X7 User Manual

HE-X7A, HE-X7R



HG-066

MAN1155_22_EN_X7_UM

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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 X7 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:

ll 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.

X7 Micro OCS Introduction



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2.1: Visual Overview

Touch Screen - Press upper right corner to bring out the function keys and SYSTEM key to access the Main Menu.

1. Touchscreen
2. Function Keys Slide Out
3. MicroSD Card Slot
4. RS232/RS485 Serial Port
5. CANPort (Via RJ45)
6. LAN Port
7. USB Mini-B Port
8. Analog I/O
9. DC Inputs
10. DC Outputs
11. DC Power

NOTE: See "Precautions" on page1 about USB and grounding.



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2.2: Where to find more information for the X7 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 **MAN1156** via the Documentation Search page on the Horner website.

2.3: Connectivity to the X7

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

2.4: Features of X7 Micro OCS

The X7 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 X7 OCS include the following.

- Small, sleek profile saves space and resources.
- Physical Specifications
  - mm: 143.50 tall x 186.08 wide x 46.6 deep
  - in: 5.65 tall x 7.33 wide x 1.34 deep
  - 20.8 oz. / 590g
- Bright color 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 X7 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.

Electrical Installation



Chapter 3: Electrical Installation

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3.2: How to Test for Good Ground 16
3.3: Primary Power Port 17

NOTE: The datasheet is the first document to refer to for model-specific information. Refer to the Documentation Search on the Horner website.

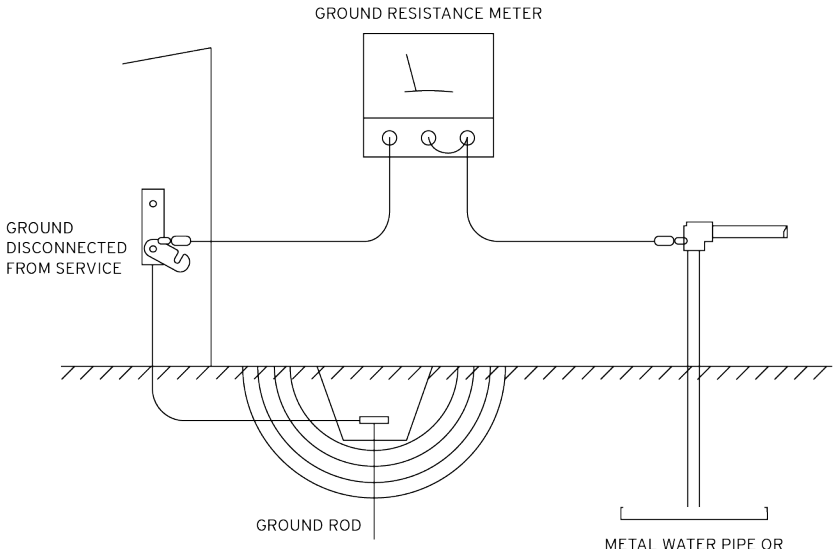
3.1: Ground Specifications

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).

3.2: 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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3.3: Primary Power Port

The Primary Power Range is 24VDC ± 20%.



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

3.3.1: DC Input/Frame

- Solid/Stranded Wire: 12-24 AWG (Φ2.5-0.2mm)
- 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.

3.3.2: 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.



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

NOTE: Refer to datasheet for power specifications

Mechanical Installation



Chapter 4: Mechanical Installation

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NOTE: Refer to the High Speed I/O chapter for more information and refer to the datasheet for X7 [**MAN1156**] via the Document Search.

4.1: 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.

4.2: 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 X7 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 X7. 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 (MAN1156). 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 X7 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 X7 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).
8. Connect communications cables to the serial port, USB ports, and CAN port as required.

4.3: Mounting Clip Locations



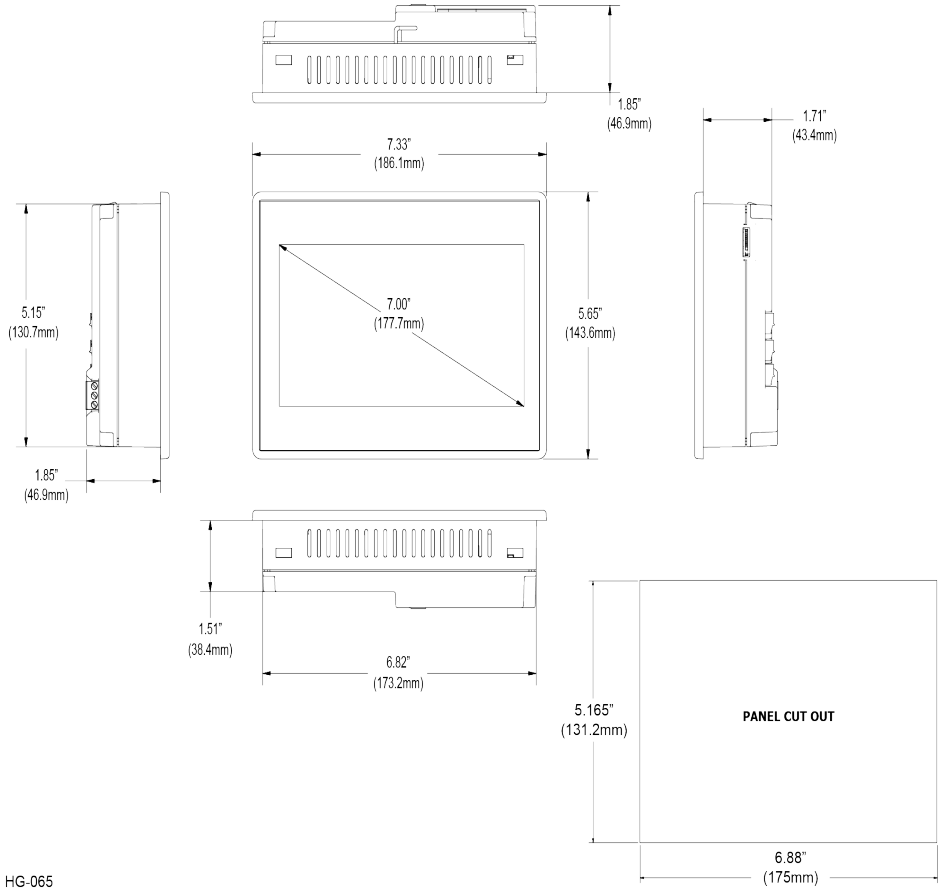
4.3.1: X7 OCS Mounting Orientation



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.

4.4: Dimensions

For installations requiring NEMA 4X liquid and dust protection, the panel cutout should be cut with a tolerance of +0.5mm / -0mm.



4.5: Installation Procedure

- This equipment is panel mounted and is meant to be installed in an enclosure suitable for the environment, such that the back of the equipment is only accessible with the use of a tool.
- 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 X7 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.

1. Carefully locate an appropriate place to mount the X7. 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 131.2mm x 175mm (with a tolerance of +/- 0.5mm) opening into which the X7 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. For standard composite mounting clips (included with product). NOTE: Torque Rating is 2-3 in-lbs (0.23-0.34 Nm). 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.

4.6: 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.

4.6.1: 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)
If more than one device installed in panel box (or on door): Minimum Distance between bases of each device	4” (101.60mm) between bases of each device
When door is closed: Minimum distance between device and closed door (Be sure to allow enough depth for the OCS.)	2” (50.80mm)

4.6.2: 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 manufactuer and also meet applicable electrical codes and standards.

4.6.3: 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.

4.6.4: 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.

4.6.5: 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.

4.6.6: 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?

System Settings and Adjustments



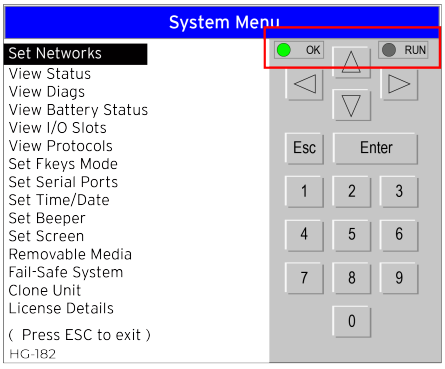
Chapter 5: System Settings

5.1: OCS LED Indicator Lights 25
5.2: System Menu 26
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5.4: View Status & Diags 30
5.5: View Protocols 32
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5.9: Fail – Safe System 40
5.10: Clone Unit 43
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5.1: OCS LED Indicator Lights

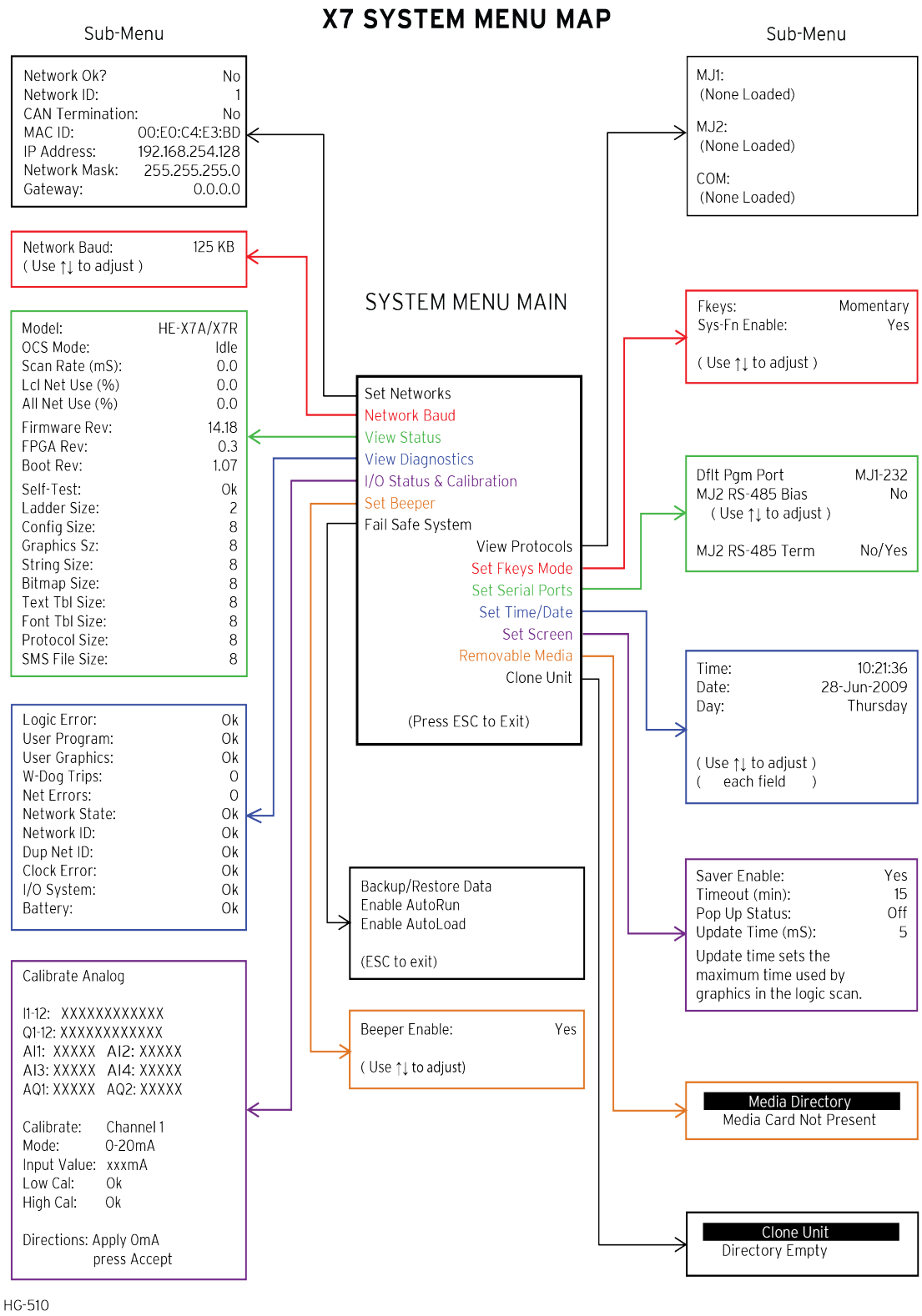
The X7 OCS has a built-in System Menu, which lets the user view System Settings and makes adjustments. To start the System Menu, press the SYSTEM key (or set %SR3 to 1), which will display the Main Menu. Then use the ↑ and ↓ (Up Arrow or Down Arrow) keys to select a Main Menu item and press Enter (Return Arrow) to display the item's submenu.

NOTE: Press the upper right corner to bring out the function keys and SYSTEM key in order to access the Main Menu.

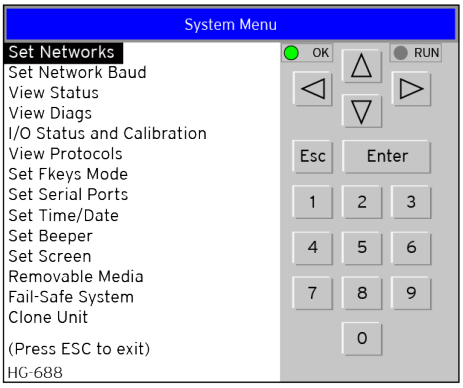


	OCS LEDs
RUN	■ OFF indicates OCS is in IDLE/STOP mode. ■ Flashing indicates DO / IO mode or RUN with no ladder program. ■ ON indicates ladder code running.
OK	■ OFF indicates one or more self-tests failed. ■ ON indicates all self-tests passed. ■ Flashing at 1 Hz indicates forcing is active.

5.2: System Menu



5.2.1: Navigation and Editing



As mentioned above, the System Menu is started by pressing the System key on the X7 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 submenu.

A submenu generally shows a list of System Settings and their values. After opening a submenu, 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 submenu (returning to the Main Menu) or press **Enter** to edit the highlighted System Setting. If **Enter** is pressed, the System Setting's value will be highlighted, indicating that it is ready to be modified.

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

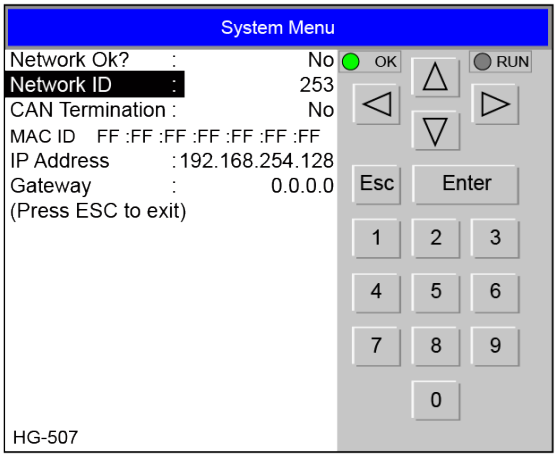
The arrow keys are used to edit System Settings that have just a few possible values. Each time the arrow key is pressed, a new possible value is displayed. When the desired value appears, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

The numeric keys are normally used to enter numeric System Settings.

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

5.3: Set Networks & Set Network Baud Rate

5.3.1: Set Networks

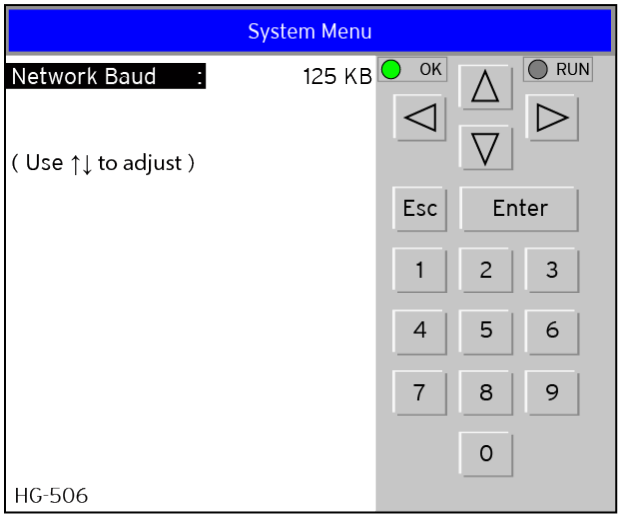


This submenu allows setting for the CAN and Ethernet network to be viewed or changed.

Network Ok?	**Yes** = connected to a network and functioning properly **No** = Not ready to communicate on the network
Network ID	1 to 253 = This node's CsCAN Network ID; must be unique on network
CAN Termination	**Yes** = 121Ω termination is internally placed between CAN_H and CAN_L terminals **No** = No termination present
MAC ID	Displays the Ethernet MAC ID of the unit
IP Address	Displays the Ethernet IP address of the unit
Network Mask	Displays the Ethernet net mask of the unit
Gateway	Displays the Ethernet gateway of the unit

NOTE: The IP address, Net Mask, and Gateway can be changed from the System Menu. This is designed for commissioning or temporary field changes. The actual parameters are defined in Cscape under the Ethernet configuration.

5.3.2: Set Network Baud Rate

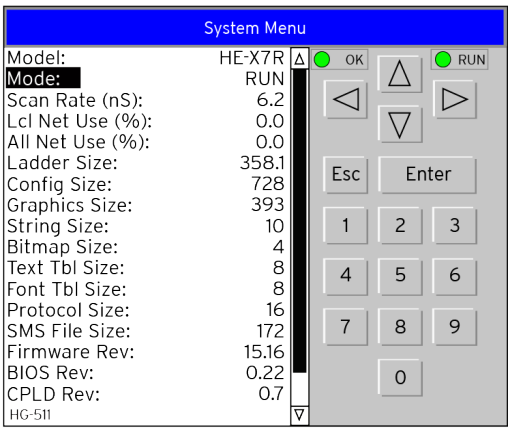


The Set Network Baud submenu for both X7 models displays just one System Setting and it is editable.

Network Baud	125kB = 125kBd CAN network 250kB = 250kBd CAN network 500kB = 500kBd CAN network 1MB = 1MBd CAN network

5.4: View Status & Diags

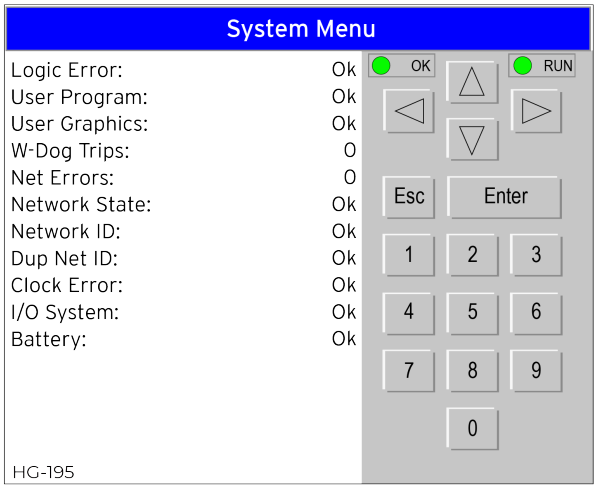
5.4.1: View Status



The View Status submenu displays up to 18 System Settings. Only the Mode System Setting is editable.

Model	**Xxyyz** = 5 or 6 character model number of this X7 unit **x** is 1 for models that have a CAN port; **0** = no CAN port **yy** indicates the installed I/O module; **00** = no I/O module **z** indicates the installed COM module; **N** = no COM module
Mode	**Idle** = X7 is in Idle mode **DoIO** = X7 is in Do I/O mode **Run** = X7 is in Run mode
Scan Rate(mS)	**0.0** = X7 is not in Run mode **0.1 to 999.9** = Average number of mS for each ladder scan
Lcl Net Use %	**0.0 to 100.0** = CAN network bandwidth % used by this X7 node
All Net Use %	**0.0 to 100.0** = CAN network bandwidth % used by all nodes
Ladder Size	**2** (Number of bytes in application ladder program)
Config Size	**8** (Number of bytes in application I/O configuration)
Graphics Size	**8** (Number of bytes in application graphic screens)
String Size	**8** (Number of bytes in application string table)
Bitmap Size	**8** (Number of bytes in application bitmaps)
Text Tbl Size	**8** (Number of bytes in application text tables)
Font Tbl Size	**8** (Number of bytes in application font tables)
Protocol Size	**8** (Number of bytes in application downloaded protocols)
SMS Msg Size	**8** (Number of bytes in application SMS protocol configuration)
Firmware Re:	**14.18** (xx.yy of current firmware version)
BIOS Rev	**0.22** (Basic I/O System)
CPLD Rev	**0.3** (x.y of current CPLD—Complex Programmable Logic Device)
Self-Test	**Ok** = All power-on self-tests passed **Fault** = One or more power-on self-tests failed

5.4.2: View Diags



The View Diags submenu 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 X7 will not enter or remain in Run mode, and the problem must be investigated and corrected.

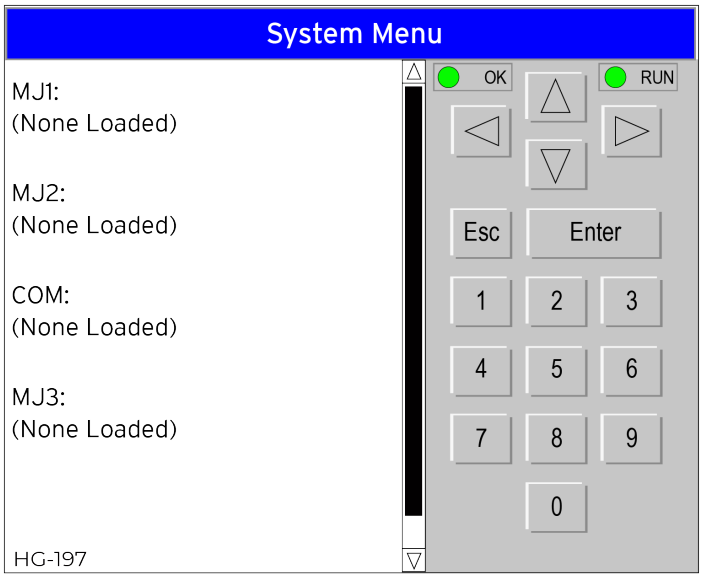
Logic Error	**Ok** = All executed ladder instructions are legal for loaded firmware **Fault** = A ladder instruction not supported by firmware was found
User Program	**Ok** = Ladder program and I/O configuration loaded successfully **Fault** = Ladder program or I/O configuration not loaded or load failed

The last nine System Diagnostics are informational. If any of them indicate a Warning condition, the X7 can still enter and remain in Run mode, but the problem should be investigated and corrected.

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

5.5: View Protocols

See also: "Protocol Configuration " on page 119



The View Protocols submenu displays currently configured serial protocols. The configuration is not editable from the System Menu.

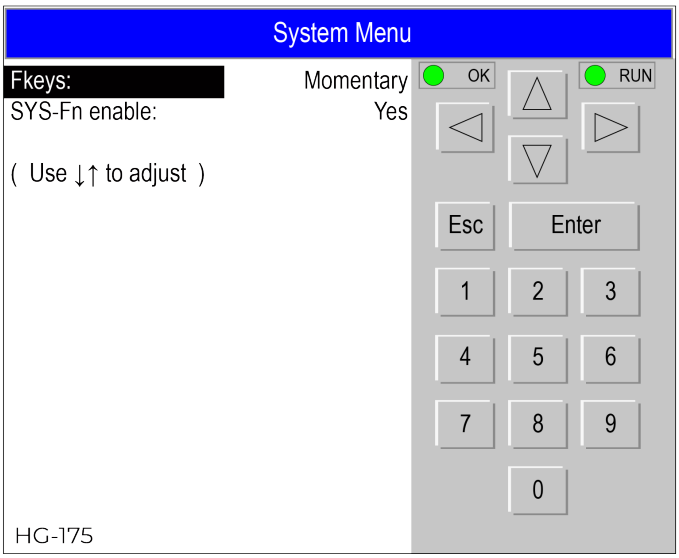
As mentioned in Downloadable Serial Communication Protocols section, both the MJ1 (Port 1) and MJ2 (Port 2) serial ports support downloadable protocols. To assign a downloadable protocol to an X7 OCS serial port, select the Protocol Config item in Cscape's Program menu and then setup a protocol for Port 1 or Port 2 (or both).

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

Port 1	
Protocol Name	(None Loaded) or name of the protocol assigned to MJ1
Protocol Version	Blank or version of the protocol assigned to MJ1
Port 2	
Protocol Name	(None Loaded) or name of the protocol assigned to MJ2
Protocol Version	Blank or version of the protocol assigned to MJ2

5.6: Set Keys, Serial Ports, Time/Date, Beeper & Screen

5.6.1: Set Fkeys Mode

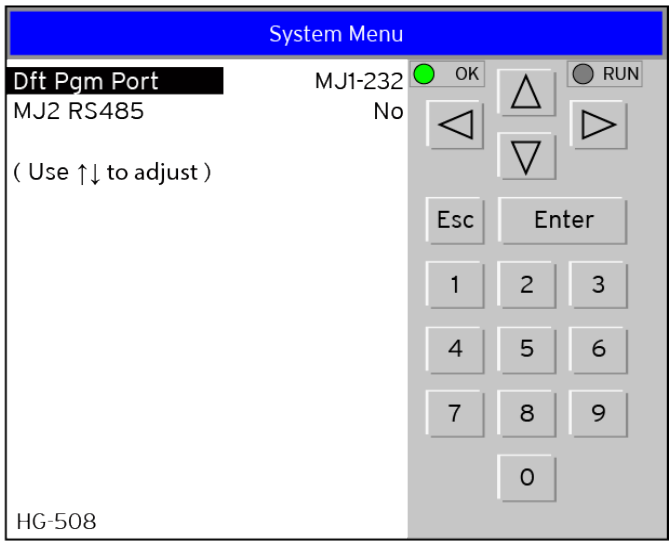


The Set Fkeys submenu displays two System Settings, both of which are editable.

Fkeys	**Momentary** = %K1-4 bits go On & Off as F1-F10 are pressed & released **Toggle** = %K1-10 bits toggle each time F1-F4 are pressed
SYS_Fn enable	**Yes** = Reset and all clear system functions enabled **No** = Reset and all clear system functions disabled

5.6.2: Set Serial Ports

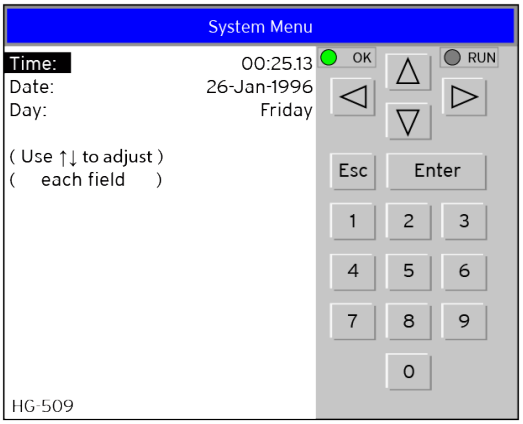
See also: "Serial Communications"



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

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

5.6.3: Set Time/Date



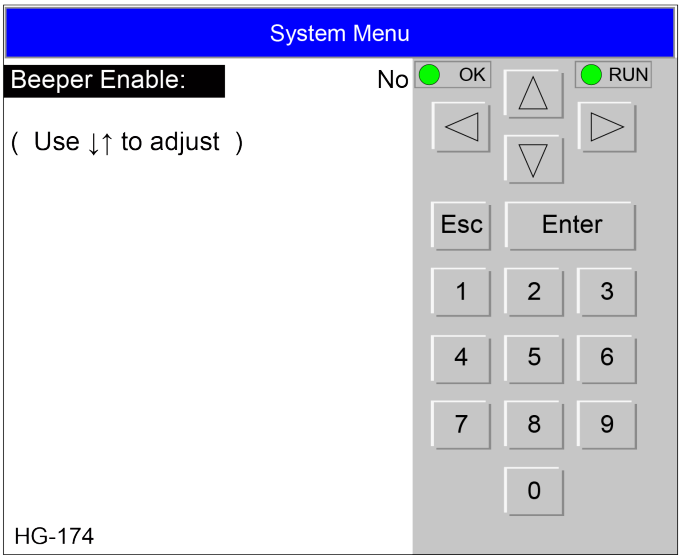
The Set Time/Date submenu displays three System Settings. Time and Date are editable, and Day is automatically calculated from the Date setting.

NOTE: Time and Date are split into three editable fields each. Use ← or → to select a field and then use ↑ or ↓ to edit the field.

Time	**16:09:49** = Current time (hours:minutes:seconds in 24-hour format)
Date	**10-Jun-1996** = Current date (day-month-year)
Day	**Monday** = Current day of week calculated from the Date setting

NOTE: The X7 must be power-cycled (or reset) before the changes take effect.

5.6.4: Set Beeper

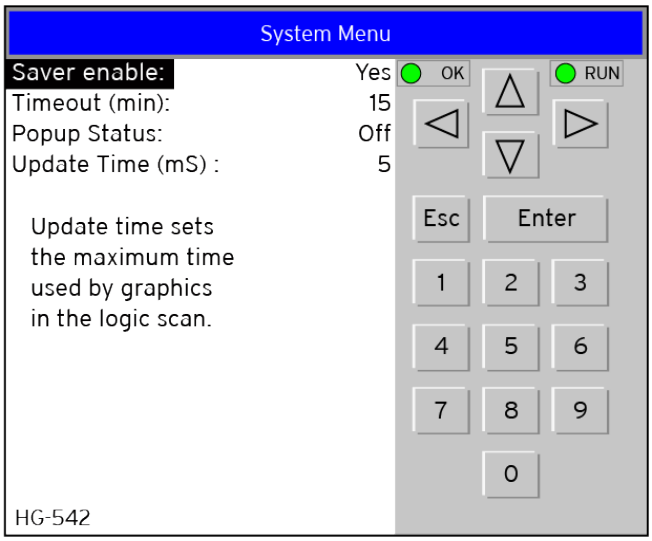


The Set Beeper submenu displays one System Setting, which is editable.

Beeper Enable	**Yes** (default) = Enables beeper **No** = Disables beeper (does NOT affect ladder access)

5.6.5: Set Screen

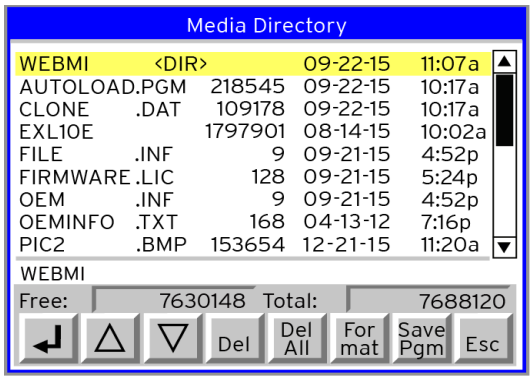
The Set Screen submenu displays four System Settings, all of which are editable.



Saver enable	**Yes** = Enable screen saver **No** (default) = Disable screen saver
Timeout (min)	**5 - 1200** = Amount of time in minutes to expire with NO touch activity before activating screen saver (black screen)
Popup Status	**Off** (default) = Disable popup status **Warning** = Display popup status only if controller status changes to NOT Ok or NOT Run mode. **On** = Display popup status on any controller status change.
Update Time (mS)	**2 - 50** = Maximum amount of time to allow for graphics update per scan

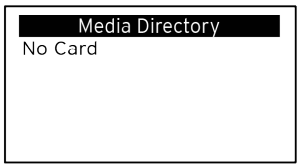
5.7: Removable Media

See also: "Removable Media" on page 140

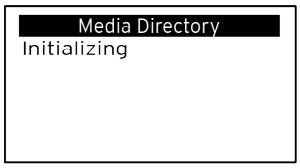


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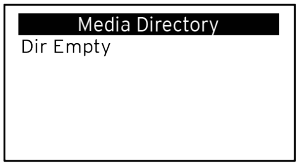
The Removable Media submenu displays the Removable Media Manager. After selecting Removable Media from the Main Menu, one of four submenu screens will appear:



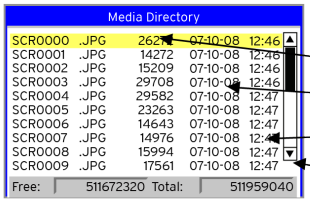
= No microSD card has been installed in the Memory slot



= microSD card is installed, but it is still initializing



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



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= microSD card is installed and initialized, and it contains files

Shows size of highlighted file or shows <DIR> if directory is highlighted.

Shows the date file or directory was created or last modified.

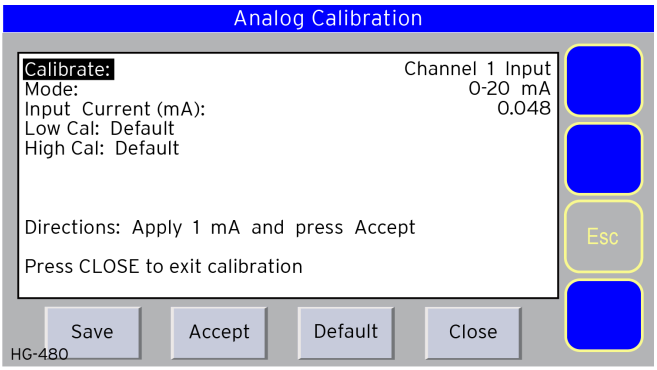
Shows the timw file or directory was created or last modified.

Scrollbar

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.

5.8: Calibrate Analog

When first entering this option, the user is presenting with information about the X7 model and current state of the IO points. Refer to "General I/O Configuration" on page 1 for more details.




```
Model:      XE-X7R
I12-1:      000000000000
Q12-1:      000000000000
AI1:  12345
AI2:  456
AI3:  789
AI4:  32100
AQ1:        33333
AQ2:        11111
Calibrate Analog
```
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The I and Q sections indicate the ON and OFF status of the individual digital inputs and outputs respectively. The AI values show the raw analog inputs scaled from 0 to 32,000. The AQ items show the raw analog outputs scaled from 0 to 32,000.

The “Calibrate Analog” item is a submenu that, when selected, allows entering the field calibration for analog inputs and outputs.

NOTE: The X7 must be power-cycled (or reset) before the changes take effect.

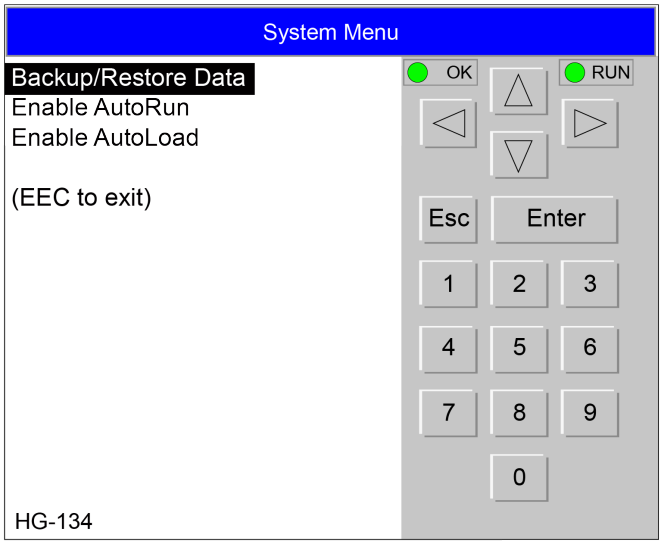
5.9: Fail – Safe System

See also: "Fail-Safe System for the XL and X Series" on page 153

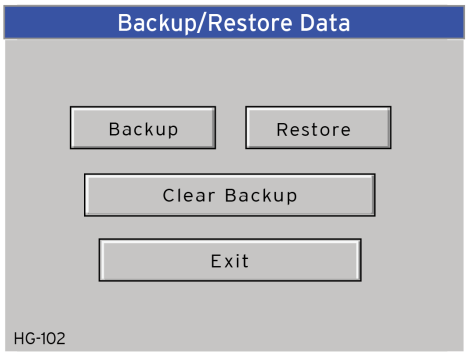
The Fail-Safe System is a set of features that allow an application to continue running in the event of certain types of "soft" failures. These "soft" failures include:

- Battery power loss
- Battery-Backed Register RAM or Application Flash corruption due to, for example, an excessive EMI, Electromagnetic Interference, event.

Selecting “Fail-Safe System” menu will open the following menu screen:



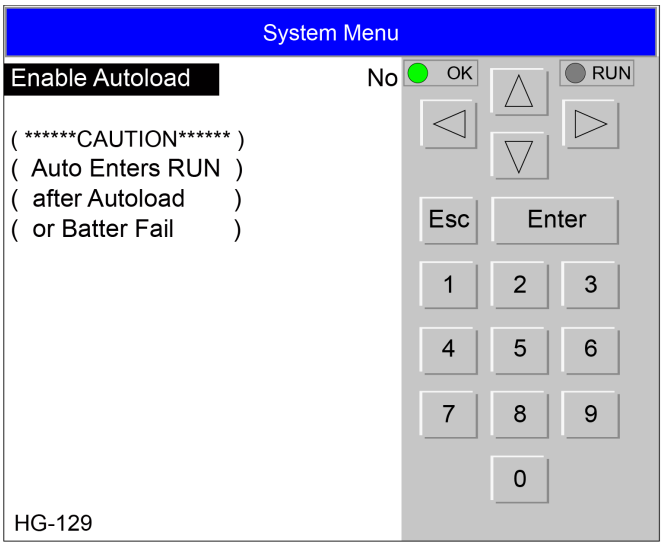
Selecting Backup/Restore Data displays the following screen in:



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

5.9.1: Enable AutoRun

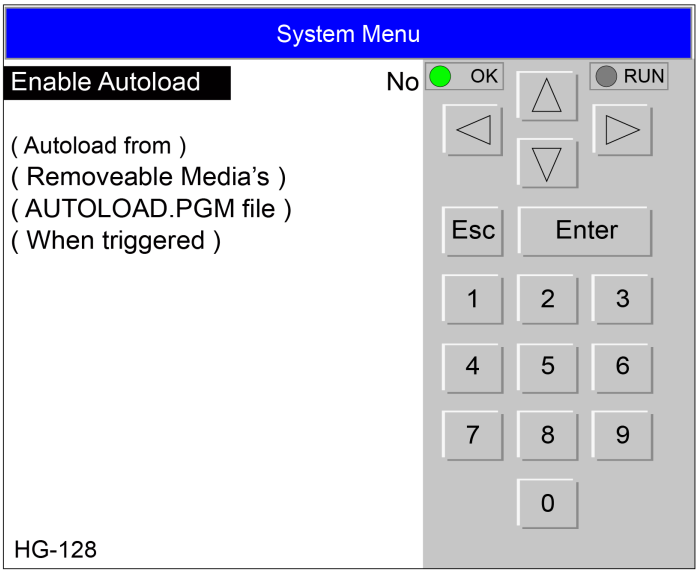
“Enable AutoRun” displays the following options which can be selected:



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

5.9.2: Enable AutoLoad

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



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

5.10: Clone Unit

See also: "Clone Unit" on page 147

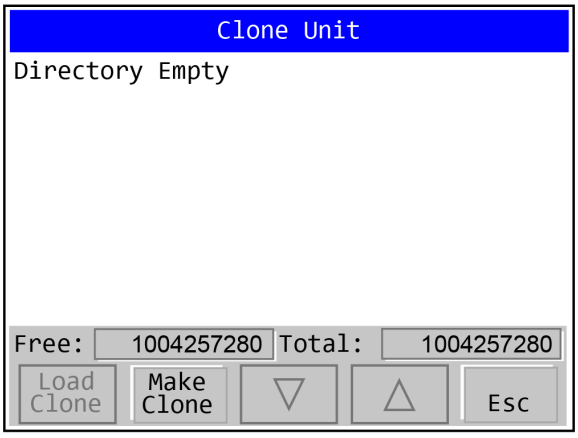
'Clone Unit' feature allows the user to "clone" the OCS of the exact same model. This feature "clones" application program and unit settings stored in battery-backed RAM of an OCS into the RM. Refer to "Removable Media" on page 140 for details on using RM. It can then be used to clone a different OCS (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:

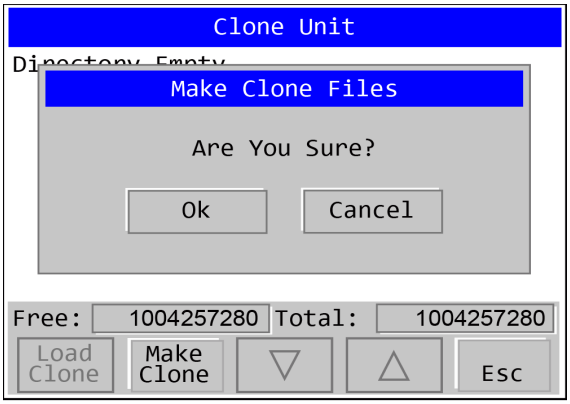


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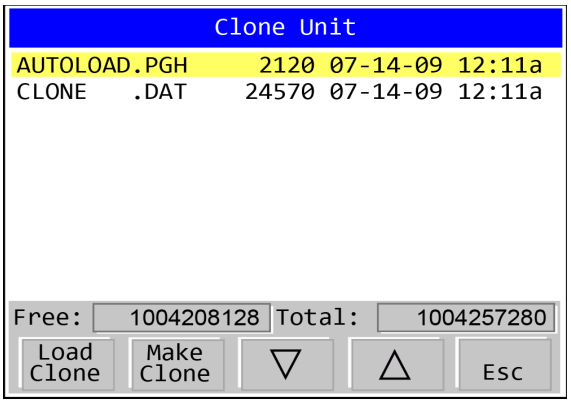
Load Clone and **Make Clone** virtual buttons are below the screen. **Free/Total**: Displays number of Free and Total bytes in Removable Media.

Selecting Make Clone brings up the screen below for the user:

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



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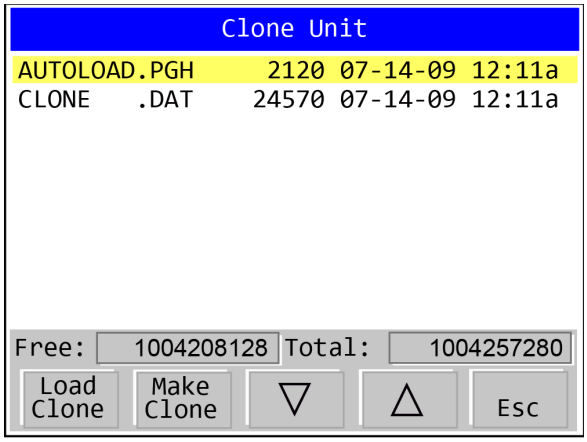


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AUTOLOAD.PGM	Application file
CLONE.DAT	File having all unit settings and register values from battery-backed RAM

5.10.2: Load Clone

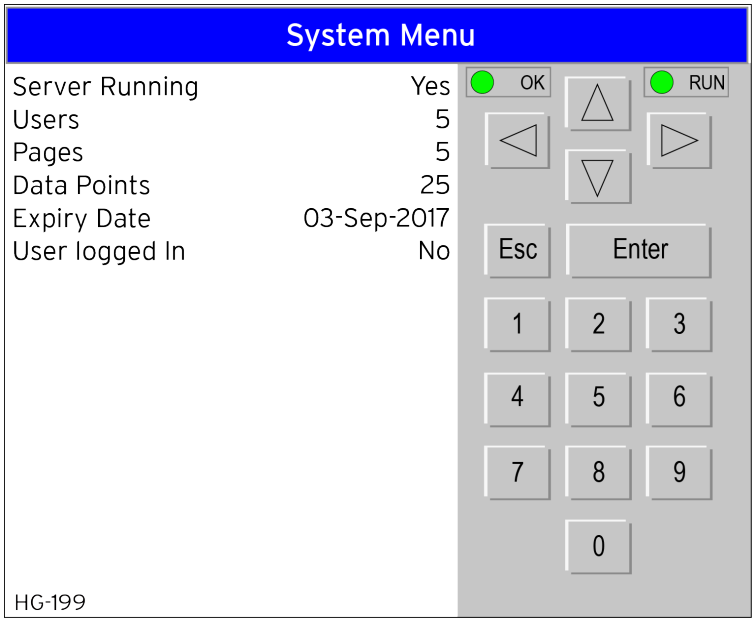
Selecting “Clone Unit” menu will open the following menu screen. Select “Load Clone” (one of the virtual buttons beneath the screen).



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

5.11: WebMI License Details

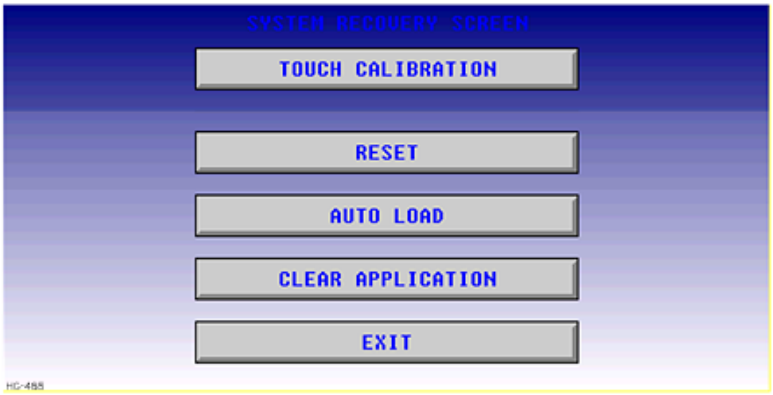


License details page displays the information about the WebMI license. Please refer to MAN1036 for the WebMI Manual using Horner's Documentation Search page. The information can also be viewed from Cscape using the following %SR registers:

%SR209.3	WebMI server status
%SR209.4	WebMI user logged in status
%SR209.9 to SR209.16	Number of Users
%SR218	Number of Webpages
%SR219	Number of Data Points
%SR220-SR222	Expiry Date of WebMI License

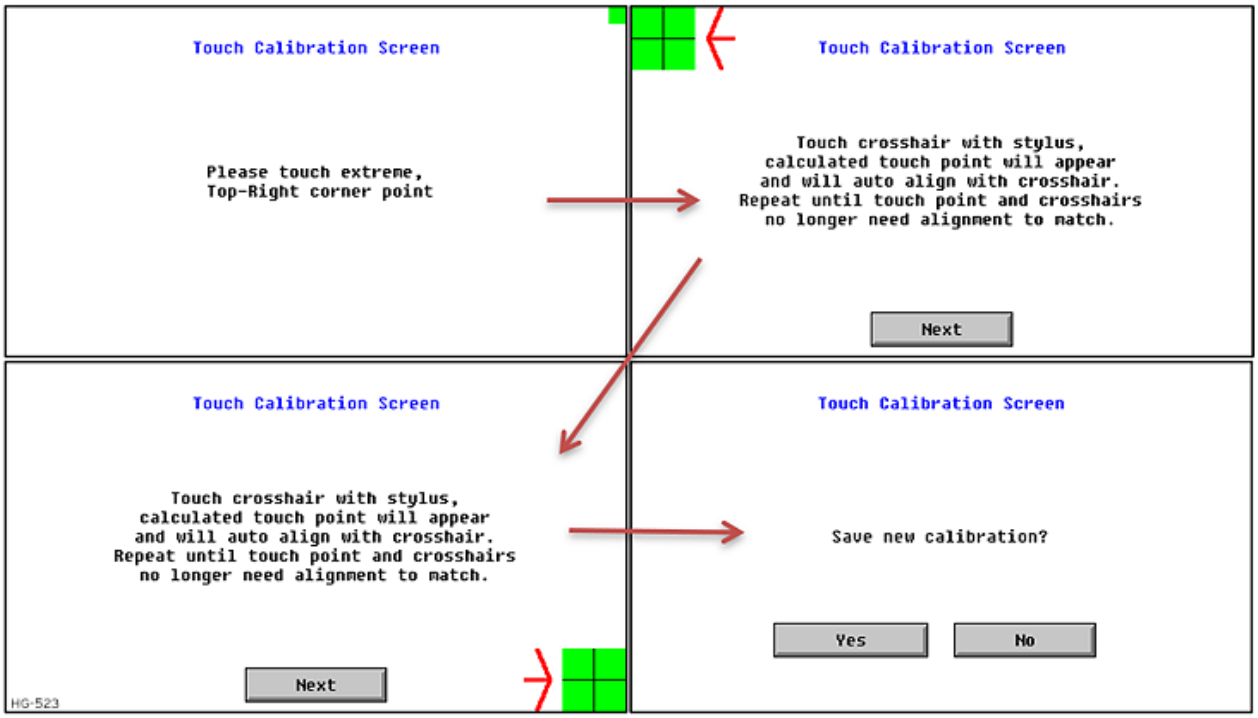
5.12: Touch Screen Calibration

The touch screen is calibrated at the factory and rarely needs modification. However, if actual touch locations do not appear to correspond with responding objects on the display, field adjustment is available. Ensure SYS_fn Enable is set to YES in System Menu. To access the field adjustable touch screen calibration dialog, press and hold both the SYS and F1 key for longer than 2 seconds and a dialog similar to the figure below will appear.



NOTE: Advanced options, accessed by holding the system key down, may be locked out from user access. If holding the SYSTEM key does NOT respond, verify that the system menu's Set Fkeys submenu's parameter SYS_Fn is enabled.

For best results in screen calibration, use a stylus with a plastic tip. When the crosshair appears, touch the center of the crosshair as exactly as possible and release. A small "+" should appear and will move closer to the center of the crosshair. Once it has done so and disappeared again, repeat the process until "+" appears in the center of the crosshair. Then move on to the next step.



Register Mapping



Chapter 6: Register Mapping

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For I/O Register Maps for individual controllers, refer to the Horner website Document Search page.

There are two types of System Registers that may be used during programming. %S registers indicate the status of several system operations. %SR registers indicate the state of many system operations and can be used to control them in several cases. Some of the system registers have predefined I/O names, though they may still be changed if desired.

6.1: Register Definitions

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

6.2: %S Registers

%S registers indicate system status as follows:

%S Registers			
S#	**Name**	**Predefined 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.

%SR Registers					
SR #	**Name and Description**	**Default I/O Name**	**Min - Max Values**	**Program (Read/Write)**	**Display (Read/Write)**
%SR1	User Screen Number (0=none)	USER_SCR	0 to 1023	Read/Write	Read/Write
%SR2	Alarm Screen Number	ALRM_SCR	0 to 1-23	Read Only	Read Only
%SR3	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 14= View Protocols 15= IP Address 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	SYS_SCR	0 to 24	Read/Write	Read/Write
%SR4	Self Test Results	SELF_TEST		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

%SR Registers					
%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	**Reserved**				
%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	Current Touch Pressure	TCH_ PRESSURE	0 to 3000	Read Only	Read Only
%SR10	Threshold Touch Pressure	TCH_ PRESSURE_ TSH	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)			Read Only	Read Only
%SR15-16	System Text Screen Size (32-Bit DINT)			Read Only	Read Only
%SR17-18	I/O Configuration Table Size (32-Bit DINT)			Read Only	Read Only
%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	Network ID	NET_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 not required		0 to 3	Read Only	Read Only

%SR Registers					
	1= Network required; 2= Network optimized; 3= Network required and optimized				
%SR32	LCD Display Contrast setting		0 to 255	Read Only	Read/Write
%SR33	Function Key Toggle Mode 0= Momentary 1= Toggle		0 to 1	Read/Write	Read/Write
%SR34	RS232 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 l LAN1 MAC ID			Read Only	Read Only
%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			Read Only	Read Only
%SR42	Horizontal Pixel Count			Read Only	Read Only
%SR43	Keypad Type			Read Only	Read Only
%SR44	Real-Time-Clock Second	RTC_SEC	0 to 59	Read Only	Read Only
%SR45	Real-Time-Clock Minute	RTC_MIN	0 to 59	Read Only	Read Only
%SR46	Real-Time-Clock Hour	RTC_HOUR	0 to 23	Read Only	Read Only
%SR47	Real-Time-Clock Date	RTC_DATE	1 to 31	Read Only	Read Only
%SR48	Real-Time-Clock Month	RTC_MONTH	1 to 12	Read Only	Read Only
%SR49	Real-Time-Clock Year	RTC_YEAR	1996 to 2095	Read Only	Read Only
%SR50	Real-Time-Clock Day (1=Sunday)	RTC_DAY	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	Key Currently Pressed No key = 0 (No key pressed since power-up) F1 = 1 F2= 2 F3= 3 F4 = 4 F5= 5 F6= 6	LAST_KEY	0 to 255	Read Only	Read Only

%SR Registers					
	F7=7 F8= 8 F9= 9 F10 = 10 F11= 11 F12 = 12 Enter = 13 +/ - = 14 . (dot) = 15 0 = 16 1 = 17 2 = 18 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)				
%SR57	LCD Backlight Dimmer Register 0-100 = 0% to 100% On 100-255 = 100% On		0 to 255	Read Only	Read Only
%SR57.16	Temporarily disable Screen Saver			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		0 to 2	Read Only	Read Only

%SR Registers					
	Build Test = 0 Build Beta = 1 Build Product = 2				
%SR61	Number of CsCAN Network IDs	NUM_IDS		Read Only	Read Only
%SR62-100	**Reserved**				
%SR101.3	WebMI License Details – WebMI server status			Read Only	Read Only
%SR101.4	WebMI License Details – WebMI user logged in status			Read Only	Read Only
%SR101.8 - 101.16	WebMI License Details – Number of users			Read Only	Read Only
%SR102 - 107	**Reserved**				
%SR108	WebMI License Details – Number of webpages			Read Only	Read Only
%SR109	WebMI License Details – Number of datapoints			Read Only	Read Only
%SR110-112	WebMI License Details – Expiry date of WebMI license			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			Read/Write	Read/Write
%SR152.2	RS485 Termination Enable			Read/Write	Read/Write
%SR152.3	**Reserved**				
%SR152.4	CAN Termination Enable			Read/Write	Read/Write
%SR153 - 163	**Reserved**				
%SR164	FailSafe / clone				
%SR164.1	RS485 Port Biasing #1 (MJ1 or MJ2)			Read/Write	Read/Write
%SR164.2	RS485 Port Biasing #2 (MJ2 or MJ3)			Read/Write	Read/Write
%SR164.3	Indicates Automatic Restore Operation has been performed	AUTO_ RESTRD		Read Only	Read Only
%SR164.4	Indicates Backup of Registers has	BCKUP_TAKN		Read Only	Read Only

%SR Registers					
	been taken				
%SR164.5	Enable AUTORUN – Sets “Enable AutoRun” to “Yes” or “No”	EN_AUTO_LD		Read/Write	Read/Write
%SR164.6	Enable AUTOLOAD – Sets “Enable AutoLoad” to “Yes” or “Not”	EN_AUTO_LD		Read/Write	Read/Write
%SR164.7	Start Backup trigger bit – Setting TRUE starts backup of all register data	STRT_BCKUP		Read/Write	Read/Write
%SR164.8	Clear Backup trigger bit – Setting TRUE clears backup of all register data (if a backup was done previously)	CLR_BACKUP		Read/Write	Read/Write
%SR164.9	MAKE_CLONE trigger bit = Setting TRUE does a Load Clone (if a media card is present)	MAKE_ CLONE		Read/Write	Read/Write
%SR164.10	LOAD_CLONE trigger bit – Setting TRUE does a LOAD CLONE (if a media card is present that contains clone files)	LOAD_CLONE		Read/Write	Read/Write
%SR164.11	Make Clone Fail (This bit goes high when Make/Create Clone fails)	MK_CLN_FL		Read/Write	Read/Write
%SR164.12	Load Clone Fail (This big goes high when Load Clone fails)	LD_CLN_FL		Read/Write	Read/Write
%SR164.14	**Reserved**			Read/Write	Read/Write
%SR164.15	**Reserved**			Read/Write	Read/Write
%SR165-166	**Reserved**				
%SR167	Screen Update Time, 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 Card			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	Bits 1-16 indicate Unacknowledged in Alarm Groups 1-16	ALM_UNACK		Read Only	Read Only
%SR182	Bits 1-16 indicate Active in Alarm Groups 1-16	ALM_ACT		Read Only	Read Only

%SR Registers					
%SR183	Beep on Keypress Enable 0= Disabled 1= Enabled	SYS_BEEP	0 to 1	Read/Write	Read/Write
%SR184	Internal Beeper 0=OFF 1=ON	USER_BEEP	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	Network Usage (Avg)	NET_USE	0 to 1000	Read Only	Read Only
%SR188	Network Usage (Min)		0 to 1000	Read Only	Read Only
%SR189	Maximum Net Usage of all units on the CAN network		0 to 1000	Read Only	Read Only
%SR190	Network TX Usage % (/ 10) (Avg)	NT_TX_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
EXTENDED SYSTEM REGISTERS					
%SR193	Online Change	ONLINE_CHG			
%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	**Reserved**				

%SR Registers					
%SR195	**Reserved**				
%SR196	**Reserved**				
%SR197	**Reserved**				
%SR198	**Reserved**				
%SR199	**Reserved**				
%SR200	InitRD Version (/100)			Read Only	Read Only
%SR201 - 205	Linux Kernel version: ASCII, 10 characters			Read Only	Read Only
%SR206-208	**Reserved**				
%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
%SR209.8 - 209.14	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	**Reserved**				
%SR219	**Reserved**				
%SR220-222	**Reserved**				

6.4: I/O Register Map for X7 OCS

NOTE: These registers can be used as general purpose registers

Fixed Address	Digital/Analog I/O Function	X7 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	3-14	3-14

6.5: X7 Resource Limits

Resource	Value
%I	1024
%Q	1024
%AI	256
%AQ	256
%M	1024
%T	1024
%R	5,000
%D	250
%K	20
%S	13
CsCAN	125kBd, 250kBd, 500kBd, or 1MBd
IDs Per CsCAN Network	64 w/o repeat (253 w/ 3 repeaters)
Serial Ports	1 RS232, 1 RS485 Ports (Single Connector)
Keypad	Slide Keys (Touch)
Display	7” Color Transmissive
Screen Memory	256kB
User Screens	250
No. of Objects per Page	30
Ladder Code	256kB

Resource	Value
Ethernet	CsCAN, Ping, Modbus TCP Master (Downloadable protocol) & Slave, Ethernet IP, FTP, or EGD (EGD does not support Multicast

6.6: PWM Function Registers 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	

6.7: HSC Functions Registers 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

Cscape Configuration



Chapter 7: Cscape Configuration

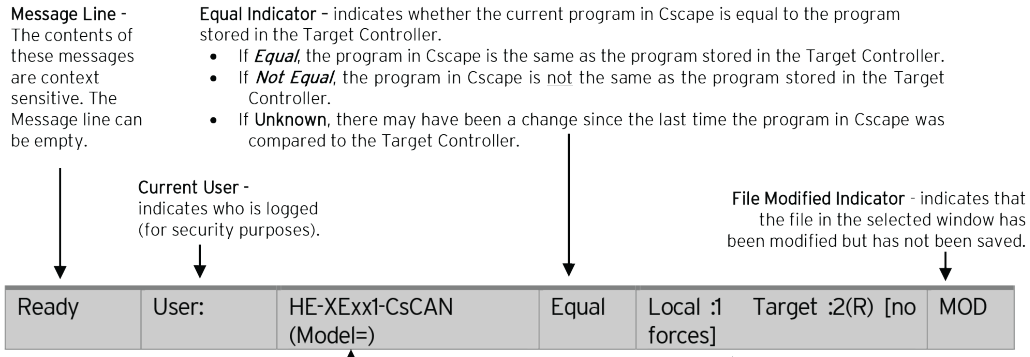
7.1: Overview 61
7.2: Cscape Status Bar 61
7.3: Establishing Communications 62

7.1: Overview

X7 Micro OCS hardware is programmed with a Windows based PC application called Cscape. This application can be used to program, configure, monitor, and debug all aspects of the X7 Micro OCS unit. Please see the Online Help provided with Cscape for additional details.

7.2: Cscape Status Bar

When the X7 Micro OCS is connected to a PC using Cscape software, a Status Bar appears at the bottom of the screen. The Cscape Status Bar can be used to determine if communications have been established between the X7 Micro OCS and the Cscape program. Components of the Cscape Status Bar are explained below:



Controller Model - Network (Model Confirmation)

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

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

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

The following are status indicators:

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

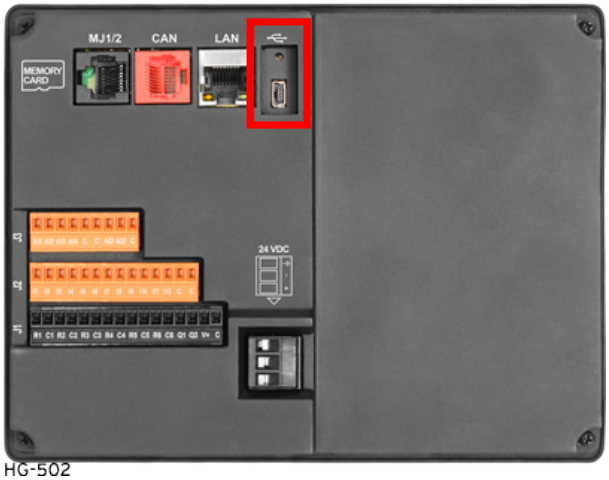
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7.3: Establishing Communications

The X7 Micro OCS can communicate with Cscape using USB to USB, USB to serial adapters, serial port communications via MJ1 Port, Ethernet (with an Ethernet adapter board), onboard Ethernet Port, CAN (CsCAN), or modems.

If a direct USB connection is to be used, connect the Mini-USB port on the OCS to an open USB port on the PC. (A cable for doing this is included in HE-CPK, the programming kits.) The OCS will install as a device once plugged in. Drivers for it are normally found automatically by the Windows operating system as long as an Internet connection is established.

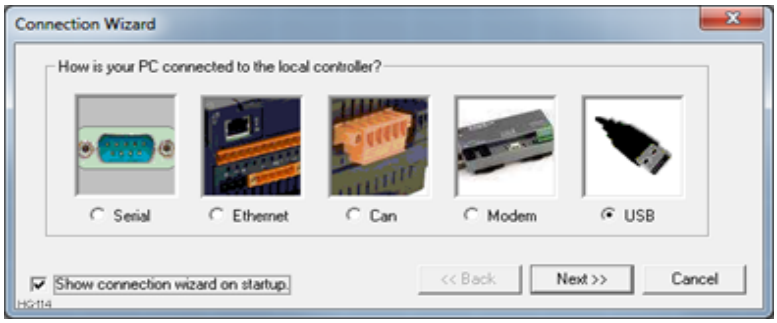
See also the Tools of the Trade on the Horner website.



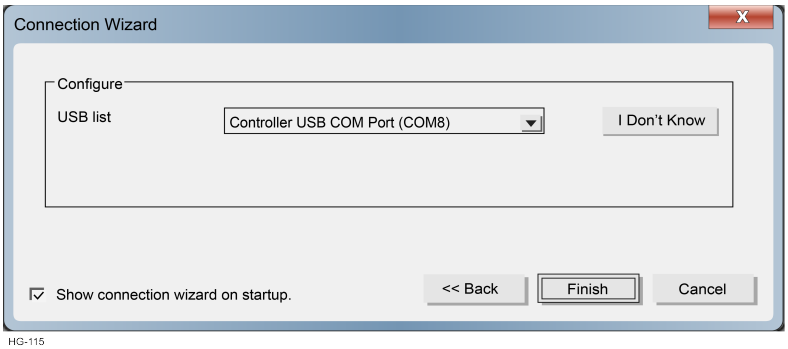
HG-502

The PC will detect a new device has been plugged into the USB port.

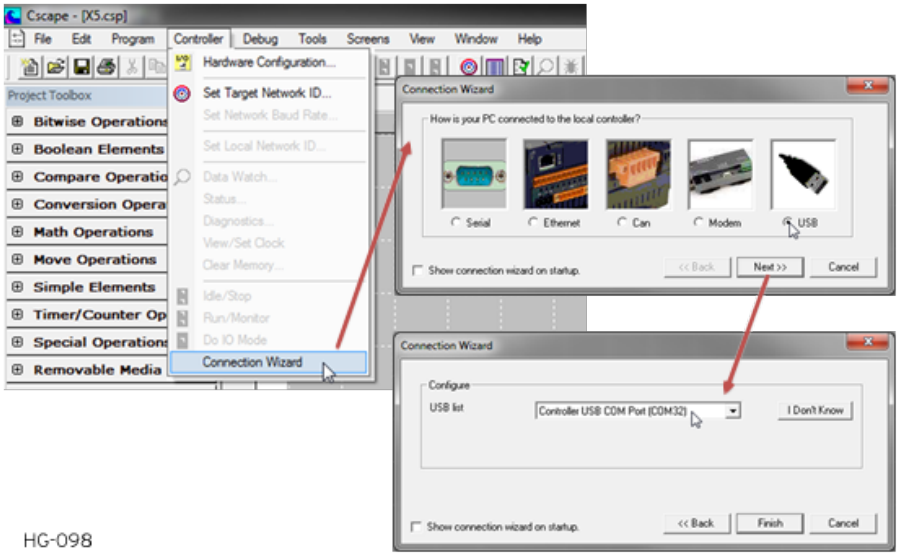
Now that the X7 Micro is plugged in, go to **Cscape > Controller > Connection Wizard**. If you are just opening Cscape, Connection Wizard usually opens by default.



Select USB and click **Next >>**.

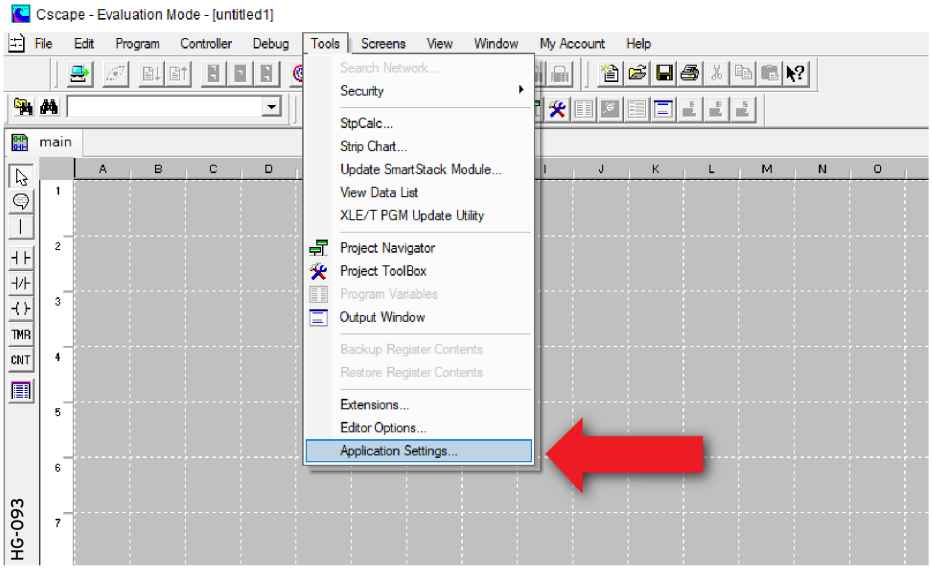


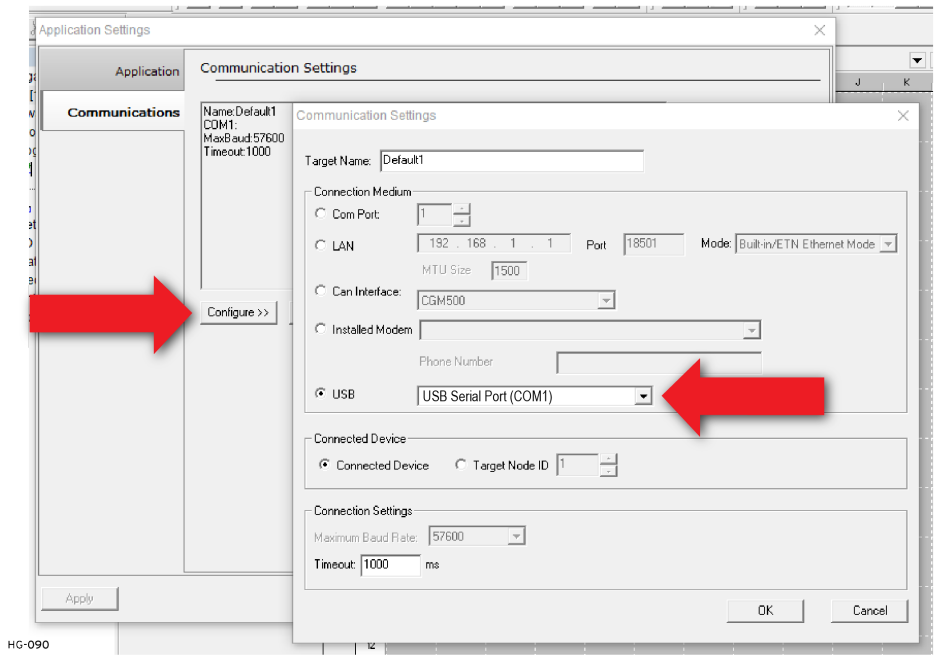
If the Connection Wizard does not pop up upon opening Cscape, then select **Controller** (in the Cscape tool bar) **> Connection Wizard**, choose your connection method. If you are connecting for the first time, we suggest connecting via USB.



If **Controller USB COM Port** is not present in the dropdown list, the Windows operating system has not yet recognized the OCS as an installed device. Be sure the installation process is complete and that the correct drivers are installed. The Connection Wizard must be completely closed and reopened to refresh the USB dropdown list.

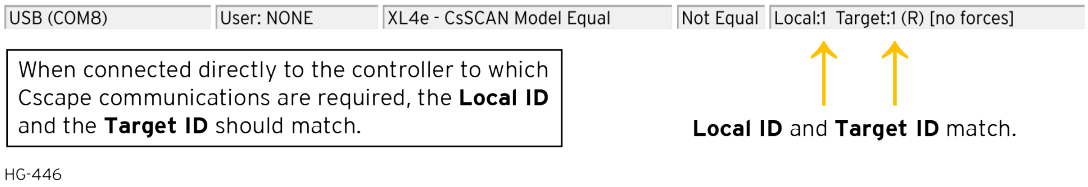
An alternate way to select the COM setting is to go to **Cscape > Tools > Application Settings > Communication > Configure** and choose connection method in **Add Target**. See table below.





Communication Configuration Dialog	
Target Name	Name for connection. This is not a mandatory column to be filled, by default Cscape will populate 'Default1' in edit box.
Connection Medium	
Com Port	Select this option to communicate over serial communication with the device. The port number can be configured here.
Ethernet	**Select** this option to communicate over Ethernet. Provide the IP address of the device and select the mode: HE GSM GPRS mode, Built in/ ETN Ethernet mode, or HE XEC Ethernet mode. **Select** HE GSM GPRS mode if communication with XL series controller on GPRS is required and the device has GSM modem installed in XL series controller. **Select** Built in/ ETN Ethernet mode if the device has on-board Ethernet port. **Select** HE XEC Ethernet mode if the device has Ethernet comm. option board installed in XL series controller. NOTE: For GPRS connectivity, GPRS configuration from Programs > Messaging > GPRS needs to be done. NOTE: The controller should support the type of connectivity selected and configured for Ethernet communication.
CAN Interface	Select this option to communicate over CAN. This option requires additional hardware to be installed with the PC to be able to do so. Select the type of hardware installed from the dropdown.
Installed Modem	Select this option to communicate to the device through the internal modem of the computer. Cscape will automatically detect the internal modem attached with PC and list in the attached drop down. User can select modem and telephone number for target controller. NOTE: Cscape will do necessary initialization for the selected internal modem.
USB	Select this option to communicate over USB. Now Horner devices and Horner USB to serial converters are recognized and can be specifically selected.
Connected Device	
NOTE: This configuration is required if the controller to which Cscape is communicating is connected to a CsCAN network.	
Connected Device	By default, this option is selected and networking feature of Cscape is disabled.
Target Node ID	On selecting this option, Networking feature of Cscape is enabled. CsCAN ID for the target controller to be provide here.
Connection Settings (General Communication Settings)	
Maximum Baud Rate	Select the baud rate for serial communication.
Timeout	Select the communication timeout. NOTE: Select a larger timeout for GPRS and installed modem communication configuration

If communications are successful, the message line should show “USB (COM8)” for this example, and an (R) should follow the Target number.



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

The main method for communicating between Cscape and an X7 is RS-232 serial. The X7 can communicate with Cscape using USB to serial adapters, CAN (CsCAN) or modems. For communications other than RS-232 serial please refer to the manual that ships with the adapter hardware being used for programming.

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

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

7.3.1: Communicating via MJ1 Serial Port

Start by configuring Cscape to use the correct communications port. This can be done using the **Tools > Application Settings > Communication** dialog in Cscape.

Next connect the PC serial port to the port labeled MJ1 on the X7.

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

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

To check or change the ID on the X7, press the far upper right corner of the touch screen to bring out the function keys, then press the **System Menu** key.

The first item in the menu is **Set Network ID**. Select **CAN ID:** > **Enter** allows you to view or modify the ID of the unit.

To point Cscape at the correct controller, change the **Target ID** using the **Controller > Set Target Network ID** dialog.

7.3.2: Communicating via On Board Ethernet Port

Configure the Ethernet settings via a PC

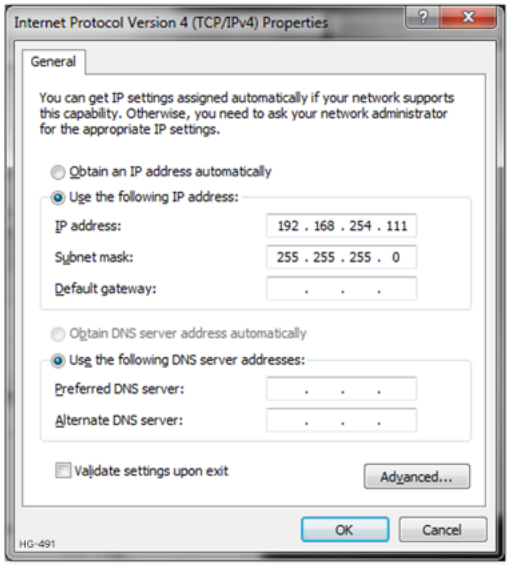
The X7 Ethernet address may be set from the System Menu depending on the program currently loaded into the X7. To check or change the Ethernet address on the X7 OCS, press in the far upper right corner of the touch screen to bring out the function keys, then press the **System Menu** key.

Select **Set Networks** and press **Enter**.

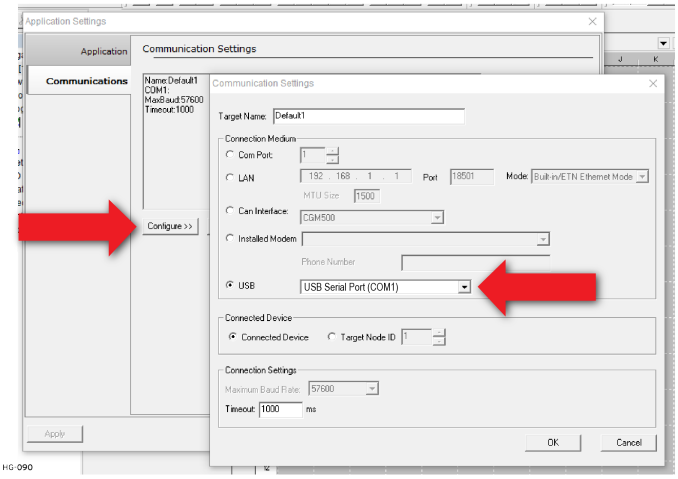
At a minimum, the **IP** (IP Address) and **NetM** (Net Mask) settings must be configured to communicate via Ethernet. Depending on how the network is setup, the GatWy (Gateway) may also need to be configured.

From the factory, the X7 OCS is set to the IP Address 192.168.254.128. To obtain Ethernet communications between Cscape and the X7 OCS using a single Ethernet cable between a PC and the X7, or through an unmanaged Ethernet Switch, the PC will also need to be manually configured as follows (may require Administrator access on PC):

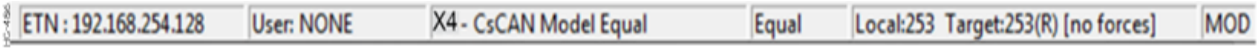
1. Access the Network Connections in the Control Panel (Shortcut: Press the **Windows** key and type **Network Connections…** select the resulting filtered link).
2. Double-click the connection being used to directly connect to the X7 OCS to bring up the Connection Status.
3. Click **Properties**.
4. Double-click **Internet Protocol Version 4 (TCP/Ipv4)** in the list of available protocols.



5. The PC may normally be set to “Obtain an IP address automatically”.
6. Click next to use the following IP address **192.168.254.111** or something other than that of the X7 OCS.



7. The **Subnet Mask** (255.255.255.0) should fill in automatically once the IP address has been entered.
8. The Default Gateway is not required for a direct connection.
9. Click **OK** all the way back to the Network Connections dialog.
10. Confirm the X7 OCS is set to the default 192.168.254.128 address or something on the same network.
11. In Cscape, click **Tools > Application Settings > Communications > Configure**.
12. Select **Ethernet**, then enter the IP address of the X7 OCS. **IMPORTANT**: The MTU setting defaults to the maximum 1500. It needs to match the PC's MTU setting for the best results. A PC may be set to an MTU of 1300 or something other than the default maximum setting by a network administrator.
13. The Port for CsCAN over Ethernet is **18501**.
14. The **Mode** for any controller with built-in **Ethernet is Built-in/ETN Ethernet Mode**.
15. Change the **Timeout** value to **3000** for direct connections. Timeout values of 5000-30000+ may be common for access over the internet or via VPN or other more complex networks.
16. Click **OK** all the way back to the main Cscape window. It may take a moment to initialize the communications.
17. Check the status bar for successful communications:

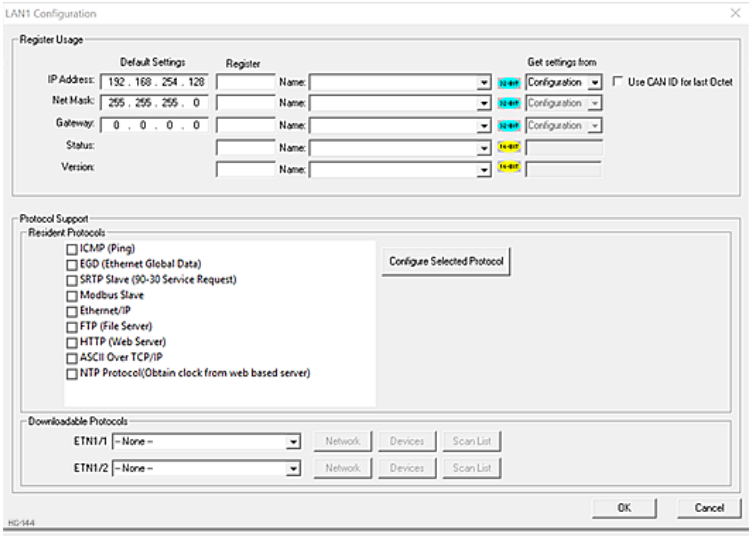


Configure Ethernet via Cscape

To configure the Ethernet settings of the X7 OCS using Cscape, go to **Controller > Hardware Configuration**. If not already done, select the correct connected controller, or use the **Auto Config** button to automatically recognize a controller that is already successfully connected to Cscape.

Below the main controller configuration, under **Network Ports**, find **LAN1**, and click on the **Config** button to the right of the greyed-out ETN300.

In the LAN1 Configuration, fill in the network setup for the X7 OCS. It may be required to consult IT personnel to determine proper settings if connection to a corporate network is required.



If **Get settings from** is set to **Configuration** for any parameter, the addresses in the **Default Settings** column will take place when this program is loaded and every time this controller enters RUN mode. Registers may optionally be defined that will reflect the settings. These settings may temporarily be changed via the SYSTEM menu but will revert to the Cscape-configured settings at any transition into RUN mode, i.e. a program download or at power-up.

If **Get settings from** is set to **Register** for any parameter, the addresses in the **Default Settings** column are ignored entirely. The addresses instead must come from the configured registers. It is not possible to change these settings via the SYSTEM menu in this case.

General I/O Configuration



Chapter 8: General I/O Configuration

8.1: Built-in Digital and Analog I/O Overview 72
8.2: Digital / HSC Input Configuration 73
8.3: Digital / PWM Output Configuration 77
8.4: Analog Input Configuration 83
8.5: Analog Output Configuration 88
8.6: I/O Status and Calibration 91

8.1: Built-in Digital and Analog I/O Overview

The X7 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 "Register Mapping" on page 48.

Model and I/O Overview

X7 Models	Solid State Digital Outputs	Relay Outputs	Digital Inputs	Analog Inputs	Analog Outputs
HE-X7A	✓		✓	✓	✓
HE-X7R	✓	✓	✓	✓	✓

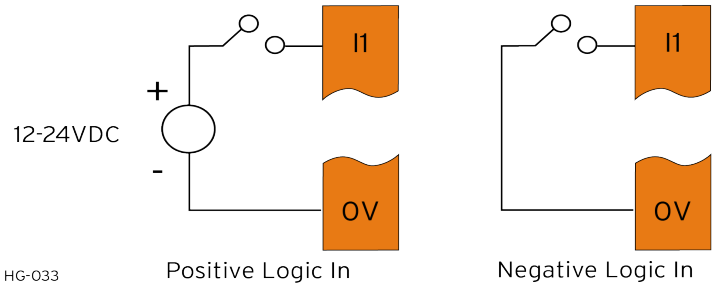
For more details, see the controller datasheet via Document Search.

8.2: Digital / HSC Input Configuration

NOTE: Refer to the High Speed I/O chapter for more information and refer to the datasheet for X7 [**MAN1156**] via the Document Search.

NOTE: The digital inputs on the X7 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.

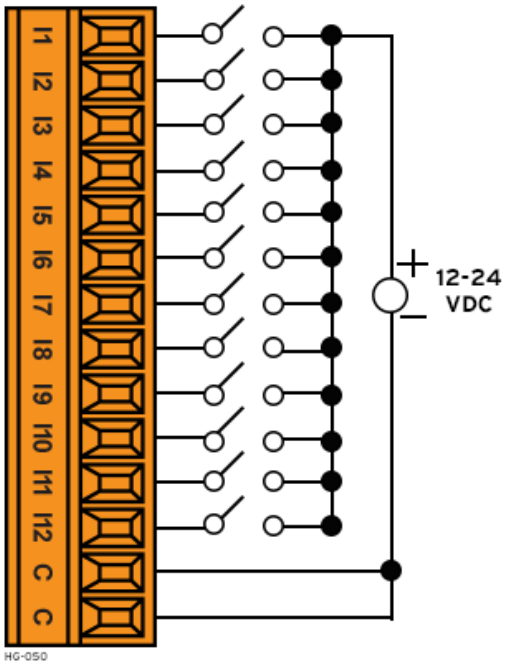


In positive logic mode a positive voltage applied to the input will turn the input. The internal design of this mode is basically a resistor from the input to I/O ground. This mode is sometimes called sourcing.

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

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

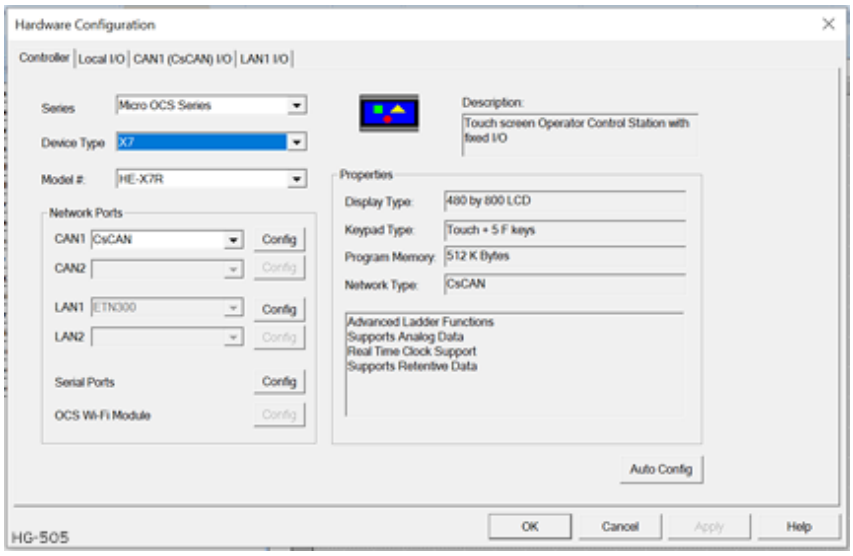
8.2.1: Model R & Model A Digital Input J2 Wiring



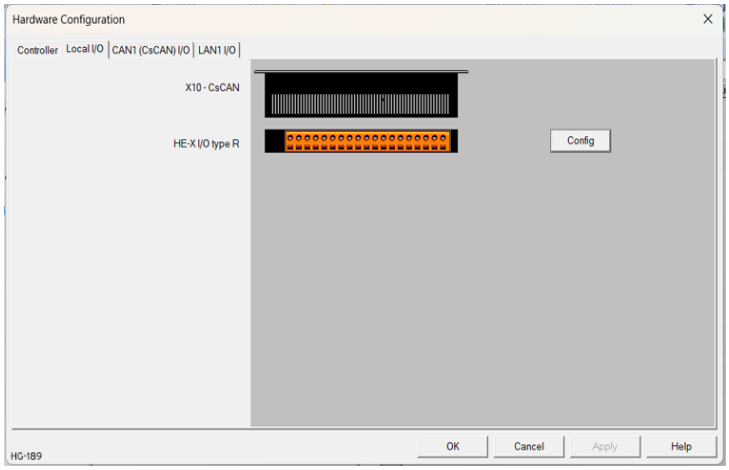
8.2.2: Digital Input Configuration

Home > Hardware Configuration [select Device Type/Model#] > Local I/O Tab > I/O / Config Button > Module Setup > Digital In/HSC

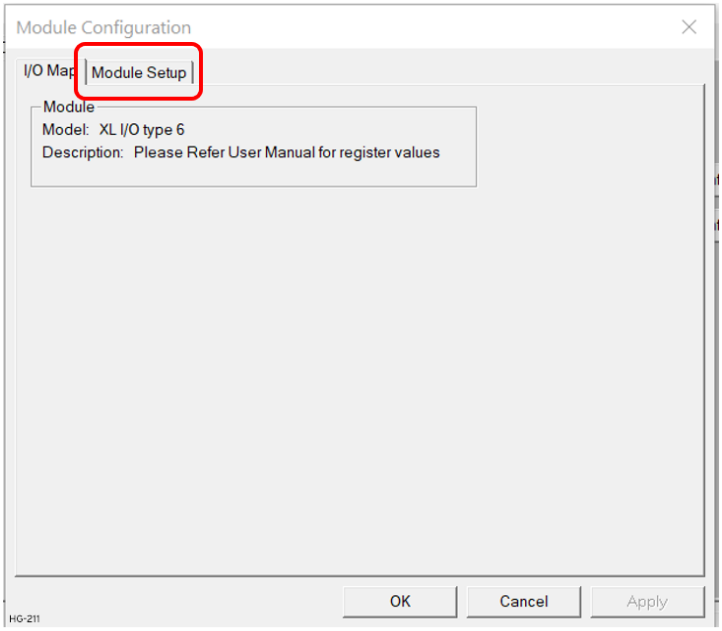
Select Hardware Configuration from the Home menu and ensure that the correct Device Type and Model# are selected. Then select the **Local I/O** tab.



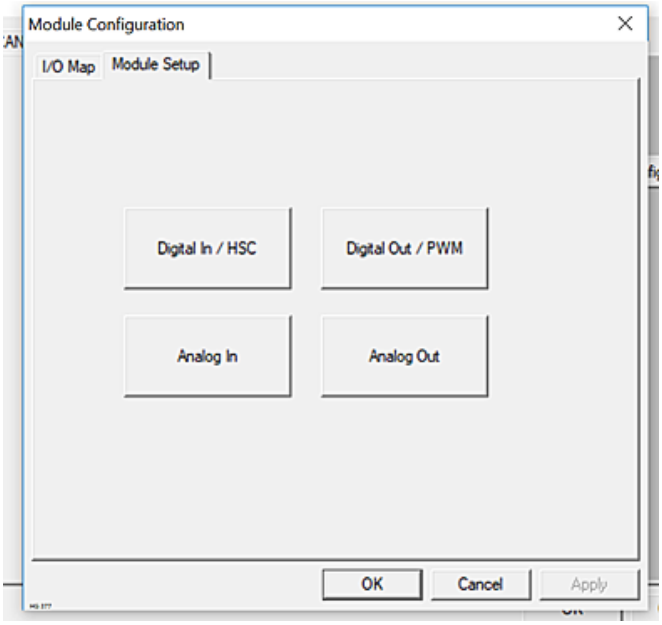
After selecting Local I/O, select the **Config** button next to the I/O connector.



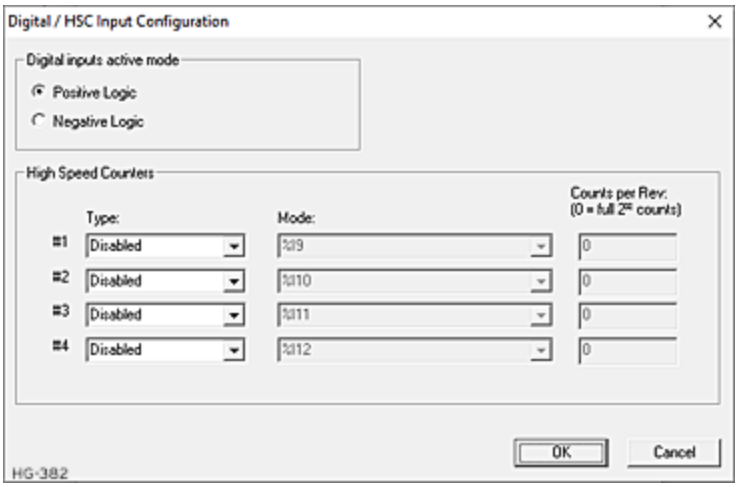
The **Module Configuration** screen will appear, select the **Module Setup** tab. See below.



The Module Setup allows a user to configure four types of I/O. **NOTE**: Not all controllers offer all four types. Refer to the controller's datasheet on the using Horner's Documentation Search page.



Select **Digital In/HSC** to open the Digital / HSC Input configuration dialog for a specific controller.

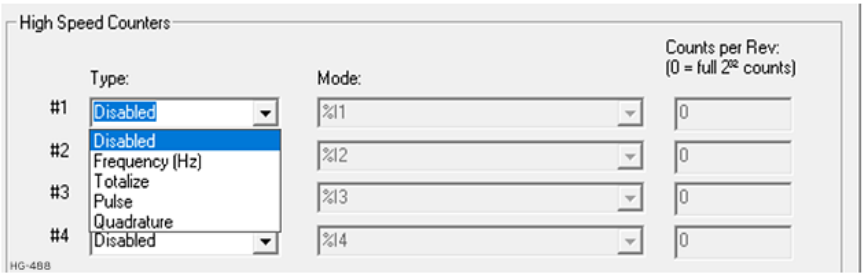


The Active mode group box allows the user to select if inputs are active high (Positive logic) or active low (Negative logic). It is important that this setting matches the jumper settings on the hardware.

The High-Speed Counters group box contains all the windows that are used to configure the four available high-speed counters on the Horner OCS. To configure a counter, the user needs to set the type, mode, and counts per rev.

The type drop down includes the following options:

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



The mode drop-down items are set according to the type selection. The Counts Per Rev. window is enabled/disabled according to the type selection as well.

8.3: Digital / PWM Output Configuration

8.3.1: Solid-State Digital Outputs

X7 - 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 X7 are “sourcing” outputs. This means the output applies a positive voltage to the output pin when turned ON. When turned off, the output applies approximately zero volts with respect to the I/O ground.

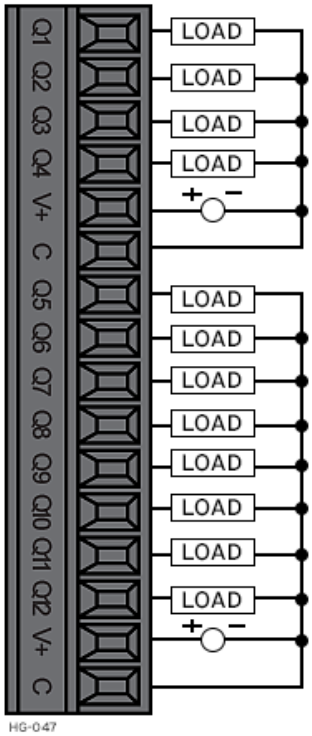
The digital outputs used in the X7 have electronic short circuit protection and current limiting. While these electronic protections work in most applications, some applications may require external fusing on these outputs.

The digital outputs in the X7 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. Refer to the X7 datasheet and "High Speed I/O" on page 95 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.

8.3.2: Model A & Model R Digital Output Wiring



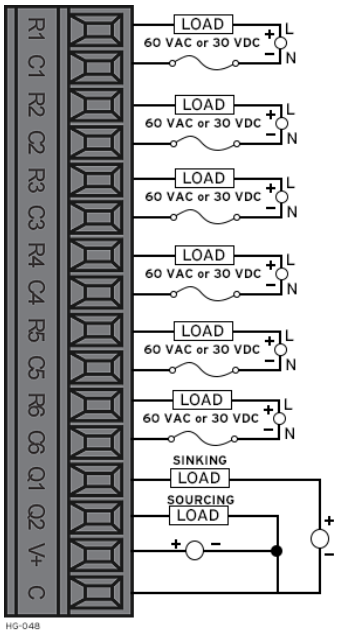
8.3.3: Relay Outputs

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.

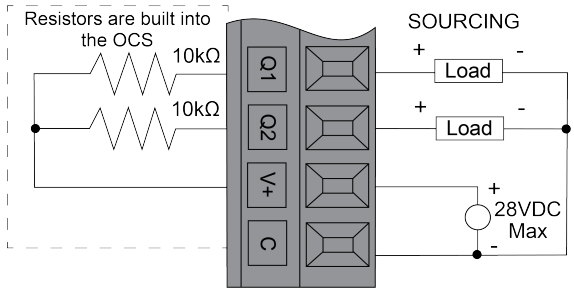


Protection for Inductive Loads – Inductive loads can cause reverse currents when they turn off that can shorten the life of relay contacts. Some protective measures must be determined by an engineer. Below are some recommendations that will work for many applications. If there are additional questions 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)

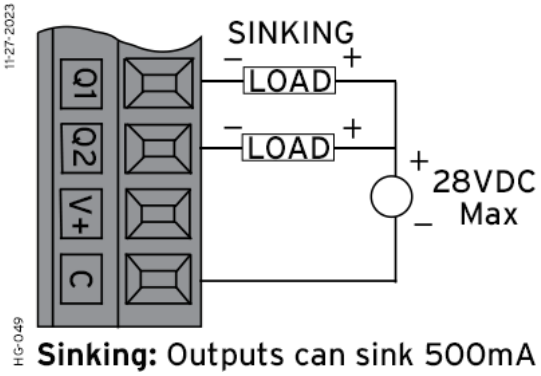
Output State on Controller Stop – When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default, relay outputs turn off. For more information on stop state, refer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

8.3.4: Model R: Sinking and Sourcing Outputs



HG-206

Sourcing: 2.4mA sourcing @ 24V

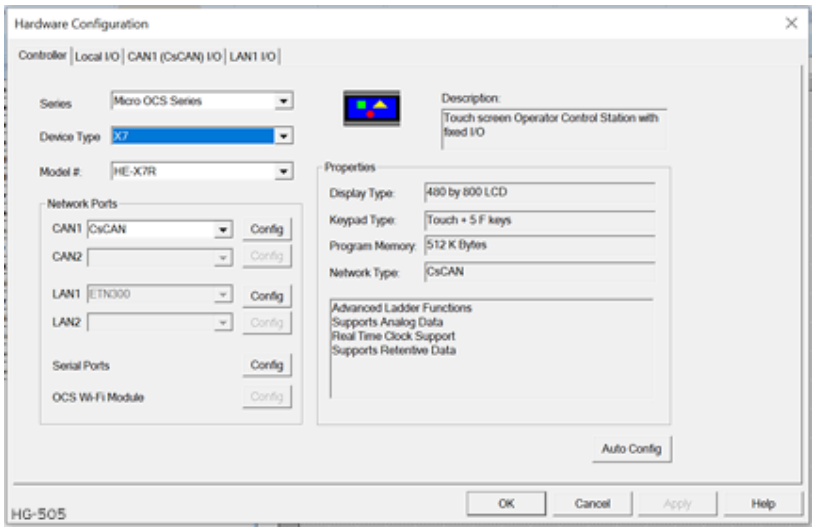


Sinking: Outputs can sink 500mA

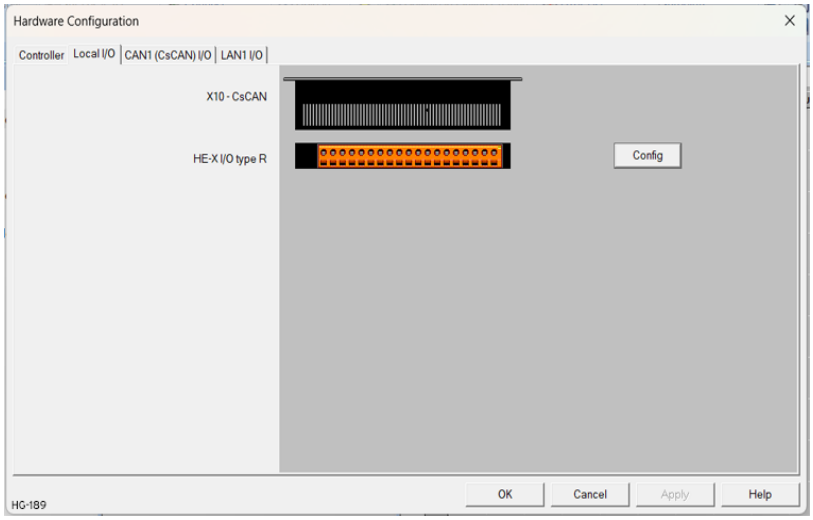
8.3.5: Digital Output Configuration

Home > Hardware Configuration [select Device Type/Model#] > Local I/O Tab > I/O / Config Button > Module Setup > Digital Out/PWM

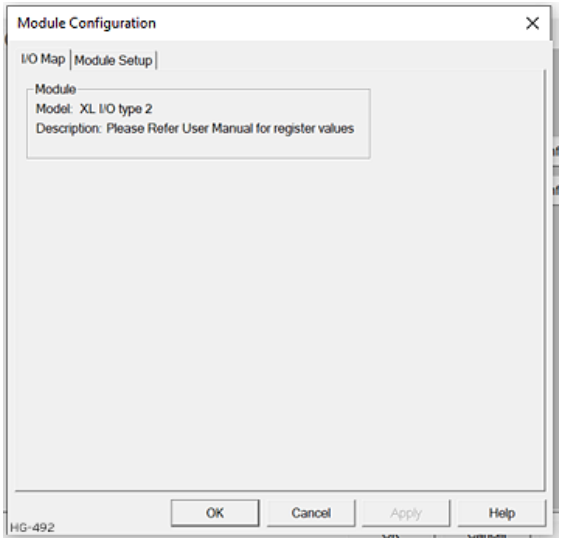
Select Hardware Configuration from the Home menu and ensure that the correct Device Type and Model# are selected. Then select the **Local I/O** tab.



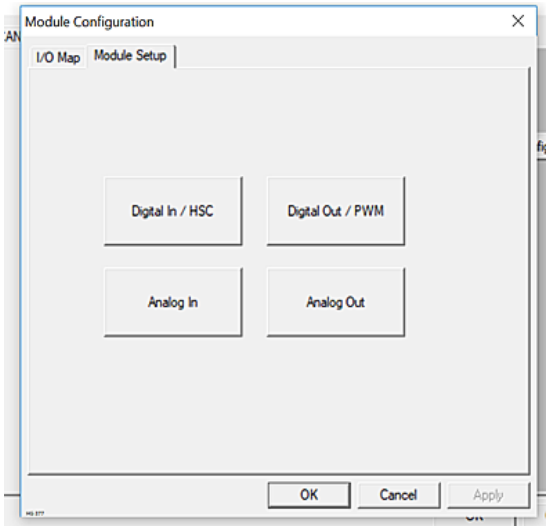
After selecting Local I/O, select the **Config** button next to the I/O connector.



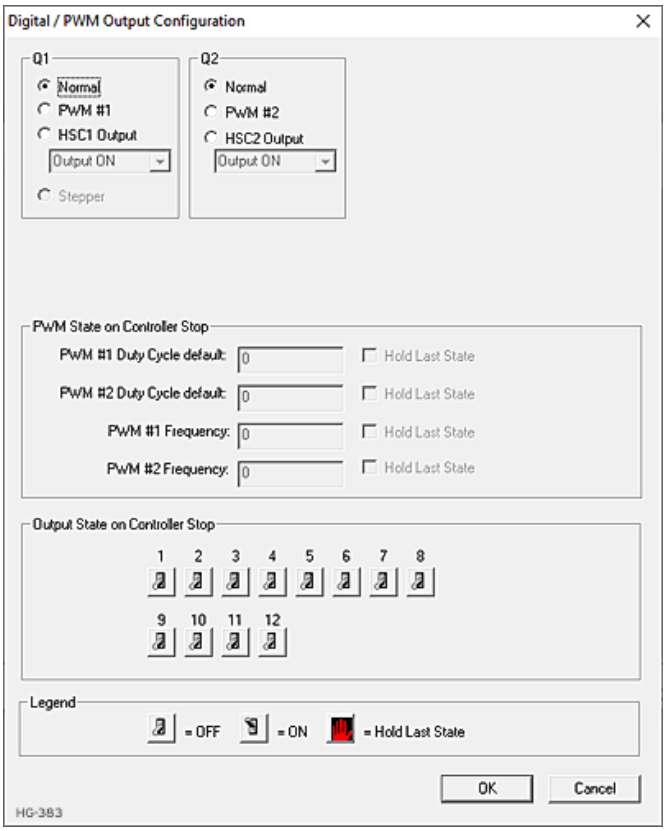
The **Module Configuration** screen will appear, select the **Module Setup** tab. See below.



The Module Setup allows a user to configure four types of I/O. **NOTE**: Not all controllers offer all four types. Refer to the controller's datasheet the using Horner's Documentation Search page.



Select **Digital Out/PWM** to open the **Digital / PWM Output Configuration** dialogue.



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

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

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

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

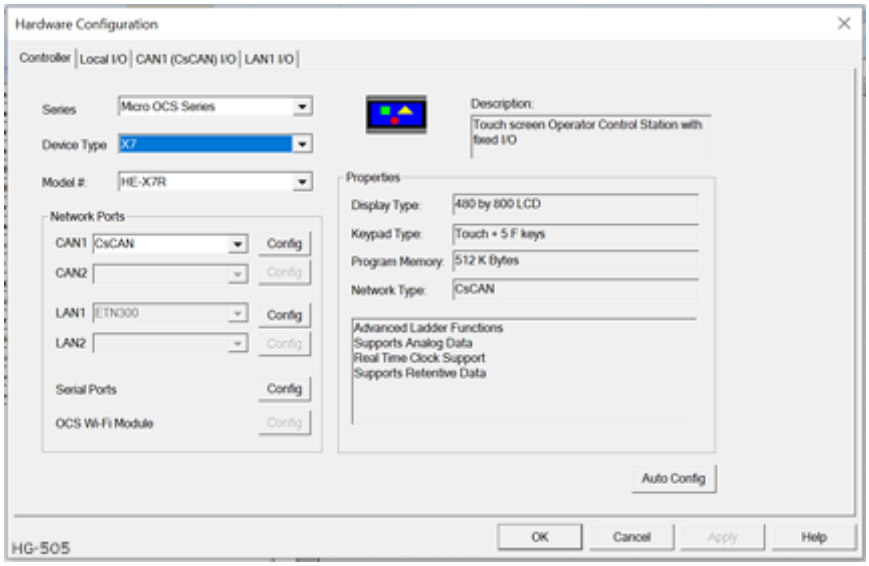
8.4: Analog Input Configuration

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

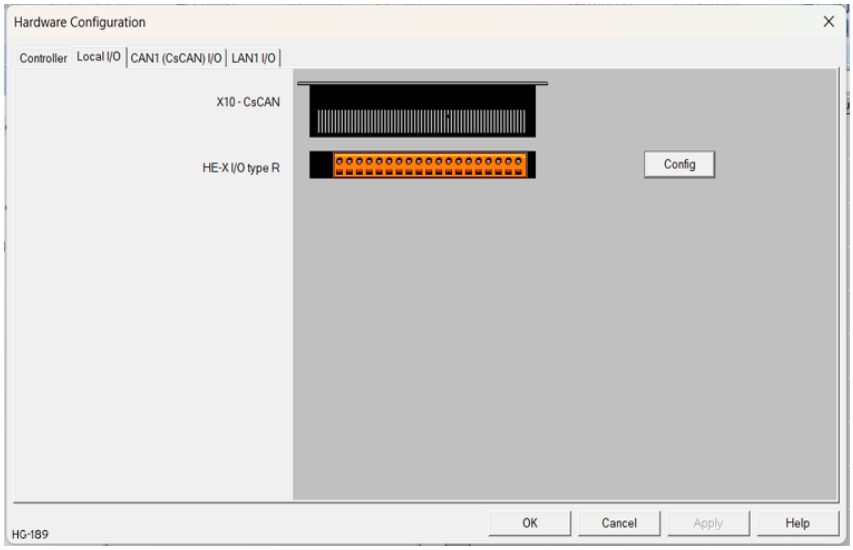
The analog inputs have a digital filter that can be used to filter electrical noise that may be unavoidable in some installations. The downside to digital filtering is the inputs will respond more slowly to sudden changes in the actual input.

Home > Hardware Configuration [select Device Type/Model#] > Local I/O Tab > I/O / Config Button > Module Setup > Analog In

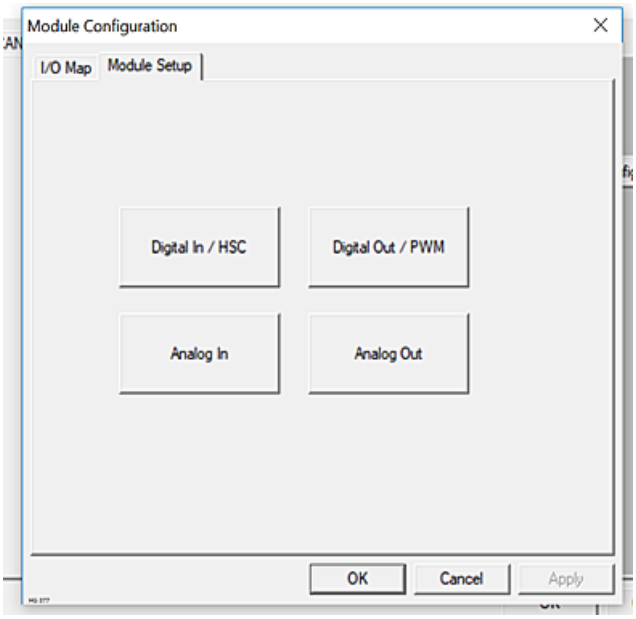
Select Hardware Configuration from the Home menu and ensure that the correct Device Type and Model# are selected. Then select the **Local I/O** tab.



After selecting Local I/O, select the **Config** button next to the I/O connector.

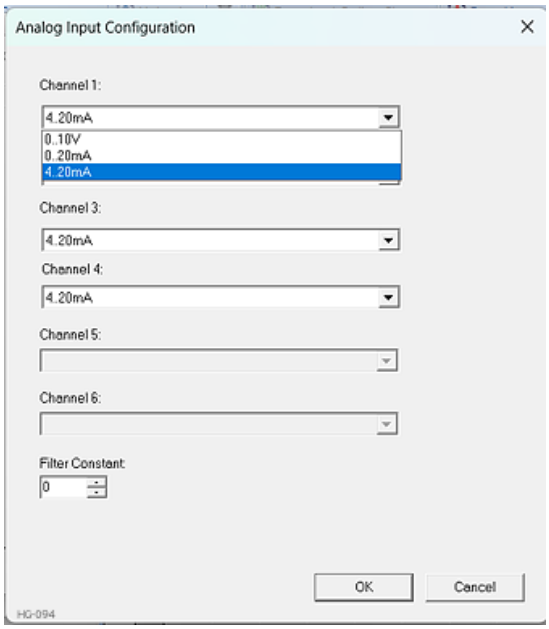


The **Module Configuration** screen will appear, select the **Module Setup** tab. See below.



The Module Setup allows a user to configure four types of I/O. **NOTE**: Not all controllers offer all four types. Refer to the controller's datasheet on the Horner website's Documentation Page for more information regarding specific models.

Select **Analog In** to open the **Analog Input Configuration** dialogue:

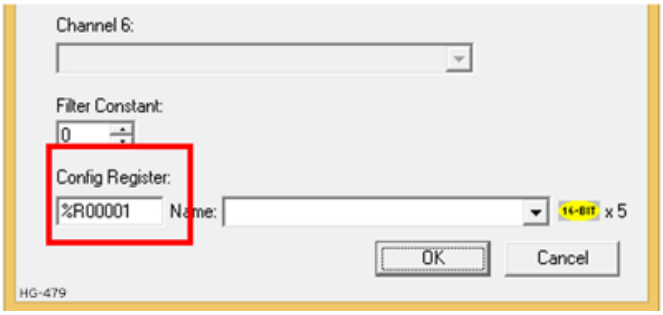


The Channel x drop down windows allow the user to specify the mode for each analog input to operate. The Channel x drop down windows are enabled/disabled according to which model is being configured. All of the models have the following modes available:

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

NOTE: Each unused channel should be set to “Disable”.

The Filter Constant provides digital filtering to all channels. Valid filter values are 0-7. Refer to the datasheet [**MAN1138**] for more information on digital filtering.



Config Register:

NOTE: If a Conf Register is configured, it takes immediate precedence over other configuration for the I/O, thus requiring valid values in the registers. These values can be changed during runtime so care needs to be taken to not mistakenly overwrite these values and program logic.

Analog Input uses five consecutive 16-Bit registers for configuration and each register has the following description:

%Rxx	channel-1 Input Type selection
%Rxx+1	channel-2 Input Type selection
%Rxx+2	channel-3 Input Type selection
%Rxx+3	channel-4 Input Type selection
%Rxx+4	Filter Constant

For example, if user entered %R1 in Config Register then:

%R1	channel-1 Input Type selection
%R2	channel-2 Input Type selection
%R3	channel-3 Input Type selection
%R4	channel-4 Input Type selection
%R5	Filter Constant for all Input channels

Analog Input type can be selected by entering appropriate Values in configured % R.

Configuration	Value to be entered
Disable	10
0 to 20mA	1
4 to 20mA	2
RTD	16

In the above example if user entered %R1=2, then channel-1 Input Type will be 4 to 20mA.

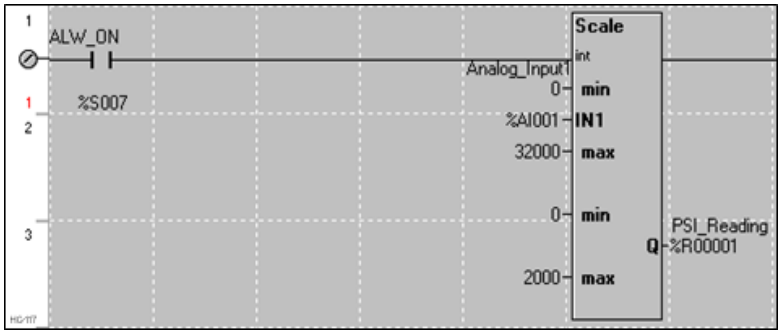
Filter constant is common for all Analog Input channels, Analog signals are filtered based on the constant value given in the %Rxx+4 register. Filter constant value should be in the range of 0 to 7 anything beyond this range will considered as constant value = 0.

8.4.1: Scaling Analog Inputs & Examples

To access the Advanced Math Scaling function, select **Home > View > Project Toolbox**. This will open a side bar, and then select **Advanced Math > Scale**.

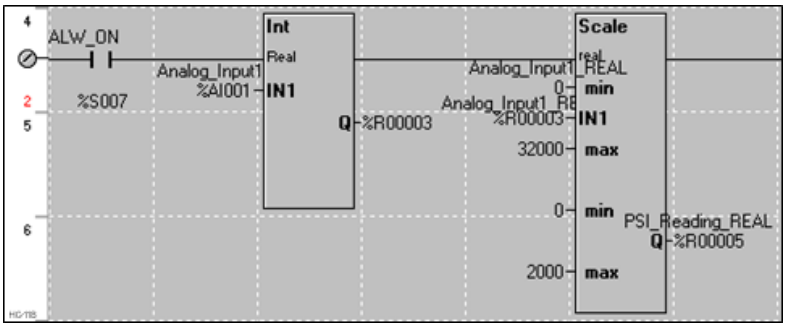
Example 1

The Cscape Scale function, found in the Advanced Math functions, allows for very easy conversion of the raw input value into a meaningful reading. For example, a pressure transducer may be specified as a 4-20mA signal to signify a 0-2000 psi pressure reading. With the analog channel set to the 4..20mA range, the raw analog input value, which is in INT format ranges from 0 to 4mA to 32000 for 20mA. Use the Scale function to obtain an Integer pressure reading using the 0-32000 raw input range and the sensor's 0-2000psi output range.



Example 2:

If readings with fractions are required, the raw Integer input value must first be translated in REAL, or Floating Point Format, see note below. . The Cscape INT-to-REAL Conversion function may be used to convert the raw input value from INT to REAL format in an intermediate memory location. The SCALE function, specified as REAL type, may be used to scale the converted raw value into a reading that supports digits beyond the decimal place, i.e. 475.25psi.



8.5: Analog Output Configuration

NOTE: Refer to the X7 datasheet and the High-Speed I/O chapter for more information.

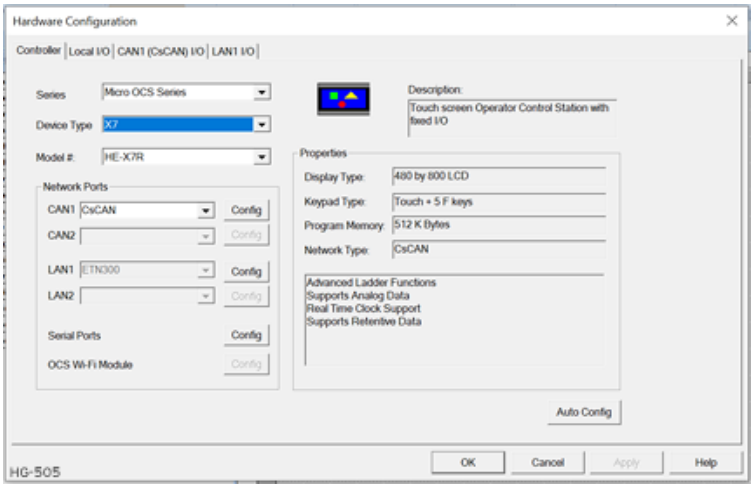
The analog outputs on X7 devices provide high resolution current outputs.

NOTE: Each channel can be separately configured for current mode.

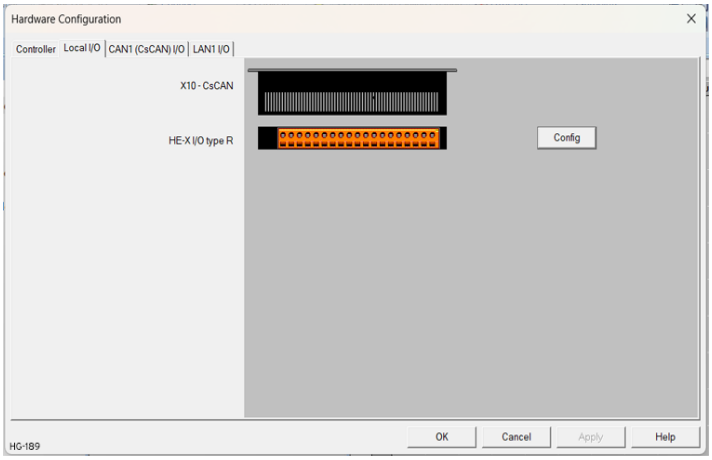
When the controller is stopped, the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined value. By default, analog outputs are set to a value of zero (0). For more information on Stop State, refer to "Cscape Configuration" on page 1.

Home > Hardware Configuration [select Device Type/Model#] > Local I/O Tab > I/O / Config Button > Module Setup > Analog Out

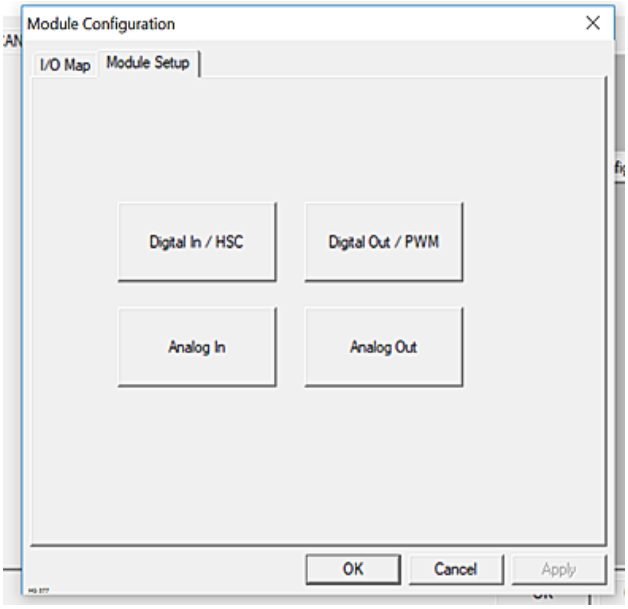
Select Hardware Configuration from the Home menu and ensure that the correct Device Type and Model# are selected. Then select the **Local I/O** tab.



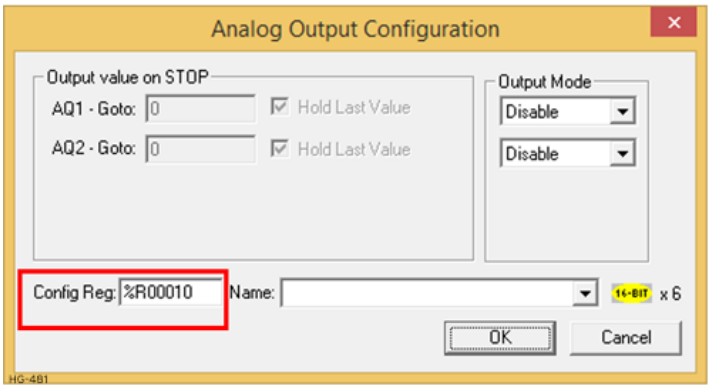
After selecting Local I/O, select the **Config** button next to the I/O connector.



The **Module Configuration** screen will appear, select the **Module Setup** tab. See below.



Select **Analog Out** to open the following dialogue:



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

The **Output Mode** group box allows the user to select the operating modes for each of the analog outputs. The available mode is 4..20mA.

Config Reg - see above screenshot

NOTE: If a Conf Register is configured, it takes immediate precedence over other configuration for the I/O, thus requiring valid values in the registers. These values can be changed during runtime so care needs to be taken to not mistakenly overwrite these values and program logic.

Analog Output uses six consecutive 16-Bit registers for configuration and each register has the following description:

%Rxx	channel-1 Output Type selection
%Rxx+1	channel-2 Output Type selection
%Rxx+2	channel-1 Hold Last or Goto value selection
%Rxx+3	channel-2 Hold Last or Goto value selection
%Rxx+4	Channel-1 Goto value
%Rxx+5	Channel-2 Goto value

For example, if user entered %R10 in Config Register then:

%R10	channel-1 Output Type selection
%R11	channel-2 Output Type selection
%R12	channel-1 Hold Last or Goto value selection
%R13	channel-2 Hold Last or Goto value selection
%R14	Channel-1 Goto value
%R15	Channel-2 Goto value

Analog Output type can be selected by entering appropriate Values in configured %R.

Configuration	Value to be entered
Disable	10
4 to 20mA	2

In the above example, if user entered %R10=2, then Analog Output -1 type will be 4 to 20mA.

Analog Output Hold last state or Goto value can be selected by entering appropriate values in configured %R.

Configuration	Value to be entered
%Rxx+2	0 –Hold Last value of Analog output
	1—Go to value in %Rxx+4 to Analog output -1
%Rxx+3	0 –Hold Last value of Analog output
	1—Go to value in %Rxx+5 to Analog output -2

In the above example, if user entered %R12=0, then Analog Output channel-1 will hold the last value when controller is in Idle mode.

In the above example, if user entered %R12=1 and %R14=12000, then Analog output channel-1 will Go to value 12000 when controller is in Idle mode.

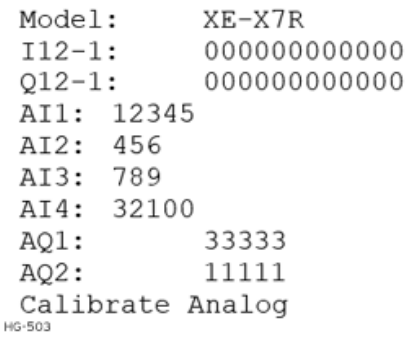
8.6: I/O Status and Calibration

I/O Status

The I and Q sections indicate the ON and OFF status of the individual digital inputs and outputs respectively. The AI values show the raw analog inputs scaled from 0 to 32,000. The AQ items show the raw analog outputs scaled from 0 to 32,000.

The X7 System Menu contains an "**I/O Status and Calibration**" selection.

When first entering this option, the user is presented with information about the X7 model and current state of the I/O points.



8.6.1: I/O Calibration

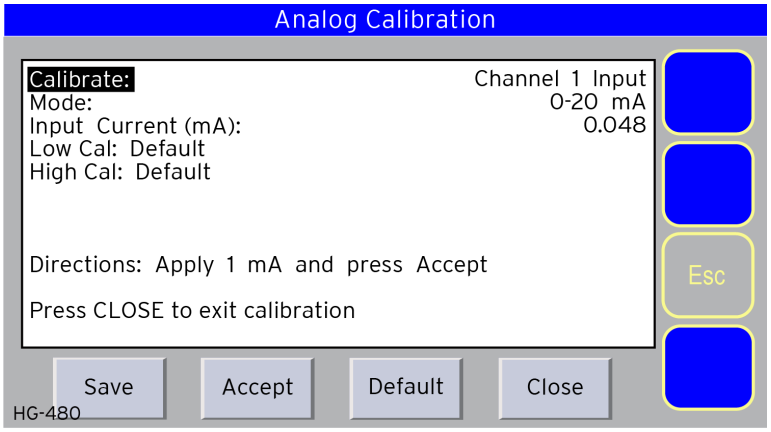
This controller has a field calibration option in the System Menu. The calibration option can be used to achieve better accuracy than factory specifications and to compensate for calibration offsets that could occur with additional connectors and environmental conditions. Calibration is stored in non-volatile memory and is retained even if the backup battery fails or is removed.

NOTE: Calibration of analog can only be performed when the controller is in idle mode.

Analog output values will change so precautions show be taken such that changes in these outputs will not affect the system or the safety of those around the equipment. The calibration process applies changes to the analog inputs, so care must be taken that the calibration process will not adversely affect the operation of the attached equipment.

Calibration should be performed by trained personnel with equipment that is designed for precise analog calibration. Ideally this equipment is also calibrated to a traceable standard. Basic calibration of the RTD inputs can be performed with 90.9Ω and 162Ω precision resistors.

The “Calibrate Analog” item is a sub-menu that, when selected, allows entering the field calibration for analog inputs and outputs.



The “Calibrate:” options allows selecting the individual input and output channels. Start by pressing select and using the up and down arrows to select the appropriate channel to calibrate. Next, the mode for the analog (if applicable) is selected using the “Mode:” option.

- The “Save” button is used to save the calibration.
- The “Accept” button is used to accept calibration values in the process.
- The “Default” button is used to restore calibration to factory defaults.
- The “Close” button is used to exit the calibration screen.

To calibrate 0-20mA, 4-20mA, or RTD PT100 Analog Inputs

NOTE: During Calibration process, the application may be placed in Idle.

1. Select the channel and mode as described above
2. Connect the analog channel to be calibrated to the calibration equipment.
3. Apply the lower current or RTD value as directed by the screen to the selected analog input channel.
4. Once the value on the screen is stable press the **Accept** button.
5. Apply the higher current or RTD value.
6. Move on to additional channels and repeat the above five steps.
7. Make sure to press **Save** when all channels are calibrated.

To calibrate 4-20mA Analog Outputs

NOTE: During Calibration process, the application may be placed in Idle.

1. Select the channel and mode as described above.
2. Connect the analog output to be calibrated to a calibrator or precision meter.
3. The controller will set the output to a lower analog output value.
4. Read the value from the calibrator and enter it into the “Output Current:” item on the menu
5. Press **Accept**.
6. The controller will set the output to a higher analog output value.
7. Read the value from the calibrator and enter it into the “Output Current:” item on the menu
8. Press **Accept**.
9. Move on to additional channels and repeat the above eight steps.
10. Make sure to press **Save** when all channels are calibrated.

High Speed I/O (HSC & PWM)



Chapter 9: High Speed I/O

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9.2: High Speed Counter (HSC) Functions 95
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9.4: Pulse Width Modulation (PWM) Functions 103
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9.1: Overview

In addition to the compliment of simple analog and digital I/O, the Micro OCS controller supports High Speed Counting (HSC) I/O functions and may support Pulse Width Modulation (PWM) Output functions. The HSC functions include frequency, totalizing, pulse width, and quadrature measurement.

The PWM functions include traditional PWM (with variable rate and duty) with variable acceleration and deceleration rates. To determine function availability, refer to the associated model's Specification/Installation sheet (Digital DC Input/Output sections).

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

9.2: 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 1µs, measured edge transitions must not occur faster than 100µs for accurate measurements. Keep in mind that pulse width measurements utilize both the rising and falling edges of the waveform, thus the pulse width must exist longer than 100µs.

NOTE: The **edge** polarity selection in the mode parameter for the totalize and pulse width functions (Digital/HSC Input Configuration) assume Positive Logic regardless of the associated I/O board's jumper setting for the **Digital DC inputs polarity**. If Negative logic is configured when using these functions, the opposite edge polarity must be selected in the mode parameter.

9.2.1: Frequency

In frequency mode, the frequency of the input signal is written to the accumulator in terms of Hertz (cycles/second). When using frequency mode, four update selections are provided which specify the width of the sample window.

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

9.2.2: Totalize

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



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: The corresponding Totalize HSC must be previously configured before this option is available). The direct digital reset controls are edge sensitive with the edge polarity configurable.

Maximum direct digital reset latency is 100µs.

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

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

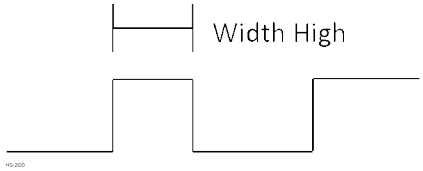
NOTE: Q1 and Q2 are PWM function outputs that may be configured independently as one of the following: standard digital output, PWM, or HSCx.

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.

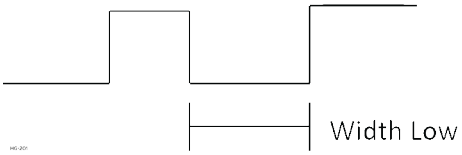
9.2.3: Pulse

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

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



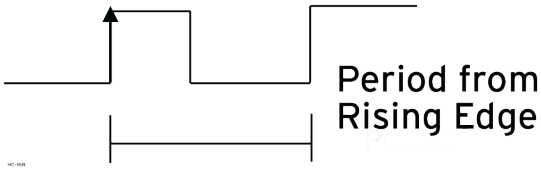
Width Low 1µs Counts - In this sub-mode the accumulator value will contain the number of 1µs counts the pulse is low.



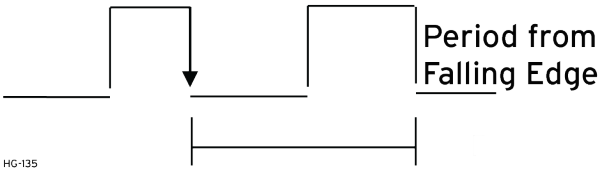
9.2.4: Period Measurement

In period measurement mode, the high-speed input can measure the period of a pulse stream in one of two modes and provides a continuous indication of the last sampled value. In this mode the Disable and Latch special functions are allowed.

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



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

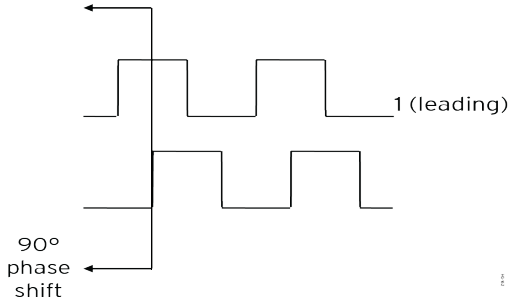


9.2.5: Quadrature

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

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

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



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

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

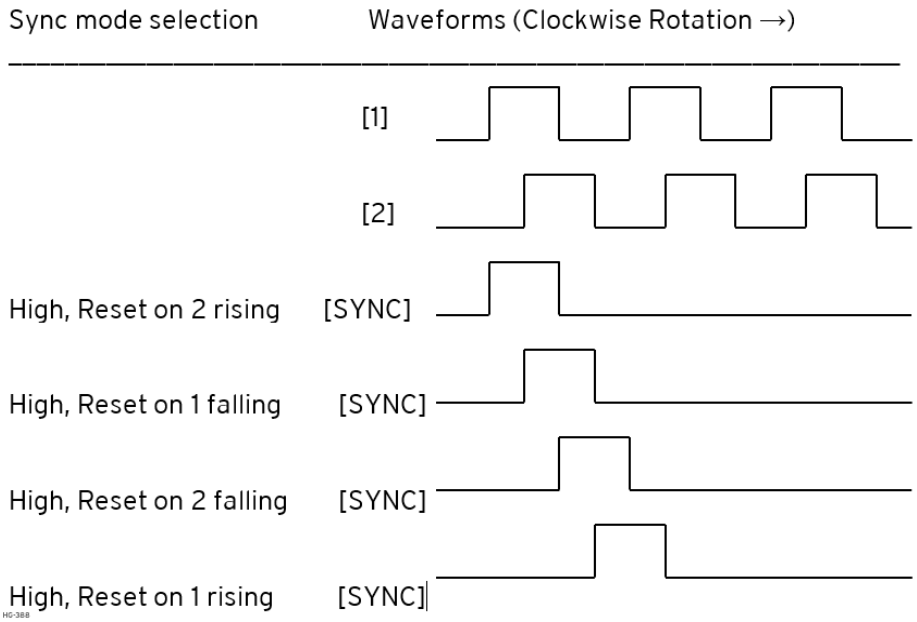
- **Configured Counts per Rev Value** - When configuring the quadrature function, a value may be specified under the Counts per Rev column. When rotation produces an increasing count, the quadrature accumulator resets to zero on reaching the Counts per Rev count. Alternately, when rotation produces a decreasing count, the quadrature accumulator is set to Counts per Rev – 1 on the count following zero. Specifying zero for this value allows the totalizer to count through the full 32-bit range before resetting. For example, if your encoder outputs 1024 counts per revolution, the value of 1024 can be entered into the configuration for Counts per rev. This will result in a counter that produces counts in the range of 0 to 1023.
- **Ladder Control** - Setting registers %Q17 or Q19 resets quadrature (HSC) 1 or quadrature (HSC) 3 (respectively) with no additional configuration. Setting registers %Q18 or Q20 sets quadrature (HSC) 1 or quadrature (HSC) 3 (respectively) to Counts per Rev – 1.
- **Direct Digital Input Control (HSC3) [Marker]** - When HSC input 1 and 2 are used for quadrature inputs, an additional choice of marker input becomes available for HSC input 3. The marker input is typically part of an encoder or motion system that signals when a cycle of motion is complete. When the marker input is triggered, the accumulator is reset to zero or to Counts per rev - 1 based on rotation direction. Marker reset operation is enabled when HSC3 is configured for Marker type. Once selected, one of several modes is available for marker operation. These modes can be sub-divided into two groups of marker operation.

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

Synchronous modes synchronize the reset (or set) to the selected quadrature input and the selected marker polarity. Figure 11.1 below indicates which mode to select based on the markers timing diagram. Consult the documentation provided with your encoder to determine the marker pulse timing.

NOTE: The Marker input is sampled within 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.

9.2.6: Sync Pulse Mode Table

Definition: **CPR** most commonly stands for Counts per Revolution, and refers to the number of quadrature decoded states that exist between the two outputs A and B. With both outputs A and B switching between high and low, there exists 2 bits of information represented as 4 distinct states.

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

9.3: High Speed Counter

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

9.3.1: HSC Register Map for Micro OCS

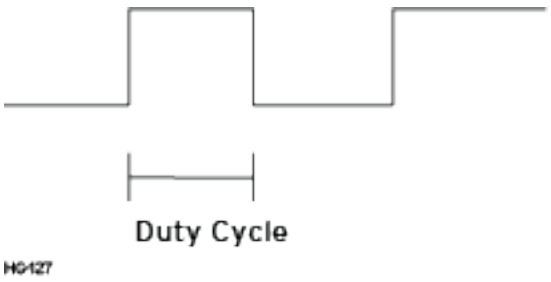
Register	Frequency	Totalize	Pulse	Quad
%AI5-6	HSC1 (function) Accumulator			Quad 1 Acc
%AI7-8	HSC2 (function) Accumulator			
%AI9-10	HSC3 (function) Accumulator			Quad 2 Acc
%AI11-12	HSC4 (function) Accumulator			
%AQ3-4		HSC1 Preset		
%AQ5-6		HSC2 Preset		
%Q17		Clear HSC1		Clear Quad 1
%Q18		Clear HSC2		Set Quad 1
%Q19		Clear HSC3		Clear Quad 2
%Q20		Clear HSC4		Set Quad 2

9.4: Pulse Width Modulation (PWM) Functions

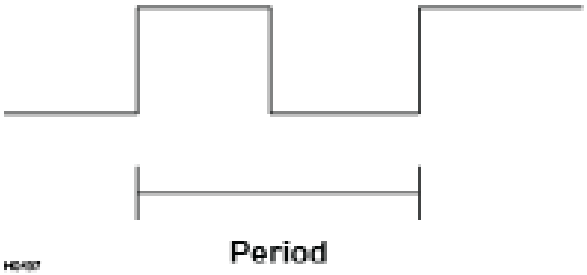
On units that support the PWM, two dedicated outputs are available that can be configured for one of four modes of operation. Those modes are Normal, PWM, and HSC (count = PV).

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

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, 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.

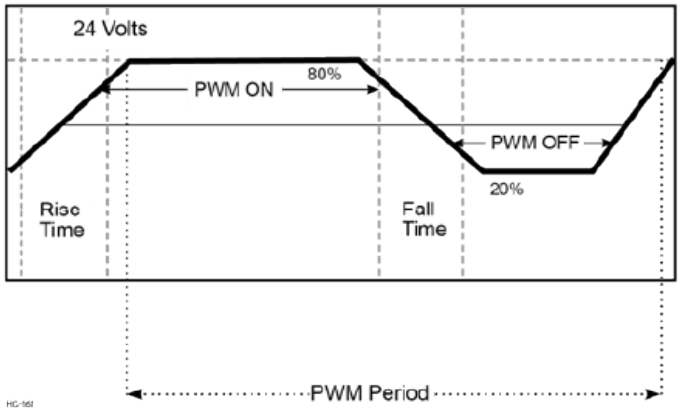


At controller power-up or during a download, the PWM output is maintained at zero until both the Frequency and the Duty cycle are loaded with non-zero values.

When the controller is placed in stop mode, the state of the PWM outputs is dependent on the PWM State on Controller Stop configuration. This configuration allows for either hold-last-state or specific frequency and duty cycle counts.

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

9.4.1: PWM Output Waveform



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

9.4.2: PWM Functions Register Map

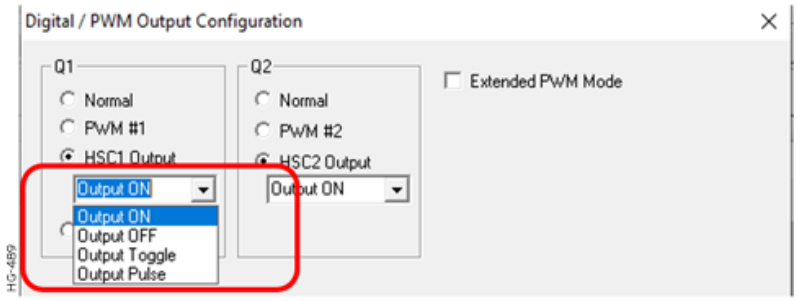
Register	PWM	HSC
%AQ3		HSC1 Preset Value (AQ3-4)
%AQ4		
%AQ5		HSC2 Preset Value (AQ5-6)
%AQ6		
%AQ7	PWM1 Duty Cycle (32-bit)	
%AQ8		
%AQ9	PWM1 Frequency (32-bit)	
%AQ10		
%AQ11	PWM2 Duty Cycle (32-bit)	
%AQ12		
%AQ13	PWM2 Frequency (32-bit)	
%AQ14		

9.4.3: PWM Examples

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

9.5: HSC Pulse Output

This feature allows configuring the High-speed output to turn ON, OFF, toggle or as a pulse output. Selecting Digital Out/PWM configuration opens the following dialog where in HSC output options are available.



OUTPUT ON: starts with LOW

When HSC1 accumulator value is greater than or equal to AQ3-4 UDINT value, then the Output Q1 becomes high or Else it will be Low.

OUTPUT OFF: starts with High

When HSC1 accumulator value is greater than or equal to AQ3-4 UDINT value, then the Output Q1 becomes Low or Else it will be high.

OUTPUT TOGGLE:

When HSC1 accumulator value is equal to AQ3-4 UDINT value, then the Output Q1 Toggles.

OUTPUT PULSE:

The new "Output Pulse" option would allow sending a configurable output pulse on a timer match. The Starting analog output allows two additional 32-bit words that will define the output pulse in microseconds.

Functionality: When the counter accumulator matches the match value stored in %AQ registers, the HSC output will be enabled. The firmware will then wait based on the configurable microsecond pulse width. After the elapsed time, the output will be turned off.

If another match happens while the countdown to turn off the output, then the pulse countdown will restart but the output will not change state until the countdown happens.

When HSC1 accumulator value is equal to AQ3-4 UDINT value, then the Output Q1 becomes high for AQ27-28 UDINT value microseconds.

NOTE: Resolution for the pulse width will be limited to 50 microseconds on the Micro OCS series hardware.

NOTE:

a. Match value is stored in register AQ5-6 UDINT for HSC2.
b. AQ29-30 UDINT is Pulse width value for HSC2

Serial Communications



Chapter 10: Serial Communications

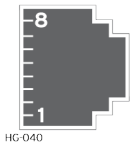
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All Micro OCS Controller models provide two serial ports, which are implemented with a single 8-position modular jack that is labeled **MJ1/2**. The MJ1 serial port is RS-232 while the MJ2 port is RS-485. MJ1 defaults to OCS programming by connecting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

10.1: 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.

10.2: Wiring—MJ1/MJ2 Serial Ports



2 Serial Ports on 1 Modular jack (8p8c)

MJ1: RS-232 w/Full Handshaking
MJ2: RS-485 Half-Duplex - RS-485 termination and biasing via System Menu or System Register

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

10.3: 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

10.4: 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.

10.5: 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.

10.6: 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.

CAN Communications



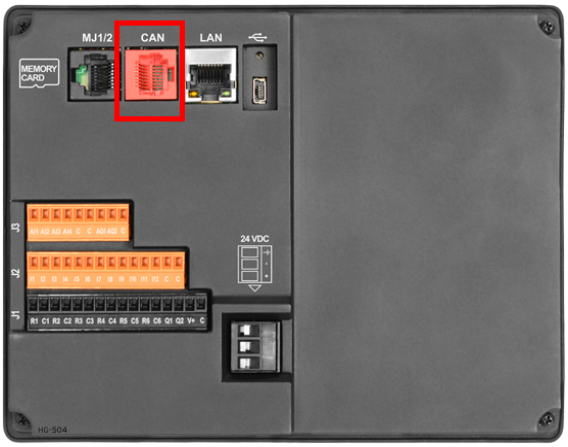
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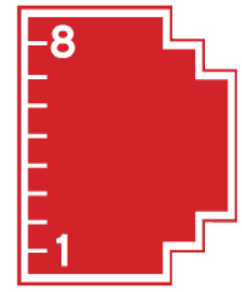
NOTE: For additional CAN information, refer to the CAN Networks manual (**MAN0799**) via Documentation Search for more details .

11.1: Overview

The Micro 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



Modular jack (8p8c)

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

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

In addition, the Micro OCS supports single-point-programming of all controllers that are connected to a CAN network. If the PC COM port is connected to the OCS programming port, then the OCS can act as a pass-through gateway allowing Cscape to access all 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 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: CAN for I/O Expansion (Network I/O)

Connecting remote I/O to the Micro OCS CAN port allows the OCS 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 OCS 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.

Ethernet Communication



Chapter 12: Ethernet Communications

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NOTE: Refer to the Ethernet Supplement (**SUP0740**)on the Document Search page for more details.

12.1: Ethernet Module Protocols

The following table describes the Ethernet Module Protocols and features supported by the Ethernet port on a Micro OCS controller.

Protocol/Feature	Protocol/Feature Description
ICMP (Ping)	Internet Control Message Protocol
EGD	Ethernet Global Data
Modbus Slave	Modbus over Ethernet
Ethernet /IP	ODVA CIP over Ethernet
FTP (File Server)	File Transfer Protocol
ASCII over TCP/IP	ASCII Data over Ethernet

12.2: Ethernet System Requirements

Full Ethernet functionality requires:

- PC running Cscape Programming Software Version 9.8 or later (for configuration).
- Micro OCS controller with onboard Ethernet port.

12.3: Ethernet Module Specifications

Speeds	10 BaseT Ethernet (10Mbps) 100 BaseTx Fast Ethernet (100Mbps)
Modes	Half or Full Duplex
Auto-Negotiation	Both 10/100Mbps and Half/Full Duplex
Connector Type	Shielded RJ-45
Cable Type (Recommended)	CAT5 (or better) UTP
Port	Auto MDI/MDI-X (Auto Crossover)

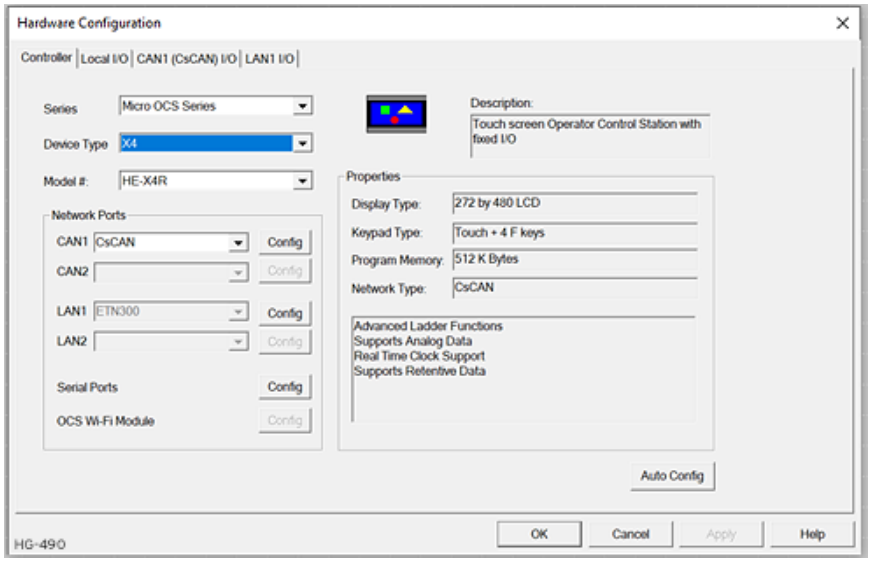
12.4: Ethernet Module Configuration

NOTE: The following configuration is required for all applications regardless of the protocols used. Additional configuration procedures must be performed for each protocol used.

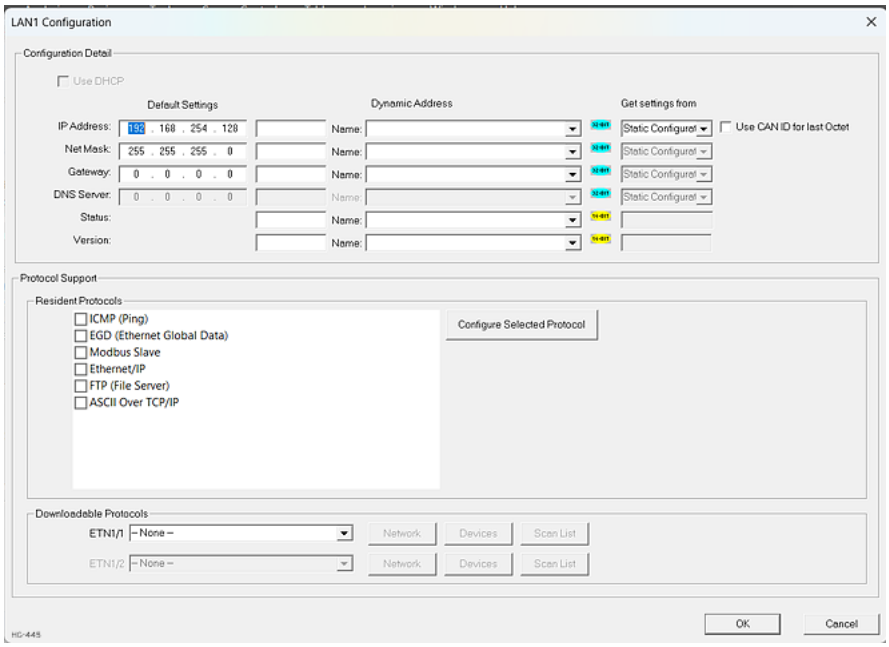
To configure the Ethernet Module, use Cscape Programming Software to perform the following steps:

Step 1: On the main Cscape screen, select the **Controller** menu and its **Hardware Configuration** sub-menu to open the Hardware Configuration dialog.

Step 2: If configuring a different OCS Model than the one shown in the **Hardware Configuration** dialog, click on the topmost Config button, select the desired OCS Model, and then click **OK**.



Step 3: Click the **Config** button to the right of the LAN1 for LAN 1 or LAN2 for LAN 2, revealing the Ethernet Module Configuration dialog.



Configure the following:

- **IP Address**: Enter the static IP Address for the Ethernet Module being configured.

  NOTE: IP Addresses are entered as four numbers, each ranging from 0 to 255. These four numbers are called octets, and they are always separated by decimal points. See also: "Ethernet Configuration – IP Parameters" on page 117

- **Net Mask**: Enter the Net Mask (sometimes called Subnet Mask) being used by all nodes on the local network. Typical local networks use Class C IP Addresses, in which case the low octet (rightmost number) is used to uniquely identify each node on the local network. In this case, the default Net Mask value of 255.255.255.0 should be used.
- **Gateway**: Enter the IP Address of a Gateway Server on the local network that allows for communication outside of the local network. To prevent the Ethernet Module from communicating outside the local network, set the Default Gateway IP Address to 0.0.0.0 (the default setting).

- **Status Register**: Enter an OCS Register reference (such as %R100) to indicate which 16-bit OCS register will have the Ethernet Status word written to it. The table shows how this register value is formatted and explains the meaning of each bit in the Status Word.

Ethernet Status Word Register Format															
High Byte								Low Byte							
Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	0	Dup	Spd	0	Rx	Tx	Link	TCP Connections							

Status Bit	Status Indication	Status Values	
		Minimum	Maximum
0	Reserved	Always 0	
Dup	Link Duplex (Auto-Negotiated)	0 = Half Duplex	1 = Full Duplex
Spd	Link Speed (Auto-Negotiated)	0 = 10 Mbps	1 = 100 Mbps
Rx	Receive State	0 = Inactive	1 = Active
Tx	Transmit State	0 = Inactive	1 = Active
Link	Link State	0 = Down	1 = Up
TCP Connections	Total Number of Active TCP Connections (CsCAN, SRTP, Modbus, Ethernet IP, FTP, HTTP)	0	40

- **Version Register**: Enter an OCS Register reference (such as %R101) to indicate which 16-bit OCS register will have the Ethernet Firmware Version written to it. The value stored in the Version Register is (Ethernet Firmware Version * 100). For example, for Ethernet Firmware Version 4.30, the Version register will contain 430.
- **Get Setting From**: “Get settings from” allows the programmer to either configure the IP Address, Net Mask, or Gateway for two functions: Configuration or Register.
- **Configuration**: The configuration for the IP Address, Net Mask, or the Gateway will be assigned using the value in the Default Settings in this window.
- **Register**: The configuration for the IP Address, Net Mask, or the Gateway will be assigned using the values in the registers assigned.

12.5: Ethernet Configuration – IP Parameters

For primary operation, the IP address, Net Mask, and Gateway should be set in the LAN config of the **Cscape Hardware Configuration**. There are options to get IP parameters from the LAN Config or to get parameters from registers. It is possible to set the Ethernet IP parameters from the OCS System Menu, but only as a temporary measure. The following points on IP parameter configuration should be considered.

IP Parameters in Non-Volatile RAM: The IP parameters of the Cscape LAN Config are written to non-volatile RAM on power down. IP parameter settings made in the System Menu are not written to non-volatile RAM. Any IP parameters settings made in the System Menu will be lost after cycling power to the unit. It will revert to the last downloaded Cscape LAN Config that was loaded into non-volatile RAM at power down.

"Cscape LAN Config"/"Get Settings from" Configuration: When 'Get settings from' is set to Configuration, the IP parameters specified under 'Default Settings' is used after downloading to the controller. The IP parameters are represented in System Menu / Set Networks and can be edited. However, any edits made from System Menu / Set Networks is not retained through a power cycle. After power cycle, the unit reverts to the last downloaded Cscape LAN Config that was loaded into non-volatile RAM at power down.

"Cscape LAN Config"/"Get Settings from" Register: When 'Get settings from' is set to Register, the IP parameters are retrieved from the OCS registers assigned in LAN Config. Configured registers must be populated with the desired IP parameters:

- The IP parameters are represented in System Menu / Set Networks.
- The IP parameters cannot be edited from System Menu / Set Networks while the unit is in run mode.
- The IP parameters always follow the values in the registers unless the OCS unit is placed in idle mode. Then the IP parameters can be edited in System Menu/Set Networks. When the OCS is placed back into run mode, it reverts to the registers for IP parameters.

12.6: Ethernet Module Protocol Configuration

The Protocol Support area contains a list of all the protocols supported by the platform being configured. To activate a protocol, check its checkbox.

For protocols that require additional configuration, click on a listed protocol to select it and then click the Configure Selected Protocol button. This will open a new dialog with configuration options for the selected protocol.

NOTE: Refer to the Ethernet Supplement (**SUP0740**)on the Document Search page for more details.

Downloadable Protocols



Chapter 13: Protocol Configuration

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13.1: 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 the OCS's control capability with negligible effect on the OCS 's ladder scan time.

Remote devices that communicate serially must do so under certain rules of data transfer known as a protocol. Many device manufactures 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.

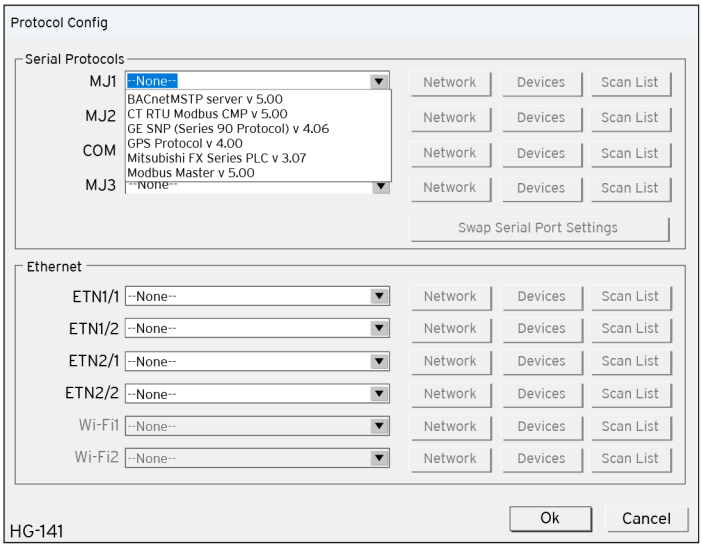
These basic types are also subdivided into read or write operations. For polled operations, a Read operation only reads from a remote device. Likewise a Read/Write operation continuously reads from the remote device unless the target OCS register value changes from one ladder scan to another. In this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

13.2: 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).

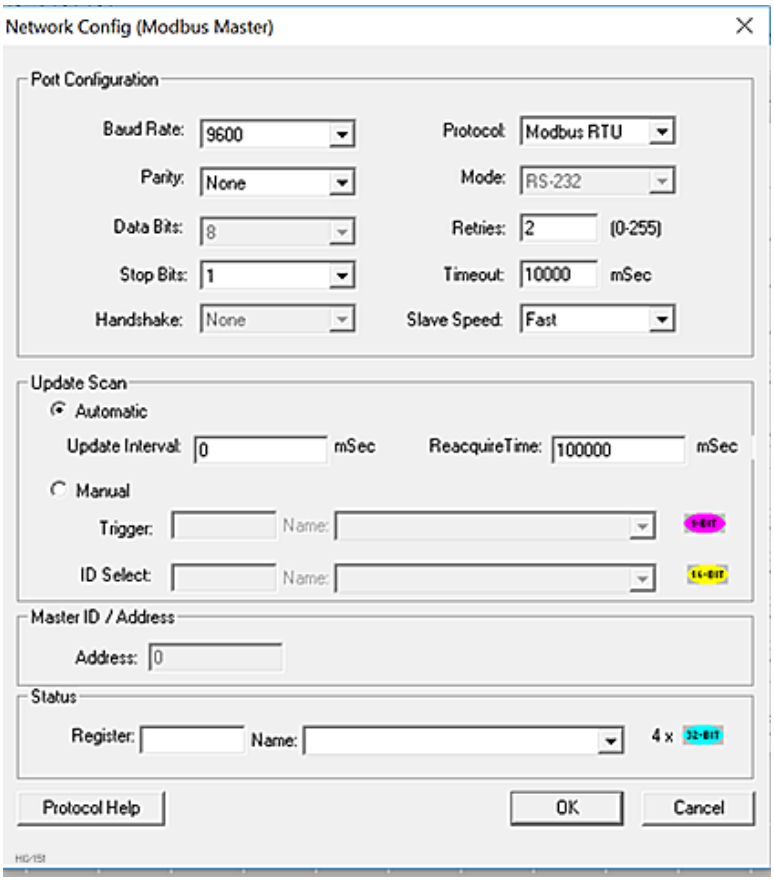


NOTE: If the MJ1 port is to be used in the Protocol Config, it will no longer be available for Cscape programming unless the controller is put into IDLE mode.

Three fields must be configured after a protocol is selected:

1. Network
2. Devices
3. Scan List

13.3: Network Configuration



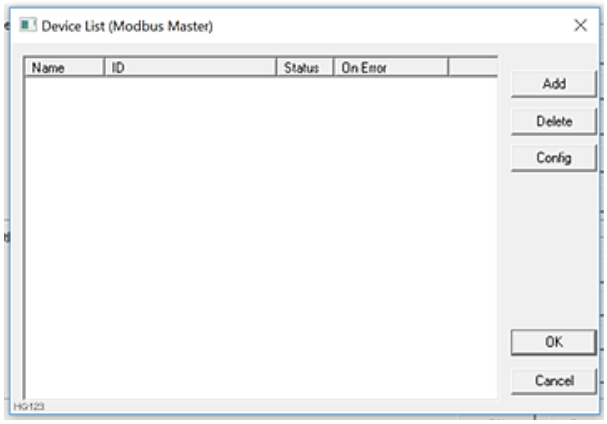
Network Configuration provides the required parameters to configure the network. Each protocol is different and may not require the entire Network Config field. Please refer to the table below for the options in the Network Config field.

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

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

13.4: Device List and Device Configuration

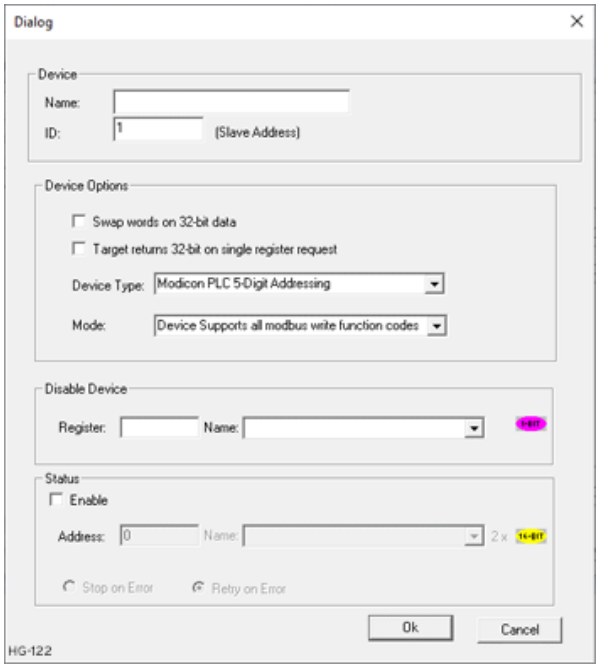
13.4.1: Device List



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.

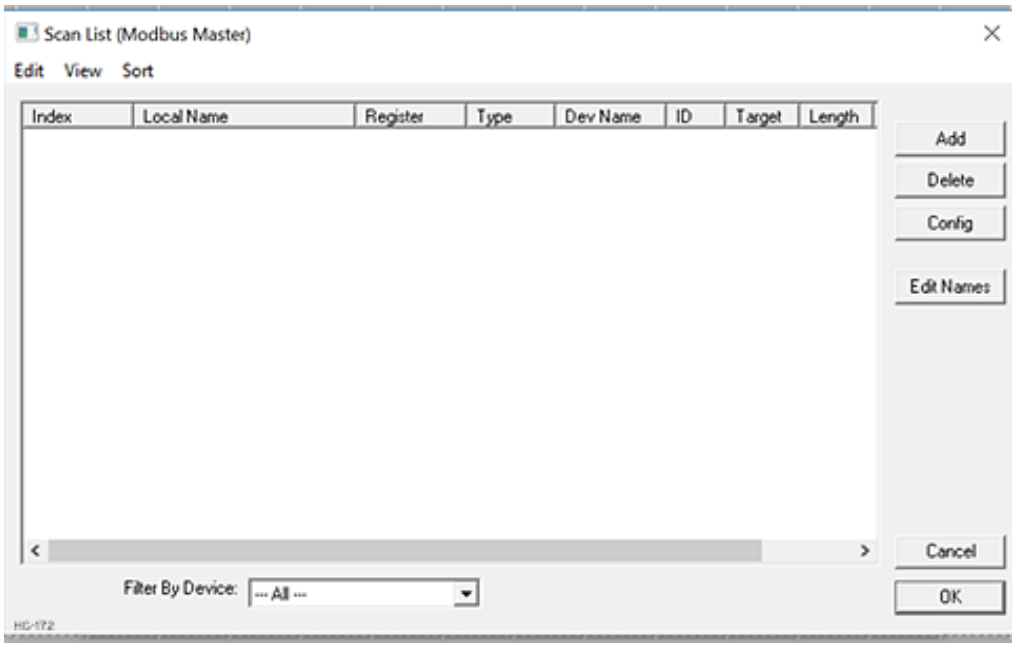
13.4.2: Device Configuration



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.

13.5: 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.

13.5.1: 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.

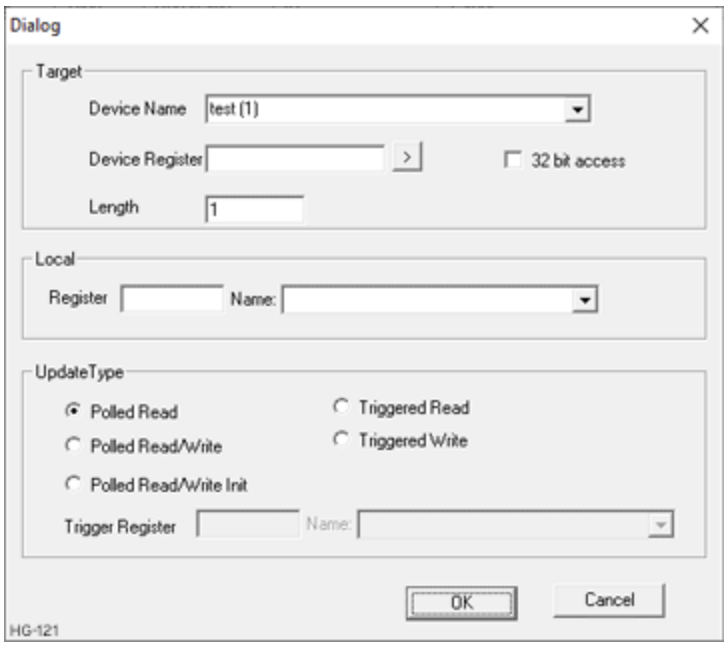
13.5.2: Buttons

- **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.

13.5.3: Display Control

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

13.5.4: 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



Chapter 14: User Interface

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This chapter presents the user interface (or operator view) of the X7 and some of the model specific characteristics of the X7 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.

14.1: Screen Specifications

Display Type	7” 65k TFT
Resolution	800 x 480 pixels
Backlight	LED – 20,000 hours to reach 50% brightness
Screen Memory	256kB
User-Programmable Screens	250
Keypad	Slide Keys (Touch)

14.2: Displaying and Entering Data



Multiple objects are provided for displaying data such as virtual panel lights, push buttons, numeric value displays, bar graphs, meters, graphs, and animated bitmaps. On the X7, these graphical objects (through ladder manipulation of attribute bits) can change color, flash, or change visibility to attract operator attention.

On objects that accept user input, the input is provided by touching the object or alternately changing an OCS register (i.e. Function Key Registers). Objects that allow input generally have a raised 3D appearance. An exception is the binary type objects, such as buttons, which are shown in a depressed 3D appearance when in the ON state. Objects that normally accept touch input may be disabled through program control (through ladder manipulation of an attribute bit). If an object is disabled, the object's representation changes to a 2D appearance.

On objects that represent non-discrete information, more action may be required beyond that of simply touching the object. For example, the slider object requires the operator to touch and slide the control in the direction desired. Alternately, alpha-numeric entry objects invoke a pop-up alpha-numeric keypad for additional user input. The alpha-numeric keypad is discussed below.

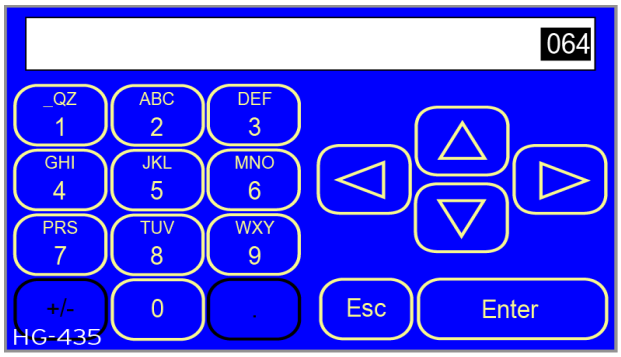
NOTE: If the numeric entry object displays >>>>>>>, the value is too big to display in the field or is above the maximum for an editable field. Likewise, if the numeric entry object displays <<<<<<< in a numeric field, the value is too small to display or is below the minimum for an editable field.

14.3: Numeric keypad

To allow entry of a specific number, several of the input objects invoke a pop-up numeric keypad when the object is touched. An example of the numeric keypad invoked from a numeric input object is shown in Figure 14.2. Once invoked, the operator may touch the appropriate keys to enter a specific value. When entering a value, the numeric keypad is in one of two modes [new-value or edit-value].

New-Value Mode - Generally, when the numeric keypad is first invoked, it is placed in new-value mode. Initially, the numeric keypad displays the current value with all the digits being highlighted. Once the first digit is entered, the current value is erased from the display and the new digit is placed in the first location. Thereafter, no digits are highlighted, and new digits are added to the rightmost position while the other digits are shifted left.

Edit-Value Mode - Edit-value mode may be entered from the initial new-value mode by pressing either the left or right arrow key before any digit key is pressed. The result will be a single character highlighted. The user may then either touch a key to change the digit at the selected position or the up and down arrows may be used to add or subtract (respectively) from the selected digit. The user may then use the left or right arrow keys to select a new position.



Once the desired value is entered, pressing the **Enter** key moves that value into the object (and the corresponding OCS register) and the alpha-numeric keypad disappears. Alternately, pressing the bkey any time before the **Enter** key cancels the operation, leaves the objects current value unchanged, and the alpha-numeric keypad disappears.

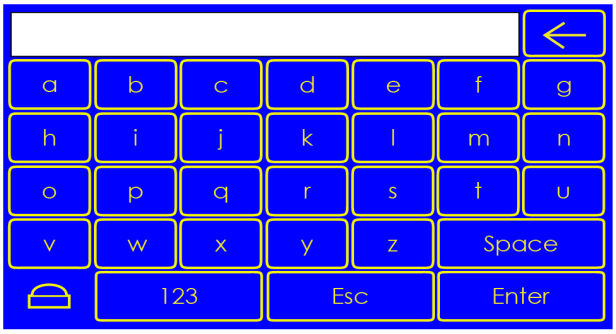
NOTE: Each numeric entry object has a configured minimum and maximum value. If the operator enters a value outside of the configured range, the new value is ignored when **Enter** is pressed and the current object value is NOT changed.

Since the alpha-numeric keypad services several different graphical objects, certain keys on the alpha-numeric keypad may be disabled (grayed) when the keypad is invoked for certain objects. The following describes the alpha-numeric keypad variation based on object.

Numeric Object - When editing a numeric value, the [+/-] or the [.] key are disabled (grayed) if the object is NOT configured for floating-point value or a signed value.

Password Object - When editing a password value, the arrow keys, [+/-], and the [.] keys are disabled. Additionally, overwrite mode is disabled. When entering digits, the pop-up keypad hides the value by displaying '*' alternately for each digit.

ASCII Object - When editing an ASCII value, an ASCII keypad is displayed as shown Figure 14.3. The ASCII keypad has three (3) modes, numeric, symbols, and alpha. In Alpha mode, the Caps Lock button may be pressed to access capital letters. When you first enter this editor, typing a character will overwrite the entire old string and start a new entry. You may press the backspace arrow to delete the previous character. Pressing Enter will save the entry, filling any unused space beyond the last character entered with NULL characters. Pressing ESC will cancel the edit and return the string to the previous value.



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Text Table Object - When editing a Text Table Object, all of the keys, except the Up and Down arrow keys, are grayed and disabled. The next text selection is made by pressing either the Up or Down arrow.

Time/Date Object - When editing a Time/Date Table Object, all the keys, except the Up, Down, Left, and Right arrow keys, are grayed and disabled. The specific field (i.e. hour or minutes) is selected using the Left and Right arrows. The value in the selected field is changed by pressing either the Up or Down arrow.

14.4: Screen Navigation

To allow the operator to change screens, a screen jump object is generally used. This object may be visually represented as a 3-D button (responding to touch) or remain invisible and logically tied to an OCS register. An optional system ICON may be configured for display along with the legend, which aids in identifying the object as one that causes a screen change, shown below.



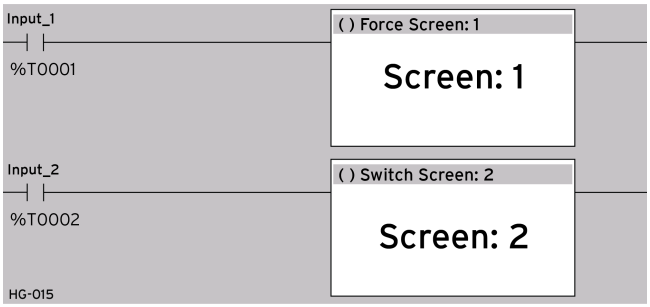
Screen jumps can also be triggered on other keys or based on control logic for more advanced applications. To allow the operator to change screens, a **screen jump object** is generally used. This object may be visually **represented as a button** (responding to touch) or remain invisible and logically tied to an OCS register. An optional system ICON may be configured for display along with the legend, which aids in identifying the object as one that causes a screen change.

14.5: 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.

14.6: Touch (Slip) Sensitivity

Touch slip sensitivity is preset to meet most applications; however, adjustment is available to reduce the sensitivity for touch release. That is, once a graphical object (button) is touched and held by a finger, the default touch slip sensitivity allows for a slight slip of the finger on the graphical object before the X7 assumes touch been released (equates to approximately a quarter inch of movement with a stylus).

In some applications (such as jog buttons) where the operator is pushing a button for a period of time, the amount of slip while holding a button pressed may exceed the default sensitivity. To increase the amount of tolerable slip and prevent false releases of the button, the X7 allows adjustment of the allowable slide up to 5x the default value.

To enable the touch (slip) sensitivity, first an OCS data register must be allocated through the Graphics Editor Configuration menu for Display Settings. Once a Touch Sensitivity register is assigned, that register may be modified [range = 1(Low) to 5 (High)] to the desired slide amount. If a value outside the valid range is entered in the touch sensitivity register, it is ignored, and the last valid value is used.

14.7: Alarms

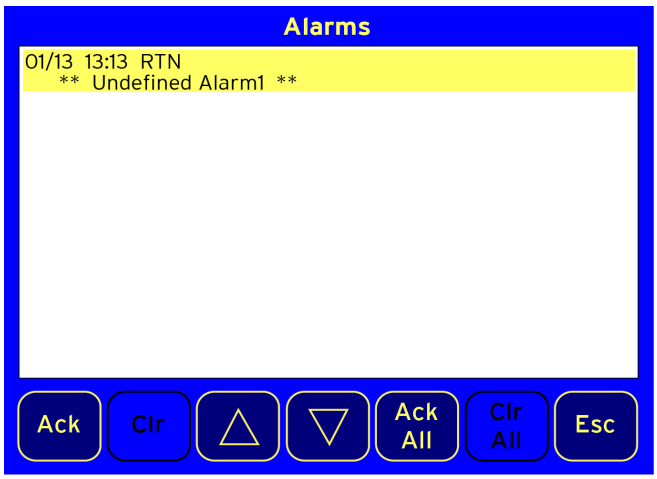
Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. The alarm object is generally used to enunciate alarms to the operator. Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. For more information refer to the graphics editor help file in Cscape. This section presents a typical configuration thereby providing an introductory description on what the operator should expect.

The alarm object is generally used to enunciate alarms to the operator. While the display characteristics of this object is configurable, it is generally displayed as a button that changes colors to indicate the highest state of the alarm(s) in the alarm group it is monitoring. The following indicates the priority of the alarm states and the default colors associated with these states.

Highest	(Red)	Unacknowledged Alarms Exist
–	(Yellow)	Acknowledged Alarms Exist
Lowest	(Green)	No Alarms Exist



Alarm Viewer - To view, acknowledge and/or clear alarms, the operator must access the alarm viewer. This is accomplished by touching an (enabled) alarm object. When accessed, the alarm viewer is displayed as pop-up alarm viewer dialog similar to that shown below.



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The currently selected entry is indicated by a yellow highlight which can be moved up or down by touching the arrow buttons or by directly touching an entry. If more entries exist than can fit on the page, a scroll bar is displayed on the right side that also indicates the current relative position.

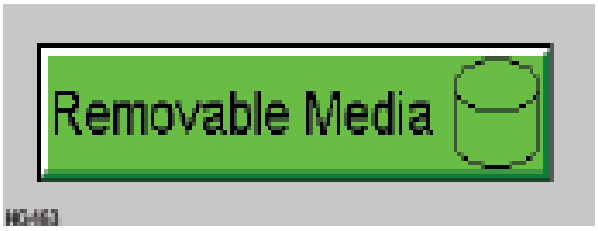
The current state of the displayed alarm is indicated by its color and optionally by an abbreviated indicator after the date/time stamp (ALM, ACK, RTN). The operator can acknowledge an alarm by selecting it from the list and touching the ACK button. The operator can also clear an alarm if that function is enabled in the alarm object. If not enabled, the Clear buttons are grayed and do not respond to touch. 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.

For more information, refer to the Help file in Cscape.

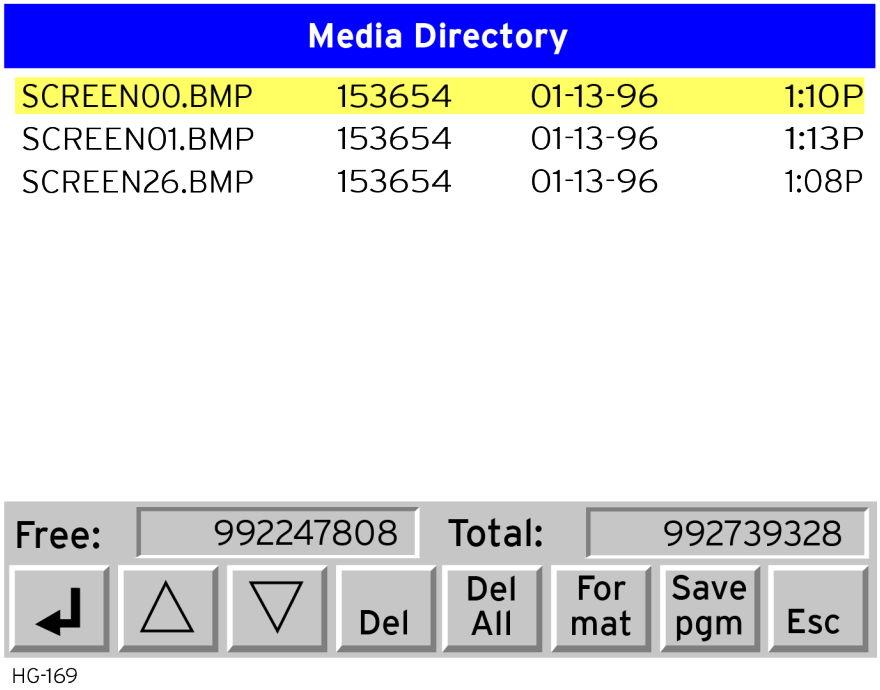
14.8: Removable Media

The removable media object is generally used to inform the operator on the current state of the removable media device and allow access to its file structure. The removable media object is displayed as a button that changes colors to indicate the current state of the removable media device. The following indicates the device states and the default colors associated with these states.



To view and perform file operations, the operator must access the removable viewer. This is accomplished by either touching an (enabled) removable media object or through the system menu. When accessed, the removable media viewer is displayed as pop-up removable media dialog similar to that shown in the figure below.

NOTE: The removable media object can be configured to open the removable media viewer at a certain directory complete with restrictions on transversing back up the file path. This may be used to restrict operator access to non-critical files.



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The currently selected entry is indicated by a yellow highlight which can be moved up or down by touching the arrow buttons or by directly touching an entry. If more entries exist than can fit on the page, a scroll bar is displayed on the right side that also indicates the current relative position.

File operations are accomplished by pressing the appropriate button at the bottom of the removable media viewer. The configuration of the removable media object that invokes the removable media viewer defines what buttons are enabled and available to the user.

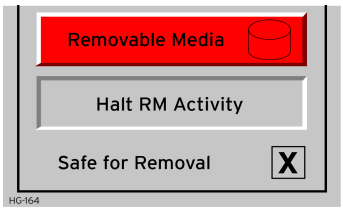
The  (Enter) button (if enabled) performs certain operations based on the selected file's type:

..	Change display to parent directory
<DIR>	Change display to child directory
bmp, jpeg	Display bitmap (if compatible format)
pgm	Load application (if compatible model and version)

Alternately, the (enter) button can be configured to simply load the ASCII representation of the file path (including the file name) to a group of OCS registers. That pathname can then be used by ladder for opening and manipulating that file.

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

It is best practice to discourage removal of removable media devices by the operator while a write operation is in process. This can be accomplished by adding a push button to the screen (tied to %SR174.1), which is used in the logic program to lock out write operations prior to media removal. An indicator object (tied to %SR174.2) can also be added to the screen, which provides positive confirmation to the operator that it is safe to remove the media.



14.9: Screen Saver

The X7 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 X7 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.

14.10: Screen Brightness

The X7 provides a feature that allows screen dimming for night operation. To enable this feature, the application must access and control system register %SR57 (Display Backlight Brightness). Screen brightness is continuously variable by driving %SR57 through the range of 100 (full bright) to 0 (full off). It is left to the screen designer on if and how to present a Screen Brightness control to the user.

NOTE: Backlight life may be shortened when the screen is dimmed, or screen brightness is varied on a repetitive basis.

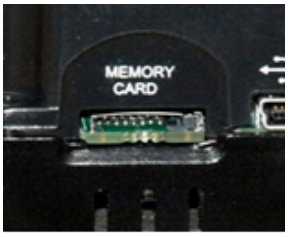
Removable Media



Chapter 15: Removable Media

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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.



15.1: microSD Cards

MicroSD cards(Memory Cards) 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 above; 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.

15.1.1: 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.

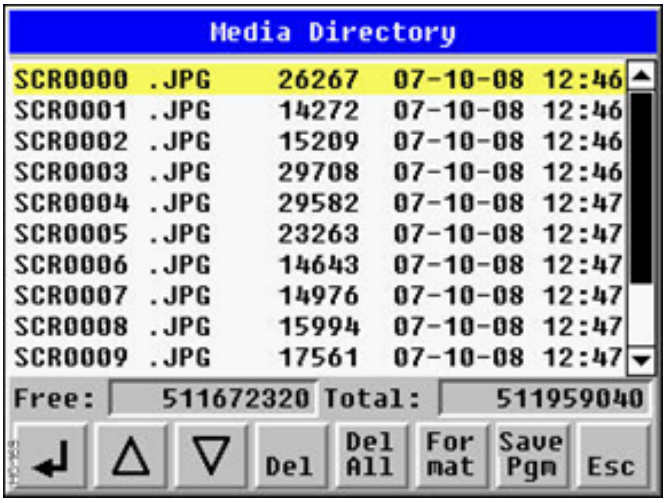
Directories and sub-directories can be nested up to 16 levels deep as long as each path name string does not exceed 147 characters.

15.2: Using the Removable Media Manager

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

a. Display total capacity, and available space in kilobytes
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

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



15.3: 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.

15.4: View and Capture Screens

The Horner controller File System uses bitmap files with the .BMP extension or JPEG files with the .JPG extension to store Horner controller graphic screen captures.

To view a captured Horner controller screen, use the Removable Media Manager to find and highlight the desire .BMP or .JPG file, and then press Enter. 

To capture an Horner controller screen, turning on the assigned **Screen Capture Control Register** will capture the current Horner controller graphics screen and write it to the microSD card using the assigned **Screen Capture Filename**.

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

To capture an Horner controller screen, turning On the assigned **Screen Capture Control Register** will capture the current Hornercontroller graphics screen and write it to the microSD card using the assigned **Screen Capture Filename**. To view a captured Horner controller screen, use the Removable Media Manager to find and highlight the desired .BMP or .JPG file, and then press Enter.

15.5: 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.

15.6: Function Blocks in Cscape

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

The following RM functional blocks are available in Cscape 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:'

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

15.6.1: 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.

15.6.2: 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.

15.6.3: 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.

15.7: 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

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

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

15.8: 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

RM Status Values	
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

Clone Unit



Chapter 16: Clone Unit

16.1: Make Clone 147
16.2: Load Clone 150

"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 the following:

- Prime Series: retentive memory
- Non-Prime controllers: battery-backed RAM of an OCS into the RM

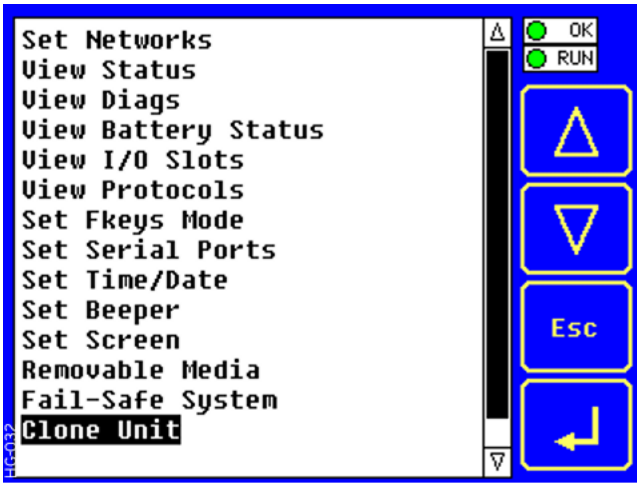
This feature can be used for:

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

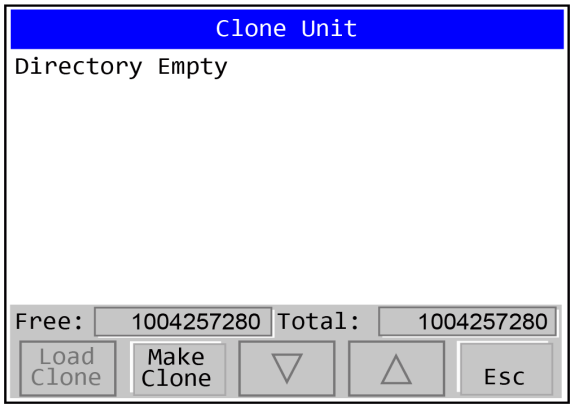
16.1: Make Clone

The user needs to perform the following to Clone:

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:



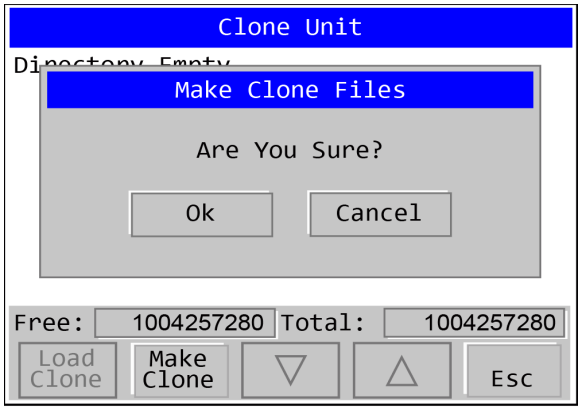
Step 2: Selecting “Make Clone” will open the following menu screen.



HG-111

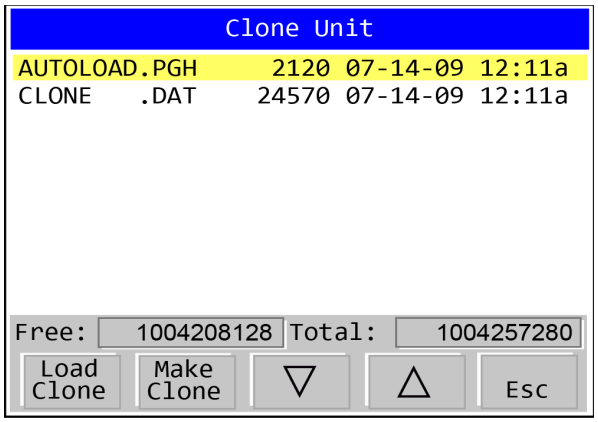
NOTE: Free/Total – displays number of free and total bytes in Removable Media.

Make/Create Clone option enables user to duplicate/Clone application file, all unit settings and all register values. Selecting Make Clone brings up the screen below for the user:



HG-110

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

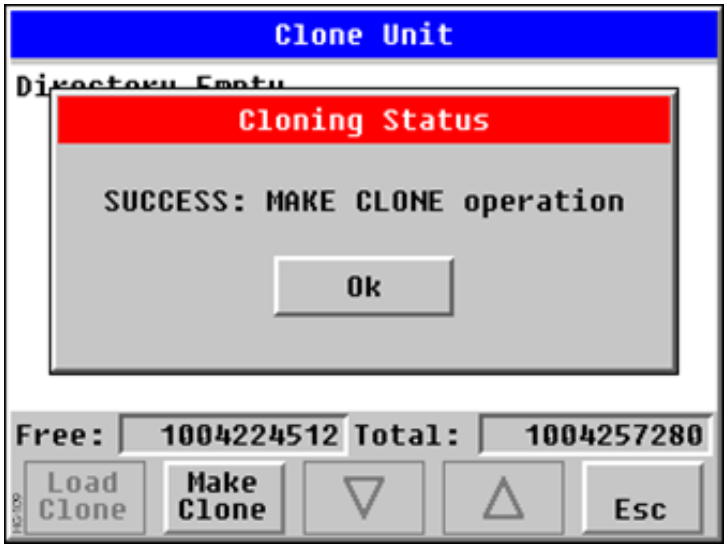


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AUTOLOAD.PGM	Application file
CLONE.DAT	File having all unit settings and register values

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

Once the cloning is successful, 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 for making 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.

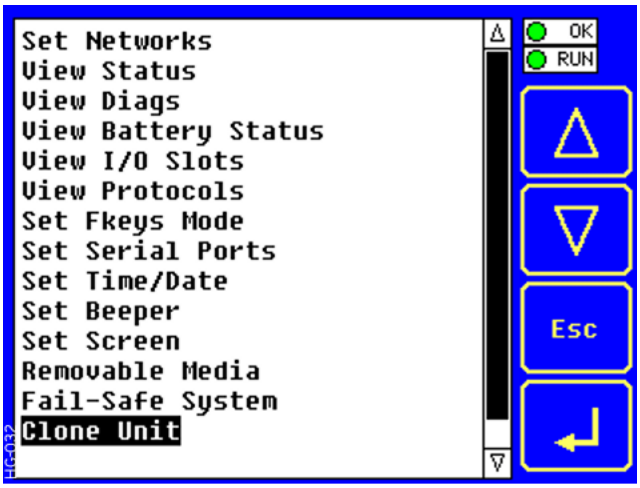
NOTE: Backup of registers in flash memory is not performed by Clone Feature. Refer to "Fail-Safe System for the XL and X Series" on page 153.

16.2: Load Clone

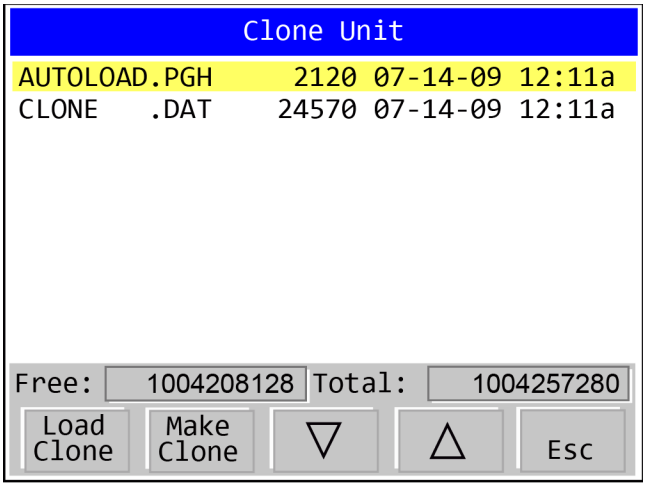
This option loads the application, all unit settings and register values from Removable media to the OCS memory (regardless of the AutoLoad settings) and then resets the OCS for the settings to take effect.

User needs to perform the following to Load Clone:

Step 1: Select “Clone Unit” from main System Menu of OCS as shown below:

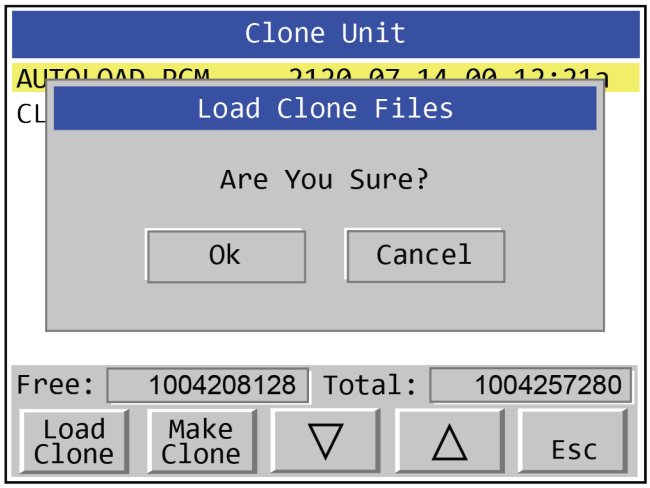


Step 2: Selecting “Clone Unit” menu will open the following menu screen. Select “Load Clone”.



HG-112

Step 3: User needs to confirm Load Clone as shown below:



HG-240

Step 4: After confirmation, all unit settings and register values will be loaded from Removable media to the OCS memory (regardless of AutoLoad settings) and then OCS resets for the settings to 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 Load Clone operation is triggered by this SR bit, it does not ask the user for confirmation for loading clone. The success / failure of the operation is also not notified on screen to the user.

In case of failure of “Load Clone” operation, %SR164.12 bit is set to “1” by the firmware and never reset.

Fail-Safe System



Chapter 17: Fail-Safe System for the XL and X Series

17.1: For the XL & X Series 153
17.2: Fail-Safe System Overview 153
17.3: Settings 154
17.4: Backup/Restore Data 154
17.5: Clear Backup Data 155
17.6: AutoLoad 158
17.7: AutoRun 160

17.1: For the XL & X Series

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:

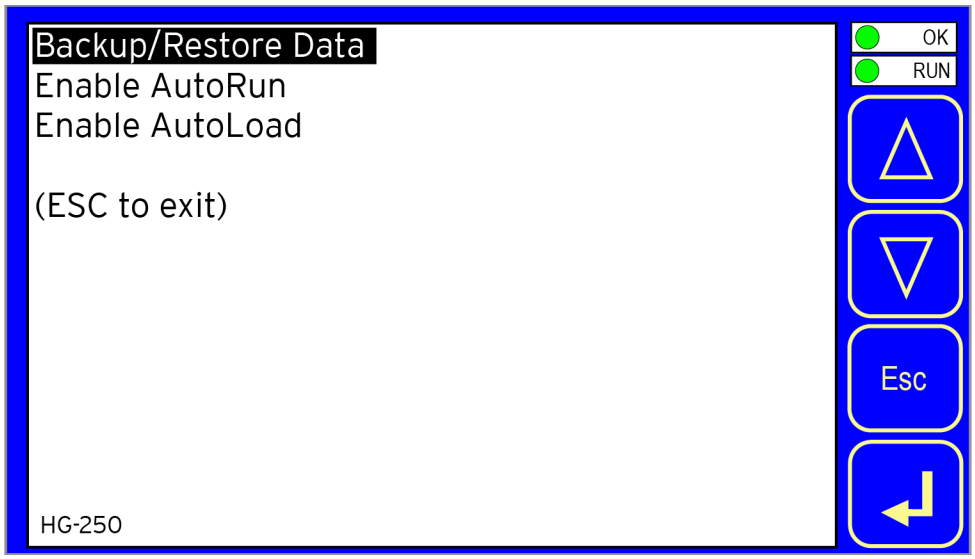
- Battery power loss
- Battery-Backed Register RAM or Application flash corruption due to, for example, an excessive EMI, Electromagnetic Interference, event.

17.2: Fail-Safe System Overview

The Fail-Safe System has the following capabilities:

- Manually backup the current retentive register settings into flash memory.
- Manually restore register settings from the values previously backed up in flash memory 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 from the System Menu of the OCS; see the **Fail-Safe System** on the main System Menu.



17.3: Settings

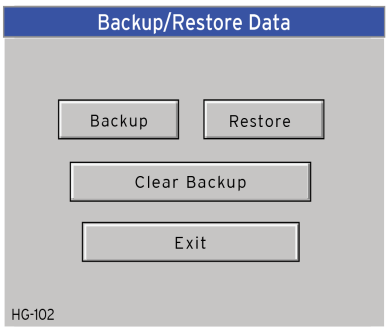
To use the Fail-Safe feature, the following steps are required:

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 primary memory register contents in the onboard flash memory using the System Menu options.

17.4: Backup/Restore Data

Use this option to display a screen with the following four operations:

- Backup OCS Data
- Restore OCS Data
- Clear Backup Data
- Exit



17.4.1: Backup OCS Data

When initiated, the user can manually copy register contents onto the an alternate section of onboard flash memory of the OCS. This will have result in backing up all the registers and controller settings (Network ID, etc.) that would otherwise be lost due to a memory failure. %SR164.4 is set to 1 when backup operation is performed.



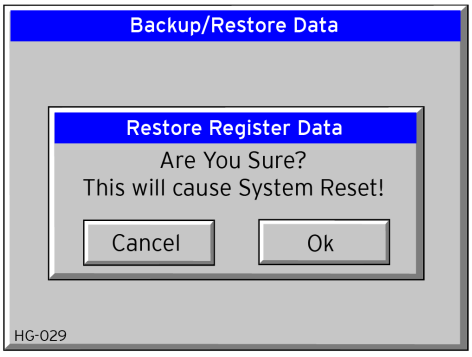
17.4.2: Restore OCS Data

When initiated, the user can manually copy the backed-up data from the onboard flash to the primary memory.

A restore operation will be automatically initiated if 1) a backup has been previously created and 2) on power-up the primary memory registers fail their check.

The following steps are required:

1. Place the controller in IDLE mode.
2. Copy data from onboard flash memory to OCS primary memory
3. Reset the Controller.
4. Put the controller in RUN mode if the AutoRun setting is 'Yes', or else it will remain in IDLE mode.

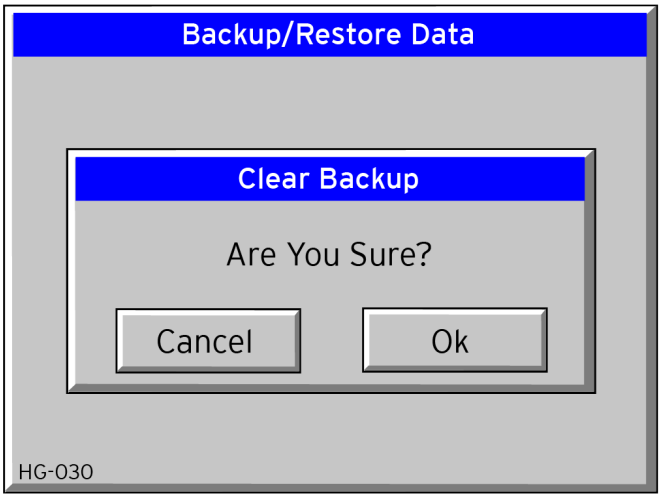


%SR164.3 is set to 1 only when an automatic restore operation is performed, not on a manual one. This bit is reset to the value of "0" when a new backup is created.

Restoring of data can be manually performed by selecting **RESTORE** option from the Backup / Restore Data menu. This causes the controller to reset.

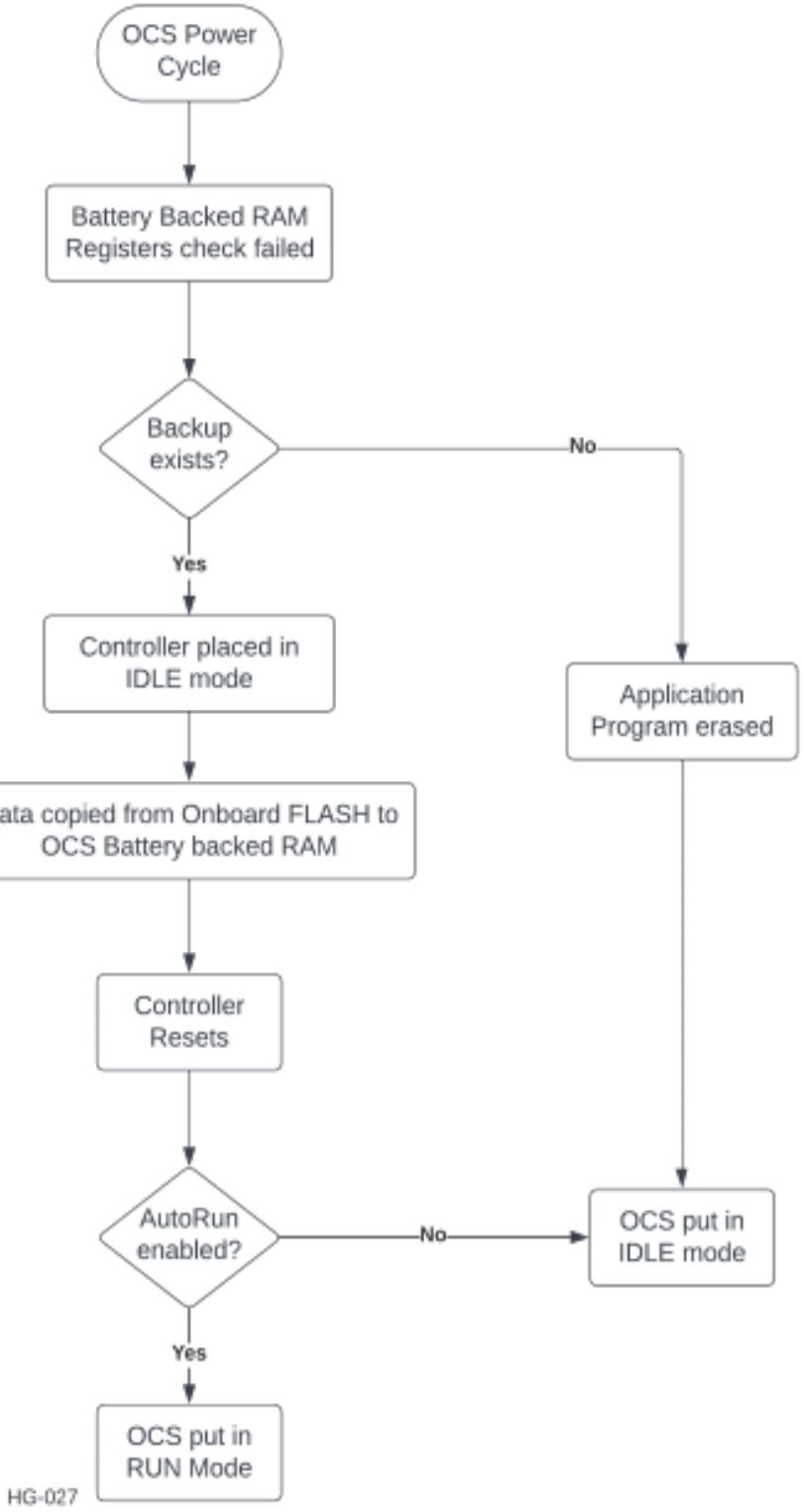
17.5: Clear Backup Data

When initiated, the backup data is erased from the onboard flash and no backup will exist. %SR164.4 and %SR164.3 is reset to 0 when backed up data is erased.



Exit: Goes back to the previous screen.

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



17.6: AutoLoad

This System Menu option permits 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 either be manually initiated or automatically initiated at power-up.

The automatic initiation will happen only in the following two cases:

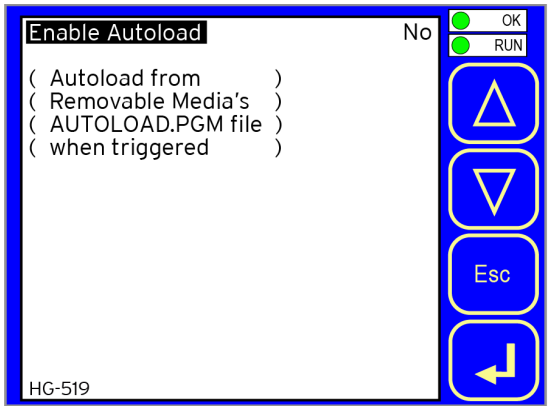
- When there is no application program in the OCS and a valid AUTOLOAD.PGM is available in the removable media of the device.
- When the program residing in onboard memory is corrupted and a valid AUTOLOAD.PGM is available in the removable media of the device.

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.

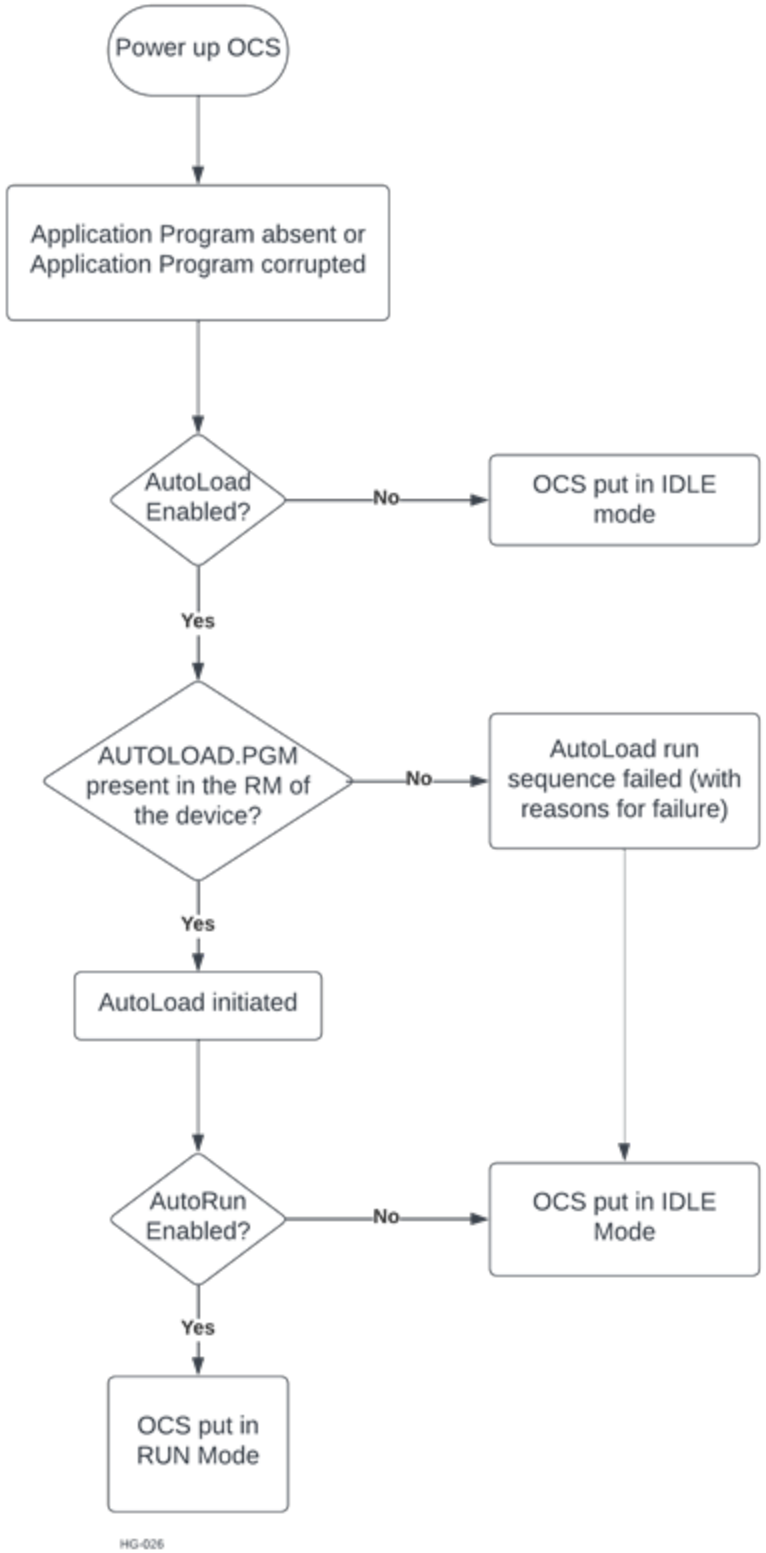
If the AUTOLOAD.PGM is security enabled, the user will be prompted to enter the password before loading the application. The application will be loaded from the Removable media only after getting the correct password.

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



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

The OCS follows the following sequence in execution of AutoLoad:



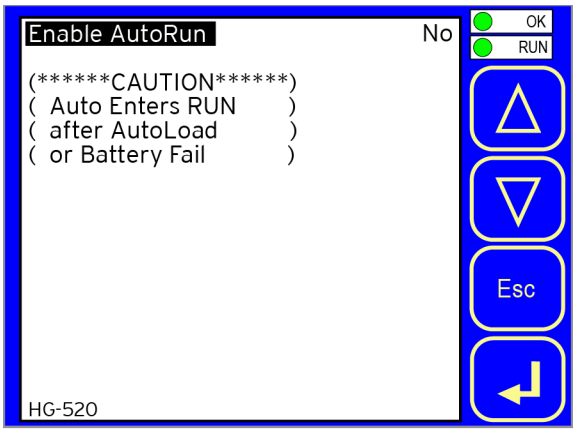
17.7: AutoRun

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** = OCS will be in IDLE mode after AutoLoad or Automatic Restore. **Yes** = OCS will automatically be placed into RUN mode after AutoLoad or Automatic Restore.

“Enable AutoLoad” displays the following options:

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

Modbus-TCP/UDP Communications



Chapter 18: Modbus Communications

18.1: Modbus Slave Overview 162
18.2: Modbus Master Overview 163
18.3: Modbus Addressing Table 164

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 Micro OCS controller 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.

18.1: 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 Micro OCS controller references (%R, %M, etc.).

18.2: 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 Micro OCS controller 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.

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

- **Network**—Parameters, such as the polling rate of the data scan, are specified along with timeout values, retry, and re-acquisition settings. Serial configuration, baud rate, parity, etc. are also set here.
- **Devices**—For every slave to be polled, configuration details are added in the Devices dialog box. This includes Slave ID (serial). Under Device Type, the Modbus addressing style matching that specified in the slave's user documentation may be selected. For instance, some slaves specify Modbus addresses (i.e. 40,001), and others specify offsets (i.e. 0000).
    - **Hex or Decimal**—Some specify addresses in hex, and others in decimal. By allowing the user to select the Modbus addressing style for each slave on the network, minimal address conversion is required. Also, if the slave is another Horner product (i.e. another OCS), the "Native Addressing" option can be selected (i.e. %R1, %M17, etc.), and this skips the conversion to Modbus style altogether.
- **Scan List**—This is where the specific Modbus addresses to be read/written from/to each slave are specified. Up to 32 words of data can be read at the same time.

NOTE: Once configuration has been completed on the Network and Devices level, Modbus data can be directly read/written from graphics objects in the Cscape screen editor. This is available even if the Modbus register is not listed on the scan list.

18.3: Modbus Addressing Table

To access the 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, Micro OCS controller Modbus Function Blocks pack several register types into each Modbus register type. Starting addresses of each register type are shown in the Traditional Modbus Reference column of the Mobus 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.

Micro OCS Controller Modbus Master Mapping					
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

Firmware Update



Chapter 19: Firmware Updates

19.1: Check for Current Firmware Revision 166
19.2: Firmware Update Details 167
19.3: Download Firmware 167
19.4: Firmware Update Steps 168
19.5: Firmware Update via microSD card 168

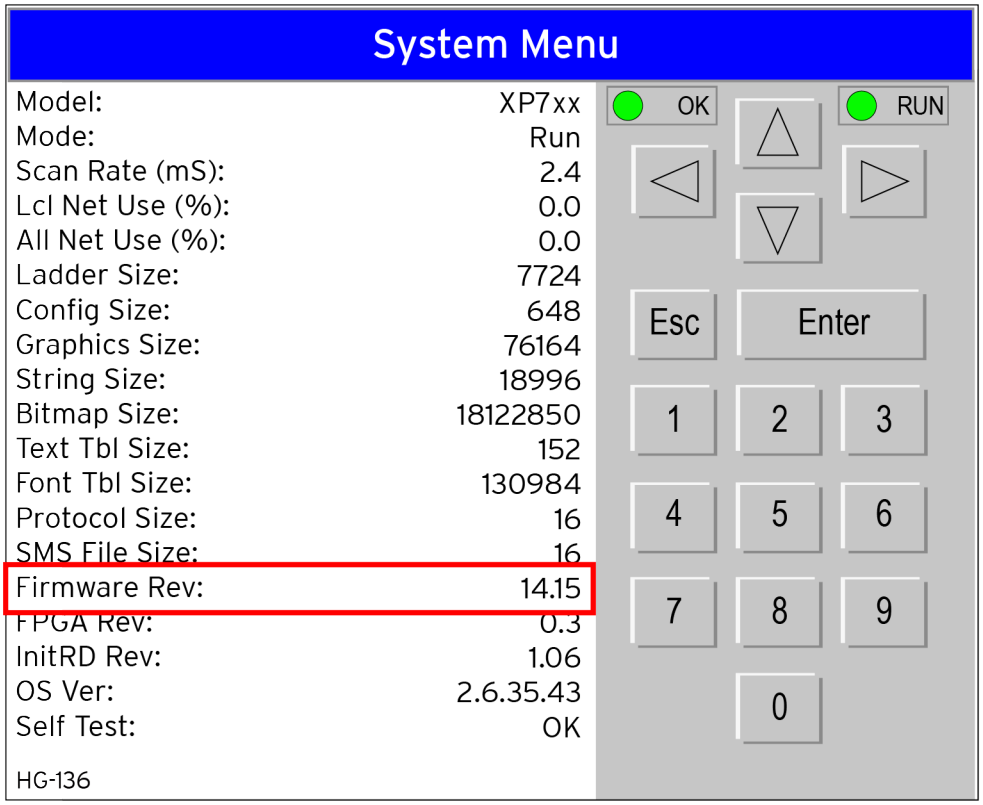
NOTE: Refer to the Firmware Update Manual (**MAN1011**)on the Document Search page for more details.

The Micro 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.

19.1: Check for Current Firmware Revision

To check the firmware revision on a controller, open **System Menu > View Status**.



19.2: 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 or USB, these are the removable media devices.
3. Update the firmware through the controller's Firmware Update Wizard

NOTE: Files from the Horner website come as a .ZIP file which need to be unzipped and placed in the root of the drive for them to function properly.

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

19.3: Download Firmware

In North America, visit https://hornerautomation.com. Then click **Support > Downloads > Controller Firmware** and 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).

19.4: Firmware Update Steps

Unzip all files from downloaded .zip file onto removable media.

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

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 more details.

19.5: Firmware Update via microSD card

NOTE: Must have Firmware 15.40 or higher in place to be able to update firmware using the microSD card.

19.5.1: Method 1

Placing ".s19" file in the root of microSD card and loading firmware manually and automatically.

Manual firmware update by selecting ".s19" file

Place ".s19" file in the root of microSD card and insert the card. Go to System menu | Removable media and select ".s19" file that needs to be loaded. Device displays the following message "Do not power Cycle Until FW is updated", select OK. Firmware update will be started, and a busy symbol will be displayed on the device until firmware will be loaded.

When firmware update will start %SR154.16 bit will be set to high. Once firmware update is completed %SR154.16 bits will be set to low.

Set %SR154.12 bit to high before selecting ".s19" file / before loading firmware if user program and register data should be cleared after the update.

Set %SR154.12 bit to low before selecting ".s19" file / before loading firmware if user program should be present, register values should be retained and status of the device needs to be retained after the update.

Auto firmware update via %SR's

Place ".s19" file in the root of microSD card and insert the card. When %SR154.9 is set to high, %SR154.16 bit goes high and controller will update the firmware which is placed in the root directory of SD Card. Once firmware update process is successful, %SR154.9 and %SR154.16 bits are reset (goes low).

NOTE: There will be no busy symbol indication for this method. User should monitor %SR's for the updates.

Set %SR154.12 bit to high if user program and register data should be cleared after the firmware update.

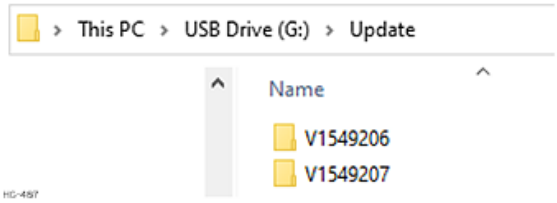
Set %SR154.12 bit to low if user program should be present, register values should be retained and status of the device needs to be retained after the firmware update.

19.5.2: Method 2

Placing ".s19" file in "Update" folder and loading firmware manually and automatically.

For this test, user should create a folder "/Update/Vxxyyzzz" folder in microSD card and then place the ".s19" files inside respective folders.

For example - "update/Vxxyyzzz/ xlee.s19" (Where, V is for version and xxyyzzz is the version number, Vxxyyzzz = V1549206)



NOTE:

a. If Firmware version on the device and firmware version inside Update folders are same then nothing should happen.

b. If multiple firmware version folders are available in the update directory then the version that is greatest / latest should get updated to device.

Manual Firmware Update via %SR's

With proper folder structure placed in microSD card, insert the card to device.

Set %SR154.10 high. If firmware version folder inside update directory is greater than the firmware version on the device, then %SR154.16 will go high indicating firmware update process have started. Once firmware update process will be completed, %SR154.10 and %SR154.16 bits goes low.

NOTE: There will be no busy symbol indication for this method. User should monitor %SR's for the updates.

Set %SR154.12 bit to high if user program and register data should be cleared after the update.

Set %SR154.12 bit to low if user program should be present, register values should be retained and status of the device needs to be retained after the update.

Auto firmware update via %SR's

Setting %SR154.10 and %SR154.11 high, whenever new firmware folder is placed in the microSD card, firmware update will happen automatically setting %SR154.16 bit high. Once firmware update process will be completed, %SR154.16 bit will be reset but %SR154.10 and %SR154.11 will remain high (for auto update of firmware).

NOTE: There will be no busy symbol indication for this method. User should monitor %SR's for the updates.

Set %SR154.12 bit to high if user program and register data should be cleared after the update.

Set %SR154.12 bit to low if user program should be present, register values should be retained and status of the device needs to be retained after the update.

In all the methods, device will reset automatically after firmware update process is completed.

Backup Battery



Chapter 20: Battery

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

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 older than seven (7) to ten (10) years old, it is recommended that it be replaced as preventative maintenance.

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

WARNING: LITHIUM BATTERIES MAY EXPLODE OR CATCH FIRE IF MISTREATED.

WARNING: DO NOT RECHARGE, DISASSEMBLE, HEAT ABOVE 100° C (212° F) INCINERATE, OR PUNCTURE.

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

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

The Micro OCS controller uses a 3V lithium coin battery which can be ordered from Horner APG, part number **HE-BAT009**.

20.1: Low or Missing Battery

If the battery voltage is low or if the battery is lost, **the program will be completely erased at power down**. 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.

20.1.1: 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 1.

20.2: 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 Micro OCS 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; refer to the above warning on disposal regulations.
6. Slide the new battery into the holder. Make sure the battery is inserted with the proper polarity. The top tab of the battery holder should contact the positive (+) terminal of the battery.
7. Place the back cover over the unit and gently press each corner evenly in order to snap the clips back into place.
8. Apply power to the unit. Check that the battery error is no longer reported. If the unit still reports the error, remove the battery immediately and contact "Troubleshooting" on page 175.

Troubleshooting & Tech Support



Chapter 21: Troubleshooting

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21.1: 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	
Local: ###	If a number shows next to **Local** then communication is established to the local controller.
Local: No Port	Cscape is unable to access the COM port of the PC. This could mean that Cscape is configured for a COM port that is not present or that another program has control of the COM port. Only one Cscape window can access a port at a time. Subsequent instances of Cscape opened will indicate No Port.
Local: No Com	Cscape has accessed a PC COM port but is not communicating with the controller. This typically occurs when the controller is not physically connected.
Local: ???	Unknown communication error. Close Cscape, power cycle the controller and reopen Cscape with a blank project. Check Local.
Target: #(I,R,D)	If I (idle), R (run), or D (do I/O) shows next to **Target number**, then communication is established to the target controller.
Target: #(?)	Communication is not established to the target controller. Check node ID of controller and set Target to match. Make sure **local** connection is established.

21.1.1: 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.

21.1.2: USB Port - Mini BType C 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 verity the port number.
5. The Mini-BType C USB port driver installs.

21.1.3: 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.

21.2: 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

21.2.1: 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.

21.3: 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.

21.3.1: 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 121Ω (or 120Ω) 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 60Ω.
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.

21.4: 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.

21.5: 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.

21.6: 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

Europe:

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

Fax: (+353)-21-4321826

Website: https://www.hornerautomation.eu

Email: technical.support@horner-apg.com

Chapter 22: X7 Change Log

Date	Rev #	Description of Revision	Location in Doc
8/16/2021	8	Reordered Chapters (Mantis 3029) Updated Install Procedure (6482) #4845 – Updated WebMI register #4802 – WebMI – Max # of connections #3573 – Added new J3 Wiring images #5381 – Load FW via microSD card	Throughout Install Procedure System Register Table Ethernet Overview RTD Wiring Firmware Update
4/14/22	8.1	#7588 – Note about %SR #7591 – LED Status Info	%SR Table System Menu
7/22/22	8.2	#7635- HSC Pulse Output Info	HSC Pulse Output
1/26/23	20	Converted to Madcap Flare	Throughout
2-9-24	21	#11467 - HSC Info; updated images	HSC and throughout