Warning

The product described herein has the potential – through misuse, inattention, or lack of understanding – to create conditions that could result in personal injury, damage to equipment, or damage to the product(s) described herein. Machinery in motion and high-power, high-current servo drives can be dangerous; potentially hazardous situations such as runaway motors could result in death; burning or other serious personal injury to personnel; damage to equipment or machinery; or economic loss if procedures aren’t followed properly. Soft Servo Systems, Inc. assumes no liability for any personal injury, property damage, losses or claims arising from misapplication of its products. In no event shall Soft Servo Systems, Inc. or its suppliers be liable to you or any other person for any incidental collateral, special or consequential damages to machines or products, including without limitation, property damage, damages for loss of profits, loss of customers, loss of goodwill, work stoppage, data loss, computer failure or malfunction claims by any party other than you, or any and all similar damages or loss even if Soft Servo Systems, Inc., its suppliers, or its agent has been advised of the possibility of such damages.

It is therefore necessary for any and all personnel involved in the installation, maintenance, or use of these products to thoroughly read this manual and related manuals and understand their contents. Soft Servo Systems, Inc. stands ready to answer any questions or clarify any confusion related to these products in as timely a manner as possible.

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This document is based on information that was available at the time of publication. All efforts have been made to ensure that this document is accurate and complete. However, due to the widely varying uses of this product, and the variety of software and hardware configurations possible in connection with these uses, the information contained in this manual does not purport to cover every possible situation, contingency or variation in hardware or software configuration that could possibly arise in connection with the installation, maintenance, and use of the products described herein. Soft Servo Systems, Inc. assumes no obligations of notice to holders of this document with respect to changes subsequently made. Under no circumstances will Soft Servo Systems, Inc. be liable for any damages or injuries resulting from any defect or omission in this manual.

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VersioBus II Release Notes

Soft Servo Systems, Inc. is pleased to announce the immediate availability of VersioBus II, the next generation of the VersioBus fiber-optic communication protocol originally developed by Soft Servo Systems. The new VersioBus II protocol is a proprietary 5 Mbps real-time fiber-optic digital servo and I/O communication protocol that provides enhanced reliability and security, and supports a 1 ms multi-axis (up to 16 axes) interpolation cycle.

The difference between the VersioBus and VersioBus II interface systems, from a customer's point of view, is just a matter of using new part numbers for the VersioBus II hardware components. The appearance, hardware specifications, connections, wiring and setup remain exactly the same. Each VersioBus hardware component has a corresponding VersioBus II hardware component that uses the new VersioBus II communication protocol, as shown in the following table:

<table>
<thead>
<tr>
<th>Component Type</th>
<th>VersioBus</th>
<th>VersioBus II</th>
</tr>
</thead>
<tbody>
<tr>
<td>VersioBus PCI Adapter Board</td>
<td>FP-95</td>
<td>FP-105</td>
</tr>
<tr>
<td>VersioBus ISA Adapter Board</td>
<td>FP-80</td>
<td>FP-85</td>
</tr>
<tr>
<td>VersioBus PC104 Adapter Board</td>
<td>FP-104</td>
<td>FP-114</td>
</tr>
<tr>
<td>Servo Interface Module</td>
<td>DC-150</td>
<td>DC-155</td>
</tr>
<tr>
<td>I/O Module</td>
<td>IM-300</td>
<td>IM-305</td>
</tr>
</tbody>
</table>

When ordering an SMP product for the VersioBus II interface system, you will need to use "V2P" or "V2I" as the suffix for the product part number ["V2P" and "V2I" replace the "VBP" and "VBI" suffixes used for the older VersioBus interface system.] For instance, "3S-SMP450-V2I" indicates SMP450 with an FP-85 (ISA) adapter board and a DC-155 servo interface module. [The "P" in the suffix indicates a PCI adapter board; the "I" indicates an ISA adapter board.]

The VersioBus and VersioBus II protocols are not compatible. In other words, VersioBus hardware components (adapter boards, servo interface modules and I/O modules) cannot be included in the same network as VersioBus II hardware components. Care must be taken to avoid mixing VersioBus and VersioBus II products in the same system.

The same VersioBus fiber-optic cable works for both VersioBus and VersioBus II interface systems. The HW-100 handwheel and the breakout boxes (TB36A, TB36B and TB37BD) that were optional components in the VersioBus interface system are also optional components in the VersioBus II interface system. These components do not use a fiber-optic protocol, and can be used interchangeably with existing VersioBus interface systems and with any new VersioBus II interface systems.

If you are using an existing VersioBus system, replacement VersioBus hardware components (FP-80s, FP-95s, FP-104s, DC-150s and IM-300s) will be made available for one year, after which they will be discontinued.

Please contact sales@softservo.com with any questions you may have regarding this new protocol.
Cautions

**Servo Drives Need to Be Connected and Powered Up**

SMP applications for the VersioBus II interface system will not run unless servo drives are connected and powered up. The hardware needs to be ready to use before the SMP Console or any other SMP program is opened.

---

**Servo Manuals**

The VersioBus II interface system accommodates a variety of servo drives from many servo drive manufacturers. This manual should be used in conjunction with any manuals or literature that accompanied the servo drives that you are using in your VersioBus II interface system.

**IntervalZero RTX Compatibility with Windows XP Service Pack**

Service Pack 3 (SP3) for Windows XP is compatible with RTX 2011, which is the version currently provided with your SMP product. However, RTX2011 is neither compatible with Windows XP with Service Pack 1, nor Service Pack 2.

If Windows XP Service Pack 3 has not been installed, you will need to install Windows XP Service Pack 3 in order to run your SMP product on a PC.

---

**64-bit Windows Compatibility**

64-bit versions of the Windows operating system are NOT COMPATIBLE with your SMP product.
**HAL Compatibility Issue with RTX**

There is a known compatibility issue with IntervalZero RTX, the real-time extension to Windows operating systems that is required for all of Soft Servo Systems’ products, including the Simulation versions of SMP products.

This compatibility issue can be avoided or easily resolved by checking and changing settings on your computer. You must review Section 3.2: Checking HAL Type for Compatibility with RTX to see if this compatibility issue applies to you. If it does, this section will also instruct you on how to resolve the issue.

---

**CAUTION**

Review Section 3.2: Checking HAL Type for Compatibility with RTX before installing any software. CHECKING YOUR SYSTEM SETTINGS BEFORE INSTALLING SOFTWARE WILL HELP YOU TO AVOID POTENTIALLY BIG PROBLEMS.
Safety Notes

PC Location

⚠️ CAUTION

It is strongly recommended that you do not locate the PC inside the electric cabinet, to minimize the possibility of problems due to electrical noise being introduced into the PC motherboard (through air and/or poorly shielded wires such as keyboard, mouse or handwheel cables). Such noise could affect the PCI or ISA bus data flow within the PC, or possibly even the CPU/memory operations of the PC. In fact, it is recommended that you locate the PC as far from the servo drives (the main source of electrical noise) as practicality permits.

Mounting Location

⚠️ CAUTION

Never use VersioBus II components in an area where those components could be exposed to water (such as splashing), due to the risk of electric shock or fire.

⚠️ CAUTION

Never use VersioBus II components next to flammable items, or in a corrosive or flammable atmosphere, due to the risk of electric shock or fire.

Operational Precautions

⚠️ CAUTION

Set all system parameters before operating any components in the VersioBus II interface system. See the Reference Manual for SMP Parameters and Functions.

⚠️ CAUTION

Test the Emergency Stop before operating any components in the VersioBus II interface system. Make sure the Emergency Stop can be applied at any time.
Never open up any VersioBus II components, or touch the inside of any VersioBus II component. Doing so may result in damage to the component, or could result in electrical shock.
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Chapter 1: Introduction

1.1 Overview of SMP General Motion Control

SMP technology is a soft motion technology forming the basis of Soft Servo Systems’ truly PC-based SMP general motion control solutions, with a single host CPU performing all real-time servo and control tasks, including feedback loops, multi-axis interpolation, motion program processing and PLC, as well as providing the graphical user interface, network communication, and more. SMP software technology runs on Windows 2000/XP/XPe with IntervalZero’s RTX technology.

Soft Servo Systems’ general motion control solutions are currently available for many servo communications platforms, based on many different communications technologies:

- VersioBus™ II fiber-optic digital servo network
- Panasonic Realtime Express™ (RTEX) Ethernet-based interface system
- Yaskawa Electric’s MECHATROLINK™ II (5 Mbps) digital servo communications platform
- Yaskawa Electric’s MECHATROLINK™ III (100 Mbps) digital servo communications platform
- Mitsubishi’s SSCNET™ interface system
- CANopen digital servo communications platform
- EtherCAT Ethernet-based servo network

1.2 Overview of the VersioBus II Interface System

VersioBus II™ is Soft Servo Systems’ proprietary, 5 Mbps fiber-optic digital servo communications system for conventional analog-interfaced servo drives. The VersioBus II interface platform consists of software, a multi-function VersioBus II adapter board (ISA, PC104 or PCI form factor), and one or more universal interface modules and I/O modules (connected with VersioBus II fiber optics) for up to 16 axes of servo control and up to 416 points of general digital I/O.

In this system, you supply the PC, and Soft Servo Systems, Inc. provides the software, the adapter board, and one or more universal interface modules (connected with VersioBus II fiber optics), depending upon your system requirements. See Section 1.4: Do You Have the Necessary Requirements for the VersioBus II Interface System?

1.3 Overview of the SMP Installation and Setup Manual for the VersioBus II Interface System

This SMP Installation and Setup Manual for the VersioBus II Interface System will take you through the software installation and configuration, hardware setup, the connections between the VersioBus II interface system and the servo drives, and the connections between the VersioBus II interface system and the machine.

You will need to use the SMP Console to set your servo control, motor and drive parameters, and test and tune the system. Refer to the SMP Console Operator’s Manual.

Chapters 5 and 6 deal with setting up VersioBus II hardware components – which chapter you use depends on the following:
If you are using an ISA or PC104 VersioBus II adapter board (FP-85 or FP-114), use Chapter 5: System Setup with an ISA or PC104 VersioBus II Adapter Board for Windows XP.

If you are using a PCI VersioBus II adapter board (FP-105), use Chapter 6: System Setup with a PCI VersioBus II Adapter Board for Windows XP.

Figure 1-1: Flow Chart for Deciding Which System Setup Chapter to Use

NOTE: If you are integrating LadderWorks into your VersioBus II interface system, you must refer to the LadderWorks PLC User’s Manual for instructions on setting up the PLC environment and writing PLC sequence programs.

1.4 Do You Have the Necessary Requirements for the VersioBus II Interface System?

1.4.1 PC Hardware Requirements

System requirements for running a VersioBus II interface system are as follows:

- **CPU:**
  - Minimum: Intel Pentium III 1 GHz or equivalent
  - Suggested and minimum for 3D-DLACC (three-dimensional dynamic look-ahead contour control): Intel Pentium IV 2 GHz or faster

  **CAUTION**

  We recommend Hyper-Threading be disabled if your PC’s CPU supports this feature. Because each physical core in a Hyper-Threaded CPU is treated as a pair of logical cores, each logical core may starve its paired logical core of resources, leading to adverse effects on real time performance.

- Random Access Memory (RAM): 256 MB (512 MB suggested)
• Hard disk space: 30 MB

• One ISA bus slot, one PCI slot or one PC104 stacking connector, depending upon requirements [NOTE: PCI slots must be “regular” PCI slots; “low profile” PCI slots do not provide sufficient space for any of the PCI adapter boards designed for SMP products.]

• Ethernet connection: 10 MB/sec or 100 MB/sec
  o An active, enabled, properly configured Ethernet port with a properly configured network card device driver. THE ETHERNET CONNECTION MUST NOT BE DISABLED.
  o You do not need an actual Ethernet cable plugged in or connected to a LAN or to the Internet, just an active Ethernet port

• Display
  o 256-color graphic adapter
  o Color monitor capable of 800 x 600 pixel resolution (1024 x 768 recommended)
  o Recommended video chips: ATI or nVidia
  o Video chips that are known to be incompatible with Soft Servo Systems' products: S3, SMI Lynx, Trident and VIA [NOTE: This list of video chips is not comprehensive; any video chip other than our recommended video chips should be tested with RTX.]

• One of the following HAL types must be supported:
  o PC Compatible EISA/ISA HAL
  o ACPI Compatible EISA/ISA HAL
  o MPS 1.4 – APIC platform HAL
  o ACPI 1.0 – APIC Platform UP
  o ACPI 1.0 – APIC Platform MP
  o ACPI x86 Platform

NOTE: Some hardware configurations are not supported by RTX installations and therefore are not supported by SMP installations: Compaq AP400, Dell 7000 portables, HP Kayak and Alpha systems.
1.4.2 PC Software Requirements

- SMP products require 32-bit Microsoft Windows XP (Professional Edition) with Service Pack 3, or Microsoft Windows XPe. SMP products do not include an operating system.

- SMP products require IntervalZero RTX RunTime software, the real-time extension to the Windows operating system, which is included with all SMP products.

- Administrator privileges (which allow access to system settings) are required for installing, uninstalling and using IntervalZero RTX.

- If you are running SMP software on a computer with a dual-core CPU, you must have at least version 7.0 of IntervalZero RTX, the real-time extension for Windows operating systems. [NOTE: At the time of this writing, Soft Servo Systems is only providing RTX 8.1 with its SMP products. Therefore, this is only a concern for customers with dual-core CPUs who are upgrading their SMP products and who may have been planning to reuse their licensed copy of an older version of RTX].

- One of the following standard Microsoft HALs must be installed:
  - Standard PC
  - Advanced Configuration and Power Interface (ACPI) PC
  - MPS Multiprocessor PC
  - ACPI Uniprocessor PC
  - ACPI Multiprocessor PC
  - ACPI x86-based PC

- Internet Explorer 5.01 or higher is required

1.4.3 PC Functions

Depending upon the location of the PCI slot, ISA slot or PC104 stacking connector of your PC adapter card, the location of the motherboard slot, and the hardware and software configuration, there is the potential that some PC functions might have to be disabled due to IRQ conflicts. These functions include, but are not limited to: USB, Ethernet, sound, modem, and some hardware components.

Soft Servo Systems recommends consulting with our sales staff prior to purchasing a PC on which to run your Soft Servo product.
Chapter 2: Welcome to the VersioBus II Interface System

2.1 What is the VersioBus II Interface System?

The VersioBus II interface system is a servo system for the truly PC-based SMP products offered by Soft Servo Systems, Inc. that combines SMP software technology with VersioBus II communications technology. Soft Servo Systems, Inc. offers the following SMP products that run on the VersioBus II platform: SMP400 and SMP450 for 4 axes; SMP800 and SMP850 for 8 axes; and SMP1600 for 16 axes.

The SMP series is an innovative, PC-based soft motion solution for real-time general motion control. VersioBus II is a proprietary 5 Mbps real-time fiber-optic communications protocol interfacing with any analog servo drive, and supporting most types of motors and encoders.

The VersioBus II interface system is summarized in the following figure:

![VersioBus II Interface System Diagram](image)

Figure 2-1: The VersioBus II Interface System – A Complete, Next Generation General Motion Controller

2.2 VersioBus II Communications Features

2.2.1 Compatibility Features

- VersioBus II’s unique usage of FPGA (Field Programmable Gate Array) technology allows the VersioBus II interface system to easily adapt to various servo motor and encoder types with simple hardware updates, by capitalizing on the flexibility offered by FPGAs
- The VersioBus II interface system supports AC motors and DC motors
- The VersioBus II interface system supports incremental encoders

2.2.2 Inputs/Outputs

- Each VersioBus II adapter board (FP-85, FP-105 or FP-114) has 32 points of on-board optically-isolated general I/O (16 inputs/16 outputs)
- Each DC-155 servo interface module has 16 uncommitted, opto-isolated inputs and 16 uncommitted, opto-isolated outputs
- Opto-isolated forward and reverse limits and home inputs are provided for each axis
- Each IM-305 (an optional I/O module) has 64 points of general digital I/O (32 inputs/32 outputs)
- Up to 4 IM-305s can be daisy-chained together, scalable to 256 additional I/O points (for a maximum of 416 general I/O points with four DC-155s and a VersioBus II adapter board)

- Each VersioBus II adapter board provides an encoder and digital I/O connector for a handwheel

### 2.2.3 VersioBus II Connections

- The VersioBus II interface system uses dual-channel VersioBus II (a proprietary 5 Mbps real-time fiber-optic communications protocol) for the servo network and the I/O network

- Each fiber-optic cable goes up to 10 meters for distributed control

- The servo and I/O interface modules are daisy-chainable for distributed control and multiple nodes

- A single, fiber-optic cable replaces the encoder and analog cables from the PC used in other companies’ general motion control products

### 2.3 Interpolation Rate

For all SMP products using the VersioBus II interface system (ISA, PCI and PC104 versions), the interrupt service routine (ISR) that begins each servo loop is set to a 1 ms interpolation rate.

### 2.4 Absolute Encoders in the VersioBus II Interface System

At this time, absolute encoders are not supported in the VersioBus II interface system. Only incremental encoders can be used in the VersioBus II interface system.
Chapter 3: Installing the SMP Software

3.1 Preparing for Software Installation

Before you begin installing the SMP software, you must check (and possibly address) some issues regarding your computer and its settings.

First, you must make sure that you meet the necessary PC hardware and operating system requirements. See Section 1.4: Do You Have the Necessary Requirements for the VersioBus II Interface System? if you haven’t already checked for these requirements.

Second, make sure that you are logged in with administrator privileges (which allows access to system settings), or you will not be able to install, uninstall or use IntervalZero RTX, the real-time extension to the Windows operating system.

The next few sections will guide you through checking a known compatibility issue with RTX, installing operating system patches (if necessary), and enabling the network card device driver for the Ethernet card.

3.2 Checking HAL Type for Compatibility with RTX

3.2.1 Overview of Incompatible HAL Type

There is a known compatibility issue between systems with certain Hardware Abstract Layer (HAL) types, and IntervalZero RTX. There are only six HAL types that are acceptable for use with RTX 8.1.

You should read this section to see if this issue applies to you, and take the steps outlined to resolve the issue if necessary.

CHECKING YOUR SYSTEM SETTINGS NOW WILL HELP YOU TO AVOID POTENTIALLY BIG PROBLEMS LATER.

3.2.2 Potential Problems Caused by Not Addressing This Issue

If you try to install RTX on a PC with an incompatible HAL type, you may see a severe error similar to the following:

![Figure 3-1: Severe HAL Error Message](image)

It is possible that RTX will not prevent you from installing RTX on a system with a wrong HAL setting, in which case this incompatibility issue could cause some serious system failures, such as:
1) Fatal application exit (i.e., “application crash”)

2) System lock-up (or “freeze”)

3) System bug check (i.e., “Blue Screen of Death” or “Green Screen of Death”)

You must check to see whether or not your PC has an incompatible HAL type before installing RTX.

### 3.2.3 Checking HAL Type

1) From the Windows “Start” menu, go to “Control Panel” (Start Menu) as shown:

![Figure 3-2: Start Menu Selection for Control Panel](image)

2) You will see the “Control Panel” window appear, as shown:
3) Click on the “Performance and Maintenance” icon, and you will see the following window appear.
[NOTE: If you are in Classic View, just click on the “System” icon – the “System Properties” window will appear, and you should skip ahead to Step #5.]
4) Click on the “System” icon, and you will see the “System Properties” window appear, as shown:
5) Click on the “Hardware” tab.

6) In the “Device Manager” frame, click on the “Device Manager” button. You will see the “Device Manager” window appear, as shown:

![Device Manager Window](image)

Figure 3-6: Device Manager Window
7) Click on the symbol next to the “Computer” node to see the drop-down list under “Computer”. The leaf listed below “Computer” is your HAL model (“Advanced Configuration and Power Interface (ACPI) PC” in the previous example window).

Acceptable HAL models for “Standard Computers” and RTX 8.1 are:

- Standard PC HAL (PC Compatible EISA/ISA HAL)
- Advanced Configuration and Power Interface (ACPI) PC HAL (ACPI Compatible EISA/ISA HAL)
- MPS Multiprocessor PC HAL (MPS 1.4 – APIC Platform HAL)
- ACPI Uniprocessor PC HAL (ACPI 1.0 – APIC Platform UP)
- ACPI Multiprocessor PC HAL (ACPI 1.0 – APIC Platform MP)
- ACPI x86-based PC (ACPI x86 Platform)

If your HAL model is NOT listed above, then RTX cannot be installed on your system. Contact Soft Servo Systems, Inc. to discuss your options.

Otherwise, if you already have an acceptable HAL model to start installing IntervalZero RTX, proceed to the next section.

### 3.3 Software Upgrades, Backward Compatibility and Adding Software Options

#### 3.3.1 RTX Upgrading Notification

If you use RTX 7.0 or an earlier version, you will be prompted to upgrade to RTX 2011. You will be prompted to uninstall the older version of RTX with the following window, and the install buttons will be disabled after closing this notification:

![Figure 3-7: Notification Dialog for Uninstalling RTX 7.0 or Earlier](image-url)
In order to install RTX 2011, you will first need to uninstall the older version of RTX from “Add or Remove Programs” in Windows (from the Windows “Start” menu, go to “Control Panel” → “Add or Remove Programs”). Contact sales@softservo.com to receive a new PAC number for RTX 2011.

Upgrading users with RTX 8.1 series (includes RTX 8.1.1 and 8.1.2) will see the following window:

![Figure 3-8: Notification Dialog for Uninstalling RTX 8.1](image)

You will have the choice to force install and keep using the current RTX8.1 series, or you can exit the setup to uninstall RTX8.1 series and upgrade to RTX2011 as recommended. Clicking “Exit” will exit the setup and clicking “Force Install” will continue the installation using the current RTX.

### 3.3.2 Upgrading From an Older Version of an SMP Product

If you are upgrading from an older version to a newer version of an SMP product, you will receive a new installer for the newer version of the SMP product. You must use that installer to uninstall the relevant SMP component(s) before installing the newer version of the component(s). Unless you are upgrading from a version prior to Version 3.0 to Version 3.0 or greater, you will not get a new PIK number, nor will you need to reregister your software. You can use the same license code – your SMP license code will be automatically maintained during this upgrading process.

For SMP850, for instance, if you use the installer for a new version of SMP850 and click on the “SMP850” button, you will be prompted to uninstall SMP850 with the following window:
Chapter 3: Installing the SMP Software

3.3.3 Version 3 Backward Compatibility Issues

If you are upgrading to Version 3.0 or greater from a version prior to Version 3.0, there are a few known issues:

1) Pitch error compensation values will be initialized as 0. In other words, previously set pitch error data will not be imported into the new software, and will need to be input again.

2) The “Distance Per Encoder Revolution” and “Plus Stroke” parameters of Axis 1 will swap, and will need to be corrected.

Correct values for these two items will be kept from this point on, with any future post-3.0 versions.
3.3.4 Adding Options to Existing SMP Products

If you purchase software options to add to your existing SMP product, your PIK number will be reactivated by Soft Servo Systems. You must reregister your SMP product (using the original PIK number for your product) to activate those options, but you won’t need to reinstall your SMP product.

3.4 Installing Operating System Patches

3.4.1 Overview of Service Pack Requirements for Windows Systems

As noted in Chapter 1, the Microsoft Windows XP operating system requires Service Pack 3, for the IntervalZero RTX real-time extension to function properly.

3.4.2 Windows XP Service Pack 3 – Not Required, and Sometimes Prohibited

Service Pack 2 is required for Windows XP; Service Pack 3 for Windows XP is not required, but is compatible if you are running RTX 8.1 with Service Pack 1 for RTX 8.1 (the version of RTX currently provided with your SMP product).

Your SMP product will not run on a PC with Windows XP Service Pack 3 and with RTX 8.1 without Service Pack 1 for RTX 8.1. Similarly, your SMP product will not run on a PC with Windows XP Service Pack 3 and any of the following version of RTX: RTX 7.x, RTX 6.x, RTX 5.x or earlier.

Service Pack 3 (SP3) for Windows XP is ONLY COMPATIBLE with RTX 8.1 with Service Pack 1 for RTX 8.1.

---

**CAUTION**

Your SMP product will not run on a PC with Windows XP Service Pack 3 and RTX 7.1 or older. If you must, for some reason, use RTX 7.1 or older, you must not install Windows XP Service Pack 3. In this case, if Windows XP Service Pack 3 is inadvertently installed, it must be uninstalled:

- If SP3 was installed as an update, you may be able to uninstall SP3 using the “Add or Remove Programs” feature of Windows (you may have to check the “Show updates” box at the top of the window).
- If Windows XP was installed using a Windows XP SP3 disk, your only solution will be to reinstall Windows XP with Service Pack 2.

---

3.4.3 Checking Which Service Packs Are Installed For Your Windows Operating System

You can check to see which service packs (if any) are installed on your PC with the following procedure:

1) Click on the “Start” menu in the lower left hand corner of your PC’s desktop.

2) Click on “Run…”, as shown in the following figure:
3) A dialog box will appear, as shown in the following figure:

![Run Dialog Box](image)

**Figure 3-11: The Run Dialog Box**

4) Type “winver.exe” in the text box, and click “OK.” A window similar to that shown in the following window will appear telling you the latest service pack installed on your PC:
If the latest patches from these service packs haven’t been installed, you must install them now. You can install the latest service packs by going to Microsoft’s web site (www.microsoft.com), and clicking on “Downloads & Trials), then selecting “Windows Update” to start the procedure.

If you install the IntervalZero RTX software before you install the required operating system patches, there could be subtle problems with your installation. The operating system patches must be installed before you begin the SMP installation.
3.5 Enabling the Network Card Device Driver for the Ethernet Card

One of the system requirements for running an SMP product is an Ethernet connection of 10 MB/sec or 100 MB/sec. However, just having an Ethernet connection on your PC is not enough; the device driver for the Ethernet network card must be installed and enabled. Otherwise, you will not be able to properly register your SMP product.

**NOTE**: There doesn’t need to be an actual network connection (cable) to a LAN or to the Internet, just an active Ethernet port. **ETHERNET CANNOT BE DISABLED**. We recommend checking to make sure the Ethernet card and its device driver are correctly installed and enabled in the computer, with the following procedure.

1) From the Windows “Start” menu, go to “Control Panel” (Start Menu) as shown:

![Start Menu Selection for Control Panel](image)

*Figure 3-13: Start Menu Selection for Control Panel*

2) You will see the “Control Panel” window appear, as shown:
3) Click on the “Performance and Maintenance” icon, and you will see the following window appear. [NOTE: If you are in Classic View, just click on the “System” icon – the “System Properties” window will appear, and you should skip ahead to Step #5.]
4) Click on the “System” icon, and you will see the “System Properties” window appear, as shown:
5) Click on the “Hardware” tab.

6) In the “Device Manager” frame, click on the “Device Manager” button. You will see the “Device Manager” window appear, as shown:
7) Click on the symbol to see the drop-down list under “Network adapters.” This will display the current network devices that are detected by Windows. In our example, there are two devices, one of which is the Realtek RTL8139/810x Family Fast Ethernet NIC. This is the network card, which can have many different names depending on the computer, but usually contains the words “Ethernet” or “network” in its description.

In this example, the network card appears to be in working order. One of the following will appear in the Device Manager if there is a problem:

a) The Network card does not appear at all, or the “Network adapters” icon cannot be found in the Device Manager. In this case the network card may not be installed correctly, as Windows should detect almost all cards put into the computer. Recheck the card’s connection.

b) There is a listing for “Other devices” in the Device Manager. Check this listing to see if there is an item that may be the network card. If this is the case, the drivers could not be found by Windows, so the device it detected was placed in the “Other devices” category. Windows does not currently know what the device is, so updating the drivers to the correct ones will help to resolve this.

c) The card appears, but has a yellow exclamation point or a red X over the icon. In this case, the card has been detected and Windows recognizes it as a network card, but incorrect drivers may have been installed or there is another conflict with the card.

d) There are multiple network cards with the same name but there is only one network card installed in the machine. One or both of the cards may have a yellow exclamation point or a red X over its icon. In this case, right click on the network card, and select “Uninstall” from the drop-down menu. Do this for each card that appears until there are no more cards listed. Close the Device Manager and restart the computer. Windows should detect only one device when it boots up.

Right clicking on a device and selecting “Properties” from the drop-down menu will open a new window for that device – the “Device status” frame in that window may have a message that could give some insight into a problem with a device. For troubleshooting any problems, consult the literature provided with your PC.

3.6 Registering With Soft Servo Systems and IntervalZero and Obtaining Your License Code and RTX License Key

3.6.1 Overview of PIK and PAC Numbers

If you have access to the Internet from the computer on which you are installing this software, you can skip this section, proceed to Section 3.7: The Installation Procedure, and obtain your SMP license code and your RTX license key during the software installation procedure for your SMP product.

You will need to register your SMP software to obtain your license code, and register your IntervalZero RTX software and obtain your RTX license key, during the software installation procedure detailed in Section 3.7: The Installation Procedure. Ideally, you need Internet access to obtain these license codes.

You must have the SSS PIK # (Soft Servo Systems Product Identification Key) and the PAC # (Purchase Authentication Code for RTX) that Soft Servo Systems provided with your SMP product (on stickers inside the CD case, and on the license packing list inside the CD case).
### Table 3-1: Packing List and Product Registration Numbers

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>FIND ON PACKING LIST:</th>
<th>FOLLOW REGISTRATION PROCEDURE TO OBTAIN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMP product (SMP400, SMP450, SMP800, SMP850 or SMP1600)</td>
<td>SSS PIK #</td>
<td>SMP license code</td>
</tr>
<tr>
<td>IntervalZero RTX (real-time extension to Windows operating system, included with SMP product)</td>
<td>PAC #</td>
<td>RTX license key</td>
</tr>
</tbody>
</table>

#### 3.6.2 Registering for Your SMP License Code and RTX License Key Without Internet Access

If you don’t have Internet access from the computer on which you are installing this software, you should obtain both the SMP license code and the RTX license key from another computer with Internet access during the installation procedure, or you won’t be able to complete the procedure. (You’ll have to start the installation procedure on the computer on which you are installing the SMP product in order to get the Computer ID number and the Product Part Number. With this information, you can go to a computer with Internet access, go to Soft Servo Systems’ registration web page, and get the license code to take back to the first computer. Similarly, you must continue the installation on the first computer to get the Machine ID number. With the Machine ID number, you can get the RTX license key using the computer with Internet access, then go back to the first computer to finish the RTX installation.) Make sure you have Internet access from some computer before you start the installation procedure.

**NOTE:** If you don’t have any Internet access on any computer, you can still get your SMP license code and your RTX license key. To get your SMP license code, you will have to fax a text page created automatically by the installation software during the registration process to Soft Servo Systems, Inc. – instructions will be provided during the installation process if you indicate that you don’t have Internet access. [You can also phone Soft Servo Systems, Inc. at 1-781-891-9555 if you don’t have a fax machine.]

To get your RTX license key without Internet access, you can call technical support at IntervalZero at 1-800-334-8649 from within the United States, or at 1-781-996-4481 (Ext. 226) from outside the United States. You must provide the PAC # and the Machine ID number (which you can only get by starting the installation procedure), and an IntervalZero representative will go to the web site for you, register you, and provide your license key number over the phone. Again, you must have your Machine ID number before calling, so you must have started the installation procedure to get that number before calling.

At the time of this writing, IntervalZero’s telephone technical support is available from 8:30 AM to 5:30 PM Eastern Standard Time. If you plan to register by telephone, you should perform the SMP installation during those hours.
3.6.3 Saving Your PAC # and RTX License Key

When you get your IntervalZero RTX license key, it is VERY important that you retain this RTX license key, as well as your PAC number, in a safe and accessible place.

If you replace the hard drive, change the partition of your hard drive, reformat your hard drive, reinstall your operating system, change to a new operating system, or move your SMP product to another computer (and possibly if you update the service pack for your operating system), you will need a replacement RTX license key (without which IntervalZero RTX will no longer operate). To get a replacement RTX license key, you will need your PAC number AND your previous RTX license key.

We recommend that you report your RTX license key number (and PAC#) to Soft Servo Systems at registration@softservo.com. Soft Servo Systems maintains a database of RTX license keys for the PAC numbers we distribute, for your convenience in the event that you lose your license key number.

3.6.4 Getting a Replacement RTX License Key

To get a replacement RTX license key, you will have to contact Soft Servo Systems at ssa-sales@softservo.com and provide the following information:

1) PAC # (Purchase Authentication Code for RTX)
2) Previous RTX license key
3) Machine ID of the computer on which you want to install RTX (to get this Machine ID number, start the RTX installation procedure and follow the steps until the installer gives you the machine ID).

**CAUTION**

This is a change from how RTX replacement license keys were previously generated. Until recently, you could obtain an RTX replacement license key using the IntervalZero web site during the RTX installation procedure. Therefore, there was no delay in reinstalling RTX after reformatting your hard drive, changing to a new operating system, etc.

Now, you must contact Soft Servo Systems via e-mail for a replacement license key, and await a reply. You should plan your RTX reinstallation accordingly.

3.6.5 Saving Your PIK # and SMP License Code

It is VERY important that you retain your PIK number and your SMP license code in a safe and accessible place.

You will need to contact Soft Servo Systems (by phone, fax or e-mail) to reactivate your PIK number if you need to reinstall your SMP product because you do any of the following:

- Replace the hard drive
- Change the partition of your hard drive
- Reformat your hard drive
• Reinstall your operating system

• Switch to a new operating system

• Update the service pack for your operating system (possibly, depending upon the service pack – some service packs may require re-registration of your SMP product; others may not)

• Move your SMP product to another computer

When your PIK number has been reactivated by Soft Servo Systems, you will need to reregister your SMP product to obtain a new SMP license code (by clicking the “Register” button in the SMP installer).

NOTE: If you upgrade your SMP product to a newer version, you will not need to reactive your PIK number or reregister your SMP product. You will uninstall the older version of the software, and then install the new version. The SMP license code for that product will be automatically maintained during this process.

If you purchase new options for your SMP product, Soft Servo Systems will automatically reactivate your PIK number, and you will need to reregister your SMP product to activate those new options (by clicking the “Register” button in the SMP installer).

3.7 The Installation Procedure

3.7.1 Starting the Installation

The SMP installation procedure includes registering your SMP product with Soft Servo Systems, Inc.; registering and installing IntervalZero RTX; installing LadderWorks PLC, the SMP base components, and the SMP Console HMI application; and installing the LadderWorks Console application and the DAO (Data Access Objects) package.

Before installing your SMP product, you should review Section 3.2: Checking HAL Type for Compatibility with RTX to check for and resolve any known compatibility issues with IntervalZero RTX.

MAKE SURE YOU ARE LOGGED IN WITH ADMINISTRATOR PRIVILEGES (WHICH ALLOWS ACCESS TO SYSTEM SETTINGS), OR YOU WILL NOT BE ABLE TO INSTALL, UNINSTALL OR USE INTERVALZERO RTX, THE REAL-TIME EXTENSION TO THE WINDOWS OPERATING SYSTEM.

IF YOU TAKE A FEW MOMENTS TO CHECK YOUR SYSTEM SETTINGS BEFORE INSTALLING RTX, YOU CAN AVOID POTENTIALLY BIG PROBLEMS.

The following software will be installed:

1) IntervalZero RTX RunTime

2) SMP – components include:
   a) SMP Motion Engine
   b) SMP Motion Parser
   c) LadderWorks PLC Engine
   d) SMP RealTime DLL

3) SMP Console application for the SMP400, SMP450, SMP800, SMP850 or SMP1600 (HMI)
4) Motion Development Kit (MDK)

5) LadderWorks PLC (refer to the LadderWorks manuals for setting up your PLC environment)

There are three different versions of VersioBus II adapter boards: the FP-105 plugs into a PCI slot in the host PC; the FP-85 plugs into an ISA bus extension socket in the host PC; and the FP-114 plugs into a PC104 stacking connector on the motherboard. The screen shots in this section are for the PCI version of the VersioBus II interface system. However, the software installation procedure for the PC104 and ISA versions are the same as for the PCI version, so the screen shots are not shown here.

Also, the screen shots for the software installation are for the SMP450, but the procedure is the same (and the screen shots differ only in product name) for every SMP product.

Start the SMP installation process with the following steps:

1) Close all running applications.

2) Place the SMP CD-ROM in the CD-ROM drive. The installation software will start automatically and the “Welcome to SMP” window will appear, as shown in the following figure. [NOTE: If the “Welcome to SMP” window doesn’t appear automatically, click on the executable file (SMP450_Install.exe or similarly named file), and the window will appear.]

![Figure 3-18: Welcome to SMP Window](image)

3) In the “Welcome to SMP” 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.
3.7.2 Registering Your SMP Product

1) In the “Welcome to SMP” window (shown in the previous figure), click on the “Registration” button – this will start the registration procedure, and the SMP License Code Window will appear as shown:

![Figure 3-19: SMP License Code Window (1 of 2)](image)

2) If you have already obtained a license code from Soft Servo Systems, Inc. (if, for example, you are reinstalling this software), you can proceed directly to step #13, skipping all steps in between. Otherwise, click the “Get License Code” button (not the “Finish” button), and you will see the following window appear:

![Figure 3-20: SMP Registration Options Window](image)
3) If you have access to the Internet (either on the computer on which you are installing your SMP product, or on another computer), select “Register over the Internet,” click the “Next” button, and proceed to step #4.

If you do not have access to the Internet, select “Manually register by e-mail, fax, or telephone,” click the “Next” button, and skip ahead to step #8.

4) You should see the registration form shown in the following figure:

![SMP Product Registration Form](image)

Figure 3-21: SMP Product Registration Form (1 of 2)

5) The Computer ID number and the Product Part Number are filled in automatically. Fill in the rest of the required information for every remaining field in the above window, as shown:

![SMP Product Registration Form](image)
6) When you have completed the form, click the “Next” button.

If you have Internet access, a browser will open up taking you to a secure web page on Soft Servo Systems’ on-line registration web site (similar to the following web page). [NOTE: The browser may open up below your installation software window – you may have to click on your computer’s status bar to see it.] The web page should be automatically filled in with all the information you provided in the product registration window.

If you don’t have Internet access from the computer on which you are installing your SMP product, but you do have Internet access on another computer, make a note of your PIK Code, your Computer ID number, and your Product Part Number, and take this information to the computer with Internet access. Open up a web browser with the following URL: https://www.servoworks.com/register. Select your SMP product from the “Software” pull-down menu – valid values are “SMP400,” “SMP450,” “SMP800,” “SMP850” or “SMP1600.” Select your interface platform from the “Platform” pull-down menu – valid values for the VersioBus II platform are “V2P (VersioBus II PCI)” for a VersioBus II PCI adapter board, and “V2I (VersioBus II ISA)” for a VersioBus II ISA adapter board. Type in all the information in every field in the section numbered “1,” as shown in the following figure:
Figure 3-23: Sample Web Page for Automatic Retrieval of an SMP License Key (1 of 2)

7) Click on the “GET YOUR LICENSE CODE” button, and the license code will be displayed on screen (as shown in the following figure), and will also be e-mailed to you at the e-mail address you have provided. Select and copy the license code into your computer’s Clipboard (or make a note of it and take it back to the computer on which you are installing your SMP product). Proceed directly to step #13.
Figure 3-24: Sample Web Page for Automatic Retrieval of an SMP License Key (2 of 2)

8) If you selected “Manually register by e-mail, fax, or telephone,” you should see the registration form shown in the following figure:
9) The Computer ID number and the Product Part Number will be filled in for you. Fill in the rest of the required information for every remaining field, as shown:

Figure 3-25: SMP Product Registration Form (2 of 2)

10) Click the “Save” button, and the following message will appear:
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11) This dialog box tells you the location of the registration text file that was created by the installation software: in this case, the file name is Registration.txt, and it is located on the C: drive. This file may open up automatically; if it does not, open up the file in Notepad, or some other word processor, and then click the “OK” button to close the dialog box.

Print this registration text file, and either e-mail or fax it to Soft Servo Systems, Inc. (the e-mail address and fax number in the United States are provided in the Registration.txt file). The text file appears similar to the following:

![Registration.txt File](image)

12) Soft Servo Systems, Inc. will mail or e-mail your license code to you, depending upon how you submitted your registration file.

When you receive the license code (either by Internet, phone or e-mail), go back to the SMP License Code window, as shown in the following figure:
13) Input your license code. (If you have obtained your license key automatically, using Internet access on the computer on which you are installing an SMP product, you should cut and paste the license key number from the web page to the License Code Window. If you had to go to a different computer or phone Soft Servo Systems, Inc. to obtain the license key, you’ll need to type in your license number.) Click the “Finish” button to continue.

3.7.3 Installing IntervalZero RTX 2011 and SMP Software

1) In the “Welcome” window (Figure 3-18), click on the third button (the “SMP450” button in this example) again – you will see a Windows Installer dialog box briefly appear, followed by a Welcome to the Setup Wizard window, shown in the following two figures:
Chapter 3: Installing the SMP Software

2) Click the “Next” button, and a Choose Setup Type window will appear, as shown in the following figure. Click the “Typical” button to install the SMP software to the default install location (“C:\Program Files\SoftServo” folder if the system drive is the C drive), or click “Custom” for custom setup. Skip to step #5 if you choose “Typical” setup.

3) You will see a Custom Setup window, as shown in the following figure, if you choose “Custom” setup. You can choose software features you will install, and the location where you will install. Select the feature(s) to install from the tree. Click the “Browse…” button to select the install location.
4) The following figure shows the Change Destination Folder window. Choose the destination folder for your installation and click the “OK” button. The destination folder will appear next to “Location” in the Custom Setup window in Figure 3-33. Click the “Next” button to continue.

Figure 3-33: Custom Setup Window

Figure 3-34: Change Destination Folder Window
5) If IntervalZero RTX has not been installed, the dialog shown in the following figure will appear. Make sure that Intel® Hyper-Threading is disabled, then click the “OK” button to continue. Skip to step #18 if IntervalZero RTX is already installed:

![Intel® Hyper-Threading Confirmation Window](image)

Figure 3-35: Intel® Hyper-Threading Confirmation Window

6) An RTX Installation window, as shown in the following figure, will appear. Fill in the RTX PAC Number (Purchase Authentication Code number – you can find it on a sticker on your SMP CD case). Then click the “Install” button.

![RTX Installation Window](image)

Figure 3-36: RTX Installation Window

7) A dialog box will appear, as shown in the following figure, asking whether you have access to the Internet on this computer.

![Question Dialog Box](image)

Figure 3-37: Question Dialog Box

8) If you don’t have access to the Internet, skip ahead to step #14.
9) If you do have access to the Internet, click “Yes”, and a window will appear, as shown in the following figure:

![RTX License Key Window (1 of 2)](image)

Figure 3-38: RTX License Key Window (1 of 2)
10) A web browser should have opened up taking you to IntervalZero’s web site (similar to the web page shown in the following figure). [NOTE: The browser will probably open up below the RTX License Key window shown in the previous figure -- you may have to click on your computer’s status bar to see it.] The web page should be automatically filled in with your PAC #, your Machine ID number, and your e-mail address.

![CAUTION]

If for some reason your web browser does not launch automatically, you should visit https://licensing.intervalzero.com/licenseform.asp. You will have to manually fill in your PAC #, Machine ID and e-mail address. To get your Machine ID, you will have to click on the “Back” button to cancel the installation. Then, start the installation again from the beginning of this section. When you reach the Question dialog box shown in Figure 3-37, click “No” this time and skip ahead to step #14.

NOTE: If you need a replacement (new) RTX license key because you are reinstalling IntervalZero RTX on a different computer from where it was previously installed, and reusing the PAC number, please see Section 3.6.4: Getting A Replacement RTX License Key. You will be unable to continue with your installation until you have contacted IntervalZero and received your replacement RTX license key from them.

![Figure 3-39: Sample Web Page for Product Licensing for RTX]
11) Click on the **Terms & Conditions** link, to view the IntervalZero RTX license agreement, as shown in the following window:

![Figure 3-40: Sample Web Page for IntervalZero License Key Agreement](image)

**NOTE:** You cannot skip this step. If you click on “GET LICENSE!” without clicking the **Terms & Conditions** link, you will get the following message:

![Figure 3-41: Warning Message Regarding Terms & Conditions](image)

12) You should read the license agreement, and then close this web page. You will be taken back to the previous web page shown in Figure 3-39. Check the “I agree with the Terms & Conditions…” check box to accept the terms of the agreement.

13) Click on the “GET LICENSE!” button, and an RTX license key number will be displayed on the screen (as shown in the following figure), and will also be e-mailed to you at the e-mail address you have provided. Highlight (select) this license key, and copy it into your computer’s clipboard (to paste into the installer window). Save or print this number, and keep this number in a safe place. Close your web browser.
It is VERY important that you retain this RTX license key, as well as your PAC number, in a safe and accessible place.

If you change the partition of your hard drive, reformat your hard drive, reinstall your operating system, or move your SMP product to another computer, you will need a replacement RTX license key (without which IntervalZero RTX will no longer operate). To get a replacement RTX license key, you will need your PAC number AND your previous RTX license key. See Section 3.6.4 Getting A Replacement RTX License Key.

We recommend that you report your RTX license key number (and PAC#) to Soft Servo Systems at registration@softservo.com. Soft Servo Systems maintains a database of RTX license keys for the PAC numbers we distribute, for your convenience in the event that you lose your license key number.

Skip ahead to step #17.
14) If you don’t have Internet access, click the “No” button in the Question dialog box shown in Figure 3-37, and instructions will appear (as shown in the Manual Registration window in the following figure) as to how you can obtain your RTX license number from another computer WITH Internet access. Also, see Section 3.6: Registering With Soft Servo Systems and IntervalZero and Obtaining Your License Code and RTX License Key for more information, including how to register by phone if you don’t have Internet access available to you on any computer.

![Manual Registration Instructions](image)

**Figure 3-43: RTX Manual Registration Window**

15) To get an IntervalZero RTX license key using Internet access, use another computer to get on the Internet and go to [https://licensing.intervalzero.com/Licenseform.asp?](https://licensing.intervalzero.com/Licenseform.asp?). The web page will appear as shown in Figure 3-39. Input the PAC # (Purchase Authentication Code number – you can find this on a sticker on the SMP CD case) in the “PAC Number” text box in the web page. Input the Machine ID number for your computer (which has been provided by the IntervalZero RTX installation procedure and is shown in the Manual Registration window in the previous figure), in the “Machine ID” text box in the web page. Input your e-mail address in the “Email Address” text box in the web page.

**NOTE:** If you need a replacement (new) RTX license key because you are reinstalling IntervalZero RTX on a different computer from where it was previously installed, and reusing the PAC number, please see Section 3.6.4: Getting A Replacement RTX License Key. You will be unable to continue with your installation until you have contacted IntervalZero and received your replacement RTX license key from them.

Click on the **Terms & Conditions** link, to view the IntervalZero RTX license agreement, as shown in Figure 3-40. **[NOTE: You cannot skip this step. If you click on “GET LICENSE!” without clicking the **Terms & Conditions** link, you will get the message shown in Figure 3-41.]**

You should read the license agreement, and close this web page. You will be taken back to the previous web page shown in Figure 3-39. Check the “I agree with the Terms & Conditions…” check box to accept the terms of the agreement.

Click on the “GET LICENSE!” button, and an RTX license key number will be displayed on the screen (as shown in Figure 3-42), and will also be e-mailed to you at the e-mail address you have provided. Write this number down, and take it back to the computer on which you are installing your SMP product.
3-37

CAUTION

It is VERY important that you retain this RTX license key, as well as your PAC number, in a safe and accessible place.

If you change the partition of your hard drive, reformat your hard drive, reinstall your operating system, or move your SMP product to another computer, you will need a replacement RTX license key (without which IntervalZero RTX will no longer operate). To get a replacement RTX license key, you will need your PAC number AND your previous RTX license key. Otherwise, you will have to contact IntervalZero, Inc. directly to get a replacement license key.

We recommend that you report your RTX license key number (and PAC#) to Soft Servo Systems at registration@softservo.com. Soft Servo Systems maintains a database of RTX license keys for the PAC numbers we distribute, for your convenience in the event that you lose your license key number.

16) After you obtain your RTX license key, click the “Next” button in the Registration window to continue, and you will see the RTX License Key window appear, as shown in the following window:

![RTX License Key Window (2 of 2)](image)

Figure 3-44: RTX License Key Window (2 of 2)

17) If you have obtained your license key automatically, using Internet access on the computer on which you are installing a SMP product, you should paste the license key number from the web page to the RTX License Key Window. If you had to go to a different computer or phone IntervalZero to obtain the license key, you’ll need to type in your RTX license key number. Click the “Next” button to continue, and you will see the IntervalZero RTX Installation dialog appear, as shown in the following figure, until the IntervalZero RTX installation has been completed.
18) The following figure shows the Confirm Installation window showing where the SMP450 software will be installed. Click the “Next” button, and the SMP installation will start automatically.

19) The Installing SMP450 (or similar) window will appear and display the installation progress, as shown in the following figure.
When the installation has completed, the following Installation Complete window will appear. You will see the “Close” button if there are no further SMP software features to be installed. Click “Close” and continue to Section 3.7.5 Installing LadderWorks Console and the DAO Package. If you installed IntervalZero RTX2011 Service Pack 1, you will see the “Next” button in the window; click the button to install IntervalZero RTX2011 Service Pack 1 Update 1.

The Preparing IntervalZero RTX 2011 with Service Pack 1 Update 1 dialog will automatically appear while the installation package is decompressing. After the decompression has been completed, you will see the Welcome Window as shown in Figure 3-50. Click the “Next” button to continue the installation.
22) A Ready to Install the Program Window will appear as shown in the following figure. Click the “Install” button to start the installation.
23) The IntervalZero RTX2011 with Service Pack 1 Update 1 installation will start and the following figure will appear:

![IntervalZero RTX 2011 with Service Pack 1 Update 1 Window](image1)

**Figure 3-52: Installing IntervalZero RTX 2011 with Service Pack 1 Update 1 Window**

24) When the installation has completed, the Installation Completed Window will appear, as shown in the following figure. Click the “Finish” button.
Figure 3-53: IntervalZero RTX 2011 with Service Pack 1 Update 1 Installation Completed Window

25) You will be prompted to restart the computer for the configuration changes. You must restart the computer to complete the installation. We recommend you to choose “Yes” to restart at this point.
3.7.4 Installing the Motion Development Kit (MDK)

1) In the “Welcome to SMP” window (Figure 3-18), click on the “MDK” button – this will start the installation of the Motion Development Kit. You will see a “Windows Installer” window, as shown:

![Windows Installer Window]

Figure 3-54: Windows Installer Window

2) Then a “Welcome to the Setup Wizard” window will appear automatically, as shown:

![Welcome to the Setup Wizard Window]

Figure 3-55: Welcome to the Setup Wizard Window

3) Click the “Next” button. You will see the following window appear:
3) This window is asking you where you want to install the MDK files. You can accept the default destination folder listed, or click the “Browse” button, which brings up a “Choose Folder” dialog box where you can choose a new destination folder. When you are done, click the “Next” button. You will see the following window:

![Figure 3-56: The Select Installation Folder Window](image)

4) Click the “Next” button, and MDK will install automatically. During the installation process, you will see the following window:

![Figure 3-57: Confirm Installation Window](image)

5) Click the “Next” button, and MDK will install automatically. During the installation process, you will see the following window:
6) When the installation is complete, you will see the next window appear:

![Figure 3-58: Installing MDK Window](image)

7) Click the “Close” button to exit, and your installation of the Motion Development Kit is complete.

Refer to Chapter 7: Setting Up Visual Studio in the Programming Manual for the SMP Motion Development Kit (MDK) for setting up your MDK programming environment.

### 3.7.5 Installing LadderWorks Console and the DAO Package

1) In the “Welcome to SMP” window (Figure 3-18), click on the “LadderWorks” button – you will see the following dialog box will appear:
2) You must install the DAO package for LadderWorks PLC. Click the “OK” button to start the installation, and the following dialog box will appear:

![Figure 3-60: LadderWorks Install Dialog Box](image)

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

![Figure 3-61: Setup Dialog Box](image)

4) Click the “Next” button, and the following window will appear:
Chapter 3: Installing the SMP Software

5) Click the “Next” button without changing any settings, and the following window will appear:

6) Click the “Next” button without changing any settings, and the DAO software will automatically start installing. [NOTE: In some instances, the DAO installation may seem to hang up indefinitely. Should this happen, press any key or move your mouse to continue.] The following dialog box will be displayed to show the progress of DAO installation:
7) When the DAO software has been successfully installed, the following dialog box will appear:

![Figure 3-66: Information Dialog Box](image)

8) Click the “OK” button to finish the LadderWorks PLC and DAO package installation.
3.8 Finishing Your Software Installation

Click the “Exit” button in the “Welcome to SMP” window (Figure 3-18) to close that window.

In order to finish your software installation, see the LadderWorks PLC User’s Manual for setting up your PLC environment, including creating and compiling a sequence program for your machine.

3.9 Preventing the RtxServer Screen from Popping Up

IntervalZero RTX (the real-time extension of the Windows operating system) includes a service called RtxServer. This service displays or logs messages from all RTX applications and RTDLLs, and is available while RTX services are running (i.e. when SMP products are running). The default setting of this RtxServer is to run in GUI mode, causing an RtxServer window to pop up and display messages, including the state of the service and error messages.

SMP products will provide any messages or error messages that you should require, so you won’t need to rely on this RtxServer for information. It has been our experience that customers are disconcerted and annoyed when this window pops up unexpectedly, and we recommend that you change this setting on the RtxServer to prevent this window from appearing, with the following steps:

1) From the Windows “Start” menu, go to “All Programs” → “IntervalZero” → “RTX” → “RTX Properties,” as shown:

![Start Menu Selection for RTX Properties](image.png)

Figure 3-67: Start Menu Selection for RTX Properties

2) You will see the “RTX Properties” window appear, as shown in the following figure:
3) Click on the “Control” tab, as shown in the following window:

![RTX Properties Window – Control Tab](image)

4) Click on the “Start” button to manually start RTX. After a moment, the “Status” displayed in the above window will change from “Stopped” to “Running.” [If the “Start” button is disabled, then the RTX service must already be running. The RTX service is automatically invoked when an SMP program starts.]

5) Click the “OK” button to close the RTX Properties window.
6) From the Windows “Start” menu, go to “All Programs” → “IntervalZero” → “RTX” → “RTX Server Console,” as shown:

![Start Menu Selection for RTX Server Console](image)

**Figure 3-70:** Start Menu Selection for RTX Server Console

7) The RtxServer window will appear, as shown:

![RtxServer Window](image)

**Figure 3-71:** RtxServer Window

8) Select “Options..” from the “View” pull-down menu, as shown:
9) An “Options” window will appear, as shown:

![Figure 3-73: Options Window (1 of 2)](image)

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

![Figure 3-74: Options Window (2 of 2)](image)

11) Select “Exit” from the “File” pull-down menu of the RtxServer window, as shown:
The RtxServer window won’t pop up again.

3.10 Setting Up Your VersioBus II Interface System

Chapter 4 explains the VersioBus II hardware components, how they are used, and how to plug and unplug the VersioBus II fiber-optic cables into and out of VersioBus II hardware components.

Chapters 5 and 6 deal with setting up SMP components – which chapter you use depends on whether you are using an ISA, PC104 or PCI VersioBus II adapter board.

Figure 3-76: Flow Chart for Deciding Which System Setup Chapter to Use
Chapter 4: VersioBus II Hardware

VersioBus II hardware components are easy to use and easy to connect. The hardware components required to use the VersioBus II interface system are described in this chapter.

4.1 Required VersioBus II Hardware

Following are the required hardware components in the VersioBus II interface system:

- **FP-85/FP-105/FP-114**: dual-link VersioBus II adapter boards that get plugged into the ISA bus extension socket, plugged into the PCI extension slot, or plugged into the PC104 stacking connector in the host PC, and provide I/O for a handwheel and 32 points of on-board opto-isolated general I/O. The FP-85 is for an ISA slot; the FP-105 is for a PCI slot; and the FP-114 is for FP104 stacking connectors. Only one of these three VersioBus II adapter boards is required for the VersioBus II interface system.

- **DC-155 Servo Interface Modules**: a servo interface module that connects to the servo drives of the machine tool and to the VersioBus II adapter board. Up to four DC-155s can be daisy-chained together with VersioBus II fiber-optic cables, for up to 16 axes of motion control. Each DC-155 has 32 points of opto-isolated general I/O through two general I/O connectors, available for dedicated and user-defined signals (both digital and analog). You must provide the power supply for the DC-155 servo interface module(s): 24 VDC ±15%, maximum load current 800 mA.

- **VersioBus II Fiber-Optic Cables**: for connecting VersioBus II hardware components.

4.2 Optional VersioBus II Hardware

Following are the optional hardware components that can be included in the VersioBus II interface system to extend the system to accommodate your needs:

- **IM-305**: a 64-point general input/output module with built-in screw terminals and LEDs that extends the I/O capabilities of the VersioBus II interface system. Up to four IM-305s may be daisy-chained together with VersioBus II fiber-optic cables, to provide as many as 256 additional I/O points. You must provide the power supply for the IM-305(s); the power supply should be 24 VDC ±10%, 300 mA maximum.

- **TB36A and TB36B**: breakout boxes with screw terminal blocks, for making connections between the I/O devices and the DC-155, and/or the servo drives and the DC-155. The TB36A and TB36B vary only in the size and style of the screw terminals. The TB36A has two screw terminal blocks for spade terminals, while the TB36B has a single screw terminal block for wire entry screw terminals.

- **TB37BD**: a 37-pin breakout box with a screw terminal block, for making connections between the local I/O devices and the VersioBus II adapter board.

- **HW-100**: a handheld manual pulse generator (handwheel) with an emergency switch, for manual jog operation of the machine.

- **Servo Drive and I/O Cables**: for your convenience, you can order servo drive cables and/or general I/O cables that are preconfigured with the correct pin assignments for your servo drives and/or your I/O devices. (You will need to provide pin assignment requirements.)
4.3 Field Programmable Gate Array Technology

The flexibility of VersioBus II’s unique FPGA (Field Programmable Gate Array) technology is what allows the VersioBus II interface system to adapt to various motor and encoder types, with only simple hardware updates. See Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System for the different configurations of FPGA in the shell architecture (specifically, for AC and DC motors, and for linear scales).

4.4 Plugging and Unplugging VersioBus II Fiber-Optic Cables into Transceivers

To plug the fiber-optic cable into a VersioBus II device (such as the FP-85, FP-105, FP-114, DC-155 or IM-305), complete the following steps (refer to Figure 4-1):

1) Remove the two rubber plugs from the transceiver.

2) Position the two prongs of the cable at the two openings of the two transceivers by aligning the top of the cable connection (the side with the clip on it, as shown in Figure 4-1) with the top of the transceiver connection (the side not connected to the board). The transmitting prong should align with the light-colored transmitter, and the receiving prong should align with the darker-colored receiver.

![Figure 4-1: Connection of VersioBus II Fiber-Optic Cable to Transceiver](image-url)
3) Gently push the prongs of the cable into the transceiver holes until you hear a distinct click, and you have a solid connection.

To unplug the fiber-optic cable from a VersioBus II device, complete the following steps:

1) Grasp the cable connection with one hand, pinching the clip together.

2) Hold the VersioBus II device with your other hand, and gently wriggle the connection as you pull it back to remove it. It should come fairly easily; if it doesn’t, you may not be pinching the clip hard enough.

3) Push the rubber plugs into the transceiver to protect the connection while it is not in use.
Chapter 5: System Setup with an ISA or PC104 VersioBus II Adapter Board for Windows XP

5.1 Before You Start

Figure 5-1 shows a schematic of all the possible VersioBus II hardware connections for an off-the-shelf PC. You may want to refer to this diagram as you set up your hardware. This diagram shows the full capability of the system, including all optional components.
Before you start setting up your hardware, you should have installed the SMP software. You should also make sure that you have all the components listed in the packing list, as well as all the peripherals you are expected to provide to set up this system, such as cables, power supply, etc.

This chapter concerns itself only with setting up the VersioBus II hardware. Connecting the VersioBus II interface system to the servo drives and general input/output devices is covered in Chapter 7: Connecting to the Servo Drives and General I/O Devices.

You must follow the steps in this chapter in order, without skipping steps.

5.2 Inserting the VersioBus II Adapter Board (FP-85 or FP-114)

Insert the ISA or PC104 VersioBus II adapter board by completing the following steps:

1) Unplug the power supply to the PC.

2) Insert the VersioBus II adapter board:

   a) **FP-85**: Plug the FP-85 board firmly into any available ISA bus extension socket in the host PC (it should “click” into place), and screw the bracket in place. See Figure 5-2 for a schematic of the FP-85 VersioBus II adapter board. See your PC owner’s manual for the ISA bus socket location.

   b) **FP-114**: Plug the FP-114 board as firmly as possible into the PC104 stacking connector on the motherboard in the host PC. See Figure 5-3 for a schematic of the FP-114 VersioBus II adapter board. See your PC owner’s manual for more information about PC104 stacking connections to your PC’s motherboard.

**NOTE**: We suggest leaving the PC box open and the VersioBus II adapter board accessible until after you have completed this setup in its entirety.
Figure 5-2: FP-85 ISA VersioBus II Dual-Link Fiber-Optic Adapter Board

Align this slot with the matching projection of the ribbon cable plug connector of the flat cable (if using a TB37BD connector)

J2 40-pin header block for general purpose I/O

J1 26-pin header block for connection to an auxiliary encoder or handwheel

Align this slot with the matching projection of the ribbon cable plug connector of the flat cable (if using an HW-100 handwheel)

Bracket plate

Transceiver that connects to the DC-155(s)

Transceiver that connects to the IM-305(s)
Align this slot with the matching projection of the ribbon cable plug connector of the flat cable (if using a TB37BD connector)

J2 40-pin header block for general purpose I/O

Align this slot with the matching projection of the ribbon cable plug connector of the flat cable (if using an HW-100 handwheel)

J1 26-pin header block for connection to an auxiliary encoder or handwheel

Transceiver that connects to the IM-305(s)

Transceiver that connects to the DC-155(s)

Alternate location of transceivers

Figure 5-3: FP-114 PC104 VersioBus II Dual-Link Fiber-Optic Adapter Board
5.3 Connecting the Servo Interface Module(s) to the VersioBus II Adapter Board

You can connect one, two, three or four servo interface modules (DC-155s) in your VersioBus II interface system, depending upon how many axes you want to control. Make sure the DC-155(s) are not connected to a power supply.

Connect your servo interface module by completing the following steps:

1) Connect one end of the fiber-optic cable provided to the transceiver connector labeled “DC-155” on the bracket plate of the VersioBus II adapter board. Connect the other end of the fiber-optic cable to the connector labeled “Transceiver 1” on the DC-155.

[NOTE: See Figure 5-2 for the transceiver location on the FP-85 and see Figure 5-3 for the transceiver location on the FP-114. See Figures 5-4 and 5-5 for detailed schematics of the DC-155 general servo interface module. See Section 4.4: Plugging and Unplugging VersioBus II Fiber-Optic Cables into Transceivers for how to plug and unplug fiber-optic cables into transceivers.]
Battery backup for an absolute encoder (NOT USED)

24 VDC power supply screw terminal: connects to power supply cable

Power grounding point

Figure 5-4: DC-155 VersioBus II General Servo Interface Connector Front Diagram
Figure 5-5: DC-155 VersioBus II General Servo Interface Connector Bottom Diagram

**IF YOU ARE ONLY USING ONE SERVO INTERFACE MODULE IN YOUR SYSTEM, PLEASE PROCEED DIRECTLY TO Section 5.4: Connecting the IM-305(s) to the Adapter Board (Optional).**

2) If you are using more than one servo interface module, you will need to use another fiber-optic cable to connect the next DC-155 to the first DC-155. First connect one end of the cable to the connector labeled “Transceiver 2” on the first DC-155. Then connect the other end of the cable to the connector labeled “Transceiver 1” on the second DC-155.

Repeat this step until all the DC-155s in your setup are connected (for a maximum of four if you purchased SMP1600).

3) If you are using more than one DC-155, you must give each DC-155 a unique identification number. Identify the first DC-155 as “1,” the second DC-155 as “2,” the third DC-155 as “3,” and the fourth DC-155 as “4.” The first DC-155 is the one directly connected to the VersioBus II adapter board. The second DC-155 is the next DC-155 in the daisy chain, and so on.
NOTE: It’s very important that you correctly identify your DC-155s with the proper dipswitch identification numbers (as shown in the following figure).

![Diagram showing dipswitch ID numbers for Daisy-Chained DC-155s]

Soft Servo Systems’ SMP applications use these DC-155 numbers to reference DC-155s.

You must specify the identification number on a DC-155 by flipping the switches on the 2-digit dipswitch on the DC-155. (See Figure 5-5 for the location of the 2-digit dipswitch on the DC-155.) Figure 5-7 shows the configurations of switch locations, which correspond to identification numbers 1 through 4 – use these as your guide.

[NOTE: For single DC-155 usage, the dipswitch ID number has to be set to 0, which is the factory default.]

![Possible 2-Digit Dipswitch Configurations]

**5.4 Connecting the IM-305(s) to the Adapter Board (Optional)**

An IM-305 I/O module is an optional component in the VersioBus II interface system. You may include up to four optional IM-305 I/O modules in your VersioBus II interface system. If you are not including any IM-305s, you should skip this section, and proceed to Section 5.5: Connecting a HandWheel. If you are using IM-305(s), make sure they are not connected to a power supply.

Connect your IM-305(s) by completing the following steps:
1) If you are using one or more optional IM-305s, they need to be connected to the VersioBus II adapter board. Connect one end of the fiber-optic cable provided to the transceiver connector labeled “IM-305” on the bracket plate of the VersioBus II adapter board. Connect the other end of the fiber-optic cable to the connector labeled “Transceiver 1” on the IM-305. See the following figure for a detailed schematic of the IM-305 Input/Output Module.

2) If you are using more than one IM-305, you will need to use another fiber-optic cable to connect the next IM-305 to the first IM-305. First connect one end of the cable to the connector labeled “Transceiver 2” on the first IM-305. Then connect the other end of the cable to the connector labeled “Transceiver 1” on the second IM-305.

Repeat this step until all the IM-305s in your setup are connected (for a maximum of four).

3) If you are using more than one IM-305, you must give each IM-305 a unique identification number. Identify the first IM-305 as “1”, the second IM-305 as “2,” the third IM-305 as “3,” and the fourth IM-305 as “4.”

Figure 5-8: IM-305 VersioBus II 64-Point Input/Output Module

IF YOU ARE ONLY USING ONE IM-305 IN YOUR SYSTEM, PLEASE PROCEED DIRECTLY TO Section 5.5: Connecting a HandWheel.
NOTE: It’s very important that you correctly identify your IM-305s with the proper dipswitch identification numbers (as shown in the following figure).

Soft Servo Systems’ SMP applications use these IM-305 numbers to reference IM-305s.

You must specify the identification number on an IM-305 by flipping the switches on the 2-digit dipswitch on the IM-305. (See Figure 5-8 for the location of the 2-digit dipswitch.) Figure 5-7 shows the configurations of switch locations, which correspond to identification numbers 1 through 4 – use these as your guide.

[NOTE: For single IM-305 usage, the dipswitch ID number has to be set to 0, which is the factory default.]

5.5 Connecting a HandWheel

5.5.1 Overview

A handwheel pulse generator (used for manually controlling motion operations and position commands) is an optional part of the VersioBus II interface system. If no handwheels are used in your system, you should skip this section.

You can use either Soft Servo Systems’ HW-100 Handwheel (manual pulse generator) or any other handwheel in your VersioBus II interface system.

5.5.2 Connecting the HW-100 HandWheel

Refer to Figure 5-10 for a diagram of the HW-100 handwheel connection. Your PC must be open with access to the VersioBus II adapter board. Connect the IDC26 female connector on the flat DB-25 ribbon cable (which is shipped connected to the handwheel cord) to the handwheel header block on the VersioBus II adapter board (the J1 header block 26-pin connector on the FP-85 or the J1 header block 26-pin connector on the FP-114 – see Figures 5-2 or 5-3 for the location of the J1 header block on the FP-85 and FP-114, respectively). Align the slot on the J1 header block with the matching projection of the ribbon cable plug connector of the flat cable.

Screw the bracket of the DB-25 female connector (on the other end of the internal ribbon cable) in place in your computer. Then plug the DB-25 male connector (at the end of the HW-100 handwheel cord) into the DB-25 female connector. A schematic for the connection to the FP-85 follows; the connection to the FP-114 is quite similar.
5.5.3 Connecting a HandWheel Other Than the HW-100

If you are using your own handwheel instead of the HW-100 Handwheel provided by Soft Servo Systems, Inc., you will need to set the pin assignments for that handwheel. See Chapter 1: VersioBus II Adapter Boards in the Hardware and Wiring Manual for the VersioBus II Interface System for these pin assignments.

5.6 Powering Up Your VersioBus II Components

1) Visually inspect that all cables are connected as described in the previous steps. Plug in the power supply to the PC that you unplugged before inserting the adapter board.

2) Connect the power supply cable(s) to the 24 VDC power supply screw terminal on the DC-155(s). (See Figure 5-4 for the location of the 24 VDC power supply screw terminal on the DC-155.) Upon doing so, you should see a green light labeled “READY” appear, which indicates that the unit is receiving power, and that the FPGA is configured.

   [NOTE: If you do not see the green light labeled “READY” appear, double check that the connections are correct, shut down the power supply to the DC-155, and restart the DC-155.]

3) If you are using one or more IM-305s, you must plug in the power supply for each. (See Figure 5-8 for the location of the 24 VDC power supply screw terminal.) Upon doing so, you should see a green light labeled “READY” appear, which indicates that the unit is receiving power, and that the FPGA is configured.
5.7 Using the BIOS Settings to Reserve IRQ #5 for the VersioBus II Adapter Board

The SMP Motion Engine and SMP Motion and Logic APIs (MAPI) use Interrupt #5 to communicate with the FP-85 and FP-114 servo interface boards. You must go into your PC’s BIOS settings program to make sure both that ISA bus is enabled, and that IRQ #5 is reserved for ISA Legacy usage only. Refer to the documentation for your motherboard for an explanation of how to access the BIOS program and change the BIOS settings. In many PCs, you can access the PNP/PCI Configuration Window by pressing the “Delete” key during the boot (startup) of your computer. In most off-the-shelf PCs, IRQ #5 is assigned to “Legacy ISA.” If this is not the case, you need to change the setting to “Legacy ISA.”

BIOS screens vary from computer to computer. On some PCs, you will go to the “Advanced” screen to find “Resource Configuration;” on others, you will go to “PnP/PCI Configurations.” An example procedure for reserving IRQ #5 follows, for one possible BIOS setup:

1) Start or restart your computer and hold the “Delete” key down during the computer’s startup. You will see a screen similar to the following appear:

![Figure 5-11: Main BIOS Screen (Example)](image)

2) Use the left and right arrow keys to select the “Advanced” BIOS screen, similar to the following:
3) Use the up and down arrow keys to select “Resource Configuration,” and press the “Enter” button. You will see a screen similar to the following:

![Resource Configuration BIOS Screen (Example)](image)

Figure 5-13: Resource Configuration BIOS Screen (Example)
4) Use the up and down keys to select IRQ #5, and use the F9 function key to make sure that the setting for the IRQ #5 is set to “Reserved” or “Legacy ISA” (indicating “reserved for use by legacy ISA devices”) rather than “Available.”

5) Press the F10 function key to save your changes and exit BIOS (at which point your computer should finish booting up).

**NOTE:** In the unlikely scenario that your PC has reserved IRQ #5 for some other function, you must change the IRQ of the resource that is using IRQ #5, to make it available for the FP-85 or FP-114. The FP-85 and FP-114 adapter boards will not work without IRQ #5.

Some older PCs may require that you set the I/O port resources 300h and 302h to “ISA Resource.” Most new PCs will not require that you manually set this, and won’t allow you access to the I/O port resources anyway.

### 5.8 Finishing Your Setup of VersioBus II Components

Your VersioBus II interface system is now set up, and you are ready to connect the VersioBus II interface system to your servo drives and your general input/output devices. This procedure is explained in Chapter 7: Connecting to the Servo Drives and General I/O Devices.

**SKIP CHAPTER 6, AND PROCEED DIRECTLY TO CHAPTER 7:** Connecting to the Servo Drives and General I/O Devices.
Chapter 6: System Setup with a PCI VersioBus II Adapter Board for Windows XP

6.1 Before You Start

Figure 6-1 shows a schematic of all the possible VersioBus II hardware connections for an off-the-shelf PC. You may want to refer to this diagram as you set up your hardware. This diagram shows the full capability of the system, including all optional components.
Before you start setting up your hardware, you should have installed the SMP software. You should also make sure that you have all the components listed in the packing list, as well as all the peripherals you are expected to provide to set up this system, such as cables, power supply, etc.

This chapter concerns itself only with setting up the VersioBus II hardware. Connecting the VersioBus II interface system to the servo drives and general input/output devices is covered in Chapter 7: Connecting to the Servo Drives and General I/O Devices.

You must follow the steps in this chapter in order, without skipping steps.

### CAUTION

Do not power up any components in the VersioBus II interface system before all of the connections are made in the system (unless explicitly instructed to do so). Powering up components prior to connecting them may cause unpredictable results.

#### 6.2 Inserting the VersioBus II Adapter Board (FP-105)

Insert the FP-105 VersioBus II adapter board by completing the following steps:

1) Unplug the power supply to the PC.

2) Plug the FP-105 board firmly into any available PCI slot in the host PC (it should “click” into place), and screw the bracket in place. See Figure 6-2 for a schematic of the FP-105 VersioBus II adapter board.

**NOTE:** We suggest leaving the PC box open and the VersioBus II adapter board accessible until after you have completed this setup in its entirety.
Figure 6-2: FP-105 PCI VersioBus II Dual-Link Fiber-Optic Adapter Board
6.3 Installing and Configuring the PCI Device Driver for the FP-105 and Windows XP

The following steps will guide you through installing the PCI device driver and converting the Windows driver to an RTX driver.

**CAUTION**

If you haven’t installed IntervalZero RTX, you will not be able to complete this procedure.

6.3.1 Installing the Device Driver Software for the FP-105 PCI Adapter Board

Install the device driver software for the VersioBus II PCI adapter board (FP-105) by completing the following steps:

1) Turn on your PC. You will see a message in the Windows taskbar notification area in the lower right corner of your screen, as shown in the following figure:

   ![Figure 6-3: Windows Taskbar Notification Message](image)

2) You can click on this, or you can wait for the “Found New Hardware Wizard” window to appear automatically, as shown in the following figure:

   ![Figure 6-4: Found New Hardware Wizard – Welcome Window](image)
3) Select “No, not this time” and click the “Next” button. Another Found New Hardware Window will appear, as shown in the following figure:

![Figure 6-5: Found New Hardware Wizard – Installation Options Window (1 of 2)](image)

4) Choose “Install from a list or specific location (Advanced).” Click the “Next” button, and you will see another window appear, as shown:

![Figure 6-6: Found New Hardware Wizard – Installation Options Window (2 of 2)](image)

5) Choose “Don’t search. I will choose the driver to install.” Click the “Next” button, and you will see another window appear, as shown:
6) Choose “Show All Devices.” Click the “Next” button, and you will see another window appear, as shown in the following figure. [NOTE: There may be a significant delay before this window appears.]

7) Click on “Have Disk...” You will see the “Install From Disk” window appear, as shown:
Figure 6-9: Install From Disk Window (1 of 2)

8) Click the “Browse” button, and you will see a “Locate File” window appear, as shown:

Figure 6-10: Locate File Window

9) Navigate to the “PCI_Driver” folder on the SMP CD. Choose the “VersioBusPCI.inf” file, and then click the “Open” button. This will bring you back to the “Install From Disk” window, as shown:

Figure 6-11: Install From Disk Window (2 of 2)

10) Click the “OK” button. You will see another “Found New Hardware Wizard” window appear, as shown:
Figure 6-12: Found New Hardware Wizard – Select Device Driver Window

11) Click on “SoftServo VersioBus PCI Adapter Board,” click the “Next” button, and the following “Update Driver Warning” dialog box will appear:

Figure 6-13: Update Driver Warning Dialog Box

12) Ignore this warning message. [This software has been verified by Soft Servo Systems, Inc. for the purposes of our product.] Click the “Yes” button, and the following “Hardware Installation” window will appear:

Figure 6-14: Hardware Installation Dialog Box
13) Ignore this warning message. [This software has been verified by Soft Servo Systems, Inc. for the purposes of our product.] Click the “Continue Anyway” button, and the following window will appear while the driver software is automatically installed:

![Found New Hardware Wizard - Installing Window](image1.png)

Figure 6-15: Found New Hardware Wizard – Installing Window

14) After the Windows driver for the FP-105 board has installed automatically (which will take a few moments), the following window will appear:

![Found New Hardware Wizard - Completing Window](image2.png)

Figure 6-16: Found New Hardware Wizard – Completing Window
15) Finish the installation by clicking the “Finish” button. You will briefly see a message in the Windows taskbar notification area in the lower right corner of your screen, shown in the following figure:

![Found New Hardware](image)

*Figure 6-17: Windows Taskbar Notification Message*

### 6.3.2 Confirming That the Windows Driver for the FP-105 Board Was Properly Installed

Confirm that the Windows driver for the VersioBus II PCI adapter board (FP-105) was properly installed by completing the following steps:

1) From the Windows “Start” menu, go to “Control Panel” (Start Menu) as shown:

![Start Menu](image)

*Figure 6-18: Start Menu Selection for Control Panel*

2) You will see the “Control Panel” window appear, as shown:
Figure 6-19: Control Panel Window

3) Click on the “Performance and Maintenance” icon, and you will see the following window appear.  
   [NOTE: If you are in Classic View, just click on the “System” icon – the “System Properties” window appears, and you should skip ahead to Step #5.]
4) Click on the “System” icon, and you will see the “System Properties” window appear, as shown:
5) Click on the “Hardware” tab.

6) In the “Device Manager” frame, click on the “Device Manager” button. You will see the “Device Manager” window appear, as shown:

![Device Manager Window](image)

**Figure 6-22: Device Manager Window – Other Devices (1 of 2)**
7) Select “Other devices,” and make sure you see an icon labeled “SoftServo VersioBus PCI Adapter Board” as shown in the previous window. (You may have to click on the symbol to see the drop-down list under “Other devices.”)

If you do not see an icon labeled “SoftServo VersioBus PCI Adapter Board,” you must uninstall the device, turn off your PC, and repeat these instructions starting from the beginning of this chapter, including removing and reinstalling the FP-105 in another PCI slot. If this problem continues to occur, please contact Soft Servo Systems, Inc. for customer support.

8) Right click on the “SoftServo VersioBus PCI Adapter Board” icon, and select “Properties” from the drop-down menu, as shown in Figure 6-22. A SoftServo VersioBus PCI Adapter Board Properties window will appear, as shown:

![Figure 6-23: SoftServo VersioBus PCI Adapter Board Properties Window – General Tab (1 of 2)](image)

9) Make sure the “Device status” frame states that “This device is working properly,” and click the “OK” button to get back to the Device Manager window.
6.3.3 Converting the Windows PCI Device Driver to an RTX Device Driver

Now you need to convert the windows PCI driver for the “SoftServo VersioBus PCI Adapter Board” to an RTX device driver by completing the following steps. **INTERVALZERO RTX MUST HAVE BEEN INSTALLED ALREADY.**

1) From the Windows “Start” menu, go to “All Programs” → “IntervalZero” → “RTX” → “RTX Properties,” as shown:

![Figure 6-24: Start Menu Selection for RTX Properties](image)

2) You will see the “RTX Properties” window appear, as shown in the following figure:
3) Click on the “Hardware” tab, as shown in the following window:

![RTX Properties Window – Hardware Tab](image)

Figure 6-26: RTX Properties Window – Hardware Tab

4) Click on the “Settings…” button in the “Devices” frame to display the current Plug and Play devices on your system, and you will see the “Pnp Device Settings” window appear, a shown:

![RTX Properties Window – Hardware Tab](image)
5) Click on the symbol to see the drop-down list under “Windows.” Make sure you see an icon labeled “SoftServo VersioBus PCI Adapter Board” under the “Windows” folder, as shown in the previous window.

![Figure 6-27: PnP Device Settings Window](image-url)
6) From the device list under the “Windows” folder, right click on the “SoftServo VersioBus PCI Adapter Board,” and select “Add RTX INF Support,” as shown in the previous window. This will edit the RtxPnp.inf to support the FP-105. You won’t see any confirmation at this point that RTX INF Support has been added, but the “OK” and “Apply” buttons will become enabled.

7) Click the “OK” button. You will see a prompt message, as shown in the following figure:

![Figure 6-28: RTX Properties Dialog Box](image)

8) Ignore this message and click the “OK” button. Then close the “RTX Properties” window by clicking the “OK” button.

6.3.4 Updating the Windows Device Driver

1) The Systems Properties window should still be open, as shown in Figure 6-21. [If the System Properties window was closed, or you don’t see it, you can open it from the Windows “Start” menu, by going to “Settings” → “Control Panel” → “Performance and Maintenance” and clicking on the “System” icon, or if you are in Classic View, going to “Settings” → “Control Panel” and clicking on the “System” icon.]

2) Click on the “Hardware” tab.

3) In the “Device Manager” frame, click on the “Device Manager” button. You will see the “Device Manager” window appear, as shown:

![Figure 6-29: Device Manager Window – Other Devices (2 of 2)](image)
4) Select “Other devices,” and make sure you see an icon labeled “SoftServo VersioBus PCI Adapter Board” as shown in the above window. (You may have to click on the + symbol to see the drop-down list under “Other devices.”)

5) Right click on the “SoftServo VersioBus PCI Adapter Board” icon, and select “Properties” from the drop-down menu, as shown in the previous window. A SoftServo VersioBus PCI Adapter Board Properties window will appear, as shown:

![Figure 6-30: SoftServo VersioBus PCI Adapter Board Properties Window – General Tab (2 of 2)](image)

6) Click on the “Driver” tab, and you will see the following window:
7) Click the “Update Driver…” button, and the following window will appear:

![Figure 6-31: SoftServo VersioBus PCI Adapter Board Properties Window – Driver Tab](image)

8) Select “No, not this time” and click the “Next” button. Another Found New Hardware Window will appear, as shown in the following figure:

![Figure 6-32: Found New Hardware Wizard – Welcome Window](image)
6) Choose “Install from a list or specific location (Advanced).” Click the “Next” button, and you will see another window appear, as shown:

![Hardware Update Wizard – Welcome Window](image)

**Figure 6-33: Hardware Update Wizard – Welcome Window**

7) Choose “Don’t search. I will choose the driver to install.” Click the “Next” button, and you will see another window appear, as shown:

![Hardware Update Wizard – Installation Options Window](image)

**Figure 6-34: Hardware Update Wizard – Installation Options Window**

8) Choose “Don’t search. I will choose the driver to install.” Click the “Next” button, and you will see another window appear, as shown:
Figure 6-35: Hardware Update Wizard – Select Device Driver Window

11) Select the “SoftServo VersioBus PCI Adapter Board RTX Supported” as shown above. Click the “Next” button, and you will briefly see the following window while the software installs automatically:

Figure 6-36: Hardware Update Wizard – Installing Window

12) Then the following window will automatically appear:
13) Click the “Finish” button, and the following message may appear if you need to restart your computer. The system will only need to be rebooted if there are conflicts with the IRQ requested by the device. If you don’t have to reboot, just close the Device Manager window and proceed to the next section (Section 6.3.4: Verifying That the Windows Driver for the FP-105 Board Was Properly Installed As RTX Supported, and that the FP-105 Has Been Assigned An Exclusive IRQ). If you do have to reboot, you will see the following message:

![System Settings Change Dialog Box]

14) Click the “Yes” button, and your computer will restart automatically.

6.3.5 Verifying That the Windows Driver for the FP-105 Board Was Properly Installed As RTX Supported, and that the FP-105 Has Been Assigned An Exclusive IRQ

When your computer has restarted (if you had to restart your computer), you need to confirm that the windows driver for the FP-105 board was properly installed as RTX supported, and that the FP-105 has been assigned its own exclusive IRQ, by completing the following steps:

1) From the Windows “Start” menu, go to “Control Panel” (Start Menu) as shown in Figure 6-18.

2) You will see the “Control Panel” window appear, as shown in Figure 6-19.
3) Click on the “Performance and Maintenance” icon, and you will see the “Performance and Maintenance” window appear, as shown in Figure 6-20. [NOTE: If you are in Classic View, just click on the “System” icon – the “System Properties” window appears, and you should skip ahead to Step #5.]

4) Click on the “System” icon, and you will see the “System Properties” window appear, as shown in Figure 6-21.

5) Click on the “Hardware” tab.

6) In the “Device Manager” frame, click on the “Device Manager” button. You will see the “Device Manager” window appear, as shown:

![Device Manager Window](image)

**Figure 6-39: Device Manager Window – RTX Drivers**

7) Select “Rtx Drivers” (you may have to click on the symbol to see the drop-down list under “Rtx Drivers”) and make sure you see an icon labeled “SoftServo VersioBus PCI Adapter Board RTX Supported” as shown in the previous window. [The “Rtx PnP and Power Management Device” was added automatically when you installed RTX.]

---

**CAUTION**

If you do not see an icon labeled “SoftServo VersioBus PCI Adapter Board RTX Supported,” you must uninstall the device, turn off your PC, and repeat these instructions starting from the beginning of this chapter, including removing and reinstalling the FP-105 in another PCI slot. If this problem continues to occur, please contact Soft Servo Systems, Inc. for customer support.
8) Right click on the “SoftServo VersioBus PCI Adapter Board RTX Supported” icon, and select “Properties” from the drop-down menu, as shown in the previous window. A "SoftServo VersioBus PCI Adapter Board RTX Supported Properties” window will appear, as shown:

![SoftServo VersioBus PCI Adapter Board RTX Supported Properties Window](image)

Figure 6-40: SoftServo VersioBus PCI Adapter Board RTX Supported Properties Window

9) Make sure the “Device status” frame states that “This device is working properly,” and click the “OK” button to get back to the Device Manager window.

![CAUTION]

If you do not see the statement “This device is working properly,” but instead see the statement “This device cannot find enough free resources that it can use,” it may be that the “SoftServo VersioBus PCI Adapter Board RTX Supported” has not been assigned its own (exclusive) IRQ. If that is the case, continue on to step #10 to view the IRQ assignments and assign the SoftServo VersioBus PCI Adapter Board to an exclusive IRQ by disabling other devices using the same IRQ.

If you do not see the statement “This device is working properly,” AND you do not see the statement “This device cannot find enough free resources that it can use,” you must uninstall the device, turn off your PC, and repeat these instructions starting from the beginning of this chapter. If this problem continues to occur, please contact SoftServo Systems, Inc. for customer support.

10) Under the “View” menu in the Device Manager window, select “Resources by connection,” as shown in the following window:
11) The following window will appear:

![Device Manager Window – View Pull-Down Menu](image)

**Figure 6-41: Device Manager Window – View Pull-Down Menu**

12) Double-click “Interrupt request (IRQ),” and the window will change to display the IRQ settings for your computer, similar to the following window:

![Device Manager Window – Resources by Connection](image)

**Figure 6-42: Device Manager Window – Resources by Connection**
13) Verify that the “SoftServo VersioBus PCI Adapter Board RTX Supported” has been assigned its own (exclusive) IRQ. In this case, the SoftServo VersioBus PCI Adapter Board RTX Supported is on IRQ #7. Since no other device is listed as also being assigned to IRQ #7 (in the previous example window), then the SoftServo VersioBus PCI Adapter Board RTX Supported is on its own (exclusive) IRQ.

If the “SoftServo VersioBus PCI Adapter Board RTX Supported” has not been assigned its own (exclusive) IRQ, you will need to disable all the other devices that are using the same IRQ, or remove and reinstall the FP-105 in another PCI slot (and start the setup process again from the beginning of this chapter).

To disable other devices that are using the same IRQ, go to the Windows “Start” menu, choose “Settings” → “Control Panel” → “System” → “Hardware” → “Device Manager,” and use the “Device Manager” window that appears. You can right click on other devices using the same IRQ, and select “Disable” if you don’t need that device.

If you don’t want to or cannot disable the other device(s) that share the PCI slot with the SoftServo VersioBus PCI Adapter Board, then you must move the FP-105 to another PCI slot, and start again from the beginning of this chapter.

You can also get additional help by opening RTX Runtime Documentation (from the Windows “Start” menu, choose “Programs” → “IntervalZero” → “RTX” → “RTX Runtime Help” or “RTX Documentation.”) In the section called “Managing Devices,” there is a subsection titled “Converting a Windows PCI Device to an RTX Device” that may be helpful.
6.3.6 Finishing Your PCI Driver Installation and Configuration

Shut down your PC to continue with the hardware setup.

6.4 Connecting the Servo Interface Module(s) to the VersioBus II Adapter Board

You can connect one, two, three or four servo interface modules (DC-155s) in your VersioBus II interface system, depending upon how many axes you want to control. Make sure the DC-155(s) are not connected to a power supply.

Connect your DC-155(s) by completing the following steps:

1) Connect one end of the fiber-optic cable provided to the transceiver connector labeled “DC-155” on the bracket plate of the FP-105 VersioBus II adapter board. Connect the other end of the fiber-optic cable to the connector labeled “Transceiver 1” on the DC-155.

   [NOTE: See Figure 6-2 for the transceiver location on the FP-105. See Figures 7-44 and 7-45 for detailed schematics of the DC-155 general servo interface module. See Section 4.4: Plugging and Unplugging VersioBus II Fiber-Optic Cables into Transceivers for how to plug and unplug fiber-optic cables into transceivers.]
Figure 6-44: DC-155 VersioBus II General Servo Interface Connector Front Diagram
Figure 6-45: DC-155 VersioBus II General Servo Interface Connector Bottom Diagram

**IF YOU ARE ONLY USING ONE SERVO INTERFACE MODULE IN YOUR SYSTEM, PLEASE PROCEED DIRECTLY TO Section 6.5: Connecting the IM-305(s) to the Adapter Board (Optional).**

2) If you are using more than one DC-155, you will need to use another fiber-optic cable to connect the next DC-155 to the first DC-155. First connect one end of the cable to the connector labeled “Transceiver 2” on the first DC-155. Then connect the other end of the cable to the connector labeled “Transceiver 1” on the second DC-155.

Repeat this step until all the DC-155s in your setup are connected (for a maximum of four).

3) If you are using more than one DC-155, you must give each DC-155 a unique identification number. Identify the first DC-155 as “1,” the second DC-155 as “2,” the third DC-155 as “3,” and the fourth DC-155 as “4.” The first DC-155 is the one directly connected to the VersioBus II adapter board. The second DC-155 is the next DC-155 in the daisy chain, and so on.

**NOTE:** It’s very important that you correctly identify your DC-155s with the proper dipswitch identification numbers (as shown in the following figure).
You must specify the identification number on a DC-155 by flipping the switches on the 2-digit dipswitch on the DC-155. (See Figure 6-45 for the location of the 2-digit dipswitch.) Figure 6-47 shows the configurations of switch locations, which correspond to identification numbers 1 through 4 – use these as your guide.

[NOTE: For single DC-155 usage, the dipswitch ID number has to be set to 0, which is the factory default.]

Figure 6-47: Possible 2-Digit Dipswitch Configurations

6.5 Connecting the IM-305(s) to the VersioBus II Adapter Board (Optional)

An IM-305 I/O module is an optional component in the VersioBus II interface system. You may include up to four optional IM-305 I/O modules in your VersioBus II interface system. If you are not including any IM-305s, you should skip this section, and proceed to Section 6.6: Connecting a HandWheel. If you are using IM-305(s), make sure they are not connected to a power supply.

Connect your IM-305(s) by completing the following steps:
1) If you are using one or more optional IM-305s, they need to be connected to the FP-105 VersioBus II adapter board. Connect one end of the fiber-optic cable provided to the transceiver connector labeled “IM-305” on the bracket plate of the VersioBus II adapter board. Connect the other end of the fiber-optic cable to the connector labeled “Transceiver 1” on the IM-305. See the following figure for a detailed schematic of the IM-305 Input/Output Module.

![Figure 6-48: IM-305 VersioBus II 64-Point Input/Output Module](image)

**IF YOU ARE ONLY USING ONE IM-305 IN YOUR SYSTEM, PLEASE PROCEED DIRECTLY TO Section 6.6: Connecting a HandWheel.**

2) If you are using more than one IM-305, you will need to use another fiber-optic cable to connect the next IM-305 to the first IM-305. First connect one end of the cable to the connector labeled “Transceiver 2” on the first IM-305. Then connect the other end of the cable to the connector labeled “Transceiver 1” on the second IM-305.

Repeat this step until all the IM-305s in your setup are connected (for a maximum of four).

3) If you are using more than one IM-305, you must give each IM-305 a unique identification number. Identify the first IM-305 as “1”, the second IM-305 as “2,” the third IM-305 as “3,” and the fourth IM-305 as “4.”

**NOTE:** It’s very important that you correctly identify your IM-305s with the proper dipswitch identification numbers (as shown in the following figure).
You must specify the identification number on an IM-305 by flipping the switches on the 2-digit dipswitch on the IM-305. (See Figure 6-48 for the location of the 2-digit dipswitch.) Figure 6-47 shows the configurations of switch locations, which correspond to identification numbers 1 through 4 – use these as your guide.

[NOTE: For single IM-305 usage, the dipswitch ID number has to be set to 0, which is the factory default.]

### 6.6 Connecting a HandWheel

#### 6.6.1 Overview

A handwheel pulse generator (used for manually controlling motion operations and position commands) is an optional part of the VersioBus II interface system. If no handwheels are used in your system, you should skip this section.

You can use either Soft Servo Systems’ HW-100 Handwheel (manual pulse generator) or any other handwheel in your VersioBus II interface system.

#### 6.6.2 Connecting the HW-100 HandWheel

Refer to Figure 6-50 for a diagram of the HW-100 handwheel connection. Your PC must be open with access to the VersioBus II adapter board. Connect the IDC26 female connector on the flat DB-25 ribbon cable (which is shipped connected to the handwheel cord) to the J1 header block 26-pin connector on the FP-105 (see Figure 6-2 for location of the J1 header block on the FP-105). Align the slot on the J1 header block with the matching projection of the ribbon cable plug connector of the flat cable.

Screw the bracket of the DB-25 female connector (on the other end of the internal ribbon cable) in place in your computer. Then plug the DB-25 male connector (at the end of the HW-100 handwheel cord) into the DB-25 female connector. A schematic for the connection to the FP-105 is follows.
6.3 Connecting a HandWheel Other Than the HW-100

If you are using your own handwheel instead of the HW-100 Handwheel provided by Soft Servo Systems, Inc., you will need to set the pin assignments for that handwheel. See Chapter 1: VersioBus II Adapter Boards in the Hardware and Wiring Manual for the VersioBus II Interface System for these pin assignments.

6.7 Finishing Your Setup of VersioBus II Components

1) Visually inspect that all cables are connected as described in the previous steps. Plug in the power supply to the PC that you unplugged after finishing your PCI driver installation and configuration.

2) Connect the power supply cable(s) to the 24 VDC power supply screw terminal on the DC-155 (s). See Figure 6-44 for the location of the 24 VDC power supply screw terminal.) Upon doing so, you should see a green light labeled “READY” appear, which indicates that the unit is receiving power, and that the FPGA is configured.

[NOTE: If you do not see the green light labeled “READY” appear, double check that the connections are correct, shut down the power supply to the DC-155, and restart the DC-155.]

3) If you are using one or more IM-305s, you must plug in the power supply for each. (See Figure 6-48 for the location of the 24 VDC power supply screw terminal.) Upon doing so, you should see a green light labeled “READY” appear, which indicates that the unit is receiving power, and that the FPGA is configured.
[NOTE: If you do not see the green light labeled “READY” appear, double check that the connections are correct, shut down the power supply to the IM-305, and restart the IM-305.]

Your VersioBus II components are now set up, and you are ready to connect the VersioBus II interface system to your servo drives and your general input/output devices. This procedure is explained in Chapter 7: Connecting to the Servo Drives and General I/O Devices.
6.8 Preventing CPU Idle State

6.8.1 Settings for Preventing Intel® SpeedStep®

The idle state of a CPU with Intel® SpeedStep® can affect the real time performance of the system. Following the procedure below to avoid the idle state of the CPU is strongly recommended for optimal system performance:

1) Open “RTX Properties” and click on the “Hardware” tab, as shown in the following figure.
2) Confirm that the two checkboxes under SpeedStep® are checked, as shown below.
3) Click “Apply” to apply the change in settings.

![RTX Properties](image)

Figure 6-51: SpeedStep® settings

**CAUTION**

Prevent Windows idle state prevents the Windows idle thread from running by running an RTSS idle thread instead. Intel® SpeedStep® modifications occur after the Windows idle thread has run for some period of time, so by disabling the Windows idle thread, Intel SpeedStep technology is disabled as well.

Preventing Windows idle state may have the side effect of the Windows task manager constantly showing 100% CPU usage while RTX is running. This should not be a concern - as the RTSS idle thread runs with the lowest possible priority, the responsiveness of Windows and any running Windows applications is unaffected.
Chapter 7: Connecting to the Servo Drives and General I/O Devices

7.1 Overview of Servo I/O and General I/O in the VersioBus II Interface System

This chapter explains how to connect the machine’s servo drives and other devices to the VersioBus II interface system. The VersioBus II interface system should be set up and connected as described in Chapters 5 or 6 before beginning any of the procedures described in this chapter.

7.1.1 The I/O Capabilities of the VersioBus II Interface System

The VersioBus II interface system has extensive input/output (I/O) capabilities for both servo I/O signals (to and from the servo drives of the machine) and general I/O signals (to and from devices on the machine).

The servo drives of the machine need to be connected to the DC-155 axis connectors. Each of the two I/O connectors on each DC-155 has 8 digital inputs and 8 digital, for a total of 32 digital I/O. The two I/O connectors together also have 12 servo specific I/O signals for negative limit switches, positive limit switches and home switches.

This connection to the servo drives can be made by setting the correct pin assignments for both ends of the servo drive cables, or by using a screw terminal interface as an alternative to a properly configured cable. (See Section 7.1.4 Connections to DC-155(s): With Configured Cables or Breakout Boxes with Screw Terminals.) For more information about the servo I/O signals available with the DC-155 axis connectors, see Section 7.3.4 Explanation of Servo I/O Signals in the VersioBus II Interface system.

The remote and local general I/O devices of the machine also need to be connected to the VersioBus II interface system. Local I/O signals (from the operator’s panel switches) need to be connected to the I/O header block on the VersioBus II adapter board. Remote general I/O signals can be connected to the VersioBus II interface system via I/O connectors on the DC-155(s), or via the IM-305 I/O module(s). See Section 7.4.1 Overview of the VersioBus II Interface System General I/O Capabilities for information on the I/O signals available with the DC-155 I/O connectors and with the IM-305 I/O modules.

7.1.2 The Difference Between Servo I/O and General I/O

There are two kinds of (I/O) in the VersioBus II interface system: servo I/O and general I/O (which includes local and remote general I/O).

![Figure 7-1: Breakdown of I/O Types in the VersioBus II Interface System](image-url)
Servo I/O is included in the servo interface module (DC-155) axis connections. Servo I/O is I/O that facilitates servo communication, such as encoder signals, servo commands (like “servo on” or “servo off”), servo status, direction signals, fault signals, etc. The DC-155 already has multiple connections to the servo drive, and the servo I/O is electrically isolated and uses the same voltage and ground as the servo amplifier. The output drive capability of the servo I/O is limited and must be used only as intended.

General I/O, on the other hand, is uncommitted, isolated and very flexible – it can be used for anything: door switches, limit switches, etc. With general I/O, you have a lot of freedom with your voltage settings, and with what each I/O switch controls on your machine. General I/O provides you with the capability of driving heavy loads and controlling every aspect of your machine.

You should note that general I/O includes some servo specific signals, such as limit and home switches. These should still be considered general I/O.

7.1.3 The Difference Between Remote General I/O and Local General I/O

Remote general I/O and local general I/O each serve the same purpose. The difference lies in where the signals originate. Signals originating from the operator’s panel are considered local because they are at the same location as the PC, and will be directly connected to an adapter board in the PC. Signals originating from the machine, rather than from the operating panel (such as home switch, door close, etc.), are considered remote general I/O signals in the VersioBus II interface system. Remote general I/O signals will be connected to the VersioBus II interface system via either the DC-155 I/O connectors, or via one or more optional IM-305 components.

7.1.4 Connections to the DC-155(s): With Configured Cables or Breakout Boxes with Screw Terminals

Both servo I/O and some remote general I/O connections from the VersioBus II interface system to the machine and servo drives can be made with twisted-pair cables with a male connection on each end. These cables need to be properly configured with the correct pin assignments:

- The pin assignments for the VersioBus II side of the connection (to the DC-155) are shown in Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System. This chapter includes both pin assignments for the axis connectors and pin assignments for the general I/O connectors.

- Recommended pin assignments for servo I/O connections to specific servo drives are shown in Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System. Of course, you don’t have to follow the recommendations we provide; there are many acceptable ways to configure the connections to your servo drives, and take advantage of the many servo I/O signals in the VersioBus II interface system. Refer to the user’s manual for the pin assignments for your servo drive.

- You should consult your user’s manual for the pin assignments for your machine’s devices.

Connections to the DC-155 servo interface modules (axis connections or I/O connections) can be made in one of three ways:

1) You can properly configure cables with connections on both ends that are configured according to the pin assignments provided by Soft Servo Systems, Inc., your servo drive manufacturer, and your machine manufacturer.

2) You can custom order servo drive cables or general I/O cables that are preset with the correct pin assignments from Soft Servo Systems, Inc. You will need to provide the pin assignments you want for your servo drive and machine I/O connections.
3) You can use either the TB36A or the TB36B breakout boxes with screw terminals (ordered directly from Soft Servo Systems, Inc.) to make the connection. These breakout boxes allow you to interface two cables, one of which is properly configured for the servo drive or the machine, and the other of which is properly configured for the DC-155 axis or general I/O connection.

The TB36A and TB36B breakout boxes perform the same function; they differ only in size and style. The TB36A has two screw terminal blocks, with spade terminals, and the TB36B has a single screw terminal block, with wire entry screw terminals (which are smaller than spade terminals). Which breakout box you should use depends on your screw terminal preference.

To use a breakout box, you would need to use a regular 2-male jumper cable (with one to one pin assignments) to connect the DC-155 (axis connector or I/O connector) to either the TB36A or TB36B. Then connect a twisted pair cable to the servo drive, and connect the end with exposed wires to the screw terminals on the breakout box, using the TB36A and TB36B terminal pin number assignments found in Chapter 4: Breakout Boxes in the Hardware and Wiring Manual for the VersioBus II Interface System. You should note that when you use a breakout box in lieu of a properly configured cable, you won’t need to concern yourself with the pin assignments for the DC-155 axis connectors or general I/O connectors – you will only need the breakout box terminal pin number assignments.

7.1.5 Opto-Isolation of Digital I/O

All digital I/O connections in the VersioBus II interface system (both servo I/O and general I/O) are opto-isolated to protect the hardware components of the system.

When the DC-155 and IM-305 are powered up, the user default output signals are off. The configuration of the user default output signals may be changed with the SMP Console.

7.2 Wiring Examples

Many wiring diagrams can be found in the Hardware and Wiring Manual for the VersioBus II Interface System. There are wiring diagrams for servo-related inputs and outputs and examples of wiring diagrams for a variety of connections.

**CAUTION**

NOTE: It is very important for the safe operation of the machine that you correctly wire the Emergency Stop. See page 7-1 of Chapter 7: Wiring Examples for Connections in the Hardware and Wiring Manual for the VersioBus II Interface System for a typical power wiring diagram.

7.3 Servo Drive Connections in the VersioBus II Interface System

7.3.1 Schematic Servo motor Connections

The essential connections required to operate a servo motor are shown in Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System. Usually, the connection from the DC-155 axis connector outputs will be directly to the servo amplifier. However, if you can’t interface directly with your servo amplifier, the VersioBus II interface system also allows you to interface directly with the encoder.
7.3.2 Encoder Connections

A typical differential encoder connection is shown in Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System.

7.3.3 Connecting Your Servo Drives to the VersioBus II Interface System

You need to connect the VersioBus II interface system to the servo drives of your machine with either a properly configured cable or with the use of a breakout box. (See Section 7.1.4 Connections to DC-155(s): With Configured Cables or Breakout Boxes with Screw Terminals.) Connect the servo drive cable(s) to the “AXIS 1” through the “AXIS 4” connectors on the DC-155 on the one end, and to the servo drive(s) on the other end.
### 7.3.4 Explanation of Servo I/O Signals in the VersioBus II Interface System

Each of the pins in the DC-155 axis connector has a specific servo-related function. These servo functions are listed, with explanations, in the following table.

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>NAME</th>
<th>I/O</th>
<th>SERVO FUNCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>A_OUT</td>
<td>O</td>
<td>Analog Command</td>
<td>Required for all servo amps</td>
</tr>
<tr>
<td>36</td>
<td>AGND</td>
<td></td>
<td>Analog Ground</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>+5V</td>
<td>O</td>
<td>5 VDC for Encoders</td>
<td>Required only for direct connection to encoder</td>
</tr>
<tr>
<td>23</td>
<td>GND</td>
<td></td>
<td>Isolated 24V Return</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>E_A_H</td>
<td>I</td>
<td>Encoder Signal A, High Side</td>
<td>Required for all encoders</td>
</tr>
<tr>
<td>34</td>
<td>E_A_L</td>
<td>I</td>
<td>Encoder Signal A, Low Side</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>E_B_H</td>
<td>I</td>
<td>Encoder Signal B, High Side</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>E_B_L</td>
<td>I</td>
<td>Encoder Signal B, Low Side</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>E_Z_H</td>
<td>I</td>
<td>Encoder Signal Z, High Side</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>E_Z_L</td>
<td>I</td>
<td>Encoder Signal Z, Low Side</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>FAULT</td>
<td>I</td>
<td>Amp Fault</td>
<td>Recommended for all servo amps.</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td></td>
<td>Isolated 24V Return</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>V_OUT</td>
<td>O</td>
<td>Isolated 24 VDC Output For Servo-Related I/O</td>
<td>Use as needed.</td>
</tr>
<tr>
<td>27</td>
<td>GND</td>
<td></td>
<td>Isolated 24V Return</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>SC0</td>
<td>O</td>
<td>Servo Command 0</td>
<td>Optional</td>
</tr>
<tr>
<td>6</td>
<td>SC1</td>
<td>O</td>
<td>Servo Command 1</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>SC2</td>
<td>O</td>
<td>Servo Command 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SC3</td>
<td>O</td>
<td>Servo Command 3</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>GND</td>
<td></td>
<td>Isolated 24V Return</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>SS0</td>
<td>I</td>
<td>Servo Status 0</td>
<td>Optional</td>
</tr>
<tr>
<td>3</td>
<td>SS1</td>
<td>I</td>
<td>Servo Status 1</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>SS2</td>
<td>I</td>
<td>Servo Status 2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SS3</td>
<td>I</td>
<td>Servo Status 3</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>GND</td>
<td></td>
<td>Isolated 24V Return</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>SVON</td>
<td>O</td>
<td>Amp Enable (Servo On)</td>
<td>Required for all servo drives.</td>
</tr>
<tr>
<td>7</td>
<td>RST</td>
<td>O</td>
<td>Amp Reset (Alarm Reset)</td>
<td></td>
</tr>
</tbody>
</table>

Table 7-1: Servo I/O Signals in the VersioBus II Interface System
7.3.5 Example of Connecting a YASKAWA Servo Drive to the VersioBus II Interface System

For some servo drives supported by the VersioBus II interface system, you can find a schematic for the direct cable connections between that servo drive and the DC-155 axis connector in Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System. The example schematic presented here is for the YASKAWA Sigma I Servo Drive.

Pins shown on the servo side of the connection with black, bold text are required to be connected to the VersioBus II interface system side of the connection. Pins shown on the servo side of the connection with gray text are not used in the connection.

Each necessary connection is shown as a line between the YASKAWA SGDA 1CN connector and the DC-155 axis connector. If two lines are shown with a P, you must twist these wires together when you make the connection.

If you are using breakout boxes with screw terminals to make the connection (rather than one fully configured cable), the block and terminal numbers are given for both the TB36A and the TB36B screw terminals.
## Chapter 7: Connecting to the Servo Drives and General I/O Devices

![Figure 7-2: Example Schematic of a Direct Connection Between the DC-155 Axis Connector and the YASKAWA Sigma I Servo Drive (Incremental Encoder)](image)

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>DC-155 AXIS CONNECTOR</th>
<th>VERSIOBUS II SIDE OF THE CONNECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-REF</td>
<td>35 SG</td>
<td>Signal Ground</td>
</tr>
<tr>
<td>V-REF</td>
<td>18 A OUT</td>
<td>Analog Command</td>
</tr>
<tr>
<td>SG-V</td>
<td>36 AGND</td>
<td>Analog Ground</td>
</tr>
<tr>
<td>SEN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSEN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/BK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/V-CMP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/TGN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SG-COM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/P-CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/N-CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+24VIN</td>
<td>9 Vcc</td>
<td>Isolated 24 VDC Output</td>
</tr>
<tr>
<td>/S-ON</td>
<td>26 SVON</td>
<td>Amp Enable (Servo On)</td>
</tr>
<tr>
<td>/P-CON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-OT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-OT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/ALMST</td>
<td>7 RST</td>
<td>Amp/Reset (Alarm Reset)</td>
</tr>
<tr>
<td>SG-FG</td>
<td>20 GND</td>
<td>Digital Ground (Isolated)</td>
</tr>
<tr>
<td>PAO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*PAO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*PBO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*PCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*PSO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAT0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL01</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>AL02</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>AL03</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>SG-AL</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>ALM</td>
<td>4</td>
<td>FAULT</td>
</tr>
<tr>
<td>ALM~SG</td>
<td>23 GND</td>
<td>Digital Ground (Isolated)</td>
</tr>
<tr>
<td>FG</td>
<td>36</td>
<td>Connector Case</td>
</tr>
</tbody>
</table>
7.4 General I/O Connections in the VersioBus II Interface System

7.4.1 Overview of the VersioBus II Interface System General I/O Capabilities

The on-board general I/O capabilities of the VersioBus II adapter board provide you with 16 optically isolated digital inputs and 16 optically isolated digital outputs, for use with local I/O (such as the switches from the operator’s sub panel).

The two I/O connectors on the DC-155 module together provide you with the following I/O capabilities:

- 32 digital I/O switches (16 digital inputs and 16 digital outputs)
- positive and negative limit switches for up to four axes
- home switches for up to four axes
- 4 isolated digital grounds, 2 analog grounds and 14 common grounds for digital inputs and digital outputs

Each IM-305 is capable of handling up to 64 digital I/O switches (32 digital inputs and 32 digital outputs)

7.4.2 Local General I/O Connections to the VersioBus II Adapter Boards

For local general I/O connections (such as from the operator’s sub panel) to the VersioBus II adapter boards, you must create a DB37A I/O port for your PC. To do this, you must use an internal ribbon cable with an IDC40 female connector on one end, and a DB-37 female connector with a bracket on the other end. (Soft Servo Systems, Inc. can provide these cables.) Connect the IDC40 female connector to the I/O header block on the VersioBus II adapter board. Screw the bracket of the DB-37 female connector (on the other end of the internal ribbon cable) in place in your computer.

Once you have installed your DB37A I/O port, you can use a TB37BD breakout box with screw terminals, a terminal box provided by your machine manufacturer, or an I/O cable that is preconfigured with the correct pin assignments for your I/O devices (which can be custom ordered from Soft Servo Systems, Inc.).

If you are using the TB37BD breakout box, you will probably want to mount it in the enclosure. Connect the TB37BD to the DB37F local I/O port on your PC with a DB37M to DB37F ribbon jumper cable (with one to one pin assignments). Then wire the signals by connecting the exposed wires from the operator’s panel to the screw terminals on the TB37BD, using the TB37BD terminal pin number assignments found in Chapter 4: Breakout Boxes in the Hardware and Wiring Manual for the VersioBus II Interface System.

7.4.3 Remote General I/O Connections to the DC-155 Module

For remote general I/O connections to the DC-155, you need to set the correct pin assignments for each end of the connecting cables, or use a screw terminal interface in lieu of a properly configured cable. (See Section 7.1.4 Connections to the DC-155(s): With Configured Cables or Breakout Boxes with Screw Terminals.)

You need to connect the relevant machine devices to the DC-155 general I/O connectors (labeled “I/O 1” and “I/O 2” on the DC-155). See Chapter 2: Servo Interface Modules in the Hardware and Wiring Manual for the VersioBus II Interface System for the DC-155 General I/O Connector Pin Assignments for the VersioBus II side of the connection. Refer to the machine manual for the necessary connection information, for any machine control devices that require connections.
7.4.4 Remote General I/O Connections to IM-305 Modules

If you are using one or more IM-305s, you must connect each IM-305 to the peripheral devices that need digital I/O communication. For general I/O connections to the IM-305, screw terminals are provided. To connect, plug in your cables on the machine side of the connection, and connect the wires to the screw terminals on the IM-305 (using the proper screw terminal assignments). The screw terminal blocks on the IM-305s eliminate the need to configure a cable connection on the VersioBus II side.

Refer to Figures 5-8, 6-45, or 7-48 for the locations of the digital input and digital output screw terminals. Refer to Chapter 3: I/O Modules in the Hardware and Wiring Manual for the VersioBus II Interface System for terminal number assignments and I/O specifications for the IM-305.
Chapter 8: Finishing Your Setup and Integration

8.1 Synchronous Control with Slave Axes

For all SMP products, you can include synchronous slave axes in your VersioBus II interface system. Refer to Section 2.6.1: Synchronous Control Without Absolute Encoders in the SMP Console Operator’s Manual for more information.

8.2 Testing and Tuning the System

8.2.1 Overview

If you have been following this manual from start to finish, you have now set up all of your VersioBus II hardware modules, and made all of the connections from the machine and servo drives to the VersioBus II interface system.

To finish your machine integration, you will need to use the SMP Console to set your servo control, motor and drive parameters, and to test and tune the system. Refer to the SMP Console Operator’s Manual.

You will also need to tune your servo drive parameters manually (usually with push buttons on the servo drives).

In order to achieve excellent control performance with your SMP product, you must understand the nature of how inaccuracy is caused in motion control in general (both in Soft Servo Systems’ motion control products and in other motion control products).

CAUTION

Without a good understanding of the SMP parameters smoothing time and position loop gain, you will be unlikely to achieve the performance you desire.

You must properly tune your SMP system with respect to these two parameters to maximize the performance of your SMP product.

A finely tuned SMP system with finely tuned servo drives can achieve amazing performance for demanding applications, even without look-ahead contour control.

8.2.2 How Position Loop Gain and Smoothing Time Relate to Trajectory Accuracy (Without 3D-DLACC)

The following discussion applies to ordinary motion control without the 3D-DLACC function (three-dimensional dynamic look-ahead contour control). A discussion of tuning with 3D-DLACC follows in Section 8.2.5: Discussion of Tuning With 3D-DLACC.

In general, when you cut or mill something with motion control by executing G code, you'll see some inaccuracy. Some inaccuracy is inevitable. Your objective is to reduce the inaccuracy as much as possible by tuning the motion control parameters.

The two most important and dominant parameters affecting motion control trajectory accuracy are position loop gain ($K_p$) and smoothing time ($T_s$). [NOTE: This is true for motion control without 3D-DLACC.] Position loop
gain is measured in terms of Hz, and the smoothing time is measured in milliseconds. [NOTE: You can set different smoothing time parameters for different modes: rapid mode, manual modes and cutting mode.]

In fact, the trajectory error (inaccuracy) can be broken down into the trajectory error related to position loop gain and the trajectory error related to smoothing time. Thus, the trajectory error (E) is described with the following equation:

\[ E = E_1(K_p) + E_2(T_s) \]

where \( E_1 \) is the “servo lag” or “servo error,” and \( E_2 \) is the “smoothing error.”

\( E_1 \) is inversely proportional to \( K_p \), and \( E_2 \) is proportional to \( T_s \). [NOTE: \( E_1 \) and \( E_2 \) are also functions of the axis feedrate and the radius of the curves, but for the purpose of this discussion we will not address those aspects because those are not parameters, and are not related to this discussion of tuning.]

The effect of position loop gain (\( K_p \)) is obvious. \( K_p \) is like a spring. If you have a big servo error, \( K_p \) generates the force to move it back, just like a spring. The higher the value of position loop gain, the stiffer (or firmer) the position control, the faster the response and the smaller the servo lag, but the greater the likelihood of vibration or oscillation. In other words, if the \( K_p \) is large, the spring is stiff, and you can achieve good control. If \( K_p \) is too small, it is like a too soft, compliant spring, and good control cannot be achieved. [NOTE: The \( K_p \) value is the same for all the axes; if each axis had a different \( K_p \), perfect interpolation could not be achieved.]

The effect of the smoothing time is also obvious. A long smoothing time results in the smoothing out of sharp trajectories, resulting in a round, smoothed-out trajectory, which is not good especially for milling:

![Figure 8-1: Example: When Smoothing Time Is Too Long](image)

Desired trajectory

Actual, rounded-out trajectory due to a smoothing time that is too long

In summary, the equation for trajectory inaccuracy tells us that trajectory accuracy will improve greatly if you increase the position loop gain and reduce the smoothing time. This is very simple and common sense, and generally understood in the control industries.

When you install an SMP product on a PC, there are default parameter values for all SMP parameters. The default value for position loop gain (\( K_p \)) is 20.0 Hz, and the default value for all smoothing times (for rapid, manual and cutting modes) is 20 ms. These default values are, of necessity, quite conservative, because these values need to apply to many different kinds of machines. [Setting aggressive values for \( K_p \) and \( T_s \) could create a safety issue for some machines.] But for most machine tools, these default parameters will not allow you to achieve satisfactory motion control performance: \( K_p \) is too small and \( T_s \) is too large, meaning that you would get huge trajectory errors with these default parameters.

All SMP parameters are meant to be changed by the machine tool integrator, to meet the requirements of the particular machine tool to be controlled. Obviously, the meaning of every parameter should be understood before that parameter is changed – please refer to the Reference Manual for SMP Parameters and Functions. It is possible to use the equations for trajectory error to calculate the optimal parameter values for \( K_p \) and \( T_s \) based on the dynamics of the machine tool, the servo drives and the required accuracy. Or, you can tune these parameters based
on trial and error. In many cases, all that is needed for tuning is to increase $K_p$ significantly and decrease $T_s$ significantly, although in the interests of safety this should be done in gradual, successive increases.

To reiterate: you must properly tune your SMP system and optimize the SMP parameters (especially position loop gain and smoothing time) to maximize the performance of your SMP product.

### 8.2.3 How Velocity Loop Gain Relates to Trajectory Accuracy

As explained in the previous section, position loop gain and smoothing time are the two most important SMP parameters that must be correctly tuned to optimize trajectory accuracy. But, in addition to the SMP parameters that must be set correctly in the software, there are servo drive parameters that must be set for each servo drive. The most important of these, as pertains to trajectory accuracy, is the velocity loop gain parameter ($K_v$).

General industrial control is based on the nesting of control loops. The most internal loop is the current loop, followed by the velocity loop and then the outer position loop (as shown in the following figure). The performance of the position feedback control loop depends on the performance of the velocity feedback control loop.

![Figure 8-2: Embedded Feedback Loops: Current Loop, Velocity Loop and Position Loop](image)

The underlying theory of this type of control architecture is that the tuning of an outer loop is based on the assumption that the inner loop is perfectly tuned. In other words, if you want to tune the position loop, you need to have tuned the velocity loop already. If you want to tune the velocity loop, you need to have tuned the current loop already.

In general, the current loop and the velocity loop are closed inside the servo drives. The current loop is based on the power electric dynamics inside the servo drive and the servo motor, and the performance of the current loop has nothing to do with the load and other mechanical things to be controlled. So, in general, the current loop of the servo drive is already optimized in the factory before being shipped. [**NOTE:** Do not change any of the current loop parameters for the servo drives.]

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8-3
The velocity loop is quite different from the current loop. The performance of the velocity loop depends upon the load on the motor. So, the factory-default velocity loop gain setting \( K_v \) needs to be adjusted for the actual load on the motor. You can determine the optimal value of this parameter by trial and error (connecting the servo drives to real machines, and running the machines to see if \( K_v \) is good or not). Or, you can calculate the optimal \( K_v \) based on simple equations, which are generally provided in the servo manuals which accompany the servo drives. The tuning of \( K_v \) can be a little difficult, so we highly recommend paying close attention to your servo manuals.

Here are a few suggestions related to tuning the velocity loop gain parameter. We suggest increasing the velocity loop gain \( K_v \), also known as velocity bandwidth setting to as high as possible. Your velocity loop gain should be three to four times higher than the position loop gain \( K_p \). If the velocity loop gain is 200 Hz, then you can safely set \( K_p \) to 50 Hz. If the values for \( K_v \) and \( K_p \) are too close (i.e. if you set \( K_p \) to 50 Hz, and \( K_v \) to 40 or 50 Hz), your control system becomes very unstable and cannot do any meaningful performance.

In general, the process we recommend is as follows:

1) Determine the position loop gain based on the required trajectory accuracy.
2) Determine the required velocity loop gain, which should be three or four times higher than the position gain.
3) Tune the velocity bandwidth of the servos to achieve the velocity loop gain you require.

In summary, the tuning of \( K_v \) is very important. If \( K_v \) is not tuned correctly, then no matter how you tune the SMP parameters \( K_p \) and \( T_s \), it is impossible to achieve good control performance.

### 8.2.4 Using Velocity Feedforward to Increase Trajectory Accuracy

There is another aspect to reducing the servo error \( E_1 \) that was discussed in Section 8.2.2: How Position Loop Gain and Smoothing Time Relate to Trajectory Accuracy (Without 3D-DLACC). As discussed in that section, \( E_1 \) can be reduced easily by increasing \( K_p \). But, obviously there is a limit on \( K_p \) – you cannot increase \( K_p \) to infinity, due to the limitation of the servo capacity. But, you can make \( E_1 \) even smaller with the same \( K_p \) by making use of velocity feedforward control. The velocity feedforward control predicts the future velocity and adds some portion of that predicted future velocity to the velocity command from the position loop. By using this function, you can significantly reduce \( E_1 \).

### 8.2.5 Discussion of Tuning With 3D-DLACC

3D-DLACC (three-dimensional dynamic look-ahead contour control) is basically a combination of a look-ahead control and smoothing before interpolation. There are many complicated algorithms involved, but the bottom line is that the DLACC is designed to reduce the smoothing error, \( E_2 \), that was discussed in Section 8.2.2: How Position Loop Gain and Smoothing Time Relate to Trajectory Accuracy (Without 3D-DLACC). So, by combining velocity feedforward and 3D-DLACC, you can reduce \( E_1 \) and \( E_2 \) to zero, achieving perfect trajectory \( (E=0) \).

When DLACC is turned on, it disables the regular smoothing filter, meaning that smoothing time \( (T_s) \) becomes ineffective. \( T_s \) is a dominant parameter when DLACC is not in use, but \( T_s \) has no effect when DLACC is turned on. Instead, DLACC has its own smoothing filter, called look ahead smoothing time, and you need to tune this parameter well. Basically, the look ahead smoothing time is very similar to the regular smoothing time: a long look ahead smoothing time makes the surface smooth reduces the sharp accuracy of the original trajectory. It’s a trade off that you must balance by determining the needs of your machine tool.
K_p, however, is still a dominant parameter with or without DLACC in effect. But, just like K_p requires a very big K_v, DLACC requires that K_p is very high. DLACC is a very demanding function that is predicated on the regular position loop being well tuned. So, if DLACC is used without the position loop being well tuned, the performance will be disappointing. And, a well-tuned position loop requires a well-tuned velocity loop. So, in order to make use of the benefits of DLACC, you should tune the velocity loop first, and position loop second.

**8.3 Integrating LadderWorks PLC Into Your System**

If you are integrating LadderWorks in your system, you must refer to the *LadderWorks PLC User’s Manual* for instructions on setting up the PLC environment and writing PLC sequence programs.

**8.4 Backing Up Final Software Settings After Tuning**

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

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