

LadderWorks PLC User's Manual

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Chapter 1: LadderWorks PLC Product Overview

1.1 Components Included with LadderWorks PLC

LadderWorksTM PLC is an independent programmable logic control (PLC) package that is included with and integrated with all of Soft Servo Systems' SMP general motion control products and all ServoWorks CNC products.

LadderWorks PLC includes:

- <u>The LadderWorks PLC Engine</u> a real-time soft PLC module that executes PLC sequence programs in binary format. [NOTE: the LadderWorks PLC Engine only executes in conjunction with the soft Motion Engine of a ServoWorks CNC product or an SMP product, because the LadderWorks PLC Engine is seamlessly integrated with the ServoWorks CNC Engine/SMP Motion Engine into a single motion/machine control application.] This PLC for machines and machine tools reads and executes the binary PLC sequence program file every 5 ms (or every 8 ms for ServoWorks S-100T, or some other user-defined scan time), decides if it needs to take any action based on these inputs or changes in these inputs, and issues commands to the ServoWorks CNC Engine/SMP Motion Engine or the machine, if necessary.
- <u>LadderWorks Console</u> a Win32 application for creating, editing, monitoring, debugging and compiling PLC ladder diagram (LD) sequence programs (see Note #3 on page 1-2 for compatibility requirements)
- Four separate utility programs:
 - <u>PLC Control Screen Utility</u> a stand-alone application that you can use to edit and compile your sequence programs in PLC Instruction List (IL) format into executable binary files, which can then be understood and executed by the LadderWorks PLC Engine
 - <u>PLC Diagnose Utility</u> for verifying sequence programs with ladder diagrams (viewing ladder diagrams only you cannot edit in the ladder diagram format with this utility). [<u>NOTE</u>: This is a LadderWorks PLC legacy product that will be discontinued in the future you shouldn't need to use this, as LadderWorks Console has all of these functions and more. However, its use is explained here for completeness.]
 - o <u>PLC Bit Pattern Utility</u> real-time bit pattern display for any signal address (F, G, X or Y data)
 - <u>PLC Time Chart Utility</u> for showing the history of specified bit signals in any signal address, to aid in debugging PLC sequence programs

NOTES:

- The LadderWorks PLC software includes the LadderWorks PLC Engine. You must run LadderWorks PLC in conjunction with a ServoWorks CNC product or an SMP product in order to run the LadderWorks PLC Engine. However, you can use LadderWorks Console by itself to create and edit sequence programs without running (executing) a ServoWorks CNC product or an SMP product.
- 2) PLC axes are available for ServoWorks S-120M, ServoWorks S-140M, ServoWorks S-200M and SMP products only. Refer to *Chapter 4: LadderWorks PLC Axis Control* in the *LadderWorks PLC Reference Manual* for more information.



1.2 LadderWorks PLC File Structure

The LadderWorks PLC files are installed in the following folders:



Figure 1-1: LadderWorks PLC File Structure



1.3 Overlapping Functions in Different LadderWorks PLC Components

There are some overlapping functions between different LadderWorks PLC components, due to the inclusion of some legacy software that has yet to be eliminated.

1.3.1 Overlapping Functions of LadderWorks Console and the PLC Control Screen Utility

Both LadderWorks Console and the PLC Control Screen utility can compile PLC sequence programs, as shown:



Figure 1-2: Comparison of LadderWorks Console and the PLC Control Screen Utility

1.3.2 Overlapping Functions of LadderWorks Console and the PLC Diagnose Utility

Both LadderWorks Console and the PLC Diagnose utility display sequence code program execution. However, while LadderWorks Console can be used to create and edit a sequence program in a ladder diagram format (as well as compile, generate binary code, etc.), the PLC Diagnose utility only displays sequence code program execution.

You cannot use the PLC Diagnose utility to create, edit or compile a sequence program.



Function	LadderWorks Console	PLC Diagnose Utility
Create ladder diagram sequence programs	\checkmark	
Import existing Instruction List (text format) sequence code programs	\checkmark	
View instruction list (IL) version of sequence programs	\checkmark	
Edit sequence programs in ladder diagram view	\checkmark	
Search ladder diagrams by address	\checkmark	✓
Search ladder diagrams by label	✓	
Display sequence code program currently being executed by the LadderWorks PLC Engine (monitor sequence programs)	✓	✓
Export sequence code programs	\checkmark	
Generate executable binary code from a sequence program	\checkmark	
Print ladder diagram sequence programs	\checkmark	
Force component values while monitoring sequence programs	\checkmark	
View I/O mapping tables and edit descriptions	\checkmark	

Table 1-1: Comparison of LadderWorks Console and the PLC Diagnose Utility.

1.4 The Difference Between the Regular Version (On-Line Version) and the Off-Line Version of LadderWorks Console

The regular version of LadderWorks Console can be thought of as an "on-line" version that is tightly integrated with the ServoWorks CNC and SMP products offered by Soft Servo Systems, Inc. The regular version of LadderWorks Console has a Diagnostic Mode that displays the execution of a PLC sequence program by the LadderWorks PLC Engine. The LadderWorks PLC Engine operates in the real-time subspace created by Ardence's RTX, and is completely integrated with either the ServoWorks CNC Engine or the SMP Motion Engine (depending upon whether you are using a ServoWorks CNC product or an SMP general motion control product). The LadderWorks PLC Engine and the ServoWorks CNC Engine/SMP Motion Engine perform the critical functions necessary for motion control, and are given the highest priority by the computer's CPU.

The off-line version of LadderWorks Console can be thought of as strictly an editing application. This version doesn't support the Ardence RTX Real-Time Extension or any real-time functions; therefore, the on-line functions displaying real-time PLC sequence code execution are disabled. The PLC sequence program is displayed statically. However, this version can be very useful for creating and editing PLC sequence code programs on another computer (a laptop, for instance), rather than the PC that will be controlling the motion and the machine (using either a ServoWorks CNC or an SMP application).



The off-line version of LadderWorks Console does not require a VersioBus, Panasonic Realtime Express (RTEX), MECHATROLINK or SSCNET adapter board to be plugged in to the host CPU. The off-line version needs to be installed separately, on a separate computer than the computer on which the entire LadderWorks PLC product is installed. See *Section 3.4: LadderWorks Console Off-Line Version Installation Procedure*.

A comparison of available functions in each version follows:

Function	LadderWorks Console, Regular Ed. (ON-LINE Version)	LadderWorks Console OFF-LINE Version
Create and edit PLC sequence programs with ladder diagrams	✓	✓
Insert basic instructions by pointing and clicking on symbols with easy-to-use GUI	✓	✓
Insert functional commands by selecting functions from a pull- down menu, and entering parameters (if any) in pop-up text boxes	\checkmark	~
Meaningfully comment or label components in ladder diagrams	✓	✓
Search for addresses, labels or comments within a ladder diagram	✓	✓
View Ladder Diagrams (LD) or Instruction List (IL) format	\checkmark	\checkmark
Print a Ladder Diagram sequence program	✓	✓
View I/O mapping tables and modify descriptions	\checkmark	\checkmark
Import existing Instruction List (text format) sequence program codes	~	~
Export PLC sequence program codes in Instruction List (text format) according to the ladder diagram	✓	✓
Generate (compile) executable binary code according the ladder diagram or the sequence code	\checkmark	✓
Verify and monitor PLC by viewing the execution of a sequence program in Diagnostic Mode – signal values are shown in different colors	✓	
Force component values while monitoring a sequence program (helpful in diagnosing problems during machine setup and integration)	✓	

 Table 1-2: Comparison of LadderWorks Console Off-Line and On-Line Versions



1.5 Additional Documentation for LadderWorks PLC and ServoWorks CNC or SMP Products

1.5.1 LadderWorks PLC Documentation Suite

This manual will explain how to use LadderWorks PLC. You should also refer to the other documents accompanying LadderWorks PLC:

- LadderWorks PLC Programming Language (Basic Commands and Function Blocks)
- LadderWorks PLC I/O Mapping for SMP Products
- LadderWorks PLC I/O Mapping for ServoWorks MC-Quad and the ServoWorks S-100M Series
- LadderWorks PLC I/O Mapping for ServoWorks S-100T
- LadderWorks PLC Reference Manual

1.5.2 Setup Documentation

To install and set up your ServoWorks CNC or SMP system, refer to one of the following manuals:

- ServoWorks CNC Setup and Integration Manual for the VersioBus 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
- SMP Installation and Setup Manual for the VersioBus Interface System
- SMP Installation and Setup Manual for the Panasonic Realtime Express (RTEX) Interface System
- SMP Installation and Setup Manual for the MECHATROLINK Interface System
- Quick Start Setup Guide for the Mitsubishi Interface System

1.5.3 Additional Documentation References for PLC Axes, ATC and Inverter Spindles

1.5.3.1 PLC Axes

Refer to *Chapter 4: LadderWorks PLC Axis Control* in the *LadderWorks PLC Reference Manual* for information on setting up PLC axes.

1.5.3.2 ATC

For an example of using PLC to set up automated tool changes (ATC), see Section 8.5: ATC Example #3: ATC for a Rotary Tool Changer Using PLC, Standard G Codes, and a Customized T Code in the ServoWorks CNC Macro Programming Manual.



1.5.3.3 Inverter Spindles

For information on setting up an inverter spindle in an all-digital interface system (by using an analog inverter, having S codes generate F data, and writing a PLC sequence program to generate output signals (Y data) to control the spindle), refer to one of the following:

- <u>For a MECHATROLINK interface system</u>, see Section 7.6: Including an Inverter Spindle in a ServoWorks CNC System with a MECHATROLINK Interface System in the ServoWorks CNC Setup and Integration Manual for the MECHATROLINK Interface System
- <u>For an RTEX interface system</u>, see Section 5.9: 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



Chapter 2: Overview of PLC in the ServoWorks CNC or SMP System

Programmable logic control (PLC) is the process of automating the monitoring and sequence control of machines or machine tools. In the ServoWorks CNC or SMP system, this process is performed by the LadderWorks PLC Engine, which is included as part of LadderWorks PLC.

The ServoWorks CNC Engine or SMP Motion Engine controls the high-performance, multi-axis servo loops: the motion of the machine. Based on its feedback loops for motion control, it may want to send a command to the machine to slow down, speed up, etc. But let's imagine that there is a door open on the machine tool. The ServoWorks CNC Engine and SMP Motion Engine don't have access to the signal that would tell it about the open door. This is why the LadderWorks PLC Engine (for machine control, as opposed to motion control) is required.

The LadderWorks PLC Engine has access to *all* the information about not only the ServoWorks CNC or SMP system (hardware and software), but also the machine or machine tool inputs and outputs. The LadderWorks PLC Engine is the one element that has access to everything there is to know about the ServoWorks CNC or SMP system and the machine. As such, it functions as the "central headquarters" for all decision-making regarding the motion and the machine. It controls the sequencing of everything that happens with the machine, the servo motors, etc.

The relationships between the ServoWorks CNC or SMP application software; the ServoWorks CNC Engine or SMP Motion Engine; the LadderWorks PLC Engine; and the machine in the VersioBus interface system are shown as follows (other servo interface systems are similar):



Figure 2-1: Overview of the LadderWorks PLC Engine in the VersioBus Interface System



The LadderWorks PLC Engine executes a sequence program in a cyclical fashion. The LadderWorks PLC Engine has a timer, and uses it to run the following PLC cycle every scan time (by default, the scan time is 5 msec for all SMP and ServoWorks CNC products except for ServoWorks S-100T, which has a default scan time of 8 msec):

- The LadderWorks PLC Engine performs a full scan of inputs from both the ServoWorks CNC Engine/SMP Motion Engine and inputs from the machine tool (which go through the ServoWorks CNC Engine/SMP Motion Engine). In other words, it checks the status of each bit ("0" or "1") for each F and each X input signal (which will be discussed later).
- 2) The LadderWorks PLC Engine runs the executable sequence program based on these new input values. It executes the program by reading and executing each command sequentially, at high speed. The command may specify reading or writing inputs or outputs, or performing logical operations such as AND or OR (arithmetic processing).
- 3) The LadderWorks PLC Engine sends any outputs or commands generated by the sequence program to the ServoWorks CNC Engine/SMP Motion Engine or to the machine (using the G and Y output signals) via the ServoWorks CNC Engine/SMP Motion Engine.

This cycle of scan, execute sequence program, and generate outputs or commands is repeated every 5 or 8 ms. Every time the sequence program finishes executing, it starts again almost immediately. This means that the LadderWorks PLC Engine is very responsive to any inputs or commands.

For example, if a lathe operator gives a command (using the ServoWorks S-100T program) to start the spindle on a lathe, that command gets relayed through the S-100T CNC Engine to the LadderWorks PLC Engine. The command is picked up by the LadderWorks PLC Engine (in the form of an F signal, which will be discussed later) the next time it scans all the inputs from the S-100T CNC Engine and the machine tool. The LadderWorks PLC Engine then executes the sequence program, which will check that the door is closed on the machine tool, the collet is in position, etc. (It checks these by looking at the status of X signals from the machine tool.) If all the conditions for starting the spindle are met, the LadderWorks PLC Engine will issue a command to the S-100T CNC Engine, which is sent to the machine tool (in the form of a Y signal) to start the spindle on the lathe.



Chapter 3: Installing LadderWorks PLC and the LadderWorks Console Off-Line Edition

3.1 Overview

LadderWorks PLC is included with (and installed as part of the product installation of) all ServoWorks CNC products and SMP general motion control products. In most cases, you will have installed LadderWorks PLC as part of a package installation of a ServoWorks CNC product or an SMP product. If you have already installed LadderWorks PLC as part of a ServoWorks CNC or SMP product, you don't need to separately install anything for LadderWorks PLC. See Section 3.2: LadderWorks PLC Installation as Part of a ServoWorks CNC or SMP Product Installation for more information. You will need to create a customized sequence program for your machine, and generate binary code for execution, as explained in the rest of this manual.

<u>NOTE</u>: The LadderWorks base components are always installed in C:\SwPLC.

A separate, off-line version of LadderWorks Console is available, and can be installed on a different computer than the PC that is controlling the motion and the machine. This second PC doesn't require Ardence's RTX Real-Time extension. See *Section 1.4: The Difference Between the Regular Version (On-Line Version) and the Off-Line Version of LadderWorks Console* for more information about the off-line version of LadderWorks Console. The off-line version needs to be installed separately, on a separate computer than the computer on which the entire LadderWorks PLC product is installed. The installation procedure for this separate application is explained in *Section 3.4: LadderWorks Console Off-Line Version Installation Procedure*.

Some customers who are using older versions of ServoWorks CNC or SMP products (that were purchased before the LadderWorks Console component was included in their ServoWorks CNC or SMP product) may need to install LadderWorks Console separately. See *Section 3.5: LadderWorks Console Regular Version Installation Procedure*.

3.2 LadderWorks PLC Installation as Part of a ServoWorks CNC or SMP Product Installation

As previously noted, LadderWorks PLC is included with and automatically installed as part of the product installation of all the latest ServoWorks CNC products and SMP general motion control products. If you have already installed LadderWorks PLC as part of a ServoWorks CNC or SMP product, you don't need to separately install LadderWorks PLC.

See one of the following documents for instructions on installing ServoWorks CNC products or SMP products and LadderWorks PLC:

- ServoWorks CNC Setup and Integration Manual for the VersioBus 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
- SMP Installation and Setup Manual for the VersioBus Interface System
- SMP Installation and Setup Manual for the Panasonic Realtime Express (RTEX) Interface System
- SMP Installation and Setup Manual for the MECHATROLINK Interface System
- Quick Start Setup Guide for the Mitsubishi Interface System





You must have installed Ardence RTX prior to installing LadderWorks PLC, or installation of LadderWorks PLC will not be possible. You must check for known compatibility issues with Ardence RTX, and resolve before installing RTX.

Before you begin installing the LadderWorks PLC software (with ServoWorks CNC or SMP software), you must make sure that you meet the necessary PC hardware and operating system requirements, and have installed the necessary operating system patches for your OS. [NOTE: The Microsoft Windows 2000 operating system requires Service Pack 1 for Ardence's real-time extension to function properly. No service pack is required for Windows XP.] The previously listed setup manuals will guide you through this.

Also, there are two known compatibility issues with Ardence's RTX (Physical Address Extension enabled, and incompatible HAL type), each of which can be easily resolved by changing the settings on your computer. You should read the setup and installation manual for the ServoWorks CNC product or SMP product (and the appropriate servo interface platform) to see if either issue applies to you, and take the steps outlined to resolve the issue if necessary.

3.3 Finishing Your LadderWorks PLC Setup (Compiling a PLC Sequence Program)

In order to finish your setup for your ServoWorks CNC or SMP product, you must compile a customized sequence program specifically for your machine. This is explained in *Chapter 5: Compiling an Instruction List (IL) Sequence Program with the PLC Control Screen Utility* and Section 7.12: Compiling a Ladder Diagram (LD) Sequence Program (Generating Executable Binary Code – .bin, .fig, .lad, .lst and .mod Files) for LadderWorks Console.

3.4 LadderWorks Console Off-Line Version Installation Procedure

The off-line version needs to be installed separately, on a separate computer than the computer on which the entire LadderWorks PLC product is installed.

The following steps will guide you through installing your LadderWorks Console Off-Line application:

- 1) Close all running applications.
- 2) Place the Soft Servo Systems, Inc. CD-ROM in the CD-ROM drive. The installation software will start automatically and the "Welcome to LadderWorks Console" window will appear, as shown in the following figure. [NOTE: If the "Welcome to LadderWorks Console" window doesn't appear automatically, click on LadderWorks_Install.exe, and a window similar to the following will appear.]



Chapter 3: Installing LadderWorks PLC and the LadderWorks Console Off-Line Edition

🛃 Welcome to LadderWorks Console Off-Line Edition v1.10 🛛 🛛 🔀		
Welcome to LadderWorks Console LadderWorks Console Edition		
SUSTEMS, INC	Welcome to LadderWorks Co This program allows you to in Console Off-Line Edition on y Please check the ReadMe of installation, which provides y necessary instructions.	onsole Off-Line Edition Istall Ladder/Works iour computer. document before iou with brief and
	Read Me	Brief information about installation Install LadderWorks Console Off-Line Edition
	Exit	Exit this program

Figure 3-1: Welcome to LadderWorks Console Window – Off-Line Edition

- 3) In the "Welcome to LadderWorks Console" window (above), click on the "Read Me" button. This will open up a Notepad file with installation information. We recommend that you print out this file for reference during the installation procedure and for future reference. Exit the Notepad application to continue.
- 4) In the "Welcome to LadderWorks Console" window (Figure 3-1), click on the "LadderWorks Console Off-Line Edition" button – the LadderWorks Console off-line edition will install automatically, then the following window will appear:



Figure 3-2: LadderWorks Install Dialog Box

5) You must install the DAO package for LadderWorks Console. Click the "OK" button to start the installation, and the following dialog box will appear:



Figure 3-3: Setup Dialog Box



6) When the InstallShield Wizard has been set up (which happens automatically), the following window will appear:



Figure 3-4: Welcome to the DAO Setup Window

7) Click the "Next" button, and the following window will appear:



Figure 3-5: Select Components Window (1 of 2)

8) Click the "Next" button without changing any settings (leave both "Jet 3.5" and "ODBC Direct" checked), and the following window will appear:



1

Chapter 3: Installing LadderWorks PLC and the LadderWorks Console Off-Line Edition



Figure 3-6: Select Components Window (2 of 2)

9) Click the "Next" button without changing any settings (select all the optional formats), and the DAO software will automatically start installing. The following dialog box will be displayed to show the progress of DAO installation:

	Copying Jet files msxbse35.dll
	26 %
	Cancel
Ì (†℃ (Low)	

Figure 3-7: Installation Progress Dialog Box

10) When the DAO software has been successfully installed, the following dialog box will appear:



Figure 3-8: Information Dialog Box

- 11) Click the "OK" button to finish the LadderWorks Console and DAO package installation.
- 12) Click the "Exit" button in the "Welcome to LadderWorks Console" window (Figure 3-1) to close that window.



3.5 LadderWorks Console Regular Version Installation Procedure

If you are using a ServoWorks CNC or SMP product that you purchased before the LadderWorks Console component was included in that product, you will need to install LadderWorks Console separately.

The procedure for the separate installation of the regular version of LadderWorks Console is the same as the procedure for installing the off-line version of LadderWorks Console, except for the text in the "Welcome to LadderWorks Console" screen and the label on the "LadderWorks Console" button. See *Section 3.4: LadderWorks Console Off-Line Version Installation Procedure*. The "Welcome to LadderWorks Console" screen for the separate installer for the regular version of LadderWorks Console is shown in the following figure:

🚽 Welcome to LadderWorks Console v1.10		
Welcome to LadderWorks Console		
SOFT SERVO SYSTEMS, INC	Welcome to LadderWorks Co This program allows you to in Console on your computer. Please check the ReadMe of installation, which provides y necessary instructions.	nsole stall LadderWorks locument before ou with brief and
	Read Me	Brief informati on about installation Install LadderWorks Console
	Exit	Exit this program

Figure 3-9: Welcome to LadderWorks Console Window – Regular Edition



Chapter 4: Setting Up a Customized Sequence Program

4.1 Description of the Sequence Program and Other PLC Files

A sequence program is a program that is written in PLC code, in Instruction List (IL) text format, or in Ladder Diagram (LD) format. This sequence program tells the LadderWorks PLC Engine how to control the machine or machine tool, and how to control the computer numerical control (ServoWorks CNC Engine/SMP Motion Engine).

The PLC language used by LadderWorks PLC and described in this manual is compatible with Fanuc's PLC ladder logic.

Because each machine is different, you will need to write a unique PLC sequence program for each machine setup, although sequence programs can be reused for machines that are the exact same make and model. The specifics of using LadderWorks Console to create a unique PLC sequence program are explained in *Chapter 7: Using LadderWorks Console*. The file types of sequence programs are explained in this chapter.

4.2 Sequence Program File Types

4.2.1 Overview

The actual sequence program (the ".lad" or ".ldv" file) is one of a series of files with the same name, but different file extensions, located by default in the folder "C:\SwPLC\Ladder." Some of these files are automatically generated when you compile your sequence program.

If you are creating a sequence program in IL format, you must create ".lad" and ".mod" files, and compile them to create the rest of the required files. The ".lad" and the ".mod" files must reside in the same folder.

If you are creating a sequence program with LadderWorks Console, you should create and save an ".ldv" file, and compile it to create the rest of the required files.

<u>NOTE</u>: LadderWorks PLC includes default ".lad" and ".mod" sequence program files that are precompiled during your LadderWorks PLC installation to create the executable binary format and all the other required files, so that you can turn on (start) your ServoWorks CNC or SMP product even before you create and compile your customized sequence program.

4.2.2 Creating .lad Files in Text (IL) Format

A sequence program (the ".lad" or ".ldv" file) is a way of expressing sequential logic to control a machine. The PLC Control Screen utility takes a representation of the system requirements (the PLC sequence program, in Instruction List Format) and converts it to an executable binary format so that it can be executed by the LadderWorks PLC Engine. Because you will most likely be creating sequence programs with LadderWorks Console, it will probably be more convenient to compile your sequence program with LadderWorks Console.

One way to create a sequence program is to write PLC code in Instruction List (IL) Format using a text editor. Any text editor or word processor can be used to create a sequence program. That text file should then be saved as a .lad file – the sequence program must be a text file with a ".lad" extension. The default .lad file that comes with LadderWorks PLC needs to be modified or replaced with a sequence program that is customized for your machine.

A .lad file must have "%@3" for the first line, and "%" for the last line. Comments can be included in sequence programs by beginning a line with ";" or "//". Comments must be on separate lines. Each command should be on a separate line.



NOTE: Any lines starting with tabs in a sequence program are ignored.

You can view the PLC code of your sequence program (that you wrote in IL text format) in a ladder diagram format to verify and debug your sequence program using LadderWorks Console (described in *Chapter 7: Using LadderWorks Console*) or using the PLC Diagnose utility (described in *Chapter 10: Verifying Sequence Programs Using the LadderWorks PLC Diagnose Utility*).

We strongly recommend that you begin with our default sequence program, included in LadderWorks PLC. A typical .lad file (which demonstrates how to correctly handle the HandWheel E-STOP) is shown as follows, and continues on the next 2 pages:

```
8@3
// E-Stop using HandWheel E-Stop input
RD
        X0.0
        G8.4
WRT
// Handwheel axis selection
RD
        X0.1
        X0.3
OR
        G41.0
WRT
WRT
        G18.0
        X0.2
RD
        X0.3
OR
        G41.1
WRT
        G18.1
WRT
        X0.4
RD
        G41.2
WRT
WRT
        G18.2
// Handwheel multiple
        X1.0
RD
WRT
        G19.4
RD
        X1.1
        G19.5
WRT
```

Figure 4-1: Typical .lad File: SoftServo_0 (1 of 3)



<pre>////////////////////////////////////</pre>
// Cycle Start Rising Edge Relay RD F0.5 AND.NOT R1.5 WRT R1.6
RD F0.5 WRT R1.5
<pre>// M30 Falling Edge Relay RD.NOT F9.4 AND R1.0 RD.STK R1.4 AND.NOT R1.6 OR.STK WRT R1.4 RD F9.4 WRT R1.0</pre>
// Cycle start RD R1.4 //TMR 1 // With Timer delay AND.NOT F0.5
<pre>wkr G7.2 // Feed hold (M00, M01) RD F9.6 AND F2.5 WRT R2.0</pre>
RD F9.7 AND F7.0 OR R2.0 WRT G8.5

Figure 4-2: Typical .lad File: SoftServo_0.lad (2 of 3)



// MFIN RD OR OR	(M00, F9.7 F9.6 F9.5	м01,	M02,	МОЗ,	M04,	МО5,	M30)		
OR WRT	F9.4 R0.0								
RD AND WRT	F7.0 R0.0 R0.2								
RD.NOT AND WRT	F7.0 R0.1 R0.3								
RD AND.NOT WRT	R0.2 R0.3 G5.0								
RD WRT	R0.0 R0.1								
// SFIN RD WRT	(By S F7.2 G5.2	Strok	pe)						
// TFIN RD WRT	(By T F7.3 G5.3	Strok	pe)						
00									

Figure 4-3: Typical .lad File: SoftServo_0.lad (3 of 3)



4.2.3 .mod Files

The ".mod" is a text file that you must create or verify with a ".mod" extension that tells LadderWorks PLC which files to reference. Specifically, the ".mod" file refers to the ".lad" file, and tells the compiler to compile the ".lad" file and generate a series of files with the same name as the ".lad" file, but with different extensions. It is the ".mod" file that is actually compiled when you compile your sequence program. The .mod file will always be one line.

The ".lad" and the ".mod" files must reside in the same folder.

The default .mod file is shown as follows:

```
SoftServo_0 1
```

Figure 4-4: Example .mod File: SoftServo_0.mod

In this case, the name of the series of files will all be named "SoftServo_0," but will have different extensions: SoftServo_0.lad, SoftServo_0.bin, SoftServo_0.div, SoftServo_0.fig and SoftServo_0.lst.

4.2.4 Creating .lad and .mod Files From a Ladder Diagram Format Sequence Program

You can create .lad and .mod sequence program files in Instruction List (text format) from ladder diagram format sequence programs with LadderWorks Console. See *Section 7.11: Exporting PLC Sequence Program Code in Instruction List (IL) Format (.mod and .lad Files)* for more information.



4.2.5 .bin Files, .div Files, .fig Files and .lst Files

These files are automatically generated in the same folder as the .lad and .mod files when you compile the .mod file.

The .bin file is the binary file for execution. The .div file contains the module divide table. The .fig table is the file used for real-time ladder diagram display (for LadderWorks Console or the PLC Diagnose utility). The .lst file has the assembly-code format and machine codes.

4.2.6 .ldv Files

The .ldv file type is a graphical file type, containing ladder diagram format graphical information that is used by LadderWorks Console. This is the main format used by LadderWorks Console.

4.2.7 What is the Difference Between the .lad and .ldv Files?

The .lad and .ldv file types are inter-compatible formats, summarized as follows:

File Type	Data Type	PLC Format
.lad	text	Instruction List (IL)
.ldv	graphical	Ladder Diagram (LD)

Table 4-1: Comparison of .lad and .ldv Files

The same PLC sequence (logic) program can exist in both IL and LD formats.

4.3 Overview of File Structure

In order to control the machine using PLC, the sequence program files will be automatically set up according to one of the following two figures, depending upon whether or not you are using LadderWorks Console.





Figure 4-5: Sequence Program Setup Procedure with the LadderWorks Utility Tools (and Without LadderWorks Console)





Figure 4-6: Sequence Program Setup Procedure with LadderWorks Console)



4.4 Coding Convention

PLC commands make up your sequence program and represent the specifications of your machine. Writing PLC commands in Instruction List (IL) format or creating PLC commands in Ladder Diagram (LD) format is called "coding." An example of PLC code and the corresponding ladder diagram is shown in Figures 4-7 and 4-8, and Table 4-1.

```
%@3
// E-Stop using HandWheel E-Stop input
      X0.0
RD
      G8.4
WRT
// Handwheel axis selection
      X0.1
RD
      X0.3
OR
WRT
      G41.0
WRT
      G18.0
      X0.2
RD
      X0.3
OR
      G41.1
WRT
      G18.1
WRT
      X0.4
RD
      G41.2
WRT
WRT
      G18.2
```





Step No.	Command	Address Bit No. No.	Description
1	RD	X0.0	HW_ESTP
2	WRT	G8 . 4	*ESP
3	RD	X0.1	HW_1
4	OR	X0.3	HW_3
5	WRT	G41 . 0	HS1IA
6	WRT	G18 . 0	HS1A
7	RD	X0.2	HW_2
8	OR	X0.3	HW_3
9	WRT	G41 . 1	HS1IB
10	WRT	G18 . 1	HW1B
11	RD	X0.4	HW_4
12	WRT	G41 . 2	HS1IC
13	WRT	G18 . 2	HS1C

Table 4-2: PLC Coding Example – Program Breakdown





Figure 4-8: PLC Coding Example – Ladder Diagram Format (.ldv)

4.5 Coding Limitation – Horizontal Ladder Length of a PLC Sequence Program

There is a limitation to the horizontal ladder length in a PLC sequence program: the ladder length cannot exceed 8 addresses. This problem can occur when a series of AND-type operations are repeated eight or more times on a single coil, or when a certain number of AND-type operations are combined with certain functions.

Two examples follow:

RD R0.0	RD R0.0
AND R0.1	AND R0.1
AND R0.2	AND R0.2
AND R0.3	AND R0.3
AND R0.4	AND R0.4
AND R0.5	AND R0.5
AND R0.6	AND R0.6
AND R0.7	AND R0.7
WRT R2.0	AND R1.0
	WRT R2.0
THIS COMPILES	THIS DOES NOT COMPILE

Figure 4-9: Example #1 of Horizontal Ladder Length Limitation



	WRT R1.0
WRT R1.0	TMR 1
TMR 1	AND R0.4
AND R0.3	AND R0.3
AND R0.2	AND R0.2
AND R0.1	AND R0.1
RD R0.0	RD R0.0

THIS COMPILES

THIS DOES NOT COMPILE

Figure 4-10: Example #2 of Horizontal Ladder Length Limitation

A CAUTION

YOU MUST BE AWARE OF THIS CODING LIMITATION. IF YOU EXCEED THE LIMITATION OF 8 HORIZONTAL ADDRESSES, YOUR PLC SEQUENCE PROGRAM WILL EITHER NOT COMPILE OR WILL NOT LOAD CORRECTLY.

Chapter 5: Compiling an Instruction List (IL) Sequence Program with the PLC Control Screen Utility

5.1 Overview

In order to finish your machine setup, you must create and compile a sequence program for your machine/machine tool. In order for you to use your ServoWorks CNC or SMP product immediately, and start setting up your parameters and tuning, default .lad and .mod sequence program files were copied over and precompiled automatically during the software installation for all ServoWorks CNC and SMP products. Of course, before you use your ServoWorks CNC or SMP product to correctly operate your machine tool or machine, you will need to create a customized sequence program specifically for your machine tool or machine setup, rather than just using the default sequence program.

There are two ways to create a sequence program:

- 1) You can create a sequence program in text (IL) format using the Notepad application, or any word processing application.
- 2) You can create a sequence program in ladder diagram (LD) format with LadderWorks Console, as explained in *Chapter 7: Using LadderWorks Console*. [NOTE: You can then use LadderWorks Console to create a text format from this ladder diagram format if you want.]

This chapter explains how to compile a text format sequence program (.lad file and .mod file) using the PLC Control Screen Utility. Compiling a ladder diagram format sequence program using LadderWorks Console is explained in *Section 7.12: Compiling a Ladder Diagram (LD) Sequence Program (Generating Executable Binary Code – .bin, .fig, .lad, .lst and .mod Files)*. Either method of compiling a sequence program is acceptable.

5.2 Compiling an Instruction List (IL) Sequence Program with the PLC Control Screen Utility



Figure 5-1: Compiling a Sequence Program with the PLC Control Screen Utility

To use the PLC Control Screen utility to compile a sequence program, your sequence program must be in .lad format, and you must also have a .mod file. The .lad and .mod files must reside in the same folder. See *Section 4.2: Sequence Program File Types* for more information.

The following steps will guide you through compiling your sequence program:

1) Start the PLC Control Screen utility by double clicking on the swPLC_CONTROL.exe file in the C:\SwPLC\Utility folder.

If the status of ladder logic is "RUN," you will see the PLC Control Screen window shown in the following figure:


Chapter 5: Compiling an Instruction List Sequence Program with the PLC Control Screen Utility

PLC control screen		
	start PLC stop	Ladder edit
Message table	SLINK/T setting	Compile
D table	Table setting	
D edit	K edit	
T edit	C edit	Drawing

Figure 5-2: PLC Control Screen Window for "RUN" Status

If the status of ladder logic is "STOP," you will see the PLC Control Screen window shown in the following figure:

PLC control screen		
PLC	start PLC stop	Ladder edit
Message table	SLINK/T setting	Compile
D table	Table setting	
D edit	K edit	
T edit	C edit	Drawing

Figure 5-3: PLC Control Screen Window for "STOP" Status

2) The PLC status must be "STOP." If the status is "RUN," you must click on the "PLC stop" button, and the ladder logic process will stop immediately.





3) Click on the "Compile" button, and you will see the following window:

PLC ladder compilier screen		×
Module definite file name	C:\SwPLC\Ladder\SoftServo_0.mo	Refer
Executive type binary file making Managing file name	0%	100%
Figure arrangement file making Managing file name	0%	100%
Division executive table making	0%	100%
Compile execute	Cancel	

Figure 5-4: PLC Ladder Compiler Screen

4) In the above window, the .mod file you want to compile should be listed in the "Module definite file name" text box.

<u>NOTE</u>: The default sequence program is named "SoftServo_M.mod" (for ServoWorks MC-Quad and the ServoWorks S-100M series of products); "SoftServo_T.mod" (for ServoWorks S-100T); or "SoftServo_SMP.mod" (for the SMP series of products) in the "C:\SwPLC\Ladder" folder.

5) To select a different .mod file, click the "Refer" button. You will see the "Select Module Definition File" window appear, as shown:

Select modul	e definition file				? ×
Look jn:	🔁 Ladder	•	£	C	
SoftServo	_0.mod				
, File <u>n</u> ame:	SoftServo_0.mod				<u>O</u> pen
Files of type:	Module definition file(*.mod)		•		Cancel
	Open as read-only				

Figure 5-5: Select Module Definition Window

- 6) Browse to the folder where the .mod file you have created for your customized sequence program resides. [The default sequence program SoftServo_M.mod, SoftServo_T.mod or SoftServo_SMP.mod file resides in the "C:\SwPLC\Ladder" folder (C:\SwPLC\Ladder\SoftServo_M.mod)]. Click the "Open" button once you have selected the correct file. You will see the PLC Ladder Compiler Screen again.
- 7) Click on the "Compile" button to start the compiling process. When it is finished successfully, you will see the following dialog box:



Compile I	inish 🔀
•	Compile success.
C	OK

Figure 5-6: Compile Finish Dialog Box

- 8) Click the "OK" button and the compilation of your sequence program will be complete.
- 9) To exit the PLC Control Screen utility, click the "Cancel" button in the PLC Ladder Compiler Screen, and then click the exit button (\Join) in the upper right hand corner of the PLC Control Screen.



Chapter 6: Using the PLC Control Screen Utility to Set Up Tables for PLC

6.1 Starting the PLC Control Screen Utility

The PLC Control Screen utility enables you to set up the timer, the counters, and table setup data, as well as to start, stop and compile ladder logic. Setting up tables for your PLC is necessary for using LadderWorks PLC for your machine. [NOTE: Setting up tables for your PLC cannot be done with LadderWorks Console – YOU MUST USE THE PLC CONTROL SCREEN UTILITY, explained in this chapter.]

Start the PLC Control Screen utility by double clicking on the swPLC_CONTROL.exe file in C:\SwPLC\Utility.

If the status of ladder logic is "RUN," you will see the PLC Control Screen window shown in the following figure:

PLC control screen		
	start PLC stop	Ladder edit
Message table	SLINK/T setting	Compile
D table.	Table setting	
D edit	K edit	
T edit	C edit	Drawing

Figure 6-1: PLC Control Screen Window for "RUN" Status

If the status of ladder logic is "STOP," you will see the PLC Control Screen window shown in the following figure:



PLC control screen		
	start PLC stop	Ladder edit
Message table	SLINK/T setting	Compile
D table	Table setting	
D edit	K edit	
T edit	C edit	Drawing

Figure 6-2: PLC Control Screen Window for "STOP" Status

The first time you run the PLC Control Screen utility, the "K edit," "T edit" and "C edit" buttons may be disabled. If these three buttons are ever disabled, you can enable them by compiling the SwPLC table – see *Section 6.2: PLC Tables for Input/Output Declaration*, and follow the procedure described in this section.

To exit the PLC Control Screen utility at any time, click on the 🗵 button in the upper right hand corner.

6.2 PLC Tables for Input/Output Declaration

One of the steps necessary to convert a sequence program into machine language is I/O declaration. After you define the specifications (commands) for the sequence program, you need to create the interface settings. In the I/O interface setup table, you assign each I/O signal a name (under six characters), depending on the signal type.

LadderWorks PLC includes a default Sw_PLC.tbl file with all the default I/O mapping of X, Y, F and G addresses, which upon installation sets up an initial set of default X, Y, F, G, K, T and C address settings into the registry files of your computer. See *Chapter 2: Memory Addresses* in the *LadderWorks PLC Reference Manual* for more information.

If you modify the Sw_PLC.tbl file, or the "K edit," "T edit" and "C edit" buttons in the PLC Control Screen utility are disabled, you will need to compile your tables for PLC again, as explained in the following steps:

1) Click the "Table setting" button on the PLC Control Screen, and the following window will appear:



PLC table setting screen				
This program is for setting the table, based on the address table In case of no address table file, Only K is set. Simultaneously, C and T is set. Select either BINARY or BCD as for After selecting a language, press Execute				
Table file C:\SwPLC\SwPLC.tbl	Refer			
Language C C Japanese © English © BINARY © BCD Execute Cancel				

Figure 6-3: PLC Table Setting Screen

- 2) Make sure the I/O interface setup table file shown in the "Table file" text box is the file you want. If you want to use a different file for your table, click on the "Refer" button and browse to the file you do want to use as the comment setup table file for the PLC Diagnose utility.
- 3) Select either "BINARY" or "BCD" in the "C" frame, to select whether the data in the counter addresses should be stored in binary or BCD. [See Section 3.8: Numerical Data Examples in the LadderWorks PLC Programming Language (Basic Commands and Function Blocks) manual for more information.]
- 4) Click on the "Execute" button. The setup process of putting I/O mapping information and default keep relay, timer and counter addresses into your PC's registry, will start automatically. When the process has finished successfully, you will see the following dialog box:

PLC table setting screen 🛛
Success.
ОК

Figure 6-4: PLC Table Setting Screen Dialog Box

Your tables are now successfully set up (incorporated into the PLC environment – in the registry files of your computer). Click "Cancel" to close the PLC Table Setting Screen.



6.3 Editing Your Keep Relay for PLC

To edit the default settings of the keep relay for PLC, click the "K edit" button in the PLC Control Screen utility, and the following window will appear:

Edit Keep Relay - Page01: Keep Relay(K000)	×	
OK Reload First Last Page	1/100	Back Forward
K000.0	⊙ ON	O OFF
K000.1	O ON	OFF
K000.2	O ON	OFF
K000.3	O ON	OFF
K000.4	O ON	OFF
K000.5	O ON	OFF
K000.6	O ON	OFF
K000.7	O ON	OFF

Figure 6-5: Edit Keep Relay Window

If the "K edit" button is disabled, you need to compile the SwPLC table – *Section 6.2: PLC Tables for Input/Output Declaration*, and follow the procedure described in this section.

For each keep relay address, you can select "ON" or "OFF" for the status of the keep relay.

To set all the keep relays back to "OFF," click on the "Reload" button.

You can use the "Back" and "Forward" buttons to scroll through the keep relays. Clicking on the "First" button displays the first page of keep relays, while clicking on the "Last" button displays the last page of keep relays. If you click on the "Page" button, a Page Selection Window will appear (as shown in the following figure), and you can scroll through all pages of keep relays, and select one by clicking on the "OK" button.

Page selection	X
Page01:Keep Relay(K000) Page02:Keep Relay(K001) Page03:Keep Relay(K002) Page04:Keep Relay(K003) Page05:Keep Relay(K004) Page06:Keep Relay(K005) Page07:Keep Relay(K006) Page08:Keep Relay(K007) Page09:Keen Relay(K008)	
OK Cancel	

Figure 6-6: Page Selection Window

When you have finished setting up your keep relays, click on the "OK" button to save the settings.



6.4 Editing the Timer for PLC

To edit the default settings of the timer for PLC, click the "T edit" button in the PLC Control Screen utility, and the following window will appear:

Edit Timer - Page01: Timer(T000-T036)			
OK Reload First Last Page	1/10 Back Forward		
T000 Timer1[ms]	0		
T004 Timer2[ms]	0		
T008 Timer3[ms]	0		
T012 Timer4[ms]	0		
T016 Timer5[ms]	0		
T020 Timer6[ms]	0		
T024 Timer7[ms]	0		
T028 Timer8[ms]	0		
T032 Timer9[ms]	0		
T036 Timer10[ms]	0		

Figure 6-7: Edit Timer Window

If the "T edit" button is disabled, you need to compile the SwPLC table – see Section 6.2: PLC Tables for *Input/Output Declaration*, and follow the procedure described in this section.

For each timer, you can specify the time in milliseconds.

To set all the timers back to "0," click on the "Reload" button.

You can use the "Back" and "Forward" buttons to scroll through the timers. Clicking on the "First" button displays the first page of timers, while clicking on the "Last" button displays the last page of timers. If you click on the "Page" button, a Page Selection Window will appear (similar to Figure 6-6), and you can scroll through all pages of timers, and select one by clicking on the "OK" button.

When you have finished setting up your timers, click on the "OK" button to save the settings.



6.5 Editing the Counters for PLC

These counter values are used by the CTR counter functional command (SUB5) and the CTRC counter functional command (SUB55). Each counter has 4 bytes: 2 bytes for a preset value, and 2 bytes for a count-up value.

To edit the default settings of the counters for PLC, click the "C edit" button in the PLC Control Screen utility, and the following window will appear:

Edit Counter - Page01: Counter(C000-C018)								
OK Reload First Last Page	1/5 Back Forward							
C000 Counter1 Preset(Binary)	0							
C002 Counter1 Total (Binary)	0							
C004 Counter2 Preset(Binary)	0							
C006 Counter2 Total (Binary)	0							
C008 Counter3 Preset(Binary)	0							
C010 Counter3 Total (Binary)	0							
C012 Counter4 Preset(Binary)	0							
C014 Counter4 Total (Binary)	0							
C016 Counter5 Preset(Binary)	0							
C018 Counter5 Total (Binary)	0							

Figure 6-8: Edit Counter Window

If the "C edit" button is disabled, you need to compile the SwPLC table – see Section 6.2: PLC Tables for *Input/Output Declaration*, and follow the procedure described in this section.

For each counter, you can specify the number of counts.

To set all the counters back to "0," click on the "Reload" button.

You can use the "Back" and "Forward" buttons to scroll through the counters. Clicking on the "First" button displays the first page of counters, while clicking on the "Last" button displays the last page of counters. If you click on the "Page" button, a Page Selection Window will appear (similar to Figure 6-6), and you can scroll through all pages of counters, and select one by clicking on the "OK" button.

When you have finished setting up your counters, click on the "OK" button to save the settings.



6.6 Setting Up and Editing Data Table Addresses

6.6.1 Overview

D data in the D address settings are stored in the registry files of the computer. [See Section 2.9: Data Addresses (D) in the LadderWorks PLC Reference Manual for more information.]

There are two ways to enter data in the data table:

- 1) Use the PLC Control Screen utility to enter data manually.
- Read and write into the data table using a sequence program. Create a sequence program file to define data using the NUME (constant declaration) or NUMEB (binary constant declaration) functional commands. When the sequence program is compiled, LadderWorks PLC will populate the data table.

6.6.2 Using the PLC Control Screen to Enter Data in the Data Table

6.6.2.1 Adding or Deleting Data

To create a default data table, click the "D table" button in the PLC Control Screen utility, and the following window will appear:

PLC data table setting screen			
Table list D0000 BIN BYTE	<- Add -	Edit table to be added First address: D 0 Number of making: 1 Data type: © BINARY © BCD	
	-Delete->	<pre>G 1byte length(BYTE) C 2byte length(WORD) C 4byte length(D.WORD) Comment (Max. 20 letters)</pre>	OK Cancel

Figure 6-9: PLC Data Table Setting Screen

Enter the address, data type, data size and comment in the "Edit table to be added" frame, and use the "<- Add -" button to add data. Or, select data from the Table list box, and use the "-Delete->" button to delete data.

6.6.2.2 Editing Data

To edit the data table (without adding or deleting data items), click the "D edit" button in the PLC Control Screen utility (Figure 6-2), and the following window will appear:



Edit Data Table - Page01:								
OK Reload First Last Page	1/ 2 Back Forward							
D0000 BIN-BYTE :	0							
D0001 BIN-BYTE :	0							
D0003 BIN-BYTE :	0							
D0004 BIN-BYTE :	0							
D0005 BIN-BYTE :	0							
D0006 BIN-BYTE :	0							
D0007 BIN-BYTE :	0							
D0008 BIN-BYTE :	0							
D0009 BIN-BYTE :	0							
D0010 BIN-BYTE :	0							

Figure 6-10: PLC Edit Data Table Screen

To set all data back to "0," click on the "Reload" button.

You can use the "Back" and "Forward" buttons to scroll through the data. Clicking on the "First" button displays the first page of data, while clicking on the "Last" button displays the last page of data. If you click on the "Page" button, a Page Selection Window will appear (similar to Figure 6-6), and you can scroll through all pages of data, and select one by clicking on the "OK" button.

When you have finished setting up your data, click on the "OK" button to save the settings.



Chapter 7: Setting Up Customized PLC Alarm Messages

7.1 Overview

You can customize PLC alarm messages to be displayed in the GUI of ServoWorks CNC and SMP general motion control applications. There are two steps to customizing PLC alarm messages for your PLC sequence program:

- 1) Modify the "AlarmMsg.dat" file
- 2) Modify the PLC sequence program

7.2 Modifying the "AlarmMsg.dat" file

There is a default "AlarmMsg.dat" file automatically installed in the directory "C:\Program Files\SoftServo\application\ini", where "application" varies depending upon the Soft Servo Systems application you are running ("SMP850, MC-Quad, S-140M, etc.).

You can double-click to edit this file in Notepad. The contents of the default (unmodified) file are shown in the following figure:

📕 AlarmMsg.dat - Notepad	
File Edit Format View Help	
A00 Sample alarm message 0 A01 Sample alarm message 1 A02 Sample alarm message 2 A799 Sample alarm message 799	4
	Y

Figure 7-1: Default AlarmMsg.dat File

"A00" indicates the alarm number. "Sample alarm message 0" indicates the message to be displayed when this alarm is activated. There are 100 bytes (A00 through A99) in the A address space. Each byte holds 8 possible alarms, for a total of 800 possible alarms: A00.0 through A99.7.

7.3 Modifying the PLC Sequence Program to Write to the "A" Address Space

You must modify your customized PLC sequence program to include the line "WRT A00.0" (or similar) for each situation in which you want to display an alarm message, in which "A00.0" in the sequence program corresponds to alarm message "000" to be displayed.

The relationship between the alarm numbers used in the AlarmMsg.dat text file and the corresponding alarm A addresses that should be used in the PLC sequence program are shown in the following table:



A addresses in the PLC sequence program	Alarm numbers in the AlarmMsg.dat file
A00.0 (A0.0)	A000 (A00)
A00.1 (A0.1)	A001 (A01)
A00.2 (A0.2)	A002 (A02)
A00.3 (A0.3)	A003 (A03)
A00.4 (A0.4)	A004 (A04)
A00.5 (A0.5)	A005 (A04)
A00.6 (A0.6)	A006 (A06)
A00.7 (A0.7)	A007 (A07)
A01.0 (A1.0)	A008 (A08)
A01.1 (A1.1)	A009 (A09)
- -	
A99.7	A799

Table 7-1: Address Map for PLC Sequence Program A Addresses and Alarm Numbers in the AlarmMsg.dat File

<u>NOTE</u>: "A21.0" and "A021.0" will be interpreted the same in the PLC sequence program, as will "A0.0" and "A00.0" and "A000.0" in the PLC sequence program.

For the default AlarmMsg.dat file shown in Figure 7-1, the "WRT A00.0" line would cause the following alarm to be displayed:

Soft Servo Systems, inc

Soft Serve		Ma	achine Pos	Progra	n Pos	Relative Pos	Serv	o Lag	And and a second se
	X(mm): (000.000	0000.	000	0000.000	0000	0.000	eettinee
0000:00:02	Y(mm): (000.000	0000.	000	0000.000	0000	0.000	
SPINDLE	Z(mm)	: (000.000	0000.	000	0000.000	0000	0.000	
(rpm)	A(mm): (000.000	0000.	000	0000.000	0000	0.000	SCREEN
0.000	-S 140M	Alorm (000 000	0000	000	0000 000	0000	000	
FEEDRATE-	- 3-140M	Alam							20
	3								LOCKS
				Alarm	Code :	0			1.Ac
100 0 (%)									
100.0 (20)		Sample a	alarm mess	age 0					PLOT
	1			- J					T
X _B Y _B									FOIT
									EDIT
CF									S
В									SPINDLE
STATUS					_				
Stopped	MAIN	PLEA	SE SELECT	MODE					*
									HELP/MSG
2. – A. –									原用用
									RESET
7.0 A.0									710
C:=									
1			[1		[MAIN
•• <u>*</u>	[∞] <u>∧</u>	-		Ê	≣ £≣	4			
JOG CONT	JOG INCR	RAPID	HNDWHL	HOME	MDI	AUTO	CONFIG		EXIT

Figure 7-2: Alarm Message Display – 1 of 2



7.4 Unspecified PLC Alarms

When an alarm is unspecified, it displays as "Unspecified alarm," as shown in the following screen shot:

ServoWorks RUN TIME 0000:00:02 FEEDRATE (mm/min) 0.0 OVERRIDE (%) 100.0	X(mm): Y(mm): Z(mm): MC-Quad A	Machine Pos 0000.092 0000.068 0000.020 Jarm	Program Pos 0000.092 0000.068 0000.020	Relative Pos 0000.092 0000.068 0000.020	Servo Lag 0000.000 0000.000 0000.001	Diffset/Others
LOCKS X ^F _B Y ^F _B Z ^F _B A ^F _B STATUS Stopped X: Y: Z: A:	Uns	pecified alarm	17			Locks Plot Edit
HOME X: Y: Z: A: SOFT LIMIT + - X: C Y: C Z: C A: C	MAIN	LEASE SELECT N	MODE			Reset
Augo I	Rapid Pol	ton Handwheel		Auto	Configure	Esit

Figure 7-3: Alarm Message Display – 2 of 2



Chapter 8: Using LadderWorks Console

8.1 What You Can Do With LadderWorks Console

LadderWorks Console is a Graphical User Interface (GUI)-based software system for developing PLC sequence programs.

With LadderWorks Console, you can:

- Create and edit PLC sequence programs with ladder diagrams
- Insert basic instructions by pointing and clicking on symbols with easy-to-use GUI
- Insert functional commands by selecting functions from a pull-down menu, and entering parameters (if any) in pop-up text boxes
- Meaningfully comment or label components in ladder diagrams
- Search for addresses or labels within a ladder diagram
- View Ladder Diagram (LD) or Instruction List (IL) format
- Print a Ladder Diagram sequence program
- View I/O mapping tables and modify address descriptions (with the Register Address map)
- Import existing Instruction List (text format) sequence programs
- Export PLC sequence programs in Instruction List (text format) according to the ladder diagram
- Generate (compile) executable binary code according to the ladder diagram sequence code
- Verify and monitor PLC by viewing the execution of sequence programs in Diagnostic Mode signal values are shown with different colors
- Force component values while monitoring sequence programs (helpful in diagnosing problems during machine setup and integration)

All of these functions are explained in this chapter. All the screen shots in this chapter are taken on a Windows XP computer; the operating procedure in Windows 2000 is very similar.



8.2 Starting LadderWorks Console



Start LadderWorks Console by double clicking the **Console** icon on the desktop, or by double clicking **Z**LadderWorksConsole.exe in the directory "C:\Program Files\SoftServo\LadderWorks\LadderWorksConsole.exe". The application window will appear as shown in the following figure:

										- Main too	olbar	
Ladder:1 -												
File Edit View OnLine Hi	elp								J			
	, P	8 0	/⊢	-어 C	×	ĸ	/ 댜	ा धि	Fu	nction		-
Ladder View		1		3	<mark>4</mark>	5	<mark>-</mark> 6	7	<mark>8</mark>	9		- ^-
Instruction List View	00	+	+	Υ., Έ	Ŧ	4	ц.	4	+	+	+	
	01- ·	+	+	+	+	+	+	+	÷	+	+	
	02- ·	+	+	+	+	+ •	+	+	+	+	+	
	03- ·	+	+	• +	+	4	+	4	4	4	÷	
	04- ·	+	+	· •	+	4	+	4	4	4	+	
	05- ·	+	+	+	+	+	+	+	+	÷	+	
	06- ·	+	+	+	+	+	+	+	4	+	+	
	07-	+	+		+	+	-	+	+	+	+	~
x: 0 y: 30	1											

Figure 8-1: LadderWorks Console Main Window

8.3 The Ladder Diagram Format (Interpreting the Ladder Diagram)

8.3.1 Overview

The ladder diagram is interpreted by you. There is a set of consistent symbols described below. The ladder diagram will contain addresses, signal names, and comments.



8.3.2 Addresses

An address is composed of an address number and a bit number, as described in the following figure:



Figure 8-2: Format for an Address in a Ladder Diagram

There is always a letter of the alphabet in front of the address number to indicate the kind of signal it is. See the following table for letters used and their meanings.

Signal Letter	Signal Description					
Х	Input signal from the machine to the LadderWorks PLC Engine (MT \rightarrow PLC)					
Y	Output signal from the LadderWorks PLC Engine to the machine (PLC \rightarrow MT)					
F	nput signal from the ServoWorks CNC Engine / SMP Motion Engine (NC) to the LadderWorks PLC Engine (NC \rightarrow PLC)					
G	Output signal from the LadderWorks PLC Engine to the ServoWorks CNC Engine / SMP Motion Engine (NC) (PLC \rightarrow NC)					
R	Internal Relay					
А	Requesting Message Display					
С	Counter					
К	Keep Relay					
D	Data Table					
Т	Variable Timer					

Table 8-1: Signal Letters and Their Meanings

8.3.3 Signal Names

All signal names will be at most 8 characters. Each character can be a letter, a number, or a special symbol.



8.3.4 Commenting

Up to 30 characters may be displayed to comment each relay coil and signal in the sequence program.

8.3.5 Symbols

The ladder diagram utilizes the following symbols:

Symbol	Description
	RD (for an internal variable, an input signal from the ServoWorks CNC Engine/ SMP Motion Engine, or an input signal from the machine tool)
*	RD.NOT (for an internal variable, an input signal from the ServoWorks CNC Engine/ SMP Motion Engine, or an input signal from the machine tool)
-0-	WRT (for a relay coil for an internal variable, for a relay coil that is output to the ServoWorks CNC Engine/ SMP Motion Engine, or a relay coil that is output to the machine tool)
	WRT.NOT (for a relay coil for an internal variable, for a relay coil that is output to the ServoWorks CNC Engine/ SMP Motion Engine, or a relay coil that is output to the machine tool)
	AND
	OR
	Functional command of the LadderWorks PLC language. Symbols differ slightly depending on the kind of functional command.
H	Left vertical power rail
	Right vertical power rail
	Horizontal line connection
	Vertical line connection

Table 8-2: Ladder Diagram Symbols for LadderWorks Console



8.3.6 Rungs/Rows

The ladder diagram is composed of rows (or "rungs").



Figure 8-3: Ladder Diagram Rows

8.3.7 Relay Junction Labeling

The relay junction will contain the name of the relay coil and either the line number or the address of the signal.

Symbol Name
X Double click here to edit label

X Double click here to edit address

Symbol Address

Figure 8-4: Format for Relay Junction Labeling in Ladder Diagrams

8.3.8 Hardware-Based PLC Programming Compared to Software-Based PLC Programming

In a usual hardware-based relay sequence circuit, the number of relay junctions is limited, so in order to minimize the number of relays, relays are reused within the circuit.



Figure 8-5: Ladder Diagram Format for a Limited Number of Relays



In the LadderWorks PLC Engine, the number of relay junctions is not subject to the same hardware-based limits, so the ladder diagram is written with separate circuits (separate lines of code/separate rungs of the ladder diagram) as shown in the following figure. The logic expressed is the same as above, but the ladder diagram PLC coding format is different.



Figure 8-6: Ladder Diagram Format for LadderWorks Console Software-Based PLC

8.4 Opening, Creating and Saving Ladder Diagrams

To open a ladder diagram, select "Open..." from the "File" pull-down menu, as shown in the following figure:

۲.	adde	r:1 -				
File	Edit	View	OnLine	Help		
N	ew			Ctrl+N		
0	pen			Ctrl+O		
C	ose					
Si	ave			Ctrl+S		
Si	ave As					
Import Mnemonic Code						
E	xport N	Inemor	nic Code			
G	enerat	e Binar	y Code			
Pr	rint			Ctrl+P		
Pr	rint Set	up				
E	xit					

Figure 8-7: File Pull-Down Menu for Opening

The following Open window will appear; locate the desired .ldv file, and click the "Open" button in the dialog window to open the ladder diagram file.

Open		? 🛛
Look in: 🛅	Ladder	- 🗈 📸 🖃
🖬 Ladder.ldv		
File name:		Open
Files of type:	LadderView Files (*.ldv)	▼ Cancel

Figure 8-8: Open the Ladder Diagram .ldv File



To create a new ladder diagram sequence program (at any time), select "New" from the "File" pull-down menu shown in Figure 8-7. The ladder diagram display area will clear. You should then save this empty file with a new name before you create your new sequence program.

To save a ladder diagram, follow a similar procedure to opening a ladder diagram. Select "Save" or "Save as…" from the "File" pull-down menu shown in Figure 8-7.

A Save As window will appear, similar to the window shown in Figure 8-8; type in a file name for your sequence program. The ladder diagram should be saved in the selected directory with the file extension ".ldv"; for example, "test01.ldv". Click the "Save" button in the dialog window to save the ladder diagram file.

8.5 Creating and Editing Ladder Diagrams

<u>NOTE</u>: Refer to *Section 4.5 Coding Limitation – Horizontal Ladder Length of a PLC Sequence Program* for limitations on horizontal ladder length.

8.5.1 Inserting Basic Instruction Symbols

8.5.1.1 Overview

The main toolbar is shown in the following figure:



Figure 8-9: Symbols for Creating PLC Components

To insert basic instruction symbols [such as read (RD), read not (RD.NOT), write (WRT) and write not (WRT.NOT)], click the icon that corresponds to the desired basic instruction on the main toolbar shown above, position the mouse at the point you want to place the symbol, and click. Enter an address with a label (such as "X2.1"), then press the "Enter" key.

Specific information for each tool follows.



8.5.1.2 Using the Line Drawing Tool





Figure 8-10: Beginning Point of Horizontal Line Connection

The second place you click becomes the end point of the line, as shown:



Figure 8-11: Completed Horizontal Line Connection

8.5.1.3 Using the Contact Point Tool

When the and single click. A cursor appears; enter an address with a label (such as "X2.1"), as show in the following figure:



Figure 8-12: Entering the Address for a Contact Point

Press the "Enter" key to confirm the input: the address will change to a normal display size, as shown in the following figure, and the corresponding label will appear as follows:



Figure 8-13: Normal Display Size of the Input Label



<u>NOTE</u>: If you don't enter an address and press enter, you will get an error message. Also, you must input an address before you can change or add a label. If you try to add a label before inputting an address, you will get an error message.

8.5.1.4 Using the Coil Tool

When the tool is selected (shown as), position the mouse at the point you want to place the output coil, and single click. A cursor appears; enter an address with a label (such as "G18.0"), and press the "Enter" key to confirm the input: the address will change to a normal display size, and the corresponding label will appear.

<u>NOTE</u>: If you don't enter an address, you will get an error message. Also, you must input an address before you can change or add a label. If you try to add a label before inputting an address, you will get an error message.

8.5.1.5 Using the Comment Tool

Comments MUST be placed only on empty rows. (You may need to insert a row – see Section 8.5.5: Inserting

Rows.) When the comment, and single click. A cursor appears; type in your comment text, as shown in the following figure:



Figure 8-14: Entering a Comment

Press the "Enter" key to confirm the input: the text will change to blue as shown in the following figure:



Figure 8-15: Completed Comment



8.5.1.6 Using the Delete Tool to Delete Components



See Section 8.5.4: Deleting Basic Instruction and Function Block Components for more information.

8.5.1.7 Using the Select Tool to Select Components and Cut and Paste Components

When the tool is selected (shown as), you can select any contact point or coil component. The Select tool doesn't select horizontal or vertical lines, or comments.

Once a component is selected, you can right click anywhere in the ladder diagram and select "Copy" or "Cut" from the drop-down menu that appears, as shown:



Figure 8-16: Drop-Down Menu Available in Ladder Diagram Upon Right Clicking

Or, when a component is selected, cut and copy tools appear in the main toolbar, as shown:



Figure 8-17: Cut and Copy Tools in the Main Toolbar

When a component has been cut or copied, you can paste that component by clicking at the desired location in the ladder diagram. [NOTE: You don't need to select "Paste," and no "Paste" tool exists or is required.]



8.5.1.8 Using the NOT Tool to Create RD.NOT or WRT.NOT Components







8.5.2 Inserting Function Block Components

Insert function block components such as TMR, TMRC, MOVE, and DEC with the following steps:

1) Select the desired function block component from the "Function" pull-down menu in the upper right corner of the screen, as shown in the following figure:

			X
Fu	nction		•
8	9	ADD	^
•	5	ADDB	
		COD	
-	-	CODB	=
		COIN	_
4	+	сом	
		COME	
		COMP	
+	+	COMPB	
		CIR	
4	+		
4	+		~

Figure 8-18: Function Block Components Pull-Down Menu

2) Position the mouse at the point you want to place the component, and click.



3) Enter the parameters for the function block component. For function block components with multiple parameters, a Parameter Edit Dialog box will appear, as shown in the following example:

	PLC Function Parameters Input	
Pull-down menu for multiple parameters ———	Timer Number OK Cancel	— Enter values for parameters in this text box



4) For function blocks with multiple parameters, a pull-down menu will appear where you can select each parameter. Input the parameter values one by one in the parameter value box right next to the parameter name box, as shown in the following figure:

PLC Function Parameters Input	
Timer Number Timer Number Time Length	01 Cancel

Figure 8-20: PLC Function Parameters Input Box – Selecting Parameter Name

<u>NOTE</u>: If the format of the parameter you input is incorrect (in the wrong form or in an unacceptable range), you will get an error message similar to the following:



Figure 8-21: Parameter Setting Error Message



8.5.3 Modifying Basic Instruction and Function Block Components

To modify a basic instruction or function block component, position the mouse cursor on the desired basic instruction or function block component, and double click the input line, as shown in the following figure:



Figure 8-22: Modify Parameters by Double Clicking the Input Line

For basic instruction components, a cursor will appear and the user will be able to edit the address.

For function block components, the Parameter Edit Dialog box will appear, and you will be able to modify the parameters of the function block in the same manner that you entered the parameters originally.

8.5.4 Deleting Basic Instruction and Function Block Components

You can delete basic instruction and function block components with the following steps:

- 1) Click the \times icon on the main toolbar shown in Figure 8-9.
- 2) Position the mouse at the desired basic instruction symbol or function block component.
- 3) Double click the line, symbol or component to be deleted.



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 To delete the TMRB function shown, click here first....

📕 Ladder:1 -						/						X
File Edit View OnLine He	elp											
	i 🖻	8 /	″ -⊩	-어 C		ĸ	/ 댸	1 छ	Fu	inction T	MRB	•
Ladder View		1	2	3	4	5	6	7	8	9	10	^
Instruction List View	00	±	+	+	+	+	4	4	+	4	+	
	01	+	a A	CT TMRB	T 10 5000	æ	+	+	+	+	+	
then click	02	+	+	+	+	+	+	+	+	+	+	
this line ———	03	+	÷	· +	+	+	4	+	4	4	+	
	04	÷	÷	• +	+	4	4	4	4	4	+	
	05	+	+	+	+	+	+	+	+	÷	+	
	06	+	+	+	+	+	.+	+	+	+	+	
	07-	+	+	+	+	· •	+	+	+	+	+	~
	<											>
x: 135 y: 208												11

Figure 8-23: Example: Deleting a Component

8.5.5 Inserting Rows

Position the mouse cursor on a basic instruction symbol, function block component, or relay coil in a row adjacent to where you want to insert a new row. Then select either "Insert Row Before" or "Insert Row After" from the "Edit" pull-down menu (as shown in the following figure), depending on where you want the new row to be located.

Ladder:1 -					
File	Edit	View	OnLine	Help	
	Ur	ndo		Ctrl+Z	
	In	sert Ro	w Before		
Ĺĸ	In	tert Ro	w After	Ctrl+I	
	De	elete Ro	w	Ctrl+D	
	Co	ру	Ctrl+C		
G	Pa	ste	Ctrl+P		
	Cu	ut			
	Di	sable de nd	evice	Ctrl+F	
	Se	election	Mode		

Figure 8-24: Edit Pull-Down Menu for Inserting/Deleting Rows



8.5.6 Deleting Rows

Position the mouse cursor on a basic instruction symbol, function block component, or relay coil in the row you want to delete. Then select either "Delete Row" from the "Edit" pull-down menu (as shown in the previous figure).

8.6 Searching the Ladder Diagram for an Address or Label

Select "Find..." from the "Edit" pull-down menu, as shown in the following figure:



Figure 8-25: Edit Pull-Down Menu for Exporting Mnemonic Code

A Direction window will appear, as show in the following figure:

Direction	1		×
Search for:			Find Next
	C Up	Own	Cancel

Figure 8-26: Direction Dialog Box for Searching the Ladder Diagram

Type the search text in the "Search for:" text box, select the direction to search (up or down), and click the "Find Next" button. The ladder diagram automatically scrolls to display the first instance of matching text for an address or label for a component, and that component is highlighted in yellow.

LadderWorks Console finds the exact, whole word that you have typed in – only a match for an exact address or label would return a result, not partial addresses or labels. For instance, if you specify "0.0" in the text box, LadderWorks Console would not consider "X0.0" a match.



8.7 Printing the Ladder Diagram

Select "Print Setup..." from the file menu to set your print settings (printer, paper size, etc.). Then select "Print" from the "File" pull-down menu, as shown in the following figure:

۲.	adde	r:1 -			
File	Edit	View	OnLine	Help	
N	ew			Ctrl+N	
0	pen			Ctrl+O	
0	lose				
S	ave			Ctrl+S	
S	ave As.				
Import Mnemonic Code					
Export Mnemonic Code					
G	enerate	e Binar	y Code		
P	rint			Ctrl+P	
Pi	rint Set	up			
E	xit				

Figure 8-27: Selecting Print from the File Menu

LadderWorks Console will print the entire ladder diagram.

8.8 Changing Between the Ladder Diagram View and the Instruction List View

The same sequence code program can be viewed in both Ladder Diagram (LD) graphical view and Instruction List (IL) text view. However, the sequence code program cannot be edited in Instruction List format in LadderWorks Console.

Click on either "Ladder View" or "Instruction List View" at the left of the screen to change the PLC sequence code format, as shown:





The Instruction List view looks similar to the following window:



Ladder:1 -								
File Edit View OnLine Help								
	Pa 6	∥ +⊦	-어 C	××	/ T	】 3	Function	<u> </u>
Ladder View Instruction List View Register Address Map	;PLC Sequ ;Copy Rigl ;1377 Main ;Waltham, N ;Phone: (781) ;Fax: (781); ;www.softse ;e-mail:info(%@3 RD X0.0 WRT G8.0 WRT G8.0 WRT G8.0 WRT G130. WRT G130. WRT G130.	ence Code Ge ht (c) 2004 by 9 1402451, USA 1981-9555 891-3853 rvo.com Øsoftservo.cor 0 1 1 2 3	nerated b SoftServo m	y LadderWo System Inc.	rks 1.0.0.1	0		*
For Help, press F1								

Figure 8-29: Instruction List View



8.9 Viewing the Register Address Map

The F, G, X and Y addresses in the register address map can be viewed and the descriptions can be edited by selecting "Register Address Map" at the left of the screen, as shown in Figure 8-28. The display changes to something similar to the following window:

📽 🖬 🐰	h 6 //	⊪ -બ C ×	 ✓ ♯ 墩 	Function
Ladder View		- Trava		
Tostruction List View	Address		Description	
	Y0.1	Y	Auto Mode	
Register Address Map	X8.0	WW		
	X4.5	SEARCH	A 11 17 A P	
	X30.0	TESTING 2	Added for testing	
	X3.2	WW	кк	
	A3.0 ⊻29.7	DICO	Positivo Limit suvitale Avia 9	
	A23.7 V29.6		Negative Limit switch Axis 6	
	×29.5		Home Switch Avis 9	
	X29.3	PIS 7	Positive Limit switch Avis 7	
	X29.2	NIS 7	Negative Limit switch Avis 7	
	X29.1	HS 7	Home Switch Axis 7	
	X28.7	PIS 6	Positive Limit switch Axis 6	
	X28.6	NLS 6	Negative Limit switch Axis 6	
	X28.5	HS 6	Home Switch Axis 6	
	X28.3	PLS 5	Positive Limit switch Axis 5	
	X28.2	NLS 5	Negative Limit switch Axis 5	
	X28.1	HS_5	Home Switch Axis 5	
	X2.4			
	X2.2	TEST		
	X2.1	TEST		
	X13.7	PLS_4	Positive Limit switch Axis 4	
	X13.6	NLS_4	Negative Limit switch Axis 4	
	X13.5	HS_4	Home Switch Axis 4	
	×133	PIS3	Positive Limit switch Avis 3	

Figure 8-30: Register Address Map View

A sample address table is provided. You can set user-defined descriptions on any desired existing PLC I/O component, by double clicking on an address, label or description, highlighting the text, and typing the new text.

To insert a new address, right click within the table, and a drop-down menu will appear, as shown in the following figure:



i 🖉 🔒	x 🖻 🏉	//	× 🔥 🗸 切	TO Function [
Ladder View	Address	Label	Description	A
Instruction Lis	V0.1		Auto Mode	
	V0.0	1 Junit	Auto Mode	
Register Addre		CEADCH		
	V2.2	July (kk.	
	V20	TECT	NN	
	X29.7	PIS 9	Positive Limit switch Avis 9	
	V29.6	NIS 9	Negative Limit switch Avis 9	
	X29.5		Home Switch Avia 9	
	X29.3	PIS 7	Positive Limit switch Avis 7	
	X29.2	NIS 7	Negative Limit switch Avis 7	
	X28.7	PIS 6	Positive Limit switch Avis 6	
	X28.6	NIS 6	Negative Limit switch Avis 6	
	X28.5	HS 6	Home Switch Avis 6	
	X28.3	PISS	Positive Limit switch Avis 5	
	X28.2	NIS 5	Negative Limit switch Avis 5	
	×281	HS 5	Home Switch Avis 5	
	X24	110_0	THOME OTHER PARTS O	
	X2.2	TEST		
	X2.1	TEST	Insert	
	X13.7	PLS 4	Positive Delete 4	
	X13.6	NLS 4	Negative Limit switch Axis 4	
	X13.5	HS 4	Home Switch Axis 4	
	X13.3	PLS 3	Positive Limit switch Axis 3	
	X13.2	NLS_3	Negative Limit switch Axis 3	1000
	×131	HS 3	Home Switch Avis 3	×

Figure 8-31: Insert/Delete Drop-Down Menu in Register Address Map View

If you select "Insert," the following pop-up window will appear:

New Address	
Address :	
Prefix :	
Bit Offset :	
Label :	
Description :	
ОК	Cancel

Figure 8-32: New Address Pop-Up Window for Inserting Addresses in the Registry

Fill in the text boxes, and click "OK" to add a new I/O address.

To delete an address, click on that address, right click within the table, and select "Delete" from the drop-down menu shown in Figure 8-31.



8.10 Importing a PLC Sequence Program File in Instruction List (IL) Format

To import an existing PLC sequence program code that exists in Instruction List (IL) format, select "Import Mnemonic Code" from the "File" pull-down menu as shown in the following figure:

Ladder:	-	
File Edit Vi	ew OnLine	Help
New		Ctrl+N
Open		Ctrl+O
Close		
Save		Ctrl+S
Save As		
Import Mne	monic Code	
Export Mne	monic Code	
Generate B	inary Code	
Print		Ctrl+P
Print Setup		
Exit		

Figure 8-33: File Pull-Down Menu for Importing the Existing Sequence Program Code

An "Open" window will appear as shown below; locate and select the desired .lad file containing the PLC sequence program code, and click the "Open" button.

Open				? 🛛
Look in: 🔀	Ladder	•	← 🗈	-111 *
SoftServo SoftServo SoftServo SoftServo SoftServo SoftServo	_M.bin _M.div _M.fig _M.lad _M.lst _M.mod	SoftServo_T.bin SoftServo_T.div SoftServo_T.fig SoftServo_T.lad SoftServo_T.lst SoftServo_T.mod		
<				>
File name:	SoftServo_M.lad			Open
Files of type:	Mnemonic Code (*.*)		•	Cancel
	C Open as read-only			

Figure 8-34: Open Window – Selecting the Sequence Program File to Import

The ladder diagram corresponding to the selected sequence program code will appear in LadderWorks Console (Ladder View) if the importing is successful, as shown in the following figure:


Ţ	Soft Servo
	SYSTEMS, INC

📕 Ladder:1 -											
File Edit View OnLine He	lp										
	ß	6	∥ +⊦	-어 C	×	ĸ	/ 댸	ा द्वी	Function 7	mrb	•
Ladder View		1	2	3	4	5	6	7	8 9	10	^
Instruction List View	00	HW_EStop			P				*ESP	+	
Register Address Map		X0.0							G8.4		-
	01- ·	R0.0	80 - 7 72		- F	i.	ł,	ţ.	G8.0	+	
	02	R0.0	+	+	+	+	-+	+	G1300	+	
	02					10	-				
	03	÷	.*	+	+		-	4	G1301	+	
	04- ·	÷	+	· + 1	+	4	4	4	G130.2	+	
	05- ·	+	+	+	+	+	+	+	G1303	+	
	06- ·	+	+	+	+	+	+	+	61304	+	
									01544		
	07- ·	+	+	+	+	+	+	+	G130.5	+	
	08		+	+	+	4	+	4	-0-	+	
									G1306		
	09- ·	+	+	+	+	+	+	+	G1307	+	
		HW_1							HSILA		
	10- •	X0.1				1	1		G41.0	+	
	11.	HW_3	+	+	+		+	4	H SIA	+	
		X0.3							G18.0		~
x: 634 y: 298											

Figure 8-35: Ladder Diagram Imported From an Existing Sequence Program Code



8.11 Exporting PLC Sequence Program Code in Instruction List (IL) Format (.mod and .lad Files)

To export a PLC sequence program in Instruction List (IL) format (from ladder diagram format), select "Export Mnemonic Code" from the "File" pull-down menu, as shown in the following figure:

21	.adde	r:1 -		
File	Edit	View	OnLine	Help
N	ew			Ctrl+N
0	pen			Ctrl+O
0	lose			
S	ave			Ctrl+S
S	ave As			
Ir	nport N	Inemor	nic Code	
E	xport N	4nemor	nic Code	
G	enerat	e Binar	y Code	
P	rint			Ctrl+P
P	rint Sei	tup		
E	xit			

Figure 8-36: File Pull-Down Menu for Exporting Mnemonic Code

A Save As window will appear, as show in the following figure:

Save As				? 🗙
Save in: 🔁 Li	adder	•	+ 🗈 💣	·
SoftServo_M SoftServo_T SoftServoPL	.mod .mod C.mod			
File name:	SoftServoPLC			Save
Save as type:	PLC Module File (*.mod)		•	Cancel

Figure 8-37: Save As Window for Saving the .mod File

With this function, LadderWorks Console can export the sequence program code generated according to the ladder diagram created in the editing window. The sequence code will be exported as a ".lad" file in the selected directory, together with a ".mod" file bearing the same file name as the ".lad" file. [See Section 4.2: Sequence Program File Types.]

You just need to type in a file name (for example, "SoftServoPLC") in the Save As window in the above figure for the ".mod" file, and save it to the selected directory (usually it should be saved in the directory "C:\SwPLC\Ladder", but you can save these files in any folder you want). The corresponding ".lad" file (in the case of SoftServoPLC.mod, it would be SoftServoPLC.lad) will be saved to the same directory automatically.





The filename of ".mod" file should not contain any spaces, meaning "test 01.mod" is not allowed. Otherwise, the compiler won't work properly. (You can use "test_01.mod" instead.)

After saving the ".mod" file to the directory "C:\SwPLC\Ladder", two files will be created in that directory, one of them is ".mod" file such as "test01.mod", and the other is ".lad" file with the same file name such as "test01.lad".

8.12 Compiling a Ladder Diagram (LD) Sequence Program (Generating Executable Binary Code – .bin, .fig, .lad, .lst and .mod Files)

To generate the executable binary code according to the ladder diagram, select "Generate Binary Code" from the "File" pull-down menu, as shown in the following figure:



Figure 8-38: File Pull-Down Menu for Generating Executable Binary Code

A Save As window will appear, as shown in the following figure; type in the desired file name with the extension ".bin," such as "SoftServoPLC.bin", and then click the "Save" button.

Save As	? 🛛
Save in: 🗀 Ladder	▼ ← € [*] ■
國 SoftServo_M.bin 國 SoftServo_T.bin	
File name: SoftServoPLC	Save
Save as type: PLC Module File (*.bin)	Cancel

Figure 8-39: Save As Window for Saving the Binary Code File



Five files will be created with the same file name but with different file extensions, in the same folder: .bin, .fig, .lad, .lst and .mod files. [See *Section 4.2: Sequence Program File Types.*] You can save these files in any folder you want. (The LadderWorks PLC Engine stores the location of the most recently created .bin file.) If the generation of binary code is successful, and a message window will appear as shown in the following figure:

Success 🛛 🔀
Binary Generation Success
ОК

Figure 8-40: Message Window Showing a Successful Binary Generation

8.13 Verifying and Monitoring PLC in Diagnostic Mode

8.13.1 Overview

In Diagnostic Mode, LadderWorks Console displays the execution of PLC sequence programs by the LadderWorks PLC Engine, which operates in the real-time subspace created by Ardence RTX. The LadderWorks PLC Engine is completely integrated with either the ServoWorks CNC Engine or the SMP Motion Engine (depending upon whether you are using a ServoWorks CNC product or an SMP general motion control product). The LadderWorks PLC Engine and the ServoWorks CNC Engine/SMP Motion Engine perform the critical functions necessary for motion control, and are given the highest priority by the computer's CPU.

8.13.2 Using Diagnostic Mode (On-Line Mode)

To start Diagnostic Mode, select "Diagnostic Mode" from the "OnLine" pull-down menu, as shown in the following figure:



Figure 8-41: OnLine Pull-Down Menu for Starting Diagnostic Mode

In Diagnostic Mode, components whose value is "ON" or "1" are shown as green. Components whose value is "OFF" or "0" are shown as blue. A selected component is shown as highlighted in yellow. See the following figure:



ZLadder:1 -									
<u>File E</u> dit <u>V</u> iew <u>O</u> nLine <u>H</u> e	lp								
	E	à 4	U		H C	×	x 🖌	\$ \$	Function
Ladder View	21-	X2.6	X2.7	TEST X3.0	X3.1	x3.2			R100.1
Register Address Map	22.	X2.6	X2.7	TEST X3.0	X3.1	X3.2	••		R100.2
	23.	X2.6	X2.7	X3.0 TEST	X3.1	x3.2			R100.3
	24.	X2.6	X2.7	X3.0 TEST	X3.1	x3.2 ww			R100.4
	26-	X2.6	x2.7	X3.0 TEST	x3.1	x3.2			R100.5
	27.	X2.6	X2.7		X3.1	X3.2 WW			R100.6
	28-	X2.6	X2.7	TEST X3.0	X3.1 X3.1	X3.2			R100.7
	29.	X2.6	X2.7	TEST X3.0	X3.1	WW X3.2			R101.1
x: 567 y: 93	•			TEOT					

Figure 8-42: LadderWorks Console Diagnostic Mode

When a component's signal value changes (from "0" to "1" or from "1" to "0"), that component flashes.

8.13.3 Disabling and Enabling Devices

While in Diagnostic Mode, you can disable a device (component), so that device becomes like a comment.

First select the device to disable, then select "Disable device" from the "Edit" pull-down menu.

Ladder:1 -										
File	Edit	View	OnLine	Help						
C	Ur In	ndo sert Ro	Ctrl+Z							
	In	tert Ro	w After	Ctrl+I						
	De	elete Ro	Ctrl+D							
	Co	ру		Ctrl+C						
i	Pa	ste	Ctrl+P							
	C	ut								
	Di	Disable device								
	Fir	Find Ctrl								
	🗸 Se	election	Mode							

Figure 8-43: Edit Pull-Down Menu for Disabling a Device

A disabled device becomes dashed, as shown in the following figure:



				- Disat	oled de	evice									
📕 Ladder:1 -															a 🗙
<u>File Edit View</u>	<u>O</u> nLine	<u>H</u> elp													
	l X		9	U	┨┣	-어	С	×	* /	۲ ۵	धि	F	unction	-	
Ladder View		1		2	3	4		5	6	7	8	9	10	11	1^
S Instruction Li	00-	HW_EStop						<u> </u>				*ESP	+	+	4
🖾 🔯 Register Addı	,-	X0.0										G8.4			
	01-	R0.0		4	te-					4		G8.0	+	+	+
	\ \-		!												
	02	R0.0		+	+	+		+	+	+	G	0 130.0		+	+
	03			<u>т</u>	1	-		1						1	
	0.3-								28	· · ·	G	1301			
	04 -	<u>_</u> +		+	+	+		+	4	4		0	+	+	4
												1302			
	05	+		+	+	+		+	+	+		130.3	+	+	+
	06	+		+	+	+		+	+	+	0	130.4	+	+	+
	07-	+		+	+	+		+	+	4		പ		+	4
											G	130.5			
	08	+		+	+	+		+	4	4		0	+	+	+
												1340			
	09	+		+	+	+		+	+	+	L.	1307	+	+	+
												_ i			
	10-	X17.0	R10.0	64	10	i	i.	2		1		R11.0	+	+	+
	11-	- ()	- 14									-	+	+	+
		X17.1	R 10.1									R11.1			~
	<														>
x: 205 y: 261														NUM	1

Figure 8-44: LadderWorks Console – Disabled Device in Diagnostic Mode

You can select and enable a disabled device in the same way.

8.13.4 Forcing Component Values While Monitoring Sequence Programs

LadderWorks Console allows you to force component values while monitoring sequence programs. This is helpful in diagnosing problems during machine setup and integration.

When you overwrite a value for an F, R or D address, the LadderWorks PLC Engine stops reading the "real" value, and substitutes the overwritten value.

<u>NOTE</u>: This feature is only available for F, R and D addresses.

To force a value for a component, and see its effect on PLC sequence program execution, select "Overwrite" from the "OnLine" pull-down menu, as shown in the following figure:





Figure 8-45: OnLine Pull-Down Menu for Overwriting a Component's Value

An Online Overwrite window appears, as shown in the following figure:

Online Overwrite	
Address Letter :	F
Address :	0
Bit Offset :	0 👤
Data Type	1 Bit 💌
Value :	0
OK	Cancel

Figure 8-46: Online Overwrite Window

Select the address letter, the data type, and fill in the address, bit offset and new value, then click the "OK" button.

8.13.5 Restarting Diagnostic Mode

When you make changes to a sequence program during Diagnostic Mode, you must generate a new binary code [see *Section 8.12: Compiling a Ladder Diagram (LD) Sequence Program (Generating Executable Binary Code – .bin, .fig, .lad, .lst and .mod Files)*], then you must restart Diagnostic Mode in order to see the execution of the newest PLC sequence code.

If you make changes to a sequence program during Diagnostic Mode, and you DON'T restart Diagnostic Mode, the display of sequence code execution is misleading. LadderWorks Console is not executing the ladder diagram you see on the screen; it is executing the ladder diagram as it was the last time you generated a new binary code and restarted.



CHANGES YOU MAKE IN THE LADDER DIAGRAM WILL NOT BE REFLECTED IN DIAGNOSTIC MODE UNTIL YOU GENERATE A NEW BINARY CODE AND RESTART ONLINE MODE.



8.14 Closing a Sequence Program

Select "Close" from the "File" pull-down menu. A pop-up window will appear, as shown in the following figure:

LadderV	iew	
⚠	Save changes to Ladde	er?
Yes	No	Cancel

Figure 8-47: Confirm Closing Sequence Program Dialog Box

Click "Yes" to save and close the .ldv file.

8.15 Exiting LadderWorks Console

By selecting "Exit" from the "File" pull-down menu, you can exit LadderWorks Console, as shown in the following figure:

Ladder:1 -							
File	Edit	View	OnLine	Help			
N	ew			Ctrl+N			
0	pen			Ctrl+O			
d	ose						
Si	ave		Ctrl+S				
Si	ave As						
In	nport N	Inemor	nic Code				
E	xport N	Inemor	nic Code				
G	enerat	e Binar	y Code				
Pr	rint			Ctrl+P			
Pr	rint Se	tup					
E	xit						

Figure 8-48: File Pull-Down Menu for Closing LadderWorks Console

A dialog box may appear, similar to Figure 8-47. Click "Yes" to save the sequence program file before closing the application, or click "No" to exit the application without saving the sequence program file.



8.16 LadderWorks Console Automatically Shutting Down

If LadderWorks Console is running concurrently with another Soft Servo Systems application (such as ServoWorks MC-Quad, ServoWorks S-140M or SMP400), closing that other application will automatically shut down the LadderWorks Console application, due to the need to stop the Ardence RTX real-time extension to the operating system (that is interfacing with both LadderWorks Console and the other Soft Servo Systems application). [If LadderWorks Console didn't shut down when the other Soft Servo Systems application shut down, there would be errors with Ardence RTX upon trying to restart the other Soft Servo Systems application.]

LadderWorks Console provides a dialog box that allows you to save your PLC sequence program before it closes. You will see a dialog box similar to the following:

Save
S-140Mv284 has closed. LadderWorks Console must be closed. Do you want to save the changes?
Yes No

Figure 8-49: 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.

<u>NOTE</u>: When LadderWorks Console is the only Soft Servo Systems application running, it will not close down automatically.



Chapter 9: Using the PLC Bit Pattern Utility

The PLC Bit Pattern utility shows the PLC byte data in binary format. You can see the 8-bit address in a byte address that you specify.

Start the PLC Bit Pattern utility by double clicking on the swPLC_BIT_PATTERN.exe file in C:\SwPLC. You will see the Bit Pattern window shown in the following figure:

BitPa	ttern			
¢372	00000000	f372	00000011	
f376	00000000	f373	00000000	
¢374	00000000	f374	00000000	
f371	01100111	f375	00000000	
¢371	00001100			
				[Start]

Figure 9-1: Bit Pattern Window

Type in a byte address, click the "Start" button, and you will see the current bit pattern.

For example, let's say you type in the address "x12," click on the "Start" button, and see the bit pattern "11101110," as shown:

×12 11101110

In this case, the data is showing from the left side:



Therefore, the "ON" bits are the following six values: x12.7, x12.6, x12.5, x12.3, x12.2, and x12.1.



Chapter 10: Using the PLC Time Chart Utility

The PLC Time Chart Utility can show PLC internal data as a time chart.

Start the PLC Time Chart utility by double clicking on the swPLC_TIME_CHART.exe file in C:\SwPLC. You will see the PLC Time Chart window shown in the following figure:

🛱 TimeChart	_ 🗆 ×
f370. 4	C 10ms C 20ms C 40ms C 100ms C 200ms C 500ms C 1000ms Start Start Clear

Figure 10-1: Time Chart Window

The following steps will guide you in using the PLC Time Chart Utility:

- 1) Input the address(es) for which you need to see the status.
- 2) At the right side of the window, set up the sampling interval by selecting the time in milliseconds.
- 3) Click on the "Start" button, and you will see the ON/OFF status in the center of the screen. During the sampling, you can change the sampling intervals by changing interval time.
- 4) Click on the "Stop" button to stop the sampling.

At any time, you can click on the "Clear" button to clear the window and delete the graph(s).



Chapter 11: Verifying Sequence Programs Using the LadderWorks PLC Diagnose Utility

11.1 Overview of the PLC Diagnose Utility

This utility shows the status of an executing PLC sequence program as a ladder diagram circuit in real time. By monitoring the real-time status of contacts, you can verify that you have properly set up your PLC sequence program for your machine.

The PLC Diagnose utility only displays the currently executing sequence program. You cannot choose which sequence program to display in ladder diagram format.

<u>NOTE</u>: The PLC Diagnose utility is legacy software. Its use is explained here for completeness, since it is still included in LadderWorks PLC. However, we recommend using the more functional LadderWorks Console, explained in *Chapter 7: Using LadderWorks Console*, which not only allows you to monitor real-time execution of your PLC sequence program, but also to create, import, edit, compile and print sequence programs.

11.2 Using the PLC Diagnose Utility

The following steps will guide you in using the LadderWorks PLC Diagnose utility:

1) Start the PLC Diagnose utility by double clicking on the swPLC_DIAGNOSE.exe file in C:\SwPLC. You will see the PLC Diagnose window shown in the following figure:



Figure 11-1: PLC Diagnose Window



2) Click on "Module selection" from the menu, and you will see the window shown in the following figure:

tServo_	M	
		Î

Figure 11-2: Module Selection Window

3) Only the currently executing sequence program module will be available for selection. Select that module, and click the "OK" button. A ladder diagram window will appear for that module, similar to that shown in the following figure:

PLC diagnose - SoftServoPLC	_ [JN
Display Module selection Search		
HandMheel E-Stop HW ESTP X0.0	Emergency Stop *ESP G8.4	•
R0.0	Interlock *IT G8.0	
	G130.0	
	G130.1	
	G130.2	
	G130.3	
	G130.4	•

Figure 11-3: PLC Diagnose Window with Comments for an Example Module

Signals shown in bold indicate a value of "ON" or "1." While the PLC Diagnose utility is running, signals flash when they change value (from "0" to "1" or from "1" to "0.")



11.3 Ladder Diagram Format (Interpreting the Ladder Diagram)

11.3.1 Overview

The ladder diagram is interpreted by you. There is a set of consistent symbols described below. The ladder diagram will contain addresses, signal names, and comments.

11.3.2 Addresses

An address is composed of an address number and a bit number, as described in the following figure:



Figure 11-4: Format for an Address in a Ladder Diagram

There is always a letter of the alphabet in front of the address number to indicate the kind of signal it is. See the following table for letters used and their meanings.

Signal Letter	Signal Description
Х	Input signal from the machine to the LadderWorks PLC Engine (MT \rightarrow PLC)
Y	Output signal from the LadderWorks PLC Engine to the machine (PLC \rightarrow MT)
F	Input signal from the ServoWorks CNC Engine / SMP Motion Engine (NC) to the LadderWorks PLC Engine (NC \rightarrow PLC)
G	Output signal from the LadderWorks PLC Engine to the ServoWorks CNC Engine / SMP Motion Engine (NC) (PLC \rightarrow NC)
R	Internal Relay
А	Requesting Message Display
С	Counter
к	Keep Relay
D	Data Table
Т	Variable Timer

Table 11-1: Signal Letters and Their Meanings



11.3.3 Signal Names

All signal names will be at most 8 characters. Each character can be a letter, a number, or a special symbol.

11.3.4 Commenting

Up to 30 characters may be displayed to comment each relay coil and signal in the sequence program.

11.3.5 Symbols

The ladder diagram utilizes the following symbols:

Symbol	Description	
Ajunction	Relay (for an internal variable) inside of the LadderWorks PLC Engine	
Ajunction	Input signal from the ServoWorks CNC Engine/ SMP Motion Engine	contact signals
Ajunction	Input signal from the machine tool	
- Ø	Relay coil used only inside the LadderWorks PLC Engine (for an internal variable)	
-0- Ø-	Relay coil that is output to the ServoWorks CNC Engine/ SMP Motion Engine	coils
-©- -Ø-	Relay coil that is output to the machine tool	

 Table 11-2: Ladder Diagram Symbols for the PLC Diagnose Utility (1 of 2)



Symbol	Description
-	Functional command of the LadderWorks PLC language. Symbols differ slightly depending on the kind of functional command.
	Left vertical power rail
	Right vertical power rail
	Horizontal line connection
	Vertical line connection

 Table 11-3: Ladder Diagram Symbols for the PLC Diagnose Utility (2 of 2)

11.3.6 Rungs/Rows

The ladder diagram is composed of rows (or "rungs"). <u>NOTE</u>: Refer to *Section 4.5 Coding Limitation – Horizontal Ladder Length of a PLC Sequence Program* for limitations on horizontal ladder length.



Figure 11-5: Ladder Diagram Rows



11.3.7 Relay Junction Labeling

The relay junction will contain the name of the relay coil and either the line number or the address of the signal.



Figure 11-6: Format for Relay Junction Labeling in Ladder Diagrams

11.3.8 Hardware-Based PLC Programming Compared to Software-Based PLC Programming

In a usual hardware-based relay sequence circuit, the number of relay junctions is limited, so in order to minimize the number of relays, relays are reused within the circuit.



Figure 11-7: Ladder Diagram Format for a Limited Number of Relays

In the LadderWorks PLC Engine, the number of relay junctions is not subject to the same hardware-based limits, so the ladder diagram is written with separate circuits (separate lines of code/separate rungs of the ladder diagram) as shown in the following figure. The logic expressed is the same as above, but the ladder diagram PLC coding format is different.



Figure 11-8: Ladder Diagram Format for the Software-Based PLC Diagnose Utility



11.4 Changing the Display of the PLC Diagnose Utility

You can click on the \Box symbol in the upper right hand corner of the window to maximize the window, or use the scroll bar to scroll through the complete display.

You can also click on "Display" from the menu and uncheck the "Comment display", as shown in the following figure:



Figure 11-9: Changing the Comment Display

This will hide the comments (descriptions) and make the display more condensed, as shown in the following window:



Figure 11-10: PLC Diagnose Window Without Comments for an Example Sequence Program



11.5 Using the Search Function of the PLC Diagnose Utility

Click on "Search" from the menu in the PLC Diagnose window, and you will see the window shown in the following figure:

PLC diagnose Search	×
Search address: R1.1	Search upward
🔽 Search a contact point	Search downward
✓ Search a coil	Cancel

Figure 11-11: PLC Diagnose Search Window

To scan for an address in the PLC Diagnose Window, type the address you want to find in the "Search address" text box. You can search for a contact point, or a coil, or both. Click on either "Search upward" or "Search downward" buttons – if the address exists, the first instance of it will be highlighted in the PLC Diagnose window.

11.6 Exiting the PLC Diagnose Utility

Select "Exit" from the "Display" pull-down menu, as shown:

PLC diagnose - SoftServo_M		
Display	Module selection Search	
✔ Comment display		
Exit		

Figure 11-12: Selecting "Exit" from the "Display" Pull-Down Menu

The PLC Diagnose utility will terminate.



Chapter 12: Troubleshooting

12.1 The PLC won't start or does not work correctly. How can I restore it?

Please use the following steps to recover PLC and put the settings back to the default settings. [NOTE: An uninstall/reinstall procedure doesn't help, because it doesn't reset parameters.]

- 1) Check the PLC service:
 - For Windows 2000, go to "Start" → "Settings" → "Control Panel" → "Administrative Tools" → "Services" → "swplc_link"
 - For Windows XP, go to "Start" → "Settings" → "Control Panel" → "Administrative Tools" → "Services" → "swplc_link" OR "Start" → "Control Panel" → "Administrative Tools" → "Services" → "swplc_link"
- 2) If the status is not started, run C:\SwPLC\Service\swplclink_service_remove.bat, then run C:\SwPLC\Service\swplclink_service_install.bat
- 3) Run C:\SwPLC.SwPLC.reg [<u>NOTE</u>: You will lose all timer settings, keep relay settings, etc. You can skip this step to keep your settings.]
- 4) Recompile: run c:\swPlc\Utility\swPLC_CONTROL.exe, and click the "Compile" button in the PLC Control Screen. Click the "Refer" button in the screen that appears, browse to the C:\SwPLC\Ladder" folder, choose the proper module (.mod file), then click the "Open" button. Click the "Compile execute" button. You will see the "Compile Success" message. Click "Cancel," and close the PLC Control Screen.

12.2 The PLC didn't work. How can I check that the PLC service is running?

You can check as follows:

- 1) Check the PLC service:
 - For Windows 2000, go to "Start" → "Settings" → "Control Panel" → "Administrative Tools" → "Services" → "swplc_link"
 - For Windows XP, go to "Start" → "Settings" → "Control Panel" → "Administrative Tools" →
 "Services" → "swplc_link" OR "Start" → "Control Panel" → "Administrative Tools" → "Services" →
 "swplc_link"
- 2) If the status is not started, run C:\SwPLC\Service\swplclink_service_remove.bat, then run C:\SwPLC\Service\swplclink_service_install.bat.

12.3 When I started PLC_DIAGNOSE, it shows me a black screen. What should I do?

Please run C:\SwPLC\SwPLC_Diagnose_Color.reg.

The "SwPLC_Diagnose_Color.reg" file is to set PLC_DIAGNOSE to its default settings when it doesn't operate correctly.



12.4 The TMRC command for PLC didn't work.

When the TMRC (timer) command is used in a PLC sequence program, you must set the table with the "D Table" button of swPLC_CONTROL. See Section 6.6: Setting Up and Editing Data Table Addresses.

12.5 How can I disable the pulse generator with the PLC sequence program?

1) Open "C:\SwPLC\Ladder\SoftServo_0.lad" file with any text editor. Replace one line of code:

// E-Stop using HandWheel E-Stop input
"RD X0.0"
Change this line to become
"RD.NOT X0.0"

- 2) Save the file and start "C:\SwPLC\Utility\swPLC_CONTROL.exe"
- Click the "Compile" button and make sure the "Module definite file name" is "C:\SwPLC\Ladder\SoftServo_0.mod" and click "Compile execute"; you will see a "Compile success" message.
- 4) Click "Cancel" to close the PLC control screen.

12.6 The PLC Diagnose utility cannot load my sequence program.

This phenomenon occurs when neither the PLC service nor other processing is being correctly done. Check that the PLC service is running correctly or put the settings back to the default settings (as explained in previous sections).

12.7 I can't stop PLC with the PLC Control Screen utility. What is going on?

This phenomenon occurs when neither the PLC service nor other processing is being correctly done. Check that the PLC service is running correctly or put the settings back to the default settings (as explained in previous questions).

12.8 The PLC didn't start correctly with my customized application; what's wrong?

The PLC function calls must be in the following order:

- sssStartInterrupt(HD)
- Plc_ini_start(PLC_setdata)
- sssPLC_Start(HD, PLC_setdata)



12.9 I am using LadderWorks Console, and the "Diagnostic Mode" option in the OnLine pull-down menu isn't available – it appears grayed out. What is going on?

It could be one of three things:

- 1) Are you using the On-Line version of LadderWorks Console on a PC on which Ardence RTX is not installed? Ardence RTX must be properly installed before the LadderWorks Console On-Line version is installed.
- Are you using the On-Line version of LadderWorks Console on a PC that has no adapter card installed? An adapter board for VersioBus, Panasonic Realtime Express (RTEX), MECHATROLINK or SSCNET must be installed.
- 3) Is your ServoWorks CNC or SMP software compatible with LadderWorks Console? See page 1-2 for compatibility requirements.

12.10 Using G100, I am trying to move Axis 4, but cannot move. However, if I try to move Axis 5, I could move Axis 4. What's going on?

Please refer to Table 4-10 on page 4-6 of the LadderWorks PLC I/O Mapping for ServoWorks MC-Quad and the ServoWorks S-100M Series.

12.11 Through PLC (using G10 and G11), I could only set up the value of the Jog Feedrate Override (Manual Feedrate Override) up to 24,576 [mm/min]. Why?

The value of Jog Override faces restrictions on Feedrate according to the following parameters:

- 1) Jog Feedrate Override [mm/min or deg/min] (under Spindle Tab in Config)
- 2) Rapid Override [mm/min or deg/min] (under Spindle Tab in Config)
- 3) Rated Velocity [RPM] (Motor/Drive Tab in Config)
- 4) Peak Velocity [RPM] (Motor/Drive Tab in Config)
- 5) Distance Per Encoder Revolution [mm or deg] (Axis Control Tab in Config)

Suppose, for instance, Rated Velocity is 3000 [RPM] and Distance Per Encoder Revolution is 8.192 [mm/RPM], the maximum speed would be 24,576 [mm/min] in this case (3000 x 8.192).

As an actual speed calculation, if G10.7 is set to 0, which corresponds to a weight of 128, and Jog Feedrate is set to 10,000, the calculated speed is $10,000 \times 1.28 = 12,800 \text{ [mm/min]}.$

If you use an incremental motor whose maximum rated velocity (Rated Velocity) is 3000 [RPM] and set Distance Per Encoder Revolution to 16.384 [mm/RPM], in this case, the Jog override value will be 49,152 [mm/min] (3000 x 16.384).

Therefore, please check to see whether or not these parameters restrict the velocity of Jog Feedrate Override.



Please refer to Table 4-4 on page 4-6 of the LadderWorks PLC I/O Mapping for ServoWorks MC-Quad and the ServoWorks S-100M Series.

12.12 We created a customized PLC sequence program for our ServoWorks CNC system, but there are some input bits that are not stable. After much checking, we have changed to other inputs, and now it works. Please advise.

There are certain I/O points (X/Y) and internal relay (R) addresses that are already used in the default LadderWorks PLC sequence program provided with your ServoWorks CNC or SMP product. Please read and fully understand the default PLC sequence program. If certain I/O addresses are already used, please modify the default sequence program and reuse the code, or avoid those used addresses completely.



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