SMLC Model 30, 80, 160 & 240

Hardware Rev2 Installation & Operation Manual

SMLC-004a

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Welcome

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.

What's new in SMLC hardware revision 2?

- SMLC hardware rev2 supports locking ServoWire cables.
- The expansion bus is now PCI-104
- Some of the connectors and terminal blocks have been moved and/or renamed.

IMPORTANT: If you have SMLC hardware rev1 please refer to manual SMLC-002 – SMLC-30, 80 & 160 Installation & Operation Manual.

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 **SMLC System Components provides** an overview of all of the connectors and terminal blocks on an SMLC, including the pin-outs.

Chapter 5 **System Power Wiring & Interlocks** explains how to make power and interlock connections between the SMLC and the ServoWire drives. Also see Appendix B.

Chapter 6 **System Operation** explains the power-up sequence of the SMLC including LED operation. This section also includes the specifications for the SMLC, including all of the local I/O and communication ports.

Chapter7 **WAGO I/O Installation & Operation** provides instructions for installing the WAGO and detailed descriptions of all the hardware interfaces, as well as an explanation of the LED status indicators.

Chapter 8 **Getting Started** provides detailed instructions on how to communicate and run your SMLC unit for the first time

Chapter 9 **Product History** provides a chronological revision history for the ServoWire Motion & Logic Controller hardware

Chapter 10 **Maintenance & Troubleshooting** provides tips for maintaining and troubleshooting your SMLC system

Chapter 11 **Terms & Mnemonics** provides definitions for term's specific to Motion Control and/or ORMEC's Motion Control products

Appendices **Appendices** 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**. Detailed information on commissioning ServoWire drives to an SMLC can be found in the on-line **ServoWire Pro Help**. Detailed information on servo drive interfacing can be found in the ServoWire drive manuals.

To obtain the latest version of any of the ORMEC documentation visit ORMEC's site on the World Wide Web at ***http://www.ormec.com.***

Note: the functionality of certain portions of the SMLC hardware is dependent on the firmware and SMLC hardware version used.

Chapter 2
General Description

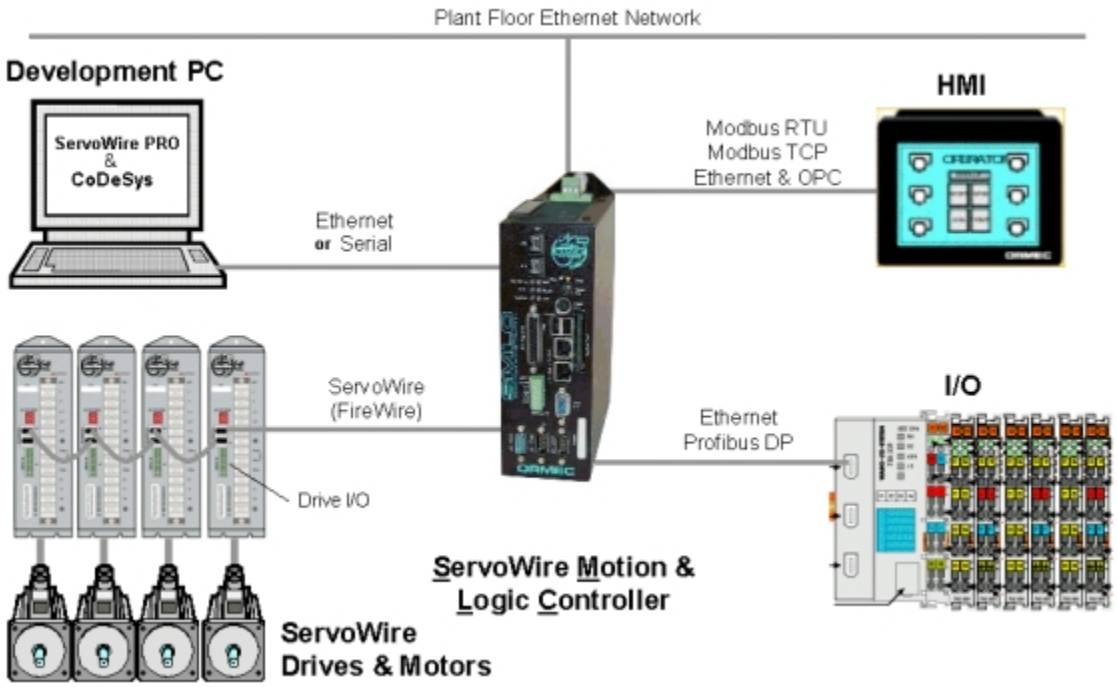


Figure 1, SMLC System

SMLC General System Description

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, user applications – run outside the kernel as separate, memory-protected processes. Fault resilience is built right in. See: www.QNX.com

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 SERVO DRIVES:
Connection of up to 24 ServoWire Drives with up to a 2.67 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, ETHERNET (MODBUS/TCP & PROFIBUS):
Compact, highly reliable and cost effective, with a wide variety of Input / Output modules. See section 0

SMLC Models

This manual covers SMLC Models 30, 80, 160 and 240.

Model	Motor Axes	Pacer Axes[1]	Virtual Axes[2]	Ethernet Ports	RS-232 Ports	Local DIO	Local AIO	Expansion Slots
SMLC-30	3	3	Up to 3	2	3	8 in/8 out	1 in/1 out	1 PCI-104
SMLC-80	8	8	Up to 8	2	3	8 in/8 out	1 in/1 out	1 PCI-104
SMLC-160	16	16	Up to 16	2	3	8 in/8 out	1 in/1 out	2 PCI-104
SMLC-240	24	24	Up to 24	2	3	8 in/8 out	1 in/1 out	2 PCI-104

Table 1, SMLC Models

[1]Pacer axes require additional drive hardware; either a pacer option or a secondary feedback adapter on the drive. Assuming that each drive has the required pacer interface you can have one pacer for each drive in the system.

[2]Beginning with SMLC firmware version 2.6.0 (which is required for rev2 hardware), the first virtual axis is “free” and does not apply to the maximum motor axis count for that SMLC model. E.g. an SMLC-30 can have 3 real motor axes + 1 virtual axis; an SMLC-80 can have 8 real motor axes + 1 virtual axis, etc. Any virtual axes after the first one DO apply to the maximum motor axis count.

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 Ports – 10/100baseT (/1000baseT on Models 80, 160 & 240).
- FireWire (IEEE 1394b) network interface.
- serial ports (4 on Models 160 & 240)
- Development, HMI, Keyboard connectors.

- Optional PCI-104 expansion
- Built-in digital and analog I/O

SMLC memory includes:

- 128 Mb Dynamic RAM - Random Access Memory (volatile)
- 128Mb Removable Compact Flash memory for application program and data storage.
- 32 Kb Battery backed static RAM used for non-volatile data storage.

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 SMLC online help file included with ORMEC's CDS-SDK, CoDeSys Software Development Kit. The latest version of the CDS-SDK as well as a demo version is available for download on ORMEC's web site at www.ormec.com.

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 and FESTO CPX 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, CD-ROM, incl. CoDeSys, ServoWire Pro, online documentation, WAGO BootP server, serial communication cable

Table 2, Development Software Part Number

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 SMM drives to latest firmware
- 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.

Chapter 3
SMLC Installation

ServoWire Motion & Logic Controller 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. A qualified person should write this program. 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: Save the original SMLC packaging material for shipping returned units.

Included with your SMLC is a CD package, which contains 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 (3) provided on the base plate.

ServoWire Cabling

1394 has a restriction that there can be no more than 16 “hops” between any two nodes on the network. On SMLC models 30, 80 & 160 the ServoWire cables can be connected in any configuration without violating this rule. On an SMLC-240 it is possible to violate this rule. Therefore, each 1394 port on the SMLC-240 should connect to no more than 8 ServoWire drives. The suggested topology is as shown below:

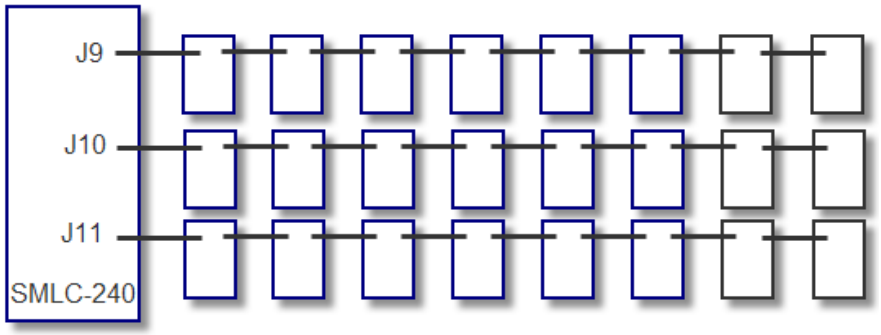
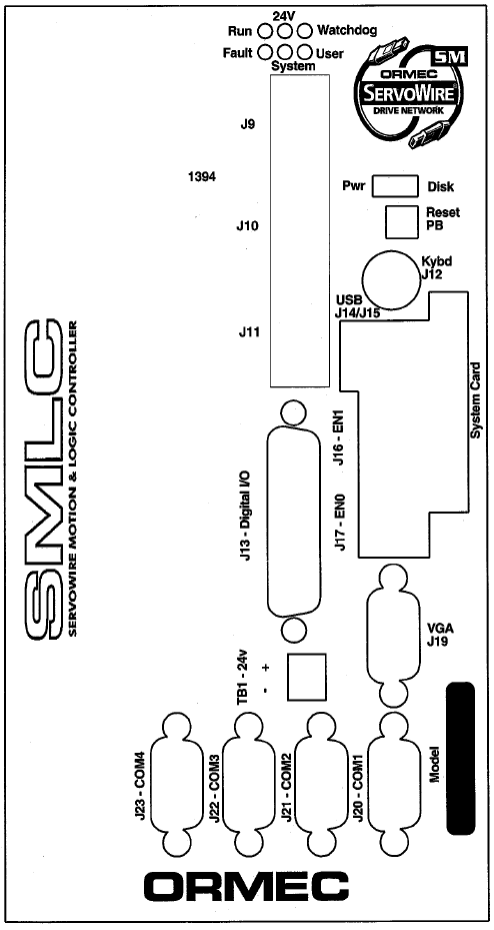


Figure 2, SMLC-240 ServoWire Cabling

Chapter 4
SMLC System Components

SMLC System Components



SMLC-160, SMLC-240 System Components

LEDs - Watchdog OK, Run, User, Fault, System, 24v power, 5v power, Disk activity

J9/J10/J11 – ServoWire 1394b ports

Reset Pushbutton

J12 – Keyboard port

J13 – Digital I/O connector

J14/15 – USB ports

J16 – EN1

J17 – EN0

System Card – Compact Flash

J19 – VGA connector

J20 – Development Serial Port – COM1

J21 – HMI /User Serial Port - COM2

J22 – User serial port - COM3 (J22)

J23 – User serial port – COM4

TB1 – 24VDC connector

TB2 – Analog I/O connector (on top, not shown)

TB3 – Input AC Power connector (on top, not shown)

Figure 3, SMLC-160/240 System Components

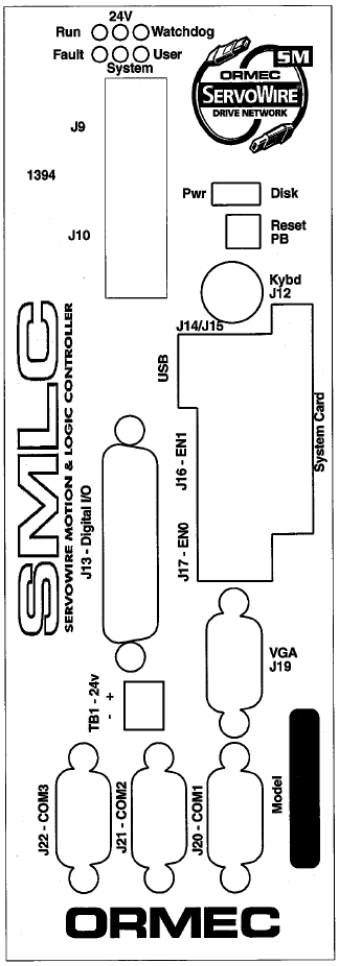


Figure 4, SMLC-30/80 System Components

SMLC-30, SMLC-80 System Components

LEDs - Watchdog OK, Run, User, Fault, System, 24v power, 5v power, Disk activity

J9/J10/J11 – ServoWire 1394b ports

Reset Pushbutton

J12 – Keyboard port

J13 – Digital I/O connector

J14/15 – USB ports

J16 – EN1

J17 – EN0

System Card – Compact Flash

J19 – VGA connector

J20 – Development Serial Port – COM1

J21 – HMI /User Serial Port - COM2

J22 – User serial port - COM3 (J22)

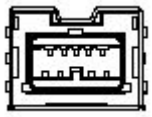
J23 – User serial port – COM4

TB1 – 24VDC connector

TB2 – Analog I/O connector (on top, not shown)

TB3 – Input AC Power connector (on top, not shown)

J9 – ServoWire IEEE 1394 Interface Port
J10 – ServoWire IEEE 1394 Interface Port
J11 – ServoWire IEEE 1394 Interface Port (SMLC-160 & SMLC-240 only)



The SMLC ServoWire interface uses 9-pin bilingual IEEE 1394b connectors. SAC-SDM drives are available with locking and non-locking connectors. Connections made to SAC-SDM drives with locking connectors are CBL-SW-BL-##. Connections made to SAC-SDM without locking connectors are made with CBL-SW-B-#. Note that CBL-SW-B-## cables can be used with either locking or non-locking SAC-SDM drives. CBL-SW-BL-## may be used on non-locking SAC-SDM drives with some restrictions.

Connections from the SMLC to the ServoWire Drives with 6-pin IEEE 1394a connectors (SAC-SWM and SAC-SMM) are made using bilingual ServoWire cables (CBL-SW-BA-##).

ServoWire Cables	Description
CBL-SW-BL-3	ServoWire Cable, 9 pin to 9 pin, locking, 3.3ft
CBL-SW-BL-6	ServoWire Cable, 9 pin to 9 pin, locking, 6.6ft
CBL-SW-BL-14	ServoWire Cable, 9 pin to 9 pin, locking, 14.8ft
CBL-SW-BL-25	ServoWire Cable, 9 pin to 9 pin, locking, 25.0ft
CBL-SW-BL-33	ServoWire Cable, 9 pin to 9 pin, locking, 33.3ft
CBL-SW-B-3	ServoWire Cable, 9 pin to 9 pin, 3.3ft
CBL-SW-B-6	ServoWire Cable, 9 pin to 9 pin, 6.6ft
CBL-SW-B-14	ServoWire Cable, 9 pin to 9 pin, 14.8ft
CBL-SW-B-25	ServoWire Cable, 9 pin to 9 pin, 25.0 ft
CBL-SW-B-33	ServoWire Cable, 9 pin to 9 pin, locking, 33.3ft
CBL-SW-BA-3	ServoWire Cable, 9 pin to 6 pin, 3.3 ft
CBL-SW-BA-6	ServoWire Cable, 9 pin to 6 pin, 6.6 ft
CBL-SW-BA-14	ServoWire Cable, 9 pin to 6 pin, 14.8 ft
CBL-SW-BA-33	ServoWire Cable, 9 pin to 6 pin, 33.3 ft

Table 3, ServoWire: IEEE 1394 Cable part numbers.

J12 – Keyboard/Mouse Interface Connector

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

The Keyboard interface is not supported by CoDeSys in the current release of SMLC firmware.

Figure 5, Keyboard Connector (J12) 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 4, Keyboard/Mouse Connector (J12) pin-out

J13 – Digital I/O Connector

The SMLC includes 8 digital inputs and 8 digital outputs via a 25 pin D-Sub female connector (J13). These I/O points are optically coupled and require an external voltage source via connector TB-1.

Pin	Description
1	Chassis Frame
2	Digital Input 1
3	Digital Input 2
4	Digital Input 3
5	Digital Input 4
6	Digital Input 5
7	Digital Input 6
8	Digital Input 7
9	Digital Input 8
10	Digital Output 2
11	Digital Output 4
12	Digital Output 6
13	Digital Output 8
14	Ground
15	Ground
16	Ground
17	Ground
18	Ground
19	Ground
20	Ground
21	Ground
22	Digital Output 1
23	Digital Output 3
24	Digital Output 5
25	Digital Output 7

Table 5, Digital I/O connector (J13) pin-out

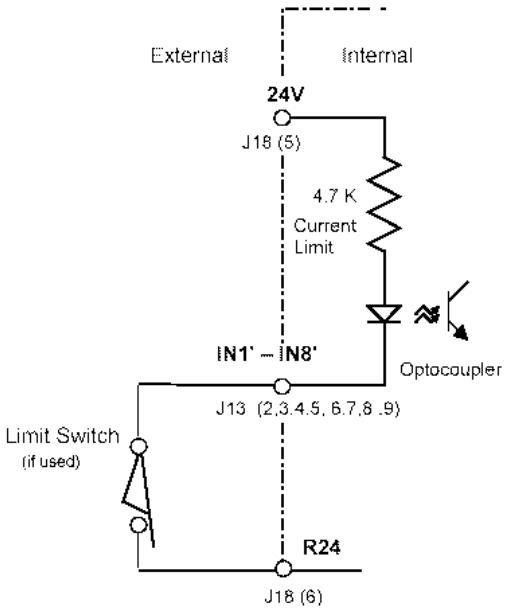


Figure 6, Schematic of Discrete Inputs IN1'-IN8'

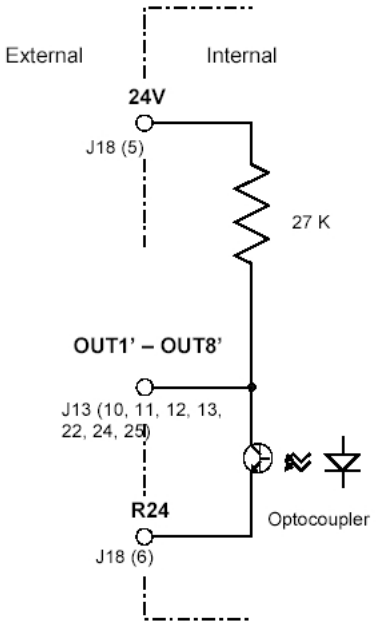


Figure 7, Schematic of Discrete Outputs OUT1'-OUT8'

J14 – USB Port

J15 – USB Port

The USB ports are not supported by CoDeSys in the current release of SMLC firmware.

J16 – Ethernet Port EN1

J17 – Ethernet Port EN0

The Ethernet interface ports use an industry standard Intel 82551ER 10/100Base-Tx Ethernet chip on EN0 and an Intel 82541 10/100/1000Base-T Ethernet chip on EN1 (except for some revisions of the SMLC-30 which are 10/100 on both EN0 and EN1). They can be used for networking with WAGO I/O, Ethernet/IP, MODBUS/TCP based HMI packages or communications with the CoDeSys IDE or OPC Server as well as general purpose TCP/IP communications.

Figure 8, SMLC - Ethernet Connector (J16 & J17) connector

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

Table 6, Ethernet Port (J16 & J17) 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 connecting 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.

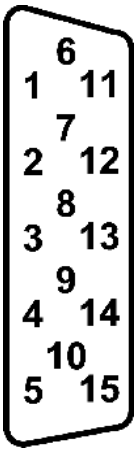
Table 7, Ethernet Cables & Accessories part numbers

J19 – VGA Connector

The VGA connector is capable of supporting a wide range of flat panel, CRT and LCD displays. There is no CoDeSys support for the VGA display in the initial release of these SMLC models.

NOTE: Beginning with SMLC firmware revision 2.0.0 the IP addresses assigned to the Ethernet ports are printed to the VGA port at power-up. If the IP address assignments of the Ethernet ports is unknown they may be determined by connecting a standard VGA monitor to this port and power cycling the SMLC.

Figure 9, SMLC - CRT Connector (J19) 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	NC	No Connection
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.

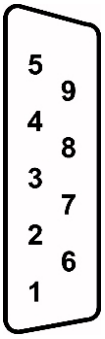
Table 8, CRT Connector (J19) pin-out

J20 – Development Serial Port COM1 - RS232

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 (J20), which is located on the front of the SMLC. 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.

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.

Figure 10, RS-232 Serial Port Connector (J20, J21, J22, and J23) Pin-out



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 9, RS-232 Serial Port Connector (J20, J21, J22, and J23) pin-out.

J21 – SMLC HMI Serial Port COM2 - RS232

The SMLC HMI serial port J21 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 are made through connector J21, which is located on the lower left side of the SMLC. The pin-out of the SMLC HMI Serial Port is shown in **Figure 10,** RS-232 Serial Port Connector (J20, J21, J22, and J23) Pin-out.

J22 – SMLC User Serial Ports COM3 - RS232

J23 – SMLC User Serial Ports COM4 - RS232 (SMLC-160 & SMLC-240 only)

The SMLC User serial ports use a DB9 connector that provides access to asynchronous serial RS-232 communications. The ports can be used for general purpose serial communications with terminals, computers or programmable controllers by using the CoDeSys Library SysLibCom.lib.

Connections to the SMLC User Serial Ports are made through connector J22 & J23, which are located on the lower left side of the SMLC. The pin-out of the SMLC User serial ports is shown in Table 9, RS-232 Serial Port Connector (J20, J21, J22, and J23) pin-out. COM4 (J23) is only available on the Model 160 and Model 240.

TB1 – 24VDC Connector

This pluggable connector is the location for supplying the power for the SMLC's local digital inputs and outputs. The presence of the I/O supply voltage is indicated by the 24V LED on the front of the SMLC. Screw type terminals accept 16 to 28 AWG wire.

Signal	Description
+	I/O supply voltage +
-	I/O supply voltage -

Table 10, 24VDC connector (TB1) pin-out

TB2 – Analog I/O Connector

The SMLC includes a 14-bit analog input and a 14-bit analog output on pluggable connector TB2, located on the top of the SMLC. Screw type terminals accept 16 to 28 AWG wire. Shielded cable is recommended for analog connections.

Pin	Description
AO	Analog output
AG	Analog ground
AI	Analog input
SH	Chassis ground/Shield connection

Table 11, Analog I/O connector (TB2) pin-out

TB3– Input AC Power Connector

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.

The SMLC power connector is pluggable. Screw type terminals accept 12 to 24 AWG gauge wire.

Pin	Description
1	L1
2	Chassis ground
3	L2

Table 12, Power connector (TB3) pin-out

LEDs

The functioning of the LEDs is defined in section 0. When the SMLC is powered up or reset the Watchdog, User and System LEDs are lit. When the SMLC firmware has finished loading the LEDs flash several times in sequence and then the Watchdog LED will start flashing. This indicates that the boot process has completed.

Reset Pushbutton

The reset pushbutton is recessed on the front panel of the SMLC. Pressing the reset pushbutton will reset the processor causing motors to be disabled and the SMLC to reboot. Resetting is a satisfactory alternative to power cycling the SMLC after performing an SMLC firmware upgrade.

System Card

The System Card is a Compact Flash format storage device that contains the operating system, SMLC firmware, SMLC settings such as Ethernet IP addresses as well as the user application and data. The system card may be transferred from SMLC to SMLC or even pre-programmed and sent to a remote location.

IMPORTANT NOTE: SMLC hardware rev2 requires SMLC firmware v2.6.0 or later. If you insert a card with firmware prior to v2.6.0 into a rev2 SMLC it will not finish the boot process. It will, however, boot enough so that the firmware may be upgraded using the SMLC upgrade utility in ServoWire Pro.

Chapter 5
System Power Wiring & Interlocks

System Power Wiring & Interlocks

The SMLC provides integrated emergency stop and fault interlocks **through the servo drives**.

System wiring diagrams for standard ORMEC servo drives, which include the recommended safety and fault interlocks for a typical system, are provided in the Appendix B, page # 55. 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 on the servo drive to be closed, five conditions must be satisfied:
- There must be no SMLC diagnostic faults, including power-up diagnostics.
- There must be power (+5 to +24 referenced to RTN) applied to the drives V+S input and RTN must be connected to V-S.
- There must be current flow from the drives E-Stop/Quick-Stop input to V-S.
- There must be no drive faults from any standby or active servo drive and no open encoder signal wires on axes in pacer, standby, or active mode.
- Bus power must be applied to the drive.

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. Un-asserting 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, and zero speed is commanded. Commanding zero speed may result in commanded current to bring the motor to a stop.

WARNING: The SMLC and servo drives must be configured in ServoWire Pro for E-Stop / Quick-Stop operation. Refer to the ServoWire Pro online documentation for more information.

ServoWire Drive Input / Output

SDM Servo drive 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

Drive I/O Connections

TB4		TB5	
1	Shield	1	V+S
2	**ASEN**	2	V-S
3	**BSEN**	3	**IN1/HTLF**
4	V+S	4	**IN2/HTLR**
5	V-S	5	**IN3**
		6	**IN4/OUT4**
TB3		7	Out4 Return
1	**AIN**	8	Shield
2	AGND	9	**OUT1**
3	**AOUT**	10	**OUT2**
4	Shield	11	**OUT3**
		12	**OUT5/ZREF**

* 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.

Figure 11, SAC-SDM Servo drive I/O

SMM Servo drive 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.

Figure 12, SAC-SMM Servo drive I/O

SWM Servo drive 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

Figure 13, SAC-SWM Servo drive I/O

Chapter 6
System Operation

System Operation

SMLC Status LED's

A total of eight status LEDs are provided on the face of the SMLC for indicating system status.

Name	Color	Description
POWER	Green	There is 5V present on the main processor board
Disk	Yellow	The Compact Flash disk is being accessed
RUN	Green	The SMLC is in run mode.
FAULT	Red	Solid on indicates an Internal error. The SMLC must be power cycled to reset. A dump file will be generated and may be retrieved via ServoWire Pro's Dump utility. Flashing indicates a fault code. Currently the only fault code is two flashes, which indicates that the BIOS test failed. Contact ORMEC Service department for instructions.
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 the Fault LED should come on. If you have disconnected CoDeSys and the LED is still flashing twice per second you will not be able to re-establish CoDeSys communications until you power cycle the SMLC.
USER	Yellow	Under application program control by MC_UserLED.
24V	Green	The User supplied I/O voltage is present on TB1+.
SYSTEM	Yellow	SRAM Non-volatile memory batteries need to be replaced. The battery is tested at power up and then every 24 hours while power remains on. The battery status can be tested programmatically using the function OrmNonVolCheckBattery. The battery is not user replaceable. Contact ORMEC Service for repair.

Table 13, SMLC Status LED's

Power-up

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

Whenever AC power is applied to the SMLC, it executes its power-up sequence, which can last up to 30 seconds. When the Watchdog OK LED starts flashing at its once per second rate the power-up sequence is complete.

NOTE: While the SMLC is booting, the Watchdog, User and System LEDs are lit.

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. 32 Kbytes of NV storage is available on the SMLC Models covered in this manual (minus 256 bytes reserved for unit information).

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.

Specifications

CPU Processor types	Model: 30 – 800 MHz Celeron M 80 – 1.0 GHz Celeron M 160 – 1.4 GHz Pentium M 240 – 1.8 GHz Pentium M
Total controller memory	128 M bytes DRAM
SMLC program memory	128 M bytes Compact Flash
Non-volatile variable memory	32 K bytes Battery Backed SRAM

Table 14, SMLC Controller General Specifications

SMLC Mechanical and Environmental Specifications

Dimensions	Model 30 & 80: 9.0” High x 2.75" Wide x 7.23"Deep (228.6 H x 69.8 W x 183.6 D) Model 160 & 240: 9.0” High x 4.25” Wide x 7.23” Deep (228.6 H x 107.9 W x 183.6 D)
Weight	Model 30/80: 3.3lb Model 160/240: 3.5 lb
Operating Temperature	0 ~ 50C, (32~122 ^{o}F)
Storage Temperature	-25C to 70C (-13 ^{o}F to 158 ^{o}F)
Relative Humidity	10 ~ 95% @ 40'C, non-condensing
Mounting & Airflow	Mounting must be vertical Airflow must be unrestricted, 100 CFM system airflow required for 50C operation.

Table 15, SMLC Controller Mechanical and Environmental Specifications

Input AC Power Ratings

SMLC	115 VAC (90 - 127 VAC), 47 - 63 Hz – or – 230 VAC (190 - 253 VAC), 47 - 63 Hz The power supply is auto sensing

Table 16, SMLC Input Power

Battery Power Specifications

SMLC Main processor - BIOS	One - lithium Battery
SMLC Battery Backed SRAM	One - BR2032 lithium Battery (3 Volt, 190 mA Hr)
Data Retention	10 years of data retention powered. 1 year minimum, 5 year typical, unpowered.

Table 17, SMLC Battery Power

Digital I/O Power requirements

VIO+	4.5 volts to 27 volts
VIO-	not tied to SMLC ground

Table 18, Digital I/O Power requirements

Digital Input Specifications

Current to turn on	0.7ma minimum 7.0ma maximum
Common VIO+	inputs sink to VIO-
Voltage max	VIO+ + 5vdc

Table 19, Digital input specifications

Digital Output Specifications

Open collector outputs with a common VIO-. Internal pull-up on each output

Max sink current	33ma
low level voltage	1.2VDC
high level voltage	VIO+ - 0.5VDC
absolute maximum	27VDC

Table 20, Digital output specifications

Analog Input Specifications

Return pin is shared with analog output. Note that analog ground is not isolated from the SMLC ground.

Resolution	12 bits
Input range	+10VDC to –10VDC

Table 21, Analog input specifications

Analog Output Specifications

Return pin is shared with analog input. Note that the analog ground is not isolated from the SMLC ground.

Resolution	12 bits
Output range	+10VDC to –10VDC
Max output rate	5kHz
Output settling time	20usec
Max output current	10mA

Table 22, Analog output specifications

Development port COM1 Specifications

Connector	9 pin Male D Sub
Standards	EIA RS-232C
Default Configuration	8 data bits 1 stop bit no parity
Baud Rate	115.2K

Table 23, SMLC Development Serial Port

HMI Serial Port COM2 Specifications

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

Table 24, SMLC HMI Serial Ports

Serial Port COM3 and COM4 Specifications

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

Table 25, SMLC Serial Ports COM3 & COM4

Note: COM4 is available on the SMLC-160 and SMLC-240 only

Chapter 7
WAGO I/O Installation & Operation

WAGO I/O Installation & Operation

General Purpose I/O

General-purpose I/O options are supported using 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.

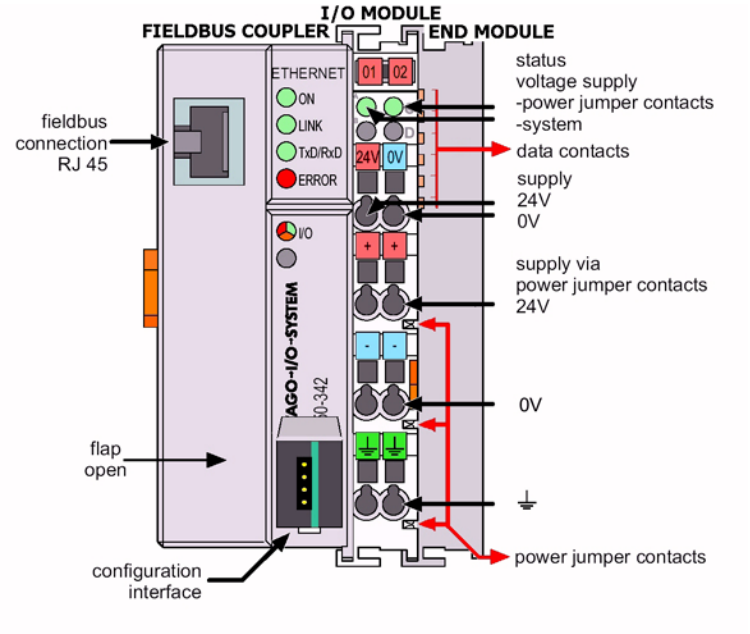


Figure 14, WAGO bus coupler

The WAGO System consists of at least three components: a Fieldbus Coupler, one or more I/O modules and an End Module.

The WAGO-ETH-KIT contains a 10baseT field bus coupler, supports up to 64 I/O modules (256 points max) that support 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

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.

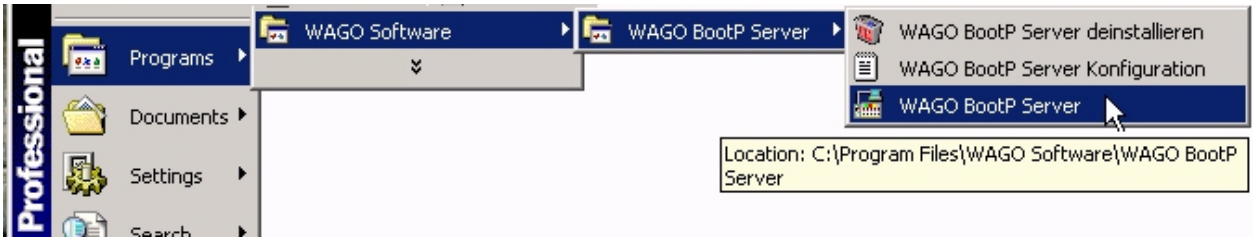


Figure 15, WAGO Launch BootP server

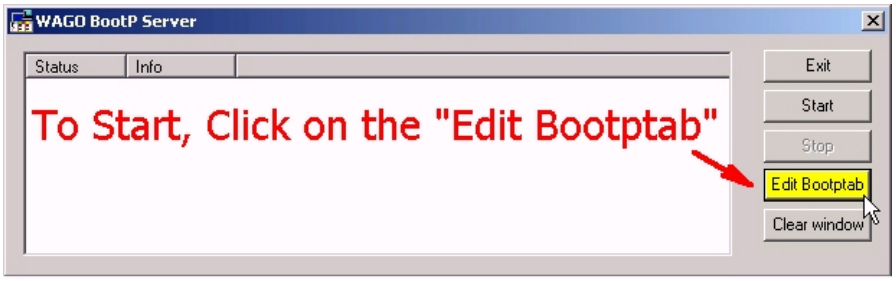


Figure 16, WAGO Launch Notepad

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

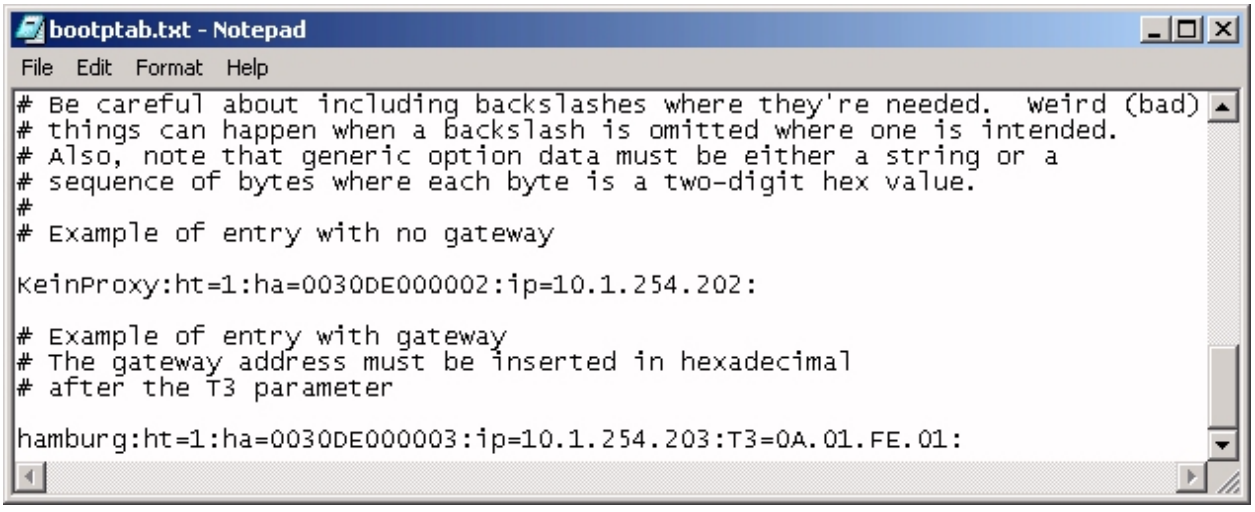


Figure 17, WAGO - edit BootPtab.txt.

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.

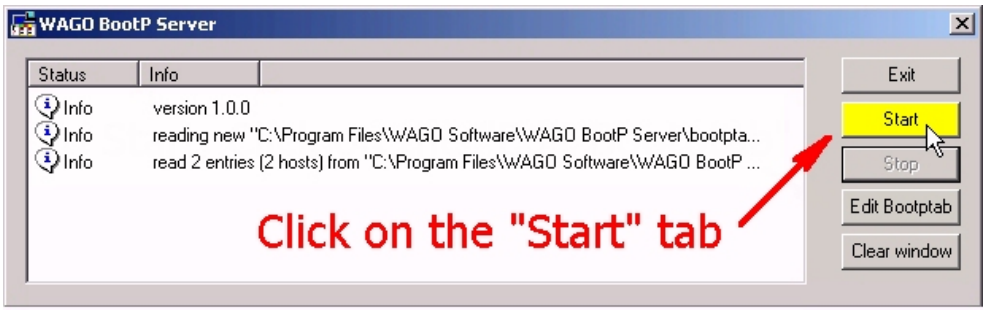


Figure 18, WAGO - Start BootP Server

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 bus coupler 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.

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-750-654	Data Exchange Module
WAGO-750-655	AS-i interface module
WAGO-750-670	Stepper Motor interface module
WAGO-750-671	Stepper Motor interface module
WAGO-750-672	Stepper Motor interface module

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

Table 26, WAGO parts list

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 8
Getting Started

Getting Started

Preparation for Test Run

For the test run, you need to:

- Complete the appropriate System Wiring.
- Create the configuration file “SwSetup” for your system by using ServoWire Pro.
- 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 appropriate *Servo Drive Manual*.
- 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. Servo drives 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*.
- Verify that the system grounding is correct. Refer to Appendix B and the appropriate *servo drive manual*.
- Check for compatible voltage ratings on all servo drives obtaining control power from terminals “ **r** ” and “ **t** ” on the servo drive.
- Verify that all wiring leads are firmly connected to their terminals.
- Verify SMLC incoming line voltage (115 or 230 VAC) CHECK POWER BEFORE APPLYING IT TO THE MOTION CONTROLLER!
- Attach a computer operating either the CoDeSys or ServoWire Pro communications utility to the SMLC Serial Development Port (J6) or Ethernet port (J5).

Servomotor Checklist

- Verify proper motor mounting and that the **shaft is not connected to the machine.**
- Verify that the encoder cables and motor cables are properly installed.

Note: ORMEC manufactured motor cables are color-coded.

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

Table 27, ORMEC motor cable color code

- Check that mounting bolts and nuts are tight.
- 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.
- For motors with oil seals, (standard on IP-67 rated motors) the seals should be in good condition and properly lubricated.
- 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

Refer to the section – Power Up (page 28) for further information regarding the SMLC power-up sequence.

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

The SMLC will execute its Power-up sequence as detailed in the section System Operation chapter (page 27).

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.

Setting up SMLC Serial communications

ServoWire Pro uses Dial-Up Networking (DUN) to communicate with the SMLC Development port COM1 (J20). 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 Development Port communication rate is 115K Baud.

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.

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 Serial Port (J6).

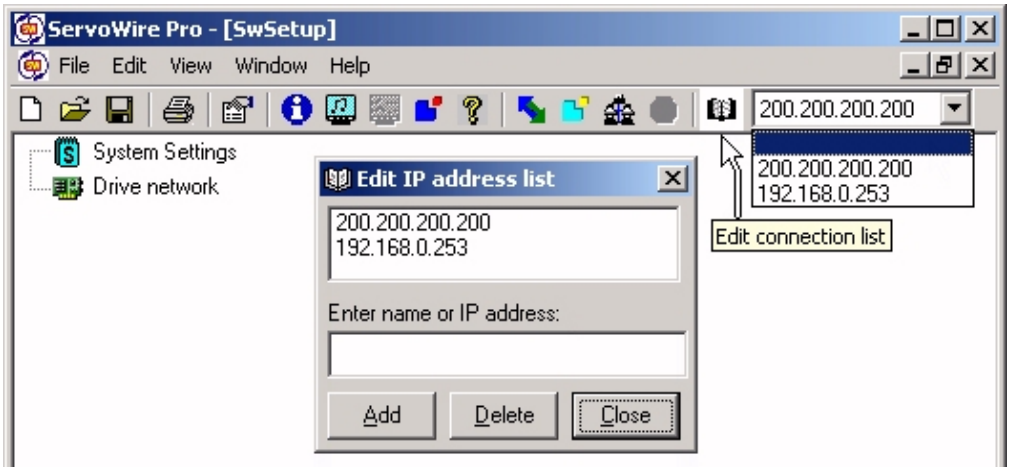


Figure 19, ServoWire Pro IP Address

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 the ServoWire Pro network setup help.

Troubleshooting Connection Problems

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

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

The SMLC assigns the **default IP Address of 192.168.0.253** to EN0 (J17).

The SMLC assigns the **default IP Address of 192.168.1.253** to EN1 (J16).

If you are going to use the default IP addresses you need to do nothing else.

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.

To change the Ethernet settings on the SMLC, refer to the ServoWire Pro online help for the SMLC Ethernet Settings. Enter the desired Ethernet settings and send them to the SMLC. You must then cycle the power on the SMLC for the new settings to take effect.

The SMLC Ethernet configuration can also be load/saved in a file. This is provided as convenient way to keep a record of Ethernet settings for different projects.

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 online help as appropriate for installation, startup, and communications details.

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.

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 Servo drive 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 9
Product History

Product History

Determining Hardware Revision Numbers

The hardware revision numbers for the SMLC motion controller is located on the left hand side of the unit. Revision 2 hardware is indicated both by the Revision level and the fact that the serial number suffix is > 200.

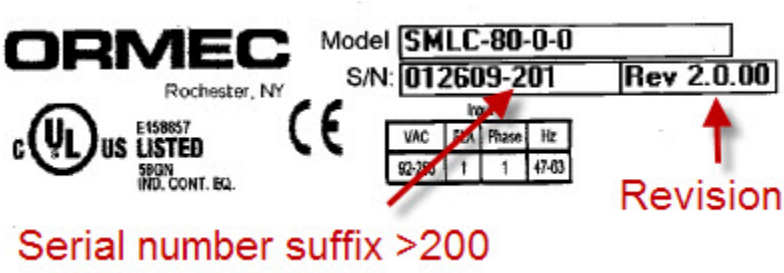


Figure 20, SMLC Product Revision Label

SMLC Model History

Version 1.0 – September 2005 - Initial release, refer to manual SMLC-002

Version 2.0 – January 2009 – Release covered in this manual

Chapter 10
Maintenance & Troubleshooting

Maintenance & Troubleshooting

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 at (585) 385-3520. Or contact support@ormec.com via e-mail.
- 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 communication).
- 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.

The latest software and documentation is always available on the ORMEC Web Site at
http://www.ormec.com

SMLC Troubleshooting

No LEDs Lit on SMLC

Verify that there is AC power to the unit. Verify that the AC voltage on the input power terminal block is the appropriate level (either 115 or 230 VAC).

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.

- SMLC model number, hardware version number & serial number, available on the sticker on the left side of the unit.
- With the SMLC in the incomplete power up sequence, note the status of the LED's located on the front of the controller.

  24VDC, Run, Fault, Watchdog, User, and System.
- The SMLC firmware version:
- If you are able to communicate with the SMLC after resetting the unit or cycling power, the SMLC firmware version can be determined by using ServoWire Pro's SwMonitor.

Chapter 11
Terms & Mnemonics

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.

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

Current Sink - The ability 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 SMLC 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 500 and 2,000 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.

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*.

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 servo drive decodes the resolver position digitally.

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

Servo drive - 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 servo drives 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

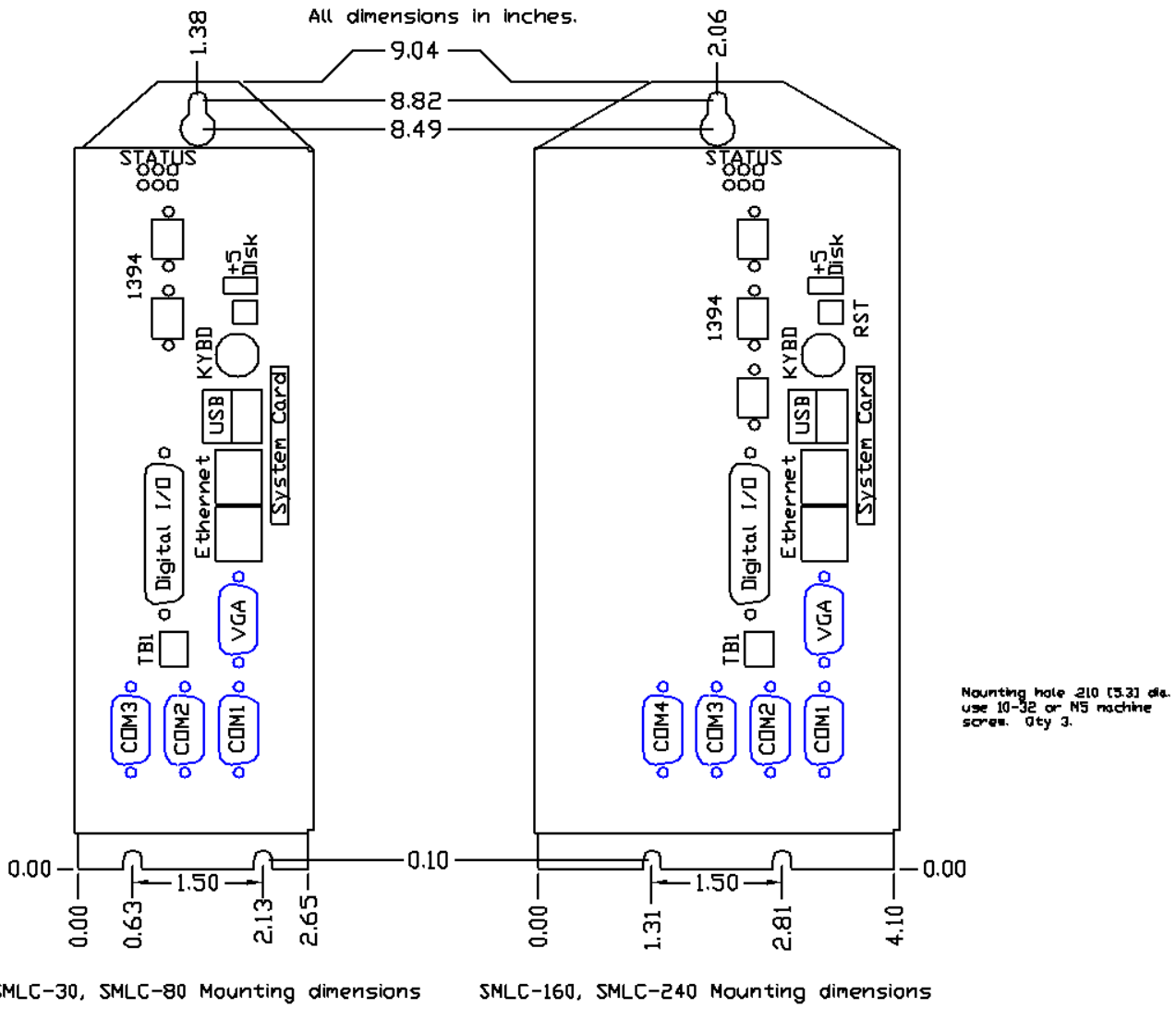


Figure 21, SMLC mounting dimensions - height and width

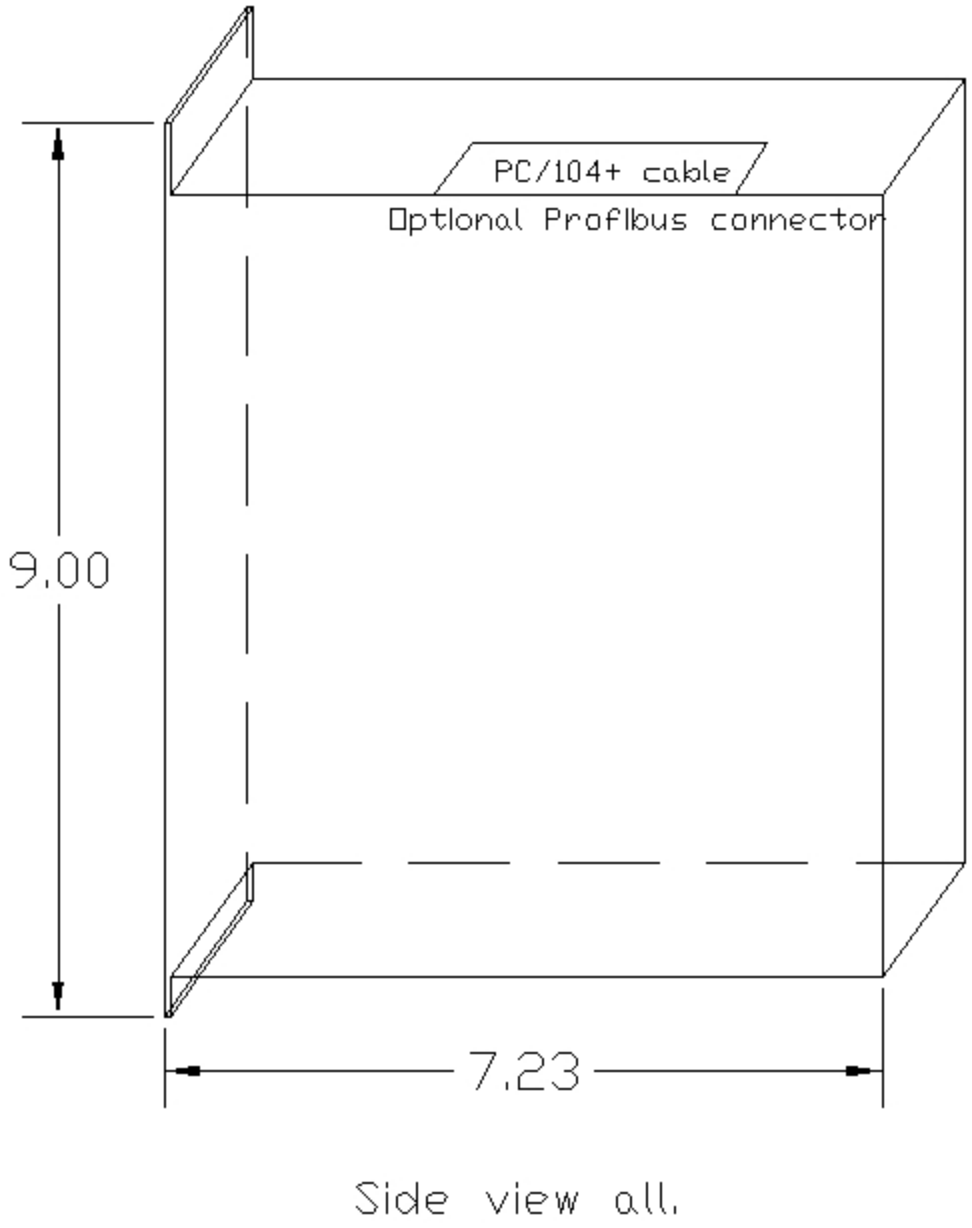
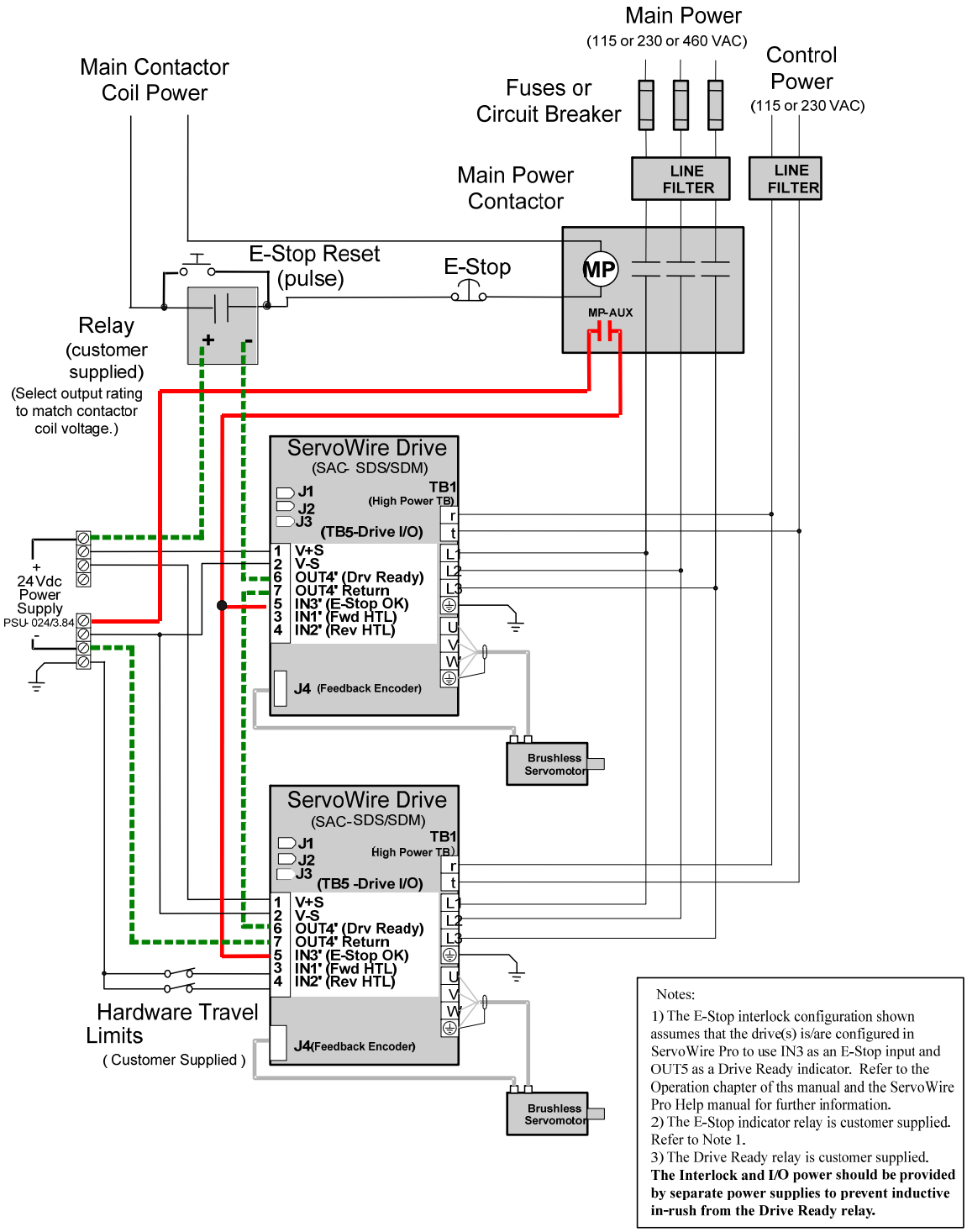


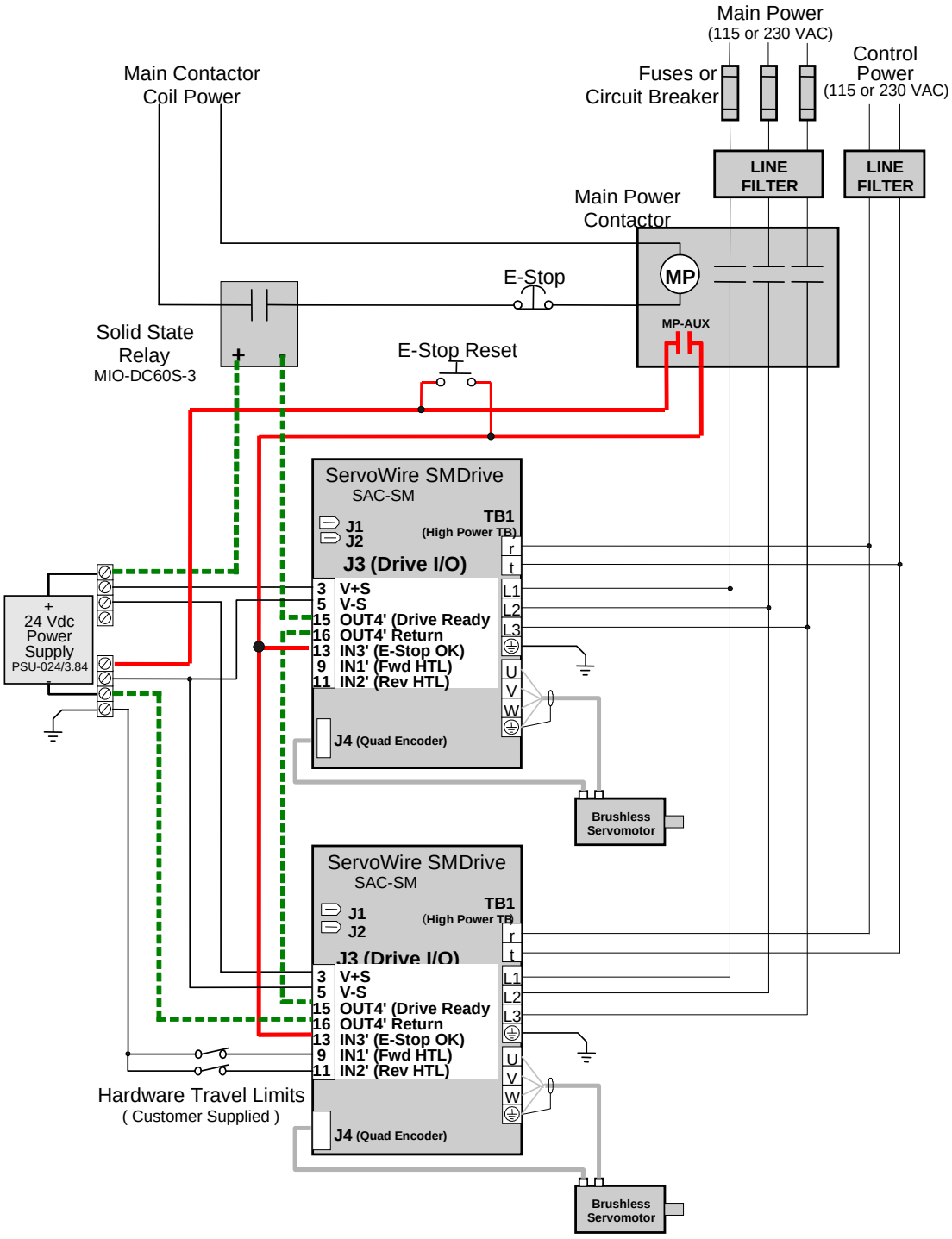
Figure 22, SMLC mounting dimensions – depth

Appendix B – System Wiring Drawings

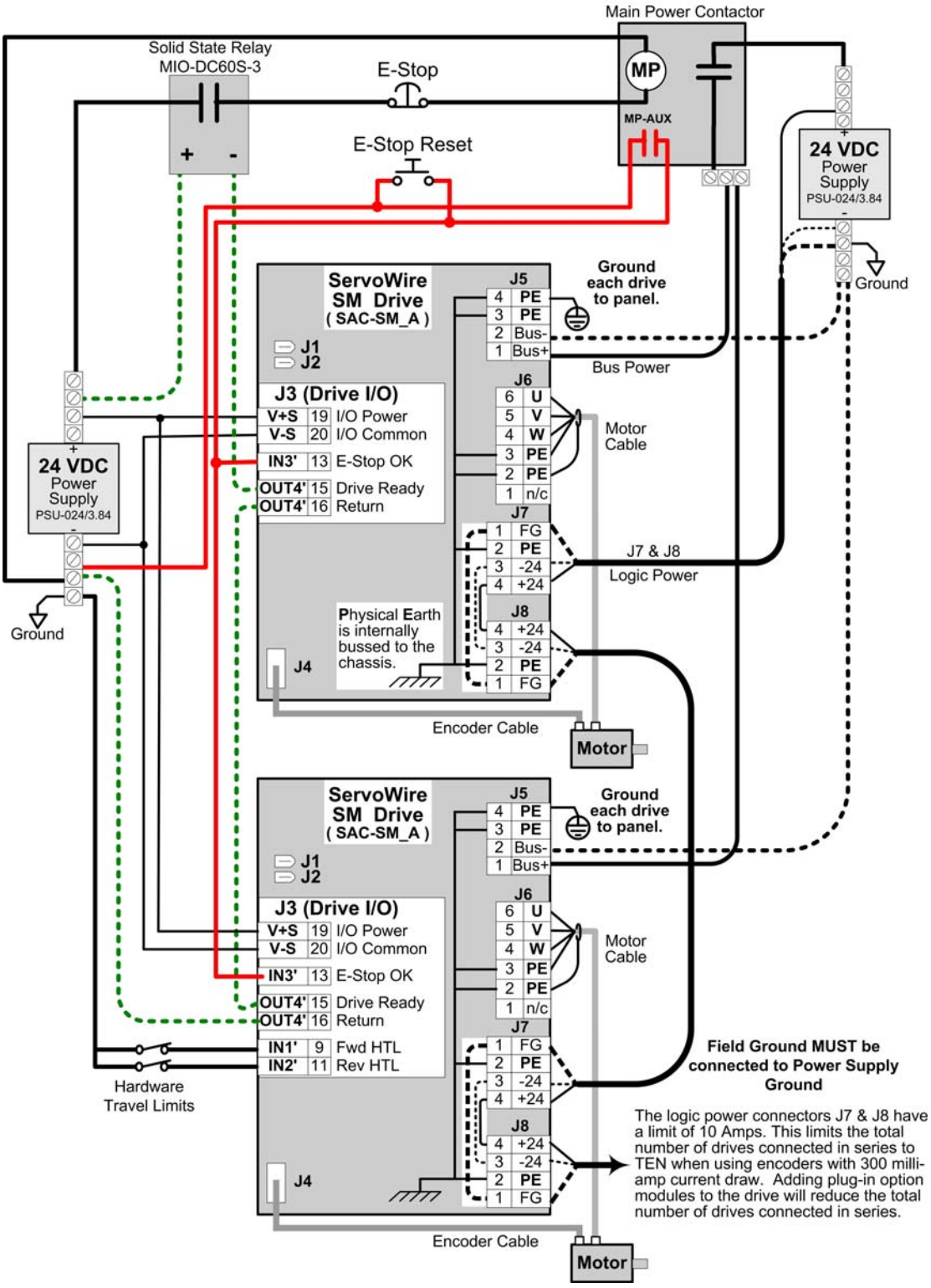
ServoWire SDM Drives 120 ~ 460 VAC System Wiring



ServoWire SMM Drives 120 ~ 460 VAC System Wiring



ServoWire SMM Drive 12 ~ 96 VDC System Wiring



Appendix C – SMLC Interface Cables & Accessories

Serial Communications Null Modem Cable to PC

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

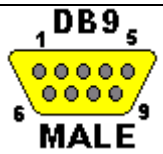
SMLC – J20		PC
Data Carrier Detect (DCD)		
Receive Data (RD)	**2 - 3**	(TD) Transmit Data
Transmit Data (TD)	**3 - 2**	(RD) Receive Data
Data Terminal Ready (DTR)	**4 - 6**	(DSR) Data Send Ready
Signal Ground (SG)	**5 - 5**	(SG) Signal Ground
Data Send Ready (DSR)	**6 - 4**	(DTR) Data Terminal Ready
Request To Send (RTS)	**7 - 8**	(CTS) Clear To Send
Clear To Send (CTS)	**8 - 7**	(RTS) Request To Send

Table 28, SMLC Serial Communications cable

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.

Profibus Cable Drawing