User Manual for X2 OCS

MAN1130-02-EN_X2_UserManual

HE-X2A, HE-X2R

PREFACE

This manual explains how to use the X2 OCS.

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

ABOUT PROGRAMMING EXAMPLE

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 X2 OCS module to appropriately design the end system, to appropriately integrate the X2 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.

VISUAL MAP OF MAJOR TASKS AND KEY CHAPTERS

FIRST STEP of ANY TASK: DATASHEET			
Each X2 OCS unit is sent with a datasheet in the box. **The datasheet (MAN1131) is the <u>first</u> document to refer to for model-specific information related to X2 OCS models such as pin-outs, jumper settings, and other key installation information.** To obtain updates to datasheets, manuals and user documentation, visit a Horner website. (North America: http://www.hornerautomation.com or Europe: http://www.horner-apg.com)			

QUICK START	INSTALLATION	PROGRAMMING	TROUBLESHOOTING
Safety / Compliance Page 10	Safety / Compliance Page 10	Safety / Compliance Page 10	Safety / Compliance Page 10
Introduction Page 12	Introduction Page 12	Introduction Page 12	Introduction Page 12
	Mechanical Installation Page 17	Serial Communications Page 25	Maintenance Page 113
	Electrical Installation Page 22	CAN Communications Page 28	Modbus Communications Page 114
		System Settings Page 30	Troubleshooting Page 118
		Removable Media Page 42	
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		Clone Unit Page 109	

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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 – EXPLOSION HAZARD: Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous

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 <u>not</u> replace the fuse again as a repeated failure indicates a defective condition that will <u>not</u> clear by replacing the fuse.

WARNING: EXPLOSION HAZARD–Substitution of components may impair suitability for Class I, Division 2.

WARNING: The USB parts are for operational maintenance only. Do not leave permanently connected unless area is known to be non-hazardous.

WARNING: EXPLOSION HAZARD–BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS

WARNING: BATTERY MAY EXPLODE IF MISTREATED. DO NOT RECHARD, DISASSEMBLE, OR DISPOSE OF IN FIRE.

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.

a. Connect the green safety (earth) ground first before making any other connections.
b. When connecting to electric circuits or pulse-initiating equipment, open their related breakers. Do not make connections to live power lines.
c. Make connections to the module first; then connect to the circuit to be monitored.
d. Route power wires in a safe manner in accordance with good practice and local codes.
e. Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
f. Ensure hands, shoes, and floors are dry before making any connection to a power line.
g. Make sure the unit is turned OFF before making connection to terminals. Make sure all circuits are de-energized before making connections.
h. 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.

1.3   Compliance

To check for compliance and updates, visit the Horner website.
North America: https://hornerautomation.com or **Europe:** http://www.horner-apg.com

CHAPTER 2: INTRODUCTION

2.1   Visual Overview of the X2

1. Function Keys
2. High Capacity microSD Slot
3. RS232/RS485 Serial Connector
4. CAN Port (via RJ45)
5. USB Mini-B Port
6. Analog I/O
7. DC Inputs
8. DC Outputs
9. DC Power

Figure 2.1 – Visual Overview of the X2

2.2   Where to Find Information about the X2 OCS

a) **Datasheet – The datasheet is the first document to refer to for key information related to specific X2 OCS models.**

> 1. The datasheets for all X2 OCS models are available on the Horner website.
> 2. Datasheets contain pin-outs, jumper settings, and other model specific information.

b) **User Manual – This manual provides general information that is common to X2 OCS models and can be downloaded from our website.** Visit the Horner website to obtain user documentation and updates. (USA: http://www.hornerautomation.com or Europe: http://www.horner-apg.com)

2.3   Four Main Types of Information are covered in this Manual

a) Safety and Installation guidelines / instructions (Mechanical and Electrical)
b) Descriptions of hardware features – Serial ports, Removable Media, Communications, etc.
c) Configuration and Use of the X2 OCS
d) Maintenance and Support

2.4   Manual Index

Major topics of interest may be found in the Main Index near the end of this manual.

2.5   Table of Figures

Location of important drawings, illustrations, etc., may be found in the Index of Figures and Tables at the end of this manual.

2.6 Connectivity to the X2 OCS

The X2 has excellent capability for connecting to a variety of devices. The diagram below shows some examples of devices that can be used with the X2 OCS.
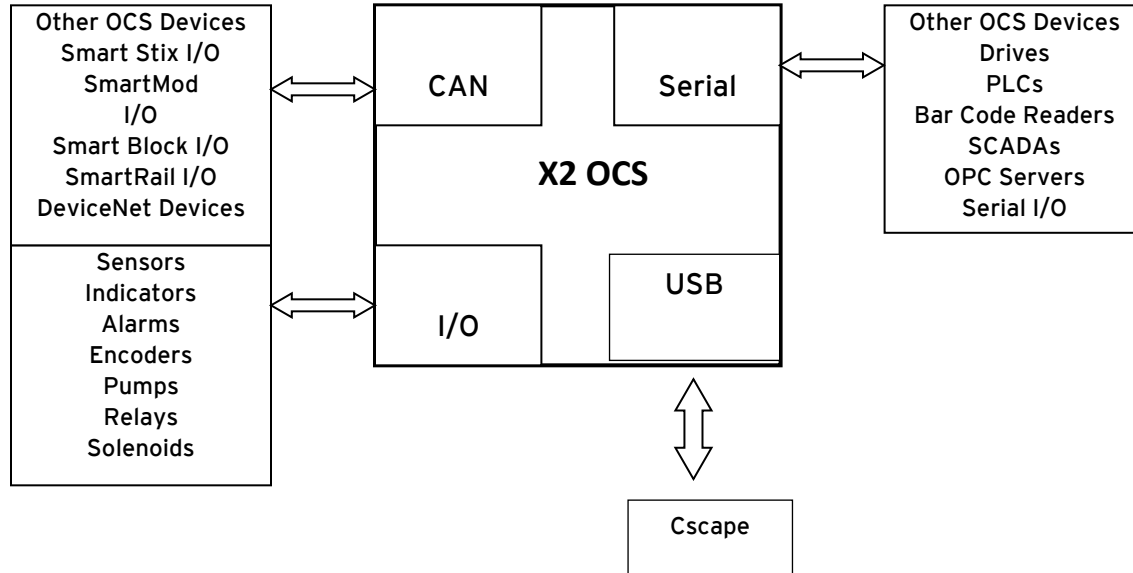
Figure 2.2 – Visual Overview of X2 Connectivity

2.7   Features of the X2 OCS

The X2 OCSs are all-in-one industrial control devices. They combine control, user interface, I/O and networking into a single, integrated package. Unique features of the X2 OCs include the following.

- Small, sleek profile saves space and resources.
- Physical Specifications
  - mm: 89.76 tall x 119.18 wide x 35.8 deep
  - inches: 3.53 tall x 4.69 wide x 1.41 deep
  - weight: 270 g / 9.5 oz.
- Bright monochrome 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
- Intuitive interface
- Removable media for storage of programs, data logging, or screen captures
- CsCAN networking port (optional) for communication with remote I/O, other controllers or PCs
- Cscape programming software that allows all aspects of the X2 to be programmed and configured from one integrated application
- Fail – Safe System which allows an application to continue running in the event of "Soft" failures such as (Battery power loss or Battery Backed register RAM / Application Flash corruption)
- Clone Unit allows the user to "clone" the OCS. This feature "clones" application program and unit settings stored in Battery backed RAM of an OCS. It can then be used to clone a different OCS (but must be the exact same model).
- Suited for most applications across a diverse range of industries

2.8 Accessories

Please visit the Horner Control Accessories website for communication, programming, and I/O accessories.

North America: http://hornerautomation.com/product-category/home/control-accessories/
Europe: http://horner-apg.com/en/products.aspx

2.9 Useful Documents and References

The following information serves as a *general* listing of Horner controller products and other references of interest with their corresponding manual numbers. Visit the Horner websites to obtain user documentation and updates.

Table 2.1- Useful Documents and References	
Controller	**Manual Number**
EXL6 OCS e.g., HE-EXL1Ex, HEXT351C1xx	MAN1032
EXL10 OCS e.g., HE-EXV1Ex, HEXT505C1xx	MAN1029
RCC1410 e.g., HE-RCC1410	MAN1020
RCC2414 e.g., HE-RCC2414	
RCC8842 e.g., HE-RCC8842	
RCC972 e.g., HE-RCC972	
XL4 OCS e.g., HE-XC1Ex, HEXT251C1xx	MAN0964
XL7 OCS e.g., HE-XW1Ex, HEXT391C1xx	MAN0974
XLE OCS e.g., HE-XE1xx, HE-XE1Ex, HEXE220Cxx	MAN0878
XLT OCS e.g., HE-XT10X, HE-XT1Ex, HEXT240C1xx	
X2 OCS e.g. HE-X2A, HEX2R	MAN1130
X5 OCS HE-X5	MAN1039
ZX OCS e.g., HE-ZX452, HE-ZX752, HE-ZX1152	MAN1018
Other Useful References	
CAN Networks	MAN0799
Cscape Programming and Reference	MAN0313
DeviceNet™ Implementation	SUP0326

CHAPTER 3: MECHANICAL INSTALLATION

NOTE: The datasheet is the first document to refer to for model-specific information related to X2 OCS models such as pin-outs, jumper settings, and other key installation information. Visit the Horner websites to obtain datasheets, user documentation, and updates.

3.1 Mounting 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 Procedures (Installed in a Panel Door)

Once the panel design has been completed using the criteria and suggestions in the following sections, use the following steps to panel mount the X2 OCS.

NOTE: Unit comes with composite clips, which are tested for typical wash down, shock, and vibration. If metal mounting clips are needed, they can be ordered at the Horner Automation website.

1. Carefully locate an appropriate place to mount the X2. Be sure to leave enough room at the top of the unit for insertaion. Remove the micro SD card to prevent damage to the panel edge.
2. Carefully cut the host panel per the measurements found in the datasheet (MAN1131). Dimensions can also be found below in Section 3.5. If the opening is too large, water may leak into the enclosure, potentially damaging the unit. If the opening is too small, the OCS may not fit through the hole without damage.
3. Remove any burrs and/or shape edges and ensure the panel is not warped in the cutting process.
4. Make sure the gasket is installed on the X2 OCS and is free from dust and debris. Check that the corners of the gasket are secure.
5. Pass the unit through the panel.
6. Insert each of the four (**4**) mounting clips into the slots in the X2 OCS case. One composite plastic clip should be installed on each corner. Lightly tignten each screw so the clip is held in place.
7. Tighten the screws on the clips such that the gasket is compressed against the panel. Recommended torque is 2-3 in-lbs (0.23 – 0.34 Nm). If metal mounting clips are used in place of the plastic composite mounting clips, the recommended torque is 4-8 in-lbs (0.45-0.90 Nm).
8. Connect communications cables to the serial port, USB ports, and CAN port as required.

Clip Description	Part Number
Composite Plastic Clip	400B178-R2.0
Metal Clip	HE500ACC604

3.3 Mounting Clip Locations

Figure 3.1 – X2 OCS with Mounting Clip Locations

3.4 Mounting Orientation
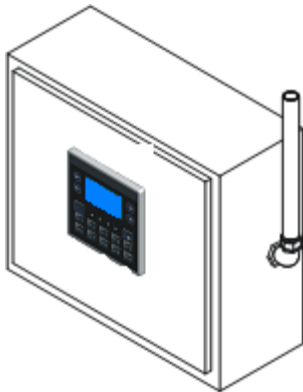
NOTE: For panel mounting—The orientation shown provides for optimum readability screen and ease of use of the keypad.

Figure 3.2 – Orientation of X2 OCS

3.5   Panel Cutout

For installations requiring NEMA4X liquid and dust protection, the panel cutout should be cut with a tolerance of +/- 0.005" (0.1 mm).

3.580" (91mm)

4.675" (118.75mm)
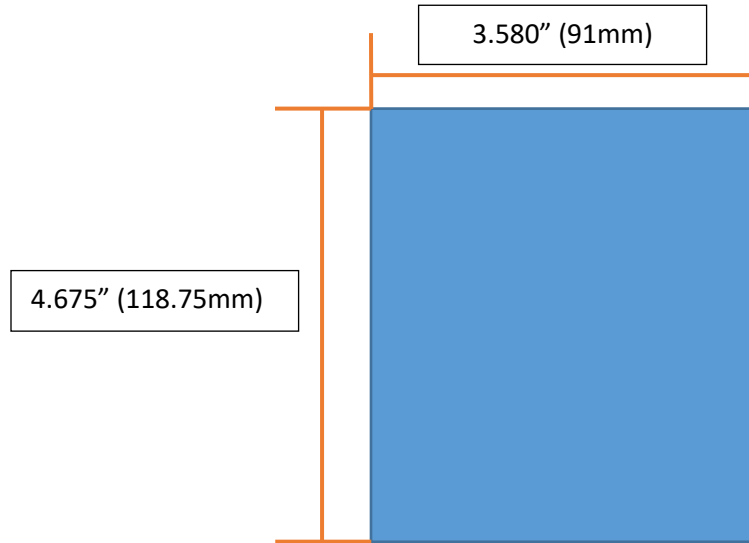
Figure 3.3 – Panel Cutout Tolerances

3.6   X2 Dimensions

3.78" (96mm)

4.92" (125mm)

1.220" (31mm)
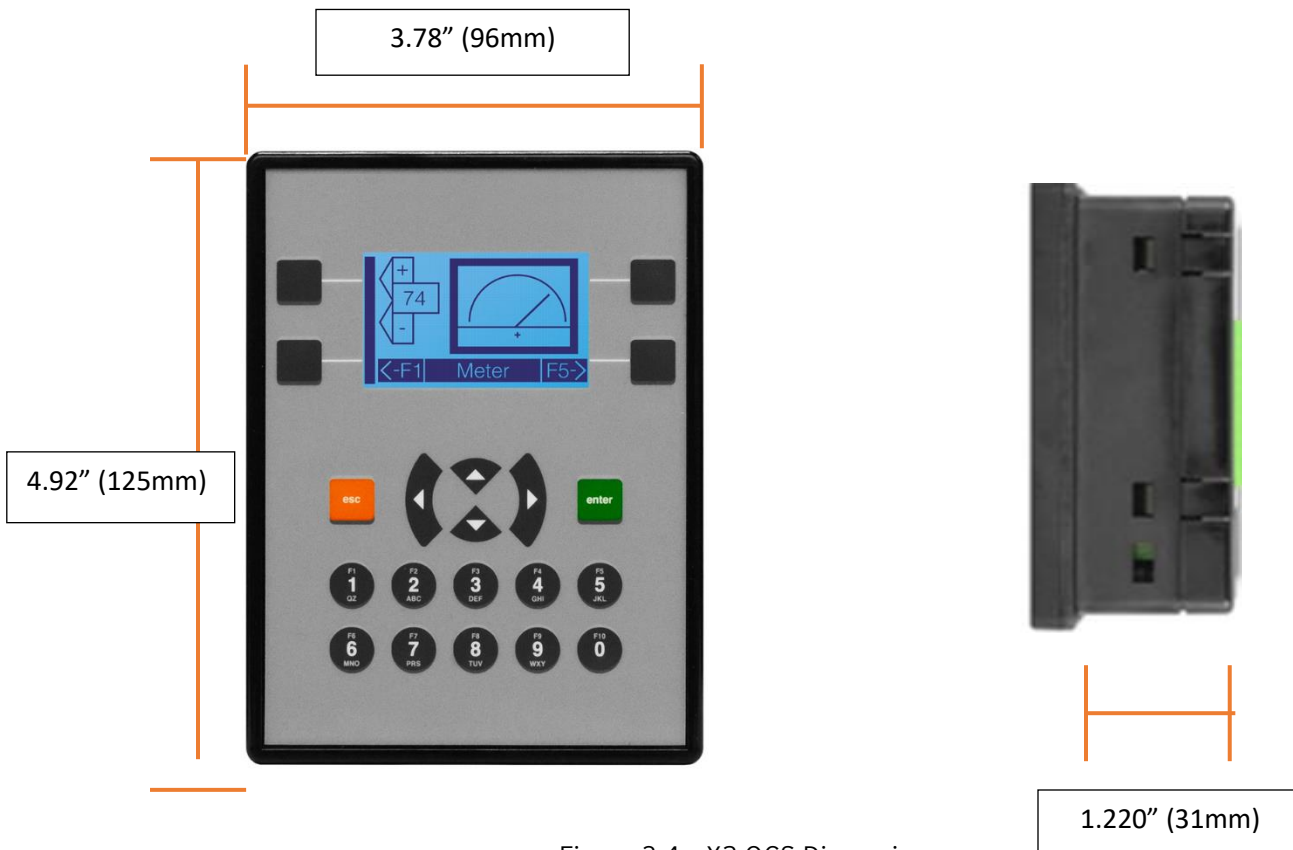
Figure 3.4 – X2 OCS Dimensions

3.7   Factors Affecting Panel Layout Design and Clearances

> **WARNING: It is important to follow the requirements of the panel manufacturer and to follow all 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.

3.8   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" (50.80mm)
Minimum Distance – between base of device and wiring ducts.	1.5" (38.10mm)
Minimum Distance - between bases of each device if more than one device is installed in panel box or on door.	4" between bases of each device (101.60mm)
Minimum Distance – between device and closed door when door is closed. (Be sure to allow enough depth for the OCS.)	2" (50.80mm)

3.9   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.

3.10   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.

3.11   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 X2 OCS and noisy devices such as relays, motor starters, etc.

For details on output protection, especially when using contactors and solenoids, see MAN0962 on "Spark Quenchers".

3.12   Shock and Vibration

The X2 OCS 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 X2 OCS to a location that minimizes shock and/or vibration.

CHAPTER 4: ELECTRICAL INSTALLATION

NOTE: The datasheet is the first document you need to refer to for model-specific information related to X2 OCS models such as pin-outs and other key installation information. Visit our website to obtain datasheets, user documentation, and updates.
(North America: https://hornerautomation.com or Europe: http://www.horner-apg.com).

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 interference (RFI).

4.2   Ground Specifications

Ideally, a ground resistance measurement from equipment to earth ground is 0 Ω. In reality, it typically is higher. The U.S. National Electrical Code (NEC) states the resistance to ground shall not exceed 25 Ω. Horner Automation recommends *less than* 15 Ω resistance from our equipment to ground. Resistance *greater than* 25 Ω 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 a three-point ground test.

GROUND RESISTANCE METER

GROUND DISCONNECTED FROM SERVICE

GROUND ROD

METAL WATER PIPE OR OTHER GOOD GROUND
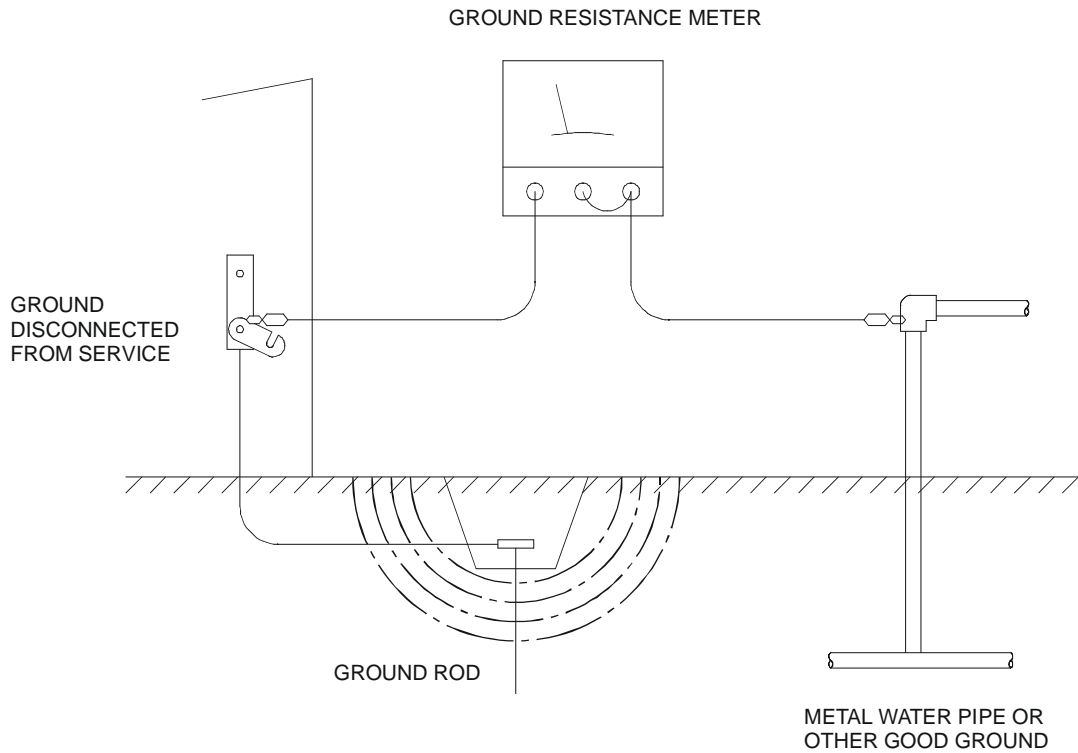
Figure 4.1 – Two-Point Ground Connection Test

4.4   Primary Power Port

Table 4.1 – Primary Power Port Pins		
Pin	**Signal**	**Description**
+	24VDC + / - 20%	Input Power Supply Voltage
–	0V	Input Power Supply Ground
⏚	⏚	Frame Ground
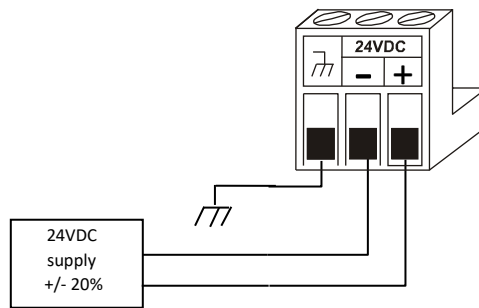
Figure 4.2 – Power Connector (Primary Power Port)
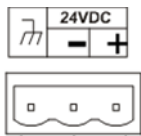
DC INPUT / FRAME

Solid/Standard wire: 12-24 awg (2.05-0.511mm or 3.31-.205mm²).
Strip length–0.28'' (7mm).
Torque rating: 4.5 – 7 in-lbs (0.50 – 0.78 Nm).
DC- is internally connected to I/O 0 V.
A Class 2 power supply must be used.

Figure 4.3 – Primary Power Port as Viewed Looking at the X2 OCS

CHAPTER 5: SERIAL COMMUNICATIONS

5.1 Overview

All X2 OCS models provide two serial ports, which are implemented with a single 8-position modular jack that is labeled **MJ1/2**. The MJ1 serial port is RS-232 while the MJ2 port is RS-485. MJ1 defaults to OCS 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 a RS-232 interface with RTS/CTS handshaking.

The MJ2 serial port contains half-duplex RS-485 interface with no handshaking. The MJ2 RS-485 interface provides switchable termination and bias resistors internally.

5.3 Wiring–MJ1/MJ2 Serial Ports
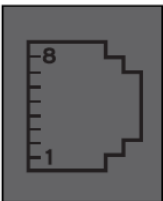
MJ1: RS-232 w/Full Handshaking
MJ2: RS-485 Half-Duplex

Table 5.1 – MJ1/ MJ2 Serial Ports				
Pin	MJ1 Pins		MJ2 Pins	
	Signal	Direction	Signal	Direction
8	TXD	OUT	--	--
7	RXD	IN	--	--
6	0V	Common	0V	Common
5	+5VDC @ 60 mA	OUT	+5VDC @ +/-60mA	OUT
4	RTS	OUT	--	--
3	CTS	IN	--	--
2	--	--	RX- / TX-	IN / OUT
1	--	--	RX+ / TX+	IN / OUT

5.4   RS-485 Termination and Biasing

Termination—Proper RS-485 termination minimizes reflections and improves reliability.

The MJ2 serial port allows an internal termination resistor to be placed across pins 1 and 2 by software control. Only the two devices physically located at the endpoints of the RS485 network should be terminated.

This termination is only in place when the X2 is powered on. This would typically only be an issue if the X2 is being used as a slave on the RS485 network. In that case, the electronic should not be used, but a physical external termination resistor should be used instead.

Biasing—RS485 biasing passively asserts a line-idle state when no device is actively transmitting, which is useful for multi-drop RS485 networking. The MJ2 serial port allows internal bias resistor to be activated by software control, pulling pin 1 up to 3.3 V and pulling pin 2 down to ground.

NOTE: If biasing is used, it should be enabled in only one of the devices attached to the RS485 network.

The "Set Serial Ports" option in the OCS System Menu can be used for termination and biasing. Also, an application graphics screen that writes to %SR can do the same thing.

Biasing Details:
• %SR152.3 enables RS485 Port Termination
• %SR164.1 enables RS485 Port Biasing

5.5   Cscape Programming via Serial Port

MJ1 is the default programming port. The connection is RS232 serial and is compatible with the Horner programming cable kits, HE-XCK or HE-CPK. MJ2 can be configured as the programming port; however it is only RS485 and is not compatible with the programming cable kits.

Selecting the default programming port between the MJ1 and MJ2 ports is done in the System Menu. No configuration is required to use the Mini-B USB port for programming.

NOTE: Only one Cscape software connection is allowed at a time.

5.6   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.

5.7   Configuration via Mini-B USB

NOTE: The unit must be connected via the mini-USB port to the PC or laptop.

It is possible to load the program and monitor data via the Mini-B USB. To load via Mini-B USB, configure the communications port in Cscape as follows:
Select **Tools** from the toolbar → **Application Settings** → **Communications** → **USB** button.

It is possible to download or upload and use the data monitoring functions once connected.

NOTE: It is advisable to use an isolated USB cable between the PC or laptop and the X2 when third party devices are connected to the X2 to avoid damage to the PC or laptop and/or the X2.

CHAPTER 6: CAN COMMUNICATIONS

NOTE: For additional CAN information, refer to the CAN Networks manual (MAN0799) on the website.
(North America: https://hornerautomation.com or Europe: http://www.horner-apg.com)

6.1 Overview

The X2 OCs provides a CAN networking port, which is implemented with an 8-position RJ-45 modular jack. The connector is labeled CAN and is red.

CAN Connector is red on the X2.
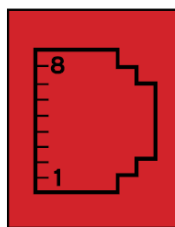
CAN

Modular jack (8posn RJ45)

CAN Pin Assignments	
PIN	SIGNAL
8	No Connection
7	Ground
6	Shield
5	No Connection
4	No Connection
3	Ground
2	CAN Data Low
1	CAN Data High
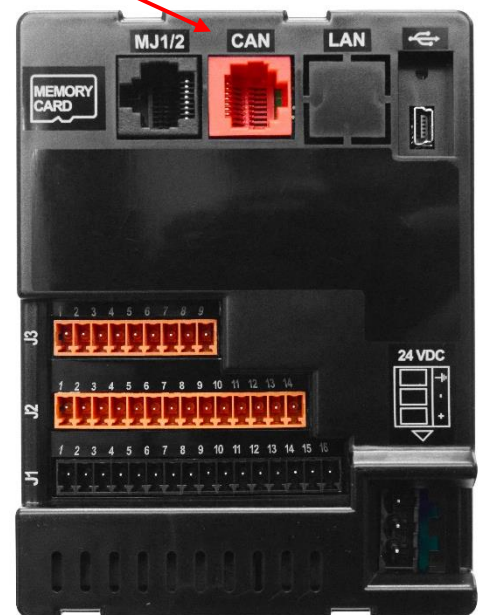
Figure 6.1 – CAN Connector

6.2 Cscape Programming via CAN

The CAN 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 X2 CAN port, then Cscape can access the X2 for programming and monitoring.

In addition, the X2 supports single-point-programming of all X2 and other Horner controllers that are connected to a CAN network. If the PC COM port is connected to the X2 programming port, then the X2 can act as a pass-through gateway allowing Cscape to access all X2 and Horner controllers that are attached to the CAN network.

6.3 Ladder-Controlled CAN Communication

Using Put and Get Network Words function blocks, the CAN port can exchange digital and analog global data with other X2 or Horner controllers 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.

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

Connecting remote I/O to the X2 CAN port, allows the X2 I/O to be economically expanded and distributed. A variety of remote I/O modules are available for this purpose.

6.5 CAN and Termination and Bias

If there is controller to controller communication on a network, and an X2 will be at either end, then it is recommended that onboard electronic termination NOT be used. Physical external resistors should be used instead. In this case utilizing an RJ-45 to open-style connector cable will make termination easier.

NOTE: %SR152.4 enables CAN port termination.

NOTE: When powered down, the biasing and termination is no longer in effect.

CHAPTER 7: SYSTEM SETTING AND ADJUSTMENTS

7.1 System Menu - Overview

The X2 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 Figure 7.1. Then use the ↓ and ↑ keys to select a **Main Menu** item and press **Enter** to display the item's Sub-Menu.

Sub-Menus

```
Network Ok?       Yes
Network ID:       253
```

```
Network Baud:  125 KB
( Use ↓↑ to adjust )
```

```
Contrast: ■ ■ ■ ■

(Use ← → to adjust)
```

```
Model:         XE104E
Mode:          Idle
Scan Rate(mS):  0.0
Lcl Net Use(%): 0.0
All Net Use(%): 0.0
Ladder Size:      2
Config Size:      8
Graphics Sz:      8
String Size:      8
Bitmap Size:      8
Text Size:        8
Font Size:        8
Protocol Sz:      8
SMS Msg Sz:       8
Firmware Rev: 11.59
CPLD Rev:       1.5
Self-Test:       Ok
```

```
System RAM:       Ok
System BIOS:      Ok
Firmware:         Ok
Logic Error:      Ok
User Program:     Ok
User Graphics:    Ok
W-Dog Trips:       0
Net Errors:        0
Network State:    Ok
Network ID:       Ok
Dup Net ID:       Ok
Clock Error:      Ok
I/O System:       Ok
Battery:          Ok
```

```
 Slot 1:+I/O: XEx04
 Slot 2:+I/O: XEC
```

X2

Main Menu

```
Set Network ID
Set Network Baud
Set Contrast
View Status
View Diags
View I/O Slots
View Protocols
Set Fkeys Mode
Set Serial Ports
Set Time/Date
Set Screen
Removable Media
Fail - Safe System
Clone Unit
(ESC to Exit)
```

NOTE: The X2 display shows up to six (6) lines of text at a time. For System Menu screens that contain more than 6 lines of text, use the ↓ and ↑ keys to scroll the display.

```
Backup/Restore Data
Enable AutoRun
Enable AutoLoad
(ESC to exit)
```

Sub-Menus

```
Port 1:
(None Loaded)

Port 2:
(None Loaded)
```

```
Fkeys:      Momentary
Sys-Fn enable:    Yes
( Use ↓↑ to adjust )
```

```
Dflt Pgm Port MJ1-232
MJ1 RS485 Bias     No
MJ2 RS485 Bias     No

  ( Use ↓↑ to adjust )
```

```
Time:        10:21:36
Date:    22-Jun-2006
Day:        Thursday
( Use ↓↑ to adjust )
(    each field    )
```

```
Saver enable:     Yes
Timeout(min):      15
Popup Status:     Off
Update Time(mS):    5
  Max. graphics time
  In the log scan.
```

```
    Media Directory
No Card
```

```
      Clone  F1 Create
Dir Empty  F2 Load
           F3
           F4

           Esc Cancel
```
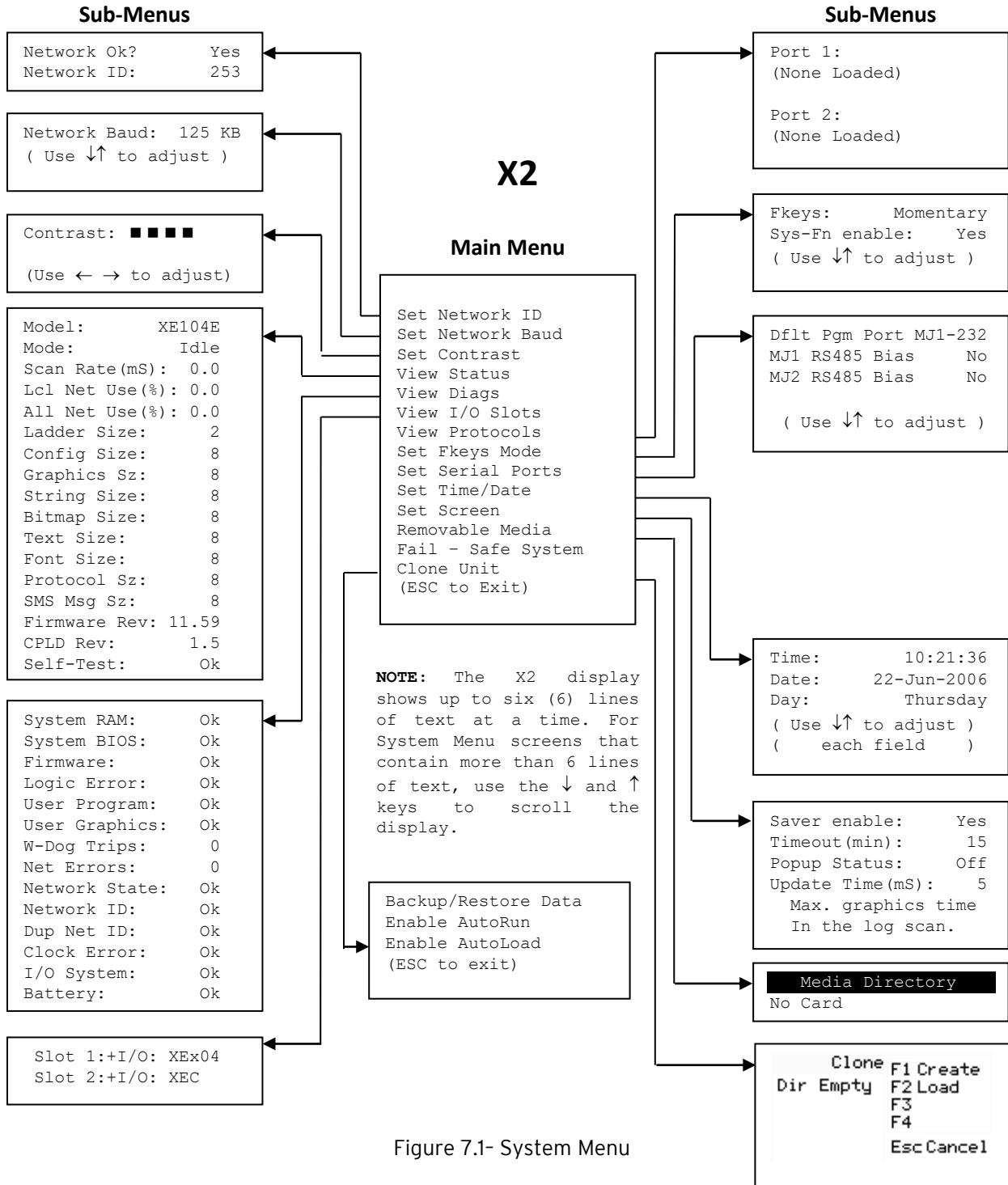
Figure 7.1– System Menu

7.2   System Menu – Navigation and Editing

As mentioned above, the System Menu is started by pressing the ↓ and ↑ keys at the same time for the X2. 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 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.

7.3 System Settings Details

Set Network ID

The Network ID Sub-Menu appears for both X2 models. 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 for both X2 models. This Sub-Menu displays just one System Setting and it is editable.

Network Baud?	125kB = 125kBd CAN network 250kB = 250kBd CAN network 500kB = 500kBd CAN network 1MB = 1MBd 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. Only the **Mode** System Setting is editable.

Model:	**Xxyyz** = 5 or 6 character model number of this X2 unit **x** is 1 for models that have a CAN port; **O** = no CAN port **yy** indicates the installed I/O module; **OO** = no I/O module **z** indicates the installed COM module; **N** = no COM module
Mode:	**Idle** = X2 is in Idle mode **DoIO** = X2 is in Do I/O mode **Run** = X2 is in Run mode
Scan Rate(mS):	**0.0** = X2 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 X2 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 11 System Diagnostics, none of which are editable. The first two System Diagnostics are critical. If either of these indicate a Fault condition, then the X2 OCS will <u>not</u> enter or remain in Run mode, and the problem must be investigated and corrected.

Logic Error:	**Ok** = All executed ladder instructions are legal for loaded firmware **Fault** = A ladder instruction <u>not</u> 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 first five System Diagnostics are critical. If any of them indicate a Fault condition, then the X2 will <u>not</u> 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, then the X2 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 Protocols

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

As mentioned in, both the MJ1 (Port 1) and MJ2 (Port 2) serial ports support downloadable protocols. To assign a downloadable protocol to an X2 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 a Modem (XMC) COM module is installed.

Dflt Pgm Port	**MJ1-232** = MJ1 RS232 port is the default programming port **Modem** = Modem COM module is the default programming port
MJ2 RS485 Bias	**No** = MJ2 RS485 bias resistors are <u>not</u> switched in **Yes** = MJ2 RS485 bias resistors are switched in

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: 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: The X2 must be power-cycled (or reset) before the changes take effect.

Removable Media

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

```
 Media Directory
No Card
```
= No Micro SD card has been installed in the Memory slot

```
 Media Directory
Initializing
```
= Micro SD card is installed, but it is still initializing

```
 Media Directory
Dir Empty
```
= Micro SD card is installed and initialized, but contains no files

```
 Media Directory
FILENAM1.EXT  △11.7K
FILENAM2.EXT   10-20
FILENAM3.EXT  ■  -05
FILENAM4.EXT   1:09p
FILENAM5.EXT  ▽Free▷
```
= Micro SD card is installed and initialized, and it contains files

Shows size of highlighted file or shows <DIR> if directory is highlighted
Shows the date file or directory was created or last modified
Shows the time file or directory was created or last modified

Scrollbar only appears if displayed directory contains more than five files and/or directories.

Figure 8.2 - Removable Media Submenu

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.

Fail – Safe System

The Fail-Safe System is a set of features that allows an application to continue running in the event of certain types of "soft" failures. These "soft" failures include:
- Battery power loss
- Battery-Backed Register RAM or Application Flash corruption due to, for example, an excessive EMI event.

The fail-safe system can be accessed through the system menu of the controller. A new menu "Fail-Safe System" has been added at the end of the main system menu for this. Selecting "Fail-Safe System" menu will open the following menu screen:

```
Backup/Restore Data
Enable AutoRun
Enable AutoLoad

(ESC to exit)
```

Figure 14.1 – Fail – Safe System Menu

Selecting this option brings up a screen having four operations:

Backup OCS Data–Copies Battery Backed RAM contents on to the onboard flash memory of the OCS.
Restore OCS Data– Copies the backed up data from onboard flash to the battery backed RAM.
Clear Backup Data– The backup data will be erased from the onboard flash.
Exit– Goes back to previous menu.

```
Backup/Restore Data
F1 Backup  F2 Restore
    F3 Clear Backup
      Esc  Exit
```

Enable AutoRun

"Enable AutoRun" displays the following options which can be selected:

```
Enable AutoRun      No

(******CAUTION******)
( Auto Enters RUN    )
( after AutoLoad     )
( or Battery Fail    )
```

Enable AutoRun	**No** = OCS will be in IDLE mode after AutoLoad or Automatic Restore. **Yes** = OCS will automatically be placed into RUN mode after AutoLoad or Automatic Restore.

Enable AutoLoad

"Enable AutoLoad" displays the following options:

```
Enable AutoLoad     No

( AutoLoad from      )
( Removable Media's  )
( AUTOLOAD.PGM file  )
( when triggered     )
```

Enable AutoLoad	**No** = Does not load AUTOLOAD.PGM automatically when application program is absent or corrupted. **Yes** = Loads AUTOLOAD.PGM file automatically from RM when application program is absent or corrupted.

Clone Unit

The 'Clone Unit' feature allows the user to "clone" the OCS of the exact same model. This feature "clones" application program and unit settings stored in Battery backed RAM of an OCS into the RM (refer Removable Media (Chapter 8) for details on using RM). It can then be used to clone a different OCS (exact same model).
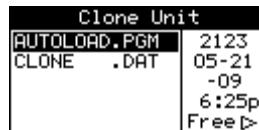
This feature can be used for:

- Replacing an OCS by another unit of the same model.
- Duplicating or "clone" units without a PC.

Make Clone

Selecting "Clone Unit" menu will open the following menu screen:
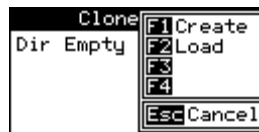
Selecting "Create" will open the following screen:

AUTOLOAD.PGM	Application file
CLONE.DAT	File having all unit settings and register values from Battery Backed RAM

Load Clone

Selecting "Clone Unit" menu will open the following menu screen. Select "Load".
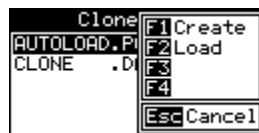
CHAPTER 8: REMOVABLE MEDIA

8.1 Overview

All X2 models provide a Removable Media slot, labeled **Memory**, which supports standard Micro SD Flash memory cards. MicroSD cards can be used to save and load applications, to capture graphics screens, and to log data for later retrieval.
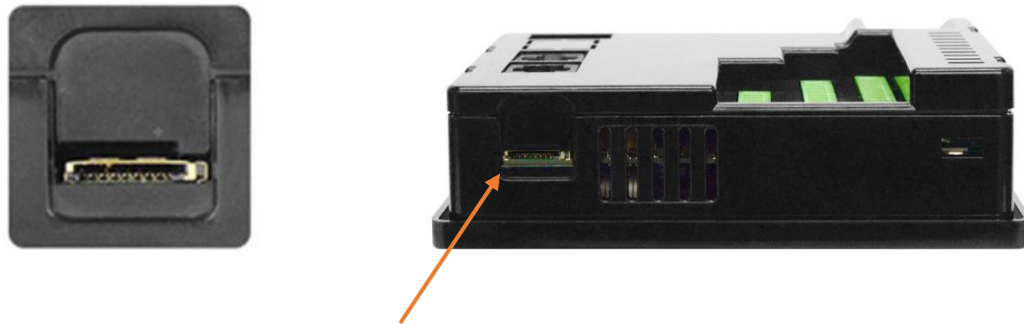

Figure 8.1 – Removable MicroSD Memory Card Slot

8.2 Micro SD Cards

The X2 Memory slot is equipped with a "push-in, push-out" connector and a Micro SD card can be safely inserted into the Memory slot when the X2 is powered On or Off.

To install a Micro SD card: Align its 8-pin gold edge connector down, facing the front of the X2; 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.

8.3   Micro SD File System

The X2 supports the 8.3 filename format. This means that all file and directory names <u>must</u> consist of up to eight (8) characters left of the dot, and three (3) characters right of the dot, i.e. filename.pgm.

Directories and sub-directories may be nested up to 16 levels deep as long as each pathname string does <u>not</u> exceed 147 characters.

8.4   Using the Removable Media Manager

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

The Removable Media Manager is an interactive X2 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

To access via System Menu, press the Up and Down keys simultaneously. In the System Menu, you can press the Down arrow key until Removable Menu is selected and then press Enter.

For additional options, press one of the soft keys to the right of the display. Options are 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 X2 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.

8.5   Using Removable Media to Log Data

Using Read and Write Removable Media function blocks, an application ladder program can read and write X2 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 X2 application programs on Micro SD. To load an application from Micro SD to the X2, use the Removable Media Manager to find and highlight the desired .PGM file, and then press **Enter**.

To save an application from the X2 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. Press either of the two soft-keys to the right of the display to see options.

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

NOTE: Saving an application to Micro SD does not also save register data.

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   Configuration of a Removable Media

The configuration of the Removable Media Object that invokes the Removable Media Viewer defines what buttons are enabled and available to the user.

The ↵ (Enter) button performs certain operations based on the selected file's type:

..	- change display to parent directory
<DIR>	- change display to child directory
pgm	- load application (if compatible model and version)

Alternately, by checking the 'Write Selected Filename' option, the RM Manager object will load the currently displayed path and filename into a block of registers for use with other Removable Media functions. The register block is assigned in the 'File Select' config found in the Config menu of the graphic/screen editor.

Once view operations are complete, simply touch the *Esc* button to remove the pop-up removable media viewer.

8.8   Removable Media (RM) Features—Program Logic

NOTE: For detailed information regarding RM function blocks and parameters, refer to the Help file in Cscape software. Refer to "USB Flash Media support for RM Functions" for USB Flash drive access details.

The following RM function blocks are available in Cscape Software. These function blocks will reference:
- Micro SD when filename is prefixed with 'A:' or nothing, or
- USB A Flash Drive when filename is prefixed with 'B:'.

a. Read RM csv—This function allows reading of a comma-separated value file from the Micro SD interface into the controller register space.

b. Write RM csv—This function allows writing of a comma-separated value file to the Micro SD interface from the controller register space.

c. Rename RM csv—This function allows renaming a file on the RM card. The data in the file is not changed.

d. Delete RM csv—This function allows deleting a file on the RM card.

e. Copy RM csv—This function can be used to copy files from A: to B: or vice versa. The data in the file is not changed.

Additional features that utilize the Removable Media port are the datalog and report features, as well as graphic editor options: alarm and trend objects, screen capture, filename counters, and file select.

8.9 Removable Media (RM) Features— Program Features

a. Datalog Configuration—This feature allows the controller to periodically log register values to Removable Media. The register data is stored in **.csv** (comma separated value) format, which is compatible with 3rd party PC applications, such as Microsoft Excel.

b. Report Editor—This feature allows the OCS to be configured to generate text printouts which incorporate data from the registers embedded in the text. The reports can be printed using a serial interface printer through any of the serial ports of the OCS or can be saved on the removable media of the device.

c. Recipes Editor—Recipes allow the user to send or update multiple registers simultaneously.

8.10 Removable Media (RM) Features—Graphic/Screen Editor

a. Trends—The historic support feature in the trend object utilizes Removable Media.

b. Removable Media—This is a graphic object used to access files and functions pertaining to Removable Media.

c. Recipes—This is a graphic object that is used in conjunction with the recipe editor which is mentioned above.

8.11 Removable Media Features—Additional Configuration

a. Alarms—Alarm data can be logged to a .csv file stored on Removable Media.

b. Screen Capture—The screen capture function allows a bitmap or jpeg image of the displayed OCS screen to be written to the Removable Media card.

c. Filename Counters— The filename counters can be accessed wherever Removable Media functions require a path name. A typical application is the auto-incrementing of a file name when doing screen captures.

d. File Select— File Select is used to specify the register block that is used with the Removable Media Manager object 'Write Selected Filename' option.

8.12   Filenames used with the Removable Media (RM) Function Blocks

The RM function blocks support the flash with a DOS/Windows standard FAT32 file system. All names must be limited to the "8.3" format where the filename contains eight characters a period then a three-character extension.

The entire filename including any path must be less than or equal to 147 characters.

When creating filenames and directories it is sometimes desirable to include parts of the current date or time, or even the screen number in the case of screen capturing. There are special symbols that can be entered into a filename that are replaced by the OCS as follows.

Table 8.1 – Filename Special Symbols		
Symbol	Description	Example
$Y	Substitutes the current 2 digit year	2004 = 04
$M	Substitutes the current month with a 2 digit code	March = 03
$D	Substitutes the current day	22nd = 22
$h	Substitutes the current hour in 24 hour format	4 PM = 16
$m	Substitutes the current minute	45 = 45
$s	Substitutes the current second	34 = 34
$p	Substitutes 4-digit current screen displayed	Screen 76 = 0076

NOTE: All the symbols start with the dollar sign ($) character. Date symbols are in upper case, time symbols are in lower case. The following are examples of the substituted time/date filenames:

Current date and time: March 1, 2004 3:45:34 PM; Screen 4 is currently displayed.

Filename: Data$M$D.csv = Data0301.csv

Filename: Year$Y\Month$M\aa$D_$h.csv = Year04\Month03\aa01_15.csv

Filename: Month_$M\Day_$D\$h_$m_$s.csv = Month_03\Day_01\15_45_34.csv

Filename: captures\SCR$p.bmp = captures\SCR0004.bmp

8.13   System Registers used with RM

%SR174 - Removable Media Protect**.** Write a one (1) to %SR174 to prohibit read/write access to the removable media card. Write a zero (0) to allow access.

%SR175 Status – This shows the current status of the RM interface.

%SR176 Free Space – This 32-bit DINT register shows the free space on the RM card in bytes.

%SR178 Card Capacity – This 32-bit DINT register shows the total card capacity in kilobytes.

Possible status values are shown in the table:

Table 8.2– RM Status Values	
0	RM interface OK
1	Card present but unknown format
2	No card in slot
3	Card present, but not supported
4	Card swapped before operation was complete
5	Unknown error
6	Access protected

8.14   Safe Removal of Removable Media Card

If the Removable Media card should need to be removed during operation, it can be safely removed by moving a one (1) into %SR174. This prevents corruption to the file system if the card is removed during a file-write sequence. The graphic objects should set OCS register %SR174.1 (when requesting the card be removed) and provide an indicator based on OCS register %SR174.2 (which indicates that it is safe to remove the removable media). %SR174 must be set back to zero after the card is reinserted.

Figure 8.3 – Safe Removal of Removable Media

CHAPTER 9:   GENERAL I/O

NOTE: Each X2 unit is shipped with a datasheet in the box. The datasheet is the first document to refer to for **model-specific information related to X2 models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the X2 datasheets attached to it. Visit the website to obtain datasheets, user documentation, and updates.
(North America: https://hornerautomation.com or Europe: http://www.horner-apg.com)

9.1   Overview

The X2 is a compact unit that contains high density and very versatile I/O. Using the I/O properly requires wiring to the proper terminals 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 12 on Registers.

NOTE: To remove remote I/O connectors, gently pry up the connectors with a small flathead screwdriver.

9.2   Model and I/O Overview

Table 9.1- I/O and Model Overview					
X2 Models	Solid State Digital Outputs	Relay Outputs	Digital Inputs	Analog Inputs	Analog Outputs
HE-X2A	✓		✓	✓	✓
HE-X2R	✓	✓	✓	✓	✓

Table 9.1 shows the different types of I/O included with the two X2 models. Specific specifications and wiring diagrams can be found on the data sheets. Descriptions and applications of the different type of I/O can be found below.

9.3   Solid-State Digital Outputs

X2—Model A: Solid-state digital outputs are generally used to activate lamps, low voltage solenoids, relays, and other low voltage and low current devices.

NOTE*: The digital outputs used on the X2 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 (0) volts with respect to the I/O ground.
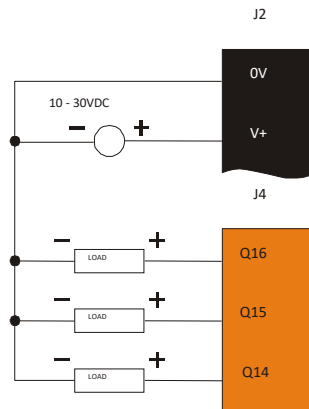
Figure 9.1 – Typical Output Wiring

The digital outputs used in the X2 have electronic short circuit protection and current limiting. While these electronic protections work in most applications, some applications may require external fusing on these outputs.

The digital outputs in the X2 are typically controlled 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 Chapter 10 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 Chapter 13 on Configuration 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.

Below are the Wiring Connectors for Model A and R Digital Output

POSITION/PIN		DIGITAL MODEL
1	Q1	Output 1 (PWM)
2	Q2	Output 2 (PWM)
3	Q3	Output 3
4	Q4	Output 4
5	V+	External V+
6	C	Common
7	Q5	Output 5
8	Q6	Output 6
9	Q7	Output 7
10	Q8	Output 8
11	Q9	Output 9
12	Q10	Output 10
13	Q11	Output 11
14	Q12	Output 12
15	V+	External V 2 +
16	C	Common
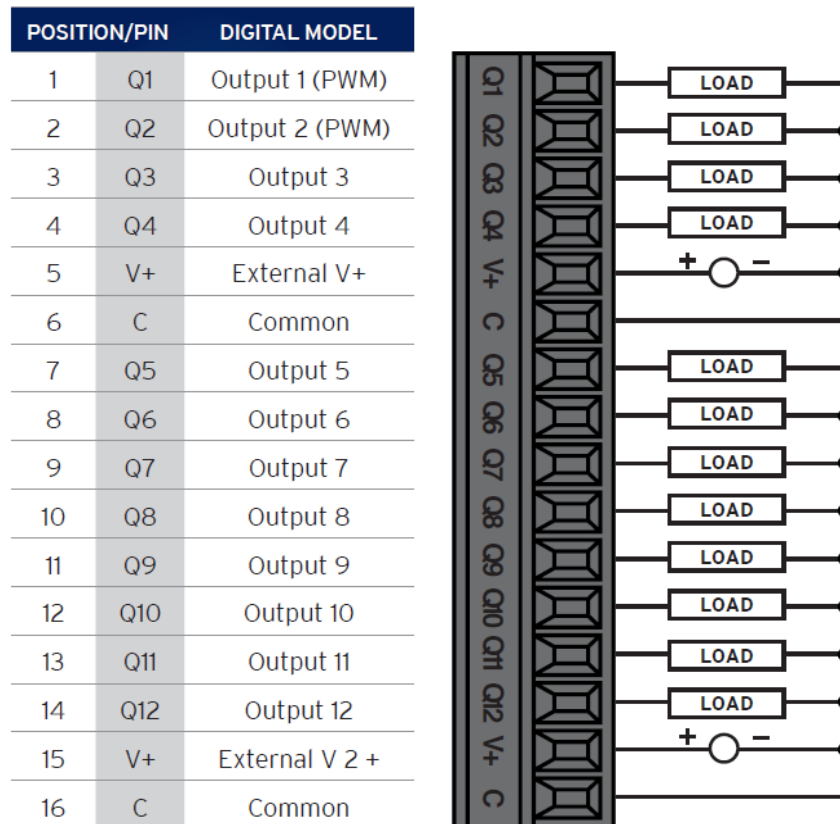
Figure 9.2 – Model A Digital Output

POSITION/PIN		DIGITAL MODEL
1	R1	Relay 1 N.O.
2	C1	Relay 1 C
3	R2	Relay 2 N.O.
4	C2	Relay 2 C
5	R3	Relay 3 N.O.
6	C3	Relay 3 C
7	R4	Relay 4 N.O.
8	C4	Relay 4 C
9	R5	Relay 5 N.O.
10	C5	Relay 5 C
11	R6	Relay 6 N.O.
12	C6	Relay 6 C
13	Q1	Output 1
14	Q2	Output 2
15	V+	External V+
16	C	Common
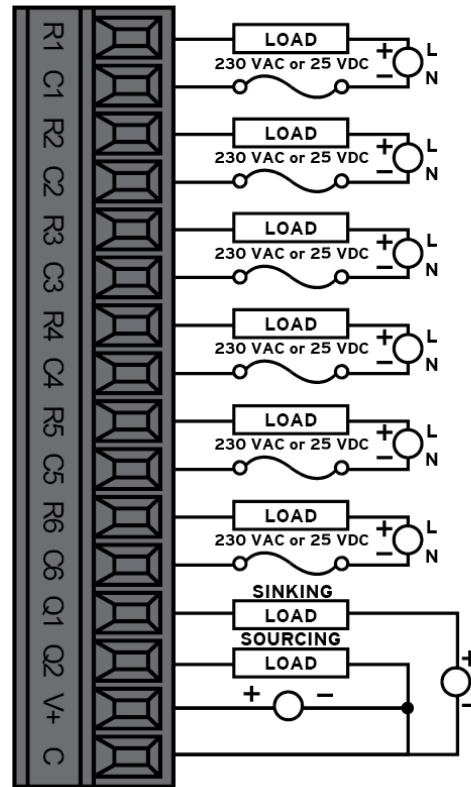
NOTE: Internal 10kΩ resistors
between: V+ and Q1; V+ and Q2

Figure 9.3 – Model R Relay and Digital Output

9.4   Relay Outputs

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

NOTE: The design of the X2 does not require external coil power for the relays to function. The relays will activate anytime the X2 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 switching more current limits the life of relays. Please check the datasheet 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 datasheet 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 **(5A)** fuse(s) as shown. Fuses of lower current or fusing for the entire system must be in place to ensure that the maximum current rating of the unit is <u>not</u> 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 turn off that can shorten the life of relay contacts. Some protective measures must be determined by an engineer. Below are some recommendations that will work for many applications. If there are additional questions on protection from inductive load, consult Horner Technical Support.

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

AC Load – MOV (Harris V140xxx for 120 V, 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 Cscape Configuration (Chapter 13) for Cscape settings.

9.4.1 Model R: Sinking and Sourcing Outputs

Model R Sinking and Sourcing Outputs

Model R: Sinking Outputs
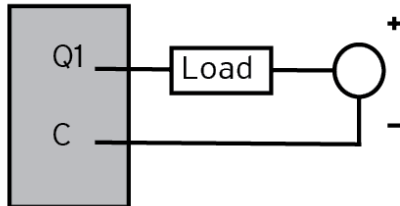
Model R: Sourcing Outputs
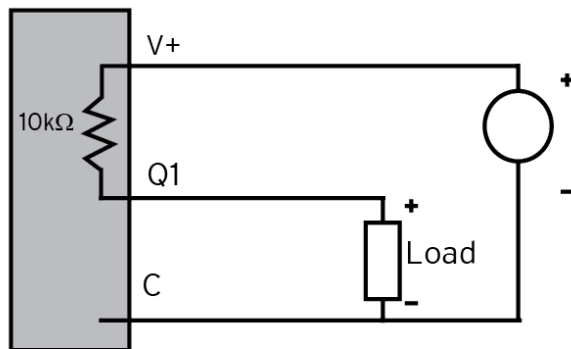
Sinking: Outputs can sink 500mA.
Sourcing: 2.4mA sourcing @ 24mA

Figure 9.4 – Model R: Sinking and Sourcing Outputs

9.5   Digital Inputs

NOTE: See <u>Chapter 10</u> for High Speed I/O information and refer to the datasheet for X2 model being used for details on jumper settings.

NOTE: **The digital inputs on the X2 are designed for low voltage DC inputs.**

The inputs are designed to support both positive and negative input modes. The mode is set by software setting in Cscape and a configuration parameter also in Cscape. All the inputs on the unit must be configured to the same mode.
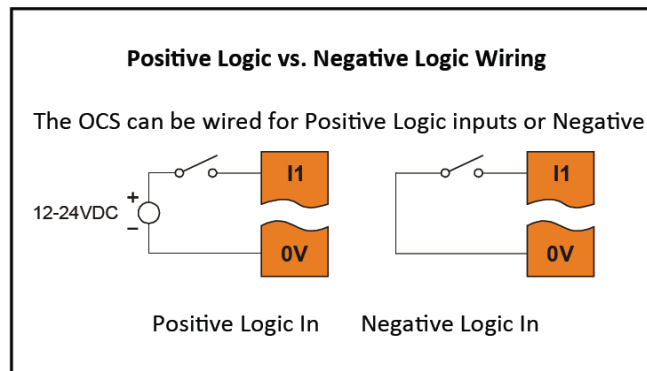
Figure 9.5 – Positive and Negative Inputs

In positive logic mode, a positive voltage applied to the input will turn the input 'On'. 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 V). This mode is sometimes called sinking.

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

POSITION/PIN		DIGITAL MODEL
1	I1	Input 1 (HSC)
2	I2	Input 2 (HSC)
3	I3	Input 3 (HSC)
4	I4	Input 4 (HSC)
5	I5	Input 5
6	I6	Input 6
7	I7	Input 7
8	I8	Input 8
9	I9	Input 9
10	I10	Input 10
11	I11	Input 11
12	I12	Input 12
13	C	Common
14	C	Common
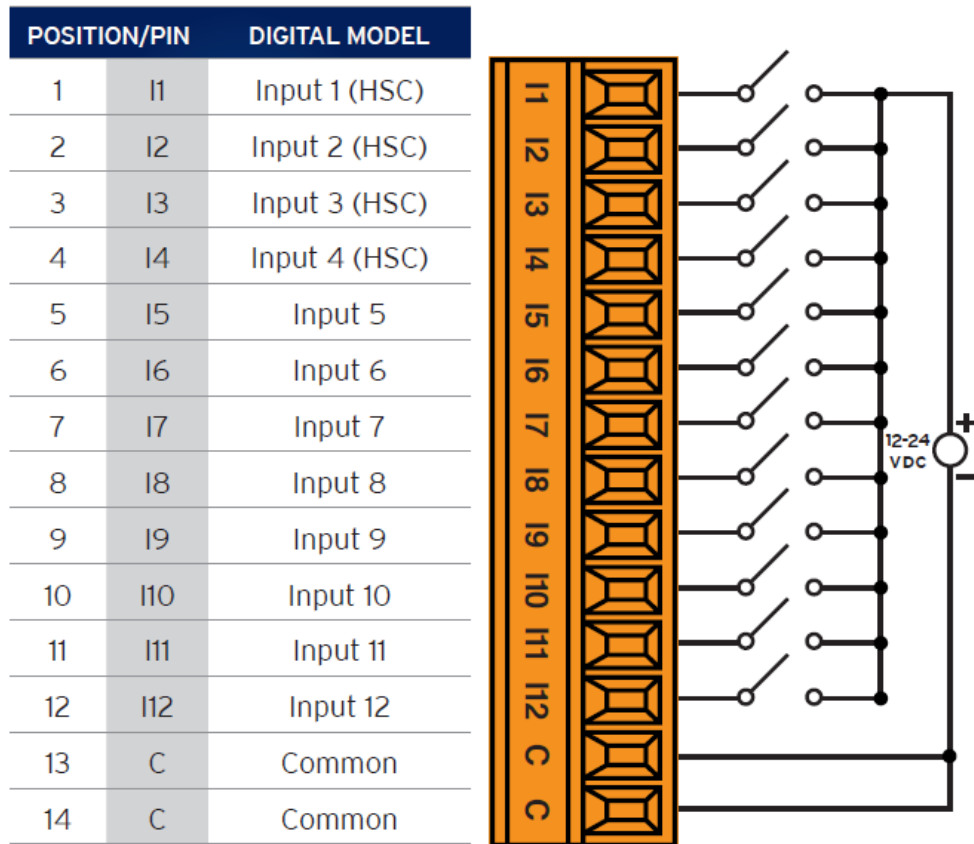
Figure 9.6 – Model R and A Digital Input

9.6   Analog Inputs

NOTE: See the data sheet and Chapter 13 for details on how to use Cscape to configure the digital filtering.

The analog inputs on the X2 allow 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. Refer to Table 9.6 for analog input information.

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.

Model R and A Analog Input and Output

POSITION/PIN		DIGITAL MODEL
1	AI1	Analog Input 1
2	AI2	Analog Input 2
3	AI3	Analog Input 3
4	AI4	Analog Input 4
5	C	Common
6	C	Common
7	AQ1	Analog Output 1
8	AQ2	Analog Output 2
9	C	Common
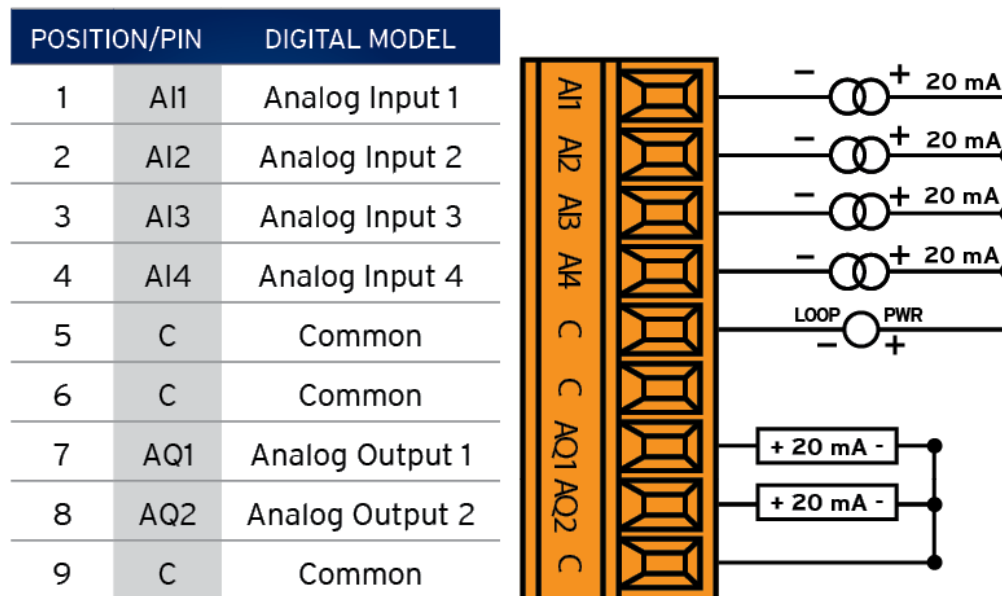
Figure 9.7 – Model R and A Analog In and Out

9.7   Analog Outputs

NOTE: See Chapter 10 for high-speed I/O information and refer to the datasheet for X2 model.

The analog outputs on X2 devices provide high resolution current outputs. The current selection is controlled with jumpers and configuration settings in Cscape.

NOTE: 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 (0). For more information on Stop State, see Chapter 13 on Cscape Configuration.

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 X2 I/O modules support High Speed Counting (HSC) I/O functions and may 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) 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 Chapter 13, Cscape Configuration.

10.2 Glossary of High Speed I/O Terms

Table 10.1 – Glossary of High Speed I/O Terms	
Accumulator	Register used to accumulate or store up a sum or count of many items or events.
Clear	A special function to zero out the value in a specific register. (Not used with Frequency or Period Measurement.)
Disable	A special function to prevent the counter from running.
Encoder	A sensor or transducer for converting rotary motion or position to a series of electronic pulses
Frequency Input	The number of times an electromagnetic signal repeats an identical cycle in a unit of time, usually one second.
Latch (strobe)	A special function that uses a digital logic circuit to store one or more bits. A latch has a data input, a clock input and an output. When the clock input is active, data on the input is "latched" or stored and transferred to the output register, either immediately or when the clock input goes inactive. The output retains its value until the clock goes active again.
Marker	Input into the OCS indicates a particular position. Typically, an encoder has a marker output that represents a specific point in the rotation.
Polarity	A polarity pull-down box is associated with each function and indicates the manner in which the trigger happens (e.g., High Level, Low Level, Falling Edge, Rising Edge).
Preload (load)	A special function used to trigger loading of a value into a register upon an event. (Not used with Frequency or Period Measurement.)
Quadrature	A high-speed device that expresses the phase relationship between two periodic quantities of the same period when the phase difference between them is one fourth of a period. A coupler in which the two output signals are 90° out of phase.
Totalizer	A counter that sums the total number of cycles applied to its input.

10.3   High Speed Counter (HSC) Functions

On units that support the HSC, four dedicated inputs are available that 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.

NOTE: While the high-speed input circuitry has a resolution of 1μs, measured edge transitions must not occur faster than 100μs 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 100μs.

NOTE: 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**.**

10.3.1 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: Selecting a shorter sample window provides a quicker measurement (faster response) but lowers the frequency accuracy (resolution) and increases the minimum frequency measurement limit.

10.3.2 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
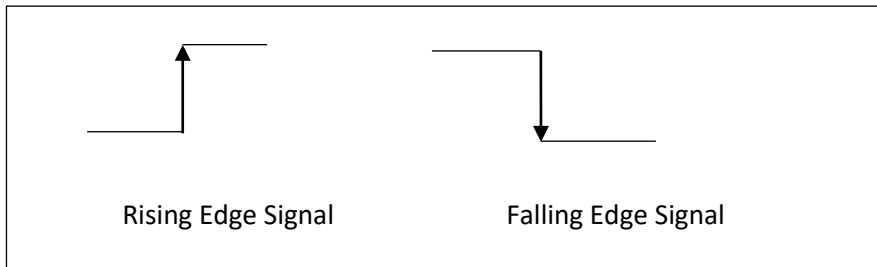
Three different options are available to reset the current count.

- **Configured reset value**
  When configuring the Totalize function, a value may be specified under the *Counts per Rev* column. When the totalizer accumulator reaches the 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).

- **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.

NOTE: Maximum direct digital reset latency is 100µs.

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

10.3.3 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 1µs Counts – In this sub-mode the accumulator value will contain the number of 1µs counts for which the pulse is high.
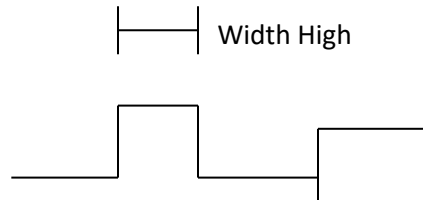
Width Low 1µs Counts - In this sub-mode the accumulator value will contain the number of 1µs counts for which the pulse is low.
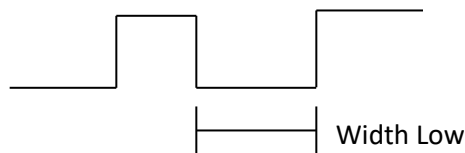
Period Rising Edges 1µs Counts – In this sub-mode the period of the input signal is reported in 1µs units. The period measurement will start on the rising edge of the input.
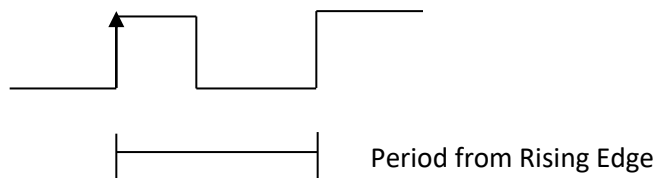
Period Falling Edges 1µs Counts – In this sub-mode the period of the input signal is reported in 1µs units. The period measurement will start on the falling edge of the input.

THE
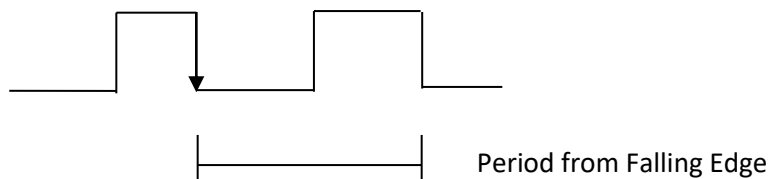
10.3.4 Quadrature

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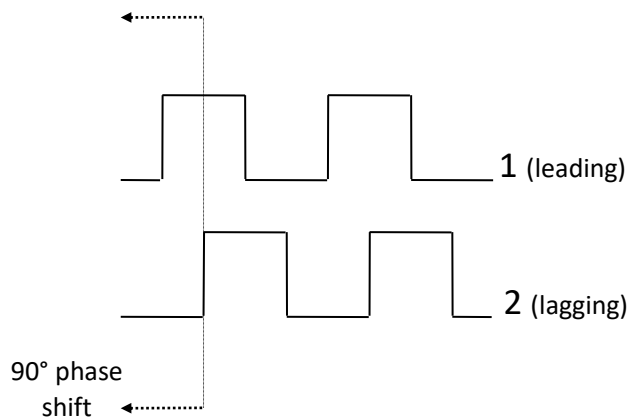
Using the above waveforms and a HSC input configuration of "Quadrature" - "1 leads 2, count up," the accumulator will count up when 1 is rising and 2 is low, 1 is high and 2 is rising, 1 is falling and 2 is high, and when 1 is low and 2 is falling. This results in 4 counts per revolution. So in order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

- **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: The Marker input is sampled within 50 μs of the associated quadrature edge. It is left to the user to determine if this meets the time constraints of the measured drive.

NOTE: If the Marker input pulse consecutively spans more than one of the specified edges, quadrature-decoding operation is unpredictable.

Sync mode selection   **Waveforms (Clockwise Rotation ⟶)**

[1]

[2]

High, Reset on 2 rising   [SYNC]

High, Reset on 1 falling   [SYNC]

High, Reset on 2 falling   [SYNC]

High, Reset on 1 rising   [SYNC]
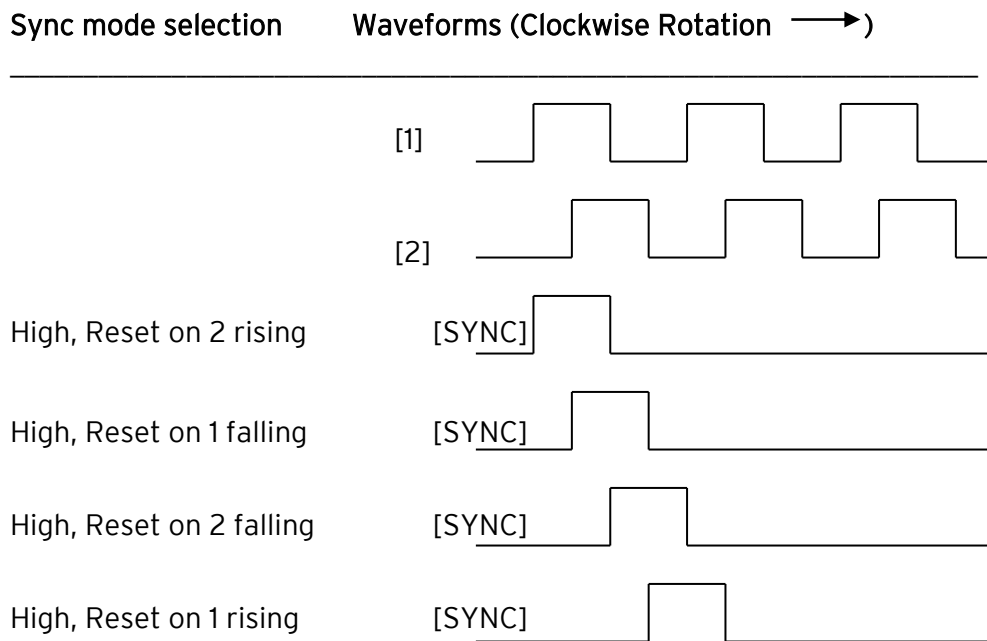
*While not displayed in this figure, modes for low level (inverse logic) are also supported for each state.

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.

Table 10.2 – Marker Function Table					
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

10.4   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.

10.4.1 HSC Functions Register Map

Table 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			
%AQ9-10		HSC1 Preset		
%AQ13-14		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

10.5   Pulse Width Modulation (PWM) Functions

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

NOTE: In Cscape, the X2 automatically defaults to Extended PWM Mode.

10.5.1 Normal

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

10.5.2 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 same output frequency (with the low going pulses synchronized). Otherwise, each PWM's pulse width can be independently adjusted.

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 pre-scaler 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.
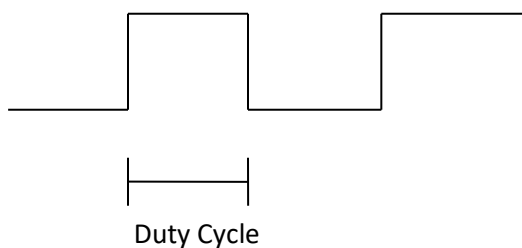
Duty Cycle

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: The nominal output driver turn-on-time delay (to reach 50% output) is 25 µs on models 3-5. Therefore, this limitation should be considered when determining both the minimum pulse width and the duty cycle accuracy of the application.

10.5.3 PWM Output Waveform
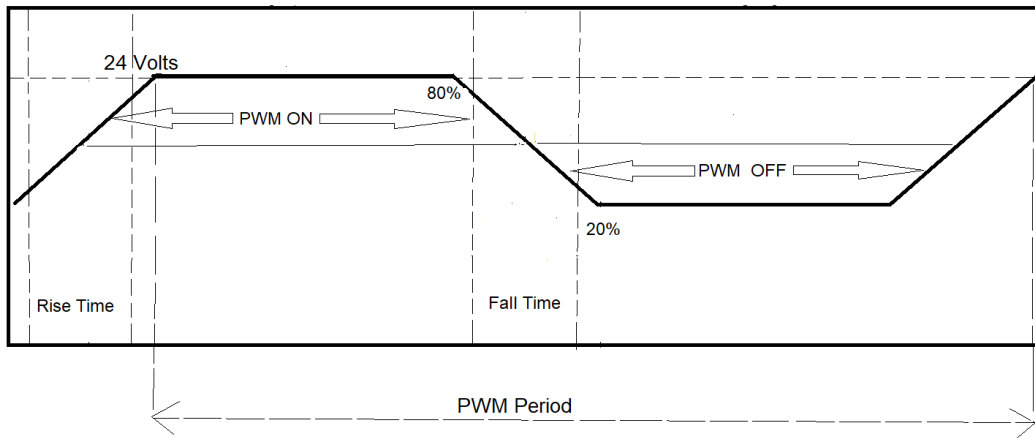
Figure 10.2 – PWM Output Waveform

Table 10.4 – PWM Output Waveform Table	
Rise Time	150ns Max
Fall Time	150ns Max
PWM Period	Frequency $= \dfrac{1}{Period}$

10.6   PWM Functions Register Map

Table 10.5 – PWM Functions Register Map		
Register	PWM	HSC
%AQ7	PWM1 Duty Cycle (32-bit)	HSC1 Preset Value(AQ3-4)
%AQ8		
%AQ9	PWM1 Frequency (32-bit)	
%AQ10		
%AQ11	PWM2 Duty Cycle (32-bit)	HSC2 Preset Value (AQ5-6)
%AQ12		
%AQ13	PWM2 Frequency (32-bit)	
%AQ14		

10.6.1 PWM Examples

Example 1	Duty Cycle	Frequency
To get a 50% Duty Cycle @ 10kHz waveform on **PWM1**:	Set %AQ7 – 8 = 16,000	Set %AQ9 – 10 = 10,000

Example 2	Duty Cycle	Frequency
To get a 25% Duty Cycle @ 5kHz waveform on **PWM2**:	Set %AQ11 – 12 = 8,000	Set %AQ13 – 14 = 5,000

Example 3	Duty Cycle	Frequency
To turn PWM 1 output ON all the time:	Set %AQ7 – 8 = 32,000	Set %AQ9 – 10 = Any Value

Example 4	Duty Cycle	Frequency
To turn PWM 1 output OFF all the time:	Set %AQ7 – 8 = 0	Set %AQ9 – 10 = Any Value

Table 10.6 – PWM Examples

Chapter 11: User Interface

11.1   Overview

This chapter presents the user interface (or operator view) of the X2 and some of the model specific characteristics of the X2 as compared to the rest of the OCS line. This chapter does NOT cover building screens or using the Cscape graphics editor. For instructions on creating screens and using the graphics editor, refer to the **Graphics Editor Help** file in Cscape.

NOTE: The X2 screen is a 2.2-inch diagonal LCD screen with an LED backlight.

11.2   Displaying and Entering Data
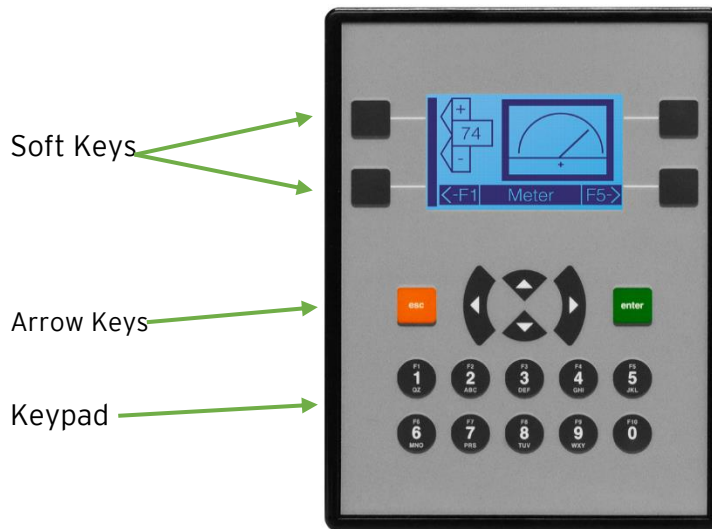
Figure 11.1 – Types of Keys and Buttons

The X2 uses multiple objects to display data. The user can use either the soft keys, which are the black buttons on either side of the screen to select items. The user can also use the arrows or the alpha-numeric keys that can also be used as function keys.

Based on the editable field as programmed in Cscape, the numeric entry will automatically switch between numbers or letters. In order to type in some letters, a button may have to be pressed numerous times until the desired letter is displayed.

11.3   Types of Objects

The X2 has two types of objects which must be defined using the Cscape program. Please refer to the Cscape Help file for further instructions.

Display Objects—Display objects just display data and cannot be edited.

Editable Screen Objects— Editable Field Objects contain fields that can be edited by using the arrow keys and the Function Keys.

11.4   Using Editable Screen Objects

When a screen contains editable objects, 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.
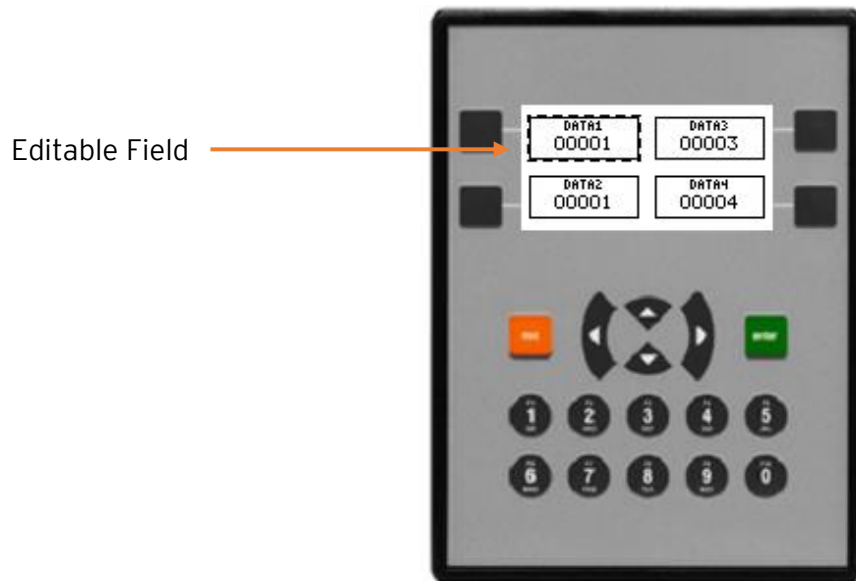
Editable Field

Figure 11.2—X2 and Editable   Field

If the X2 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 X2 displays <<<<< in a numeric field, the value is too small to display or is below the minimum for an editable field.

NOTE: Display Objects—Some objects just display data and cannot be edited.

11.5   Navigation Keys

The X2 has two types of navigation keys: **Soft Keys**

Arrow Keys
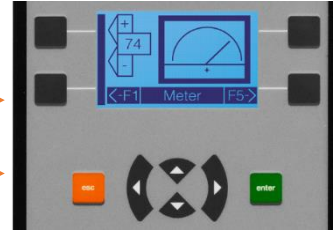
Soft Keys–The black squares on the sides of the screen are called "soft keys" and can be used to select objects that have an arrow icon pointing to the soft key. Soft keys can be assigned to certain objects, such as switch objects or jump objects.

Arrow Keys–The arrows keys are used for editable fields. Select an editable field by using one of the arrow keys to highlight a field to be edited. Then press Enter to change the value using the numeric key pad. Then press Enter again to store the value.

11.6   Screen Navigation

To allow the operator to change screens, a **screen jump object** is generally used. This object is typically tied to a soft key (One of the four keys to the sides of the display for the X2). Pressing the soft key will switch to the screen that is programmed in Cscape.

NOTE: A triangle or arrow on the side of an image on the X2 screen indicates that this button can be selected by using one of the soft keys on the side of the screen.
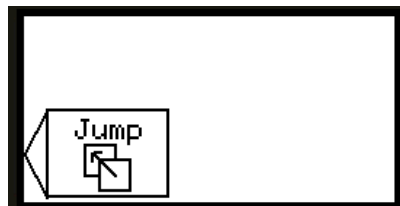
Figure 11.3 – Typical Screen Jump Object

11.7   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.
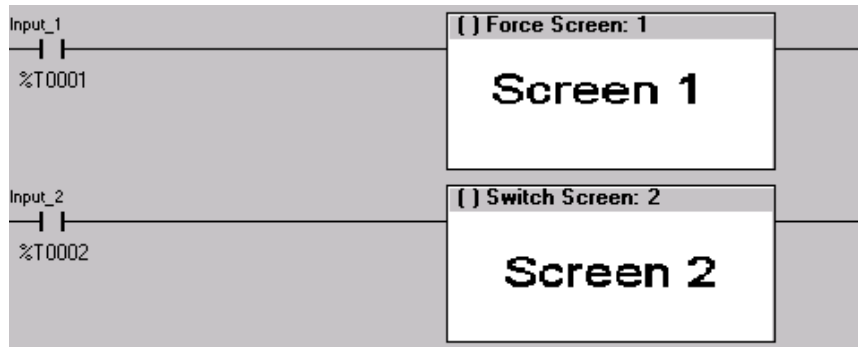
Figure 11.4 – Force and Switch Coils in Ladder Programming
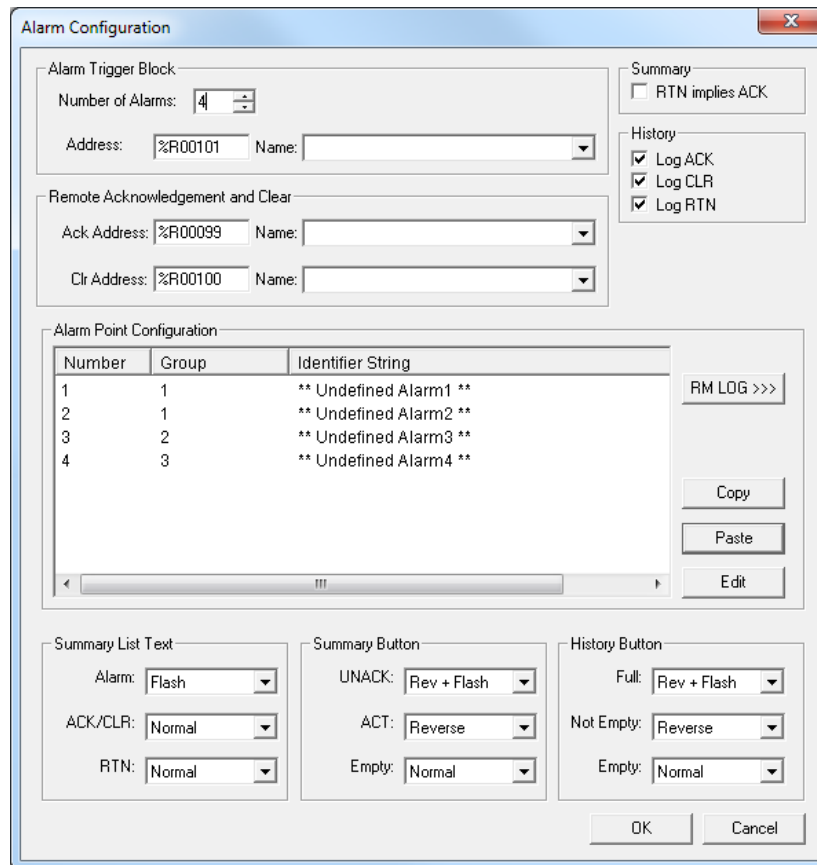
There is also a system register that can be used to for control based screen navigation. %SR1 can be read to determine the current screen or written to change the current screen.

Refer to the to the Cscape Help file for more information on control-based screen navigation.

11.8   Alarms

Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. The alarm object is generally used to enunciate alarms to the operator.

For more information, refer to the **Graphics Editor Help** file in Cscape. This section presents a typical configuration thereby providing an introductory description on what the operator should expect.

Figure 11.5–Alarm Configuration in Cscape

To view, acknowledge, and/or clear alarms, the operator must access the alarm viewer. This is accomplished by selecting an alarm object. When accessed, the alarm object is displayed as pop-up alarm viewer dialog similar to that shown in Figure 11.6.

Figure 11.6 – Alarm Object

Once view operations are complete, simply touch the *Esc* button to remove the pop-up alarm viewer.

NOTE: OCS registers %SR181 and %SR182 are available for ladder use, which indicate presence of unacknowledged or acknowledged alarm (respectively). The screen designer may implement these registers to switch screens or activate the beeper to attract the operator's attention.

11.9   Screen Saver

The X2 screen backlight life remains sufficiently bright for five (5) years. It will dim to 70% brightness if it is left on continuously for five (5) years. If the application does not require interaction with the X2 for long periods of time, the backlight life can be extended by using the screen saver function. When enabled through the System Menu, the backlight is shut off (screen goes black) after a specified time of no activity on the screen. When the screen saver shuts off the backlight, any key or button reactivates the backlight.

It is possible for the application to temporarily disable the screen saver by generating a positive transition to %SR57.16 (coil only) at a rate faster than the screen saver timeout value. This may be desired while waiting for alarm acknowledgement.

NOTE: The backlight life can be extended by powering off the backlight.

CHAPTER 12: REGISTERS

12.1   Register Definitions

When programming the X2 OCS, 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.

Table 12.1 - Types of Registers in the X2 OCS	
%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.
%D Display Bit	These 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.
%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.
%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.

12.2   Useful %S and %SR registers

Table 12.2 – 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

Table 12.3 – %SR Registers				
Register	Name	Description	Min Val	Max Val
%SR1	USER_SCR	Current User Screen Number	1	1023
%SR2	ALRM_SCR	Current Alarm Screen Number (0=none)	0	1023
%SR3	SYS_SCR	Current System Screen Number (0=none)	0	14
%SR4	SELF_TEST	Bit-Mapped Self-Test Result	0	65535
%SR5	CS_MODE	Control Station Mode (0=Idle, 1=Do I/O, 2=Run)	0	2
%SR6	SCAN_RATE	Average Scan Rate (/ 10)	-	1000
%SR7	MIN_RATE	Minimum Scan Rate (/ 10)	-	1000
%SR8	MAX_RATE	Maximum Scan Rate (/ 10)	-	1000
%SR9-10	EDIT_BUF	Data Field Edit Buffer	0	2^{32}-1
%SR11-12	LADDER_SIZE	Ladder Code Size	2	256K
%SR 13-16	Reserved	-	-	-
%SR17-18	IO_SIZE	I/O Configuration Table Size	16	127K
%SR19-20	NET_SIZE	Network Configuration Table Size	34	1K
%SR21-22	SD_SIZE	Security Data Table Size	-	-
%SR23	LADDER_CRC	Ladder Code CRC	0	65535
%SR 24-25	Reserved	-	-	-
%SR26	IO_CRC	I/O Configuration Table CRC	0	65535
%SR27	NET_CRC	Network Configuration Table CRC	0	65535
%SR28	SD_CRC	Security Data Table CRC	0	65535
%SR29	NET_ID	This Station's Primary Network ID (CsCAN)	1	253
%SR30	NET_BAUD	Network Baud Rate (CsCAN) (0=125KB; 1=250KB; 2=500KB; 3=1MB)	0	3
%SR31	NET_MODE	Network Mode (0=network not required; 1=network required; 2=network optimized; 3=network required and optimized)	0	3
%SR32	LCD_CONT	LCD Display Contrast setting	0	255
%SR33	FKEY_MODE	Function Key Mode (0=Momentary; 1=Toggle)	0	1
%SR34	SERIAL_PROT	RS232 Serial Protocol Mode (0=Firmware Update (RISM); 1=CsCAN; 2=Generic	0	4

Register	Name	Description	Min Val	Max Val
		(Ladder- Controlled); 3=Modbus RTU; 4=Modbus ASCII)		
%SR35-36	SERIAL_NUM	This Station's 32-bit Serial Number	0	2^{32}-1
%SR37	MODEL_NUM	This Station's Binary Model Number	0	65535
%SR38	ENG_REV	Firmware Rev Number (/ 100)	0000	9999
%SR39	CPLD_REV	BIOS Rev Number (/ 100)	000	255
%SR40	FPGA_REV	FPGA Image Rev Number (/ 10)	000	255
%SR41	LCD_COLS	Vertical Pixel Count		
%SR42	LCD_ROWS	Horizontal Pixel Count		
%SR43	KEY_TYPE	Keypad Type		
%SR44	RTC_SEC	Real-Time-Clock Second	0	59
%SR45	RTC_MIN	Real-Time-Clock Minute	0	59
%SR46	RTC_HOUR	Real-Time-Clock Hour	0	23
%SR47	RTC_DATE	Real-Time-Clock Date	1	31
%SR48	RTC_MON	Real-Time-Clock Month	1	12
%SR49	RTC_YEAR	Real-Time-Clock Year	1996	2095
%SR50	RTC_DAY	Real-Time-Clock Day (1=Sunday)	1	7
%SR51	NET_CNT	Network Error Count	0	65535
%SR52	WDOG_CNT	Watchdog-Tripped Error Count	0	65535
%SR53-54	BAD_LADDER	Bad Ladder Code Error Index	0	65534
%SR55	F_SELF_TEST	Filtered Bit-Mapped Self-Test Result	0	65535
%SR56	LAST_KEY	Key Code of Last Key Press or Release	0	255
%SR57	BAK_LITE	LCD Backlight Dimmer Register 0 = 0% On; 100-255 = 100% On	0	255
%SR59-60	Reserved	-	-	-
%SR61	NUM_IDS	This Station's Number of Network IDs	1	253
%SR62	NUM_IDS	This Station's Number of Network IDs	1	253
%SR113-114	GOBJ_SIZE	Graphics Object Table Size	8	256K
%SR115-116	GSTR_SIZE	Graphics String Table Size	8	128K

Table 12.3 – %SR Registers

Table 12.3 – %SR Registers				
Register	Name	Description	Min Val	Max Val
%SR117-118	GBMP_SIZE	Graphics Bitmap Table Size	4	256K
%SR119-120	GTXT_SIZE	Graphics Text Table Size	8	128K
%SR121-122	GFNT_SIZE	Graphics Font Table Size	8	256K
%SR123-124	PROT_SIZE	Protocol Table Size	16	64K
%SR125	GOBJ_CRC	Graphics Object Table CRC	0	65535
%SR126	GSTR_CRC	Graphics String Table CRC	0	65535
%SR127	GBMP_CRC	Graphics Bitmap Table CRC	0	65535
%SR128	GTXT_CRC	Graphics Text Table CRC	0	65535
%SR129	GFNT_CRC	Graphics Font Table CRC	0	65535
%SR130	PROT_CRC	Protocol Table CRC	0	65535
%SR131-163	Reserved	-	-	-
%SR152.3		Enables RS485 Port Termination		
%SR152.4		Enables CAN Port Termination		
%SR164.1		Enables RS485 Port Biasing		
%SR164.3		Read bit indicating Auto Restore of Register Data has been performed (Fail Safe)		
%SR164.4		Read bit indicating Backup of Register Data has been performed (Fail Safe)		
%SR164.5		Enable AUTORUN (Fail Safe)		
%SR164.6		Enable AUTOLOAD (Fail Safe)		
%SR164.7		Backup trigger bit		
%SR164.8		Clear Backup trigger bit		
%SR164.9		MAKE_CLONE trigger bit		
%SR164.10		LOAD_CLONE trigger bit		
%SR164.11		Status indicating Make Clone Fail (This bit goes high when Make / Create clone fails)		
%SR164.12		Status indicating Load Clone Fail (This bit goes high when Load clone fails)		
%SR165-174	Reserved			
%SR175	Removable Media	Current Removable Media interface status	0	6

Table 12.3 – %SR Registers				
Register	Name	Description	Min Val	Max Val
%SR176-177	Removable Media	Indicates free space on the Removable Media card in K bytes.	0	2^{31}
%SR178-179	Removable Media	Indicates the total card capacity in K bytes.	0	2^{31}
%SR180	Reserved	-	-	-
%SR181	ALM_UNACK	Unacknowledged Alarm (high bit indicates what group #)		
%SR182	ALM_ACT	Active Alarm (high bit indicates what group #)		
%SR183	SYS_BEEP	System Beep Enable (0=disabled; 1=enabled)		
%SR184	USER_BEEP	Software configurable (0=OFF; 1=ON)		
%SR185	SCR_SAVER	Screen Saver Enabled (0=disabled; 1=enabled)		
%SR186	SCR_SA_TM	Screen Saver Time in minutes (delay)		
%SR187	NET_USE	Average Net Usage of all units on the CAN network		
%SR188	NET_MIN	Minimum Net Usage of all units on the CAN network		
%SR189	NET_MAX	Maximum Net Usage of all units on the CAN network		
%SR190	NT_TX_AVG	Average Net Usage of this unit		
%SR191	NT_TX_MIN	Minimum Net Usage of this unit		
%SR192	NT_TX_MAX	Maximum Net Usage of this unit		

For additional information on system bits and registers, refer to the Cscape Help file.

12.3   Register Map for X2 OCS I/O

Fixed Address	Digital/Analog I/O Function	X2 Models	
		R	A
%I	Digital Inputs	1-12	1-12
	Reserved	13-32	13-32
%Q	Digital Outputs	1-6	1-12
	Reserved	7-16	13-16
%AI	Analog Inputs	1-4	1-4
	Reserved	5-12	5-12
%AQ	Analog Outputs	1-2	1-2
	Reserved	3-6	3-6

Table 12.4 – Register Map for X2 OCS I/O

12.4 Resource Limits

Table 12.5- Resource Limits for X2 OCS			
Resource	**Value**	**Resource**	**Value**
%S	16	CsCAN	125kBd, 250kBd, 500kBd, or 1MBd
%SR	255	Serial Ports	1 RS232, 1 RS485 Ports (Single Connector)
%T	1024	IDs Per CsCAN Network	64 w/o repeat (253 w/ 3 repeaters)
%M	1024	Keypad	20 Metal Dome Keys
%R	5,000	Display	128 x 64 Monochrome LCD
%K	20	Screen Memory	256kB
%D	250	User Screens	250
%I	1024	Data Fields Per User Screen	15
%Q	1024	Ladder Code	256 kB
%AI	256		
%AQ	256		

CHAPTER 13: CSCAPE CONFIGURATION

13.1 Overview

X2 OCS 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 X2 OCS unit. Please refer to the Cscape Help file for additional details.

13.2 Cscape Status Bar

When the X2 OCS 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 X2 OCS and the Cscape program. Components of the Cscape Status Bar are explained below.

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.

Ready	User:	HE-XExx1-CsCAN (Model=)	Equal	Local :1 Target :2(R) [no forces]	MOD

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 OCS 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.

Figure 13.1 – Cscape Status Bar

13.3 Establishing Communications

The X2 OCS can communicate with Cscape using USB to USB, USB to serial adapters, serial port communications via MJ1 Port, CAN (CsCAN), or modems. For X2, use Cscape Version 9.80 or newer.

To communicate with the X2 via USB you will need the Automated Driver Installer located on the Horner APG web site. The drivers may be loaded from the **HE-XEC Ethernet Utility / HTTP Web Server Demo / Communications Drivers** section of the support files page on our website, found here: https://hornerautomation.com/support-files .

Next, connect a PC's (Personal Computer running a Windows Microsoft operating system) USB port via USB cable to the USB mini B port on the X2 OCS.

USB Mini Port B Port
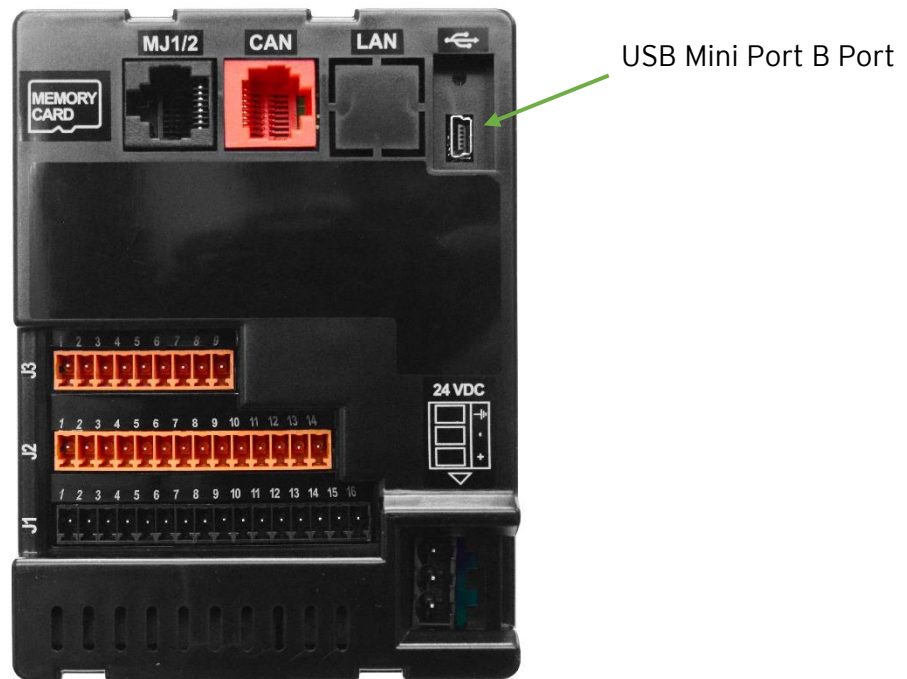
Figure 13.2 – USB Programming Connector

The PC will detect a new device has been plugged into the USB port.
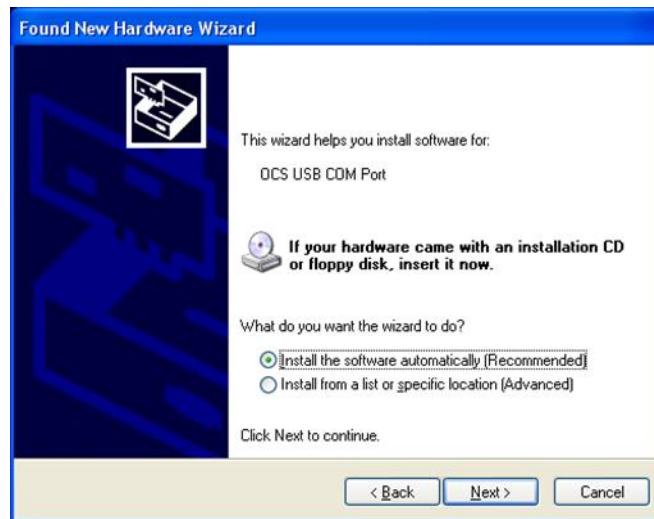
Figure 13.3 – Hardware Wizard Screenshots

Now that the X2 is plugged in, go to the Cscape menu **Controller → Connection Wizard**, choose your connection method. If you are connecting for the first time, we suggest connecting via USB.
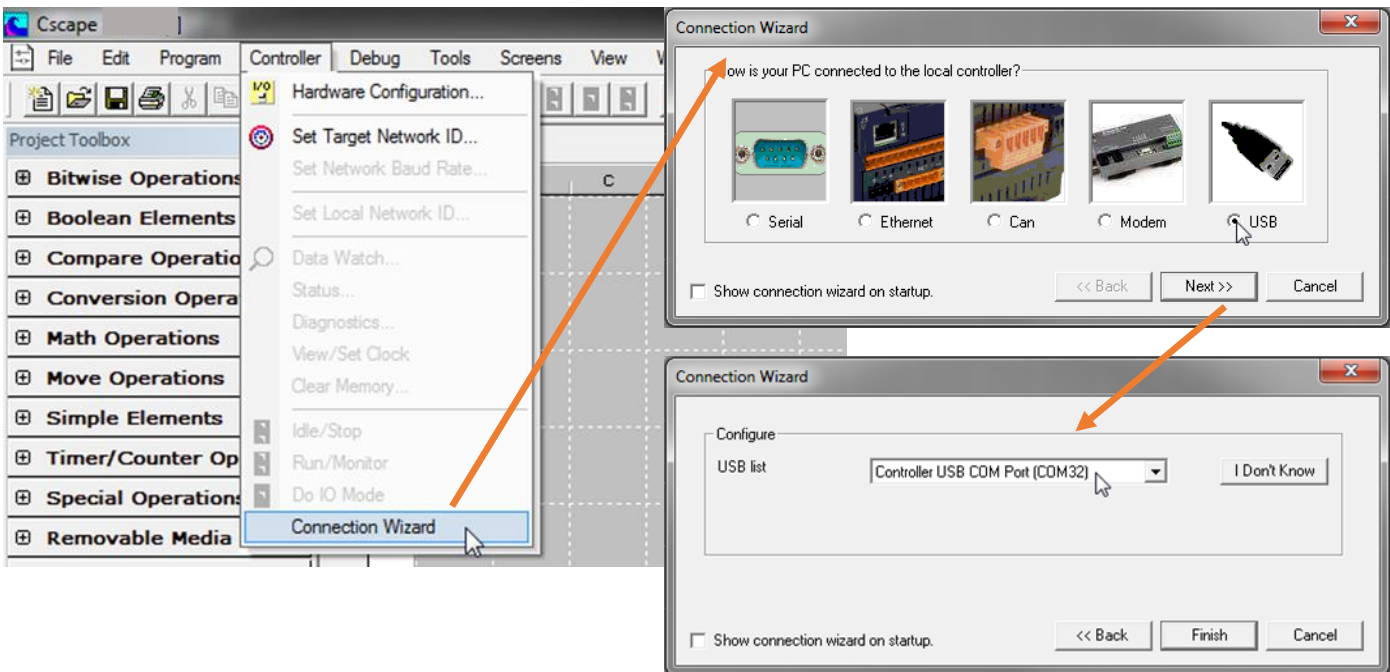
Figure 13.4 – Cscape Connection Wizard Screenshots

If **Controller USB COM Port** is not present in the dropdown list, the Windows operating system has not yet recognized the OCS as an installed device. Be sure the installation process is complete and that the correct drivers are installed.

An alternate way to select the COM setting is to go to **Cscape** → **Tools** → **Application Settings** → **Communication** → **Configure** and choose connection method in **Add Target**.
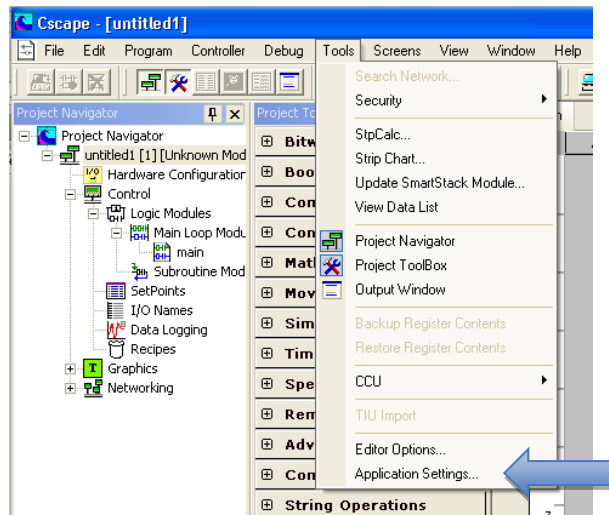
Figure 13.5 – Cscape: Alternative Connection Method Screenshot
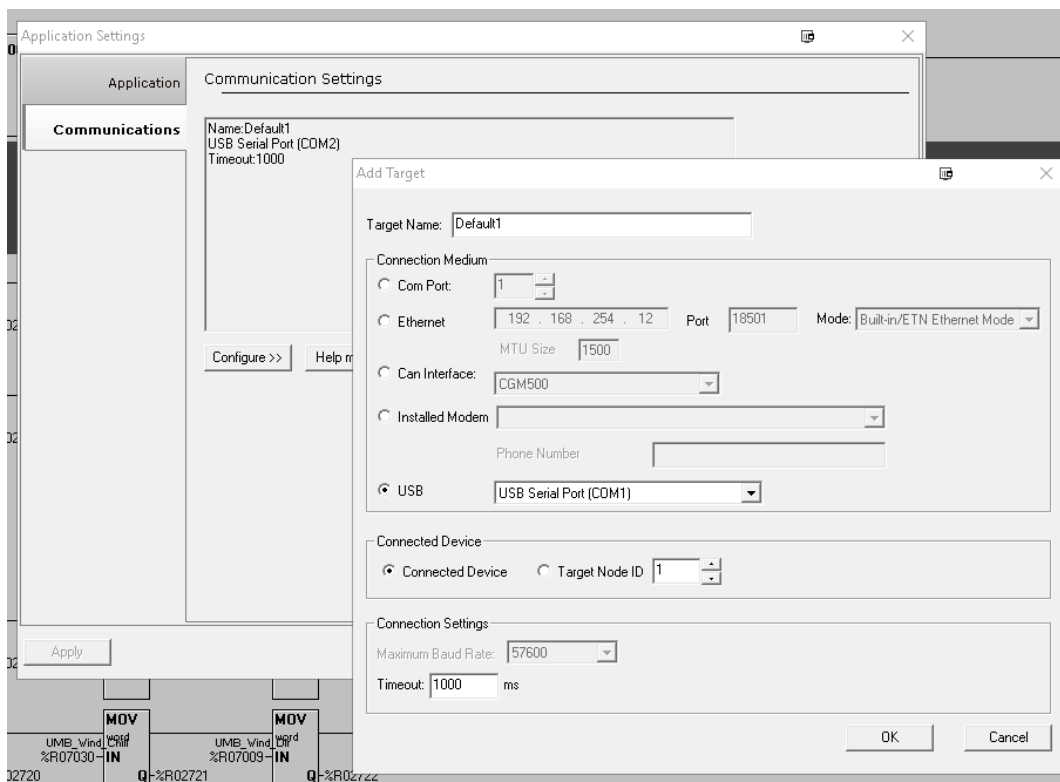
Figure 13.6 – Add Target Screenshot in Cscape
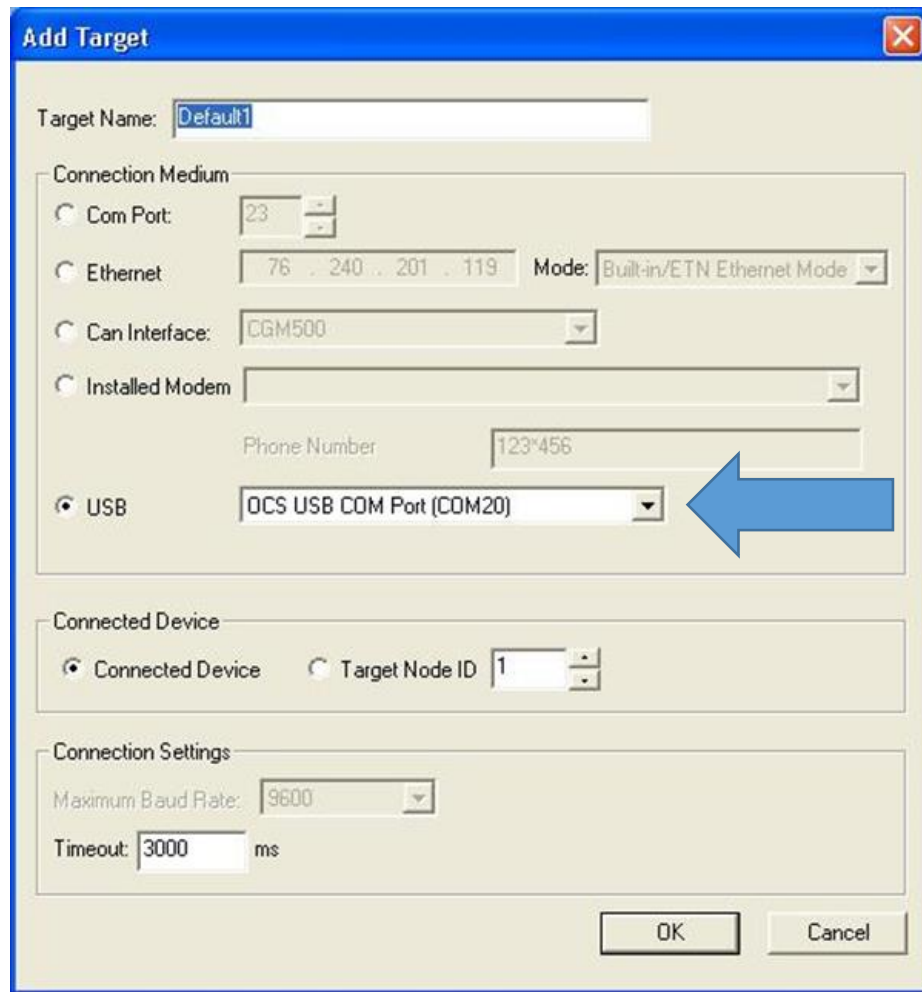
Figure 13.7 – Cscape: Add Target

NOTE: The following fields need to be filled for communication configuration if Cscape Connection Wizard was not used. Table 13.1 explains the information needed in each field.

1. Target Name
2. Connection Medium
3. Connected Device
4. Connection Settings

Table 13.1 – Communication Configuration Dialog	
Target Name	Name for connection. This is not a mandatory column to be filled, by default Cscape will populate 'Default1' in edit box.
Connection	
Com Port	Select this option to communicate over serial communication with the device. The port number can be configured here.
Ethernet	Connection through Ethernet is **not** an option with the X2 OCS.
CAN Interface	Select this option to communicate over CAN. This option requires additional hardware to be installed with the PC to be able to do so. Select the type of hardware installed from the dropdown.
Installed Modem	Select this option to communicate to the device through the internal modem of the computer. Cscape will automatically detect the internal modem attached with PC and list in the attached drop down. User can select modem and telephone number for target controller. **NOTE**: Cscape will do necessary initialization for the selected internal modem.
USB	Select this option to communicate over USB. Now Horner devices and Horner USB to serial converters are recognized and can be specifically selected.
Connected Device	
NOTE: This configuration is required if the controller to which Cscape is communicating is connected to a CsCAN network.	
Connected Device	By default this option is selected and networking feature of Cscape is disabled.
Target Node ID	On selecting this option, Networking feature of Cscape is enabled. CsCAN ID for the target controller to be provide here.
Settings (General Communication Settings)	
Maximum Baud Rate	Select the baud rate for serial communication.
Timeout	Select the communication timeout. **NOTE**: Select a larger timeout for GPRS and installed modem communication configuration

If communication is established, the target indicator will show the mode of the controller **Target: yy(R)** as shown in the status section above in this chapter, section Cscape Status Bar.

| USB (\\.\COM32) | User: NONE | ☐ CsCAN Model Equal | Equal | Local:253 Target:253(R) [no forces] | MOD |
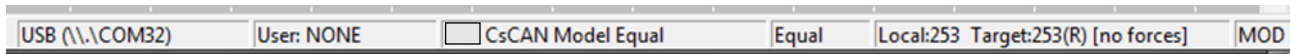
When connected directly to the controller to which Cscape communications are required, the **Local ID and the Target ID should match.**

Local ID and Target ID Match

If the controller is not communicating, you may need to set the Target ID of the controller in Cscape or change the controllers ID on the unit itself. 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 <u>not</u> require the ID to be configured.

The main method for communicating between Cscape and an X2 is RS-232 serial. The X2 can communicate with Cscape using USB to serial adapters, 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.

13.4   Communicating via MJ1 Serial Port

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 X2.

NOTE: 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 <u>not</u> require the ID to be configured.

To check or change the ID on the X2, press the UP and DOWN keys on the X2 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 point Cscape at the correct controller, change the Target ID using the **Controller → Set Target Network ID** dialog. Also, to change the Target ID of Cscape use the **Controller → Set Target Network ID** dialog.

13.5   Configuration

An overview of configuration:
1. Start the configuration by selecting the **Controller → Hardware Configure** menu item.
2. If the X2 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 X2 is <u>not</u> 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 **X2 CsCAN** or **X2 No Net** from the type drop down box.
5. Once the type of X2 is selected, the model number drop down box will provide the X2 model numbers from which to choose from.
6. Once the X2 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 four (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 X2 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 (Chapter 9) or High Speed I/O (Chapter 10).

The four areas of I/O configuration are Digital In/HSC, Digital Out/PWM, Analog In, and Analog Out.

13.6 Digital / HSC Input Configuration

The following figure illustrates the **Digital / HSC Input Configuration** dialog.
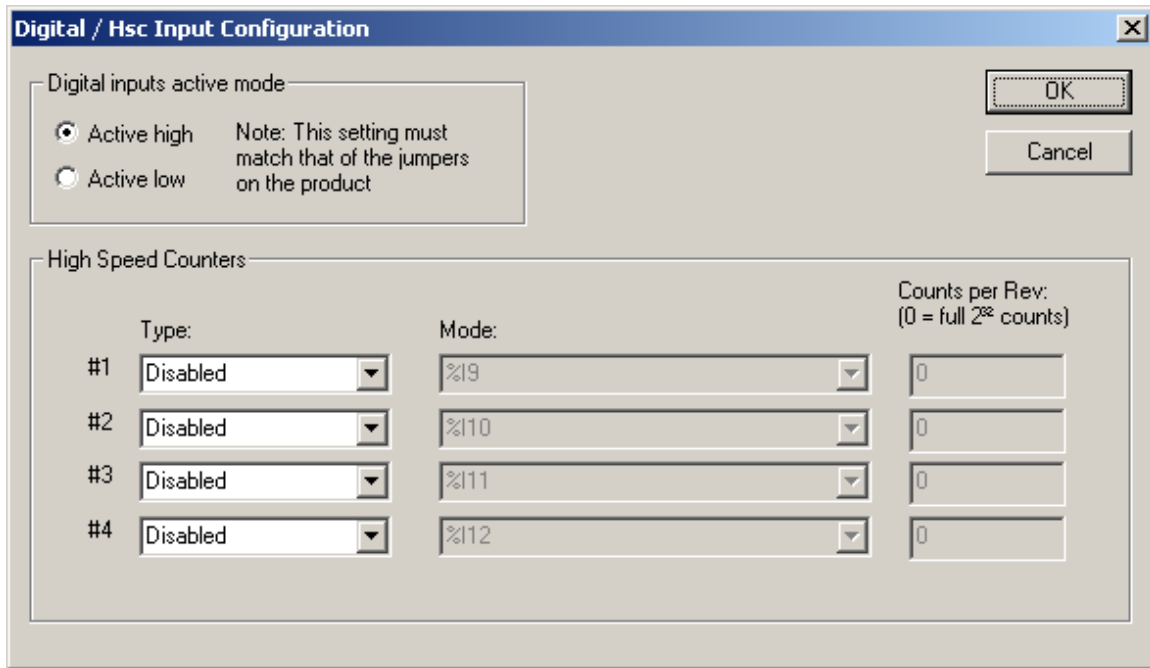
Figure 13.8– Digital / HSC Input Configuration Dialog

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 matches the jumper settings on the hardware.

The High Speed Counters group box contains all of the windows that are used to configure the four available high-speed counters on the X2. To configure 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.

13.7   Digital / PWM Output Configuration

The following figure illustrates the **Digital / PWM Output Configuration** dialog.
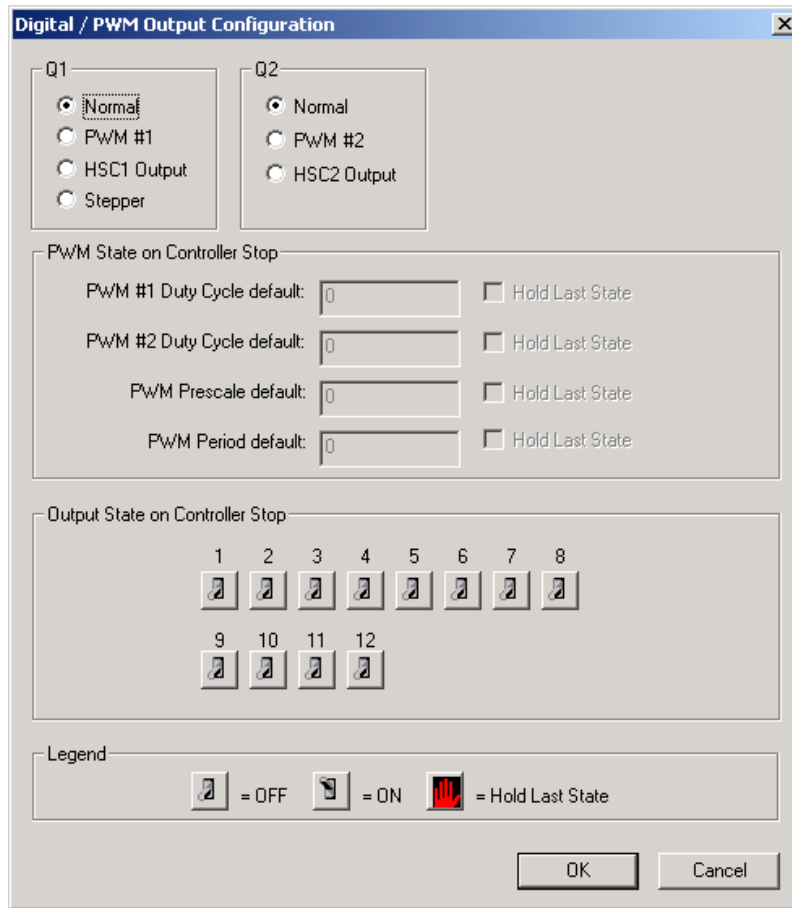
Figure 13.9 – Digital / PWM Output Configuration Dialog

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: 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.

13.8   Analog Input Configuration

The following figure illustrates the **Analog Input Configuration** dialog.
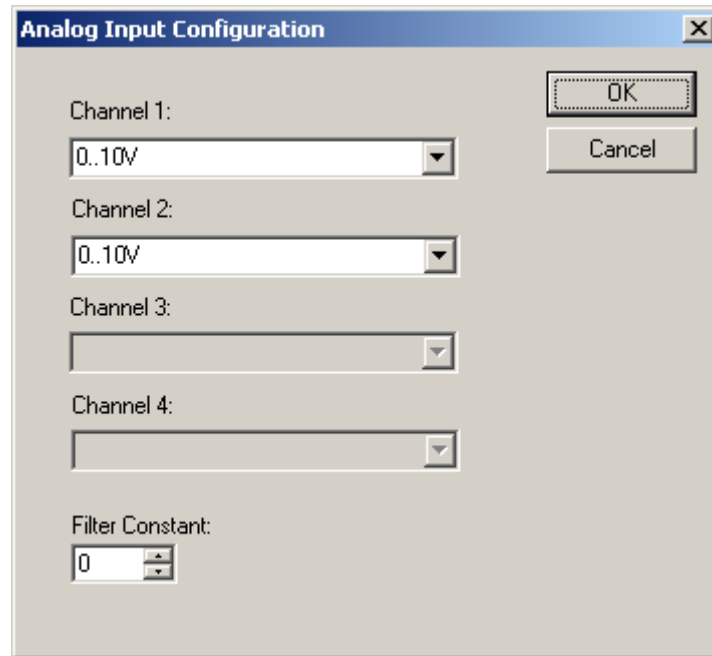
Figure 13.10– Analog Input Configuration Dialog

The **Channel x** drop down windows allows 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, and 4..20mA.

13.9 Analog Output Configuration

The following figure illustrates the **Analog Output Configuration** dialog.
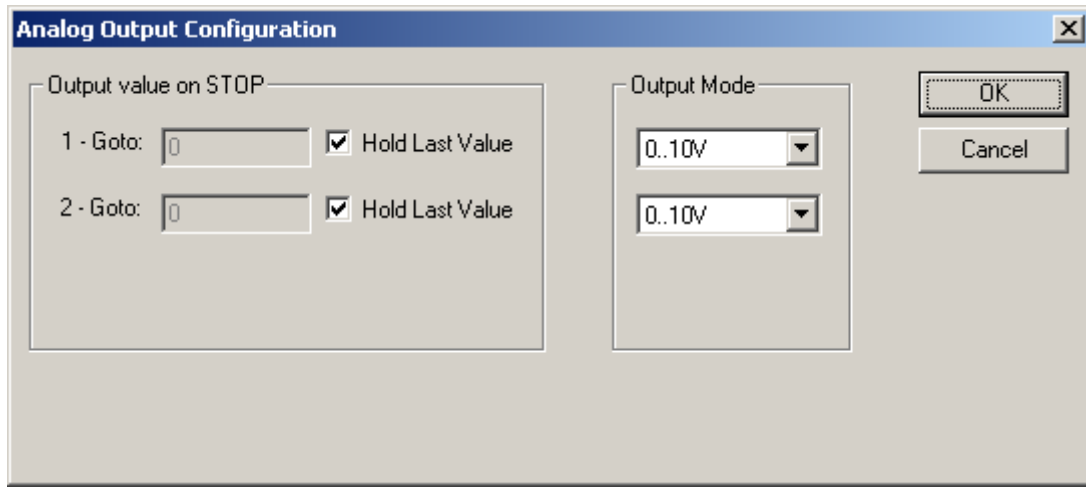
Figure 13.11 – Analog Output Configuration Dialog

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 0..10V, 0..20mA, and 4..20mA.

CHAPTER 14: FAIL – SAFE SYSTEM

14.1 Overview

The Fail-Safe System has the following capabilities:
- Manually backup the current Battery-Backed RAM Register Settings into Flash memory.
- Manually restore Register Settings from the values previously backed up in Flash to Battery-Backed RAM.
- Detect corrupted Register Settings at power-up and then automatically restore them from Flash.
- Detect corrupted or empty application in Flash memory at power-up and then automatically load the AUTOLOAD.PGM application file from Removable Media (Compact Flash or MicroSD).
- If an automatic Register Restore or Application Load occurs, the OCS can automatically be placed in RUN mode

14.2 Settings

To use the fail – safe feature, the user must do the following:
1. Backup the current Battery-Backed RAM Register contents in On-Board Flash memory using System Menu options.
2. From Cscape, create AUTOLOAD.PGM for the application program using 'Export to Removable Media'.
3. Place the Removable Media with AUTOLOAD.PGM in the device.
4. Set the 'Enable AutoLoad' option `in the device to YES.
5. Set the 'Enable AutoRun' option to YES if the controller needs to be placed in RUN mode automatically after automatic restore of data or AutoLoad operation.

14.3 Backup / Restore Data

Selecting this option brings up a screen having four operations:
Backup OCS Data–Copies Battery Backed RAM contents on to the onboard flash memory of the OCS.
Restore OCS Data– Copies the backed up data from onboard flash memory to the battery backed RAM.
Clear Backup Data– The backup data will be erased from the onboard flash.
Exit– Goes back to previous menu.

Figure 14.2 – Backup / Restore Data

Backup OCS Data:

When initiated, this will allow the user to manually copy Battery-Backed RAM contents on to the onboard FLASH memory of the OCS. This will have the effect of backing up all the registers and controller settings (Network ID, etc.) that would otherwise be lost due to a battery failure.

%SR164.4 is set to 1 when backup operation is performed.

Figure 14.3 – Backup Registers

Restore OCS Data:

When initiated, this will allow the user to manually copy the backed up data from the onboard FLASH to the Battery-Backed RAM.

A restore operation will be automatically initiated if a backup has been previously created and on power-up the Battery-Backed RAM registers fail their check.

The following process is implemented to restore data:

- The controller will be placed in IDLE mode.
- Data will be copied from onboard FLASH to OCS Battery-Backed RAM
- The controller will reset.
- The controller will be put in RUN mode if the AutoRun setting is 'Yes' else it will remain in IDLE mode.
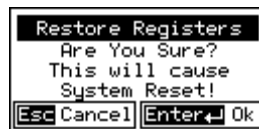
Figure 14.4 – Restore OCS Data

%SR164.3 is set to 1 only when an automatic restore operation is performed - not on a manual one. This bit is reset to 0 when a new backup is created.

Restoring of data can be manually performed by selecting RESTORE option from the Backup / Restore Data menu.

This will cause the controller to reset.

Clear Backup Data:

When initiated, the backup data will be erased from the onboard Flash and no backup will exist.
%SR164.4 and %SR164.3 is reset to 0 when backed up data is erased.
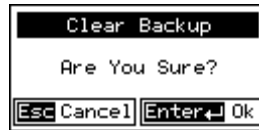
Figure 14.5 – Clear Backup Data

Exit: Goes back to the previous screen.

The OCS follows the following sequence in execution of Automatic Restore:
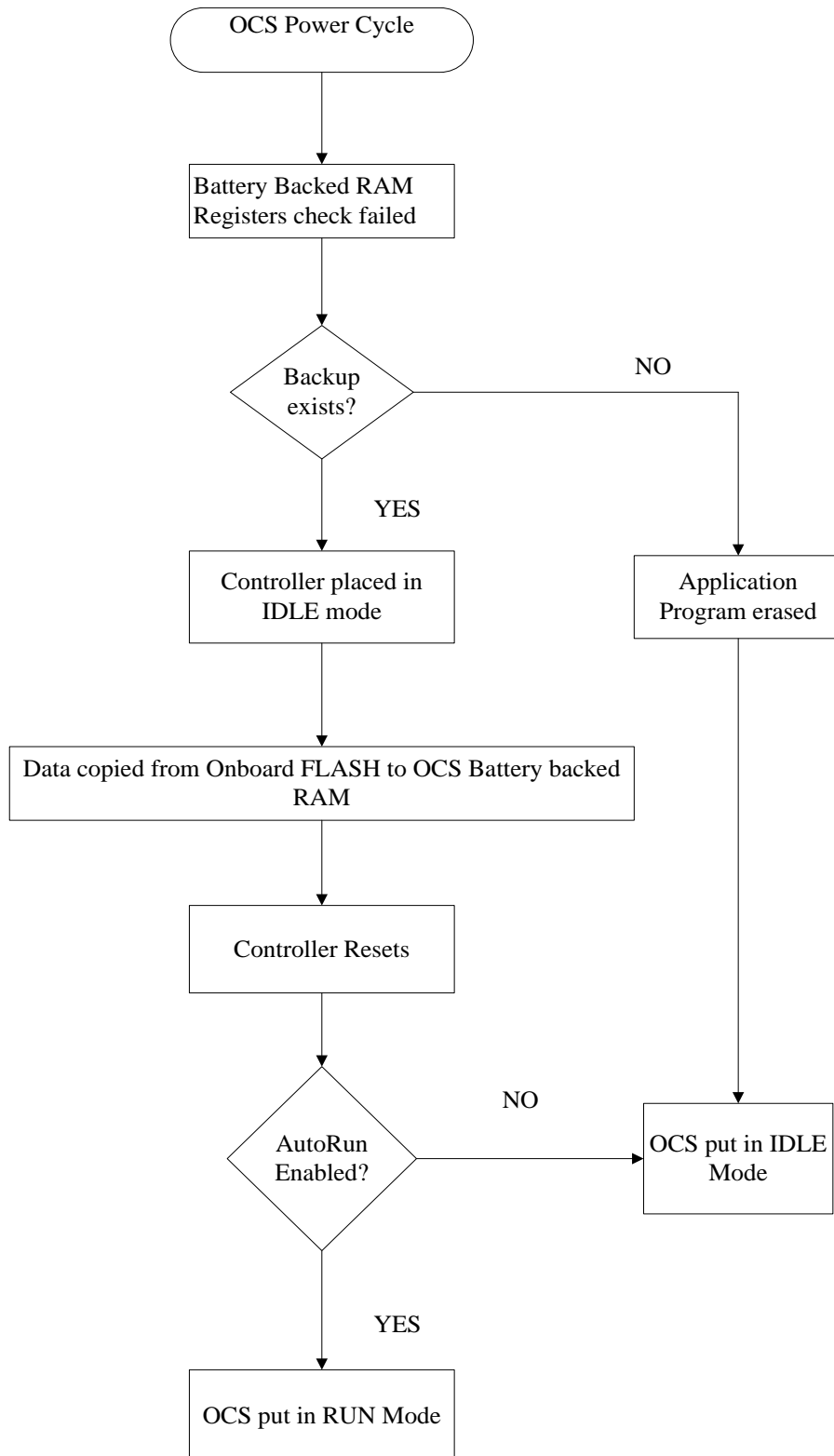
Figure 14.6 – Flow Chart for Automatic Restore

14.4 AutoLoad

This system menu option allows the user to specify whether the OCS automatically loads the application AUTOLOAD.PGM located in Removable Media.

When the AutoLoad setting is enabled (set to YES), it can be manually or automatically initiated at power-up.

The automatic initiation will happen only in the following two cases:
- When there is no application program in the OCS and a valid AUTOLOAD.PGM is available in the removable media of the device.
- When the program residing in onboard memory is corrupted and a valid AUTOLOAD.PGM is available in the removable media of the device.

AutoLoad can be manually initiated when the SYS-F3 key is pressed (OCS can be in any of the following mode – Idle / Run / DoIO). This also requires a valid AUTOLOAD.PGM to be present in the removable media of the device.

When the AutoLoad setting is not enabled (set to NO), OCS will be in IDLE mode and the application is not loaded.

If the AUTOLOAD.PGM is security enabled, the user will be prompted to enter the password before loading the application. The application will be loaded from the Removable media only after getting the correct password.

%SR164.6 can be set to enable AutoLoad feature.

```
Enable AutoLoad    No

( AutoLoad from     )
( Removable Media's )
( AUTOLOAD.PGM file )
( when triggered    )
```

Figure 14.7 – AutoLoad Menu

The OCS implements the following sequence to execute the AutoLoad function:
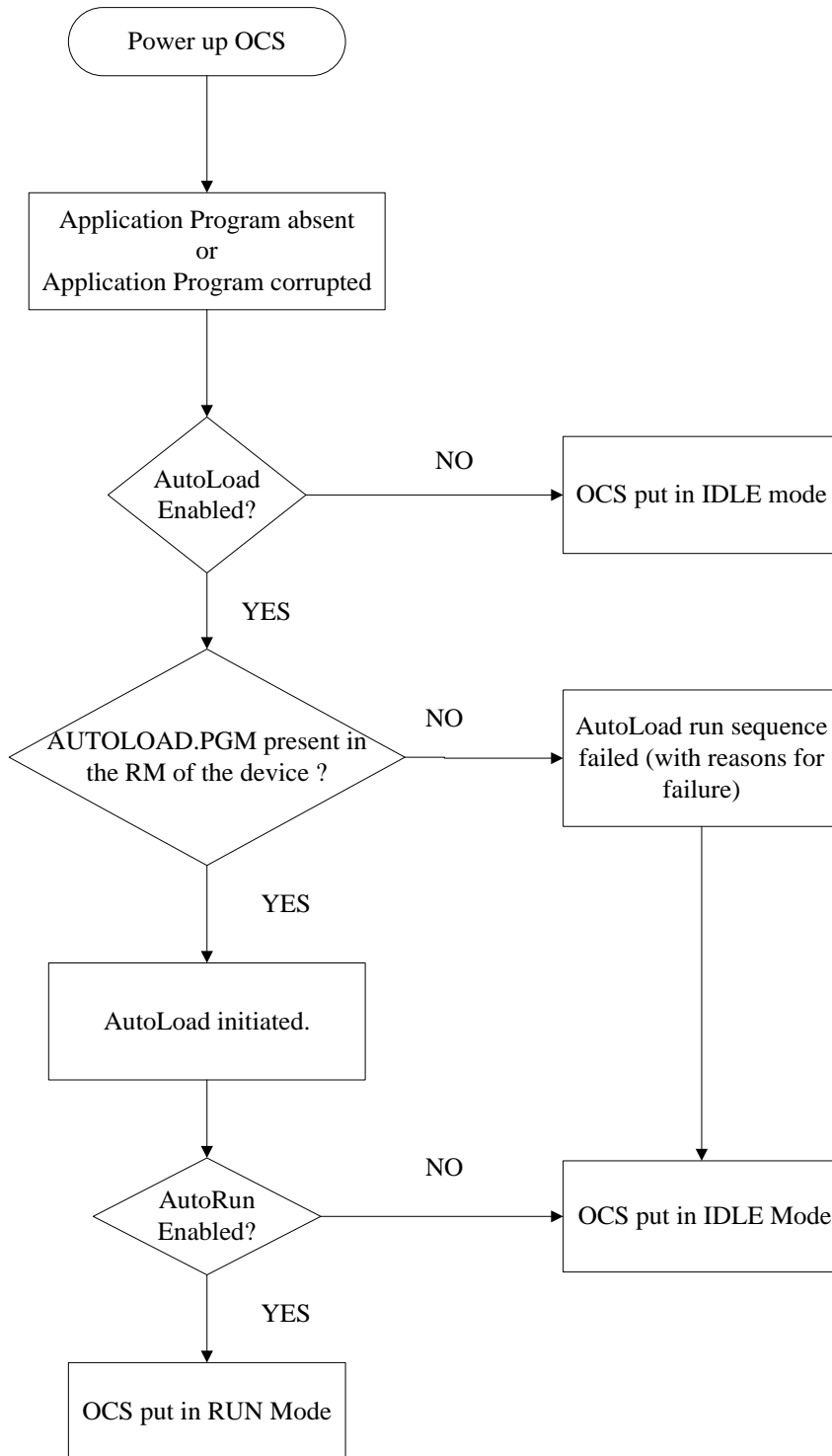
Figure 14.8 – Flow Chart for AutoLoad

14.5   AutoRun

This system menu option, when enabled (YES), allows the user to automatically place the OCS into RUN mode after the AutoLoad operation or automatic Restore Data operation.

When the AutoRun setting is disabled (NO), the OCS remains in the IDLE mode after a Restore Data or AutoLoad operation.

%SR164.5 can be set by putting the system into RUN mode automatically, once an AutoLoad has been performed or an Automatic Restore has occurred.

If for any reason the AutoLoad-Run (Loading the AUTOLOAD.PGM automatically and OCS put in RUN mode) sequence does not succeed, a pop-up message box saying "AUTO-LOAD-RUN SEQUENCE FAILED" will be displayed. It will also show the reason for its failure. On acknowledging this message box the AutoLoad-Run sequence will be terminated, controller will return to the first user-screen and will be placed in IDLE mode.

```
Enable AutoRun     No

(******CAUTION******)
( Auto Enters RUN   )
( after AutoLoad    )
( or Battery Fail   )
```

Figure 14.9 – AutoRun Menu

| Enable AutoRun | **No** = OCS will be in IDLE mode after AutoLoad or Automatic Restore. |
| | **Yes** = OCS will automatically be placed into RUN mode after AutoLoad or Automatic Restore. |

"Enable AutoLoad" displays the following options:

```
Enable AutoLoad    No

( AutoLoad from     )
( Removable Media's )
( AUTOLOAD.PGM file )
( when triggered    )
```

| Enable AutoLoad | **No** = Does not load AUTOLOAD.PGM automatically when application program is absent or corrupted. |
| | **Yes** = Loads AUTOLOAD.PGM file automatically from Removable Media when application program is absent or corrupted. |

CHAPTER 15: CLONE UNIT

15.1   Overview

The 'Clone Unit' feature allows the user to "clone" the OCS of the exact same model. This feature "clones" application program and unit settings stored in Battery backed RAM of an OCS into the RM (refer Removable Media, Chapter 8, for details on using RM). It can then be used to clone a different OCS (exact same model).

This feature can be used for:

- Replacing an OCS by another unit of the same model.
- Duplicating or "clone" units without a PC.

15.2   Clone

User must perform the following sequence of action to Clone a unit:

1. The 'Clone Unit' can be accessed by going to the 'System Menu' of the OCS. A new menu "Clone Unit" has been added at the end of the main system menu as shown below:
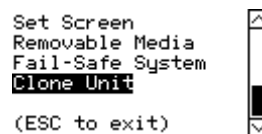
Figure 15.1 – System Menu

2. Selecting "Clone Unit" menu will open the following screen:
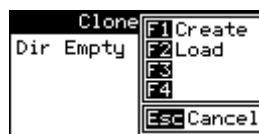
Figure 15.2 – Clone Unit Menu before Cloning

NOTE: In the above Figure 15.2, F3 and F4 are inactive in the clone Unit.

Make/Create Clone option enables the user to duplicate / Clone an application file, all unit settings and all register values from Battery Backed RAM.

Selecting Make Clone brings up the screen below:
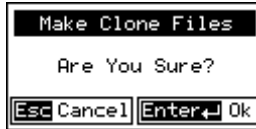
Figure 15.3 – Clone Unit Confirm Screen

After confirmation, the OCS will create two new files in the root directory of the Removable Media Drive as shown below:

AUTOLOAD.PGM	Application file
CLONE.DAT	File having all unit settings and register values from Battery Backed RAM
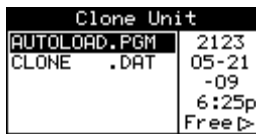
Figure 15.4 – Clone Unit Files

NOTE: Make/Create clone operation automatically includes the security in AUTOLOAD.PGM file for security enabled files.

3. Once the cloning is successful, the OCS gives a message as below:

Figure 15.5 – Cloning Status

Make/Create clone can also be triggered by setting %SR164.9 bit to "1" from Ladder program or graphics. Once the operation is completed, this bit is made zero (0) by the firmware. When Make Clone operation is triggered by this SR bit, it does not ask the user for confirmation to make the clone. The success / failure of the operation is also not notified on screen to the user.

In case of failure of "Make Clone" operation, %SR164.11 bit is set to "1" by the firmware and never reset.

NOTE: Backup of registers in Flash memory is not performed by the Clone Feature. If user desires, backup should be done as explained in Chapter 14 (Fail – Safe System).

15.3 Load Clone

This option loads the application, all unit settings, and register values from Removable Media to the battery-backed RAM (regardless of AutoLoad settings), and then resets the OCS for the settings to take effect.

User must perform the following to Load the Clone:

1. Select "Clone Unit" from main system menu of OCS as shown below:
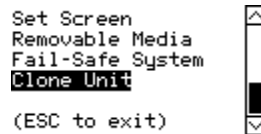
Figure 15.6 – System Menu

2. Selecting "Clone Unit" menu will open the following menu screen. Select "Load Clone".
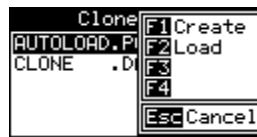
Figure 15.7 – Clone Unit Menu after Cloning

3. User must confirm Load Clone as shown below:
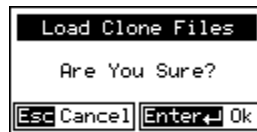
Figure 15.8 – Load Clone Confirm Screen

4. After confirmation, all unit settings and register values will be loaded from the Removable media to the Battery backed RAM (Regardless of AutoLoad settings) and then the OCS resets at which stage the settings take effect.

NOTE: For security enabled files, Load Clone asks for password validation before loading the application.

Load Clone can also be triggered by setting %SR164.10 bit to "1" from Ladder program or graphics. Once the operation is completed, this bit is made zero (0) by the firmware. When the Load Clone operation is triggered by this SR bit, it does not ask the user for confirmation to load the clone. The success / failure of the operation is not notified on the screen to the user. In case of failure of the Load Clone operation, %SR164.12 bit is set to "1" by the firmware and never reset.

CHAPTER 16: MAINTENANCE

16.1   Firmware Updates

The X2 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 should only be performed when the equipment being controlled by the X2 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 or USB.
2. Make sure your application is available on your PC or upload the application.
3. Make sure the machinery connected to the X2 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 X2 system to an operation mode.

16.2   Backup Battery

The X2 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 X2 should last 7 to 10 years. Higher operating temperatures or variations in batteries may reduce this time.

16.3   Battery Replacement

If the battery is 7 to 10 years old, it is recommended that it be replaced as preventative maintenance.

WARNING: Lithium Batteries may explode or catch fire if mistreated.
Do not recharge, disassemble, heat above 100°C (212°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.

WARNING: EXPLOSION HAZARD—BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

The X2 uses a CR2450 (Part No. HE-BAT14) coin lithium battery produced by a variety of manufacturers.

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 X2 unit including I/O power.
3. Remove all connectors, and then use a flat head screwdriver to press and release the four (4) clips. Remove the back cover.
4. Remove the old battery. It may require a small flat blade screwdriver to lift it from the holder.
5. Dispose of the battery properly; see the above warning on disposal regulations.
6. 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.
7. Place the back cover over the unit and gently press each corner evenly in order to snap the clips back into place.
8. 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 .

CHAPTER 17: MODBUS COMMUNICATIONS

17.1 Modbus Overview

For complete Modbus instructions, please refer to the Help file in Cscape.

Modbus (serial) is a popular, de-facto standard protocol that allows industrial devices from multiple manufacturers to easily share data in real-time. For Modbus serial communications, the X2 can act as either a Master or a Slave.

Modbus protocol (serial) allows for one master and multiple slaves. The master always initiates the conversation by sending a request to a particular slave. Only the addressed slave will send a response when the request is completed. Should the slave be unable to complete the request, it returns the appropriate error response. Should the slave be unable to respond, the master's timeout timer expires to provide an indication of **No Response**.

17.2 Modbus Slave Overview

For complete Modbus Slave instructions, please refer to the Help file in Cscape.

The Modbus slave function block, when used with the appropriate Modem and/or Open function blocks, allows the primary serial port on the controller to act as a Modbus slave. The Modbus function supports both ASCII and RTU modes of operation across a range of baud rates and protocol frames. Also supported is port activity status, an inactivity timer, support for call-on exception, and support for store and forward (repeater) operation for radio modems.

Section 17.5 describes the supported Modbus Commands as well as the Modbus Map for X2 References (%R, %M, etc.).

17.3 Modbus Master Overview

For complete Modbus Master instructions, please refer to the Help file in Cscape.

When acting as a Modbus master, there are two primary mechanisms used by the X2 to allow the user to specify the data to be read/written from/to the slaves.

Modbus Master Function Block—This is for serial only. This is an advanced feature that should only be used in rare occasions.

Protocol Config—The Protocol Config is configured in the Hardware Configuration dialog box in Cscape (serial) – See Section 17.5. This is the preferred method in most applications.

After the protocol has been selected from the dropdown menu, the **Network**, **Devices**, and **Scan List** become available. The Protocol Config is configured on three different levels:

- **Network**—Parameters, such as the polling rate of the data scan, are specified along with timeout values, retry, and re-acquisition settings. Serial configuration, baud rate, parity, etc. are also set here.
- **Devices**—For every slave to be polled, configuration details are added in the Devices dialog box. This includes Slave ID (serial). Under Device Type, the Modbus addressing style matching that specified in the slave's user documentation may be selected. For instance, some slaves specify Modbus addresses (i.e. 40,001), and others specify offsets (i.e. 0000).
  - **Hex or Decimal**—Some specify addresses in hex, and others in decimal. By allowing the user to select the Modbus addressing style for each slave on the network, minimal address conversion is required. Also, if the slave is another Horner product (i.e. another OCS), the "Native Addressing" option can be selected (i.e. %R1, %M17, etc.), and this skips the conversion to Modbus style altogether.
- **Scan List**—This is where the specific Modbus addresses to be read/written from/to each slave are specified. Up to 32 words of data can be read at the same time.
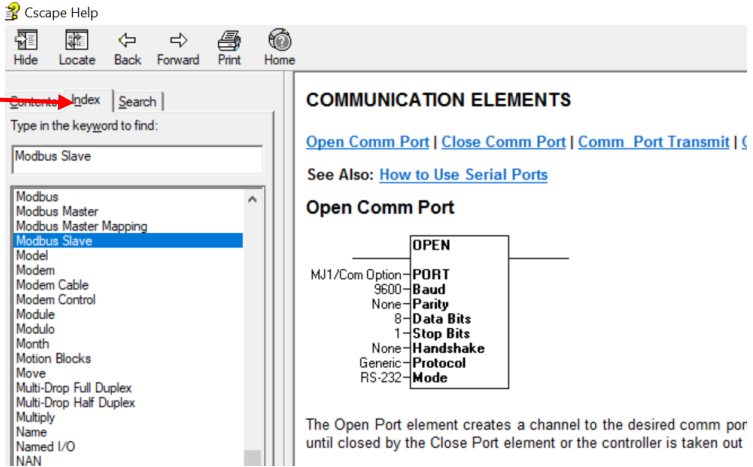
  NOTE: Once configuration has been completed on the Network and Devices level, Modbus data can be directly read/written from graphics objects in the Cscape screen editor. This is available even if the Modbus register is not listed on the scan list.

The above information is just an introduction to the topic. For more detailed information, please consult the Cscape Help file.

17.4 Opening Cscape Help File

After opening the Cscape Help file, select the Index table and search for "Modbus Slave" or "Modbus Master", as shown below.

Select "Index" tab.

17.5   Modbus Addressing Table for X2 Units

To access X2 registers, a Modbus Master must be configured with the appropriate register type and offset. This is usually accomplished with one of two methods:

Method 1: The first method uses **Traditional Modbus References**, in which the high digit represents the register type and the lower digits represent the register offset (starting with Register 1 for each type). Since only four register types can be represented in this manner, X2 Modbus Function Blocks pack several X2 register types into each Modbus register type. Starting addresses of each X2 register type are shown in the **Traditional Modbus Reference** column of the Table 17.1.

Method 2: The second method requires the Modbus Master to be configured with a specific **Modbus Command** and **Modbus Offset.** The supported Modbus commands and the associated offsets are also illustrated in Table 17.1.

X2 Reference	Maximum Range	Traditional Modbus Reference	Modbus Commands	Modbus Offset
%I1	1024	10001	Read Input Status (2)	0
%IG1	256	13001		3000
%S1	266	14001		4000
%K1	10	15001		5000
%Q1	1024	1	Read Coil Status (1) Force Coil (5) Force Multiple Coils (15)	0
%M1	1024	3001		3000
%T1	1024	6001		6000
%QG1	256	9001		9000
%AI1	256	30001	Read Input Register (4)	0
%AIG1	32	33001		3000
%SR1	200	34001		4000
%AQ1	256	40001	Read Holding Register (3) Load Register (6) Load Multiple Registers (16)	0
%R1	2488	40513		0
%R1	2048	43001		3000
%AQG1	32	46001		6000
%R1	5000	410001		10000

Table 17.1 – Modbus Master Mapping

CHAPTER 18: TROUBLESHOOTING / TECHNICAL SUPPORT

Chapter 18 provides commonly requested **troubleshooting information and checklists** for the following topics.

18.1   Connecting to the X2

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.

Local:253 Target:253(R) [no forces]

NOTE: 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.

18.2 Connecting Troubleshooting Checklist (serial port – MJ1 Programming)

1. Controller must be powered up.
2. Ensure that the correct COM port is selected in Cscape. **Tools → Applications Settings → Communications** .
3. Ensure that a cable with proper pinout is being used between PC and controller port MJ1.
4. 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.
5. Successful communications with USB-to-serial adapters vary. If in doubt, Horner APG offers a USB to serial adapter. Part numbers HE-XCK and HE-CPK.

18.3 Connecting Troubleshooting Checklist (USB Port - Mini B Programming)

1. Controller must be powered up.
2. Ensure that the correct COM port is selected in Cscape. **Tools → Applications Settings → Communications**.
3. Be sure that the USB cable is connected between the PC and the controller. Check Windows Device Manager to ensure that the USB driver is properly installed and to verity the port number.

18.4 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 7 for full details on the System Menu diagnostic capabilities.

18.5   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.

18.6   CsCAN Network

For complete information on setting up a CsCAN network, refer to CAN Networks manual (MAN0799) by visiting our website 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 7 for full details on the System Menu.

18.7   CsCAN Network Troubleshooting Checklist

1. Use the proper Belden wire type or equivalent for the network as specified in MAN0799.
2. The X2 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 Ω (or 120 Ω) resistors at each end of the network. The resistors should be placed across the CAN_HI and CAN_LO terminals. The X2 contains a software selectable internal CAN termination resistor. Please see the CAN details for additional information.
5. Measure the resistance between CAN_HI and CAN_LO. If the network is properly wired and terminated there should be around 60 Ω.
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 6 m (20'). 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.

18.8 Basic Troubleshooting

Description	Action
X2 does not read media card.	The media card should be formatted with the 2.
X2 will not download project file.	Make sure the project file is saved as a .pgm file and not a .csp file.

18.9 Technical Support Contacts

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

North America:
Tel: (317) 916-4274
     (877) 665-5666
Fax: (317) 639-4279
Website: https://hornerautomation.com
Email: techsppt@heapg.com

Europe:
Tel: (+) 353-21-4321-266
Fax: (+353)-21-4321826
Website: www.horner-apg.com
Email: technical.support@horner-apg.com

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