User Manual for

HE-XE102,
HE-XE103/ HE-XE104,
HE-XE105

XLe OCS

21 August 2007 **MAN0805-03**

PREFACE

This manual explains how to use the XLe OCS Modules.

For user manual updates, contact Technical Support:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Horner APG, LLC. ("HE-APG") warrants to the original purchaser that the XLe OCS module manufactured by HE-APG is free from defects in material and workmanship under normal use and service. The obligation of HE-APG under this warranty shall be limited to the repair or exchange of any part or parts which may prove defective under normal use and service within two (2) years from the date of manufacture or eighteen (18) months from the date of installation by the original purchaser whichever occurs first, such defect to be disclosed to the satisfaction of HE-APG after examination by HE-APG of the allegedly defective part or parts. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES AND HE-APG NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR HE-APG, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS XLe OCS module. THIS WARRANTY SHALL NOT APPLY TO THIS XLe OCS module OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. HE-APG MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY HE-APG. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE XLe OCS module IS ORIGINALLY INSTALLED. THIS WARRANTY SHALL APPLY ONLY WITHIN THE BOUNDARIES OF THE CONTINENTAL UNITED STATES.

In no event, whether as a result of breach of contract, warranty, tort (including negligence) or otherwise, shall HE-APG or its suppliers be liable of any special, consequential, incidental or penal damages including, but not limited to, loss of profit or revenues, loss of use of the products or any associated equipment, damage to associated equipment, cost of capital, cost of substitute products, facilities, services or replacement power, down time costs, or claims of original purchaser's customers for such damages.

To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing the XLe OCS module to appropriately design the end system, to appropriately integrate the XLe OCS module and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

Table of Contents

VISUAL MAP OF MAJOR TASKS AND THE KEY CHAPTERS TO ASSIST YOU

The following map is provided to show you the major types of tasks needed to be performed and the key chapters in this manual you need to refer to for information and help.

Directions: Major tasks are listed at the top of the map with the key chapters listed beneath that you need to consult in order to perform the tasks.

FIRST STEP of ANY TASK: DATASHEET

Each XLe unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to XLe models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the XLe datasheets attached to it. Visit our website (see page 80) to obtain updates to datasheets and user documentation.

QUICK START	INSTALLATION	PROGRAMMING	TROUBLESHOOTING
Safety / Compliance page 9	**Safety / Compliance** page 9	**Safety / Compliance** page 9	**Safety / Compliance** page 9
Introduction page 11	**Introduction** page 11	**Introduction** page 11	**Introduction** page 11
	Mechanical Installation page 15	**System Settings** page 52	**Maintenance** page 75
	Electrical Installation page 21	**Cscape Configuration** page 66	**Troubleshooting** page 77
	Serial Comm page 23	**User Interface** page 60	
	CAN Comm page 25	**Removable Media** page 29	
	Communication Options page 27	**General I/O** page 33	
	General I/O page 33	**High Speed I/O** page 39	
		Registers page 62	

CHAPTER 1: SAFETY / COMPLIANCE

1.1 Safety Warnings and Guidelines

When found on the product, the following symbols specify:

Warning: Consult user documentation.

Warning: Electrical Shock Hazard.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.

WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.

WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.

WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.
- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.

Adhere to the following safety precautions whenever any type of connection is made to the module.

- Connect the green safety (earth) ground first before making any other connections.
- When connecting to electric circuits or pulse-initiating equipment, open their related breakers. Do not make connections to live power lines.
- Make connections to the module first; then connect to the circuit to be monitored.
- Route power wires in a safe manner in accordance with good practice and local codes.
- Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
- Ensure hands, shoes, and floor are dry before making any connection to a power line.
- Make sure the unit is turned OFF before making connection to terminals. Make sure all circuits are de-energized before making connections.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

1.2 Grounding

Grounding is covered in various chapters within this manual.

- For grounding specifications and testing for a good ground, refer to page 21.
- For panel grounding, refer to 18.

1.3 CE Compliance

To check for compliance and updates, visit our website at:

http://www.heapg.com/Support/compliance.htm

CHAPTER 2: INTRODUCTION

2.1 Visual Overview of XLe and Topics Covered in this Manual

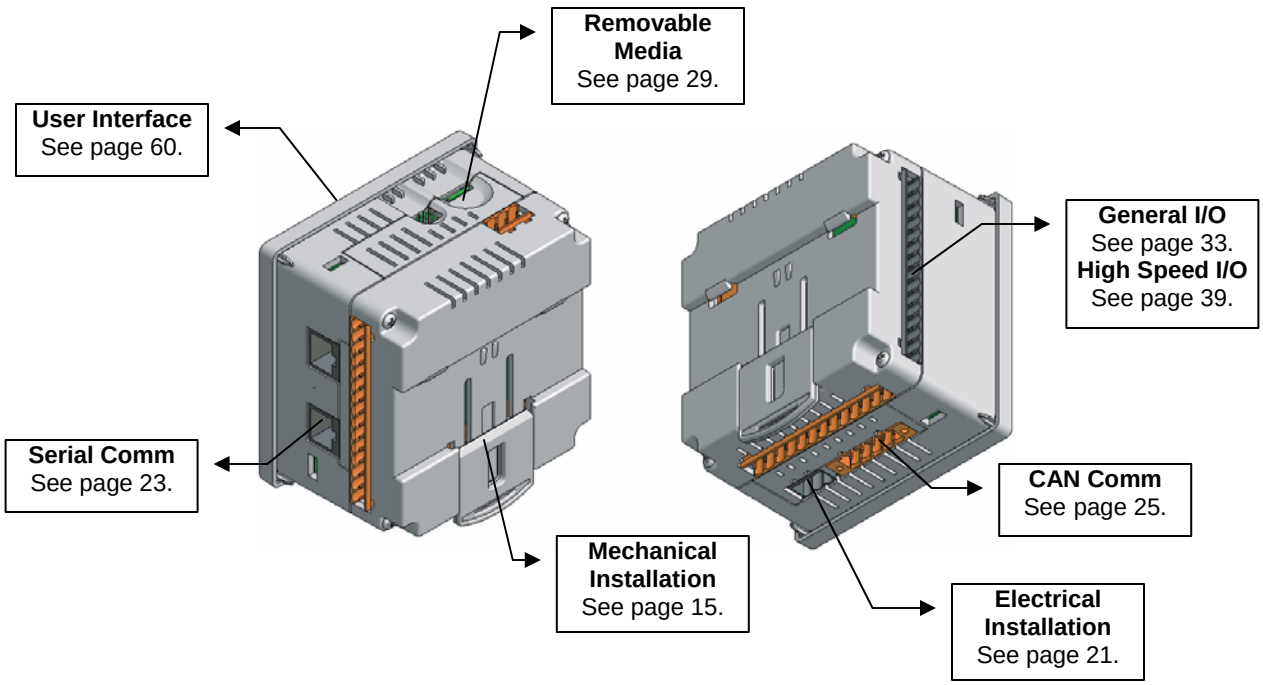


Figure 2.1 – Visual Overview of XLE and Topics of Interest Covered in the User Manual

2.1.1 Where to Find Information about the XLe

a. Datasheets - The **datasheets are the first documents you need to refer to for key information** related to specific XLe models. (A datasheet is provided in the box with your unit.)

The datasheets for all XLe models are attached to the back of this manual on our website, and they are also available individually on the web.

Datasheets contain pin-outs, jumper settings and other model specific information.

b. User Manual -This manual provides general information that is common to XLe models and can be downloaded from our web. Visit our website (see page 80) to obtain user documentation and updates.

Four main types of information are covered in the manual.

- Safety and Installation guidelines / instructions (Mechanical and Electrical)
- Descriptions of hardware features (Serial ports, Removable Media, Communication Options, etc.)
- Configuration and Use of the XLe
- Maintenance and Support

2.2 Connectivity to the XLe

The XLe has tremendous capabilities for connecting to a variety of devices. The diagram below shows some examples of devices that can be used with the XLe.

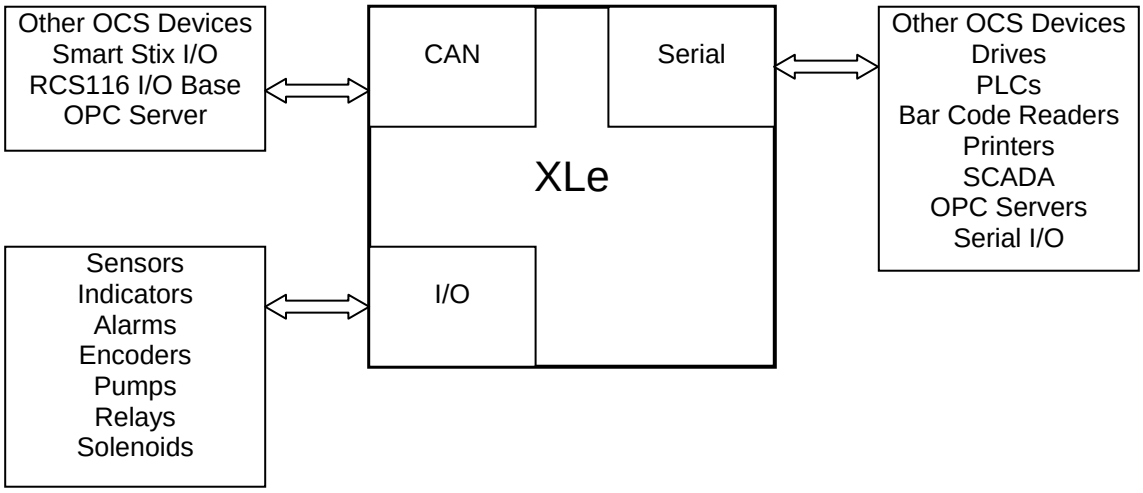


Figure 2.2 – Visual Overview of Types of Devices that can be connected to XLe

2.2 Features of XLe

The XLe is an all-in-one industrial control device. It combines control, user interface, I/O and networking into a single, integrated package. Unique features of the XLe include:

- Bright, graphical LCD display
- Display of complex graphical objects including trends, gauges, meters and animations
- Advanced control capabilities including floating point, multiple auto-tuning PID loops and string handling capabilities
- Removable media for up to one gigabyte of storage of programs, data logging or screen captures
- CsCAN networking port (optional) for communication with remote I/O, other controllers or PCs
- Configurable serial protocols for communication to drives, PLCs, or other serial peripherals
- Full featured, built-in I/O including high resolution analog, thermocouple, RTD, high speed counters, PWM outputs and relays (depending upon the XLe model used)
- Cscape programming software that allows all aspects of the XLe to be programmed and configured from one integrated application
- Optional communication add-on modules that allow additional capabilities such as Ethernet or modems

2.3 Required and Suggested Accessories

The following list contains a sampling of required and suggested XLe accessories. Visit our website (see page 80) to view updates on new products and accessories.

Note: The XLe is not shipped with a programming cable in the box. To obtain a programming cable, order HE500CBL300.

Table 2.1 – XLe Accessories

Part Number	Description
HE-XEC	10/100 Ethernet option kit - field installable. Kit includes all parts necessary for internal installation within the XLe case, including a deeper plastic back cover adapted for Ethernet operation.
HE-XMC	14.4 k Telephone modem option kit - field installable. Kit includes all parts necessary for internal installation within the XLe case, including a deeper plastic back cover adapted for modem operation.
HE-MC1	Removable Media card - compatible with XLe. Card capacity is 256 MB or larger.
HE-MR1	Media Card Reader for HE-MC1. Portable device allows HE-MC1 to be plugged into the USB port of personal computers as a portable hard drive.
HE-X24-AS	Power supply 100-240VAC or 140-340VDC Switching supply that outputs 1.5 A / 3 A (HE-X24-AS/AL) at 24 VDC. Mounts on Standard DIN rail. Designed for X Family products.
HE-X24-AL	Power supply 100-240 VAC or 140-340 VDC Switching supply that outputs 1.5 A / 3 A (HE-X24-AS/AL) at 24VDC. Mounts on Standard DIN rail. Designed for X Family products.
HE500OSW232	Cscape Software Package. Includes Cscape CD, 9-pin OCS Programming Cable, RJ-45 Programming Cable, Documentation
HE500CBL300	OCS Programming Cable, 9-pin female (PC) to RJ-45 (OCS) - 6 feet.
HE500USB600	USB programming kit. Includes USB to RS-232 adapter, and 6-foot RS-232 cable with D-sub connections. Requires HE500CBL300 to program the XLe.

2.4 Useful Documents and References

The following information serves as a *general* listing of Horner controller products and other references of interest with their corresponding manuals numbers. Visit our website (see page 80) to obtain user documentation and updates.

Note: This list is not intended for users to determine which products are appropriate for their application; controller products differ in the features that they support. If assistance is required, refer to Technical Support (page 80).

Controllers	Manual Number
XLe Series (e.g., HE-XExxx)	MAN0805
QX Series (e.g., HE-QXxxx)	MAN0798
NX Series (e.g., HE-NXxxx)	MAN0781
LX Series (e.g., LX-xxx; also covers RCS116)	MAN0755
Color Touch OCS (e.g., OCSxxx)	MAN0465
OCS (Operator Control Station) (e.g., OCS1xx / 2xx; Graphic OCS250)	MAN0227
Remote Control Station (e.g., RCS2x0)	
MiniOCS (e.g., HE500OCSxxx, HE500RCSxxx)	MAN0305
Other Useful References	**Manual Number**
CAN Networks	MAN0799
Cscape Programming and Reference	MAN0313
Wiring Accessories and Spare Parts Manual	MAN0347

CHAPTER 3: MECHANICAL INSTALLATION

Note: Each XLe unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to XLe models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the XLe datasheets attached to it. Visit our website (see page 80) to obtain datasheets, user documentation, and updates.

3.1 Overview

The mechanical installation greatly affects the operation, safety and appearance of the system. Information is provided to mechanically install the unit such as cut-out sizes, mounting procedures and other recommendations for the proper mechanical installation of the unit.

3.2 Mounting Requirements

XLe products can be mounted through a panel or on DIN rail.

3.2.1 Mounting Procedures (Installed in a Panel Door)

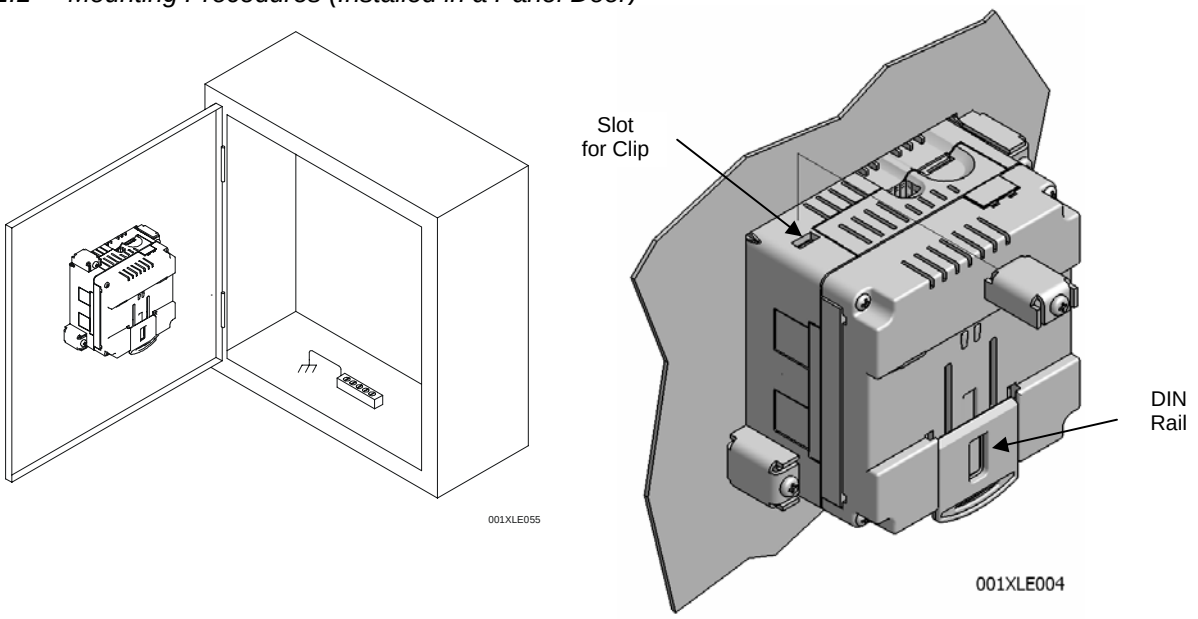


Figure 3.1 – Panel Mounting of the XLe and Close-up View of Back

Once the panel design has been completed using the criteria and suggestions in the following sections, use the following steps to panel mount the XLe.

1. Remove all connectors from the XLe unit.
2. Press the DIN rail clip up to make passing the unit through the cutout easier.
3. Make sure the gasket is installed on the XLe and is free from dust and debris. Check that the corners of the gasket are secure.
4. Pass the unit through the panel.
5. Insert the each of the four (4) mounting clips into the slots in the XLe case. One clip should be installed on each corner. Lightly tignten each screw so the clip is held in place.
6. Tighten the screws on the clips such that the gasket is compressed against the panel.

3.2.2 Mounting Procedures (Installed on DIN Rail)

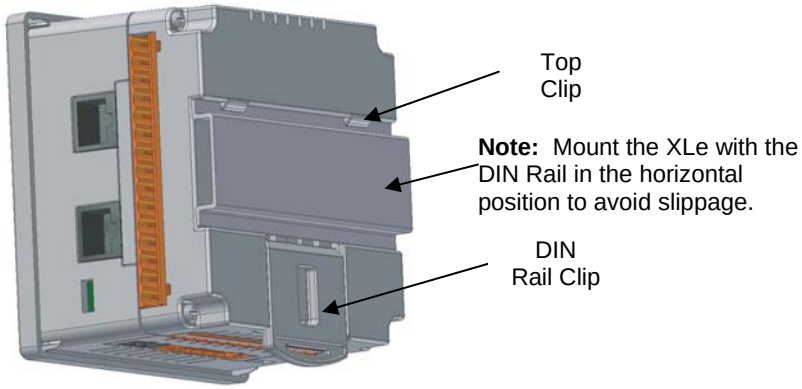


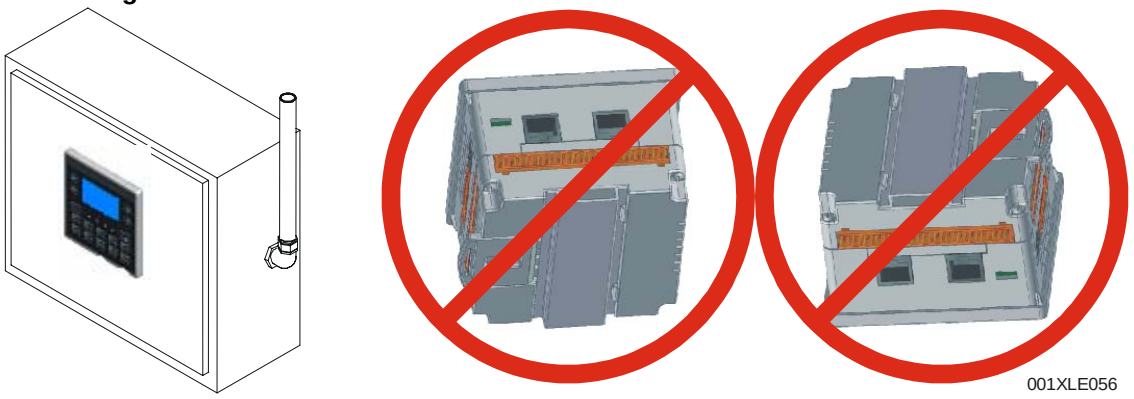
Figure 3.2 – DIN Rail Mounting of the XLe

The XLe is designed to clip onto standard 35 millimeter DIN rail. If your installation requires liquid or dust protection, make sure the XLe is placed in an appropriate sealed panel when mounting on DIN rail. Use the following steps to mount the XLe on DIN rail.

1. Move the DIN rail clip to the lower position.
2. Clip the "Top Clips" on the top of the DIN rail.
3. Press the unit into place and press the DIN rail clip up. A small flat-head screw driver can be used in the slot of the DIN rail clip if clearance is an issue.

Note: The DIN rail connection does not provide an earth ground. Refer to CHAPTER 4 for proper grounding information.

3.3. Mounting Orientation



NOTE: For panel or DIN rail mounting:
The orientation shown above provides for optimum readability of the screen and ease of use of the keypad.

CAUTION: For DIN Rail mounting:
To prevent the unit from slipping off the DIN Rail, do not install the unit on its sides as shown. Be sure the DIN Rail is in the horizontal position. .

Figure 3.3 – Orientation of XLe OCS

3.4 Panel Cut-Out

For installations requiring NEMA4X liquid and dust protection the panel cutout should be cut with a tolerance of ± 0.005" (0.1 mm). The XLe is designed to fit ¼ DIN panel openings. There are a number of punches and enclosures designed to accommodate opening of this size.

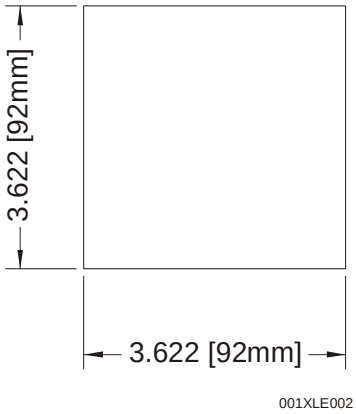


Figure 3.4 – XLe Panel Cut-out

3.5 Dimensions

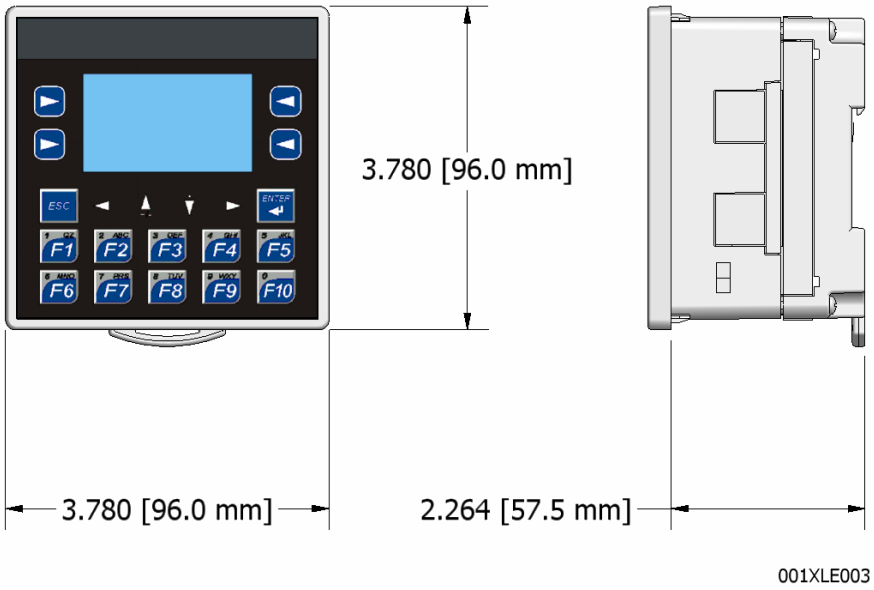


Figure 3.5 – XLe Dimensions

Note: When the communication add-on modules are installed such as Ethernet or Modem the depth of the product increase from 2.264 (57.5 mm) to 2.68 (68 mm).

3.6 Factors Affecting Panel Layout Design and Clearances

Warning: It is important to follow the requirements of the panel manufacturer and to follow applicable electrical codes and standards.

The designer of a panel layout needs to assess the requirements of a particular system and to consider the following design factors. *A convenient checklist is provided on page 19.*

a. Clearance / Adequate Space

Install devices to allow sufficient clearance to open and close the panel door.

Table 3.1 – Minimum Clearance Requirements for Panel Box and Door	
Minimum Distance between base of device and sides of cabinet	2 inches (50.80mm)
Minimum Distance between base of device and wiring ducts	1.5 inches (38.10mm)
If more than one device installed in panel box (or on door): Minimum Distance between bases of each device	4 inches between bases of each device (101.60mm)
When door is closed: Minimum distance between device and closed door (Be sure to allow enough depth for XLe.)	2 inches (50.80mm)

b. Grounding

Warning: Be sure to meet the ground requirements of the panel manufacturer and also meet applicable electrical codes and standards.

Panel box: The panel box needs to be properly connected to earth ground to provide a good common ground reference.

Panel door: Tie a low impedance ground strap between the panel box and the panel door to ensure that they have the same ground reference.

c. Temperature / Ventilation

Ensure that the panel layout design allows for adequate ventilation and maintains the specified ambient temperature range. Consider the impact on the design of the panel layout if operating at the extreme ends of the ambient temperature range. For example, if it is determined that a cooling device is required, allow adequate space and clearances for the device in the panel box or on the panel door.

d. Orientation

When panel-mounted, there are no orientation restrictions on the XLe. However, the orientation shown in Figure 3.3 provides for optimum readability of the screen and ease of use of the keypad. When DIN Rail mounted, observe the orientation shown in Figure 3.2.

e. Noise

Consider the impact on the panel layout design and clearance requirements if noise suppression devices are needed. Be sure to maintain an adequate distance between the XLe and noisy devices such as relays, motor starters, etc.

f. Shock and Vibration

The XLe has been designed to operate in typical industrial environments that may inflict some shock and vibration on the unit. For applications that may inflict excessive shock and vibration please use proper dampening techniques or relocate the XLe to a location that minimizes shock and/or vibration.

3.6.1 Panel Layout Design and Clearance Checklist:

The following list provides highlights of panel layout design factors.

____Meets the electrical code and applicable standards for proper grounding, etc.?

____Meets the panel manufacturer's requirements for grounding, etc.?

____Is the panel box properly connected to earth ground? Is the panel door properly grounded? Has the appropriate procedure been followed to properly ground the devices in the panel box and on the panel door?

____Are minimum clearance requirements met? (See **Table 3.1**.) Can the panel door be easily opened and closed? Is there adequate space between device bases as well as the sides of the panel and wiring ducts?

____Is the panel box deep enough to accommodate the XLe?

____Is there adequate ventilation? Is the ambient temperature range maintained? Are cooling or heating devices required?

____Are noise suppression devices or isolation transformers required? Is there adequate distance between the base of the XLe and noisy devices such as relays or motor starters? Ensure that power and signal wires are not routed in the same conduit.

____Are there other requirements that impact the particular system, which need to be considered?

NOTES

CHAPTER 4: ELECTRICAL INSTALLATION

Note: Each XLe unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to XLe models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the XLe datasheets attached to it. Visit our website (see page 80) to obtain datasheets, user documentation, and updates.

4.1 Grounding Definition

Ground: The term ***Ground*** is defined as a conductive connection between a circuit or piece of equipment and the earth. Grounds are fundamentally used to protect an application from harmful interference causing either physical damage such as by lightning or voltage transients or from circuit disruption often caused by radio frequency (RF) interference.

4.2 Ground Specifications

Ideally, a ground resistance measurement from equipment to earth ground is 0 ohms. In reality it typically is higher. The U.S. National Electrical Code (NEC) states the resistance to ground shall not exceed 25 ohms. Horner APG recommends less than 15 ohms resistance from our equipment to ground. Resistance greater than 25 ohms can cause undesirable or harmful interference to the device.

4.3 How to Test for Good Ground

In order to test ground resistance, a Ground Resistance Tester must be used. A typical Ground Resistance Meter Kit contains a meter, two or three wire leads, and two ground rods. Instructions are supplied for either a two-point or three-point ground test. **Figure 4.1** shows a two-point ground connection test.

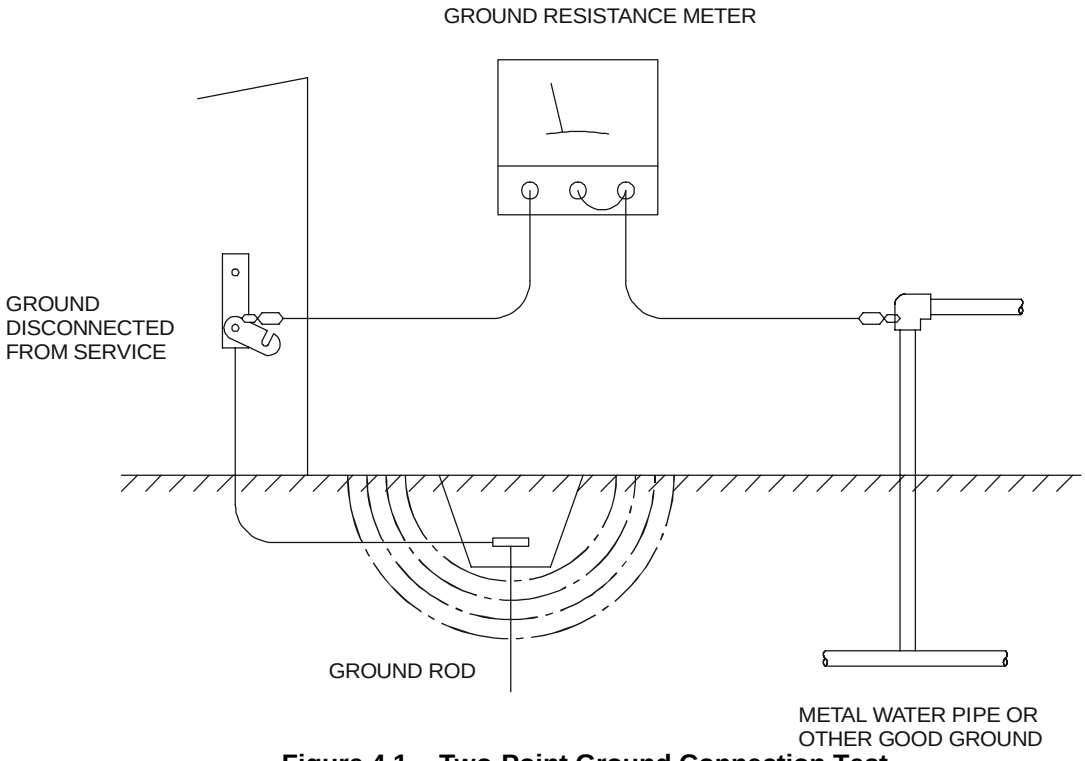


Figure 4.1 - Two-Point Ground Connection Test

4.4 Primary Power Port

Table 4.1 – Primary Power Port Pins		
Pin	**Signal**	**Description**
1	⏚	Frame Ground
2	0V	Input power supply ground
3	+24V	Input power supply positive voltage

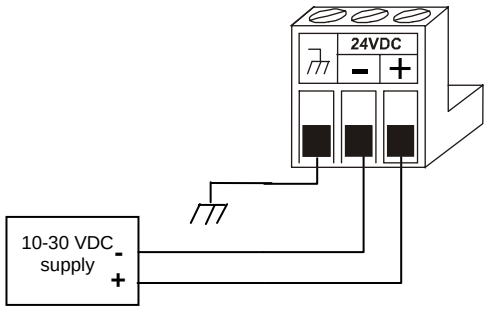


Figure 4.2 - Power Connector (Primary Power Port)

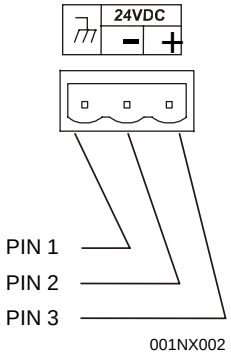


Figure 4.3 - As Viewed Looking at the XLe

CHAPTER 5: SERIAL COMMUNICATIONS

5.1 Overview

All XLE models provide two serial ports, which are implemented with 8-pin modular RJ45 connectors, and are labeled **MJ1** and **MJ2**. The MJ1 serial port is normally used for XLE programming by connecting it to the COM port of a PC running Cscape. In addition, both MJ1 and MJ2 can be used for application-specific communication, using a variety of standard data exchange protocols.

5.2 Port Descriptions

The MJ1 serial port contains both a half-duplex RS-485 interface and an RS-232 interface with RTS/CTS handshaking. **Note: MJ1 shares its serial port with the optional COM module, so when an optional Ethernet or Modem COM module is installed and active, the MJ1 connector is inactive.**

The MJ2 serial port contains both a full-duplex RS-485 interface and an RS-232 interface with no handshaking. Both the MJ1 and MJ2 RS-485 interfaces provide switchable termination and bias resistors internally.

5.3 Wiring

Figure 5.1 along with **Table 5.1** and **Table 5.2** show how the MJ1 and MJ2 serial port pins are assigned.

Note: MJ1 and MJ2 look the same but have different pin assignments and functions.

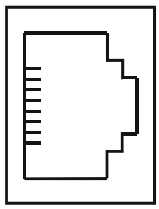


Figure 5.1 – MJ Serial Port Connector

Table 5.1 – MJ1 Serial Port Pin Assignments			
Pin	**Signal**	**Signal Description**	**Direction**
1	RX/TX+	RS-485 Receive/Transmit Positive	In/Out
2	RX/TX–	RS-485 Receive/Transmit Negative	In/Out
3	CTS[1]	RS-232 Clear to Send	Out
4	RTS[1]	RS-232 Request to Send	In
5	NC	No Connect	–
6	0V	Ground	–
7	TD[1]	RS-232 Transmit Data	In
8	RD[1]	RS-232 Receive Data	Out

Table 5.2 – – MJ2 Serial Port Pin Assignments			
Pin	**Signal**	**Signal Description**	**Direction**
1	RX+	RS-485 Receive Positive	In
2	RX–	RS-485 Receive Negative	In
3	TX+	RS-485 Transmit Positive	Out
4	TX–	RS-485 Transmit Negative	Out
5	NC	No Connect	–
6	0V	Ground	–
7	TD[1]	RS-232 Transmit Data	In
8	RD[1]	RS-232 Receive Data	Out

[1]Signals are labeled for connection to a DTE device

5.4 RS-485 Termination

Proper RS-485 termination minimizes reflections and improves reliability.

Both serial ports allow an internal 121-Ohm RS-485 termination resistor to be placed across pins 1 and 2. This can be done by installing a jumper. Please refer to the XLE data sheet for jumper locations.

In any case, only the two devices physically located at the endpoints of the RS-485 network should be terminated.

5.5 RS-485 Biasing

RS-485 biasing passively asserts a line-idle state when no device is actively transmitting, which is useful for multi-drop RS-485 networking.

Both serial ports allow internal 390-Ohm RS-485 bias resistors to be switched in, pulling pin 1 up to 3.3V and pulling pin 2 down to ground. The Set Serial Ports item in the System Menu (see page 52) can be used to enable RS-485 biasing. Also, an application graphics screen that writes to %SR164 can do the same thing. Setting %SR164.1 enables MJ1 biasing and setting %SR164.2 enables MJ2 biasing.

If biasing is used, it should be enabled in only one of the devices attached to the RS-485 network.

5.6 Cscape Programming via Serial Port

The XLE MJ1 serial port supports CsCAN Programming Protocol, but MJ2 does not. If a PC COM port is connected to the XLE MJ1 serial port, Cscape can access the XLE for programming and monitoring.

5.7 Ladder-Controlled Serial Communication

Using Serial Communication function blocks, both MJ1 and MJ2 support Generic, Modbus Master and Modbus Slave Protocols. In addition, external modems can be connected and accessed using Init, Dial and Answer Modem function blocks.

5.8 Downloadable Serial Communication Protocols

Both MJ1 and MJ2 also support downloadable protocols, such as Allen Bradley DF1, CsCAN Master, GE Fanuc SNP and Modbus Master.

CHAPTER 6: CAN COMMUNICATIONS

Note: For additional CAN information, refer to the CAN Networks manual (MAN0799) on our website. (See page 80 for our website address.)

6.1 Overview

Some XLE models (XE1xx) provide a CAN networking port, which is implemented with a 5-pin connector, labeled **NET1**.

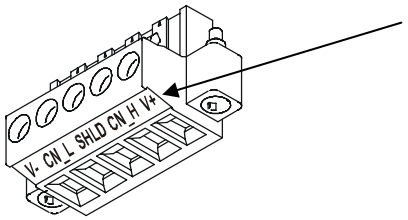
Like the MJ1 serial port, the NET1 port can be used for XLE programming by connecting it to the CAN port of a PC running Cscape. The NET1 port also allows the XLE to exchange global data with other OCS/RCS controllers and to access remote Network I/O devices (SmartStix Modules).

6.2 Port Description

The XLE NET1 port implements the ISO 11898-2 physical layer and the CAN 2.0A data link layer standards. Also, since the NET1 port is powered by an internal isolated power supply, external CAN power is not required.

6.3 Wiring

Figure 6.1 and **Table 6.1** show how the NET1 port pins are assigned.



Note: The V+ connection is not required on the XLe. The XLe network port is self-powered. Supporting devices can require this connection, and this pin can be used to land the extra wire required for those devices.

Figure 6.1 - NET1 Port Connector

Table 6.1 – NET1 Port Pin Assignments

Pin	Signal	Signal Description	Direction
1	V-	CAN Ground	–
2	CN_L	CAN Data Low	In/Out
3	SHLD	Shield Ground	–
4	CN_H	CAN Data High	In/Out
5	NC	No Connect	–

6.4 Cscape Programming via CAN

The NET1 port supports CsCAN Programming Protocol. If a PC has a CAN interface installed (via PCI card or USB), and the PC CAN port is connected to the XLE NET1 port, Cscape can access the XLE for programming and monitoring.

In addition, the XLE supports single-point-programming of all XLE and other OCS/RCS devices that are connected to a CAN network. If the PC COM port is connected to the XLE MJ1 serial port (see CHAPTER 5), the XLE can act as a pass-through gateway allowing Cscape to access all XLE and OCS/RCS devices that are attached to the CAN network.

6.5 Ladder-Controlled CAN Communication

Using Put and Get Network Words function blocks, the NET1 port can exchange digital and analog global data with other XLE or OCS/RCS devices (nodes) attached to the CAN network.

In addition, Put and Get Network Heartbeat function blocks allow nodes on the CAN network to regularly announce their presence and to detect the presence (or absence) of other nodes on the network.

6.6 Using CAN for I/O Expansion (Network I/O)

Connecting Network I/O devices (SmartStix Modules) to the XLE NET1 port, allows the XLE I/O to be economically expanded and distributed. A variety of SmartStix Modules is available for this purpose.

CHAPTER 7: COMMUNICATION OPTIONS

7.1 Overview

To supplement the built-in MJ1 and MJ2 serial ports (see CHAPTER 5), additional communication options are available. This is accomplished by installing a COM module internal to the XLe controller. Currently, there are two COM modules available for this purpose: Ethernet (XEC) and Modem (XMC).

Note: MJ1 shares its serial port with the optional COM module, so when an Ethernet or Modem COM module is installed and active, the MJ1 connector is inactive.

Internal to the XLe, there is a CPU board, and up to two installed modules. Models XE000 and XE100 have no installed I/O or COM modules. All other models have an I/O module in Slot 1 and can have a user-installed COM module in Slot 2.

This chapter briefly describes both the Ethernet and Modem COM module options. For detailed information regarding these modules, please refer to the individual documents provided with the modules.

7.2 Ethernet COM Module (XEC) Option

An Ethernet COM module can be installed to allow Cscape programming of an XLe over a Local Area Network or over the Internet. In addition, the Horner OPC Server can be installed on a PC to allow other standard PC applications (such as database and spreadsheets programs) access to XLe register data.

The Ethernet COM module supports both 10 BaseT (10 MHz) and 100 BaseTx (100 MHz) as well as both half and full duplex communication. Both the connection speed and the duplex are auto-negotiated.

Although the physical connection between the Ethernet COM Module and the Local Area Network is done using a standard Ethernet cable (CAT5 or better with RJ45 modular plug), a **Serial Port Tunnel** protocol is employed that makes the Ethernet COM Module appear as a serial port to Cscape or OPC Server software running on the PC.

On the XLe end of the Serial Port Tunnel, the Ethernet COM module should be properly configured using the XLe System Menu (see CHAPTER 11). This configuration consists of making Ethernet the Default Programming Port and setting its target IP Address, Net Mask and optionally the Gateway IP Address. The Gateway IP Address is required if the XLe will be accessed from outside the Local Area Network (e.g. the Internet).

On the PC end of the Serial Port Tunnel, the PC should be connected to the Local Area Network (or to the Internet) and a **Com Port Redirector** driver must be installed on the PC and properly configured. The Com Port Redirector allows multiple “virtual” PC serial ports to be created and each one can be assigned to a different target device IP Address, thus allowing access to Ethernet COM modules in multiple XLe controllers.

After installing and configuring both the Ethernet COM module and the Com Port Redirector, Cscape or OPC Server software should be set up to communicate to one of the “virtual” serial ports, at which point they should function as if a “real” PC serial port was connected to the XLe MJ1 serial port.

7.3 Modem COM Module (XMC) Option

A Modem COM module can be installed to allow Cscape programming of an XLe over a dial-up network. In addition, the application ladder program can take control of the modem for application-specific modem communication.

The Modem COM module supports the standard AT command set and can connect to the dial-up network at speeds up to 14.4 KBaud. Connection speed is auto-negotiated. The Modem COM module connects to the dial-up network (phone line) via a cable with a standard RJ11 modular plug.

To enable Cscape programming via a dial-up network, the Modem COM module should first be configured as the Default Programming Port, using the XLe System Menu (see CHAPTER 11). Doing this puts the Modem COM module in auto-answer mode, so Cscape can call the XLe via a remote modem.

To program the ladder application to communicate via the Modem COM module, standard Cscape Serial and Modem function blocks can be used.

CHAPTER 8: REMOVABLE MEDIA

8.1 Overview

All XLE models provide a Removable Media slot, labeled **Memory**, which supports standard Micro SD Flash memory cards. Micro SD cards can be used to save and load applications, to capture graphics screens and to log data for later retrieval.

8.2 Micro SD Cards

When the Micro SD card format was introduced, it was originally called TransFlash. Cards labeled either Micro SD or TransFlash, with up to 2.0 GB of Flash memory, are compatible with the XLE Memory slot.

The XLE Memory slot is equipped with a "push-in, push-out" connector and a Micro SD card can be safely inserted into the Memory slot whether the XLE power is On or Off.

To install a Micro SD card: Align its 8-pin gold edge connector down, facing the front of the XLE unit as shown in **Figure 8.1**; then carefully push it all the way into the Memory slot. Ensure that it clicks into place.

To remove the Micro SD card: Push down on the top of the card gently to release the spring. The card pops up for removal.

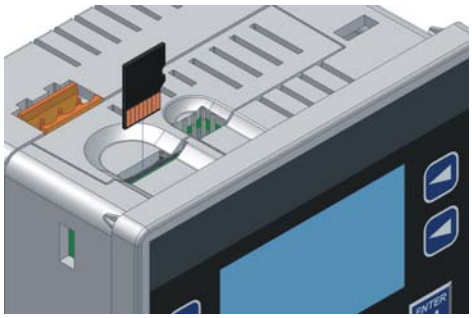


Figure 8.1 – Installing Removable Memory Card

8.3 Micro SD File System

The XLE Micro SD Memory slot uses the PC-compatible FAT16 File System. This means that a PC, with a Micro SD-compatible card reader, can read files that have been written by the XLE and can write files that can be read by the XLE.

However, the XLE does not support long filenames, but instead implements the 8.3 filename format. This means that all file and directory names must consist of up to 8 characters, followed by an optional dot, and an optional extension with up to 3 characters.

Directories and sub-directories can be nested up to 16 levels deep as long as each pathname string does not exceed 147 characters.

8.4 Using the Removable Media Manager

The Removable Media Manager is an interactive XLE screen that performs the following functions:

- Display number of total and free bytes
- Browse file and directory lists
- Delete files and directories
- Format a Micro SD card
- Load and save application programs
- View screen capture bitmaps

The Removable Media Manager can be accessed via the System Menu (see CHAPTER 11) or by using Cscape to place a Removable Media Manager object on an application graphics screen.

8.5 Using Removable Media to Log Data

Using Read and Write Removable Media function blocks, an application ladder program can read and write XLE register data in the form of comma-delimited files, with a .CSV extension. These files are compatible with standard database and spreadsheet PC programs. In addition, an application ladder program can use Rename and Delete Removable Media function blocks to rename and delete files.

8.6 Using Removable Media to Load and Save Applications

A special file type, with a .PGM extension, is used to store XLE application programs on Micro SD.

To load an application from Micro SD to the XLE, use the Removable Media Manager to find and highlight the desired .PGM file, and then press **Enter**.

To save an application from the XLE to Micro SD, open the Removable Media Manager in the System Menu and press the F4 function key. The application will be saved in a file called **DEFAULT.PGM** in the Micro SD root directory.

> **Note:** Saving an application to Micro SD can only be done from the System Menu and is not available on a Removable Media Manager object that was placed on an application graphics screen by Cscape.

Cscape can also save an application directly to a Micro SD card, which is plugged into the PC's Micro SD compatible card reader by selecting the Export to Removable Media item on the **File** menu.

8.7 Using Removable Media to View and Capture Screens

The XLE File System uses bitmap files, with a .BMP extension, to store XLE graphics screen captures.

To view a captured XLE screen, use the Removable Media Manager to find and highlight the desired .BMP file, and then press **Enter**.

To capture an XLE screen, turning On the assigned **Screen Capture Control Register** will capture the current XLE graphics screen and write it to the Micro SD card using the assigned **Screen Capture Filename**.

Before capturing an XLE screen, Cscape must first be used to assign a **Screen Capture Control Register** and **Filename** in the application. To do this, first open the Graphics Editor by selecting the **View / Edit Screens** item on the Cscape **Screens** menu. Next select the **Screen Capture** item of the Graphics Editor Config menu and then enter a **Control Register** and **Filename**.

NOTES

CHAPTER 9: GENERAL I/O

Note: Each XLe unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to XLe models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the XLe datasheets attached to it. Visit our website (see page 80) to obtain datasheets, user documentation, and updates.

9.1 Overview

The XLe is a compact unit that contains high density, very versatile I/O. Using the I/O properly requires wiring to the proper terminals, configuring jumpers inside the XLe unit and configuring Cscape properly. This section will offer some tips and suggestions to configure the I/O properly. For the register mapping of the I/O, refer to CHAPTER 13.

9.2 Removing the XLe Back Cover

Warning: Power, including I/O power must be removed from the unit prior to removing the back cover. Failure to do so could result in electrocution or damage to equipment.

Some I/O configurations require jumper settings to be changed inside the XLe unit. Examples of these settings are setting positive or negative logic on digital inputs or setting current or voltage on analog inputs.

Each XLe I/O jumper is set to a factory default. Refer to the data sheet for your XLe model to find the default setting to determine if a jumper change is necessary for your application.

To remove the back cover of the XLe, remove the four (4) Phillips screws from the back of the unit. It may help to place the XLe unit face down on a clean work surface. Once the four screws are removed the back cover can be lifted straight off.

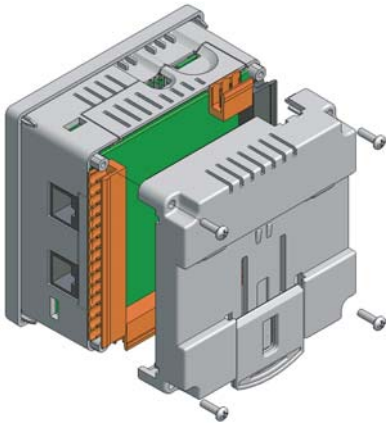


Figure 9.1 – Removing the Back Cover

Once the back is removed the jumper selection can be changed. The jumper settings are documented on each data sheet using a diagram such as Figure 12.2 below and a description of the jumper settings.

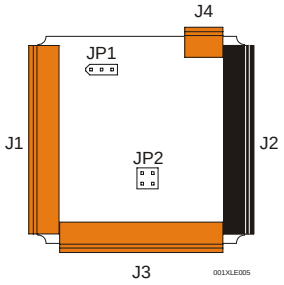


Figure 9.2 – Example Jumper Diagram

To re-install the back cover, place the cover back on the unit. The DIN clip should be on the same side as the power connector.

Place the screw back into the hole and turn the screw slowly counter clockwise until it clicks into the threads. This prevents the screw from being cross-threaded. Now turn the screw clock-wise until the cover is firmly secured. Repeat this process for all four (4) screws.

9.3 Model and I/O Overview

Table 9.1 – I/O and Model Overview						
Model	**Solid State Digital Outputs**	**Relay Outputs**	**Digital Inputs**	**Analog Inputs**	**Universal Analog Inputs**	**Analog Outputs**
HEXExx0						
HEXExx2		✓	✓	✓		
HEXExx3	✓		✓	✓		
HEXExx4	✓		✓	✓		
HEXExx5	✓		✓		✓	✓

Table 9.1 shows the different types of I/O included with the various XLe models. Specific specifications, jumper settings and wiring diagrams can be found on the data sheets attached at the end of the manual. Descriptions and applications of the different type of I/O can be found below.

9.4 Solid-State Digital Outputs

Solid-state digital outputs are generally used to activate lamps, low voltage solenoids, relays and other low voltage and low current devices.

The digital outputs used on the XLe are “sourcing” outputs. This means the output applies a positive voltage to the output pin when turned ON. When turned off, the output applies approximately zero volts with respect to the I/O ground.

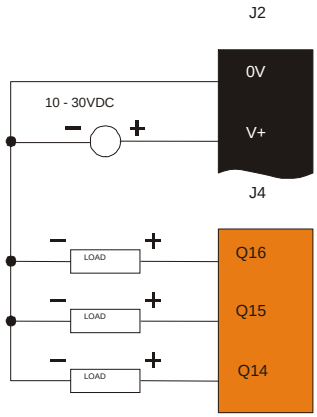


Figure 9.3 – Typical Output Wiring

The digital outputs used in the XLe have electronic short circuit protection and current limiting. While these electronic protections work in most applications, some application may require external fusing on these outputs.

The digital outputs in the XLe are typically controller via %Q bits in the register mapping. Some of the outputs are designed for high-speed applications and can be used for PWM or frequency output applications. Please see the data sheet and the chapter on High Speed I/O for additional information.

When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default digital outputs turn off. For more information on stop state see the configuration chapter for Cscape settings.

The digital outputs feature an output fault bit. %I32 will turn on if any of the outputs experience a short circuit, over-current or the output driver overheats.

9.5 Relay Outputs

Relay outputs are designed to switch loads that typically have high voltage or current requirements or require isolation that relays provide.

The design of the XLe does not require external coil power for the relays to functions. The relays will activate anytime the XLe is powered.

There are several factors that should be considered when using relays.

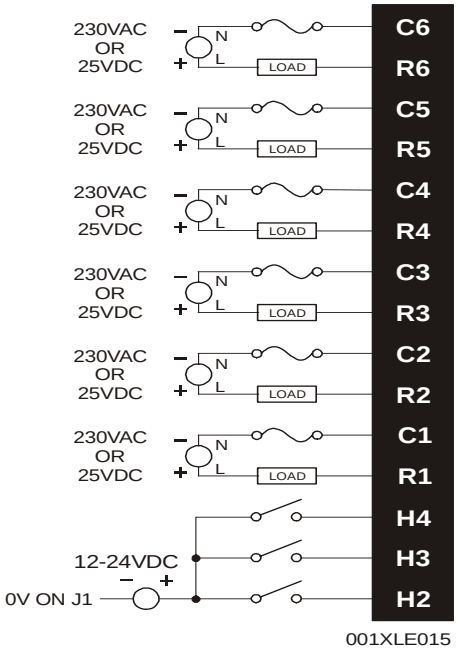
Relay Life – Relays are mechanical devices that have a long but limited life. Typically the switching more current limits the life of relays. Please check the data sheets at the end of this manual for expected relay life.

Current / Temperature De-Rating – Products containing relays often have total current limits based on the ambient temperature of the application. Please see the product data sheet for current / temperature de-rating information for relays.

Fusing – External fusing is generally required to protect the relays, devices and wiring from shorts or overloads.

Warning: To protect the module and associated wiring from load faults, use external **(5 A)** fuse(s) as shown. Fuses of lower current or fusing for the entire system need to be in place to assure the maximum current rating of the unit is not exceeded.

Warning: Connecting high voltage to any I/O pin can cause high voltage to appear at other I/O pins.



Protection for Inductive Loads – Inductive loads can cause reverse currents when they shut off that can shorten the life of relay contacts. Some protective measures need to be determined by an engineer. Below you will find recommendations that will work for many applications. If you have additional questions on protection from inductive load, consult an application engineer or Technical Support (page 80).

DC Loads – General purpose diode (IN4004) in reverse bias across the load.

AC Load – MOV (Harris V140xxx for 120V, V275xx for 220V)

Output State on Controller Stop

When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default relay outputs turn off. For more information on stop state see the configuration chapter for Cscape settings.

9.6 Digital Inputs

Note: See the CHAPTER 10 for high speed I/O information and refer to the datasheet for XLe model you are using for details on jumper settings.

The digital inputs on the XLe are designed for low voltage DC inputs. The inputs are designed to support both positive and negative input modes. The mode is set by a jumper setting and a configuration parameter in Cscape. All the inputs on the unit must be configured to the same mode.

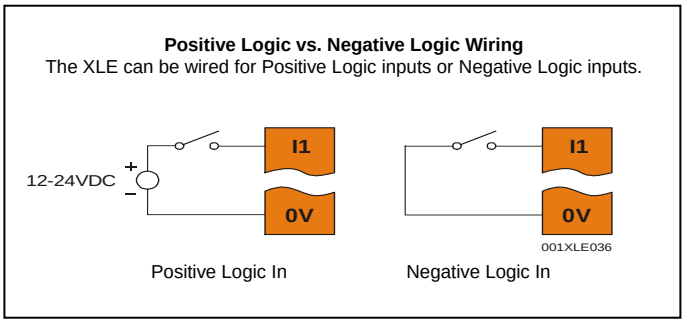


Figure 9.4 – Positive and Negative Inputs

In positive logic mode a positive voltage applied to the input will turn the input. The internal design of this mode is basically a resistor from the input to I/O ground. This mode is sometimes called sourcing.

In negative logic mode, connecting the input to the I/O ground or zero volts will turn the input on. The internal design of this mode is basically a resistor from the input to the positive I/O voltage (usually 12 or 24 volts). This mode is sometime called sinking.

Some of the digital inputs may support high speed input functional such as counting or frequency measurement.

9.7 Analog Inputs

Note: See the data sheet for the XLe model you are using for jumper settings and CHAPTER 14 for details on how to use Cscape to configure the digital filtering.

The analog inputs on the XLe allow voltage or current measurement from a variety of devices. The voltage or current mode is set though jumpers on the unit and settings in Cscape. Each channel can be separately configured for voltage or current mode.

The analog inputs have a digital filter that can be used to filter electrical noise that may be unavoidable in some installations. The downside to digital filtering is the inputs will respond more slowly to sudden changes in the actual input.

9.8 Universal Analog Inputs

Note: See the data sheet for the XLe model you are using for jumper settings and CHAPTER 14 for details on how to use Cscape to configure the digital filtering.

The universal analog inputs provide a high resolution, very flexible interface for a variety of analog inputs. These inputs include voltage, current, thermocouple, RTD and millivolt. Each channel can be configured separately using jumpers and configuration settings in Cscape.

Like the standard analog inputs, these inputs have a digital filter that can be used to filter electrical noise that may be unavoidable in some installations. The downside to digital filtering is the inputs will respond more slowly to sudden changes in the actual input.

9.9 Analog Outputs

Note: See the CHAPTER 10 for high speed I/O information and refer to the datasheet for XLe model you are using for details on jumper settings.

The analog outputs on XLe devices provide high resolution voltage or current outputs. The voltage or current selection is controlled with jumpers and configuration settings in Cscape. Note that each channel can be separately configured for voltage or current mode.

When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined value. By default analog outputs are set to a value of zero. For more information on Stop State, see CHAPTER 14 for the configuration chapter for Cscape settings.

CHAPTER 10: HIGH SPEED I/O (HSC / PWM)

10.1 Overview

In addition to the compliment of simple analog and digital I/O, several of the XLE I/O modules support High Speed Counting (HSC) I/O functions and may also support Pulse Width Modulation (PWM) Output functions. The HSC functions include: frequency, totalizing, pulse width and quadrature measurement. The PWM functions include: traditional PWM (with variable rate and duty) and a stepper (limited functionality) with variable acceleration and deceleration rates. To determine function availability, refer to the associated model's Specification/Installation sheet (Digital DC Input/Output sections).

This chapter describes the operation of these high level I/O functions. For configuration details of these functions, see Cscape Configuration (page 66).

10.2 High Speed Counter (HSC) Functions

On units that support the HSC, four dedicated inputs are available than can be configured for one of four modes of operation. Those modes are Frequency, Count (totalize), Pulse width or period (pulse) and Quadrature measurement. For some modes, more than one HSC input may be consumed. The measurement value is provided to ladder in a %AI register (see mapping below).

> **Note that while the high-speed input circuitry has a resolution of 1 µs, measured edge transitions must not occur faster than 100 µs for accurate measurements. Keep in mind that pulse width measurements utilize both the rising and falling edges of the waveform, thus the pulse width must exist longer than 100 µS.**
>
> **Note that the *edge* polarity selection in the mode parameter for the totalize and pulse width functions (Digital/HSC Input Configuration) assume Positive Logic regardless of the associated I/O board's jumper setting for the *Digital DC inputs polarity*. If Negative logic is configured when using these functions, the opposite edge polarity must be selected in the mode parameter.**

a. Frequency

In frequency mode, the frequency of the input signal is written to the accumulator in terms of Hertz (cycles/second). When using frequency mode, four update selections are provided which specify the width of the sample window. Note that selecting a shorter sample window provides a quicker measurement (faster response) but lowers the frequency accuracy (resolution) and increases the minimum frequency measurement limit.

b. Totalize

In totalize mode, the accumulator is simply incremented each time the input transitions in a specific direction. Totalize mode is configurable to specify the edge (rising or falling) on which the accumulator is incremented.

Rising Edge Signal Falling Edge Signal

Three different options are available to reset the current count. They are:

- Configured reset value
  When configuring the Totalize function, a value may be specified under the *Counts per Rev* column. When the totalizer accumulator reaches this value - 1, the accumulator will reset to zero on the next count. Specifying zero for this value allows the totalizer to count through the full 32-bit range before resetting.

- Ladder control
  Setting registers %Q17-20 reset HSC1-4 (respectively) with no additional configuration. When these registers are asserted, the associated totalizer accumulator is reset and held at zero (level sensitive). *See also Section 10.6.*

- Direct digital input control (HSC1 and HSC2 only)
  HSC3 (%I11) and HSC4 (%I12) may be configured as hardware digital reset signals for HSC1 and HSC2 (respectively). To enable these inputs as reset signals, specify the type as *Totalize Reset* (note that the corresponding Totalize HSC must be previously configured before this option is available). The direct digital reset controls are edge sensitive with the edge polarity configurable.

  Maximum direct digital reset latency is 100 µs.

The totalize function also supports an option which compares the current accumulator value with a supplied Preset Value (PV), which is provided through a %AQ, and drives a physical digital output based on the that comparison.

- This option (available for HSC1 and HSC2 only) drives Q1 or Q2 output point (respectively) once the associated totalizer accumulator reaches (or exceeds) the PV value. To enable this function, the corresponding PWM function output (Q1 or Q2) must be configured for *HSCx Output*.

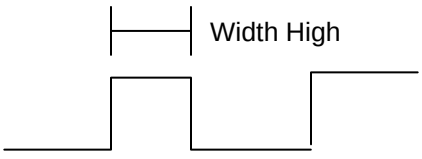
  Note that Q1 and Q2 are PWM function outputs that may be configured independently as one of the following: standard digital output, PWM, HSCx or stepper output.

  Preset values may be modified during run-time. A preset value of zero disables (resets) the totalizer compare function output causing the output to remain low.

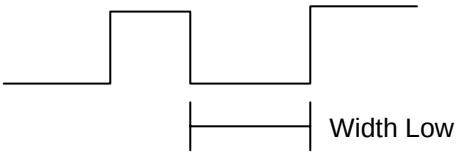
c. Pulse

In pulse mode, the high-speed input can measure the width or period of a pulse stream in one of four modes and provides a continuous indication of the last sampled value.

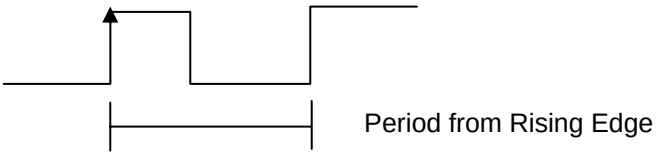
Width High 1 µs Counts – In this sub-mode the accumulator value will contain the number of 1 µs counts the pulse is high.



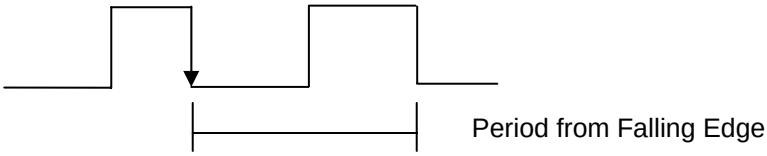
Width Low 1 µs Counts - In this sub-mode the accumulator value will contain the number of 1 µs counts the pulse is low.



Period Rising Edges 1 µs Counts – In this sub-mode the period of the input signal is reported in one (1) µs units. The period measurement will start on the rising edge of the input.



Period Falling Edges 1 µs Counts – In this sub-mode the period of the input signal is reported in one (1) µs units. The period measurement will start on the falling edge of the input.

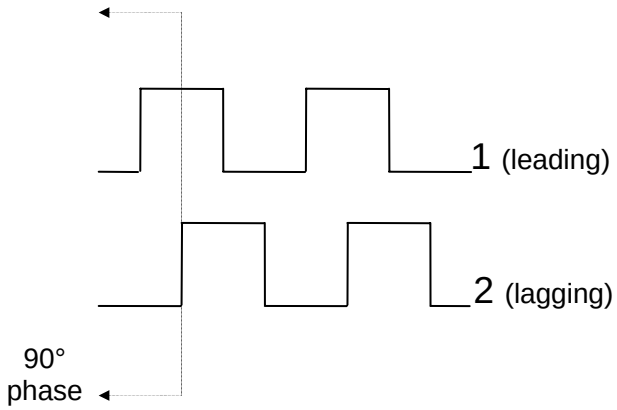


d. Quadrature

Two HSC inputs are consumed for each of the two possible Quadrature counters. For example, selecting quadrature mode for HSC 1 will use HSC inputs 1 and 2, which correspond to A and B quadrature signals. Therefore, HSC 1 and 3 may be configured for quadrature input. Alternately, HSC 3 may be configured to reset HSC1 (quadrature) count on a marker input

Quadrature mode works much like the totalizer except the accumulator will automatically increment or decrement based on the rotation phase of the two inputs. See the following example for more details. Quadrature inputs are typically used for reporting the value of an encoder.

Two modes are available for quadrature that select whether the accumulator counts up or down when the phase of input 1 leads input 2. Check your encoder's documentation to determine the output form it uses or try both modes to determine if the encoder counts up when expected.



Using the above waveforms and a HSC input configuration of "Quadrature" - "1 leads 2, count up," the accumulator will count up when 1 is rising and 2 is low, 1 is high and 2 is rising, 1 is falling and 2 is high, and when 1 is low and 2 is falling. This results in 4 counts per revolution. So in order to determine the number of cycles, the accumulator would have to be divided by 4.

Three different options are available to reset (or set) the current count. They are:

- Configured *Counts per Rev* value
  When configuring the quadrature function, a value may be specified under the *Counts per Rev* column. When rotation produces an increasing count, the quadrature accumulator resets to zero on reaching the *Counts per Rev* count. Alternately, when rotation produces a decreasing count, the quadrature accumulator is set to *Counts per Rev* – 1 on the count following zero. Specifying zero for this value allows the totalizer to count through the full 32-bit range before resetting.

  For example if your encoder outputs 1024 counts per revolution, the value of 1024 can be entered into the configuration for *Counts per rev*. This will result in a counter that produces counts in the range of 0 to 1023.

- Ladder control
  Setting registers %Q17 or Q19 resets quadrature (HSC) 1 or quadrature (HSC) 3 (respectively) with no additional configuration. Setting registers %Q18 or Q20 sets quadrature (HSC) 1 or quadrature (HSC) 3 (respectively) to *Counts per Rev* – 1.

- Direct digital input control (HSC3) [Marker]
  When HSC input 1 and 2 are used for quadrature inputs, an additional choice of marker input becomes available for HSC input 3. The marker input is typically part of an encoder or motion system that signals when a cycle of motion is complete. When the marker input is triggered, the accumulator is reset to zero or to *Counts per rev - 1* based on rotation direction.

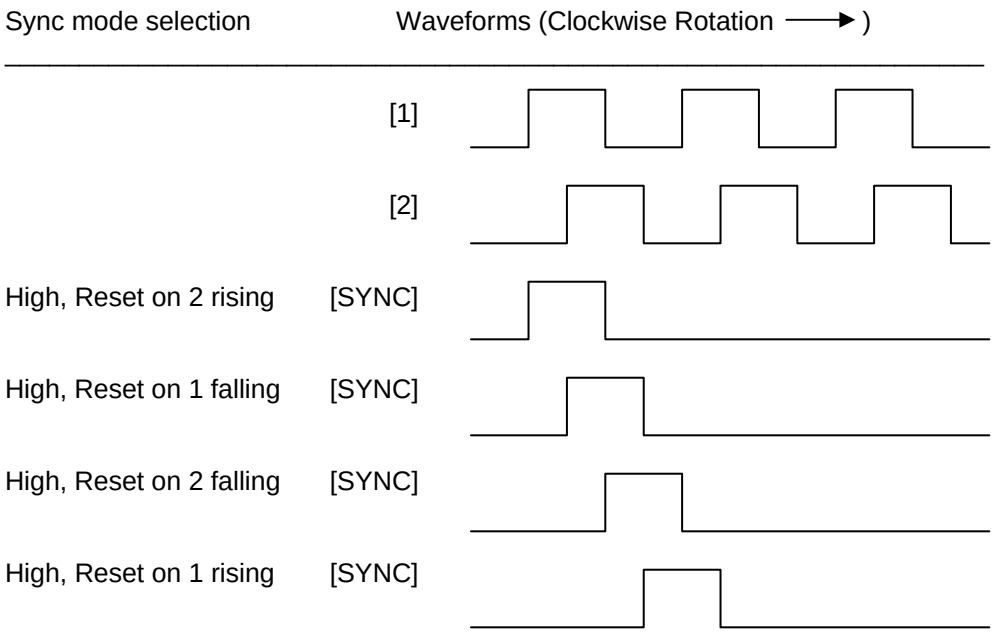
  Marker reset operation is enabled when HSC3 is configured for *Marker* type. Once selected, one of several modes is available for marker operation. These modes can be sub-divided into two groups of marker operation.

  Asynchronous modes ignore the quadrature inputs and reset the quadrature accumulator to zero on the configured edge (rising, falling or both). These are the most common settings used. When configuring, asynchronous mode selections are prefixed with the word *Async.*

Synchronous modes synchronize the reset (or set) to the selected quadrature input and the selected marker polarity. Figure 10.1 below indicates which mode to select based on the markers timing diagram. Consult the documentation provided with your encoder to determine the marker pulse timing.

Note that the Marker input is sampled within 50 micro seconds of the associated quadrature edge. It is left to the user to determine if this meets the time constraints of the measured drive.

Note that if the Marker input pulse consecutively spans more than one of the specified edges, quadrature-decoding operation is unpredictable.



*While not displayed in this figure, modes for low level (inverse logic) are also supported for each state.

Figure 10.1 – Sync pulse mode illustration

The accumulator is reset to zero on the specified edge if rotation is clockwise (as shown in figure 10.1 above). However, if rotation is reversed, the accumulator is alternately set to *Counts per rev* – 1 on that same physical edge. When direction is reversed, that same physical edge is seen (by the internal decoder) as having the opposite edge polarity as shown below.

Mode	Direction	A (HSC1)	B (HSC2)	Marker (HSC3)	Reset Value
Async, Reset on rising edge				Rising	0
Async, Reset on falling edge				Falling	0
Async, Reset on both edge				Both	0
High, Reset on 1 rising	Clockwise	Rising		High	0
"	Counter	Falling		High	CPR - 1
Low, Reset on 1 rising	Clockwise	Rising		Low	0
"	Counter	Falling		Low	CPR - 1
High, Reset on 1 falling	Clockwise	Rising		High	CPR - 1
"	Counter	Falling		High	0
Low, Reset on 1 falling	Clockwise	Rising		Low	CPR - 1
"	Counter	Falling		Low	0
High, Reset on 2 rising	Clockwise		Rising	High	0
"	Counter		Falling	High	CPR - 1
Low, Reset on 2 rising	Clockwise		Rising	Low	0
"	Counter		Falling	Low	CPR - 1
High, Reset on 2 falling	Clockwise		Rising	High	CPR - 1
"	Counter		Falling	High	0
Low, Reset on 2 falling	Clockwise		Rising	Low	CPR - 1
"	Counter		Falling	Low	0

10.3 HSC Functions Register Map

Register	Frequency	Totalize	Pulse	Quad
%AI5-6	HSC1 (function) Accumulator			Quad 1 Acc
%AI7-8	HSC2 (function) Accumulator			
%AI9-10	HSC3 (function) Accumulator			Quad 2 Acc
%AI11-12	HSC4 (function) Accumulator			
%AQ1-2		HSC1 Preset		
%AQ3-4		HSC2 Preset		
%Q17		Clear HSC1		Clear Quad 1
%Q18		Clear HSC2		Set Quad 1
%Q19		Clear HSC3		Clear Quad 2
%Q20		Clear HSC4		Set Quad 2

10.4 Pulse Width Modulation (PWM) Functions

On units that support the PWM, two dedicated outputs are available than can be configured for one of four modes of operation. Those modes are Normal, PWM, HSC (count = PV) and Stepper.

a. Normal

When either Q1 or Q2 is configured for Normal operation, the digital output registers %Q1 and %Q2 drives that respective output.

b. PWM

When either Q1 or Q2 is configured for PWM, the PWM function drives that respective output. Both PWM channels may be individually enabled; however, when both PWM outputs are enabled, both share the to the same output frequency (with the low going pulses synchronized). Otherwise, each PWM's pulse width can be independently adjusted.

The PWMs require three parameters (%AQs) to be set for operation. These parameters may be set at run-time.

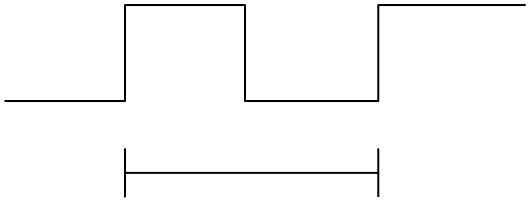
- Prescale Count
  The prescale (%AQ5-6) count sets the resolution of the internal counter used for generating the PWM output. The (prescale count + 1) is a divisor applied to a 16MHz clock that drives the internal PWM counter. For the highest resolution PWM output, this value should be set as low as possible (0 provides a 1/16 micro second resolution). Both the Period and Duty cycle (pulse width) are based on *counts* of the internal PWM counter.

  The frequency of the PWM output is calculated using the following formula:

$$\text{Frequency} = \frac{16{,}000{,}000}{(\text{Prescale Count}+1)\times \text{Period Count}}$$

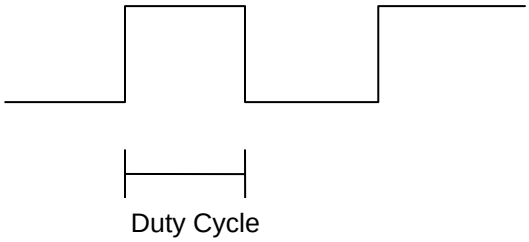
- Period Count
  This value (%AQ7-8) sets the period of the output signal by specifying the number of internal PWM counter *counts* before the cycle is reset (larger count results in a smaller frequency). The duration of each *count* is determined by the prescaler value. This parameter affects the Period of both PWM outputs.

  See the previous formula to see how the prescale and period counts create an output frequency. For example, setting the PWM for 1 µs resolution (prescale=15), and a period count of 20,000 would result in a 50 Hz output.



- Duty Cycle Count
  This value (PWM1: %AQ1-2, PWM2: %AQ3-4) sets the width of the output signal by specifying the number of internal PWM counter *counts* that the output is maintained high. The duration of each *count* is determined by the prescaler value. Each PWM channel has its own duty cycle count parameter.

  Setting the period count to 1000 and the duty cycle count to 500 results in a duty cycle of 50 percent. Changing just the duty cycle count to a value of 250 results in a duty cycle of 25 percent.



At controller power-up or during a download, the PWM output is maintained at zero until both the Period (count) and the Duty cycle (count) are loaded with non-zero values. When the controller is placed in stop mode, the state of the PWM outputs is dependent on the *PWM State on Controller Stop* configuration. This configuration allows for either hold-last-state or specific prescale, period and duty cycle counts. Specifying zero for either the period or duty causes the PWM output to remain low during stop mode.

Note that the nominal output driver turn-on-time delay (to reach 50% output) is 25 microseconds. Therefore, this limitation should be considered when determining both the minimum pulse width and the duty cycle accuracy of the application.

c. HSC (High Speed Counter)

When either Q1 or Q2 is configured for HSC operation, HSC1 or HSC2 totalize functions are extended to allow respective direct output control based on a comparison of the current count and a preset value (PV). See totalize in the HSC section above for more information.

d. Stepper Function

When Q1 is configured for Stepper, the stepper function is enabled at the Q1 output. Only one stepper function and output is available.

Note that when Q1 is configured for stepper operation, Q2 operation is limited to direct digital output.

The Stepper requires five parameters (%AQs) to be set for operation. These parameters may be set at run-time but are 'latched' when the stepper is commanded to start.

- Start Frequency (cycles per second)
  This value (%AQ1) sets the frequency for the first cycle during the acceleration phase and the frequency of the last cycle during the deceleration phase. When an acceleration or deceleration count is specified, the Start Frequency must be greater than 0 and must not exceed the run frequency or an error is generated.

- Run Frequency (cycles per second)
  This value (%AQ2) sets the frequency for the last cycle during the acceleration phase, the consistent frequency during the run phase, and the frequency of the first cycle during the deceleration mode. The Run Frequency must be greater than 0 and must not exceed 5000 cycles/sec. or an error is generated.

- Acceleration Count
  This value (%AQ3-4) sets the number of cycles to occur within the acceleration phase. The frequency of the cycles within this mode will vary linearly between the specified Start and Run frequency. The Accel count must not equal 1 or an error is generated. Setting this value to zero disables this phase.

- Run Count
  This value (%AQ5-6) sets the number of cycles to occur within the run phase. The frequency of the cycles within this mode is constant at the specified Run frequency. The Run count may be any value. Setting this value to zero disables this phase.

- Deceleration Count
  This value (%AQ7-8) sets the number of cycles to occur within the deceleration phase. The frequency of the cycles within this phase will vary linearly between the specified Run and Stop frequency. The Decel count must not equal 1 or an error is generated. Setting this value to zero disables this phase.

The stepper provides two Boolean registers to provide stepper status

- Ready/Done
  A high indication on this register (%I30) indicates the stepper sequence can be started (i.e. not currently busy).

- Error
  A high indication on this register (%I31) indicates that one of the analog parameters specified above is invalid or the stepper action was aborted before the operation was complete. This register is cleared on the next start command if the error was corrected.

The stepper requires one discrete register (%Q1) to control the stepper action. Setting this register starts the stepper cycle. This register must remain set to complete the entire cycle. Clearing this register before the cycle is complete aborts the step sequence and sets the error bit.

Note that setting the PLC mode to Stop while the stepper is in operation causes the stepper output to immediately drop to zero and the current stepper count to be lost.

Note that stepper output level may cause damage or be incompatible with some motor driver inputs. Consult drive documentation to determine if output level and type is compatible.

10.5 PWM functions register map

Register	PWM	HSC	Stepper
%AQ1	PWM1 Duty Cycle (32-bit)	HSC1 Preset Value	Start Frequency
%AQ2			Run Frequency
%AQ3	PWM2 Duty Cycle (32-bit)	HSC2 Preset Value	Accel Count (32-bit)
%AQ4			
%AQ5	PWM Prescale (32-bit)		Run Count (32-bit)
%AQ6			
%AQ7	PWM Period (32-bit)		Decel Count (32-bit)
%AQ8			
%Q1			Run
%I30			Ready/Done
%I31			Error

10.6 PWM Examples

All of the PWM examples use the following formula.

$$\text{Frequency} = \frac{16{,}000{,}000}{(\text{Prescale}+1)\times \text{PeriodCount}}$$

Example 1
To get a 50% Duty Cycle @ 10 kHz waveform on PWM1:

Set %AQ1-2 = 50 (duty cycle count)
Set %AQ5-6 = 15 (prescale count)
Set %AQ7-8 = 100 (period count)

Example 2
To get a 50% Duty Cycle on PW1 and 90 % Duty Cycle on PWM2 @ 1 kHz waveform:

Set %AQ1-2 = 500 (duty cycle count)
Set %AQ3-4 = 900 (duty cycle count)
Set %AQ5-6 = 15 (prescale count)
Set %AQ7-8 = 1000 (period count)

Example 3
To turn PWM 1 output ON all the time

Set %AQ1-2 = Same value as AQ7-8 (duty cycle count)
Set %AQ5-6 = Any value (prescale count)
Set %AQ7-8 = Non-Zero value (period count)

Example 4
To turn PWM 1 output OFF all the time

Set %AQ1-2 = 0 (duty cycle count)
Set %AQ5-6 = Any value (prescale count)
Set %AQ7-8 = Any value <or> 0 (period count)

10.7 STP Examples

Example 1

10,000,000 steps control sequence

The following example starts at 2.5 kHz and ramps up to 5 kHz during the first 1,000,000 steps. Then, it runs at 5 kHz for the next 8,000,000 steps. Finally during the last 1,000,000 steps it slows to a stop.

```
Set %AQ1 = 2500 (Hz)          {Start Frequency}
Set %AQ2 = 5000 (Hz)          {Run Frequency}
Set %AQ3-4 = 1000000 (Steps) {Accel Count}
Set %AQ5-6 = 8000000 (Steps) {Run Count}
Set %AQ7-8 = 1000000 (Steps) {Decel Count}
```

Example 2

5,000,000 steps control sequence

The following example starts at 0.5 kHz and ramps up to 1 kHz during the first 2,000,000 steps. Then, it runs at 1 kHz for the next 2,000,000 steps. Finally during the last 1,000,000 steps it slows to a stop.

```
Set %AQ1 = 500 (Hz)           {Start Frequency}
Set %AQ2 = 1000 (Hz)          {Run Frequency}
Set %AQ3-4 = 2000000 (Steps) {Accel Count}
Set %AQ5-6 = 2000000 (Steps) {Run Count}
Set %AQ7-8 = 1000000 (Steps) {Decel Count}
```

Example 3

6,000,000 steps control sequence

The following example starts at 50 Hz and ramps up to 250 Hz during the first 150,000 steps. Then, it runs at 250 Hz for the next 5,500,000 steps. Finally during the last 350,000 steps it slows to a stop.

```
Set %AQ1 = 50 (Hz)            {Start Frequency}
Set %AQ2 = 250 (Hz)           {Run Frequency}
Set %AQ3-4 = 150000 (Steps)   {Accel Count}
Set %AQ5-6 = 5500000 (Steps) {Run Count}
Set %AQ7-8 = 350000 (Steps)   {Decel Count}
```

Note: The highest usable frequency is *65 KHz* for the PWM output.

NOTES

CHAPTER 11: SYSTEM SETTINGS AND ADJUSTMENTS

11.1 System Menu - Overview

The XLE controller has a built-in System Menu, which lets the user view System Settings and make adjustments. To start the System Menu, press the ↓ and ↑ keys at the same time (or set %SR3 to 1), which will display the Main Menu, as shown in **Figure 11.1**. Then use the ↓ and ↑ keys to select a **Main Menu** item and press **Enter** to display the item's Sub-Menu.

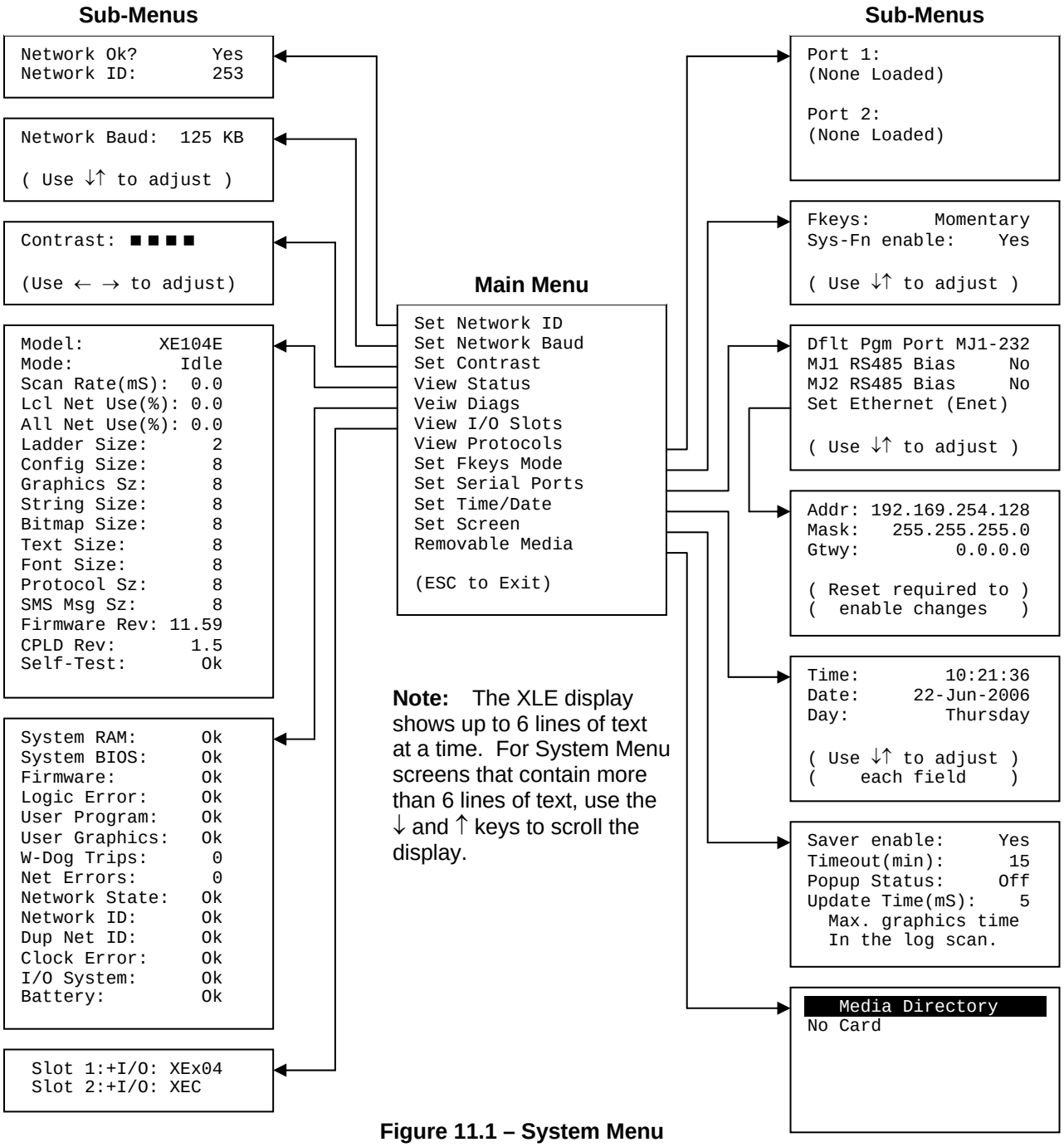


Figure 11.1 – System Menu

11.2 System Menu – Navigation and Editing

As mentioned above, the System Menu is started by pressing the ↓ and ↑ keys at the same time. Then, either press ESC to exit the System Menu, or use the ↓ and ↑ keys to select an item and press **Enter** to display the item's Sub-Menu.

A Sub-Menu generally shows a of list of System Settings and their values. After opening a Sub-Menu, if any of its System Settings are editable, the first System Setting that can be edited is highlighted. If desired, the ↓ and ↑ keys can be used to select a different System Setting to be edited.

At this point, either press **ESC** to exit the Sub-Menu (returning to the Main Menu) or press **Enter** to edit the highlighted System Setting. If **Enter** is pressed, the System Setting's value will be highlighted, indicating that it is ready to be modified.

When modifying a System Setting's value, use either the arrow keys (← → ↓ ↑) or the numeric keys to select a new value.

The arrow keys are used to edit System Settings that have just a few possible values. Each time the arrow key is pressed, a new possible value is displayed. When the desired value appears, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

The numeric keys are normally used to enter numeric System Settings. In addition, to edit a single numeric digit, use the ← or → key to select the digit and then either press a numeric key or use ↓ or ↑ to modify the digit. In any case, after entering the new desired value, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

11.3 System Menu – Details

The following sections describe each of the Sub-Menus in detail.

Set Network ID

The Network ID Sub-Menu only appears for XLE models that have CAN ports (XE1xx). This Sub-Menu displays two System Settings of which only **Network ID** is editable.

Network Ok?	Yes	= NET1 connected to a CAN network and functioning properly
	No	= Not ready to communicate on CAN network
Network ID:	1 to 253	= This node's CsCAN Network ID; must be unique on network

Set Network Baud

The Network Baud Sub-Menu only appears for XLE models that have CAN ports (XE1xx). This Sub-Menu displays just one System Setting and it is editable.

Network Baud?	125 KB	= 125 KBaud CAN network
	250 KB	= 250 KBaud CAN network
	500 KB	= 500 KBaud CAN network
	1 MB	= 1 MBaud CAN network

Set Contrast

The Set Contrast Sub-Menu displays just one System Setting and it is editable.

Contrast: ■ ■ ■ ■ = Current display contrast setting

View Status

The View Status Sub-Menu displays up to 17 System Settings. The **Lcl Net Use %** and **All Net Use %** System Settings only appear for XLE models that have CAN ports (XE1xx). Only the **Mode** System Setting is editable.

Model:	XExyyz	= 5 or 6 character Model number of this XLE unit x is 1 for models that have a CAN port; 0 = no CAN port yy indicates the installed I/O module; 00 = no I/O module z indicates the installed COM module; N = no COM module
Mode:	Idle	= XLE is in Idle mode
	DoIo	= XLE is in Do I/O mode
	Run	= XLE is in Run mode
Scan Rate(mS):	0.0	= XLE is not in Run mode
	0.1 to 999.9	= Average number of mS for each ladder scan
Lcl Net Use %:	0.0 to 100.0	= CAN network bandwidth % used by this XLE node
All Net Use %:	0.0 to 100.0	= CAN network bandwidth % used by all nodes
Ladder Size:	x	= Number of bytes in application ladder program
Config Size:	x	= Number of bytes in application I/O configuration
Graphics Sz:	x	= Number of bytes in application graphic screens
String Size:	x	= Number of bytes in application string table
Bitmap Size:	x	= Number of bytes in application bitmaps
Text Size:	x	= Number of bytes in application text tables
Font Size:	x	= Number of bytes in application font tables
Protocol Sz:	x	= Number of bytes in application downloaded protocols
SMS Msg Sz:	x	= Number of bytes in application SMS protocol configuration
Firmware Rev:	xx.yy	= Current firmware version
CPLD Rev:	x.y	= Current CPLD (Complex Programmable Logic Device) version
Self-Test:	Ok	= All power-on self-tests passed
	Fault	= One or more power-on self-tests failed

View Diags

The View Diags Sub-Menu displays up to 14 System Diagnostics, all of which are not editable. The **Net Errors, Network State, Network ID** and **Dup Net ID** System Diagnostics only appear for XLE models that have CAN ports (XE1xx).

The first five System Diagnostics are critical. If any of them indicate a Fault condition, the XLE will not enter or remain in Run mode, and the problem must be investigated and corrected.

System Ram:	Ok	= System RAM power-up self-test passed
	Fault	= System RAM power-up self-test failed
System BIOS:	Ok	= System BIOS power-up self-test passed
	Fault	= System BIOS power-up self-test failed
Firmware:	Ok	= Firmware power-up self-test passed
	Fault	= Firmware power-up self-test failed
Logic Error:	Ok	= All executed ladder instructions are legal for loaded firmware
	Fault	= A ladder instruction not supported by firmware was found
User Program:	Ok	= Ladder program and I/O configuration loaded successfully
	Fault	= Ladder program or I/O configuration not loaded or load failed

The last nine System Diagnostics are informational. If any of them indicate a Warning condition, the XLE can still enter and remain in Run mode, but the problem should be investigated and corrected.

User Graphics:	Ok	= Application graphics objects loaded successfully
	Fault	= Application graphics objects not loaded or load failed
W-Dog Trips:	0	= Watchdog timer has not tripped since the last power-up
	x	= Number of times watchdog timer has tripped
Net Errors:	0	= No CAN network bus-off errors have occurred
	x	= Number of CAN network bus-off errors that have occurred
Network State:	Ok	= At least one other node was found on the CAN network
	Warning	= No other nodes were found on the CAN network
Network ID:	Ok	= This node's CAN Network ID is in the range 1 to 253
	Warning	= This node's CAN Network ID was out of range at power-up
Dup Net ID:	Ok	= This node's Network ID is unique on the CAN network
	Warning	= This node's Network ID is duplicated in another node
Clock Error:	Ok	= Time and date have been set
	Warning	= Time and date need to be set
I/O System:	Ok	= I/O configuration matches the installed I/O and COM modules
	Warning	= I/O configuration needs updating to match installed modules
Battery:	Ok	= Backup battery operating properly
	Warning	= Backup battery needs to be replaced

View I/O Slots

The View I/O Slots Sub-Menu displays two System Settings, both of which are not editable.

Internal to the XLE, there is a CPU board, and up to two installed modules. Models XE000 and XE100 have no installed I/O or COM modules. All other models have an I/O module in Slot 1 and can have a user-installed COM module in Slot 2.

Depending on which I/O module is installed and which I/O module has been configured by Cscape, one of the following six System Settings should appear for Slot 1:

Slot 1: I/O: Empty	= No I/O module installed or configured
Slot 1:*Unsupported	= Unsupported I/O module installed
Slot 1:-I/O Missing	= No I/O module installed but an I/O module is configured
Slot 1:+I/O: XExyy	= yy I/O module installed but no I/O module configured
Slot 1:?I/O: XExyy	= yy I/O module installed but another I/O module configured
Slot 1: I/O: XExyy	= yy I/O module installed and configured properly

Depending on the COM module that is installed and the COM module that has been configured by Cscape, one of the following six System Settings appears for Slot 2:

Slot 2: I/O: Empty	= No COM module installed or configured
Slot 2:*Unsupported	= Unsupported COM module installed
Slot 2:-I/O Missing	= No COM module installed but a COM module is configured
Slot 2:+I/O: XzC	= z COM module installed but no COM module configured
Slot 2:?I/O: XzC	= z COM module installed but another COM module configured
Slot 2: I/O: XzC	= z COM module installed and configured properly

View Protocols

The View Protocols Sub-Menu displays two System Settings, both of which are not editable.

As mentioned in CHAPTER 5, both the MJ1 (Port 1) and MJ2 (Port 2) serial ports support downloadable protocols. To assign a downloadable protocol to an XLE serial port, select the **Protocol Config** item in Cscape's Program menu and then setup a protocol for Port 1 or Port 2 (or both).

In the View Protocols Sub-Menu, the currently downloaded protocol, if any, and its version number are displayed for both Port 1 and Port 2.

Port 1:	
Protocol name	= **(None Loaded)** or name of the protocol assigned to MJ1
Protocol version	= Blank or version of the protocol assigned to MJ1
Port 2:	
Protocol name	= **(None Loaded)** or name of the protocol assigned to MJ2
Protocol version	= Blank or version of the protocol assigned to MJ2

Set Fkeys

The Set Fkeys Sub-Menu displays two System Settings, both of which are editable.

Fkeys:	Momentary	= %K1-10 bits go On & Off as F1-F10 are pressed & released
	Toggle	= %K1-10 bits toggle each time F1-F10 are pressed
SYS_Fn enable:	Yes	= Reset and all clear system functions enabled
	No	= Reset and all clear system functions disabled

Set Serial Ports

The Set Serial Ports Sub-Menu displays three System Settings, all of which are editable, and one optional item. For the **Dflt Pgm Port** System Setting, only MJ1-232 can be selected, unless either an Ethernet (XEC) or a Modem (XMC) COM module is installed. Also, the **Set Ethernet (Enet)** item only appears if an Ethernet COM module is installed.

Dflt Pgm Port:	MJ1-232	= MJ1 RS232 port is the default programming port
	Enet	= Ethernet COM module is the default programming port
	Modem	= Modem COM module is the default programming port
MJ1 RS485 Bias:	No	= MJ1 RS485 bias resistors are not switched in
	Yes	= MJ1 RS485 bias resistors are switched in
MJ2 RS485 Bias:	No	= MJ2 RS485 bias resistors are not switched in
	Yes	= MJ2 RS485 bias resistors are switched in
Set Ethernet (Enet)		= Select and press **Enter** to setup the Ethernet COM module

Set Ethernet (Enet)

The Set Ethernet (Enet) Sub-Menu displays three System Settings, all of which are editable. The values shown below are the default values. Note that if **Gtwy** is set to 0.0.0.0, Ethernet communication will be confined to the local network.

Addr:	192.168.254.128	= IP Address for installed Ethernet COM module
Mask:	255.255.255.0	= Net Mask for installed Ethernet COM module
Gtwy:	0.0.0.0	= Gateway device IP Address for installed Ethernet COM module

Set Time/Date

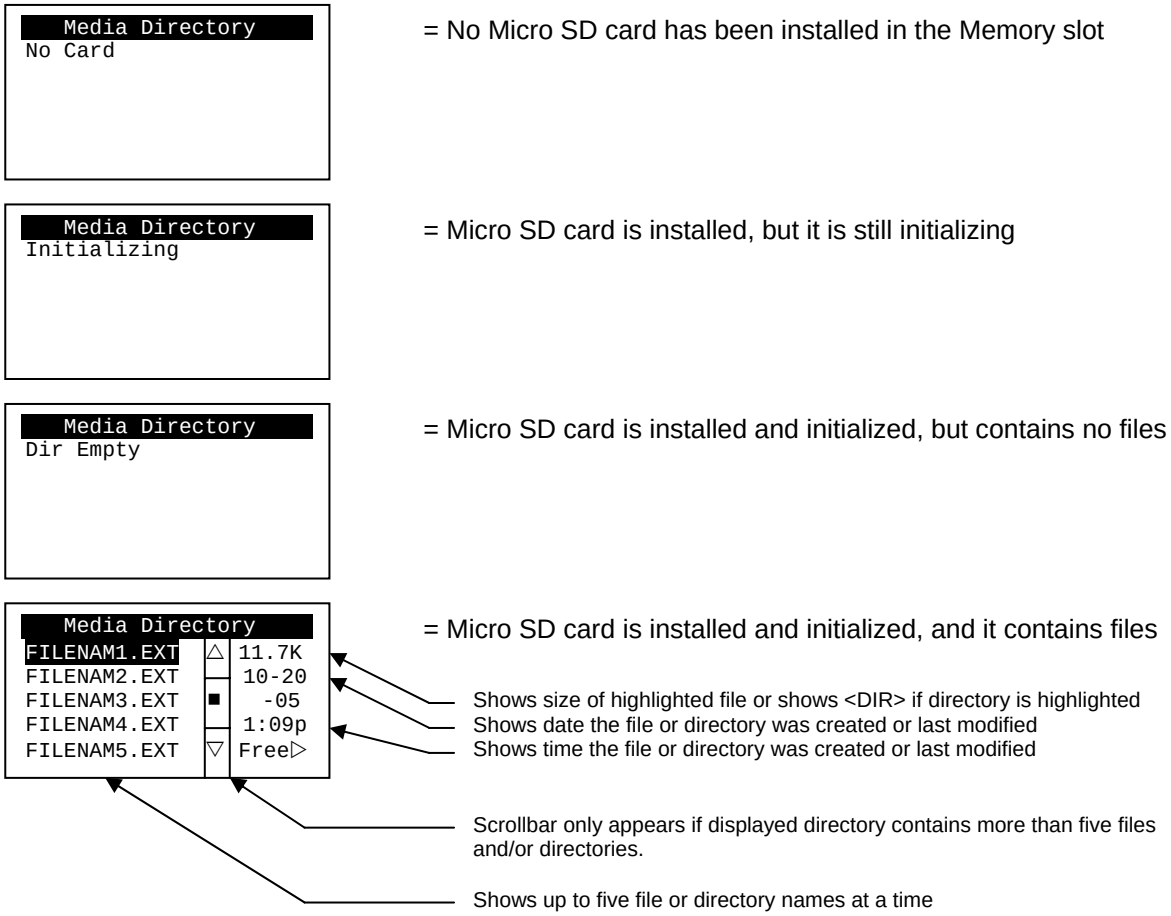
The Set Time/Date Sub-Menu displays three System Settings. **Time** and **Date** are editable, and **Day** is automatically calculated from the **Date** setting. Note that **Time** and **Date** are split into three editable fields each. Use ← or → to select a field and then use ↓ or ↑ to edit the field.

Time:	10:21:36	= Current time (hours:minutes:seconds in 24-hour format)
Date:	22-Jun-2006	= Current date (day-month-year)
Day:	Thursday	= Current day of week calculated from the Date setting

Note: After changing the Ethernet Addr, Mask, or Gtwy, the XLe must be power-cycled (or reset) before the changes take effect.

Removable Media

The Removable Media Sub-Menu displays the Removable Media Manager (see CHAPTER 8). After selecting Removable Media from the Main Menu, one of four Sub-Menu screens will appear:



If the Removable Media Manager displays files or directories, as in the last example above, there are several options available:

If → is pressed, the number of total and free bytes is displayed. Then, pressing ← returns to the normal file and directory display.

If a soft key (on either side of the display) is pressed, a pop-up window appears on the right side of the display, showing the function key options as follows:

F1 Delete	= Delete the highlighted file or directory
F2 DelAll	= Delete all files and directories
F3 Format	= Format the Micro SD card
F4 SavPgm	= Save XLE application to DEFAULT.PGM
Esc Cancel	= Cancel current operation (back up one screen)

Pressing the soft key again or pressing ESC returns to the normal file and directory display.

If a directory name is highlighted, pressing **Enter** will switch to that directory showing its files and sub-directories. In a sub-directory, highlighting **..** (dot dot) and pressing **Enter** will move up one directory

NOTES

CHAPTER 12: USER INTERFACE

12.1 Screen Navigation

The screen navigation on the XLE is quite flexible. Basic methods will be described here. Control programming can be used to create complex screen navigation techniques.

One form of screen navigation is the **Jump Screen** graphics object. This object is typically tied to a soft key (One of the four keys to the sides of the display). Pressing the soft key will switch to the screen that is programmed. Screen jumps can also be triggered on other keys or based on control logic for more advanced applications.

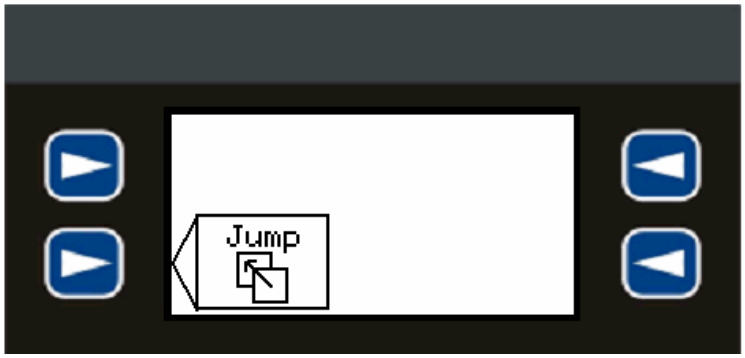


Figure 12.1 – Typically Screen Jump Object

12.2 Ladder Based Screen Navigation

Ladder logic can use several techniques to control screen navigation. Coils can be tied to %D registers to make them screen coils. These coils have two modes, switch and alarm. If the ladder program energizes an alarm display coil, the screen associated with this coil is displayed and overrides the normal user screens. This is designed to show alarm conditions or to display other ladder-detected events. When the text coil is de-energized, the previous screen that was being viewed before the alarm is returned.

The switch display coil switches to the associated screen when it is energized. Once it is de-energized the screen remains until it is switched by the user or ladder.

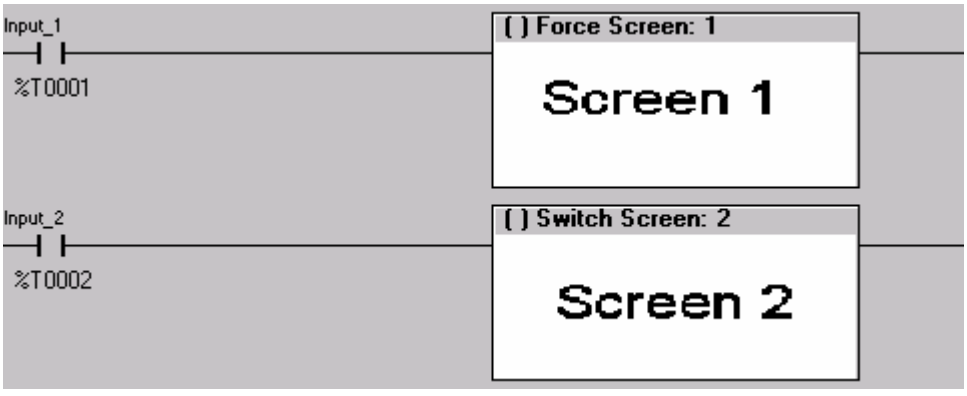


Figure 12.2 – Force and Switch Coils in Ladder Programming

There is also a system register that can be used to for control based screen navigation. %SR1 can be read to determine the current screen or written to change the current screen.

Refer to the on-line help in Cscape for more information on control-based screen navigation.

12.3 Using Editable Screen Objects

When a screen contains editable objects the one of the objects will be selected by default. Selected objects will be outlined with a dotted line. The arrow keys can be used to navigate the editable objects and allow selection of an object to edit. When the object to be edited is selected press the **Enter** button. This enters the objects editing mode.

The most common editable object is the numeric object. When in edit mode, a cursor appears on one digit of the editable field. Use the direction keys ⇦ and ⇨ to move to the cursor to the desired position. Use the ⇧ and ⇩ keys to increment or decrement the digit or enter the number/data with the alphanumeric keys.

The value chosen by the operator can not exceed the minimum or maximum set by the user program. If the user tries to exceed the maximum point or enter a value below the minimum point, the value does not change.

Note: If the XLe displays >>>>>> in a numeric field, the value is too big to display in the field or is above the maximum for an editable field. If the XLe displays <<<<<< in a numeric field, the value is too small to display or is below the minimum for an editable field.

For addition information on a specific object please see the on-line help in Cscape.

CHAPTER 13: REGISTERS

13.1 Register Definitions

When programming the XLe, data is stored in memory that is segmented into different types. This memory in the controller is referred to as registers. Different groups of registers are defined as either bits or words (16 bits). Multiple registers can usually be used to handle larger storage requirements. For example 16 single bit registers can be used to store a Word or two 16 bit registers can be used to store a 32-bit value.

Below is a list of the type of registers found in the XLe.

%AI Analog Input
16-bit input registers used to gather analog input data such as voltages, temperatures, and speed settings coming from an attached device.

%AQ Analog Output
16-bit output registers used to send analog information such a voltages, levels or speed settings to an attached device.

%AIG Global Analog Input
Specially defined 16-bit input registers that come from the network.

%AQG Global Analog Output
Specially defined 16-bit output registers that go to the network.

%D Display Bit
The are digital flags used to control the displaying of screens on a unit which has the ability to display a screen. If the bit is SET, the screen is displayed.

%I Digital Input
Single-bit input registers. Typically, an external switch is connected to the registers.

%IG Global Digital Input
Specially defined single-bit inputs that come from the network.

%K Key Bit
Single-bit flags used to give the programmer direct access to any front panel keys appearing on a unit.

%M Retentive Bit
Retentive single-bit registers.

%Q Digital Output
Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or other physical outputs.

%QG Global Digital Output
Specially defined single-bit outputs that go to the network.

%R General Purpose Register
Retentive 16-bit registers.

%S System Bit
Single-bit bit coils predefined for system use.

%SR System Register
16-bit registers predefined for system use.

%T Temporary Bit
Non-retentive single-bit registers.

13.2 Useful %S and %SR registers

Table 13.1 – Common %S Register Definitions	
Register	**Description**
%S1	Indicate First Scan
%S2	Network is OK
%S3	10mS timebase
%S4	100mS timebase
%S5	1 second timebase
%S6	I/O is OK
%S7	Always ON
%S8	Always OFF
%S9	Pause 'n Load soon
%S10	Pause 'n load done
%S11	I/O being forced
%S12	Forcing is enabled
%S13	Network I/O is OK
%S16	Ethernet COM module is OK

Table 13.2 – Common %SR Register Definitions	
Register	**Description**
%SR1	This register displays/controls the current user scrollable screen. Setting this register to 0 displays no user screens
%SR2	This register displays/controls the current alarm screen.
%SR6	This register displays the average scan rate of the controller in tenths of milliseconds. (123 = 12.3 mSec)
%SR44	*This register displays the seconds from the real time clock*
%SR45	This register displays the minutes from the real time clock.
%SR46	This register displays the hours from the real time clock.
%SR47	This register displays the day of the month from the real time clock.
%SR48	This register displays the month from the real time clock. 1 = January ... 12 = December.
%SR49	This register displays the four digit year from the real time clock.
%SR50	This register displays the day of the week from the real time clock. 1 = Sunday, 2 = Monday ... 7 = Saturday
%SR56	This register displays the current key being pressed on the controller keypad.
%SR57	This register displays/controls the LCD backlight. 0 = OFF, non-zero = ON
%SR175	Status of the removable media
%SR176 to %SR177	This register shows the amount of free space on the inserted removable media in bytes. This is a 32-bit value.
%SR178 to %SR179	This register shows the total size of the inserted removable media in bytes. This is a 32-bit value.

Table 13.2 – Common %SR Register Definitions	
%SR181	This register is a bit-mapped indicator of the advanced alarm manager. Each bit shows if a group has an unacknowledged alarm. For example, if bit one is ON there is an unacknowledged alarm in group one.
%SR182	This register is a bit-mapped indicator of the advanced alarm manager. Each bit shows if a group has an active alarm. For example, if bit one is ON there is an active alarm in group one.

For additional information on system bits and registers, refer to the on-line help found in Cscape.

13.3 Register Map for XLe I/O

Table 13.3 – I/O Register Map for XLe	
Registers	**Description**
%I1 to %I24	Digital Inputs
%I25 to %I31	Reserved
%I32	Output Fault
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

13.4 Resource Limits

Table 13.4- Resource Limits

Resource	Value
%S	13
%SR	192
%T	2048
%M	2048
%R	9999
%K	10
%D	1023
%I	2048
%Q	2048
%AI	512
%AQ	512
%IG	64
%QG	64
%AIG	32
%AQG	32
Network Ports	CsCAN (Optional depending on model.)
Controllers Per Network	253
Keypad	20 keys (10 fn keys and 4 soft keys)
Display	128x64 LCD Backlit, monochrome
Screen Memory	1 M
User Screens	1023
Data Fields Per User Screen	50
Ladder Code	256 k

CHAPTER 14: CSCAPE CONFIGURATION

14.1 Overview

XLe hardware is programmed with a Windows based PC application called Cscape. This application can be used to program, configure, monitor and debug all aspects of the XLe unit. Please see the on-line help provided with Cscape for additional details.

14.2 Cscape Status Bar

When the XLe is connected to a PC using Cscape software a Status Bar appears at the bottom of the screen. The Cscape Status Bar can be used to determine if communications have been established between the XLe and the Cscape program. Components of the Cscape Status Bar are explained in Figure 4.1.

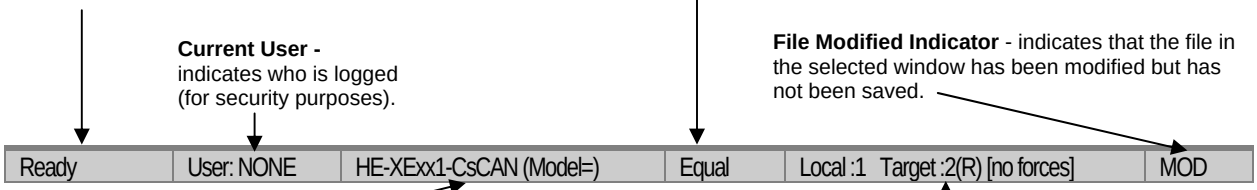
Message Line - The contents of these messages are context sensitive. The Message line can be empty.

Equal Indicator – indicates whether the current program in Cscape is equal to the program stored in the Target Controller.

- If ***Equal***, the program in Cscape is the same as the program stored in the Target Controller.
- If ***Not Equal***, the program in Cscape is not the same as the program stored in the Target Controller.
- If **Unknown**, there may have been a change since the last time the program in Cscape was compared to the Target Controller.

Current User - indicates who is logged (for security purposes).

File Modified Indicator - indicates that the file in the selected window has been modified but has not been saved.



Controller Model - Network (Model Confirmation)

- ***Controller Model*** indicates the controller model for which the program in Cscape is configured.
- ***Network*** indicates the type of network that the program in Cscape expects to use (e.g., CsCAN).
- ***(Model Confirmation)*** provides the following indications:
- **(Model=)** - the actual Target Controller matches the configured Controller Model and Network.
- **(Model Not=)** – the actual Target Controller does not match the configured Controller Model and Network.
- **(Model ?)** – there may have been a change since the last time the Target Controller was compared to the configured Controller Model and Network.

Communications Status - indicates the current status of the "pass through" Connector.

- **Local: xx** – indicates the Network ID of the XLe to which the Cscape program is physically connected through its serial port. It can serve as a pass through device to other nodes on the network.
- **Target: yy(R)** – indicates the Network ID of the device with which the Cscape program is exchanging data.
  Note: The **Local** unit and **Target** unit can be the same unit or they can be separate units.

  The following are status indicators:

  (R) – Running
  (D) - Do I/o
  (I) – Idle
  (?) – Cscape is not communicating with the remote unit.
  [no forces] – indicates no I/O has been forced.

14.3 Establishing Communications

The main method for communicating between Cscape and an XLe is RS-232 serial. The XLe can communicate with Cscape using USB to serial adapters, Ethernet, CAN (CsCAN) or modems. For communications other than RS-232 serial please refer to the manual that ships with the adapter hardware being used for programming.

Start by configuring Cscape to use the correct communications port. This can be done using the **Tools | Options | Communication Port** dialog in Cscape.

Next connect the PC serial port to the port labeled MJ1 on the XLe.

If communications are successful, the target indicator should show the mode of the controller **Target: yy(R)** as shown in the status section above.

If the controller is not communicating you may need to set the target ID of the controller in Cscape or on the unit. The **Target ID** allows directing communications to a particular unit when multiple units are connected via a CsCAN network. Units without CsCAN network ports respond to any network ID and do not require the ID to be configured.

To check or change the ID on the XLe, press the UP and DOWN keys on the XLe simultaneously to enter the system menu. The first item in the menu is **Set Network ID**. Pressing **Enter** allows you to view or modify the ID of the unit.

To change the Target ID of Cscape use the **Controller | Set Target Network ID** dialog.

14.4 Models supported

At the time of printing Cscape 8.00 supports all models and options offered in the XLe line. For the latest version of Cscape or compatibility information, contact Technical Support (page 80).

14.5 Configuration

An overview of configuration:

1.) Start the configuration by selecting the **Controller | I/O Configure** menu item.
2.) If the XLe is connected to the PC press the **Auto Config System** button to automatically detect the Base model, I/O and any communication options.
3.) If the XLe is not connected press the **Config** button to the right of the top of the unit. This allows the base CPU to be selected.
4.) Select either **XLE Cscan** or **XLE No Net** from the type drop down box.
5.) Once the type of XLE is selected, the model # drop down box will provide the XLE model numbers from which to choose from.
6.) Once the XLE CPU is selected, press **OK** to exit the dialog and configure the I/O that is present in the first slot.
7.) The I/O configure dialog (Specifically the **Module Setup** tab) provides 4 buttons to configure all of the I/O. Go through each area of I/O and configure it.
8.) Once done configuring the I/O OK out of configuration dialogs.

Configuring the XLE I/O has four main portions that are covered in this chapter. For additional information on I/O, refer the chapters covering General I/O (page 33) or High Speed I/O (page 39) in this manual.

The four areas of I/O configuration are:

- Digital in / HSC
- Digital out / PWM
- Analog in
- Analog out

14.6 Digital Input / HSC Configuration

The following figure illustrates the **Digital Input / HSC Configuration** dialog.

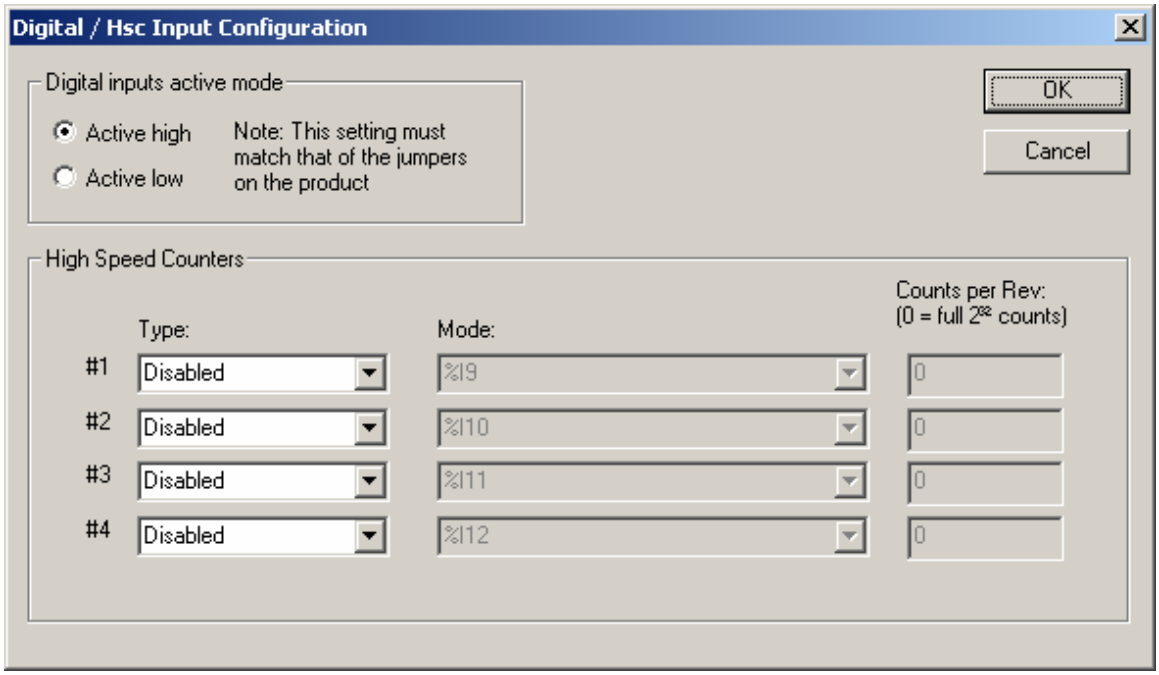


Figure 14.1 – Digital Input / HSC Configuration Dialog

The Active mode group box allows the user to select if inputs are active high (Positive logic) or active low (Negative logic). It is important that this setting match what the jumper settings are on the hardware.

The High Speed Counters group box contains all of the windows that are used for configuring the 4 available high speed counters on the XLE. In configuring a counter, the user needs to set the type, mode, and counts per rev.

The type drop down includes the following options:

- Disabled
- Frequency
- Totalize
- Pulse
- Quadrature
- Marker (Only available in counter #3 if counter #1 is set to quadrature.)

The mode drop-down items are set according to the type selection. The **Counts Per Rev**. window is enabled/disabled according to the type selection as well. The following table shows what is available with each type selection.

Table 14.1- Count Per Rev

Type	Mode	Counts Per Rev.
Disabled	Grayed out. Displays %Ix to indicate to the user that the input devoted to the high speed counter is just dumb I/O, and its location RELITIVE to the I/O map	Grayed out
Frequency	Enabled. Contains the following: 1 sec. 100 msec. 10 msec. Scan resolution	Grayed out
Totalize	Enabled. Contains the following: Rising edge Falling edge	Enabled. Value can be 0 → 0xffffffff (Hex)
Pulse	Enabled. Contains the following: Width high, 1 usec. Counts Width low, 1usec. Counts Period rising edges, 1usec. Counts Period falling edges, 1usec. Counts	Grayed out
Quadrature	Enabled. Contains the following: 1 leads 2, count up 1 leads 2, count down	Enabled. Value can be 0 → 0xffffffff (Hex)
Marker	Enabled. Only available in counter #3 and only when counter #1 is set to quadrature. Contains the following: Async, reset on rising edge Async, reset on falling edge Async, reset on both edges High, reset on 1 rising Low, reset on 1 rising High, reset on 1 falling Low, reset on 1 falling High, reset on 2 rising Low, reset on 2 rising High, reset on 2 falling Low, reset on 2 falling	Grayed out

14.7 Digital Output / PWM Configuration

The following figure illustrates the **Digital Output / PWM Configuration** dialog.

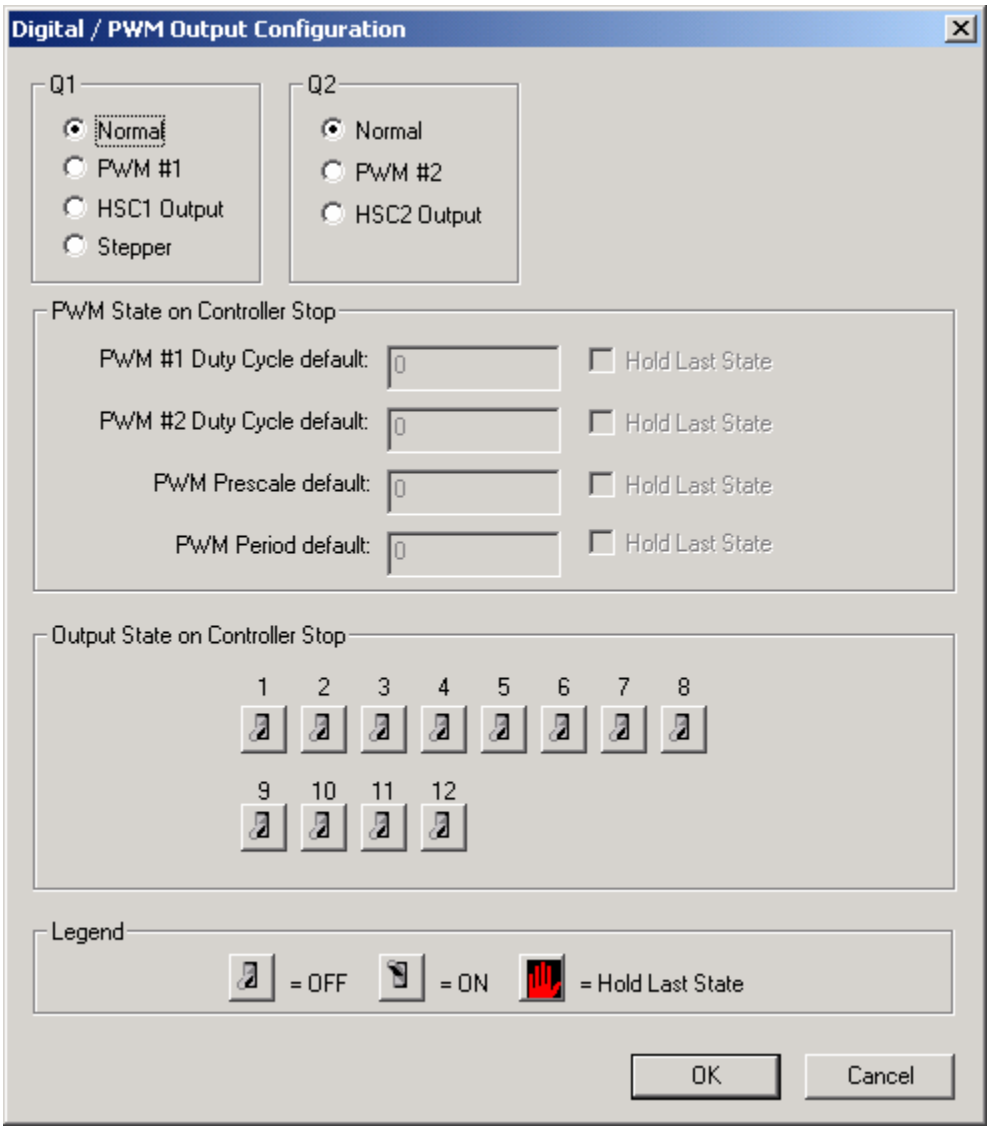


Figure 14.2 – Digital Output / PWM Configuration Dialog

The **Q1** and **Q2** group boxes allow the user to specify the operation of the multi-function outputs.

The **PWM State On Controller Stop** group box contains items that allow the user to specify how the PWM outputs behave when the controller is stopped. These items can either hold their value or default to some value when the controller is stopped.

Note that the PWM outputs are set to the OFF state at power-up and during program download and remain in that state until the unit is placed in RUN

The **Output State On Controller Stop** group box contains items to allow the user to specify how the remaining digital outputs behave when the controller is stopped. These items can either hold their value or default to some value when the controller is stopped.

14.8 Analog Input Configuration

The following figure illustrates the **Analog Input** Configuration dialog.

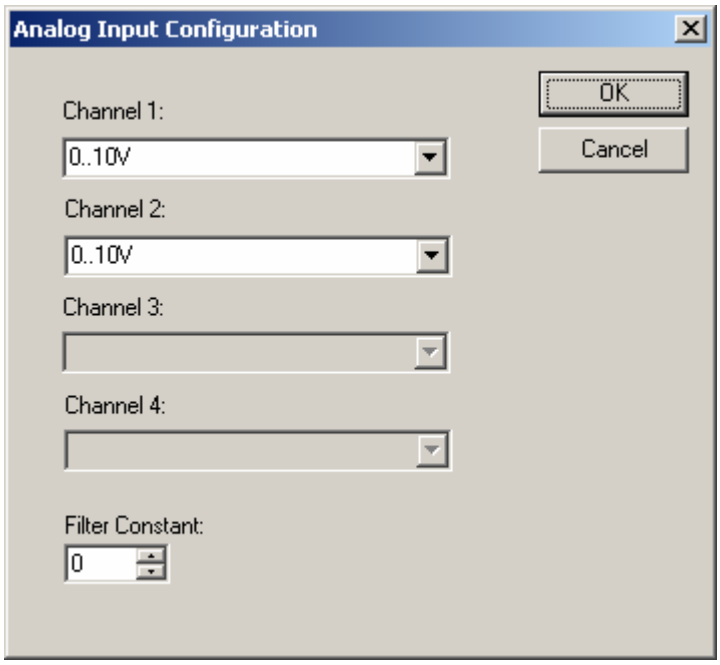


Figure 14.3 – Analog Input Configuration Dialog

The **Channel x** drop down windows allow the user to specify the mode for each analog input to operate. The **Channel x** drop down windows are enabled/disabled according to which model is being configured. All of the models have the following modes available:

- 0..10V
- 0..20mA
- 4..20mA

On model 005, channels 3 and 4 also have the following modes available:

- 100mV
- PT100 DIN RTD, 1/20°C
- Type J Thermocouple, 1/20°C
- Type K Thermocouple, 1/20°C
- Type N Thermocouple, 1/20°C
- Type T Thermocouple, 1/20°C
- Type E Thermocouple, 1/20°C
- Type R Thermocouple, 1/20°C
- Type S Thermocouple, 1/20°C
- Type B Thermocouple, 1/20°C

The **Filter Constant** provides filtering to all channels.

14.9 Analog Output Configuration

The following figure illustrates the **Analog Output** Configuration dialog.

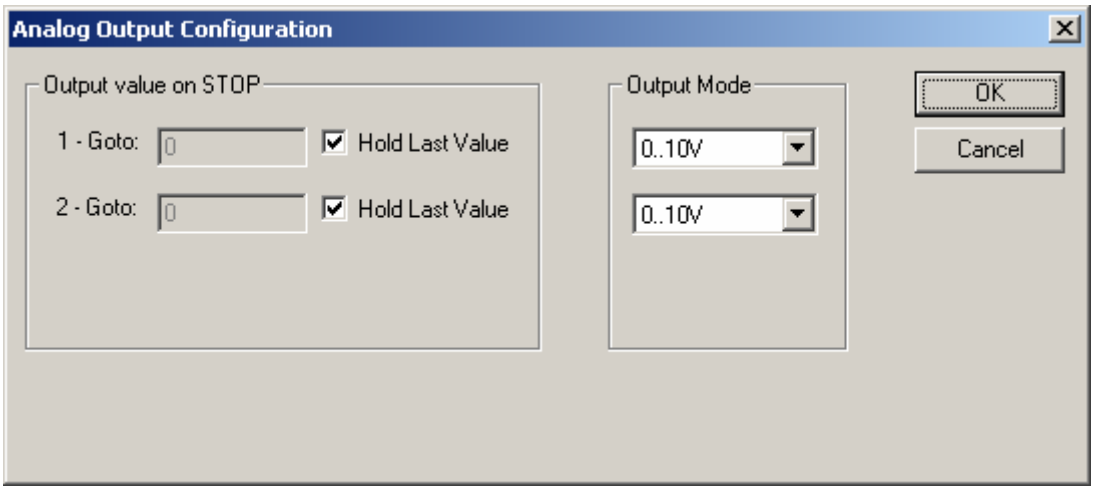


Figure 14.4 – Analog Output Configuration Dialog

The **Output value on Stop** group box contains items that allow the user to specify how the analog output channels behave when the controller is stopped. The outputs can either hold their value or default to a value when the controller is stopped.

The **Output Mode** group box allows the user to select the operating modes for each of the analog outputs. The modes include the following:

- 0..10V
- 0..20mA
- 4..20mA

NOTES

CHAPTER 15: MAINTENANCE

15.1 Firmware Updates

The XLe products contain field updatable firmware to allow new features to be added to the product at a later time. Firmware updates should only be performed when a new feature or correction is required.

Warning: Firmware updates are only performed when the equipment being controlled by the XLe is in a safe, non-operational state. Communication or hardware failures during the firmware update process can cause the controller to behave erratically resulting in injury or equipment damage. Make sure the functions of the equipment work properly after a firmware update before returning the device to an operational mode.

Steps for updating the firmware:

1. Establish communication between Cscape and the controller using a direct serial connection to MJ1.
2. Make sure your application is available on your PC or upload the application.
3. Make sure the machinery connected to the XLe is in a safe state for firmware update (see warning above).
4. Start the firmware update by selecting File | Firmware Update Wizard.
5. The correct product type should be selected, if it is not select the type of controller from the drop down list.
6. Press the start button
7. Wait for the firmware update to complete.
8. If there is a communication failure check the cable, connections and comm. port setting and try again.
9. Firmware updates typically delete the user applications to ensure compatibility. You will need to reload your application.
10. Test the operation of the equipment with the new firmware before returning the XLe system to an operation mode.

13.2 Backup Battery

The XLe contains a run-time battery monitor that checks the voltage of the internal lithium battery. This battery is used to run the real-time clock and maintains retentive registers when power is disconnected.

Under normal conditions the battery in the XLe should last 7 to 10 years. Higher operating temperatures or variations in batteries may reduce this time.

13.2.1 Indications the battery needs replacing

The XLe indicates the battery is low, failed or missing in a variety of ways. At power-up, an error message is displayed indicating the low or missing battery. The user program can monitor the battery using %SR55.13. This bit will turn on if the battery is low or missing. The system menu also contains a battery status message under the diagnostics sub-menu (see the chapter on System Settings and Adjustments).

13.2.2 Battery Replacement

Warning: Lithium Batteries may explode or catch fire if mistreated
Do not recharge, disassemble, heat above 100 deg.C (212 deg.F) incinerate, or puncture.

Warning: Disposal of lithium batteries must be done in accordance with federal, state, and local regulations. Be sure to consult with the appropriate regulatory agencies *before* disposing batteries. In addition, do not re-charge, disassemble, heat or incinerate lithium batteries.

Warning: Do not make substitutions for the battery. Be sure to only use the authorized part number to replace the battery.

The XLe uses a CR2450B coin lithium battery produced by a variety of manufactures.

Below are the steps to replace the battery.

1. Make sure the user program and any data stored in retentive memory is backed up.
2. Disconnect all power from the XLE unit including I/O power.
3. Remove the four screws on the back of the XLe unit and remove the back cover.
4. Remove the I/O board (if present) by lifting it straight up.
5. Remove the old battery. It may require a small flat blade screwdriver to lift it from the holder.
6. Dispose of the battery properly; see the above warning on disposal regulations.
7. Slide the new battery into the holder. Make sure the battery is inserted with the proper polarity. The top tab of the battery holder should contact the positive (+) terminal of the battery.
8. Place the I/O board back into the case by aligning the connecting and pressing straight down.
9. Place the back cover back on the unit.
10. Place the screw back into the hole and turn the screw slowly counter clockwise until “clicks” into the threads. This will prevent the screw from being cross threaded. Now turn the screw clockwise until the cover is firmly secured. Repeat this process for all four (4) screws.
11. Apply power to the unit. Check that the battery error is no longer reported. If the unit still reports the error, remove the battery immediately and contact Technical Support (page 80).

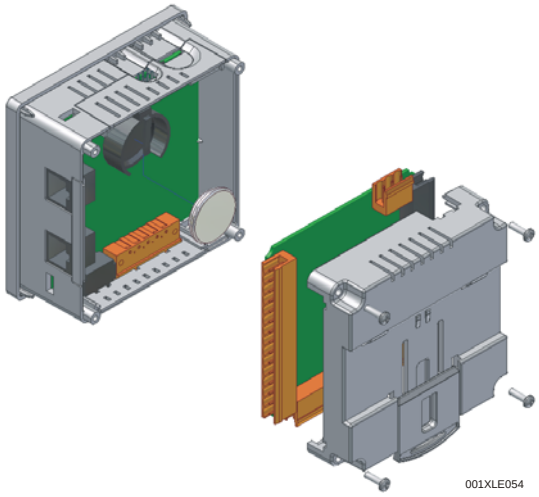


Figure 15.1 – Replacing the back-up battery

CHAPTER 16: TROUBLESHOOTING / TECHNICAL SUPPORT

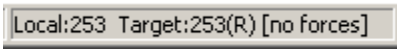
CHAPTER 16 provides commonly requested **troubleshooting information and checklists** for the following topics.

- Connecting to the XLe controller
- Local controller and local I/O
- CsCAN Network
- Removable media

In the event that this information is not what you need, please contact Technical Support at the locations indicated at the end of this chapter.

16.1 Connecting to the XLe

Cscape connects to the local controller automatically when the serial connection is made. The status bar below shows an example of a successful connection. This status bar is located in the bottom right hand corner of the Cscape window.



In general the **Target** number should match the **Local** number. The exception to this is when the controller is being used as a "pass through" unit where other controllers on a CsCAN network could be accessed through the local controller.

Determine connection status by examining feedback next to **Local** & **Target** in the status bar of Cscape.

Local: ###	If a number shows next to **Local** then communication is established to the local controller.
Local: No Port	Cscape is unable to access the COM port of the PC. This could mean that Cscape is configured for a COM port that is not present or that another program has control of the COM port. Only one Cscape window can access a port at a time. Subsequent instances of Cscape opened will indicate No Port.
Local: No Com	Cscape has accessed a PC COM port, but is not communicating with the controller. This typically occurs when the controller is not physically connected.
Local: ???	Unknown communication error. Close Cscape, power cycle the controller and reopen Cscape with a blank project. Check Local.
Target: #(I,R,D)	If I (idle), R (run), or D (do I/O) shows next to **Target number** then communication is established to the target controller.
Target: #(?)	Communication is not established to the target controller. Check node ID of controller and set Target to match. Make sure **local** connection is established.

16.1.1 Connecting Troubleshooting Checklist

1. Programming and debugging must use MJ1.
2. Controller must be powered up.
3. Assure that the correct COM port is selected in Cscape.
   Tools/Options/Communications Port.
4. Assure that a straight through (non null modem) serial cable is being used between PC and controller.
5. Check that a Loaded Protocol or ladder is not actively using MJ1. Taking the controller out of run mode from the System Menu on the controller will make MJ1 available to Cscape.
6. Make sure the COM port of the PC is functioning. An RS-232 serial loopback and Microsoft HyperTerminal can determine positively if the COM port is working. Or connect to an alternate device to determine if the port is working.
7. Successful communications with USB-to-serial adapters vary. If in doubt, Horner APG offers a USB to serial adapter. Part number HE500USB600.
8. XLe units without Ethernet must use MJ1 for programming and debugging. If Ethernet is installed it can be selected as the programming port. The selection is made in the controller's System Menu. If there are difficulties connecting, make sure that the default programming port is set correctly with the connection method being attempted.

16.2 Local Controller and Local I/O

The system menu provides the following status indications that are useful for troubleshooting and system maintenance.

- Self-test results, diagnostics.
- RUN and OK status
- Network status and usage
- Average logic scan rate
- Application memory usage
- Loaded firmware versions
- Loaded protocols
- Removable media access

To view the system menu, press the UP and DOWN arrow keys simultaneously. See CHAPTER 11 for full details on the system menu diagnostic capabilities.

16.2.1 Local I/O Troubleshooting Checklist

1. Verify the controller is in RUN mode.
2. Check diagnostics to insure controller passed self-tests.
   View diags in System Menu or in Cscape, click; Controller/Diagnostics
3. Check data sheets to insure proper wiring.
4. Insure that hardware jumpers and software configuration for I/O match.
5. Check data sheets for voltage and current limits.
6. Take ladder out of the picture. From Cscape set controller to “Do I/O” mode. In this mode inputs can be monitored and outputs set from a data watch window in Cscape without interference from the ladder program. Some I/O problems are only a result of a mistake in the ladder program.

WARNING: Setting outputs ON in Do I/O mode can result in injury or cause machinery to engage in an unsafe manner depending on the application and the environment.

16.3 CsCAN Network

For complete information on setting up a CsCAN network, refer to CAN Networks manual (MAN0799) by visiting our website (page 80) for the address to obtain documentation and updates.

Network status, node ID, errors, and baud rate in the controller system menu are all in reference to the CsCAN network. These indications can provide performance feedback on the CsCAN network and can also be used to aid in troubleshooting. Refer to CHAPTER 11 for full details on the system menu.

16.3.1 CsCAN Network Troubleshooting Checklist

1. Use the proper Belden wire type or equivalent for the network as specified in MAN0799.
2. The XLe does not provide 24VDC to the network. An external voltage source must be used for other devices such as SmartStix I/O.
3. Check voltage at both ends of the network to insure that voltage meets specifications of attached devices.
4. Proper termination is required. Use 121-ohm (or 120-ohm) resistors at each end of the network. The resistors should be placed across the CAN_HI and CAN_LO terminals.
5. Measure the resistance between CAN_HI and CAN_LO. If the network is properly wired and terminated there should be around 60 ohms.
6. Check for duplicate node ID's.
7. Keep proper wires together. One twisted pair is for V+ and V- and the other twisted pair is used for CAN_HI and CAN_LO.
8. Make sure the baud rate is the same for all controllers on the network.
9. Assure shields are connected at one end of each segment -- they are not continuous through the network.
10. Do not exceed the maximum length determined by the baud rate and cable type.
11. Total drop length for each drop should not exceed 6m (20 feet). A drop may include more than one node. The drop length adds to the overall network length.
12. Network should be wired in "straight line" fashion, not in a "star" pattern.
13. In applications requiring multiple power supplies, make sure the V- of all supplies is connected together and to earth ground at one place only.
14. In some electrically noisy environments it may be necessary to add repeaters to the network. Repeaters can be used to add additional nodes and/or distance to the network and protect the signal against noisy environments. The Horner APG repeater is part # HE200CGM100.

16.4 Removable Media

16.4.1 Basic Troubleshooting

Description	Action
XLe does not read media card.	The media card should be formatted with the XLe.
XLe will not download project file.	Make sure the project file is saved as a .pgm file and not a .csp file.

16.5 Technical Support Contacts

For manual updates and assistance, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

INDEX

XLE OCS Model: HE-XE102
12 Digital DC Inputs
4 Analog Inputs (Medium Resolution)
6 Digital Relay Outputs

Want More Information?
To download the XLE User Manual (MAN0805), refer to *Technical Support* in this document.

1 SPECIFICATIONS

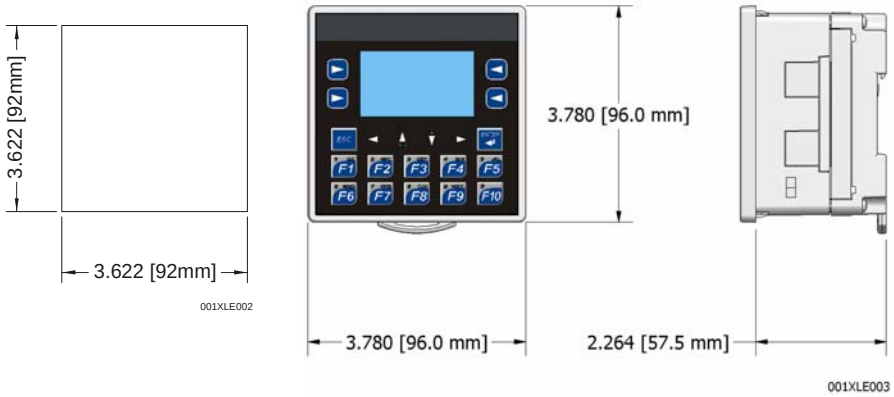
HE-XE102 Specifications		
Digital DC Inputs		
Inputs per Module	12 including 4 configurable HSC inputs	
Commons per Module	1	
Input Voltage Range	12 VDC / 24 VDC	
Absolute Max. Voltage	35 VDC Max.	
Input Impedance	10 kΩ	
Input Current	Positive Logic	Negative Logic
Upper Threshold	0.8 mA	-1.6 mA
Lower Threshold	0.3 mA	-2.1 mA
Max Upper Threshold	8 VDC	
Min Lower Threshold	3 VDC	
OFF to ON Response	1 ms	
ON to OFF Response	1 ms	
HSC Max. Switching Rate	10 kHz Totalizer/Pulse, Edges 5 kHz Frequency/Pulse, Width 2.5 kHz Quadrature	
Digital Relay Outputs		
Outputs per Module	6 relay	
Commons per Module	6	
Max. Output Current per Relay	3 A at 250 VAC, resistive	
Max. Total Output Current	5 A continuous	
Max. Output Voltage	275 VAC , 30 VDC	
Max. Switched Power	1250 VA, 150 W	
Contact Isolation to XLE ground	1000 VAC	
Max. Voltage Drop at Rated Current	0.5 V	
Expected Life (See Derating section for chart.)	No load: 5,000,000 Rated load: 100,000	
Max. Switching Rate	300 CPM at no load 20 CPM at rated load	
Type	Mechanical Contact	
Response Time	One update per ladder scan plus 10 ms	
Analog Inputs, Medium Resolution		
Number of Channels	4	
Input Ranges	0 - 10 VDC 0 – 20 mA 4 – 20 mA	
Safe input voltage range	-0.5 V to +12V	
Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	Current Mode: 100 Ω	Voltage Mode: 500 k Ω
Nominal Resolution	10 Bits	
%AI full scale	32,000 counts	
Max. Over-Current	35 mA	
Conversion Speed	All channels converted once per ladder scan	
Max. Error at 25°C (excluding zero) *can be made tighter (~0.25%) by adjusting the digital filter setting to 3.	4-20 mA 1.00% 0-20 mA 1.00% 0-10 VDC 1.50%*	
Additional error for temperatures other than 25°C	TBD	
Filtering	160 Hz hash (noise) filter 1-128 scan digital running average filter	
General Specifications		
Required Power (Steady State)	130 mA @ 24 VDC	
Required Power (Inrush)	30 A for 1 ms @ 24 VDC	
Primary Power Range	10 – 30 VDC	
Relative Humidity	5 to 95% Non-condensing	
Clock Accuracy	+/- One Minute/Month at 20C	
Highest usable frequency for PWM output is 65 KHz		

General Specifications continued	
Operating Temperature	0°C to +50°C
Terminal Type	Screw Type, 5 mm Removable
Weight	12 oz. (340.19 g)
CE UL	See Compliance Table at http://www.heapg.com/Support/compliance.htm

2 Panel Cut-Out and Dimensions

Note: Max. panel thickness: 5 mm.

Refer to XLE User Manual (MAN0805) for panel box information and a handy checklist of requirements.
Note: The tolerance to meet NEMA standards is ± 0.005" (0.1 mm).

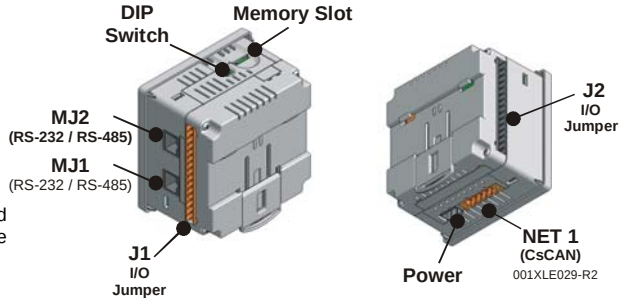


3 Ports / Connectors / Cables

Note: The case of the XLE is black, but for clarity, it is shown in a lighter gray color.

To Remove Back Cover:
Unscrew 4 screws located on the back of the unit.
Lift lid.

CAUTION: Do not overtighten screws when screwing the lid back on.



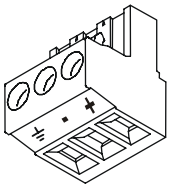
I/O Jumpers: (Not Shown):
I/O Jumpers (**JP**) are located internally. To access, remove back cover of unit.

Wiring Connectors (J1 / J2):
I/O Jumpers (JP1 / JP2), and **External Jumpers (RS-485)** are described in the ***Wiring and Jumpers*** section of this document.

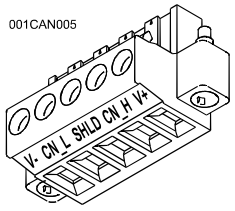
Memory Slot:
Uses **Removable Memory** for data logging, screen captures, program loading and recipes.
Horner Part No.: HE-MC1

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Power Connector



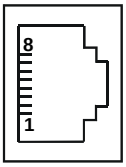
CAN Connector

Use the CAN Connector when using CsCAN network.

Power Up:
Connect to Earth Ground.
Apply 10 - 30 VDC.
Screen lights up.

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Pin	MJ1 Pins		MJ2 Pins	
	Signal	Direction	Signal	Direction
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5	NC	No Connect	NC	No Connect
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	RX-	IN
1	RX+ / TX+	IN / OUT	RX+	IN

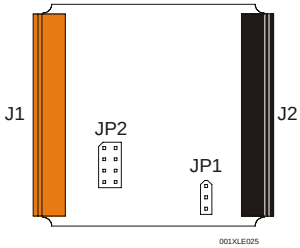
4 Wiring and Jumpers

Wire according to the type of inputs / outputs used, and select the appropriate jumper option.

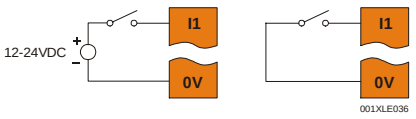
Wiring Specifications

- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.
- For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG or larger.
- For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG or larger.

Location of I/O jumpers (**JP**) and wiring connectors (J1 and J2).



Positive Logic vs. Negative Logic Wiring
The XLE can be wired for Positive Logic inputs or Negative Logic inputs.

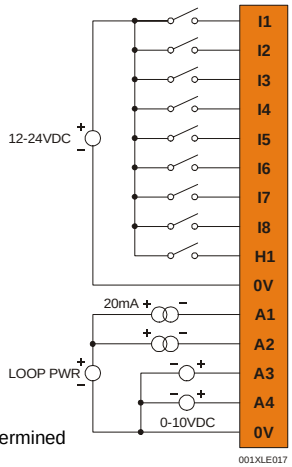


Positive Logic In Negative Logic In

a. Wiring Examples

J1 Orange Terminal Connector	XE102 Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 /IN9
0V	Ground
A1	Analog IN1
A2	Analog IN2
A3	Analog IN3
A4	Analog IN4
0V	Ground

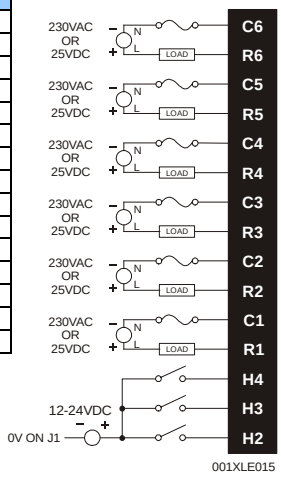
XE102 J1 Orange
Positive Logic In
Digital In / Analog In



Note:
Loop Power requirements are determined by the transmitter specification.

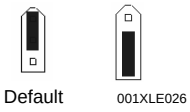
J2 Black Terminal Connector	XE102 Name
C6	Relay 6 COM
R6	Relay 6 NO
C5	Relay 5 COM
R5	Relay 5 NO
C4	Relay 4 COM
R4	Relay 4 NO
C3	Relay 3 COM
R3	Relay 3 NO
C2	Relay 2 COM
R2	Relay 2 NO
C1	Relay 1 COM
R1	Relay 1 NO
H4	HSC4 / IN12
H3	HSC3 / IN11
H2	HSC2 / IN10

XE102 J2 Black
Positive Logic
Digital In / Relay Out

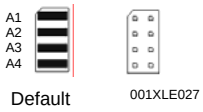


b. I/O Jumpers Settings (JP1 - JP2)

JP1 Digital DC In / HSC



JP2 Analog In (A1 – A4)



Note: The Cscape Module Setup configuration must match the selected I/O (JP) jumper settings.

Note:
When using JP2 (A1-A4), each channel can be independently configured.

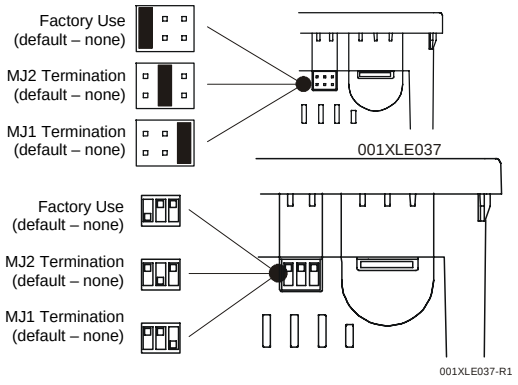
c. External DIP Switch Settings (or Jumpers Settings)

Some XLes have jumpers to set RS-485 port termination, though most use DIP Switches.

The External Jumpers or DIP Switches are used for termination of the RS-485 ports. The XLE is shipped un-terminated.

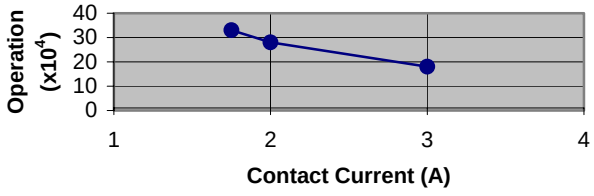
To terminate, select one of the jumpers shipped with the product and insert it based upon the option that is desired or, select the switch and configure based upon the option that is desired.

As seen when looking at the top of the XLE unit: Refer to Section 3 for the location of the DIP Switches (or External Jumpers).



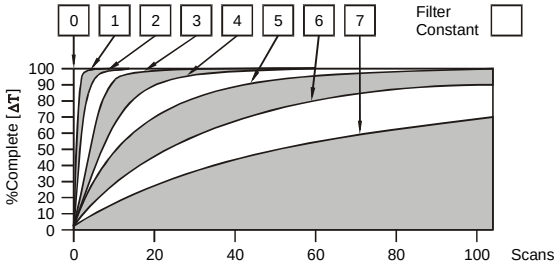
5 Derating

XLE102 Relay Life Expectancy



6 Filter

Filter Constant sets the level of digital filtering according to the following chart.



Digital Filtering. The illustration above demonstrates the effect of digital filtering (set with Filter Constant) on module response to a temperature change.

7 I/O Register Map

Registers	Description
%I1 to %I24	Digital Inputs
%I32	Output Fault
%I25 to %I31	Reserved
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 Accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

8 Safety

When found on the product, the following symbols specify:


Warning: Electrical Shock Hazard.


Warning: Consult user documentation.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.
- Adhere to the following safety precautions whenever any type of connection is made to the module:

- Connect the safety (earth) ground on the power connector first before making any other connections.
- When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
- Do not make connections to live power lines.
- Make connections to the module first; then connect to the circuit to be monitored.
- Route power wires in a safe manner in accordance with good practice and local codes.
- Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
- Ensure hands, shoes, and floor are dry before making any connection to a power line.
- Make sure the unit is turned OFF before making connection to terminals.
- Make sure all circuits are de-energized before making connections.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

9 Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

XLE OCS Model: HE-XE102-10
12 Digital DC Inputs
2 10k Thermistors , 2 Analog Inputs (Medium Resolution)
6 Digital Relay Outputs

Want More Information?
To download the XLE User Manual (MAN0805), refer to *Technical Support* in this document.

1 Specifications

HE-XE102 Specifications		
Digital DC Inputs		
Inputs per Module	12 including 4 configurable HSC inputs	
Commons per Module	1	
Input Voltage Range	12 VDC / 24 VDC	
Absolute Max. Voltage	35 VDC Max.	
Input Impedance	10 kΩ	
Input Current	Positive Logic	Negative Logic
Upper Threshold	0.8 mA	-1.6 mA
Lower Threshold	0.3 mA	-2.1 mA
Max Upper Threshold	8 VDC	
Min Lower Threshold	3 VDC	
OFF to ON Response	1 ms	
ON to OFF Response	1 ms	
HSC Max. Switching Rate	10 kHz Totalizer/Pulse, Edges 5 kHz Frequency/Pulse, Width 2.5 kHz Quadrature	
Digital Relay Outputs		
Outputs per Module	6 relay	
Commons per Module	6	
Max. Output Current per Relay	3 A at 250 VAC, resistive	
Max. Total Output Current	5 A continuous	
Max. Output Voltage	275 VAC , 30 VDC	
Max. Switched Power	1250 VA, 150 W	
Contact Isolation to XLE ground	1000 VAC	
Max. Voltage Drop at Rated Current	0.5 V	
Expected Life (See Derating section for chart.)	No load: 5,000,000 Rated load: 100,000	
Max. Switching Rate	300 CPM at no load 20 CPM at rated load	
Type	Mechanical Contact	
Response Time	One update per ladder scan plus 10 ms	
Analog Inputs, Medium Resolution		
Number of Channels	2	
Input Ranges	0 - 10 VDC 0 – 20 mA 4 – 20 mA	
Safe input voltage range	-0.5 V to +12V	
Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	Current Mode: 100 Ω	Voltage Mode: 500 k Ω
Nominal Resolution	10 Bits	
%AI full scale	32,000 counts	
Max. Over-Current	35 mA	
Conversion Speed	All channels converted once per ladder scan	
Max. Error at 25°C (excluding zero) *can be made tighter (~0.25%) by adjusting the digital filter setting to 3.	4-20 mA 1.00% 0-20 mA 1.00% 0-10 VDC 1.50%*	
Additional error for temperatures other than 25°C	TBD	
Filtering	160 Hz hash (noise) filter 1-128 scan digital running average filter	

Thermistor Inputs, Medium Resolution	
Number of Channels	2
Input Ranges	10K OHMThermistor
Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	Half Bridge 9.59K ohm pulled up to 4.8 VDC
Nominal Resolution	10 Bits
%AI at 10K Ohm	15,008 counts
Conversion Speed	All channels converted once per ladder scan
Max. Error at 25°C reading / ambient	±0.5°F or ±0.3°C Using specified linearization in ladder program
Additional error for reading / ambient temperatures other than 25°C	TBD
Filtering	160 Hz hash (noise) filter 1-128 scan digital running average filter

General Specifications	
Required Power (Steady State)	130 mA @ 24 VDC
Required Power (Inrush)	30 A for 1 ms @ 24 VDC
Primary Power Range	10 – 30 VDC
Relative Humidity	5 to 95% Non-condensing
Operating Temperature	0°C to +50°C
Terminal Type	Screw Type, 5 mm Removable
Weight	12 oz. (340.19 g)
CE UL	See Compliance Table at http://www.heapg.com/Support/compliance.htm
Clock Accuracy	+/- One Minute/Month at 20C
Highest usable frequency for PWM output is 65 KHz	

2 Safety

When found on the product, the following symbols specify:

Warning: Electrical Shock Hazard.

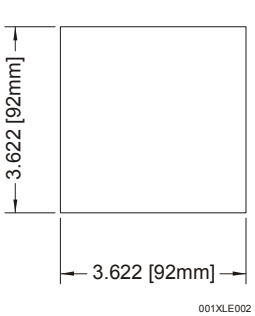
Warning: Consult user documentation.

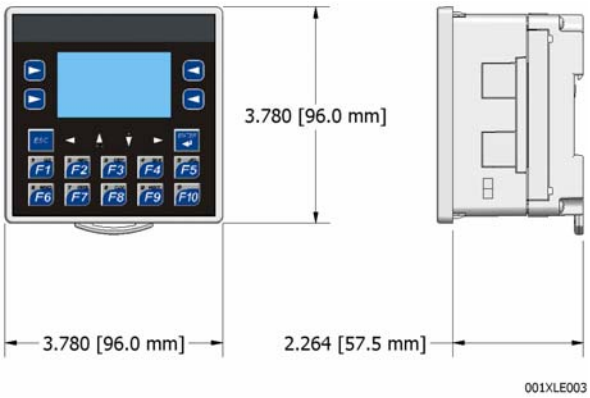
WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

3 Panel Cut-Out and Dimensions

Note: Max. panel thickness: 5 mm.

Refer to XLE User Manual (MAN0805) for panel box information and a handy checklist of requirements.
Note: The tolerance to meet NEMA standards is ± 0.005" (0.1 mm).





4 Ports / Connectors / Cables

Note: The case of the XLE is black, but for clarity, it is shown in a lighter gray color.

To Remove Back Cover:
Unscrew 4 screws located on the back of the unit.
Lift lid.

CAUTION: Do not overtighten screws when screwing the lid back on.

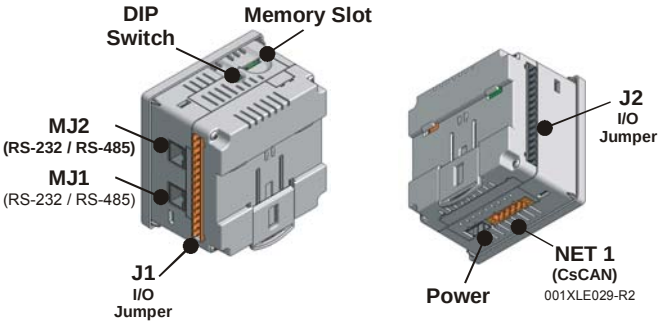
I/O Jumpers: (Not Shown):
I/O Jumpers (**JP**) are located internally. To access, remove back cover of unit.

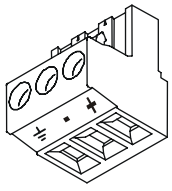
Wiring Connectors (J1 / J2): I/O Jumpers (JP1 / JP2), and **External Jumpers (RS-485)** are described in the ***Wiring and Jumpers*** section of this document.

Memory Slot:
Uses **Removable Memory** for data logging, screen captures, program loading and recipes.
Horner Part No.: HE-MC1

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

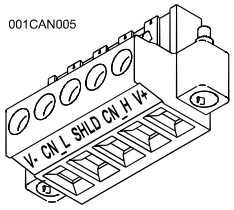
MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.





Power Connector

Power Up:
Connect to Earth Ground.
Apply 10 - 30 VDC.
Screen lights up.

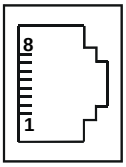


CAN Connector

Use the CAN Connector when using CsCAN network.

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Pin	MJ1 Pins		MJ2 Pins	
	Signal	Direction	Signal	Direction
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5	NC	No Connect	NC	No Connect
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	RX-	IN
1	RX+ / TX+	IN / OUT	RX+	IN

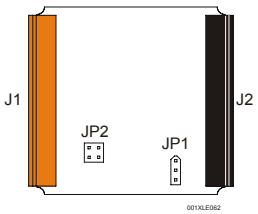
5 Wiring and Jumpers

Wire according to the type of inputs / outputs used, and select the appropriate jumper option.

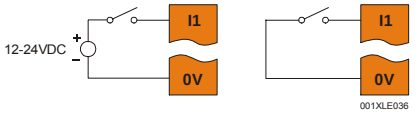
Wiring Specifications

- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.
- For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG or larger.
- For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG or larger.

Location of I/O jumpers (**JP**) and wiring connectors (J1 and J2).



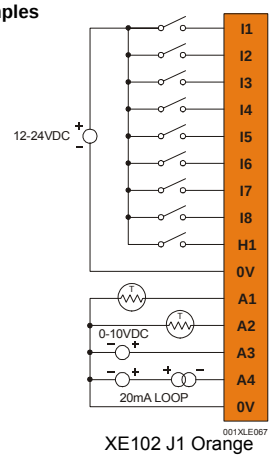
Positive Logic vs. Negative Logic Wiring
The XLE can be wired for Positive Logic inputs or Negative Logic inputs.



Positive Logic In Negative Logic In

5.1. Wiring Examples

J1 Orange Terminal Connector	XE102 Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 /IN9
0V	Ground
A1	Thermistor 1
A2	Thermistor 2
A3	Analog IN3
A4	Analog IN4
0V	Ground

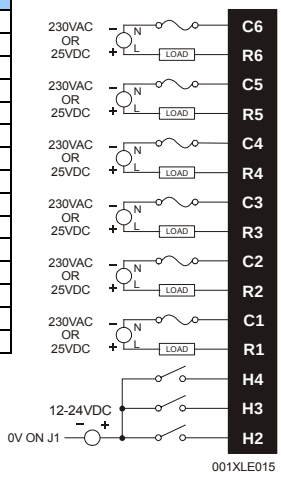


XE102 J1 Orange Positive Logic In **Digital In / Analog In**

Note:
Loop Power requirements are determined by the transmitter specification.

J2 Black Terminal Connector	XE102 Name
C6	Relay 6 COM
R6	Relay 6 NO
C5	Relay 5 COM
R5	Relay 5 NO
C4	Relay 4 COM
R4	Relay 4 NO
C3	Relay 3 COM
R3	Relay 3 NO
C2	Relay 2 COM
R2	Relay 2 NO
C1	Relay 1 COM
R1	Relay 1 NO
H4	HSC4 / IN12
H3	HSC3 / IN11
H2	HSC2 / IN10

XE102 J2 Black Positive Logic **Digital In / Relay Out**



5.2 I/O Jumpers Settings (JP1 - JP2)

JP1 Digital DC In / HSC
Positive Logic Negative Logic

JP2 Analog In (A3 – A4)
Current (20 mA) Voltage (10 V)

Note: The Cscape Module Setup configuration must match the selected I/O (JP) jumper settings.

Note:
When using JP2 (A3-A4), each channel can be independently configured.

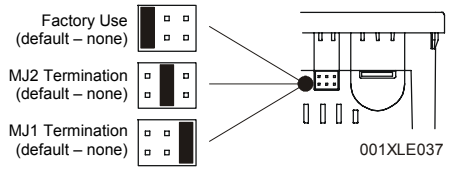
5.3 External DIP Switch Settings (or Jumpers Settings)

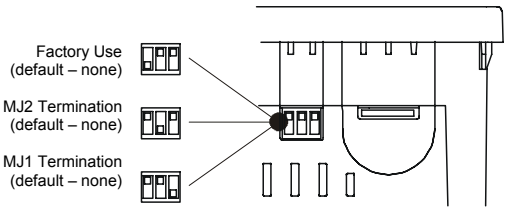
Some XLes have jumpers to set RS-485 port termination, though most use DIP Switches.

The External Jumpers or DIP Switches are used for termination of the RS-485 ports. The XLE is shipped un-terminated.

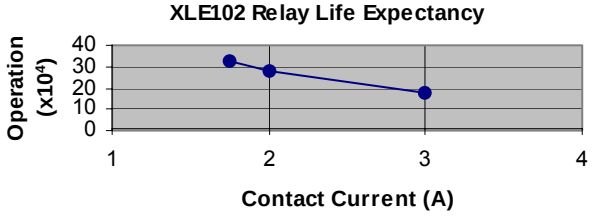
To terminate, select one of the jumpers shipped with the product and insert it based upon the option that is desired or, select the switch and configure based upon the option that is desired.

As seen when looking at the top of the XLE unit: Refer to Section 3 for the location of the External Jumpers.





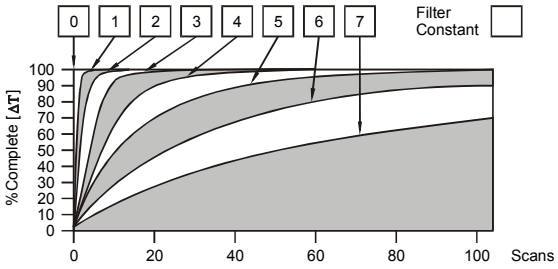
6 Derating



7 Analog Conditioning

7.1 Filter

Filter Constant sets the level of digital filtering according to the following chart.



Digital Filtering. The illustration above demonstrates the effect of digital filtering (set with Filter Constant) on module response to a temperature change.

It is recommended that the filter constant for the HE-XE103-10 be set to a value of 7. This will minimize noise and jitter, improve effective resolution, and provide adequate speed for most temperature monitor and control applications.

7.2 Thermistor Linearization

Thermistors are measured using a half-bridge circuit that exhibits variable resolution and the associated increased measurement range.

Temperature, degrees C	Resolution, degrees C
-55	1.05
-35	0.36
-15	0.17
5	0.11
25	0.1
45	0.13
65	0.22
85	0.30
105	0.55
125	0.85
145	1.35

Best resolution is at 25°C, 77°F. With a constant 0.1°C resolution circuit, the measurement range would only extend from –26°C to +76°C.

Linearization must be performed by the user in the ladder application code, using 26 internal %R registers per channel. The example below uses %R1-26 to linearize one channel - %AI1. Linearization consists of the following example steps.

1) Load the desired linearization coefficients into a table on First Scan using a Move Constant Data block.

Registers (Real)	Degrees C	Degrees F
R0011	-1.94454e-028	-3.50017e-028
R0013	2.40268e-023	4.32483e-023
R0015	-1.24101e-018	-2.23381e-018
R0017	3.46655e-014	6.23979e-014
R0019	-5.69403e-010	-1.02493e-009
R0021	5.62368e-006	1.01226e-005
R0023	-0.0353121	-0.0635617
R0025	163.878	326.981

2) Load %AI0001 into %R0001 as a Real.

3) Perform the Real Math Expression
4) %R3 = (((%R11*%R1+%R13)*%R1+%R15)*%R1+%R17)

5) Perform the Real Math Expression %R5 = (((%R3*%R1+%R19)*%R1+%R21)*%R1+%R23)*%R1+ %R25

6) Load %R0005 result into another register such as %R0007 to save the temperature value.

7) Steps 2 though 5 can be on a single rung.

The expression rung may be copied, substituting %AI0002 and %R00011 for %AI0001 and %R0007, and used to linearize the second channel. Contact Horner APG Technical Support for an example file containing the above program.

7.3 Thermistor types

The HE-XE103-10 with the given example ladder code supports Kele Engineering Precon Type III, 10 KΩ thermistors. It also directly supports the following 10 KΩ (Beta=3574) thermistors from Yellow Springs Instruments (YSI).

44006 46006
44106 46031
44406 46041
44031 44907
45006 44908

8 I/O Register Map

Registers	Description
%I1 to %I24	Digital Inputs
%I32	Output Fault
%I25 to %I31	Reserved
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 Accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

9 Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

10 Safety Precautions for Installation and Connections to XLe

- ❑ All applicable codes and standards need to be followed in the installation of this product.
- ❑ Adhere to the following safety precautions whenever any type of connection is made to the module:

- ✓ ▪Connect the safety (earth) ground on the power connector first before making any other connections.
- ✓ ▪When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
- ✓ ▪Do not make connections to live power lines.
- ✓ ▪Make connections to the module first; then connect to the circuit to be monitored.
- ✓ ▪Route power wires in a safe manner in accordance with good practice and local codes.
- ✓ ▪Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
- ✓ ▪Ensure hands, shoes, and floor are dry before making any connection to a power line.
- ✓ ▪Make sure the unit is turned OFF before making connection to terminals.
- ✓ ▪Make sure all circuits are de-energized before making connections.
- ✓ ▪Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

XLE OCS Model: HE-XE103-10
12 Digital DC Inputs / 12 Digital Outputs
2 10K Thermistor Inputs

Want More Information?
To download the XLE User Manual (MAN0805), refer to *Technical Support* in this document.

1 Specifications

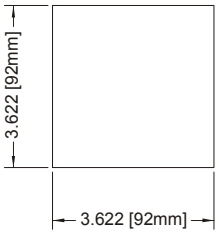
HE-XE103-10 Specifications				
Digital DC Inputs	**XLE103-10**		**Digital DC Outputs**	**XLE103-10**
Inputs per Module	12 including 4 configurable HSC inputs		Outputs per Module	12 including 2 configurable PWM outputs
Commons per Module	1		Commons per Module	1
Input Voltage Range	12 VDC / 24 VDC		Output Type	Sourcing / 10 K Pull-Down
Absolute Max. Voltage	35 VDC Max.		Absolute Max. Voltage	28 VDC Max.
Input Impedance	10 kΩ		Output Protection	Short Circuit
Input Current	Positive Logic	Negative Logic	Max. Output Current per point	0.5 A
Upper Threshold	0.8 mA	-1.6 mA	Max. Total Current	4 A Continuous
Lower Threshold	0.3 mA	-2.1 mA	Max. Output Supply Voltage	30 VDC
Max Upper Threshold	8 VDC		Minimum Output Supply Voltage	10 VDC
Min Lower Threshold	3 VDC		Max. Voltage Drop at Rated Current	0.25 VDC
OFF to ON Response	1 ms		Max. Inrush Current	650 mA per channel
ON to OFF Response	1 ms		Min. Load	None
HSC Max. Switching Rate	10 kHz Totalizer/Pulse,Edges 5 kHz Frequency/Pulse,Width 2.5 kHz Quadrature		OFF to ON Response	1 ms
Thermistor Inputs, Medium Resolution	**XLE103-10**		ON to OFF Response	1 ms
Number of Channels	2		Output Characteristics	Current Sourcing (Pos logic)
Input Ranges Safe input voltage range Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	10K OHM Thermistor Half Bridge 9.59K ohm pulled up to 4.8 VDC		**General Specifications**	
Nominal Resolution %AI at 10K Ohm	10 Bits 15,008 counts		Required Power (Steady State)	130 mA @ 24 VDC
			Required Power (Inrush)	30 A for 1 ms @ 24 VDC
			Primary Power Range	10 – 30 VDC
Conversion Speed	All channels converted once per ladder scan		Relative Humidity	5 to 95% Non-condensing
Max. Error at 25°C reading / ambient	±0.5°F or ±0.3°C Using specified linearization in ladder program		Operating Temperature	0°C to +50°C
Additional error for reading / ambient temperatures other than 25°C	TBD		Terminal Type	Screw Type,5 mm Removable
			CE	See Compliance Table at http://www.heapg.com/Support/compliance.htm
Filtering	160 Hz hash (noise) filter 1-128 scan digital running average filter		UL	
			Weight	12.5 oz. (354.36 g)
Clock Accuracy	+/- One Minute/Month at 20C			
Highest usable frequency for PWM output is 65 KHz				

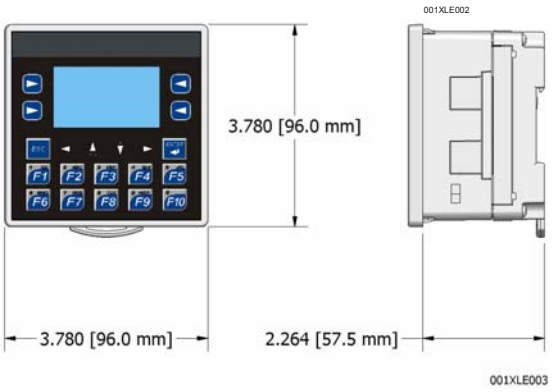
2 Panel Cut-Out and Dimensions

Note: Max. panel thickness: 5 mm.

Refer to XLE User Manual (MAN0805) for panel box information and a handy checklist of requirements.

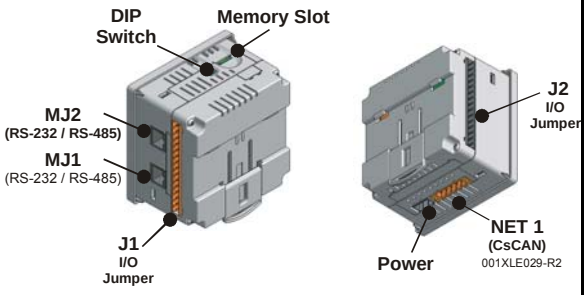
Note:
The tolerance to meet **NEMA** standards is ± 0.005" (0.1 mm).





3 Ports / Connectors / Cables

Note: The case of the XLE is black, but for clarity, it is shown in a lighter gray color.

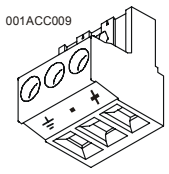


To Remove Back Cover:
Unscrew 4 screws located on the back of the unit.
Lift lid.

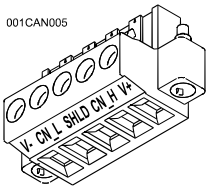
CAUTION: Do not overtighten screws when screwing the lid back on.

I/O Jumpers (Not Shown): I/O Jumpers (**JP**) are located internally. To access, remove back cover of unit.

Wiring Connectors (**J1 – J4**), **I/O Jumpers** (**JP1-3**), and **External Jumpers** (**RS-485**) are described in the ***Wiring and Jumpers*** section of this document.



Power Connector



CAN Connector

Power Up:
Connect to Earth Ground.
Apply 10 – 30 VDC.
Screen lights up.

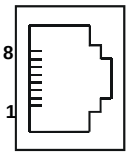
Use the CAN Connector when using CsCAN network.

Section 3 continued

Memory Slot:
Uses **Removable Memory** for data logging, screen captures, program loading and recipes.
Horner Part No.: HE-MC1

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Pin	MJ1 Pins		MJ2 Pins	
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5	NC	No Connect	NC	No Connect
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	RX-	IN
1	RX+ / TX+	IN / OUT	RX+	IN

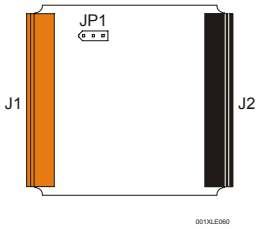
4 Wiring and Jumpers

Wire according to the type of inputs / outputs used and select the appropriate jumper option.

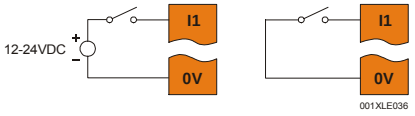
Wiring Specifications

- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.
- For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG or larger.
- For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG or larger.

Location of I/O jumper (JP1) and wiring connectors (J1 & J2).



Positive Logic vs. Negative Logic Wiring
The XLE can be wired for Positive Logic inputs or Negative Logic inputs.

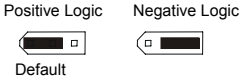


Positive Logic In Negative Logic In

4.1. I/O Jumper Setting (JP1)

Note: The Cscape Module Setup configuration must match the selected I/O (JP) jumper settings.

JP1 Digital DC Inputs



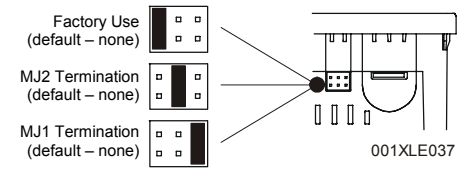
4.2. External DIP Switch Settings (or Jumpers Settings)

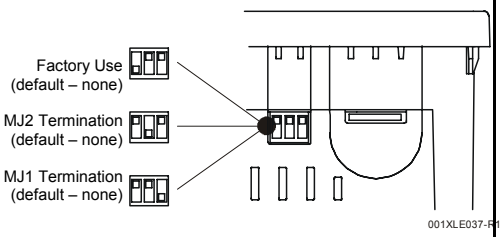
Some XLes have jumpers to set RS-485 port termination, though most use DIP Switches.

The External Jumpers or DIP Switches are used for termination of the RS-485 ports. The XLE is shipped un-terminated.

To terminate, select one of the jumpers shipped with the product and insert it based upon the option that is desired or, select the switch and configure based upon the option that is desired.

As seen when looking at the top of the XLE unit. Refer to Section 3 for the location of the External Jumpers.



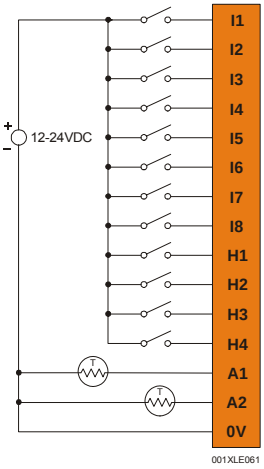


4.3. Wiring Examples

Note: The wiring examples show **Positive Logic** input wiring.

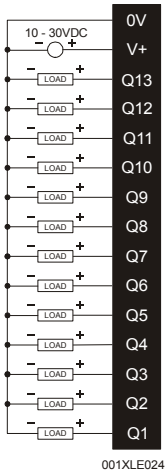
J1 Orange	XE103-10 Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 / IN9
H2	HSC2 / IN10
H3	HSC3 / IN11
H4	HSC4 / IN12
A1	Thermistor 1
A2	Thermistor 2
0V	Ground

XE103-10 J1 Orange
Positive Logic
Digital In



J2 Black	XE103-10 Name
0V	Ground
V+	V+ *
NC	No Connect
Q12	OUT12
Q11	OUT11
Q10	OUT10
Q9	OUT9
Q8	OUT8
Q7	OUT7
Q6	OUT6
Q5	OUT5
Q4	OUT4
Q3	OUT3
Q2	OUT2 / PWM2
Q1	OUT1 / PWM1
V+* Supply for Sourcing Outputs	

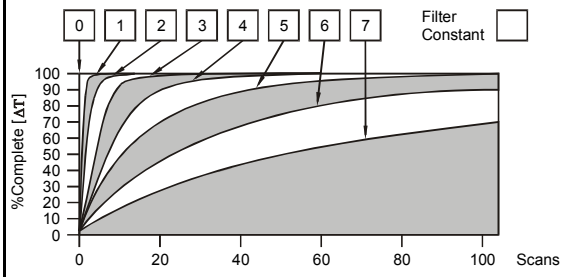
XE103-10 J2 Black
Positive Logic
Digital Out



5 Analog Conditioning

5.1 Filter

Filter Constant sets the level of digital filtering according to the following chart.



Digital Filtering. The illustration above demonstrates the effect of digital filtering (set with Filter Constant) on module response to a temperature change.

It is recommended that the filter constant for the HE-XE103-10 be set to a value of 7. This will minimize noise and jitter, improve effective resolution, and provide adequate speed for most temperature monitor and control applications.

5.2 Thermistor Linearization

Thermistors are measured using a half-bridge circuit that exhibits variable resolution and the associated increased measurement range.

Temperature, degrees C	Resolution, degrees C
-55	1.05
-35	0.36
-15	0.17
5	0.11
25	0.1
45	0.13
65	0.22
85	0.30
105	0.55
125	0.85
145	1.35

Best resolution is at 25°C, 77°F. With a constant 0.1°C resolution circuit, the measurement range would only extend from –26°C to +76°C.

Linearization must be performed by the user in the ladder application code, using 26 internal %R registers per channel. The example below uses %R1-26 to linearize one channel - %AI1. Linearization consists of the following example steps.

1. Load the desired linearization coefficients into a table on First Scan using a Move Constant Data block.

Registers (Real)	Degrees C	Degrees F
R0011	-1.94454e-028	-3.50017e-028
R0013	2.40268e-023	4.32483e-023
R0015	-1.24101e-018	-2.23381e-018
R0017	3.46655e-014	6.23979e-014
R0019	-5.69403e-010	-1.02493e-009
R0021	5.62368e-006	1.01226e-005
R0023	-0.0353121	-0.0635617
R0025	163.878	326.981

2. Load %AI0001 into %R0001 as a Real.

3. Perform the Real Math Expression
%R3 = (((%R11*%R1+%R13)*%R1+%R15)*%R1+%R17)

4. Perform the Real Math Expression %R5 =
(((%R3*%R1+%R19)*%R1+%R21)*%R1+%R23)*%R1+%R25

5. Load %R0005 result into another register such as %R0007 to save the temperature value.

Steps 2 though 5 can be on a single rung.

The expression rung may be copied, substituting %AI0002 and %R00011 for %AI0001 and %R0007, and used to linearize the second channel. Contact Horner APG for an example file containing the above program.

5.3 Thermistor types

The HE-XE103-10 with the given example ladder code supports Kele Engineering Precon Type III, 10 KΩ thermistors. It also directly supports the following 10 KΩ (Beta=3574) thermistors from Yellow Springs Instruments (YSI).

44006 46006
44106 46031
44406 46041
44031 44907
45006 44908

6 I/O Register Map

Registers	Description
%I1 to %I24	Digital Inputs
%I32	Output Fault
%I25 to %I31	Reserved
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 Accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

Registers	PWM	HSC	Stepper
%AQ1	PWM1 Duty Cycle (32 bit)	HSC1 Preset Value	Start Frequency
%AQ2			Run Frequency
%AQ3	PWM2 Duty Cycle (32 bit)	HSC2 Preset Value	Accel Count (32 bit)
%AQ4			
%AQ5	PWM Prescale (32 bit)		Run Count (32 bit)
%AQ6			
%AQ7	PWM Period (32 bit)		Decel Count (32 bit)
%AQ8			
%Q1			Run
%I30			Ready/Done
%I31			Error

7. Safety

When found on the product, the following symbols specify:


Warning: Electrical Shock Hazard.


Warning: Consult user documentation.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.

- Adhere to the following safety precautions whenever any type of connection is made to the module:
  - Connect the safety (earth) ground on the power connector first before making any other connections.
  - When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
  - Do not make connections to live power lines.
  - Make connections to the module first; then connect to the circuit to be monitored.
  - Route power wires in a safe manner in accordance with good practice and local codes.
  - Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
  - Ensure hands, shoes, and floor are dry before making any connection to a power line.
  - Make sure the unit is turned OFF before making connection to terminals.
  - Make sure all circuits are de-energized before making connections.
  - Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

8 Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

Notes

XLE OCS Model: HE-XE103
12 Digital DC Inputs / 12 Digital Outputs
2 Analog Inputs (Medium Resolution)

XLE OCS Model: HE-XE104
24 Digital DC Inputs / 16 Digital Outputs
2 Analog Inputs (Medium Resolution)

Want More Information?
To download the XLE User Manual (MAN0805), refer to *Technical Support* in this document.

1 Specifications

HE-XE103 / 104 Specifications

Digital DC Inputs	XLE103	XLE104
Inputs per Module	12 including 4 configurable HSC inputs	24 including 4 configurable HSC inputs
Commons per Module	1	
Input Voltage Range	12 VDC / 24 VDC	
Absolute Max. Voltage	35 VDC Max.	
Input Impedance	10 kΩ	
Input Current	Positive Logic	Negative Logic
Upper Threshold	0.8 mA	-1.6 mA
Lower Threshold	0.3 mA	-2.1 mA
Max Upper Threshold	8 VDC	
Min Lower Threshold	3 VDC	
OFF to ON Response	1 ms	
ON to OFF Response	1 ms	
HSC Max. Switching Rate	10 kHz Totalizer/Pulse,Edges 5 kHz Frequency/Pulse,Width 2.5 kHz Quadrature	

Analog Inputs, Medium Resolution	XLE103	XLE104
Number of Channels	2	2
Input Ranges Safe input voltage range Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	0 - 10 VDC 0 – 20 mA 4 – 20 mA -0.5 V to +12V Current Mode: 100 Ω Voltage Mode: 500 k Ω	
Nominal Resolution %AI full scale Max. Over-Current	10 Bits 32,000 counts 35 mA	
Conversion Speed	All channels converted once per ladder scan	
Max. Error at 25°C (excluding zero)	4-20 mA 1.00% 0-20 mA 1.00% 0-10 VDC 0.50%	
Additional error for temperatures other than 25°C	TBD	
Filtering	160 Hz hash (noise) filter 1-128 scan digital running average filter	

Digital DC Outputs	XLE103	XLE104
Outputs per Module	12 including 2 configurable PWM outputs	16 including 2 configurable PWM outputs
Commons per Module	1	
Output Type	Sourcing / 10 K Pull-Down	
Absolute Max. Voltage	28 VDC Max.	
Output Protection	Short Circuit	
Max. Output Current per point	0.5 A	
Max. Total Current	4 A Continuous	
Max. Output Supply Voltage	30 VDC	
Minimum Output Supply Voltage	10 VDC	
Max. Voltage Drop at Rated Current	0.25 VDC	
Max. Inrush Current	650 mA per channel	
Min. Load	None	
OFF to ON Response	1 ms	
ON to OFF Response	1 ms	
Output Characteristics	Current Sourcing (Pos logic)	

General Specifications	
Required Power (Steady State)	130 mA @ 24 VDC
Required Power (Inrush)	30 A for 1 ms @ 24 VDC
Primary Power Range	10 – 30 VDC
Relative Humidity	5 to 95% Non-condensing
Operating Temperature	0°C to +50°C
Terminal Type	Screw Type,5 mm Removable
CE / UL	See Compliance Table at http://www.heapg.com/Support/compliance.htm
Weight	12.5 oz. (354.36 g)

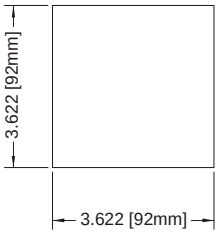
Clock Accuracy	+/- One Minute/Month at 20C
Highest usable frequency for PWM output is 65 KHz	

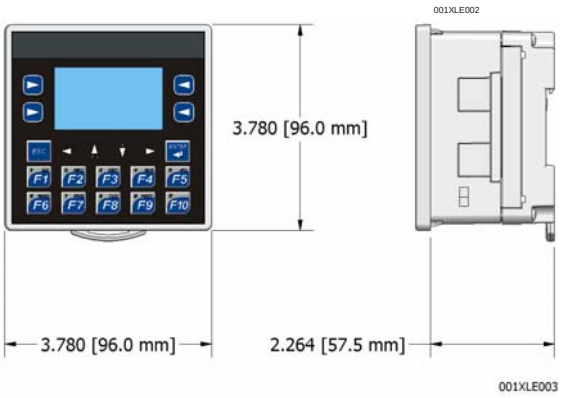
2 Panel Cut-Out and Dimensions

Note: Max. panel thickness: 5 mm.

Refer to XLE User Manual (MAN0805) for panel box information and a handy checklist of requirements.

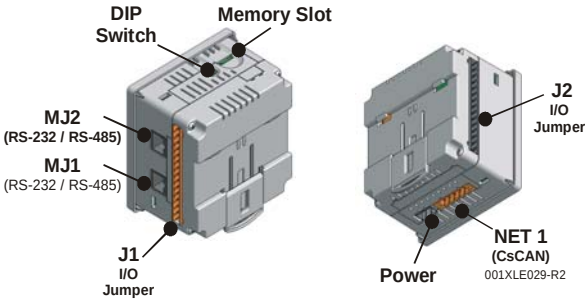
Note:
The tolerance to meet **NEMA** standards is ± 0.005" (0.1 mm).





3 Ports / Connectors / Cables

Note: The case of the XLE is black, but for clarity, it is shown in a lighter gray color.

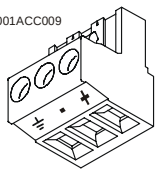


To Remove Back Cover:
Unscrew 4 screws located on the back of the unit.
Lift lid.

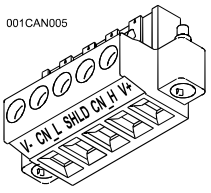
CAUTION: Do not overtighten screws when screwing the lid back on.

I/O Jumpers (Not Shown): I/O Jumpers (**JP**) are located internally. To access, remove back cover of unit.

Wiring Connectors (**J1 – J4**), **I/O Jumpers** (**JP1-3**), and **External Jumpers** (**RS-485**) are described in the ***Wiring and Jumpers*** section of this document.



Power Connector



CAN Connector

Power Up:
Connect to Earth Ground.
Apply 10 – 30 VDC.
Screen lights up.

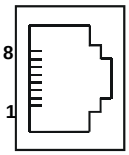
Use the CAN Connector when using CsCAN network.

Section 3 continued

Memory Slot:
Uses **Removable Memory** for data logging, screen captures, program loading and recipes.
Horner Part No.: HE-MC1

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Pin	MJ1 Pins		MJ2 Pins	
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5	NC	No Connect	NC	No Connect
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	RX-	IN
1	RX+ / TX+	IN / OUT	RX+	IN

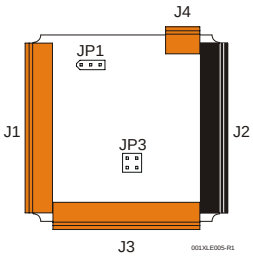
4 Wiring and Jumpers

Wire according to the type of inputs / outputs used and select the appropriate jumper option.

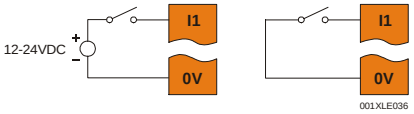
Wiring Specifications

- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.
- For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG or larger.
- For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG or larger.

Location of I/O jumpers (JP) and wiring connectors (J1 – J4).



Positive Logic vs. Negative Logic Wiring
The XLE can be wired for Positive Logic inputs or Negative Logic inputs.

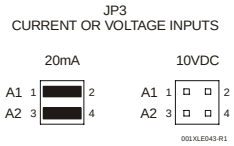


Positive Logic In Negative Logic In

a. I/O Jumpers Settings (JP1 – JP3)

Note: The Cscape Module Setup configuration must match the selected I/O (JP) jumper settings.

JP1 Digital DC Inputs



Note:
When using JP3 (A1-A2), each channel can be independently configured.

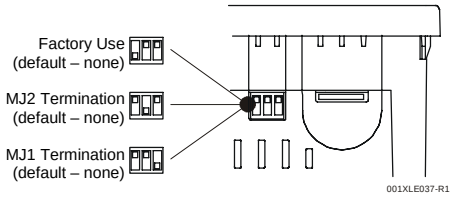
b. External DIP Switch Settings (or Jumpers Settings)

Some XLes have jumpers to set RS-485 port termination, though most use DIP Switches.

The External Jumpers or DIP Switches are used for termination of the RS-485 ports. The XLE is shipped un-terminated.

To terminate, select one of the jumpers shipped with the product and insert it based upon the option that is desired or, select the switch and configure based upon the option that is desired.

As seen when looking at the top of the XLE unit. Refer to Section 3 for the location of the DIP Switches/ Jumpers.

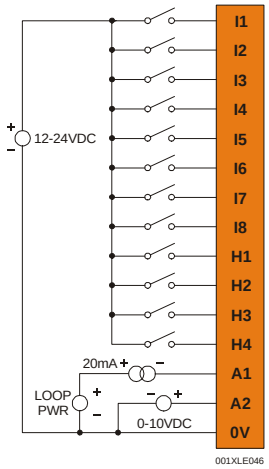


c. Wiring Examples

Note: The wiring examples show **Positive Logic** input wiring.

J1 Orange	XE103 / XE104 Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 / IN9
H2	HSC2 / IN10
H3	HSC3 / IN11
H4	HSC4 / IN12
A1	Analog IN1
A2	Analog IN2
0V	Ground

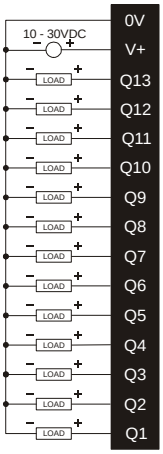
XE103 / 104 J1 Orange
Positive Logic
Digital In



Note:
Loop Power requirements are determined by the transmitter specification.

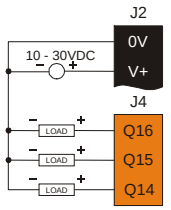
J2 Black	XE103	XE104
0V	Ground	
V+	V+ *	
NC	No Connect	OUT13
Q12	OUT12	
Q11	OUT11	
Q10	OUT10	
Q9	OUT9	
Q8	OUT8	
Q7	OUT7	
Q6	OUT6	
Q5	OUT5	
Q4	OUT4	
Q3	OUT3	
Q2	OUT2 / PWM2	
Q1	OUT1 / PWM1	
V+* Supply for Sourcing Outputs		

XE103 / 104 J2 Black
Positive Logic
Digital Out



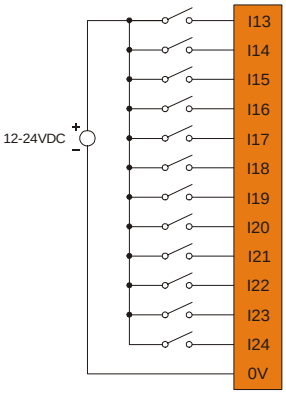
J4 Orange	XE104
Q16	OUT16
Q15	OUT15
Q14	OUT14

XE104 J4 Orange
Positive Logic
Digital Out



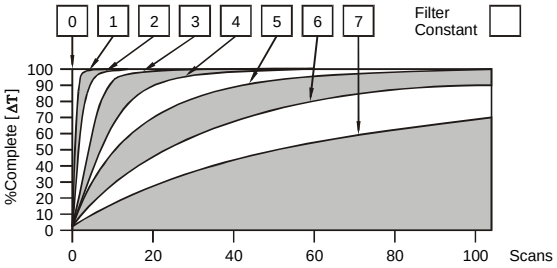
J3 Orange	XE104
I13	IN13
I14	IN14
I15	IN15
I16	IN16
I17	IN17
I18	IN18
I19	IN19
I20	IN20
I21	IN21
I22	IN22
I23	IN23
I24	IN24
0V	Ground

XE104 J3 Orange
Positive Logic
Digital In



5 Filter

Filter Constant sets the level of digital filtering according to the following chart.



Digital Filtering. The illustration above demonstrates the effect of digital filtering (set with Filter Constant) on module response to a temperature change.

6 I/O Register Map

Registers	Description
%I1 to %I24	Digital Inputs
%I32	Output Fault
%I25 to %I31	Reserved
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 Accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

Registers	PWM	HSC	Stepper
%AQ1	PWM1 Duty Cycle (32 bit)	HSC1 Preset Value	Start Frequency
%AQ2			Run Frequency
%AQ3	PWM2 Duty Cycle (32 bit)	HSC2 Preset Value	Accel Count (32 bit)
%AQ4			
%AQ5	PWM Prescale (32 bit)		Run Count (32 bit)
%AQ6			
%AQ7	PWM Period (32 bit)		Decel Count (32 bit)
%AQ8			
%Q1			Run
%I30			Ready/Done
%I31			Error

7. Safety

When found on the product, the following symbols specify:

Warning: Electrical Shock Hazard.

Warning: Consult user documentation.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.

- Adhere to the following safety precautions whenever any type of connection is made to the module:
  - Connect the safety (earth) ground on the power connector first before making any other connections.
  - When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
  - Do not make connections to live power lines.
  - Make connections to the module first; then connect to the circuit to be monitored.
  - Route power wires in a safe manner in accordance with good practice and local codes.
  - Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
  - Ensure hands, shoes, and floor are dry before making any connection to a power line.
  - Make sure the unit is turned OFF before making connection to terminals.
  - Make sure all circuits are de-energized before making connections.
  - Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

8 Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

XLE OCS Model: HE-XE105

12 Digital DC Inputs / 12 Digital DC Outputs
2 Analog Inputs (High Resolution) / 2 Analog Outputs
(for firmware version 11.82 and later)

Want More Information?
To download the XLE User Manual (MAN0805), refer to *Technical Support* in this document.

Digital DC Inputs		
Inputs per Module	12 including 4 configurable HSC inputs	
Commons per Module	1	
Input Voltage Range	12 VDC / 24 VDC	
Absolute Max. Voltage	35 VDC Max.	
Input Impedance	10 kΩ	
Input Current	Positive Logic	Negative Logic
Upper Threshold	0.8 mA	-1.6 mA
Lower Threshold	0.3 mA	-2.1 mA
Max Upper Threshold	8 VDC	
Min Lower Threshold	3 VDC	
OFF to ON Response	1 ms	
ON to OFF Response	1 ms	
HSC Max. Switching Rate	10 kHz Totalizer/Pulse, Edges 5 kHz Frequency/Pulse, Width 2.5 kHz Quadrature	

Digital DC Outputs	
Outputs per Module	12 including 2 configurable PWM outputs
Commons per Module	1
Output Type	Sourcing / 10 K Pull-Down
Absolute Max. Voltage	28 VDC Max.
Output Protection	Short Circuit
Max. Output Current per point	0.5 A
Max. Total Current	4 A Continuous
Max. Output Supply Voltage	30 VDC
Minimum Output Supply Voltage	10 VDC
Max. Voltage Drop at Rated Current	0.25 VDC
Max. Inrush Current	650 mA per channel
Min. Load	None
OFF to ON Response	1 ms
ON to OFF Response	1 ms
Output Characteristics	Current Sourcing (Pos logic)

Analog Inputs, High Resolution			
Number of Channels	2	Thermocouple	Temperature Range
Input Ranges (Selectable)	0 - 10 VDC 0 – 20 mA 4 – 20 mA 100mV PT100 RTD, and J, K, N, T, E, R, S, B Thermocouples	B / R / S	2912°F to 32.0°F (1600°C to 0°C)
		E	1652°F to -328°F (900°C to -200°C)
		T	752.0°F to -400.0°F (400°C to -240°C)
Safe input voltage range	10 VDC: -0.5 V to +15 V 20 mA: -0.5 V to +6 V RTD / T/C: ±24 VDC	J	1382.0°F to -346.0°F (750°C to -210°C)
		K / N	2498.0°F to -400°F (1370°C to -240°C)
		Thermocouple Common Mode Range	±10V
Nominal Resolution	10V, 20mA, 100mV: 14 Bits RTD, Thermocouple: 16 Bits	Converter Type	Delta Sigma
Input Impedance (Clamped @ -0.5 VDC to 12 VDC)	Current Mode: 100 Ω, 35mA Max. Continuous Voltage Mode: 500 kΩ, 35mA Max. Continuous	Max. Error at 25°C (*excluding zero)	*4-20 mA ±0.10%* *0-20 mA ±0.10%* *0-10 VDC ±0.10%* RTD (PT100) ±1.0 °C 0-100 mV ±0.05%
		Max Thermocouple Error (After Warm Up Time of One Hour)	±0.2% (±0.3% below -100°C)
%AI full scale	10 V, 20 mA, 100 mV: 32,000 counts full scale. RTD / T/C: 20 counts / °C	Conversion Speed, Both Channels Converted	10V, 20mA, 100mV: 30 Times/Second RTD, Thermocouple: 7.5 Times/Second
Max. Over-Current	35 mA	Conversion Time per Channel	10V, 20mA, 100mV: 16.7mS RTD, Thermocouple: 66.7mS
Open Thermocouple Detect Current	50 nA	RTD Excitation Current	250 µA

Analog Outputs		General Specifications	
Number of Channels	2	Required Power (Steady State)	130 mA @ 24 VDC
Output Ranges	0-10 VDC, 0-20 mA	Required Power (Inrush)	30 A for 1 ms @ 24 VDC
Nominal Resolution	12 Bits	Primary Power Range	10 - 30 VDC
Update rate	Once per PLC scan	Operating Temperature	0° to 50° Celsius
Minimum 10 V load	1 kΩ	Storage Temperature	14 to 140°F (-10 to 60°C)
Maximum 20 mA load	500 Ω	Relative Humidity	5 to 95% Non-condensing
Analog Outputs; Output Points Required	2	Filtering	15Hz hash (noise) filter 1-128 scan digital running average filter
Maximum Error at 25°C (excluding zero)	0.1%	Terminal Type	Screw Type,5 mm Removable
		Weight	12.5 oz. (354.36)
Additional error for temperatures other than 25°C	0.01% / °C	CE	See Compliance Table at http://www.heapg.com/Support/compliance.htm
		UL	

Clock Accuracy is +/- One Minute/Month at 20C

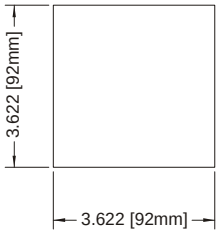
Highest usable frequency for PWM output is 65 KHz

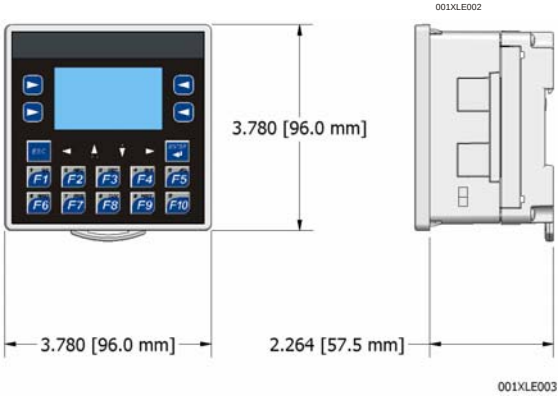
2 Panel Cut-Out and Dimensions

Note: Max. panel thickness: 5 mm.

Refer to XLE User Manual (MAN0805) for panel box information and a handy checklist of requirements.

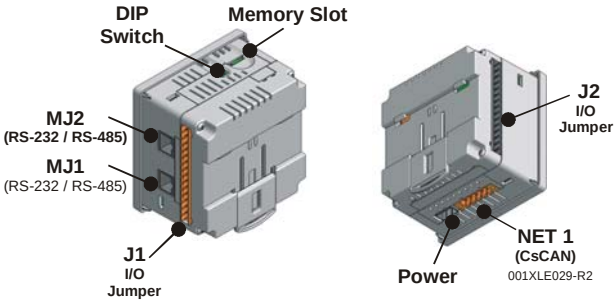
Note:
The tolerance to meet **NEMA** standards is ± 0.005" (0.1 mm).





3 Ports / Connectors / Cables

Note: The case of the XLE is black, but for clarity, it is shown in a lighter gray color.

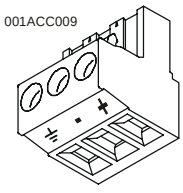


To Remove Back Cover:
Unscrew 4 screws located on the back of the unit.
Lift lid.

CAUTION:
Do not overtighten screws when screwing the lid back on.

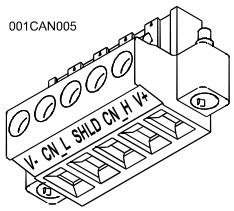
I/O Jumpers (Not Shown): I/O Jumpers (JP) are located internally. To access, remove back cover of unit.

Wiring Connectors (J1 – J3), I/O Jumpers (JP1 – JP4), and **External Jumpers (RS-485)** are described in the ***Wiring and Jumpers*** section of this document.



Power Connector

Power Up:
Connect to Earth Ground.
Apply 10 - 30 VDC.
Screen lights up.



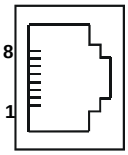
CAN Connector

Use the CAN Connector when using CsCAN network.

Memory Slot:
Uses **Removable Memory** for data logging, screen captures, program loading and recipes.
Horner Part No.: HE-MC1

Serial Communications:
MJ1: (RS-232 / RS-485) Use for Cscape programming and Application-Defined Communications.

MJ2: (RS-232 / RS-485) Use for Application-Defined Communications.



Pin	MJ1 Pins		MJ2 Pins	
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5	NC	No Connect	NC	No Connect
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	RX-	IN
1	RX+ / TX+	IN / OUT	RX+	IN

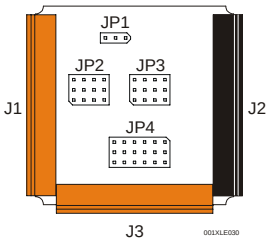
4 Wiring and Jumpers

Wire according to the type of inputs / outputs used and select the appropriate jumper option.

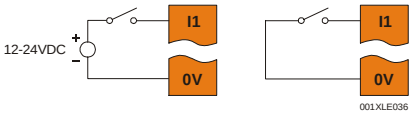
Wiring Specifications

- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.
- For shielded Analog I/O wiring, use the following wire type or equivalent: Belden 8441, 18 AWG or larger.
- For CAN wiring, use the following wire type or equivalent: Belden 3084, 24 AWG or larger.

Location of I/O jumpers (JP) and wiring connectors (J1 – J3).



Positive Logic vs. Negative Logic Wiring
The XLE can be wired for Positive Logic inputs or Negative Logic inputs.



Positive Logic In Negative Logic In

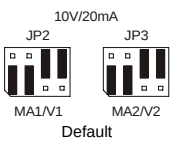
a. I/O Jumpers Settings (JP1 – JP4)

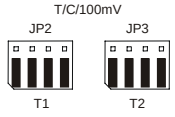
Note: The Cscape Module Setup configuration must match the selected I/O (JP) jumper settings.

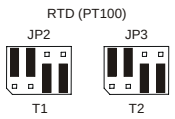
JP1 Digital DC Inputs

JP4 ANALOG OUTPUT SETTING VOLTAGE OR CURRENT

Analog In Settings AI1 AI2







Note: When using **JP4** (output) *or* **JP2 / JP3** (inputs), each channel can be independently configured. For example, JP2 can be configured for 10 V and JP3 can be configured as an RTD.

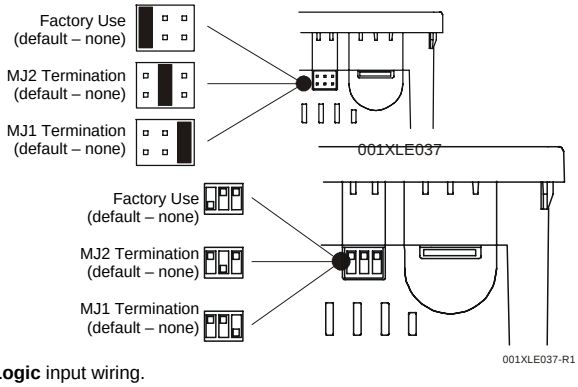
b. External DIP Switch Settings (or Jumpers Settings)

Some XLes have jumpers to set RS-485 port termination, though most use DIP Switches.

The External Jumpers or DIP Switches are used for termination of the RS-485 ports. The XLE is shipped un-terminated.

To terminate, select one of the jumpers shipped with the product and insert it based upon the option that is desired or, select the switch and configure based upon the option that is desired.

As seen when looking at the top of the XLE unit: Refer to Section 3 for the location of the External Jumpers.

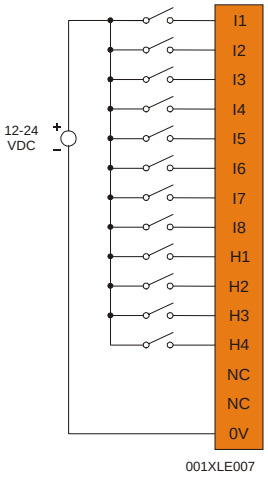


c. Wiring Examples

Note: The wiring examples show **Positive Logic** input wiring.

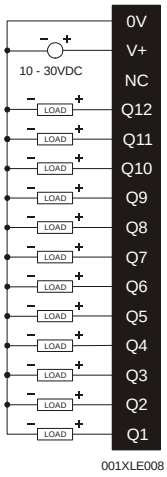
J1 Orange	XE105 Name
I1	IN1
I2	IN2
I3	IN3
I4	IN4
I5	IN5
I6	IN6
I7	IN7
I8	IN8
H1	HSC1 / IN9
H2	HSC2 / IN10
H3	HSC3 / IN11
H4	HSC4 / IN12
NC	No Connect
NC	No Connect
0V	Ground

XE105 J1 Orange
Positive Logic
Digital In



J2 Black	XE105 Name
0V	Ground
V+*	V+*
NC	No Connect
Q12	OUT12
Q11	OUT11
Q10	OUT10
Q9	OUT9
Q8	OUT8
Q7	OUT7
Q6	OUT6
Q5	OUT5
Q4	OUT4
Q3	OUT3
Q2	OUT2 / PWM2
Q1	OUT1 / PWM1
V+* Supply for Sourcing Outputs	

XE105 J2 Black
Positive Logic
Digital Outputs

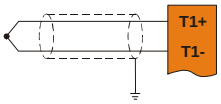


J3 Orange	XE105 Name
T1+	T/C / RTD IN1+ / 100 mV+
T1-	T/C / RTD IN1- / 100 mV-
T2+	T/C / RTD IN2+ / 100 mV+
T2-	T/C / RTD IN2- / 100 mV-
AQ1	10 V / 20 mA OUT1
AQ2	0 V / 20 mA OUT2
0V	Ground
MA1	20 mA IN1
V1	10 V IN1
0V	Ground
MA2	20 mA IN2
V2	10 V IN2
0V	Ground

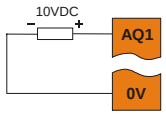
XE105 J3 Orange
Analog In / Analog Out

Note: A total of 2 Analog Inputs can be used (T/C, RTD, mV, mA, and V).

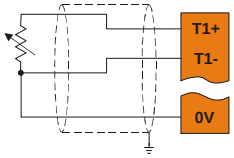
Thermocouple In



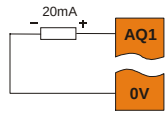
0 -10 V Analog Out



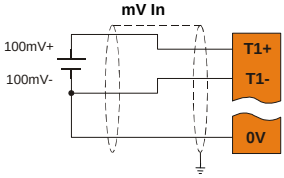
RTD In



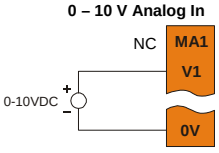
4 - 20 mA Analog Out



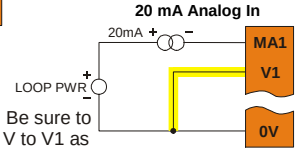
mV In



0 – 10 V Analog In



20 mA Analog In



Note: Loop Power (LOOP PWR) requirements are determined by the transmitter specification.

Note: Be sure to wire 0 V to V1 as shown for proper operation.

5 I/O Register Map

Registers	Description
%I1 to %I24	Digital Inputs
%I32	Output Fault
%I25 to %I31	Reserved
%Q1 to %Q16	Digital outputs
%Q17	Clear HSC1 accumulator to 0
%Q18	Totalizer: Clear HSC2 Quadrature 1-2: Accumulator 1 Reset to max – 1
%Q19	Clear HSC3 Accumulator to 0
%Q20	Totalizer: Clear HSC4 Quadrature 3-4: Accumulator 3 Reset to max – 1
%Q21 to %Q32	Reserved
%AI1 to %AI4	Analog inputs
%AI5, %AI6	HSC1 Accumulator
%AI7, %AI8	HSC2 Accumulator
%AI9, %AI10	HSC3 Accumulator
%AI11, %AI12	HSC4 Accumulator
%AQ1, %AQ2	PWM1 Duty Cycle
%AQ3, %AQ4	PWM2 Duty Cycle
%AQ5, %AQ6	PWM Prescale
%AQ7, %AQ8	PWM Period
%AQ9 to %AQ14	Analog outputs
Note: Not all XLe units contain the I/O listed in this table.	

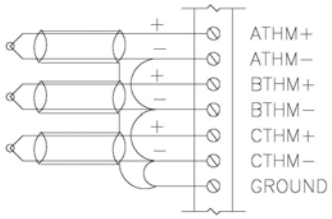
Registers	PWM	HSC	Stepper
%AQ1	PWM1 Duty Cycle (32 bit)	HSC1 Preset Value	Start Frequency
%AQ2			Run Frequency
%AQ3	PWM2 Duty Cycle (32 bit)	HSC2 Preset Value	Accel Count (32 bit)
%AQ4			
%AQ5	PWM Prescale (32 bit)		Run Count (32 bit)
%AQ6			
%AQ7	PWM Period (32 bit)		Decel Count (32 bit)
%AQ8			
%Q1			Run
%I30			Ready/Done
%I31			Error

6 Digital Filtering for Analog Inputs

The digital filter is updated once per conversion. It is an "IIR" running average filter that emulates a simple RC filter. The equivalent time constant is determined by the Filter Constant and the sum of the conversion times for the two channels. The Filter Constant determines the weight given to the most recent conversion. The following table lists the equivalent time constant for the three possible total conversion times, which are dependent upon the two input mode selections. This filter delay is in addition to the PLC scan delay.

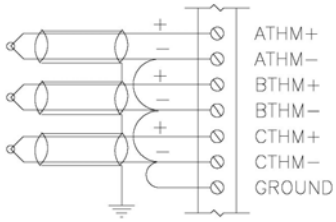
Equivalent RC Time Constant in Seconds (Nominal time to reach 63% of final value.)			
	Total Conversion Time in Seconds		
Filter Constant	0.03	0.09	0.13
0*	0.03*	0.09*	0.13*
1	0.07	0.18	0.27
2	0.13	0.35	0.53
3	0.27	0.71	1.07
4	0.53	1.41	2.13
5	1.07	2.83	4.27
6	2.14	5.65	8.54
7	4.28	11.30	17.08
* No filter delay, reading is unfiltered conversion value			

7 Thermocouple Grounding Schemes



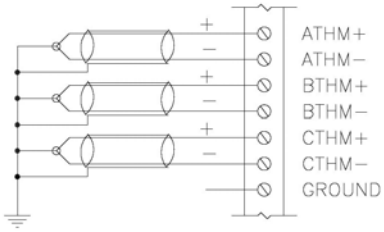
Ungrounded Thermocouples

Alternate Shield Connection for Ungrounded Thermocouples.



Ungrounded Thermocouples

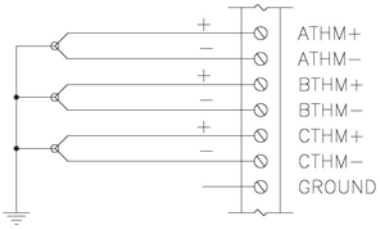
Preferred Shield Connection for Ungrounded Thermocouples.



Grounded Thermocouples

Field Ground Potential Less Than Seven Volts AC

Typical Shield Connection for Grounded Thermocouples



Grounded Thermocouples

Field Ground Potential Less Than Seven Volts AC

Shields Connected at One End Only May be Used to Reduce Noise

Grounded Thermocouples May Use the Ungrounded Thermocouple Shield Connections if the Shield is not Grounded at the Field End

8 Safety

When found on the product, the following symbols specify:

Warning: Electrical Shock Hazard.

Warning: Consult user documentation.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.
WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.

- Adhere to the following safety precautions whenever any type of connection is made to the module:
  - Connect the safety (earth) ground on the power connector first before making any other connections.
  - When connecting to electric circuits or pulse-initiating equipment, open their related breakers.
  - Do not make connections to live power lines.
  - Make connections to the module first; then connect to the circuit to be monitored.
  - Route power wires in a safe manner in accordance with good practice and local codes.
  - Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
  - Ensure hands, shoes, and floor are dry before making any connection to a power line.
  - Make sure the unit is turned OFF before making connection to terminals.
  - Make sure all circuits are de-energized before making connections.
  - Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

9 Technical Support

For assistance and manual updates, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email:
techsupport@hornerirl.ie