ServoWire Motion & Logic Controller

Installation & Operation Manual

SML-001c

19 Linden Park
Rochester, NY 14625
(585) 385-3520

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Chapter 1
Welcome

1 Welcome

This manual covers the ORMEC's ServoWire Motion & Logic Controller (SMLC) and accessories used with it. It provides a detailed description of the SMLC hardware and needed information for installing, operating and "getting started" with a SMLC system.

The manual is divided into the following chapters:

Chapter 1	Welcome introduces you to this manual and its organization.
Chapter 2	General Description - Overview of the SMLC product family.
Chapter 3	SMLC Installation provides instructions for installing the SMLC and detailed descriptions of all the hardware interfaces. It explains the power up and initial configuration operation as well as the LED status indicators. This chapter also provides detailed environmental, mechanical, and electrical interface specifications for the SMLC Controller.
Chapter 4	WAGO I/O Installation provides instructions for installing the WAGO and detailed descriptions of all the hardware interfaces, as well as an explanation of the LED status indicators. This chapter also provides detailed specifications for the electrical interface specifications for the WAGO I/O.
Chapter 5	Getting Started provides detailed instructions on how to communicate and run your SMLC unit for the first time.
Chapter 6	Product History provides a chronological revision history for the ServoWire Motion & Logic Controller.
Chapter 7	Maintenance & Troubleshooting provides tips for maintaining and troubleshooting your SMLC system.
Chapter 8	Terms & Mnemonics provides definitions for term's specific to Motion Control and/or ORMEC's Motion Control products.
Appendix	Appendixes contain detailed drawings, which document the SMLC dimensions, system interface, as well as associated interface cables and accessories. See the Table of Contents for details.

This manual concentrates on providing SMLC hardware and cabling documentation. Detailed information on ORMEC's SMLC programming language is found in the on-line **SMLC Help**.

To obtain the latest version of the SMLC Help visit ORMEC's site on the World Wide Web at ***http://www.ORMEC.com***, or call the ORMEC Service Department at **1-(585) 385-3520**.

The functionality of certain portions of the SMLC hardware is dependent on the firmware and optional SMLC hardware version used.
Example: The initial release did not support PROFIBUS communications.

Throughout this manual the term SMLC refers to both the SMLC and SMLC-Lite unless otherwise indicated.

Chapter 2
General Description

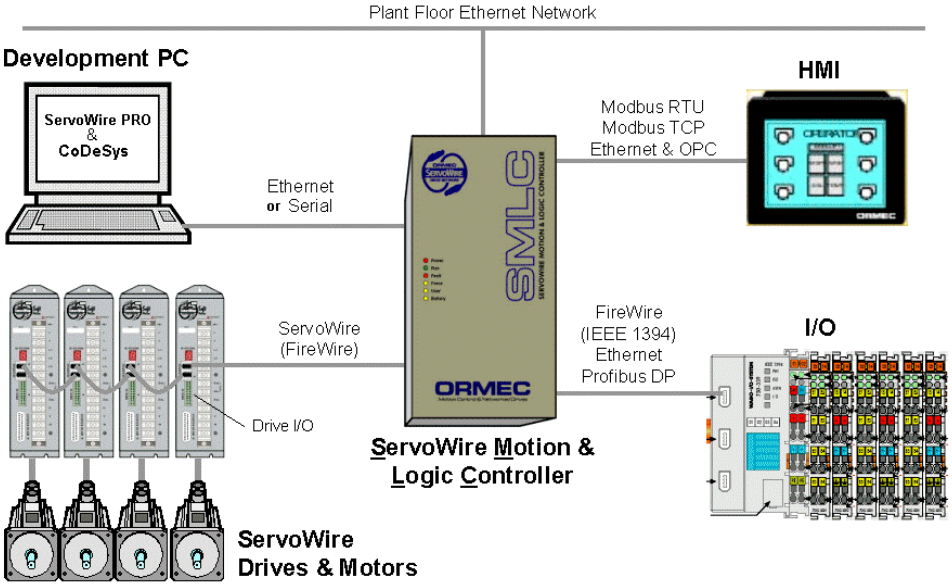


***Figure 1**, SMLC*

2 SMLC General System Description

2.1 Features

- ***Application Development** - CoDeSys IEC 61131-3 Programming:*
  IEC 61131-3 is a open standard developing application programs for motion and I/O control, running on a single processor. See: www.3s-software.com & www.PLCopen.org
- ***Operating System** - QNX Neutrino Real Time Operating System (RTOS):*
  In QNX Neutrino, only the most fundamental OS primitives (e.g. signals, timers, scheduling) are handled in the kernel itself. All other components – drivers, file systems, protocol stacks,
- ***System configuration & diagnostic's** - ServoWire Pro:*
  ServoWire Pro provides an integrated suite of configuration, diagnostic and maintenance utilities that assist in the development and on-going support of ServoWire SM systems.
- ***All Digital** - IEEE-1394 Networked Servodrives:*
  Connection of up to16 ServoWire Drives with up to a 4 kHz loop update rate, without the need to purchase additional hardware or software. All digital servo drive network using open standard IEEE 1394 (FireWire) interface hardware and cabling.
- ***ServoWire Drive I/O:***
  High speed ServoWire Drive I/O is used to capture axis position (example: registration) and control (start / stop) motion.
- ***General Purpose I/O** - WAGO, PROFIBUS, Ethernet (MODBUS/TCP) and FireWire I/O:*
  Compact, highly reliable and cost effective, with a wide variety of Input / Output modules. user applications – run outside the kernel as separate, memory-protected processes. Fault resilience is built right in. See: www.QNX.com

Hardware Features

ORMEC's ServoWire Motion & Logic Controller uses a PC-based system packaged using off the shelf hardware in a wall-mount chassis for easy installation.

SMLC hardware includes:

- CPU - Celeron or Pentium Class processors
- Ethernet Port - 10/100baseT.
- FireWire (IEEE 1394) network interfaces.
- Development, HMI, Keyboard connectors.

Figure 2, SMLC with SMM ServoWire drives

SMLC memory includes:

- RAM - Random Access Memory (volatile).
- FLASH memory for application program and data storage.
- SRAM (battery backed) Static RAM used for non-volatile data storage (optional for some models).

The all-digital ServoWire servo drive provides support for a variety of actuator technologies, including brushless rotary and linear motors, DC brush motors and voice coils. The drives are configured over the ServoWire 1394 network, eliminating all manual configuration and offline configuration utilities, reducing the cost and complexity of maintaining the motion control system.

Software Features

ORMEC has selected the highly reliable QNX Neutrino as the SMLC real time operating system (RTOS). The use of a RTOS in the SMLC facilitates the integration of new functionality and eases product lifecycle maintenance by allowing for easy migration to new and more powerful hardware platforms, as they become available.

To implement the ServoWire Controller's programming, ORMEC has partnered with 3S to integrate high performance ServoWire Soft Motion technology with CoDeSys IEC 61131-3 software. CoDeSys covers all five IEC 61131-3 standard compliant languages, and is incorporated in over one hundred OEM partner products. All application motion and I/O control is implemented in a single program running on one processor, without the delays and timing issues associated with separate processor cards in PCs and PLC racks.

For the motion control programming, ORMEC has implemented PLCopen Motion Control function blocks. Powerful features have been added to the open standard motion control function blocks, allowing motions to be loaded into a motion queue for sequential operation initiated independent of the I/O scan rate. Motions in the queue can be automatically repeated, simplifying application programming, and triggered by high-speed sensor inputs at the servo command Loop Rate (faster than the I/O scan rate). It is also possible to easily superimpose incremental time-based and geared motions on top of a constant motion gear ratio, without the need to develop cam profiles. For more details, read the help file **SMLCsoftware.chm**.

2.2 SMLC Support Software

CoDeSys - Development Software

CoDeSys IEC 61131-3 programming with PLCopen motion function blocks provides open standard tools for developing application programs for motion and I/O control. General-purpose I/O options are fully supported using WAGO's 750 Series.

The IEC 61131-3 standard suite of programming languages provides an integrated set of software tools and graphical interfaces to meet a wide range of software development needs:

- Relay Ladder Logic (LD)
- Structured Text (ST)
- Sequential Function Chart (SFC)
- Function Block Diagram (FBD)
- Instruction List (IL) tools
- CoDeSys also includes a sixth language, Continuous Function Chart (CFC)

Development Software Part Number:

CDS-SDK/C - CoDeSys Developers Kit (one seat), CD-ROM, incl. ServoWire Pro, Wago BootP server, serial communication cable and one year of maintenance & support.

ServoWire Pro - System Configuration Software

ServoWire Pro provides an integrated suite of configuration, diagnostic and maintenance utilities that assist in the development and on-going support of ServoWire systems. The software is designed to run on the development PC. ServoWire Pro is used to create a project file containing all of the motor and drive configuration information, which is then downloaded to the SMLC. ServoWire Pro includes the following utilities:

- SWSetup — Menus and software wizards to simplify drive configuration & set-up
- SWMonitor — Diagnostic utilities for monitoring drive and network performance
- SWTune — Tuning scope and software for optimizing motion performance
- SWUpgrade — Tools for upgrading ServoWire SM drives to latest firmware
- SWScope — Monitor real-time parameters and dynamic system performance
- SMLCUpgrade — Tool for upgrading SMLC firmware
- SMLC utilities — Manage files on the SMLC and configure the SMLC Ethernet ports

WAGO Ethernet I/O

Wago BootP server is used to configure the IP address of Wago Ethernet bus couplers.

2.3 SMLC Models

There are two families of SMLC models: **SMLC** and **SMLC-Lite**. The SMLC-Lite is a reduced axis count version of the SMLC that offers all of the programming and I/O control power of the SMLC in a low cost package for applications with fewer axes.

The SMLC can control up to 16 ServoWire drives where each drive can contain one motor axis and one auxiliary (pacer) axis. In addition, up to 16 virtual axes can be created and controlled. The SMLC-Lite can control a total of 3 ½ axes where each motor or virtual axis counts as one, the first auxiliary (pacer) axis counts as ½ and subsequent auxiliary axes count as one.

Unless otherwise indicated, all comments and diagrams in this manual referring to SMLC apply to SMLC-Lite as well.

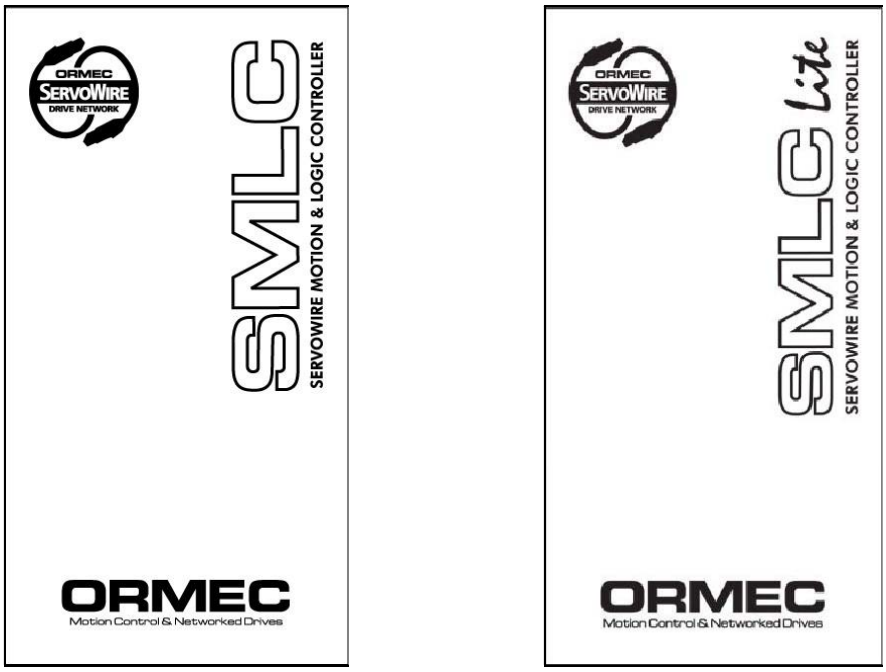


Figure 3, SMLC and SMLC-Lite front panels

SMLC - *Model number / Options*

Model number:	
10	The SMLC-10 has one available expansion slot for an additional communications interface option. Standard is 2 – IEEE 1394 ServoWire (FireWire) Ports. 1 – Ethernet Communication Port 2 – RS232 Communication Ports 1 – CRT Connector 1 – Keyboard / PS2 connector. 8k Battery backed SRAM for retain variables

Options:	Options are specified by adding characters to the part number following the "/". Option field #1 must be specified.
Microprocessor:	Microprocessor options (must be specified)
A	Celeron, 850 MHz
B	Pentium III, 850 MHz (standard)

Network:	Communication interface options
PCI-PFB	PROFIBUS Adapter
PCI-ENE	Ethernet 10/100baseT interface card.
PCI-RS232	Two additional RS-232 ports

Example: **SMLC-10/B** = SMLC Model 10, 115/230 VAC, 50/60 Hz, Pentium III 850 processor, one expansion slot, one Ethernet and two serial interfaces.

SMLC-Lite - *Model number / Options*

Model number:	
05	The SMLC-Lite comes standard with: 2 – IEEE 1394 ServoWire (FireWire) Ports. 1 - Ethernet Communication Port 2 - RS232 Communication Ports 1 - CRT Connector 1 - Keyboard / PS2 connector.

Options:	Options are specified by adding characters to the part number following the "/". Option field #1 must be specified.
Microprocessor:	Microprocessor options (must be specified)
A	Celeron, 850 MHz
Other:	
N	8k bytes of battery backed SRAM for retain variables

Network:	Communication interface options
PCI-PFB	PROFIBUS Adapter
PCI-ENE	Ethernet 10/100baseT interface card.
PCI-RS232	Two additional RS-232 ports

Example: **SMLC-05/AN** = SMLC Model 10, 115/230 VAC, 50/60 Hz, Celeron 850 processor, 8k bytes battery backed SRAM.

Chapter 3
SMLC Installation

3 ServoWire Motion & Logic Controller Installation

3.1 Installation

Safety Related Guidelines for Installation in the European Union

General: ORMEC product manuals are written to provide information required for the proper use of the equipment in the intended operation. They are written for technically qualified personnel such as engineers, programmers and maintenance specialists who have been trained in the application of automation control systems.

Proper Use: The equipment and/or system or components may only be used as described in the product manuals.

Guidelines: ORMEC motion control products generally form a part of a larger system or installation. These guidelines are intended to help integrate ORMEC products into the system.

- Since these products are component devices, overall automated system safety is beyond the scope of the product manuals and is the responsibility of the integrator.
- Compliance with EN292-1 and EN292-2 (Safety of Machinery) as well as EN60204 (Electrical Equipment of Industrial Machines) must be observed during the design phase.
- Only qualified personnel should be allowed access to the equipment.
- Opening the housing or protective covers may expose dangerous voltages.
- Emergency tripping devices in accordance with EN60204 must be effective in all operating modes of the automation equipment.
- Measures must be taken when interfacing the inputs and outputs of the automation equipment to prevent an undefined state from being assumed in the case of a wire break in the signal lines.
- The motion controller is a programmable device with the application program being written by the person integrating it into the machine. This program should only be written by a qualified person. Measures must be taken to verify that the program written does not cause dangerous and unwanted machine operation.
- These systems are of rugged design and intended for general-purpose service. However, as with any equipment, the more stressing the service conditions the worse

is the reliability and some benefit may be expected when real service conditions are better than the worst service conditions specified in the product manual and Standards. Some applications may require consideration of special packaging, cooling, electrical noise protection, etc. for reliable operation.

Receiving and Inspection

ORMEC ServoWire Motion & Logic Controller and their associated accessories are put through rigorous tests at the factory before shipment. After unpacking, however, check for damage, which may have been sustained in transit. Check the SMLC and any of the accessories for bent or broken components, loose bolts or screws and any other physical damage before installing.

NOTE: Use the original SMLC packaging material for shipping units.

Included with your SMLC is a CD package, which contains of installation disks, Users Guide, license agreement, and registration card. Please open this package, read the license agreement, and fill out and return the registration card. SMLC operates on the QNX operating system, with the RUN-TIME License pre-installed on your SMLC.

Panel Mounting and Environment

Panel Mounting data is available in the SMLC Mechanical and Environmental Specifications section of this chapter. The controller's environment should be maintained as follows:

- Operating temperature should be between 0 and 50C (32^{o}F to 122^{o}F).
- The SMLC should be mounted in a grounded metal enclosure
- If the electrical panel is subject to vibration, mount the unit on shock absorbing material.
- Avoid use in corrosive atmospheres, which may cause damage over time.
- Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust or metallic particles.
- The proper mounting orientation for the SMLC is vertical on a panel using the mounting holes (4) provided on the base plate.

3.2 SMLC System Components

An SMLC Motion Controller system consists of the following components:
It is required that they never change order.

- HMI Serial Port
- Slot 1 - 1394 FireWire Card.
- Slot 2 - Optional: Communications adapter
- Slot 3 - System Card
- Slot 4 - Not Used

WARNING: DO NOT INSTALL OR REMOVE ANY SMLC SYSTEM COMPONENTS WITH POWER APPLIED TO THE SYSTEM.

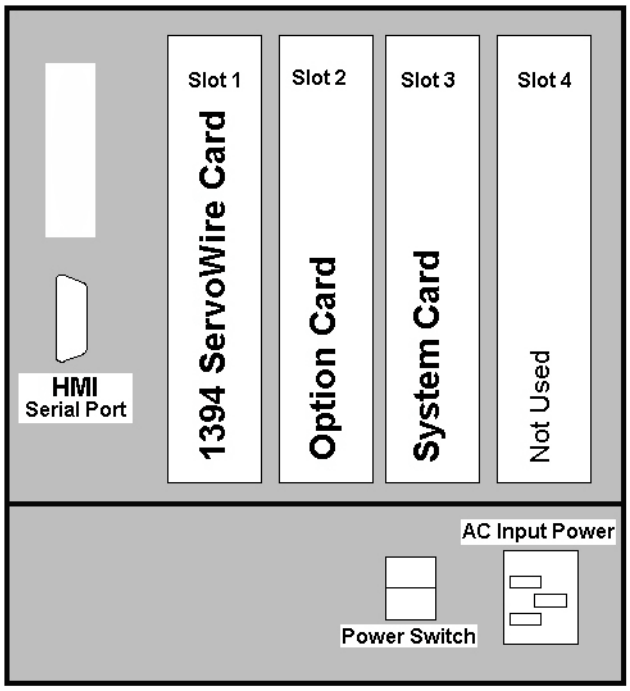
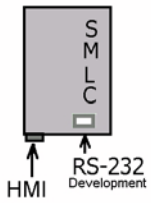


***Figure 4**, SMLC System Components layout*

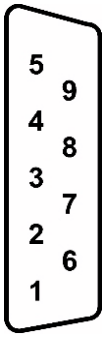
SMLC HMI Serial Port



The SMLC HMI serial port uses a DB9 connector that provides access to asynchronous serial 232 communications. This port is commonly used to interface to the ORMEC HMI flat-panel touch-screen, but any serial MODBUS protocol master device can be used. It can alternately be used for general purpose serial communications with terminals, computers or programmable controllers by using the CoDeSys Library SysLibCom.lib.

Connections to the SMLC HMI Serial Port is made through connector J1, which is located on the bottom, left side of the SMLC. The pin-out of the SMLC HMI Serial Port is shown below.

Figure 5, SMLC HMI 232 Serial Port Connector (J1) connection.



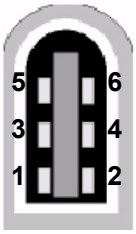
Pin	Signal	Description
1	DCD	Data Carrier Detect. This signal indicates that the modem or data set has detected the data carrier.
2	RxD	Serial input. This signal receives serial data from the communication link.
3	TxD	Serial output. This signal sends serial data to the communication link. The signal is set to a marking state on hardware reset when the transmitter is empty or when loop mode operation is initiated.
4	DTR	Data Terminal Ready. This signal indicates to the modem or data set that the on-board UART is ready to establish a communication link.
5	GND	Ground
6	DSR	Data Set Ready. This signal indicates that the modem or data set is ready to establish a communication link.
7	RTS	Request To Send. This signal indicates to the modem or data set that the on-board UART is ready to exchange data.
8	CTS	Clear To Send. This signal indicates that the modem or data set is ready to exchange data.
9	RI	Ring Indicator. This signal indicates that the modem has received a telephone ring signal.

Table 1, HMI Serial Port Connector (J1) pin-out.

SMLC ServoWire IEEE 1394 Interface Card

The ServoWire interface connectors, are standard 6 pin IEEE 1394 connectors (Molex p/n 53462-0611), as shown. Connections from the *SMLC* to the ServoWire Drives are made using prefabricated ServoWire cables (CBL-SW/##).

Figure 6, SMLC ServoWire IEEE 1394 Modular connector.



Pin	Signal	Description
1	Power	Bus Power
2	GND	Ground
3	TPB1 -	Twisted Pair B, provides differential and common mode signals.
4	TPB1 +	
5	TPA1 -	Twisted Pair A.
6	TPA1 +	

Table 2, ServoWire: IEEE 1394 Board Mount Connectors

Figure 7, SMLC with SM ServoWire drives

ServoWire Cables	Description
CBL-SW/2	ServoWire Cable, 2 ft. (0.7 M)
CBL-SW/6	ServoWire Cable, 6 ft. (2.0 M)
CBL-SW/14	ServoWire Cable, 14 ft. (4.5 M)
CBL-SW/33	ServoWire Cable, 33 ft. (10 M)

Table 3, ServoWire: IEEE 1394 Cable part numbers.

SMLC System Card Overview

The SMLC System Card is an all-in-one PCI-bus Half-size Pentium® III / Celeron® single card computer that supports Real Time Clock functionality.

Other features include CRT and LCD display connector, onboard Ethernet interface, PC133 FSB, Ultra DMA100 IDE, a Compact Flash socket for type I/II Compact Flash storage card, two 16C550 compatible serial ports, one 168-pin DIMM socket allowing for up to 256MB of SDRAM to be installed.

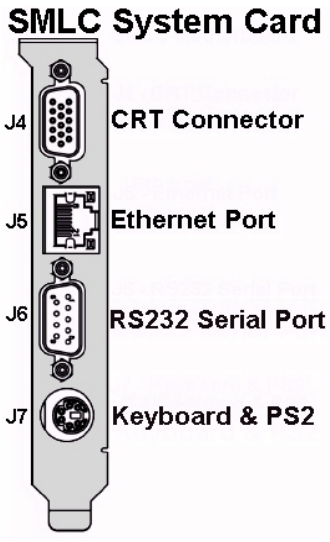
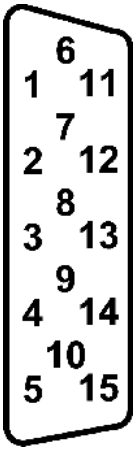


Figure 8, SMLC System Card

SMLC CRT Connector (J4)

It supports a wide range of flat panel, CRT and LCD displays.

Figure 9, SMLC System Card - CRT Connector (J4) connector



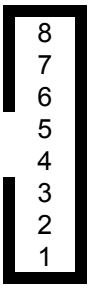
Pin	Signal	Description
1	RED	Analog output carrying the red color signal to the CRT. For 75 ohm cable impedance.
2	GREEN	Analog output carrying the green color signal to the CRT. For 75 ohm cable impedance.
3	BLUE	Analog output carrying the blue color signal to the CRT. For 75 ohm cable impedance.
4	*NC*	No Connection
5	DIG-GND	Ground reference for HSYNC and VSYNC.
6	ANA-GND	Ground reference for RED, GREEN, and BLUE
7	ANA-GND	
8	ANA-GND	
9	VCC	Power
10	DIG-GND	Ground reference for HSYNC and VSYNC.
11	*NC*	
12	DDCDAT	Display Data Channel Data. Used as data signal to/from monitors with DDC interface.
13	HSYNC	CRT horizontal synchronization output.
14	VSYNC	CRT vertical synchronization output.
15	DDCCLK	Display Data Channel Clock. Used as clock signal to/from monitors with DDC interface.

Table 4, System Card - CRT Connector (J4) pin-out

SMLC Ethernet Port (J5)

Ethernet interface port uses an industrial standard Intel 82559ER 10/100Base-Tx Ethernet chip. It can be used for networking with WAGO I/O, a MODBUS/TCP based HMI package or communications with the CoDeSys IDE or OPC Server.

Figure 10, SMLC System Card - Ethernet Connector (J5) connector



Pin	Signal	Description
8	*NC*	*NC* = No Connection
7	*NC*	
6	**RXD-**	Ethernet 10/100Base-Tx differential receiver inputs.
5	*NC*	
4	*NC*	
3	**RXD+**	Ethernet 10/100Base-Tx differential receiver inputs.
2	**TXD-**	Ethernet 10/100Base-Tx differential transmitter outputs.
1	**TXD+**	Ethernet 10/100Base-Tx differential transmitter outputs.

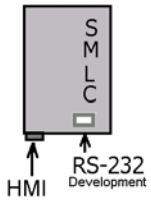
Table 5, System Card - Ethernet Port (J5) pin-out.

Ethernet Cables & Accessories

EI8-10T	Ethernet Hub, 10BASE-T, 8 port, 24 VDC input, rail mount
405TX	Ethernet Switch, 10BASE-T, 5 port, 24 VDC input, rail mount
CBL-ENET/3	Cable, Ethernet, RJ45, 3 ft.
CBL-ENET/7	Cable, Ethernet, RJ45, 7 ft.
CBL-ENET/10	Cable, Ethernet, RJ45, 10 ft.
CBL-ENET/25	Cable, Ethernet, RJ45, 25 ft.
CBL-ENET/50	Cable, Ethernet, RJ45, 50 ft.
CBL-ENET/75	Cable, Ethernet, RJ45, 75 ft.
CBL-ENET/100	Cable, Ethernet, RJ45, 100 ft.
	DO NOT USE CROSSOVER CABLES WITH A HUB. Crossover cables are used for connection only two devices together. Example: SMLC to WAGO I/O without a hub.
CBL-ENET**X**/3	Cable, Ethernet **crossover**, RJ45, 3 ft.
CBL-ENET**X**/7	Cable, Ethernet **crossover**, RJ45, 7 ft.
CBL-ENET**X**/10	Cable, Ethernet **crossover**, RJ45, 10 ft.
CBL-ENET**X**/25	Cable, Ethernet **crossover**, RJ45, 25 ft.

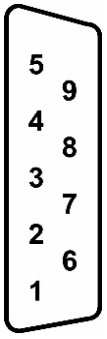
Table 6, Ethernet Cables & Accessories part numbers.

SMLC Development RS232 Serial Port (J6)



SMLC programming, system development, and system monitoring are accomplished by using an IBM-PC or compatible PC attached to the RS-232 Development Serial Port connector (J6), which is located on the *SMLC System Card*. The Development Serial Port is an asynchronous RS-232 device. It is handled internally by a 16C550 compatible serial communications controller, and interfaced through a DB9 connector. Connection between the development computer and SMLC Development Serial Port can be made while power is applied to the SMLC.

Figure 11, SMLC System Card - Serial Port DB9 (J6) connector



Pin	Signal	Description
1	DCD	Data Carrier Detect. This signal indicates that the modem or data set has detected the data carrier.
2	RxD	Serial input. This signal receives serial data from the communication link.
3	TxD	Serial output. This signal sends serial data to the communication link. The signal is set to a marking state on hardware reset when the transmitter is empty or when loop mode operation is initiated.
4	DTR	Data Terminal Ready. This signal indicates to the modem or data set that the on-board UART is ready to establish a communication link.
5	GND	Ground
6	DSR	Data Set Ready. This signal indicates that the modem or data set is ready to establish a communication link.
7	RTS	Request To Send. This signal indicates to the modem or data set that the on-board UART is ready to exchange data.
8	CTS	Clear To Send. This signal indicates that the modem or data set is ready to exchange data.
9	RI	Ring Indicator. This signal indicates that the modem has received a telephone ring signal.

Table 7, System Card - Serial Port DB9 Connector (J6) pin-out

ORMEC can provide a coil-cord style communication cable (part number **CBL-CDS-SER/10**) for the Development Serial Port which are compatible with an IBM PC (DB9) style serial connector. Refer to Appendixes E-1 and E-2 for further information.

SMLC Keyboard Interface Connector (J7)

The Keyboard Interface, standard on all SMLC controllers, is a 6-pin connector. It is compatible with all IBM PC-AT compatible keyboards. The keyboard is only recognized at power-up.

Not supported in the initial release.

WARNING: The keyboard is only recognized at power on.

Figure 12, SMLC System Card - Keyboard Connector (J7) connector.

Pin	Signal	Description
1	KDAT	Bi-directional serial data line used to transfer data from or commands to the PC-AT keyboard.
2	MDAT	Bi-directional serial data line used to transfer data from or commands to the PS/2 mouse.
3	GND	Ground
4	VCC	Power
5	KCLK	Bi-directional clock signal used to strobe data/commands from/to the PC-AT keyboard.
6	MCLK	Bi-directional clock signal used to strobe data/commands from/to the PS/2 mouse.

Table 8, SMLC System Card - Keyboard Connector (J7) pin-out.

SMLC - Ethernet Communications Card (*Optional)*

Ethernet communications adapters (PCI-ENE) are available for use in an SMLC controller. They support a RJ45 connector.

Use of ORMEC's Ethernet Communications Adapters requires a working knowledge of TCP/IP network addressing.

Ethernet Communications Adapter Hardware

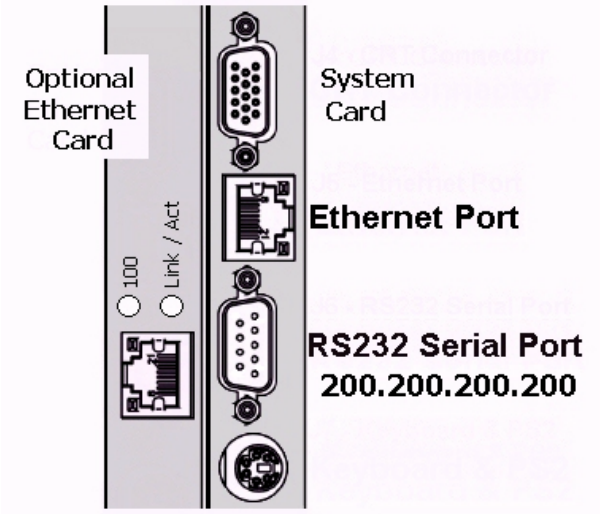


***Figure 13**, Ethernet Card Layout*

Ethernet Communications: Adapter Configuration

Ethernet communications adapters used in SMLCs have no hardware configuration jumpers; they are configured with a software setup utility in ServoWire Pro.

SMLC PROFIBUS Card *(Optional)*

The PCI-PFB is not supported in the initial release.

SMLC RS-232 Card *(Optional)*

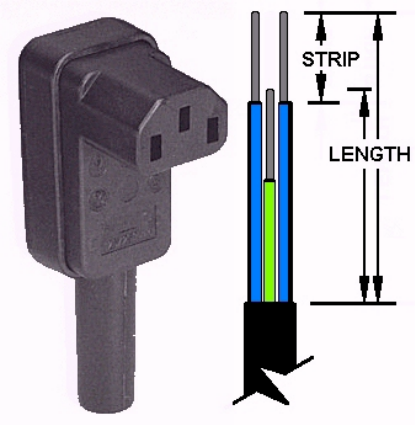
The PCI-RS232 card has not hardware configuration jumpers. The two additional ports are automatically configured as COM3 and COM4. The pinouts of the connectors are identical to J6.

3.3 Input AC Power

ServoWire Motion & Logic Controller Manual operate on either 115 VAC or 230 VAC power (50/60 Hz), without the need to configure the unit for the desired input power.

Input Connector

The SMLC comes standard with a removable, down angle, IEC 60320 (320) C-13 black thermoplastic connector. Screw type terminals accept 14 AWG gage (2.5 mm2) wire.



Neutral & Line wires are cut 25 mm in length.

Ground wire is cut 20 mm in length.

Strip off the end of each wire, 6 mm in length.

Figure 14, SMLC Power Connector

3.4 System Power Wiring & Interlocks

The SMLC provides integrated emergency stop and fault interlocks through the servodrives. System wiring diagrams for standard ORMEC servodrives, which include the recommended safety and fault interlocks for a typical system, are provided in the Appendix B, page # 54. The primary features of these system-wiring diagrams are:

- The Main Power Contactor switches servomotor power, called Main Power.
- For the *Main Power Contactor* to be enabled, both the ServoWire Drive *E-Stop/Quick Stop* input and the Drive Ready output must be closed.
- For the *Drive Ready* output to be closed, three conditions must be satisfied:

  1. There must be no SMLC diagnostic faults, including power-up diagnostics.
  2. There must be power (either +12 to +35 VDC or 12 to 30 VAC referenced to RTN) applied to the E-Stop / Quick-Stop input.
  3. There must be no drive faults from any standby or active servodrive and no open encoder signal wires on axes in pacer, standby, or active mode.

There are many acceptable variations of these System Wiring Diagrams. If using a variation, it should incorporate the primary features as described above and as shown in the Appendix. Contact the ORMEC Service Department with any questions you may have in this area.

Emergency-Stop / Quick-Stop and Drive Ready Configuration

Located on the ServoWire drive is an Emergency-Stop / Quick -Stop input and Drive Ready output, allowing fail-safe control.

Emergency Stop Input:

A discrete input can be configured to operate as Emergency Stop input. When unasserted, this input causes the servo drive to generate a drive fault and disable output power to the motor, as well as generating an **OP_FAULT** condition in the application program.

Quick Stop Input:

A discrete input can be configured to operate as Quick Stop input. Unasserting the input in this mode generates an **OP_ALARM** condition in the application program and has the effects indicated below, which are dependent on the axis mode of operation (torque, velocity or position).

- **Torque mode -** Generates an OP_ALARM condition in the application program, output remains enabled and the drive continues to receive torque commands. This allows the application program to decelerate the load under control.

- **Velocity / Position mode -** Generates an OP_ALARM condition in the application program, output remains enabled, zero speed is commanded. Commanding zero speed may result in commanded current to bring the motor to a stop.

WARNING: **The SMLC must be configured in ServoWire Pro for E-Stop / Quick-Stop operation.**

ServoWire Pro Drive Properites

Right mouse click on the ServoWire Pro "Drive network \ Drive Icon" to display the drive properties form.

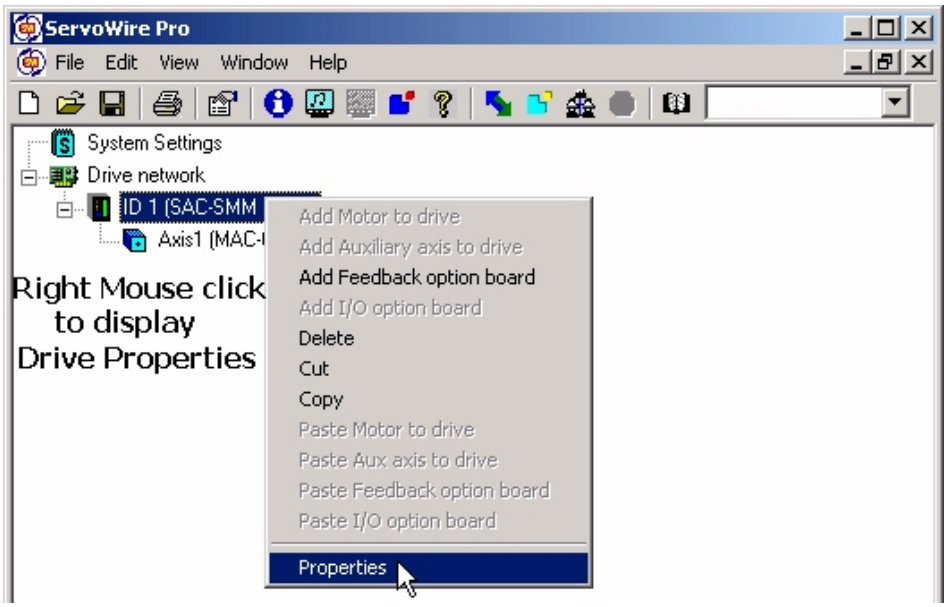


Figure 15, ServoWire Pro Drive Proprieties

Selecting the ServoWire drive input behavor

ServoWire Pro, "Drive Properties / Inputs" Setup screen, allows a user-configurable input to be used to indicate when the drive is operating normally, without faults.
This input is intended for use in the system E-Stop interlock circuit.

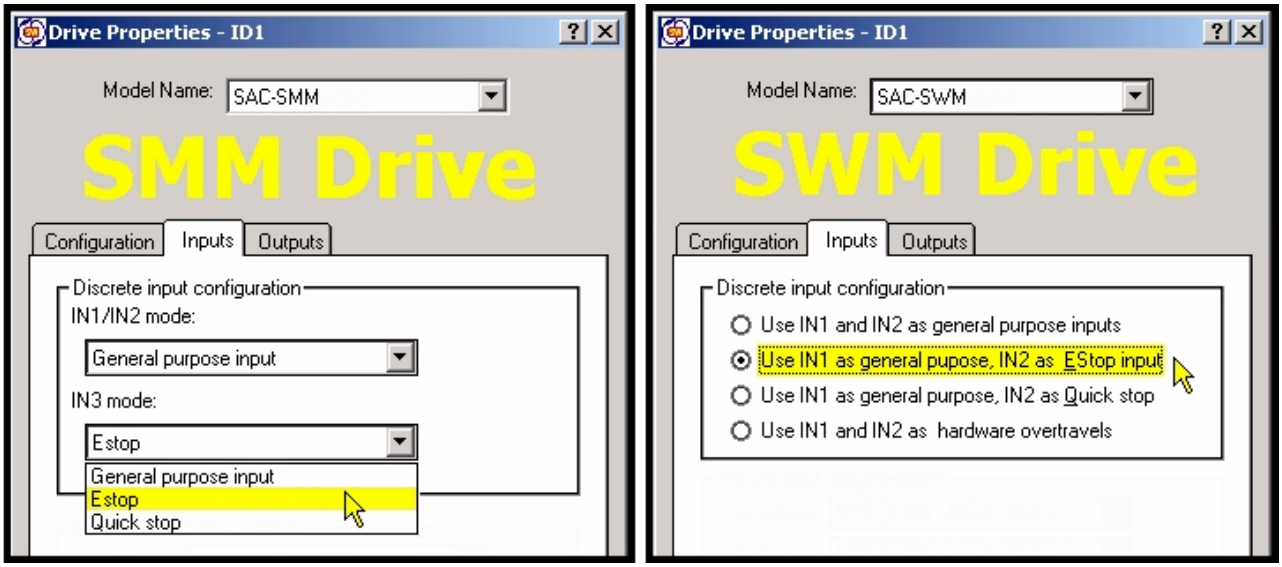


Figure 16, ServoWire Pro E-Stop / Quick Stop configuration

Selecting the ServoWire drive output behavor

ServoWire Pro, "Drive Properties / Outputs" Setup screen, allows a user-configurable output to indicate when the drive is operating normally, without faults and the main bus is charged. This output is intended for use in the system Emergency-Stop interlock circuit.

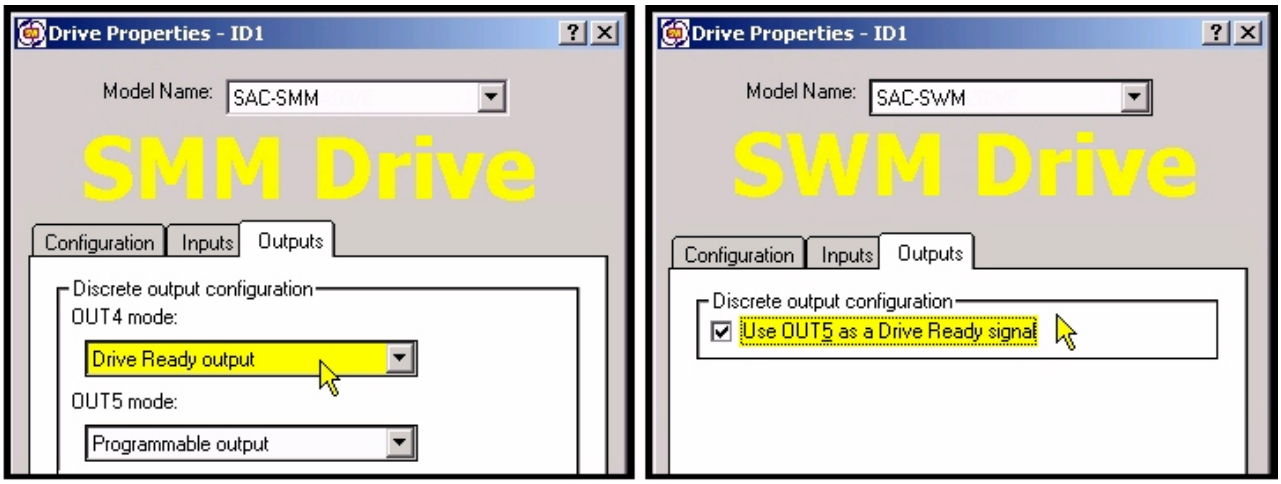


Figure 17, ServoWire Pro Drive Ready configuration

3.5 ServoWire Drive Input / Output

SM Servodrive I/O

3 Discrete Inputs:
IN1 or Hardware Travel Limit Forward
IN2 or Hardware Travel Limit Reverse
IN3 or E-Stop / Quick Stop

1 Discrete Bi-directional I/O:
IN4 or [OUT4 or Drive Ready] *See note.

4 Discrete Outputs:
OUT1
OUT2
OUT3 or Brake Control

OUT5 or ZREF Feedback

2 Sensors Inputs:
ASEN, BSEN

J3 SM Drive I/O Connections

1	**ASEN**	2	**BSEN**
3	V +S	4	V +S
5	V -S	6	V -S
7	Shield	8	Shield
9	**IN1** / HTLF	10	**OUT1**
11	**IN2** / HTLR	12	**OUT2**
13	**IN3**	14	**OUT3**
15	**IN4** / **OUT4**	16	Output 4 Return
17	Shield	18	**OUT5**
19	V +S	20	V -S

*** Note:**
Input #4 is Bi-directional & shares the same pin with Output #4. If Output #4 is enabled, then Input #4 will read the state of Output #4.

SW Servodrive I/O

2 Discrete Inputs:
IN1 or Hardware Travel Limit Forward
IN2 or Hardware Travel Limit Reverse
or E-Stop / Quick Stop

6 Discrete Outputs:
OUT1
OUT2
OUT3
OUT4
OUT5 or Drive Ready
OUT6 or Brake Control

3 Sensors Inputs:
ASEN, BSEN, CSEN

2 Analog Outputs:
Analog 1 Out
Analog 2 Out

SW Drive I/O Connections

TB1a		TB1b	
1	**ASEN**	1	**Analog 1 Out**
2	**BSEN**	2	**Analog 2 Out**
3	**CSEN**	3	Analog Gnd
4	Shield	4	Shield
5	V +S	5	**ZREF** Out
6	V +S	6	**OUT1**
7	V -S	7	**OUT2**
8	V -S	8	**OUT3**
9	**LR** / **IN2** E-Stop	9	**OUT4**
10	**LF** / **IN1**	10	**OUT5** / Drive Ready
11	Delay	11	**OUT6** / Break

3.6 SMLC Operation

SMLC Status LED's

Six status LEDs are provided on the face of the SMLC for indicating system status. Refer to the following table for a list of the LED's and what they indicate.

Name	Color	Description
POWER	Green	AC power is present that is controlled by a power switch located on the bottom of the SMLC.
RUN	Green	PLC is in run mode.
FAULT	Red	Internal error. The SMLC must be power cycled to reset. A dump file may be generated.
Watchdog OK	Yellow	System Watchdog LED **MUST BE FLASHING**. This flashing yellow system Watchdog OK LED on the front of the controller will flash every second during normal operation. When CoDeSys is online with the SMLC this LED will flash twice a second. When CoDeSys is logged out the flashing will resume at once per second. If the LED stops flashing the SMLC operation is completely suspended and WAGO outputs are turned OFF. Cycling the SMLC power should clear this watchdog timeout. After this is done, operation should proceed normally.
USER	Yellow	Under application program control by MC_UserLED.
LOW BATTERY	Yellow	SRAM Non-volatile memory batteries need to be replaced. Tested only at power-up. Replace the two batteries on the SRAM board. ***DO NOT replace the motherboard BIOS Battery by mistake.***

Table 9, SMLC Status LED's

3.6.1.1 Power-up

ServoWire Motion & Logic Controller is a user-programmable device and operation is dependent on the ServoWire Pro configuration file & SMLC program loaded on the System Flash memory.

Whenever AC power is applied to the SMLC, it executes the following power-up sequence, which can last up to 10 seconds. All the System LED's, will flash ON-OFF three times to indicate the power-up sequence is completed.

NOTE: Until the SMLC is initialized the state of the Status LED's on the SMLC do not properly indicate the system status.

3.7 SMLC Non-volatile memory

The CoDeSys Programming language supports non-volatile (NV) variables through the use of **RETAIN** and **PERSISTENT** keywords. Unlike normal CoDeSys variables, NV variable values are maintained through a loss of power or system reset, and are available to a user's application program when power is restored. NV storage is available on all SMLC systems, and on SMLC-Lite systems that have the optional battery backed SRAM board. The base SMLC-Lite model does not contain any battery backed SRAM.

Retain variables are identified by the keyword **RETAIN**. These variables maintain their value even after an uncontrolled shutdown of the controller as well as after a normal switch off and on of the controller. When the program is run again, the stored values will be processed further.

Persistent variables are identified by the keyword **PERSISTENT**. Unlike Retain variables, these variables retain their value after a re-download or 'Online' 'Reset, but not at switching off and on of the controller (i.e. not at the command 'Online' 'Reset'), because they are not saved in the "retain area".

To reset the non-volatile variables to 0 use the command ‘Online’ ‘Reset (original)’. Note that this will delete your boot project as well.

See: CoDeSys Help for further details.

General Specifications

CPU Processor types	Option: A – 850 MHz Celeron B – 850 MHz Pentium III
Total controller memory[1]	128 M bytes DRAM
SMLC program memory[1]	64 M bytes FLASH
Non-volatile variable memory[1]	8 K bytes SRAM (battery backed)
Memory Cards	None

***Table 10**, SMLC Controller General Specifications*

SMLC Mechanical and Environmental Specifications

Dimensions	9.6” High x 5.95" Wide x 8.0"Deep (243.8 H x 151.1W x 203.2 D) Looking at the SMLC face:
Weight	7.9 lb With System & ServoWire cards.
Cooling Fan	One - 49 Cubic Feet per Minute
Air Filter	Air filter located on top.
Operating Temperature	0 ~ 50 °C, (32~122 °F)
Storage Temperature	-25C to 70C (-13 °F to 158 °F)
Relative Humidity	10 ~ 95% @ 40'C, non-condensing
Mounting & Airflow	Mounting must be vertical; Airflow must be unrestricted.

***Table 11**, SMLC Controller Mechanical and Environmental Specifications*

[1] Refer to the SMLC Memory chapter of for further information regarding memory utilization.

Input AC Power Ratings

ServoWire Motion & Logic Controller	115 VAC (90 - 127 VAC), 47 - 63 Hz – or – 230 VAC (190 - 253 VAC), 47 - 63 Hz
ServoWire SM Drive Control Power	115 or 230 VAC, 50/60 Hz SAC-SM203, 205, 210 & 217 20 W typical (45 W max.) SAC-SM220 30 W typical (55 W max.)
Operator Display	24 VDC

***Table 12**, SMLC and Accessories Input Power*

Battery Power Specifications

Location	See Appendix C for battery location.
SMLC System Card	One - TL-5186 lithium Battery (3 Volt)
SMLC SRAM Card	Two - BR2032 lithium Batteries (3 Volt, 190 mA Hr)
Data Retention	3 years of data retention.

***Table 13**, SMLC Battery Power*

RS-232 (Development port) Specifications

Connector	9 pin Male D Sub
Standards	EIA RS-232C
Default Config	8 data bits 1 stop bit no parity
Baud Rates	115.2K, 57.6K, 38.4K, 19.2K, 9600, 4800, 2400, 1200 Unit will autobaud to one of the above baud rates upon receipt of two "carriage return" characters after "powerup" or "reset".

***Table 14**, SMLC Development Serial Port*

HMI Serial Port RS-232 Specifications

Connector	9 pin Male D Sub
Standards	EIA RS-232
Default Config.	8 data bits 1 stop bits no parity
Baud Rates	115.2K, 57.6K, 38.4K, 19.2K, 9600, 4800, 2400, 1200

***Table 15**, SMLC Serial Ports*

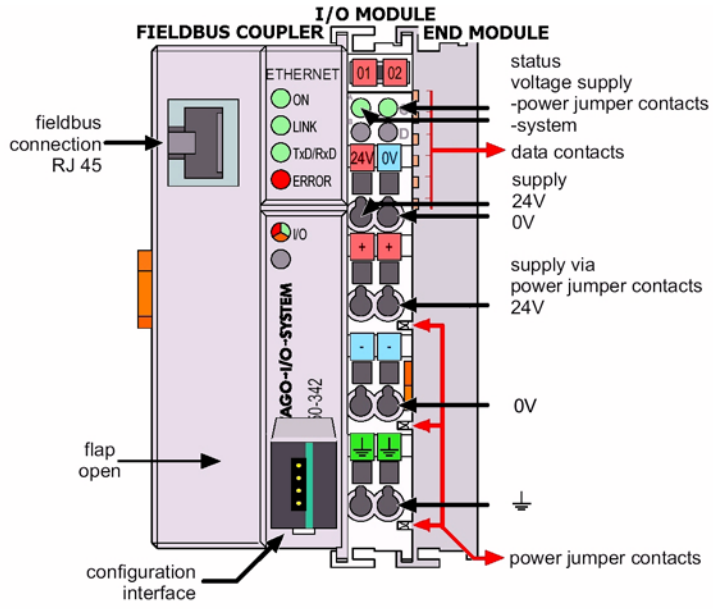
Chapter 4
WAGO Installation & Operation

4 WAGO Installation & Operation

General Purpose I/O

General-purpose I/O options are supported using FireWire, PROFIBUS DP or MODBUS/TCP I/O from WAGO (750 Series). Depending on your application's speed, distance, wiring and budget requirements, you can select a technology that matches your system requirements.

The I/O system offers a Fieldbus independent node design, even though the Fieldbus couplers utilizing different protocols. Cage clamp technology helps reduce installation time and provides gas-tight I/O connections that are maintenance-free and resistant to vibration.



The WAGO System consists of three components:

1. One Fieldbus Coupler (Left end)
2. A number of I/O modules (Middle)
3. One End Module (Right end).

The WAGO-ETH-KIT (fieldbus coupler) is a 10baseT, 64 I/O module (256 points max) that supports a wide selection of I/O module types and includes the end module. Your system can mix and match a wide variety of I/O modules including digital I/O with up to eight points each and analog I/O in several resolutions and signal types. A selection of specialty modules are also available – including a selection of thermocouples that can be used to implement PID control, up/down counters and an incremental encoder interface

4.1 WAGO Installation

Setting the WAGO IP Address

The WAGO fieldbus coupler needs to be assigned an IP address. WAGO's BootP Server is used to assign an IP Address to the hardware MAC (Media Assess Code) ID of the fieldbus coupler.

- Launch the WAGO BootP server.

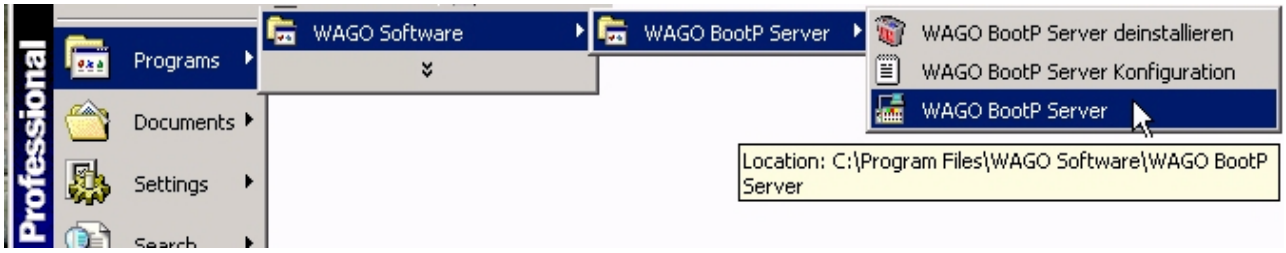


***Figure 18**, WAGO Launch BootP server:*

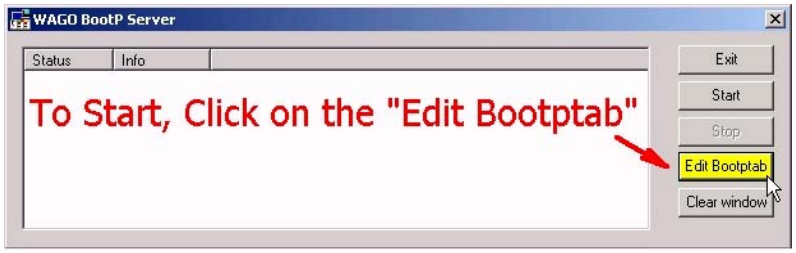


***Figure 19**, WAGO Launch Notepad*

- The file "**BootPtab.txt"** needs to be modified.

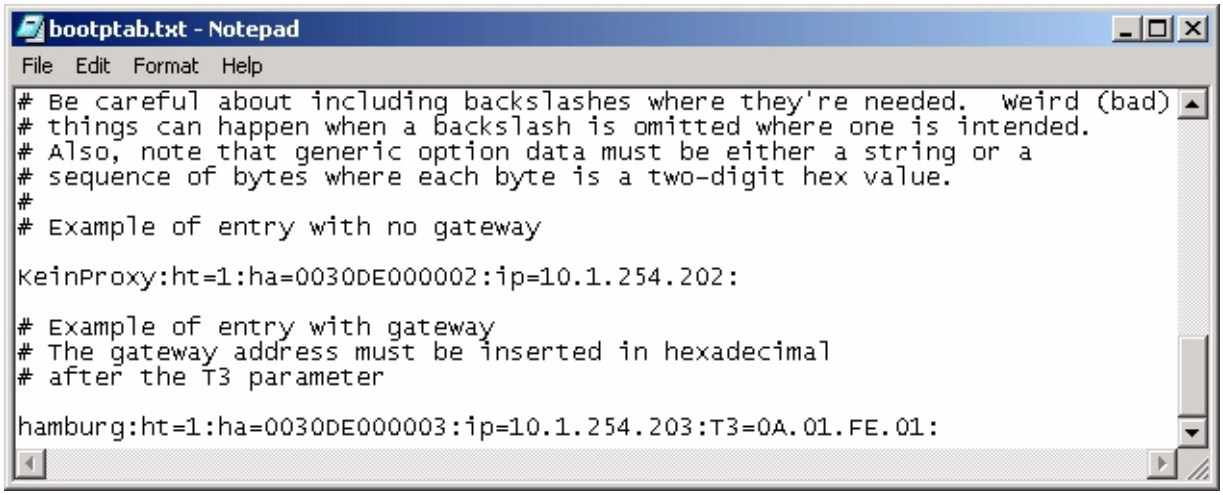


***Figure 20**, WAGO edit BootPtab.txt.*

The file "**BootPtab.txt"** has many lines that are commented by the "#" (pound symbol). Any line without a # will be processed so be careful when editing this file.

Look at the first line (near the bottom of the file) that does not have a pound symbol. (#)

KeinProxy:ht=1:ha=0030DE000002:ip=10.1.254.202:

- **KeinProx** - is a label. German meaning "Node Name". It may be changed to any label or descriptor you like to identify the WAGO Ethernet I/O hardware.
  Example **MyWAGOconfig:**

- **ht** = hardware type.

- **ha** = is short for **H**ardware **A**ddress, also known as the MAC ID. It needs to match the MAC ID number that is located on the right side of the field coupler.
  Example **ha=0030DE000002:**

- **ip** = is short for **I**nternet **P**rotocol, the WAGO node address.
  Example **ip=192.168.0.123:**

MyWAGOconfig:ht=1**:ha=**0030DE000002**:ip=**192.168.0.123**:**

Look at the bottom (last) line in the file. This is a **second example** that demonstrates how to add the gateway address. If a gateway address is not going to be used, comment out this line by adding a #. Most applications typically do not use the gateway.

hamburg:ht=1:ha=0030DE000003:ip=10.1.254.203:**T3=0A.01.FE.01:**

- Now save the WAGO configuration file **BootPtab.txt** by clicking on the notepad - File/Save. Close the notepad editor.

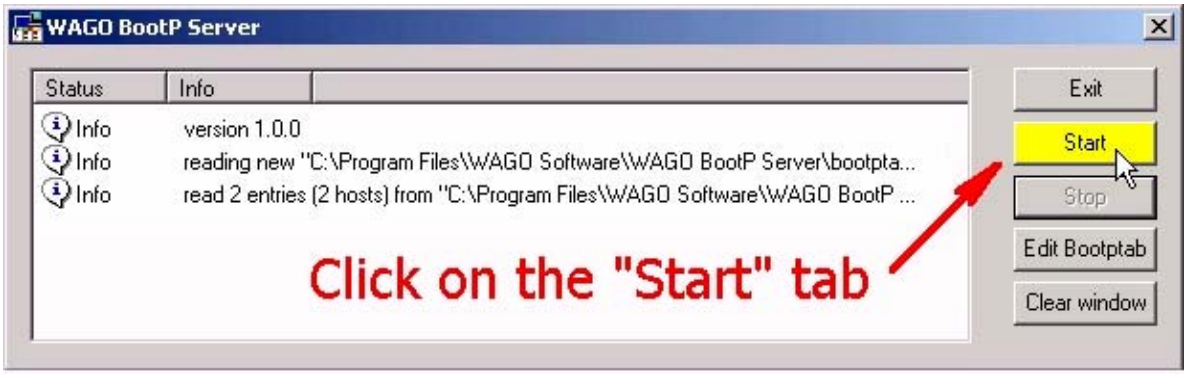


***Figure 21**, WAGO Start BootP Server*

- Now click on the start tab to display status messages.

- Turn the power off on the WAGO fieldbus coupler and wait for 5 seconds.

Now turn the power back on the WAGO fieldbus coupler. You should see additional status messages scrolling down the BootP Server screen.

Verify the status information displayed:

- Packets were received from an IP Address.
- The Ethernet Address is the same as the MAC ID of the Fieldbus coupler.
- The KeinProxy, or node identifier, and IP Address match what was entered in the text file using Notepad.

Verify the WAGO buscoupler or PFC is operating correctly. Its diagnostic LED's should be illuminated as follows:

On	Green
Link	Green
TxD/RxD	Flash as data is Sent/Received
Error	Should not be illuminated
I/O	Green

Your WAGO Fieldbus coupler is now ready for communications on an Ethernet network.

4.2 WAGO Part List

WAGO-ETH-KIT	Ethernet Fieldbus Coupler Kit, 10baseT, 64 I/O modules for 256 ins & 256 outs max. (incl. one End Module and two 10 mm End Stops) **NOTE 1:** WAGO Fieldbus couplers supply a limited amount of 24 VDC power to the I/O modules, which may not be sufficient for the application. A Power Supply and Supply Module may be required. Refer to the WAGO Ethernet or PROFIBUS I&O Manual or the WAGO Web Site for further information.
WAGO-750-342	Ethernet Fieldbus Coupler, 10BaseT, 64 I/O modules for 256 inputs & 256 outputs max.

WAGO Digital Input Modules

WAGO-750-400	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter	
WAGO-750-401	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 0.2 msec filter, high spd	
WAGO-750-410	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.msec filter, 2-wire prox. switch	
WAGO-750-411	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 0.msec filter, high spd, 2-wire prox. Switch.	
WAGO-750-418	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter, diagnostics w/ ack	
WAGO-750-419	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter, diagnostics	
WAGO-750-412	2-Ch DC Input, Sourcing (high-side switch), 48 VDC, 3.0 msec filter	(see note 2)
WAGO-750-424	2-Ch DC Input, Sourcing (high-side switch), 24 VDC, Intruder Detection	
WAGO-750-402	4-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter	
WAGO-750-403	4-Ch DC Input, Sourcing (high-side switch), 24 VDC, 0.2 msec filter, high spd	
WAGO-750-408	4-Ch DC Input, Sinking (low-side switch), 24 VDC, 3.0 msec filter	
WAGO-750-409	4-Ch DC Input, Sinking (low-side switch), 24 VDC, 0.2 msec filter, high spd	
WAGO-750-414	4-Ch DC Input, Sourcing (high-side switch), 5 VDC, 0.2 msec filter, high spd	(see note 2)
WAGO-750-422	4-Ch DC Input, Sourcing (high-side switch), 24 VDC, 1.0 msec filter, w/ 10 msec ext.	
WAGO-750-415	4-Ch AC/DC Input, 24VAC/VDC, 20 msec filter, 2-wire connection	(see note 2)
WAGO-750-423	4-Ch AC/DC Input, Sourcing (high-side switch), 24 VAC/VDC, 50 msec filter, w/ power jumper contacts (supply module req'd for 24 VAC operation)	(see note 2)
WAGO-750-430	8-Ch DC Input, Sourcing (high-side switch), 24 VDC, 3.0 msec filter	
WAGO-750-431	8-Ch DC Input, Sourcing (high-side switch), 24 VDC, 0.2 msec filter, high spd	
WAGO-750-435	1-Ch DC Input, 24 VDC, 3.0 msec filter, NAMUR	
WAGO-750-425	2-Ch DC Input, 24VDC, 3.0 msec filter, NAMUR	
WAGO-750-405	2-Ch AC Input, 230VAC	(see note 2)
WAGO-750-406	2-Ch AC Input, 120VAC	(see note 2)

WAGO Digital Output Modules

WAGO-750-501	2-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 0.5 A	
WAGO-750-502	2-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 2.0 A	
WAGO-750-504	4-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 0.5 A	
WAGO-750-506	2-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 0.5A, w/ diagnostics	
WAGO-750-507	2-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 2.0 A, w/ diagnostics	
WAGO-750-509	2-Ch AC/DC	Output, SSR, 230 VAC/VDC, 300 mA	(see note 2)
WAGO-750-512	2-Ch Relay	Output, normally open, 230 VAC/30 VDC, 2.0 A	(see note 2)
WAGO-750-513	2-Ch AC/DC	Output, Isolated relay, 250 VAC/30VDC, 2.0A	(see note 2)
WAGO-750-514	2-Ch Relay	Output, changeover contacts (SPDT), 125 VDC/30 VDC, 0.5 A	(see note 2)
WAGO-750-516	4-Ch DC	Output, Sinking (low-side switch), 24 VDC, 0.5 A	
WAGO-750-517	2-Ch Relay	Output, changeover contacts (SPDT), 230 VDC/300 VDC, 1.0 A	(see note 2)
WAGO-750-519	4-Ch DC	Output, Sourcing (high-side switch), 5 VDC, 20 mA	(see note 2)
WAGO-750-522	2-Ch AC	Output, opto isolated, 35-230 VAC, 0.5 A, 3.0A for 30 sec once per hour	(note2)
WAGO-750-523	1-Ch AC	Output, opto isolated, 230 VAC, 16A, auto/manual operation	
WAGO-750-530	8-Ch DC	Output, Sourcing (high-side switch), 24 VDC, 0.5A	
WAGO-750-535	2-Ch DC	Output, Sourcing (high-side switch), 24 VDC Eex I	

WAGO Analog Input Modules

WAGO-750-465	2-Ch Analog Input, 0-20 mA, 12-bit, single-ended	
WAGO-750-453	4-Ch Analog Input, 0-20 mA, 12-bit, single-ended	
WAGO-750-452	2-Ch Analog Input, 0-20 mA, 12-bit, differential	(see note 3)
WAGO-750-480	2-Ch Analog Input, 0-20 mA, 13-bit, differential	(see note 3)
WAGO-750-472	2-Ch Analog Input, 0-20 mA, 16-bit, single-ended	
WAGO-750-472/005-000	2-Ch Analog Input, 0-20 mA, 16-bit, single-ended, 60 Hz	
WAGO-750-466	2-Ch Analog Input, 4-20 mA, 12-bit, single-ended	
WAGO-750-455	4-Ch Analog Input, 4-20 mA, 12-bit, single-ended	
WAGO-750-485	2-Ch Analog Input, 4-20 mA, 12-bit single-ended, explosion protection	
WAGO-750-454	2-Ch Analog Input, 4-20 mA, 12-bit, differential	(see note 3)
WAGO-750-492	2-Ch Analog Input, 4-20 mA, 12-bit, differential, isolated	(see note 3)
WAGO-750-474	2-Ch Analog Input, 4-20 mA, 16-bit, single-ended	
WAGO-750-474/005-000	2-Ch Analog Input, 4-20 mA, 16-bit, single-ended, 60 Hz	
WAGO-750-456	2-Ch Analog Input, +/-10 V, 12-bit, differential	(see note 3)
WAGO-750-457	4-Ch Analog Input, +/-10 V, 12-bit, single-ended	
WAGO-750-479	2-Ch Analog Input, +/-10 V, 14-bit, differential	(see note 3)
WAGO-750-476	2-Ch Analog Input, +/-10 V, 16-bit, single-ended	
WAGO-750-467	2-Ch Analog Input, 0-10 V, 12-bit, single-ended	(see note 3)
WAGO-750-459	4-Ch Analog Input, 0-10 V, 12-bit, single-ended	
WAGO-750-468	4-Ch Analog Input, 0-10 V, 12-bit, single-ended	(see note 3)
WAGO-750-478	2-Ch Analog Input, 0-10 V, 16-bit, single-ended	
WAGO-750-460	4-Ch Analog Input for RTD, Pt100 resistance sensors	(see note 3)
WAGO-750-483	2-Ch Analog Input, 0-30 V14-bit, differential	
WAGO-750-469	2-Ch Analog Input for Thermocouple, Type K, w/ diagnostics	(see note 3)
WAGO-750-469/000-001	2-Ch Analog Input for Thermocouple, Type S, w/ diagnostics	(see note 3)
WAGO-750-469/000-002	2-Ch Analog Input for Thermocouple, Type T, w/ diagnostics	(see note 3)
WAGO-750-469/000-003	2-Ch Analog Input for Thermocouple, +/-120 mV, w/ diagnostics	(see note 3)
WAGO-750-469/000-006	2-Ch Analog Input for Thermocouple, Type J, w/ diagnostics	(see note 3)
WAGO-750-469/000-008	2-Ch Analog Input for Thermocouple, Type E, w/ diagnostics	(see note3)
WAGO-750-469/000-012	2-Ch Analog Input for Thermocouple, Type L, w/ diagnostics	(see note 3)
WAGO-750-461	2-Ch Analog Input for RTD, Pt100 resistance sensors	(see note 3)
WAGO-750-461/000-003	2-Ch Analog Input for RTD, Pt1000 resistance sensors	(see note 3)
WAGO-750-461/000-004	2-Ch Analog Input for RTD, Ni100 resistance sensors	(see note 3)
WAGO-750-461/000-005	2-Ch Analog Input for RTD, Ni1000 resistance sensors	(see note 3)
WAGO-750-461/000-002	2-Ch Analog Input for RTD, Resistor measurement, 10 - 1.2k ohms	(see note3)
WAGO-750-461/000-007	2-Ch Analog Input for RTD, Resistor measurement, 10 - 5.0k ohms	(see note3)
WAGO-750-491	1-Ch Analog Input for Resistor Bridges, 16-bits, 250 msec conversion time	(see note 3)
WAGO-750-491/000-001	1-Ch Analog Input for Resistor Bridges, 16-bits, 65 msec conversion time	(see note 3)

WAGO Analog Output Modules

WAGO-750-552	2-Ch Analog Output, 0-20 mA, 12-bit	
WAGO-750-585	2-Ch Analog Output, 0-20 mA, 12-bit, explosion protection	
WAGO-750-554	2-Ch Analog Output, 4-20 mA, 12-bit	
WAGO-750-556	2-Ch Analog Output, +/-10 V, 12-bit	(see note 3)
WAGO-750-557	4-Ch Analog Output, +/-10 V, 12-bit	
WAGO-750-550	2-Ch Analog Output, 0-10 V, 12-bit	(see note 3)
WAGO-750-559	4-Ch Analog Output, 0-10 V, 12-bit	

WAGO Specialty Modules

WAGO-750-404	1-Ch Up/Down Counter, 24 VDC, 32-bit, 100 kHz
WAGO-750-638	2-Ch Up/Down Counter, 24 VDC, 16-bit, 500 Hz
WAGO-750-511	2-Ch PWM Output, 24 VDC, 0.1A, 10-bit, 250 Hz, configurable duty cycle
WAGO-750-630/000-013	SSI Transmitter Interface, 29-bit, 125 kHz, binary
WAGO-750-630/000-008	SSI Transmitter Interface, 25 bit, 125 kHz, graycode
WAGO-750-630/000-011	SSI Transmitter Interface, 25-bit, 125 kHz, binary
WAGO-750-630/000-006	SSI Transmitter Interface, 24-bit, 250 kHz, graycode
WAGO-750-630/000-002	SSI Transmitter Interface, 24-bit, 250 kHz, binary
WAGO-750-630	SSI Transmitter Interface, 24-bit, 125 kHz, graycode
WAGO-750-630/000-004	SSI Transmitter Interface, 24-bit, 125 kHz, graycode w/ status
WAGO-750-630/000-001	SSI Transmitter Interface, 24-bit, 125 kHz, binary
WAGO-750-630/000-007	SSI Transmitter Interface, 24-bit, 83 kHz, graycode w/ status
WAGO-750-630/000-005	SSI Transmitter Interface, 15-bit, 125 kHz, graycode w/ status
WAGO-750-630/000-009	SSI Transmitter Interface, 13-bit, 250 kHz, binary
WAGO-750-630/000-012	SSI Transmitter Interface, 13-bit, 125 kHz, graycode
WAGO-750-631	Incremental Encoder Interface, 16-bit pos capture, 5 VDC edr power output (note 2)
WAGO-750-637	Incremental Encoder Interface, 32-bit pos capture, pos compare, 5 VDC edr power output (see note 2)
WAGO-750-635	Digital Impulse Interface, for magnetostrictive distance measurement sensors

WAGO Power Supplies and Accessories

WAGO-787-602	Power Supply 1.3A, 24 VDC output
WAGO-787-612	Power Supply 2.5A, 24 VDC output
WAGO-787-622	Power Supply 5.0A, 24 VDC output
WAGO-787-632	Power Supply 10A, 24 VDC output
WAGO-787-640	Power Supply 10A, 24 VDC output, 3-phase 230 VAC input
WAGO-750-601	Supply module with fuse, 24 VDC
WAGO-750-612	Supply module, 0 – 230 AC/DC (incl. 5 VDC modules)
WAGO-750-602	Supply module, 24 VDC
WAGO-750-615	Supply module with fuse, 120 VAC
WAGO-750-609	Supply module with fuse, 230 VAC
WAGO-750-622	Binary Spacer Module
WAGO-750-600	End Module
WAGO-249-117	End Stop
WAGO-247-PWR	Power and Ground Label Strip Pack blue “0V”, blue "-", red “24V”, red "+", light green ground symbol, light green “PE”, 100 each
WAGO-247-513/522	I/O Point Numbering Label Strip Pack, digits 00-99, 10 each

NOTE 2: Any WAGO Digital I/O modules operating at voltages other than 24 VDC require a Power Supply and Supply Module with the appropriate voltage rating for input power and isolation. Refer to the WAGO Ethernet or PROFIBUS I&O Manual or the WAGO Web Site for further information.

NOTE 3: WAGO Analog Output and 2-Channel AC/DC Output Isolated Relay modules do not pass the power supply on to other modules in the rack. A supply module will be required for any I/O modules to the right of an Analog Output or Isolated Relay module in a WAGO I/O system. Refer to the WAGO Ethernet or PROFIBUS I&O Manual or the WAGO Web Site for further information.

Chapter 5
Getting Started

5 Getting Started

5.1 Preparation for Test Run

For the test run, you need to:
1. Complete the appropriate System Wiring.
2. Create the configuration file “SwSetup” for your system by using ServoWire Pro.
3. Load the “SwSetup” file into the SMLC.

DO NOT connect the motor shafts to the driven machine until after the test run is complete!

Before the test run, do the following checks of the servomotor and ServoWire Motion & Logic Controller and their installation. Correct any problems before proceeding.

ServoWire Motion & Logic Controller Checklist

Verify that the power is fused properly and that the system power wiring and grounding are correct. See Appendix B of this manual, as well as the *Servo Drive Manual*.

1) If a "lot system test" (integrated system test) was performed at ORMEC, the servo system **must be** installed the same as they were at the ORMEC factory. Servodrives and servomotors must be connected in the same order because the servo loop configuration parameters are stored in the ServoWire Pro configuration file “*filename.SwSetup*” by *Axis-ID*.

2) Verify that the system grounding is correct. Refer to Appendix B and the appropriate *servodrive manual*.

3) Check for compatible voltage ratings on all servodrives obtaining control power from terminals “ **r** ” and “ **t** ” on the servo drive.

4) Verify that all wiring leads are firmly connected to their terminals.

5) Verify SMLC incoming line voltage (115 or 230 VAC) **CHECK POWER BEFORE APPLYING IT TO THE MOTION CONTROLLER!**

6) Attach an IBM-PC or compatible computer operating either the CoDeSys or ServoWire Pro communications utility to the SMLC Serial Development Port (J6) or Ethernet port (J5).

Servomotor Checklist

1) Verify proper motor mounting and that the **shaft is not connected to the machine.**

2) Verify that the encoder cables and motor cables are properly installed.
Note: ORMEC manufactured motor cables are color-coded.

Motor Cable Color	Servodrive Connection
RED	U
WHITE	V
BLACK	W
GREEN & SILVER	GROUND

3) Check that mounting bolts and nuts are tight.

4) Verify that motor shaft rotates freely by hand.
NOTE: If your motor has an integral fail-safe brake you must apply power to the brake coil in order to allow the motor shaft to rotate.

5) For motors with oil seals, (standard on IP-67 rated motors) the seals should be in good condition and properly lubricated.

6) Verify that the metal key is removed from the motor shaft keyway, or that it is securely taped down, for test.

Applying System Control Power

1) Refer to the section - SMLC Operation (page 25) for further information regarding the SMLC power-up sequence.

2) After checking the items above, apply control power to the servodrives and toggle on the SMLC power switch located on the bottom of the SMLC chassis.

3) The SMLC will execute it's Power-up sequence as detailed in the section SMLC Operation chapter (page 25).

4) After the Power-up sequence is complete, the Run light should be ON. At this point, the system is operating correctly and executing your application program.

5.2 Setting up SMLC Serial communications

ServoWire Pro uses Dial-Up Networking (DUN) to communicate with the SMLC Serial port. When your PC is properly configured and DUN is initialized (running), communications between ServoWire Pro and SMLC is possible. The connection address is 200.200.200.200. The serial port communication rate is 115K Baud maximum.

NOTE: You must configure your Network Connections in Windows before you can communicate with an SMLC. See: "**Network Setup Help**" included with ServoWire Pro software.

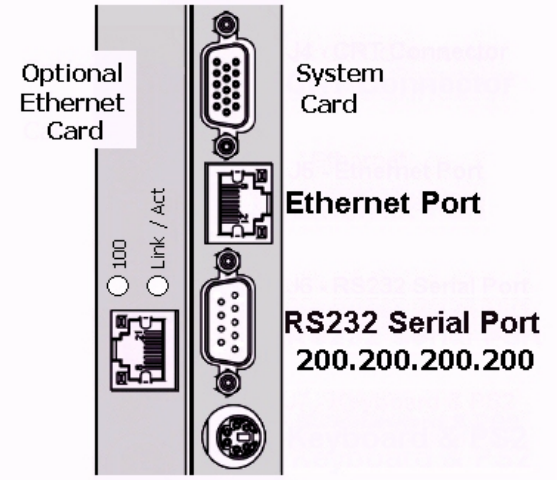


Figure 22, SMLC Communication Connector

Initializing the Communications Connection

When ServoWire Pro needs to communicate with a SMLC, it checks to see if a DUN connection has been established. If no connection exists, the "Connect To" dialog is displayed, allowing you to initialize the SMLC connection. Thereafter, Windows handles all serial communications in the background.

Note: ServoWire Pro must know the correct Internet Protocol (IP) address of the SMLC it is connecting with. The factory address for the RS-232 Serial Port is "200.200.200.200". This address refers to a Direct Cable Connection between ServoWire Pro and the SMLC System Card Serial Port (J6).

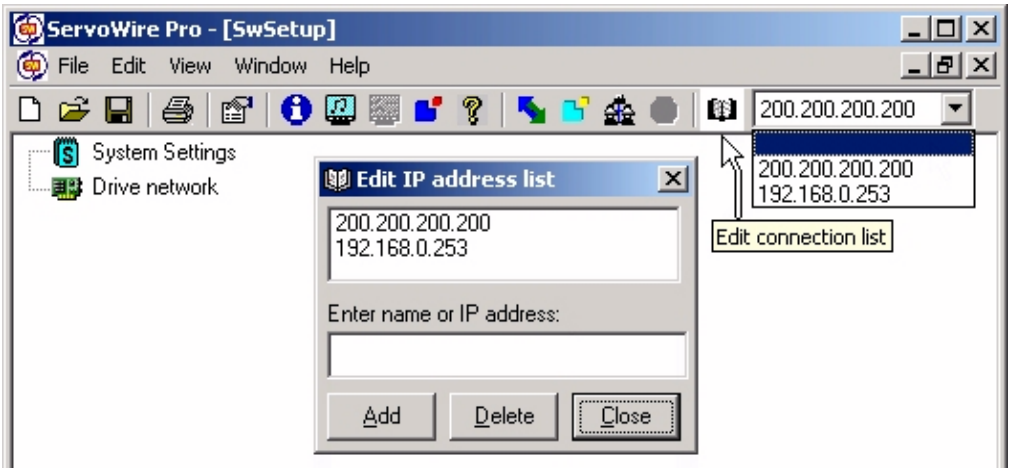


Figure 23, ServoWire Pro IP Address

Disconnecting serial communications from SMLC and your PC.

Chose the Close Project command, in the ServoWire Pro File menu, if you want to reconnect to a different SMLC, or make changes to your network connections. To change your network connections, see Network Setup HELP.

Troubleshooting Connection Problems

If you are having difficulty in establishing communications with SMLC, see the ServoWire Pro Communications Troubleshooter.

5.3 SMLC Ethernet Configuration

It is strongly recommended that the Ethernet port be used for development with the SMLC because it supports a much faster communication rate of 10/100 M baud.

Default SMLC Ethernet Port Addressing

Using the ORMEC factory default IP address
The SMLC will assign the **default IP Address of 192.168.0.253** to the LEFT card first.

1 Ethernet Port	If the SMLC has only one Ethernet Port (J5) then the default address of 192.168.0.253 will be on the System Card.
2 Ethernet Ports	If the SMLC has the optional Ethernet card installed, them the SMLC will assign the default IP address to the left Ethernet Port.

Assigning SMLC Ethernet Port Addressing in ServoWire Pro.

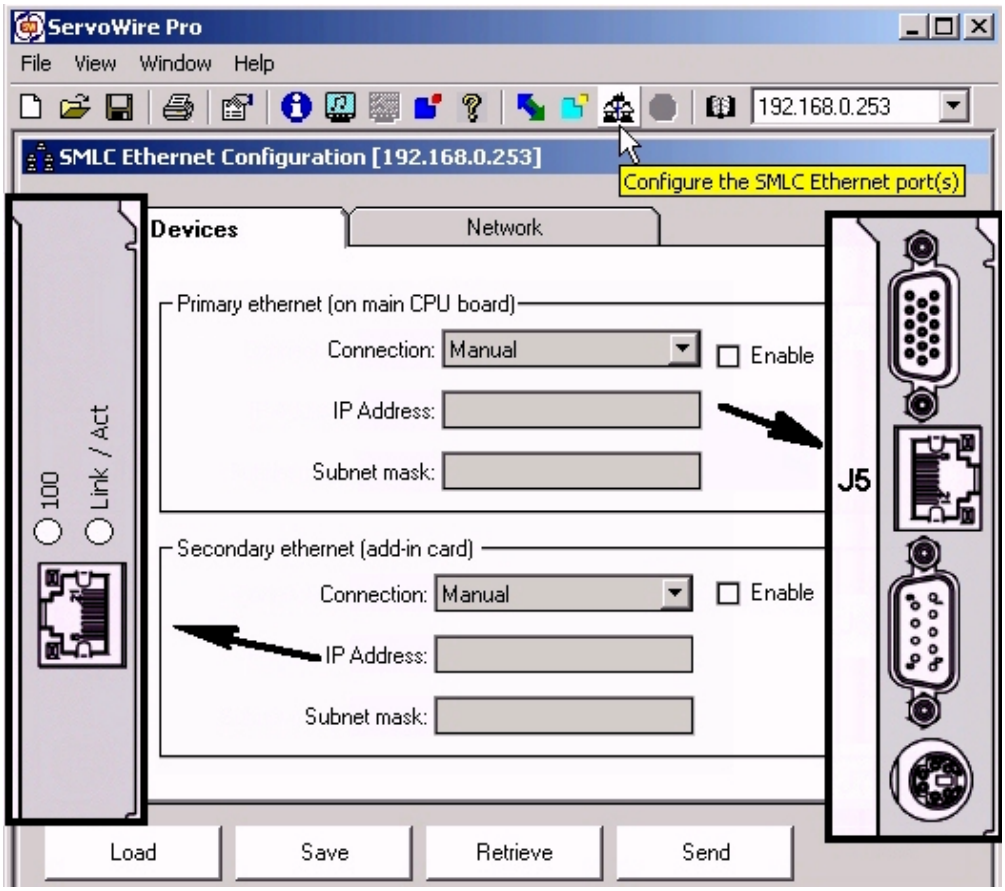


Figure 24, ServoWire Pro Ethernet Ports IP Address

If you are adding the SMLC to an existing network, consult your Network Administrator to obtain an IP address and subnet mask that is compatible with your existing network.

The SMLC Ethernet configuration is stored in the in file "*Filename**.SwSetup**"* Use ServoWire Pro to open the configuration file, and change the IP Address and subnet Mask to the values determined in Step 1 above. Edit the section with the label that matches your adapter model.

5.4 Setting up SMLC "OPTIONAL Ethernet Port" for Communications

There are no jumpers with an ORMEC Ethernet adapter. Plug in the Ethernet card in slot number 2. See ***Figure 4**, SMLC System Components layout* page #13.

5.5 ServoWire Pro Development Software

Once power has been applied to the system, you should run ServoWire Pro to communicate with the SMLC unit. Consult the ServoWire Pro manual as appropriate for installation, startup, and communications details.

Test Running Your SMLC System

Once communications is established between the development computer and the SMLC unit, press the SwMonitor Icon to execute the SETUP program installed in the unit at the factory. SwTune allows a user to exercise an SMLC controller.

The SwTune program is menu-driven and will allow you to:

1) Home, Index one motor at a time and observe the motors response.
2) Interactively adjust servo loop parameters after the motors are connected to their respective loads, if required.

After setting up your system, you may save the system's loop configuration by using ServoWire Pro. When the system is configured for your application, you should proceed to develop your IEC 61131-3 application software.

Test Running Your SMLC System

Once communications is established between the development computer and the SMLC controller, ServoWire Pro can be used to configure the SMLC hardware.
The ServoWire Pro provides the ability to:

- Select the type of ServoWire drives the SMLC controller will use.
- Configure the ServoWire drive analog and digital I/O.
- Select the appropriate motors and drives and configure the Servodrive I/O using the Axis Settings configurator.

After the SMLC hardware has been configured for your application, the ServoWire Pro SwTune utility can be used to index and tune the axes.

The ServoWire Pro SwTune utility is a Windows based program that allows you to:

- Index all the motors, one at a time
- Interactively adjust servo loop parameters after the motors are connected to their respective loads, if required
- View graphical display of the commanded and actual motor velocity, commanded motor torque, and the position following error.

When the system hardware is configured for your application and the axes are tuned, you should proceed to develop your application software.

Chapter 6
Product History

6 Product History

6.1 Determining Hardware Revision Numbers

The following is a description of the locations for the hardware revision numbers for the SMLC motion controller and its components:

6.2 SMLC Model ( )

Version 1.0a - December 5, 2003

1) SMLC System Module revision

Chapter 7
Maintenance & Troubleshooting

7 Maintenance & Troubleshooting

7.1 ORMEC Product Support

ORMEC Product Support relates to the functionality and proper operation of ORMEC supplied software and equipment

- Product Service is provided by the ORMEC Service Department.
  (585) 385-3520 Rochester New York, 14625.
- Assistance installing and upgrading ORMEC supplied development software (e.g. CoDeSys), and ServoWire Drive firmware, including necessary third-party supporting files (i.e. MicroSoft Windows Dial-Up Networking used for serial communcation).
- Assistance configuring ORMEC development software communications.
- Explanation/clarification of the functionality and proper operation of ORMEC supplied hardware and software, as provided in the various documentation available for those products (e.g. Windows Help, Installation & Operation Manuals, Tech and App Notes, etc.)
- Troubleshooting assistance for ORMEC supplied hardware and firmware to insure the proper operation of ORMEC supplied equipment. Assistance troubleshooting third-party equipment connected to ORMEC equipment is not included.
- Providing return authorization (RA) numbers and replacement units (if appropriate) for defective products.

Product Support
Phone and e-mail support, available from 8 AM to 5 PM EST. There is no charge for this service.

24-Hour Product Support
Phone support, available 24-hours a day, 7 days a week, 365 days per year.
There is an additional charge for this service.

7.2 Fan

SMLC is equipped with One 49-CFM cooling fan with air filter located on top. The fan and air filter should be checked periodically to insure proper operation.
With the SMLC **power OFF**, verify that the fan grill is clear of obstructions.
With the SMLC **power ON**, verify that the fan is spinning and drawing air out of the unit.

7.3 Batteries

Measuring Non-Volatile Battery Voltage

To measure the voltage of the Non-volatile memory battery:
Turn off power to the SMLC and remove the SMLC System Card from the controller. Remove the battery from the system card.

To measure battery voltage, place the positive lead of a voltmeter on the top (positive side as indicated by the "+" symbol) of the battery, and the negative lead of the voltmeter on the bottom side. Be sure that the voltmeter display range is accurate to at least 1 decimal place. Refer to the General Specifications section (page # 27) of the SMLC Controller chapter for battery voltage level information, Appendix C, page # 56 for the location of the Non-volatile memory battery.

NOTE: Removing the non-volatile memory battery results in the loss of all non-volatile variable values.

Replacing the Non-volatile Memory Battery (SMLC-BAT)

With the power off, remove the SMLC Motherboard from the chassis. Refer to Appendix C-1 for the location of the non-volatile memory battery. Remove the old battery from the socket and insert the new battery (SMLC-BAT).

Removal of the Non-volatile memory battery will result in the loss of all SMLC program Non-volatile variable values, and loss of the SMLC application program.

Be sure that the positive side of the battery (indicated by the "+" symbol) is facing up while inserting it into the socket

7.4 SMLC Troubleshooting

No LEDs Lit on SMLC

If no LED's are lit on the *SMLC* face:

1) Verify that there is AC power to the unit, and the power switch located on the bottom is ON. Verify that the AC voltage on the input power terminal block is the appropriate level (either 115 or 230 VAC). If there is power to the unit and the power switch is ON, but there are no LED's lit on the *SMLC,* remove the cover and verify that the back-plane power LED's (-12V, +12V, and +5V) are lit. Note the SMLC is not using +3Vdc so the LED is off. If any of the top-three back plane LED's are not lit, (-12V, +12V, and +5V) call the ORMEC Service Department.

SMLC Does Not Complete the Power Up Sequence

If the SMLC doesn't complete the power up sequence, gather the information listed below and call the ORMEC Service Department.

1) Look at the "Low Battery" LED. If illuminated (ON), replace both SRAM batteries, memory batteries. **DO NOT REMOVE THE BIOS BATTERY!**
   See: Appendix C for battery location.

2) SMLC model number, serial number.

3) SMLC version number, serial number, and all the numbers on any labels.

4) With the SMLC in the incomplete power up sequence, note the status of the LED's located on the front of the controller.
   Power, Run, Fault, Force, User, and Low Battery.

5) The SMLC version:
   If you are able to communicate with the SMLC after resetting the unit or cycling power, the SMLC version can be determined by using ServoWire Pro's SwMonitor.

Chapter 8
Terms & Mnemonics

8 Terms & Mnemonics

There are a number of terms or "buzzwords" which are often used in the Motion Control Industry, some of which have very specific meanings in ORMEC's products and systems. This section attempts to define many of these terms used in this document which may be unfamiliar.

Absolute Encoder **-** a sensing device that provides the position of the motor shaft relative to a fixed reference point at power up without having move the motor shaft to determine that point. In the case of a multiple revolution absolute rotary encoder, the current position may be multiple turns away from the reference point.

Axis - In motion control, this term normally refers to one of the servomotors in the system, either by name or *Axis-ID* (Identification number) from 1 to 16. It is also used to refer to any *Master (Pacer) Encoders* in the system. Many ORMEC pre-defined variables in the SMLC are defined for each axis in the system and are therefore indexed by Axis-ID name.

CoDeSys – **Co**ntroller **De**velopment **Sy**stem. The IEC-61131-3 runtime system developed by 3S Software used on the SMLC.

CoDeSys IDE – The CoDeSys Integrated Development Environment is the Win32 based application that allows you to develop, download and debug SMLC programs.

Controller Motherboard - The SMLC uses an IBM PC compatible motherboard.

Current Source - The ability for a device to switch and provide current for a circuit.

Current Sink - The ability to for a device to switch and accept the current in a circuit.

Electronic Gearing - A means of precisely coordinating the motion of a number of *servo axes* with a *pacer (master) axis.* The master axis can be an encoder or a servo axis.

Encoder - A digital position transducer used to determine the position of a motor, a rotating shaft on a machine or a linear position associated with a machine. It has two *quadrature* channels (A & B) which determine incremental movements and a single *encoder reference* channel (Z) which defines a unique position within its travel. Most, but not all, position encoders internally use optical gratings and sensors.

Encoder Zero Reference - A signal generated by the position *encoder* once per revolution, which may be used to determine the encoder's overall angular or linear orientation. Also sometimes called an *encoder marker pulse*.

Factory network adapters - A physical layer network interface which plugs into the Controller Motherboard and contains a co-processor for performing factory network communications (e.g. PROFIBUS requires a factory network adapter card).

Follower - A servo axis, which is controlling its motion as a function of MotionDATA, generated by a *pacer* axis. Follower motions are generated with the MC_GEAR statement in the SMLC.

Home Position - A reference position for either a servo or an encoder *axis*.

Hardware Travel Limits HTL's - Inputs to ServoWire drive which must be asserted (sinking current), or disabled by software setting, for a servo axis to operate.

IEC-61131-3 - A global standard defining programming languages for industrial control.

Loop Update - *Servo Loops* in the SMLC systems are updated by the *Motherboard* at rates of between 250 and 4,000 times per second. At each *Loop Update*, (Loop Rate) the SMLC performs housekeeping operations such as updating the axis position and the output signals in addition to performing the real-time control algorithm for that servomotor.

Machine Sensor - Any of a number of types of ON-OFF sensors, like proximity switches or mechanical switches mounted to a machine.

MODBUS – MODBUS® Protocol is a messaging structure developed by Modicon in 1979, used to establish master-slave/client-server communication between intelligent devices. It is a de facto standard, truly open and the most widely used network protocol in the industrial manufacturing environment.

MODBUS/TCP – Modbus/TCP is an implementation of the MODBUS Protocol, allowing MODBUS messages to be transferred via Ethernet.

MotionDATA - SMLC high speed motion position information used to coordinate motion among multiple *axes*.

OPC – OLE for Process Control. A set of open standards for connectivity and interoperability of industrial automation and enterprise systems.

Pacer - A *servo* or *encoder axis* which transmits either its actual or commanded motion to other servo axes through the MotionDATA communication channel to another servo axis.

Pacer Encoder - An incremental encoder or device that generates *quadrature* signals which are used by other servo axes when they operate as *followers*.

PC/AT Bus - Open standard 16-bit ISA bus used as the backplane of IBM-PC/AT compatible computers.

PC Card - Credit card size memory module conforming to the widely accepted PCMCIA open standard.

PC Card™ Memory Cards - a *PC Card™ Memory Card* is plugged into the PC Card™ slot on the SMLC System Module, it provides a removable non-volatile memory disk drive.

- ATA Flash Memory Cards provide read/write memory that is inherently non-volatile and are available in sizes from 2M to 40M bytes. They have limitations with respect to dynamic data storage.

- SRAM Memory Cards provide read/write memory with internal lithium battery backup. Read/write speeds comparable to RAM drives provide ideal dynamic data storage including random access files.

Quadrature - Quadrature or "phase quadrature" signals are the most commonly used method of

electronically determining or transmitting bi-directional position information. The two-quadrature signals are digital square waves, which have their cycles displaced 90 degrees (of the 360 electrical degrees in the repeated waveform). All four edges of the two digital signals are normally used for the maximum possible position resolution ("4x").

RTOS - Real-Time Operating System.

Registration Control - The act of maintaining a fixed position relationship between machine tooling and a product in the machine. Registration is normally measured by capturing the tooling position with respect to the product using a registration sensor of some type. It is controlled by phasing the tooling ahead or behind based on the difference between the actual and desired positional orientation.

Resolver - A position transducer used to determine the position of a motor. Resolvers are rotary transformer devices with analog interfaces. However, in ORMEC Motion Control systems which use resolvers, the servodrive decodes the resolver position digitally.

Servo (or Servomotor) - A motor which is controlled by comparing its measured position with its desired position.

Servodrive - A power unit necessary to control a servomotor.

Servo Loop - The act of controlling a servo by repeatedly observing its speed and position and adjusting its torque creates a "servo loop". With ServoWire Motion & Logic Controller Manual, these digital loops are "closed" at *loop update* rates of 250 to 4,000 times per second.

ServoWire Pro – ORMEC's Win32 based commissioning software for SoftMotion platforms including the SMLC. ServoWire Pro contains tools for configuring, monitoring, tuning and upgrading the firmware of SoftMotion based drives and products.

SMLC - ServoWire Motion & Logic Controller (SMLC) is ORMEC motion programming language which enhances industry IEC 61131-3 standard with additional built-in statements and pre-defined variables specifically intended for ServoWire Motion & Logic Control applications.

SoftMotion – Open, PC-based software for controlling servodrives that eliminates the need for motion control boards or standalone motion controllers.

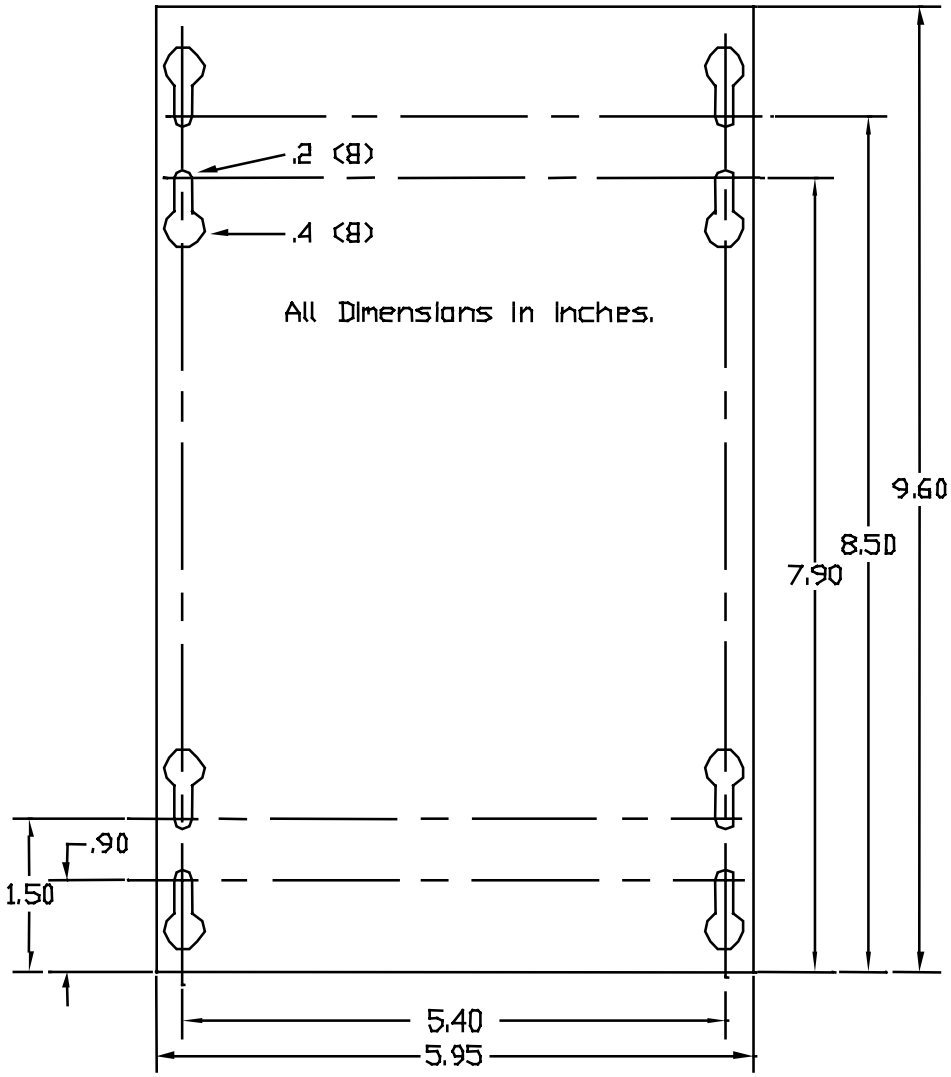
TCP/IP – Transmission Control Protocol over Internet protocol. The de facto standard Ethernet protocol.

Tension - the magnitude of force uniformly distributed through a material as a result an external force on that material which constrains movement.

Tension Control – using Tension feedback to control the velocity of a servomotor.

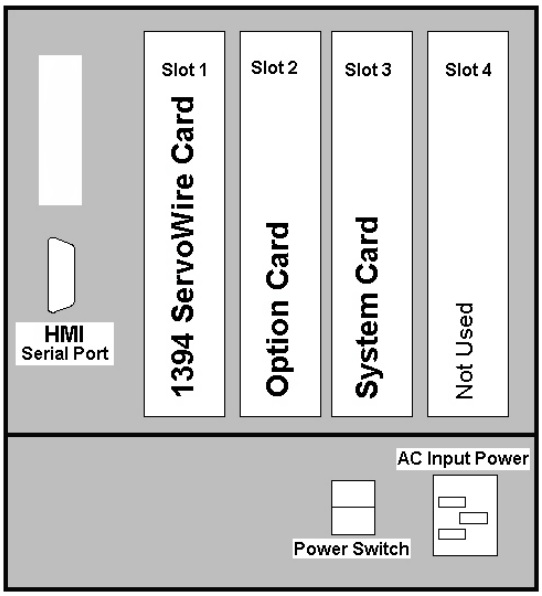
Appendix A - SMLC Installation Diagrams

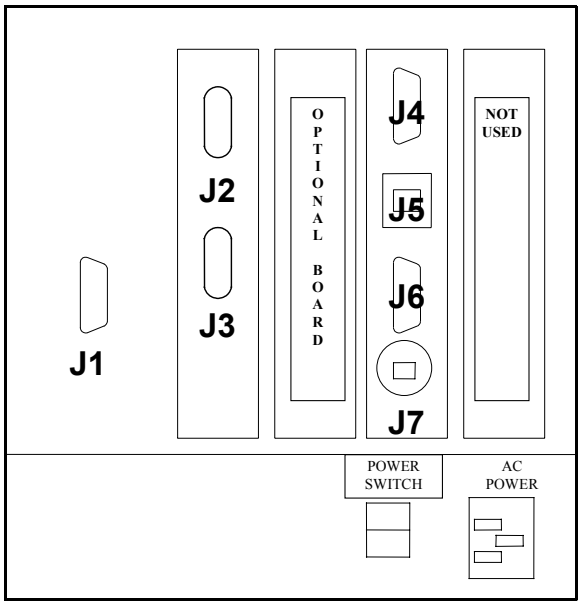
SMLC – Installation Dimensions



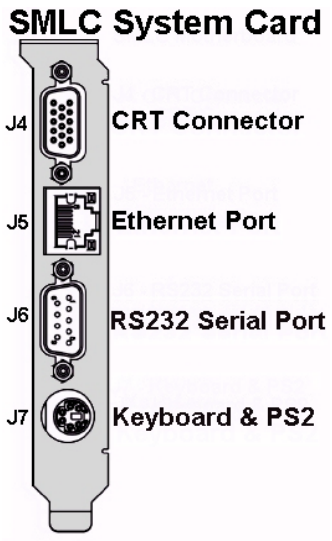
SMLC - Board Connector Location

Bottom View:



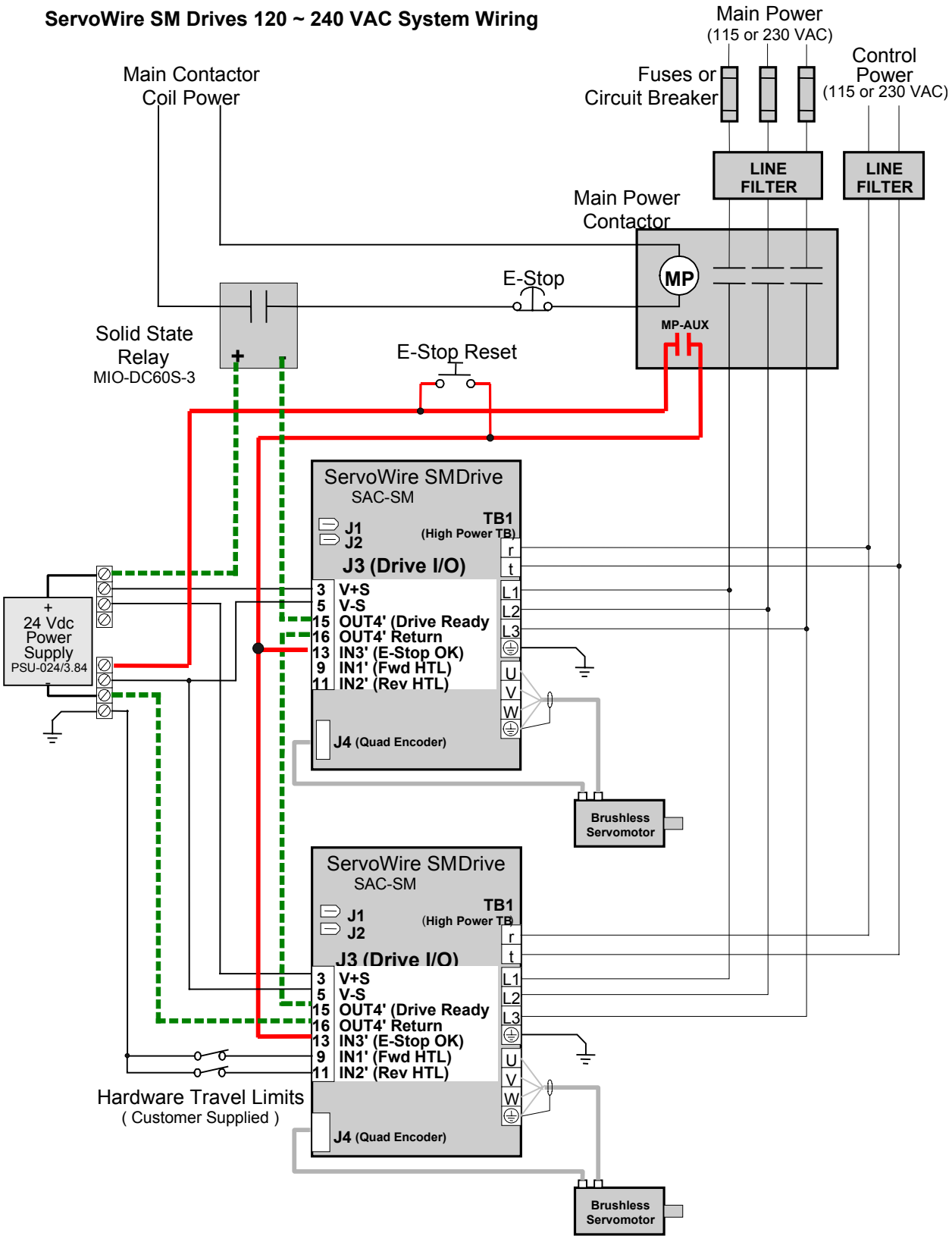


	J1	HMI Serial Port Connector
Slot 1	**J2**	ServoWire 1394 Connector 1
	J3	ServoWire 1394 Connector 2
Slot 2		Option Card
Slot 3	**J4**	CRT Connector
	J5	Ethernet Port Connector
	J6	Development Serial Port
	J7	Keyboard and PS/2 Connector
Slot 4		Not Used

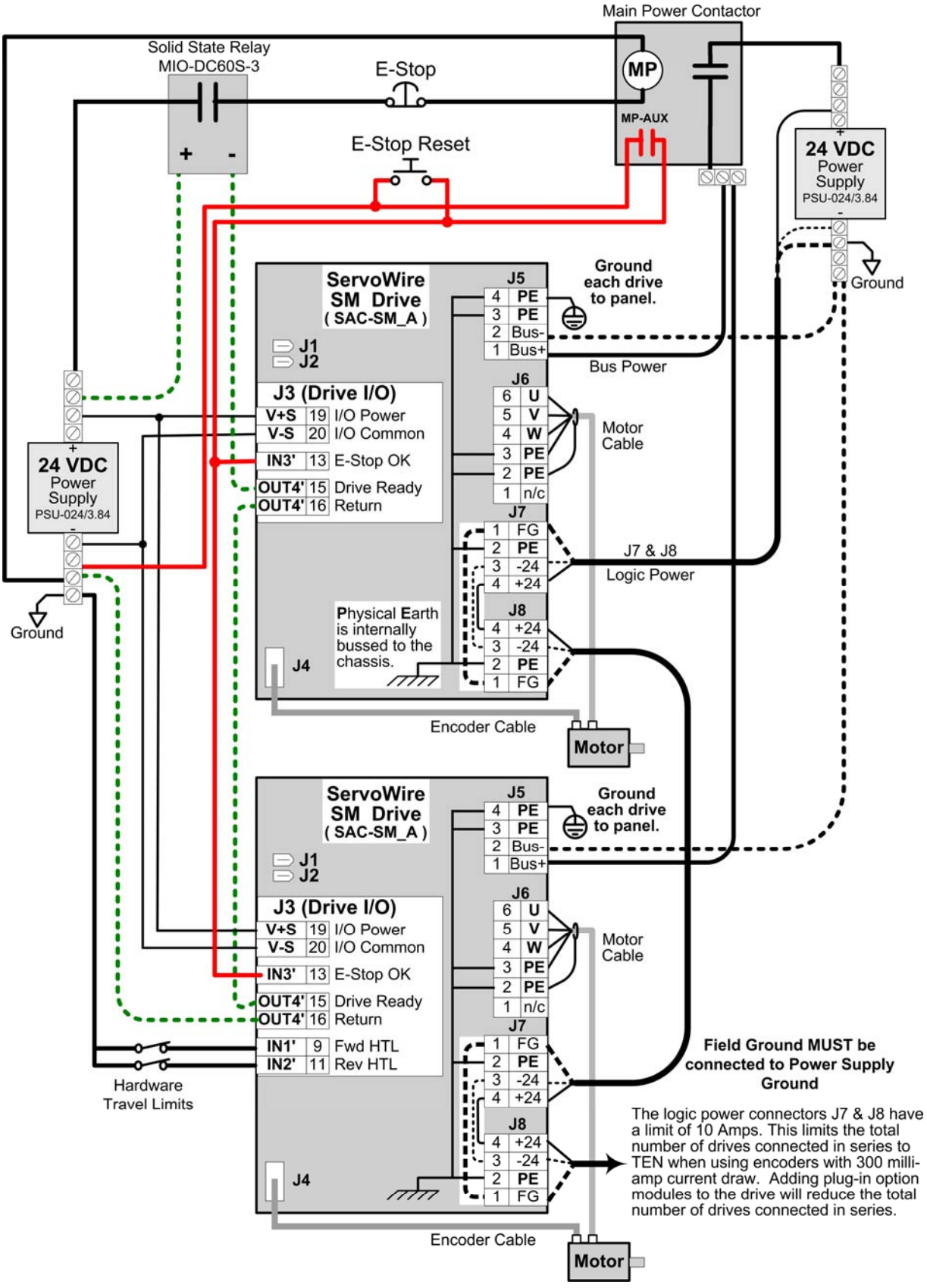


Appendix B – System Wiring Drawings

ServoWire SM Drives 120 ~ 240 VAC System Wiring



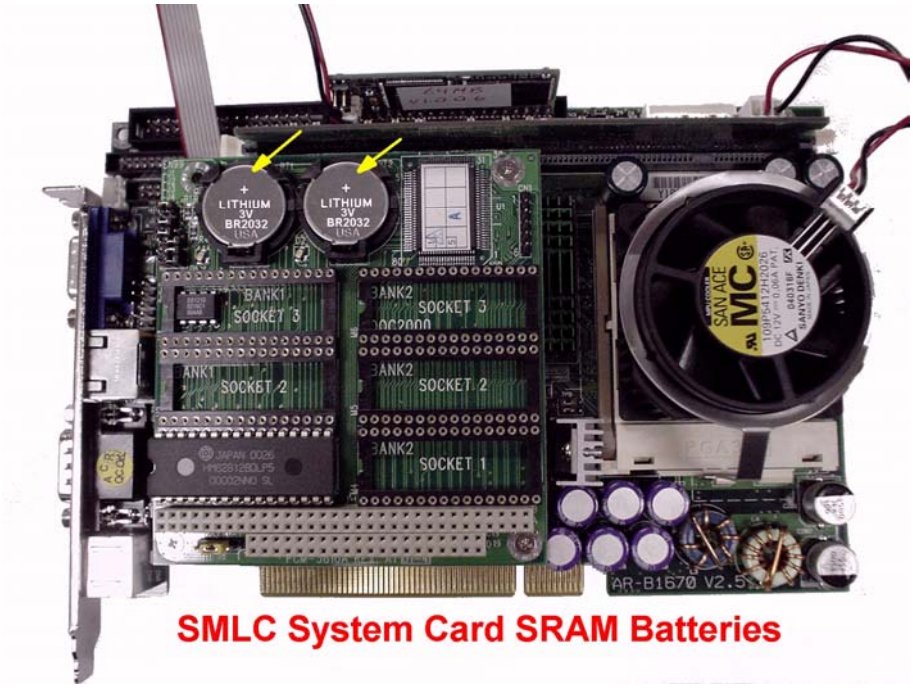
ServoWire SM Drive 12 ~ 96 VDC System Wiring



Appendix C – SMLC Batteries

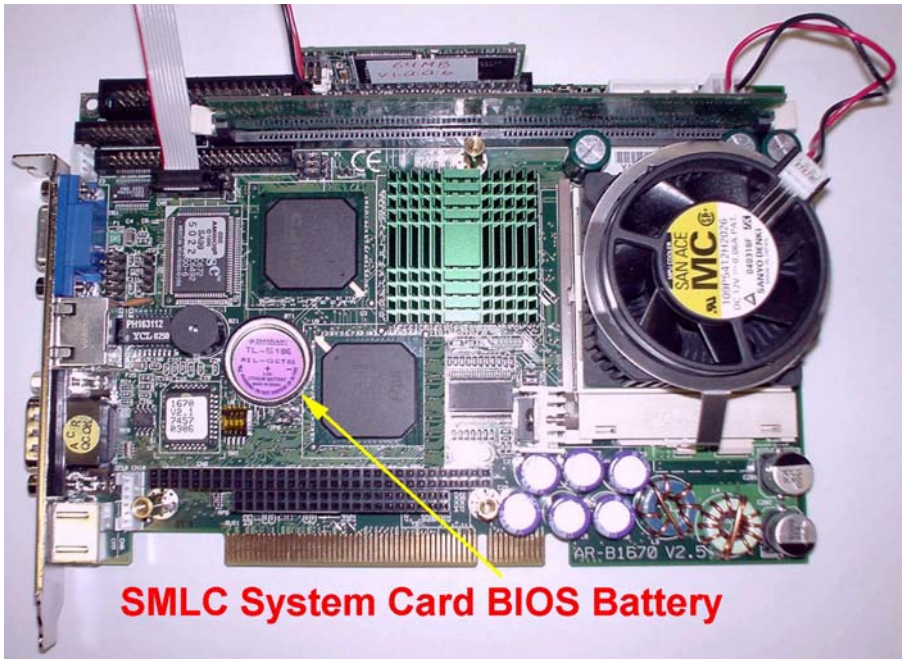
WARNING: Electronic devices like the SMLC System Card are very sensitive to static electric charges. Always ground yourself to remove any static charge before handling the System Card. As a safety precaution, use a grounding wrist strap at all times. Place the System Card on a static-dissipative surface or static shielded bag when it is not in the SMLC chassis.

System Card SRAM Batteries - Lithium BR2032



Note: SRAM board must be removed to access the System Card BIOS battery.

DO NOT REMOVE THE BIOS BATTERY!



Appendix D - SMLC System Card Jumpers and Component Locations

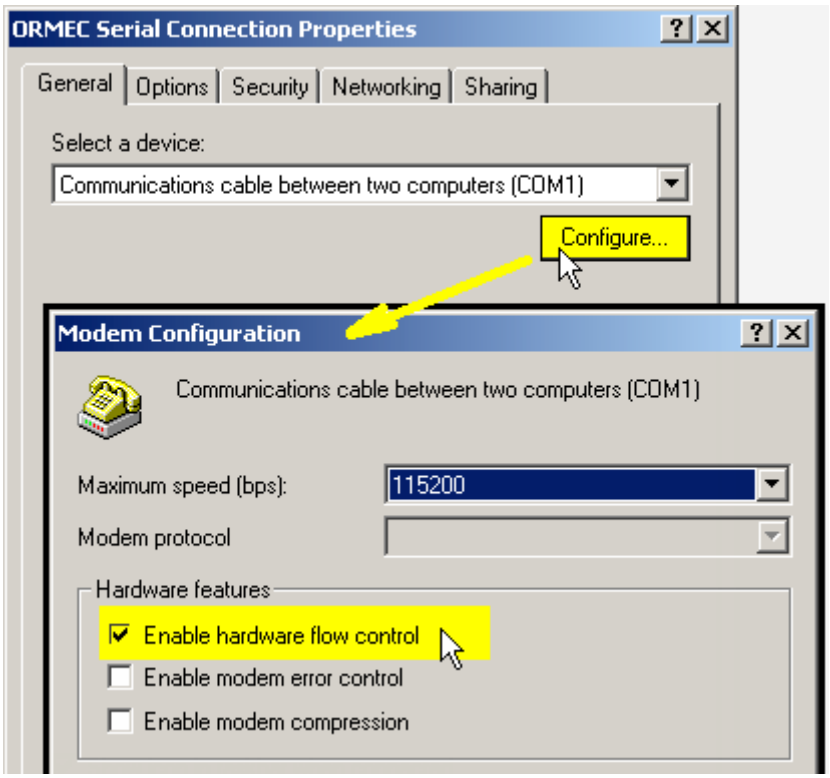
Appendix E – SMLC Interface Cables & Accessories

Serial Communications Null Modem Cable to IBM-PC

This cable is used with the SMLC RS-232 serial connector and Windows Dial-up connections.

SMLC - J6		DB9 MALE	IBM-PC	
Data Carrier Detect	(DCD)			
Receive Data	(RD)	2 - 3	(TD)	Transmit Data
Transmit Data	(TD)	3 - 2	(RD)	Receive Data
Data Terminal Ready	(DTR)	4 - 6	(DSR)	Data Send Ready
Signal Ground	(SG)	5 - 5	(SG)	Signal Ground
Data Send Ready	(DSR)	6 - 4	(DTR)	Data Terminal Ready
Request To Send	(RTS)	7 - 8	(CTS)	Clear To Send
Clear To Send	(CTS)	8 - 7	(RTS)	Request To Send

The above pin-out will provide the best possible signaling between a SMLC and a PC allowing you to use hardware flow control (RTS/CTS). This type of cable requires that you enable hardware flow control.



Note: Not all Null modem cables are alike. Some Null Modem Cables will bypass hardware flow control. This type of cable adds a short between pin 1 and 6 on the same connector to fool the communication program to thinking that they are online.

Appendix F – ServoWire Drive Fault Codes

LED Hex	Code Decimal	ServoWire Drive "A" Fault Codes
A0	**160**	**The maximum continuous current output of the drive has been exceeded.** Drive Over Current (RMS). The Drive shutdown with a overload fault. **Under load or during acceleration:** • The most common cause for this fault is mechanical binding. Check the machine for excessive friction. -OR- • If this fault shows up when the machine is run at higher speeds, then the Drive and/or motor may be undersized for the application. **When enabling axis with Servomotor connected:** • Incorrect servomotor wiring. Check for proper wiring. On the drive power Terminal Block, the Ormec standard motor cable colors used are: U = Red, V = White, W = Black, Ground = Green and Silver. -OR- • Defective Servomotor - Replace Servomotor. **After applying control power with Servomotor disconnected:** • Defective Servodrive - Replace Servodrive.
A1	**161**	**The drive's peak current rating has been exceeded.** Drive Over Current (Peak) **Under load or during acceleration:** • The most common cause for this fault is mechanical binding. Check the machine for excessive friction. -OR- • If this fault shows up when the machine is run at higher speeds, then the Drive and/or motor may be undersized for the application. **When enabling the axis:** • The application program has not yet configured the drive. Configure the drives before changing to a torque-producing mode.
A2	**161**	**The drive power module detected over current, overtemp or under voltage.** • The Power Module's self-protection has detected a short circuit, over current, over temperature, control supply under voltage. -OR- • An SCR soft-start circuit error has been detected on the SAC-SM or SAC-SW 225, 235 & 260 drives only. Note: This fault is detected after the drive has been enabled.
A3	**163**	**The bus voltage dropped below the software configured Minimum Bus Voltage.** The bus voltage dropped below the drive configuration setting. Bus Power LED is OFF. **When the drive is being or has been enabled:** • Main fuses blown or circuit breaker tripped. Correct main input power problem, and replace fuses or reset circuit breaker. • Input voltage does not match ServoWire Pro software setting. Decrease software setting or increase applied AC input voltage. • Defective Servodrive - Replace Servodrive.

LED Hex	Code Decimal	ServoWire Drive "A" Fault Codes
A4	**164**	**The bus voltage exceeded the software configured Maximum Bus Voltage.** The bus voltage exceeded the drive configuration setting. The bus voltage is above the high voltage limit, which is calculated based on the lessor of the motor rated voltage and the drive maximum voltage. **When power is applied to the main circuit:** • Applied voltage exceeds the Servomotor's rating - Reduce applied voltage. • ServoWire Pro software settings for ServoWire Drive Input Voltage are lower than desired applied voltage – Increase setting in ServoWire Pro software. • Defective Servodrive – Replace Servodrive **When motor is in regeneration, or when drives share bus power.** Regeneration may exist during deceleration, or during downward motion in a non-counterbalanced vertical application, or in a tensioned unwind application. • A regenerative discharge resistor is required by the application but is not present- Install regenerative resistor, reduce inertial load, or reduce max speed and/or acceleration. • The regenerative resistor installed has been damaged and is no longer fully functional - Install higher-wattage regenerative resistor, and reduce inertial load, or reduce max speed and/or acceleration.
A5	**165**	**The drive type does not match the software configuration settings.** SMLC has detected that the drive hardware does not match ServoWire Pro project settings. **Either:** • Auxiliary feedback encoder is created in user program but drive does not have pacer (/P) hardware option. -OR- • Axis is configured for drive type SAC-SW_ but actual drive type is SAC-SM_. -OR- • Axis is configured for drive type SAC-SM_ but actual drive type is SAC-SW_. SMLC may also indicate this by the exception # 1031, Error Message = Configured Drive type doesn't match actual drive hardware.
A6	**166**	**Unable to enable torque before the drive setup parameters have been configured.** • An attempt was made to enable torque before the drive's setup parameters have been configured. The drive setup parameters must be configured each time the drive's control power cycles on, before the drive can be enabled.
A7	**167**	**Drive configuration is illegal while a motor is enabled.** • An attempt was made to write parameters for the 'Number of Poles ' or 'Resolution' to the drive while the drive was enabled. The drive must be disabled before changing these parameters. It is illegal to perform certain operations while a motor on the drive is enabled, such as changing the configuration of the drive.

LED Hex	Code Decimal	ServoWire Drive "A" Fault Codes
A8	**168**	**An Invalid commutation position was detected.** A drive configured for a motor with an absolute encoder was commanded to enable when the absolute encoder was discharged, or while the commutation position was invalid, or the Absolute battery power output was toggled on a Drive configured for an incremental encoder. The commutation position is invalid on a drive configured for an absolute encoder motor when: ❑ The Drive is powered up, prior to drive configuration. ❑ An open encoder line is detected. ❑ During trapezoidal commutation. ❑ "Number Of Poles" is written. ❑ "Resolution" is written. The commutation position becomes valid when the absolute encoder's position is read.
A9	**169**	**The drive detected a phase loss.** • The drive detected the loss of a main power phase.
AA	**170**	**The drive Soft Start SCR did not turn on.** The drive inrush current is greater than 0.5 amps or there is a low bus voltage (<50 VDC). Note: This is only checked when enabling the drive. The hardware switch from soft start mode to full power mode doesn't take place until after startup is complete, as evidenced by low inrush current and sufficient bus voltage. This error may be caused by: • Enabling too soon after applying AC bus power. – Wait longer between disabling and reapplying AC bus power. • Low AC bus power input voltage so that BUS+ never reaches 50 VDC –Correct the AC bus power input voltage • The load on BUS+ and BUS- is drawing current as soon as AC bus power is applied. - Remove the load from BUS+ and BUS- (there should not be a load on BUS+ and BUS-, regen resistors are connected to BUS- and RG.
AB	**171**	Unused
AC	**172**	**Drive Overtemp or Drive Inrush Resister Current failure.** • An overtemperature condition was detected in the drive powerblock, or a failure of the inrush current resistor. This fault is detected when the drive is being enabled.
AD	**173**	**The drive detected an E-Stop indication.** • A drive emergency stop was detected. This requires that the drive be configured to use one of the general purpose inputs as an E-Stop input. See: Emergency Stop / Quick Stop Inputs.
AE	**174**	Host PC driver software upgrade is required.
AF	**175**	Unused

LED Hex	Code Decimal	ServoWire Drive "b" Fault Codes
b0	**176**	**The checksum on the downloaded code was incorrect. Try again.** • The checksum calculation performed on the downloaded code was incorrect. The download has been aborted. Try again.
b1	**177**	**The download code was not recognized. The wrong file was used.** • The ServoWire drive does not recognize the download file format. Usually caused by wrong file being sent to the drive. The drive firmware may be too old to recognize this format.
b2	**178**	**Downloaded code not compatible with this drive.** • The downloaded code is not designed for this drive hardware, but rather for a different drive hardware. Obtain the correct file and try again.
b3	**179**	Internal firmware program checksum error, reload drive firmware.
b4-bF	**180-191**	Unused

LED Hex	Code Decimal	Description - ServoWire Drive "C" Fault Codes
C0	**192**	**The position following error for an axis exceeded its PosErrFault limit.** **LAG_FAULT (Position Error) Generation** The most common cause for this fault is mechanical binding. Check the machine for excessive friction. LAG_FAULT is the axis configuration property that defines the allowable magnitude of following error that will be tolerated and the axis will continue to operate in a non-faulted state. If this following error setpoint is exceed, an axis fault will occur, and the fault function OP_FAULT will be called. OnFault is invoked when an axis detects a fault condition. The drive will fault out and the drive status display will show a hexadecimal " C 0 " code = Lag Fault . OP_FAULT returns the fault code in progress on an axis, and in this case a decimal "192" is returned.  ServoWire Pro, "Axis Properties / Settings" Setup screen, allows the user to define the magnitude of LAG (position error) in counts that will be tolerated before a fault is generated.
Blank	**192**	**The position following error for an axis exceeded its PosErrAlarm limit.** **LAG_ALARM (Position Error) Notification** LAG_ALARM is the configuration property that defines the allowable magnitude of following error for the axis to be considered "in position". If this following error setpoint is exceeded, an axis alarm will occur, and the alarm function OP_ALARM will be called. OP_ALARM is invoked when an axis detects an alarm condition. OP_ALARM returns the current alarm code for an axis. The axis will NOT go into a Fault state for exceeding this position error threshold. The drive will NOT display any codes.  ServoWire Pro, "Axis Properties / Settings" Setup screen, allows the user to define the magnitude of LAG (position error) in counts that will be tolerated before an alarm is generated.

LED Hex	Code Decimal	ServoWire Drive "C" Fault Codes
C1	193	**The commanded speed exceeded the software configured speed limit.** The commanded speed exceeded the application - specified limit for Speed Maximum.
C2	194	**The actual (feedback) speed exceeded the software configured speed limit.** The actual (feedback) speed exceeded the application-specified limit for Speed Maximum.
C3	195	**Motion was commanded further into a travel limit, while still active.** Motion was commanded further into a travel limit while that travel limit was asserted.
C4	196	**Unused**
C5	197	**The software configured Loop Rate was too high to finish the control loop.** The specified LoopRate was too high to finish control loop processing.
C6	198	**Missing MotionData.**
C7	199	**Motion Segment Overflow.**
C8	200	**Missing Motion Table.**
C9	201	**Unexpected Off-line, no isochronous feedback.** SMLC has a built in tolerance for the maximum number of (3) consecutive ServoWire isochronous communication feedback packets that can be missed per axis before faulting out that axis. When this limit is reached then the drive fault "C9" is generated for that axis. There is a variety of reasons that can cause a missed 1394 isochronous data packet, but the most common problem is electrical static discharge (noise). It is strongly recommended that the application developer read the Ormec application paper on "Shielding and Ground Electrical Panels" that is available on the web site www.Ormec.com
CA	202	**1394 Network driver failure.** No longer getting an once-per-looprate update information from the Ormec 1394 Bus Driver (Orm1394Bus).
CB	203	**Pacer Backup Compensation Overflow.** See: Pacer Backup Compensation.

LED Hex	Code Decimal	ServoWire Drive "C" Fault Codes
CC	**204**	**Invalid MotionData Configuration - MotionData configured in a Loop.** SMLC provides the ability to electronically GEAR multiple servomotors together, or GEAR multiple servomotors to a common source of position information such as an axis encoder mounted to a machine. This is accomplished with MotionData communications link, which transmits real-time motion information between axes at each position loop update. The MotionData Network is a daisy-chained, one-way, error-correcting communications link, commonalty starting with the lowest numbered axis in the system and proceeding to the highest. This is an application program error. Call your application programmer. • An axis is attempting to use itself as the pacer (gearing off itself). -OR- • MotionData is configured in a continues closed loop.
CD	**205**	Unused
CE	**206**	Unused
CF	**207**	Unused

LED Hex	Code Decimal	ServoWire Drive "E" Fault Codes
E0	**224**	**Incompatible ServoWire Protocol.** • The ServoWire communications protocol in the drive is not compatible with the one in SMLC. Either the drive's firmware should be changed to a version that is compatible with ServoWire SM RTX, or ServoWire SM RTX must be changed to a version that is compatible with the ServoWire SMM Drive.
E1	**225**	**The host PC unexpectedly stopped providing isochronous commands to the drive.** • This normally occurs when the servodrive has control power, but the SMLC loses power, or the IEEE 1394 Network interface hardware fails. In either case, once the cause has been corrected, the fault can be cleared by the application program (or by cycling power on the servodrive). There is a variety of reasons that can cause a missed 1394 isochronous data packet, but the most common problem is electrical static discharge (noise). **It is recommended that the application developer read the ORMEC application paper on "Shielding and Ground Electrical Panels" that is available on the web site** www.Ormec.com
E2	**226**	**Isochronous Arbitration Failure.** • One possible cause is the Loop Rate is set too high to allow all the drives on the 1394 network to send there isochronous data packets. Lower the LoopRate.

LED Hex	Code Decimal	Description - ServoWire Drive "E" Fault Codes
E3	**227**	**Isochronous data not changing. (Watchdog timeout).** • The ServoWire Isochronous communications watchdog bit has not changed state within the allotted time. The ServoWire drive shut itself down because it lost communication with the SMLC. One possible cause is the application program crashed causing the communication drivers to locked up. Check that the SMLC application program is running correctly. There is a variety of reasons that can cause a watchdog timeout, but the most common problem is electrical static discharge (noise). **It is recommended that the application developer read the ORMEC application paper on "Shielding and Ground Electrical Panels" that is available on the web site www.Ormec.com.**
E4	**228**	**ServoWire Initialization Error.** A hardware error was detected when initializing the IEEE 1394 communications controller circuitry.
E5	**229**	**Host PC Power Loss or unexpected failure.** • The drive internal watchdog has timed out due to either the loss of ServoWire network power (usually due to loss of PC power) or an unexpected failure.
E6	**230**	**No ServoWire 1394 Network power.** • The drive is powered up and is not detecting ServoWire 1394 network power. Power for the ServoWire interface is supplied by the SMLC (8 – 40 Vdc). Possible causes include: • The ServoWire cable is not connected to the drive and/or the SMLC. Be sure to verify that all the cables in the drive 1394 network are properly connected. The SMLC is turned off and/or not supplying power to the ServoWire 1394 network.
E7	**231**	Unused
E8	**232**	**Duplicate Drive Identification number.** • The SMLC has detected more than one drive with same Axis identification (ID) number on the network. The drive ID number is changed by pressing the push-button located on the top of the drive. The drive ID number can be changed after each power-up, SMM Drives - before torque has been enabled. SWM Drives - before the drive is configured. (Three red LED's are flashing The push-button is then disabled.
E9-EF	**233-239**	Unused

LED Hex	Code Decimal	ServoWire Drive "F" Fault Codes
F0	**240**	**The motor's rating for continuous current has been exceeded.** • The motor's rating for continuous current has been exceeded by the actual RMS current for longer than allowed by the thermal time constant of the motor.
F1	**241**	**Primary Axis - Feedback device, open wire failure.** • At least one encoder or resolver feedback channel for the motor is not connected properly. Check the motor feedback cable for damage. -OR- **Resolver Feedback Only:** The optional plug-in module SAC-SM-RES, used with a SAC-SM drive is required to support a resolver motor. • Resolver open wire debounce detected. During hard accelerations the Resolver to Digital converter may issue a false error. ServoWire Pro, "Feedback Option Board / Open wire debounce time" Setup screen, allows the user to define the amount of debounce time. Increasing the debounce time can eliminate that extraneous error. **Absolute Encoder Feedback Only**: The optional /A, used with a SAC-SW ### /A drive is required to support an absolute motor. • The Absolute Encoder needs to be reset. See: Absolute Encoder Reset.
F2	**242**	**Auxiliary Axis - Feedback device, open wire failure.** • At least one encoder or resolver feedback channel for an auxiliary (pacer) axis feedback is not connected properly. Check the motor feedback cable for damage. Note: Fault F2 = Auxiliary feedback Open Wire will not cause the primary axis to lose torque.
F3	**243**	**The hall track feedback from the motor is improperly wired.** The hall track encoder feedback from the motor is improperly wired. An unexpected combination of Hall inputs has occurred. Differential or single-ended input, commutation feedback channels U, V and W from the motor encoder feedback connector. The U, V and W (pins 7, 9 & 11) inputs are intended for use with single ended commutation feedback. If the feedback signals are open collector outputs, external biasing hardware may be required. The U', V' and W' (pins 8, 10 & 12) inputs are internally biased and no connection or external circuitry is required for use with single ended feedback. Invalid states detected: U,V,W all ON at the same time. U,V,W all OFF at the same time. U',V',W' all ON at the same time. U',V',W' all OFF at the same time. **When enabling axis:** • Bad feedback cable - Check pins above. • Wrong axis feedback type selected in ServoWire Pro Setup software settings – Correct software.

LED Hex	Code Decimal	Description - ServoWire Drive "F" Fault Codes
F4	**244**	**The motor over temperature sensor is open, indicating an overtemp condition.** The thermal contact has opened (pins 19 & 20) indicating that the motor is over temperature. This condition can not be reset until the motor has sufficiently cooled. **When the motor is hot:** • Motor is overloaded - Reduce motor load • Excessive ambient temperature - Reduce ambient temperature to 25oC **When the motor is cool to the touch:** • Faulty motor feedback wiring - Check cable and all termination points. • Defective thermal switch in motor - Disconnect motor and test for continuity at motor pins. • Motor has no thermal switch, and ServoWire Setup software settings are configured to expect a closed contact. - Disable Thermal Contact in ServoWire Setup Axis Configuration. • Defective Servodrive - Replace Servodrive.
F5	**245**	**The drive firmware does not recognize an installed feedback option board.** The SAC-SMM drive has detected an installed option module, but does not recognize and/or support that module type. • Not supported by the drive firmware - Verify that the drive firmware revision supports the option module, and update as needed. • Improper option module installation - Reinstall the option module and verify it is properly connected to the drive. • Defective option module - Replace the option module.
F6	**246**	**The motor overtemp software configuration does not match the actual wiring.** • The motor configuration indicates that there is no over temperature sensor, but an over temperature sensor was detected by the drive. •
F7	**247**	**Serial Encoder Alarm.** When using an Yaskawa Sigma 2 An alarm bit has been returned by the Sigma 2 encoder. • Check connections & feedback cable for good electrical connection. • Try cycling the ServoWire Drive control power. • Defective encoder feedback - Replace Servomotor.
F8	**248**	**Unsupported Serial Encoder detected.** • Unsupported encoder feedback type detected - Replace servomotor to a supported type. • Not supported by the drive firmware - Verify that the drive firmware revision supports the Serial Encoder, and update as needed.
F9-FF	**247-255**	Unused

LED Hex	Code Decimal	ServoWire Drive Internal Fault Codes
Internal Errors		Internal errors may require cycling the servodrive control power to clear the fault. If the problem recurs or does not clear, contact ORMEC Application Support at (585) 385-3520 or via e-mail at support@ORMEC.com. Please have your Support ID available when you call or reference it in your e-mail message. Drive faults 70 - 9F may require cycling the drive control power to clear the fault. The application program can clear all other faults (after the cause of the fault has been cleared).
70	**112**	Axis Off-line. • This can be caused by shutting off the Servodrive Control power. Check that the servodrive has control power.
71	**113**	Reference Generation Conflict (Internal error)
90	**144**	This failure is normal during ServoWire cable pulls.