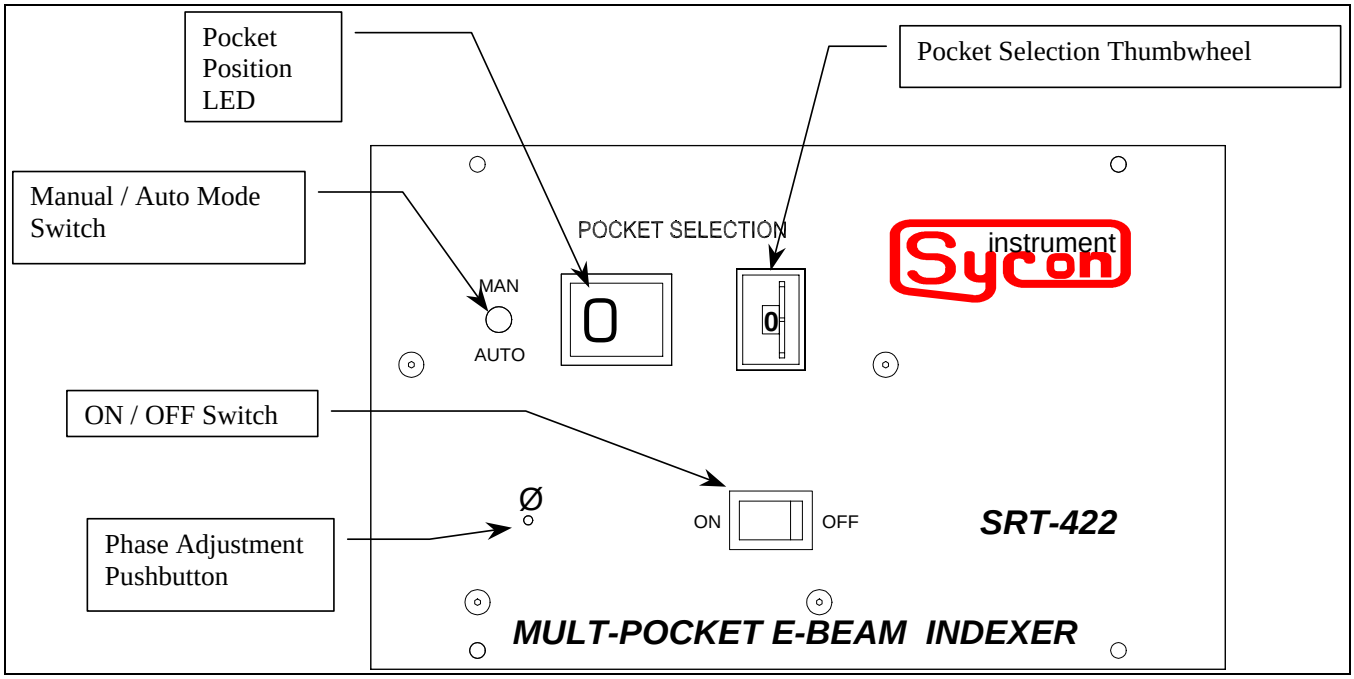

Figure 3.10: Control/display features on the control unit's front panel

Electromechanical Method

DANGER: HIGH VOLTAGE

If a high-voltage power supply is installed in the vacuum system in which the SRT-422 has been installed, observe all applicable high-voltage precautions in performing the following procedure. These precautions include making sure that the high-voltage is OFF and using a properly connected grounding rod to neutralize any residual charge on the structures on and around the source tray.

STEP NO. PROCEDURE

1 Perform the following sub steps only if a high-voltage power supply is connected to the vacuum system in which the SRT-422 is being installed. Otherwise, proceed to step 2.
(a)Make sure that the high-voltage power supply is switched OFF.

(b)If the power supply is equipped with a key lock, remove it arid keep it in your pocket while you complete this procedure.

2 Lower the source tray, open the vacuum enclosure's access doors, and swing the source tray away from the enclosure.

3 (This step may be skipped if a high-voltage power supply has not been connected to the vacuum system in which you are installing the SRT-422.) Using a properly connected grounding hook, touch the source tray and the frame of the vacuum enclosure in several places to neutralize any residual high-voltage charge.

4 Make sure the MAN/AUTO switch on the control unit's front panel is set to MAN.

5 Use the thumbwheel on the control unit's front panel to select pocket 1.

6 Switch on the indexer, if it is not already on. After going through some rotation involved in its initialization routine, the indexer will rotate the hearth to the factory-set home position for pocket 1.

7 If pocket 1 is not correctly centered within the cutout in the top of the source, switch off the indexer.

8 Turn the hearth by hand until pocket 1 is precisely centered within the cutout.

9 Using the end of a paper clip or some other small-diameter probe, push in the spring-loaded phase adjustment pushbutton and keep it depressed as you switch on the indexer and as the hearth goes through its initialization routine. (This routine involves what may appear to be random rotation.) Release the pushbutton only after the hearth has returned to the new home position for pocket 1 and stopped. If this is not the correct home position switch off the indexer and repeat steps 8 and 9.

10 Use the pocket selection thumbwheel to change pockets several times, checking to see that each pocket goes to the correct home position. If the hearth does not remain properly in phase, return to pocket 1 and repeat steps 8-10.

Electronic Method

STEP NO. PROCEDURE

1 Make sure the MAN/AUTO switch on the control unit's front panel is set to MAN.

2 Use the thumbwheel on the control unit's front panel to select pocket 1.

3 Switch on the indexer, if it is not already on. After going through some rotation involved in its initialization routine, the indexer will rotate the hearth to the factory-set home position for pocket 1.

4 If pocket 1 is not correctly centered within the cutout in the top of the source, switch off the indexer.

5 Switch the indexer on and off rapidly, watching the hearth move a small amount each time you do so. When pocket 1 is centered in the cutout, leave the indexer switched off.

6 Using the end of a paper clip or some other small-diameter probe. push in the spring-loaded phase adjustment pushbutton and keep it depressed as you switch on the indexer and as the hearth goes through its initialization routine. (This routine involves what may appear to be random rotation.) Release the pushbutton only after the hearth has returned to the new home position for pocket 1 and stopped. If this is not the correct home position, switch off the indexer and repeat steps 5 and 6.

7 Use the pocket selection thumbwheel to change pockets several times, checking to see that each pocket goes to the correct home position. If the hearth does not remain properly in phase, return to pocket 1 and repeat steps 5-7.

Section 3.13: making system connections via the rear panel I/O interface

The I/O (ISOLATED) connector on the control unit's rear panel provides an opto-isolated interface for exchanging digital signals with other system components. The user must supply cabling between this connector and external devices. The figure below identifies the signals that can be exchanged via this connector and shows the function of each pins Power for the I/Os can be either internally or externally supplied. If internally supplied, the I/Os are -9 Vdc when low and +9 Vdc when high. If externally supplied, they are 0 Vdc when low and +24 Vdc when high. Outputs are limited by the indexer's internal circuitry to a maximum of 10 ma per output. If you use the internal +/- 9 Vdc supply, connect pin 1 4 on the I/O connector as the ground. If an external +24 Vdc is supplied, connect pin 15 as the ground.

Interlock Connections

One of two signals (either the POCKET GOOD output or the system interlock input) must be connected to provide an interlock that will prevent the e-beam from damaging portions of the hearth while it is rotating. The POCKET GOOD output is high as long as a given pocket is within 5° of the calibrated home position. To use this signal as the indexer's interlock, connect pin 5 on the I/O connector to the electron beam power supply in such a way that the power supply is switched off when POCKET GOOD goes low. If you are using a Temescal Simba 2 power supply, connect this wire to the input for the power supply's AUXiliary interlock. Refer to the Simba 2 manual for detailed instructions.

Alternatively, if a system interlock signal is input via pin 3, the signal high when as it is not safe for the hearth to rotate. Such an interlock would prevent hearth rotation when the e-beam is on. However, this arrangement would not protect the source from damage if the hearth should get severely out of phase.

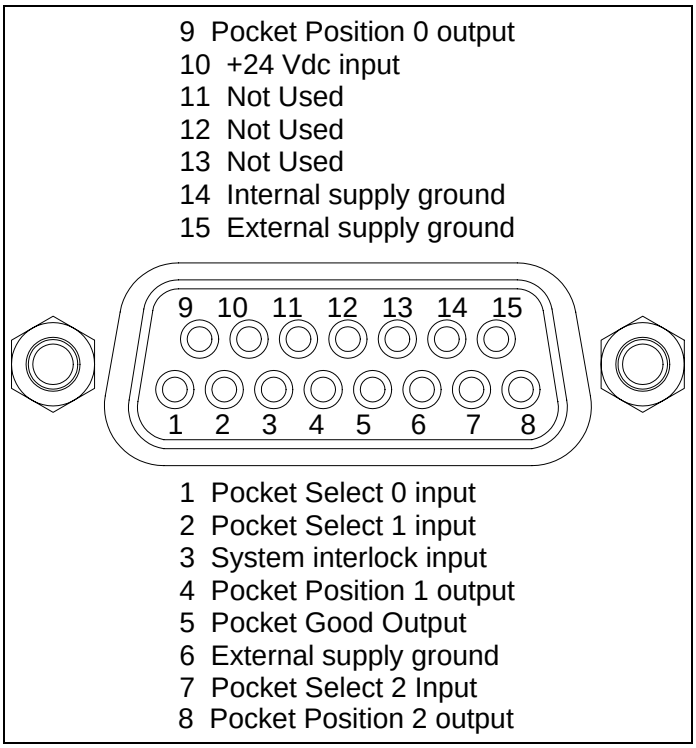

Figure 3.11: Pinout for the rear panel I/O (ISOLATED) connector

Pins 1, 2, and 7 (Pocket SELect Inputs 0,1, and 2 respectively)

When the front-panel MAN/AUTO switch is set to AUTO, these inputs control pocket selection in multipocket modes and rotation speed in banana and continuous modes. Table 2-3 shows the digital code required to select each pocket and correlates those codes to the pins 1 , 2, and 7.

		Pocket	1	2	3	4	5	6	7	8
LSB	A	Pin 1 (SEL 0)	0	1	0	1	0	1	0	1
	B	Pin 2 (SEL 1)	0	0	1	1	0	0	1	1
MSB	C	Pin 7 (SEL 2)**	0	0	0	0	1	1	1	1

Table 3.5: Pocket-select codes input via pins 1, 2, and 7

**SEL2 not required for four pocket configurations

Pin 3 (System Interlock Input)

This is a user-defined interlock input. The drive motor cannot turn when this signal is true.

Pins 4, 8, and 9 (Pocket POSition Outputs 1, 2, and 0, respectively)

These outputs indicate the current pocket location. The Table below shows the digital code for each pocket position and correlates those codes to pins 4, 8, and 9.

	Pocket	1	2	3	4	5	6	7	8
LSB	Pin 9 (POS0)	0	1	0	1	0	1	0	1
	Pin 4 (POS1)	1	0	0	1	1	0	0	1
MSB	Pin 8 (POS2)	1	1	1	0	0	0	0	1

Table 3.6: Pocket-position codes output via pins 4, 8, and 9

Pin 5 (POCKET GOOD Output)

This output is high when the selected pocket is within 5° of the calibrated home position. Directions for using this signal as the indexer's interlock are provided above.

Pin 6 (External Supply Ground)

If you are providing +24 V dc from an external source to power the I/Os, either this pin or pin 15 must be connected to the ground of the external power supply.

Pin 10 (External Supply Positive Input)

Pin 10 is the input point for the externally supplied +24 Vdc that can be used to power the I/Os. The control unit's opto-isolator PC board must be reconfigured if you wish to use 24-V I/Os.

Pins 11, 12, and 13

Not used.

Pin 14 (Internal Supply Ground)

If you are using the internally supplied voltage (9 Vdc) to power the I/Os, a ground for this supply must be connected to pin 14 the unit is factory configured to operate with this voltage.

Pin 15 (External Supply Ground)

This pin is internally connected to pin 6. Ground for the external supply can be connected to either pin.

Section 3.14: making system connections via the rear panel rs232 interface

The RS-232 connector on the control unit's rear panel enables you to establish serial communications between the SRT-422 and a host computer, a deposition controller, or another system component. This section describes the interconnection details. For further information on implementing serial communications see the section on serial protocol.

The user must supply cabling for RS-232 communications. The figures below show the pin-by-pin connections required. The figure shows how the 9-pin male connector that would plug into the indexer's RS-232 port must be wired to a 9-pin connector that would plug into the RS-232 port on an external device. Figure also shows how the 9-pin male connector that would plug into the indexer must be wired to a 25-pin connector that would plug into the external device.

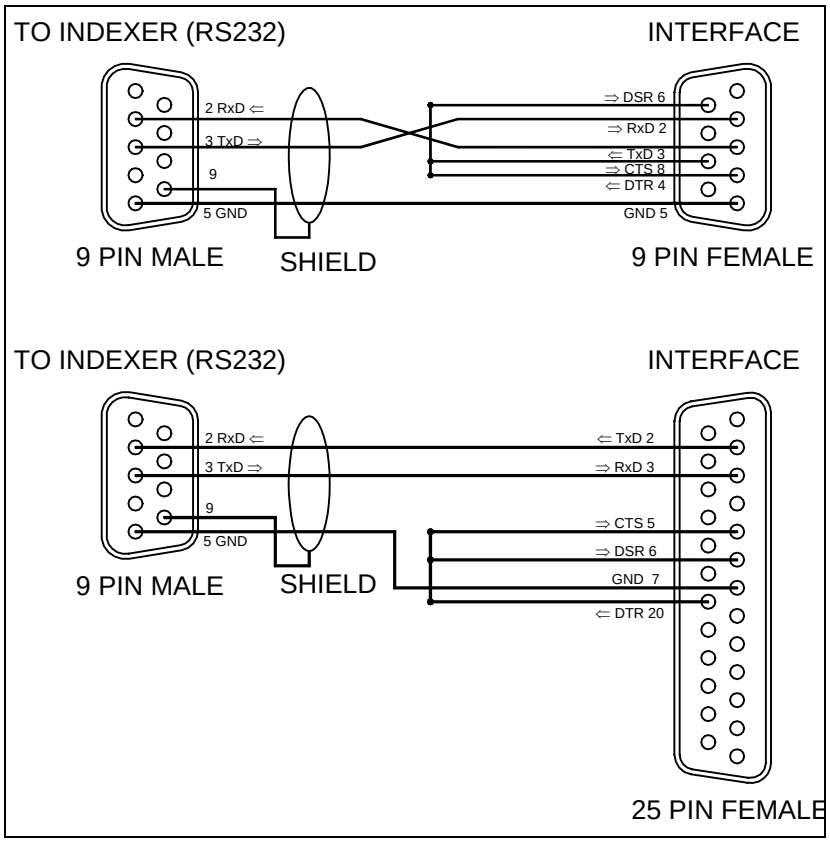

Figure 3.12: Connections required for RS-232 communications between the SRT-422 and a remote device with a 9-pin RS-232 port and a 25 pin RS-232 port.

Section 3.15: Warranty Repair and Replacement

5 Year Service Policy

Sycon warrants the SRT-422 for 1 year. After that period, Sycon will replace or repair the SRT-422 for a fixed charge of $175 during the 4 additional years. Rotary Vacuum Feedthrough are warranted by the manufacturer

Section 4

Serial Communications

Section 4

Computer Interfacing

The Source Indexer can be connected to a computer or system controller through its standard RS-232 interface. A simple ASCII protocol is used to send data or commands to, or to read data from the SRT. This section will describe this protocol and the command set and the cabling required for operation with a PC.

RS-232 Interface

Section 4.1: RS-232 Description

RS-232 is an electrical specification for the transmission of data in a serial format. It defines and establishes the electrical compatibility of the communication link between two pieces of RS-232 equipped instruments. In addition to this RS-232 link a language of communication and a command set must be defined. Since most every piece of equipment has different data requirements, more often than not, the commands and the protocol to communicate to an instrument are unique.

Like the manual use of the Indexer, the RS-232 command set and protocol of the unit are simple and straightforward.

Section 4.2: Baud Rates And Cabling

After the proper cable connections are made, the baud rate of the computer and the SRT should be checked or set so that they are set the same.

Section 4.3: Setting The computer Baud Rate

If required, change the baud rate on your computer to the same baud rate as the SRT. The SRT is shipped from the factory set at 9600 baud. To set a PC to the 9600 baud rate, type in the DOS command:

Mode Com1:9600,N,8,1 <Enter>

This will set the PC for 9600 baud, no parity, 8 data bits, and 1 stop bit on its COM1 port. It is important to use 8 data bits because the protocol uses all of them. This assumes the SRT is cabled to COM1 of the PC type computer.

Section 4.4: ASCII Protocol

The SRT does not initiate any messages on its own. It responds only when “spoken” to . The format of the ASCII protocol used to send a message to the SRT is as follows:

$byte (byte) (byte...byte)CR

The ‘$’ is the start of a message. A single ASCII character is a byte. Either a space or comma separates different parameters in the command. Parameters can have multiple bytes. No space or comma separator exists between the ‘$’ and the first byte or the last byte and the CR. The number of parameters in a message depends on the command. A CR terminates the message. In the following paragraphs the CR (Carriage Return) or, optionally, the CR LF will be designated by **<cr>**.

Section 4.5: Communication Commands

A set of commands follow which when used allow control of and communications with the Source Indexer by a process controller or a PC type computer. These commands follow the ASCII protocol described above. The function of each command along with its form and a typical response is described below. *Note: In a response, the first byte after the '$' is the response byte which encodes the success or failure of the command and the status of the reset flag. See the paragraph following the command set for a complete explanation of the response byte.*

Section 4.6: Command Responses

In response to all messages received with a valid protocol, the first byte returned after the '$' is the response byte which may be one of the following.

	Reset Flag Cleared	**Reset Flag Set**
Message OK	'*'	'#'
Illegal Command	'3'	'4'
Illegal Data Value	'5'	'6'
Illegal Syntax	'7'	'8'

All commands received with a valid protocol ('$' first char and <cr> last char) will return some type of response based on the message received and the state of the Reset Flag. The Reset Flag is set when power is first applied to the unit. The Flag remains set until it is cleared by the RS-232 command R. The purpose of the Reset flag is to notify a remote control source that the SRT has been turned off and back on again or a power failure has occurred so it may take the appropriate steps if necessary. A typical control program would initially clear the Reset flag, then test the response byte of each response to see if some type of power failure has occurred.

For example, assume you have written a program to talk to the Indexer through the serial port. Your program is running and you set the current pocket to Three (3). After the pocket is set you have a power failure of short duration and the SRT is reset. Next you may issue a command and you notice the response byte indicates you had a power failure. This may be a problem for the following reason. Your program assumes you have set the current pocket of 3, but on a power fail reset the unit to pocket 1. An appropriate action at this point may be to set the correct pocket.

Response to a valid **Set Parameter** command. A response to a successful set command with the reset flag cleared would be **$*<cr>** where **$** and **<cr>** are the protocol, ***** says the message was received and there has been no power failures since the Reset flag was cleared.

Response to a valid **Ask Parameter** command
A response to a successful ask command with the reset flag set would be **$#1.5<cr>** where # indicates there has been a power failure (if you reset the flag when your program started) the **1.5** indicates the value of the parameter you requested.

Section 4.7: 'Illegal' Responses

All messages with the proper protocol ($.....<cr>) will be processed by the Source Indexer. If the content or form of the message of the message is determined to be incorrect by the Source Indexer one of the following messages will be returned.

Note: ***If the protocol sent or baud rate used is not correct the SRT will not respond to the transmitted message.***

Illegal Command	A command code (first byte) which the SRT does not recognize has been sent.
Illegal Data Value	The data value or parameter sent following the command code is out of range or an incorrect code.
Illegal Syntax	This indicates the format of the data is incorrect. Wrong number of data parameters sent for the command used. Or, improper delimiters between data.

Section 4.8: Command Set

Query the unit for any operating parameter

$<Parameter>?<cr>

Version Command @

$@<cr**>** Version Query: Returns Software Version

Response: **$*SRT422VXXXX<cr>**

This command reports the identity of the instrument and the version # of the firmware installed. This command is useful in initially testing the communications link and in the initial debugging of the communication software.

Lockout Command A

Parameters: 0 or 1

$A1<cr> This command defines which SEL inputs will have priority. A1 defines the RS232 inputs as having priority while A0 defines the STC I/O SEL inputs as having priority.

To use the RS-232 command inputs the AUTO.MAN switch must be in AUTO, and a Lockout command $A1<cr> should be sent once. This “Lockout” state is maintained until the unit is either powered down, or another Lockout command is sent, setting Lockout State to “AO”.

There is a “panic” mode in which if your RS-232 link should go down and you need to select another pocket location simply move the AUTO/MAN switch to MAN and select the desired pocket using the thumbwheel. If you then re-establish your RS-232 link, move the AUTO/MAN switch back to AUTO, and you will still have RS-232 control.

Response: **$*<cr>**

Pocket Command B

Parameters: 1, 2, 3, 4, 5, 6, 7, 0

$B3<cr> Moves rotator from current position to pocket # corresponding to the parameter selected. A selection of zero is equivalent to a thumbwheel, or I/O , selection of 8. The example shows move to pocket three.

Response: **$*<cr>**

Power Fail Status Command C

Parameters: None

$C<cr> Queries the unit for power fail status. Returns 'A' for no power fail: returns 'B' for power failed detected.

Response: **$*A or B<cr>**

Moving Command D

Parameters: None

$D<cr> Queries unit for Motor Moving Status. Returns an 'M' if motor is moving; an 'R' if unit is at rest.

Response: **$*M or R<cr>**

Stall Error Command E

Parameters: None

$E<cr> Queries unit for Stall Motor Error. Returns an 'S' for stalled error condition: an 'N' for normal status.

Response: **$*N<cr> or $*S<cr>**

Pocket 1 Offset Command F

Parameters: None

$F<cr> Returns the pocket 1 calibration offset.

Response: **$*0 to 1999<cr>**

Current Location Command G

Parameters: None

$G<cr> Returns current optical encoder location.

Response: **$*0 to 1999<cr>**

Move To Command H

Parameters: 0 to 1999

$H<cr> Move the Indexer to specified location.

Response: **$*<cr>**

Read Configuration Command I

Parameters: None

$I<cr> Reads internal configuration switch.

Response: **$*0 to 255<cr>**

Reset Command J

Parameters: None

$J<cr> Reset power fail indication.

Response: **$*<cr>**

Read AUTO/MAN Switch Command K

Parameters: None

$K<cr> Reads AUTO/MAN switch setting.

Response: **$*T or L<cr>**

RS-232 Source Type Command L

Parameters: XXX

$LXXX<cr> The first parameter (X) is the source type and will have a range of 0 through 7. As list in Figure 3.3 for the configuration switch, 0 will select a four pocket and 7 will select a 3 pocket 145 degree banana. The second parameter (X) is the uni-bi-directional switch. A zero for this parameter will select unidirectional and a 1 bi-directional. The third parameter (X) will select the rotation direction. A zero will select counter-clockwise and a 1 will select clockwise.

Example	$L501<cr>	Selects a three pocket 120 degree banana, uni-directional, clockwise source.

It is also possible to query this parameter and obtain the current definition of the above three parameters. The query command will be $L?<cr>.

If the user has never sent a valid "L" command to change the source type, and you query the status with an "L?<cr>", the response will be "999". This is to indicate that the unit functioning as initially set by the DIP switches. If you send a valid "L" command changing any of these parameters, all subsequent queries will respond with the current setting as set by the previous "L" command.

When you send an "L" command the unit will reconfigure the source type and then immediately search for the home index pulse. This was implemented because the Indexer may not be at a valid pocket once reconfigured and there was a possibility of sending a false Pocket Good indication signal. Searching for the index pulse will prevent this from happening and the unit will then go pocket one.

Response: $L*

Zero Non-Volitile offset and Goto Index Pulse Command ¦

Parameters: None

$¦<cr>

Response: **$*<cr>**

Section 5

Trouble shooting

Section 5

Trouble Shooting

Section 5.1: SECTION OVERVIEW

The STC-422 should prove to be an extremely reliable and trouble free unit. However, the troubleshooting checklist provided would help in resolving any problems that do occur. In addition, the signal-flow diagram provided will make it possible to trace signals between indexer components when problems must be tracked to their sources.

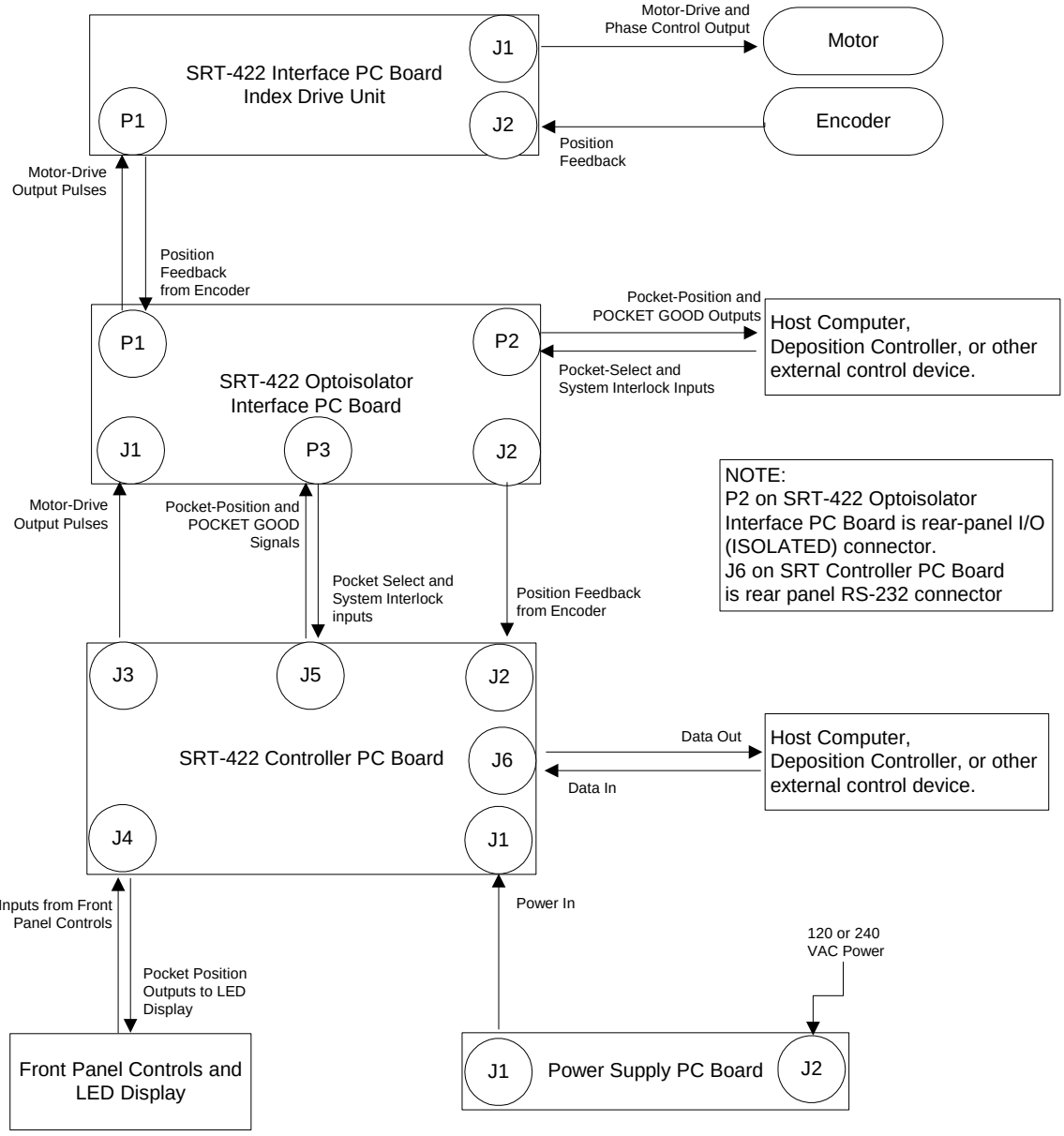

Figure 5.1: Signal Flow Diagram

Section 5.2: ROUTINE TROUBLESHOOTING

Symptom	Possible Cause(s)	Procedure
1. When indexer is switched on, front-panel LED on control unit does not display anything, and rear-panel READY light is not lit.  **DANGER** Shocks from 120V and 240V power can cause physical injury and even death. Perform this and all other internal checks with the Input power cable disconnected.	1a. Incorrect input power cable connected. 1b. Input power cable not properly connected. 1c. No power at wall receptacle that power cable is plugged into. 1d. Fuse blown.	1a. Make sure that power cable is correct type for input power voltage. 1b. Check to see that power cable is securely plugged in at both ends. 1c. Plug power cable into a different receptacle of correct voltage, or test to see whether power is available at the original receptacle 1d. Open fuse holder in rear panel of control unit, check condition of fuse. If necessary, replace with correctly rated fuse. If fuses blow repeatedly, check control unit for internal shorts in input power circuit
2. LED and READY light perform correctly. But drive motor does not turn as indexer goes through its initialization routine and as pocket selection is changed.	2a. Motor cable (which connects control unit to index drive unit) not properly connected. 2b Continuity problem in motor cable. 2c. Continuity problem between motor and connector J1 on interlace PC board in index drive unit	2a. Check to see that connectors on both ends of motor cable are plugged in and that screws securing these connectors to the connectors on indexer components are screwed in reasonably tight. 2b. Check continuity between pins 6 and 14 on the 'D' connectors on both ends of motor cable. 2c. Open case of index drive unit and check continuity of wires running between motor and J1 pins 5 and 6.
3. LED on control unit front panel flashes between pocket currently selected and zero.	3a. Index drive motor cannot rotate hearth because of buildup of material under edge of cutout in top of source. 3b. Drive Assembly could be binding 3c. A higher torque selection is required.	3a. Clean deposited material from cutout edges and from ridges in top of hearth 3b. Check for proper alignment 3c. Set switches 7, 8 to a higher torque setting

Table 5.1: Trouble Shooting guide

Appendix A
Application Notes

Interfacing a Sycon SRT422 to a Sycon STC2002/STC2000A/Telemark 880

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This document describes how to connect a Sycon indexer (SRT422M/I) to a Sycon deposition controller. This will take advantage of the built-in knowledge of indexing inherent in the Sycon advanced deposition controller film program.

1) Make a cable.
   Make a cable as per drawing in figure 1. This will use output relays 5 and 6, and input 8. For systems with 5-8 pockets, this will also use relay 7.

2) Set jumper on input card.
   Remove the top cover on the STC. Since the indexer pocket good signal is connected to input 8, the jumper for input 8 will need to be set to the "AB" position. In this position, the pin closest to the circuit board will be unconnected.

3) Install I/O program.
   Use the following I/O program. For systems with 4 or less pockets, the first line can be deleted. The **BOLD** type represents the actual I/O program. The type in parenthesis is just an explanation of what that line does.

   IO Program to interface STC2KA/2K2 to SRT422. ID=37008
   I103 #4 & O14 (Map D2 pocket select gun 1 to relay 7 (PSEL_2).)
   I103 #2 & O13 (Map D1 pocket select gun 1 to relay 6 (PSEL_1).)
   I103 #1 & O12 (Map D0 (LSB) pocket select gun 1 to relay 5 (PSEL_0).)
   I98 #1 & I7 & T234 (Trip pocket good only when film program is looking.)

   This program can be added to any existing program, provided the existing program does not use input 8 (I7) or the relay outputs required by this program (O12,O13, and for systems with 5-8 pockets, O14).

4) Configure map (timeouts).
   When configuring the parameters in the STC for your system, make sure to configure the following parameters for any map that uses source out channel (gun) 1 with the indexer:

   SOURCE OUT CHNL 1
   INDEXER SYNC MODE FEEDBACK
   INDEXER SYNC TIME 120 seconds.

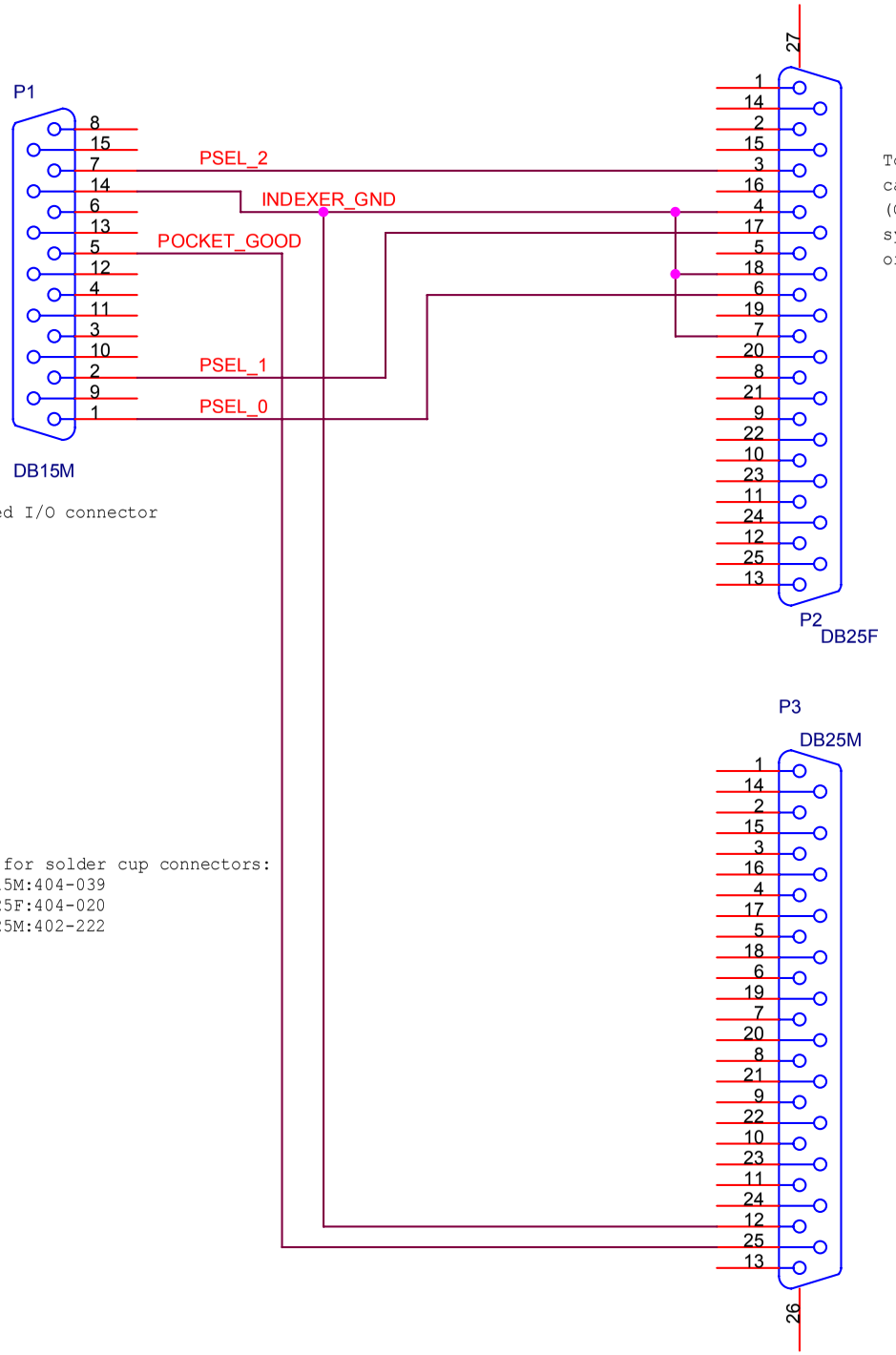
5) Use pocket number in film program.
   When programming film parameters, use the pocket select parameter to position the indexer to the appropriate pocket. Also make sure the correct map is selected, the map that is configured as above (in step 4).

   Special note for 8 pocket systems: On the SRT422, pocket 8 is displayed on the front panel of the SRT422 as pocket 0. Also, if selecting pocket 0 in the film program, the indexer will position to pocket 8. Therefore, in the film program, pocket 0 and pocket 8 will both run the indexer to pocket 8. For 4 pocket systems, selecting pocket 0 or pocket 4 in the film program will position the indexer to pocket 4.

6) Make sure indexer is set to “auto”

Once the STC is configured, the film program automatically selects the appropriate pocket based on the film program. When the film begins, the film state will go to “INDEXING” after “XTAL VFY”, and the STC will command the indexer to go to the selected pocket. The STC will remain in the INDEXING state until the indexer indicates it has successfully reached the selected pocket (via the pocket_good wire). While in the INDEXING state, the phase timer counts down until the indexer reaches the pocket, or until the timer reaches zero, whichever occurs first. If the indexer reaches the pocket in time, the film program automatically advances on to the rises and soaks, etc. If the timer reaches zero, which means the indexer did not get to the pocket in time, then the film program is halted with a “STOP: INDEXR” message.

<end>



To SRT422 Isolated I/O connector

To STC2000A/STC2002/Telemark 880 relay output card. Uses relay 5 (O12) as LSB. Uses relay 6 (O13) next, and relay 7 (O14) as MSB. For 4 pocket systems, it is OK to leave PSEL_2 wire unconnected or connected.

To STC2000A/STC2002/Telemark 880 input card. Uses input 8 (I7) for "pocket good" input. I7 will be TRUE when indexer is at the requested pocket. Make sure the jumper on the input card for input 8 is set to "AB". The pin closest to the circuit board will be unconnected when the jumper is in the correct position.

Sycon part numbers for solder cup connectors:
DB15M:404-039
DB25F:404-020
DB25M:402-222

Title: SRT 422 to STC2000A wiring		
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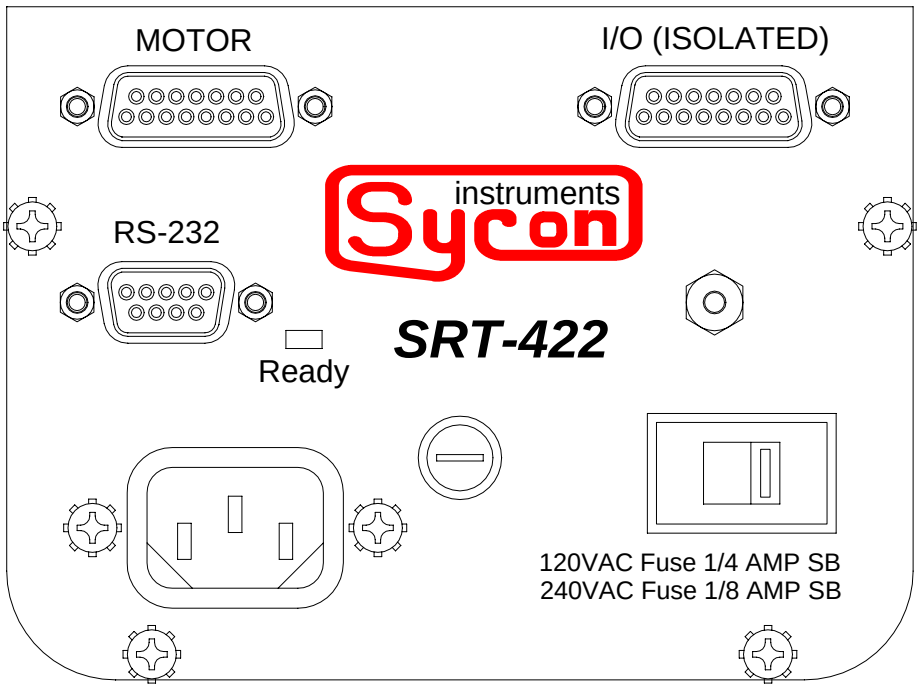
Date: Tuesday, January 27, 2004	Sheet 1 of 1	



instruments
Sycon
Made in the U.S.A

Sycon Instruments
6757 Kinne Street
East Syracuse, New York 13057-1215
V (315) 463-5297 F (315) 463-5298 info@sycon.com