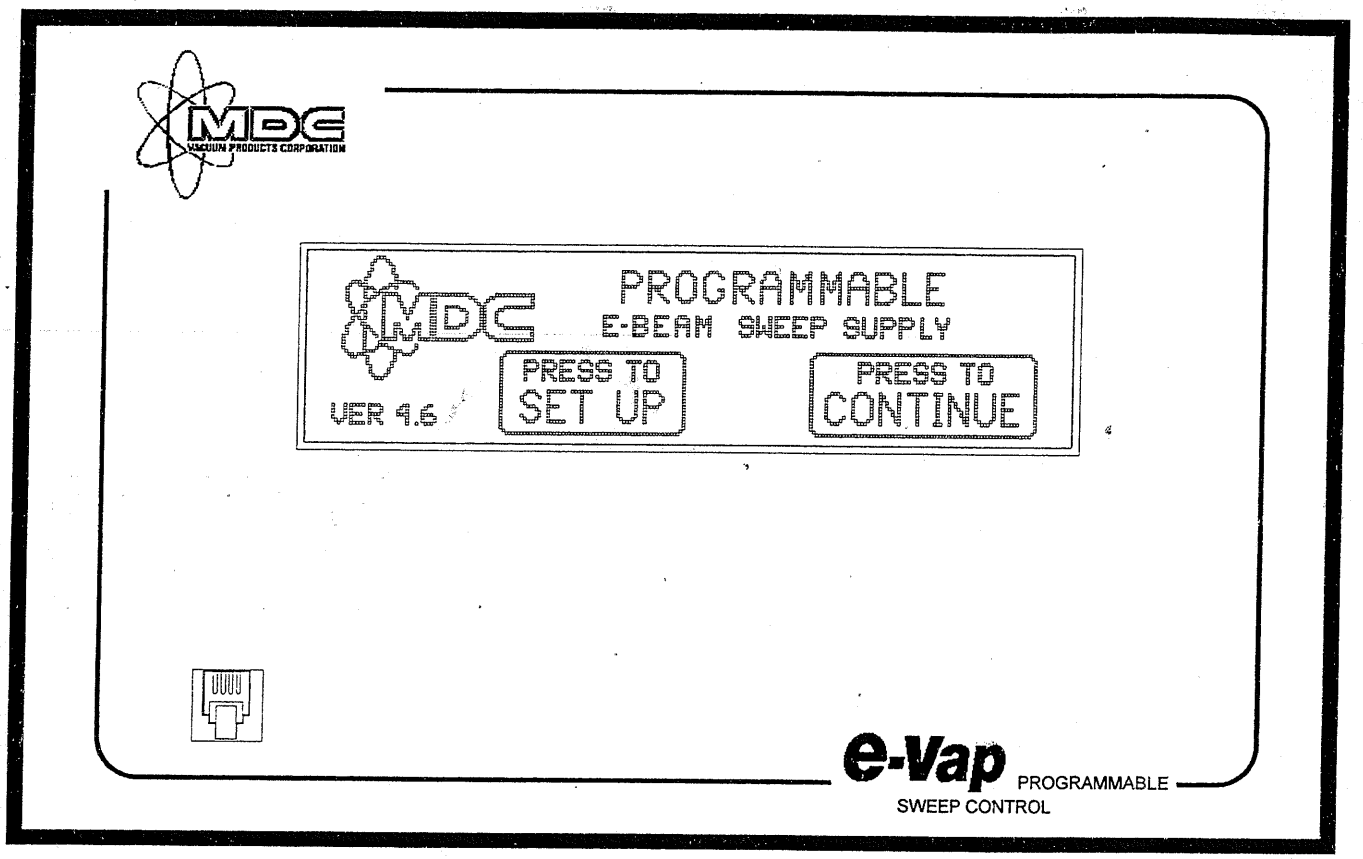
eVap - PSC

Programmable Sweep Controller



User's Manual

Revision D, March 1997

SECTION 1

General Information

Preface

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EC Declaration of Conformity

We,
MDC Vacuum Products Corporation
23482 Cabot Boulevard
Hayward, CA 94545-1651
USA

declare under sole responsibility that the eVap-PSC Programmable Sweep Controller meets the intent of Directive 89/336/EEC as amended by 92/31/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 50022 — Class B Radiated and Conducted Emissions
- EN 61000-3-2 — 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 Immunity

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

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General Information

Introduction

SECTION 1.1

The MDC Programmable E-Beam Sweep Control generates a large number of precision sweep patterns for application with electron beam deposition sources. Selecting or programming these sweep patterns is easily accomplished through the user friendly front panel touch screen LCD display. Through this 64 x 256 graphic touch panel, the user is able to select or generate a wide variety of E-Beam Sweep patterns for optimum deposition control of metals and dielectric materials.

Starting with a fixed set of basic sweep patterns which are embedded in the Sweep Control, the user can design E-beam sweep patterns which are ideally suited to the characteristic of their source and deposition materials.

The sweep patterns generated within the unit produces dual current outputs which can drive the X and Y Sweep Coils of almost any type of electron beam deposition source.

Three basic *pattern types* (Circle, Fig-8, and Line) are generated by the Sweep Control. The user can create many variations of these pattern types by applying various degrees of the three pattern modifiers provided. Reference Section 2.7, Selection of Pattern Types. The pattern modifiers are: sweep frequencies, rotational speed and power profiles.

In addition to the three basic pattern types, the ability to generate a user defined pattern is also provided within the Sweep Control. The *user defined pattern* allows the user to specify up to 256 X-Y beam locations, each with a different dwell time, to create just about any sweep pattern desired. The rotational speed of this pattern can also be varied by the phase pattern modifier to create additional variations to the user pattern.

Up to eight different sweep patterns can be stored within the unit. The eight stored patterns are based on different variations of the four pattern types. These different patterns can easily be selected from the front panel, remotely through back remote input, or through RS-232 Computer Interface which is provided as a standard feature. The Sweep Control is a 5 1/4" H half rack module. It is designed to mount next to the MDC Gun Control to make a full 5 1/4" H by 19" W rack assemble. The two units are connected

together by using the (991099) coupling kit which is provided. For stand alone 19" rack mounting of the PSC, a (991062) rack extender should be ordered.

SECTION 1.2

E-Beam Sweep Generator Specifications

Specifications

Output Longitudinal Coil	0 to 5 Amps
Output Lateral Coil	0 to 5 Amps
Output Frequency Range	0 to 100 Hz
Dimensions	5 1/4"H x 8 3/4"W x 14"D
Weight	7 lbs
Power Required (Input)	150 VA
Sweep Patterns Type	4 types (Line, Circle, Fig-8, User)
Storage Capacity	8 Patterns
Data Display	LCD (Backlit) 64 x 256 graphic
Programming Buttons	32 touch screen buttons
Remote Pendent Input	4 pin modular connection

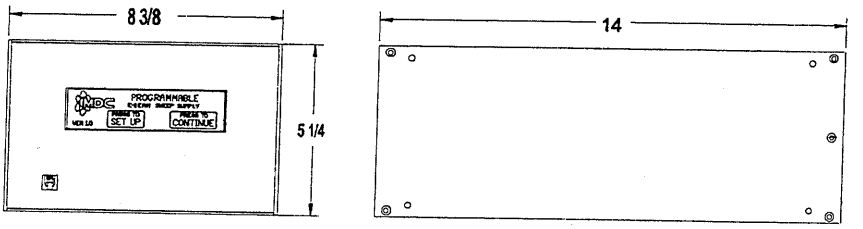


Figure 1.1 - Sweeper Dimensions

Unpacking

The Sweep Control is shipped in a single carton with the following Kit of accessories:

	(PN)
1 MDC Sweep Control Unit	(991023)
Rack Mount Ears and Screws	(991061)
Coupling Kit	(991099)
1 Operator's Manual	(M10080)
1 Connector/Cable Kit containing:	
Remote I/O Connector (DB25S)	(991100)
Sweep Coil Cable 12' long	(991101)
1 Remote Pendent	(991102)
1 IEC Power Cord for 110 Volt operation	(014502)

Options:

19" Rack Extender	(991062)
STC-200 Control Cable	(991103)

Front Panel Description

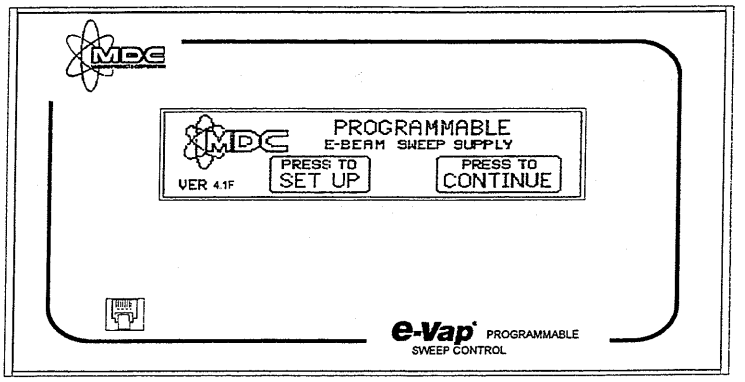


Figure 1.2 - Front Panel

The touch panel LCD is used for the selection, programming, and display of all the functions of the Sweep Controller. Different displays are presented in response to users selections. These displays and the operation of the unit are described in latter sections of this manual. While the touch panel is durable, it is meant to be pressed by finger touch. It should not be pressed with sharp or metal objects.

A modular connector (for the connection of a remote pendent or a mouse) is located in the bottom left corner of the front panel.The function of this connector is selected by three jumpers on the cpu board JP3, JP4, and JP5. If pins 1 and 2 of these connectors are jumpered the mouse is functional. If pins 2 and 3 are jumpered the remote pendant is active. The main power on/off switch for the unit is located on the back of the unit.

Remote Pendent

The remote pendent has two modes, depending on whether the sweep unit is in the program mode or not. When in the PRM mode the Remote Pendent allows beam positioning and amplitude adjustments while remotely viewing the source. The arrow keys on the pendent have the same effect as the front panel arrows. The large stop button on the pendant changes the parameter in focus, so that different parameters can also be selected remotely. When the Sweeper is not in the PRM mode the remote pendent controls the 0 to +10V analog output labeled "Control Out" on the back panel. This can be used as the remote input to the gun control unit.

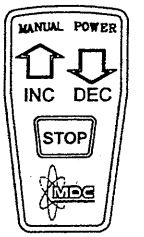
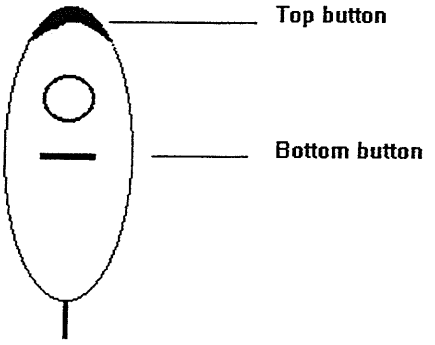


Figure 1.3
Remote Pendent

MOUSE



The mouse is used to modify the xy offsets, sw_amp, and the analog output provided at the control out connector on the rear of the unit.

X and Y offset mode

To enter this mode push and release the top button. You will know you are in this mode if there are asterisks next to the x and y parameters. The gray pad is used to change the parameters. If pressed on the top edge Y will increase, on the bottom edge Y decreases, on the right edge X will increase, and on the left edge X will decrease.

SW_AMP mode

To enter this mode, press and release the top and bottom buttons together. An asterisk will be next to the SW_AMP parameter to indicate it has mouse focus. To increase the parameter hold the top edge of the gray pad. To decrease hold the bottom edge.

Analog Output

To enter this mode press and release the bottom button. No asterisks should be present on the base screen if you are in this mode and your unit is configured to use the mouse. Holding the top edge of the pad will increase the analog output voltage,holding the bottom edge will decrease it.

Rear Panel Description

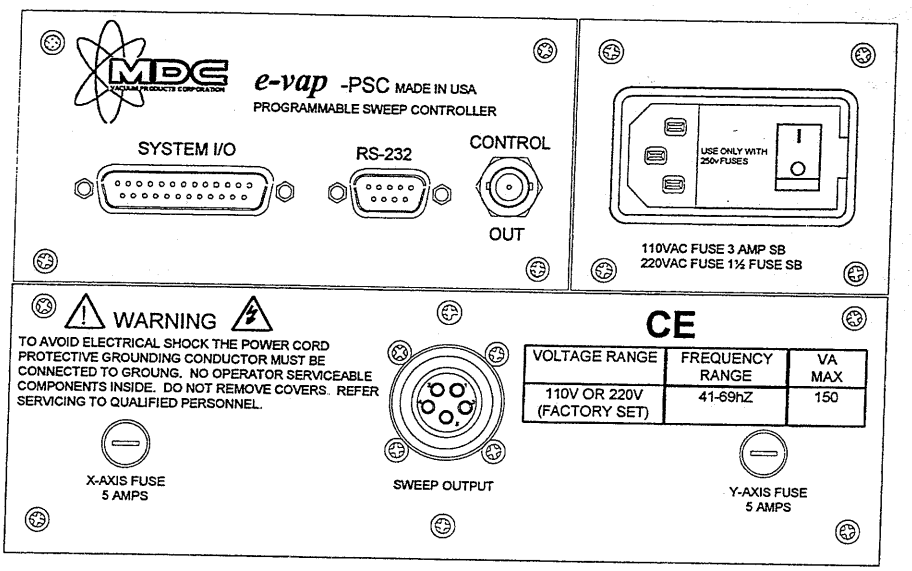
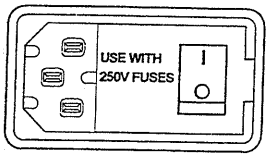


Figure 1.4 - Back Panel

Back Panel Components

Power Switch	On/Off
Power Input	110V/220V (int. change reg.)
Input Fuse	3 Amp (110V), 1 1/2 A (220V)
RS-232 Data Ports	9 pin D type coon. (DB9S)
X,Y Current Output	5 pin circular (Amp 208720-1)
X,Y Coil Line Fuse	5 Amps
Interlocks & Digital I/O Ports	25 Pin connector (DB25P)

Input Power/Switch Module



The unit has an OFF/ON switch mounted on the back panel power module. This module also accepts an IEC type power cord. In most applications, the power switch will always be left on and the unit will be plugged into a switched outlet strip which controls all the E-Beam and Deposition Instrumentation. The companion MDC Gun Control has a switched outlet on the back panel. Plugging the Sweep Control into this outlet allows the main power to the sweep unit to be controlled from the ON/OFF switch of the MDC Gun Control Unit.

Input Fuses

The input line fuse is contained in this power module. To change or replace this fuse, first remove the power cord from the module. Insert a small flat blade screwdriver under the tab at the right of the switch. Pry open the fuse cover. The fuse is contained in the gray fuse holder. Remove the holder and replace fuse. The fuse and holder reside in the bottom position as indicated by arrow on inside fuse cover.

The unit is capable of running off of 110 or 220 volts. Internal jumper changes are required for 110 to 220 volt conversion. The 110 to 220 volt conversion is described in the installation section of this manual.

System Interface Connector Specifications

A 25 pin D type connector (DB25P) is located on the back panel to provide the remote interface connection to the Sweep Control.

DB25P

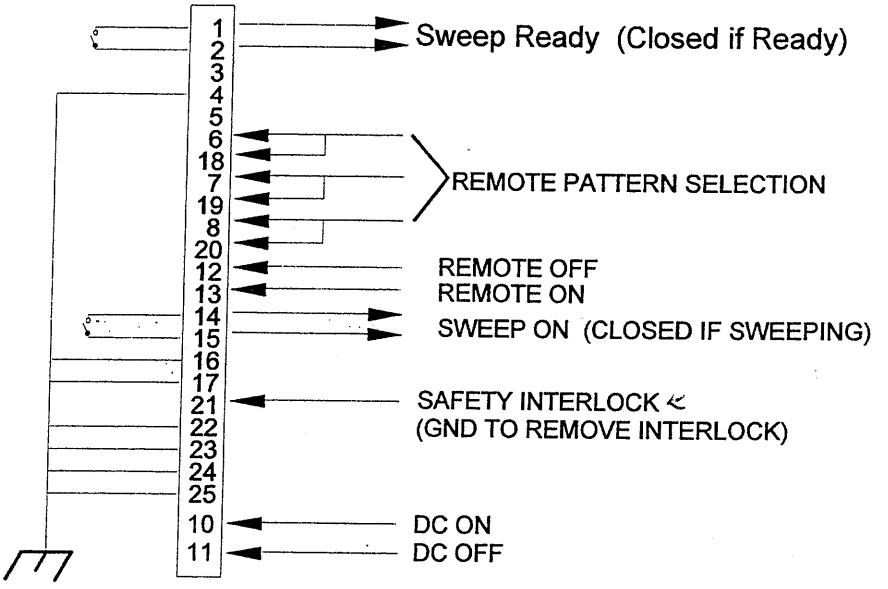


Figure 1.5 - 25 pin System Interface Connector

SECTION 1.3

Remote ON and OFF

System Interface Inputs

Remote ON and OFF (Pin 13 and 12) cause action to occur on a negative going edge. The functions of these pins are context dependent. If PRM is active the unit is in the joined mode. An ON\OFF event while in this mode will turn ON\OFF both the AC and DC components. If PRM is inactive the unit is in the independent mode. An ON\OFF event while in the independent mode will turn ON\OFF the AC component only. When the unit senses a transition

to ground of the ON input (Pin 13), the unit will turn on the AC component (if in the independent mode) or AC and DC components(if in the joined mode) on. Likewise, the grounding of the OFF input (Pin 12) will turn off the AC component (if in the independent mode) or AC and DC components (if in the joined mode). Signal levels and positive transitions are ignored. These signals do not control the main power to the unit only whether or not sweep current is applied to the X & Y coil output.

Remote Dc on and off

Remote Dc on and off (Pins 10 and 11) cause action to occur on a negative edge. When the unit senses a transition to ground of the DC on input (Pin 10) the DC component will be turned on. Likewise, the grounding of the DC off input (Pin 11) will turn the DC component off.

System Interlock

An input is provided which disables the X & Y coil current outputs and the DC component of the Sweep Unit. For sweep or DC current to be available at the output connector of this unit, it is required that this interlock input (Pin 21) be connected to ground. If this interlock is not at ground and the Sweep is turned ON than the status indication above ON/OFF switch will display "STAND-BY". Once the interlock input is grounded the status indication will return to "SWEEP". If system interlocks are not used, a jumper to ground from Pin 21 must be installed in the mating part of this connector for the unit to operate. *Units shipped from the factory have a temporary jumper installed on system I/O connector to by-pass this interlock.*

Remote Pattern Selection

A binary pattern of ground connections on the three selection pins provides for remote selection of the sweep pattern as follows:

REMOTE PATTERN SELECTION INPUTS

		SYSTEM I/O PINS		
		8,20	**7,19**	**6,18**
Pattern	1	open	open	open
	2	open	open	ground
	3	open	ground	open
	4	open	ground	ground
	5	ground	open	open
	6	ground	open	ground
	7	ground	ground	open
	8	ground	ground	ground

When the unit is first powered up, the selected pattern is determined by the conditions of these remote inputs. Remote pattern selection can be overridden by many front panel pattern

selections, but anytime a different remote pattern is selected the unit will respond to the new remote pattern. A new remote pattern selection will also remove the unit from the front panel program mode if it is in that condition.

Electrical Specifications of Inputs

Activation	Contact closure to ground or TTL low
Input Impedance	2770 Ohms
Open Circuit Voltage	3.5V typical, 5V max.
Maximum On Voltage	0.6 Volts
Maximum Sink Current	2 mA (1 TTL load)

These inputs are debounced such that a one second delay will occur when these inputs change and when the sweep pattern changes. If no remote inputs are connected on initial power-on of the Sweeper, pattern 1 will be selected.

System Interface Outputs

Two output relays are provided with connections on the 25 pin interface connector.

Pins 1 & 2 - Sweep Ready
This relay is closed when the Sweeper is ready to sweep. It basically indicates that the main power is on and that the unit has not detected interlock or error conditions that would prevent it from sweeping.

Pins 14 & 15 - Sweep On
When this relay is closed it indicates that sweep current is being applied to the sweep unit outputs.

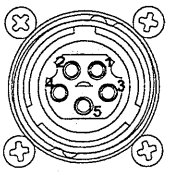
Electrical Output Specifications

Relay Contact Ratings	2.5 Amps - N.O. SPST
Contacts	
Input/Output Connector	
Mating Connector	DB25S
Type	25 Pin "D" Female

RS232 Connector
This connector is described in Section 4 of this manual.

Sweep Output Connector & Fuses

A single circular 5 pin connector supplies the connections to the sweeping coils of the source. The proper connections are shown below.

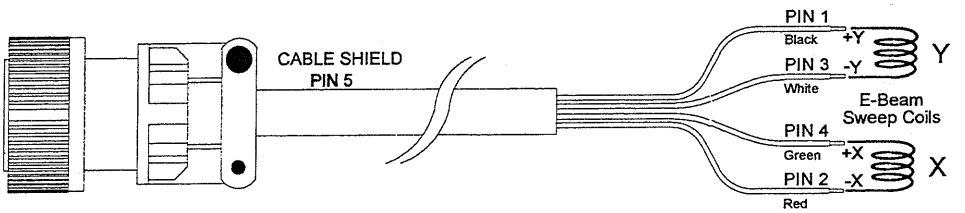


PIN 1	+Y COIL
PIN 2	-X COIL
PIN 3	-Y COIL
PIN 4	+X COIL
PIN 5	SHIELD GND

SWEEP OUTPUT

Figure 1.6 - Sweep Connections

A 12 foot long cable is supplied with the sweep control. A drawing of the cable is shown below.



SWEEP COIL CABLE (STANDARD LENGTH 12')

Figure 1.7 - Sweep Cable

Output Fuses

The output power section of the sweeper has internal monitoring and current limiting protection. Two fuses are also located on the back panel to supplement this internal protection. If these fuses "blow" the most probable cause is a short circuit somewhere in the vacuum chamber or improper wiring of the sweep coils. After the cause of the short is removed, these fuses should be replaced with similar type fuses with a 5 Amp rating.

X-AXIS
FUSE
5 AMPS

Control Output

A BNC connector labeled Control Out provide an analog voltage (0 to +10 volt) which is set and controlled by the remote pendent (when the unit is not in the program mode). This output is meant to supply the remote control input of the gun control unit.

SECTION 2

Operation

Operation

Front Panel

Greeting Display

SECTION 2.1

When power is applied to the unit, a greeting display is immediately seen. This display allows the user to initially configure the sweep unit with one-time system or source parameters which are applied universally to all sweep patterns.

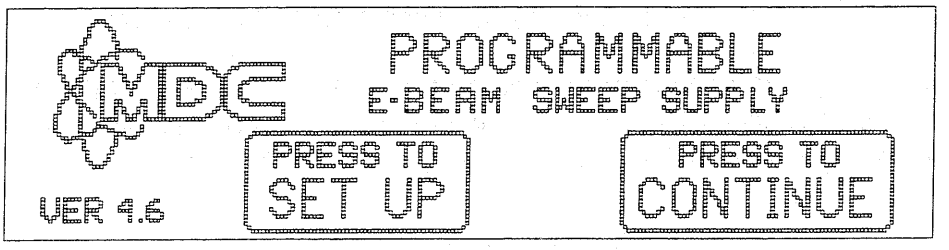


Figure 2.1 - Greeting Display

The Set up items which are accessed through this display include: Maximum Current Limit, RS232 Baud Rate, Display Contrast, Password, Linearity, and Mouse sensitivity settings. Each of these are fully described later in this section. This screen gives the user the opportunity to either set up the unit (PRESS TO SET UP), or continue to the main operational display (PRESS TO CONTINUE) if set up is not necessary.

Three areas of interest are shown on this display:

VER 4.6

VER # In the lower left hand corner, a VER # appears. This identifies the version of firmware that is contained in the unit. The Sweep Control unit is a microprocessor based instrument. Thus the operations and features are controlled by firmware contained in a read only memory (ROM) located on the CPU board. It is likely that new features may be added to the unit or corrections to existing firmware will occur in the future. When this occurs, field upgrade of the unit is generally possible by installing the new version of firmware. It is important to note the VER code when discussing any operational features or problems with the factory. This manual describes all features of version 4.6 of the PSC firmware.

PRESS TO SET UP

PRESS TO SET UP - This touch button allows the user to configure the Sweep Control with system parameters. When pressed, the screen will show a new menu with several options. One option is PRESS TO EXIT which brings the user to the Operational Menu. The other options are CURRENT LIMIT, PASSWORD, LINEARITY, RS232, MOUSE, and DISPLAY CONTRAST. The Set up Display and the functions are described in Section 2.10.

PRESS TO CONTINUE

PRESS TO CONTINUE - This touch button is convenient for familiar users if set up or changes are not necessary. This command brings the user directly to the operational menu without waiting for the greeting display to terminate.

The initial greeting display will appear for about 8 seconds unless the SET UP or CONTINUE touch button is pressed. Otherwise, the unit automatically then advances to the Main Operational Display.

SECTION 2.2

Operational Display

Main Operational Display

The Main Operational Display is shown below. The display is divided into several areas which provide many of the data displays and user touch button inputs for the control of the E-Beam Sweeper. The Main Operational Display has two modes. The joined mode (PRM is highlighted) and the independent mode (PRM is not highlighted). In the joined mode a single pair of ON/OFF buttons control both AC (Sweep) and DC (X/Y offsets) components together, see figure 2.2. In the independent mode the AC and DC components can be turned ON or OFF independently , see figure 2.3.

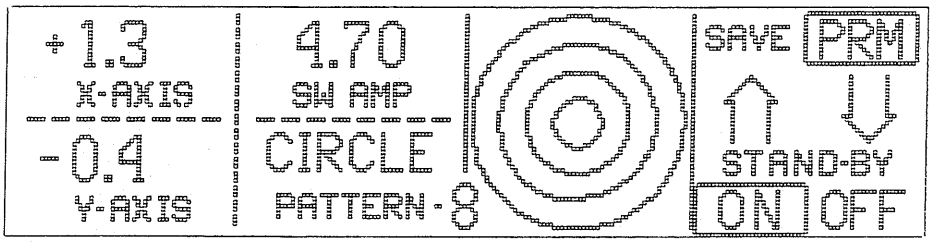


Figure 2.2 - Main Operational Display (Joined mode)

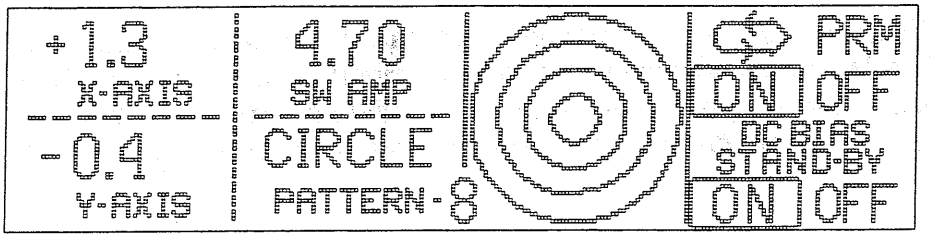


Figure 2.3 - Main Operational Display (Independent mode)

This display provides for the selection of 1 of 8 sweep patterns, adjusting of sweep amplitude and setting and display of the X and Y beam offset. A non-real time representation of the sweep patterns p-type is graphically indicated. Switches to turn the AC/DC components on and off along with up/down cursors for data entry and sweep pattern selection are on the right hand portion of the display.

Basic Programming Operation

SECTION 2.3

To select or program a sweep pattern or to change any setpoint, the Sweep Control must first be placed in the PRM mode by touching the PRM legend in the upper right corner of the Main operational display. Once selected, the PRM legend becomes inverted and the display appears as in figure 2.2. Prior to going into the PRM mode, no other touch areas of the LCD, with the exception of the ON\OFF areas and ⇦ touch buttons, are active.

The ⇦ button toggles the function of the PRM button to SET UP which allows navigation to the SET UP screen and its parameters. Once PRM is selected, all zones of the LCD touch switches are active (assuming no password has been entered). The Sweep Pattern or any of its parameters can be changed while the coil supply is ON, OFF, or at STAND-BY.

⇦
Flip Flop

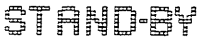
Once the PRM mode has been selected and the touch screen is fully active, the main operational display can be used to select 1 of 8 sweep patterns, increase or decrease the sweep amplitude of the current pattern, or to position the beam by entering an X-Axis and Y-Axis offset. The X & Y-Axis offsets (also called the DC component) are global parameters which apply to all 8 patterns. These offsets are used to center the sweep pattern within the crucible.

The Sweep and X & Y offsets can be turned on or off together ,while in the joined mode, (figure 2.2) or they can be turned on or off independently while in the independent mode (see figure 2.3). *These do not turn the main power to the unit on or off - only the sweep voltages and current.*

Several status indicators are shown in the area just above the ON/OFF buttons (while in the joined mode) or above the lower pair of ON/OFF buttons (while in the independent mode). When an indication occurs, it replaces the SWEEP legend if in the independent mode, or the AC DC legends if in the joined mode. The status indicators include

STAND BY
COIL ERR
MEM LOSS

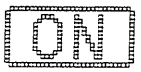
STAND-BY and *error conditions* such as SWP ERR and MEM LOSS. (See Maintenance section for error conditions). *Note: The SWP ERR indicator will appear if unit is turned on with no sweep coil connected. It can be ignored during initial programming and familiarization with the unit.*



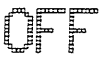
STAND-BY This condition is entered when the back panel remote interlock is not at ground state and the AC and/or DC state is on. When the remote interlock input (which is causing the Sweep Control to be held at STAND-BY) is grounded, the AC and/or DC component turns on if the AC and/or DC state was ON. The safety interlock is pin 21 on the system interface connector.

INDEPENDENT MODE

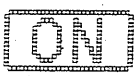
While in the independent mode, two, sets of ON/OFF buttons are displayed and have the following functions.



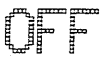
ON - (UPPER) The ON touch button on the front panel relates to the AC sweep current that is applied to the E-Beam sources sweep coils, not whether the main power to the sweep supply is on or off. A remote relay closure is also provided to indicate when the sweep pattern is ON.



OFF (UPPER) This button turns the AC sweep current off. On initial power on, the unit powers up in the OFF state.



ON - (LOWER) The DC bias ON touch button on the front panel relates to the X/Y DC offset current that is applied to the E-Beam sources sweep coils, not whether the main power to the sweep supply is on or off.



OFF

(LOWER) The DC bias OFF touch button on the front panel relates to the X/Y DC offset current that is applied to the E-Beam sources sweep coils, not whether the main power to the sweep supply is on or off.

JOINED MODE

While in the joined mode there is only one set of ON/OFF buttons which have the following functions.

ON - The ON touch button on the front panel relates to both the X/Y DC offset and AC sweep currents that are applied to the E-Beam sources sweep coils.

OFF — The OFF touch button on the front panel relates to both the X/Y DC offset and AC sweep currents that are applied to the E-Beam sources sweep coils.

OFF

Pattern Selection

SECTION 2.4

Up to eight different patterns can be stored for use by the Sweep Control. A pattern (identified by a number 1 to 8) is defined as a collection of the following parameters: SW AMP, PHASE, SPEED, P-PROFILE, and P-TYPE. To select a pattern, first place the unit in Program Mode by touching PRM. When you enter the program mode, the focus will be on pattern selection.

Focus is defined as the parameter to be changed if an arrow key is pressed and is identified by having its label displayed in inverted video.

PARAMETER FOCUS

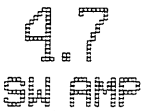
The current pattern shown will either be the last pattern manually selected or what had been selected by the remote inputs.

While in PROGRAM with the focus on PATTERN, the cursor keys (arrows) are used to increment through the 8 different patterns. The different patterns can also be selected through the remote hand controller, back panel Inputs or the RS232 computer interface. (remote pattern selection is described in Section 1.3.)

Changing the Sweep Amplitude

SECTION 2.5

SW-AMP



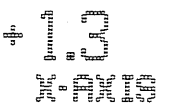
The Sweep Amplitude of the currently selected sweep pattern can be altered as follows:

Select the sweep amplitude parameter by touching the SW AMP area of the display. Once selected, the amplitude of the beam sweep can be adjusted. The SW AMP is the absolute value of the peak to peak sweep current. With the SW AMP in focus (legend is displayed in inverted video), the value can be increased or decreased by using the cursor keys (including those on the remote hand controller). This reading is in Amps and has a range of 0.0 to 5.0. The value of this setting depends on the crucible size and the type of deposition material. With the E-Beam set near the desired deposition power, the sweep amplitude should be adjusted to cover the desired portion of the crucible. This value is bounded by the global Maximum Current Limit value which was programmed from the Set Up display. A unique sweep amp value is stored for each of the eight stored patterns.

X & Y Axis Offset Positioning

SECTION 2.6

X-Axis Positioning



The X-Axis and Y-Axis are beam positioning offsets that compensate for E-Beam Source magnetics. The X and Y Axis offsets are global parameters that apply to all eight patterns. To adjust the X and Y offsets place the unit in the independent mode, turn off the AC component and turn on the DC component. Next, go to the joined mode

by pressing the PRM button. To adjust the X position, select the X-Axis parameter by touching this area of the display. This will bring the X-Axis parameter into focus. By using the two cursor keys or the remote hand controller, the X direction of the beam offset can be increased or decreased. The cursor keys continue to affect this offset with focus until the unit is removed from the program mode by touching the PRM button or another parameter is given focus. The X-Axis adjustment moves the beam in a line across the crucible. Observe this movement by using the cursor key and viewing the beam position. The X-Axis is a relative coordinate and depends on your viewing position. Set the X-position to what you determine to be the center of the crucible. The offset is limited to +/-3.0 amps.

Y-Axis Positioning

The Y-Axis adjustment causes the beam to move in an orthogonal manner to the X-Axis. Select the Y-Axis offset adjustment by touching the Y-Axis area of the display. Once satisfied with the adjustment, you may want to increase the sweep amplitude to obtain a full beam sweep of the crucible. This is done in the identical manner as when the sweep amplitude was set to zero. The X and Y offset can further be adjusted with a full beam sweep if desired.

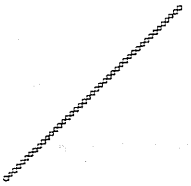
SECTION 2.7

Selection of Pattern Types

Four pattern types are generated by the Sweep Controller. The four types are: LINE, FIG-8, CIRCLE, and USER. Each of the eight Sweep Patterns use one of these pattern types.

To change or modify a pattern type, touch the area in which the name of the current pattern type is displayed. If CIRCLE is the pattern type being used, pressing the word CIRCLE will change the display to allow for the selection of different pattern types and modification of other parameters associated with the current sweep pattern. When the new display appears, the focus is on P-TYPE. Pressing the cursor keys at this point will change the pattern type which is associated with the current Sweep Pattern.

Description of Pattern Types



LINE: This pattern type causes the beam to sweep in a straight line across the crucible. A non-zero PHASE modifier causes this line to rotate around the center of the crucible at one of three different rotational speeds. The SPEED modifier changes how fast the beam sweeps from endpoint to endpoint of the LINE. The P-PROFILE modifier varies the velocity of the sweep depending on the X,Y position of the beam.

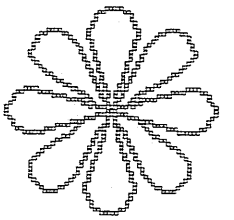
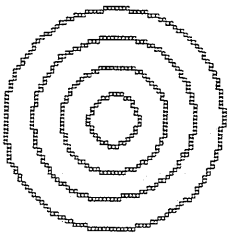
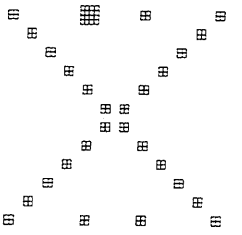


FIG-8: This pattern type causes the beam to sweep in a figure-8 pattern. A non-zero PHASE modifier will cause this pattern to rotate around the center of the crucible. The SPEED modifier changes how fast the beam sweeps the complete pattern. The P-PROFILE modifier varies the velocity of the sweep depending on the X,Y position of the beam.



CIRCLE: This pattern type causes the beam to sweep a set of concentric circles from the outside to the center and back out again. A non-zero PHASE modifier will cause this pattern to rotate around the center of the crucible but because of the pattern symmetry it appears to not have any effect. The SPEED modifier changes how fast the beam sweeps the complete set of circles. The P-PROFILE modifier varies the velocity of the sweep depending on the X,Y position of the beam.



USER: This pattern type causes the beam to sweep to follow a user programmed series of X and Y locations. Up to 255 coordinate pairs can be stored, with each point having a different dwell time. A non-zero PHASE modifier will cause this pattern to rotate around the center of the crucible. The SPEED and P-PROFILE do not apply to this pattern as their function is contained in the user pattern design by the specification of a different dwell time for each point. Programming of the USER pattern type is straight forward and is described in Section 2.9.

Pattern Modifiers

At this point, you may want to familiarize yourself with some of the parameters which can be used to modify the Pattern Type. The modifiers are: Speed, Phase, and Power Profile. The effects of each pattern modifier are somewhat dependent on the pattern type. To select the pattern type to be modified, press the box which contains the description of the pattern (Circle, Fig-8, Line, or User)

If the pattern type (P-Type) screen is selected, a new set of parameters is displayed on the left half portion of the display. These parameters can alter the characteristics related to the Pattern Type. Specifically, these parameters alter the speed, rotation, and power profile of the sweep beam.

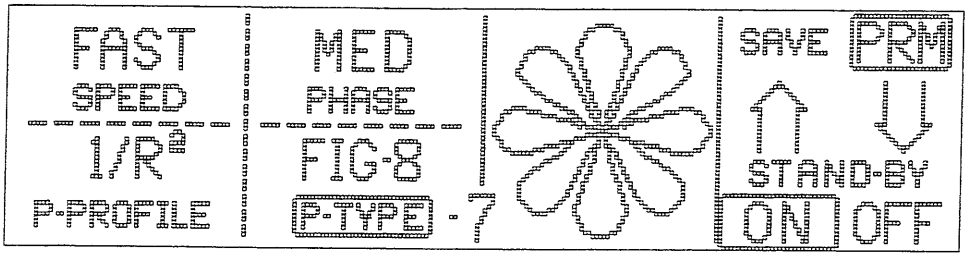


Figure 2.4 - Pattern Type Parameters

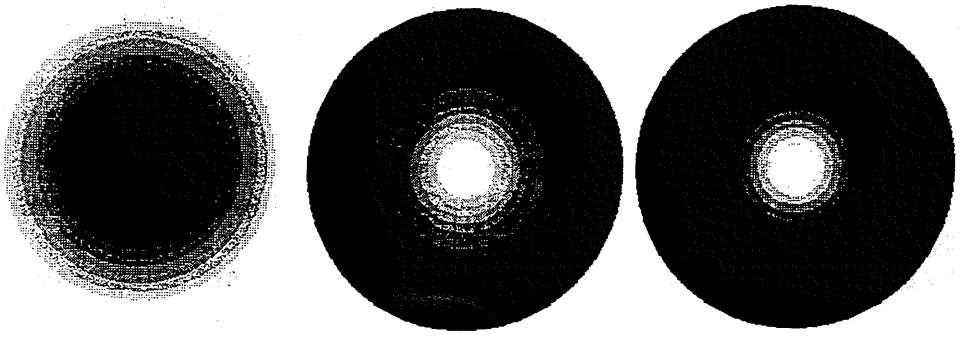
FAST SPEED

Speed - FAST, MED, or SLOW can be selected by cursor. This is the fundamental frequency of the X or the Y sweep. For some of the basic patterns, the X and the Y frequency may be different. (i.e. Fig-8 Y frequency is two times the X frequency) For example, using the LINE P-Type, the three speed choices (FAST, MED, or SLOW) control the frequency at which the beam is swept from endpoint to endpoint.

1/R² P-PROFILE

Power Profile (P-Profile) - This is the parameter altered to sweep the beam faster in the center of the crucible than out towards the edges. The choices for functions are 1, 1/r, and $1/r^2$. When 1 is chosen, the beam sweeps in a linear fashion; when 1/r is chosen, the beam moves quicker when in the center of the crucible. The $1/r^2$ term makes it move faster yet when passing through the center of the sweep pattern.

The graphic below depicts the power density of the three choices (1,1/r, 1/r2). The method used is to lengthen the dwell time at the X and Y locations as a function of the radius from the center of the crucible. Depending on the deposition material, crucible linear and pocket cooling characteristics, one of these three power profile parameters will give the most uniform heat distribution across the crucible.



1 1/R $1/R^2$

Figure 2.5 - Power Profiles

Phase This parameter changes the number of degrees of rotation per pattern repetition. Changing this parameter causes a rotation of the pattern around the center of the crucible. Three PHASE selections (SLOW, MED and FAST) are available in addition to ZERO phase (no rotation).

MED
PHASE

Saving Changed Parameters

While in the main operational display (X-Axis, Y-Axis, SW AMP, and Pattern displayed) any modified parameters will be saved by pressing SAVE or pressing PRM (while in the PRM mode).

While in the pattern modifier display (Speed, Phase, P-Profile, and P-Type displayed), any modified parameters will be saved by pressing save or PRM (if in the PRM mode). However, if PRM is pressed while in the program mode, the unit will return to the main operational display.

If in the User pattern edit display (X-Pos, Y-Pos, Dwell, and point displayed), all edited user points will be saved by pressing EXIT and you will be returned to the pattern modifier display.

X and Y-Axis Offsets

SECTION 2.8

Centering the Beam

Generally, the first thing to do when initially setting up a sweep pattern is to center the beam using the X and/or Y-Axis offsets. These are global parameters which apply to all of the possible sweep patterns. A procedure to center the beam is as follows:

With the E-Beam source power off (0%), power up the Sweep Controller. The E-Beam filament current can be increased to observe the location of the beam in the crucible. With the AC sweep OFF and the DC component ON, the X and Y position of the beam can be adjusted by selecting, alternately, the X-Axis and Y-Axis parameters on the left side of the Main Operational Display and using the cursor or hand controller to position the beam in the center of the crucible. When the sweep is turned ON the sweep pattern is added to the offset currents.

Beam centering and pattern adjustments are done by direct observation of the deposition source and requires a visual observation port in the system.

Use proper eye protection and optical filters when viewing any E-Beam source.

WARNING

Programming Example

The different standard sweep patterns of the Sweep Controller are easily selected and modified. For an example, let us program pattern 8 to have a P-TYPE of FIG-8 with 1.5 amps pp sweep amplitude. The pattern number is indicated at the bottom center of the display. To change or program a pattern, place the unit in the program mode by

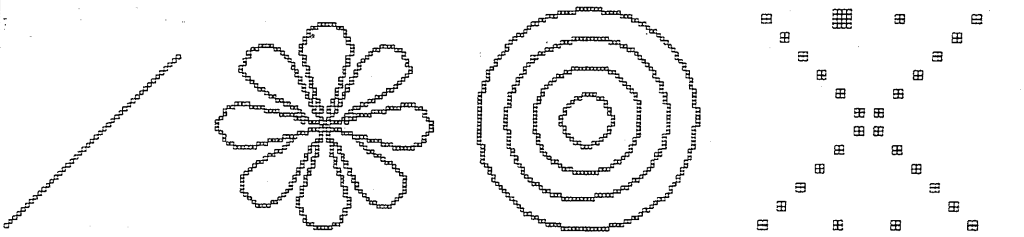
touching the PRM button. This allows selections of patterns and changes to patterns if desired. Select the item to be programmed by touching the legend or value you desire to change. When a valid area is touched, a single beep will occur and the legend will be highlighted and that parameter will become the focus parameter. The two cursor arrows will now increment and decrement the selected parameter.

Pattern Selection

FIG-8

To select or change to Pattern 8, first enter the program mode by touching PRM. When this is done, the Pattern Number at the bottom center of the display will be highlighted. Use the up/down cursors to select a different pattern number. *As you cursor through the patterns, the outputted sweep amplitude of each pattern is decreased to 1/4 of the programmed amplitude for about 1 second and is gradually increased to full amplitude if you remain at that pattern.*

After reaching Pattern 8 by using the cursors, touching either the SAVE touch button or selecting another parameter is possible at this point. *(Pressing the SAVE touch button while on the main operational display removes the program mode)* Once at Pattern 8, we would like to make the Pattern Type a FIG-8. The Pattern Type is indicated with large letters over the word PATTERN. To change the Pattern Type, touch the area of the display where the pattern type is shown (Line, Fig-8, Circle, or User) while in the PRM mode. Once selected, P-Type legend occurs below the current pattern type. The cursors now select a different Pattern Type. The display changes to one of the figures shown below and the name of the pattern type is shown. With the highlight focus on P-Type, the cursor keys will rotate you through the four pattern types.



LINE FIG-8 CIRCLE USER (sample)

Figure 2.6 - Pattern Type

There are four Pattern Types available: CIRCLE, FIG-8, LINE, and USER. While you are selecting the Pattern Type, three other parameters related to the pattern type appear on the display (SPEED, PHASE, and P-PROFILE). These parameters are all related to the movement of the Pattern Type and are called Pattern Modifiers.

Cursor around until the FIG-8 Pattern Type appears. Pressing the SAVE touch button returns you to the main display with the Pattern Number highlighted. At this point, we have selected the Pattern (8) and Pattern Type (FIG-8).

To complete the pattern we desire, we need to set the sweep amplitude to 1.5 amps. Press the SW AMP touch button of the display. With SW AMP highlighted, the cursor keys can be used to change the sweep current to 1.5 amps. After doing this, the sweep can be turned ON. At this point you may want to optimize your sweep pattern by using the Pattern Modifiers to change the sweep speed, rotation speed or power density of the sweep pattern. To change your sweep pattern, touch the area indicating the pattern type (FIG-8). The Pattern Modifier screen will appear, allowing access to the Pattern Modifiers.

User Defined Pattern

SECTION 2.9

The three standard patterns, with the variation allowed by the pattern modifiers, should provide for most all deposition material and conditions. If a unique sweep pattern is required , the pattern can be constructed by using the USER pattern.

One basic user defined pattern can be programmed and stored in addition to the three standard supplied patterns. The user pattern consists of a series of up to 255 X,Y beam locations with each location having a programmable dwell time. Once the basic user pattern is programmed, it can be edited or altered using the INSERT or DELETE button to add or remove a point. When the desired pattern is achieved, the standard PHASE pattern modifier can be applied to cause rotation.

Additionally the user pattern can be up loaded or down loaded to a computer or system controller through the RS232 Interface. If this is done, many different user patterns can be generated. The drawing below shows the possible X,Y locations in the USER pattern type. The allowable coordinate values for X and Y are +/-(2,6,10,14,18,22,26 & 30). The center coordinate is 0,0. Locations outside the crucible circle are not available to be programmed. The USER pattern should be designed to occupy the full graphic screen. The actual pattern size is adjusted by the SW AMP parameter.

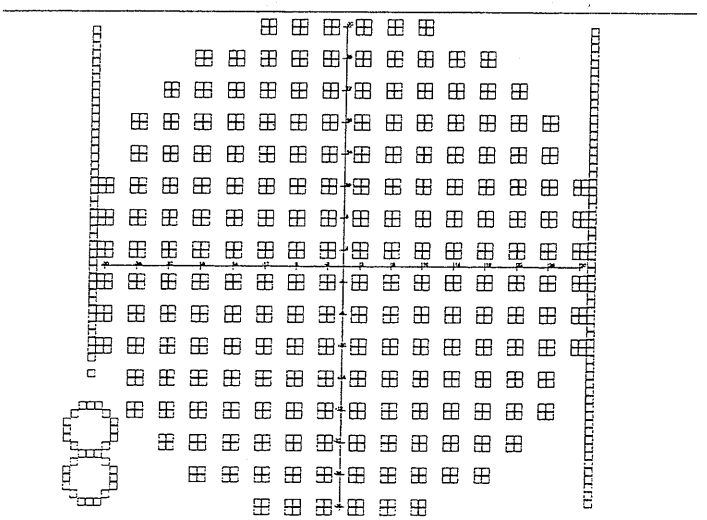


Figure 2.7 - Allowable X, Y Location - User Pattern

The USER pattern programming screen is shown below. Entry to this display is gained from the pattern modification screen by pushing the USER button.

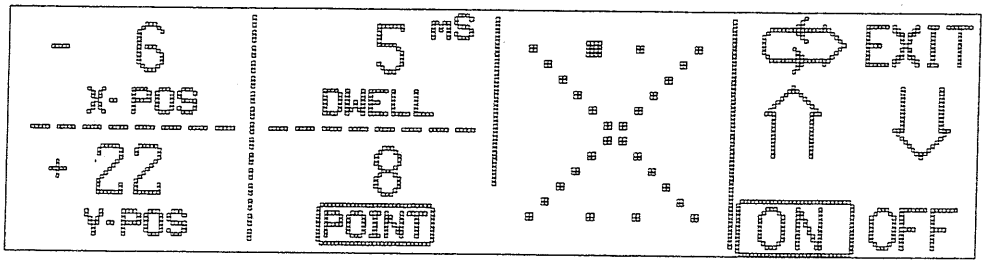


Figure 2.8 - User Programming Screen

This display allows the generation and editing of a USER pattern. After entering this display, the focus is on POINT. A POINT is one of up to 255 possible locations in a list which defined the USER pattern. Each point has programmable X-Position, Y-Position and Dwell Time information stored in this list. Data for a sample USER pattern is given in Table 2.1. This is the pattern shown in Figure 2.9

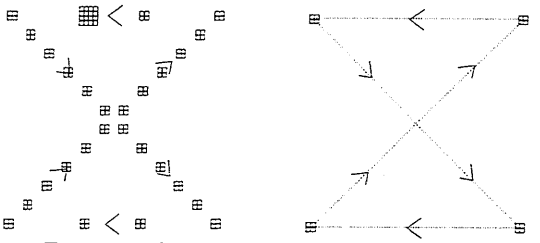
To program a USER pattern enter the user programming screen by selecting user pattern type on the pattern modification display. When this is done, the USER pattern programming display appears with the initial focus on POINT. The point number can range from 1 to 255 which corresponds to the list of data used to generate the user pattern. The data from Table 2.1 can now be entered. With POINT 1 select the "X-POS" and enter the X coordinate = 2, select "Y-POS" and enter the Y coordinate = 2. Next, select dwell and enter 1 ms. This completes the programming of the first point in this example. To complete the next example, select POINT and increment it to "2" by using the UP arrow button. Once point 2 is selected, the corresponding X, Y position and dwell from Table 2.1 for that point can be entered. The remaining 26 points of the example can now be entered.

Sample User Pattern

Point	X	Y	DWELL
1	2	2	1 MSec
2	6	6	2
3	10	10	3
4	14	14	4
5	18	18	5
6	22	22	6
7	6	22	5
8	-6	22	5
9	-22	22	6
10	-18	18	5
11	-14	14	4
12	-10	10	3
13	-6	6	2
14	-2	2	1
15	2	-2	1
16	6	-6	2
17	10	-10	3
18	14	-14	4
19	18	-18	5
20	22	-22	6
21	6	-22	5
22	-6	-22	5
23	-22	-22	6
24	-18	-18	5
25	-14	-14	4
26	-10	-10	3
27	-6	-6	2
28	-2	-2	1

Table 2.1 - Point and Dwell of X & Y

The sample "USER" program uses a fairly large number of points (28). This gives precise control of beam position and dwell time at every location. The same general shape pattern could be produced by using only four points shown in Table 2.2.



Pattern 1 Pattern 2

"<" indicates direction of sweep pattern

Point	X,Y	DWELL
1	22,22	20
2	-22,22	20
3	22,-22	20
4	-22,-22	20

Table 2.2

Figure 2.9 - User Pattern

The difference in the two patterns is that in the second pattern the movement of the beam is controlled by the 100 Hz response characteristics of the sweep supply and not programmed dwell times. With proper choice of dwell times, the simpler second pattern may produce a totally acceptable beam sweep, especially if the PHASE pattern modifier is used to cause rotation of this pattern.

Editing an Existing User Pattern

An existing user program can be reviewed by stepping through the program list by placing the focus on POINT and repetitively pushing the arrow key. A point can be edited just by selecting and changing the desired parameter.

EDITING USER PATTERN

A point can be inserted or deleted in an existing pattern list. To insert or delete you first have to make the desired function available by touching the  icon. This rotates the function of the button in the upper right corner between Insert, Delete, and Exit. If you rotate to INSERT and then press INSERT, a new point will be added at the current point location. The large cursor can be moved to a new X and Y coordinate. A dwell can be entered which becomes the dwell for the inserted point.

A point can be deleted from the USER pattern list by first rotating to the DELETE function and pressing the DELETE button. The current point of the user pattern is deleted.

A pattern list can be shortened by programming a 0 (zero) dwell in any point position. (The list can later be restored to full length by entering a non-zero dwell value at that point.)

LOCKING USER PATTERN

Once the user pattern is programmed, it can be 'locked' from any alteration from the front panel by using the RS232 computer interface and the appropriate lock command. (See Section 4)

General Comments on User Pattern

- 208 possible X Y coordinates are available (restricted to circular area).
- Programmable dwell (1 to 100 ms) for each location.
- "0" Dwell terminates pattern list (At the Previous Point).
- Consider the 100 Hz response of the sweep supply when designing your pattern. A large 4 point square pattern with 1 ms dwell times will have rounded corners due to this.
- The first and last point of the pattern should form a continuous pattern; otherwise an unexpected beam stroke may occur as pattern is repeated. The Pattern is repeated from the First Point to the Last Point then back to the First Point.

Set Up

On initial power turn on the user has a brief time to enter this set up mode. This is done by pressing "PRESS TO SET UP" while on the greeting screen. This display can also be entered from the main operational display by using the ⇦ button to select SET UP. When this is done the following screen appears:

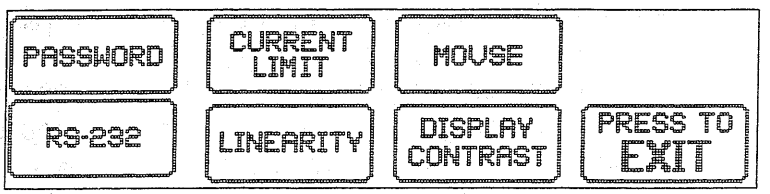
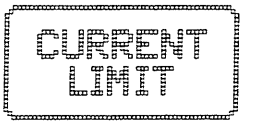


Figure 2.10 - Set Up Menu

Each of the selectable items are described below:

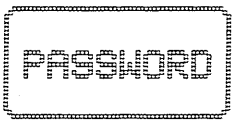
CURRENT LIMIT - This is a global parameter which limits the maximum current which can be applied to the X & Y coils. The range of this setting is 0.0 to 5.0 Amps. The actual setting varies with the size and type of the source. It is meant to act as a safety override to sweep amplitude which may be programmed from the front panel. When the programmed sweep amplitude exceeds the maximum current limit setting, the SW AMP legend is alternated with a MAX CUR legend.



RS232 (Communications Interface) - If the sweep unit is to communicate with a computer or system controller through its RS232 interface, the baud rate is set or altered through this display.

DISPLAY CONTRAST - The contrast of the display can be adjusted using this button. The change in contrast can be observed while pushing the arrow keys on this display.

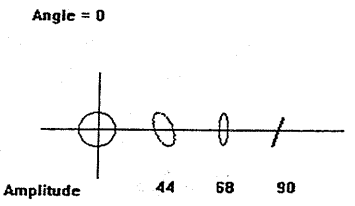
PASSWORD - When the unit is first delivered it will be in a No Password mode, meaning no password is required to modify parameters. To add a password when we are in the No Password mode, go to the password menu. A valid password is 1 to 10 digits with no two numbers being the same. If you look at the screen you will see a keypad displaying 0 - 9. pressing a number inverts its video and makes the number part of the code , if you press the number again the video is non inverted and is



no longer part of the code. The order in which you press the numbers is not important. After the code is entered on the touch pad press the enter password part of the screen, the screen will change to the main screen and in place of the flip flop and PRM buttons LOCKED will be displayed. This disables any parameter modification. If you press LOCKED it will take you to the password menu. If you try to change the password the entry will be rejected if a password is already present. If you want to change the password you must first purge the old password and bring the unit to a No Password mode again. You purge a password by entering a purge code which is defined to be the sequence 4 3 7 6 1 9 8 5 0 2 4 3 and pressing the enter password region of the screen. At this point you can enter a new password. If you enter the existing password (assuming we are in the locked mode) the displayed mode in the password menu will go from locked to unlocked. If exit is pressed you will go back to the setup main menu, pressing exit again will bring you back to the main menu and LOCKED will no longer be displayed. If you wish to enable the password locking feature, go back to the password menu which should show you are in the unlocked mode and touch the relock part on the screen. This will put you in the locked mode again (same password).

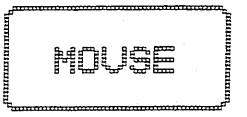
LINEARITY

LINEARITY- Linearity parameters allow the user to make corrections for non linear characteristics of system magnetics. The adjustable parameters are amplitude and angle. The amplitude has a range of 0 to 90 in increments of 2 degrees and is best described as illustrated below. With an amplitude of degrees no correction is applied. Note the figures shown below illustrate the effect of the correction parameters of a system with linear magnetics.



The amplitude parameter adjusts the amount of correction. After this is adjusted, the angle parameter can be adjusted. It rotates the corrected pattern between +/- 100 degrees.

MOUSE- This allows you to adjust the sensitivity of the mouse. The higher the number selected the more the parameter will increment for a given mouse button press duration. Also note that the pressure applied the mouse pad also affects how quickly the selected parameter will change. The more pressure applied to the pad the faster the selected parameter will change.



SECTION 3

Maintenance

Maintenance

Fuses

SECTION 3.1
Changing Input Fuses

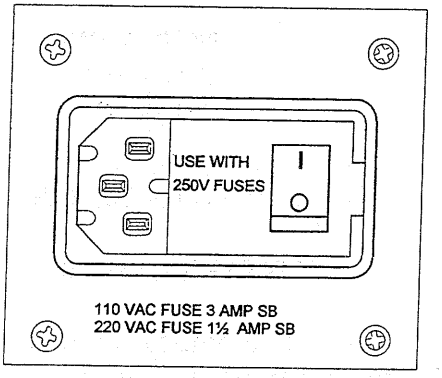


Figure 3.1 - Power Module

The input line fuse is contained in the power module. To change or replace this fuse, first remove the power cord from the module. Insert a small flat blade screwdriver under the tab at the right of the switch. Pry open the fuse cover. The fuse is contained in the gray fuse holder. Remove the holder and replace fuse. The fuse and holder reside in the bottom position as indicated by arrow on inside fuse cover. If this fuse fails, it generally indicates a serious problem with the unit. The cause of the problem should be corrected prior to replacing the fuse.

Changing Output Fuses

The output power section of the sweeper has internal monitoring and current limiting protection. Two fuses are also located on the back panel to supplement this internal protection. If these fuses "blow", the most probable cause is a short circuit somewhere in the vacuum chamber or improper wiring of the sweep coils. After the cause of the short is removed, these fuses should be replaced with similar type fuses with a 5 Amp rating.

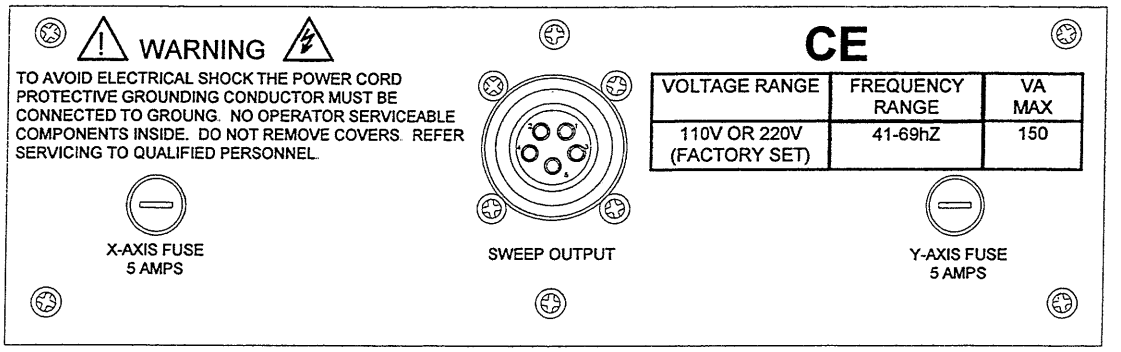


Figure 3.2 - Output Module

Detected Errors

SECTION 3.3

Two error conditions can be detected by the PSC. If they occur, they are indicated in the area over the sweep ON & OFF buttons. A description of each is given below.

MEM LOSS ERROR

MEM LOSS

The programmable parameters for the PSC are stored in an electrically alterable memory. The contents of this part are checked and compared for error each time the PSC is powered up. If the contents of the memory does not agree with a stored error checking sum, the MEM LOSS indication is shown on the front panel. This means that one or more of the stored parameters has been corrupted or lost. When this happens all the stored parameters are ignored and a set of default parameters is used.

It may be possible to continue use of the PSC when this condition occurs except when power is removed any parameter which has been changed or altered may be lost. To correct this problem requires factory service.

COIL ERROR

COIL ERROR

A COIL ERROR indication occurs on the main display when one of the sweep coils that the unit is driving has opened or shorted. The SWEEP goes OFF when is this condition is detected.

SECTION 4

Computer Interfacing

Computer Interfacing

SECTION 4.1

The Sweep Controller 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 PSC. This section will describe this protocol and the command set and the cabling required for operation with a PC.

RS-232 Interface

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 Sweep Controller, the RS-232 command set and protocol of the unit are simple and straightforward.

Baud Rates And Cabling

Figure 4.1 shows the cable connections required to connect an IBM-PC or an IBM-AT to the Sweep Controller. Note that the connector types are different for each end.

Cabling

Making An RS-232 Cable

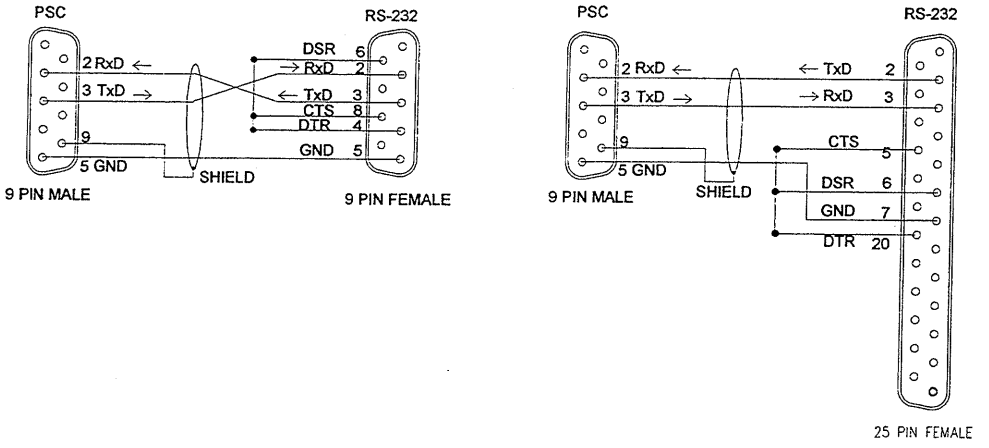


Figure 4.1: Cable Connections from PSC to MS-DOS Computer.

After the proper cable connections are made, the baud rate of the computer and the PSC should be checked or set so that they are set the same. For the PSC this is done by going into the initial Set-Up Menu (by using the ⇦ icon to toggle from PGM to SET-UP) and selecting the RS-232 setup option. You will see a screen with the

current baud rate on it. Use cursors to change the baud rate of the PSC if needed.

Setting The computer Baud Rate

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

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

This will set the PC for 9600 baud, 8 data bits, no parity, 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 PSC is cabled to COM1 of the PC type computer.

ASCII Protocol

SECTION 4.2

The PSC 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 PSC is as follows:

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

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

Communication Commands

A set of commands follow which when used allow control of and communications with the Programmable Sweep Controller 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.*

Command Set

Version Command @

$@<cr> Version Query: Returns Software Version
Response: **$*PSC/1.0<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.

$A,x<cr> Set parameter to x
$A,?<cr> Asks parameter value

Setting Linearity angle Parameter Command 'A'

Sending this command sets the linearity angle parameter. X is the command parameter whose range is 0 to 90 and increments steps of 2.
Response: **$*<cr>**. On setting parameter

$B,x,cr> set parameter to x
$B,?,cr> Asks parameter value

Setting Linearity Amplitude parameter 'B'

Sending this command sets the linearity parameter amplitude. X is a parameter whose range is -100 to +100 and increments in steps of 2.

Response **$10<cr>** On asking parameter value

$R<cr> Sending this command Resets the power fail flag. See the command response section after the commands for an explanation.
Response: **$*<cr>**.

Resetting Power Fail flag Command 'R'

$L<cr> The 'L' command Prevents user from editing the user pattern from the touch panel.
Response: **$*<cr>**.

User Lockout Command 'L'

$E<cr> The 'E' command enables user to edit user pattern from touch panel.
Response: **$*<cr>**.

Enable user pattern Command 'E'

$M<cr> Updates non-volatile memory. All RS-232 commands sent to the PSC will not be retained if power is lost to the PSC, unless this command is issued to up-date the non-volatile memory. This command needs to be issued only once at the end of an RS-232 session to update all previously issued commands
Response: **$*<cr>**.

Non-Volatile Memory Command 'M'

$N,1<cr> Sending this command Turns Sweep On
$N,0<cr> Sending this command Turns Sweep Off
$N,?<cr> Request the Sweep On / Off / Status
Response **$*<On/Off>,<Status><cr>**
where :
On = 1 Off = 0
Status: 0 = None
1 = Standby
2 = Coil Open
3 = Mem Loss

Sweep On / Off and Status Command 'N'

This command turns the sweep ON or OFF along with reading any status or error conditions which may exist in the PSC.

Example: The response **$*1,1<cr>** signifies the Sweep is on and a remote interlock is placing it at Stand-by.

Global Pattern Parameters

There are three global parameters (ones which affect all sweep patterns). These are Maximum Current Limit and X & Y Offset Currents. The following RS-232 commands can be used to read or alter these parameters.

Maximum Current Limit Command 'C'

This command sets or reads the maximum peak to peak current that the current limit is set to.

$C,v<cr> Set Max Sweep Limit in Amps; v=variable (Range 0.0 - 5.0 Amps) ,

Example: **$C,1.0<cr>** Sets Max Current Limit to 1.0 amps
Response: **$*<cr>**.

Example **$C,?<cr>** Ask Max Sweep Limit in Amps
Response: **$*3.8<cr>**

Max Current Limit is set at 3.8 amps p/p. The '*' before the 3.8 is the response byte indicating command was received successfully and reset flag is cleared

X and Y Offset Currents Command 'X' & 'Y'

This command sets or reads the X & Y offset currents which are used to center the beam in the crucible.

$X,v<cr> Set X Offset v=variable (Range 0.0 - +/-3.0 Amps)
$X,?<cr> Ask X Offset
$Y,v<cr> Set Y Offset v=variable (Range 0.0 - +/-3.0 Amps)
$Y,?<cr> Ask Y Offset

Pattern Parameters

Setting Current Pattern Command 'P'

$P,n<cr> Set Pattern number (n = 1 to 8)
$P,?<cr> Asks current pattern number

Pattern Parameters Command 'D'

This command allows you to read or alter the stored parameters of all eight of the stored Sweep Patterns.

$D,p,m,n<cr> Set Stored Parameter
$D,p,m,?<cr> Ask Single Parameter
p = Pattern number 1 to 8
m = Parameter to set (T, A, P, S, F)
n = data or code

	T Type	A Sw Amp	P Phase	S Speed	F P-Profile
m →					
n →	L= Line 8= Fig 8 C= Circle U= User	0.0 to 5.0 Amps	S= Slow M= Med F= Fast	S= Slow M= Med F= Fast	1= 1 2= 1/R 3= $1/R^2$

This command gives the ability to set or read one or all of the data items stored for the eight sweep patterns. The command starts with a '$D' followed by a space or coma and then a series of parameters or value separated by commas or spaces. The first parameter (p) selects the pattern and is a number 1 through 8. The second parameter selects the pattern modifier. (T=Pattern Type, A=Sweep Amp, P=Phase, S=Speed, F=Power Profile). The last parameter is the code or value associated with the Pattern modifier. The command is terminated with a <CR> with an optional LF.

Examples:

$D,2,T,8<cr> Sets Pattern **2** to a Pattern **T**ype of Fig-**8**
$D,3,A,1.5<cr> Sets Pattern **3**'s Sweep **A**mp to **1.5** Amps
$D,5,A,?<cr> Asks for Pattern **5**'s Sweep **A**mp
Response **$*3.5<cr>** (Pattern 5-Sweep Amp=3.5) The * before the 3.5 indicate the command was successful and the reset flag is cleared.

User Pattern

User Pattern Data Command 'U'

The User Pattern Data consists of a list of X & Y coordinates points and a dwell time for that point. Each point is individually numbered from 1 to 255. The following Command is used to enter or list User Pattern Data. The data format is identical to that used in the front panel operation, in that only a certain set of X & Y locations are valid and a 'zero' dwell signifies the last point in the user pattern.

$U,n,x,y,d<cr> Set User Pattern Point
x = X coordinate ±(2, 6, 10, 14, 22, 26, 30) Valid points
y = Y coordinate ±(2, 6, 10, 14, 22, 26, 30) Valid points
d = Dwell 0 - 100 MS Range
$U,n,?<cr> List User Pattern Point n = Point Range 1 to 256
Example: $U,56,10,10,25<cr>
Response: **$*<cr>** This command was understood, the unit has not been reset (*). The user pattern point 56 has been set to x=10, y=10 and a dwell of 25 MS.

Example: Command 'U' Query
Command: $U,56,?<cr>

Response: **$#10,10,25<cr>** This command was understood, the unit has been reset (#). The user pattern point 56 values are reported to be x=10, y=10 and a dwell of 25 MS.

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 PSC has been turned off and back on again or a power failure has occurred so it may take the appropriate steps if necessary. In 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 sweeper through the serial port. Your program is running and you set the current pattern to 6. After the pattern is set you have a power failure of short duration and the sweeper 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 pattern to six, but on a power fail reset the unit reads the status of the remote input pattern selector and sets it accordingly which may not be pattern six. An appropriate action at this point may be to obtain the current pattern number and if it is not correct, set it correctly.

Examples:

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.

'Illegal' Responses

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

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

Illegal Command	A command code (first byte) which the PSC 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.

Warranty

All products manufactured by MDC Vacuum Products Corporation are warranted to be free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment by MDC to the buyer. Liability under this warranty is expressly limited to repair or replacement of the defective products at the option of MDC. Products returned to MDC for repair or replacement shall be received prepaid.

Expandable items such as tubes, heaters, bellows, etc., may have a service life of less than one year, in normal usage. If such items fail to give reasonable service for a reasonable period of time, as determined by MDC, they will be repaired or replaced by MDC, at its election.

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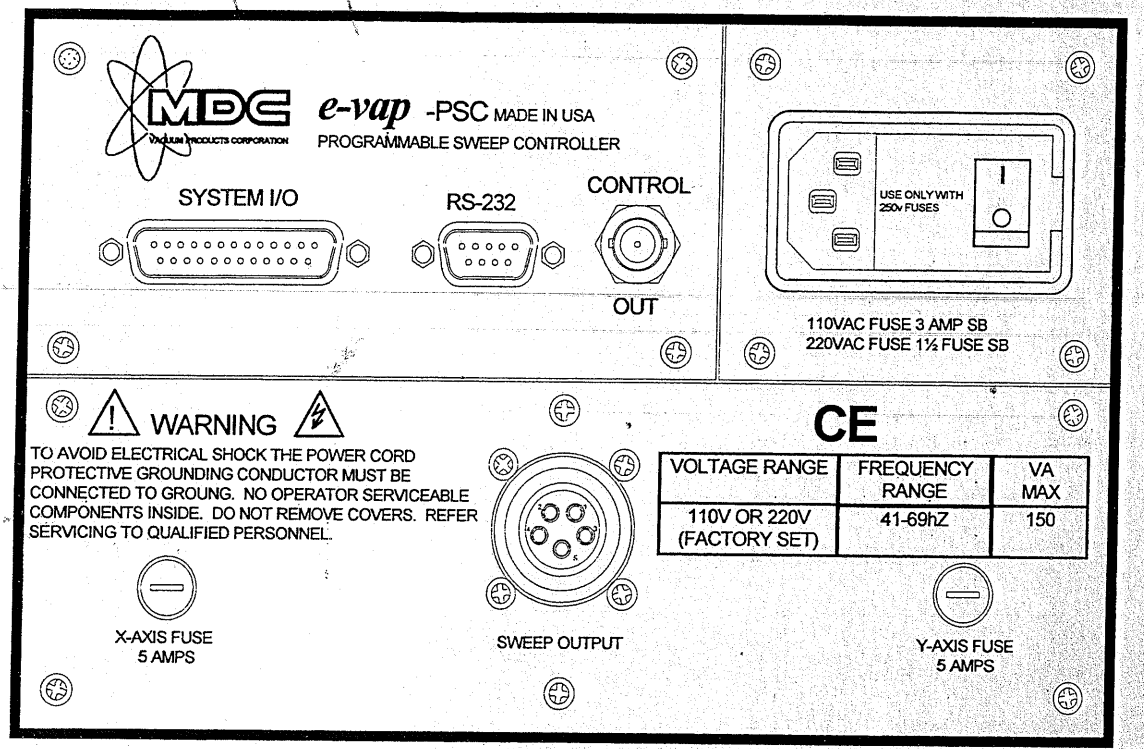

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