

# Operator's Manual for ServoWorks S-100M, S-120M and S-140M

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# Attention

Throughout this manual, the term "ServoWorks S-1\_0M" is used to refer to all three products in the ServoWorks S-100M series product line: ServoWorks S-100M, ServoWorks S-120M and/or ServoWorks S-140M.



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# Chapter 1: Welcome to ServoWorks S-100M, S-120M and S-140M

### 1.1 Overview of ServoWorks S-100M, S-120M and S-140M

ServoWorks S-100M, ServoWorks S-120M and ServoWorks S-140M are CNC controllers for mills and machining centers. These controllers run on any desktop or panel PC that meets the PC requirements for ServoWorks CNC products.

<u>NOTE</u>: Throughout this manual, "ServoWorks S-100M, ServoWorks S-120M and/or ServoWorks S-140M" will be abbreviated as "ServoWorks S-1\_0M" for convenience.

You will use ServoWorks S-1\_0M to perform manual or automatic motion control and to view the status of the overall motion control operation, including axis positions, feedrates, etc. This manual will explain how to use ServoWorks S-1\_0M (or the Simulation Editions of ServoWorks S-1\_0M). You should also refer to these other documents:

- Quick Start Guide for ServoWorks CNC Products
- Installation Manual for Simulation Versions of ServoWorks CNC Products
- ServoWorks CNC Setup and Integration Manual for the VersioBus II Interface System
- ServoWorks CNC Setup and Integration Manual for the Panasonic Realtime Express (RTEX) Interface System
- ServoWorks CNC Setup and Integration Manual for the MECHATROLINK Interface System
- Quick Start Setup Guide for the Mitsubishi SSCNET Interface System
- Hardware and Wiring Manual for the VersioBus II Interface System
- Reference Manual for ServoWorks CNC Parameters and Functions
- ServoWorks MotionLite Operator's Manual
- Part Programming Manual for ServoWorks S-100M, S-120M and S-140M
- ServoWorks CNC Macro Programming Manual
- Quick Reference Guide for Soft Servo Macro Specifications
- Soft Servo Glossary for ServoWorks CNC Products and SMP Series General Motion Control Products
- And all documentation for LadderWorks PLC

Select the appropriate document(s) for your interface system



See the ServoWorks CNC Setup and Integration Manual for the VersioBus II Interface System, the ServoWorks CNC Setup and Integration Manual for the Panasonic Realtime Express (RTEX) Interface System, the ServoWorks CNC Setup and Integration Manual for the MECHATROLINK Interface System, or the Quick Start Setup Guide for the Mitsubishi SSCNET Interface System for instructions on setting up your VersioBus II, RTEX, MECHATROLINK or SSCNET interface system. [NOTE: System setup is not required for the Simulation Edition of ServoWorks S-1\_0M.]

# 1.2 Differences Between ServoWorks S-100M, ServoWorks S-120M and ServoWorks S-140M

ServoWorks S-100M, ServoWorks S-120M and ServoWorks S-140M are very similar and share nearly the same graphical interfaces. The main difference is the number of axes each application controls.

ServoWorks S-100M controls 4 axes: 3 coordinated CNC axes plus a spindle. The three servo axes (typically X, Y and Z) are for tool movement, with a spindle axis (typically axis C or S). The X, Y and Z axes correspond to axis connectors #1, 2 and 3 on the DC-155 in a VersioBus II interface system. The spindle axis corresponds to axis connector #4 on the DC-155.

The spindle axis can be a servo type spindle (closed loop) that operates like a servo motor and can interpolate with the other servo axes – this would be called axis C. Or the spindle axis can be an inverter type spindle (open loop) that rotates at a certain velocity and does not interpolate with the servo axes – this would be called axis S.

Axis # (1-4)	DC-155 Axis Connector # (VersioBus II Interface System)	Axis Type	Typical Axis Name	Alternate Naming Scheme (Example)
1	1	Servo	$X^{*}$	$Z^*$
2	2	Servo	Y*	X*
3	3	Servo	$Z^*$	Y <sup>*</sup>
4	4	Spindle	S (open loop) or C (closed loop)	S (open loop) or C (closed loop)

Table 1-1: ServoWorks S-100M Axes

\*Each of these axes can be named X, Y or Z, as long as each axis name is unique. If your spindle is an inverter type spindle, the spindle axis will be automatically named "S," in which case you can also use the "C" designation for one of the servo axes.



ServoWorks S-120M controls 7 axes plus a spindle: 4 coordinated CNC axes, and three axes that can be used for synchronous control or as PLC axes. For ServoWorks S-120M, a typical configuration would be 4 CNC axes (typically called X, Y, Z and A), one spindle axis, two slave axes and one PLC axis.

The X, Y, Z and A axes correspond to axis connectors #1, 2 and 3 on the first DC-155 in a VersioBus II interface system, and axis connector #1 on the second DC-155, respectively. The spindle axis corresponds to axis connector #4 on the first DC-155.

The spindle axis can be a servo type spindle (closed loop) that operates like a servo motor and can interpolate with the other servo axes – this would be called axis C. Or the spindle axis can be an inverter type spindle (open loop) that rotates at a certain velocity and does not interpolate with the servo axes – this would be called axis S.

Axis #		s II Interface stem		Typical	Alternate Naming
(1-8)	DC-155 #	Axis Connector #	Axis Type	Axis Name	Scheme (Example)
1	1	1	Servo	$\mathbf{X}^{1}$	$A^1$
2	1	2	Servo	$Y^1$	$\mathbf{B}^1$
3	1	3	Servo Z <sup>1</sup>		X <sup>1</sup>
4	1	4	Spindle	S (open loop) or C (closed loop)	S (open loop) or C (closed loop)
5	2	1	Servo A <sup>1</sup>		$\mathbf{Y}^1$
6	2	2	Sync slave axis or PLC axis	See Notes 2 and 3	
7	2	3	Sync slave axis or PLC axis	See Notes 2 and 3	
8	2	4	Sync slave axis or PLC axis	See Note	es 2 and 3

#### Table 1-2: ServoWorks S-120M Axes

#### NOTES

- 1) Each of these axes can be named X, Y, Z, A or B, as long as each axis name is unique. If your spindle is an inverter type spindle, the spindle axis will be automatically named "S," in which case you can also use the "C" designation for one of the servo axes.
- 2) Sync slave axes are named after the master axis' name. For example, a slave axis to axis Y would be named Y2. If there are two slave axes to axis Y, they are named Y2 and Y3.
- 3) PLC axes are named P1, P2, etc.



ServoWorks S-140M controls 7 axes plus a spindle: 5 coordinated CNC axes, and two axes that can be used for synchronous control or as PLC axes. For ServoWorks S-140M, a typical configuration would be 5 CNC axes (typically called X, Y, Z, A and B), one spindle axis, a slave axis, and a PLC axis.

The X, Y, Z, A and B axes correspond to axis connectors #1, 2 and 3 on the first DC-155 in a VersioBus II interface system, and axis connectors #1 and #2 on the second DC-155, respectively. The spindle axis corresponds to axis connector #4 on the first DC-155.

The spindle axis can be a servo type spindle (closed loop) that operates like a servo motor and can interpolate with the other servo axes – this would be called axis C. Or the spindle axis can be an inverter type spindle (open loop) that rotates at a certain velocity and does not interpolate with the servo axes – this would be called axis S.

Axis #		s II Interface stem		Typical	Alternate Naming
(1-8)	DC-155 #	Axis Connector #	Axis Type	Axis Name	Scheme (Example)
1	1	1	Servo	$X^1$	$A^1$
2	1	2	Servo	$Y^1$	$\mathbf{B}^1$
3	1	3	Servo	$Z^1$	$\mathbf{X}^{1}$
4	1	4	Spindle	S (open loop) or C (closed loop)	S (open loop) or C (closed loop)
5	2	1	Servo	$A^1$	$\mathbf{Y}^1$
6	2	2	Servo B <sup>1</sup>		$Z^1$
7	2	3	Sync slave axis or PLC axis	See Notes 2 and 3	
8	2	4	Sync slave axis or PLC axis	See Note	es 2 and 3

Table 1-3	ServoWorks	S-140M Axes
-----------	------------	-------------

#### NOTES

- 1) Each of these axes can be named X, Y, Z, A or B, as long as each axis name is unique. If your spindle is an inverter type spindle, the spindle axis will be automatically named "S," in which case you can also use the "C" designation for one of the servo axes.
- 2) Sync slave axes are named after the master axis' name. For example, a slave axis to axis Y would be named Y2. If there are two slave axes to axis Y, they are named Y2 and Y3.
- 3) PLC axes are named P1, P2, etc.



The GUIs (graphic user interfaces) for ServoWorks S-100M, ServoWorks S-120M and ServoWorks S-140M are mostly the same, except for the number of axes displayed. For example, the display area in the lower left corner of the screen varies for each application, as shown in the following figure. Note the different number of axes displayed for each application:

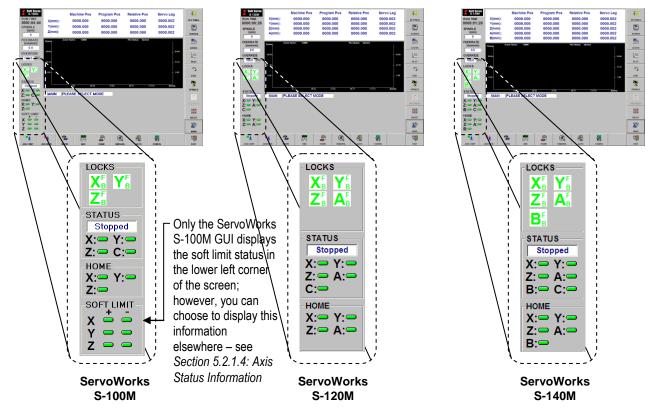


Figure 1-1: Differences Between ServoWorks S-100M, S-120M and S-140M GUIs

# 1.3 What You Can Do With ServoWorks S-100M, S-120M and S-140M

With ServoWorks S-100M, ServoWorks S-120M or ServoWorks S-140M, you can control motion either manually or automatically. There are six operational modes and one sub mode for manual control of the mill or machining center:

- 1) Jog Continuous Mode
- 2) Jog Incremental Mode
- 3) Rapid Mode
- 4) HandWheel Mode
- 5) Home Mode
- 6) MDI Mode
- 7) Spindle Mode (a sub mode)



There is one operational mode for automatic control of the mill or machining center in ServoWorks S-1\_0M:

• Auto Mode, in which you execute G-code part programs (You edit G-code part programs in Edit Mode – another sub mode)

This manual explains how to operate the mill or machining center in each of these modes, plus how to set motor, servo, NC and many other parameters relating to the configuration and operation of the mill or machining center, and how to set up the display of information in ServoWorks S-1\_0M.

## 1.4 The Simulation Editions of ServoWorks S-100M/S-120M/S-140M

The ServoWorks S-1\_0M Simulation Editions are extremely useful versions of ServoWorks S-1\_0M in which motion control and hardware are simulated. You can "play with" the software without having hardware or motors connected to your PC. For instance, you can "jog" an axis that doesn't exist, and still be able to see the "simulated movement" reflected in the display of position data, the plot display, etc.

These Simulation Editions do not require a VersioBus II, RTEX, MECHATROLINK or SSCNET adapter board to be plugged in to the host CPU. In a normal (non-Simulation) ServoWorks S-1\_0M system, the adapter board generates the outside signal that starts each servo loop. With the Simulation Editions, a real-time timer function replaces the interrupt service routine of the adapter board. Servo lag is set to a theoretical value, to replace actual feedback from an encoder.

The Simulation Editions have three different purposes:

- 1) **Training**. The ServoWorks Simulator is the perfect vehicle to train operators to use ServoWorks S-1\_0M. People can try out ServoWorks S-1\_0M without worrying about damaging real (and costly) hardware.
- Software Development. With simulated motion control, developers using ServoWorks S-1\_0M as a basis for their own, customized ServoWorks CNC applications can quickly test applications under development, without the possibility of damaging hardware or machines.
- 3) **<u>Program Verification / Testing</u>**. With simulated motion control, developers can test part programs and view plots created by those part programs without the possibility of damaging hardware or machines.

## 1.5 Selecting Toolbar Buttons

Throughout this manual, we will instruct you to "press the **EXAMPLE** button." In fact, there are three ways to "press," or select, toolbar buttons:

- 1) If you have included a mouse as part of your ServoWorks S-1\_0M system, you can single click the toolbar button on the screen directly with the mouse.
- 2) If you have a touch screen, you can press the toolbar button on the screen with your finger.
- 3) If you have included a keyboard as part of your ServoWorks S-1\_0M system, you can use the "Shift" keys together with function keys to select buttons on the toolbar.



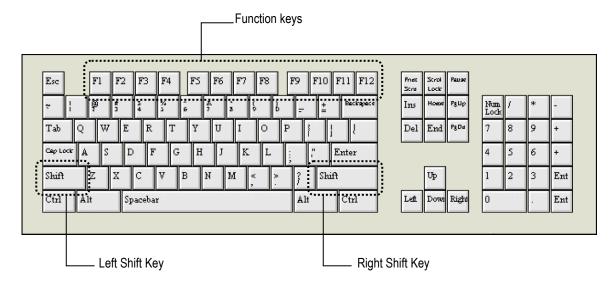


Figure 1-2: Keys Used to Selecting Toolbar Buttons – Typical QWERTY Keyboard

									Shift + F10
									Shift + F9
									Shift + F8
									Shift + F7
									Shift + F6
									Shift + F5
									Shift + F4
									Shift + F3
									F12
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10 or F11

Figure 1-3: Keyboard Shortcuts for Selecting Toolbar Buttons



Function Key	Equivalent Keyboard Shortcut
F1	F1
F2	F2
F3	F3
F4	F4
F5	F5
F6	F6
F7	F7
F8	F8
F9	F9
F10	F10

Function Key	Equivalent Keyboard Shortcut
F11	F11
F12	F12
F13	Shift Key + F3
F14	Shift Key + F4
F15	Shift Key + F5
F16	Shift Key + F6
F17	Shift Key + F7
F18	Shift Key + F8
F19	Shift Key + F9
F20	Shift Key + F10

Table 1-4: Keyboard Shortcuts for Selecting Toolbar Buttons



# Chapter 2: Starting ServoWorks S-100M, S-120M and S-140M

## 2.1 Starting ServoWorks S-100M, S-120M and S-140M

To start ServoWorks S-1\_0M, use the "Start" menu on the desktop of your PC to select "Programs," then "SoftServo," then "S-100M," "S-120M" or "S-140M." Or select the shortcut (1000, 1000

When you first start ServoWorks S-1\_0M, you will see a startup window (with the version number of the application) similar to the following appear:



Figure 2-1: ServoWorks S-1\_0M Startup Window

The following initialization procedure is executed automatically:

1) The ServoWorks CNC Engine, the ServoWorks G-Code Parser, and the LadderWorks PLC Engine will be loaded automatically.

The ServoWorks CNC Engine is the part of ServoWorks S-1\_0M that actually controls the motion of the mill or machining center, and operates in real-time. (As opposed to the ServoWorks S-1\_0M HMI application, which is just the interface to the ServoWorks CNC Engine, and which operates with split second delays that are transparent to the user.) The ServoWorks CNC Engine controls the feedback loop, performs the calculations pertinent to machine motion, and sends commands to the servo drives, which control the motors, and thus control the mill or machining center. When the ServoWorks CNC Engine starts, the IntervalZero RTX real-time extension also starts. RTX works with your operating system to make real-time motion control possible.

The ServoWorks G-Code Parser is the part of the S-1\_0M system that analyzes basic G-code part program statements, and operates in real-time.

The LadderWorks PLC Engine is a soft PLC module that is seamlessly integrated with the ServoWorks CNC Engine into a single motion/machine control application. The LadderWorks PLC Engine also operates in real-time.

2) Parameters will be loaded from the system registry automatically (the program creates a set of default parameters if parameters are not already present).

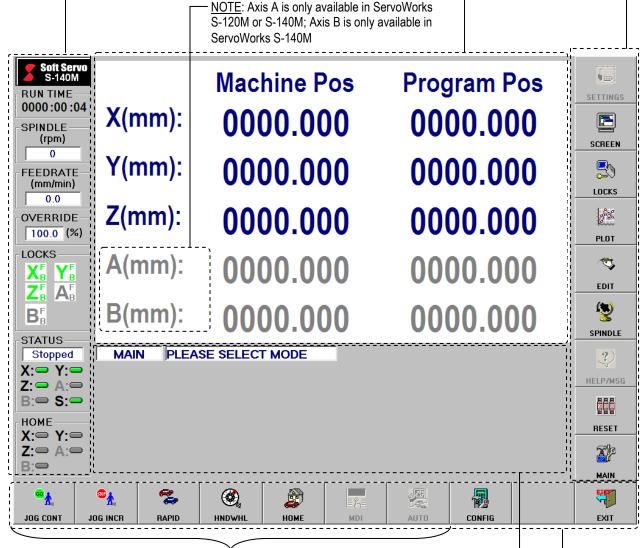
Once ServoWorks S-1\_0M is started, you will see the Main Window. The Main Window of ServoWorks S-140M is shown in Figure 2-2; the Main Windows of ServoWorks S-100M and ServoWorks S-120M are similar.



- Status Indicator Area: this area indicates the run time, the actual spindle speed, the actual feedrate, the feedrate override percentage, the status of axis locks, the servo loop status, the on/off status of the servo drives for each axis, whether or not the axis is at the home position (and for ServoWorks S-100M, it also indicates whether or not the soft limits of the machine have been activated)

Right Toolbar: this toolbar displays sub modes available to you, whatever operational mode you are in.

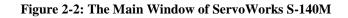
**Main Display Area:** This area displays the axes' positions, plots of tool trajectory, the status of I/O signals, etc. (you can select what to display)



These are the seven basic motion modes available to you in ServoWorks S-1\_0M program. [NOTE: MDI Mode and Auto Mode (as well as Settings Mode) are disabled (not available to you) until after you home all axes. See Section 2.5: Performing a Homing Operation.]

**Mode Display Area:** This area displays the mode status (current control mode) and the parameters and settings for the current mode

Bottom Toolbar





<u>NOTE</u>: An "RtxServer" window may also open up on the desktop of your PC (as shown in the following figure) when the IntervalZero RTX real-time extension is invoked by the ServoWorks CNC Engine. This happens automatically, unless you disabled this during machine setup and integration by following the procedure described in *Section 3.9: Preventing the RtxServer Screen from Popping Up* in your *ServoWorks CNC Setup and Integration Manual.* You won't need to use this window, so you can use the **\_\_\_** button in the top right corner of the window to minimize the window. Or, you can use the "Options" menu:

1) Select "Options.." from the "View" pull-down menu, as shown:

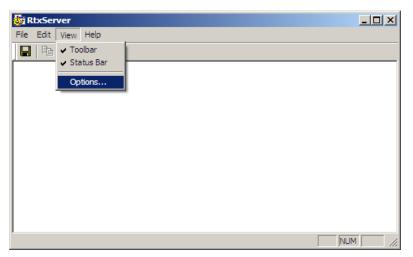


Figure 2-3: RtxServer Window – Options Pull-Down Menu

2) An "Options" window will appear, as shown:

Options	x
Display Logging	
<ul> <li>✓ Start the RtxServer Console minimized</li> <li>✓ Display output to screen</li> </ul>	
Suppress warning messages	
Maximum screen buffer size (KB): 64	
OK Cancel Apply	

Figure 2-4: Options Window (1 of 2)

3) The default setting for "Display output to screen" is checked ( ✓). To prevent the RtxServer window from appearing unexpectedly, this setting should be unchecked (deselected). It should appear as follows:



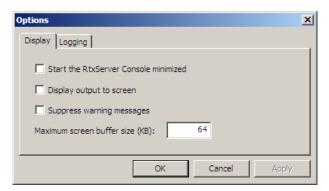


Figure 2-5: Options Window (2 of 2)

### 2.2 Navigating Control Modes in ServoWorks S-100M/S-120M/S-140M

#### 2.2.1 Types of Control Modes

There are three types of control modes in ServoWorks S-1\_0M:

1) Main Mode – a single mode that controls all the other modes. When you first start ServoWorks

S-1\_0M, you will be in Main Mode. Pressing the button or the "Escape" key on your keyboard while in Main Mode will cause you to exit ServoWorks S-1\_0M (after the program prompts you to make certain that you *want* to exit the program).

2) **Operational Modes** – control modes that can be entered only from Main Mode. These include six manual NC modes (Jog Continuous Mode, Jog Incremental Mode, Rapid Mode, MDI Mode, Home Mode and Handwheel Mode), Auto Mode (for automatic NC control) and Configuration Mode (for changing system

T)?

parameters and configuration settings). Pressing the button or the "Escape" key on your keyboard while in an operational mode will cause you to return to Main Mode.

3) **Sub Modes** – control modes that can be entered from either Main Mode or from any operational mode except Configuration Mode. If you enter a sub mode from an operational mode, you can work in that sub mode while you are also in the operational mode. For instance, while executing a part program in Auto Mode, you can go to Plot Mode to adjust the plot display without stopping motion. Pressing the button corresponding to the highlighted sub mode or pressing the "Escape" key on your keyboard while in a sub mode will cause you to return to the mode you were in (either an operational mode or Main Mode) before you entered the sub mode.

#### 2.2.2 Navigating Control Modes

SCREEN

It's important to know how to navigate control modes in ServoWorks S-1\_0M. For example, let's say you are in Auto Mode (an operational mode). While in Auto Mode, while running a part program, you decide to change the display so you can change what types of positions are displayed. While the motion is still ongoing (by execution of

a part program), you can enter Screen Mode (a sub mode) by pressing the

SCREEN

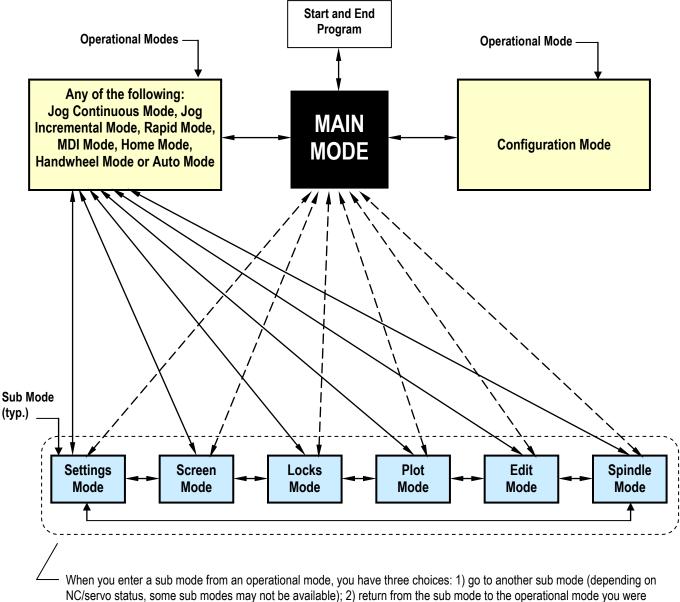
button, change the display, and

then press the

button again to go back to Auto Mode.



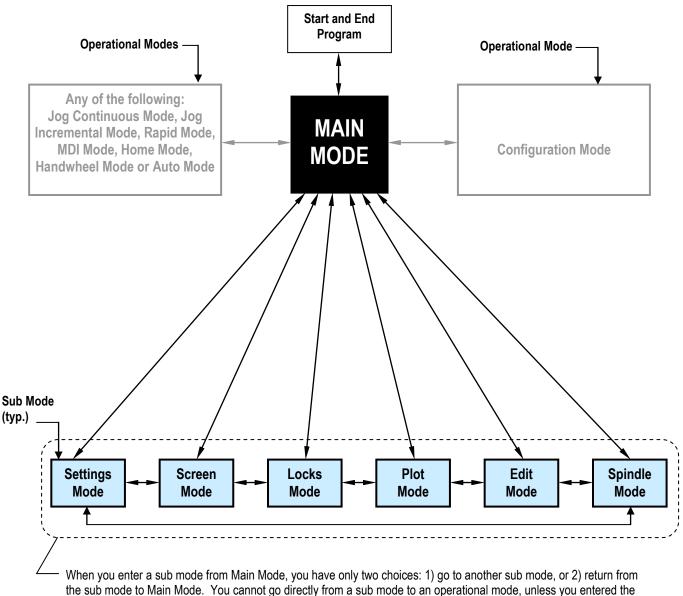
Flow charts showing how to navigate the various control modes follows:



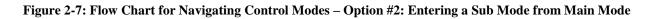
NC/servo status, some sub modes may not be available); 2) return from the sub mode to the operational mode you were in before entering a sub mode (by pressing the sub button again); or, 3) going directly to Main Mode (not recommended).

# Figure 2-6: Flow Chart for Navigating Control Modes – Option #1: Entering an Operational Mode from Main Mode





sub mode from that operational mode (see Figure 2-4).



#### 2.2.3 Control Mode Display

ServoWorks S-1\_0M displays which mode you are in, and whether that mode is a sub mode or an operational mode (except for Main Mode, which is neither a sub mode nor an operational mode). Mode information is displayed on-screen as shown in the following figure:



Soft Serve S-140M RUN TIME 0000:07:26 SPINDLE (rpm)	X(mm):		ne Pos ).000		ram Pos )0.000	SETTINGS
FEEDRATE (mm/min)	Y(mm):	000	0.000	000	00.00	
OVERRIDE 100.0 (%)	Z(mm):	0000	0.000	000	00.000	PLOT
LOCKS	A(mm):	0000	0.000	000	000.00	EDIT
	- B <del>(</del> mm):	0006	0 <del>.0</del> 00.0	000	000.00	
Stopped X:- Y:- Z:- A:-	MAIN PLE	EASE SELECT M	ODE			2) HELP/MSG
						000 Reset
Z:= A:= B:=						
JOG CONT JI	CG INCR RAPID	(O) HNDWHL	HOME MDI	AUTO	CONFIG	EXIT

 Mode information is permanently displayed in this area of the ServoWorks S-1\_0M program window.

#### Figure 2-8: Mode Information Displayed in ServoWorks S-1\_0M

For Main Mode, you will see MAIN PLEASE SELECT MODE

For an operational mode you will see something like **HOME OPERATION**, although the text box displaying "HOME" will vary according to which operational mode you are in.

For a sub mode, you will see something like either MAIN SUB LOCKS (which indicates that you entered the sub mode "Locks Mode" from Main Mode), or JOG SUB LOCKS (which indicates that you entered the sub mode "Locks Mode" from the operational mode "Jog Continuous Mode.")

#### 2.2.4 Getting Into and Out of Configuration Mode

All instructions for the rest of this chapter involve getting into and out of Configuration Mode, with the following procedure:



1) Press the <u>config</u> button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password when the following window appears:

<u> </u>

Figure 2-9: The Password Prompt Window

The first time you use ServoWorks S-1\_0M, the default password will be "softservo." You can change your password as explained in *Section 3.3: General Parameters*.





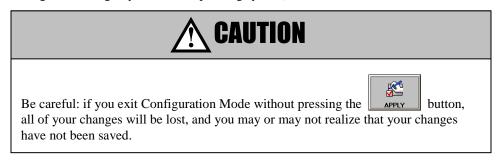
2) Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear:

Soft Servo S-140M RUN TIME 0000 :43 :48 SPINDLE (rpm) 0.000 FEEDRATE (mm/min)	X(mm): Y(mm): Z(mm): A(mm): B(mm):	Machine Pos 0000.000 0000.000 0000.000 0000.000 0000.000	Program Pos 0000.000 0000.000 0000.000 0000.000	Relative Pos 0000.000 0000.000 0000.000 0000.000 0000.000	Servo Lag 0000.002 0000.002 0000.002 0000.002 0000.002	SETTINGS SCREEN
0.0 OVERRIDE 100.0 (%)	General	Machine	NC	Feedrate	Motor	
LOCKS <b>X</b> <sup>F</sup> <sub>B</sub> <b>Y</b> <sup>F</sup> <sub>B</sub> <b>Z</b> <sup>F</sup> <sub>B</sub> <b>A</b> <sup>F</sup> <sub>B</sub>	Servo Loop	Acc / Dec	Safety	Home	Sync Control	EDIT
STATUS Stopped	Machine Compensation	Pitch Error Compensation	Tool Compensation	Display	Plot	
X: Y: Z: A: B:	Масто	Cutting Speed Adj.	Normal Direction Control	DLACC		HELP/MSG
номе Х:● Y:● Z:● A:● B:●						RESET
	PAGE UF	P PAGE DN	LEFT RIGHT	r UP	DOWN SWITCH AXES	MAIN

Figure 2-10: Configuration Mode – Main Screen



- 3) Select the desired category of parameters by clicking on that button with a mouse.
- 4) Whenever you make any changes, you must press the your changes into a registry file in the operating system).



5) To return to the main screen in Configuration Mode, shown in Figure 2-10, (so that you can select a

different set of parameters), press the	QUIT	button.	
<b>X</b>			

6) Press the \_\_\_\_\_ button to exit Configuration Mode.

# 2.3 Turning On and Off the Servo Drives

The first time you use ServoWorks S-1\_0M, all axes will be disabled (the "Axis Type" will be set to "Unused"). You can enable the axes with the following procedure:



- 1) Press the config button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.
  - Machine
- 2) Select the "Machine" screen by clicking on the \_\_\_\_\_\_ button. The "Machine" parameters screen displays parameters related to machine configuration for all axes, and is shown in the following figure:



Axis Configuration	Axis1 (X)	Axis	2 (Y)	Axis3 (2	Z)	Spindle	(S)
Axis Configuration Axis Name	x	• Y	•	Z	•	S	-
Axis Type	Unused	<ul> <li>Unuse</li> </ul>	d 🔻	Unused	•	Unused	•
Rotary Position Display Range [deg]	0~360	• 0~360	-	0~360	-	0~360	-
Rotary ST Rotating Type	Shorter	Shorte	er 🔻	Shorter	~	Shorter	-
I/O Configuration Number of IM200	Н	6, LS Sour Iome Swit .imit Switc	ch Source	• [	On Ser On Ser		•
Handwheel Settings Handwheel Type VersioBus							

Figure 2-11: Configuration Mode – Machine Parameters Screen

3) Change the "Axis Type" for your servo axes to either "Normal," "Rotary" or "Rotary ST," depending upon your machine. [If you want any axis to remain disabled, leave it as "Unused."]. Set the spindle type to either "Servo" or "Inverter," and set any remaining axes to either "PLC," "Sync slave" or "Unused." For

ServoWorks S-120M and S-140M, use the switch axes button to switch to additional axes not displayed on the first screen.

- 4) Press the APPLY button on the bottom toolbar.
  5) Press the MAIN button to exit Configuration Mode.
- 6) If you have set one or more axes as "Sync slave," you need to exit and restart ServoWorks S-120M/

S-140M. Press the button to exit the application. Any axes not set to "Unused" will be turned on when you restart.

Otherwise, if you haven't set any axes to the "Sync Slave" Axis Type, press the \_\_\_\_\_ button on the right toolbar. A dialog box will appear (shown in the following figure), asking you to confirm that you want to reset ServoWorks S-1\_0M.

5-14	юм		×
0	Are you sure you wa	nt to reset S-1	40M?
	Ok	Cancel	

Figure 2-12: Confirmation Dialog Box for Resetting ServoWorks S-1\_0M

7) Press "OK," and any servo drives that are not set to "Axis Type: Unused" will be turned on.



To disable one or more axes, repeat the above procedure, setting the "Axis Type" to "Unused" for any axis you want to disable.

# 2.4 Synchronous Control with Slave Axes

For ServoWorks S-120M and S-140M, you can include synchronous slave axes in your system. The procedure for setting up synchronous control varies depending upon whether or not you are using absolute encoders.

If you are using ServoWorks S-100M, or using ServoWorks S-120M or S-140M without slave axes, please skip this section and proceed to *Section 2.5: Performing a Homing Operation*.

#### 2.4.1 Synchronous Control Without Absolute Encoders

If you are not using absolute encoders, you can enable synchronous control with the following procedure:

- Press the config button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.
- 2) Select the "Machine" screen by clicking on the \_\_\_\_\_\_ button. The "Machine" parameters screen displays parameters related to machine configuration for all axes, and is shown in Figure 2-11.

Machine

Axes 6 and 7 are each slave axes associated to Master Axis X in this

3) Only Axes 5, 6 and 7 can ever be used for synchronous slave control. Use the switch axes button to display the settings for Axes 4 through 7, as shown in the following figure:

			example -			
Axis Configuration	Axis4 (A)	Axis5 (B)	Axis6	(X2)	Axis7 (P	'1)
Axis Name	A	В	- ×	-	X	-
Axis Type	Normal	Normal	Sync 9	Slave 🔻	Sync Sla	ve
Rotary Position Display Range [deg]	0~360	0~360	0~360	-	0~360	Y
Rotary ST Rotating Type	Shorter	Shorter	Shorte	er 🔻	Shorter	-
I/O Configuration Number of IM200	Но	LS Source S me Switch S nit Switch So	ource	On Se On Se		<b>•</b>
Handwheel Settings         Handwheel Type         VersioBus         ✓         Accumulate handwheel pulse						

Figure 2-13: Configuration Mode – Machine Parameters Screen – Showing Synchronous Slave Axes



the

- For each slave axis, set the "Axis Type" to "Sync Slave", and press the press the button on the bottom toolbar.
- 5) Select the master axis using the "Axis Name" pull-down menu, as shown in the previous figure, and press

**APPLY** button on the bottom toolbar again.

Here are a few notes regarding synchronous control:

- 1) The master axis and each slave axis must have the same encoder type: absolute or incremental.
- 2) There are two critical parameters to be aware of with regard to synchronous control:
  - a) "Sync Control On Startup" (in the "Sync Control" screen of Configuration Mode): any synchronous slave axes are immediately synchronized with their master axis/axes upon startup of the ServoWorks S-120M/S-140M application.
  - b) "Sync Control On Reset" (in the "Sync Control" screen of Configuration Mode): no synchronization

occurs between master and slave axes until the BESET button in ServoWorks S-120M/140M is pressed.

ā dā

At least one of these must be checked in order to use synchronous control.

3) After setting one or more axes to be synchronous slave axes, you must exit and restart ServoWorks S-120M

or S-140M to make synchronous control effective, or click the **DESET** button to make synchronous control effective, depending on your settings for the parameters discussed in Note #2.

- 4) When you are using synchronous control, when you home the master axis any synchronized slave axes are homed at the same time automatically.
- 5) In order to view information (such as home limits, soft limits or position information) for synchronous slave axes, see *Section 5.2.1.4: Axis Status Information*.

#### 2.4.2 Synchronous Control and Homing With Absolute Encoders

This one-time setup procedure for homing synchronous axes with absolute encoders is for the machine integrator and sets the reference position for the absolute encoders of the slave and master axes. The master axis and each slave axis must have the same encoder type: absolute or incremental. This procedure only applies to synchronous control with absolute encoders.

There are three parts to this procedure:

#### 2.4.2.1 Part ONE of Setting Synchronous Control and Homing For Absolute Encoders

<u>NOTE</u>: Part ONE only applies to a Panasonic Realtime Express (RTEX) interface system. If you are using a MECHATROLINK or SSCNET system, you must reset the absolute encoders (using a Yaskawa digital operator or ServoWorks MotionLite) and proceed to *Section 2.4.2.2: Part TWO of Setting Synchronous Control and Homing for Absolute Encoders*.

For a Panasonic Realtime Express (RTEX) interface system:



- 1) ServoWorks S-120M or S-140M must be turned off.
- 2) Using the "PANATerm" software and a serial communication cable, go to the "Parameter" page and set the servo amplifiers as "Absolute Encoder". Set Parameter No "0B" to "0". Save as "EPP".
- 3) Using the "PANATerm" software and a serial communication cable, go to the "Monitor" page and clear both servo amplifiers' "Multi-turn data and encoder error" values.
- 4) Recycle the power of the servo amplifiers.

#### 2.4.2.2 Part TWO of Setting Synchronous Control and Homing for Absolute Encoders

1) Start ServoWorks S-120M/140M by using the "Start" menu on the desktop of your PC to select

"Programs," then "SoftServo," then "S-120M" or "S-140M." Or select the shortcut (for a result of servoWorks S-120M/140M, either by double clicking on the shortcut with your mouse, or with a keyboard (by pressing the "Ctrl" and "Shift" keys together, using the arrow keys to reach the icon, then pressing the "Enter" key). When the program has booted up, you will be in the main screen of ServoWorks S-120M/140M.

2) Change settings in Configuration Mode:



a) Press the config button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.

Machine

se in the second second

APPLY

b) Select the "Machine" screen by clicking on the \_\_\_\_\_\_ button. The Machine screen will appear, as shown in Figure 2-11.

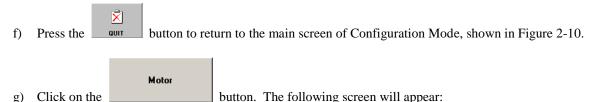


- c) Use the switch axes button to switch the display to Axes 4 through 7, as shown in Figure 2-13.
- d) For each slave axis (potentially axes 5 through 7, depending on whether you are using ServoWorks

S-120M or ServoWorks S-140M), set the "Axis Type" to "Sync Slave," and press the button on the bottom toolbar .

e) Select the master axis for each slave axis using the "Axis Name" pull-down menu, as shown in Figure

2-13. Then click the APPLY button on the bottom toolbar again.



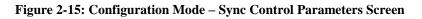


Motor/Drive Parameters	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Rated Velocity [RPM]	3000.0	3000.0	3000.0	3000.0
Peak Velocity [RPM]	4500.0	4500.0	4500.0	4500.0
Encoder Resolution [pulses per rev]	2048	2048	2048	2048
Encoder Polarity [1:Normal, -1:Reversed]	1	1	1	1
Encoder Type [1:Abs, 0:Inc]	0	0	0	0
Servo Drive Velocity Sensitivity (RPM/V)	300.0	300.0	300.0	300.0
Motor Polarity [1:Normal, -1:Reversed]	1	1	1	1



- h) For all axes that have absolute encoders, set the "Encoder Type" to "1." Use the switch to switch to additional axes not displayed on the first screen. When you have made these changes, click
  - the button on the bottom toolbar.
- i) Press the button to return to the main screen of Configuration Mode, shown in Figure 2-10.
- j) Click on the \_\_\_\_\_\_ button. A Sync Control screen will appear, as shown in the following figure:

Sync Control Parameters	Axis6 ( )	Axis7 ( )
Sync Lag Limit at Rapid [mm or deg]	6000.0	6000.0
Sync Lag Limit Stopped [mm or deg]	1000.0	1000.0
Sync Control Gain [%]	50	50
Catch Up Speed [mm/min]	200.0	200.0
Starting Sync Control Sync Control on Startup Sync Control on Reset Sync Startup Type Normal		



k) UNCHECK ( ) both "Sync Control on Startup" and "Sync Control on Reset," as shown in the previous figure. Click the button on the bottom toolbar.



- 3) Exit ServoWorks S-120M/140M. [NOTE: You are required to restart ServoWorks S-120M/S-140M when you change either of the "Sync Control on Startup" or "Sync Control on Reset" settings.]
  - MAIN button to get to Main Mode, and then press the EXIT a) Press the button to exit. A dialog box will appear, as shown in the following figure:

5-14	S-140M										
0	Are you sure you want to exit S-140M?										
	Ok	Cancel									

Figure 2-16: Dialog Box to Confirm Exiting ServoWorks S-140M

b) Click the "OK" button to exit.

**X** 

#### 2.4.2.3 Part THREE of Setting Synchronous Control and Homing for Absolute Encoders

- 1) Restart ServoWorks S-120M/140M. When the program has booted up, you will be in the main screen of ServoWorks S-120M/140M.
- 2) Use one of the manual modes (Jog Continuous Mode, Jog Incremental Mode, Rapid Mode or HandWheel Mode) to move each master axis and each slave axis to where you want to set the machine reference position. [Refer to Chapter 9: Continuous Jogging (Using Jog Continuous Mode), Chapter 10: Incremental Jogging (Using Jog Incremental Mode), Chapter 11: Rapid Positioning (Using Rapid Mode) or Chapter 13: Using HandWheel Mode.]
- 3) Change settings in Configuration Mode:

Home



- a) Get into Configuration Mode by pressing the configuration on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.
- b) Click on the button. The Home screen will appear, as shown in the following figure:



- Home Parameters	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Home Parameters Home Type	Z Pulse 💌	Z Pulse 🔻	Z Pulse 🔻	Z Pulse
Home Direction	Plus -	Plus -	Plus 🔻	Plus 🔽
Home Switch Type	Act Close 💌	Act Close 💌	Act Close 💌	Act Close
Home Shift [mm or deg]	1.0	1.0	1.0	1.0
Home Position [mm or deg]	0.0	0.0	0.0	0.0
Home Reverse Dwell Time [ms]	100	100	100	100
Home Reverse Distance [mm or deg]	1.0	1.0	1.0	1.0
Grid Search Speed [mm/min or deg/min]	300.0	300.0	300.0	300.0
Home Switch Search Speed [mm/min or deg/min]	1000.0	1000.0	1000.0	1000.0
Reference Position 2 [mm or deg]	0.0	0.0	0.0	0.0
Reference Position 3 [mm or deg]	0.0	0.0	0.0	0.0
Reference Position 4 [mm or deg]	0.0	0.0	0.0	0.0
Always search for home	No	No 💌	No 💌	No

Set Home Position for Absolute Encoder in HOME Mode

Figure 2-17: Configuration Mode – Home Parameters Screen

c) CHECK ( ) "Set Home Position for Absolute Encoder in HOME Mode," and click the button on the bottom toolbar.

T

d) Exit Configuration Mode by pressing the button to get to Main Mode.

- 4) Set the machine reference position in Home Mode:
  - a) Each axis should be at the desired machine reference position. Press the **HOME** button on the bottom toolbar in the Main Window of ServoWorks S-120M/140M. (You can only enter Home Mode from Main Mode.) You will be prompted for your password when the window shown in Figure 2-9 appears again. The password is the same as for Configuration Mode.

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After you enter your password and click "OK," you will see the following window appear for ServoWorks S-140M (and similar windows appear for ServoWorks S-120M):

Soft Servo S-140M	Nachine P				os Program Pos			
0001:05:56 SPINDLE (rpm)	<b>X(mm)</b> :	0000.0	00	00	00.000	SCREEN		
FEEDRATE (mm/min)	Y(mm):	0000.0	00	00	00.000			
0.0 OVERRIDE 100.0 (%)	Z(mm):	0000.0	00	00	00.000	PLOT		
	A(mm):	0000.0	00	00	00.000	EDIT		
	B(mm):	0000.0	00	00	00.000			
STATUS Stopped		?)						
X: Y: Z: A: B: S: X:	Axis X Not At Home	Axis Z Not At Home		3 Not At ome	Axis Y2 Not At Home	HELP/MSG		
номе Х:Ф Ү:Ф Z:Ф А:Ф B:Ф	Axis Y Not At Home	Axis A Not At Home		2 Not At ome		RESET		
	XÂN	AXIS A AXIS B	AXIS X2	AXIS Y2	HOME AL	MAIN		
	display buttons show t of the homing operatio			Pressing the function key for this button will start the homing operation for all axes.				
	ng one of these button g operation for the X, Y			Pressing the function key for this button will interrupt the homing operation.				

Soft Servo

#### Figure 2-18: The Home Mode Window

b) Set the home position for each master axis and each slave axis by pressing the buttons (ONE TIME EACH) on the bottom toolbar that correspond to the axes whose home position you want to set. [The

AXIS X	button on the bott	om toolbar corre	spor	nds to the X axis]	(Or, if you	have a mouse, y	ou can		
	Axis X Not At Home								
click on th	ne	button). For a	axes	with absolute end	coders, this	will establish th	е		
coordinate system for that axis, and set the current position as the home position. You will see the									
		Axis X Not At Home		Homing Axis X		Axis X At Home			
display button change from to , and then Ax									
X will the registry.	n be at the home p	osition. Reference	e p	osition parameter	s will be say	ved in the Windo	ows		

<u>NOTE</u>: If the servo drive for an axis is not turned on, the button for that axis will be disabled.



- c) Exit Home Mode by pressing the \_\_\_\_\_ button to get to Main Mode.
- 5) Change settings in Configuration Mode:
  - a) Get into Configuration Mode by pressing the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.
- Home b) Click on the button. The Home screen will appear, as shown in Figure 2-17. UNCHECK ( 🔲 ) "Set Home Position for Absolute Encoder in HOME Mode," and click the c) <u>K</u> button on the bottom toolbar. APPLY × d) Press the QUIT button to return to the main screen of Configuration Mode, shown in Figure 2-10. Sync Control button. A Sync Control screen will appear, as shown in Figure 2-15. e) Click on the R CHECK ( 🗹 ) both "Sync Control on Startup" and "Sync Control on Reset." Click the f) button on the bottom toolbar. Ϋ́, 6) Exit ServoWorks S-120M/140M by pressing the MAIN button to get to Main Mode, and then pressing EXIT button to exit. A dialog box will appear, as shown in Figure 2-16. Click the "OK" button to the exit. [NOTE: You are required to restart ServoWorks S-120M/S-140M when you change either of the "Sync Control on Startup" or "Sync Control on Reset" settings.]
- 7) Restart ServoWorks S-120M/140M.

Your synchronized control is now established. The gantry axis can be moved after the motor is connected to the machine. If you need to reconfigure the position of the gantry axis, please repeat the above procedure.



## 2.5 Performing a Homing Operation

#### 2.5.1 Overview

If you have synchronous slave axes with absolute encoders, you should already have performed a homing operation, as explained in *Section 2.4.2: Synchronous Control and Homing with Absolute Encoders*. If this is the case, please skip this section, and proceed to *Chapter 3: Configuring the System and Program Parameters*.

Once you have started ServoWorks S-1\_0M, before doing anything else, you should perform a homing operation on the mill or machining center. Doing so establishes the coordinate system for the mill or machining center, and establishes the machine and home positions within that coordinate system.

<b><u>A</u>CAUTION</b>
It is highly recommended that you set the home position for all axes immediately after starting ServoWorks S-1_0M, before you use the program for any manual or automatic motion control.
You MUST set the home position for all axes before you can enter MDI or Auto Mode.

The homing procedure varies depending upon whether or not you are using absolute encoders in your ServoWorks S-1\_0M system.

#### 2.5.2 The Homing Procedure for a System with No Absolute Encoders

To set the home position of an individual axis or of all axes, you must be in Home Mode (an operational mode that

you can access only from Main Mode). To enter Home Mode, press the button on the bottom toolbar in the Main Window of ServoWorks S-1\_0M. (You can only enter Home Mode from Main Mode.) You will see the window shown in Figure 2-18 appear for ServoWorks S-140M (and similar windows appear for ServoWorks S-100M and ServoWorks S-120M).

To set the home position for an individual axis, press the button on the bottom toolbar that corresponds to the axis

whose home positio	n you want to set.	Th	is example uses .	Axis X. Fo	r instance, the	AXIS X	button	on the bottom	
						Axis X Not At H			
toolbar corresponds to the X axis. (Or, if you have a mouse, you can click on the button). This									
will establish the coordinate system for that axis, and move that axis to the home position. You will see the display									
	Axis X Not At Home		Homing Axis X		Axis X At Home	e de la companya de la			
button change from		to		, and then		. Axis	X will t	hen be at the	
home position.									

<u>NOTE</u>: If the servo drive for an axis is not turned on, the button for that axis will be disabled.

To set the home position of all axes at the same time, you can use the HOME ALL button in the lower right corner.



- 🖄

At any point during the homing operation, you can press the **STOPALL** button to interrupt the homing procedure, and stop the movement of both axes.

In Home Mode, all acceleration and deceleration is performed with linear smoothing filters. For an explanation of linear acceleration/deceleration, see the *Reference Manual for ServoWorks CNC Parameters and Functions*.

### 2.5.3 The Homing Procedure for a System with Absolute Encoders with No Home Switch

#### 2.5.3.1 One-Time Setup Procedure for the Machine Integrator

If you are using synchronous slave axes AND absolute encoders, please refer to *Section 2.4.2: Synchronous Control and Homing With Absolute Encoders* for setting the reference position of the slave and master axes.

You must refer to the documentation for the servo drives to properly wire your absolute encoders and initialize the servo amplifiers.

This one-time setup procedure for homing absolute encoders is for the machine integrator and sets the reference position for the absolute encoders. This homing operation establishes the coordinate system for the machine tool, and establishes the machine home positions within that coordinate system. This homing process is required only once. The reference point is kept even when the system is powered off.

The screen shots shown are for ServoWorks S-140M, but the procedure is essentially the same for ServoWorks S-100M and S-120M.

1) Start ServoWorks S-1\_0M by using the "Start" menu on the desktop of your PC to select "Programs," then

"SoftServo," then "S-100M," "S-120M" or "S-140M." Or select the shortcut (1000, 1000 or 1000) on your desktop for ServoWorks S-1\_0M, either by double clicking on the shortcut with your mouse, or with a keyboard (by pressing the "Ctrl" and "Shift" keys together, using the arrow keys to reach the icon, then pressing the "Enter" key). When the program has booted up, you will be in the main screen of ServoWorks S-1\_0M.

2) Change settings in Configuration Mode:

Ń

- a) Get into Configuration Mode by pressing the converse button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.
- b) Click on the button, and the Motor Screen will appear, as shown in Figure 2-14.
- c) For axes that have absolute encoders, set the "Encoder Type" to "1." For ServoWorks S-120M and

se i

S-140M, use the switch axes button to switch to additional axes not displayed on the first screen. When

you have made these changes, click the \_\_\_\_\_ button on the bottom toolbar.

d) Press the **uttern** button to return to the main screen of Configuration Mode, shown in Figure 2-10.



Home Click on the button. The Home screen will appear as shown in Figure 2-17.

- ĸ CHECK ( 🗹 ) "Set Home Position for Absolute Encoder in HOME Mode," and click the f) APPLY button on the bottom toolbar.
- 3) Exit ServoWorks S-1\_0M:
  - button to get to Main Mode, and then press the a) Press the MAIN EXIT button to exit ServoWorks S-1\_0M. A dialog box will appear, as shown in Figure 2-16.
  - b) Click the "OK" button to exit.

**X**þ

- 4) Restart ServoWorks S-1\_0M. When the program has booted up, you will be in the main screen of ServoWorks S-1 0M.
- 5) Use one of the manual modes (Jog Continuous Mode, Jog Incremental Mode, Rapid Mode or HandWheel Mode) to move each axis to where you want to set the reference position. [Refer to Chapter 9: Continuous Jogging (Using Jog Continuous Mode), Chapter 10: Incremental Jogging (Using Jog Incremental Mode), Chapter 11: Rapid Positioning (Using Rapid Mode) or Chapter 13: Using HandWheel Mode.]
- 6) Set the machine reference position using Home Mode:
  - a) When each axis is at the desired reference position, press the button on the bottom toolbar HOME in the Main Window of ServoWorks S-1 0M. (You can only enter Home Mode from Main Mode.) You will be prompted for your password when the window shown in Figure 2-9 appears again. The password is the same as for Configuration Mode.

After you enter your password and click "OK," you will see the window shown in Figure 2-18 appear for ServoWorks S-140M (and similar windows appear for ServoWorks S-100M and ServoWorks S-120M):

b) To set the home position for an individual axis, press the button on the bottom toolbar that corresponds to the axis whose home position you want to set. This example uses Axis X. For instance, the



button on the bottom toolbar corresponds to the X axis. (Or, if you have a mouse, you can

#### Axis X Not At Home

click on the button). For axes with absolute encoders, this will establish the coordinate system for that axis, and sets the current position for that axis as the home position. [For axes that do not use absolute encoders, this will move the axes to their home positions.] You will see

Axis X Not At Home

Axis X At Home

the display button change from . Axis X will then be set to the to home position. [NOTE: If the servo drive for an axis is not turned on, the button for that axis will be disabled.]



To set the home position of all axes at the same time, you can use the button in the lower HOME ALL right corner.



At any point during the homing operation, you can press the stop ALL button to interrupt the homing procedure, and stop the movement of both axes.

<u>NOTE</u>: In Home Mode, all acceleration and deceleration is performed with linear smoothing filters. For an explanation of linear acceleration/deceleration, see the *Reference Manual for ServoWorks CNC Parameters and Functions*.

c) Exit Home Mode by pressing the MAIN

button to get to Main Mode.

- 7) Change settings in Configuration Mode:
  - a) Get into Configuration Mode by pressing the conrise
     button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.

**X**r

- b) Click on the \_\_\_\_\_\_ button. The Home screen will appear, as shown in Figure 2-17.
- c) UNCHECK ( ) "Set Home Position for Absolute Encoder in HOME Mode," and click the

button on the bottom toolbar.

Home

8) Exit ServoWorks S-1\_0M by pressing the button to get to Main Mode, and then pressing the

<u> A</u>r

**EXIT** button to exit. A dialog box will appear, as shown in Figure 2-16. Click the "OK" button to exit.

9) Restart ServoWorks S-1\_0M.

At this point, Home Mode will no longer be password protected. Going into Home Mode and "homing" any axes will move the selected axes back to the home position, but it WILL NOT reset the home reference point.

#### 2.5.3.2 Homing Procedure for Setting Axes Back to Their Home Position (for Operators)

After the one-time homing procedure has been performed for the absolute encoders, using the Home Mode to "home" axes will not reset the reference point for the absolute encoders; it will merely move the selected axes back to their home position.

From the operator's point of view, the homing procedure is the same as *Section 2.5.2: The Homing Procedure for a System with No Absolute Encoders*. Refer to this section for setting axes back to their home positions.



### 2.5.4 The Homing Procedure for a System with Absolute Encoders Using A Home Switch

#### 2.5.4.1 One-Time Setup Procedure for the Machine Integrator

If you are using synchronous slave axes AND absolute encoders, please refer to *Section 2.4.2: Synchronous Control and Homing With Absolute Encoders* for setting the reference position of the slave and master axes.

You must refer to the documentation for the servo drives to properly wire your absolute encoders and initialize the servo amplifiers.

This one-time setup procedure for homing absolute encoders is for the machine integrator and sets the reference position for the absolute encoders using a home switch. This homing operation establishes the coordinate system for the machine tool, and establishes the machine home positions within that coordinate system. This homing process is required only once. The reference point is kept even when the system is powered off.

The screen shots shown are for ServoWorks S-140M, but the procedure is essentially the same for ServoWorks S-100M and S-120M.

1) Start ServoWorks S-1\_0M by using the "Start" menu on the desktop of your PC to select "Programs," then

"SoftServo," then "S-100M," "S-120M" or "S-140M." Or select the shortcut (and select the shortcut with your mouse, or with a keyboard (by pressing the "Ctrl" and "Shift" keys together, using the arrow keys to reach the icon, then pressing the "Enter" key). When the program has booted up, you will be in the main screen of ServoWorks S-1\_0M.

- 2) Change settings in Configuration Mode:
  - a) Get into Configuration Mode by pressing the convrise button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10.

	Motor
b)	Click on the button. The Motor screen will appear, as shown in Figure 2-14.
c)	For all axes, set the "Encoder Type" to "0" ("Incremental Encoder"), EVEN FOR AXES WITH
	ABSOLUTE ENCODERS. Use the switch acts button to switch to additional axes not displayed on
	the first screen. When you have made these changes, click the button on the bottom boolbar.
d)	Press the button to return to the main screen of Configuration Mode, shown in Figure 2-10.
e)	Click on the button. The Home screen will appear, as shown in Figure 2-17.
f)	Make sure that "Set Home Position for Absolute Encoder in HOME Mode" is UNCHECKED ( 🔲 ).



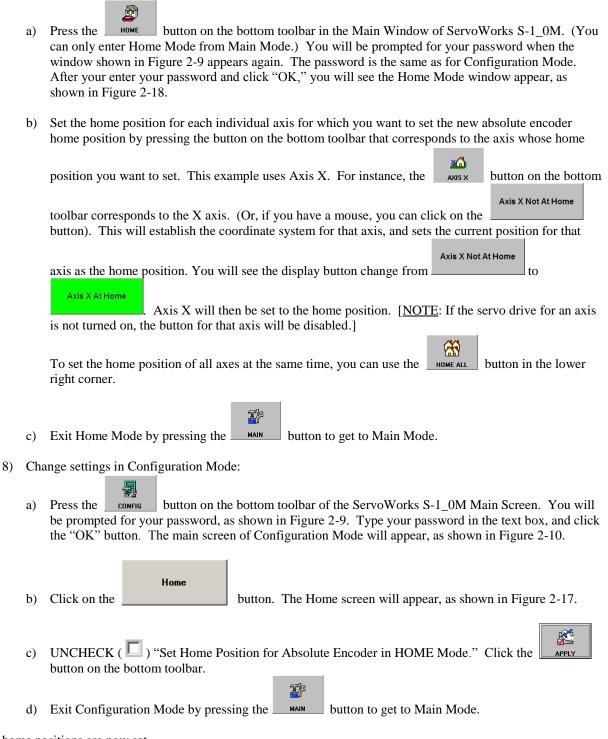
ĸ Set "Home Type" to "HSOn." Click the button on the bottom toolbar. g) APPLY 500 Set "Always search for home" to "Yes." Click the button on the bottom toolbar. h) APPLY TP-Exit Configuration Mode by pressing the button to get to Main Mode. i) MAIN 3) Perform a homing operation using the home switch: ð a) Press the HOME button on the bottom toolbar in the Main Window of ServoWorks S-1\_0M. (You can only enter Home Mode from Main Mode.) You will see the window shown in Figure 2-18 appear for ServoWorks S-140M (and similar windows appear for ServoWorks S-100M and ServoWorks S-120M). b) To set the home position for an individual axis, press the button on the bottom toolbar that corresponds to the axis whose home position you want to set. This example uses Axis X. For instance, the **X** button on the bottom toolbar corresponds to the X axis. (Or, if you have a mouse, you can AXIS X Axis X Not At Home button). This will establish the coordinate system for that axis by click on the detecting the home switch, and sets the current position for that axis as the home position. You will see Axis X Not At Home Axis X At Home the display button change from Axis X will then be set to the home position. [NOTE: If the servo drive for an axis is not turned on, the button for that axis will be disabled.] To set the home position of all axes at the same time, you can use the HOME ALL button in the lower right corner. button to get to Main Mode. c) Exit Home Mode by pressing the MAIN 4) Change settings in Configuration Mode: a) Get into Configuration Mode again by pressing the configuration on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will be prompted for your password, as shown in Figure 2-9. Type your password in the text box, and click the "OK" button. The main screen of Configuration Mode will appear, as shown in Figure 2-10. Motor b) Click on the button. The Motor screen will appear, as shown in Figure 2-14.



	c)	For all absolute encoder axes, set the "Encoder Type" to "1" ("Absolute Encoder"). Use the
		switch axes button to switch to additional axes not displayed on the first screen. When you have made
		these changes, click the button on the bottom toolbar.
	d)	Press the button to return to the main screen of Configuration Mode, shown in Figure 2-10.
	e)	Click on the button. The Home screen will appear, as shown in Figure 2-17.
	f)	Set "Always search for home" to "No." Click the <b>APPLY</b> button on the bottom toolbar.
	g)	CHECK ( ) "Set Home Position for Absolute Encoder in HOME Mode." Click the Level 1 apply button on the bottom toolbar.
	h)	Exit Configuration Mode by pressing the button to get to Main Mode.
5)	Exi	t ServoWorks S-1_0M:
	a)	Press the button to get to Main Mode, and then press the button to exit. A dialog box will appear, as shown in Figure 2-16.
	b)	Click the "OK" button to exit.

- 6) Restart ServoWorks S-1\_. When the program has booted up, you will be in the main screen of ServoWorks S-1\_0M.
- 7) Set the machine reference position of each axis while each axis is at the home position determined by the home switch:





The home positions are now set.

### 2.5.4.2 Homing Procedure for Setting Axes Back to Their Home Position (for Operators)

After the one-time homing procedure has been performed for the absolute encoders, using the Home Mode to "home" axes will not reset the reference point for the absolute encoders; it will merely move the selected axes back to their home position.



From the operator's point of view, the homing procedure is the same as *Section 2.5.2: The Homing Procedure for a System with No Absolute Encoders*. Refer to this section for setting axes back to their home positions.

# 2.6 Setting Up Automatic Tool Changes (ATC)

Please refer to *Chapter 8: Macro Examples: Automatic Tool Change (ATC) with ServoWorks S-100T or the ServoWorks S-100M Series* in the *ServoWorks CNC Macro Programming Manual.* 



# **Chapter 3: Configuring the System and Program Parameters**

## 3.1 Overview

Before you operate the mill or machining center, you should configure your system and program parameters. System parameters are discussed in detail in the *Reference Manual for ServoWorks CNC Parameters and Functions*. You should refer to the *Reference Manual for ServoWorks CNC Parameters and Functions* when setting the system parameters, as descriptions of these parameters are omitted from this chapter. Program parameters, however, are described in this chapter.

The machine parameters that you need to set for general machine operation are the machine, NC settings, feedrate, motor/drive, servo loop, acceleration/deceleration, safety, synchronization control and compensation parameters. These parameters apply to the machine, and you should seldom need to change them. You should refer to the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible range of values, default values, etc.

The program parameters relate to plot settings, display, etc. that affect how you interact with ServoWorks S-1\_0M. You use the program parameters to customize ServoWorks S-1\_0M to your preferences.

The screen shots for this chapter are for ServoWorks S-140M, but are essentially the same for ServoWorks S-100M and ServoWorks S-120M.

## 3.2 Accessing the Machine and Program Parameters

To access the machine and program parameters, you must get into Configuration Mode, an operational mode in which ServoWorks S-1\_0M displays parameter settings and accepts and applies new parameter settings for numerous types of parameters. Refer to *Section 2.2.4: Getting Into and Out of Configuration Mode*.

In Configuration Mode, you have access to many types of parameters: general, machine, NC settings, feedrate, motor, servo loop, acceleration/deceleration, safety, home, synchronization control, machine compensation, pitch error compensation, tool compensation, display, plot, macros, cutting speed adjustment, normal direction control and DLACC settings. Click the button for each parameter type, and make sure that each machine parameter is set in accordance with the recommendations and requirements of the *Reference Manual for ServoWorks CNC Parameters and Functions*, and that each program parameter reflects your preference for interacting with ServoWorks S-1\_OM.

To return to the main screen in Configuration Mode (so that you can select a different set of parameters), press the

×
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button.



For ServoWorks S-120M and S-140M, use the switch axes button to switch to additional axes not displayed on the first screen. In other words, for ServoWorks S-140M, the first screen displays the parameters for four axes. To

view and/or change the parameters for the additional four axes, use the switch axes button.



## 3.3 General Parameters

The "General" parameters screen is shown in the following figure. It displays the software version of the ServoWorks S-1\_0M application you are running, and any options you have purchased.

Version
S-140M SIM v3.977
Option DLACC, Macro
Password Setting
New Password (16-Character Maximum)
Confirm New Password
Remember Password
Flight Recorder Data Sampling
Save sampled data upon E-Stop

Figure 3-1: Configuration Mode – General Parameters Screen

The "General" screen also allows you to modify your password, and to specify whether or not you want ServoWorks S-1\_0M program to remember your password so you don't have to type your password when you use Configuration Mode. If you do not check the "Remember Password" box, you will be prompted for your password each time you go into Configuration Mode. [NOTE: When you check the "Remember Password" box, you will still have to enter your password the first time you go into Configuration Mode after restarting ServoWorks S-1\_0M.]

The "General" screen allows you to specify whether or not to record sampled data when an Emergency Stop is triggered (i.e. use the "Flight Recorder" feature). See *Section 17.2: Using the Flight Recorder for Debugging* for more information. If you intentionally and frequently trigger E-Stops, you may want to disable the flight recorder, as it will occasion a delay of up to 10 seconds or more each time, as data is saved to a file. You also have the option of "Save All" (saving all the types of data that the flight recorder is able to process, for 20 seconds before failure), or "Save Extended Pos" (saving only the command and feedback positions for an extended period of time of 100 seconds before failure, as compared to 20 seconds for the "Save All" option).



## 3.4 Machine Parameters

Handwheel Type

Accumulate handwheel pulse

Unused

### 3.4.1 Overview

The "Machine" parameters screen for ServoWorks S-140M is shown in the following figures. It displays parameters related to the axis configuration, I/O configuration, limit switch source selection, and handwheel settings. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

	For Axes	—— For Axes 1 through 3, this parameter is the Axis Name.				
Axis Configuration	Axis1 (X)	Axis2 (Y	) /	Axis3 (Z)	Spindle	(S)
Axis Nam	- X	• Y	• Z	•	s	-
Axis Typ	e Normal	Normal	▼ No	ormal 🔄	Unused	-
Rotary Position Display Range [deg	a] 0~360	• 0~360	▼ 0~	-360	0~360	-
Rotary ST Rotating Typ	e Shorter	Shorter	▼ Sł	norter	Shorter	-
I/O Configuration     HS, LS Source Selection       Number of IM200     0       Limit Switch Source     On Servo				•		
Handwheel Settings Handwheel Type Unused Accumulate handwheel pulse						

Figure 3-2: Configuration Mode – Machine Parameters Screen – First Four Axes

For Axes 4 through 8, this parameter varies: for "Normal" and "Rotary" axes, this is how you set "Axis Name;" for "Sync Slave" axes, this is the "Sync Master Axis," the master axis number with which the slave axis is associated. For a "PLC" axis, this parameter is disabled. Axis4 (A) Axis6() Axis7() Axis5 (B) Axis Configuration **Axis Name** ▼ P В X A • Ŧ Axis Type Normal Normal PLC Sync Slave -• • Rotary Position Display Range [deg] 0~360 0~360 Ŧ 0~360 Ŧ Ŧ 0~360 Axis 6 is a Rotary ST Rotating Type Shorter Shorter Ŧ Shorte **Y** Shorte **Y** sync slave axis associated to I/O Configuration HS, LS Source Selection Axis X as the Number of IM200 **Home Switch Source** 0 • On Servo  $\mathbf{T}$ master axis. Limit Switch Source On Servo • Handwheel Settings

Figure 3-3: Configuration Mode – Machine Parameters Screen – Second Four Axes (ServoWorks S-120M and S-140M)

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### 3.4.2 Inverter Spindles

For the VersioBus II interface system, if you are using an inverter spindle, just select "Inverter" from the drop-down menu for "Axis Type" for the Spindle (S) Axis. For all other interface systems, "Inverter" won't be an option. However, it is possible to include an inverter spindle in your ServoWorks S-1\_0M system, even if you are using a digital servo communications platform such as MECHATROLINK, Panasonic Realtime Express (RTEX) or SSCNET.

See Section 7.9: Including a Spindle in a MECHATROLINK Interface System in the ServoWorks CNC Setup and Integration Manual for the MECHATROLINK Interface System or Section 5.10: Including an Inverter Spindle in an RTEX Interface System in the ServoWorks CNC Setup and Integration Manual for the Panasonic Realtime Express (RTEX) Interface System.

## 3.5 NC Settings Parameters

The "NC Settings" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to accuracy, canned cycles and NC programming. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

⊂NC Setting	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Distance Per Encoder Revolution [mm or deg]	8.192	8.192	8.192	8.192
Machine Unit (Minimum Resolution) [mm or deg]	0.001	0.001	0.001	0.001
In Position Width [mm or deg]	0.100	0.100	0.100	0.100
Over Position Error Limit (Moving) [mm or deg]	10.000	10.000	10.000	10.000
Over Position Error Limit (Stopped) [mm or deg]	0.500	0.500	0.500	0.500
Canned Cycle Parameters Shift Direction Retract Vector [mm]	Shift + <b>•</b> 7.000	Shift +	Shift + 💌	Shift +
NC Programming Options Enable Integer Programm M -> G G00 Perform Linear Interpolation G and M Code Order Circle Error Allowance [mm] 100.0	2			

Figure 3-4: Configuration Mode – NC Settings Parameters Screen

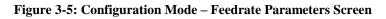
The "circle error allowance" parameter (in the "NC Programming Options" frame) is a program parameter that applies to the execution of the G02 and G03 codes. Please refer to *Section 6.3.3: Circular Interpolation (G02, G03)* of the *Part Programming Manual for ServoWorks S-100M, S-120M and S-140M* for more information.



## 3.6 Feedrate Parameters

The "Feedrate" parameters screen for ServoWorks S-140M is shown in the following figure, and displays parameters related to feedrate settings. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

- Feedrate Settings	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Jog Feedrate [mm/min or deg/min]	1000.0	1000.0	1000.0	1000.0
Rapid Feedrate [mm/min or deg/min]	3000.0	3000.0	3000.0	3000.0
Dry Run Feedrate [mm/min]	2000.0			



## 3.7 Motor Parameters

The "Motor" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to the motors and servo drives for all axes. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

- Motor/Drive Parameters	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Rated Velocity [RPM]	3000.0	3000.0	3000.0	3000.0
Peak Velocity [RPM]	4500.0	4500.0	4500.0	4500.0
Encoder Resolution [pulses per rev]	2048	2048	2048	2048
Encoder Polarity [1:Normal, -1:Reversed]	1	1	1	1
Encoder Type [1:Abs, 0:Inc]	0	0	0	0
Servo Drive Velocity Sensitivity (RPM/V)	300.0	300.0	300.0	300.0
Motor Polarity [1:Normal, -1:Reversed]	1	1	1	1

Figure 3-6: Configuration Mode – Motor Parameters Screen



## 3.8 Servo Loop Parameters

The "Servo Loop" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to the servo loop control for all axes. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

- Servo Control Parameters	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Position Loop Gain [Hz]	5.0	5.0	5.0	5.0
Position Loop Integral Control Enable	Enable	Enable	Enable	Enable
Position Loop Integral Time Constant [ms]	1000000	1000000	1000000	1000000
Position Loop Integral Saturation [mm or deg]	1.000	1.000	1.000	1.000
Velocity Feedforward	Enable	🗆 Enable	Enable	🗖 Enable
Percentage [%]	0.0	0.0	0.0	0.0

Figure 3-7: Configuration Mode – Servo Loop Parameters Screen

## 3.9 Acceleration/Deceleration Parameters

The "Acceleration/Deceleration" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to acceleration/deceleration (smoothing times and smoothing modes). See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Acc / Dec Time		Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Acc / Dec Time					
	Cutting [ms]	60	60	60	60
	Rapid [ms]	60	60	60	60
	Manual [ms]	60	60	60	60
Acc / Dec Mode Cutting Rapid Manual	Linear  Linear Linear				

Figure 3-8: Configuration Mode – Acceleration/Deceleration Parameters Screen



## 3.10 Safety Parameters

The "Safety" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to limit switches, E-stops and soft limits. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Act close	Act close	<ul> <li>Act close</li> </ul>	Act close
	0	0	0 0
Svo off	Svo off	Svo off	Svo off
100.00	0   1000.	000 1000.0	00 1000.000
-1000.00	0 -1000.	-1000.0	-1000.000
	Act close	Act close  Act close	Act close         Act close         Act close           0         0         0           Svo off         Svo off         Svo off           100.000         1000.000         1000.000

Figure 3-9: Configuration Mode – Safety Parameters Screen

## 3.11 Home Parameters

The "Home" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to homing operations for all axes. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Z Pulse	Z Pulse 💌	Z Pulse 💌	Z Pulse 🔻
Plus 🔹	Plus 🔹	Plus 🔹	Plus 🔻
Act Close 💌	Act Close 💌	Act Close 💌	Act Close 🔻
1.0	1.0	1.0	1.0
0.0	0.0	0.0	0.0
100	100	100	100
1.0	1.0	1.0	1.0
300.0	300.0	300.0	300.0
1000.0	1000.0	1000.0	1000.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
No 🔻	No	No 💌	No
	Z Pulse       •         Plus       •         Act Close       •         1.0       0.0         100       1.0         300.0       1000.0         0.0       0.0         0.0       0.0	Z Pulse       Z Pulse         Plus       Plus         Act Close       Act Close         1.0       1.0         0.0       0.0         100       100         100       100         100       100         100       1.0         100       0.0         0.0       0.0         0.0       0.0         0.0       0.0         0.0       0.0         0.0       0.0	Z Pulse       Z Pulse       Z Pulse       Z Pulse         Plus       Plus       Plus       Plus         Act Close       Act Close       Act Close       Act Close         1.0       1.0       1.0       1.0         0.0       0.0       0.0       0.0         100       100       100       100         100       1.0       1.0       1.0         100       100       100       100         100.0       1000.0       1000.0       0.0         0.0       0.0       0.0       0.0         0.0       0.0       0.0       0.0

Set Home Position for Absolute Encoder in HOME Mode

Figure 3-10: Configuration Mode – Home Parameters Screen



There is a program parameter that relates to setting the reference position for absolute encoders. If this parameter ("Set Home Position for Absolute Encoder in HOME Mode") is checked, <u>and</u> if there are one or more absolute encoders in the system:

- 1) Home Mode becomes password protected, and
- 2) Homing one or more axes sets the reference home position to the current position for axes that have absolute encoders.

See Section 2.4.2: Synchronous Control and Homing With Absolute Encoders, Section 2.5.3: The Homing Procedure for a System with Absolute Encoders with No Home Switch and Section 2.5.4: The Homing Procedure for a System with Absolute Encoders Using A Home Switch.

## 3.12 Synchronization Control Parameters

The "Synchronization Control" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to synchronization control, otherwise known as "dual axes" (common in gantry control). See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Sync Control Parameters	Axis6 ( )	Axis7 ( )
Sync Lag Limit at Rapid [mm or deg]	6000.0	6000.0
Sync Lag Limit Stopped [mm or deg]	1000.0	1000.0
Sync Control Gain [%]	50	50
Catch Up Speed [mm/min]	200.0	200.0
Starting Sync Control Sync Control on Startup Sync Control on Reset Sync Startup Type Normal		

Figure 3-11: Configuration Mode – Synchronization Control Parameters Screen

## 3.13 Machine Compensation Parameters

The "Machine Compensation" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to backlash compensation. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of this parameter: what this parameter is, its significance, its possible values, default value, etc.

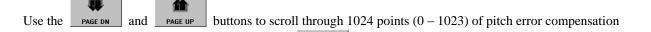
- Machine Error Compensation	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Backlash Value [mm or deg]	0.000	0.000	0.000	0.000

Figure 3-12: Configuration Mode – Machine Compensation Parameters Screen



# 3.14 Pitch Error Compensation Parameters

The "Pitch Error Compensation" parameters screen for ServoWorks S-140M is shown in the following figure. It displays pitch error compensation data. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.



data. For your convenience, you may also use the **GOTO POINT** button to go directly to a particular data point. Or, use

the **TOP PAGE** button to return to the first page of pitch error compensation data.

- Pitch Error Compensation [mm]				
	Х	Y	Z	S
Pitch Origin	0	0	0	0
Pitch Interval [mm]	10.000	10.000	10.000	10.000
Point 0	0.000	0.000	0.000	0.000
Point 1	0.000	0.000	0.000	0.000
Point 2	0.000	0.000	0.000	0.000
Point 3	0.000	0.000	0.000	0.000
Point 4	0.000	0.000	0.000	0.000
Point 5	0.000	0.000	0.000	0.000
Point 6	0.000	0.000	0.000	0.000
Point 7	0.000	0.000	0.000	0.000
Point 8	0.000	0.000	0.000	0.000
Point 9	0.000	0.000	0.000	0.000
Point 10	0.000	0.000	0.000	0.000
Point 11	0.000	0.000	0.000	0.000
			Go to Point	0 Page 1/74

Figure 3-13: Configuration Mode – Pitch Error Compensation Parameters Screen



## 3.15 Tool Compensation Parameters

The "Tool Compensation" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to tool radius compensation and tool length compensation. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

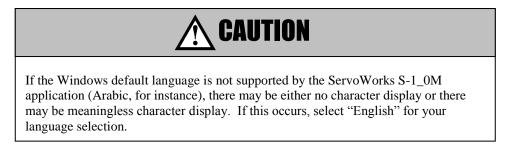
Tool Radius Compensation © Use wear data only
• Use both geometry and wear data
Start up/Cancel Type
Tool Length Compensation Tool Length Calibration Position [mm] 0.000

Figure 3-14: Configuration Mode – Tool Compensation Parameters Screen

## 3.16 Display Parameters

The "Display" screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to language selection, position data display format, units and G code display.

The "Display" screen allows you to select a language for character display. The choices are Auto, English, Japanese, simplified Chinese, traditional Chinese or Korean. The default selection is "Auto," which means that the ServoWorks S-1\_0M application detects the default language of the Windows operating system and chooses the character set that matches.



You can specify the position data display format: how many digits before and after the decimal point for data display.

You can specify whether you want to display and input lengths in millimeters or inches.

You can specify the G-code display: whether or not to wrap text to multi-line display. If you do not check this box, then each G-code line will remain a single line, and not all of that line may be visible in the G-Code Display Area. However, you will be able to view more lines of G code in the G-Code Display Area at one time.



Language Selection			
Position Data Display Fo	rmat		
O 5.3 ( XXXXX.XXX )	● 4.3 ( XXXX.XXX )	○ 4.4 ( XXXX.XXXX )	© 3.5 ( XXX.XXXXX )
Unit		G-Code Display	
• Millimeter	C Inch	☐ Wrap text to multil	ine display

Figure 3-15: Configuration Mode – Display Parameters Screen

## 3.17 Plot Parameters

The "Plot Settings" screen for ServoWorks S-140M is shown in the following figure.

This screen displays settings for plot display, such as whether to plot theoretical or actual positions, plot scale, plot direction (orientation), and the beginning and ending cycle times or sequence numbers for plotting. See *Section* 15.6: Specifying the Plot Settings for a discussion of what these settings mean.

-Plot Position Sample (	Plot Position Sample Option					
Theoretical	⊙ Actual					
Plot						
Scale 1	Plot Direction XY 💌					
Automatic start plot	in AUTO mode					
Sequence No.	O Cycle Time:					
Start from	0					
Stop at	999999999					

Figure 3-16: Configuration Mode – Plot Parameters Screen



## 3.18 Macro Parameters

The "Macro" parameters screen for ServoWorks S-140M is shown in the following figure. It displays parameters related to custom G, M, S and T macro calls. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

	Enable Custom G/M/S/T Macro Calls Custom Macro Path Settings										
Macro Program Folder (Full Path) C:\Program Files\SoftServo\											
Outpu	ut File Nam	ie (Fi	III P	'ath)	C:\Program Files\SoftServo\tempdata.dat						
-S/T Co	ode Setting	J —									
S ==>	0					T =	=>0				
- M Cod	le Setting –										
м		==>	0		_	м		==>	0		
м		==>	0		_	м		==>	0		
м		==>	0		-	м		==>	0		
м		==>	0		-	м		==>	0		
м		==>	0		_	м		==>	0		
-G Cod	e Setting –										
G		>	0		_	G		==>	0		
G		==>	0		-	G		==>	0		
G		==>	0		_	G		==>	0		
G		==>	0	<u> </u>	-	G		==>	0		
G		==>	0			G		==>	0		

Figure 3-17: Configuration Mode – Macro Parameters Screen



## 3.19 Cutting Speed Adjustment Parameters

The "Cutting Speed Adjustment" parameters screen for ServoWorks S-140M is shown in the following figure. It displays compensation parameters related to corner deceleration and velocity control in circular interpolation. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Corner Deceleration Disable	[
Corner Angle [deg] 90.0	
Corner Speed Limit [mm/min] 500.0	i i
Corner Tolerance Compensation Enable	
Corner Tolerance [mm] 0.5	
Velocity Control in Circlar Interpolation	
Enable this function 🗖 Enable	
Maximum Acceleration [mm/sec^2] 100.0	
Minimum Feedrate [mm/min] 1000.0	

Figure 3-18: Configuration Mode – Cutting Speed Adjustment Parameters Screen

## 3.20 Normal Direction Control Parameters

The "Normal Direction Control" parameters screen for ServoWorks S-140M is shown in the following figure and displays parameters related to the normal direction control function. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

Normal Direction Control		
Rotary Axis No.	5	
Rotation Feedrate [deg/min]	1000.0	
Angle Limit [deg]	10.0	
Length Limit [mm]	10.0	

Figure 3-19: Configuration Mode – Normal Direction Control Parameters Screen



## 3.21 Dynamic Look-Ahead Contour Control (DLACC) Parameters

The "Dynamic Look-Ahead Contour Control (DLACC)" parameters screen for ServoWorks S-140M is shown in the following figure and displays parameters related to the three-dimensional dynamic look-ahead contour control function. See the *Reference Manual for ServoWorks CNC Parameters and Functions* for a detailed discussion of each parameter: what the parameter is, its significance, its possible values, default values, etc.

- High Speed Cutting (Dynamic Look-Ahead)	Axis1 (X)	Axis2 (Y)	Axis3 (Z)	Spindle (S)
Maximum Acc / Dec [m/s^2]	1.0	1.0	1.0	1.0
Look Ahead Acc / Dec Time [ms]	10	10	10	10

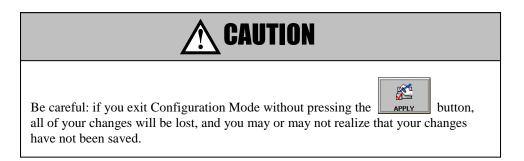
Figure 3-20: Configuration Mode – Dynamic Look-Ahead Contour Control (DLACC) Parameters Screen

## 3.22 Saving Your Changes

In order to save your changes, you must press the button on the bottom toolbar. This saves your changes into a registry file in the operating system.

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You must press the \_\_\_\_\_\_ button before you leave a set of parameters, or your changes will NOT be saved.



## 3.23 Backing Up Final Software Settings After Tuning

All current software settings are contained in the Windows registry. Therefore, when you have completed your installation, setup and integration (especially the important process of tuning your system), we highly recommend that you back up the GMC and Windows application folders in the HKEY\_CLASSES\_ROOT\ServoWorks key of the Windows registry. This will save you time and money if you need to recreate your optimized software environment for any reason. This is also useful for creating an identical control system with a new PC.

To back up your current parameter settings, you must export two folders to two Windows files (as explained in *Section 4.2: Exporting Current Parameter Settings to Windows Files* in the *Windows Registry Reference Manual for ServoWorks CNC Products and SMP Series General Motion Control Products*). [We recommend saving these files somewhere other than your PC.]



# Chapter 4: Customizing Your Display

## 4.1 Overview

following figure:

ServoWorks S-1\_0M provides a set of default color parameters, so it isn't necessary for you to make any changes at all to your color parameter settings. However, because individual preferences vary among users, these settings are available to you, so that you can customize the way your display looks by changing the colors of the text and background for all of the items on the ServoWorks S-1\_0M program screen. If you decide to customize your screen, you may have to experiment a little bit before you find the color parameters that suit you best.

If you are satisfied with the default color settings of ServoWorks S-1\_0M, you should skip this chapter.

## 4.2 Accessing the Color Parameters

To access the color parameters, you must get into Screen Mode, a sub mode in which ServoWorks S-1\_0M allows

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you to customize what is displayed and how things are displayed. To get into Screen Mode, press the **SCREEN** button on the right toolbar of the ServoWorks S-1\_0M screen. Ten buttons will appear on the bottom toolbar, as shown in the following figure:

<b>X</b>									3	
POS/PLOT	POSITION	PLOT	STATUS	BEL CLEAR	CONFIG 1	CONFIG 2	1/0.1	1/0.2	COLOB	

Figure 4-1: Bottom Toolbar in Screen Mode

Once you are in Screen Mode, press the

button. You will see the Color Selection Window, shown in the

Color Selection								
Choose an item								
Interface Display	•							
Interface Background Interface Foreground								
Select Cancel	Default							

Figure 4-2: Color Selection Window (Interface Display)



## 4.3 What Elements of the Screen Can You Change?

You can change virtually every part of the screen. The screen is broken down into five elements:

- The Interface Display
- The Button Display
- The Plot Display
- The G-Code Display
- The Data Display

The following figure shows where you will find these five elements of the screen:

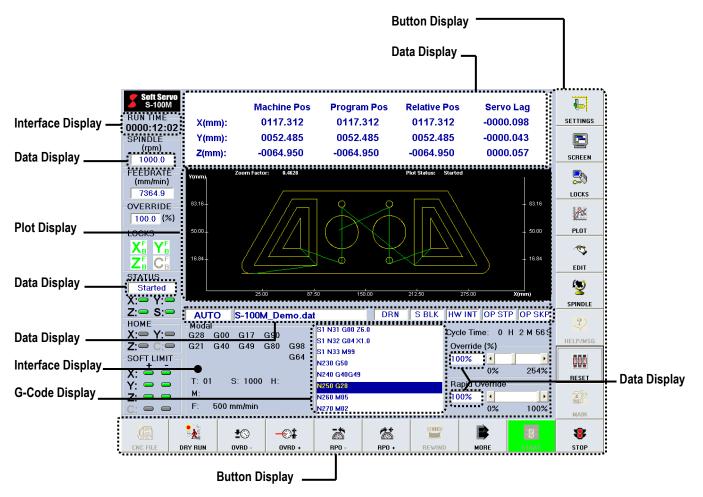


Figure 4-3: Screen Elements for Which You Can Change Color

### 4.3.1 The Interface Display

The interface display includes the basic screen background, and the text labels on the screen. It doesn't include any buttons on either the right toolbar or the bottom toolbar. It doesn't include any text boxes, which means it doesn't include the text boxes that display data or G code. And it doesn't include the plot display area.



The interface display has color settings for two parts of the display:

- <u>Interface Background</u> (the dominant color of the whole screen)
- <u>Interface Foreground</u> (text)

The two parts of the display whose color settings can be changed are shown in the following figure:

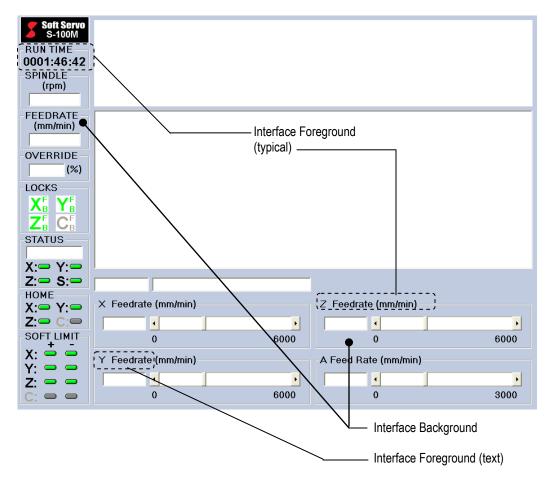


Figure 4-4: The Interface Display

### 4.3.2 The Button Display

The part of the screen referred to as the "button display" includes the bottom and right toolbars. You can only change the background of buttons; you cannot change the color of the text or icons on the buttons.

The button display has color settings for seven parts of the display:

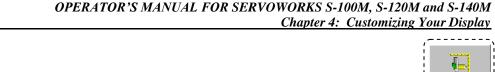


Choose an item Button Display			
Button Display			
Right Toolbar Buttons Background			
Right Toolbar Buttons On Status			
Right Toolbar Buttons Down			
Bottom Toolbar Buttons Background.			
Bottom Toolbar Buttons On Status			
Bottom Toolbar Buttons Down			
Other Buttons Background			
Other Buttons On Status			
Other Buttons Down			
Select Cancel Default			

Figure 4-5: Color Selection Window (Button Display)

- <u>Right Toolbar Buttons Background</u> (the dominant color of the buttons for the right toolbar)
- <u>Right Toolbar Buttons On Status</u> (the color of the buttons on the right toolbar when they are indicating the user is in the mode controlled by that button)
- <u>Right Toolbar Buttons Down</u> (the color of the buttons on the right toolbar upon the downward press of a mouse or a function key corresponding to that button)
- <u>Bottom Toolbar Buttons Background</u> (the dominant color of the buttons for the bottom toolbar)
- <u>Bottom Toolbar Buttons On Status</u> (the color of the buttons on the bottom toolbar when they are indicating the user is in the mode controlled by that button)
- <u>Bottom Toolbar Buttons Down</u> (the color of the buttons on the bottom toolbar upon the downward press of a mouse or a function key corresponding to that button)
- <u>Other Buttons Background</u> (the dominant color of the Display buttons for each axis in Home Mode when that axis is not at the home position)
- <u>Other Buttons On Status</u> (the color of the Display buttons for each axis in Home Mode when they are indicating that that axis is at home)
- <u>Other Buttons Down</u> (the color of the Display buttons for each axis in Home Mode while a homing operation is being performed)

These buttons are shown in the following figure:



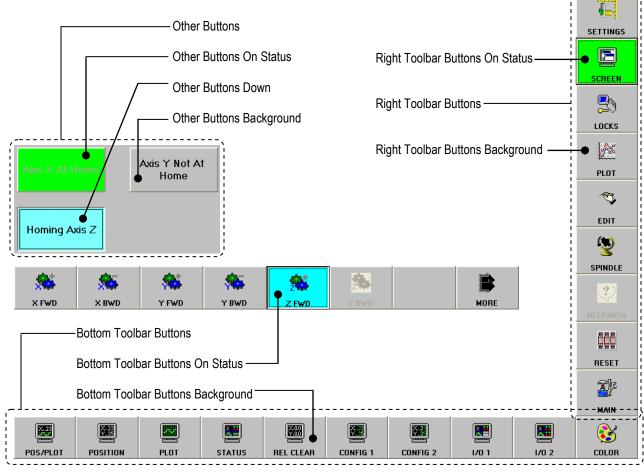


Figure 4-6: The Button Display

## 4.3.3 The Plot Display

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The part of the screen referred to as the "plot display" is a single area of the screen where tool trajectories are plotted. The size of this area varies, depending upon which option you choose in Screen Mode. See *Section 5.2: Specifying Information to Display in the Main Display Area.* 

The plot display has color settings for five parts of the display:



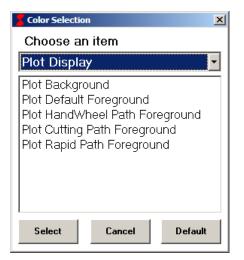


Figure 4-7: Color Selection Window (Plot Display)

- <u>Plot Background</u> (the dominant color of the plot area)
- <u>Plot Default Foreground</u> (the color of the axes, and the color of the lines of the plot itself, except for the handwheel path, the cutting path and the rapid path)
- <u>Plot HandWheel Path Foreground</u> (the color of the movement that is commanded with a handwheel)
- <u>Plot Cutting Path Foreground</u> (the color of the path that is commanded for cutting)
- <u>Plot Rapid Path Foreground</u> (the color of the path that is commanded at rapid feedrate)

Four parts of the display whose color settings can be changed are shown in the following figure (the plot handwheel path foreground is not shown):

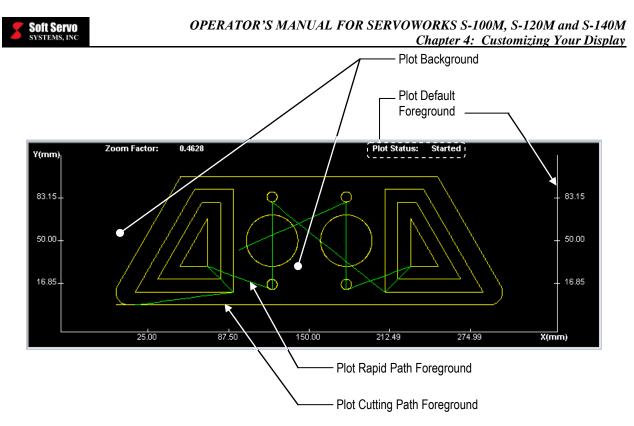


Figure 4-8: The Plot Display

### 4.3.4 The G-Code Display

The part of the screen referred to as the "G-code display" is a single area of the screen where blocks of code are shown. The area is only visible in Auto Mode and MDI Mode.

The G-code display has color settings for three parts of the display:

Color Selection		×
Choose an item		
GCode Dis	-	
GCode Back GCode Fore GCode OnSt	ground	
Select	Cancel	Default

Figure 4-9: Color Selection Window (G Code Display)



- <u>G Code Background</u> (the dominant color of the G Code area)
- <u>G Code Foreground</u> (the color of the text of the G Code)
- <u>G Code On Status</u> (the color of the text for the line of code currently being executed, or that will execute when the operation begins or resumes)

The three parts of the display whose color settings can be changed are shown in the following figure:

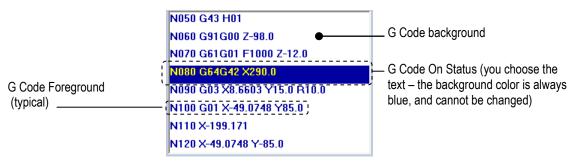


Figure 4-10: The G-Code Display

### 4.3.5 The Data Display

The part of the screen referred to as the "data display" encompasses many areas of the screen where current data is shown. Typically, it shows current settings, such as position information, the current control mode, current settings for things like feedrate, spindle speed, rapid override percentage, etc. The data display varies for each operational mode and each sub mode.

The data display has color settings for two parts of the display:

Color Selection	×
Choose an item	
Data Display	•
Main Data Background	
Main Data Foreground	
Select Cancel Default	

Figure 4-11: Color Selection Window (Data Display)

- <u>Main Data Background</u> (the dominant color of the data areas)
- <u>Main Data Foreground</u> (the color of the text in the data areas)

The two parts of the display whose color settings can be changed are shown in the following figure:

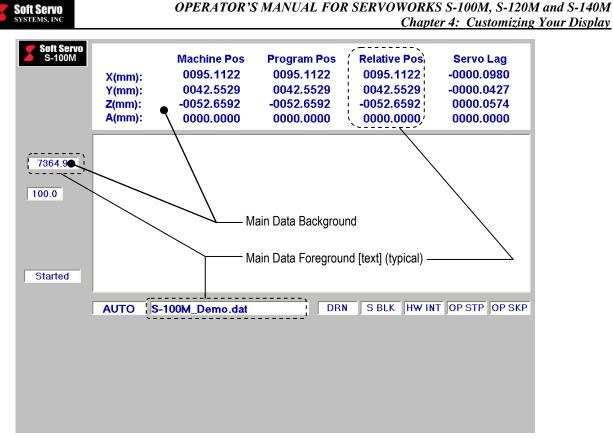


Figure 4-12: The Data Display

## 4.4 Selecting and Changing the Color Parameters

You must change and save one color setting at a time, for each screen element. You can do this with the following steps:

E

1) Get into Screen Mode by pressing the screen. (Ten buttons will appear on the bottom toolbar, as shown in Figure 4-1.)

3

- 2) Press the color button you will see the Color Selection Window, as shown in 4-2.
- 3) Select a screen element from the pull-down menu. (Your options are: the Interface Display, the Button Display, the Plot Display, the G-Code Display or the Data Display.)
- 4) Once you have chosen the screen element you want, click on the part of the display to change (foreground, background, on status, etc.)
- 5) Click the "Select" button, and you will see a Color window appear, as shown in the following figure:



	Color	? ×
This is a preview of how your color will look. Make sure you are satisfied with this color before clicking the "OK" button.	Basic colors:	
	Qustom colors:       Define Custom Colors >>       OK	Hug: 146 Bed: 192 Sat: 82 Green: 203 Color(Solid Lum: 196 Blue: 224 Add to Custom Colors

Figure 4-13: Color Window

- 6) Click on a basic or a custom color to select that color. Once that color is selected, you may want to play around with it by increasing or decreasing the hue, saturation or luminescence. You can also drag the ◀ marker up or down the color spectrum bar at the right side of the window.
- 7) When you are satisfied with the color you have specified (as shown in the "ColorSolid" box in the Color Window), click the "OK" button. You may also want to add that button to your custom colors, so that the exact color is saved for future use, by clicking the "Add to Custom Colors" button.
- 8) Repeat steps #1 7 for each screen element whose color setting you want to specify.
- 9) Click the "Cancel" button to close the Color Selection Window.

## 4.5 Setting All the Color Parameters Back to the Default Settings

If you don't like the changes you have made to the color settings, and would prefer to return to the default settings that come with the ServoWorks S-1\_0M program, you can do so with the following steps:

E

- 1) Get into Screen Mode by pressing the screen button on the right toolbar of ServoWorks S-1\_0M program screen. (Ten buttons will appear on the bottom toolbar, as shown in Figure 4-1.)
- 2) Press the color Selection Window, as shown in Figure 4-2.
- 3) Click the "Default" button.

## 4.6 Exiting Screen Mode

To exit Screen Mode (and return to whatever mode you were in before pressing the screen button), press the



button again or press the "Escape" key on your keyboard.

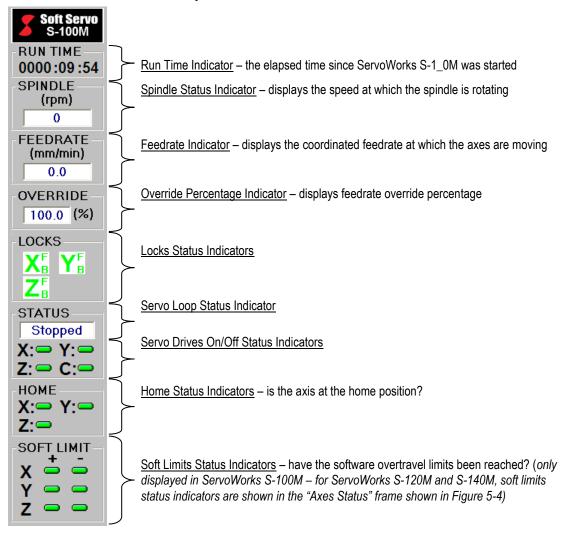


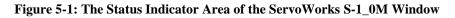
# Chapter 5: Monitoring the Status of Operations

## 5.1 Understanding the General Status of the Mill or Machining Center

### 5.1.1 Overview

The information shown in Figure 5-1 is constantly displayed in the Status Indicator Area at the left side of the ServoWorks S-100M window, no matter what mode you are in. The status indicator areas of the ServoWorks S-120M and ServoWorks S-140M windows are quite similar.





### 5.1.2 Run Time Indicator

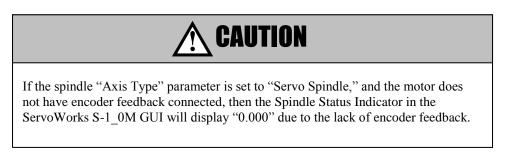
The elapsed time since ServoWorks S-1\_0M was started.



### 5.1.3 Spindle Status Indicator

The spindle status displays the speed at which the spindle is rotating, in revolutions per minute. If the spindle status displays "0," then the spindle is not moving.

The spindle speed is always displayed in RPMs, regardless of whether you set the spindle speed for a constant turning speed or a constant surface speed (in which case, ServoWorks S-1\_0M calculates, monitors and adjusts the turning speed to maintain that constant surface speed.)



### 5.1.4 Feedrate Indicator

The feedrate displayed is the coordinated feedrate of the movements of all axes. In Jog Continuous Mode, Rapid Mode and HandWheel Mode, which only allow you to operate one axis at a time, the feedrate displayed is for the selected axis only.

### 5.1.5 Override Percentage Indicator

The override indicator displays the current override percentage setting in Auto Mode. This setting can vary between 0 and 254%, and applies to the feedrates set by the part program. For instance, if the block of code "G01 X0.0 Y10.0 Z20.0 F100" were being executed, and the override percentage were set to 150%, ServoWorks S-1\_0M would use the feedrate of 150 instead of 100 for this motion.

### 5.1.6 Locks Status Indicators

The lock status indicator shows the lock status of the axes in both the forward and backward directions. The letter "F" next to each axis stands for "forward," and the letter "B" next to each axis stands for "backward." The color red indicates "locked," and the color green indicates "unlocked." Lock status indicators for the X axis are shown in the following figure:

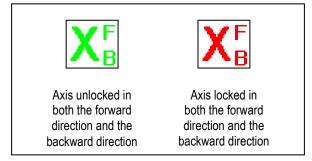


Figure 5-2: Locks Status Indicators



### 5.1.7 Servo Loop Status Indicator

The servo loop status indicator shows the current status of machine movement. "STARTED" indicates that motion has been started. "STOPPED" means that motion is stopped – there is no motion (the axes are immobile).

### 5.1.8 Servo Drives On/Off Status Indicator

The oval LED icon next to each axis indicates the on/off status of the servo drives. Green ( ) represents "on" and red ( ) indicates "off."

### 5.1.9 Home Status Indicator (Is the Axis at the Home Position?)

The oval LED icon next to each axis indicates whether or not that axis is at its home position. Green ( $\bigcirc$ ) indicates that the axis is at its home position, and gray ( $\bigcirc$ ) indicates that the axis is not at its home position, or that the coordinate system has not been established yet (no homing operations have been performed since the ServoWorks S-1\_0M program started).

#### 5.1.10 Soft Limits Status Indicator (Have the Software Limits Been Reached?)

This information is displayed in the Status Indicator Area for the ServoWorks S-100M GUI only. For ServoWorks S-120M and S-140M, soft limits status indicators are shown in the "Axes Status" frame (see Figure 5-4). [To show

the "Axes Status" frame, press the screen Mode, then press the



button on the bottom toolbar.]

The oval LED icons next to each axis indicate whether or not that axis has reached its forward or backward soft limit. The forward soft limits are indicated by a "+" over the oval LED icons, and the backward soft limits are indicated by a "-" over the oval LED icons. Gray ( $\bigcirc$ ) indicates that the soft limit for a particular axis and direction has not been checked, because a homing operation has not been performed. Green ( $\bigcirc$ ) indicates that the soft limit for a particular axis and direction has been checked and *has not* been reached, and red ( $\bigcirc$ ) indicates that the soft limit for a particular axis and direction *has* been reached.

## 5.2 Specifying Information to Display in the Main Display Area

### 5.2.1 What Information Is Available To Be Displayed?

Regardless of the current mode, you can select the information to display in the Main Display Area. You can display status information for several types of data. Some of this information is displayed only in combination with other information. *Section 5.2.2: Using Screen Mode to Select Information to Display in the Main Display Area* explains the combinations of information available for display, and how to select what to display.

You can change the display while you are in any control mode, by using Screen Mode.

The following subsections describe the information available to be displayed.



X:00 Y:00

X:23 Y:35

X:23

X-2 Y-3

#### **5.2.1.1 Position Information About Each Axis**

The following positions are available for display in the ServoWorks S-1\_0M window:

- <u>Machine Position</u> the command position measured from the machine origin
- <u>Actual Position</u> the feedback position of the axes the real, current position of the axis (obtained from encoder feedback)
- <u>Program Position</u> the desired position, specified by the program; the position that should have been generated by the command to the servo drive, if there were no position error. This position is with respect to the workpiece coordinate system.
- <u>Distance to Go</u> the distance the axis has been commanded to travel, relative to its current position (only relevant in Auto Mode, Jog Incremental Mode or MDI Mode)
- <u>Relative Position</u> this position type is for your convenience. You can specify an arbitrary position from

which to track displacement, by clearing the relative positions (press the **relative** button). From then on, the relative position is measured from the last cleared position.

• <u>Servo Lag</u> – the difference between the machine position and the real (actual feedback) position

When you are in Screen Mode (explained in *Section 5.2.2: Using Screen Mode to Select Information to Display in the Main Display Area*), you will have a choice of which of these six position types is displayed:

- When you choose the display of only position information (with the position button), two types of position data will be displayed for each axis. You may use the config and config buttons to toggle through and select which two types of position data out of the six possible position types.
- When you choose either position and plot information together (with the position) or status

display (with the status button), four types of position information will be displayed for each axis. Machine position and program position will always appear in the first two positions – the other two position types are selectable. You can choose which two of the remaining four position types by using the

 CONFIG 1
 and
 CONFIG 2
 buttons. Pressing the
 CONFIG 1
 button will toggle you through the options for

what type of position to display for the third position type. Pressing the <u>course</u> button will toggle you through the options for what type of position to display for the fourth position type. See the following figure for an illustration:



	Position #1: Machine Position	Position #2: Program Position	Position #3: Selectable	Position #4: Selectable			
	Machine Pos	Program Pos	<b>Relative Pos</b>	Servo Lag			
X(mm):	-1000.000	-1000.000	0000.000	0000.002			
Y(mm):	1000.000	1000.000	0000.000	0000.002			
<b>Z(mm):</b>	0000.000	0000.000	0000.000	0000.002			
Pressing the converse button would toggle you among "Actual Position," "Relative Position," and "Distance to Go" for Position #3. "Servo Lag" would not be an option, because "Servo Lag" is displayed in Position #4. (If you want "Servo Lag" in Position #3, you would first have to use the converse							
button select sor		$\pi - 1$					

#### Figure 5-3: Selecting Position Types for Four-Position Display

#### **5.2.1.2 Clearing the Relative Positions**

For the relative position to be useful, you need to clear the relative positions (set them back to zero) occasionally, so

that you create a position from which to measure. You must be in Screen Mode (press the screen button to get into Screen Mode).

X.00 Y.00

> X:0.0 Y:0.0

> > X.00 Y.00

¥.

- To clear the relative position for the first axis, press the **RELCLEAR** button <u>once</u>.
- To clear the relative position for the second axis, press the **RELCLEAR** button <u>twice quickly</u>.
- To clear the relative position for the third axis, press the RELCLEAR button three times quickly.
- To clear the relative position for the fourth axis, press the \_\_\_\_\_\_ button <u>four times quickly</u>.

In essence, the **RELCLEAR** button allows you to sequence through all the axes, and whichever axis you are on when

you stop pressing the **RELCLEAR** button is the axis whose relative position is set to zero.

### **5.2.1.3 A Plot of Tool Trajectory**

A plot of the tool trajectory can be displayed with the vertical and horizontal coordinates representing various axes. See *Section 5.3 Plotting Motion (Using Plot Mode)* for more information regarding all of the options available to you in viewing plots.



#### 5.2.1.4 Axis Status Information

For ServoWorks S-100M, you can access information from the "Axes Status" frame shown in Figure 5-4.

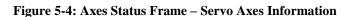
For ServoWorks S-120M and S-140M, you can access information from the "Axes Status" frame shown in the following three figures, IF you are using any PLC axes and/or sync slave axes. [While in Screen Mode, keep

pressing the STATUS

button to toggle among three different displays available for this area.]

The first display shows limit and alarm information for servo axes; the second and third displays are for sync slave axes. If you are not using any PLC axes or sync slave axes, then only the "Axes Status" frame shown in Figure 5-4 will be available.

	Only available for S S-120M or S-140M	Only available for ServoWorks S-120M or S-140M ————————————————————————————————————						available f	or ServoW	orks S-140N
	Axes Status	×	$\sim$	7	×	∎ B				
Only displayed here for	Hard Limit (+)	$\hat{\bullet}$			$\overline{\mathbf{a}}$					
ServoWorks S-120M and	Hard Limit (-)									
S-140M; for ServoWorks	Home Switch									
S-100M, this same information is instead permanently	Over Pos Err									
displayed in the Status Indicator	Amp Alarm									
Area at the left of the screen.	Soft Limit (+)					ì				
	Soft Limit (-)					;				



Axes Status X2 P1 Hard Limit (+) Hard Limit (-) Home Switch	"X2" indicates the sync slave axis associated with Axis X, "P1" indicates PLC Axis #1
Over Pos Err	NOTE: This frame is available
Amp Alarm 👄 👄	in ServoWorks S-120M and
Soft Limit (+) 👄 👄	S-140M only.
Soft Limit (-) 🗢 👄	
Servo On 🗢 👄	
At Home 👄 👄	
Over Sync Err 👄 👄	

Figure 5-5: Axes Status Frame – Sync Slave/PLC Axes Information (1 of 2)



-Axes Status —			
	×2 (mm)	P1 (mm)	
Machine Pos	000.000	0000.000	
Actual Pos	-0000.002	-0000.002	
Servo Lag	0000.002	0000.002	<u>NOTE</u> : This frame is available in ServoWorks S-120M and S-140M only.
Sync Lag	0000.000	000.000	

#### Figure 5-6: Axes Status Frame – Sync Slave/PLC Axes Information (2 of 2)

For each axis, you can view the following information:

- <u>Hard Limit ( + )</u> this displays as a green LED ( ) if the positive hard limit switch has not been triggered (activated), and as a red LED ( ) if it has been triggered
- <u>Hard Limit ( )</u> this displays as a green LED ( ) if the negative hard limit switch has not been triggered (activated), and as a red LED ( ) if it has been triggered
- <u>Home Switch</u> this displays as a gray LED ( ) if the home switch is not activated, and a red LED ( ) if it has. It will only briefly display as a red LED, because the switch will reset almost immediately
- Over Position Error this displays as a gray LED ( ) if the limit for over position error has not been reached, and a red LED ( ) if it has
- <u>Amplifier Alarm</u> this displays as a gray LED ( ) if there is no amplifier alarm for that axis, and a red LED ( ) if there is an amplifier alarm for that axis. If there is an amplifier alarm, it means that some fault occurred in the servo drive.
- <u>Soft Limit (+)</u> this displays as a green LED ( ) if the soft limit switch has not been triggered (activated), and as a red LED ( ) if it has been triggered
- <u>Soft Limit ( )</u> this displays as a green LED ( ) if the soft limit switch has not been triggered (activated), and as a red LED ( ) if it has been triggered

#### 5.2.1.5 I/O Information

You can view the status of input and output signals for on-board I/O from your FP-85, FP-105 or FP-114 VersioBus II adapter board (also known as "Local I/O") and for the I/O on your VersioBus II DC-155 module (for the VersioBus II interface system), as shown in the following figure. I/O signals can only be viewed, not modified.



Local I/O						DC Module	e #1 I/C				
	In	Out		In	Out		In	Out		In	Out
Bit 15			Bit 07		0	Bit 15			Bit 07		0
Bit 14		0	Bit 06			Bit 14	0		Bit 06	0	0
Bit 13			Bit 05			Bit 13			Bit 05		0
Bit 12	0	•	Bit 04	0	0	Bit 12	0		Bit 04	0	
Bit 11	0		Bit 03	0		Bit 11			Bit 03		0
Bit 10		0	Bit 02	0	0	Bit 10		0	Bit 02	0	0
Bit 09		0	Bit 01		0	Bit 09			Bit 01		0
Bit 08		0	Bit 00		0	Bit 08		0	Bit 00		•

Figure 5-7: I/O Information for Local I/O and DC-155 I/O

You can view the status of input and output signals for I/O from IM-305 I/O modules (for the VersioBus II interface system), as shown in the following figure. I/O signals can only be viewed, not modified.

Module	#1 1/0										
	In	Out		In	Out		In	Out		In	Out
Bit 31			Bit 23			Bit 15			Bit 07		
Bit 30			Bit 22			Bit 14			Bit 06		
Bit 29		0	Bit 21			Bit 13			Bit 05		
Bit 28		0	Bit 20		$\bigcirc$	Bit 12			Bit 04		
Bit 27		0	Bit 19			Bit 11		$\bigcirc$	Bit 03		
Bit 26		0	Bit 18	0		Bit 10		0	Bit 02	0	
Bit 25			Bit 17			Bit 09			Bit 01		
Bit 24		0	Bit 16			Bit 08			Bit 00		

Figure 5-8: I/O Information for IM-305(s)

These frames display digital input and output signals for 32 switches of general I/O connectors. Green ( ) indicates a signal of "1", and red ( ) indicates a signal of "0".

#### 5.2.2 Using Screen Mode to Select Information to Display in the Main Display Area

To specify what to display in the Main Display Area, press the **SCREEN** button on the right toolbar to enter Screen Mode. Screen Mode is a sub mode, meaning you can enter Screen Mode from any operational mode (except Configuration Mode), so that you can change the display no matter what mode you are in, even when motion is occurring.

Ten buttons will appear on the bottom toolbar, as shown in the following figure:



Figure 5-9: Bottom Toolbar in Screen Mode

Five of these buttons will cause a preset combination of data to display, as shown in the following tables. [NOTE: these tables show data displays from the ServoWorks S-140M program; data displays from the ServoWorks S-100M and S-120M programs are similar.]



Press this button	to display this in the Main Display Area.	Information included in display area:
POS/PLOT (This is the default display.)	Machine Pos X(mm):         Program Pos 0000.000         Relative Pos 0000.000         Servo Lag 0000.002           Y(mm):         0000.000         0000.000         0000.000         0000.002           Z(mm):         0000.000         0000.000         0000.002         0000.002           Y(mm):         0000.000         0000.000         0000.002         0000.002           V(nm):         0000.000         0000.000         0000.002         0000.002           V(nm):         0.4928         Plot Status:         Statled         \$3.16           50.00	<ul> <li>Position information for all axes</li> <li>Plot trajectory data</li> </ul>
POSITION	Machine PosRelative PosX(mm):0000.0000000.000Y(mm):0000.0000000.000Z(mm):0000.0000000.000A(mm):0000.0000000.000	• Position information for all axes
PLOT	Y(mm)         Zoom Factor:         0.4628         Plot Status:         Started           106.02	<ul> <li>Plot trajectory data</li> </ul>
STATUS	Machine Pos 9(mm):         Program Pos 0118.912         Relative Pos 0118.912         Servo Lag -0000.098           Y(mm):         0020.100         0020.100         0020.100         -0000.098           Z(mm):         0000.000         0000.000         0000.000         0000.002           A(mm):         0000.000         0000.000         0000.000         0000.002           B(mm):         0000.000         0000.000         0000.000         0000.002           C(deg):         0000.000         0000.000         0000.000         0000.000           V(mm)         Zoom Factor:         0257         Pot Status:         Stated         X Y Z A B C           1331-         Image: Stated         X Y Z A B C         Hard Limit (+)         Hard Limit (-)         Hard Limit (-)           371-         Image: Stated         X Y Z A B C         Toom Poter Pote Err         Toom Poter P	<ul> <li>Position information for all axes</li> <li>Plot trajectory data</li> <li>Status of limit, home, over position error, and amplifier alarm switches</li> </ul>

 Table 5-1: Screen Mode Options (1 of 2)

**Soft Servo** Systems, inc

Press this button	to display	/ this in the	Main Display		Information included in display area:				
	X(mm): Y(mm): Z(mm):	Machine Pos 0000.000 0000.000 0000.000	Program Pos 0000.000 0000.000 0000.000	Relative Pos 0000.000 0000.000 0000.000	Actual Pos -0000.002 -0000.002 -0000.002				
<b>₩</b> 1/0 1	Local I/O In Bit 15 Bit 14 Bit 13 Bit 12 Bit 12 Bit 11 Bit 10 Bit 09 Bit 08 Bit 08	Bit 07           Bit 06           Bit 05           Bit 04           Bit 03           Bit 02           Bit 01	In Out Bit 1  DC Mod  Bit 1  Bit 0  B	4     O       3     O       2     O       1     O       0     O       9     O	In         Out           Bit 07         C         C           Bit 06         C         C           Bit 05         C         C           Bit 02         C         C           Bit 02         C         C           Bit 01         C         C           Bit 01         C         C           Bit 01         C         C	<ul> <li>Position information for all axes</li> <li>Digital I/O: local I/O and DC-155 module I/O</li> </ul>			
	X(mm): Y(mm): Z(mm):	Machine Pos 0000.000 0000.000 0000.000	Program Pos 0000.000 0000.000 0000.000	Relative Pos 0000.000 0000.000 0000.000	Servo Lag 0000.002 0000.002 0000.002	<ul> <li>Position information for all axes</li> <li>Digital I/O: IM-305 modules</li> <li><u>NOTE</u>: For multiple IM-305 modules,</li> </ul>			
1/0 2	- IM Module #1 1/0 In Bit 31 Bit 29 Bit 29 Bit 28 Bit 27 Bit 26 Bit 25 Bit 24 Bit 24 Bit 24 Bit 24 Bit 24 Bit 24 Bit	Out Bit 23 Bit 22 Bit 24 Bit 20 Bit 19 Bit 19 Bit 18 Bit 17 Bit 16	In Out Bit 15 Bit 14 Bit 14 Bit 13 Bit 13 Bit 13 Bit 13 Bit 13 Bit 10 Bit 10 Bit 09 Bit 08	In Out Out Out Out Out Out Out Out	In         Out           Bit 07         —         —           Bit 06         —         —           Bit 05         —         —           Bit 04         —         —           Bit 05         —         —           Bit 04         —         —           Bit 04         —         —           Bit 05         —         —           Bit 04         —         —           Bit 05         —         —           Bit 04         —         —           Bit 00         —         —	keep pressing the button to toggle through the display for all IM-305 modules. In other words, the first press of the button will display IM Module #1, the second press will display IM Module #2, etc.			

 Table 5-2: Screen Mode Options (2 of 2)

### 5.2.3 Exiting Screen Mode



# 5.3 Plotting Motion (Using Plot Mode)

### 5.3.1 Overview

You have several different options for plotting tool trajectory coordinates: you can specify which of the axes will be the vertical and horizontal axes, you can change the scale of a plot by zooming in and out, and you can move the plot within the plot area by panning left, right, up and down.

You can change the way the plot looks while you are in any control mode, by going into Plot Mode.



### 5.3.2 Viewing a Plot

To view a plot, you must first make sure that the plot area is displayed. If the plot area is not displayed:

Press the screen button on the right toolbar to enter Screen Mode. (Ten buttons will appear on the bottom toolbar, as shown in Figure 5-9).
 Press any of the following buttons on the bottom toolbar: posplot (will show position data and plot); (will show plot alone); or status (which will show a plot along with switch data).
 Press the "Escape" key on your keyboard to return to the previous mode (the mode you were in before

going into Screen Mode), or press the screen button again.

You will see horizontal and vertical axes in the plot area, labeled in either inches or millimeters. A zoom factor also appears, telling you how the plot size relates to the actual distance on the machine tool. For instance, a zoom factor of 0.3 indicates that the plot is 30% of the size of the actual tool movement and the actual part.

When you begin motion, the plot should automatically display the tool trajectory. However, it is possible that your plot display may not show a tool trajectory. This can happen for one of four reasons:

- 1) No motion is occurring.
- 2) The motion occurs beyond the current plot display area. For instance, if the current position of the X axis is at 200, but the maximum plot coordinates are only currently set to show motion between -100 and 100. [You would need to change the scale of the plot see Section 5.3.4: Changing the Scale of a Plot (Zooming In and Out).]
- 3) The motion occurs only on an axis that is not displayed. For instance, motion on the Z axis is not displayed if the plot orientation is "XY". [You would need to change the plot orientation see Section 5.3.3: Changing the Orientation (Plane) of a Plot.]
- 4) The stop PLOT button has been pressed. In this case, the plotting has been stopped, and ServoWorks S-1\_OM program is no longer recording or plotting tool trajectories. [You would need to press the stopped, button in Plot Mode to resume plotting 1]

**START PLOT** button in Plot Mode to resume plotting.]

If you want to see the tool trajectory under these circumstances, or if the current position of an axis has moved off of the plot display area, you must go into Plot Mode and change the plot orientation, fit the plot to the display area, or add a plot (all explained in subsequent sections of this chapter).

The plot always stays at the most recent zoom factor and orientation that you chose in Plot Mode. If you haven't used Plot Mode to adjust the zoom factor or orientation, then the zoom factor and the orientation that you specified in the "Plot" parameters screen in Configuration Mode will be used. If these settings are unsatisfactory, you can change them at any time (even while running a part program), by going into Plot Mode:



Plot Mode is a sub mode that you can enter from any operational mode except Configuration Mode. To get into Plot

Mode, press the **PLOT** button on the right toolbar. Nine buttons will appear on the bottom toolbar, as shown in the following figure:



Figure 5-10: Bottom Toolbar in Plot Mode

### 5.3.3 Changing the Orientation (Plane) of a Plot

You can easily change the orientation of a plot. Continuously pressing the **CHG PLANE** button on the bottom toolbar toggles the plot among all possible orientations. An example follows:

1)  $\underline{XY}$ : the X axis plotted in the horizontal direction, and the Y axis plotted in the vertical direction, as shown in the following figure:

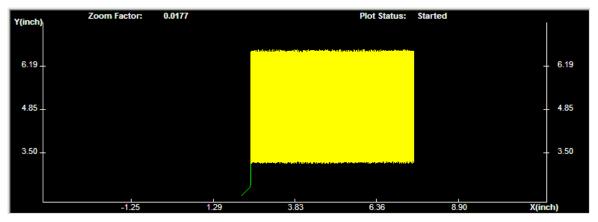


Figure 5-11: Plot with XY Orientation

2) <u>XZ</u>: the X axis plotted in the horizontal direction, and the Y axis plotted in the vertical direction, as shown in the following figure:

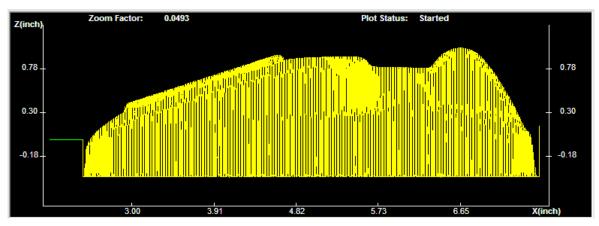


Figure 5-12: Plot with XZ Orientation



3) <u>YZ</u>: the Y axis plotted in the horizontal direction, and the Z axis plotted in the vertical direction, as shown in the following figure:

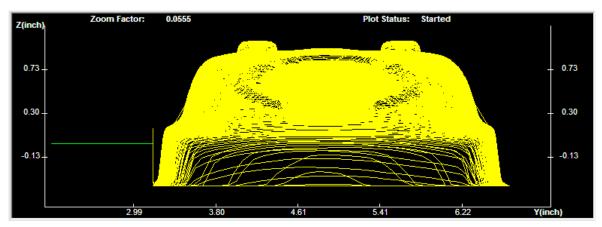


Figure 5-13: Plot with YZ Orientation

### 5.3.4 Changing the Scale of a Plot (Zooming In and Out)

Changing the scale of a plot is very easy to do, by pressing the zoom out and zoom w buttons on the bottom toolbar. Zooming out decreases the zoom factor, and makes the plot smaller in the display area. Zooming in increases the zoom factor, and makes the plot larger in the display area. Zooming in may cause only part of the plot to fit in the plot area, in which case, you will have to move the plot around to see the parts of the plot you are interested in. (See Section 5.3.5: Moving the Plot Within the Plot Area.)

To make the plot as large as possible while still fitting all of the plot data in the plot area, press the **PLOT FIT** button on the bottom toolbar. The ServoWorks S-1\_0M program will automatically readjust the coordinate scale so that the entire tool path can be shown. You will find this to be a very handy button, especially when the tool path exceeds the maximum plot coordinates, and you can no longer see the entire tool path. Using this button gives you a good starting place to begin zooming in to areas of interest to you.

### 5.3.5 Moving the Plot Within the Plot Area

You can easily move a plot within the plot area. Usually, you will want to move a plot within the plot area when you are interested in a close up view of a part of a plot area, and have zoomed in too close for the entire plot to display within the plot area.





### 5.3.6 Stopping a Plot

ServoWorks S-1\_0M will continue to record and display tool trajectories as motion occurs, unless you stop or clear

the plot. If you want to stop recording and displaying the plot trajectory, press the **STOP PLOT** button on the bottom toolbar. ServoWorks S-1\_OM program stops recording and displaying motion. While ServoWorks S-1\_OM program is stopped from continuing to plot any more motion, the plot display will continue to display what has currently been recorded and plotted on the screen, unless you clear the plot (see the following section.) This means that even though motion may continue after you stop a plot, you won't see any new plotting occur.

### 5.3.7 Clearing a Plot

ServoWorks S-1\_0M will continue to display the last recorded tool trajectory in the plot display area until you change modes, or until you clear the plot. If you want to clear the plot display area so that you can start over with a

new plot, press the <u>CIB PLOT</u> button on the bottom toolbar.

After you clear a plot, the plot display area will be empty, and plot trajectories will not be recorded.

### 5.3.8 Starting a Plot

"Starting a plot" means resuming the recording of the plot trajectory, and restarting the display of the tool trajectory from its current position.

To start a plot, press the **START PLOT** button on the bottom toolbar.



NOTE: the **START PLOT** button is only available after you have both stopped AND cleared the current plot.

### 5.3.9 Regenerating a Plot

There may be instances when your plot "disappears." This can happen when you leave ServoWorks S-1\_0M program to bring up another program simultaneously; when you return to ServoWorks S-1\_0M program that has been running in the background, the plotting will resume from the current position. Or part of your plot may disappear due, for instance, to a dialog box that pops up in the plot display area and leaves a "hole" in your plot when the dialog box goes away. In either case, you haven't "lost" your plot – the plot trajectory has been recorded. In order to redisplay your entire plot trajectory, you need to cause ServoWorks S-1\_0M to regenerate your plot. To do this, you must go into Plot Mode, and change the orientation, or zoom in or out, or move the plot left, right, up or down. Any of these actions will cause the entire recorded tool trajectory to regenerate.



### 5.3.10 Exiting Plot Mode

To exit Plot Mode (and return to whatever mode you were in before pressing the



button), press the

"Escape" key on your keyboard, or press the **PLOT** button again. If you entered Plot Mode from Main Mode, this will take you back to Main Mode. If you entered Plot Mode from an operational mode, pressing the "Escape" key on your keyboard will take you back to that operational mode.

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# Chapter 6: Locking One or More Axes

Machine Lock is used mainly for the purpose of proving a part program in Auto Mode. Machine Lock can be activated by a PLC sequence program. See the *LadderWorks PLC User's Manual* for instructions on integrating PLC into your ServoWorks CNC system.

When you use the Machine Lock switch, you can lock any or all of the axes. When you lock an axis with the Machine Lock switch, it will be locked in both directions.

With the Machine Lock switch activated, actual axis movement in any operational mode will be disabled, while the theoretical value of the program position will be simulated.

In any manual mode, you can give commands to move an axis that is locked with the Machine Lock switch, but ServoWorks S-1\_0M will not send those commands to the servo drive (because that axis is locked). However, even though a locked axis will remain still, the "Program Pos" will display data and the plot trajectory may appear *as if* the axis were moving, while the "Machine Pos" data will remain constant.

With the Machine Lock switch activated in Auto Mode, the part program will be run essentially in a simulation mode. All codes (M codes, S codes, T codes, and G codes) will actually be executed by the machine. But for G codes that change the position of any axis, the movement commands are disabled, so ServoWorks S-1\_OM will not send movement commands to the servo drive (because the axis is locked). Again, even though a locked axis will remain still, the "Program Pos" will display data and the plot trajectory may appear *as if* the axis were moving, while the "Machine Pos" data will remain constant.

When the Machine Lock is on, any simulated movement will cause a difference between "Program Pos" and "Machine Pos" data display. It has the same effect as shifting the workpiece coordinate offset. In order to restore the original workpiece coordinate offset, you must perform a homing operation again.

The following steps will guide you in using the machine lock switch:

- **B**
- 1) Press the LOCKS button on the right toolbar to enter Locks Mode (a sub mode).

The bottom toolbar will change, as shown in the following figure:

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MACH X	MACH Y	MACH Z				i

Figure 6-1: Bottom Toolbar in Locks Mode

If you want to lock the X axis, press the between two states: X axis locked and X axis unlocked. (See the following figure.) The lock status indicators are shown in the status indicator area to the left of the screen.



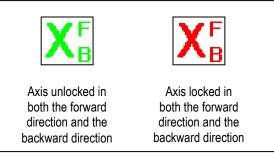
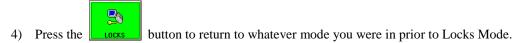


Figure 6-2: Lock Status Indicators for the Machine Lock Switch

3) Repeat Step #2 for each axis you want to lock, using relevant buttons for each axis you want to lock.

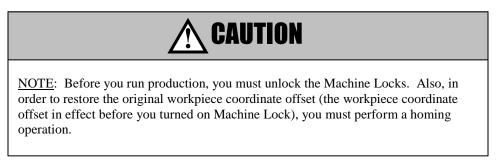


When you are ready to deactivate the Machine Lock(s):

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- Press the LOCKS button on the right toolbar to enter Locks Mode (a sub mode).
- 2) Use the of the axes.
- 3) Press the

button to return to whatever manual mode you were in before Locks Mode.



For instance, in any manual mode (Jog Continuous Mode, Joe Incremental Mode, Rapid Mode or HandWheel Mode), the Machine Lock switch will still allow you to manually input movement commands for a locked axis, and see that movement simulated in the "Program Pos" data.

For instance, let's examine a G01 code (for linear interpolation) in a part program being executed in Auto Mode, which would normally cause the axes to move in a straight line between two points. Let's say that the Z axis is locked in the commanded movement direction, and the X axis is unlocked in both directions.

With the Machine Lock switch, this G01 command will still be executed regardless of the locking of Z axis. The tool doesn't move along the Z axis, and the Z axis "Program Pos" data will be simulated as if it is not locked, while the X axis moves to the commanded position as normal.

You can change the lock settings while you are in any control mode. You can change the lock settings even while you are executing CNC code, by going into Locks Mode.



# Chapter 7: Manually Operating the Mill or Machining Center

## 7.1 Overview

Performing basic motion operations by manually operating the mill or machining center means that you are controlling the machine tool with "manual" commands to ServoWorks S-1\_0M instead of loading and running part programs (i.e. G codes) to control the motion. It does not mean that you are operating the machine directly with your hands (except for HandWheel Mode), as the term might seem to imply.

## 7.2 Summary of Manual Modes

You can perform basic motion control operations using one of six manual motion modes available to you with ServoWorks S-1\_0M: Spindle Mode, Jog Continuous Mode, Jog Incremental Mode, Rapid Mode, MDI Mode, and HandWheel Mode. Spindle Mode is a sub mode; the other five manual modes are operational modes. [NOTE: A seventh operational mode, Home Mode, is treated separately in *Section 2.5: Performing a Homing Operation*. An eighth operational mode, Auto Mode, is treated separately in *Chapter 15: Proving Part Programs and Running Production in Auto Mode*.] A brief explanation of these six manual modes follows.

**Spindle Mode** is a control mode where you start and stop the spindle, and set the spindle direction, spindle speed, and spindle override.

<u>Jog Continuous Mode</u>, the most basic operational mode of the mill or machining center, is a control mode where you operate one particular axis of the machine manually. You select a particular axis, a particular direction (forward or backwards), and a particular speed. You start the Jog Continuous Mode cycle by pressing a button, and you stop the Jog Continuous Mode cycle by letting go of the button – continuous motion until you specifically stop that motion.

**Jog Incremental Mode** is a control mode where you command one axis of the machine to move a specified distance. You specify a "Multiple" value. This "Multiple" is measured in pulses, and is not an absolute value. This "Multiple" value is multiplied by the machine unit set for the ServoWorks S-1\_0M program to obtain a "Distance to Go" (relative to the current axis location), that is displayed in the Jog Incremental Mode screen. [You specify the machine unit (minimum resolution) in the "NC Settings" parameters screen of Configuration Mode (shown in Figure 3-4), and you specify the feedrate at which that axis will move in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5).] To move the specified distance at the specified feedrate takes a certain length of time. You can interrupt the motion while the axis is moving at any time until the specified distance has been reached. Once a motion command has been interrupted, that command cannot be completed. If you restart the motion, it is a new command, not a continuation of the previous command – the axis moves the "Distance to Go" from its current position.

**Rapid Mode** is a control mode where you also operate one particular axis of the mill or machining center manually. Rapid Mode is very similar to Jog Continuous Mode: you specify the axis, a particular direction (forward or backwards), and a rapid override percentage (instead of the feedrate you specify with Jog Continuous Mode). The percentage you specify refers to a percentage of the maximum velocity for that axis. [You specify this maximum velocity feedrate for each axis in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5)]. You start the Rapid Mode cycle by pressing a button, and you stop the Rapid Mode cycle by letting go of the button – continuous motion until you specifically stop that motion.

**MDI** (Manual Data Input) Mode is a control mode where you input data for one or more blocks of G, M, T, B, S, and F codes, and then set those commands to execute. The commands you execute are logged in a temporary part program file.



**HandWheel Mode** is a control mode where you operate one axis of the mill or machining center at a time using the handheld HW-100 HandWheel (or any other handwheel) that is an optional component of the ServoWorks S-1\_0M system. You can use ServoWorks S-1\_0M to specify an axis and a multiplier for the machine unit (encoder count), or you can select the axis and multiplier on the HW-100 directly (if you are using the HW-100 HandWheel). Either way, these settings are displayed in the HandWheel screen. [You specify the machine unit (minimum resolution) for the handwheel pulse in the "NC Settings" parameters screen of Configuration Mode (shown in Figure 3-4).] Turning the dial on the handwheel starts the motion of the selected axis.

# 7.3 Stopping Movement During Manual Operation

In Jog Incremental Mode, MDI Mode or Spindle Mode, you can always stop the movement of the axis or axes

you're controlling with the stop button in the lower right corner. There should also be an Emergency Stop button on the operator's panel of the mill or machining center (as required by law). If you are using Soft Servo Systems' HW-100 HandWheel, there is a second Emergency Stop button on that handwheel, which will work whether you are in HandWheel Mode or any other mode (unless the HandWheel is turned off).

If you hit the Emergency Stop button on the HW-100 HandWheel, you must twist this button clockwise (as indicated by the Reset arrows on the top of the button) to reset the Emergency Stop button to continue. The button will "pop up" and be ready for use again.

# 7.4 Locking Axes in Manual Modes

With the Machine Lock switch activated for a particular axis, movement in manual mode along that particular axis will be simulated. You can use a manual mode to move an axis that is locked with the Machine Lock switch, but ServoWorks S-1\_0M will not send those commands to the servo drive. However, even though a locked axis will remain still, the position data and the plot area will display data *as if* the axis were moving.

We recommend against using the Machine Lock switch in manual modes.

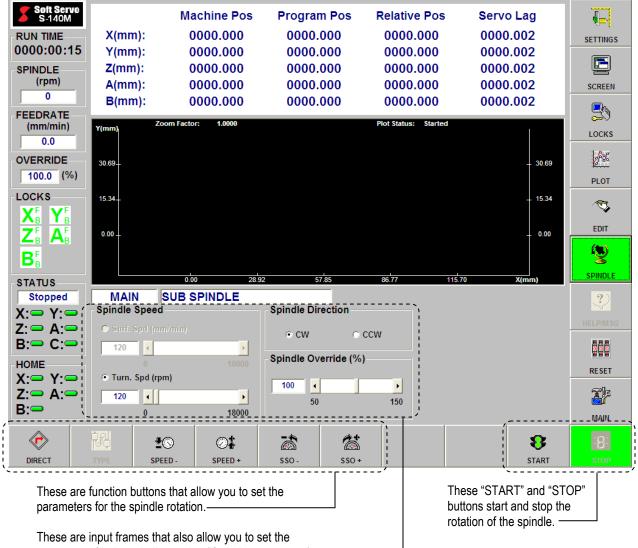


# Chapter 8: Starting and Stopping the Spindle (Using Spindle Mode)

Before you start motion in a manual operational mode, you may want to start spindle rotation. For that, you need to be in Spindle Mode (a sub mode).

The following steps will guide you in starting and stopping the spindle:

1) Press the spinole button on the right toolbar of the ServoWorks S-1\_0M Main Screen. You will then be in Spindle Mode, a sub mode, and see the following window:



parameters for the spindle rotation (if you have a mouse).-----

Figure 8-1: The Spindle Mode Window

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 Choose the direction for the spindle to rotate by pressing the Pressing this function key will toggle you between the two possible directions of clockwise or counterclockwise. The selected direction is shown in the "Spindle Direction" frame.

<u>NOTE</u>: If you have a mouse, you can click on the direction you want in the "Spindle Direction" frame.

3) Choose the spindle speed by pressing the button to decrease the feedrate, or the speed is displayed in the "Spindle Speed" frame.

<u>NOTE</u>: If you have a mouse, you can use the slider bars for Turning Speed to set the spindle speed more quickly. Or, it may be faster for you to use the mouse to move the cursor to the text input box for Turning Speed, then use the keypad or a keyboard (if you have one) to type in the speed directly.

4) The Spindle Override percentage will be applied to the spindle speed you specified in Step #4. Choose a

percentage for Spindle Override percentage by pressing the bottom tool bar. The selected spindle override percentage is displayed in the "Spindle Override (%)" frame.

As an example, if your specified spindle speed is 2000 RPM, and your spindle override percentage is 50%, your spindle will rotate at 1000 RPM (as long as the peak velocity in the "Motor" parameters screen in Configuration Mode [shown in Figure 3-6] is set to 1000 RPM or greater). A spindle speed of 2000 RPM and a spindle override percentage of 150% will give you a spindle speed of 3000 RPM (as long as the peak velocity in the "Motor" parameters screen in Configuration Mode [shown in Figure 3-6] is set to 3000 RPM or greater).

<u>NOTE</u>: If you have a mouse, you can use the slider bar for Spindle Override to set the override percentage more quickly. Or, it may be faster for you to use the mouse to move the cursor to the text input box for Spindle Override, then use the keypad or the keyboard (if you have one) to type in the speed directly.



5) Press the **START** button on the bottom toolbar to start the spindle rotation. The feedrate will be shown

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6) When you want to quit Spindle Mode, press the source button again, and you will return to whatever

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mode you were in before you pressed the \_\_\_\_\_button.



# Chapter 9: Continuous Jogging (Using Jog Continuous Mode)

Jog Continuous Mode, the most basic operational mode of the mill or machining center, is a control mode where you operate one particular axis of the machine manually. You select the particular axis, a particular direction (forward or backwards), and a particular speed, for an unspecified time. You start the Jog Continuous Mode cycle by pressing a button, and you stop the Jog Continuous Mode cycle by letting go of the button – continuous motion until you specifically stop that motion.

The default jog feedrates in effect when you first use Jog Continuous Mode are the "Jog Feedrate" values in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5). However, these feedrates can be changed in Jog Continuous Mode.

The following steps will guide you in commanding continuous jogging using Jog Continuous Mode:

1) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

Main window, press the button on the right toolbar of ServoWorks S-1\_0M screen.)

2) Press the JOG CONT button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will then see the following window:



ve Pos Servo Lag
0.000 0000.002 SETTINGS
0.000 0000.002
0.000 0000.002 🖺
0.000 0000.002 <u>screen</u>
0.000 0000.002
is: Started
LOCKS
- 30.69
PLOT
- 15.34
EDIT
= 0.00
115.70 X(mm) SPINDLE
BFeedrate (mm/min)
1000 · HELP/MSG
0 3000
X2Feedrate (mm/min) RESET
MAIN
► <b>►</b> ±© ∅ <b>≭</b>
CH AXES   MORE   JOG SPD - JOG SPD +
ly)
CH AXES   MORE JOG SPD - JOG SPD +
These function buttons allow
you to increase or decrease
the axes' feedrates
The "MORE" button is for tagelin
The "MORE" button is for togglir
hetween Toolhar #1 and Toolha
between Toolbar #1 and Toolba (ServoWorks S-120M and S-140

Figure 9-1: The Jog Continuous Mode Window



3) If you want to modify the Jog Continuous feedrate for an axis, press the switch axes button to toggle

through the feedrates for each axis. For each axis, use the <u>JOG SPD</u> and <u>JOG SPD</u> buttons to decrease and increase the Jog Continuous feedrate, respectively.

4) Select which axis to move and in which direction (forward or backward), and press and hold down the button corresponding to that axis and direction on the bottom toolbar to start and continue the motion of

that axis. To stop motion, release that button. For instance, pressing and holding the <u>x FWD</u> button causes the X axis to move in the forward direction at the specified feedrate, and pressing and holding the

button causes the X axis to move in the backward direction at the specified feedrate. You can only select one axis, because Jog Continuous Mode operates on only one axis at a time. You will see the position data of the selected axis change (unless you are displaying only a plot in the Main Display Area), to reflect the status of the Jog Continuous Operation.

For ServoWorks S-120M and S-140M, you may need to get to Bottom Toolbar #2, which displays buttons

for additional axes. Use the shown in Figure 9-1.	MORE	and	MORE	buttons to toggle between toolbars #1 and #2, as
			<b>X</b> P	

When you want to quit Jog Continuous Mode, press the keyboard.

button or press the "Escape" key on your

NOTE: It's recommended that you stop all motion before quitting Jog Continuous Mode.



# Chapter 10: Incremental Jogging (Using Jog Incremental Mode)

## 10.1 Overview

Jog Incremental Mode is a control mode where you command one axis of the machine to move a specified distance (known as the "Distance to Go").

You specify a feedrate, and you specify a "Multiple" value. This "Multiple" is measured in pulses, and is not an absolute value. This "Multiple" value is multiplied by the machine unit set for the ServoWorks S-1\_0M program to obtain a "Distance to Go" (relative to the current axis location) that is displayed in the Jog Incremental Mode screen.

[<u>NOTE</u>: The machine unit is the least input increment for ServoWorks S-1\_0M – the minimum unit of linear movement or distance that the actuator can be commanded to move. You specify the machine unit (minimum resolution) in the "NC Settings" parameters screen of Configuration Mode (shown in Figure 3-4).]

To move the specified distance at the specified feedrate takes a certain length of time. You can interrupt the motion while the axis is moving at any time until the specified distance has been reached. Once a motion command has been interrupted, that command cannot be completed. If you restart the motion, it is a new command, not a continuation of the previous command – the axis moves the "Distance to Go" from its current position. (See the example at the end of *Section 10.2: Using Jog Incremental Mode.*)

## 10.2 Using Jog Incremental Mode

The following steps will guide you in commanding incremental jogging using Jog Incremental Mode:

1) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

Main window, press the button on the right toolbar of the ServoWorks S-1\_0M window.)

2) Press the JOGINER button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will then see the following window for ServoWorks S-100M, or the window shown in Figure 10-2 for ServoWorks S-120M or ServoWorks S-140M.

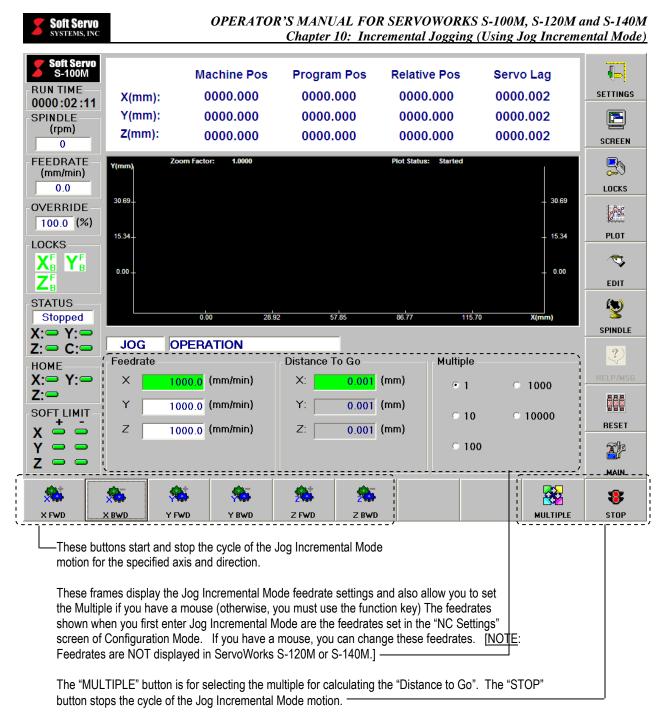
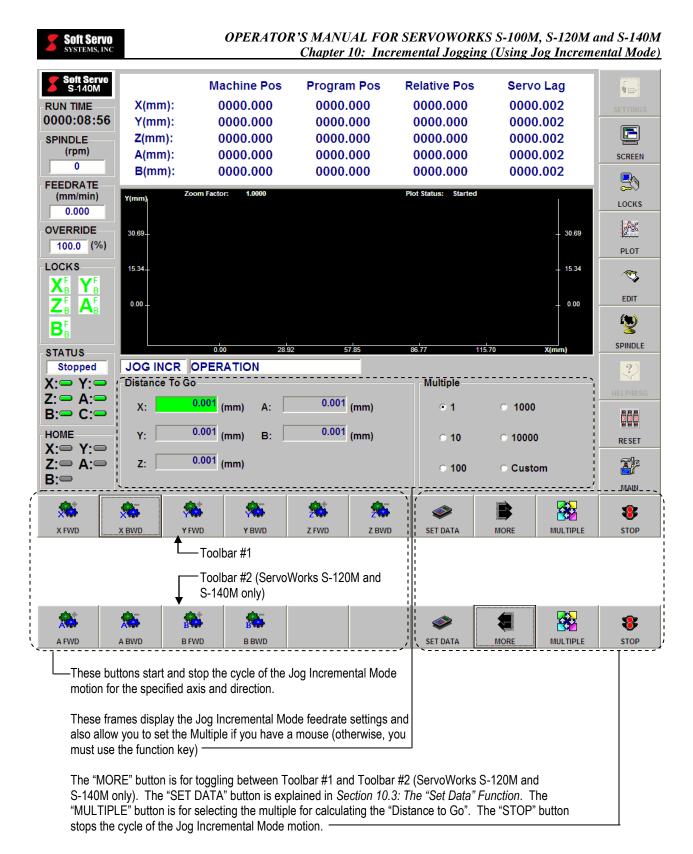


Figure 10-1: The Jog Incremental Mode Window for ServoWorks S-100M





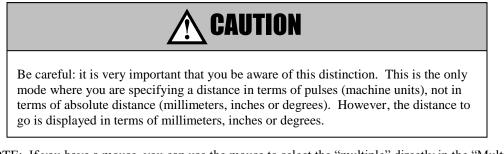


3) <u>This step is for ServoWorks S-100M only</u>: Each time you enter Jog Incremental Mode, the feedrate for each axis will be the feedrate specified as the "Jog Feedrate" in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5). You can change this by selecting text boxes in the "Feedrate" frame and typing the desired feedrate for each axis. [For ServoWorks S-120M and S-140M, the feedrate is not displayed, and cannot be changed in Jog Incremental Mode.]

<u>NOTE</u>: You must have a mouse and a keyboard or keypad to set a new feedrate.

4) Select the "Multiple" value by using the options until you see the "Distance to Go" value that you want, displayed in the "Distance To Go" frame.

For instance, if the machine unit is set to 0.001, and the "multiple" is set to "1," the "distance to go" is calculated as 0.001. If the machine unit is set to 0.001, and the "multiple" is set to "100," the "Distance to Go" is calculated as 0.100. If you select the "Custom" option in the "Distance To Go" frame, you can type the exact "distance to go" directly in the "Distance to Go" text boxes.



<u>NOTE</u>: If you have a mouse, you can use the mouse to select the "multiple" directly in the "Multiple" frame.

5) Select which axis to move and in which direction (forward or backward), and press the button corresponding to that axis and direction on the bottom toolbar to start and continue the motion of that axis.

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STOP

For instance, pressing the **x FWD** button causes the X axis to move in the forward direction at the

specified feedrate for the specified distance, and pressing the **XBWD** button causes the X axis to move in the backward direction at the specified feedrate for the specified distance. You can only select one axis, because Jog Incremental Mode operates on only one axis at a time. You will see the position data of the selected axis change (unless you are displaying only a plot in the Main Display Area), to reflect the status of the Jog Incremental Operation. While the selected axis is moving, you cannot change the direction, or the distance to go.

For ServoWorks S-120M and S-140M, you may need to get to Bottom Toolbar #2, which displays buttons

for additional axes. Use the and work and buttons to toggle between toolbars #1 and #2, as shown in Figure 10-2.

6) To interrupt the motion, press the

button on the right side of the bottom toolbar.



NOTE: Once the motion has been interrupted with the

button, you cannot complete the motion

command that was interrupted. If you press the axis/direction button again (the kew button, for instance), you are initiating a new motion command, and motion will resume from the current position. The selected axis will move the entire distance commanded, NOT the remainder of the distance of the interrupted command.

STOP

For example, let's say the X axis is at position 0.0000, and you command the X axis to move a "distance to go" of

10.000 mm in the forward direction by pressing the <u>x FWD</u> button. If you didn't interrupt the command, the new position of the X axis would be 10.000 mm. Now let's say you interrupt that command when the X axis

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reaches only 5.000 mm, then you press the **X FWD** button again. The X axis would NOT complete the command by moving the remaining 5.000 pulses mm forward. Instead, the X axis would move 10.000 mm in the forward direction from the current position of 5.000 mm, and if this command were not interrupted, the final position of the X axis would be 15.000 mm.

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When you want to quit Jog Incremental Mode, press he **MAIN** button or press the "Escape" key on your keyboard.

NOTE: It's recommended that you stop all motion before quitting Jog Incremental Mode.

## 10.3 The "Set Data" Function

NOTE: The "Set Data" function is not available in ServoWorks S-100M.

The "Set Data" function is a special function available only in ServoWorks S-120M and ServoWorks S-140M. This function is only useful if you have set up a hard START button on your operator's panel that corresponds to Incremental Jog mode. This is especially useful for people without a mouse – you can use the buttons on the soft toolbars to set the axis, direction and distance one time, then use the hard button on your operator's panel to perform a Jog Incremental operation with the recorded data.

When you press the **SET DATA** button, the current values (the highlighted axis and the chosen direction, and the multiple/ "distance to go") are saved into the ServoWorks CNC Engine. Then when you press the hard START button on your operator's panel, the machine tool runs in Incremental Mode with this recorded information.



# Chapter 11: Rapid Positioning (Using Rapid Mode)

Rapid Mode is a control mode where you operate one particular axis of the mill or machining center manually. Rapid Mode is very similar to Jog Continuous Mode: you select the axis, a particular direction (forward or backwards), and a rapid override percentage (instead of the feedrate you specify with Jog Continuous Mode). The percentage you specify refers to a percentage of the maximum velocity for that axis. [You specify this maximum velocity feedrate for each axis in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5)]. You start the Rapid Mode cycle by pressing a button, and you stop the Rapid Mode cycle by letting go of the button – continuous motion until you specifically stop that motion.

With Rapid Mode, you're commanding one axis of your mill or machining center to move in a specific direction at a specific speed for an unspecified time (continuous motion until you specifically stop that motion).

The following steps will guide you in commanding rapid positioning using Rapid Mode:

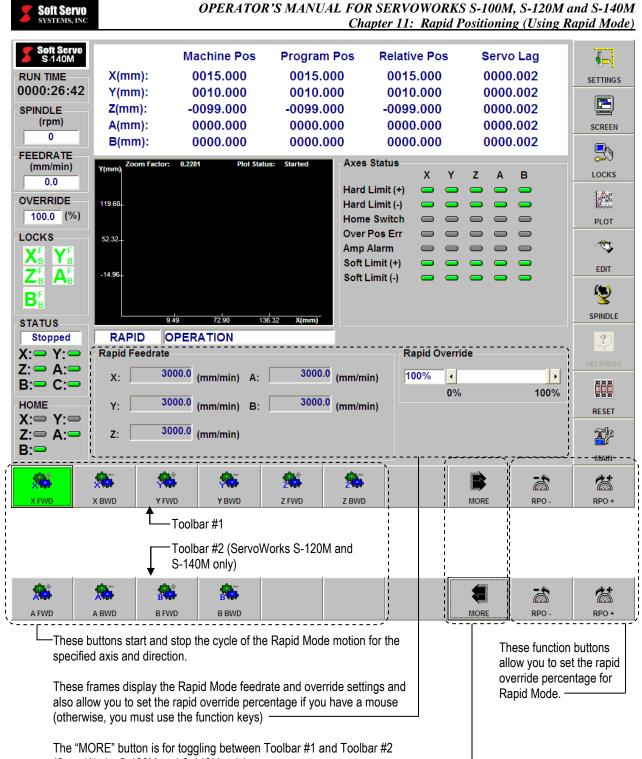
1) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

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Main window, press the button on the right toolbar of the ServoWorks S-1\_0M window.)

2) Press the RAPID button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will then see the following window:



(ServoWorks S-120M and S-140M only). ----

Figure 11-1: The Rapid Mode Window



3) The rapid override percentage is applied to the rapid feedrate for each axis. The rapid feedrate used in Rapid Mode is the "Rapid Feedrate" value in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5), and is displayed in the "Rapid Feedrate" frame. For instance, if you set the rapid override percentage to 100%, the machine will move the specified axis at 100% of its rapid traverse feedrate. If you specify a rapid override percentage of 50%, the machine will move the specified axis at half its rapid traverse feedrate.

The default rapid override percentage is 100%. You can use the	Button or the	RPO +	button
to adjust the rapid override percentage to anything between 0 and 1	00%. The RP0-	button will	
decrease the rapid override percentage, while the button percentage.	n will increase the rapic	l override	

<u>NOTE</u>: If you have a mouse, you can use the mouse to adjust the rapid override percentage slider bar.

5) Select which axis to move and in which direction (forward or backward), and press and hold down the button corresponding to that axis and direction on the bottom toolbar to start and continue the motion of

that axis. To stop motion, release that button. For instance, pressing and holding the the X axis to move in the forward direction at the rapid feedrate, and pressing and holding the

button causes the X axis to move in the backward direction at the rapid feedrate. You can only select one axis, because Rapid Mode operates on only one axis at a time. You will see the position data of the selected axis change (unless you are displaying only a plot in the Main Display Area), to reflect the status of the Rapid Operation.

For ServoWorks S-120M and S-140M, you may need to get to Bottom Toolbar #2, which displays buttons

for additional axes. Use the	MORE	and	MORE	buttons to toggle between toolbars #1 and #2, as
shown in Figure 11-1.				

**7**12

When you want to quit Rapid Mode, press the

button or press the "Escape" key on your keyboard.

<u>9</u>

<u>NOTE</u>: It's recommended that you stop all motion before quitting Rapid Mode.



# Chapter 12: Manual Data Input (Using MDI Mode)

## 12.1 Overview of MDI Mode

MDI (Manual Data Input) Mode is a control mode where you input data for one or more blocks of G, M, T, B, S, and F codes, and then set those commands to execute. The commands you execute are logged in a temporary part program file. MDI Mode can be helpful for executing one-shot blocks of codes as an aid to creating and modifying part programs, or to help you learn the part programming language.

ServoWorks S-1\_0M uses the industry standard part programming language for CNC programming. Refer to the Part Programming Manual for ServoWorks S-100M, S-120M and S-140M for more information on the specifics of the G, M, T, B, S, and F codes used by MDI Mode.

disabled, both integer	s parameter "Integer Programming With Machine Unit" is r and floating-point values in the G-code program are treated as epending on G20/21 inch/metric setting in the NC program).
mm or inch (dependin as a multiple of the " screen of Configurati accompany the paran or position for that pa- unit set for ServoWor increment for ServoV or distance that the ac	mming is enabled, floating-point values are still treated as either ng on G20/21 inch/metric settings), but integer values are treated Machine Unit" parameter (in the "NC Settings" parameters ion Mode, shown in Figure 3-4). In this case, the numerals that neters for G codes are not absolute values defining the distance arameter. Rather, these values are multiplied by the machine rks S-1_0M system. The machine unit is the least input Works S-1_0M system – the minimum unit of linear movement ctuator can be commanded to move. The machine unit can be set ler, and can be changed by an operator with password permission
system is 1.0 µm, and position or distance o you give the parameter	nteger programming is enabled, if the machine unit in your d you give the parameter X13, you're actually commanding the of 13.0 $\mu$ m. If the machine unit in your system is 2.0 $\mu$ m, and ther X13, you're actually commanding the position or distance of <b>important that you be aware of this distinction.</b>
	<b><u>A</u>CAUTION</b>
Only uppercase letter ignored.	rs will be recognized as axis symbols. Lower case letters will be



## 12.2 Getting into MDI Mode

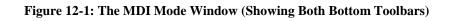
The following steps will get you into MDI Mode:

1) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

```
<u> A</u>p
                                       button on the right toolbar of the ServoWorks S-1_0M window.)
    Main window, press the
                                MAIN
                 button on the bottom toolbar of the ServoWorks S-1_0M Main Screen. You will then
2) Press the
                 MDI
    see the window shown in Figure 12-1.
                                                                <u>NOTE</u>: If the
                             button is disabled (appears as
                                                                       ), it's probably because you have not
                      MDI
                                                                MDI
    set the home position for your axes. You must set the home position – see Section 2.5 Performing a
                                       Þ
                                                                                              Homing Operation. [Press the
                                              button on the bottom toolbar, then press the
                                                                                                     button
                                      HOME
                                                                                            HOME ALL
                                                                                              P
    on the bottom toolbar to set all axes to their home positions at the same time. Press the
                                                                                                      button
                                                                                              MAIN
                                      <u>_</u>3
    to return to Main Mode. The
                                             button should now be enabled for you to select it.]
                                      MDI
```

**Soft Servo** Systems, Inc

S-140M		Machine Pos	Program Po	s Relative	Pos Serv	vo Lag	E.
RUN TIME	X(mm):	0000.000	0000.000	0000.0	00 000	0.002	SETTINGS
0000:07:58	Y(mm):	0000.000	0000.000	0000.0	00 000	0.002	
SPINDLE	<b>Z</b> (mm):	0000.000	0000.000	0000.0		0.002	
(rpm)	A(mm):	0000.000	0000.000	0000.0	00 000	0.002	SCREEN
0	B(mm):	0000.000	0000.000	0000.0	00 000	0.002	
FEEDRATE (mm/min)	Y(mm)	Zoom Factor: 1.0000		Plot Status:	Started		
0.0							LOCKS
OVERRIDE	30.69-					- 30.69	AX.
100.0 (%)	30.03					- 00.00	PLOT
LOCKS	15.34-					- 15.34	FLUI
	13.34-					- 13.34	- T - T - T - T - T - T - T - T - T - T
	0.00 -					- 0.00	EDIT
Z <sup>F</sup> <sub>B</sub> A <sup>F</sup> <sub>B</sub>	0.00					- 0.00	<b>(1</b> )
B <sup>F</sup> B							3
STATUS		0.00 28	.92 57.85	86.77	115.70	X(mm)	SPINDLE
Stopped	MDI	PLEASE EDIT G	CODE	DRN SBLK	HW INT OP S	TP OP SKP	?
X:─ Y:─(	Modal	017 000 004			Cycle Time: 0	HOMOS	
Z: — A:—	G00 G21 G40	G17 G90 G94 G49 G80 G98			Override (%)-		HELP/MSG
B:━ C:━	G50	G64			100% ·		
НОМЕ	G69	G50.1			0%	254%	RESET
X: Y:		5: H:			Rapid Overrid		
Z: • A: •	M:				100%		
B:-	F: 0mm	/min 			0%	100%	MAIN
Í		±© ؇	-	*		8	
MDI CLEAR D	RY RUN (			' 🕰 📕 📕	D MORE	START	EDIT
				NO + NEWIN			
	L	— Toolbar #1					1
	Г	— Toolbar #2					1
		,					   
						1 🔨	<b>1</b> ≤
						8	
S. BLOCK HN	IDWL INT OF	PT STOP OPT SKIP			MORE	START	EDIT
These functi	on buttons all	ow you to set the					
		for MDI Mode					
		These frames and tex					
		ou to set some param		e motion it you			
Clickina on t	Clicking on these "MORE" buttons toggles you between the two toolbars						
	you in MDI Me						
This "Start" b	This "Start" button starts single line code execution						





The MDI Mode display area contains the information shown in the following figure:

			<i>~</i>		,
MDI	PLEASE ED	IT GCODE	DRNS	BLK HW INT OP STP	OP SKP
M:		G94 G98 G64	1.0 Y100.0 F1000.0	Cycle Time: 0 H Override (%) 100% • Rapid Override 100% • 0%	• 254%
This frame displays G code in each mod and the current setti M, T, B, S and F cod	lal group, ings for the		the rapid over	feedrate override percen rride percentage ——— I hours, minutes and sec	
Input text box: when code to be executed		r block of	Status of the	operation support function	on switches ———

Figure 12-2: The MDI Mode Display Area

## 12.3 Setting Feed Override and Rapid Override

ServoWorks S-1\_0M allows you to override both the feedrate given in blocks of code for linear or circular interpolation, and the rapid feedrate for the axes (so for G00, the speed would be at some percentage of the rapid feedrate, rather than at the rapid feedrate itself).

You can override the feedrate for interpolation specified by blocks of code from 0% to 254%. Press the
and vibro buttons on the bottom toolbar to decrease and increase, respectively, the feedrate override percentage.
The rapid feedrate is the maximum velocity feedrate for each axis, and it is specified in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5). You can override the rapid feedrate from $0\%$ to $100\% - in$ other words, you still can't go beyond the rapid traverse feedrate that you set in Configuration Mode, but you can
decrease the rapid feedrate by taking a percentage of the rapid feedrate. Press the and and

buttons on the bottom toolbar to decrease and increase, respectively, the rapid traverse feedrate override percentage.

NOTE: If you have a mouse, you can use the slide bar for "Rapid Override (%)."

## 12.4 Setting the Operation Support Function Switches

#### 12.4.1 Overview

ServoWorks S-1\_0M has five operation support function switches that provide you with various options related to executing blocks of code. These switches can be used alone, or in combination. These switches are often helpful for debugging part programs.



OPERATION SWITCH	DEFAULT OFF STATUS	DEFAULT ON STATUS
Dry Run	DRN	DRN
Single Block	S BLK	S BLK
HandWheel Interrupt	HW INT	HW INT
Optional Stop	OP STP	OP STP
Optional Skip	OP SKP	OP SKP

 Table 12-1: Operation Support Switches

### 12.4.2 Dry Run

The Dry Run switch is used only for proving blocks of code, and is explained in *Section 15.5.2: Proving a Part Program Using the Dry Run Switch*.

### 12.4.3 Single Block

- If you activate the Single Block switch by pressing the s. BLOCK button on bottom toolbar #2, it means that your blocks of code will be executed in single block operational mode. Only one block of CNC data 8 will be executed at a time. In single block operational mode, pressing the START button on the bottom toolbar will cause only the current block of code to be executed, and then execution will stop. You will 8 have to press the **START** button again to execute the next block of code, and so forth. While executing code in single block operational mode, when G code execution has been completed for the current line, you have the option of pressing the button again to deactivate this switch. When S. BLOCK 8 the Single Block option is deselected, pressing the START button will cause normal, continuous execution of blocks of code to begin.
- At any time during a normal, continuous execution of a part program, pressing the **s** button will immediately change the execution to single block operational mode.



8

START

#### 12.4.4 HandWheel Interrupt

• If you activate the HandWheel Interrupt switch by pressing the button on bottom toolbar #2, ServoWorks S-1\_0M will allow the motion to be controlled by the handwheel in lieu of execution of blocks of code. The CNC code execution must be suspended before ServoWorks S-1\_0M will accept input from

the handwheel. Therefore, you must press the stop button on the bottom toolbar to stop execution of blocks of code in order to use the handwheel. You may find this switch useful if you want to use the handwheel to move a tool to another location in the middle of the execution of blocks of code.

- If the HandWheel Interrupt switch is deactivated, ServoWorks S-1\_0M will not accept input from the handwheel in MDI Mode.
- ServoWorks S-1\_0M uses whatever smoothing parameters are in effect at the time of manual intervention. For instance, if the last block of code executed was a G00 rapid traverse command, the type of smoothing and the smoothing time constant for rapid traverse will be used for motion produced by / commanded with a handwheel.

#### 12.4.5 Optional Stop

• If you activate the Optional Stop switch by pressing the \_\_\_\_\_ button on bottom toolbar #2, it means that part program execution will stop when it reaches an M01 optional stop code. In order to continue

execution of the part program after it reaches an M01 in a block of code, you must press the button on the bottom toolbar.

• If the Optional Stop switch is deactivated, the M01 code will be ignored, and execution of the part program will continue without interruption upon reaching an M01 code.

#### 12.4.6 Optional Skip

• If you activate the Optional Skip switch by pressing the **DPT SKIP** button on bottom toolbar #2, it means that CNC G code execution will skip (not execute) blocks of code marked as "Optional Skip" or "Block Delete Code" (which mean the same thing). You can specify a portion of a block as Optional Skip code by beginning such code with a "/" (forward slash) or "\\" (two backward slashes).

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• If the Optional Skip switch is deactivated, the block delete code will be ignored, and all blocks of code marked as block delete code will be executed without interruption.



### 12.5 Entering and Executing Commands in MDI Mode

The following steps will guide you in entering and executing commands in MDI Mode:

- 1) Type your command or commands in the input text box. For example, "G00 X10.0 F1000.0" or "M03."
- 2) Make sure you have set your feedrate override percentage, your rapid override percentage, and your support switches, as discussed in the previous sections.
- Press the start button on the right side of the bottom toolbar to start the execution of the block(s) of code in your text box.

<u>NOTE</u>: While the current block of code is being executed, you must wait until the execution of the current block of code completes before you can add or edit blocks of code.

4) To stop the motion before the block of code has been completely executed, press the **stop** button on the right side of the bottom toolbar.

To continue or finish execution of the current block of code, press the start button again. To put the cursor back in the input text box and add more code or edit code after motion has stopped, press the

button in the lower right corner (not the button on the right toolbar).



8

NOTE: The only way to cancel the execution of the current block of code is to press the buttom buttom buttom which deletes all blocks of code in the input text box), or to leave MDI Mode.

<u> P</u>

When you want to quit MDI Mode, press the \_\_\_\_\_ button or press the "Escape" key on your keyboard.

NOTE: It's recommended that you stop all motion before quitting MDI Mode.



# Chapter 13: Using HandWheel Mode

HandWheel Mode is a control mode where you operate one axis of the mill or machining center at a time using the handheld HW-100 HandWheel component (as shown in Figure 13-1) that is an optional component of the ServoWorks system (or, in fact, any handwheel you make part of your ServoWorks S-1\_0M system).

You use ServoWorks S-1\_0M to specify the machine unit for the handwheel pulse (under the "NC Settings" parameters screen in Configuration Mode, shown in Figure 3-4). Then, in the ServoWorks S-1\_0M window, or on the HW-100 HandWheel, you specify an axis and a multiple for that handwheel pulse. (These settings are displayed in the ServoWorks S-1\_0M display window.) Turning the dial on the handwheel starts the motion on the selected axis.

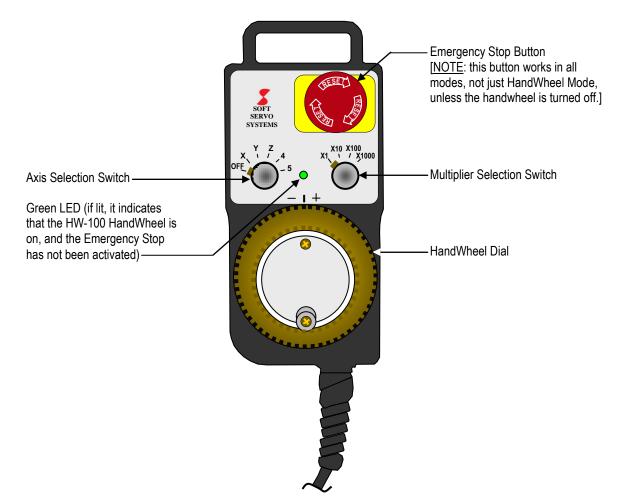


Figure 13-1: The HW-100 HandWheel Control



3

When you press the button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen, it puts you into HandWheel Mode. Once you are in HandWheel Mode, if the HandWheel is enabled (i.e. the "Handwheel Type" set to a value other than "Unused" in the "Machine" parameters screen of Configuration Mode, shown in Figure 3-2), the handwheel is automatically activated (unless the handwheel is turned off, or the Emergency Stop button is depressed), and ServoWorks S-1\_0M is ready to accept handwheel input signals. You will have instant response to any movement of the handwheel dial.



on, and you don't realize that you are in HandWheel Mode, you can't accidentally nudge or jostle the dial, and cause unintended movement of the machine.

The "HandWheel Pulse" frame of the HandWheel Window will display the total position command since you went into HandWheel Mode in either millimeters or inches (unless you uncheck "Accumulate handwheel pulse" in the "Machine" screen of Configuration Mode).

The following steps will guide you in using HandWheel Mode:

- 1) Turn on your handwheel. [For the HW-100 HandWheel, if the HandWheel Axis Selection Switch is set to "OFF," turn it to one of the axes to turn the handwheel on (see Table 13-1).]
- 2) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

Main window, press the button on the right toolbar of the ServoWorks S-1\_0M window.)

3) Press the **HNDWHL** button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. For the HW-100 HandWheel, the green LED will light up, and you will then see the window shown in Figure 13-2.

	0	
NOTE: If the HNDWHL button is disabled (appears as	(DWHL), then you need	to go to Configuration
Mode and enable the handwheel. Get into Configuration Mo	ode by pressing the	button in the
	Machine	
lower right corner of ServoWorks S-1_0M screen. Click on	the	button, and select a
"Handwheel Type" other than "Unused" in the "HandWheel	1 Settings" frame.	



Soft Servo S-140M RUN TIME		Machine Pos	Program Pos	SETTINGS
0000:00:49 SPINDLE (rpm)	X(mm):	0000.000	0000.000	SCREEN
0.000 FEEDRATE (mm/min)	Y(mm):	0000.000	0000.000	
0.000 OVERRIDE 100.0 (%)	Z(mm):	000.000	000.000	
	A(mm):	0000.000	0000.000	EDIT
	B(mm):	0000.000	0000.000	
STATUS Stopped X: Y: Z: A: B:	HNDWHL OPER HandWheel Pulse Total 0.000 m	Active Axis		C HELP/MSG
номе X:© Y:© Z:© A:©	Multīplē X1 X10	×100 ×1000		RESET
	Y AXIS Z AXIS	A AXIS B AXIS X2 AXIS		MAIN
	frames display the curr 00 handwheel.	ent settings of the two parameters t	hat you set using the	
		n total of all position commands for t de. This number resets to "0" every		

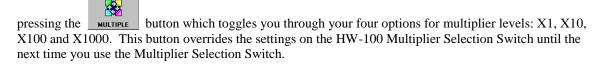
HandWheel Mode.

These function buttons allow you to choose the axis and multiple for HandWheel Mode.----

### Figure 13-2: The HandWheel Mode Window

4) You need to select a multiplier, which will be applied to the machine unit parameter (an axis control parameter) for the handwheel pulse. [You can set the machine unit in the "NC Settings" parameters screen in Configuration Mode (shown in Figure 3-4).]

There are two ways to select a multiplier. If you are using the HW-100 HandWheel, you can use the Multiplier Selection Switch (see Figure 13-1) to select a multiplier, or you can select a multiplier level by



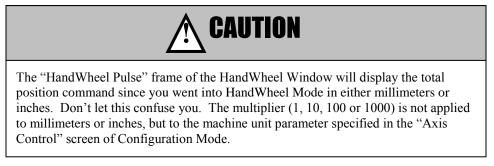




Be aware that the settings in ServoWorks S-1\_0M override the settings on the HW-100 handwheel itself. Make sure you know which axis and which multiplier is active before using the handwheel to move an axis.

The current multiplier setting, whether selected with the Multiplier Selection Switch or with the buttons on the bottom toolbar, will be reflected in the "Multiple" frame of the HandWheel Window. (The selected multiplier will be highlighted.)

- "X1" indicates a multiplier of "1" which will be applied to the machine unit. If the machine unit is 0.001 mm and the multiplier is "1," then each click of the HandWheel Dial produces a movement of 0.001 mm.
- "X10" indicates a multiplier of "10" which will be applied to the machine unit. If the machine unit is 0.001 mm and the multiplier is "10," then each click of the HandWheel Dial produces a movement of 0.01 mm.
- "X100" indicates a multiplier of "100" which will be applied to the machine unit. If the machine unit is 0.001 mm and the multiplier is "100," then each click of the HandWheel Dial produces a movement of 0.1 mm.
- "X1000" indicates a multiplier of "1000" which will be applied to the machine unit. If the machine unit is 0.001 mm and the multiplier is "1000," then each click of the HandWheel Dial produces a movement of 1.0 mm.



5) You need to specify which axis to move. There are two ways to do this. If you are using the HW-100 HandWheel, you can use the Axis Selection Switch (see Figure 13-1) to select which axis to move (see

X AXIS

Table 13-1). Or you can press the button corresponding to the axis you want (for example, the button corresponds to the X axis) on the bottom toolbar to select an axis. This overrides the settings on the HW-100 Axis Selection Switch until the next time you use the Axis Selection Switch. Whichever axis is selected will be reflected in the "Active Axis" frame of the HandWheel Window. (The selected axis will be highlighted.)

<u>NOTE</u>: you can only select one axis, because HandWheel Mode operates on only one axis at a time. If the servo drive for an axis is not turned on, the button for that axis will be disabled.



Be aware that the settings in ServoWorks S-1\_0M override the settings on the HW-100 handwheel itself. Make sure you know which axis and which multiplier is active before using the handwheel to move an axis.



AXIS FOR HANDWHEEL CONTROL	TARGET DEVICE	AXIS SELECTION SWITCH
1		X OFE C-5
2	Axis 1 – 4 (first DC-155 for the VersioBus II	Y OFE STATES
3	interface system)	Z OFE C -5
Spindle		Not applicable
4 (ServoWorks S-120M and S-140M only)	Axis 5 – 6 (second DC-155 for the	X OFE -5
5 (ServoWorks S-140M only)	VersioBus II interface system)	Y OFE STATES

<u>NOTE</u>: Selecting "X" on the Axis Selection Switch for DC-155 #1 selects Axis #1, which may not necessarily be called "Axis X," as Axis #1 can be set with an Axis Name of "X," "Y," "Z," "A," or "B". The mapping of the Axis Selection Switch is set in the default LadderWorks PLC sequence program, and can be reprogrammed to map "Axis X" on the Axis Selection Switch to an axis other than 1, if this is more convenient.

# Table 13-1: Axis Selection Switch Settings for Machine Axes in HandWheel Mode for the VersioBus II Interface System and the HW-100 HandWheel

6) Turning the dial on the HW-100 HandWheel starts motion on the selected axis. Motion will occur for as long as you move the handwheel dial. You will see the position data of the selected axis change (unless you are displaying only a plot in the Main Display Area), to reflect the status of the Handwheel Operation. The text boxes in the "HandWheel Pulse" frame will display the sum total of all position commands since you went into HandWheel Mode. (Each time you go into HandWheel Mode, this number resets to "0.")

Motion will stop when you stop moving the handwheel dial. Information about the motion, such as axis position, feedrate, etc. will be displayed in the ServoWorks S-1\_0M screen.

In HandWheel Mode, all acceleration and deceleration is performed with the exponential smoothing filter and the smoothing time constant that is selected for Jog Mode. For an explanation of exponential acceleration/deceleration, see the *Reference Manual for ServoWorks CNC Parameters and Functions*.

**X**þ

MAIN

When you want to quit HandWheel Mode, press the

button or press the "Escape" key on your keyboard.

<u>NOTE</u>: It's recommended that you stop all motion before quitting HandWheel Mode.



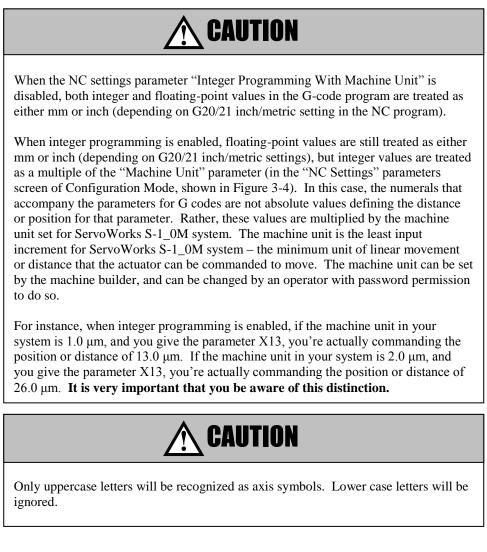
## **Chapter 14: Creating and Editing Part Programs**

## 14.1 Overview

ServoWorks S-1\_0M uses the industry standard "G Code" for CNC programming. You will write part programs from part drawings using these CNC codes, to describe the shape of the part to be created. Refer to the *Part Programming Manual for ServoWorks S-100M, S-120M and S-140M* for more information on the specifics of CNC part programming used by ServoWorks S-1\_0M.

You will use Auto Mode, an operational mode in ServoWorks S-1\_0M, to prove part programs and perform automatic CNC runs uses specified CNC G code files. (See *Section 15.5: Proving a Part Program.*)

You may create and/or edit a part program (a .dat file) in any text editor you choose – Notepad, WordPad, Microsoft Word, etc. Or, ServoWorks S-1\_0M provides Edit Mode, a convenient sub mode for creating or modifying your part programs without leaving ServoWorks S-1\_0M.



<u>NOTE</u>: You must have a mouse and a keyboard or keypad in order to use Edit mode. You cannot enter blocks of code with function keys alone.



## 14.2 Getting Into Edit Mode

T,

You can edit or create a CNC file by pressing the **EDIT** button on the right toolbar. This will put you into Edit Mode (a sub mode), and you will see the following window:

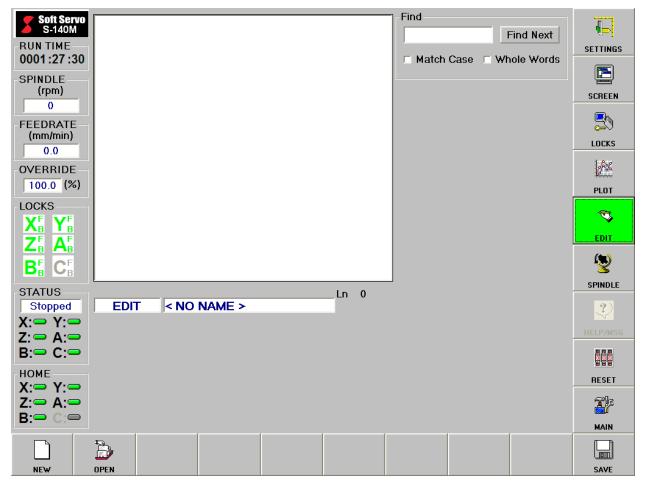


Figure 14-1: Edit Mode Window

## 14.3 Selecting a File To Edit

If you had a CNC file loaded in Auto Mode before you got into Edit Mode, that file will be loaded and ready to edit.

If this is the file you want to edit, you're all set.

If you want to create a new CNC file for a new part program, press the button on the bottom toolbar, and you are ready to start editing.

If, however, you want to edit a different, existing file, the following steps will guide you through opening that file:

Press the button on the bottom toolbar. This will bring up the following window (or a similar window):



Select the sour	ce file	? 🗙
Look in:	🗀 ncdata 💽 🔶 🖆 📰 •	
My Recent Documents Desktop	tempMDI.dat     TelDemo_XYZRobot.dat     S-100M_Demo.dat     OPocket_Circle.dat     4axes_Demo.dat	
My Documents		
My Computer		
My Network Places	File name: TelDemo_XYZRobot.dat	Open
	Files of type: All files (*.*)	Cancel

Figure 14-2: "Select the source file" Window

2) Browse to the file you want to open, and click the "Open" button.

## 14.4 Finding a String of Code in Your Part Program

ServoWorks S-1\_0M makes it easy to find a specific string of words, or block of code, within your part program. Type in the word or words you want to match in the text box of the "Find" frame.

You have the option of specifying "Match Case" – that is, that ServoWorks S-1\_0M find text matching the exact case of what you have typed in. For instance, if you specify "Match Case" (by checking the "Match Case" option button), and you type "g00" in the text box, "G00" would not be considered a match.

You also have the option of specifying "Whole Word" – that is, that ServoWorks S-1\_0M find the exact, whole word that you have typed in. The word or words you specify must have spaces around them to count as a whole word. For instance, if you specify "G5" in the text box, "G50" would not be considered a match.

## 14.5 Saving Your File After Editing

To save your file, press the save button on the bottom toolbar. You will be prompted for the destination file you want to save as, with a "Select Source File Window" (as shown in the previous figure). Select the name of your destination file (either an existing file, or type in a new file), and click the "Save" button.



## 14.6 Exiting Edit Mode

To exit Edit Mode, press the



button. If you entered Edit Mode from Main Mode, this will take you back

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to Main Mode. If you entered Edit Mode from an operational mode, pressing the <sup>EDIT</sup> button or pressing the "Escape" key on your keyboard will take you back to that operational mode.



## Chapter 15: Proving Part Programs and Running Production in Auto Mode

## 15.1 CNC Part Programming

ServoWorks S-1\_0M uses industry standard "G code" for CNC programming. You will write part programs from part drawings using these G codes, to describe the shape of the part to be created. Refer to the *Part Programming Manual for ServoWorks S-100M, S-120M and S-140M* for more information on the specifics of CNC part programming used by ServoWorks S-1\_0M.

You will use Auto Mode, an operational mode in ServoWorks S-1\_0M, to open and prove part programs, and perform automatic CNC runs uses specified CNC G code files. You can get into Auto Mode as follows:

1) Make sure you are in the Main window of ServoWorks S-1\_0M (as shown in Figure 2-2). (To get to the

<u>A</u> button on the right toolbar of the ServoWorks S-1 0M window.) Main window, press the MAIN # 2) Press the AUTO button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen. You will then be in Auto Mode and you will see the window shown in Figure 15-1. 禮 NOTE: If the button is disabled (appears as AUTO ), it's probably because you have not AUTO set the home position for your axes. You must set the home position – see Section 2.5 Performing a ð **~** Homing Operation. [Press the button on the bottom toolbar, then press the button HOME HOME ALL T on the bottom toolbar to set all axes to their home positions at the same time. Press the MAIN button 禮 button should now be enabled for you to select it.] to return to Main Mode. The AUTO

<b>Soft Servo</b> systems, inc						ORKS S-100M <u>d Running Pro</u>		
Soft Servo Systems, INC Soft Servo S-140M RUN TIME 0000:00:19 SPINDLE (rpm) 0 FEEDRATE (mm/min) 0.0 FEEDRATE (mm/min) 0.0 OVERRIDE 100.0 (%) LOCKS SF AB CB AB	X(mm): Y(mm): Z(mm): A(mm): B(mm): C(deg): Y(mm) 30.69- 15.34- 0.00 -			Part Pro Pos 00 00 00 00 00 00 00		d Running Pro           Pos         Serve           00         0000           00         0000           00         0000           00         0000           00         0000           00         0000           00         0000           00         0000           00         0000           00         0000	Duction in Lag .002 .002 .002 .002 .002 .002	Auto Mode Feli SETTINGS SCREEN COCKS LOCKS PLOT COCKS EDIT
BE CE Status Stopped X: Y: Z: A: B: C: HOME X: Y: Z: A: B: C:	Modal G00 G G21 G40 G4 G50	19 G80 G98 G64 50.1 H:		DRN		HW INT OP ST Cycle Time: 0 Override (%) 100% 4 0% Rapid Override 100% 4 0%	_	SPINDLE PINDL
				<b>ст.</b> RPO +	REWIND	MORE	START	- B- STOP
`These function		OP OPT SKIP	B. SEARCH		RETRACI	MORE	START	18: Stup
switches for Auto Mode.								

Figure 15-1: Auto Mode Window (Showing Both Bottom Toolbars)



The Auto Mode display area contains the information shown in the following figure:

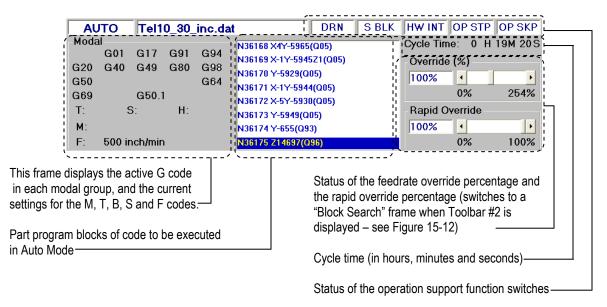


Figure 15-2: The Auto Mode Display Area

## 15.2 Opening and Closing a Part Program

When you are in Auto Mode, you must open a CNC G code file before you do anything else. (Until you open a part program, most of the buttons on the bottom toolbars are disabled.) If you have previously opened a file in Auto Mode, the most recently opened file will be open again. You open a part program as follows:

1) Make sure you are in Auto Mode.



2) Press the **CNC FILE** button on the bottom toolbar. This will bring up the following window (or a similar window):



Select the sour	ce file		? 🔀
Look in:	ncdata 💌 🔶 🖻	. 💣 🎟	
My Recent Documents Desktop	tempMDI.dat     TelDemo_XYZRobot.dat     S-100M_Demo.dat     OPocket_Circle.dat     4axes_Demo.dat		
My Documents			
My Computer			
<b></b>			
My Network Places	File name:	•	Open
i idces	Files of type: All files (*.*)	•	Cancel

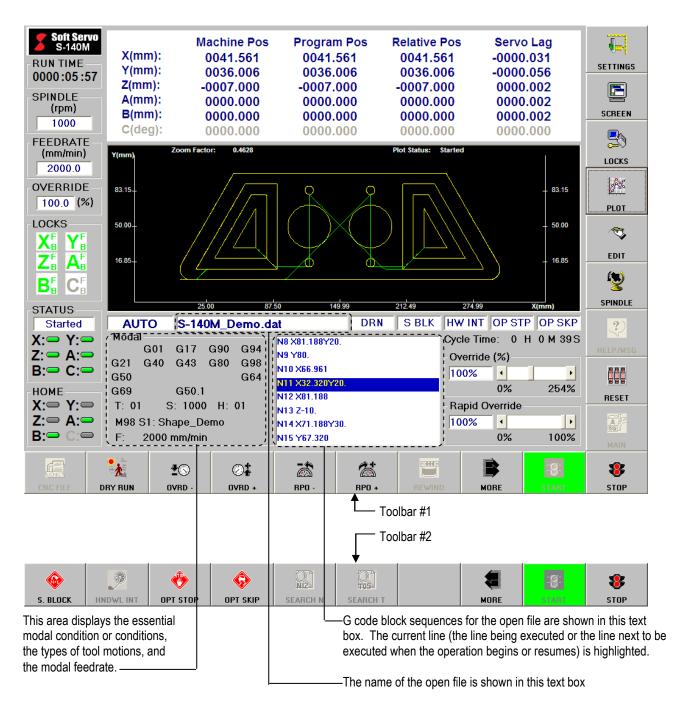
Figure 15-3: "Select the source file" Window

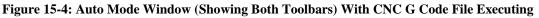
3) Select the file you want to open, and click the "Open" button.

Once the G code file is open, the G code block sequence will be displayed in the Mode Display Area, as shown in Figure 15-4.

To open another G code file, simply repeat steps #1 - 3. There is no need to close the current G code file; it will be closed automatically, either when you open another file, or when you leave Auto Mode.







## 15.3 Setting Feed Override and Rapid Override

ServoWorks S-1\_0M allows you to override both the feedrate given in part programs for linear or circular interpolation, and the rapid feedrate for the axes (so for G00, the speed would be at some percentage of the rapid feedrate, rather than at the rapid feedrate itself).



You can override the feedrate for interpolation specified by part programs from 0% to 254%, if you want to increase or decrease the feedrate specified by the CNC code. Either use the slide bar for "Override (%)" or press the

**DVRD** and **DVRD** buttons on the bottom toolbar to decrease and increase, respectively, the feedrate override percentage. The setting for the percentage is shown in the text box labeled "Override (%)."

The rapid feedrate is the maximum velocity feedrate for each axis, and it is specified in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5). You can override the rapid traverse feedrate from 0% to 100% –you still can't go beyond the rapid feedrate that you set in Configuration Mode, but you can decrease the rapid feedrate by taking a percentage of the rapid feedrate. In other words, you can't increase the feedrate beyond the maximum feedrate; you can only decrease the rapid feedrate by some percentage. Either use the slide bar for "Rapid

Override" or press the and and buttons on the bottom toolbar to decrease and increase, respectively, the rapid traverse feedrate override percentage. The setting for the percentage is shown in the text box labeled "Rapid Override."

NOTE: If you have a mouse, you can use the slide bars for "Rapid Override."

## 15.4 Setting the Operation Support Function Switches

### 15.4.1 Overview

ServoWorks S-1\_0M has five operation support function switches that provide you with various options related to executing CNC code. These switches can be used alone, or in combination. These switches are often helpful for debugging part programs.

OPERATION SWITCH	TOOLBAR BUTTON	DEFAULT OFF STATUS	DEFAULT ON STATUS
Dry Run	DRY RUN	DRN	DRN
Single Block	S. BLOCK	S BLK	S BLK
HandWheel Interrupt	HNDWL INT	HW INT	HW INT
Optional Stop	OPT STOP	OP STP	OP STP
Optional Skip	OPT SKIP	OP SKP	<b>OP SKP</b>

#### Table 15-1: Operation Support Switches

### 15.4.2 Dry Run

The Dry Run switch is used only for proving part programs, and is explained in *Section 15.5.2: Proving a Part Program Using the Dry Run Switch*.



### 15.4.3 Single Block

If you activate the Single Block switch by pressing the **S. BLOCK** button on bottom toolbar #2, it means that CNC G code will be executed in single block operational mode. Only one block of CNC data will be 8 executed at a time. In single block operational mode, pressing the START button on the bottom toolbar will cause only the current block of code to be executed, and then execution will stop. You will have to 8 button again to execute the next block of code, and so forth. press the START While executing code in single block operational mode, when G code execution has been completed for the current line, you have the option of pressing the button again to deactivate this switch. When BLOCK 8 the Single Block option is deselected, pressing the button will cause normal, continuous START execution of G code to begin. At any time during a normal, continuous execution of a part program, pressing the s. BLOCK button will immediately change the execution to single block operational mode.

### 15.4.4 HandWheel Interrupt

• If you activate the HandWheel Interrupt switch by pressing the button on bottom toolbar #2, ServoWorks S-1\_0M will allow the motion to be alternately controlled by the handwheel and the CNC part program. The CNC code execution must be suspended before ServoWorks S-1\_0M will accept input from

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the handwheel. Therefore, you must press the stop button on the bottom toolbar to stop G code execution in order to use the handwheel. You may find this switch useful if you want to use the handwheel to move a tool to another location in the middle of the execution of a part program.

- If the HandWheel Interrupt switch is deactivated, ServoWorks S-1\_0M will not accept input from the handwheel in Auto Mode.
- ServoWorks S-1\_0M uses whatever smoothing parameters are in effect at the time of manual intervention. For instance, if the last block of code executed was a G00 rapid traverse command, the type of smoothing and the smoothing time constant for rapid traverse will be used for motion produced by / commanded with a handwheel.



8

START

### 15.4.5 Optional Stop

• If you activate the Optional Stop switch by pressing the button on bottom toolbar #2, it means that part program execution will stop when it reaches an M01 optional stop code. In order to continue

• If the Optional Stop switch is deactivated, the M01 code will be ignored, and execution of the part program will continue without interruption upon reaching an M01 code.

#### 15.4.6 Optional Skip

• If you activate the Optional Skip switch by pressing the button on bottom toolbar #2, it means that CNC G code execution will skip (not execute) blocks of code marked as "Optional Skip" or "Block Delete Code" (which mean the same thing). You can specify a portion of a block as Optional Skip code by beginning such code with a "/" (forward slash) or "\\" (two backward slashes).

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• If the Optional Skip switch is deactivated, the optional skip code will be ignored, and all blocks of code marked as optional skip code will be executed without interruption.

## 15.5 Proving a Part Program

You should always prove (verify) your part program before your set up your machine for production. Proving the program will check that the part program is correct and works to produce exactly the desired workpiece as efficiently as possible.

#### 15.5.1 Proving a Part Program Using the Machine Lock Switch

When you prove a part program using the Machine Lock switch, you can lock any or all of the axes. When you lock an axis with the Machine Lock switch, it will be locked in both directions.

With the Machine Lock switch activated, actual axis movement will be disabled, while the theoretical value of the program position will be simulated – the part program will be run essentially in a simulation mode. All codes (M codes, S codes, T codes, and G codes) will actually be executed by the machine. But for G codes that change the position of any axis, the movement commands are disabled, so ServoWorks S-1\_0M will not send movement commands to the servo drive. However, even though a locked axis will remain still, the "Program Pos" will display data and the plot will appear *as if* the axis were moving, while the "Machine Pos" data will remain constant.

When the Machine Lock is on, any simulated movement will cause a difference between "Program Pos" and "Machine Pos" data display. It has the same effect as shifting the workpiece coordinate offset. In order to restore the original workpiece coordinate offset, you must perform a homing operation again.

The following steps will guide you in proving a part program using the machine lock switch:

1) In Auto Mode, load the CNC file that you want to verify.



- 5
- 2) Press the LOCKS button on the right toolbar to go into Locks Mode (a sub mode). The bottom toolbar will appear as follows, for Locks Mode:



Figure 15-5: Bottom Toolbar in Locks Mode

- 3) Lock whichever axis or axes you want to lock to prove your part program (see *Chapter 6: Locking One or More Axes*).
- 4) Press the ucces button to return to Auto Mode.
- 5) Run the part program with the Machine Lock(s) activated.

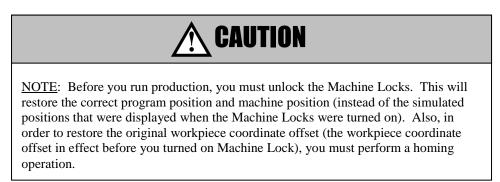
When you are ready to run production, and want to deactivate the Machine Lock(s):

- 1) Press the LOCKS button on the right toolbar. This will put you into Locks Mode (a sub mode).
- 2) Unlock all axes to prove your part program (see *Chapter 6: Locking One or More Axes*).



3) Press the

button to return to whatever manual mode you were in before Locks Mode.



## 15.5.2 Proving a Part Program Using the Dry Run Switch

When you prove a part program using the dry run switch, you can observe the tool path under the control of the part program without a workpiece loaded in the machine, to test the part program before running production. Because there is no workpiece and you're actually not cutting, the machine can run at a higher speed, and you can expedite your dry run process. Unlike proving a part program using machine lock, both axes will actually move through the entire tool trajectory specified by the code in the part program (i.e. "cutting air").

You execute a dry run with the following steps:

1) Make sure your CNC file is loaded.



2) Press the DRY RUN button.



- 3) Set the dry run speed by pressing the DRN SPD. and DRN SPD. and DRN SPD. buttons on the bottom toolbar (only visible when the Dry Run switch is activated). This dry run speed will replace any feedrates set by the CNC code in the file being executed. The dry run speed is displayed in the "DryRun Speed" frame, which is only visible when the Dry Run switch is activated. [The default dry run speed is specified in the "Feedrate" parameters screen in Configuration Mode, shown in Figure 3-5.]
- 4) Set the feedrate override percentage by pressing the toolbar, to decrease and increase, respectively, the feedrate override percentage. You can override the rapid feedrate from 0% to 100%. Because you're doing a dry run, you probably want to set the rapid feedrate to 100%.
- 5) To start the dry run, press the start button on the bottom toolbar. During the dry run, the line of code being executed is highlighted.
- 6) To stop the dry run execution, press the suspended once the current block data is executed.

After you have stopped the execution of a dry run, you can continue from where you left off by pressing the

8 START

button again. The dry run will start again from the current, highlighted block.

Or, you can restart the dry run from the beginning. To restart the program from the first line of code, press

the **BEWIND** button on the bottom toolbar. This will set the first line of your program as the current line (the line that will execute once you resume operations). This also resets the Cycle Time to 0:00:00.

### 15.5.3 Summary of Methods Available for Proving Part Programs

Method	Workpiece Loaded	Ignore Programmed Feedrate?	Axes Locked?	Position Data Reflects Actual Tool Movement	Actual Tool Movement Executed?
Machine Lock	Yes	No	Yes – both directions only (total lock)	No – simulated position data is displayed	No – in locked directions; Yes – in unlocked directions
Dry Run	No	Yes	No.	Yes	Yes

 Table 15-2: Summary of Methods for Proving Part Programs



## 15.6 Specifying the Plot Settings

You will need to set up the plot parameters for the particular workpiece you will be producing in Auto Mode.

- Make sure you are in Configuration Mode. (If not, press the convice button on the bottom toolbar of the ServoWorks S-1\_0M Main Screen.)
- 2) Click on the figure:
   Plot button, and the Plot screen will appear, as, shown in the following figure:

-Plot Position Sample	Option
Theoretical	C Actual
Plot	
Scale 1	Plot Direction XY
Automatic start plo	t in AUTO mode
Sequence No.	O Cycle Time:
Start from	0
Stop at	999999999

Figure 15-6: Configuration Mode – Plot Parameters Screen

- Make sure "Automatic start plot in AUTO mode" is checked if not, click inside the box to check "Automatic start plot in AUTO mode."
- 4) Set the default scale value for your plots of tool trajectory. (You can always change the scale of any plot by going into Plot Mode this setting just specifies the default scale for any plot.)
- 5) Use the pull-down menu for "Plot Direction" to specify which plane to plot (which axes you want to see for the horizontal and vertical coordinates.)
- 6) You can specify which part of a part program to plot, either by specifying a range of line (sequence) numbers, or a range of time to plot. Select either "Cycle Time" or "Sequence No." by clicking the button next to the selection you want.

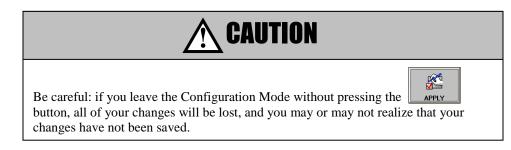
If you choose "Cycle Time," you need to specify which line number to start plotting on and which is the last line number to plot by typing in the text boxes labeled "Start from" and "Stop at."

If you choose "Sequence No.," you need to specify the cycle time at which to start plotting and the cycle time at which to stop plotting by typing in the text boxes labeled "Start from" and "Stop at." You must use the format "OH OM OS" to specify time – include the hour, the minute and the second.



7) Press the **APPLY** button to save your changes.





8) To exit Configuration Mode (and return to Auto Mode), either press the "Escape" key on your keyboard or

press the MAIN 1

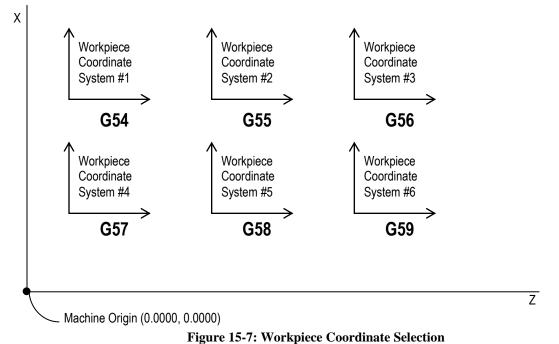
button on the bottom toolbar.

## 15.7 Setting the Workpiece Coordinate Offsets

## 15.7.1 What Are Workpiece Coordinate Offsets?

Workpiece coordinate offsets (workpiece coordinates) allow you to assign multiple part origins in one program, to produce a number of identical workpieces from one part program. You will need to set your workpiece coordinates before you run production. You should change your workpiece coordinates every time you open a new part program to run.

Six workpiece coordinate systems are selectable with G codes G54 - G59 (which are called from within the part programs with no parameters – the parameters, or arguments, are taken from the settings in the Settings Mode Window shown in Figure 15-8).



Up to 58 additional different workpiece coordinate systems can be used and selected with G54.1, in addition to the six coordinate systems that can be selected using G54-G59. The G54.1 code is called from within the part program with a "P" parameter whose number corresponds to a workpiece coordinate offset in Settings Mode. For example, "G54.1 P4" corresponds to "Workpiece Zero Offset 10 (G54.1 P4)" in Settings Mode (as shown in Figure 15-8).



## 15.7.2 Accessing the Work Point Coordinates Settings

To access the work point coordinates settings, you must get into Settings Mode (a sub mode in ServoWorks										
	S-1_0M). To get into Settings Mode, press the settings button on the right toolbar of the ServoWorks S-1_0M screen. You will see the window shown in Figure 15-8.									
	NOTE: If the set the home position for your axes. You must set the home position – see Section 2.5 Performing a Homing Operation.									
	DIME butt	on on the	bottom tool	bar, then		HOME ALL	buttor	n on the b	oottom toolb	International
axes to their ho button should n					MAIN	button t	o return	to Main	Mode. The	SETTINGS
Soft Servo S-140M		Ма	chine Pos	Progra	am Pos	Relativ	ve Pos	Serv	vo Lag	6-
RUN TIME	A(mm):	0	000.000	000	.000	0000	0.000	000	0.002	SETTINGS
0000:15:15	B(mm):	0	000.000	000	.000	0000	000.	000	0.002	
SPINDLE	X(mm):	0	196.786	0190	5.786	0196	5.786	000	0.002	
(rpm)	Y(mm):	0	100.000	010	000.	0100	0100.000 0000.			SCREEN
0	Z(mm):	-0	012.000	-0012	2.000	-0012	2.000	000	0.002	
FEEDRATE										<b>_</b>
(mm/min)		. N	/AIN		SUB S	ETTING	S			
(mm/min) 0.0	[		AIN Coordinate System		SUB S		S ol Offset Com	npensation		
	Workpied		Coordinate System					npensation		
0.0	Workpied	Workpiece	Coordinate System	A (mm	B (mm)	To X (mm)	ol Offset Con Y (mm)	Z (mm)		
0.0 OVERRIDE 100.0 (%)		Workpiece	Coordinate System Offset	A (mm	B (mm)	To	ol Offset Con			LOCKS
0.0 OVERRIDE 100.0 (%)	Workpied	Workpiece ce Cordinate	Coordinate System Offset 1 (G54)		B (mm)	To X (mm)	ol Offset Con Y (mm)	Z (mm)		
OVERRIDE 100.0 (%) LOCKS A <sup>F</sup> <sub>B</sub> B <sup>F</sup> <sub>B</sub>	Workpied	Workpiece ce Cordinate ce Zero Offset	Coordinate System Offset 1 (G54) 2 (G55)	0.00	B (mm) 0.000 0 0.000	X (mm)	ol Offset Com Y (mm) 0.000	Z (mm)		LOCKS
$\begin{array}{c} 0.0 \\ \hline 0.0 \\ \hline 0VERRIDE \\ \hline 100.0 \\ (\%) \\ \hline LOCKS \\ \hline A_B^F \\ \hline B_B^F \\ \hline \hline B_B^F \\ \hline B_B^F \\ \hline B_B^F \\ \hline B_B^F \\ \hline B_$	Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset	Coordinate System e Offset 1 (G54) 2 (G55) 3 (G56)	0.00	B (mm) 0.000 0 0.000 0 0.000	X (mm) 0.000	ol Offset Com Y (mm) 0.000 0.000	Z (mm) 0.000 0.000		LOCKS PLOT
OVERRIDE 100.0 (%) LOCKS A <sup>F</sup> <sub>B</sub> B <sup>F</sup> <sub>B</sub>	Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G55) 4 (G57)	0.00	B (mm) 0 0.000 0 0.000 0 0.000 0 0.000	X (mm) 0.000 0.000 0.000	ol Offset Com Y (mm) 0.000 0.000	Z (mm) 0.000 0.000 0.000		LOCKS PLOT EDIT
0.0 OVERRIDE 100.0 (%) LOCKS ABB XBB XBB XBB XBB XBB XBB XBB	Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System e Offset 1 (G54) 2 (G55) 3 (G56) 4 (G57) 5 (G58)	0.00	B (mm) 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000	X (mm) 0.000 0.000 0.000	V (mm) 0.000 0.000 0.000 0.000	Z (mm) 0.000 0.000 0.000 0.000		LOCKS PLOT C EDIT SPINDLE
0.0 OVERRIDE 100.0 (%) LOCKS ABB XBB XBB XBB XBB XBB XBB XBB	Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System e Offset 2 (G55) 3 (G55) 4 (G57) 5 (G58) 6 (G59)		B (mm)           0         0.000         0           0         0.000         0         0           0         0.000         0         0         0           0         0.000         0         0.000         0 </td <td>X (mm) 0.000 0.000 0.000 0.000</td> <td>ol Offset Com Y (mm) 0.000 0.000 0.000 0.000</td> <td>Z (mm) 0.000 0.000 0.000 0.000</td> <td></td> <td>LOCKS PLOT EDIT</td>	X (mm) 0.000 0.000 0.000 0.000	ol Offset Com Y (mm) 0.000 0.000 0.000 0.000	Z (mm) 0.000 0.000 0.000 0.000		LOCKS PLOT EDIT
0.0 OVERRIDE 100.0 (%) LOCKS ABB XBB XBB XBB XBB XBB STATUS Stopped A:• B:• X:• Y:•	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 1 (G54) 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1)		B (mm) 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000	X (mm) 0.000 0.000 0.000 0.000 0.000	Old Offset Com           Y (mm)           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000		LOCKS PLOT C EDIT SPINDLE
0.0 OVERRIDE 100.0 (%) LOCKS A <sup>F</sup> <sub>B</sub> B <sup>F</sup> <sub>B</sub> X <sup>F</sup> <sub>B</sub> Y <sup>F</sup> <sub>B</sub> Z <sup>F</sup> <sub>B</sub> STATUS Stopped A:• B:•	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2)		B (mm)           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000	ol Offset Con Y (mm) 0.000 0.000 0.000 0.000 0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000		LOCKS PLOT PLOT CON EDIT SPINDLE PLOP/MSG REAL
$0.0$ $0.0$ $0.0$ $100.0$ $(\%)$ $LOCKS$ $A_B^B B_B^F$ $X_B^F Y_B^F$ $Z_B^F$ $Z_B^F$ $Status$ $Stopped$ $A: B: X: Y: Y:$	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2)		B (mm)           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000           0         0.000	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Old Offset Com           Y (mm)           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000		LOCKS PLOT PLOT EDIT SPINDLE ? HELP/MSG
0.0 OVERRIDE 100.0 (%) LOCKS ABB XBB XBB XBB ZBB STATUS Stopped A: B: X: Y: Z: S: HOME A: B: HOME A: B:	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 1 (G54) 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2) 9 (G54.1 P3)		B (mm)           0.000           0	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	ol Offset Con Y (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000		LOCKS PLOT PLOT CONSCIENT SPINDLE CONSCIENT HELP/MSG RESET
0.0 $0.0$	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2) 9 (G54.1 P3) 10 (G54.1 P4)		B (mm)           0.000           0	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Old Offset Com           Y (mm)           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Page 1/6	LOCKS PLOT PLOT CON EDIT CON SPINDLE CON HELP/MSG HELP/MSG RESET CON
$\begin{array}{c} 0.0 \\ \hline 0.0 \\ \hline$	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2) 9 (G54.1 P3) 10 (G54.1 P4)		B (mm)           0.000           0	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Old Offset Com           Y (mm)           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000		LOCKS PLOT PLOT CON EDIT CON SPINDLE CON HELP7MSG HELP7MSG RESET CON RESET
$\begin{array}{c} 0.0 \\ \hline 0.0 \\ \hline$	Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec Workpiec	Workpiece ce Cordinate ce Zero Offset ce Zero Offset	Coordinate System 9 Offset 2 (G55) 3 (G56) 4 (G57) 5 (G58) 6 (G59) 7 (G54.1 P1) 8 (G54.1 P2) 9 (G54.1 P3) 10 (G54.1 P4)		B (mm)           0.000           0	X (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Old Offset Com           Y (mm)           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000	Z (mm) 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Page 1 /6	LOCKS PLOT PLOT CON EDIT CON SPINDLE CON HELP/MSG HELP/MSG RESET CON

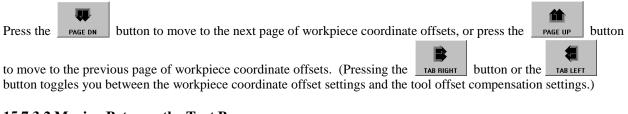
Figure 15-8: The Settings Mode Window – Workpiece Coordinates Screen



LEFT

### 15.7.3 Selecting and Changing the Input for the Work Point Parameters

#### **15.7.3.1 Moving Between Pages**



#### **15.7.3.2** Moving Between the Text Boxes

Moving between the text boxes is very simple. The selected text box is shown with a different color background

than the other text boxes. To move to a different text box, press the



buttons on the bottom toolbar to move to the desired text box.

<u>NOTE</u>: If you have a mouse, you can click on the text box you want to select.

#### **15.7.3.3** Changing Values in the Text Boxes

Once you have selected the text box whose value you want to change, use your keypad or keyboard to type in the value you want to enter.

#### **15.7.3.4 Saving Your Changes**

0.000



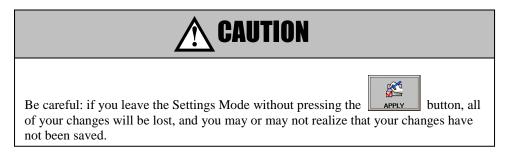
In order to save your changes, you must press the into a registry file in the operating system.

button on the bottom toolbar. This saves your changes

RIGHT

♠

and



### 15.7.4 Using the Measure Function for Workpiece Coordinate Offsets

ServoWorks S-1\_0M provides a function to measure (calibrate) the workpiece coordinate offset values.

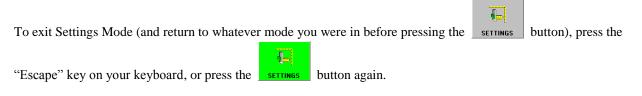
Pressing the **MEASURE** button sets the workpiece coordinate position as the current machine coordinate value for the selected (highlighted) axis in the Workpiece Coordinate System screen, and sets the program position for that axis to zero. Obviously, this saves you time when you want to quickly set up multiple workpiece coordinates.



MEASURE button works on one axis at a time, for one workpiece zero offset setting at a time.



### 15.7.5 Exiting Settings Mode



## 15.8 Setting Tool Offsets

### 15.8.1 Overview

Tool offsets are the difference between the actual tool position and the theoretical tool position.

Each tool offset is a set of distances for each axis. When T codes are executed in a part program, the program position is actually shifted to account for tool offset (as opposed to compensating each actual movement command in the part program to account for tool offset).

Tool offsets can be divided into two types: geometry offsets and wear offsets. The total tool offset is the sum of the geometry offset and the wear offset.

The geometry offset compensates for the tool mounting position and for the tool shape.

The wear offset compensates for wear to the tool tip. Wear is continually changing as tools are used in production.

Tool length offsets are shown as follows:

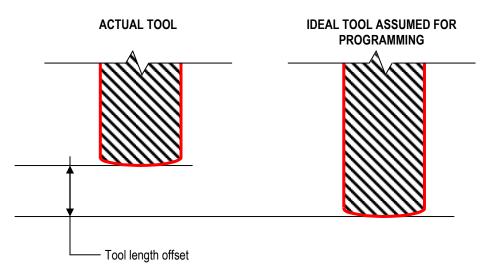


Figure 15-9: Tool Length Offset



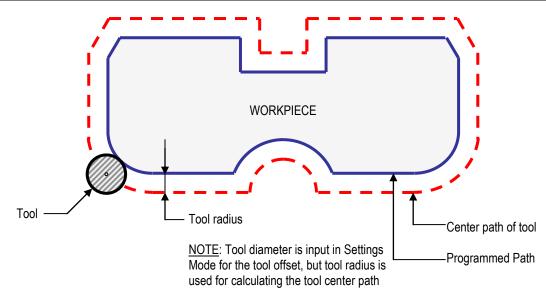
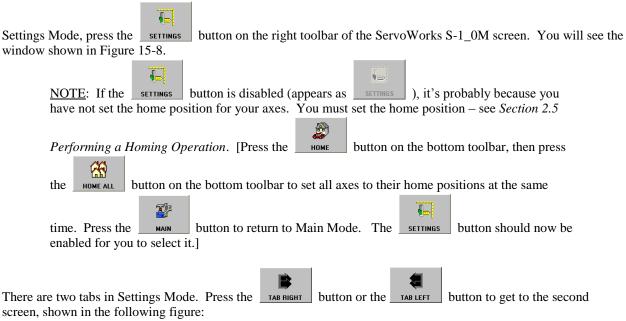


Figure 15-10: Tool Radius Offset

## 15.8.2 Accessing the Tool Offsets

To access the tool offsets, you must get into Settings Mode (a sub mode in ServoWorks S-1\_0M). To get into





Soft Servo S-140M RUN TIME 0000:39:18 -SPINDLE (rpm) 0 -FEEDRATE (mm/min)	A(mm): B(mm): X(mm): Y(mm): Z(mm):	Machin 0000. 0000. 0196. 0100. -0012.	000 000 786 000	Program 0000.0 0000.0 0196.7 0100.0 -0012.0	000 000 786 000 000	Relative 0000.0 0000.0 0196.7 0100.0 -0012.0 SETTINGS	000 000 786 000	Servo Lag 0000.002 0000.002 0000.002 0000.002 0000.002	SETTINGS SETTINGS SCREEN
		Workpiece Coordin							LOCKS
	T 10% 1		late system		]	10010	Iffset Compensat	ion	1.87
OVERRIDE	Tool Offset	Length (mm)	Diamet	er (mm)	Tool #	Length (mr	n) Dia	ameter (mm)	
100.0 (%)	Geo		Geom	Wear	1001#	<b>.</b> .	ear Geon		PLOT
LOCKS	1 0	0.000	0.000	0.000	12	0.000	0.000 0.	000 0.000	-
	2 0	0.000 0.000	0.000	0.000	13	0.000	0.000 0.	000 0.000	<b>A</b>
	3 0	0.000	0.000	0.000	14	0.000	0.000 0.	000 0.000	EDIT
									<b>(</b>
	4 0	0.000 0.000	0.000	0.000	15	0.000	0.000 0.	000 0.000	
STATUS	5 0	0.000 0.000	0.000	0.000	16	0.000	0.000 0.	000 0.000	SPINDLE
Stopped	6 0	0.000 0.000	0.000	0.000	17	0.000	0.000 0.	000 0.000	?)
A:- B:-	7 0	0.000 0.000	0.000	0.000	18	0.000	0.000 0.	000 0.000	×
X:= Y:=	8 0	0.000 0.000	0.000	0.000	19	0.000	0.000 0.	000 0.000	HELP/MSG
Z: — S: —					20				
НОМЕ		0.000 0.000	0.000	0.000				000 0.000	
A:- B:-	10 0	0.000 0.000	0.000	0.000	21	0.000	0.000 0.	000 0.000	RESET
X:= Y:=	11 0	0.000 0.000	0.000	0.000	22	0.000	0.000 0.	000 0.000	<u> </u>
Z: 🗢				Pag	e 1/12				
		1	1	1		1	1	1	MAIN
TAB LEFT TA	B RIGHT PA	AGE UP PAG	E DN	LEFT	RIGHT	UP	D0¥	/N MEASU	RE APPLY

Figure 15-11: The Settings Mode Window – Tool Offset Compensation Screen

## 15.8.3 Manually Setting Tool Offsets

### 15.8.3.1 Moving Between the Tool Offset Pages

There are 256 possible tool offset values, shown 22 per page (except for the last page), for a total of 12 pages.

Moving between the pages is actually very simple. Use the PAGE UP and PAGE DN toolbar to move to the desired page.

## **15.8.3.2** Moving Between the Text Boxes

Moving between the text boxes is actually very simple. The selected text box is shown with a different color

background than the other text boxes. To move to a different text box, press the



buttons on the bottom

and

buttons on the bottom toolbar to move to the desired text box.

<u>NOTE</u>: If you have a mouse, you can click on the text box you want to select.



#### 15.8.3.3 Changing Values in the Text Boxes

Once you have selected the text box whose value you want to change, use your keypad or keyboard to type in the value you want to enter.

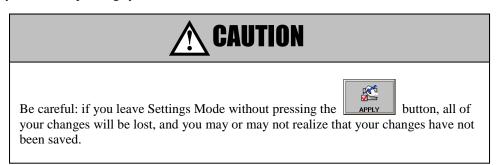
ĸ

APPLY

#### **15.8.3.4 Saving Your Changes**

In order to save your changes, you must press the into a registry file in the operating system.

button on the bottom toolbar. This saves your changes



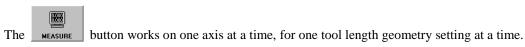
## 15.8.4 Using the Measure Function for Setting Tool Offsets

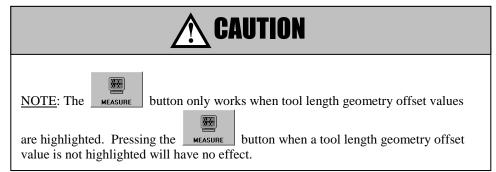
ServoWorks S-1\_0M provides a function to measure (calibrate) the tool length offset values for tool length geometry values. This is useful when you can use a handwheel to move the tool to do a touch-off or a skim cut.

Pressing the **MEASURE** button sets the tool length geometry offset value to the Z axis program position minus the Tool Length Calibration Position in the "Tool Length Compensation" frame of the "Tool Compensation" parameters screen of Configuration Mode (shown in Figure 3-14), for the selected (highlighted) tool number in the Tool Offset Compensation screen.

For example, if the Z axis program position is 0.005 mm, and the Tool Length Calibration Position is 0.003 mm,

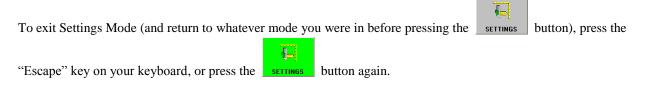
pressing the measure button would set the tool length geometry offset value for the highlighted tool # as 0.002 mm (0.005 mm - 0.003 mm = 0.002 mm).







#### 15.8.5 Exiting Settings Mode



## 15.9 Running Production

### 15.9.1 Before You Start a Production Run...

Before you start a production run, you should make sure of the following:

- Your CNC file is loaded, and you have proved the program.
- You have set the operation support function switches (Dry Run, Single Block, HandWheel Interrupt, Optional Stop and Optional Skip).
- You have set the feed override percentage and rapid override percentage to the desired settings.
- You have set the general parameters (unit of measurement, tool radius compensation, etc.) in Configuration Mode.
- You have set your Auto Plot parameters (in Configuration Mode) to the correct part size for the part program you will be running, so that your plot displays correctly.
- You have set your work coordinates.
- You have set your tool offsets.

<u>NOTE</u>: In Auto Mode, all acceleration and deceleration is performed with exponential smoothing filters. For an explanation of exponential acceleration/deceleration, see the *Reference Manual for ServoWorks CNC Parameters and Functions*.

### 15.9.2 Executing a Part Program

suspended immediately.

To start the CNC G code execution, press the code being executed is highlighted. To stop the CNC G code execution, press the stop button on the bottom toolbar. The operation will be

When you have interrupted the execution of a part program, you can continue from where you left off by pressing

the start button again. The program will start again from the current, highlighted block.

Or, you can restart the program from the beginning, which is explained in the next section.



#### 15.9.3 Rewinding the Part Program to the Beginning

At times, you may want to restart the program from the first line of code (called "rewinding"). Rewinding the program also resets the modal codes to the default modal codes, cancels the local coordinate system, and resets the Cycle Time to 0:00:00. The following steps will guide you through this process:

1)	Press the	REWIND	button on th	ne bottom toolbar.	You will see the fo	ollowing dialog box appear:
			5-1	140M	2	
			0	Are you sure that yo CNC file?	u want to rewind this	
				Ok	Cancel	
						_

Figure 15-12: Confirmation Dialog Box for Rewinding a Program

2) Click the "OK" button to confirm that you want to rewind the program. This will set the first line of your program as the current line (the line that will execute once you resume operations).

<u>NOTE</u>: If you have changed your mind about resetting, click the "Cancel" button.



#### 15.9.4 Using the Block Search Feature

#### 15.9.4.1 Overview

ServoWorks S-1\_0M provides a convenient feature in Auto Mode that allows you to find a specified N, B, T, M or L code. This block search feature is a convenient way to stop the program and change tools, for instance.

In order to use this feature, you must be in Auto Mode with Toolbar #2 displayed on the bottom (if Toolbar #1 is

displayed, select Toolbar #2 by pressing the button on the bottom toolbar). The screen should appear as follows:

Soft Servo S-140M		Machine Pos	Program Pos	Relative Pos	Servo Lag	<pre></pre>
RUN TIME	X(mm):	0000.000	0000.000	000.000	0000.002	SETTINGS
0000:01:16	Y(mm):	0000.000	0000.000	000.000	0000.002	
SPINDLE	Z(mm):	0000.000	0000.000	0000.000	0000.002	
(rpm)	A(mm):	0000.000	0000.000	0000.000	0000.002	SCREEN
0	B(mm):	0000.000	0000.000	0000.000	0000.002	
FEEDRATE	Y(mm)	Zoom Factor: 1.0000		Plot Status: Started		2
0.0	r(mm)					LOCKS
, OVERRIDE —	30.69-				- 30.69	AX
100.0 (%)	30.69-				- 50.69	
LOCKS						PLOT
	15.34-				<b>_</b> 15.34	- T
						EDIT
	0.00 -				- 0.00	
<b>B</b> <sup>F</sup>						- <b>(</b>
		0.00 28.9	2 57.85	86.77 115.7	0 X(mm)	SPINDLE
STATUS Stopped	AUTO	Cir_Abs4_3.dat	DR		T OP STP OP SKP	9
X:= Y:=	Modal		N1 G90		ime: 0 H 0 M 0 S	?)
Z: — A: —	G00	G17 G90 G94	N2 G00X300.	- Block	Search	HELP/MSG
B:━ S:━	G21 G40 G50	G49 G80 G98 G64	N3 G00X300.Y200.			
НОМЕ	G69	GE0 1	N4 G01X200F5000.	Туре:	Auto N (N#)	
X:- Y:-	T: S:	ш.	N5 G02X100.I-50. N6 G03Y100.J-50.	Start Po		RESET
Z:— A:—	M:		N7 G00Y50.Y50.	Max Blk	No. 0	T
B:=	F: 0 mm/	min	N8 G00Y0.	🗖 Rew	ind	MAIN
		💎 😯		IT RETRACE	₹   8	-8:
S. BLOCK H	NDWL INT OPT	T STOP OPT SKIP	B. SEARCH		MORE START	STOP
			Ť			
Use this button		,				
utilizing the set	tings in the "Blo	ock Search" frame	1			
	search criteria					

Figure 15-13: Auto Mode Showing the Block Search Function



#### **15.9.4.2 Block Search Type**

There are six choices for the block search type, explained as follows:

 <u>Auto N (N#)</u> – Searches for a specific automatically-generated line number (N1, N2, etc.), regardless of how the "N" code appears in that line. However, the automatic numbering scheme does take into account user specified line numbers.

For example, if the user writes the following program:

N10 G00 X10 G00 X20 N20 G00 X30

the first line will be treated as N10, the second line as N11, and the third line as N20 by the automatic numbering scheme.

- 2) <u>User-Spec N (N#)</u> Searches for a specific user-specified line number (N1, N2, etc.). These are the line numbers that are hard-coded in the G-code program, and you can see them in Auto Mode, Edit Mode, and when opening a G-code program with the Notepad application.
- 3) <u>Prgm Line No.</u> Searches for a specific program line number counting from the beginning of the G-code program. The first line has the program line number 1, the second line the program line number 2, and so on. No user-specified line numbers are taken into account (i.e. "N10" is ignored completely).
- 4) **<u>Tool No. (T#)</u>** Searches for a specific tool number in the part program (T1, T2, etc.)
- 5) <u>M-Code No. (M#)</u> Searches for a specific machine code number in the program (M01, M02, etc.).
- 6) <u>Proc. Block No.</u> Searches for a specific block number counting from when the program is started. This is similar to "Prgm Line No.," but the line count is incremented twice if the same line of code is executed twice (because of a loop, subprogram call, etc.). The count is the number of blocks that are processed after the program is started.

#### **15.9.4.3 Block Search Start Position**

The "Start Position" specifies which position to use as the program start position, in calculating the position of the search target block. There are three choices for the block search start position, explained as follows:

- 1) **Current** assumes the program was started at the current machine position
- 2) Zero assumes the program was started at machine zero
- 3) **File-Load** assumes the program was started at the machine position when the program was loaded (i.e. when the program file was opened)

Since in absolute position mode all positions are explicitly specified, the "Start Pos" parameter is usually only meaningful in incremental position mode (G91).

Example:

N1 G91 F1500 N2 G01 X10. N3 G01 X20. N4 G01 X40.



If the program was loaded at X=5mm and block search is run after jogging to X=8 mm:

Searching for block N3 using "Zero" yields the target block position X=30 mm.

Searching for block N3 using "Current" yields the target block position X=38 mm.

Searching for block N3 using "File Load" yields the target block position X=35 mm.

<u>NOTE</u>: In ServoWorks S-1\_0M, the program is unloaded when you exit Auto Mode. Hence, if you load a program in Auto Mode, exit Auto Mode, jog the X axis 5 mm forward, and reenter Auto Mode, the CNC Engine will assign a "File Load" position of X=5 mm, not X=0 mm. You will have to use the Jog Interrupt function to jog while staying in Auto Mode.

#### **15.9.4.4** Using the Block Search Function

Input your search criteria in the "Block Search" frame:

1) Select the search type from the "Type" pull-down menu.

8

START

- 2) Enter an integer in the text box at the top of the "Block Search" frame this is the number of the N, T or M code, processed block number, or program line number that you wish to search for.
- 3) Select the start position ( from the "Start Pos:" pull-down menu).
- 4) Define the end-of-search criteria by entering the maximum block number you wish to search in the "Max Blk No." text frame. This must be an integer, and it refers to an actual line number, regardless of how the "N" code appears in that line.
- 5) Specify whether or not you want the "Rewind" function to be executed prior to the block search.

To execute a block search after you have input your search criteria in the "Block Search" frame, press the **B. SEARCH** button.

A successful search results in a message stating the block number (the actual line number of the part program, regardless of how the "N" code appears in that line), the block end point, and the line of G code, as shown in the following figure:

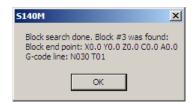


Figure 15-14: Block Search T Code Found Dialog Box

After clicking "OK" in the above dialog box, the line of code found with the Block Search function will be

highlighted. If you press the

button, the highlighted line of code (the "found" line of code) will be

**Q**1

8

executed, and then execution will stop upon reaching the block end position. If you press the start button a second time, execution of the part program will start with the next line of code, and will continue until reaching an M99 code or the end of the program.



A few notes on the block search function:

- To find "T1", you must type "1" in the text box and select "T" from the "Type" pull-down menu.
- To find "T01", you may type "1" or "01" in the text box and select "T" from the "Type" pull-down menu.
- To find "N3", you must type "3" in the text box and select "N" from the "Type" pull-down menu.
- To find "N030", you may type "30" or "030" in the text box and select "N" from the "Type" pull-down menu. But typing in "3" or "03" and selecting "N" from the "Type" pull-down menu will not return "N030" as a result.
- Any M codes that are encountered while skipping ahead to the searched block are ignored and do not affect modes, with the exception of M codes that call macro subprograms (for more information on calling macro subprograms, see *Chapter 6: Calling Macro Programs* in the *ServoWorks CNC Macro Programming Manual*).
- Any S codes that are encountered while skipping ahead to the searched block do affect the mode that is active upon starting the NC program from the searched block.
- You will be unable to start or stop the spindle using Spindle Mode after finding a block using block search but before moving to the block end point. If you must start or stop the spindle, do so before executing a block search or after moving to the block end point of the searched block.



<u>NOTE</u>: If your part program has no "N" codes in the .dat file, the lines of code will be automatically be numbered and displayed with "N" codes, starting with "N1" and increasing consecutively by one ("N1" would be the first line of code, "N2" would be the second line of code, etc.). In this case, you would type "40" to find the 40<sup>th</sup> line of code.

If the search returns no results (the specified code wasn't found in the current part program), the following error message is displayed:



Figure 15-15: Block Search Failed Message



### **15.9.5 Using the Jog Interrupt Function**

ServoWorks S-1\_0M provides a convenient feature in Auto Mode that allows you to interrupt the execution of a G code program and use the Jog Incremental function without leaving Auto Mode. This feature is a convenient way to stop the program and change tools, for instance.

In order to use this feature, you must be in Auto Mode with Toolbar #2 displayed on the bottom (if Toolbar #1 is

				JOG INT	
displayed, select Toolbar #2 by pressing the	MORE	button on the bottom toolbar).	Press the		button,
and the screen should appear as follows:					

SETTINGS SCREEN LOCKS PLOT
SCREEN SCREEN LOCKS LOCKS PLOT
SCREEN SCREEN LOCKS LOCKS PLOT
SCREEN
LOCKS LOCKS PLOT
PLOT
PLOT
PLOT
<b>T</b>
EDIT
<b>(</b>
3
SPINDLE
?)
HELP/MSG
RESET
MAIN
-8- stop

#### Figure 15-16: Auto Mode Showing the Jog Interrupt Function

The basic steps for using the Jog Interrupt function are as follows:



1) Make sure you are in Auto Mode with Toolbar #2 displayed on the bottom (if Toolbar #1 is displayed,

	select Toolbar #2 by pressing the button on the bottom toolbar).
2)	Press the button.
3)	Use the pull-down menu in the "JOG INT" frame to specify the axis you wish to move.
4)	Control the specified axis by using the FWD button to move that axis in the forward direction, or use the BWD button to move that axis in the backward direction.
5)	Press the button again to complete the Jog Interrupt function, and return to regular Auto Mode.

### 15.9.6 Using the Retrace Function

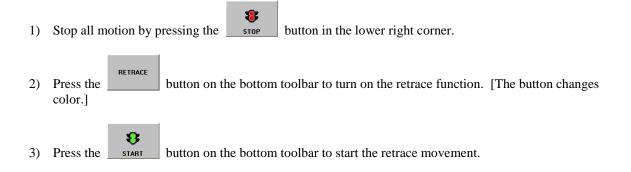
The retrace function provides a convenient way to run your G code program in reverse, to jog backwards along the path. This is convenient when, due to an unstable plasma emission process or uncertain workpiece thickness, for instance, some part of the piece was left uncut. The operator is able to run the axes in reverse (without cutting), and then repeat the forward execution of the G code program again to cut a second time.

The number of retracing steps is hard coded and fixed as 200 steps. If less than 200 steps have been executed prior to the retrace function, then less than 200 steps will be retraced. Only 200 steps are kept in the buffer, so upon completion of the retrace function, no further retracing is possible. (i.e. You can't perform a second, consecutive retrace function in order to retrace 400 steps.)

The retrace function maintains the same feedrate in retrace as the feedrate that was programmed for the original, forward execution.

<u>NOTE</u>: DLACC must be turned off during G code execution in order for retrace to be possible.

The basic steps for using the retrace function are as follows:





RETRACE 4) When the retrace movement has completed, press the button again to turn OFF the retrace 8 function. [Alternatively, you can interrupt the retrace function by pressing the STOP button before the RETRACE retrace function retraces all 200 blocks, THEN press the button again to turn OFF the retrace function. 8 button again to start normal, forward execution of the G code program. 5) Press the

## 15.10 Exiting Auto Mode

START

<u>A</u>r button on the right toolbar or press the "Escape" key on your keyboard. If To exit Auto Mode, press the MAIN you had used Auto Mode to run a part program file, you will see the following dialog box appear:

5-14	юм		x			
0	Are you sure you want to quit Auto mode?					
	Ok	Cancel				

Figure 15-17: Confirmation Dialog Box for Exiting Auto Mode

Press the "OK" button to confirm that you want to exit Auto Mode. If you have changed your mind about exiting Auto Mode, press the "Cancel" button.



## Chapter 16: Exiting ServoWorks S-100M/S-120M/S-140M

## 16.1 Exiting from Main Mode

To exit ServoWorks S-1\_0M, you can press the button from the Main window (Main Mode). If you are already in Main Mode, the button will be available (in the lower right corner).

Alternatively, you can press the "Escape" key on your keyboard (if you are using a keyboard).

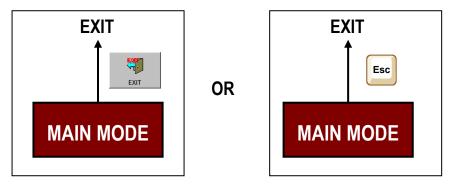


Figure 16-1: Exiting from Main Mode

When you give the command to exit, a dialog box will appear, as shown in the following figure. Click the "OK" button to exit, or click the "Cancel" button if you decide that you don't want to exit.

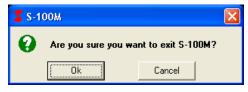
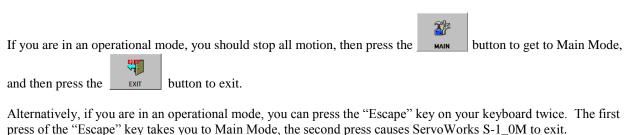


Figure 16-2: Dialog Box to Confirm Exiting ServoWorks S-100M



# 16.2 Exiting from an Operational Mode



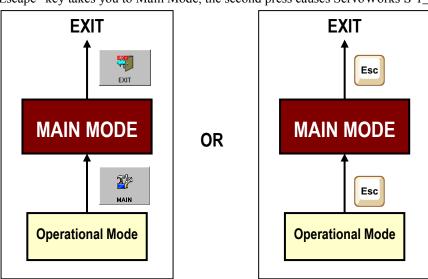


Figure 16-3: Exiting from an Operational Mode

When you give the command to exit, a dialog box will appear, as shown in Figure 16-2. Click the "OK" button to exit, or click the "Cancel" button if you decide that you don't want to exit.



**4** 

EXIT

# 16.3 Exiting from a Sub Mode

# 16.3.1 If You Entered the Sub Mode From Main Mode

ř

You can press the **MAIN** button or press the sub button again to get to Main Mode, and then press the button to exit ServoWorks S-1\_0M.

Alternatively, you can press the "Escape" key on your keyboard twice. The first press of the "Escape" key takes you to Main Mode, the second press causes ServoWorks S-1\_0M to exit.

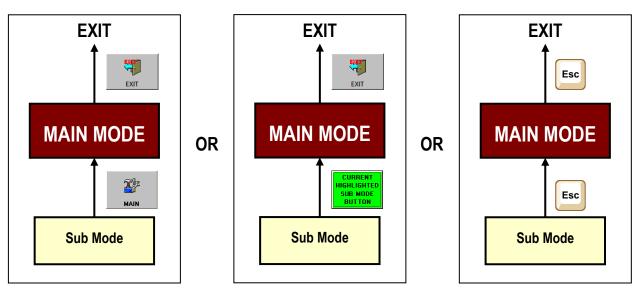


Figure 16-4: Exiting from a Sub Mode That Was Entered from Main Mode

When you give the command to exit, a dialog box will appear, as shown in Figure 16-2. Click the "OK" button to exit, or click the "Cancel" button if you decide that you don't want to exit.



# 16.3.2 If You Entered the Sub Mode From An Operational Mode



You must make sure no motion is occurring, then press the \_\_\_\_\_button to get to Main Mode, and then press the



button to exit ServoWorks S-1\_0M.

Alternatively, you can press the "Escape" key on your keyboard three times. The first press of the "Escape" key takes you to the operational mode from which you entered the sub mode; the second press of the "Escape" key takes you to Main Mode; and the third press causes ServoWorks S-1\_0M to exit.

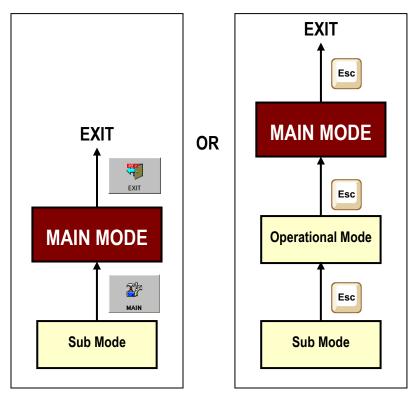


Figure 16-5: Exiting from a Sub Mode That Was Entered from an Operational Mode

When you give the command to exit, a dialog box will appear, as shown in Figure 16-2. Click the "OK" button to exit, or click the "Cancel" button if you decide that you don't want to exit.



# 16.4 LadderWorks Console Automatically Shutting Down

If LadderWorks Console is running while ServoWorks S-1\_0M is running, closing ServoWorks S-1\_0M will require the LadderWorks Console application to close, due to the need to stop the IntervalZero RTX real-time extension.

You will see a dialog box similar to the following:

Save	$\mathbf{X}$			
S-140Mv284 has closed. LadderWorks Console must be closed. Do you want to save the changes?				
Yes	No			

Figure 16-6: LadderWorks Console Automatic Closing Dialog Box

This affords you the opportunity to save any changes to your PLC sequence program before the LadderWorks Console shuts down.



# Chapter 17: Troubleshooting

# 17.1 Resetting ServoWorks S-100M/S-120M/S-140M

While using ServoWorks S-1\_0M, it is possible that you may come across some problems. Use the RESET button if the computer behaves unexpectedly. The RESET button does the following: • Resets all variables back to their default values.

- Clears memory, clears internal control flags or status, clears alarms (and alarm signals).
- If the spindle is running before you press the **RESET** button, then the spindle will be stopped.

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# 17.2 Using the Flight Recorder for Debugging

# 17.2.1 Overview of the Flight Recorder

ServoWorks S-1\_0M provides a flight recorder function to use in debugging, and determining why an Emergency Stop has occurred. The flight recorder is used to recover valuable information from the ServoWorks CNC Engine in the case of hardware failure. From this information, the operation and status of the machine immediately before failure can be obtained and used to determine the cause of failure.

# 17.2.2 Parameters Related to the Flight Recorder

You are able to choose whether or not to trigger the flight recorder in the case of an E-STOP, and you can select between two options for flight recorder operation.

There are three options related to the flight recorder in the "General" parameters screen of Configuration Mode (shown in Figure 3-1), in the "Flight Recorder Data Sampling" frame (see *Section 3.3: General Parameters*). The three options for "Save sampled data upon E-Stop" are as follows:

- 1) "No" the flight recorder feature will be turned off.
- 2) "Save All" the flight recorder will save all the types of data that the flight recorder feature is able to process, for a period of 20 seconds before failure (see Table 17-1).
- 3) "Save Extended Pos" the flight recorder will save only the command and feedback positions, but the information is saved over an extended period before the failure compared to the "Save All" option (100 seconds as compared to 10 seconds for the "Save All" option.

[<u>NOTE</u>: In order to use the Flight Recorder, you must select options #2 or #3 in the "Flight Recorder Data Sampling" frame.]



# 17.2.3 How is the Flight Recorder Triggered?

When an Emergency Stop is triggered (and option #2 or option #3 are selected) in the "Flight Recorder Data Sampling" frame), ServoWorks S-1\_0M's flight recorder will save the last 20 or 100 seconds of data (prior to the Emergency Stop) to the hard drive. If you want to intentionally trigger the flight recorder to obtained detailed information from the ServoWorks CNC Engine, you can trigger an E-STOP exactly when you want by using the PLC sequence program to assign the E-STOP signal to a manual input.

You will see the message shown in the following figure while the flight recorder data is being saved [<u>NOTE</u>: the computer may feel "frozen" while this data is saving.]

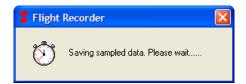
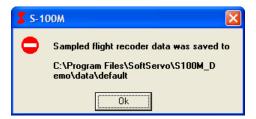


Figure 17-1: Flight Recorder Saving Dialog Box

When the data has saved to a file on the hard drive, the following dialog box will appear:



**Figure 17-2: Flight Data File Information Dialog Box** 

This dialog box tells you the name and location of the folder with the saved data files, as shown:

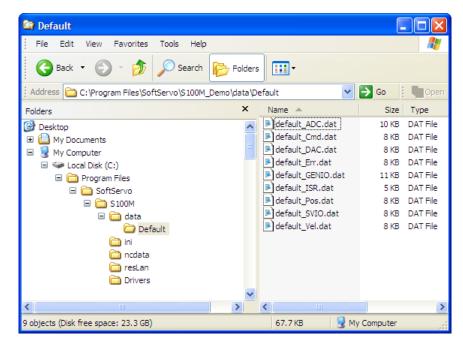


Figure 17-3: Flight Recorder Files in Default Data Folder



The files are saved in the folder "[file path]\data\default," where [file path] is the path address of the program (such as "S140M"). The files typically require 11 MB of disk space.

# 17.2.4 Information Saved by the Flight Recorder

The flight recorder saves information in nine files, described in Table 17-1, for the last 20 or 100 seconds of operation prior to an E-STOP. The information in each file is organized into a table, with the time denoted by the number of ISR (interrupt service routine) counts since the ServoWorks S-1\_0M program was started. Data samples are taken once every ISR count. For an ISR of 1 millisecond (like the VersioBus II interface system), this results in 20,000 or 1,000,000 values for each data type (depending on whether "Save All" or "Save Extended Pos" is selected).

These files can be sent to Soft Servo Systems, Inc. for debugging.

For position-related flight recorder outputs, the data from each axis is organized into a separate column (see Table 17-2). Please note the differences in axis numbers between the flight recorder data files and the ServoWorks S-1\_0M GUI display. Axis #7 in the ServoWorks S-1\_0M is in the column labeled "Axis 8" in the flight recorder files, for example.

<u>NOTE</u>: While ServoWorks S-1\_0M displays zero at the home position after the home shift, the flight recorder displays zero at the home position *before* the home shift. Thus, if the home shift is set to 1.000 mm, and the flight recorder is triggered after homing and executing "G00X10," the position data will read 1000 (= 1.000 mm) after the homing procedure and 11000 (= 11.000 mm) after the execution of "G00X10."



File Name	Data Type	Notes	Included for "Save All" Setting?	Included for "Save Extended Pos" Setting?
default_ADC.dat	analog to digital conversion (ADC)	Unused (always 0).	V	
default_Cmd.dat	position command data	The machine position based on commands sent from the ServoWorks CNC Engine to the motors. The distance units are in micrometers (1000 $\mu$ m to 1 mm; around 25400 $\mu$ m to 1 inch).	✓	✓
default_DAC.dat	digital to analog conversion (DAC)	Commands sent from the ServoWorks CNC Engine to the motors.	$\checkmark$	
default_Err.dat	position error	The difference between the machine positions of default_Pos and default_Cmd.	$\checkmark$	
default_GENIO.dat	general I/O values	General hardware I/O status.	$\checkmark$	
default_ISR.dat	the interrupt service routine (ISR)	Interrupt service routine duration, interval, abnormal samples log, and activity log.	$\checkmark$	
default_Pos.dat	position feedback (actual position)	The machine position based on the feedback from the servo amplifiers. The distance units are in micrometers (1000 $\mu$ m to 1 mm; around 25400 $\mu$ m to 1 inch).	✓	✓
default_SVIO.dat	servo I/O values	Servo amplifier and handwheel I/O status.	$\checkmark$	
default_Vel.dat	velocity	The machine velocity based on the feedback from the servo amplifiers. The velocity units are in mm/min.	$\checkmark$	

Table 17-1: Files and Data Saved by the Flight Recorder



Axis Number Used in Flight Recorder Files	Axis Name Used in ServoWorks S-1_0M
Axis 1	Axis 1
Axis 2	Axis 2
Axis 3	Axis 3
Axis 4	Spindle Axis
Axis 5	Axis 4
Axis 6	Axis 5
Axis 7	Axis 6
Axis 8	Axis 7

# Table 17-2: Relationship Between Axis Numbers Used in Flight Recorder Files and Axis Numbers Used by ServoWorks S-1\_0M

A sample data file for the ISR follows:

📕 default_ISR.dat -	Notepad		×		
File Edit Format View	Help				
ISR Counter 62 63 64 65 66 67 68 69 70	ISR Duration 42.000 27.600 31.900 22.700 21.000 24.400 19.300 21.800 19.300	0.000 1979.100 2000.800 1998.300			
141 142	25.100 33.600				
Abnormal ISR samples: ISR Count: 1 Last Duration: 9102203931328512.000 Interval: 3430447019196416.000					
VersioBus DC module timeout: None					
VersioBus IM module timeout: None					
Activity History Records: ISR[0]: Code 0x5000000 - Set servo status, AxisNum = 0, StatusCommand = 0 ISR[0]: Code 0x3000001 - Interrupt start. ISR[62]: Code 0xf000001 - PLC E-Stop on. ISR[62]: Code 0x7000000 - Set Jog stop. ISR[62]: Code 0x8000000 - Set Rapid stop. ISR[62]: Code 0x1000201 - E-Stop on, EStopMask = 0x2. End of Activity History Records.					

Figure 17-4: Sample default\_ISR.dat File



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# Index

(	
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(N#), 15-22	B. SEA
(T#), 15-22	backing
	backlas
/	backtra
/ 12 ( 15 0	block d
/, 12-6, 15-8	block s
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