

# X2 OCS User Manual HE-X2A, HE-X2R

MAN1130\_13\_EN\_X2\_UM



HG-470

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

## PREFACE

This manual explains how to use the X2 OCS.

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# Safety and Compliance



## Chapter 1: Safety and Compliance

### 1.1: Warnings

When found on the product, the following symbols specify:

**WARNING:**  Consult user documentation.

**WARNING:**  Electrical Shock Hazard.

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

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

1. To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.
2. 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.
3. Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.
4. In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.
5. 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.

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

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

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

**WARNING:** If the equipment is used in a manner not specified by Horner APG, the protection provided by the equipment may be impaired.

**NOTE:** All applicable codes and standards must be followed in the installation of this product.

**NOTE:** For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG, or larger.

**NOTE:** See "Electrical Installation" for more details.

## 1.2: FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

## 1.3: Safety Precautions

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

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

1. Connect the safety (earth) ground on the power connector first before making any other connections.
2. When connecting to the electric circuits or pulse-initiating equipment, open their related breakers.
3. Do NOT make connection to live power lines.
4. Make connections to the module first; then connect to the circuit to be monitored.
5. Route power wires in a safe manner in accordance with good practice and local codes.
6. Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
7. Ensure hands, shoes, and floor are dry before making any connection to a power line.
8. Make sure the unit is turned OFF before making connection to terminals.
9. Make sure all circuits are de-energized before making connections.
10. Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.
11. Use copper conductors in Field Wiring only, 60/75°C.
12. Use caution when connecting controllers to PCs via serial or USB. PCs, especially laptops may use "floating power supplies" that are ungrounded. This could cause a damaging voltage potential between the laptop and controller. Ensure the controller and laptop are grounded for maximum protection. Consider using a USB isolator due to voltage potential differences as a preventative measure.

# Intro to the X2



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# Chapter 2: Intro to the X2

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## 2.1: Visual Overview

1. Keypad
2. High Capacity microSD slot
3. RS232/RS485 Serial Port
4. CANPort (Via RJ45)
5. USB Mini-B Port
6. Analog I/O
7. DC Inputs
8. DC Outputs
9. DC Power



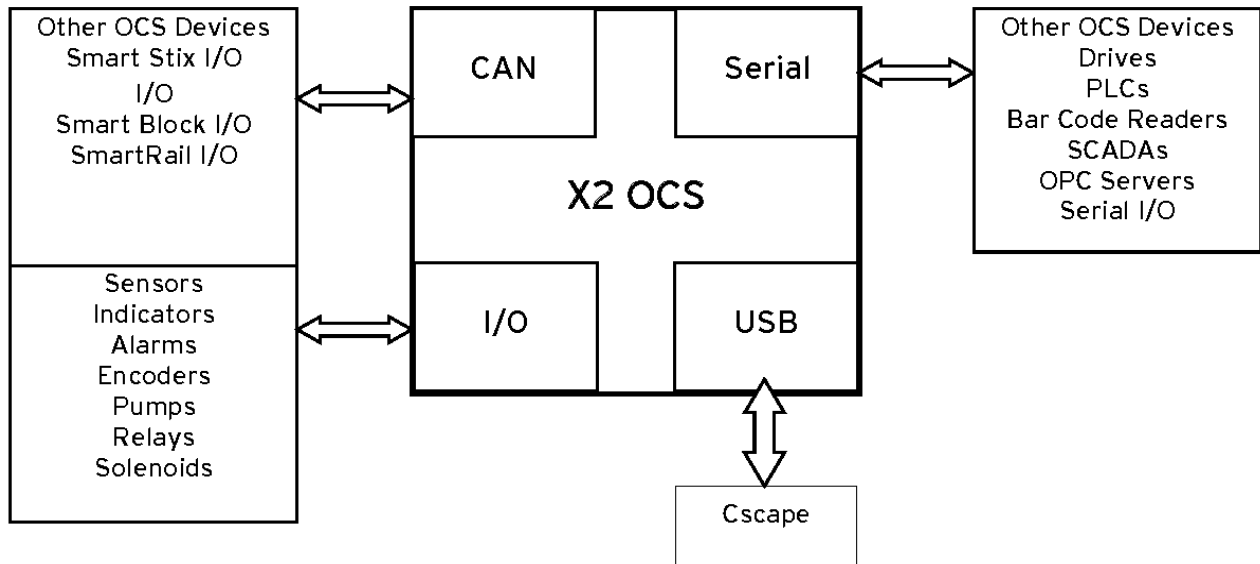
## 2.2: Where to find more information for the X2 OCS

**Datasheet** - The datasheet is the first documents to refer to for key information related to specific models. (A basic datasheet is provided in the box with the unit.) Find **MAN1131** via the [Documentation Search](#) page on the Horner website.

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## 2.3: Connectivity to the X2

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.



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Connectivity			
CAN	I/O	USB	Serial
Other OCS Devices	Sensors	Cscape	Other OCS Devices
SmartStix I/O	Indicators		Drives
SmartRail I/O	Alarms		PLCs
OPC	Encoders		Printers
	Pumps		SCADA
	Relays		OPC Server
	Solenoids		Portal
			I/O Devices

## 2.4: Features of X2 OCS

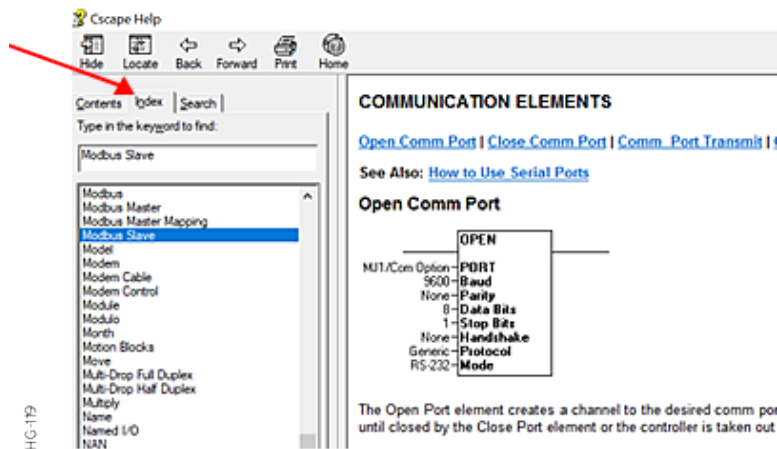
The X2 OCSs are all-in-one industrial control devices. They combine control, user interface, I/O and networking into a single, integrated package.

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 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

## 2.5: Cscape Help File

The Cscape Help file has more information than the scope of this user manual. After opening the Cscape Help file, either use the Contest, Index or Search tabs to located information.



# Mechanical Installation



## Chapter 3: Mechanical Installation

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**NOTE:** Refer to **MAN1131** via the [Documentation Search](#) for more details.

### 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 insertion. Remove the microSD 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 the Panel Cutout section. 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 tighten each screw so the clip is held in place.

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

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). 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.

### 3.3: Mounting Clip Locations



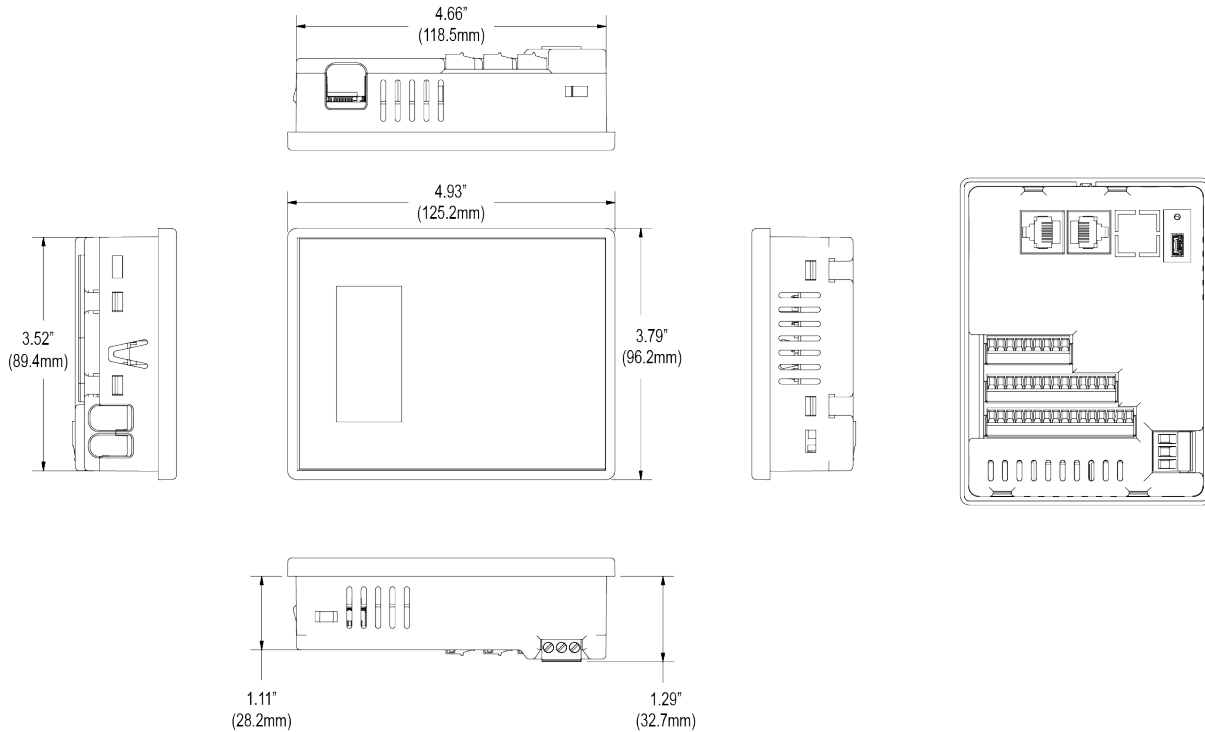
#### 3.3.1: X2 OCS Mounting Orientation



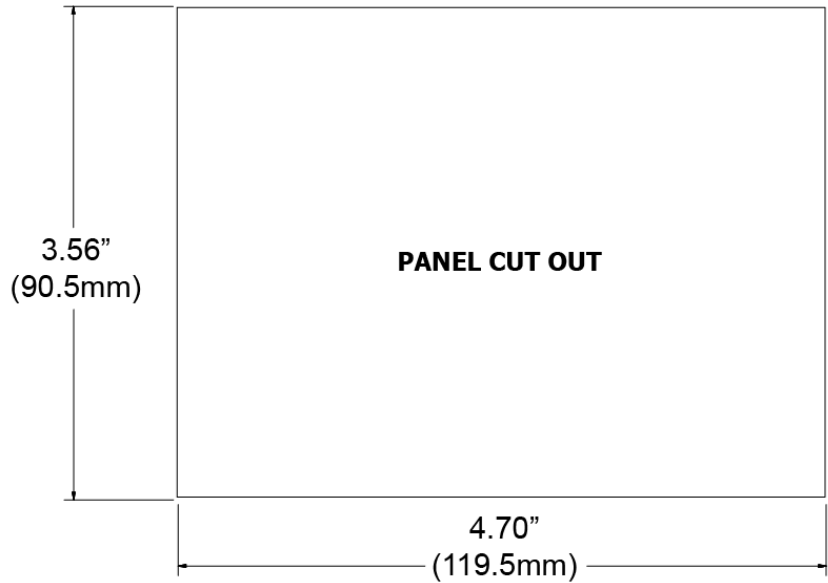
**NOTE: For panel or DIN rail mounting-** The orientation shown above provides for optimum readability of the screen and ease of use of the keypad.

### 3.4: Dimensions

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



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**Panel Tolerance: +0.5mm /-0mm**

### 3.5: Installation Procedure

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D; Class II, Division 2 Groups F and G; and Class III Hazardous Locations or Non-Hazardous Locations only.

The X2 utilizes a clip installation method to ensure a robust and watertight seal to the enclosure. Follow the steps below for the proper installation and operation of the unit.

Use the following steps to correctly install and operate the unit.

1. Carefully locate an appropriate place to mount the X2. Be sure to leave enough room at the top of the unit for insertion and removal of the microSD™ card.
2. Carefully cut the host panel per the diagram, creating a 90.5mm x 119.5mm +0.5mm / -0mm opening into which the X2 is to be installed. 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/sharp edges and ensure the panel is not warped in the cutting process.
4. Install and tighten the four mounting clips (provided in the box) until the gasket forms a tight seal.

**NOTE: For standard composite mounting clips (included with product), use a torque rating of 2-3 in-lbs (0.23-0.34Nm). For optional metal mounting clips, use a torque rating of 4-8 in-lbs (0.45-0.90 Nm).**

5. Connect communications cables to the serial port, USB ports, and CAN port as required.

### 3.6: Factors Affecting Panel Layout Design and Clearances

**WARNING:** It is important to follow the requirements of the panel manufacture and to follow all applicable electrical codes and standards.

The designer of a panel layout must assess the requirements of a particular system and to consider the following design factors.

#### 3.6.1: Clearance/Adequate Space

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

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)
<b>If more than one device installed in panel box (or on door):</b> Minimum Distance between bases of each device	4" (101.60mm) between bases of each device
<b>When door is closed:</b> Minimum distance between device and closed door (Be sure to allow enough depth for the OCS.)	2" (50.80mm)

#### 3.6.2: Grounding

**Panel Box:** The panel box must 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.

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

### 3.6.3: 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.

### 3.6.4: 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 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”.

### 3.6.5: Shock and Vibration

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

### 3.6.6: Panel Layout Design and Clearance Checklist

The following list provides highlights of panel layout design factors:

- Meets the electrical code and applicable standards for proper grounding, etc.?
- Meets the panel manufacturer’s requirements for grounding, etc.?
- Is the panel box properly connected to earth ground? Is the panel door properly grounded? Has the appropriate procedure been followed to properly ground the devices in the panel box and on the panel door?
- Are minimum clearance requirements met? Can the panel door be easily opened and closed? Is there adequate space between device bases as well as the sides of the panel and wiring ducts?
- Is the panel box deep enough to accommodate the controller?
- Is there adequate ventilation? Is the ambient temperature range maintained? Are cooling or heating devices required?
- Are noise suppression devices or isolation transformers required? Is there adequate distance between the base of the controller and noisy devices such as relays or motor starters? Ensure that power and signal wires are not routed in the same conduit.
- Are there other requirements that impact the particular system, which need to be considered?

# Electrical Installation



# Chapter 4: Electrical Installation

4.1: Ground Specifications .....	22
4.2: How to Test for Good Ground .....	22
4.3: Primary Power Port .....	23

**NOTE:** The datasheet is the first document to refer to for model-specific information. Refer to the [Documentation Search](#) on the Horner website.

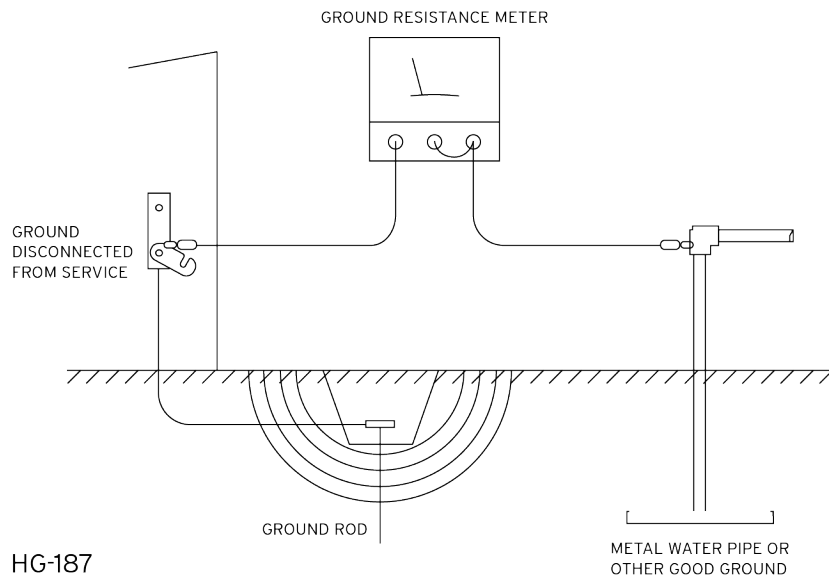
## 4.1: Ground Specifications

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

**Grounding Definition** - 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: How to Test for Good Ground

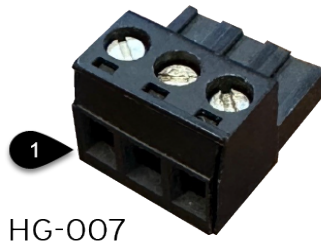
In order to test ground resistance, a Ground Resistance Tester must be used. A typical Ground Resistance Meter Kit contains a meter, two or three wire leads, and two ground rods. Instructions are supplied for either a two-point or a three-point ground test. The figure shows a two-point ground connection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



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### 4.3: Primary Power Port

The Primary Power Range is 24VDC  $\pm$  20%.



HG-007

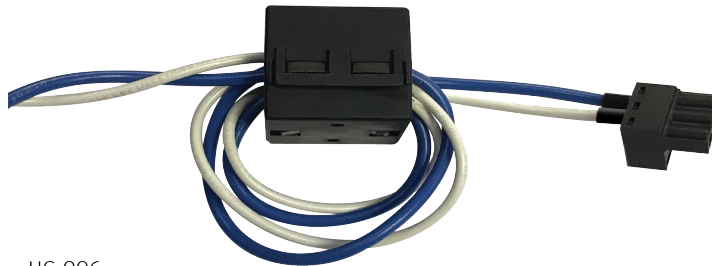
Primary Power Port Pins		
PIN	Signal	Description
1	Ground	Frame Ground
2	DC-	Input Power Supply Ground
3	DC+	Input Power Supply Voltage

#### 4.3.1: DC Input/Frame

- Solid/Stranded Wire: 12-24 AWG ( $\Phi$ 2.5-0.2mm)
- Strip length: 0.28" (7mm)
- Torque, Terminal Hold-Down Screws: 4.5 – 7 in.lbs (0.50 – 0.78 N-m)
- DC- is internally connected to I/O V-, but is isolated from the V- connection of both CAN1 and CAN2 ports. A Class 2 power supply must be used.

#### 4.3.2: Power Up

1. **OPTION:** Attach ferrite core with a minimum of two turns of the DC+ and DC- signals from the DC supply that is powering the controllers.



HG-006

2. Connect to earth ground.
3. Apply recommended power.

**NOTE:** Refer to datasheet for power specifications

# System Settings and Adjustments



## Chapter 5: System Settings

---

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### 5.1: Overview

The X2 OCS has a built-in System Menu, which lets the user view System Settings and makes adjustments. To start the System Menu, press the SYSTEM key (or set %SR3 to 1), which will display the Main Menu. Then use the ↑ and ↓ (Up Arrow or Down Arrow) keys to select a **Main Menu** item and press **Enter** (Return Arrow) to display the item's Sub-Menu.

### 5.2: Navigation and Editing

The System Menu is started by pressing the System key on the X2 OCS. Next press **ESC** to exit the System Menu, or use ↑ and ↓ to select an item and press the **Enter** key 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.

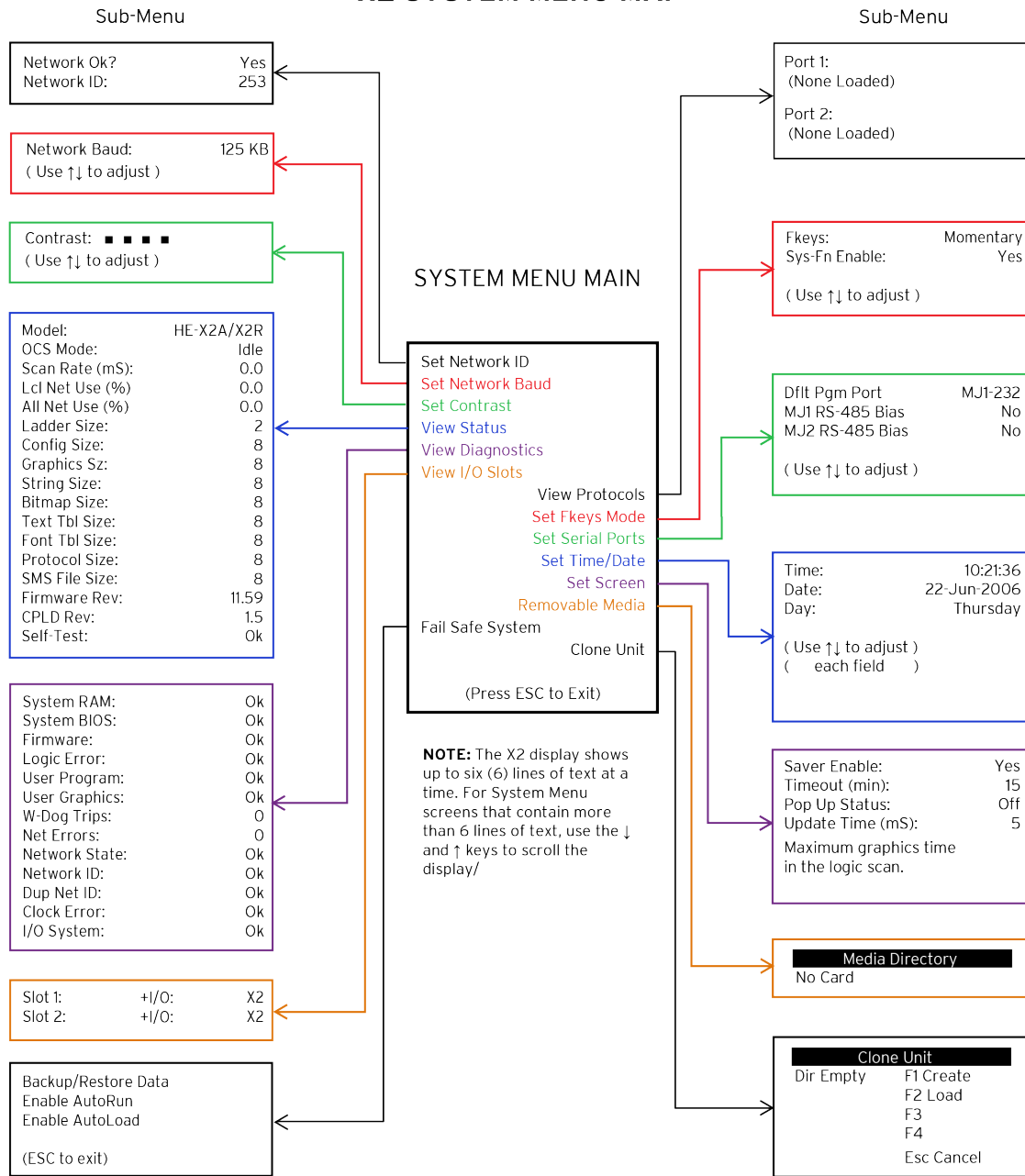
At this point, either press **ESC** to exit the Sub-Menu (returning to the Main Menu) or press **Enter** to edit the highlighted System Setting. If **Enter** is pressed, the System Setting's value will be highlighted, indicating that it is ready to be modified.

When modifying a System Setting's value, use the arrow keys ( ↓ ↑ → ← ), numeric keys, or the touch screen icons to select a new value. The arrow keys are used to edit System Settings that have only 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.

### 5.3: System Menu

#### X2 SYSTEM MENU MAP



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## 5.4: Set Network ID , Network Baud Rate & Contrast

### 5.4.1: Set Networks

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

### 5.4.2: Set Network Baud Rate

The Set Network Baud Sub-Menu for both X2 models displays just one System Setting and it is editable.

Network Baud	<b>125kB</b> = 125 kBd CAN network <b>250kB</b> = 250 kBd CAN network <b>500kB</b> = 500 kBd CAN network <b>1MB</b> = 1 MBd CAN network
--------------	--

### 5.4.3: Set Contrast

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

Contrast: ■ ■ ■ ■	= Current display contrast setting
-------------------	------------------------------------

## 5.5: View Status, Protocols & Diags

### 5.5.1: View Status

The View Status Sub-Menu displays up to 18 System Settings. Only the **Mode** System Setting is editable.

Model	<b>Xxyz</b> = 5 or 6 character model number of this X2 unit <b>x</b> is 1 for models that have a CAN port; <b>0</b> = no CAN port <b>yy</b> indicates the installed I/O module; <b>00</b> = no I/O module <b>z</b> indicates the installed COM module; <b>N</b> = no COM module
Mode	<b>Idle</b> = X2 is in Idle mode <b>DoIO</b> = X2 is in Do I/O mode <b>Run</b> = X2 is in Run mode
Scan Rate(mS)	<b>0.0</b> = X2 is not in Run mode <b>0.1 to 999.9</b> = Average number of mS for each ladder scan
Lcl Net Use %	<b>0.0 to 100.0</b> = CAN network bandwidth % used by this X2 node
All Net Use %	<b>0.0 to 100.0</b> = CAN network bandwidth % used by all nodes
Ladder Size	<b>x</b> (Number of bytes in application ladder program)
Config Size	<b>x</b> (Number of bytes in application I/O configuration)
Graphics Size	<b>x</b> (Number of bytes in application graphic screens)
String Size	<b>x</b> (Number of bytes in application string table)
Bitmap Size	<b>x</b> (Number of bytes in application bitmaps)
Text Tbl Size	<b>x</b> (Number of bytes in application text tables)
Font Tbl Size	<b>x</b> (Number of bytes in application font tables)
Protocol Size	<b>x</b> (Number of bytes in application downloaded protocols)
SMS Msg Size	<b>x</b> (Number of bytes in application SMS protocol configuration)
Firmware Re:	<b>xx.yy</b> Current firmware version
CPLD Rev	<b>x.y</b> Current CPLD (Complex Programmable Logic Device) version
Self-Test	<b>Ok</b> = All power-on self-tests passed <b>Fault</b> = One or more power-on self-tests failed

### 5.5.2: 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 any of them indicate a Fault condition, the X2 OCS will not enter or remain in Run mode, and the problem must be investigated and corrected.

Logic Error	<b>Ok</b> = All executed ladder instructions are legal for loaded firmware <b>Fault</b> = A ladder instruction <u>not</u> supported by firmware was found
User Program	<b>Ok</b> = Ladder program and I/O configuration loaded successfully <b>Fault</b> = 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 not enter or remain in Run mode, and the problem must be investigated and corrected.

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

The last nine System Diagnostics are informational. If any of them indicate a Warning condition, the X2 can still enter and remain in Run mode, but the problem should be investigated and corrected.

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

### 5.5.3: View Protocols

See also: "Protocol Configuration " on page 77

The View Protocols Sub-Menu displays two System Settings, both of which are not editable. As mentioned in Downloadable Serial Communication Protocols section, both the MJ1 (Port 1) and MJ2 (Port 2) serial ports support downloadable protocols. To assign a downloadable protocol to an X2 OCS 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	<b>(None Loaded)</b> or name of the protocol assigned to MJ1
Protocol Version	Blank or version of the protocol assigned to MJ1
Port 2	
Protocol Name	<b>(None Loaded)</b> or name of the protocol assigned to MJ2
Protocol Version	Blank or version of the protocol assigned to MJ2

## 5.6: Set Keys & Serial Ports

### 5.6.1: Set Fkeys Mode

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

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

### 5.6.2: Set Serial Ports

See also: "[Serial Communications](#)" on page 1

The Set Serial Ports Sub-Menu displays three System Settings, all of which are editable, and one optional item.

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

## 5.7: 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.

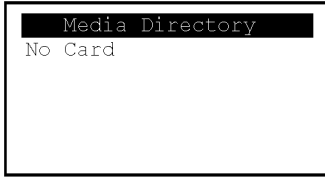
<b>Time:</b>	10:21:36 = Current time (hours:minutes:seconds in 24-hour format)
<b>Date:</b>	22-Jun-2006 = Current date (day-month-year)
<b>Day:</b>	Thursday = Current day of week calculated from the Date setting

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

## 5.8: Removable Media

See also: "Removable Media" on page 1

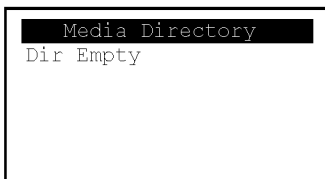
The Removable Media Sub-Menu displays the Removable Media Manager. After selecting Removable Media from the Main Menu, one of four Sub-Menu screens will appear:



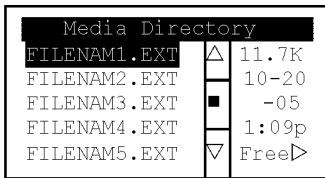
= No microSD card has been installed in the Memory slot



= microSD card is installed, but it is still initializing



= microSD card is installed and initialized, but contains no files



= microSD card is installed and initialized, and it contains

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.

HG-571

Shows up to five files or directory names at a time

- If → is pressed, the number of total and free bytes is displayed. Then, pressing ← returns to the normal file and directory display.
- If a soft key (on either side of the display) is pressed, a pop-up window appears on the right side of the display, showing the function key options as follows:

<b>F1</b> Delete	Delete the highlighted file or directory
<b>F2</b> DelAll	Delete all files and directories
<b>F3</b> Format	Format the microSD card
<b>F4</b> SavPgm	Save application to DEFAULT.PGM
<b>Esc</b> 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.

## 5.9: Fail – Safe System

See also: "Fail-Safe System" on page 105

The Fail-Safe System is a set of features that allow an application to continue running in the event of certain types of "soft" failures. These "soft" failures include **Battery Power Loss** and **Battery-Backed Register RAM** or **Application Flash Corruption** due to, for example, an excessive EMI, Electromagnetic Interference, 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)
HG-567
```

Selecting this option brings up a screen having four operations:]

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

```
Backup/Restore Data
F1 Backup F2 Restore
F3 Clear Backup
Esc Exit
HG-461
```

### 5.9.1: Enable AutoRun

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

```
Enable AutoRun No
(*****CAUTION*****)
( Auto Enters RUN )
( after AutoLoad )
( or Battery Fail )
HG-460
```

Enable AutoRun	<p><b>No</b> = OCS will be in IDLE mode after AutoLoad or Automatic Restore.</p> <p><b>Yes</b> = OCS will automatically be placed into RUN mode after AutoLoad or Automatic Restore.</p>
----------------	--

### 5.9.2: Enable AutoLoad

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

```
Enable AutoLoad No
( AutoLoad from )
( Removable Media's )
( AUTOLOAD.PGM file )
( when triggered )
HG-565
```

Enable AutoLoad	<p><b>No</b> = Does not load AUTOLOAD.PGM automatically when application program is absent or corrupted.</p> <p><b>Yes</b> = Loads AUTOLOAD.PGM file automatically from RM when application program is absent or corrupted.</p>
-----------------	---

## 5.10: Clone Unit

See also: "Clone Unit" on page 101

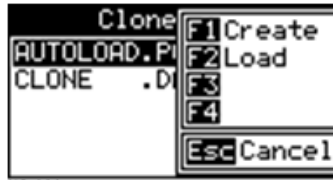
'Clone Unit' feature allows the user to "clone" the OCS of the exact same model. This feature "clones" application program and unit settings stored in battery-backed RAM of an OCS into the RM. Refer to "Removable Media" on page 94 for details on using RM. It can then be used to clone a different OCS (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.

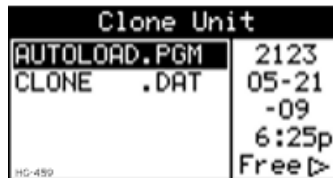
### 5.10.1: Make Clone

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



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Selecting "Create" will open the following screen:

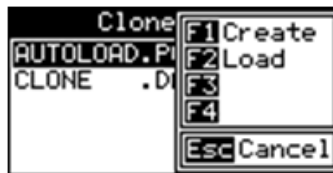


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AUTOLOAD.PGM	Application file
CLONE.DAT	File having all unit settings and register values from battery-backed RAM

### 5.10.2: Load Clone

Selecting "Clone Unit" menu will open the following menu screen. Select "Load".



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# Register Mapping



## Chapter 6: Registers

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### 6.1: Register Definitions

When programming the 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.

Types of Registers	
<b>%AI = Analog Input</b>	16-bit input registers used to gather analog input data such as voltages, temperatures, and speed settings coming from an attached device.
<b>%AQ = Analog Output</b>	16-bit output registers used to send analog information such a voltages, levels or speed settings to an attached device.
<b>%D = Display Bit</b>	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.
<b>%I = Digital Input</b>	Single-bit input registers. Typically, an external switch is connected to the registers.
<b>%K = Key Bit</b>	Single-bit flags used to give the programmer direct access to any front panel keys appearing on a unit.
<b>%M = Retentive Bit</b>	Retentive single-bit registers.
<b>%Q = Digital Output</b>	Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or other physical outputs.
<b>%R = General Purpose Register</b>	Retentive 16-bit registers.
<b>%S = System Bit</b>	Single-bit bit coils predefined for system use.
<b>%SR = System Register</b>	16-bit registers predefined for system use.
<b>%T = Temporary Bit</b>	Non-retentive single-bit registers.

## 6.2: %S Registers

%S registers indicate system status as follows:

%S Registers			
S#	Name	Predefine I/O Name	Notes
%S1	First Scan	FST_SCN	On for 1 scan only each time the program is first run
%S2	Network OK	NET_OK	If on, the Network is OK
%S3	10ms pulse	T_10MS	Cycling pulse that is high for 5ms and low for 5ms
%S4	100ms pulse	T_100MS	Cycling pulse that is high for 50ms and low for 50ms
%S5	1 second pulse	T_1SEC	Cycling pulse that is high for 500ms and low for 500ms
%S6	I/O OK	IO_OK	If on, the I/O system is OK
%S7	Always On	ALW_ON	This bit is always on
%S8	Always OFF	ALW_OFF	This bit is always off
%S9	Pause Scan	PAUSING_SCN	On for at least 1 scan prior to Pause 'n Load
%S10	Resume Scan	RESUMED_SCN	On for 1 scan only after Pause 'n Load is done
%S11	Forcing Present	FORCE	If on, I/O is presently being forced
%S12	Forcing Enabled	FORCE_EN	If on, I/O forcing is been enabled
%S13	Net I/O OK	NET_IO_OK	If on, Network I/O is OK

## 6.3: %SR Registers

%SR registers are special word-length registers that display and/or control system operations in the controller. Not all controllers support all defined system registers.

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

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR1	USER_SCR	User Screen Number *Excludes RCC Units	0 to 1023	Read/Write	Read/Write
%SR2	ALRM_SCR	Alarm Screen Number (0=none) *Excludes RCC Units	0 to 1023	Read Only	Read Only
%SR3	SYS_SCR	System Screen Number 1 = Main System Menu 2= Set Network ID, Network Status, (%SR29) 3= Set Network Baud (%SR30) 4= Set Contrast (%SR32) 5= View OCS Status 6= View OCS Diagnostics 7= View I/O Slots 8= Set Function Key Mode (%SR33) 9= Set Serial Ports (%SR34) 10= Set Time/Date (%SR44-%SR50) 11= Set Beeper (%SR183) 12= Set Screen (%SR185) 13= Removable Media	0 to 24	Read/Write	Read/Write

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
		14= View Protocols 15= IP Address (ETN I/O Board) 16= Fail Safe System 17= Backup / Restore Data 18= Enable AutoRun 19= Enable AutoLoad 20= Clone Unit - 21= Touch Calibration 24= License Details *Excludes RCC Units			
%SR4	SELF_TST	Self-Test Results		Read Only	Read Only
%SR4.1		Self-Test Results – BIOS Error		Read Only	Read Only
%SR4.2		Self-Test Results – Engine Error		Read Only	Read Only
%SR4.3		Self-Test Results – Ladder Error		Read Only	Read Only
%SR4.4		Self-Test Results – RAM Error		Read Only	Read Only
%SR4.5		Self-Test Results – Duplicate ID Error		Read Only	Read Only
%SR4.6		Self-Test Results – Bad ID Error		Read Only	Read Only
%SR4.7		Self-Test Results – I/O Configuration Error		Read Only	Read Only
%SR4.8		Self-Test Results – Bad Network Error		Read Only	Read Only
%SR4.9		Self-Test Results – Bad Logic Error		Read Only	Read Only
%SR4.10		Self-Test Results – Bad Clock Error		Read Only	Read Only
%SR4.11		Self-Test Results – DeviceNet Error		Read Only	Read Only
%SR4.12-.16	Reserved				
%SR5	CS_MODE	Control Station Mode 0= Idle 1= Do I/O 2= Run 3= Online Change *Supported in Linux and XL+ units only	0 - 3	Read Only	Read/Write
%SR6		Average Scan Rate ms ( / 10)		Read Only	Read Only
%SR7		Minimum Scan Rate ms ( / 10)		Read Only	Read Only
%SR8		Maximum Scan Rate ms ( / 10)		Read Only	Read Only
%SR9	TCH_PRESSURE	Current Touch Pressure	0 to 3000	Read Only	Read Only
%SR10	TCH_PRESSURE_TSH	Threshold Touch Pressure	0 to 3000	Read/Write	Read/Write
%SR11-12		Ladder Size (32-Bit DINT)		Read Only	Read Only
%SR13-14		User Text Screen Size (32-Bit DINT) *Excludes RCC Units		Read Only	Read Only
%SR15-16		System Text Screen Size (32-Bit DINT) *Excludes RCC Units		Read Only	Read Only
%SR17-18		I/O Configuration Table Size		Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
		(32-Bit DINT)			
%SR19-20		Network Config Table Size (32-Bit DINT)		Read Only	Read Only
%SR21-22		Security Data Table Size (32-Bit DINT)		Read Only	Read Only
%SR23		Ladder Code CRC		Read Only	Read Only
%SR24		User Text CRC		Read Only	Read Only
%SR25		System Text CRC		Read Only	Read Only
%SR26		I/O Configuration Table CRC		Read Only	Read Only
%SR27		Network Configuration Table CRC		Read Only	Read Only
%SR28		Security Data Table CRC		Read Only	Read Only
%SR29	NET_ID	Network ID		Read Only	Read/Write
		CsCAN Mode	1 to 253		
		DeviceNet Mode	0 to 63		
		CANOpen Mode	1 to 127		
%SR30		Network Baud Rate 0=125KB 1= 250kB 2= 5000KB 3= 1MB 4=50K	0 to 4	Read Only	Read/Write
%SR31		Network Required 0= Network <u>not</u> required 1= Network required 2= Network optimized 3= Network required and optimized	0 to 3	Read Only	Read Only
%SR32		LCD Display Contrast setting *Excludes RCC Units	0 to 255	Read Only	Read/Write
%SR33		Function Key Toggle Mode 0= Momentary 1= Toggle *Excludes RCC Units	0 to 1	Read/Write	Read/Write
%SR34		RS-232 Serial Protocol Mode 0= Firmware Update (RISM) 1= CsCAN 2= Generic (Ladder- Controlled) 3= Modbus RTU 4= Modbus ASCII		Read Only	Read Only
%SR35-36		Unique Serial Number / Hexadecimal LAN1 MAC ID <b>00-E0-XX-XX-XX-XX</b> SR36-High SR35-High SR36-Low SR35-Low		Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR37		Model Number		Read Only	Read Only
%SR38		Engine Version ( /100)		Read Only	Read Only
%SR39		BIOS Rev Number ( / 100)		Read Only	Read Only
%SR40		FPGA Image Rev Number ( / 10)		Read Only	Read Only
%SR41		Vertical Pixel Count *Excludes RCC Units		Read Only	Read Only
%SR42		Horizontal Pixel Count *Excludes RCC Units		Read Only	Read Only
%SR43		Keypad Type *Excludes RCC Units		Read Only	Read Only
%SR44	RTC_SEC	Real-Time-Clock Second	0 to 59	Read Only	Read Only
%SR45	RTC_MIN	Real-Time-Clock Minute	0 to 59	Read Only	Read Only
%SR46	RTC_HOUR	Real-Time-Clock Hour	0 to 23	Read Only	Read Only
%SR47	RTC_DATE	Real-Time-Clock Date	1 to 31	Read Only	Read Only
%SR48	RTC_MON	Real-Time-Clock Month	1 to 12	Read Only	Read Only
%SR49	RTC_YEAR	Real-Time-Clock Year	1996 to 2095	Read Only	Read Only
%SR50	RTC_DAY	Real-Time-Clock Day (1=Sunday)	1 to 7	Read Only	Read Only
%SR51		Network Error Count		Read Only	Read Only
%SR52		Watchdog-Tripped Error Count		Read Only	Read Only
%SR53-54	Reserved				
%SR55.13		Self-Test: Battery Low or Missing		Read Only	Read Only
%SR56	LAST_KEY	Key Currently Pressed No key = 0 (No key pressed since power-up) F1 = 1 F2 = 2 F3 = 3 F4 = 4 F5 = 5 F6 = 6 F7 = 7 F8 = 8 F9 = 9 F10 = 10 F11 = 11 F12 = 12 Enter = 13 + / - = 14 . (dot) = 15 0 = 16 1 = 17 2 = 18	0-255	Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
		3 = 19 4 = 20 5 = 21 6 = 22 7 = 23 8 = 24 9 = 25 System = 26 Escape = 27 Left = 28 Right = 29 Up = 30 Down = 31 Shift = 32 Soft Key 1 = 34 Soft Key 2 = 35 Soft Key 3 = 36 Soft Key 4 = 37 Soft Key 5 = 38 Soft Key 6 = 39 Soft Key 7 = 40 Soft Key 8 = 41 Release = 255 (Keys pressed since power-up but not currently) *Excludes RCC Units			
%SR57		LCD Backlight Dimmer Register 0-100 = 0% to 100% On 100-255 = 100% On *Excludes RCC Units	0 to 255	Read/Write	Read/Write
%57.16		Temporarily disable Screen Saver *Excludes RCC Units		Read/Write	Read/Write
%SR58	USER_LEDS	User LEDs		Read/Write	Read/Write
%SR59		Engine Build Number (Only last three numbers displayed)		Read Only	Read Only
%SR60		Build Option Build Test = 0 Build Beta = 1 Build Product = 2	0 to 2	Read Only	Read Only
%SR61	NUM_IDS	Number of CsCAN Network IDs		Read Only	Read Only
%SR62-100	Reserved				
%SR101.3		WebMI License Details – WebMI server status *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only
%SR101.4		WebMI License Details – WebMI user logged in status *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only
%SR101.8-101.16		WebMI License Details – Number of users *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR102-107	Reserved				
%SR108		WebMI License Details – Number of webpages *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only
%SR109		WebMI License Details – Number of datapoints *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only
%SR110-112		WebMI License Details – Expiry date of WebMI license *XLEe, XLTe, X2, X4, & X7 only		Read Only	Read Only
%SR113-130	Reserved				
%SR131-135		OCS Model: ASCII, 10 characters		Read Only	Read Only
%SR136		Communication Download Timeout		Read Only	Read Only
%SR137		Communication Idle Timeout		Read Only	Read Only
%SR138-148	Reserved				
%SR149-150		Free-running 10kHz count: 1 count = 0.1ms (32-Bit DINT)		Read Only	Read Only
%SR151	Reserved				
%SR152		RS-485 Termination		Read/Write	Read/Write
%SR152.1		MJ2 Termination Enable *Excludes RCC972		Read/Write	Read/Write
%SR152.2		MJ3 Termination Enable - *XL+ Only RS-485 Termination Enable - *X4 & X7 Only		Read/Write	Read/Write
%SR152.3*		MJ1 Termination Enable *XL+, XLE, XLT, RCC2414 Only		Read/Write	Read/Write
%SR152.4*		MJ1 Biasing - *XL+ Only CAN Termination Enable - *X4 & X7 Only		Read/Write	Read/Write
%SR153-163	Reserved				
%SR164		FailSafe / Clone			
%SR164.1		RS-485 Port Biasing #1 (MJ1 or MJ2)		Read/Write	Read/Write
%SR164.2		RS-485 Port Biasing #2 (MJ2 or MJ3)		Read/Write	Read/Write
%SR164.3	AUTO_RESTRD	Indicates Automatic Restore Operation has been performed		Read Only	Read Only
%SR164.4	BCKUP_TAKN	Indicates Backup of Registers has been taken		Read Only	Read Only
%SR164.5	EN_AUTO_RN	Enable AUTORUN – Sets Enable AutoRun to Yes or No		Read/Write	Read/Write
%SR164.6	EN_AUTO_LD	Enable AUTOLOAD – Sets Enable AutoLoad to Yes or No		Read/Write	Read/Write
%SR164.7	STRT_BCKUP	Start Backup trigger bit – Setting TRUE starts backup of all register data		Read/Write	Read/Write
%SR164.8	CLR_BACKUP	Clear Backup trigger bit – Setting TRUE clears backup of all register data (if a backup was done previously)		Read/Write	Read/Write
%SR164.9	MAKE_CLONE	MAKE_CLONE trigger bit = Setting TRUE does a Load Clone (if a media card is present)		Read/Write	Read/Write

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR164.10	LOAD_CLONE	LOAD_CLONE trigger bit – Setting TRUE does a LOAD_CLONE (if a media card is present that contains clone files)		Read/Write	Read/Write
%SR164.11	MK_CLN_FL	Make Clone Fail (This bit goes high when Make/Create Clone fails)		Read/Write	Read/Write
%SR164.12	LD_CLN_FL	Load Clone Fail (This bit goes high when Load Clone fails)		Read/Write	Read/Write
%SR164.14		Set to 1 to restore data manually, and this in turn sets %SR164.15 to 1. Set to 0 to abort restore operation. *RCC Units Only"		Read/Write	Read/Write
%SR164.15		Set to 1 for manual restore of data. Set to 0 to complete the restore operation. *RCC Units Only"		Read/Write	Read/Write
%SR165-166	Reserved				
%SR167		Screen Update Time, Default= 5 *X4 & X7 Only – Default = 10	2 to 50	Read/Write	Read/Write
%SR168-170	Reserved				
%SR171		X-Coordinate Touched		Read Only	Read Only
%SR172		Y-Coordinate Touched		Read Only	Read Only
%SR173		System-Function Disable	0 to 1	Read/Write	Read/Write
%SR174		Removable Media Protect		Read/Write	Read/Write
%SR174.1		Request Media Card be Removed		Read/Write	Read/Write
%SR174.2		Indicates safe to remove Media		Read/Write	Read/Write
%SR175		Removable Media - Status		Read Only	Read Only
%SR176-177		Removable Media Free Space (32-Bit DINT)		Read Only	Read Only
%SR178-179		Removable Media Total Space (32-Bit DINT)		Read Only	Read Only
%SR180	Reserved				
%SR181	ALM_UNACK	Bits 1-16 indicate Unacknowledged in Alarm Groups 1-16		Read Only	Read Only
%SR182	ALM_ACT	Bits 1-16 indicate Active in Alarm Groups 1-16		Read Only	Read Only
%SR183	SYS_BEEP	Beep on Keypress Enable 0= Disabled 1= Enabled	0 to 1	Read/Write	Read/Write
%SR184	USER_BEEP	Internal Beeper 0=OFF 1=ON	0 to 1	Read/Write	Read/Write
%SR185		Screen Saver Enabled 0= Disabled 1= Enabled NOTE: See %SR57.16	0 to 1	Read Only	Read Only
%SR186		Screen Saver Time in minutes (delay)	5 to 1200	Read Only	Read Only
%SR187	NET_USE	Network Usage (Avg)	0 to 1000	Read Only	Read Only
%SR188		Network Usage (Min)	0 to 1000	Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR189		Maximum Net Usage of all units on the CAN network	0 to 1000	Read Only	Read Only
%SR190	NT_TX_AVG	Network TX Usage % ( / 10) (Avg)	0 to 1000	Read Only	Read Only
%SR191		Network TX Usage % ( / 10) (Min)	0 to 1000	Read Only	Read Only
%SR192		Network TX Usage % ( / 10) (Max)	0 to 1000	Read Only	Read Only
<b>EXTENDED SYSTEM REGISTERS</b>					
%SR193	ONLINE_CHG	Online Change			
%SR193.1		TRUE if 2 programs in target FLASH		Read Only	Read Only
%SR193.2		TRUE to switch programs, FALSE when complete		Read Only	Read Only
%SR193.3		TRUE if executing program is temporary test		Read Only	Read Only
%SR193.4		TRUE during last scan of switched-from program		Read Only	Read Only
%SR193.5		TRUE during first scan of switched-to program		Read Only	Read Only
%SR193.6		TRUE to revert to FLASH and delete all RAM; FALSE when complete		Read Only	Read Only
%SR193.9		TRUE if error in temporary program		Read Only	Read Only
%SR194		Battery Charge Temp Low *XL+ Only – Frequency in MHz		Read Only	Read Only
%SR195		Battery Charge Temp High *XL+ Only – in degree centigrade		Read Only	Read Only
%SR196		Charging State NOTE: Refer to MAN1142 for more details on Rechargeable Batteries 0=Waiting 1=Normal Charging 2=Hot Charge 3=Hot Charge 4= Battery Hot 5= Cold Charge 6=Battery Cold 7=No Battery 8= Not Charging (after 8 hours of charging) 9= CPU Hot, not charging 10= Battery voltage <2V, not charging 11= First 2 minutes Initial Wait (Not Charging)	0 to 11	Read Only	Read Only
%SR197		Charging Current Max mA		Read Only	Read Only
%SR198		Battery Voltage is mV		Read Only	Read Only
%SR199	Reserved			Read Only	Read Only

Register	Default I/O Name	Description	Min-Max Values	Program (Read/Write)	Display (Read/Write)
%SR200		InitRD Version ( /100)		Read Only	Read Only
%SR201-205		Linux Kernel version: ASCII, 10 characters		Read Only	Read Only
%SR206- 208	Reserved			Read Only	Read Only
%SR209.3		WebMI Server Status. Bit 3 is ON if server running.		Read Only	Read Only
%SR209.4		WebMI User Logged in Status. Bit 4 is ON if 1 or more users logged in.		Read Only	Read Only
%SR209.9 - 209.16		Number of Users. Shows in upper byte in decimal format.		Read Only	Read Only
%SR210		Time Zone: set in minutes + / - UTC. (Ex: EST is -4 hours = -240 minutes)		Read/Write	Read/Write
%SR211		Daylight Saving: YES = 1 Daylight Saving NO = 0 (If daylight saving is enabled, one hour will be added to the local time).		Read/Write	Read/Write
%SR212		UTC – Seconds		Read Only	Read Only
%SR213		UTC – Minutes		Read Only	Read Only
%SR214		UTC – Hours		Read Only	Read Only
%SR215		UTC – Date		Read Only	Read Only
%SR216		UTC – Month		Read Only	Read Only
%SR217		UTC – Year		Read Only	Read Only
%SR218		Number of Webpages, license detail (XLE/XLT, X2, X4, & X7 use %SR101 & %SR108-112 for WebMI License Details.)		Read Only	Read Only
%SR219		Number of Data Points, license detail. (XLE/XLT, X2, X4, & X7 use %SR101 & %SR108-112 for WebMI License Details)		Read Only	Read Only
%SR220-222		Expiration Date of WebMI License, license detail. (XLE/XLT, X2, X4, & X7 use %SR101 & %SR108-112 for WebMI License Details)		Read Only	Read Only

### 6.3.1: Register Map for X2

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	1-2	1-12
	Relay Outputs	3-8	--
	Reserved	9-16	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

### 6.4: 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			
%AQ3-4		HSC1 Preset		
%AQ5-6		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

## 6.5: PWM Functions Register Map

Register	PWM
%AQ3	--
%AQ4	
%AQ5	--
%AQ6	
%AQ7	PWM1 Duty Cycle (32-bit)
%AQ8	
%AQ9	PWM1 Frequency (32-bit)
%AQ10	
%AQ11	PWM2 Duty Cycle (32-bit)
%AQ12	
%AQ13	PWM2 Frequency (32-bit)
%AQ14	

## 6.6: X2 Resource Limits

Resource	Value
%I	1024
%Q	1024
%AI	256
%AQ	256
%M	1024
%T	1024
%R	5,000
%D	250
%K	10
IDs Per CsCAN Network	64 w/o repeat (253 w/ 3 repeaters)
Keypad	20 Metal Dome Keys
Display	128 x 64 Monochrome LCD
Screen Memory	256kB
User Screens	250
Data Fields Per User Screen	15
Ladder Code	256kB

# General I/O Configuration



# Chapter 7: General I/O Configuration

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## 7.1: 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 "Registers" on page 35.

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

## 7.2: Model and I/O Overview

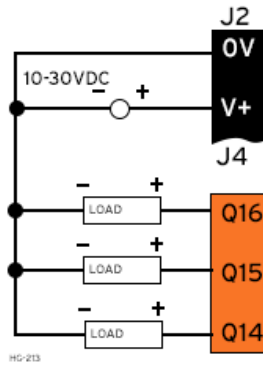
X2 Models	Solid State Digital Outputs	Relay Outputs	Digital Inputs	Analog Inputs	Analog Outputs
HE-X2A	✓		✓	✓	✓
HE-X2R	✓	✓	✓	✓	✓

This table 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. For more details, see the controller datasheet via [Document Search](#).

### 7.3: 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.



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.

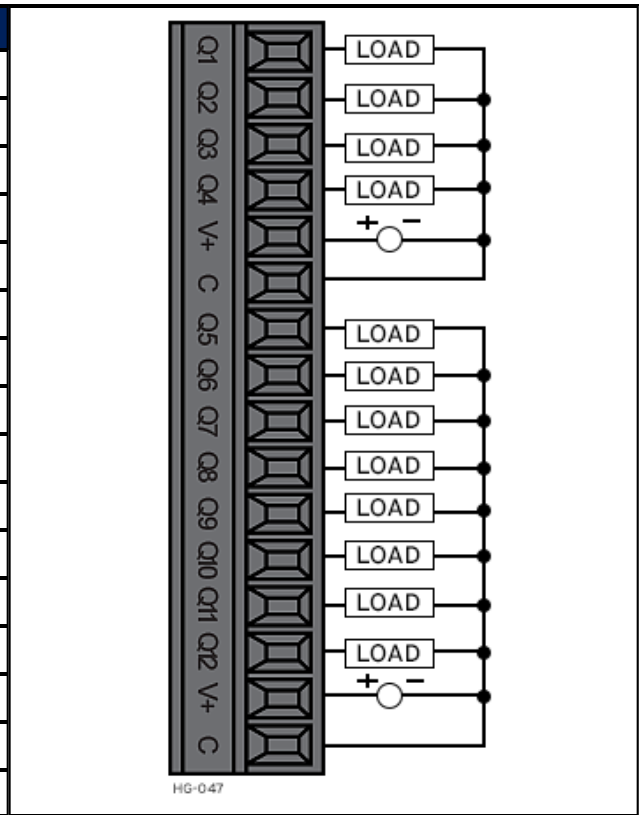
The digital outputs in the X2 are typically controlled via %Q bits in the register mapping. Some of the outputs are designed for high-speed applications and can be used for PWM or frequency output applications. Please see the datasheet and "High Speed I/O" on page 57 for additional information.

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, refer to "Cscape Configuration" on page 1.

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.

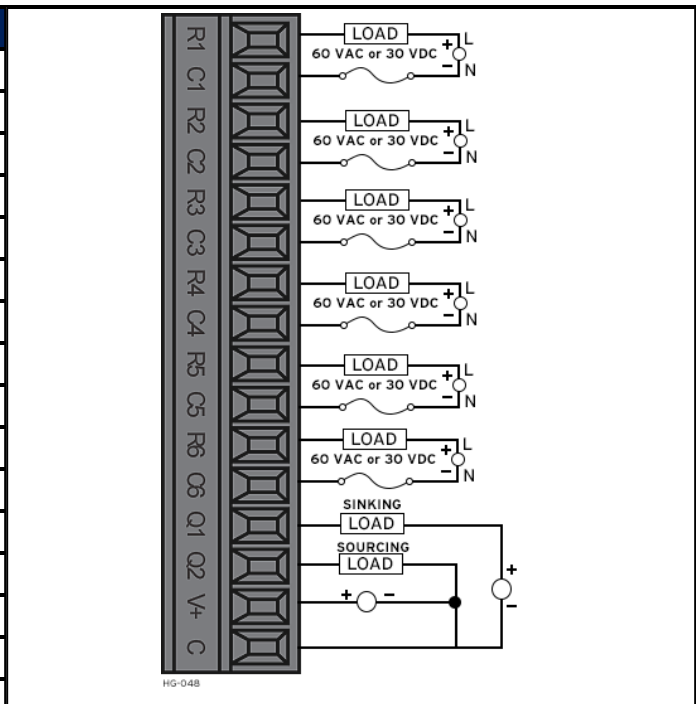
### 7.3.1: J1 Wiring: Model A - Digital Out

Position	Pin	Digital Model
1	Q1 (%Q1)	Dig. Out 1 (PWM)
2	Q2 (%Q2)	Dig. Out 2 (PWM)
3	Q3 (%Q3)	Dig. Out. 3
4	Q4 (%Q4)	Dig. Out. 4
5	V+	External V+
6	C	Common
7	Q5 (%Q5)	Dig Out. 5
8	Q6 (%Q8)	Dig Out. 6
9	Q7 (%Q7)	Dig Out 7
10	Q8 (%Q8)	Dig Out 8
11	Q9 (%Q9)	Dig Out 9
12	Q10 (%Q10)	Dig Out 10
13	Q11 (%Q11)	Dig Out 11
14	Q12 (%Q12)	Dig Out 12
15	V+	External V2+
16	C	Common



### 7.3.2: J1 Wiring: Model R - Relay/Digital Out

Position	Pin	Digital Model
1	R1 (%Q3)	Relay 1 N.O.
2	C1	Relay 1 C
3	R2 (%Q4)	Relay 2 N.O.
4	C2	Relay 2 C
5	R3 (%Q5)	Relay 3 N.O.
6	C3	Relay 3 C
7	R4 (%Q6)	Relay 4 N.O.
8	C4	Relay 4 C
9	R5 (%Q7)	Relay 5 N.O.
10	C5	Relay 5 C
11	R6 (%Q8)	Relay 6 N.O.
12	C6	Relay 6 C
13	Q1 (%Q1)	Output 1
14	Q2 (%Q2)	Output 2
15	V+	External V+
16	C	Common



**NOTE:** Internal 10kΩ resistors between: V+ and Q1; V+ and Q2.

## 7.4: Relay Outputs

Relay outputs are designed to switch loads that typically have high voltage or current requirements or require the isolation that relays provide. Relay outputs are not available on all controllers, see the datasheet.

**NOTE:** The design of the OCS does not require external coil power for the relays to function. The relays will activate anytime the OCS 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 data sheets at the end of this manual for expected relay life.
- **Current/Temperature De-Rating** – Products containing relays often have total current limits based on the ambient temperature of the application. Please see the product data sheet for current / temperature de-rating information for relays.
- **Fusing** – External fusing is generally required to protect the relays, devices and wiring from shorts or overloads.

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

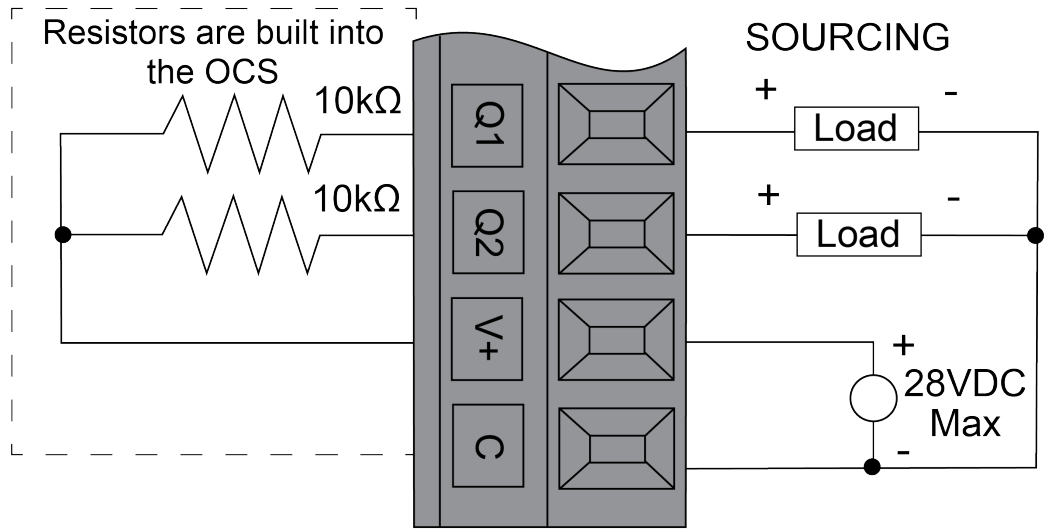
**WARNING:** Connecting high voltage to any I/O pin can cause high voltage to appear at other I/O pins.

**Protection for Inductive Loads** – Inductive loads can cause reverse currents when they 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 120V, V275xx for 220V)

**Output State on Controller Stop** – When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default, relay outputs turn off. For more information on stop state, refer to "Cscape Configuration" on page 1.

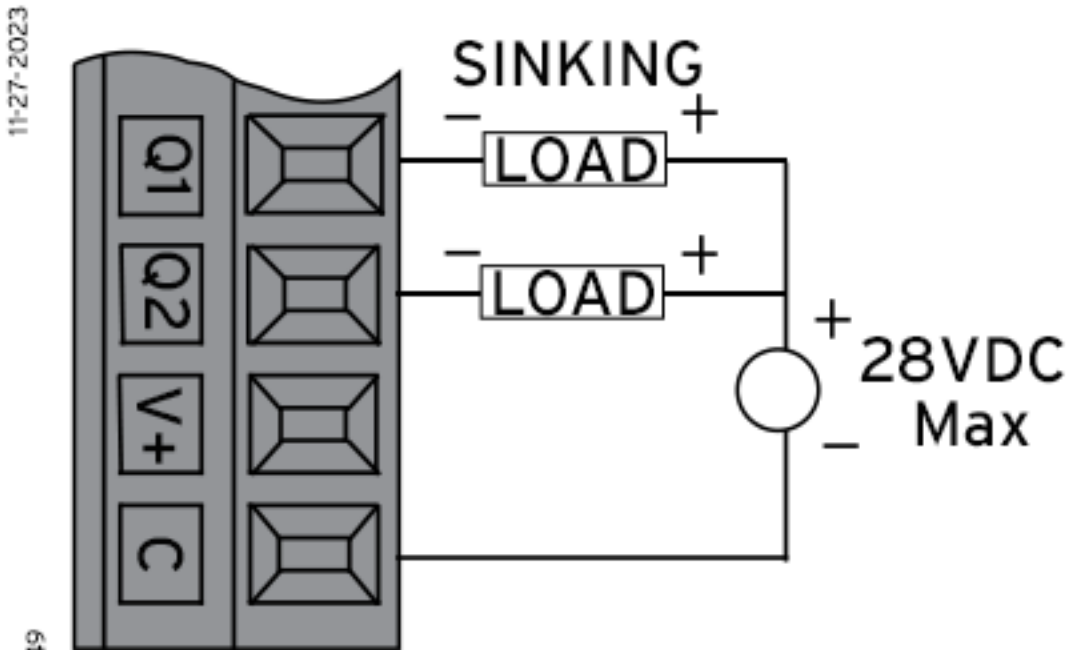
### 7.4.1: Model R: Sinking and Sourcing Outputs



HG-206

**Sourcing:** 2.4mA sourcing @ 24V

**NOTE:** Cscape offers a choice to flip the output by selecting "sourcing" as the output mode. This can come in handy when working with certain devices in this setup. It's important to note that this option doesn't alter the kind of output.



HG-049

**Sinking:** Outputs can sink 500mA

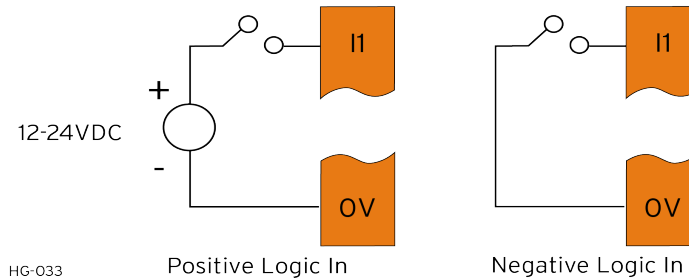
## 7.5: Digital Inputs

**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.

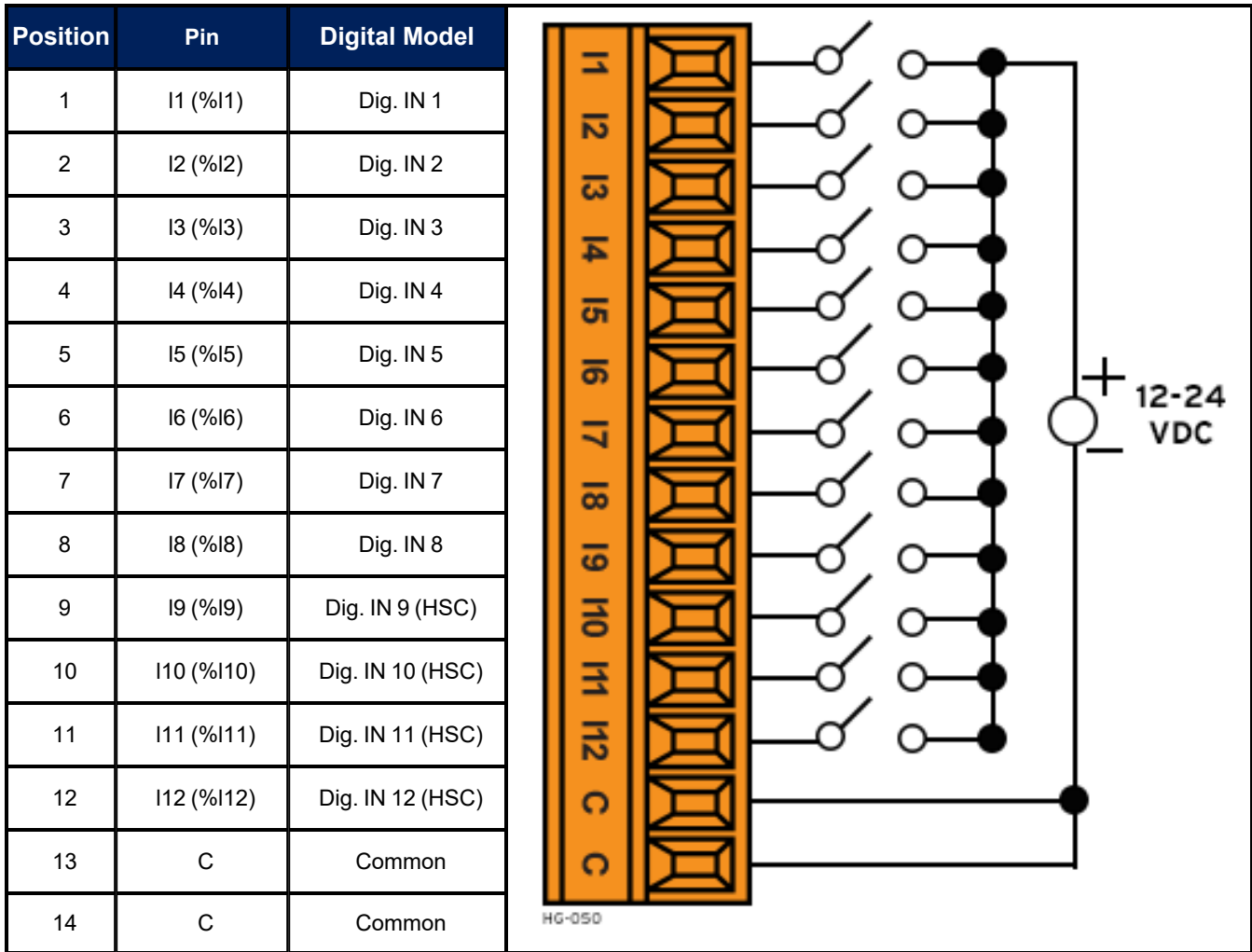
### Positive Logic vs. Negative Logic

The OCS can be wired for positive logic inputs or negative



- In **positive logic mode**, a positive voltage applied to the input will turn the input ON.
- In **negative logic mode**, connecting the input to the I/O ground or zero volts or use connected to a NPN/Sinking digital output will turn the input ON.
- Some of the digital inputs may support high-speed input functions such as counting or frequency measurement.

### 7.5.1: Model R & Model A Digital Input J2 Wiring



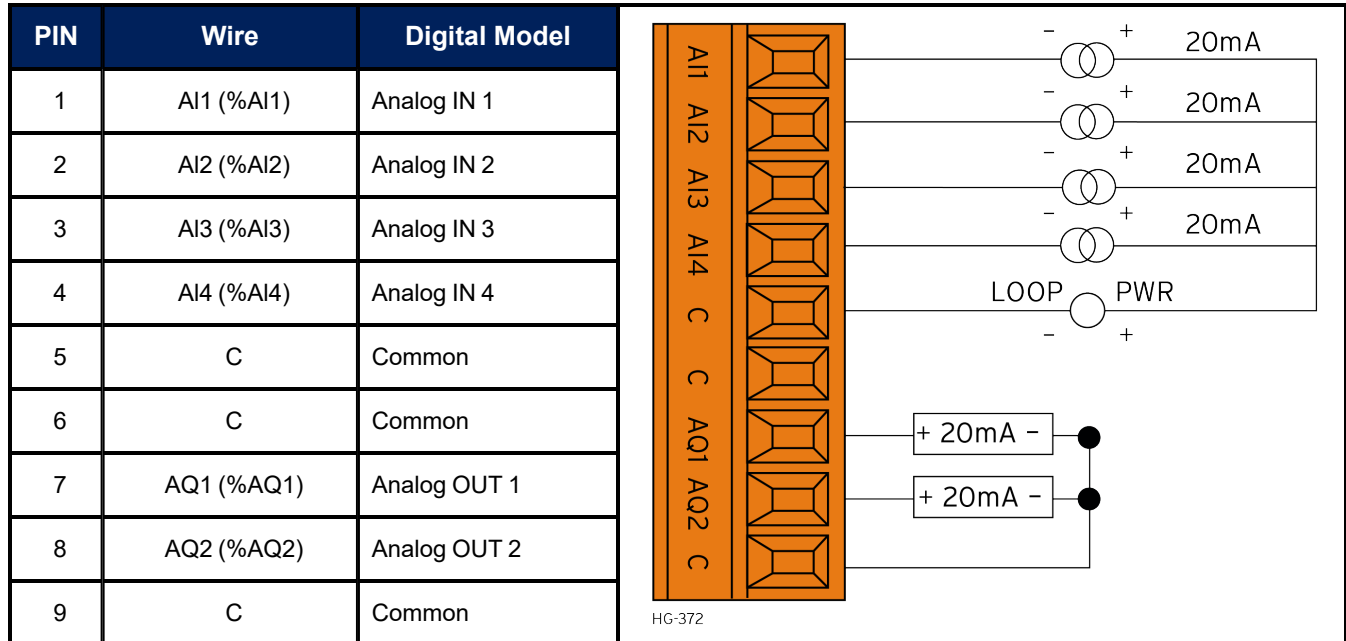
## 7.6: Analog Inputs

The X2 supports 0-20mA or 4-20mA on the analog inputs.

**NOTE:** See the datasheet and the "Cscope Configuration" on page 1 for details on how to use Cscope to configure the digital filtering.

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.

### 7.6.1: Model R & Model A - Analog Input and Output J3 Wiring



## 7.7: Analog Outputs

The X2 supports 4-20mA on the analog outputs.

**NOTE:** See "High Speed I/O" on page 57 for more information or the X2 datasheet.

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 "Cscope Configuration" on page 1.

# High Speed I/O (HSC & PWM)



## Chapter 8: High Speed I/O

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### 8.1: 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 also support Pulse Width Modulation (PWM) Output functions. The HSC functions include frequency, totalizing, pulse width, and quadrature measurement. The PWM functions include traditional PWM (with variable rate and duty) and a stepper (limited functionality) with variable acceleration and deceleration rates.

To determine function availability, refer to the associated model's Specification/Installation sheet (Digital DC Input/Output sections). This chapter describes the operation of these high-level I/O functions. For configuration details of these functions, see "Cscape Configuration" on page 1.

#### Glossary of High Speed I/O Terms

<b>Accumulator</b>	Register used to accumulate or store up a sum or count of many items or events.
<b>Clear</b>	A special function to zero out the value in a specific register. (Not used with Frequency or Period Measurement.)
<b>Disable</b>	A special function to prevent the counter from running.
<b>Encoder</b>	A sensor or transducer for converting rotary motion or position to a series of electronic pulses
<b>FPGA</b>	An integrated, configurable circuit that allows the controller to be programmed to have either two high-speed counters or four high-speed counters.
<b>Frequency Input</b>	The number of times an electromagnetic signal repeats an identical cycle in a unit of time, usually one second.
<b>Latch (stroke)</b>	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.
<b>Marker</b>	Input into the OCS that indicates a particular position. Typically, an encoder has a marker output that represents a specific point in the rotation.
<b>Polarity</b>	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).
<b>Preload (load)</b>	A special function used to trigger loading of a value into a register upon an event. (Not used with Frequency or Period Measurement.)
<b>Quadrature</b>	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.
<b>Totalizer</b>	A counter that sums the total number of cycles applied to its input.

## 8.2: High Speed Counter (HSC) Functions

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 1  $\mu$ s, measured edge transitions must not occur faster than 100  $\mu$ s for accurate measurements. Keep in mind that pulse width measurements utilize both the rising and falling edges of the waveform, thus the pulse width must exist longer than 100  $\mu$ s.

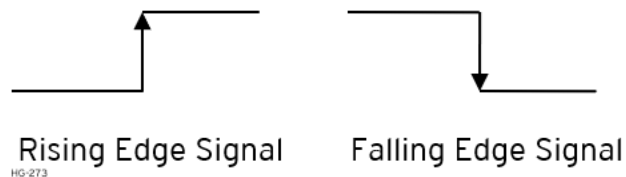
## 8.3: Frequency

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.

## 8.4: 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.



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 this value - 1, the accumulator will reset to zero on the next count. Specifying zero for this value allows the totalizer to count through the full 32-bit range before resetting.
- **Ladder control** - Setting registers %Q17-20 reset HSC1-4 (respectively) with no additional configuration. When these registers are asserted, the associated totalizer accumulator is reset and held at zero (level sensitive).
- **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 100 $\mu$ s.**

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*.

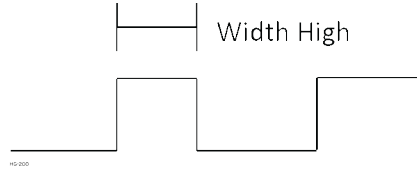
**NOTE:** Q1 and Q2 are PWM function outputs that may be configured independently as one of the following: standard digital output, PWM, HSCx or stepper output.

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

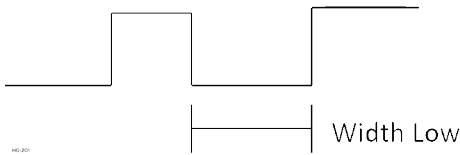
## 8.5: Pulse

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

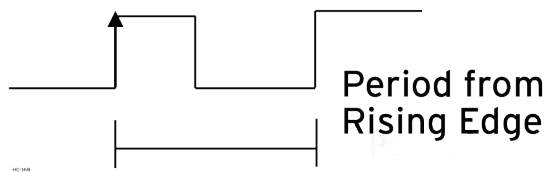
**Width High 1 $\mu$ s Counts** – In this sub-mode the accumulator value will contain the number of 1 $\mu$ s counts the pulse is high.



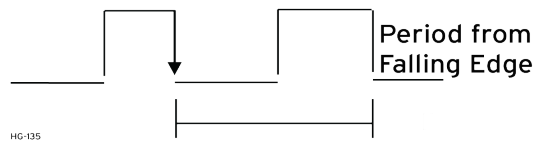
**Width Low 1 $\mu$ s Counts** - In this sub-mode the accumulator value will contain the number of 1 $\mu$ s counts the pulse is low.



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



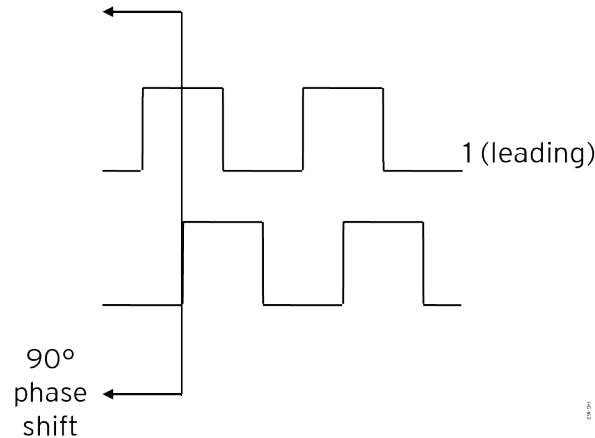
**Period Falling Edges 1 $\mu$ s Counts** – In this sub-mode the period of the input signal is reported in one (1)  $\mu$ s units. The period measurement will start on the falling edge of the input.



## 8.6: 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]**

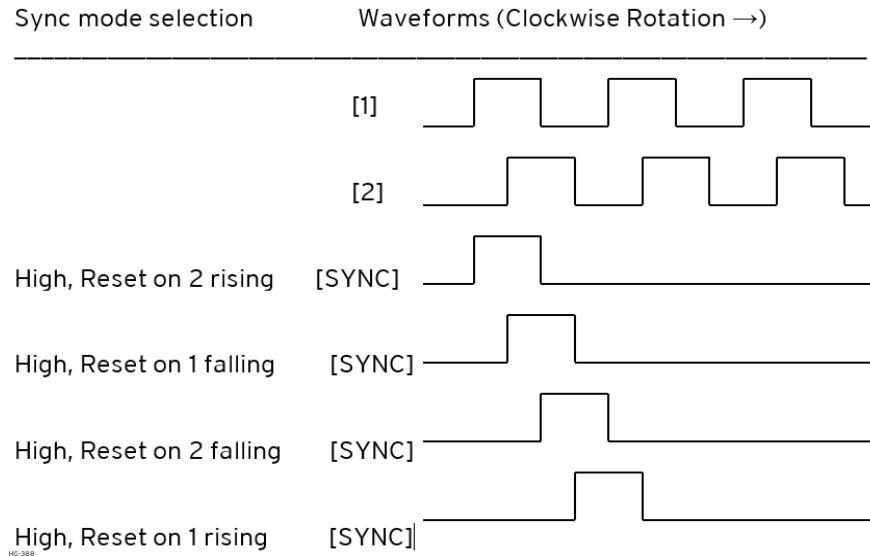
When HSC input 1 and 2 are used for quadrature inputs, an additional choice of marker input becomes available for HSC input 3. The marker input is typically part of an encoder or motion system that signals when a cycle of motion is complete. When the marker input is triggered, the accumulator is reset 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. The figure 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 50µs 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.



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

The accumulator is reset to zero on the specified edge if rotation is clockwise (as shown in figure 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.

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

## 8.7: High Speed Counter (HSC)

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 " on page 58 for more information.

## 8.8: HSC Register Map for X2

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

## 8.9: 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.

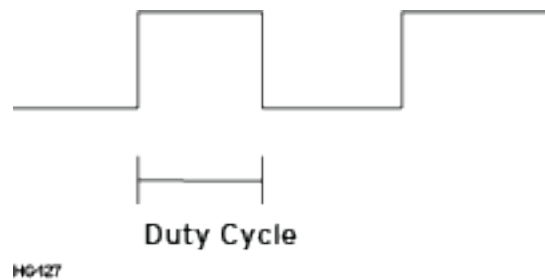
### 8.10: Normal

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

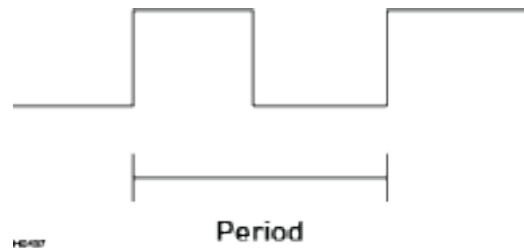
### 8.11: PWM

When either Q1 or Q2 is configured for PWM, the PWM function drives that respective output. Both PWM channels may be individually enabled and can have independent frequency and duty cycles.

**Duty Cycle** – The Duty Cycle is a 32-bit value from 0 to 32,000 indicating the relative duty cycle of the output. For example, a value of 8000 would indicate a 25% duty cycle, a value of 16,000 would indicate a 50% duty cycle. Zero (0) turns the output off, and 32,000 turns the output on.

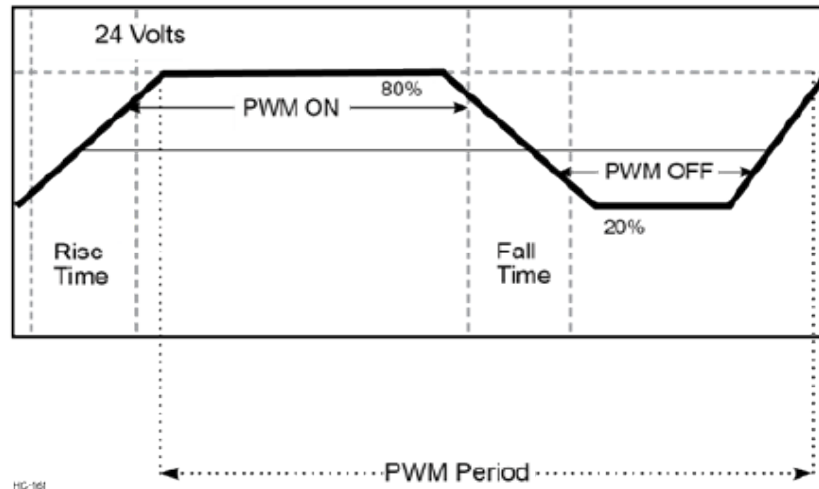


**Frequency** - The Frequency is a 32-bit value indicating the output frequency in Hertz. One over the frequency is the period.



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, period and duty cycle counts. Specifying zero for either the period or duty causes the PWM output to remain low during stop mode.

### 8.11.1: PWM Wave Output Form



HC-161

PWM Output Waveform Table	
Rise Time	150ns Max
Fall Time	150ns Max
PWM Period	Frequency = 1 / Period

### 8.11.2: PWM Functions Register Map

Register	PWM	HSC
%AQ3		HSC1 - Preset Value (AQ3-4)
%AQ4		
%AQ5		HSC2 - Preset Value (AQ5-6)
%AQ6		
%AQ7	PWM1 Duty Cycle (32-bit)	
%AQ8		
%AQ9	PWM1 Duty Cycle (32-bit)	
%AQ10		
%AQ11	PWM2 Duty Cycle (32-bit)	
%AQ12		
%AQ13	PWM2 Duty Cycle (32-bit)	
%AQ14		

### 8.11.3: PWM Examples

<b>Example 1</b>	<b>Duty Cycle</b>	<b>Frequency</b>
To get a 50% Duty Cycle @ 10kHz waveform on <b>PWM1</b> :	Set %AQ7 – 8 = 16,000	Set %AQ9 – 10 = 10,000
<b>Example 2</b>	<b>Duty Cycle</b>	<b>Frequency</b>
To get a 25% Duty Cycle @ 5kHz waveform on <b>PWM2</b> :	Set %AQ11 – 12 = 8,000	Set %AQ13 – 14 = 5,000
<b>Example 3</b>	<b>Duty Cycle</b>	<b>Frequency</b>
To turn PWM 1 output ON all the time:	Set %AQ7 – 8 = 32,000	Set %AQ9 – 10 = Any Value
<b>Example 4</b>	<b>Duty Cycle</b>	<b>Frequency</b>
To turn PWM 1 output OFF all the time:	Set %AQ7 – 8 = 0	Set %AQ9 – 10 = Any Value

# Serial Communications



## Chapter 9: Serial Communications

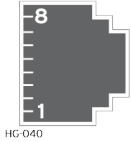
9.1: Port Descriptions .....	67
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All Micro OCS Controller models provide two serial ports, which are implemented with a single 8-position modular jack that is labeled **MJ1/2**. The MJ1 serial port is RS-232 while the MJ2 port is RS-485. MJ1 defaults 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.

### 9.1: 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.

### 9.2: Wiring—MJ1/MJ2 Serial Ports

 <p>2 Serial Ports on 1 Modular jack (8p8c)</p> <p><b>MJ1:</b> RS-232 w/Full Handshaking  <b>MJ2:</b> RS-485 Half-Duplex - RS-485 termination and biasing via System Menu or System Register</p>	MJ1 & MJ2 PINS		
	PIN	SIGNAL	DIRECTION
	8	TXD (MJ1)	OUT
	7	RXD (MJ1)	IN
	6	0V	COMMON
	5	+5V @ 60mA	OUT
	4	RTS (MJ1)	OUT
	3	CTS (MJ1)	IN
	2	RX-/TX-/- (MJ2)	IN/OUT
	1	RX+/TX+/+ (MJ2)	IN/OUT

## 9.3: 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 Micro OCS Controller is powered on. This would typically only be an issue if the Micro OCS Controller 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 3.3V 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

## 9.4: Cscape Programming via Serial Port

MJ1 is the serial port available for programming. The connection is RS-232 and is compatible with the Horner programming cable kits HE-XCK or HE-XCPK. Unlike some other OCS models, the MJ2 port cannot be configured as a programming port. The Mini-B USB port is also available for programming.

The “Set Serial Ports” option in the OCS System Menu contains an entry for Default Programming Port (Dflt Pgm Port). However, the entry is fixed at MJ1-232. No OCS configuration is required to use either the MJ1 serial port or Mini-B USB port for programming.

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

## 9.5: 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.

## 9.6: 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 Micro OCS Controller when third party devices are connected to the Micro OCS Controller to avoid damage to the PC or laptop and/or the Micro OCS Controller.

# Modbus-RTU Communications



## Chapter 10: Modbus Communications

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### 10.1: 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**.

### 10.2: Modbus Slave Overview

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.

The Modbus Addressing section describes the supported Modbus Commands as well as the Modbus Map for X2 References (%R, %M, etc.).

## 10.3: 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). Refer to the Modbus Addressing section. This is the preferred method in most applications. See [Downloadable Protocols \(Protocol Configuration\)](#) for additional information.

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.—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.
  - —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.

## 10.4: Modbus Addressing Table

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 Modbus Table.

**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 Modbus Table.

X2 Modbus Master Mapping					
X2 Reference	Maximum Range	Trad. Modbus Reference (5 Digits)	Expanded Modbus Ref. (6 Digits)	Modbus Command (s)	Modbus Offset
%I1	1024	10001	010001	Read Input Status (2)	0
%IG1	256	13001	013001		3000
%S1	256	14001	014001		4000
%K1	10	15001	015001		5000
%Q1	1024	00001	000001	Read Coil Status (1) Force Coil (5) Force Multiple Coils (15)	0
%M1	1024	03001	003001		3000
%T1	1024	06001	006001		6000
%QG1	256	09001	009001		9000
%AI1	256	30001	030001	Read Input Register (4)	0
%AIG1	32	33001	033001		3000
%SR1	200	34001	034001		4000
%AQ1	256	40001	040001	Read Holding Register (3) Load Register (6) Load Multiple Registers (16)	0
%R1	2488	40513	040513		512
%R1	2048	43001	043001		3000
%AQG1	32	46001	046001		6000
%R1	5000	--	410001		10000

# CAN Communications



# Chapter 11: CAN Communications

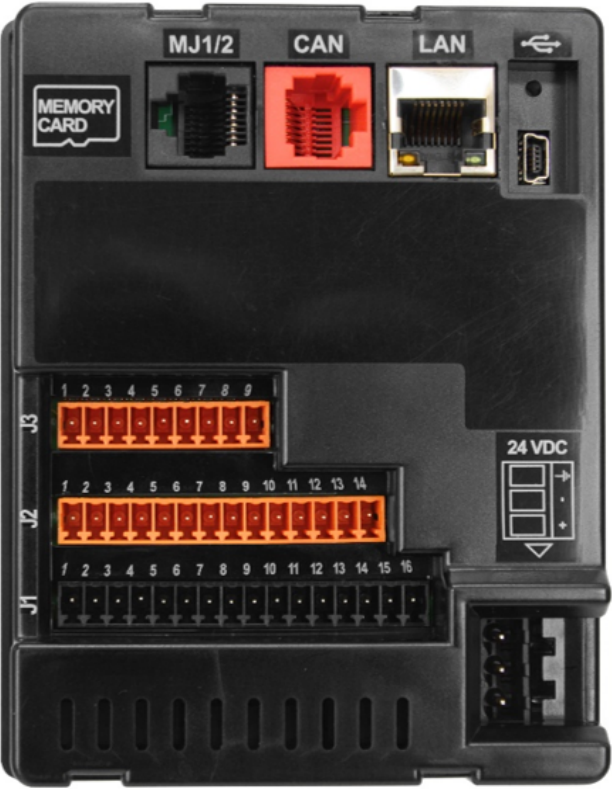
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**NOTE:** For additional CAN information, refer to the CAN Networks manual (**MAN0799**) via [Documentation Search](#) for more details .

## 11.1: 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.

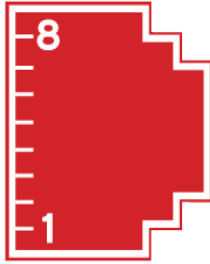
## 11.2: CAN Port Wiring



HG-482

**CAN Pin Assignments**

	PIN	SIGNAL
	8	No Connection
	7	Ground (PCB Ground)
	6	[CAN] Shield (Earth Ground)
	5	No Connection
	4	No Connection
	3	Ground (PCB Ground)
	2	CAN Data Low
	1	CAN Data High



HG-042

Modular jack (8p8c)

### 11.3: 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.

### 11.4: 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.

### 11.5: 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 is available for this purpose.

### 11.6: CAN and Termination and Bias

If there is a 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 RJ45 to open-style connector will make termination easier.

**NOTE:** %SR152 enables CAN port termination.

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

# Downloadable Protocols



## Chapter 12: Protocol Configuration

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### 12.1: Overview

Through loadable protocol device drivers, certain models of the OCS family can provide the ability to exchange data with remote devices such as variable-frequency drives, PLCs, and remote I/O devices. This feature greatly expands OCS control capability with negligible effect on OCS ladder scan time.

Remote devices that communicate serially must do so under certain rules of data transfer known as a protocol. Many device manufacturers have created their own protocol for communications with their device. For a OCS to communicate with a specific device, it must be loaded with the corresponding serial communications protocol device driver that supports that protocol.

A limited number of protocol device drivers are packaged with the Cscape distribution; however, as more are developed, they will be made available as add-on packages. A device driver is typically distributed as a Windows module, which contains the configuration menus, help files and the target executable driver code. When updating device drivers, an install routine loads the device driver to the Cscape directory structure and makes that driver available to Cscape applications.

Once installed, the protocol device driver can be included as part of a Cscape application by selecting it from a list of installed protocol device drivers and attaching it to the desired serial port (**Home > Protocols**). Only one protocol device driver can be associated with a serial port, though some OCS models support multiple protocols on a single EtherNet port.

Once the protocol is selected for a specific port, that port must be configured to match the bit transfer size and rate of the target device(s). This is configured under the **Network Config** menu, which contains port specific information such as the basic serial port parameters (i.e. baud rate, stop bits parity, retries, etc.). In addition to the serial port parameters, this menu also contains the transaction scan update control configuration and any network level protocol specific configuration.

Once the network is configured, each device on the serial communications network must be configured. For some communications (i.e. RS-232), the network can be limited to one device. The devices are configured under the **Device Config** menu, which contains an arbitrary device name, the device ID and optionally a OCS status register that contains any device fault information.

Once each device(s) is configured, a Scan List of entries must be created which defines the transfer of data between a local (OCS ) register(s) and a remote device register(s). These entries are created under the Data Mapping menu, which contains a OCS register, a target device ID, a target device register address, the number of registers to transfer, and update type.

Each entry can be configured for one of two types of initiating a transaction: **Polled and Triggered**. Polled type entries initiate a transaction with the remote device on every transaction scan. Triggered type entries only initiate a transaction when a corresponding local (OCS ) binary trigger register is set. Once a triggered type transaction completes, the protocol device driver resets the local (OCS ) binary register to indicate completion.

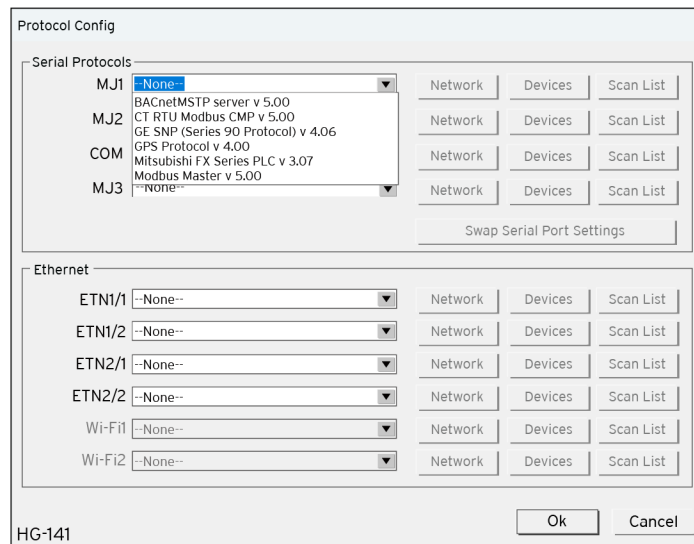
These basic types are also subdivided into read or write operations. For polled operations, a Read operation only reads from a remote device. Likewise a Read/Write operation continuously reads from the remote device unless the target OCS register value changes from one ladder scan to another. In this case, the new OCS value is written to the target device. For triggered operations, only a read or write action is available.

When downloaded to the OCS, the Scan List is scanned sequentially to generate data transactions with the remote device. This transaction scanning can be on a continual basis (**automatic**) or controlled from ladder logic (manual) once a complex connection is created via a program. The specific transaction-scanning mode is selected from the **Network Config** menu.

Refer to the Cscape Help file for more information on Downloadable Protocols Configuration.

## 12.2: Protocol Device Driver Selection

From the Cscape **Home > Protocols** menu, select the port drop-down box to select a protocol device driver. All protocol device drivers currently loaded in Cscape are displayed in the drop down selection along with their version numbers. A selected protocol can be removed by selecting **None** from the drop-down selection. Some OCS models can be limited in the number of ports or number of protocol device drivers that can be selected. Once a protocol is selected, the Network, Devices and Data (Scan List) must be configured through corresponding dialogues accessible through the respective buttons (Network, Devices and Scan List).

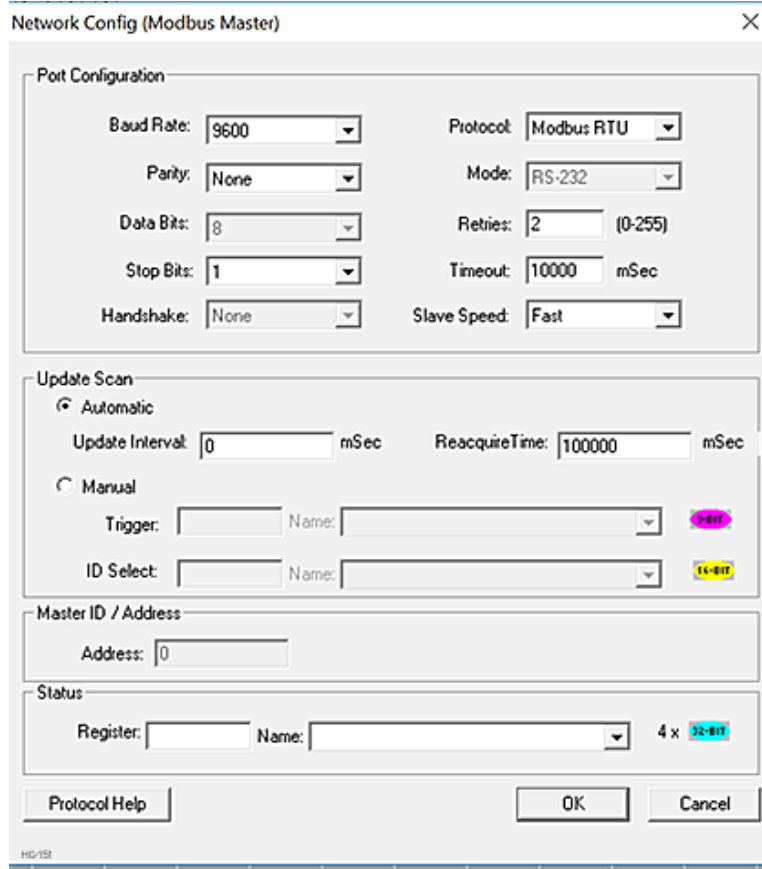


**NOTE:** If the MJ1 port is to be used in the Protocol Config, it will no longer be available for Cscape programming unless the controller is put into IDLE mode.

Three fields must be configured after a protocol is selected:

1. Network
2. Devices
3. Scan List

### 12.3: Network Configuration



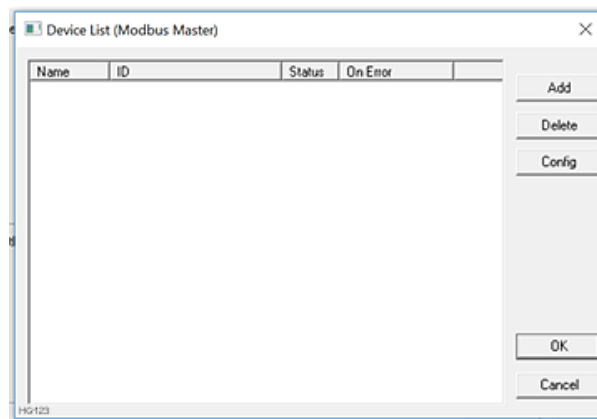
Network Configuration provides the required parameters to configure the network. Each protocol is different and may not require the entire Network Config field. Refer to the table below for the options in the Network Config field.

Network Protocols		
<b>Baud Rate, Data Bits, Stop Bits, Parity</b>	These field define the bit level transfer over the serial port.	
<b>Handshake</b>	<p><b>None</b> – No handshake lines are used</p> <p><b>Multidrop Full</b> – Rx remains active while Tx is occurring.</p> <p><b>Multidrop Half</b> – Rx is shut off while Tx is occurring.</p> <p><b>Radio Modem</b> – Wait for CTS acknowledgment before transmitting (legacy radio modem support).</p>	
<b>Protocol</b>	If a driver supports multiple protocols, it is selected here, (i.e., Modbus-TCP/UDP supports RTU or ANSI).	
<b>Mode</b>	Specifies if port operates in RS-232 or RS-485 mode.	
<b>Retries</b>	Specifies number of times a transaction is retried on a failed response.	
<b>Timeout</b>	Specifies the amount of time for a device to wait for a valid response.	
<b>Update Scan</b>	Automatic	<b>Update Interval</b> – Specifies the update interval at which all the mapped entries are executed.
		<b>Reacquire Time</b> – Specifies the amount of time to wait before attempting communications with an offline device.
	Manual	<b>Trigger</b> – Specifies the binary register that a single transaction scan of the

Network Protocols	
	<p>Scan List.</p> <p><b>ID Select</b> – If an analog is specified in the field, the ID Select filter is enabled.</p>
<b>Status Register</b>	Specifies the starting OCS register of eight (8) consecutive registers (4-32bit counters), which provide an indication of the network health.
<b>Scanner Address</b>	Specifies the OCS's device (network) ID if a master ID is required by the protocol.
<b>Protocol Help</b>	Provides protocol specific help.

## 12.4: Device List and Device Configuration


### 12.4.1: Device List



This configuration list is reached from the Device button on the Protocol Config screen and provides a list of the configured devices on the Network. Devices must be created and exist in this list before corresponding Scan List entries can be created for this device. Typically, the number of entries is limited to **64 devices**.

- **Add** - Opens the Device Config dialog to add a new device to the list.
- **Delete** - Remove selected device from list (all corresponding Scan List entries are also removed).
- **Config** - Invoke the Device Config dialog for the currently selected device. This can also be accomplished by double-clicking a device entry.
- **Mapping** - Invoke the Scan List limiting the entries displayed for the selected device.

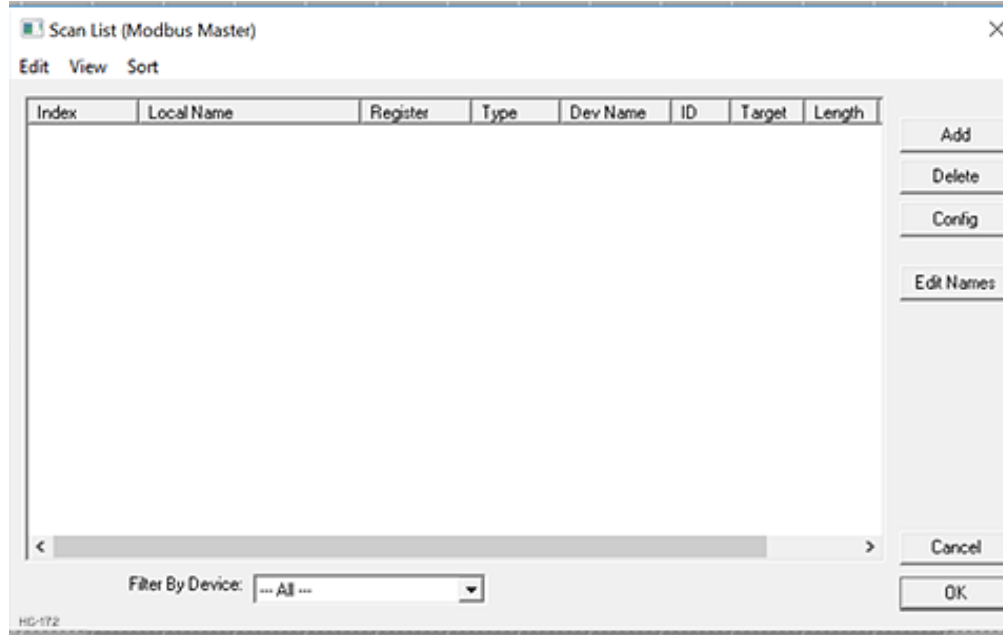
## 12.4.2: Device Configuration



This configuration is reached from the device list when adding or modifying an existing device. While each protocol is somewhat different and can contain protocol specific field, all protocols typically support at least:

- **Device Name** - Specifies a tag name for this device. This tag name is used in the Data Mapping configuration to identify this device. This allows device addresses to be modified without the need to update all associated Data Mapping entries.
- **Device ID** - Specifies the target device communications ID or station address.
- **Swap Words on 32-bit Data** - If a Scan List entry is configured to transfer 32-bits and this option is checked, the high and low 16-bit values are swapped when transferred between the target and OCS.
- **Disable Device** - From Cscape 9.90 SP3 and firmware 15.40 onwards, disable device feature has been added in protocol device configuration. This option is used to disable a particular slave configured in the network. Single bit register has to be configured to use this function. Setting the bit high disables the slave and OCS will not send any serial (TCP for EtherNet/IP protocols) packets only to this slave until the bit is high. Setting the bit low enables the communication with the slave again.
- **Status Enable** - This checkbox enables device status to be displayed and controlled from two consecutive 16-bit registers.
- **Status Address** - Enter the starting 16-bit OCS register of two consecutive registers used for device status. The first register contains the protocol device driver specific error code while the second register contains the index of the offending Scan List entry.
- **Status Modes:**
  - a. **Stop on Error** - Specifies that communications be only reattempted after offline status when the corresponding device status register is cleared.
  - b. **Retry on Error** - Specifies that communications be reattempted either during the reacquire interval or when the corresponding device status register is cleared.

## 12.5: Scan List



This configuration list is reached from the Scan List button on the Protocol Config screen or the **Mapping** button on the Device List screen and provides a Scan List of the Data Mapping entries. To transfer data between the OCS and remote target, a Scan List must be created that defines each transaction. Each mapping entry (transaction) contains the source and destination registers, the number of consecutive registers transferred, the direction of the transfer and what triggers the transfer. Typically, **the number of entries is limited to 512**.

**NOTE:** The order of the Scan List is the order in which the transactions occur. Sort functions are provided to change the order of the list. Each entry also has an identifying index. If the device status register is enabled and a transaction failure occurs, the status register indicates the index number of the transaction that failed.

### 12.5.1: Menu

- **Edit > Copy All** - Copies Scan List to clipboard in a tab delimited format suitable for pasting into an application like Microsoft Excel.
- **Edit > Paste** - Loads Scan List from clipboard. Pasted items are added to the scan list even if they are duplicates.
- **View > Toggle All Name View** - Expands Scan List such that each point and corresponding local name is displayed.
- **Sort** Scan List by different criteria. The firmware will scan the devices based on the order they are displayed or sorted. There are four ways to sort the scan list:
  - a. **By Local Address** – Sorts the list by local register address in increasing order.
  - b. **By Target Address** – Sorts the list by target register address in increasing order.
  - c. **By Device Name** – Sorts by device name, then target address.
  - d. **Interleave Devices** – This sort evenly distributes request among the different devices. Instead of requesting 100 blocks from device A, then 100 blocks from device B, one requests is sent to device A, then one request is sent to device B until all the data has been requested. This is useful for devices that may have a timeout timer because the time between each scan for a particular device is minimized. This sorting options usually doesn't affect performance.

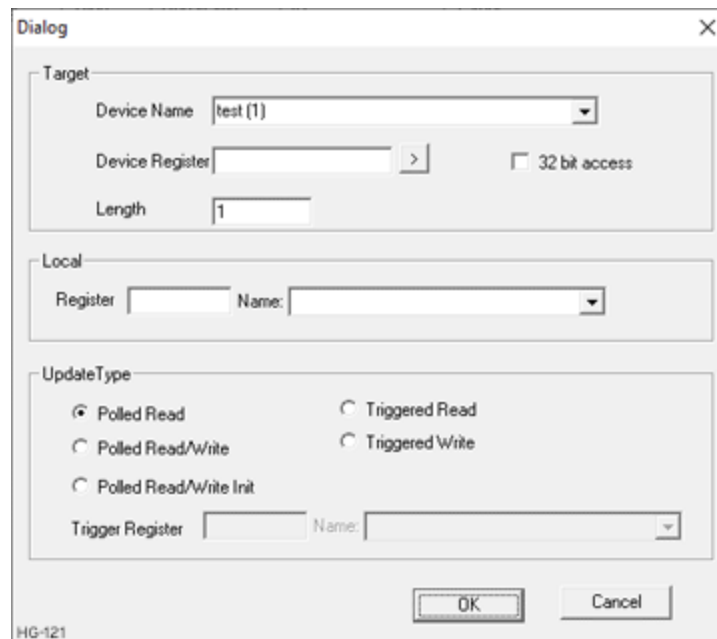
### 12.5.2: Buttons

- **Add** - Opens the Data Mapping dialog to add a new entry to the Scan List.
- **Delete** - Removes selected entry from Scan List
- **Config** - Opens the Data Mapping dialog for the currently selected entry. This can also be accomplished by double-clicking an entry.
- **Edit Names** - Invokes the Edit Names dialog for the currently selected entry. The Edit Names dialog provides the ability to create OCS program names for each point in the transaction.

### 12.5.3: Display Control

**Filter by Device** - Limits displayed entries to only those assigned to the indicated device. To show all entries select **-All-**.

### 12.5.4: Data Mapping Configuration (Scan List Entry)



#### Target

- **Device Name** - Selects the target device (by tag name) to use for this transaction. Only those device entries previously created from the Device Config menu are available.
- **Device Register** - Specifies the target device's register to use for this transaction. This designation is target-specific. The configuration menu displays an error if a specified address is unacceptable. **Generally, the data type of the local (OCS) register must match the data type of the device register.**
- **The Right Arrow button** - Displays protocol device driver specific help for the target addressing. Note that some devices can require register addresses that exist on 8-bit, 16-bit or 32-bit boundaries.
- **Local Register** - Specifies the local (OCS) register that is the source or destination for the transaction.
- **Local Name [Optional]** - Optionally allows selection of a OCS register by name <or> creation of a name for a register already selected by direct reference. Created names can be used thereafter to specify the local (OCS) register in ladder or graphics address fields.
- **32-Bit Access** - Allows two local (OCS) 16-bit registers to be treated as a single 32-bit value. For example, if the value in either 16-bit register is modified, both registers are written to the device. Device-specific, 32-bit word swapping options also apply to this designation. Since the transaction is treated as a 32-bit access, the length is generally limited to 16. Note that some protocols can disable this feature.

- **Length**
  - a. Specifies the number of consecutive device registers that are transferred in this transaction. Note that some protocols can limit the length that can be transferred. However, typically the **length is limited to 32**. The configuration menu displays an error if a specified length is unacceptable.
  - b. **If allowed, specifying a length greater than one (multiple consecutive register transfers per transaction) is more efficient than creating a single transaction for each register.** This grouping of registers per transaction can significantly reduce the transaction scan time; however, **update types that include writing on a polled basis require additional consideration.**
  - c. On **Read/Write** and **Read/Write/Init** update types, the write transaction only occurs when the local (OCS ) register value changes. If the length is greater than 1 for Read/Write and Read/Write/Init types, only the local register(s) that change in value are written. More specifically, only one write transaction occurs per scan per mapping entry for the register or consecutive sub-group of local registers that changed in value. Depending on the protocol, the number of points written with that write transaction are limited either to one or the number of consecutive points that changed value.
  - d. **Therefore, if several local registers (specified in a single mapping entry) change in value prior to a transaction scan, it takes SEVERAL transaction scans to complete all the write operations. Furthermore, all write operations are completed before a read operation is scheduled.**
  - e. **For Manual Update (transaction) scans (i.e. dialup modem), it is recommended that all Read/Write Scan List entry lengths be limited to 1.**

## Update Type

This field specifies the direction and what triggers the transfer of data between the OCS and target device for a mapping entry.

- **Polled Read** - On every transaction scan, a read-only target device register(s) transaction occurs.
- **Polled Read/Write**
  - a. On every transaction scan, a read target device register transaction occurs unless a local register value has changed. The write transaction only updates those local registers that have changed in value. If several non-consecutive local registers (contained in a single mapping entry) change value between transaction scans, it takes several consecutive transaction scans to write each changed register.
  - b. When the OCS is placed in RUN mode, **the initial action for this mapping type is a read target register transaction.** This transaction initializes the local (OCS ) register(s) to match that of the remote device register(s). Thereafter, any change to the corresponding OCS register(s) triggers a write operation to the remote device.
- **Polled Read/Write/Init**
  - a. On every transaction scan, a read target device register transaction occurs unless a local register value has changed. The write transaction only updates those local registers that have changed in value. If several non-consecutive local registers (contained in a single mapping entry) change value between transaction scans, it takes several consecutive scans to write each changed register.
  - b. On every transaction scan, a read target device register transaction occurs unless a local register value has changed. The write transaction only updates those local registers that have changed in value. If several non-consecutive local registers (contained in a single mapping entry) change value between transaction scans, it takes several consecutive scans to write each changed register.
  - c. When the OCS is placed in RUN mode, **the initial action for this mapping type is a write target register transaction.** This transaction initializes the target device register(s) to match that of the local (OCS ) register (s). Thereafter, any change to the corresponding OCS register(s) triggers a write operation to the remote device.
  - d. The initial write transaction does not occur until after the first logic scan of the OCS . This allows registers to be initialized locally before Writing to the target device register(s).
- **Triggered Read** - A read transaction is triggered by a high level on a separately designated OCS (binary) trigger register. Once the read transaction is complete (or the device is offline), the OCS trigger register is cleared by the OCS . This update type can be used for occasional data accesses such as retrieving trend data. Note that this operation increases the associated transaction scan time and can cause the **Update Interval Exceeded Counter** to increment on a tightly adjusted update interval.

- **Triggered Write** - A write transaction is triggered by a high level on a separately designated OCS (binary) trigger register. Once the write transaction is complete (or the device is offline) the OCS trigger register is cleared by OCS . This function can be used for occasional data accesses such as sending recipe data. Note that this operation increases the associated transaction scan time and can cause the **Update Interval Time Exceeded Counter** to increment on a tightly adjusted update interval.

# User Interface



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## 13.1: 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 Help File in Cscape.

## 13.2: Screen Specifications

Display Type	2.2" Monochrome LCD
Resolution	128 x 64 pixels
Backlight	LED – 50,000 hours
Screen Memory	256kB
User-Programmable Screens	250
Keypad	Membrane type switches with metal dome

### 13.3: Displaying and Entering Data



HG-470

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 Cscope, 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.

### 13.4: Types of Objects

The X2 has two types of objects which must be defined using the Cscope program. Please refer to the Cscope 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.

### 13.5: 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.



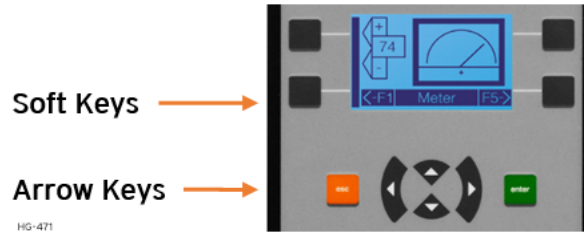
**Editable Field**

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.

## 13.6: Navigation Keys

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



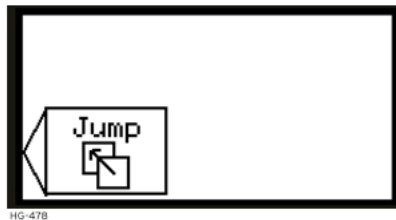
**Soft Keys** - The black squares on the sides of the screen are called “soft keys” and can be used to select objects that have an arrow icon pointing to the soft key. Soft keys can be assigned to certain objects, such as switch objects or jump objects.

**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 keypad. Then press **Enter** again to store the value.

## 13.7: Screen Navigation

**NOTE:** 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.

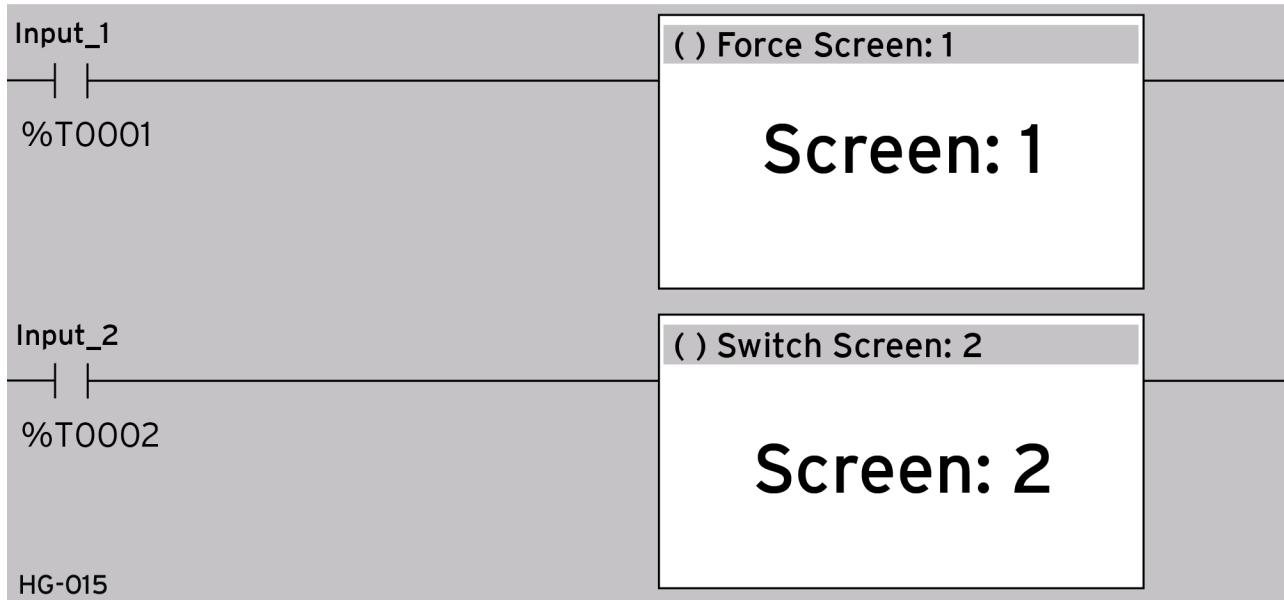
A triangle or arrow on the side of an image on the X2 screen indicates that this button can be selected by using one of the soft keys on the side of the screen.



## 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.

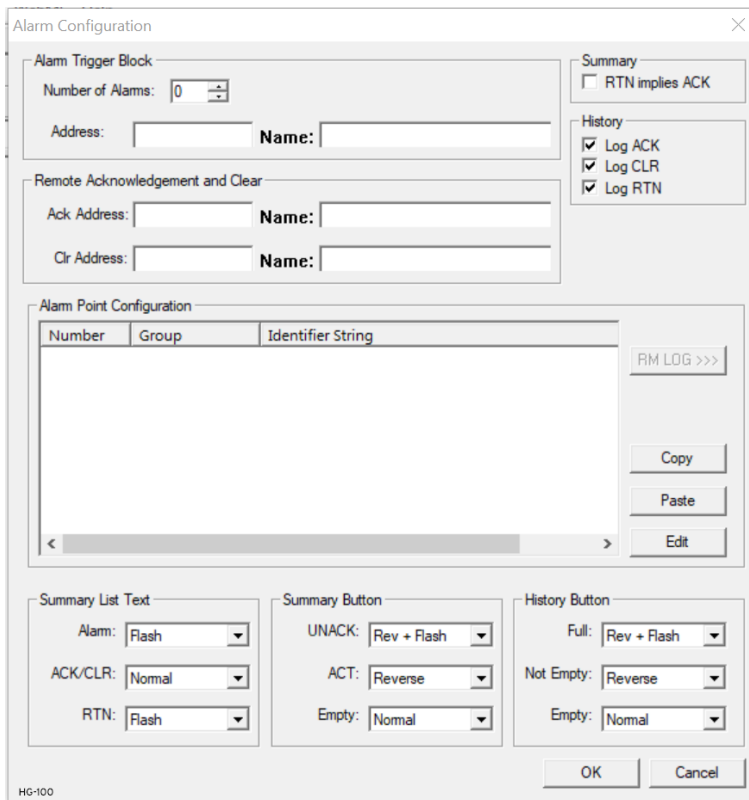
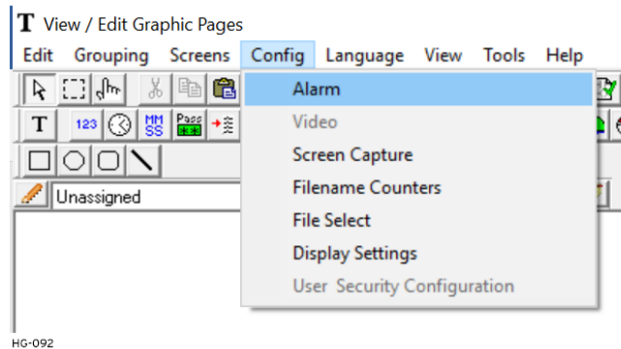
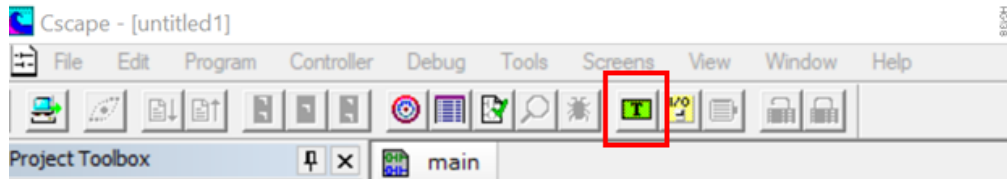


There is also a system register that can be used to for control-based screen navigation. %SR1 can be read to determine the current screen or written to change the current screen.

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

## 13.8: 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. Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. For more information refer to the graphics editor help file in Cscape. First open the Graphic Editor.



### 13.8.1: Alarm Viewer

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 the image below.



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.

### 13.9: 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 dimming or powering off the backlight.

# Removable Media

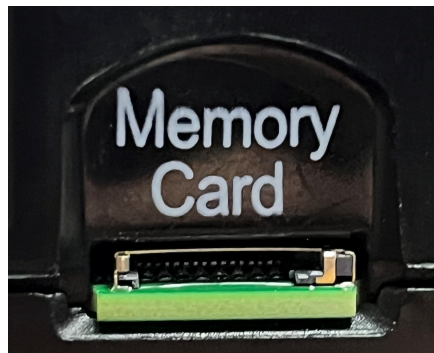


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### 14.1: Overview

All Horner controllers models provide a Removable Media slot, labeled Memory Card, which supports standard microSD flash memory cards. microSD cards can be used to save and load applications, to capture graphics screens and to log data for later retrieval.



### 14.2: microSD Cards

When the microSD card format was introduced, it was originally called TransFlash. Cards labeled either microSD or TransFlash, with up to 32GB of flash memory, are compatible with the Horner controller Memory Card slot.

The Memory Card slot is equipped with a “push-in, push-out” connector and a microSD card can be safely inserted into the Memory Card slot whether the Horner controller power is On or Off.

- To install a microSD card: Align its 8-pin gold edge connector down, facing the front of the Horner controller unit as shown below; then carefully push it all the way into the Memory Card slot. Ensure that it clicks into place.
- To remove the microSD card: Push down on the top of the card gently to release the spring. The card pops up for removal.

### 14.3: microSD File System

The microSD Memory Card slot uses the PC-compatible FAT32 File System. This means that a PC, with a microSD-compatible card reader, can read files that have been written by the Horner controller and can write files that can be read by the Horner controller.

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

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

### 14.4: Using the Removable Media Manager

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

- a. Display number of total and free K bytes
- b. Browse file and directory lists
- c. Delete files and directories
- d. Format a microSD card
- e. Load and save application programs
- f. 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:

<b>F1</b> Delete	Delete the highlighted file or directory
<b>F2</b> DelAll	Delete all files and directories
<b>F3</b> Format	Format the microSD card
<b>F4</b> SavPgm	Save application to DEFAULT.PGM
<b>Esc</b> 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.

## 14.5: Using Removable Media to Log Data

Using Read and Write Removable Media function blocks, an application ladder program can read and write Horner controller 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.

## 14.6: Using Removable Media to Load and Save Application

A special file type, with a .PGM extension, is used to store X2 application programs on microSD. To load an application from microSD 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 microSD, 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 microSD root directory. Press either of the two soft-keys to the right of the display to see options.

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

**NOTE:** Saving an application to microSD does not also save register data. Cscape can also save an application directly to a microSD card, which is plugged into the PC's microSD compatible card reader by selecting the Export to Removable Media item on the **File** menu.

## 14.7: Removable Media Object

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

The  (Enter) button (if enabled) 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.

## 14.8: Function Blocks in Cscope

**NOTE:** For detailed information regarding RM function blocks and parameters, refer to the Help File in Cscope Software. Refer to 'USB flash Media support for RM Functions' for USB flash drive access details.

The following RM functional blocks are available in Cscope Software. These function blocks will reference:

- a. microSD when filename is prefixed with 'A:' or nothing
- b. USB A flash drive when filename is prefixed with 'B:'

<b>Read RM csv</b>	Allows reading of a comma-separated value file from the microSD interface into the controller register space.
<b>Write RM csv</b>	Allows writing of a comma-separated value file to the microSD interface from the controller register space.
<b>Rename RM csv</b>	Allows renaming a file on the RM card. The data in the file is not changed.
<b>Delete RM csv</b>	Allows deleting a file on the RM card
<b>Copy RM csv</b>	Allows copying a file on the RM card. 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.

## 14.9: 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.

## 14.10: 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.

## 14.11: 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.

## 14.12: Filenames

The RM function blocks support the flash with a Windows standard FAT-16 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. There are six special symbols that can be entered into a filename that are replaced by the OCS with current time and date information.

Filename Special Symbols		
Symbol	Description	Example
\$Y	Substitutes the current 2-digit year	2015 = 15
\$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	5 pm = 17
\$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, 2015 5:45:34 PM; Sreen 4 is currently displayed.

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

**Filename:** Year\$Y\Month\$M\aa\$D\_\$h.csv = Year15\Month03\aa01\_17.csv

**Filename:** Month\_\$M\Day\_\$D\h\_\$m\_\$s.csv = Month\_03\Day\_01\17\_45\_34.csv

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

## 14.13: 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 register shows the free space on the RM card in bytes.

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

Possible status values are shown in the table:

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

## 14.14: 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.



# Clone Unit



# Chapter 15: Clone Unit

15.1: Clone ..... 101  
 15.2: Load Clone ..... 103

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 to "Removable Media" on page 1 for more details on using RM. It can then be used to clone a different OCS (same model).

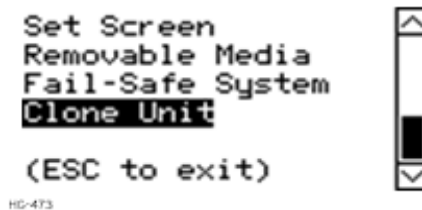
This feature can be used for:

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

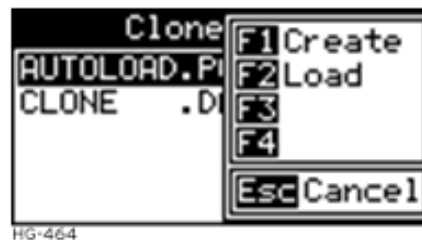
## 15.1: Clone

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

**Step 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:

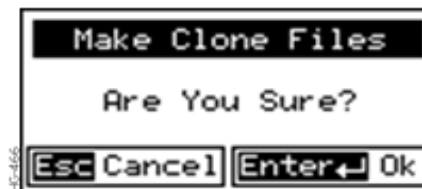


**Step 2:** Selecting "Clone Unit" menu will open the following menu screen:



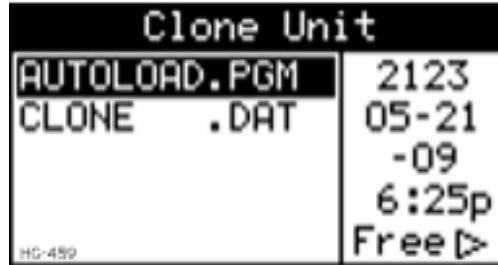
**NOTE:** In the above figure, F3 and F4 are inactive in the Clone Unit.

**Step 3 -** 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:



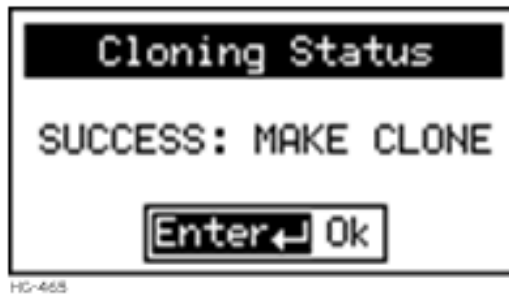
After confirmation, the OCS will create two new files in the root directory of the Removable Media Drive as shown below:

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



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

**Step 4:** Once the cloning is successful, the OCS gives a message as below:



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 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.

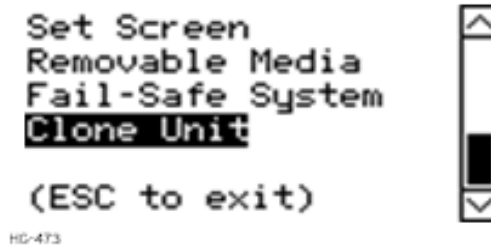
**NOTE:** Backup of registers in flash memory is not performed by the Clone Feature. If user desires, Backup should be done as explained in "Fail-Safe System" on page 105.

## 15.2: Load Clone

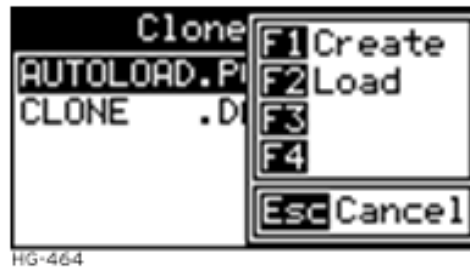
This option loads the application, all unit settings and register values from Removable media to the Battery backed RAM (Regardless of AutoLoad settings) and then resets the OCS for the settings to take effect.

User must perform the following to Load the Clone:

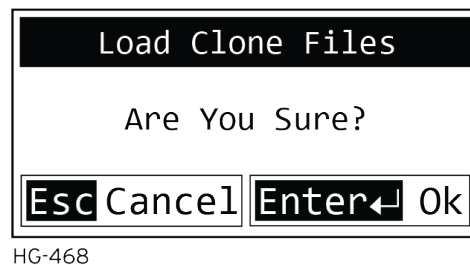
**Step 1:** Select “Clone Unit” from main system menu of OCS as shown below:



**Step 2:** Selecting “Clone Unit” menu will open the following menu screen. Select “Load Clone”.



**Step 3:** User must confirm Load Clone as shown below:



**Step 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 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.

# Fail-Safe System



# Chapter 16: Fail-Safe System

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## 16.1: Overview

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, Electromagnetic Interference, event.

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 retentive registers.
- 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

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.

## 16.2: Settings

To use the Fail – Safe feature, the user must do the following:

1. From Cscape, create AUTOLOAD.PGM for the application program using 'Export to Removable Media'.
2. Place the Removable Media with AUTOLOAD.PGM in the device.
3. Set the 'Enable AutoLoad' option in the device to YES.
4. 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.
5. Backup the current Battery-Backed RAM Register contents in On-Board Flash memory using System Menu options.

## 16.3: Backup/Restore Data

Selecting this option brings up a screen having four operations:

Backup OCS	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.



### 16.3.1: Backup OCS Data

When initiated, this permits the user to manually copy Battery-Backed RAM contents on to the onboard FLASH memory of the OCS. This backs 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.

**NOTE:** During this process the scan rate may be higher than normal.



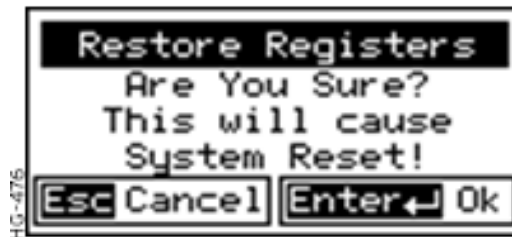
### 16.3.2: Restore OCS Data

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.



%SR164.3 is set to 1 only when an automatic restore operation is performed - not on a manual one. This bit is reset to the value of 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.

### 16.3.3: Clear Backup Data

When initiated, the backup data will be erased from the onboard Flash and no backup will exist.

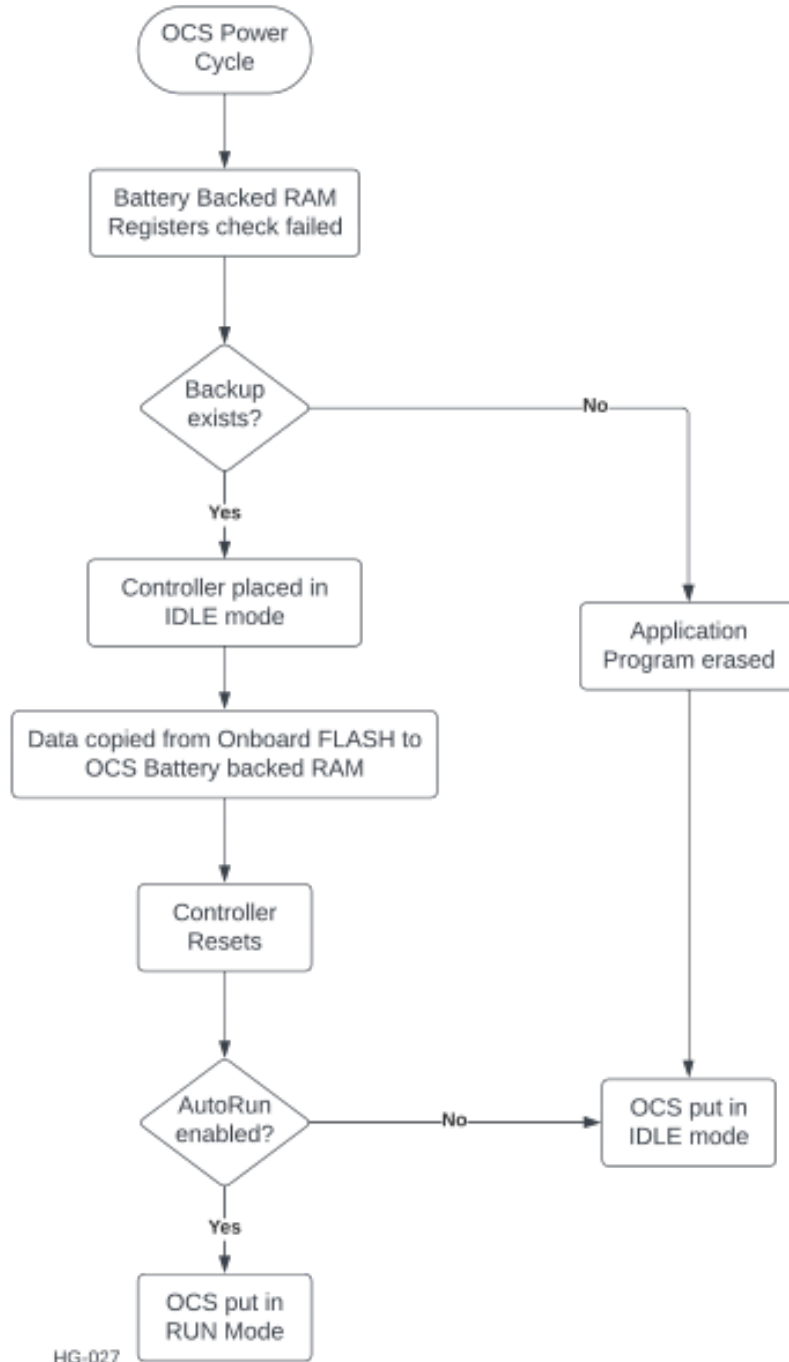
%SR164.4 and %SR164.3 is reset to the value of 0 when backed up data is erased.



**Exit:** Goes back to the previous screen.

### 16.4: Flow Chart for Automatic Restore

The OCS follows the following sequence in execution of Automatic Restore:



## 16.5: 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.

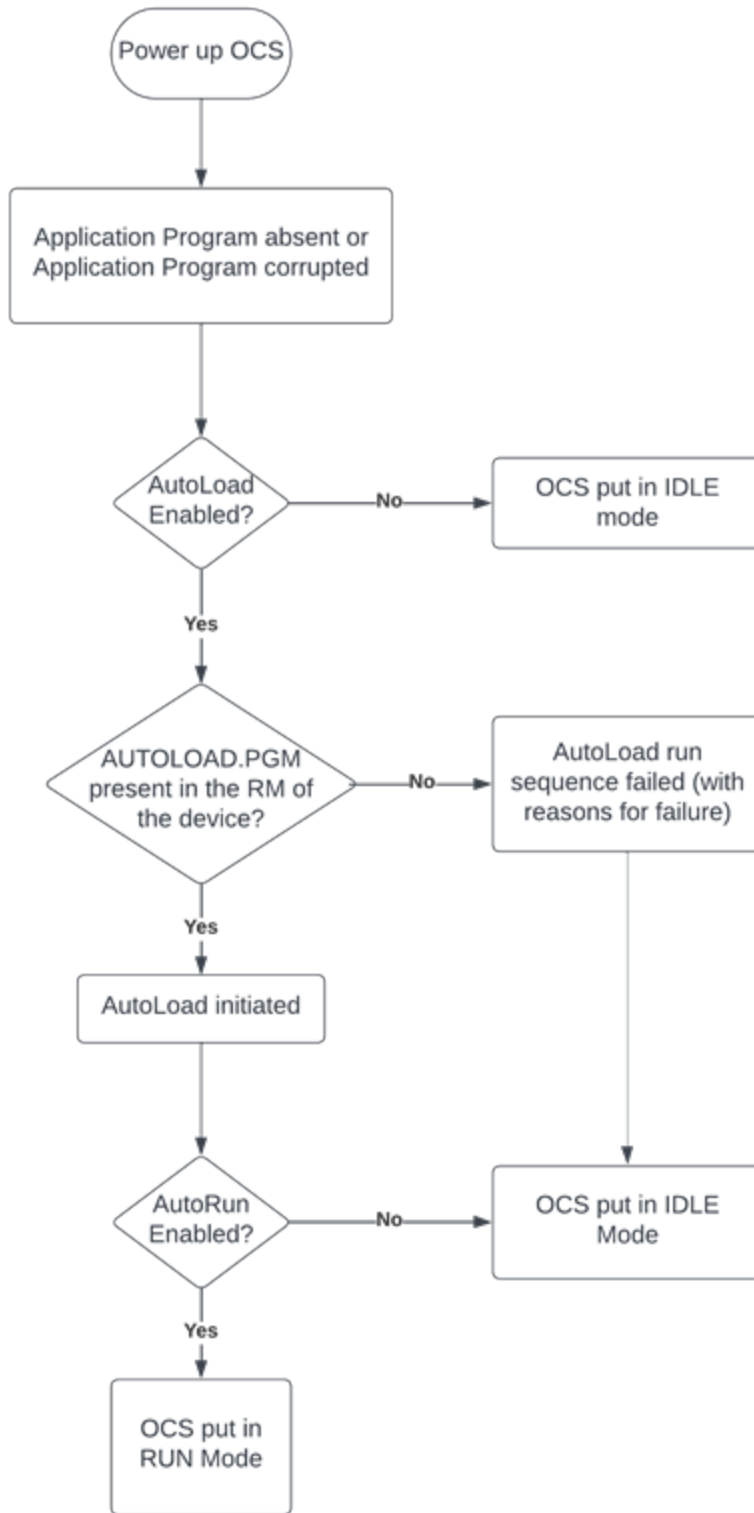
If the AUTOLOAD.PGM is security enabled, the user will be prompted to enter the password before loading the application. The application will be loaded from the Removable media only after getting the correct password.

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

```
Enable AutoLoad      No
( AutoLoad from      )
( Removable Media's  )
( AUTOLOAD.PGM file )
( when triggered     )
```

HG-565

The OCS implements the following sequence to execute the AutoLoad function:



HG-026

## 16.6: 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   )
HG-460
  
```

Enable AutoRun	<p><b>No</b> = OCS will be in IDLE mode after AutoLoad or Automatic Restore.</p> <p><b>Yes</b> = OCS will automatically be placed into RUN mode after AutoLoad or Automatic Restore.</p>
----------------	--

### 16.6.1: Enable AutoLoad

“Enable AutoLoad” displays the following options:

```

Enable AutoLoad     No
( AutoLoad from     )
( Removable Media's )
( AUTOLOAD.PGM file )
( when triggered    )
HG-565
  
```

Enable AutoLoad	<p><b>No</b> = Does not load AUTOLOAD.PGM automatically when application program is absent or corrupted.</p> <p><b>Yes</b> = Loads AUTOLOAD.PGM file automatically from Removable Media when application program is absent or corrupted.</p>
-----------------	--

# Firmware Update



## Chapter 17: Firmware Updates

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The X2 OCS products contain field updatable firmware to allow new features to be added to the product. 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 OCS 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.

### 17.1: Firmware Update Details

**NOTE:** Updating firmware will clear the application program, screens, configurations, and register data. If required, make sure to backup program and register data before updating firmware. The controller's User Manual has instructions for doing backups.

There are two methods for updating firmware. The method used depends on the type of controller being updated.

**Method A: Removable Media Method** – The controller firmware is updated by a bootloader, using a microSD card or USB Flash drive (not through the Cscape Firmware Update Wizard). To update or change firmware:

1. Download desired Firmware set from the Horner APG website. (Verify CsCAN or CANopen communications.)
2. Save Firmware files to microSD card, a removable media device.
3. Update the firmware through the controller's Firmware Update function

**NOTE:** Files from the Horner website come as a zipped, self-extracting executable file. The downloaded file must be unzipped. (If updating the firmware from removable media, the self-extracting file can also be unzipped like any zipped file, then place files on the root directory of the removable media [micro-SD card].)

**Method B: RS232 Serial Connection** – Serial firmware updates are done from Cscape software to the controller's primary serial port, MJ1 in most cases.

### 17.2: Download Firmware

In North America, visit <https://hornerautomation.com> and then click **Support > Downloads > Controller Firmware**. Download the most recent firmware set with the correct communication protocol.

-OR-

In Europe, visit <http://www.hornerautomation.eu> and click **Support > Firmware** tab and download the desired firmware (an account is required to access firmware updates, create one if necessary).

## 17.3: Firmware Update Using Cscape / Firmware Update Wizard

1. Download the firmware files; (for instructions, see "Download Firmware" on the previous page). The zipped firmware download must be unzipped to an accessible location (such as the desktop.)
2. Run the unzipped, self-extracting file to extract the firmware files. Running the self-extracting file will place the files into the correct folder on the computer hard drive. ( default path: C:\Program Files (x86)\Cscape\Firmware)
1. Establish communication between Cscape and the controller using a direct serial connection to MJ1 or USB.
2. Confirm the application is available on the computer or upload the application.
3. Confirm that 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. Reloading the application is required.
10. Test the operation of the equipment with the new firmware before returning the X2 system to an operation mode.

**NOTE:** For additional firmware updating information and instructions, refer to the [Firmware Update Manual](#), MAN1011, available on the Horner website.

# Backup Battery



## Chapter 18: Backup Battery

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### 18.1: Precautions & Safety

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, as well as the user program when power is disconnected. If the battery is low or removed, then both the user program and retentive memory are erased.

Under normal conditions the battery in the X2 should last seven (7) to ten (10) years. Higher operating temperatures or variations in batteries may reduce this time.

**Preventing Program Loss:** An available option to prevent the loss of program should the battery be drained is to use the Backup/Restore function which is part of the Fail-Safe System.

This feature is highly recommended and is accessible from the System Menu and from program logic. Backup/Restore DOES NOT require the installation of a microSD card in order to prevent program loss. Refer to "Fail-Safe System" on page 1 for complete details.

The battery will generally last seven (7) to ten (10) years. Environmental conditions, including extreme temperatures and humidity, can affect battery life. If the battery is older than seven (7) to ten (10) years old, it is recommended that it be replaced as preventative maintenance.

**NOTE:** The X2 uses a 3V coin lithium battery, part number HE-BAT009 available from Horner Automation.

**WARNING:** WARNING: DO NOT USE IF BATTERY IS LEAKING OR HAS BEEN DAMAGED.

**WARNING:** WARNING: LITHIUM BATTERIES MAY EXPLODE OR CATCH FIRE IF MISTREATED. DO NOT RECHARGE, DISASSEMBLE, HEAT ABOVE 100° C (212° F) INCINERATE, OR PUNCTURE.

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

**WARNING:** 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 recharge, disassemble, heat or incinerate lithium batteries.

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

## 18.2: Low or Missing Battery

If the battery voltage is low or if the battery is lost, **the program will be completely erased**. There will be an error message on bootup stating that the battery is low or missing. The following will also occur.

- System Menu > View Diag shows Battery as warn
- %SR55.13 bit will be High if battery is low or lost
- Device date and time will set to default values 01-01-1996 , 12am. This will need to be set again once the battery is replaced.

### 18.2.1: Lost Program

If the user has created a backup, then the program, along with the register data, will be saved in the internal memory and can be auto-restored.

To create a backup, go to System Menu > Failsafe > Backup/Restore. Click on the "Backup" button to store the program and register content in internal memory. For more information, see "Fail-Safe System" on page 105.

## 18.3: Steps for Battery Replacement

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 to snap the clips back into place.

# Troubleshooting & Tech Support

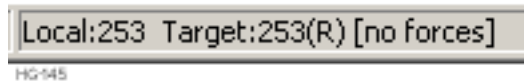


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## 19.1: Connecting to the OCS

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



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

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

Cscape Target & Local Numbers	
<b>Local: ###</b>	If a number shows next to <b>Local</b> then communication is established to the local controller.
<b>Local: No Port</b>	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.
<b>Local: No Com</b>	Cscape has accessed a PC COM port but is not communicating with the controller. This typically occurs when the controller is not physically connected.
<b>Local: ???</b>	Unknown communication error. Close Cscape, power cycle the controller and reopen Cscape with a blank project. Check Local.
<b>Target: #(I,R,D)</b>	If I (idle), R (run), or D (do I/O) shows next to <b>Target number</b> , then communication is established to the target controller.
<b>Target: #(?)</b>	Communication is not established to the target controller. Check node ID of controller and set Target to match. Make sure <b>local</b> connection is established.

### 19.1.1: 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 number [HE-CPK](#).

### 19.1.2: USB Port Programming

1. Power-up the controller.
2. Ensure that the correct COM port is selected in Cscape. **Tools > Applications Settings > Communications > Configure.**
3. Confirm that the USB cable is connected between the PC and the controller.
4. Examine the Windows Device Manager to confirm that the USB driver is correctly installed and to verify the port number.
5. The USB port driver installs.

### 19.1.3: ETN Port Programming

1. Controller must be powered up.
2. Ensure that the correct IP address is given in the Ethernet field and correct Mode is selected, in Cscape: **Tools > Applications Settings > Communications.**
3. Ensure that an Ethernet connection has been established by pinging the controller from the Windows DOS prompt.

## 19.2: Local Controller and Local I/O

The System Menu provides the following status indications that are useful for troubleshooting and system maintenance. To view the System Menu, press the **System** key.

- 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

### 19.2.1: Local I/O Troubleshooting Checklist

1. Verify the controller is in RUN mode.
2. Check diagnostics to ensure controller passed self-tests. View Diags in System Menu or in Cscape, click Controller/Diagnostics.
3. Check data sheets to ensure proper wiring.
4. Ensure 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.

## 19.3: CsCAN Network

For complete information on setting up a CsCAN network, refer to CAN Networks manual (MAN0799) by using Horner's [Documentation Search](#) page.

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.

### 19.3.1: CsCAN Network Troubleshooting Checklist

1. Use the proper Belden wire type or equivalent for the network as specified in the [CAN Networks Manual](#), MAN0799.
2. The Horner OCS 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 ensure that voltage meets specifications of attached devices.
4. Proper termination is required. Use 121 $\Omega$  (or 120 $\Omega$ ) resistors at each end of the network. The resistors should be placed across the CAN\_HI and CAN\_LO terminals.
5. Measure the resistance between CAN\_HI and CAN\_LO. If the network is properly wired and terminated, there should be around 60 $\Omega$ .
6. Check for duplicate node ID's.
7. Keep proper wires together. One twisted pair is for V+ and V- and the other twisted pair is used for CAN\_HI and CAN\_LO.
8. Make sure the baud rate is the same for all controllers on the network.
9. Assure shields are connected at one end of each segment—they are not continuous through the network.
10. Do not exceed the maximum length determined by the baud rate and cable type.
11. Total drop length for each drop should not exceed 6m (20'). 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 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.

### 19.4: USB Interfaces

- Plugging and unplugging USB devices while the OCS is powered up can cause the OCS to reset. In general, branded USB memory sticks will not cause this problem, however, with the advent of USB 3.0 and larger / faster memory devices this cannot be guaranteed.
- Larger USB devices such as hard-drives etc. should only be attached and removed when the OCS is powered down.
- The resets are caused by short sharp current spikes when devices are added or removed from the OCS, these spikes can exceed the USB specification but are usually very short and mostly do not cause problems. Some devices however draw a longer larger current as they power up causing a brief dip in the OCS internal supplies leading to a reset.
- Standard SanDisk and Kingston ranges with read times less than 120MB/sec. should not cause resets. The display will flicker when a device is added or removed.

## 19.5: Basic Troubleshooting

Description	Action
OCS does not read media card.	The media card should be formatted with the controller.
OCS will not download project file.	Make sure the project file is saved as a .pgm file and not a .csp file. In addition, the file must be .pgm. The file's I/O configuration must match the controller configuration for it to download.

## 19.6: Technical Support Contacts

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

**North America:**

Tel: (317) 916-4274

Fax: (317) 639-4279

Website: <https://hornerautomation.com>

Email: [APGUSATechSupport@heapg.com](mailto:APGUSATechSupport@heapg.com)

**Europe:**

Tel: (+) 353-21-4321-266

Fax: (+353)-21-4321826

Website: <https://www.hornerautomation.eu>

Email: [technical.support@horner-apg.com](mailto:technical.support@horner-apg.com)

## X2 Change Log

Date	Rev #	Description of Revision	Location in Doc
10-2024	13	Added descriptive language to battery backup (11287) Added note re: scan rate to backup (12146) Replaced cutout tolerance (12587)	Backup Battery Fail-Safe System Mechanical Installation
8-16-2021	12	Reordered Chapters (Mantis 3029) Updated Install Procedure (6482)	Throughout Install Procedure
DATE	21	Converted to Madcap Flare Added information about bad battery	Throughout Chapter 18

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