Soft Servo
SYSTEMS, INC

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

Revision 1.72

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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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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.

NOTE: 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*

Select the appropriate document(s) for your 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

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*
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 # (1-8)	VersioBus II Interface System		Axis Type	Typical Axis Name	Alternate Naming Scheme (Example)
	DC-155 #	Axis Connector #			
1	1	1	Servo	X[1]	A[1]
2	1	2	Servo	Y[1]	B[1]
3	1	3	Servo	Z[1]	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]	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 Notes 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 # (1-8)	VersioBus II Interface System		Axis Type	Typical Axis Name	Alternate Naming Scheme (Example)
	DC-155 #	Axis Connector #			
1	1	1	Servo	X[1]	A[1]
2	1	2	Servo	Y[1]	B[1]
3	1	3	Servo	Z[1]	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]	Y[1]
6	2	2	Servo	B[1]	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 Notes 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:

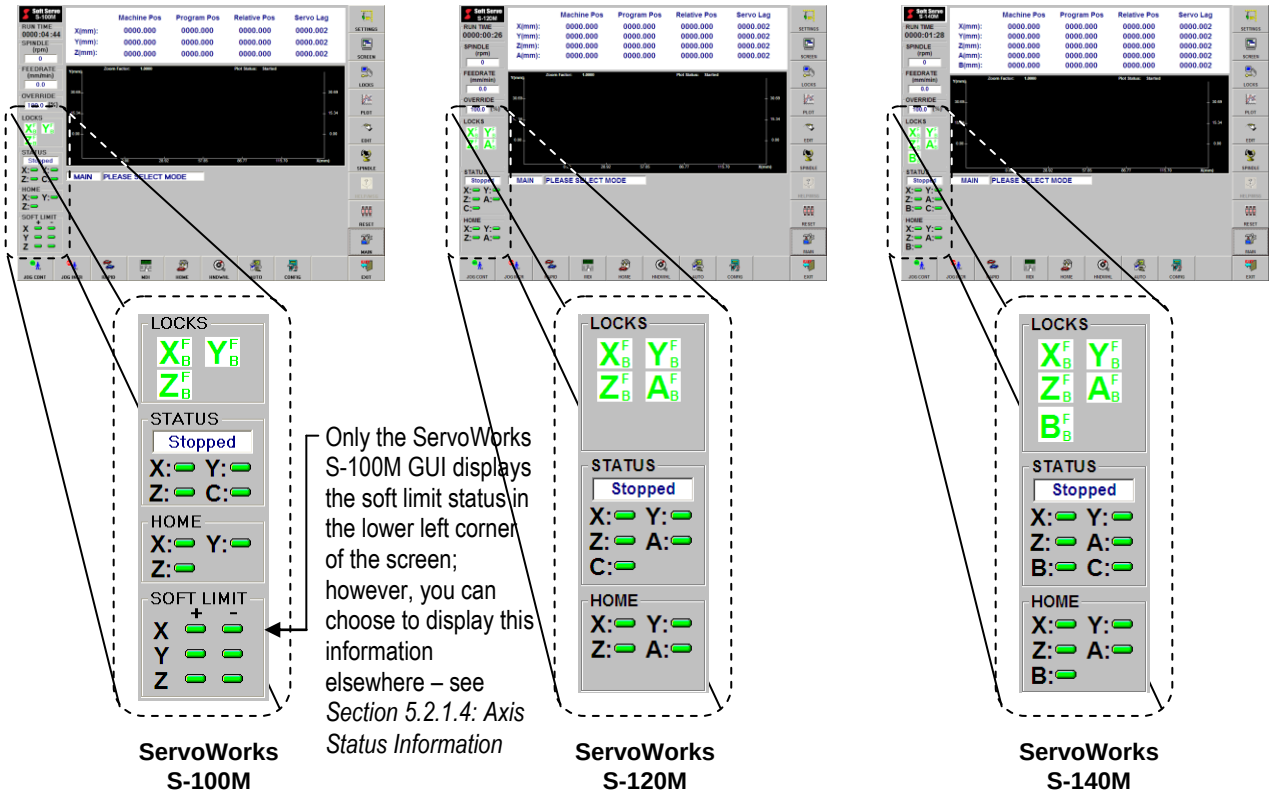


Figure 1-1: Differences Between ServoWorks S-100M, S-120M and S-140M GUIs

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.

2) **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) **Program Verification / Testing**. 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 

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.

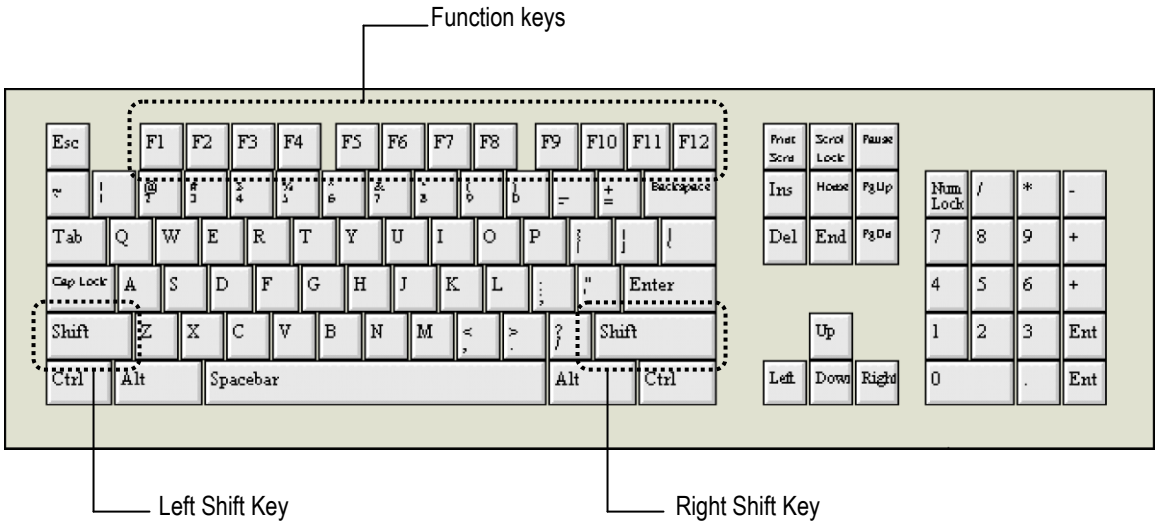


Figure 1-2: Keys Used to Selecting Toolbar Buttons – Typical QWERTY Keyboard

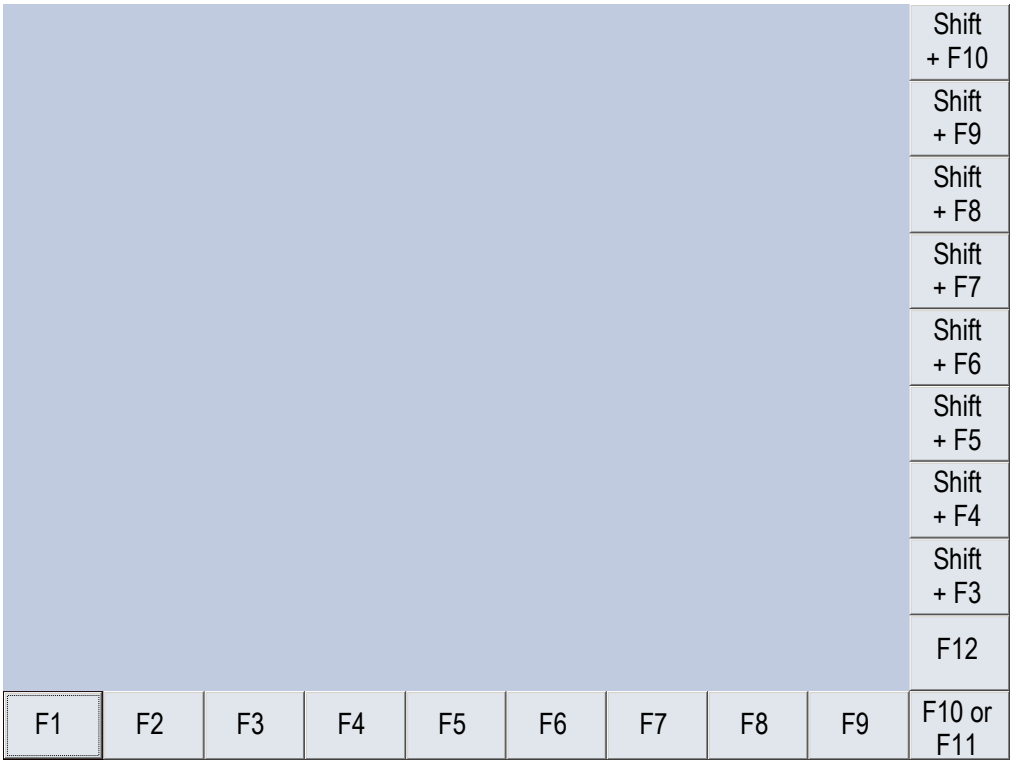


Figure 1-3: Keyboard Shortcuts for Selecting Toolbar Buttons

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 (S100M , S120M or S140M) 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 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).

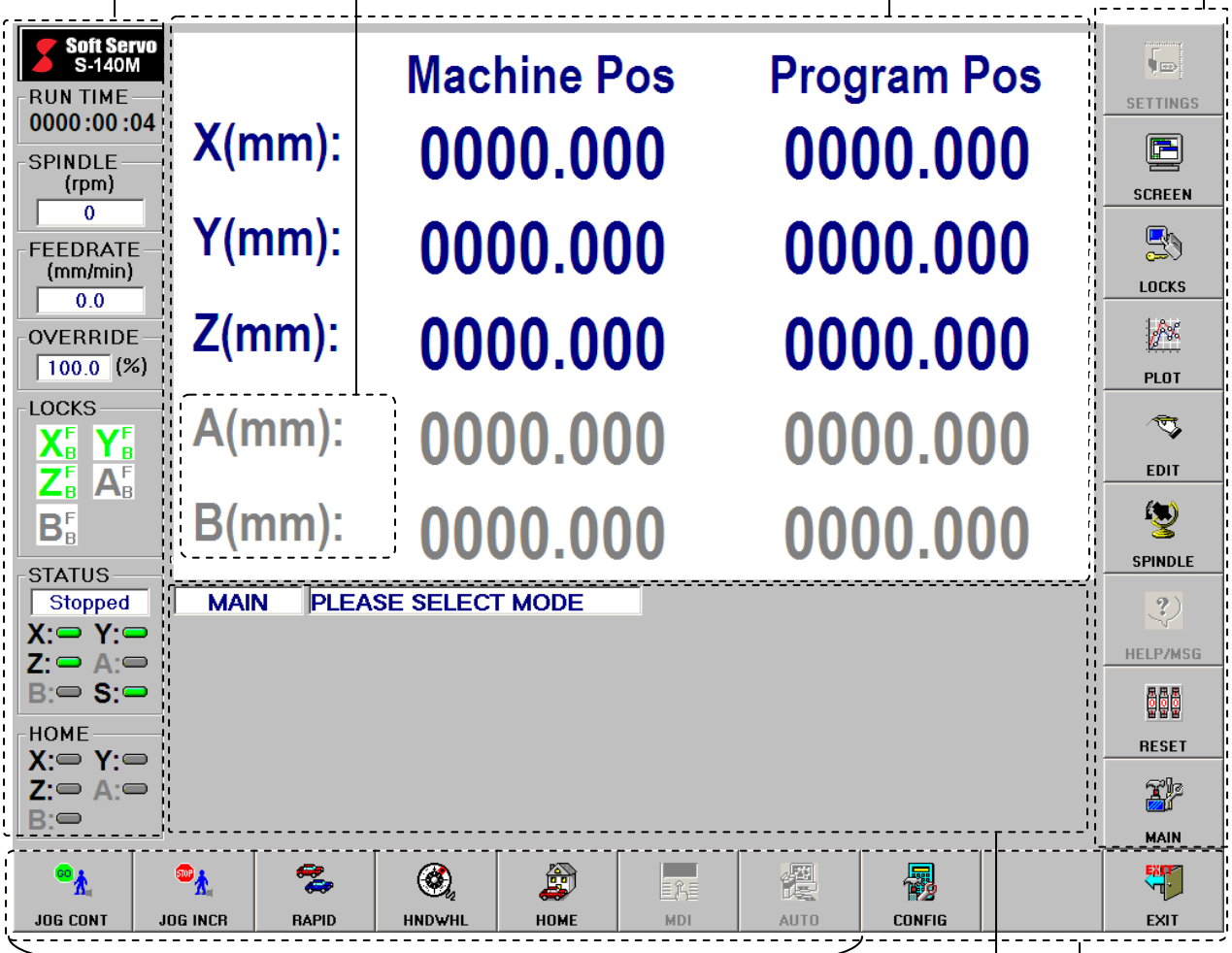
Once ServoWorks S-1_0M is started, you will see the Main Window. The Main Window of ServoWorks S-140M is shown in Figure 2-2; the Main Windows of ServoWorks S-100M and ServoWorks S-120M are similar.

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)

NOTE: Axis A is only available in ServoWorks S-120M or S-140M; Axis B is only available in ServoWorks S-140M



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

Figure 2-2: The Main Window of ServoWorks S-140M

NOTE: 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:

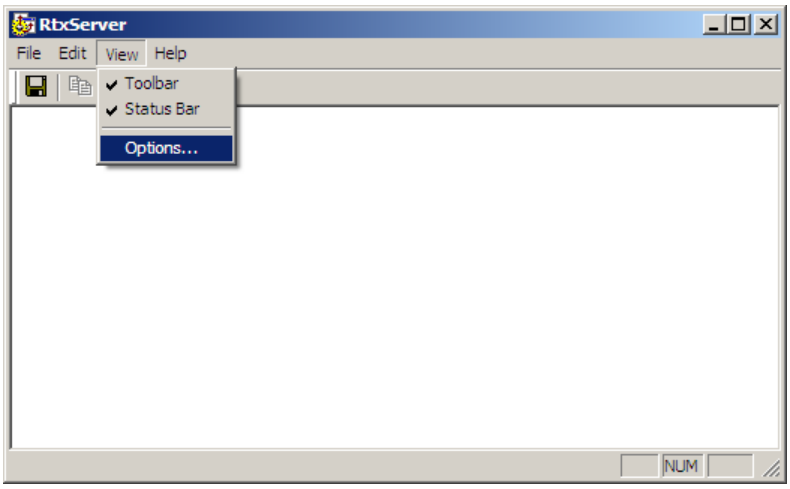


Figure 2-3: RtxServer Window – Options Pull-Down Menu

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

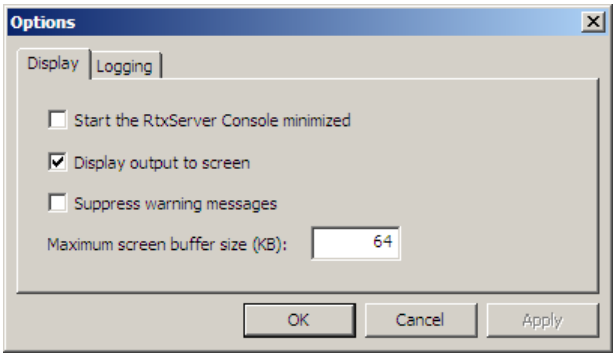


Figure 2-4: Options Window (1 of 2)

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:

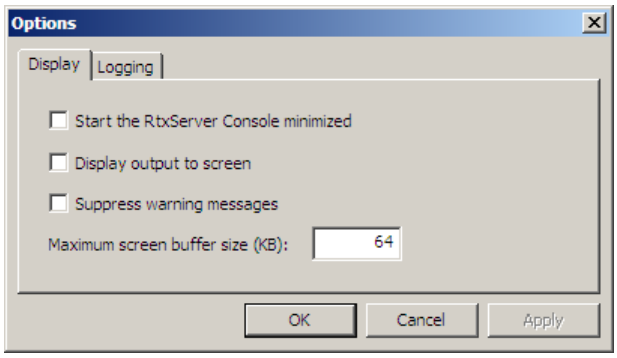


Figure 2-5: Options Window (2 of 2)

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 

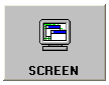
button or the "Escape" key on your keyboard while in Main Mode will cause you to exit ServoWorks S-1_0M (after the program prompts you to make certain that you *want* to exit the program).

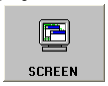
2) **Operational Modes** – control modes that can be entered only from Main Mode. These include six manual NC modes (Jog Continuous Mode, Jog Incremental Mode, Rapid Mode, MDI Mode, Home Mode and Handwheel Mode), Auto Mode (for automatic NC control) and Configuration Mode (for changing system parameters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

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 

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:

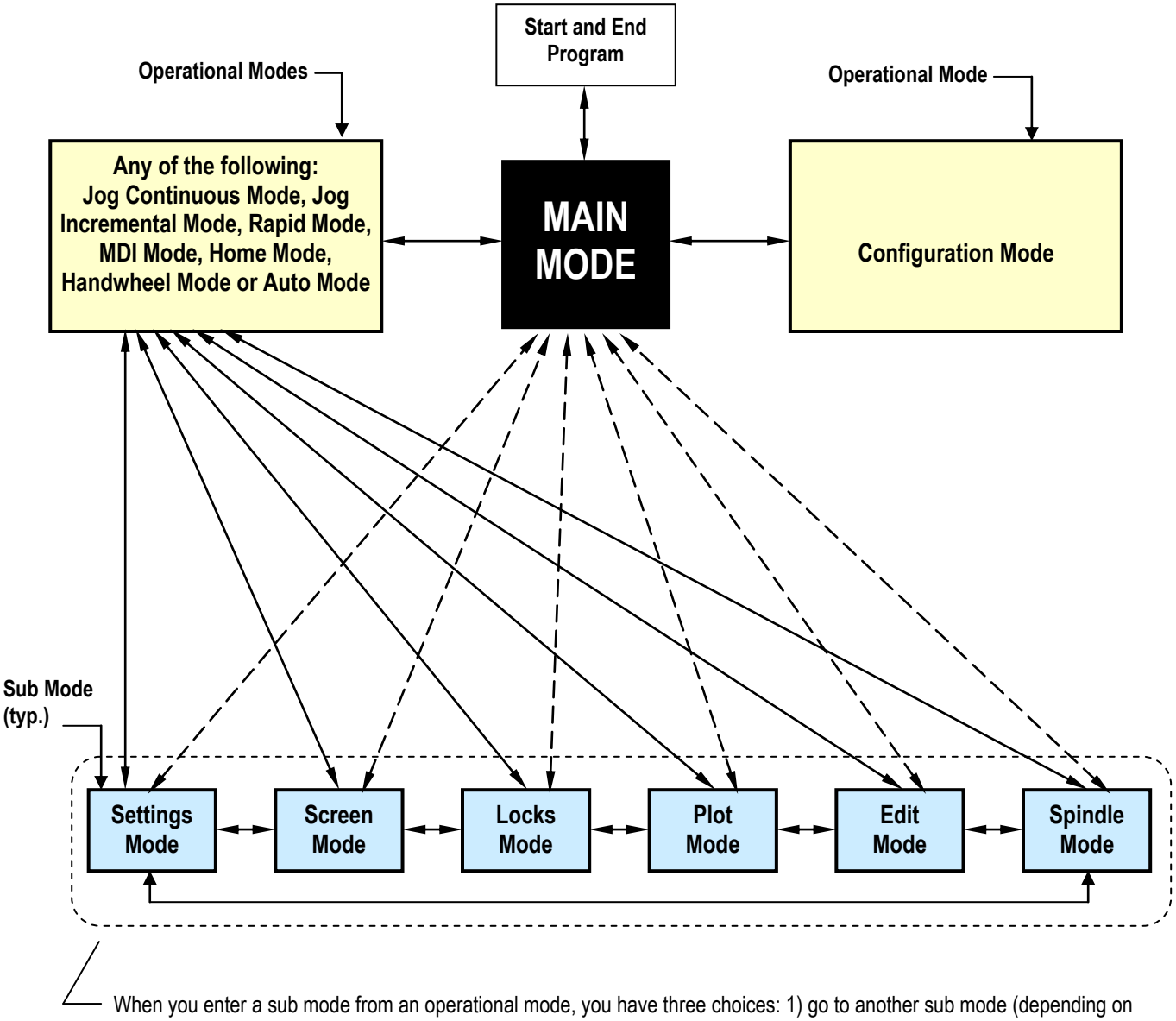


Figure 2-6: Flow Chart for Navigating Control Modes – Option #1: Entering an Operational Mode from Main Mode

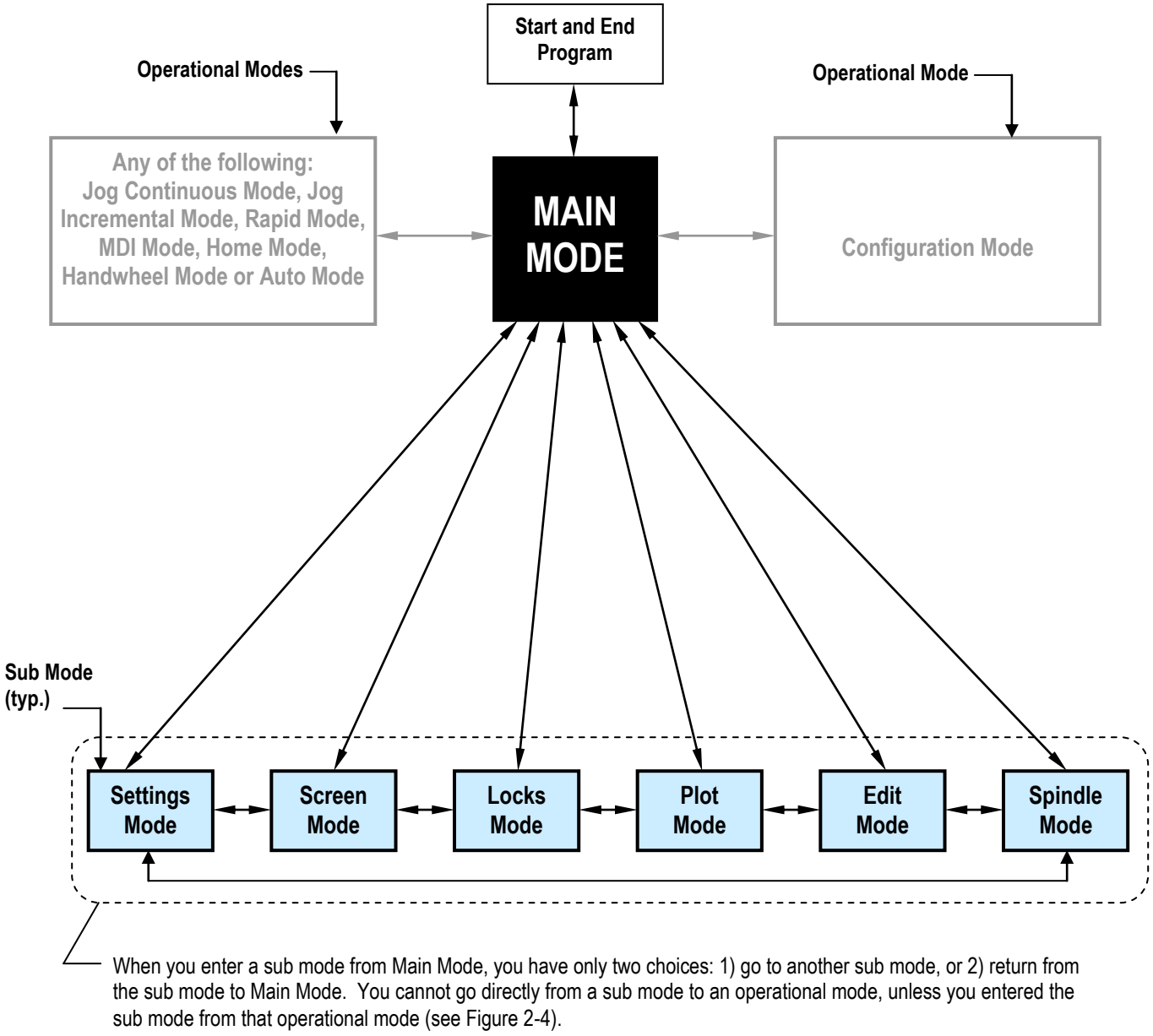


Figure 2-7: Flow Chart for Navigating Control Modes – Option #2: Entering a Sub Mode from Main Mode

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:

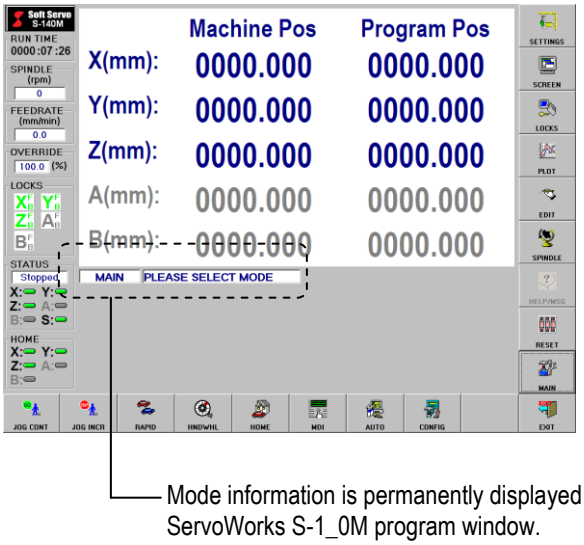


Figure 2-8: Mode Information Displayed in ServoWorks S-1_0M

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 CONFIG 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:

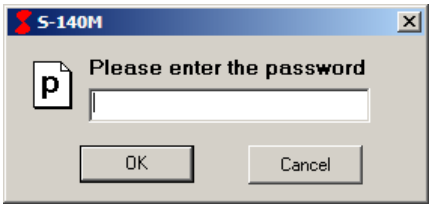
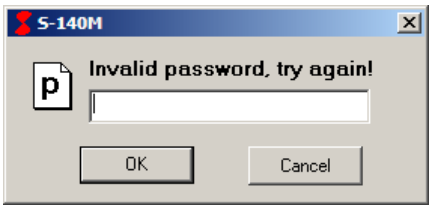


Figure 2-9: The Password Prompt Window

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*.

⚠ CAUTION

NOTE: Passwords are case sensitive, so if you type "SoftServo" in the text box instead of "softservo," you will get the following message:



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

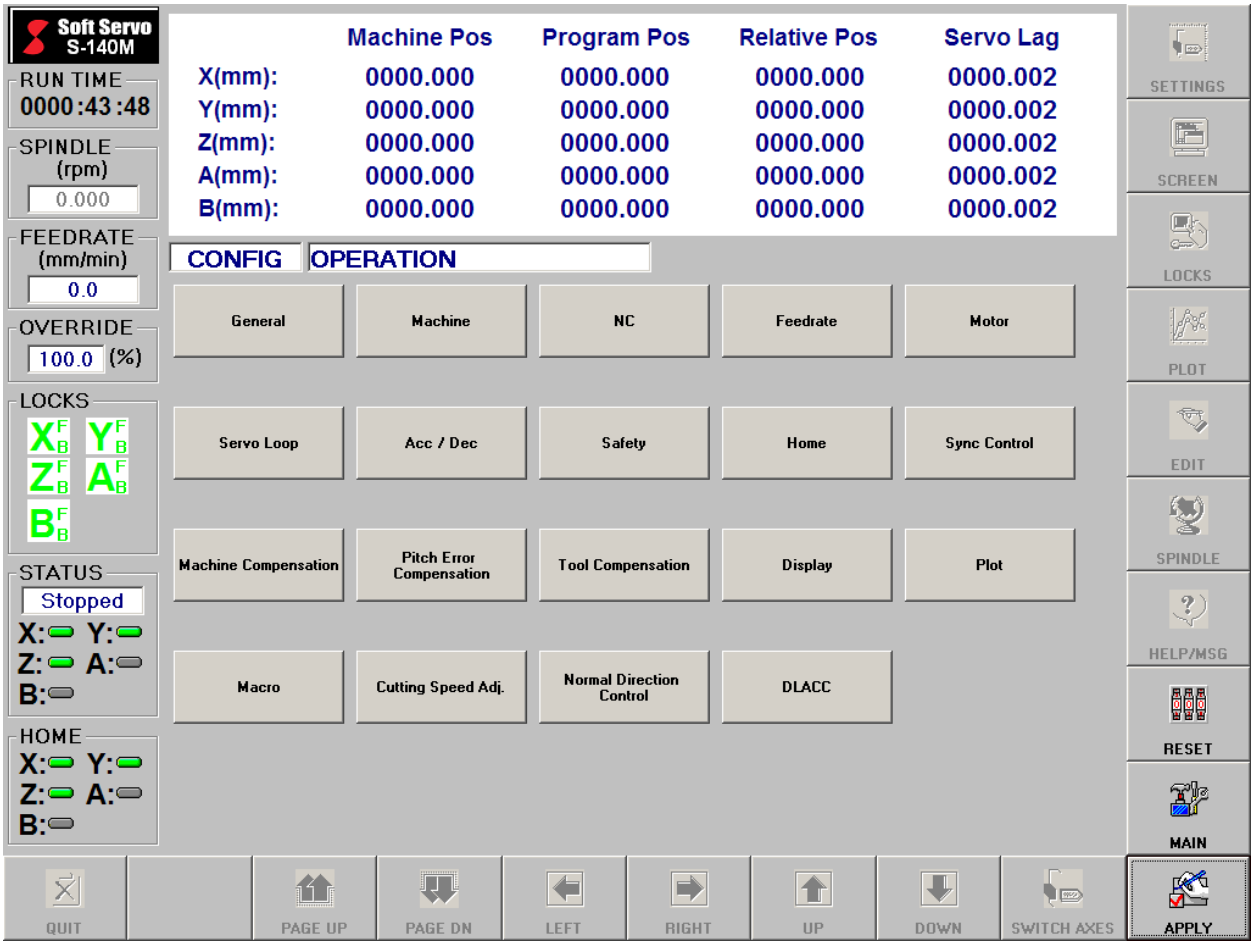


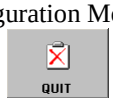
Figure 2-10: Configuration Mode – Main Screen

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 

button on the bottom toolbar (this saves your changes into a registry file in the operating system).

> **⚠ CAUTION**
>
> Be careful: if you exit Configuration Mode without pressing the 
>
> button, all of your changes will be lost, and you may or may not realize that your changes have not been saved.

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 

button.

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 

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 the following figure:

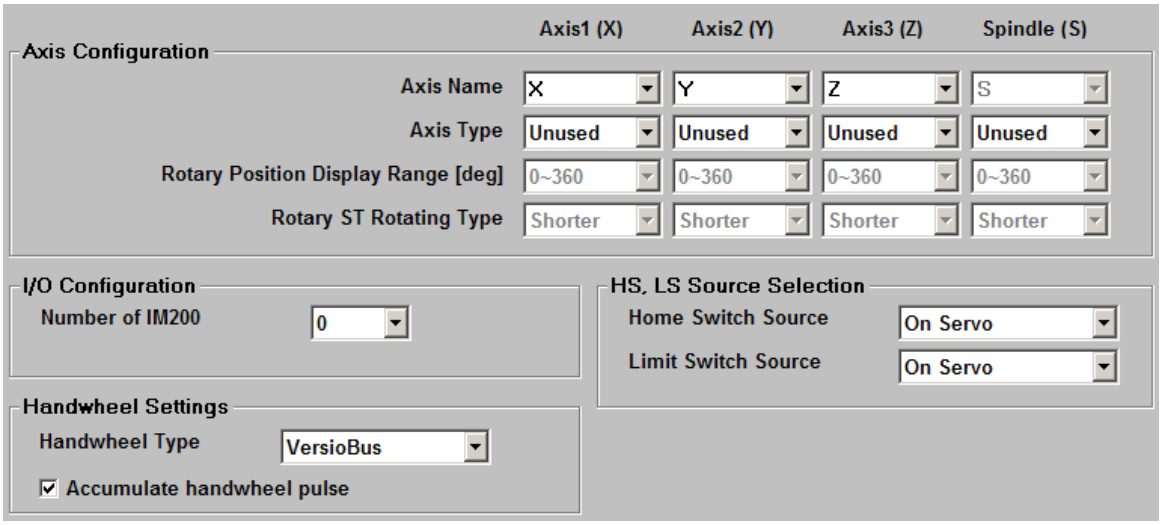


Figure 2-11: Configuration Mode – Machine Parameters Screen

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 

button to switch to additional axes not displayed on the first screen.

4) Press the 

button on the bottom toolbar.

5) Press the 

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.

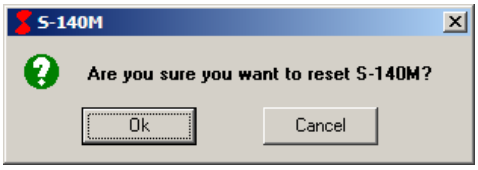


Figure 2-12: Confirmation Dialog Box for Resetting ServoWorks S-1_0M

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:

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.

2) Select the "Machine" screen by clicking on the Machine button. The "Machine" parameters screen displays parameters related to machine configuration for all axes, and is shown in Figure 2-11.

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:

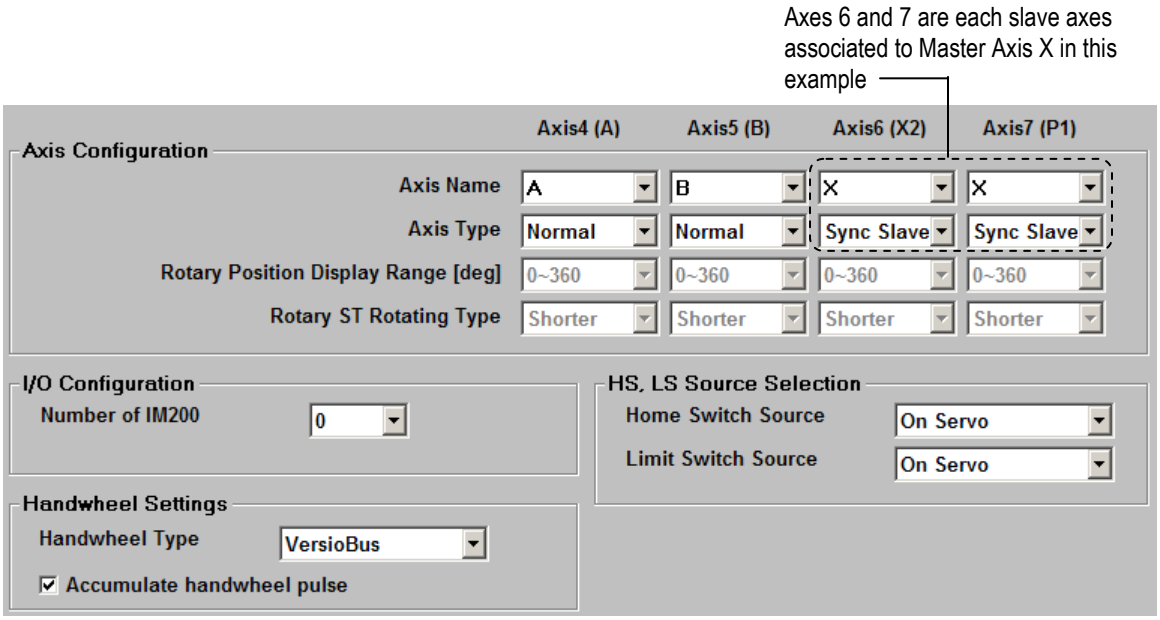


Figure 2-13: Configuration Mode – Machine Parameters Screen – Showing Synchronous Slave Axes

4) For each slave axis, set the "Axis Type" to "Sync Slave", and 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 the 

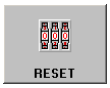
button on the bottom toolbar again.

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 

button in ServoWorks S-120M/140M is pressed.

   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 

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

NOTE: 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 (S120M or S140M) on your desktop for 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.

   b) Select the "Machine" screen by clicking on the Machine 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 APPLY 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.

   f) Press the QUIT button to return to the main screen of Configuration Mode, shown in Figure 2-10.

   g) Click on the Motor button. The following screen will appear:

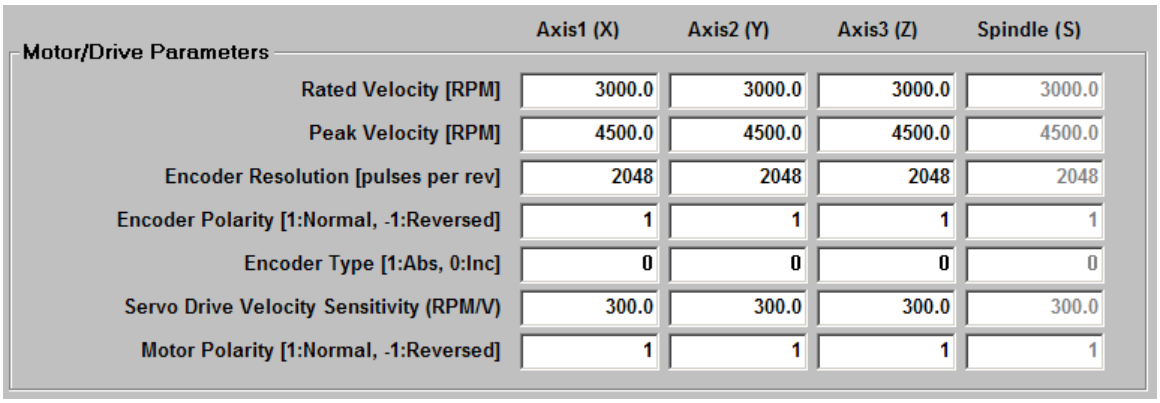


Figure 2-14: Configuration Mode – Motor Parameters Screen

h) For all axes that have absolute encoders, set the "Encoder Type" to "1." Use the 

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.

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:

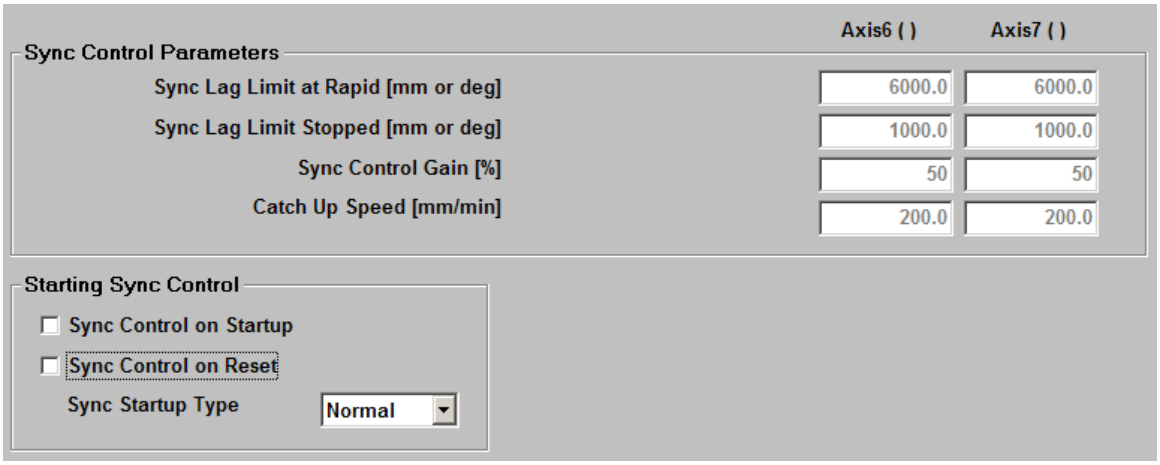


Figure 2-15: Configuration Mode – Sync Control Parameters Screen

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.]

a) Press the 

button to get to Main Mode, and then press the 

button to exit. A dialog box will appear, as shown in the following figure:

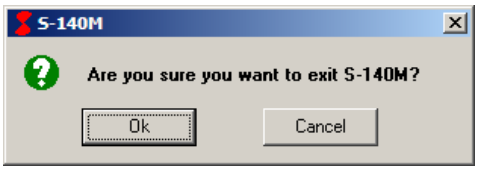


Figure 2-16: Dialog Box to Confirm Exiting ServoWorks S-140M

b) Click the "OK" button to exit.

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:

a) Get into Configuration Mode by pressing the 

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. The Home screen will appear, as shown in the following figure:

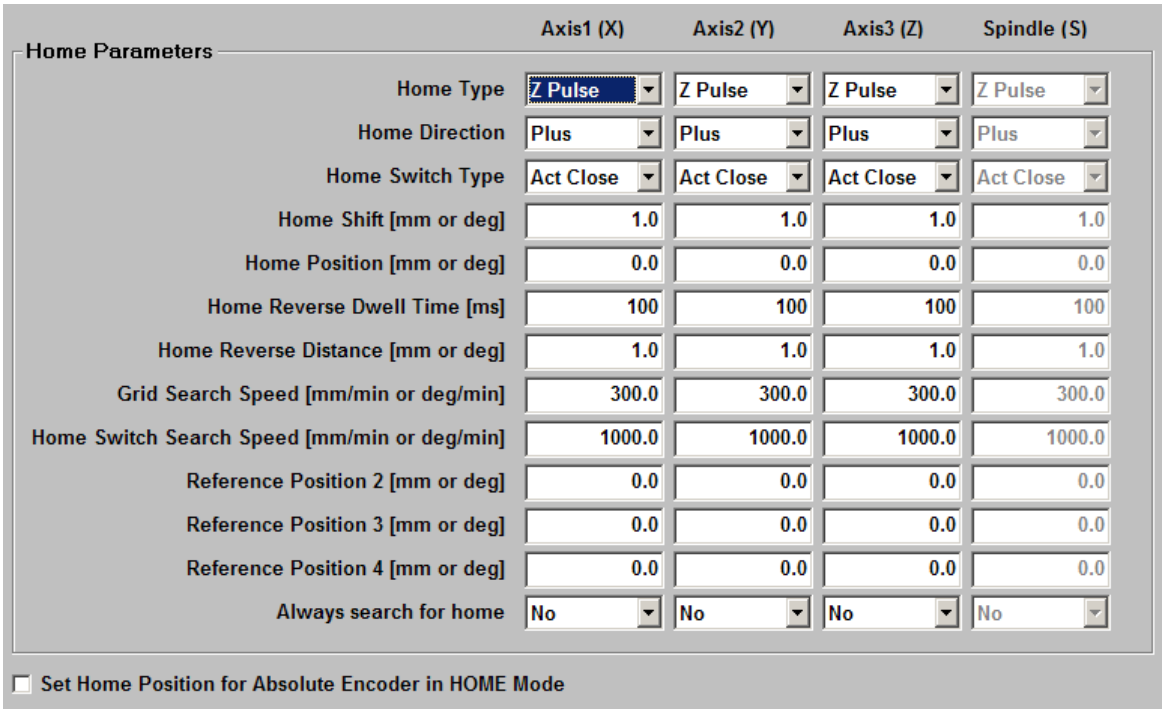


Figure 2-17: Configuration Mode – Home Parameters Screen

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

d) Exit Configuration Mode by pressing the MAIN 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.

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):

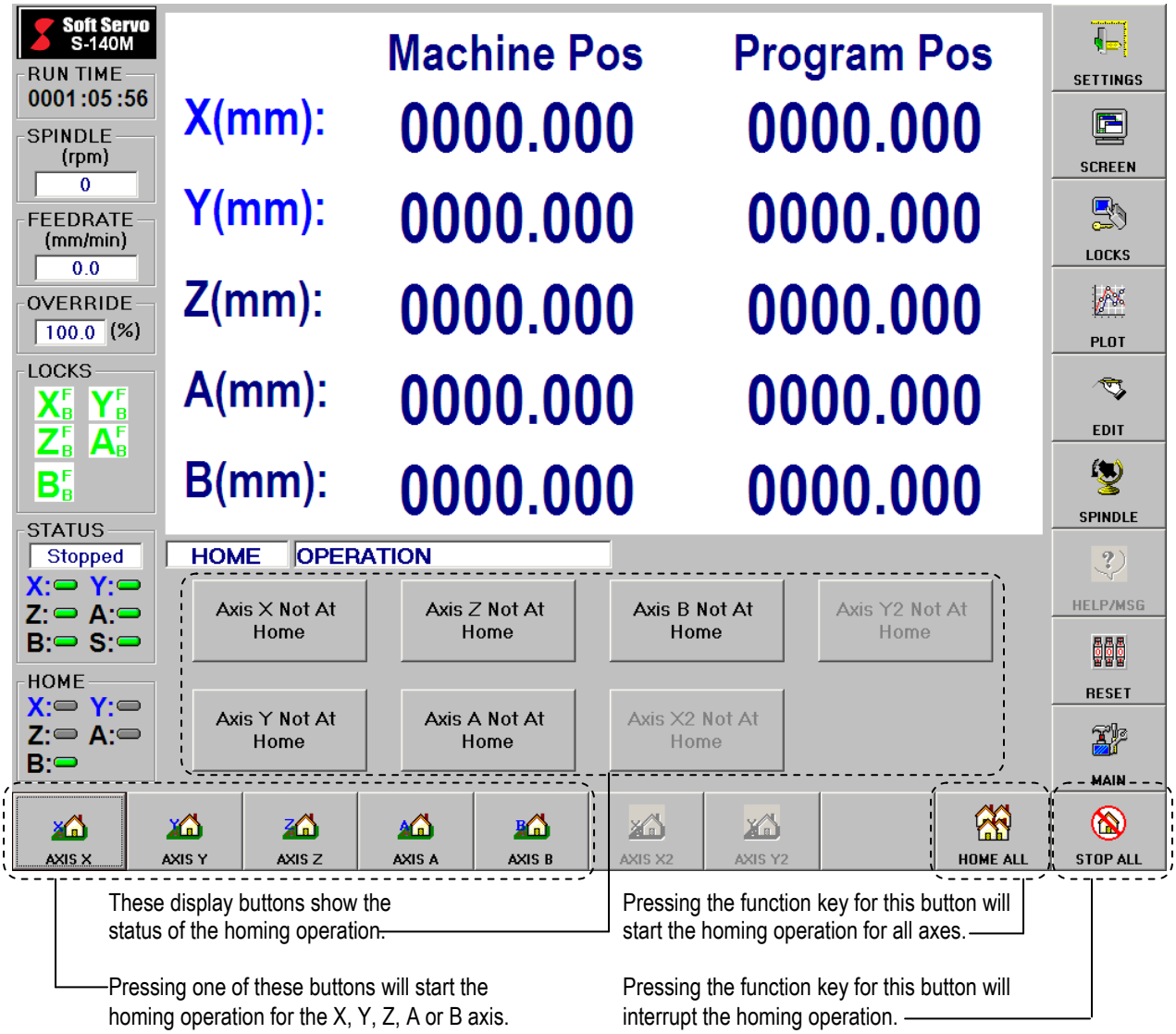
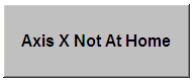
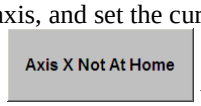
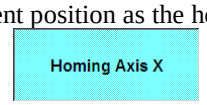


Figure 2-18: The Home Mode Window

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 

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

button). For axes with absolute encoders, this will establish the coordinate system for that axis, and set the current position as the home position. You will see the display button change from 

to 

, and then 

. Axis X will then be at the home position. Reference position parameters will be saved in the Windows registry.

NOTE: 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 

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. 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 

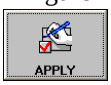
button on the bottom toolbar.

d) Press the 

button to return to the main screen of Configuration Mode, shown in Figure 2-10.

e) Click on the 

button. A Sync Control screen will appear, as shown in Figure 2-15.

f) CHECK () both "Sync Control on Startup" and "Sync Control on Reset." Click the 

button on the bottom toolbar.

6) Exit ServoWorks S-120M/140M by pressing the 

button to get to Main Mode, and then pressing the 

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

⚠ CAUTION

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.

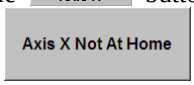
The homing procedure varies depending upon whether or not you are using absolute encoders in your ServoWorks S-1_0M system.

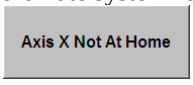
2.5.2 The Homing Procedure for a System with No Absolute Encoders

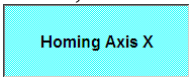
To set the home position of an individual axis or of all axes, you must be in Home Mode (an operational mode that you can access only from Main Mode). To enter Home Mode, press the 

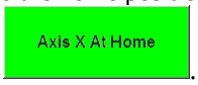
button on the bottom toolbar in the Main Window of ServoWorks S-1_0M. (You can only enter Home Mode from Main Mode.) You will see the window shown in Figure 2-18 appear for ServoWorks S-140M (and similar windows appear for ServoWorks S-100M and ServoWorks S-120M).

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

to 

, and then 

. Axis X will then be at 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 

button in the lower right corner.

At any point during the homing operation, you can press the 

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 (

, 

or 

) 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:

   a) Get into Configuration Mode by pressing the 

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 S-140M, use the 

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) CHECK () "Set Home Position for Absolute Encoder in HOME Mode," and click the 

button on the bottom toolbar.

3) Exit ServoWorks S-1_0M:

a) Press the 

button to get to Main Mode, and then press the 

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.

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*.]

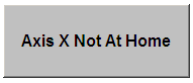
6) Set the machine reference position using Home Mode:

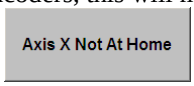
a) When each axis is at the desired reference position, press the 

button on the bottom toolbar 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 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 the display button change from 

to 

. 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 

button in the lower right corner.

At any point during the homing operation, you can press the 

button to interrupt the homing procedure, and stop the movement of both axes.

NOTE: 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 

button to get to Main Mode.

7) Change settings in Configuration Mode:

a) Get into Configuration Mode by pressing the 

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. 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.

8) Exit ServoWorks S-1_0M by pressing the 

button to get to Main Mode, and then pressing the 

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 (S100M, S120M or S140M) 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:

   a) Get into Configuration Mode by pressing 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.

   b) Click on the Motor 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 AXES button to switch to additional axes not displayed on the first screen. When you have made these changes, click the APPLY button on the bottom toolbar.

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

   e) Click on the Home 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 ( ).

g) Set "Home Type" to "HSOn." Click the 

button on the bottom toolbar.

h) Set "Always search for home" to "Yes." Click the 

button on the bottom toolbar.

i) Exit Configuration Mode by pressing the 

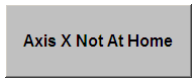
button to get to Main Mode.

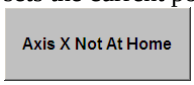
3) Perform a homing operation using the home switch:

a) 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).

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 click on the 

button). This will establish the coordinate system for that axis by detecting the home switch, and sets the current position for that axis as the home position. You will see the display button change from 

to 

. 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 

button in the lower right corner.

c) Exit Home Mode by pressing the 

button to get to Main Mode.

4) Change settings in Configuration Mode:

a) Get into Configuration Mode again by pressing the 

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. 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 

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 

button on the bottom toolbar.

g) CHECK () "Set Home Position for Absolute Encoder in HOME Mode." Click the 

button on the bottom toolbar.

h) Exit Configuration Mode by pressing the 

button to get to Main Mode.

5) Exit 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.

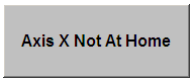
6) Restart ServoWorks S-1_. When the program has booted up, you will be in the main screen of ServoWorks S-1_0M.

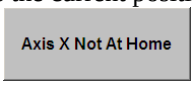
7) Set the machine reference position of each axis while each axis is at the home position determined by the home switch:

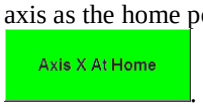
a) Press the 

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 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 your enter your password and click "OK," you will see the Home Mode window appear, as shown in Figure 2-18.

b) Set the home position for each individual axis for which you want to set the new absolute encoder home position by pressing 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 click on the 

button). This will establish the coordinate system for that axis, and sets the current position for that axis as the home position. You will see the display button change from 

to 

. 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 

button in the lower right corner.

c) Exit Home Mode by pressing the 

button to get to Main Mode.

8) Change settings in Configuration Mode:

a) Press the 

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. The Home screen will appear, as shown in Figure 2-17.

c) UNCHECK (☐) "Set Home Position for Absolute Encoder in HOME Mode." Click the 

button on the bottom toolbar.

d) Exit Configuration Mode by pressing the 

button to get to Main Mode.

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

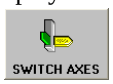
To access the machine and program parameters, you must get into Configuration Mode, an operational mode in which ServoWorks S-1_0M displays parameter settings and accepts and applies new parameter settings for numerous types of parameters. Refer to *Section 2.2.4: Getting Into and Out of Configuration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

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

button.

For ServoWorks S-120M and S-140M, use the 

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 

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.

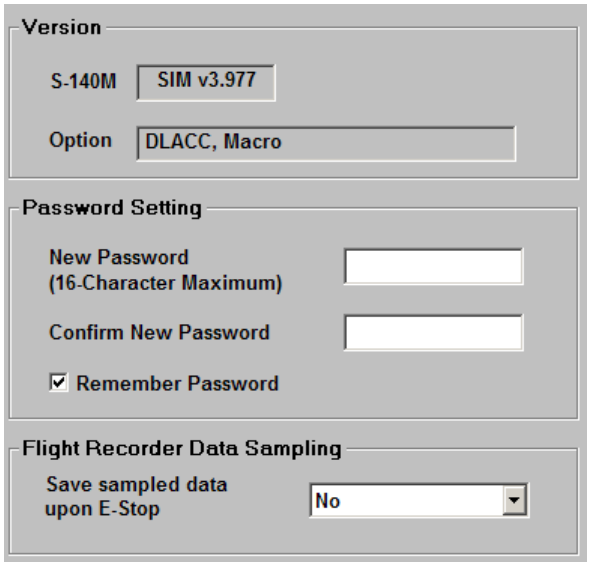


Figure 3-1: Configuration Mode – General Parameters Screen

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

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.

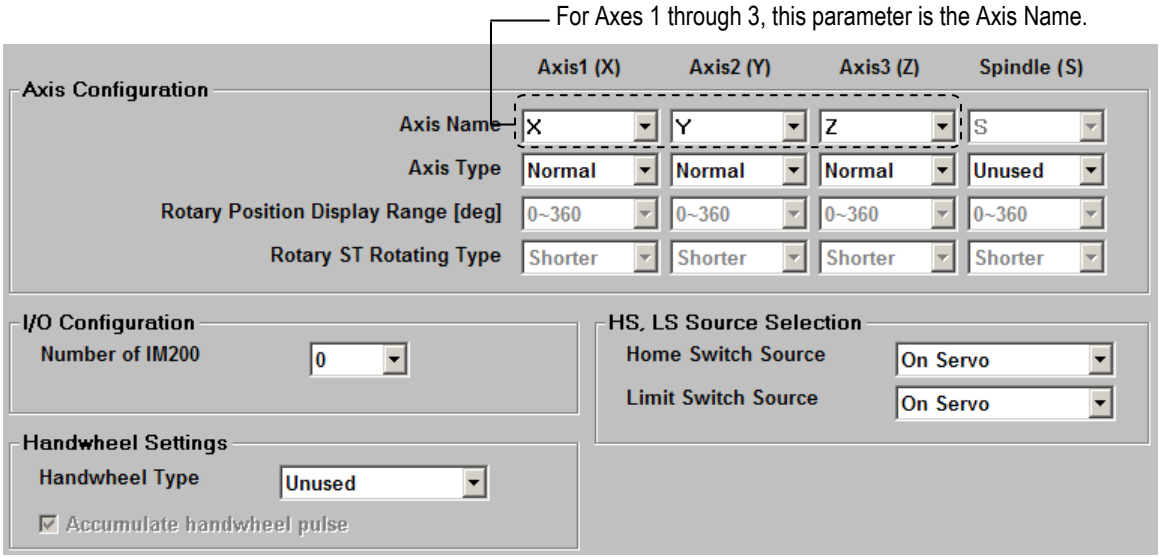


Figure 3-2: Configuration Mode – Machine Parameters Screen – First Four Axes

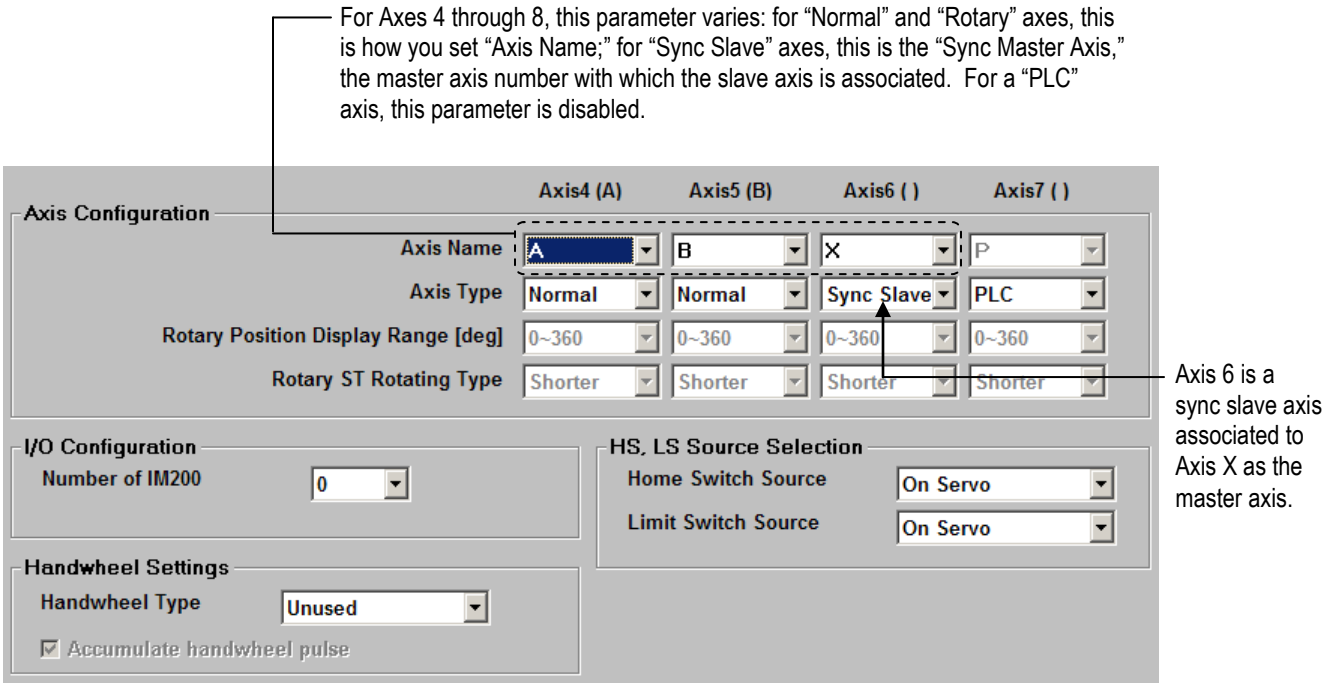


Figure 3-3: Configuration Mode – Machine Parameters Screen – Second Four Axes (ServoWorks S-120M and S-140M)

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.

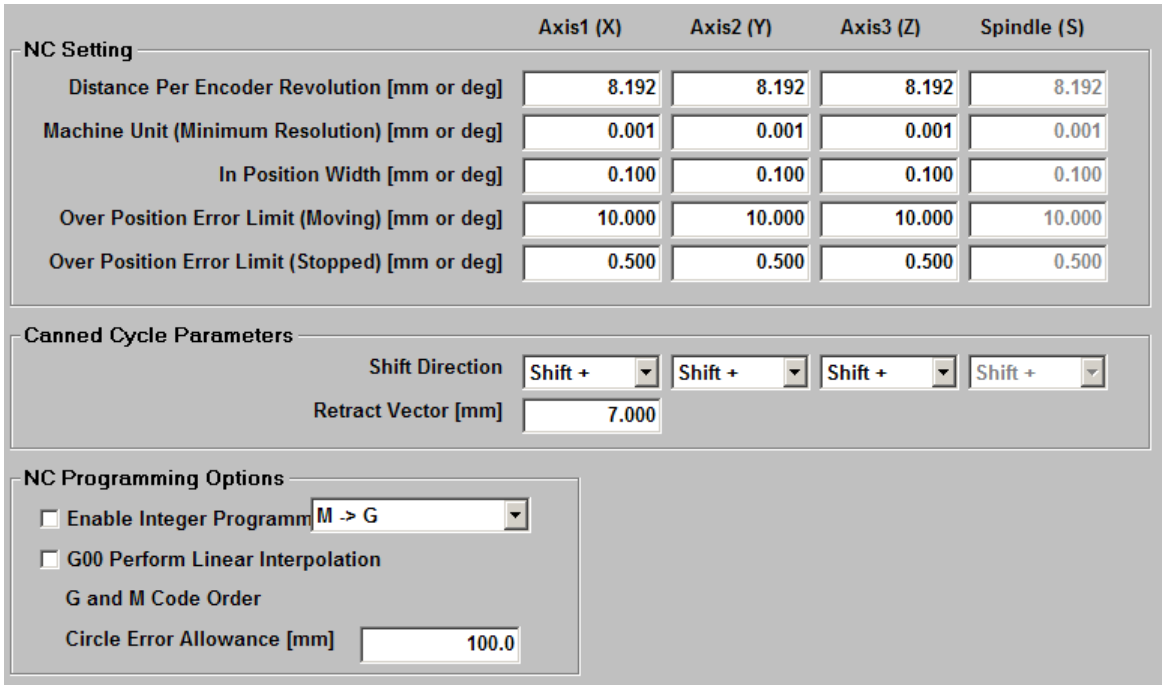


Figure 3-4: Configuration Mode – NC Settings Parameters Screen

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.

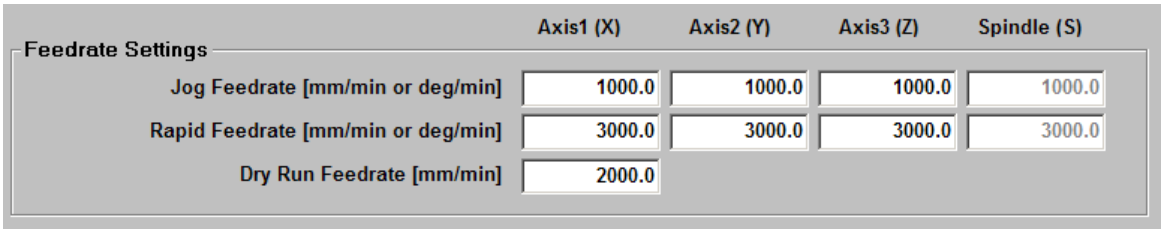


Figure 3-5: Configuration Mode – Feedrate Parameters Screen

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.

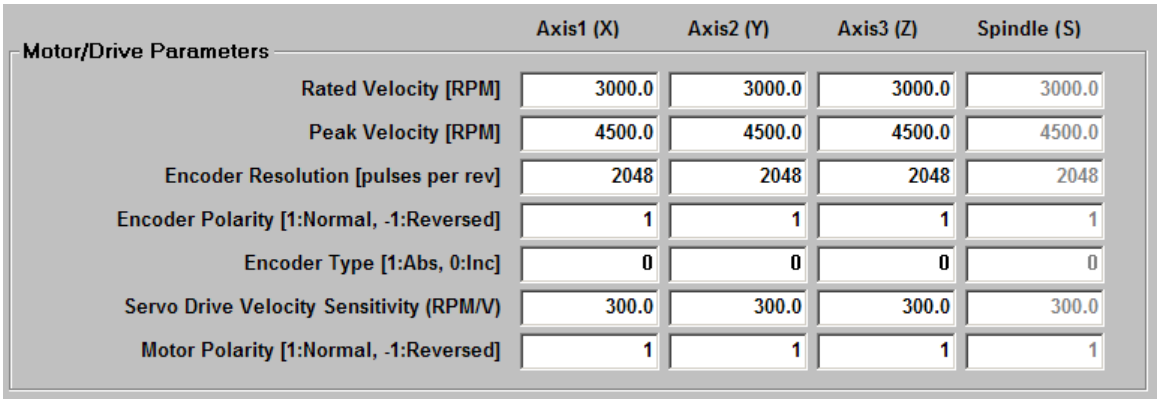


Figure 3-6: Configuration Mode – Motor Parameters Screen

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.

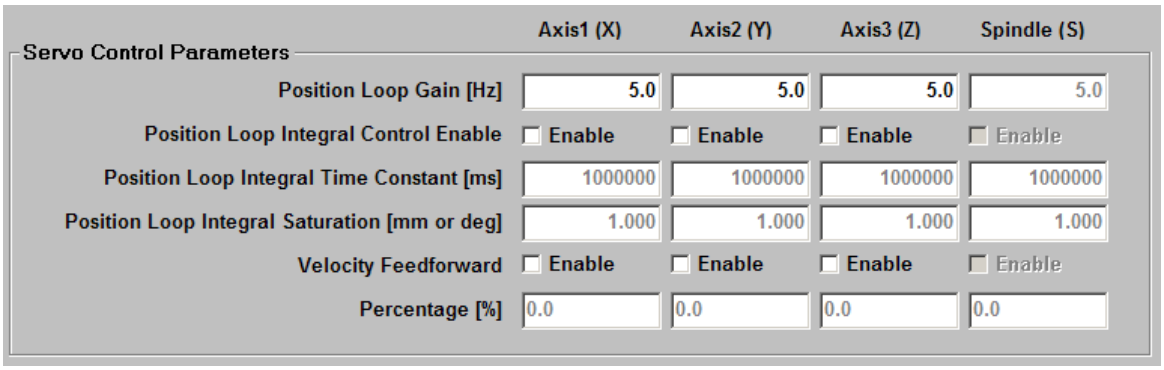


Figure 3-7: Configuration Mode – Servo Loop Parameters Screen

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.

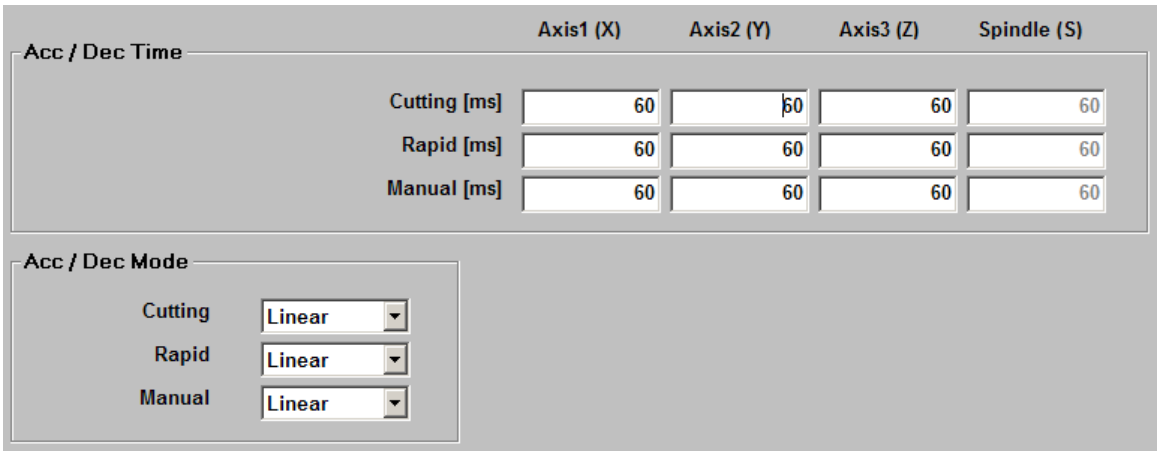


Figure 3-8: Configuration Mode – Acceleration/Deceleration Parameters Screen

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.

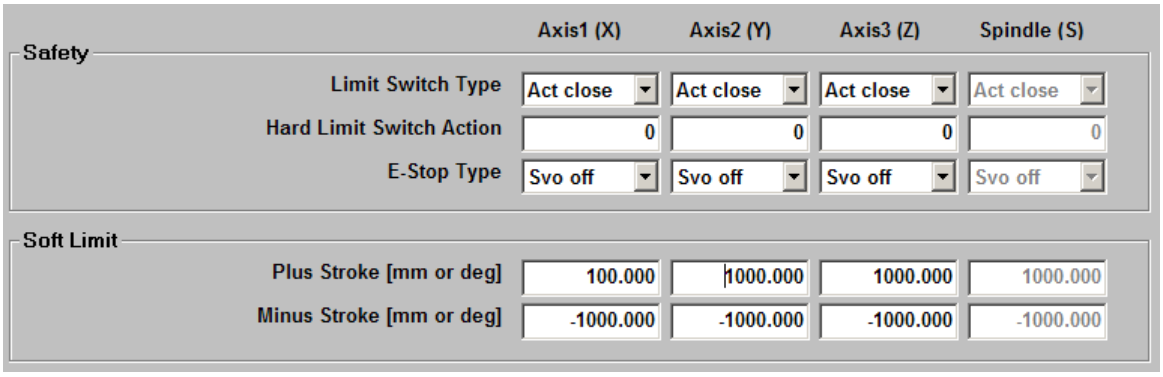


Figure 3-9: Configuration Mode – Safety Parameters Screen

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.

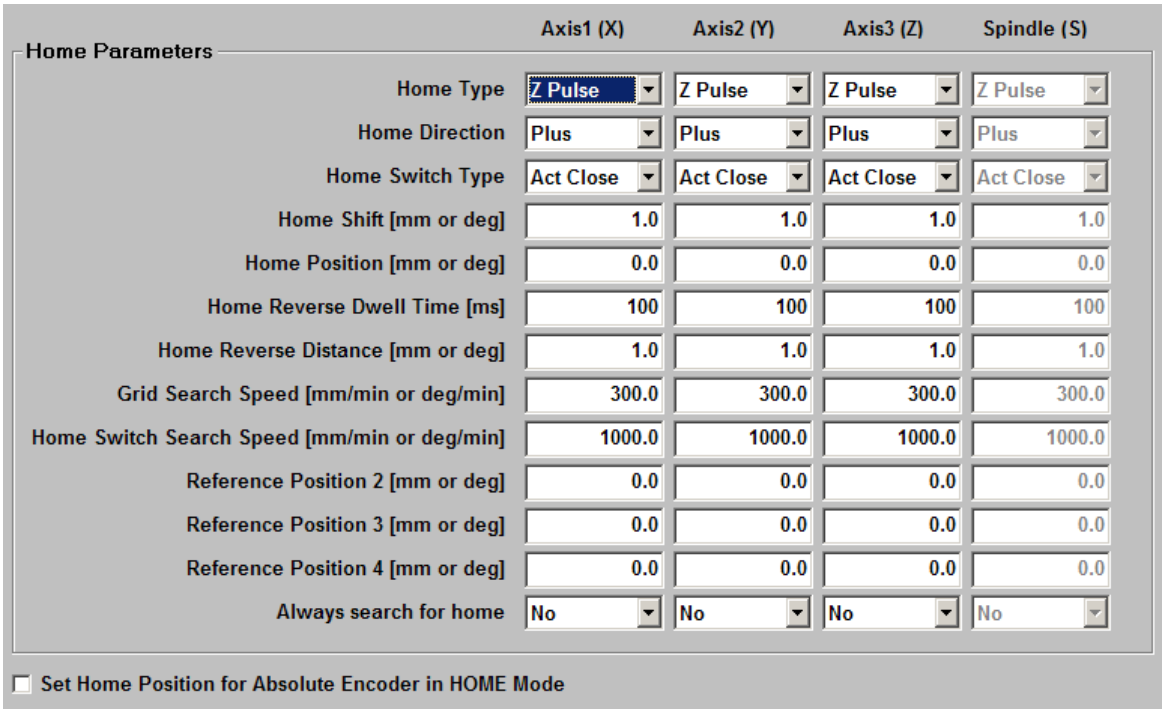


Figure 3-10: Configuration Mode – Home Parameters Screen

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, and 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.

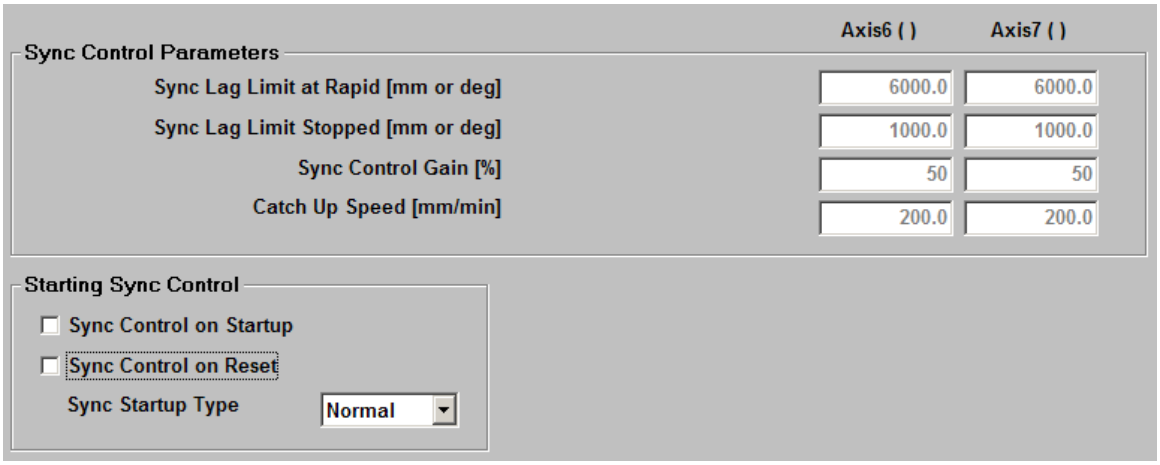


Figure 3-11: Configuration Mode – Synchronization Control Parameters Screen

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.

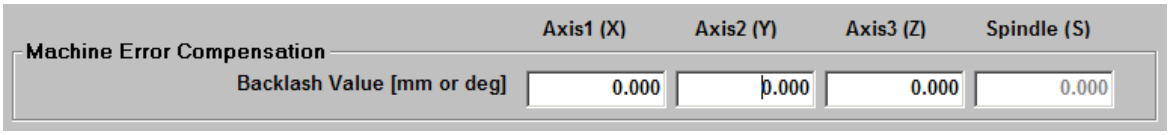


Figure 3-12: Configuration Mode – Machine Compensation Parameters Screen

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.

Use the PAGE DN and PAGE UP buttons to scroll through 1024 points (0 – 1023) of pitch error compensation 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]

	X	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.

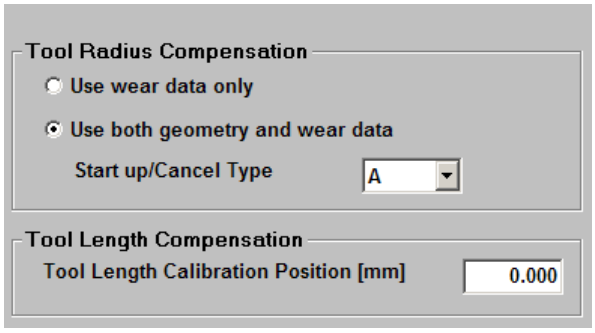


Figure 3-14: Configuration Mode – Tool Compensation Parameters Screen

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.

⚠ CAUTION

If the Windows default language is not supported by the ServoWorks S-1_0M application (Arabic, for instance), there may be either no character display or there may be meaningless character display. If this occurs, select "English" for your language selection.

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.

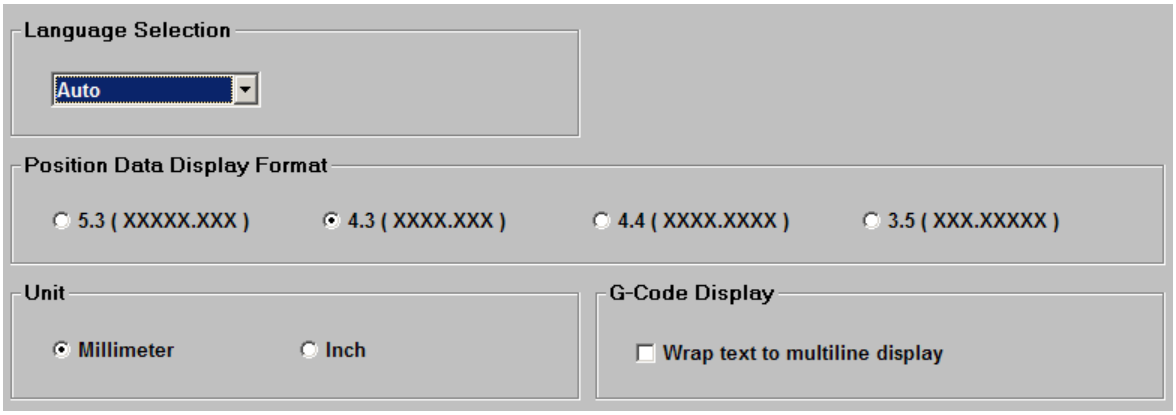


Figure 3-15: Configuration Mode – Display Parameters Screen

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.

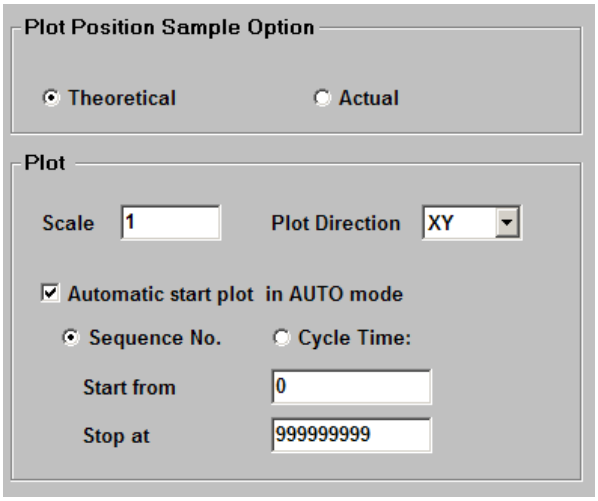


Figure 3-16: Configuration Mode – Plot Parameters Screen

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.

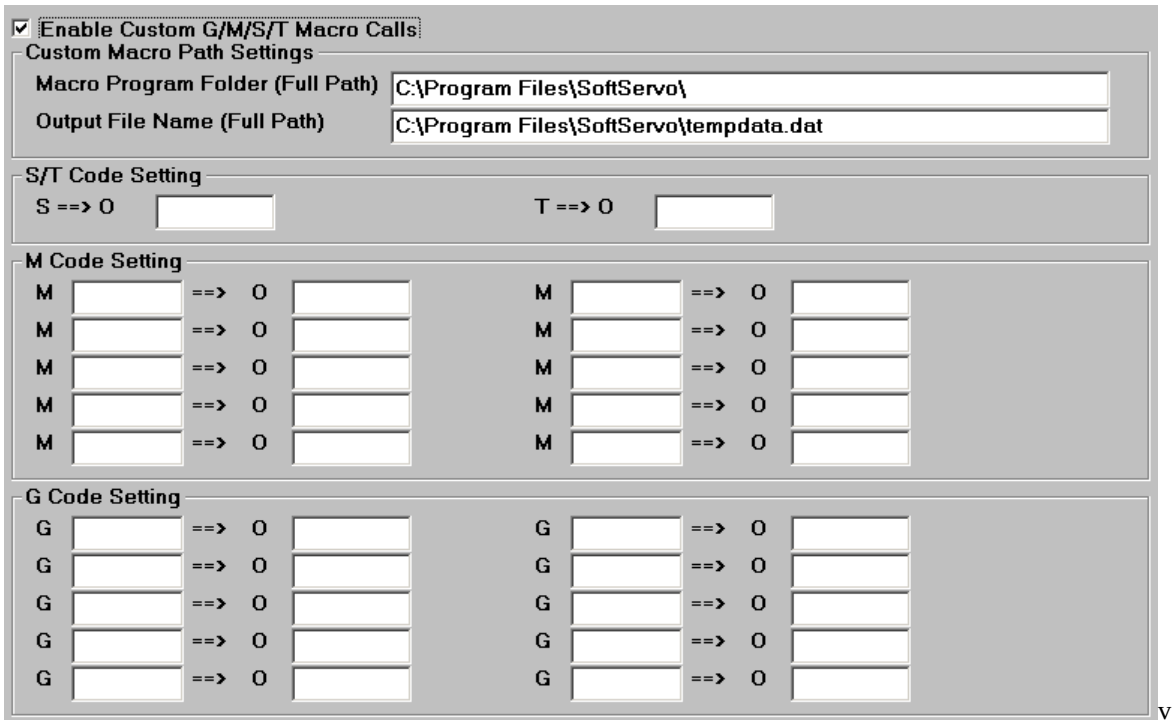


Figure 3-17: Configuration Mode – Macro Parameters Screen

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.

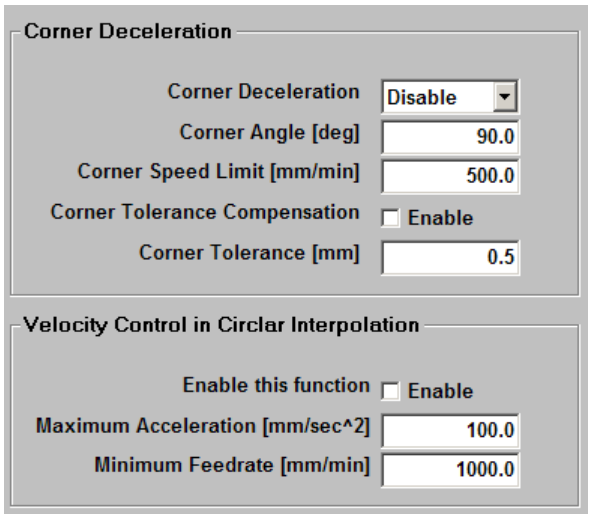


Figure 3-18: Configuration Mode – Cutting Speed Adjustment Parameters Screen

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.

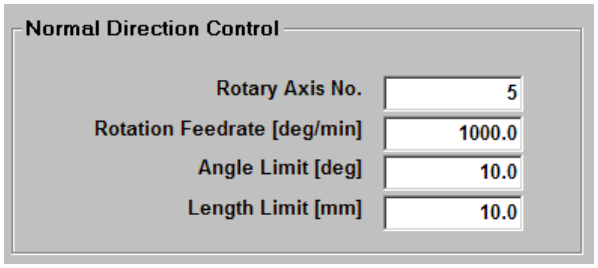


Figure 3-19: Configuration Mode – Normal Direction Control Parameters Screen

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.

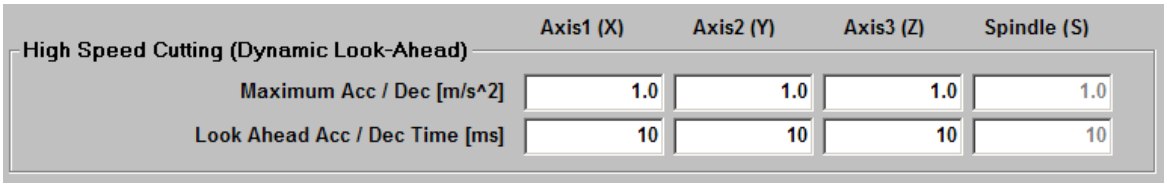


Figure 3-20: Configuration Mode – Dynamic Look-Ahead Contour Control (DLACC) Parameters Screen

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.

You must press the 

button before you leave a set of parameters, or your changes will NOT be saved.

CAUTION

Be careful: if you exit Configuration Mode without pressing the 

button, all of your changes will be lost, and you may or may not realize that your changes have not been 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

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 you to customize what is displayed and how things are displayed. To get into Screen Mode, press the 

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:

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 following figure:

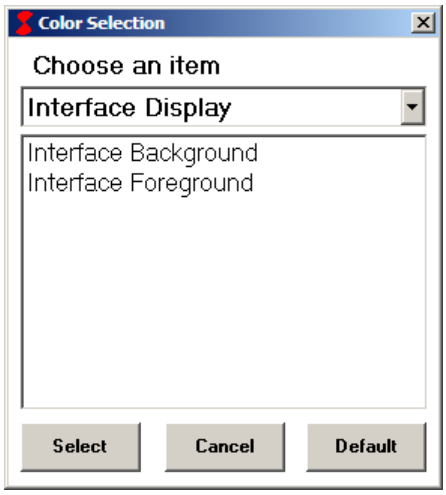


Figure 4-2: Color Selection Window (Interface Display)

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:

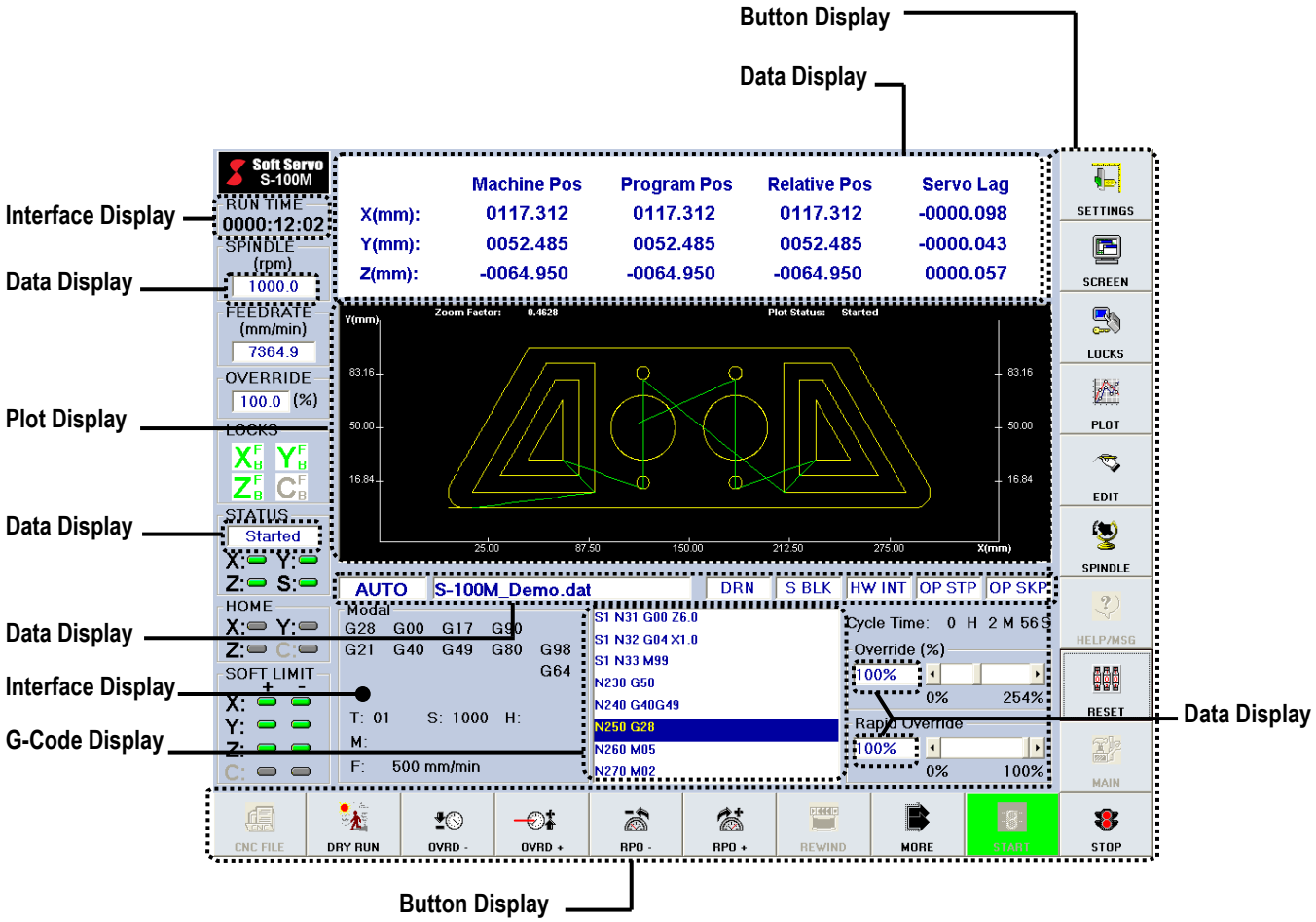


Figure 4-3: Screen Elements for Which You Can Change Color

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:

- Interface Background (the dominant color of the whole screen)
- Interface Foreground (text)

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

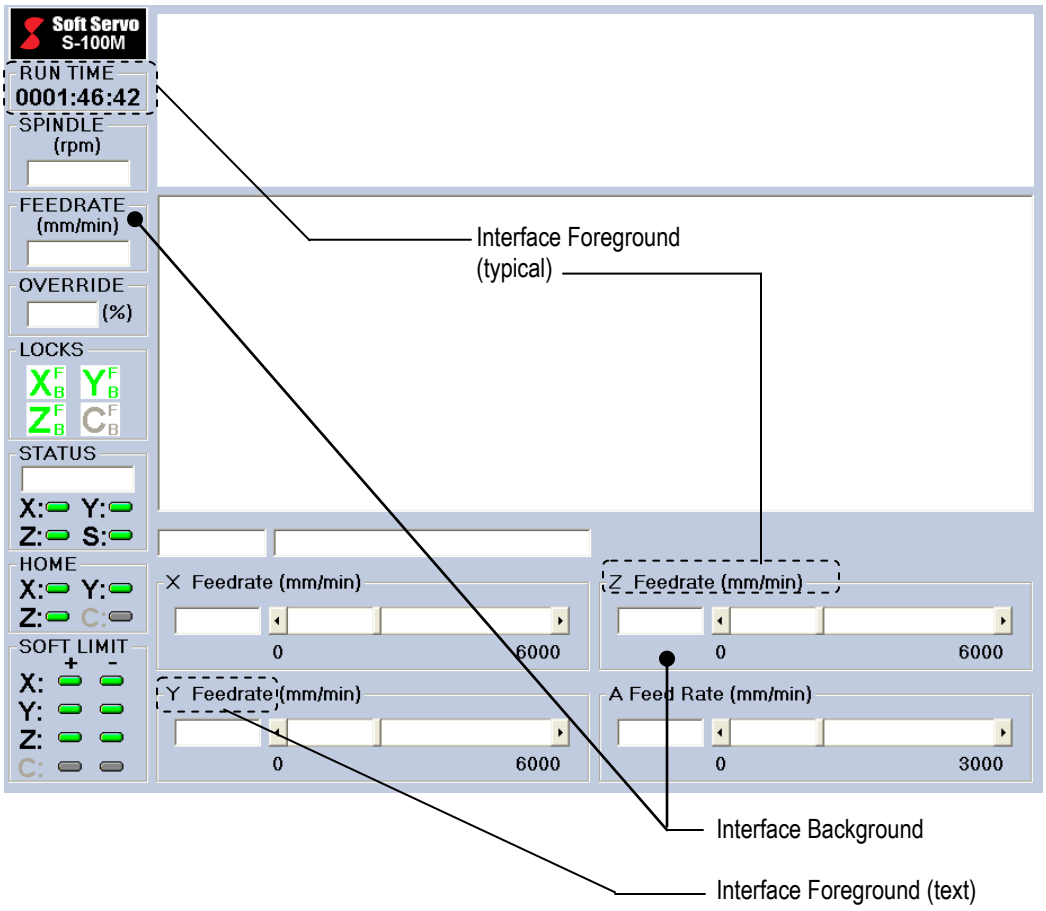


Figure 4-4: The Interface Display

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:

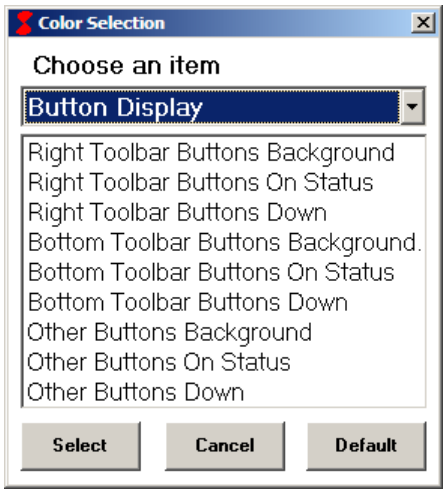


Figure 4-5: Color Selection Window (Button Display)

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

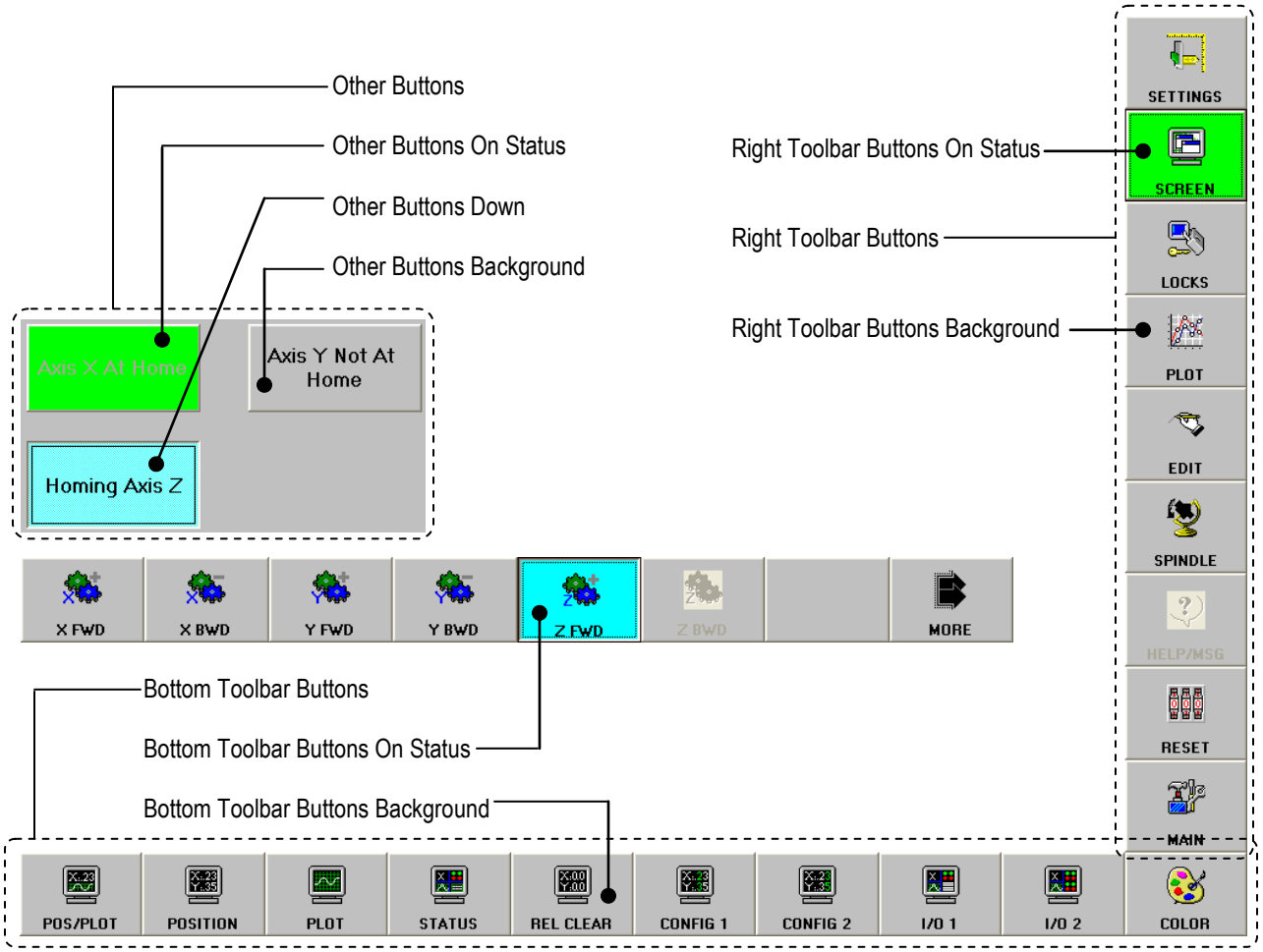


Figure 4-6: The Button Display

4.3.3 The Plot Display

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:

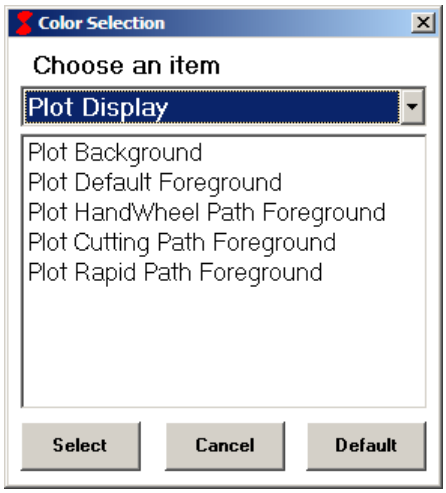


Figure 4-7: Color Selection Window (Plot Display)

- Plot Background (the dominant color of the plot area)
- Plot Default Foreground (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)
- Plot HandWheel Path Foreground (the color of the movement that is commanded with a handwheel)
- Plot Cutting Path Foreground (the color of the path that is commanded for cutting)
- Plot Rapid Path Foreground (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):

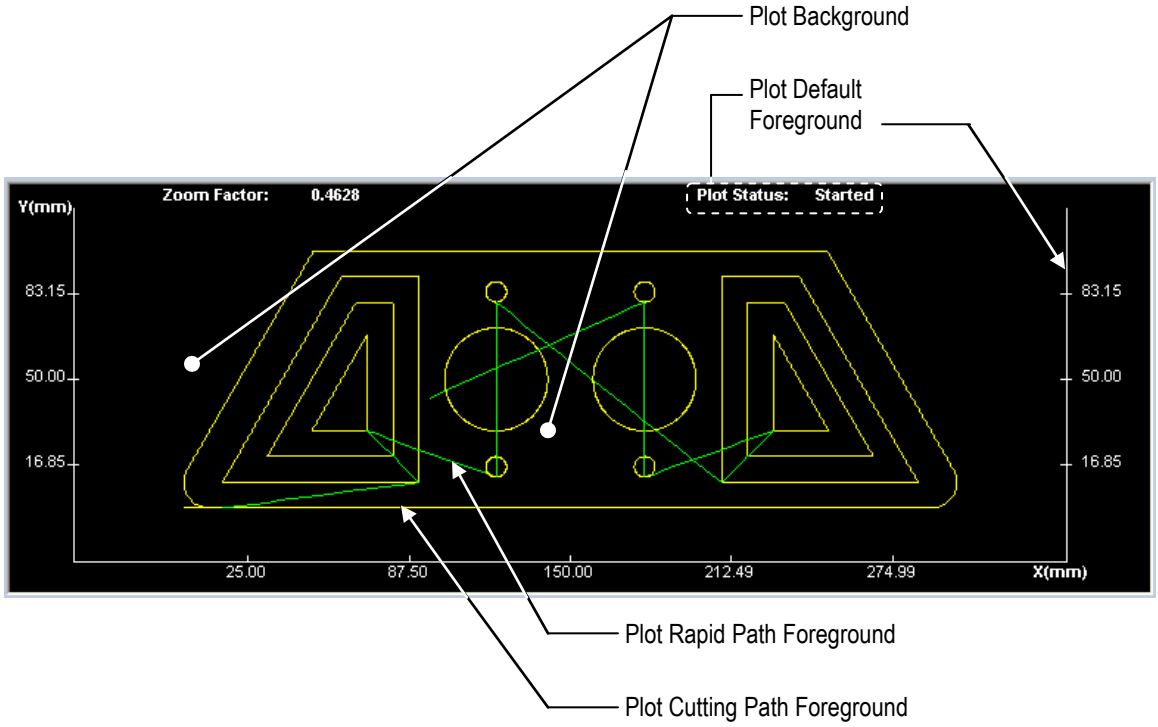


Figure 4-8: The Plot Display

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:

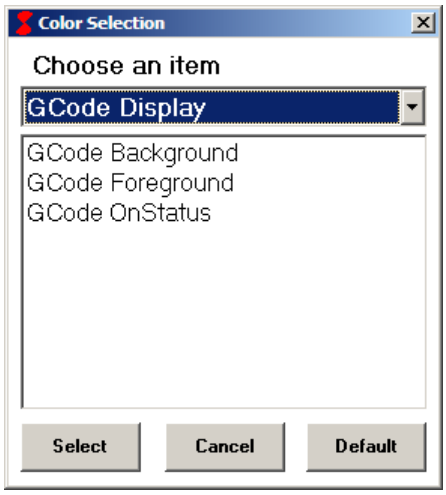


Figure 4-9: Color Selection Window (G Code Display)

- G Code Background (the dominant color of the G Code area)
- G Code Foreground (the color of the text of the G Code)
- G Code On Status (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:

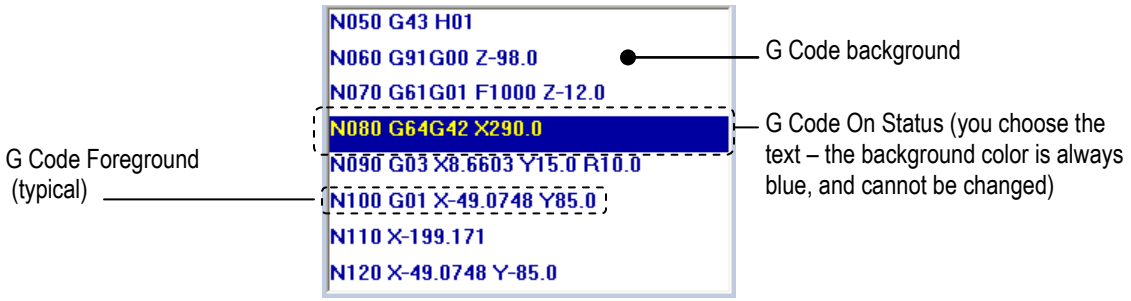


Figure 4-10: The G-Code Display

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:

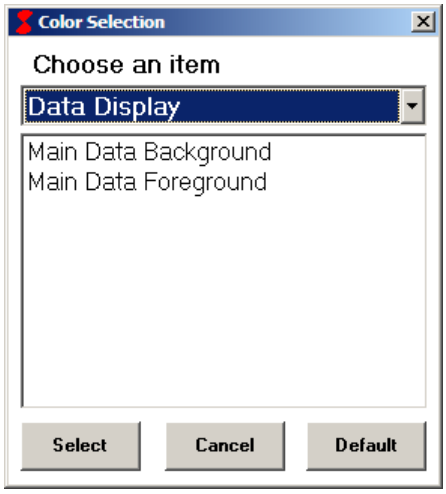


Figure 4-11: Color Selection Window (Data Display)

- Main Data Background (the dominant color of the data areas)
- Main Data Foreground (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:

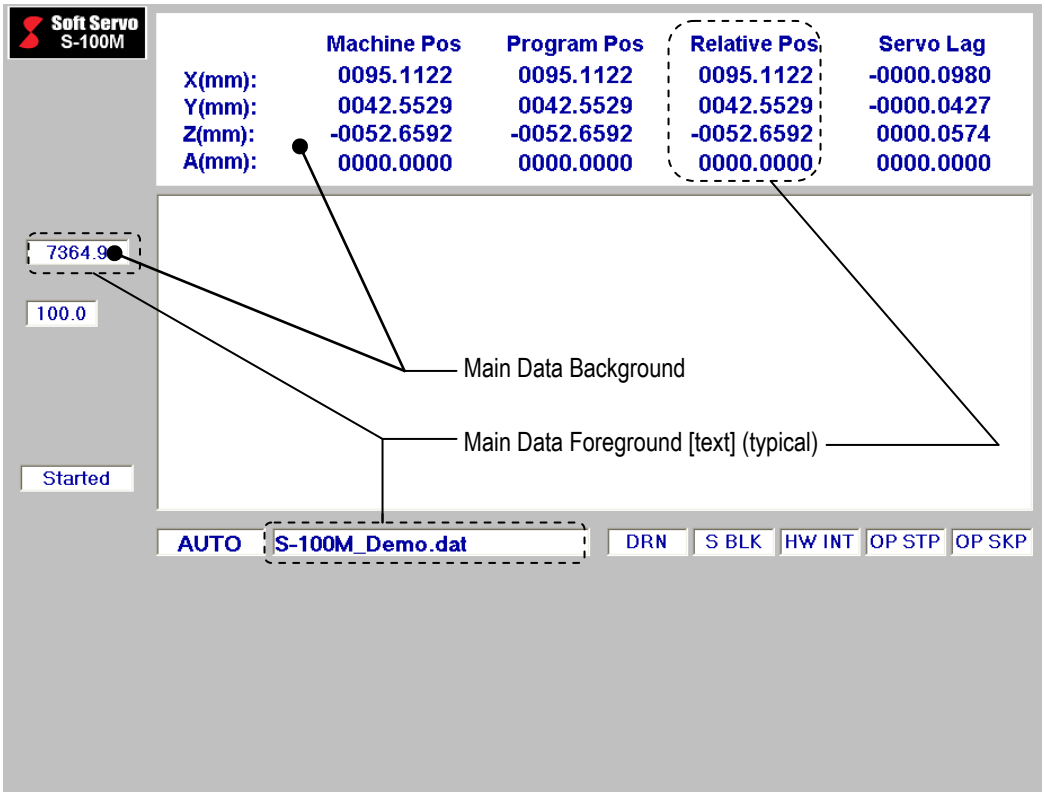
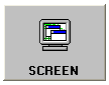


Figure 4-12: The Data Display

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:

1) Get into Screen Mode by pressing the 

button on the right toolbar of the ServoWorks S-1_0M screen. (Ten buttons will appear on the bottom toolbar, as shown in Figure 4-1.)

2) Press the 

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:

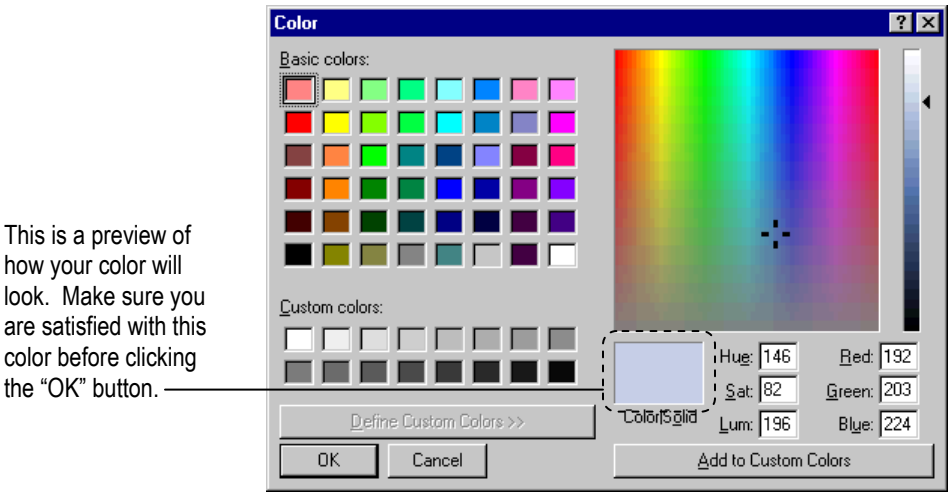


Figure 4-13: Color Window

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.

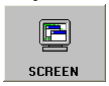
7) When you are satisfied with the color you have specified (as shown in the "ColorSolid" box in the Color Window), click the "OK" button. You may also want to add that button to your custom colors, so that the exact color is saved for future use, by clicking the "Add to Custom Colors" button.

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:

1) Get into Screen Mode by pressing the 

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.)

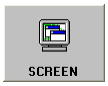
2) Press the 

button – you will see 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 

button), press the 

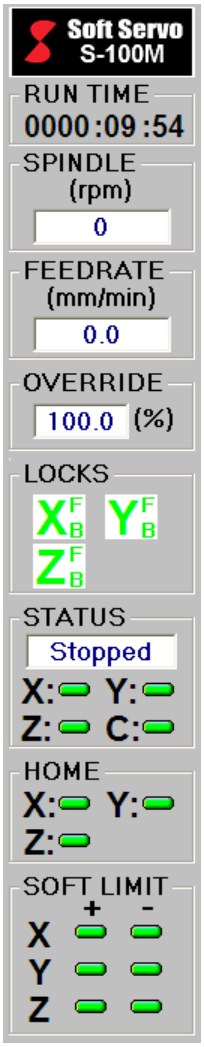
button again or press the "Escape" key on your keyboard.

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.



Run Time Indicator – the elapsed time since ServoWorks S-1_0M was started

Spindle Status Indicator – displays the speed at which the spindle is rotating

Feedrate Indicator – displays the coordinated feedrate at which the axes are moving

Override Percentage Indicator – displays feedrate override percentage

Locks Status Indicators

Servo Loop Status Indicator

Servo Drives On/Off Status Indicators

Home Status Indicators – is the axis at the home position?

Soft Limits Status Indicators – have the software overtravel limits been reached? (*only displayed in ServoWorks S-100M – for ServoWorks S-120M and S-140M, soft limits status indicators are shown in the "Axes Status" frame shown in Figure 5-4)*

Figure 5-1: The Status Indicator Area of the ServoWorks S-1_0M Window

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.)

⚠ CAUTION

If the spindle "Axis Type" parameter is set to "Servo Spindle," and the motor does not have encoder feedback connected, then the Spindle Status Indicator in the ServoWorks S-1_0M GUI will display "0.000" due to the lack of encoder feedback.

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:

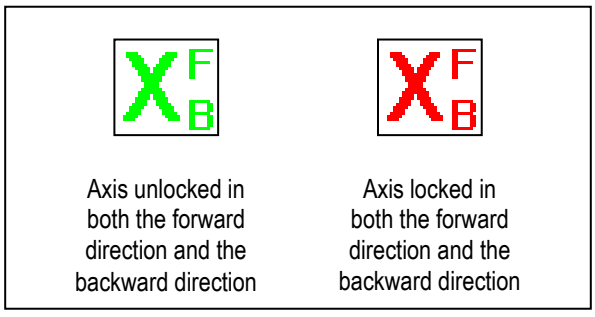


Figure 5-2: Locks Status Indicators

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

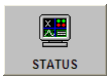
The oval LED icon next to each axis indicates the on/off status of the servo drives. Green ( ) represents "on" and red ( ) indicates "off."

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 ( ) indicates that the axis is at its home position, and gray ( ) 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 

button on the right toolbar to enter 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 ( ) indicates that the soft limit for a particular axis and direction has not been checked, because a homing operation has not been performed. Green ( ) indicates that the soft limit for a particular axis and direction has been checked and *has not* been reached, and red ( ) 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.

5.2.1.1 Position Information About Each Axis

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

- Machine Position – the command position measured from the machine origin
- Actual Position – the feedback position of the axes – the real, current position of the axis (obtained from encoder feedback)
- Program Position – 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.
- Distance to Go – 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)
- Relative Position – 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 

button). From then on, the relative position is measured from the last cleared position.
- Servo Lag – the difference between the machine position and the real (actual feedback) position

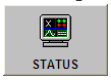
When you are in Screen Mode (explained in *Section 5.2.2: Using Screen Mode to Select Information to Display in the Main Display Area*), you will have a choice of which of these six position types is displayed:

- When you choose the display of only position information (with the 

button), two types of position data will be displayed for each axis. You may use the 

and 

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 

button) or status display (with the 

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 

and 

buttons. Pressing the 

button will toggle you through the options for what type of position to display for the third position type. Pressing the 

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:

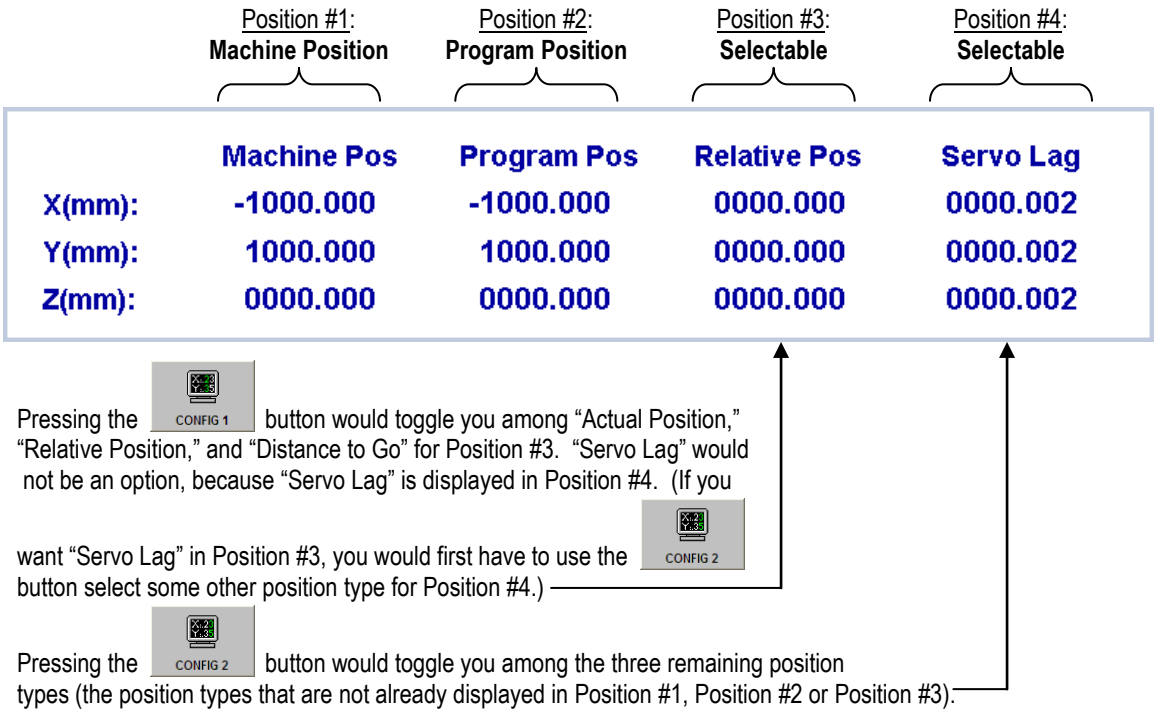


Figure 5-3: Selecting Position Types for Four-Position Display

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).

- To clear the relative position for the first axis, press the REL CLEAR button once.
- To clear the relative position for the second axis, press the REL CLEAR button twice quickly.
- To clear the relative position for the third axis, press the REL CLEAR button three times quickly.
- To clear the relative position for the fourth axis, press the REL CLEAR button four times quickly.

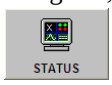
In essence, the REL CLEAR button allows you to sequence through all the axes, and whichever axis you are on when you stop pressing the REL CLEAR button is the axis whose relative position is set to zero.

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 

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.

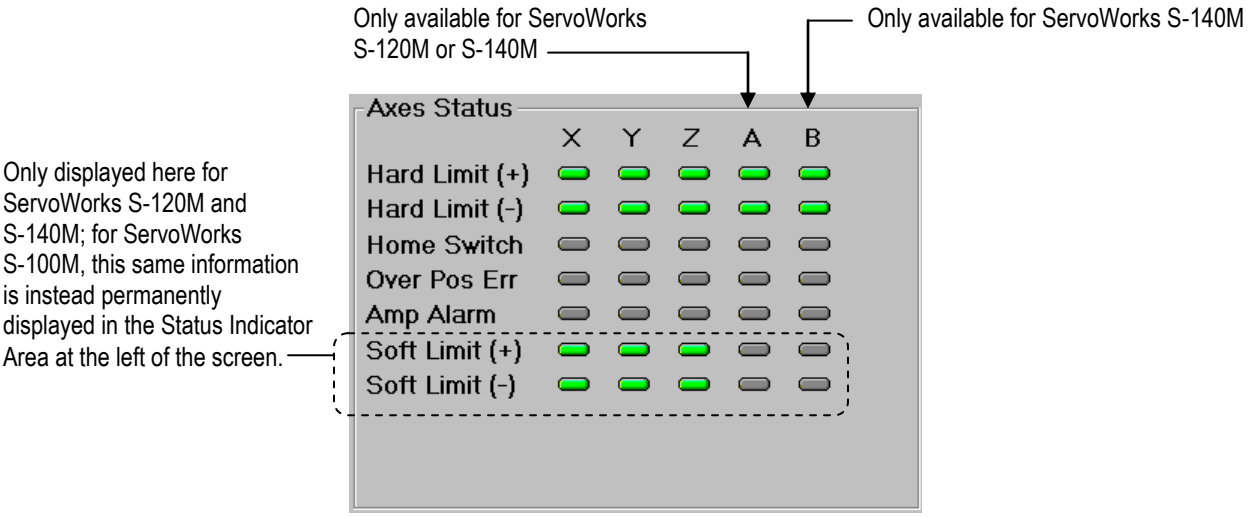


Figure 5-4: Axes Status Frame – Servo Axes Information

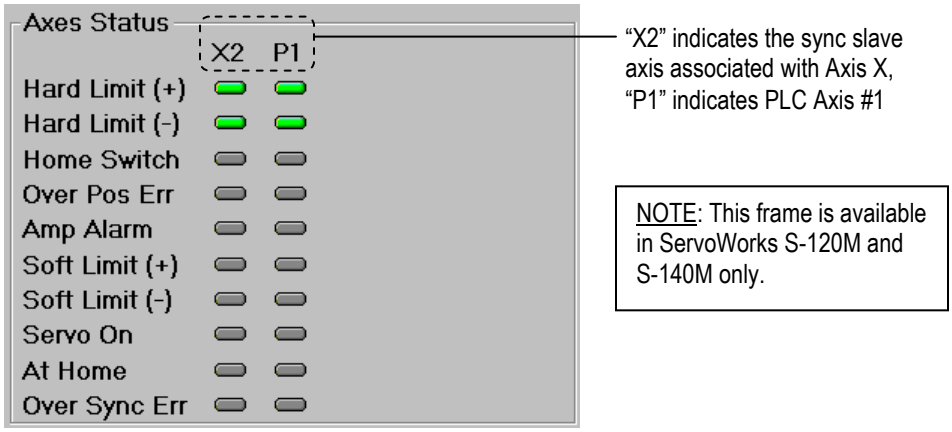
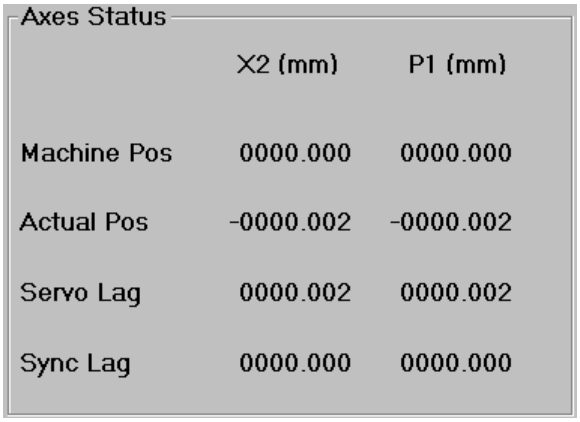


Figure 5-5: Axes Status Frame – Sync Slave/PLC Axes Information (1 of 2)



NOTE: This frame is available in ServoWorks S-120M and S-140M only.

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

For each axis, you can view the following information:

- Hard Limit (+) – 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
- Hard Limit (–) – 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
- Home Switch – 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
- Amplifier Alarm – 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.
- Soft Limit (+) – 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
- Soft Limit (–) – 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.

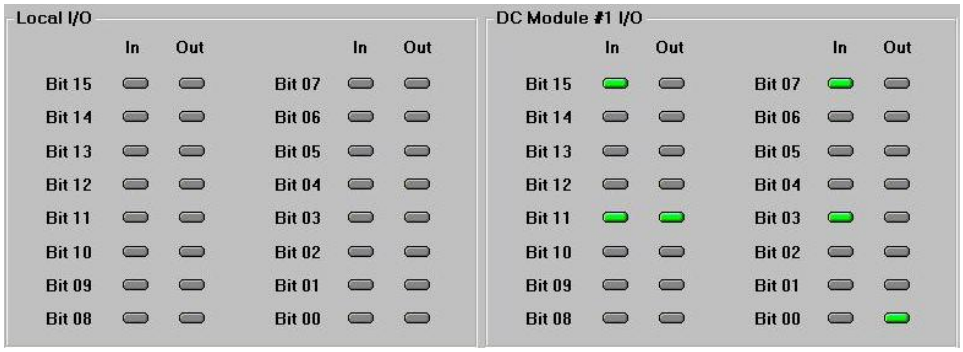


Figure 5-7: I/O Information for Local I/O and DC-155 I/O

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.

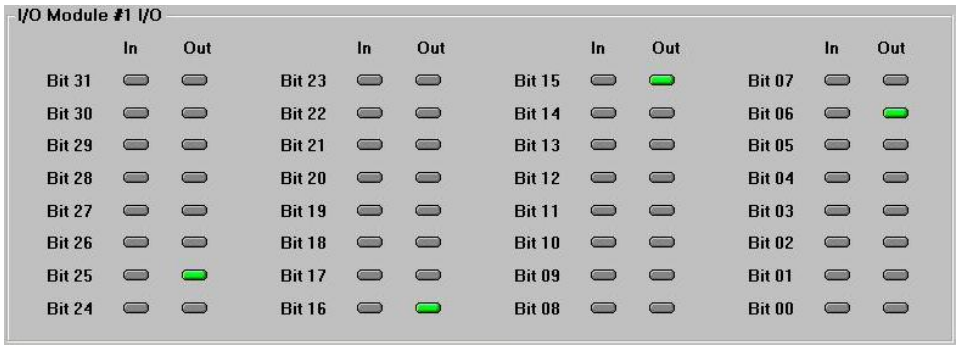


Figure 5-8: I/O Information for IM-305(s)

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 

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.]

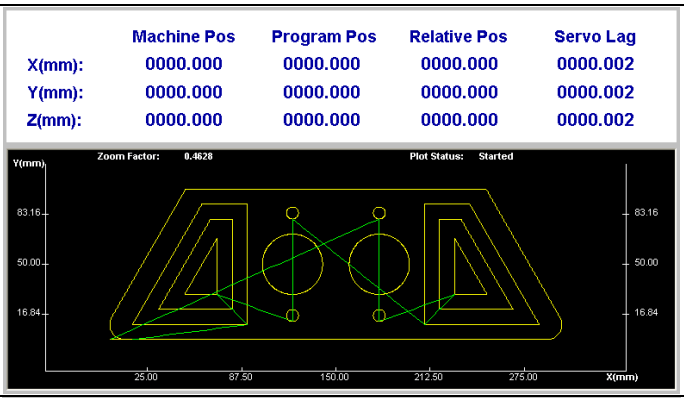
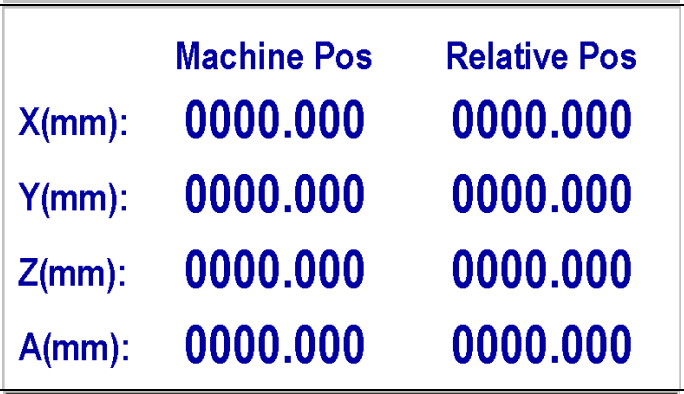
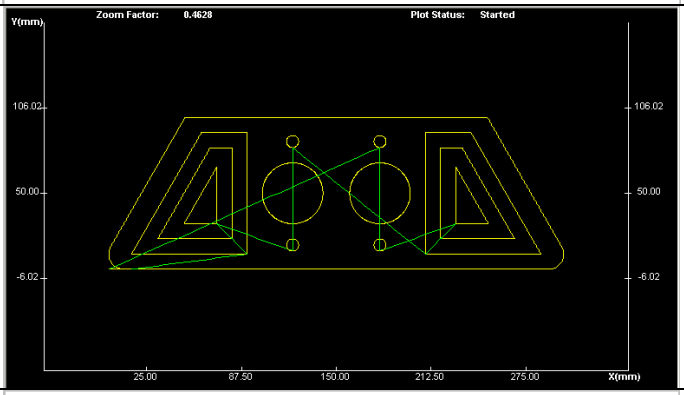
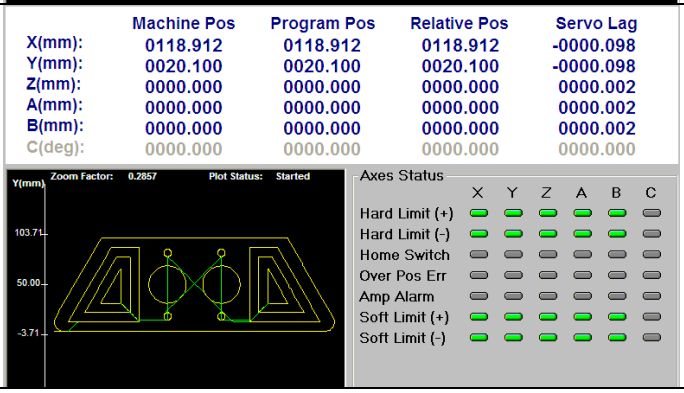
Press this button….	to display this in the Main Display Area.	Information included in display area:
POS/PLOT (This is the default display.)		• Position information for all axes • Plot trajectory data
POSITION		• Position information for all axes
PLOT		• Plot trajectory data
STATUS		• Position information for all axes • Plot trajectory data • Status of limit, home, over position error, and amplifier alarm switches

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

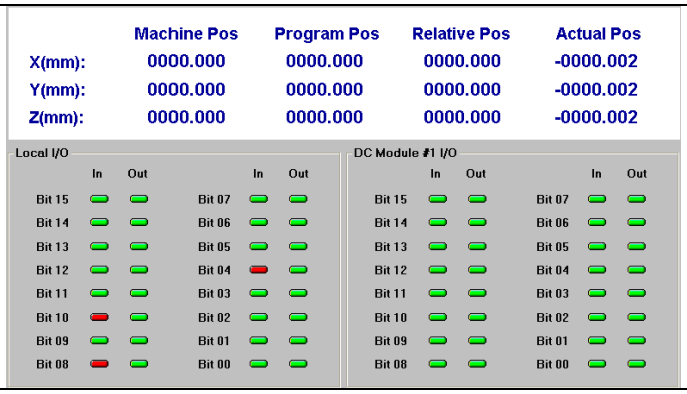
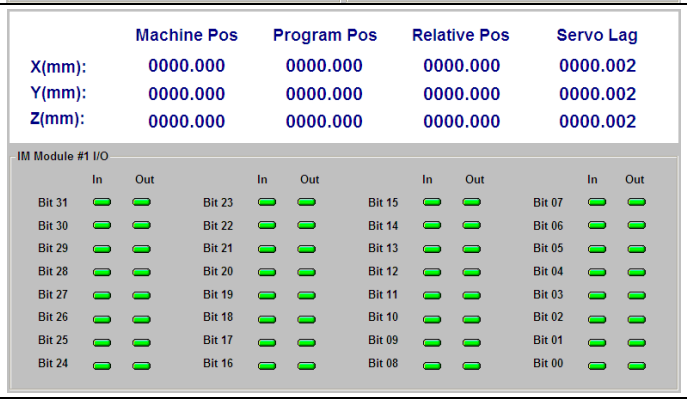
Press this button….	to display this in the Main Display Area.	Information included in display area:
I/O 1		• Position information for all axes • Digital I/O: local I/O and DC-155 module I/O
I/O 2		• Position information for all axes • Digital I/O: IM-305 modules • NOTE: For multiple IM-305 modules, keep pressing the I/O 2 button to toggle through the display for all IM-305 modules. In other words, the first press of the I/O 2 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

To exit Screen Mode (and return to whatever mode you were in before pressing the SCREEN button), press the "Escape" key on your keyboard, OR press the SCREEN button again.

5.3 Plotting Motion (Using Plot Mode)

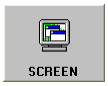
5.3.1 Overview

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

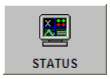
To view a plot, you must first make sure that the plot area is displayed. If the plot area is not displayed:

1) Press the 

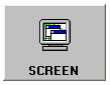
button on the right toolbar to enter Screen Mode. (Ten buttons will appear on the bottom toolbar, as shown in Figure 5-9).

2) Press any of the following buttons on the bottom toolbar: 

(will show position data and plot); 

(will show plot alone); or 

(which will show a plot along with switch data).

3) 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 

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 

button has been pressed. In this case, the plotting has been stopped, and ServoWorks S-1_0M program is no longer recording or plotting tool trajectories. [You would need to press the 

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 

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 

button on the bottom toolbar toggles the plot among all possible orientations. An example follows:

1) XY: the X axis plotted in the horizontal direction, and the Y axis plotted in the vertical direction, as shown in the following figure:

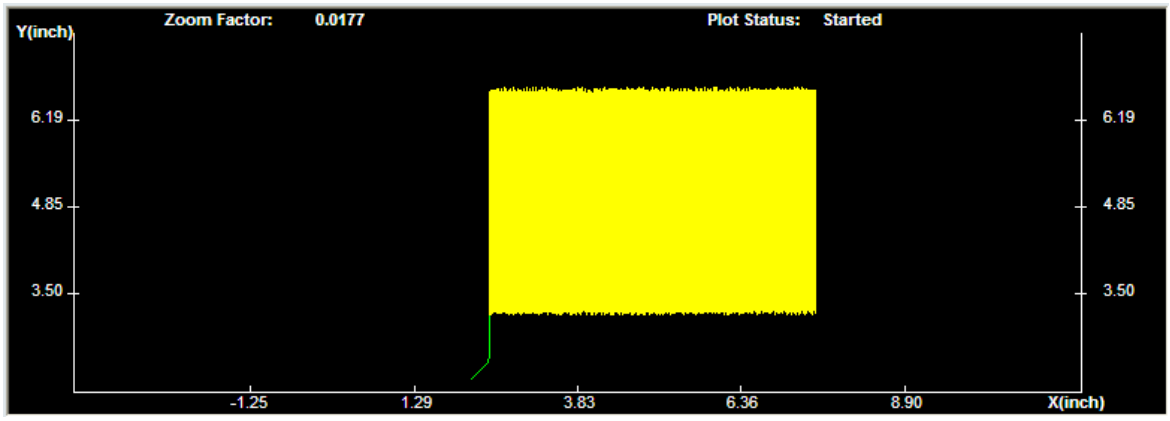


Figure 5-11: Plot with XY Orientation

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

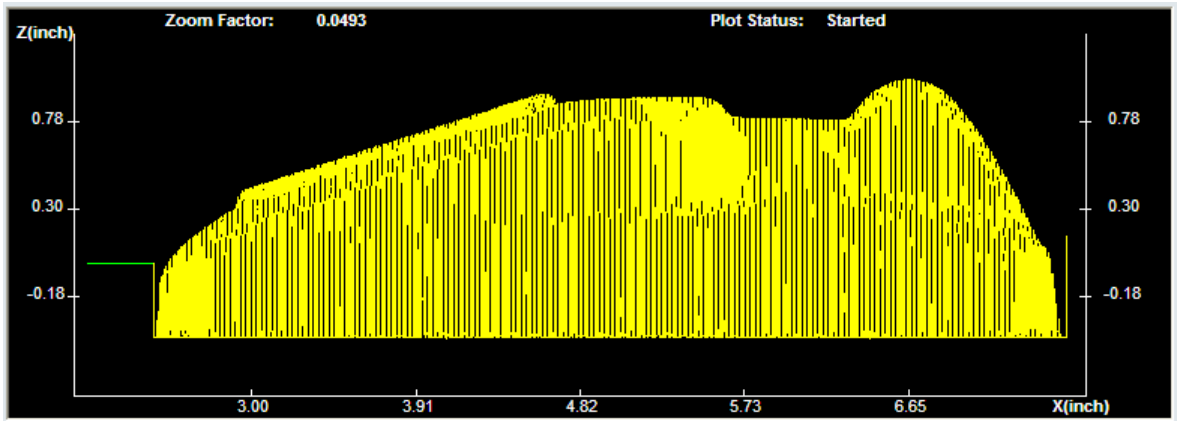


Figure 5-12: Plot with XZ Orientation

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

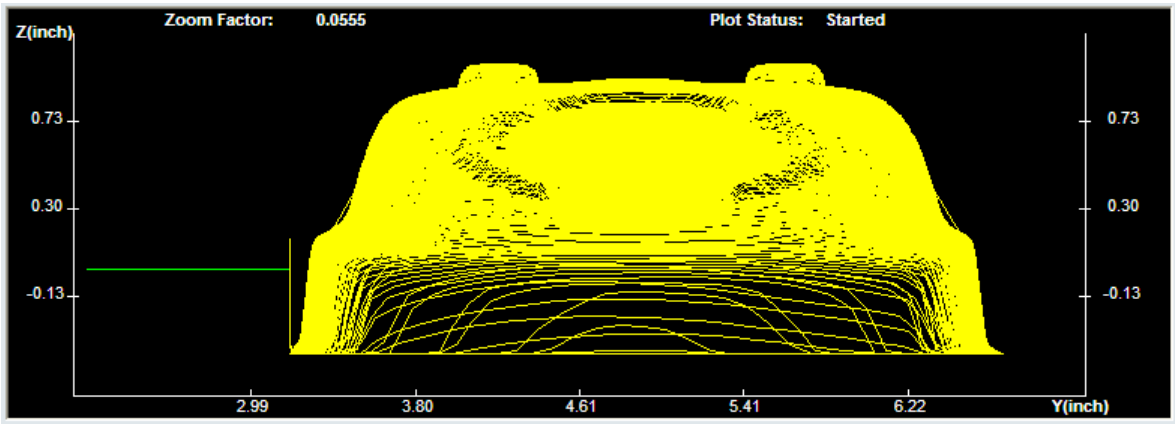


Figure 5-13: Plot with YZ Orientation

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 IN 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.

Press the LEFT, RIGHT, UP, and DOWN buttons on the bottom toolbar to move the plot in the desired direction.

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 

button on the bottom toolbar. ServoWorks S-1_0M program stops recording and displaying motion. While ServoWorks S-1_0M 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 

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 

button on the bottom toolbar.

NOTE: the 

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 

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.

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_0M 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:

1) Press the 

button on the right toolbar to enter Locks Mode (a sub mode).

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

Figure 6-1: Bottom Toolbar in Locks Mode

2) If you want to lock the X axis, press the 

button on the bottom toolbar. This will toggle you 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.

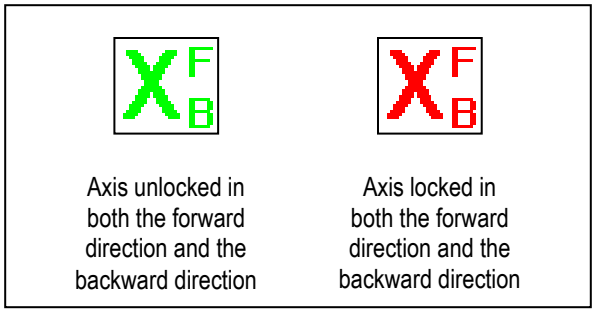
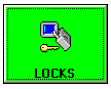


Figure 6-2: Lock Status Indicators for the Machine Lock Switch

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

4) Press the 

button to return to whatever mode you were in prior to Locks Mode.

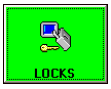
When you are ready to deactivate the Machine Lock(s):

1) Press the 

button on the right toolbar to enter Locks Mode (a sub mode).

2) Use the 

on the bottom toolbar or the corresponding buttons for other axes to unlock any or all of the axes.

3) Press the 

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

⚠ CAUTION

NOTE: Before you run production, you must unlock the Machine Locks. Also, in order to restore the original workpiece coordinate offset (the workpiece coordinate offset in effect before you turned on Machine Lock), you must perform a homing operation.

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.

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 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 

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

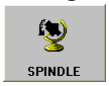
With the Machine Lock switch activated for a particular axis, movement in manual mode along that particular axis will be simulated. You can use a manual mode to move an axis that is locked with the Machine Lock switch, but ServoWorks S-1_0M will not send those commands to the servo drive. However, even 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.

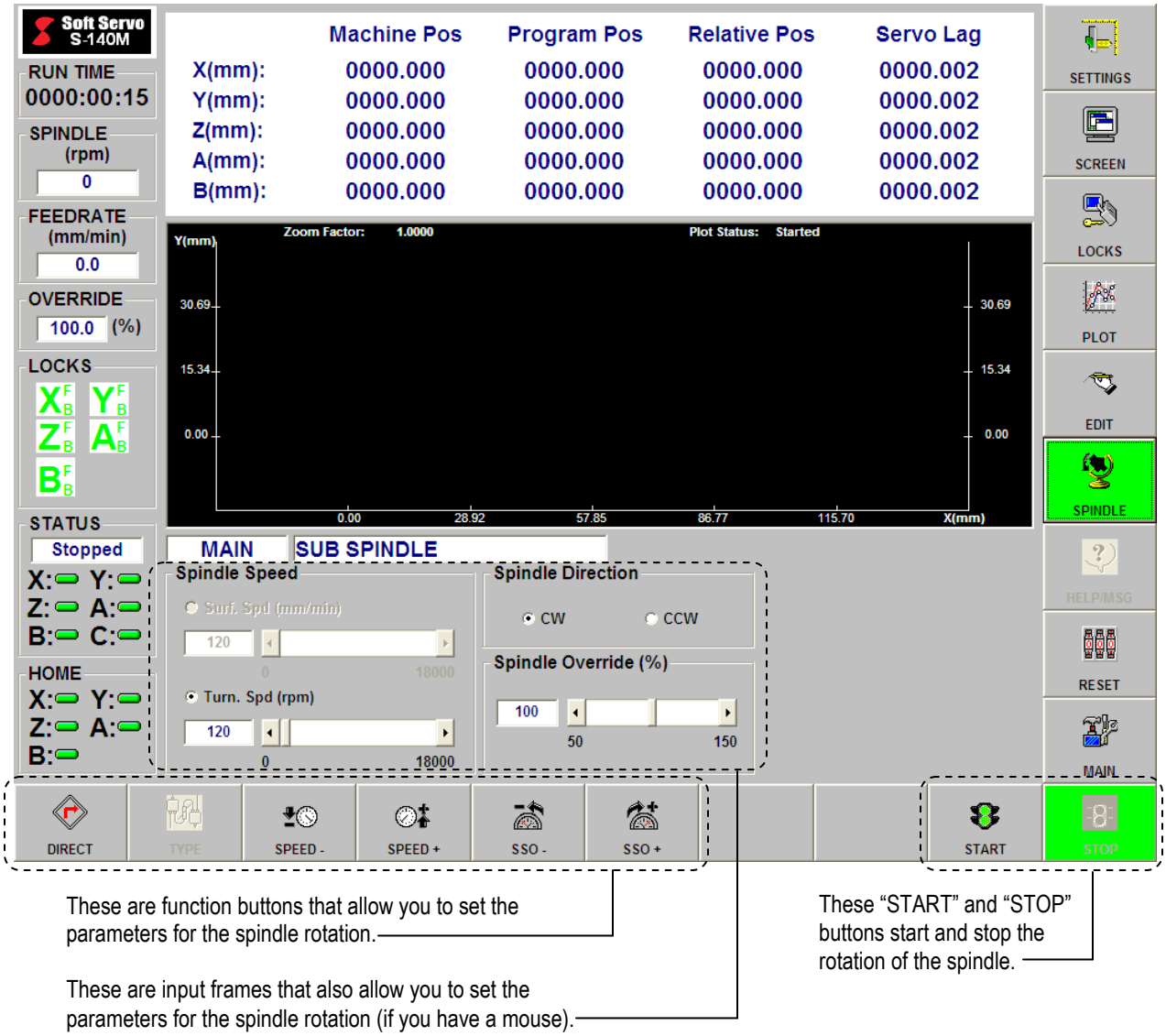
Chapter 8: Starting and Stopping the Spindle (Using Spindle Mode)

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 

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:



These are function buttons that allow you to set the parameters for the spindle rotation.

These are input frames that also allow you to set the parameters for the spindle rotation (if you have a mouse).

These "START" and "STOP" buttons start and stop the rotation of the spindle.

Figure 8-1: The Spindle Mode Window

2) Choose the direction for the spindle to rotate by pressing the 

button on the bottom toolbar. 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.

NOTE: 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 

button to increase the feedrate. The selected speed is displayed in the "Spindle Speed" frame.

NOTE: 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 

and 

buttons on 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).

NOTE: 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 

button on the bottom toolbar to start the spindle rotation. The feedrate will be shown in the Status Indicator Area (at the top left of the screen). To stop the spindle rotation, press the 

button on the right side of the bottom toolbar.

6) When you want to quit Spindle Mode, press the 

button again, and you will return to whatever 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.

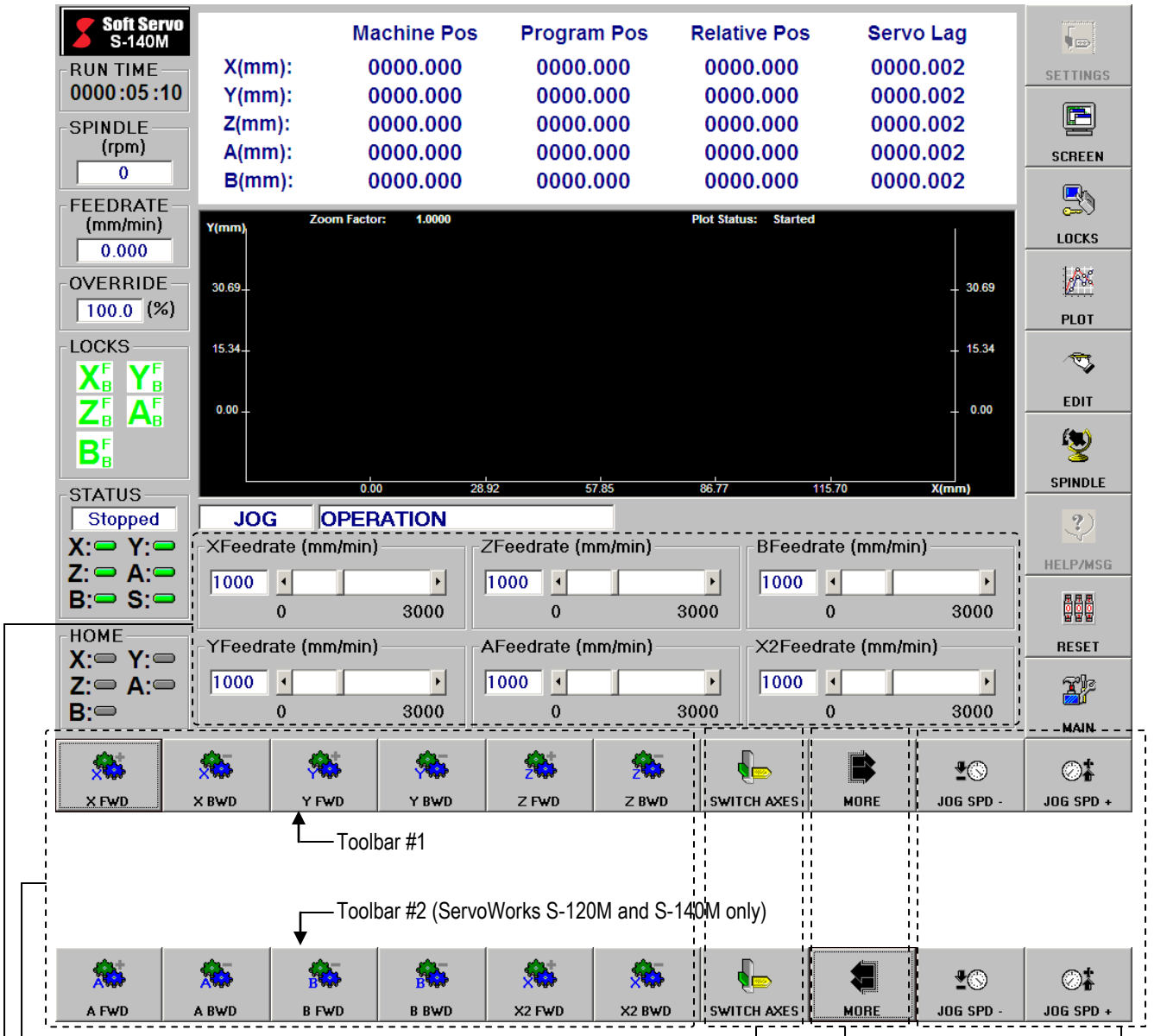
The default jog feedrates in effect when you first use Jog Continuous Mode are the "Jog Feedrate" values in the "Feedrate" parameters screen in Configuration Mode (shown in Figure 3-5). However, these feedrates can be changed in Jog Continuous Mode.

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 

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



Toolbar #1

Toolbar #2 (ServoWorks S-120M and S-140M only)

These buttons start and stop the cycle of the Jog Continuous Mode motion for the specified axis and direction.

These frames display the Jog Continuous Mode feedrate settings – you cannot use these text boxes or slider bars to set feedrates

The "SWITCH AXES" button toggles the focus among the feedrates for each axis

These function buttons allow you to increase or decrease the axes' feedrates

The "MORE" button is for toggling between Toolbar #1 and Toolbar #2 (ServoWorks S-120M and S-140M only)

Figure 9-1: The Jog Continuous Mode Window

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

button to toggle through the feedrates for each axis. For each axis, use the 

and 

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 

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 

and 

buttons to toggle between toolbars #1 and #2, as shown in Figure 9-1.

When you want to quit Jog Continuous Mode, press the 

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

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.

[NOTE: 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*.)

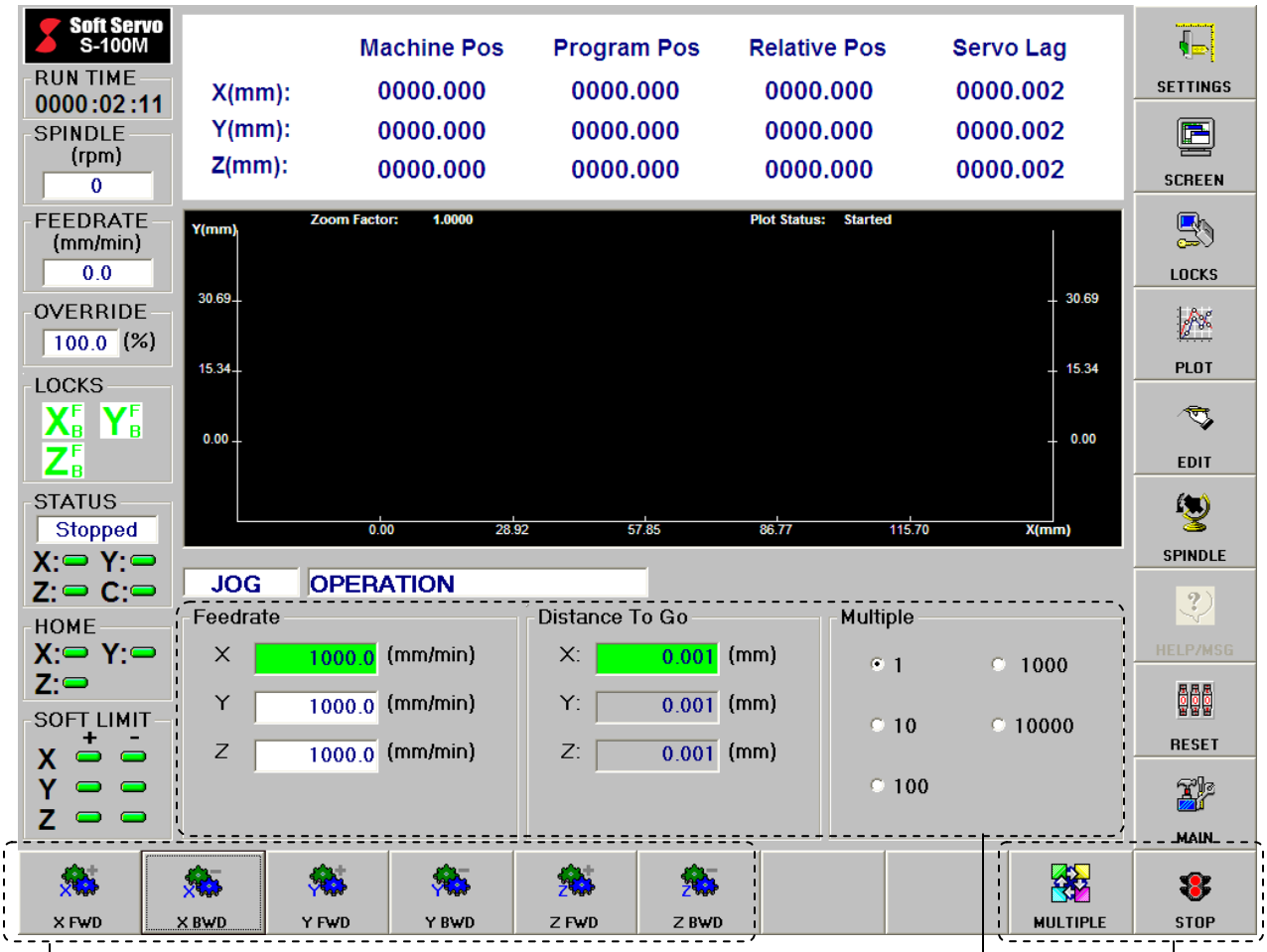
10.2 Using Jog Incremental Mode

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 

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.



These buttons start and stop the cycle of the Jog Incremental Mode motion for the specified axis and direction.

These frames display the Jog Incremental Mode feedrate settings and also allow you to set the Multiple if you have a mouse (otherwise, you must use the function key) The feedrates shown when you first enter Jog Incremental Mode are the feedrates set in the "NC Settings" screen of Configuration Mode. If you have a mouse, you can change these feedrates. [NOTE: Feedrates are NOT displayed in ServoWorks S-120M or S-140M.]

The "MULTIPLE" button is for selecting the multiple for calculating the "Distance to Go". The "STOP" button stops the cycle of the Jog Incremental Mode motion.

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

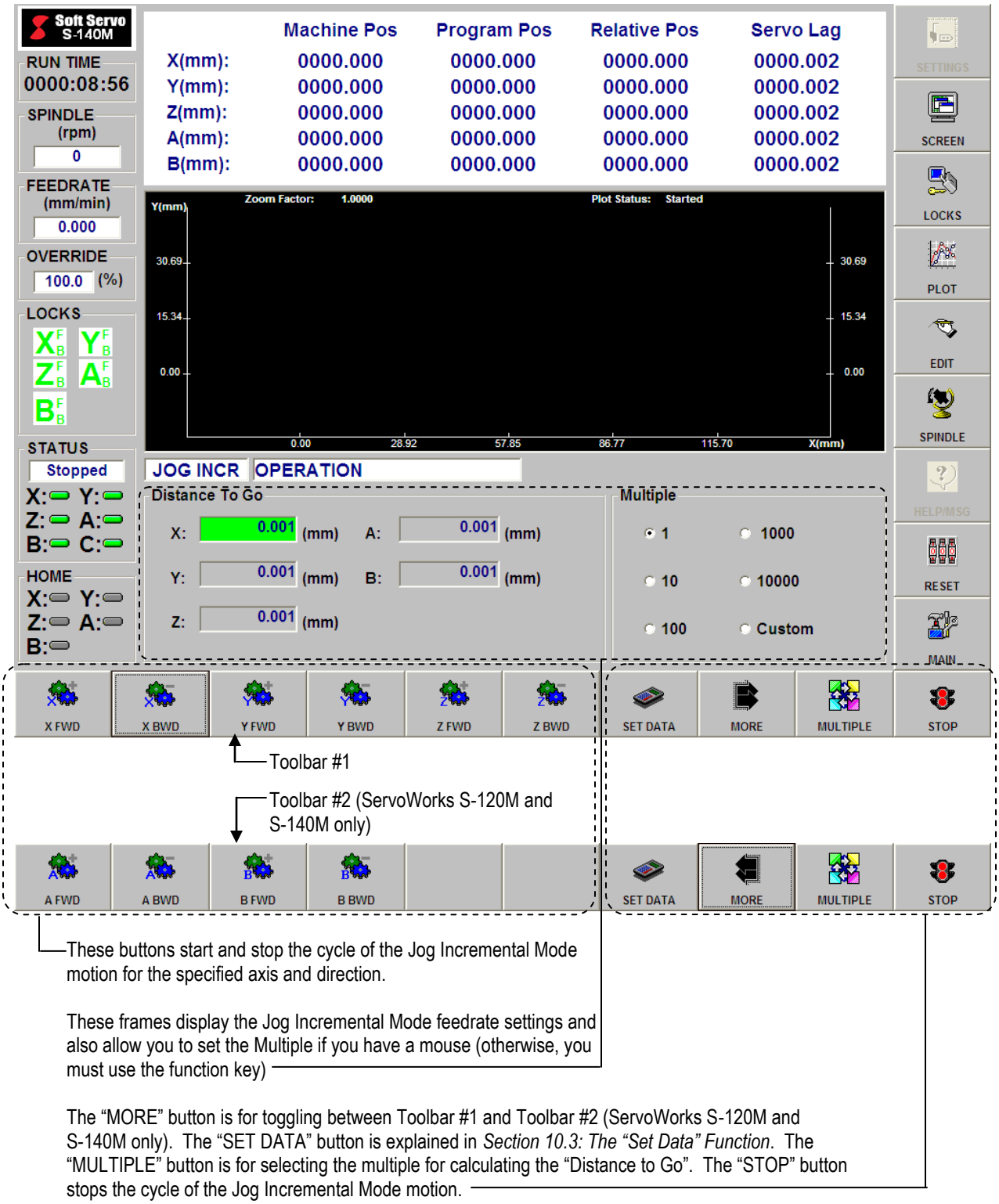


Figure 10-2: The Jog Incremental Mode Window for ServoWorks S-140M

3) This step is for ServoWorks S-100M only: 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.]

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

4) Select the "Multiple" value by using the 

button on the bottom toolbar to move through the six 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.

> **⚠ CAUTION**
>
> Be careful: it is very important that you be aware of this distinction. This is the only mode where you are specifying a distance in terms of pulses (machine units), not in terms of absolute distance (millimeters, inches or degrees). However, the distance to go is displayed in terms of millimeters, inches or degrees.

   NOTE: 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. For instance, pressing the 

button causes the X axis to move in the forward direction at the specified feedrate for the specified distance, and pressing the 

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 

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 

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.

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 

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 reaches only 5.000 mm, then you press the 

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.

When you want to quit Jog Incremental Mode, press he 

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 

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.

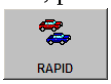
Chapter 11: Rapid Positioning (Using Rapid Mode)

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 Main window, press the 

button on the right toolbar of the ServoWorks S-1_0M window.)
2) Press the 

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

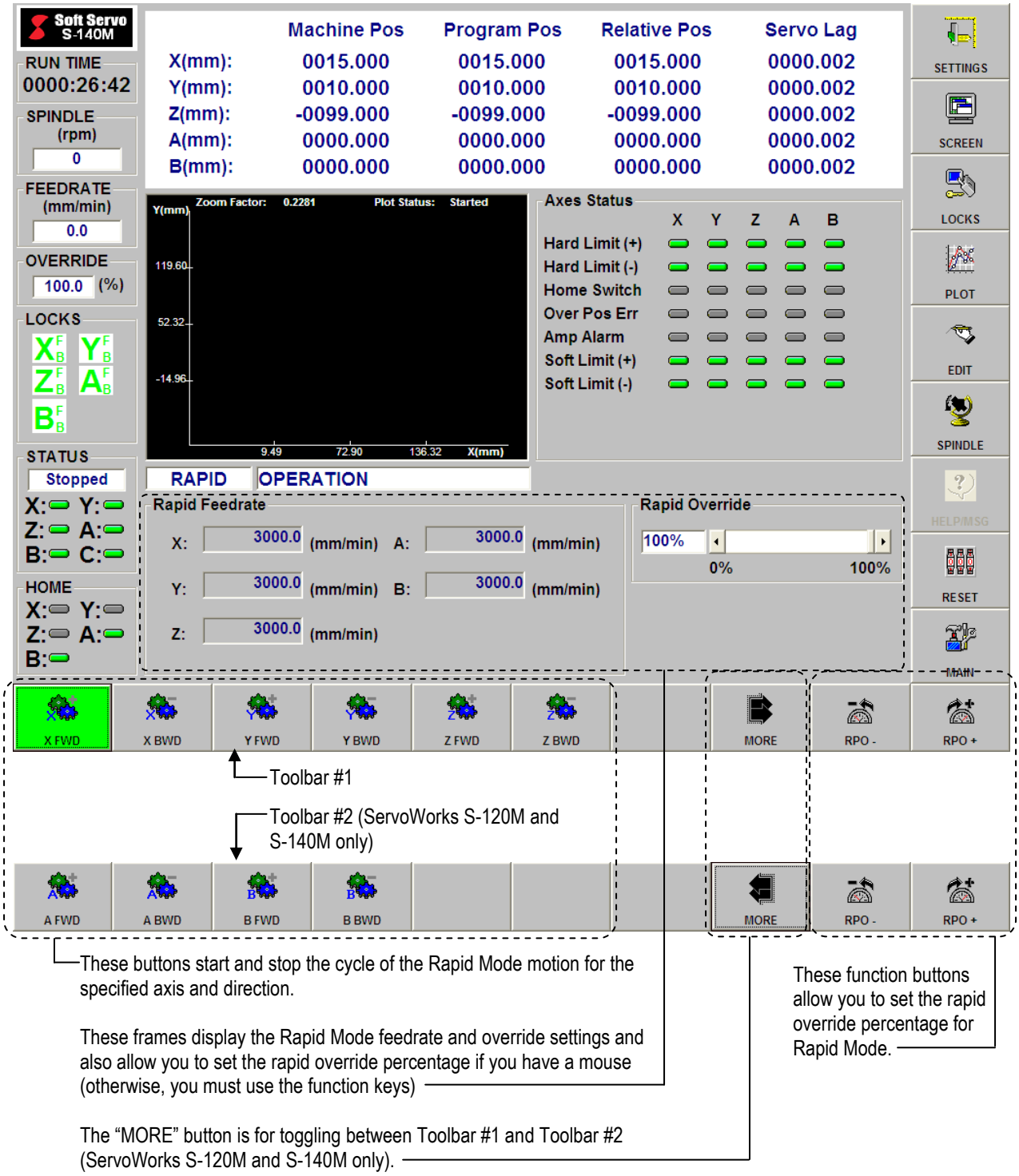


Figure 11-1: The Rapid Mode Window

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 

button to adjust the rapid override percentage to anything between 0 and 100%. The 

button will decrease the rapid override percentage, while the 

button will increase the rapid override percentage.

   NOTE: 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 

button causes 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 

and 

buttons to toggle between toolbars #1 and #2, as shown in Figure 11-1.

When you want to quit Rapid Mode, press the 

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

NOTE: 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.

⚠ CAUTION

When the NC settings parameter "Integer Programming With Machine Unit" is disabled, both integer and floating-point values in the G-code program are treated as either mm or inch (depending on G20/21 inch/metric setting in the NC program).

When integer programming is enabled, floating-point values are still treated as either mm or inch (depending on G20/21 inch/metric settings), but integer values are treated as a multiple of the "Machine Unit" parameter (in the "NC Settings" parameters screen of Configuration Mode, shown in Figure 3-4). In this case, the numerals that accompany the parameters for G codes are not absolute values defining the distance or position for that parameter. Rather, these values are multiplied by the machine unit set for ServoWorks S-1_0M system. The machine unit is the least input increment for ServoWorks S-1_0M system – the minimum unit of linear movement or distance that the actuator can be commanded to move. The machine unit can be set by the machine builder, and can be changed by an operator with password permission to do so.

For instance, when integer programming is enabled, if the machine unit in your system is 1.0 μm, and you give the parameter X13, you're actually commanding the position or distance of 13.0 μm. If the machine unit in your system is 2.0 μm, and you give the parameter X13, you're actually commanding the position or distance of 26.0 μm. **It is very important that you be aware of this distinction.**

⚠ CAUTION

Only uppercase letters will be recognized as axis symbols. Lower case letters will be ignored.

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

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 Main window, press the 

button on the right toolbar of the ServoWorks S-1_0M window.)

2) Press the 

button on the bottom toolbar of the ServoWorks S-1_0M Main Screen. You will then see the window shown in Figure 12-1.

   NOTE: If the 

button is disabled (appears as 

), it's probably because you have not set the home position for your axes. You must set the home position – see *Section 2.5 Performing a Homing Operation*. [Press the 

button on the bottom toolbar, then press the 

button on the bottom toolbar to set all axes to their home positions at the same time. Press the 

button to return to Main Mode. The 

button should now be enabled for you to select it.]

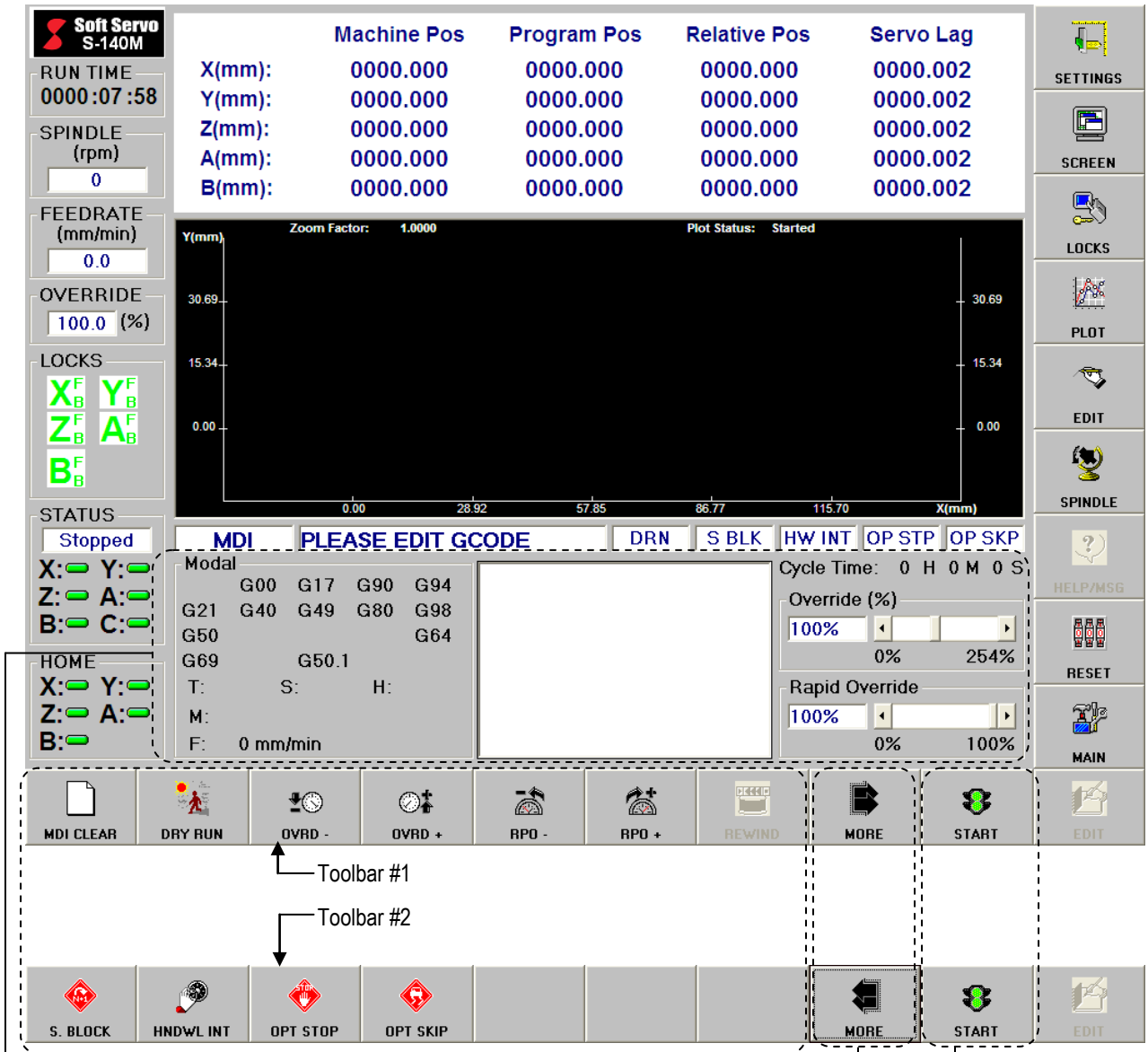


Figure 12-1: The MDI Mode Window (Showing Both Bottom Toolbars)

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

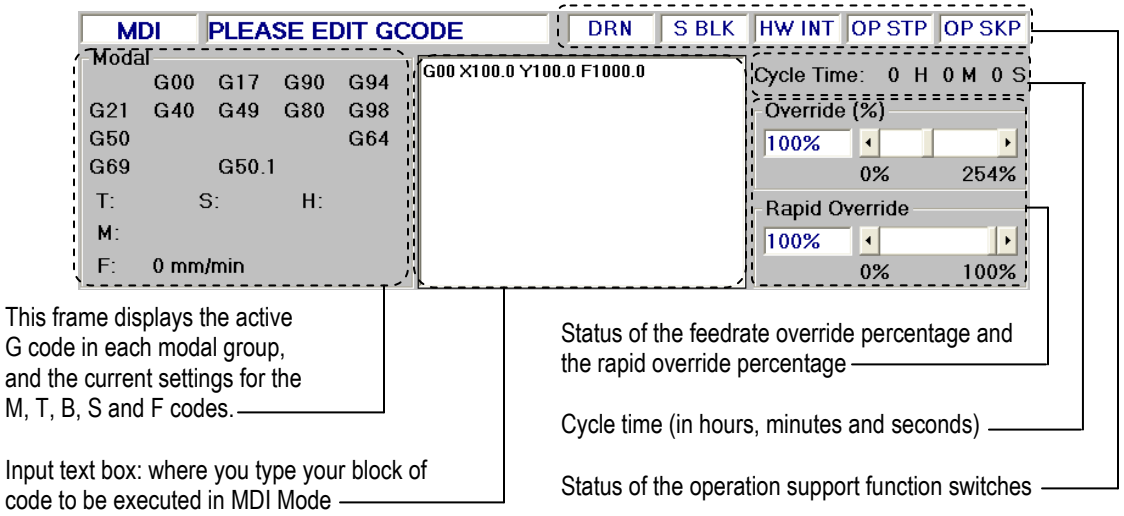


Figure 12-2: The MDI Mode Display Area

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 

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 

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 

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 will be executed at a time. In single block operational mode, pressing the 

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 press the 

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 the Single Block option is deselected, pressing the 

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 

button will immediately change the execution to single block operational mode.

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 

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 

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).

- 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.

3) Press the 

button on the right side of the bottom toolbar to start the execution of the block(s) of code in your text box.

   NOTE: 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 

button on the right side of the bottom toolbar.

   To continue or finish execution of the current block of code, press the 

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).

   NOTE: The only way to cancel the execution of the current block of code is to press the 

button and then the 

button (which deletes all blocks of code in the input text box), or to leave MDI Mode.

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.

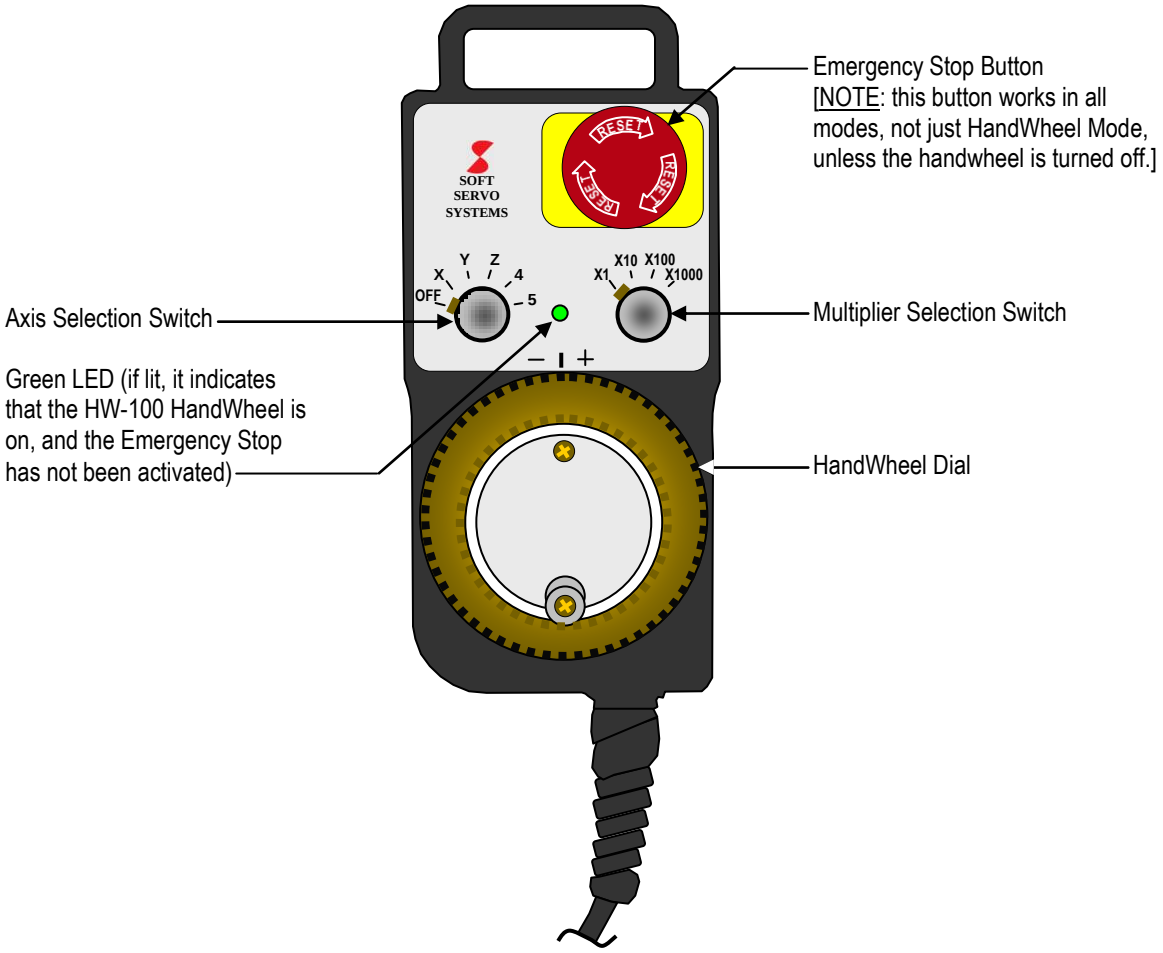


Figure 13-1: The HW-100 HandWheel Control

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.

⚠ CAUTION

Be careful about going into Handwheel Mode. Always keep the handwheel turned off when you're not using it. And try to keep the handwheel in a safe place, so if it is 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 

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.

   NOTE: If the 

button is disabled (appears as 

), then you need to go to Configuration Mode and enable the handwheel. Get into Configuration Mode by pressing the 

button in the lower right corner of ServoWorks S-1_0M screen. Click on the 

button, and select a "Handwheel Type" other than "Unused" in the "HandWheel Settings" frame.

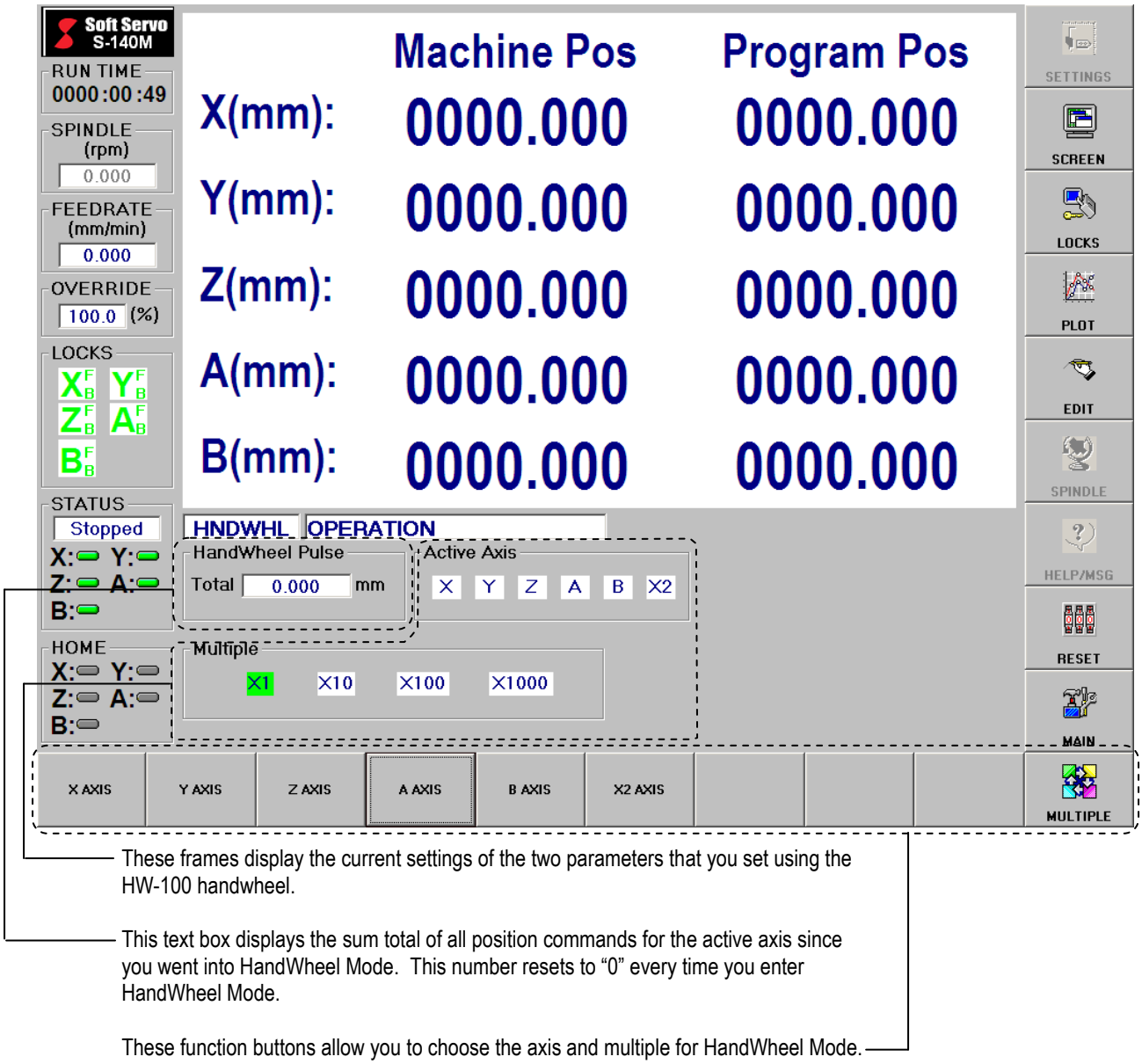


Figure 13-2: The HandWheel Mode Window

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 pressing the 

button which toggles you through your four options for multiplier levels: X1, X10, X100 and X1000. This button overrides the settings on the HW-100 Multiplier Selection Switch until the next time you use the Multiplier Selection Switch.

⚠ CAUTION

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.

⚠ CAUTION

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. Don't let this confuse you. The multiplier (1, 10, 100 or 1000) is not applied to millimeters or inches, but to the machine unit parameter specified in the "Axis Control" screen of Configuration Mode.

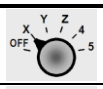
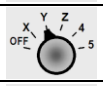
5) You need to specify which axis to move. There are two ways to do this. If you are using the HW-100 HandWheel, you can use the Axis Selection Switch (see Figure 13-1) to select which axis to move (see Table 13-1). Or you can press the button corresponding to the axis you want (for example, the 

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.)

NOTE: 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.

⚠ CAUTION

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	Axis 1 – 4 (first DC-155 for the VersioBus II interface system)	X 
2		Y 
3		Z 
Spindle		Not applicable
4 (ServoWorks S-120M and S-140M only)	Axis 5 – 6 (second DC-155 for the VersioBus II interface system)	X 
5 (ServoWorks S-140M only)		Y 

NOTE: 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*.

When you want to quit HandWheel Mode, press the 

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

NOTE: 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.

⚠ CAUTION

When the NC settings parameter "Integer Programming With Machine Unit" is disabled, both integer and floating-point values in the G-code program are treated as either mm or inch (depending on G20/21 inch/metric setting in the NC program).

When integer programming is enabled, floating-point values are still treated as either mm or inch (depending on G20/21 inch/metric settings), but integer values are treated as a multiple of the "Machine Unit" parameter (in the "NC Settings" parameters screen of Configuration Mode, shown in Figure 3-4). In this case, the numerals that accompany the parameters for G codes are not absolute values defining the distance or position for that parameter. Rather, these values are multiplied by the machine unit set for ServoWorks S-1_0M system. The machine unit is the least input increment for ServoWorks S-1_0M system – the minimum unit of linear movement or distance that the actuator can be commanded to move. The machine unit can be set by the machine builder, and can be changed by an operator with password permission to do so.

For instance, when integer programming is enabled, if the machine unit in your system is 1.0 μm, and you give the parameter X13, you're actually commanding the position or distance of 13.0 μm. If the machine unit in your system is 2.0 μm, and you give the parameter X13, you're actually commanding the position or distance of 26.0 μm. **It is very important that you be aware of this distinction.**

⚠ CAUTION

Only uppercase letters will be recognized as axis symbols. Lower case letters will be ignored.

NOTE: 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

You can edit or create a CNC file by pressing the 

button on the right toolbar. This will put you into Edit Mode (a sub mode), and you will see the following window:

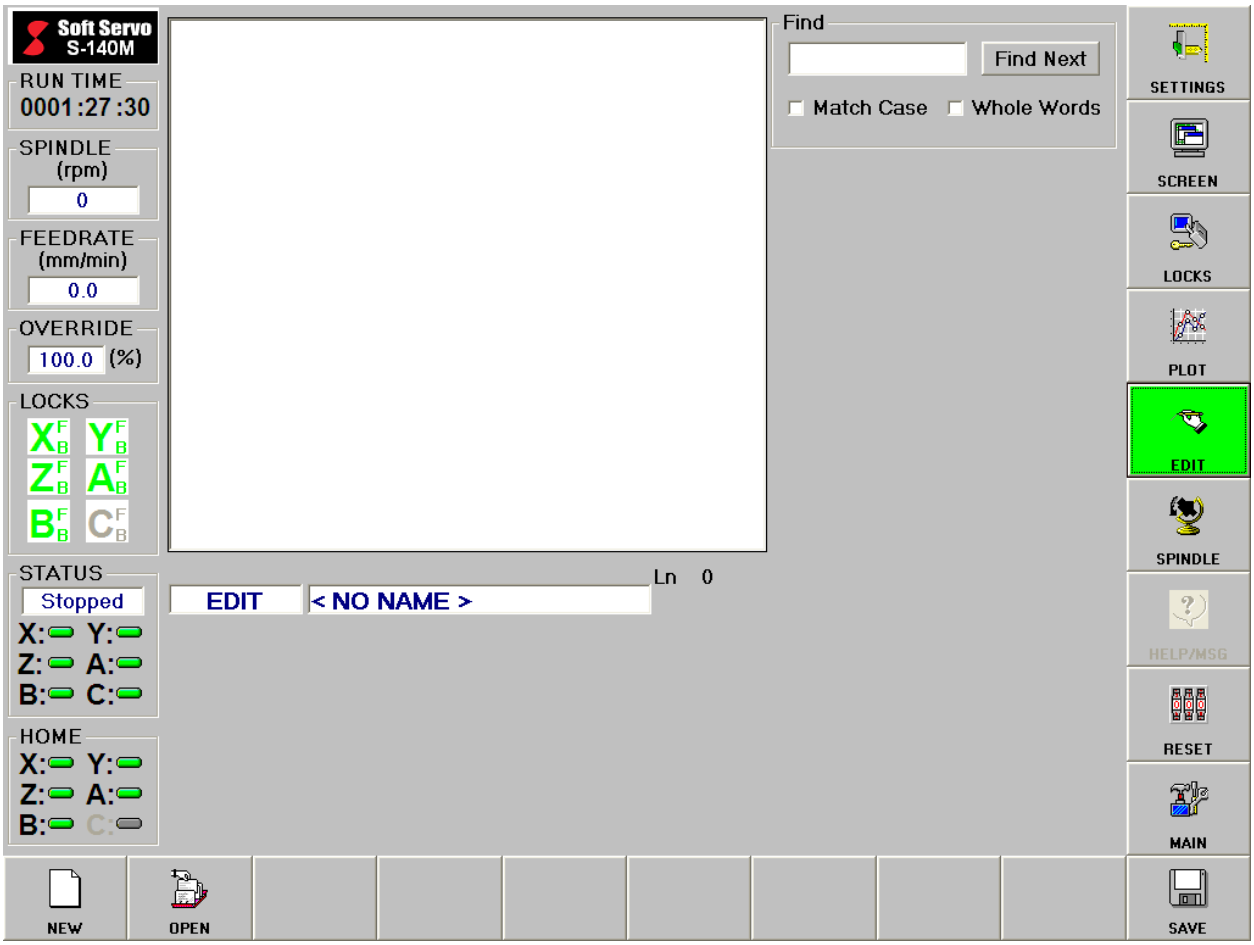


Figure 14-1: Edit Mode Window

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:

1) Press the 

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

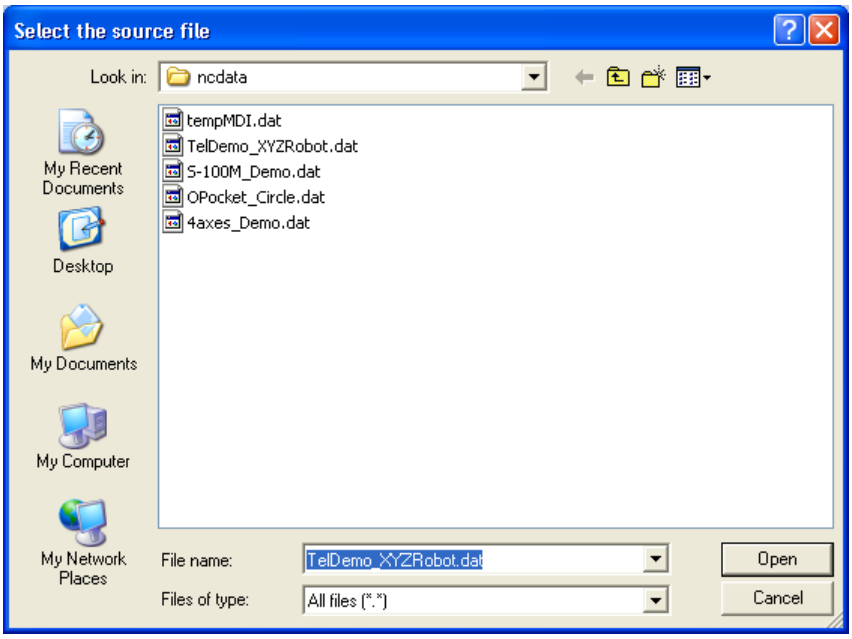


Figure 14-2: "Select the source file" Window

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.

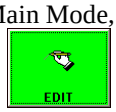
14.5 Saving Your File After Editing

To save your file, press the 

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 to Main Mode. If you entered Edit Mode from an operational mode, pressing the 

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 Main window, press the 

button on the right toolbar of the ServoWorks S-1_0M window.)

2) Press the 

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.

   NOTE: If the 

button is disabled (appears as 

), it's probably because you have not set the home position for your axes. You must set the home position – see *Section 2.5 Performing a Homing Operation*. [Press the 

button on the bottom toolbar, then press the 

button on the bottom toolbar to set all axes to their home positions at the same time. Press the 

button to return to Main Mode. The 

button should now be enabled for you to select it.]

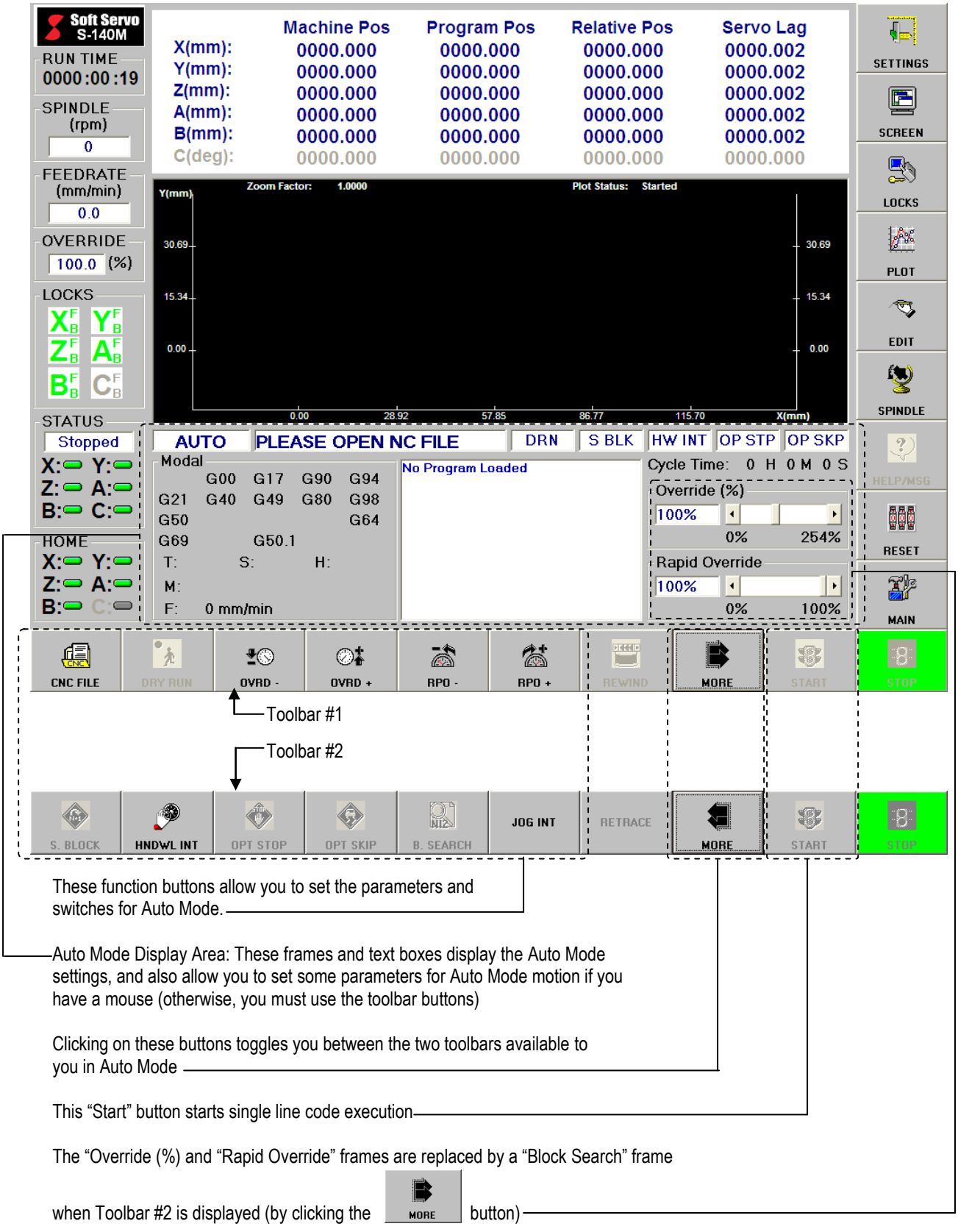


Figure 15-1: Auto Mode Window (Showing Both Bottom Toolbars)

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

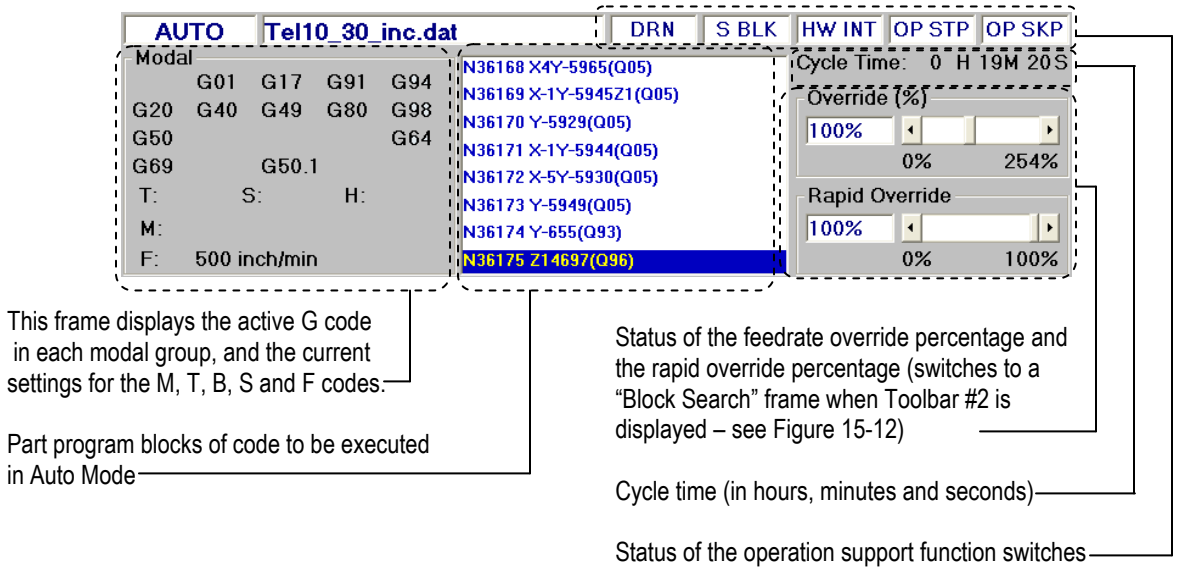


Figure 15-2: The Auto Mode Display Area

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 

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

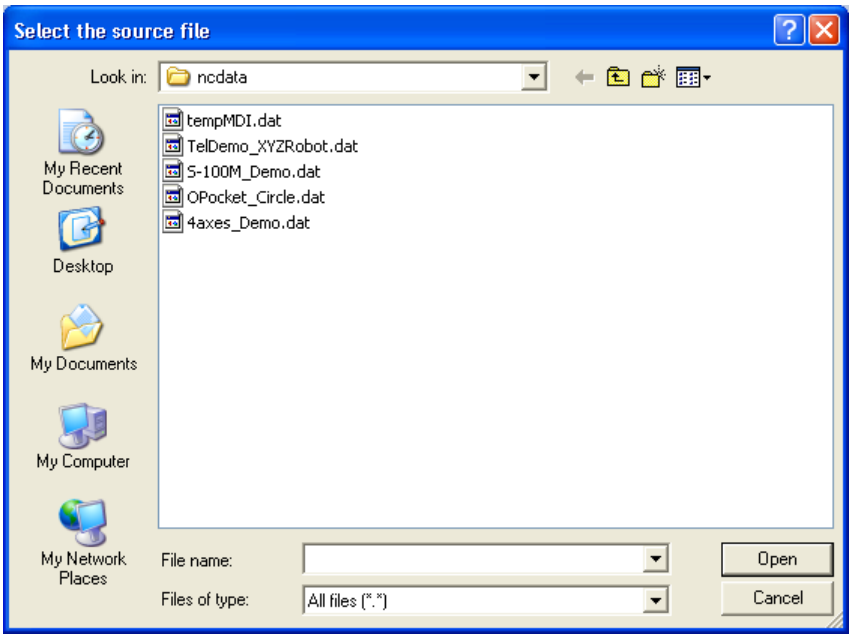


Figure 15-3: "Select the source file" Window

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.

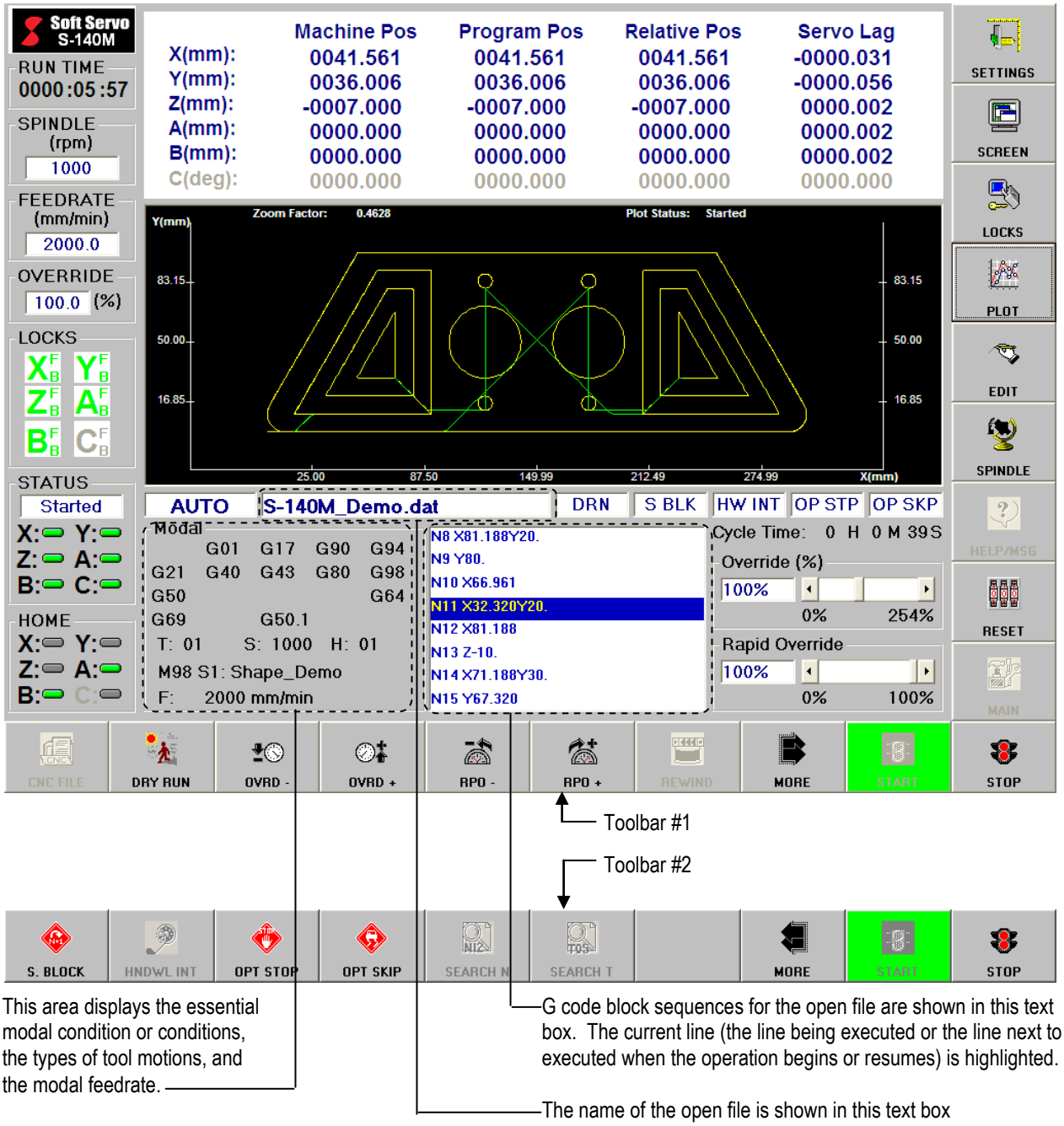


Figure 15-4: Auto Mode Window (Showing Both Toolbars) With CNC G Code File Executing

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 

and 

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 

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		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 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 

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 executed at a time. In single block operational mode, pressing the 

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 press the 

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 the Single Block option is deselected, pressing the 

button will cause normal, continuous execution of G code to begin.

- At any time during a normal, continuous execution of a part program, pressing the 

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 the handwheel. Therefore, you must press the 

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.

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 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.

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).

- 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.

2) Press the 

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 

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 

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.

⚠ CAUTION

NOTE: Before you run production, you must unlock the Machine Locks. This will restore the correct program position and machine position (instead of the simulated positions that were displayed when the Machine Locks were turned on). Also, in order to restore the original workpiece coordinate offset (the workpiece coordinate offset in effect before you turned on Machine Lock), you must perform a homing operation.

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 

button.

3) Set the dry run speed by pressing the 

and 

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 

and 

buttons on the bottom 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 

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 

button on the bottom toolbar. The dry run will be 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 

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 

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.

1) Make sure you are in Configuration Mode. (If not, press the 

button on the bottom toolbar of the ServoWorks S-1_0M Main Screen.)

2) Click on the 

button, and the Plot screen will appear, as, shown in the following figure:

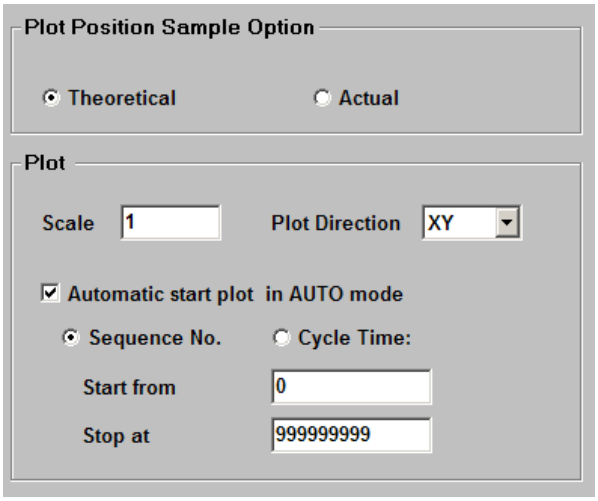


Figure 15-6: Configuration Mode –Plot Parameters Screen

3) 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 "0H 0M 0S" to specify time – include the hour, the minute and the second.

7) Press the 

button to save your changes.

CAUTION

Be careful: if you leave the Configuration Mode without pressing the 

button, all of your changes will be lost, and you may or may not realize that your changes have not been saved.

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

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).

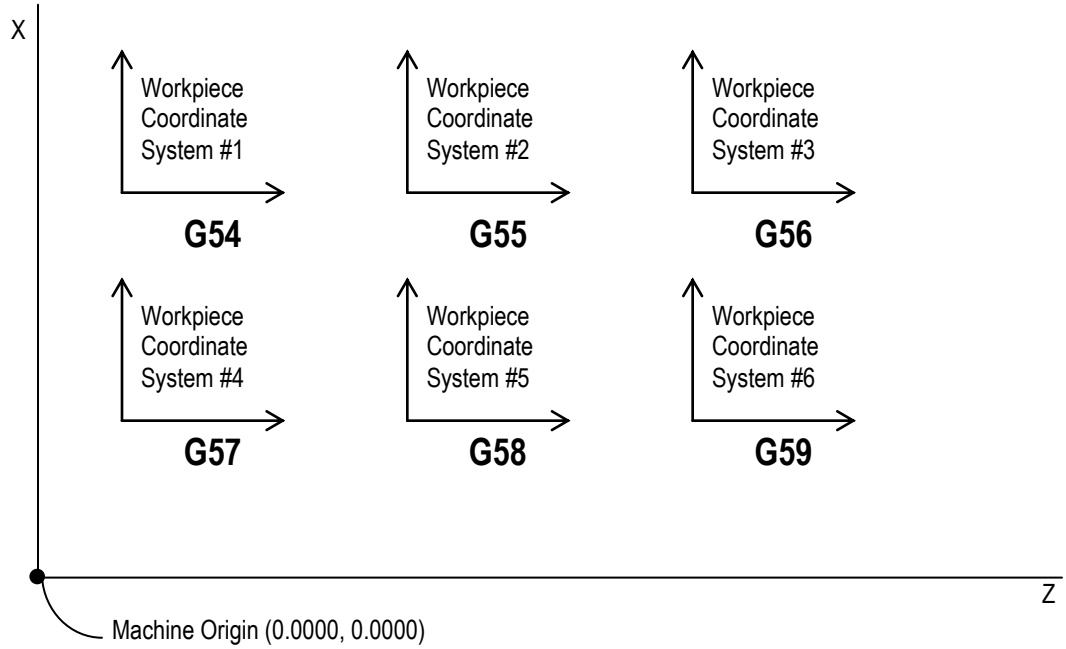


Figure 15-7: Workpiece Coordinate Selection

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 SETTINGS button is disabled (appears as SETTINGS), it's probably because you have not set the home position for your axes. You must set the home position – see *Section 2.5 Performing a Homing Operation*.

[Press the HOME button on the bottom toolbar, then press the HOME ALL button on the bottom toolbar to set all axes to their home positions at the same time. Press the MAIN button to return to Main Mode. The SETTINGS button should now be enabled for you to select it.]

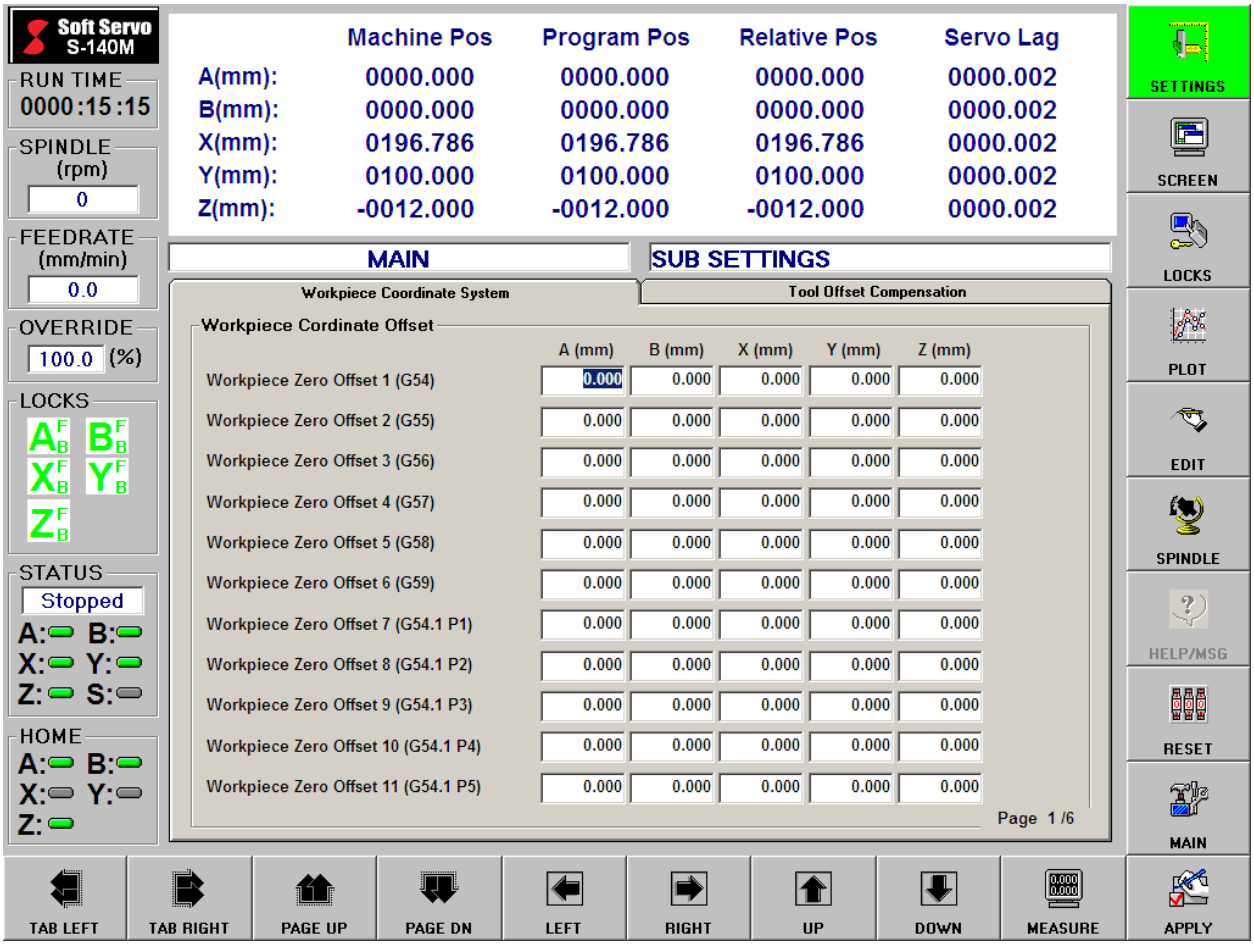


Figure 15-8: The Settings Mode Window – Workpiece Coordinates Screen

15.7.3 Selecting and Changing the Input for the Work Point Parameters

15.7.3.1 Moving Between Pages

Press the 

button to move to the next page of workpiece coordinate offsets, or press the 

button to move to the previous page of workpiece coordinate offsets. (Pressing the 

button or the 

button toggles you between the workpiece coordinate offset settings and the tool offset compensation settings.)

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 

, 

, 

, and 

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

NOTE: 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

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.

CAUTION

Be careful: if you leave the Settings Mode without pressing the 

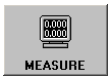
button, all of your changes will be lost, and you may or may not realize that your changes have not been saved.

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 

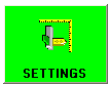
button sets the workpiece coordinate position as the current machine coordinate value for the selected (highlighted) axis in the Workpiece Coordinate System screen, and sets the program position for that axis to zero. Obviously, this saves you time when you want to quickly set up multiple workpiece coordinates.

The 

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

15.7.5 Exiting Settings Mode

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

button), press the "Escape" key on your keyboard, or press the 

button again.

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:

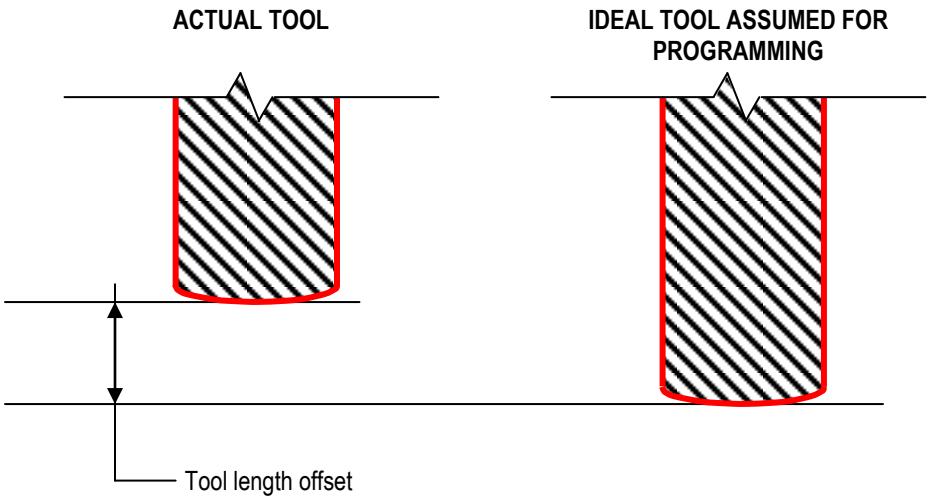


Figure 15-9: Tool Length Offset

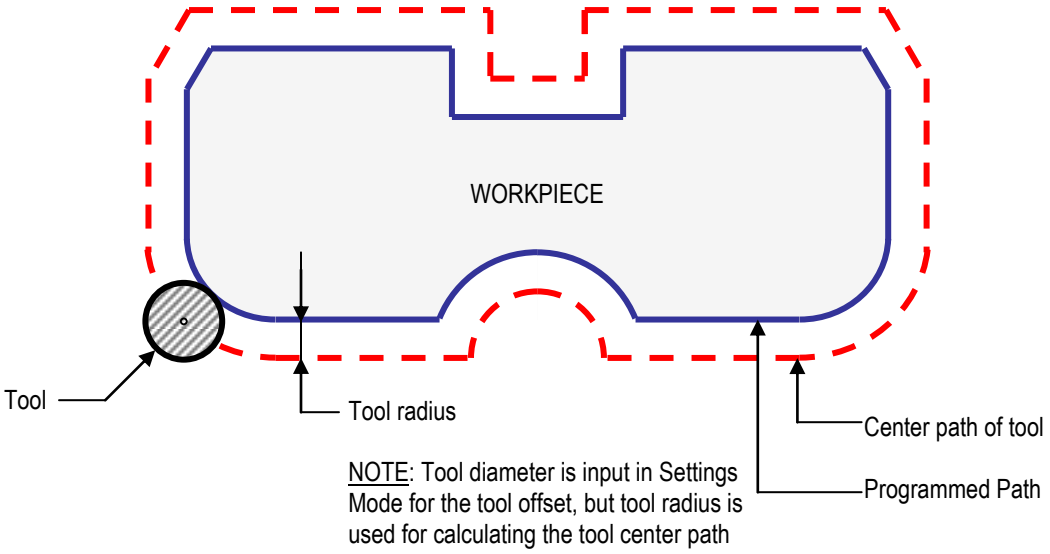


Figure 15-10: Tool Radius Offset

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 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 SETTINGS button is disabled (appears as SETTINGS), it's probably because you have not set the home position for your axes. You must set the home position – see *Section 2.5 Performing a Homing Operation*. [Press the HOME button on the bottom toolbar, then press the HOME ALL button on the bottom toolbar to set all axes to their home positions at the same time. Press the MAIN button to return to Main Mode. The SETTINGS button should now be enabled for you to select it.]

There are two tabs in Settings Mode. Press the TAB RIGHT button or the TAB LEFT button to get to the second screen, shown in the following figure:

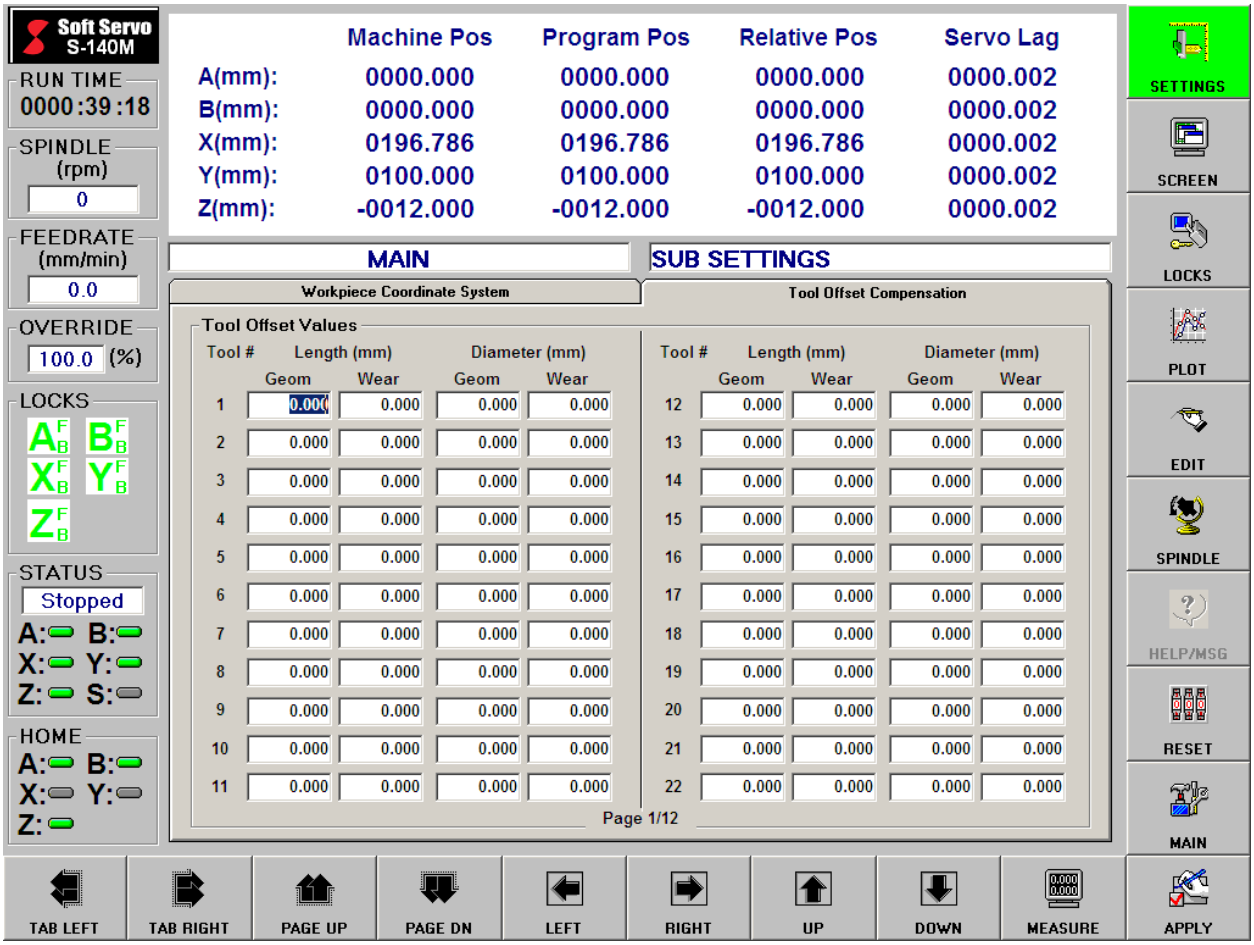


Figure 15-11: The Settings Mode Window – Tool Offset Compensation Screen

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 buttons on the bottom 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 LEFT, RIGHT, UP, and DOWN buttons on the bottom toolbar to move to the desired text box.

NOTE: 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.

15.8.3.4 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.

CAUTION

Be careful: if you leave Settings Mode without pressing the 

button, all of your changes will be lost, and you may or may not realize that your changes have not been saved.

15.8.4 Using the Measure Function for Setting Tool Offsets

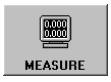
ServoWorks S-1_0M provides a function to measure (calibrate) the tool length offset values for tool length geometry values. This is useful when you can use a handwheel to move the tool to do a touch-off or a skim cut.

Pressing the 

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.

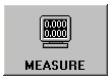
For example, if the Z axis program position is 0.005 mm, and the Tool Length Calibration Position is 0.003 mm, pressing the 

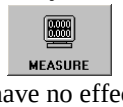
button would set the tool length geometry offset value for the highlighted tool # as 0.002 mm (0.005 mm – 0.003 mm = 0.002 mm).

The 

button works on one axis at a time, for one tool length geometry setting at a time.

CAUTION

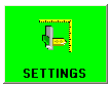
NOTE: The 

button only works when tool length geometry offset values are highlighted. Pressing the 

button when a tool length geometry offset value is not highlighted will have no effect.

15.8.5 Exiting Settings Mode

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

button), press the "Escape" key on your keyboard, or press the 

button again.

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.

NOTE: 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

To start the CNC G code execution, press the 

button on the bottom toolbar. During execution, the line of code being executed is highlighted.

To stop the CNC G code execution, press the 

button on the bottom toolbar. The operation will be suspended immediately.

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

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 

button on the bottom toolbar. You will see the following dialog box appear:

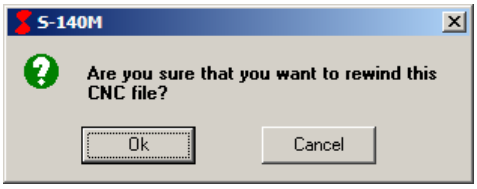


Figure 15-12: Confirmation Dialog Box for Rewinding a Program

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).

   NOTE: 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 MORE button on the bottom toolbar). The screen should appear as follows:

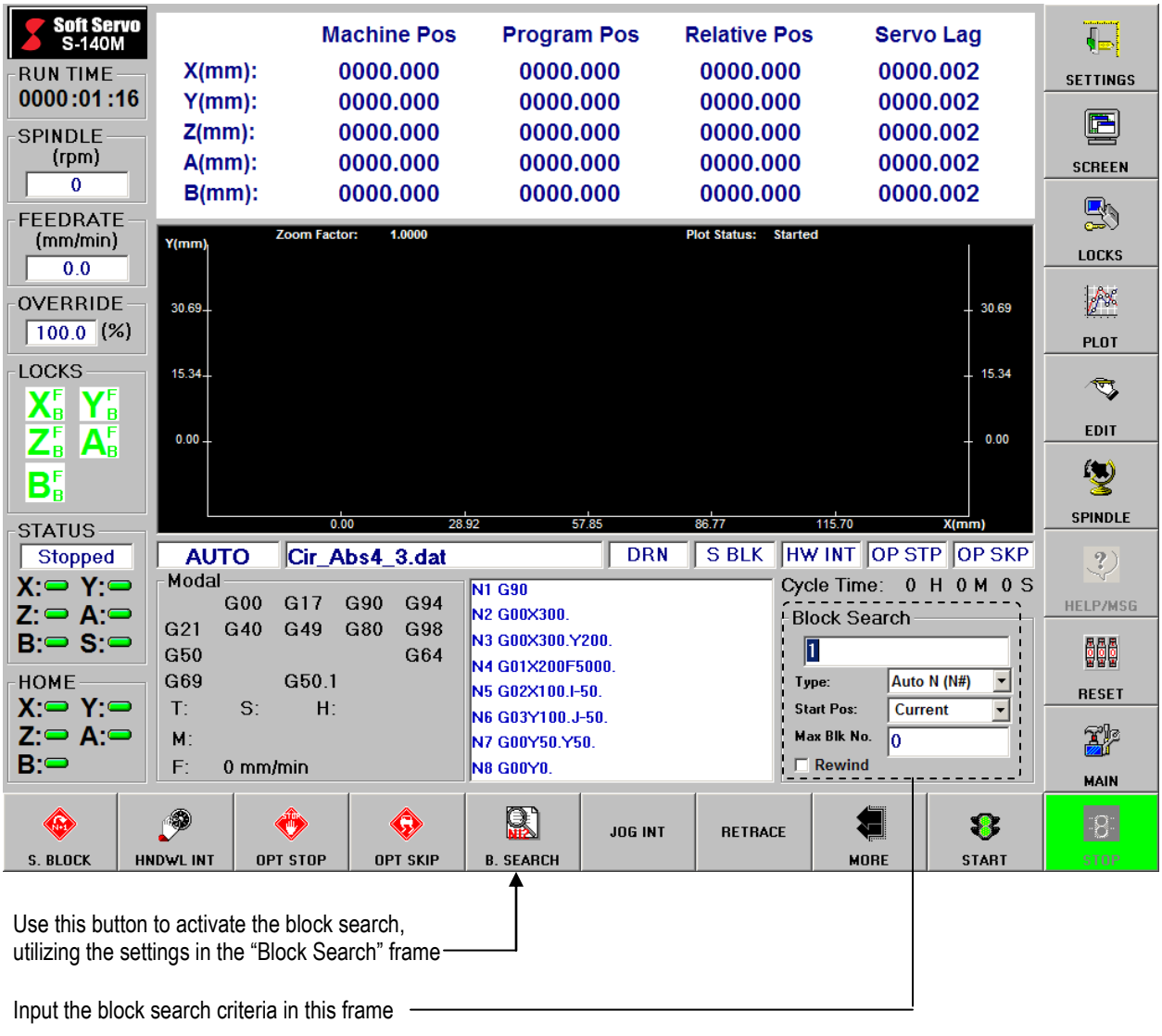


Figure 15-13: Auto Mode Showing the Block Search Function

15.9.4.2 Block Search Type

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

1) **Auto N (N#)** – 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) **User-Spec N (N#)** – 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) **Prgm Line No.** – 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) **Tool No. (T#)** – Searches for a specific tool number in the part program (T1, T2, etc.)

5) **M-Code No. (M#)** – Searches for a specific machine code number in the program (M01, M02, etc.).

6) **Proc. Block No.** – 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.

NOTE: 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.

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 

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:

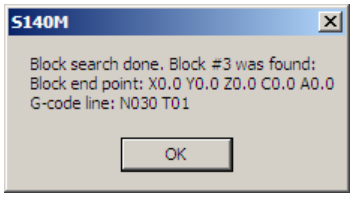


Figure 15-14: Block Search T Code Found Dialog Box

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 executed, and then execution will stop upon reaching the block end position. If you press the 

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.

⚠ CAUTION

You must not type "T01" or "N01" or any letters into the Block Search text box. Doing so will result in a serious error.

NOTE: 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 40th line of code.

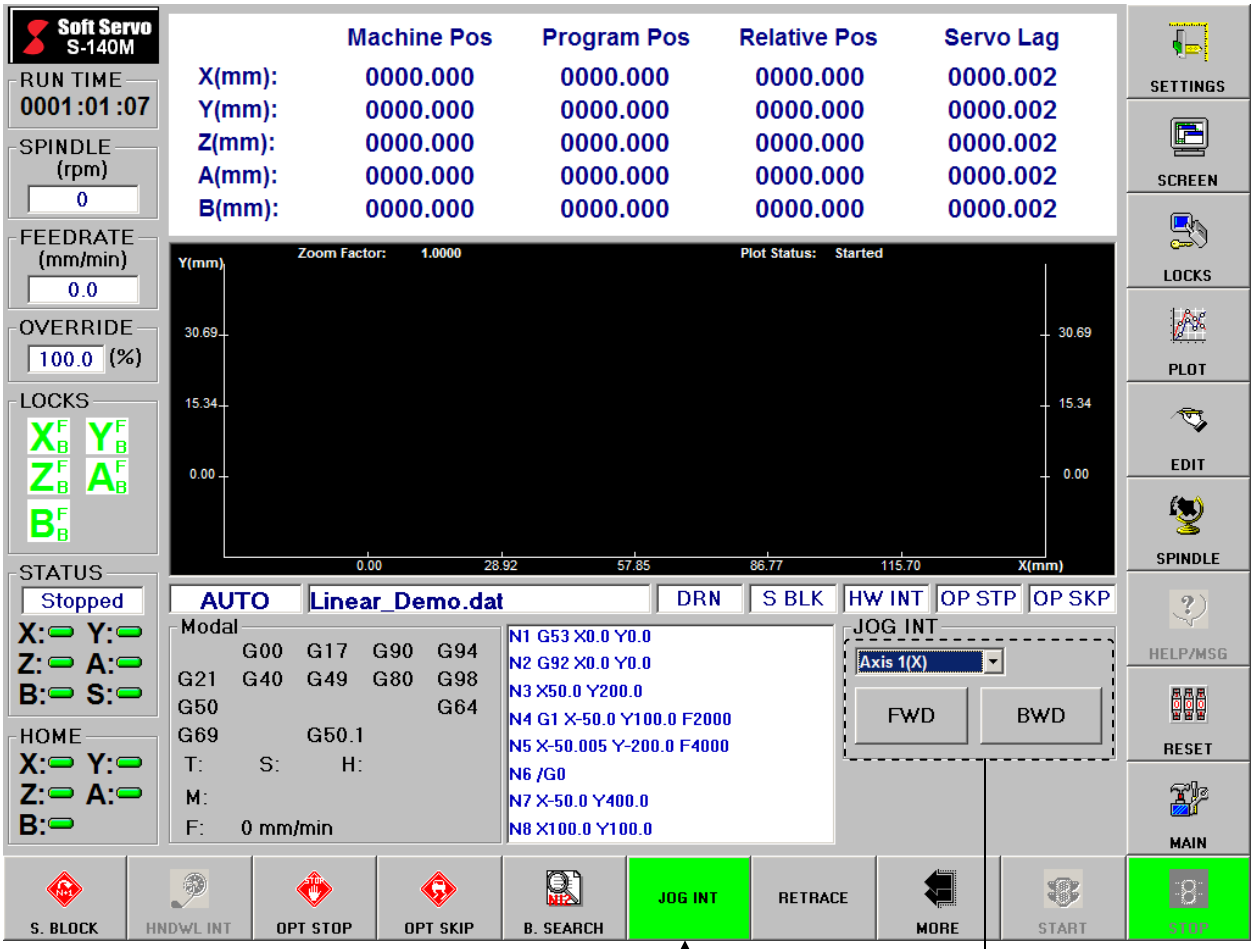
If the search returns no results (the specified code wasn't found in the current part program), the following error message is displayed:

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 displayed, select Toolbar #2 by pressing the MORE button on the bottom toolbar). Press the JOG INT button, and the screen should appear as follows:



Use this button to display the "JOG INT" frame, and to interrupt any current G code execution.

Use the pull-down menu in this frame to specify the axis you wish to move. Control that 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.

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 

button to move that axis in the forward direction, or use the 

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.

NOTE: 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:

1) Stop all motion by pressing the 

button in the lower right corner.

2) Press the 

button on the bottom toolbar to turn on the retrace function. [The button changes color.]

3) Press the 

button on the bottom toolbar to start the retrace movement.

4) When the retrace movement has completed, press the 

button again to turn OFF the retrace function. [Alternatively, you can interrupt the retrace function by pressing the 

button before the retrace function retraces all 200 blocks, THEN press the 

button again to turn OFF the retrace function.

5) Press the 

button again to start normal, forward execution of the G code program.

15.10 Exiting Auto Mode

To exit Auto Mode, press the 

button on the right toolbar or press the "Escape" key on your keyboard. If you had used Auto Mode to run a part program file, you will see the following dialog box appear:

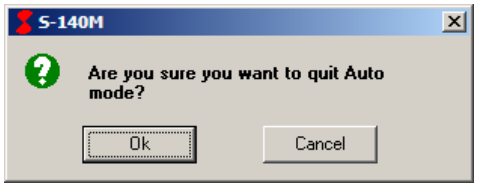


Figure 15-17: Confirmation Dialog Box for Exiting Auto Mode

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).

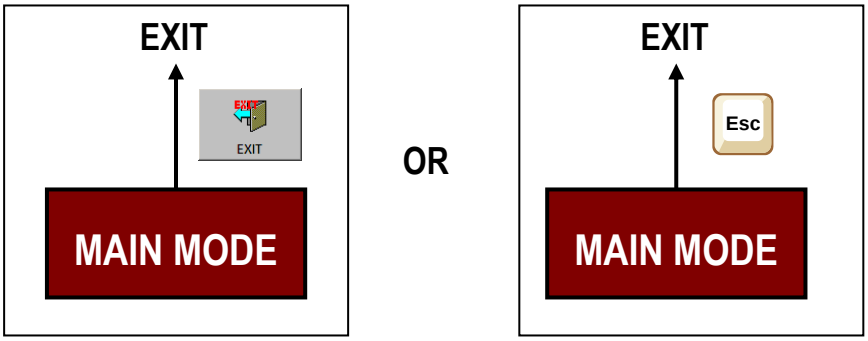


Figure 16-1: Exiting from Main Mode

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.

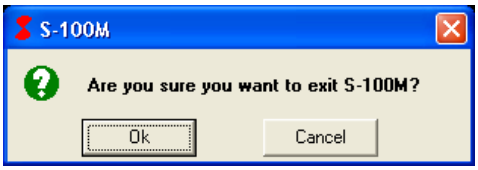


Figure 16-2: Dialog Box to Confirm Exiting ServoWorks S-100M

16.2 Exiting from an Operational Mode

If you are in an operational mode, you should stop all motion, then press the 

button to get to Main Mode, and then press the 

button to exit.

Alternatively, if you are in an operational mode, 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.

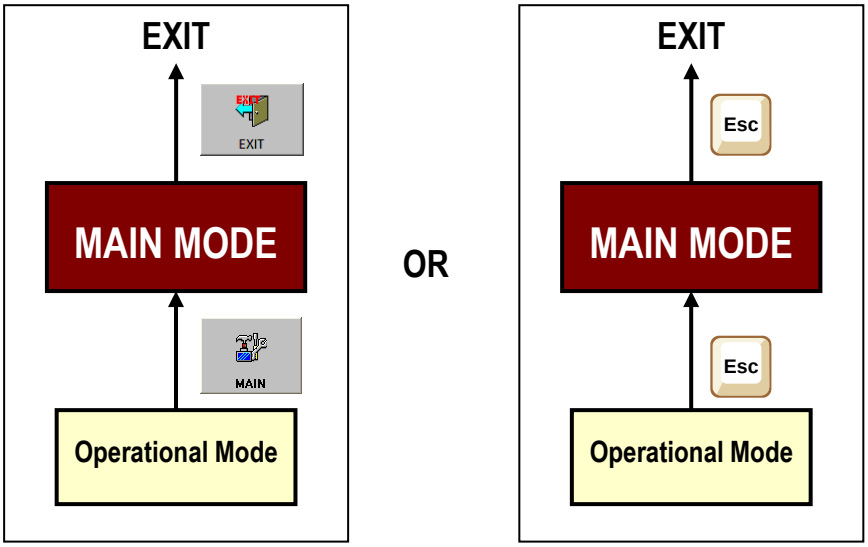


Figure 16-3: Exiting from an Operational Mode

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.

16.3 Exiting from a Sub Mode

16.3.1 If You Entered the Sub Mode From Main Mode

You can press the 

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.

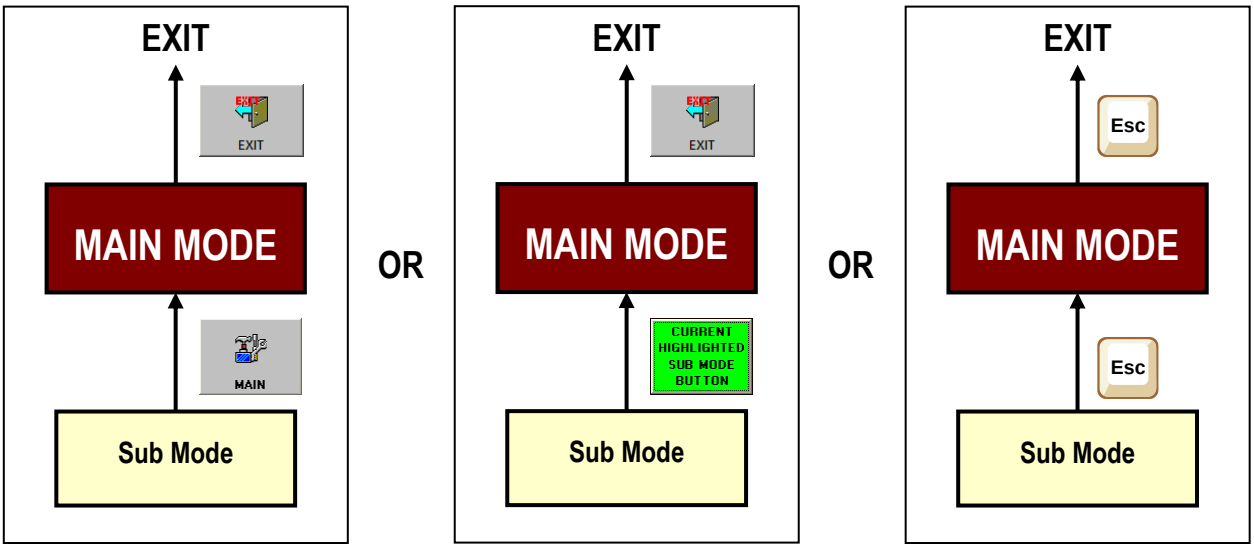


Figure 16-4: Exiting from a Sub Mode That Was Entered from Main Mode

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.

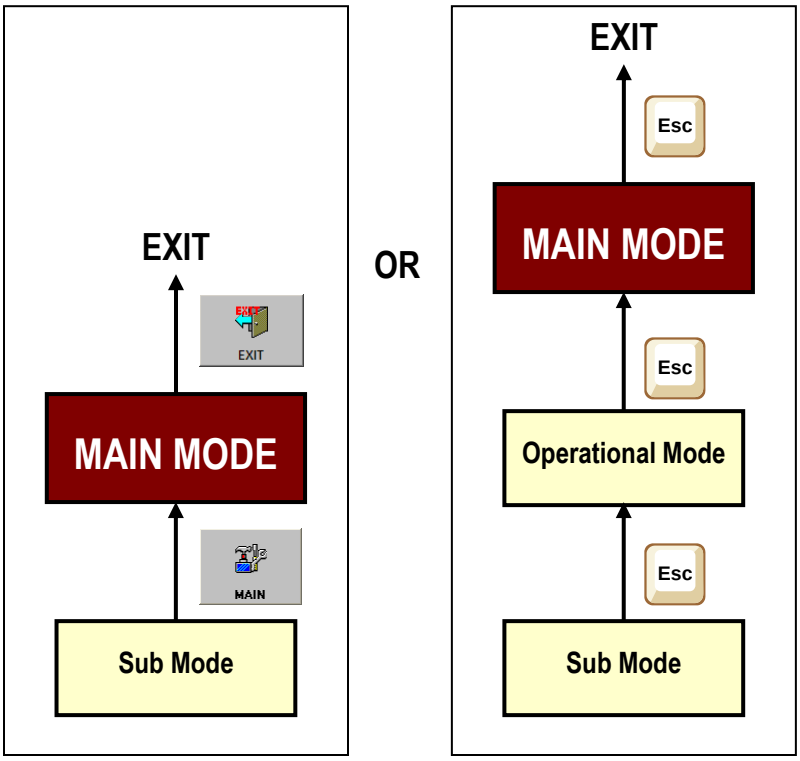


Figure 16-5: Exiting from a Sub Mode That Was Entered from an Operational Mode

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:

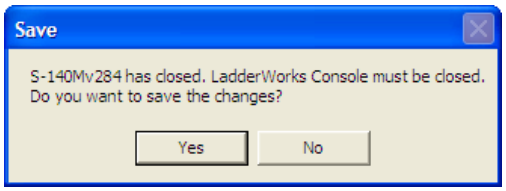


Figure 16-6: LadderWorks Console Automatic Closing Dialog Box

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 

button if the computer behaves unexpectedly. The 

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 

button, then the spindle will be stopped.

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.

[NOTE: 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 [NOTE: the computer may feel "frozen" while this data is saving.]

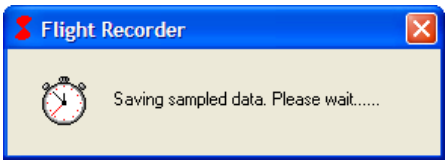


Figure 17-1: Flight Recorder Saving Dialog Box

When the data has saved to a file on the hard drive, the following dialog box will appear:

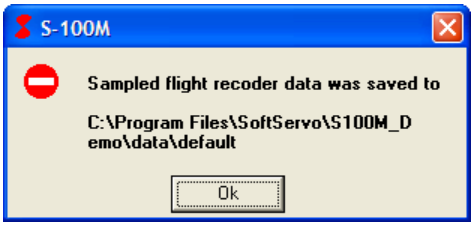


Figure 17-2: Flight Data File Information Dialog Box

This dialog box tells you the name and location of the folder with the saved data files, as shown:

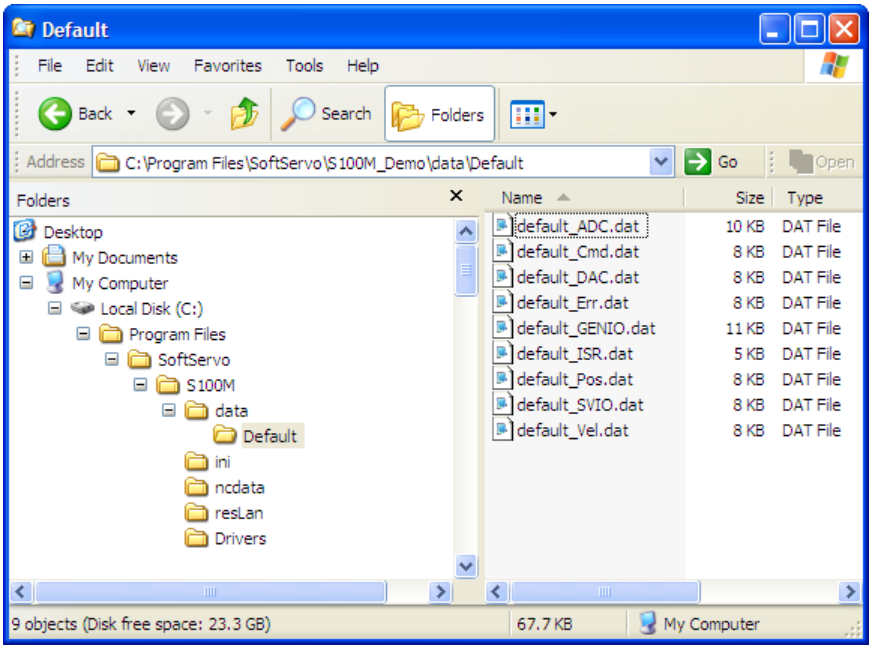


Figure 17-3: Flight Recorder Files in Default Data Folder

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.

NOTE: 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).	✓	
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 µm to 1 mm; around 25400 µm to 1 inch).	✓	✓
default_DAC.dat	digital to analog conversion (DAC)	Commands sent from the ServoWorks CNC Engine to the motors.	✓	
default_Err.dat	position error	The difference between the machine positions of default_Pos and default_Cmd.	✓	
default_GENIO.dat	general I/O values	General hardware I/O status.	✓	
default_ISR.dat	the interrupt service routine (ISR)	Interrupt service routine duration, interval, abnormal samples log, and activity log.	✓	
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 µm to 1 mm; around 25400 µm to 1 inch).	✓	✓
default_SVIO.dat	servo I/O values	Servo amplifier and handwheel I/O status.	✓	
default_Vel.dat	velocity	The machine velocity based on the feedback from the servo amplifiers. The velocity units are in mm/min.	✓	

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:

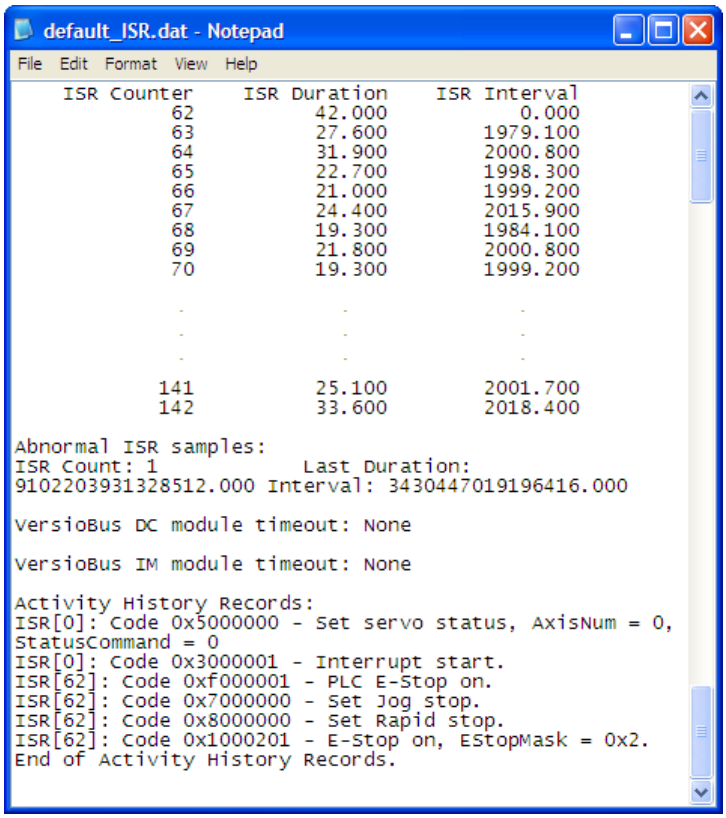


Figure 17-4: Sample default_ISR.dat File

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