User Manual for
HELX280, HELX300 and RCS116

OCS
LX Series
Hardware

22 AUG 2006 **MAN0755-03**

PREFACE

This manual explains how to use the OCS LX Series Hardware Module.

Information in this document is subject to change without notice and does not represent a commitment on the part of Horner APG.

For user manual updates, contact Technical Support:

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

Europe:
(+) 353-21-4321-266
www.horner-apg.com

LIMITED WARRANTY AND LIMITATION OF LIABILITY

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

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

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

ABOUT PROGRAMMING EXAMPLES

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

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

REVISIONS TO THIS MANUAL

This version of the OCS LX Series *Hardware Manual* contains the following revisions, additions, and deletions:

Added a **caution note** to **Figure 2.4** and in **Section 2.4.2, item d: *Additional CAN Installation Affecting LX Models*** about the need to provide strain relief for CAN cables.

Table of Contents

CHAPTER 1: INTRODUCTION

1.1 Scope

This manual covers the products listed in Table 1.1.

Note: The HE800RCS116 is covered in Chapter 4 (page 41).

Table 1.1 – Product Descriptions

<table>
<tr><th>OCS LX</th><th colspan="3">Network</th><th colspan="2">Screen Type</th></tr>
<tr><td>HELX280</td><td colspan="3">CsCAN</td><td colspan="2">5.7” STN Grayscale
with 8 shades

220 Nits luminance (candela per square meter (cd/m²).)</td></tr>
<tr><td>HELX300</td><td colspan="3">CsCAN</td><td colspan="2">5.7” STN
with 16 colors

160 Nits luminance</td></tr>
<tr><td rowspan="3">All OCS LX Models</td><td colspan="5">Functions</td></tr>
<tr><td colspan="2">Control</td><td colspan="2">Display and Keypad</td><td>Network</td><td>I/O</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td colspan="2">CsCAN I/O Expansion
HE800RCS116 (RCS116)</td><td colspan="4">Allows SmartStack I/O to be accessed by LX over CAN I/O Network</td></tr>
<tr><td colspan="2">SmartStack Modules</td><td colspan="4">Expansion I/O products (via RCS116)</td></tr>
<tr><td colspan="2">SmartStix Modules</td><td colspan="4">Remote I/O products</td></tr>
</table>

1.2 LX Models

1.2.1 LX Product Description

The LX provides controller, networking, I/O and operator interface capabilities in one unit. The LX offers color and non-color displays to fit your requirements and your budget. All LX models can be used in CsCAN networks.

LX models are equipped with standard viewing screens (STN). An STN screen is viewed by looking directly into the front of the screen. Table 1.1 describes LX models and other devices that can be used with the LX.

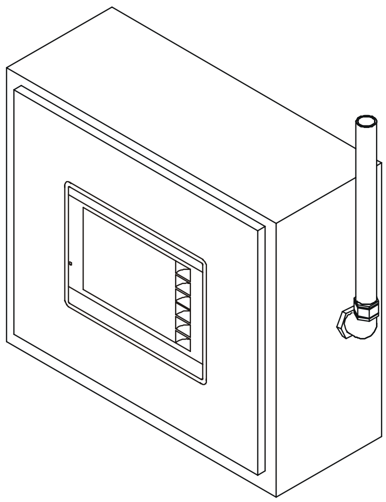
LX models have Serial and CAN (Controller Area Network) communication abilities. The units contain an RS-232 port for programming/debugging, monitoring and network administration from an IBM-compatible PC.

LX features include CsCAN (pronounced “see-scan”) peer-to-peer network. CAN-based network hardware is used in the controllers because of CAN’s automatic error detection, ease of configuration, low-cost of design and implementation and ability to operate in harsh environments. Networking abilities are built-in to the LX and require no external or additional modules.

When several LX models are networked together to achieve a specific purpose, the system is configured to behave as a large parallel-processing controller.

The LX combines several desirable functions in one compact package. Each unit is a highly integrated operator interface and controller with expandable I/O and networking capabilities. The standard features consisting of the following:

- Color or Non-Color Screens (STN)
- 24 VDC powered
- RS-232 / RS-485 Serial Ports
- Integrated Bezel
- Real-Time Clock
- Flash Memory for easy field upgrades
- System Key and Configurable Function Keys.



001OCS001

Figure 1.1- Front View of LX

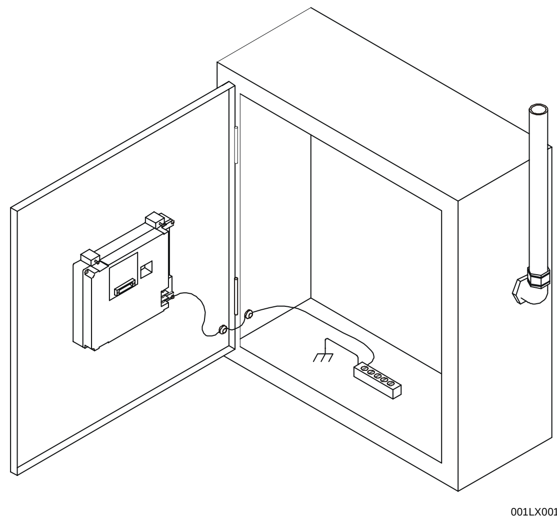


Figure 1.2 - Back View of LX (LX Shown in Panel Box Door)

The LX features the ability to pass through programming commands. When attached to an LX serial port, a programming package (i.e., Cscape) can access other LX units or any other OCS/RCS unit connected to a CsCAN network by passing the programming command through the serial port to the network port. One Cscape package (connected to one LX unit) can program all LX or other OCS/RCS units on the CsCAN network.

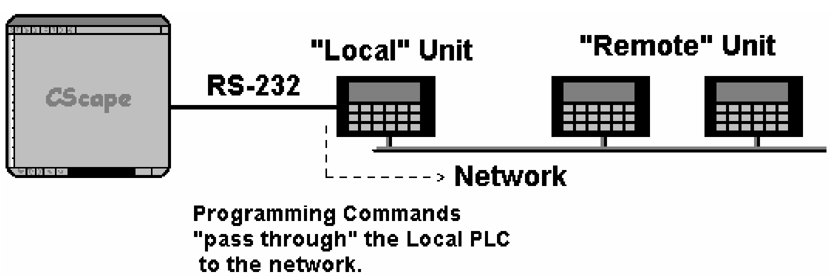


Figure 1.3 – Pass-Through Function (Available in CsCAN Networks Only)

After making a physical serial connection to one LX, you indicate which node is to be connected (called the TARGET). After that, Cscape and the LX automatically provide the pass-through connection.

1.2.2 Cscape Software

Cscape Software (pronounced “see-scape”) is used with the LX products (Part # HE500OSW232). (Cscape stands for **C**ontrol **S**tation **C**entral **A**pplication **P**rogramming **E**nvironment.) The Windows-based software package is easy to use and aids in the integration of a CAN-based Distributed Control System. The program is used for configuring controllers. Cscape is also used for programming ladder logic, programming user displays for the LX, configuring the network for global digital and analog data, setting system-wide security and monitoring controllers in the system. Provided there is **one serial connection** to one node on the network (i.e., CsCAN Network), the operator has control over the entire system. The operator can upload, download, monitor and debug to any node on the network.

1.4 LX Specifications

Table 1.2 – LX Specifications

Models	**LX280**	**LX300**
Display Type (LCD with backlight)	320 x 240 STN Grayscale	320 x 240 STN Color
Display Size	5.7”	
Display Screen Dimensions	4.6”W x 3.5”H (117 x 88mm)	
Display Memory	1 MBytes	
User Keys	5 configurable keys + System Key	
Screens Supported	1023 screens (50 data fields per screen)	
Number of Colors	8 (Grayscale)	16 (Color)
Primary Power	**Steady State Current:** 300mA @ 24VDC **Inrush Current:** (6A @ 24VDC) for 4ms.	
Primary Power Terminal Torque	10.6 In-Lb.	
Height	6.75” (171.45mm)	
Width	10 3/16” (258.76mm)	
Mounting Depth	3.00” (76.2 mm)	
Keypad Material	Faceplate made of Lexan® HP92 by GE Plastics.	
Protocols supported **Serial Ports:**	CsCAN, Modbus Master, Modbus Slave, and ASCII Read and Write	
CAN Ports:	CsCAN (up to 253 drops)	
Serial Ports	2 RS-232 / RS-485 Ports. Software Selectable.	
Network Ports	1 CAN (CsCAN peer)	
Expansion I/O	SmartStack I/O via RCS116	
Remote I/O	SmartStix support	
Control Memory	128K Ladder Memory plus 32KB Register Space	
Control Scan Rate	0.2mS / K Ladder Logic (typical)	
Portable Memory	None	
Temperature & Humidity	32 - 122°F (0 - 50°C), 5 to 95% Non-condensing	
UL **CE**	Please refer to Compliance Table located at http://www.heapg.com/Support/compliance.htm	

1.5 LX Resources

1.5.1 Overview

This section defines the resource limits that a programmer needs to know when writing a program using the LX. The LX combines operator interface (display and keypad), local I/O (analog and digital), networking, and controller, into a single product. In addition, the LX has graphical capabilities.

The controller portion of the LX products is programmed in ladder logic via the Windows-based Cscape package. Each LX provides a set of resources for use by the ladder logic control program.

1.5.2 Resource Limits

Table 1.3 shows the resources available in the LX. Note that although each register type inherently consists of either 1-bit or 16-bit registers, all registers can be accessed via User Screens and/or Ladder Code as 1, 8, 16 or 32-bit values or as ASCII character strings.

Table 1.3- Resource Limits

Resource	OCS300	OCS301	OCS350	OCS351	OCS451	OCS551	OCS651
%S Registers	16						
%SR Registers	192						
%T Registers	2048						
%M Registers	2048						
%R Registers	9999						
%K Registers	5				7		
%D Registers	300				1023		
%I Registers	2048						
%Q Registers	2048						
%AI Registers	512						
%AQ Registers	512						
Network Port	CsCAN						
Ethernet Port	No	Yes	No	Yes	Yes		
Controllers Per Network	253 CsCAN						

1.5.3 Resource Definitions

System Registers

System Registers (%S and %SR) are used to store general LX status information. This information is used internally, and is also available to the operator via the System Menu, using the Control Station's display and keypad. The System Registers are also available for User Screens and can be accessed by Ladder Code.

1. %S Registers

%S Registers are 1-bit memory locations containing system status information, which are implemented as shown in **Table 1.4**:

Table 1.4- %S Registers

Register	Name	Description
%S1	FST_SCN	On during first scan after entering RUN mode
%S2	NET_OK	On if Network is functioning properly
%S3	T_10MS	On for 5 ms.; Off for 5 ms.
%S4	T_100MS	On for 50 ms.; Off for 50 ms.
%S5	T_SEC	On for 500 ms; Off for 500 ms.
%S6	IO_OK	On if SmartStack I/O is configured properly
%S7	ALW_ON	Always On
%S8	ALW_OFF	Always Off
%S9	PAUSING_SCN	On during last scan before Pause
%S10	RESUMED_SCN	On during first scan after Pause resumes
%S11-16	-	*Reserved for Future Use*

2. %SR Registers

%SR Registers are 16-bit memory locations, containing system status information, implemented as shown in **Table 1.5**. **Note:** Where 2 %SRs are combined to make a 32-bit value, the lower numbered %SR is the low word, while the higher numbered %SR is the high word.

Table 1.5- %SR Registers

Register	Name	Description	Min	Max
%SR1	USER_SCR	Current User Screen Number (0=none)	0	1023
%SR2	ALRM_SCR	Current Alarm Screen Number (0=none)	0	1023
%SR3	SYS_SCR	Current System Screen Number (0=none)	0	12
%SR4	SELF_TEST	Bit-Mapped Self-Test Result	0	65535
%SR5	CS_MODE	Control Station Mode (0=Idle, 1=Do I/O, 2=Run)	0	2
%SR6	SCAN_RATE	Average Scan Rate (in tenths of ms.)	-	1000
%SR7	MIN_RATE	Minimum Scan Rate (in tenths of ms.)	-	1000
%SR8	MAX_RATE	Maximum Scan Rate (in tenths of ms.)	-	1000
%SR9-10	Reserved	-	-	-
%SR11-12	LADDER_SIZE	Ladder Code Size	2	256K
%SR13-14	Reserved	-	-	-
%SR15-16	Reserved	-	-	-
%SR17-18	IO_SIZE	I/O Configuration Table Size	16	127K
%SR19-20	NET_SIZE	Network Configuration Table Size	34	1K
%SR29	NET_ID	This Station's Primary Network ID (CsCAN)	1	253
		This Station's Primary Network ID (DeviceNet)	0	63
%SR30	NET_BAUD	Network Baud Rate (CsCAN) (0=125KB; 1=250KB; 2=500KB; 3=1MB)	0	3
		Network Baud Rate (DeviceNet) (0=125KB; 1=250KB; 2=500KB)	0	2
%SR31	NET_MODE	Network Mode (0=Network Not Required; 1=Network Required; 2=Reserved; 3=Network Required and Optimized)	0	3
%SR32	LCD_CONT	LCD Display Contrast Setting	0	255
%SR33	FKEY_MODE	Function Key Mode (0=Momentary; 1=Toggle)	0	1
%SR34	SERIAL_PROT	RS232 Serial Protocol Mode (0=Firmware Update (RISM); 1=CsCAN; 2=Generic (Ladder- Controlled); 3=Modbus RTU; 4=Modbus ASCII)	0	4
%SR35-36	SERIAL_NUM	This Station's 32-bit Serial Number	0	2^{32}-1
%SR37	MODEL_NUM	This Station's Binary Model Number	0	65535
%SR38	ENG_REV	Main CPU Engine Firmware Rev Number x 100	0000	9999
%SR39	BIOS_REV	Main CPU BIOS Firmware Rev Number x 100	0000	9999
%SR40	FPGA_REV	FPGA Image Rev Number x 10	000	255
%SR41	LCD_COLS	LCD Graphics Display Number of Columns	320 Max. (OCS3xx) 800 Max. (OCS451,551, 651)	
%SR42	LCD_ROWS	LCD Graphics Display Number of Rows	240 Max. (OCS3xx) 600 Max. (OCS451,551, 651)	
%SR43	KEY_TYPE	Keypad Type (0=16 Keys; 1=17 Keys; 2=32 Keys; 3=36 Keys)	0	3
%SR44	RTC_SEC	Real-Time-Clock Second	0	59
%SR45	RTC_MIN	Real-Time-Clock Minute	0	59

Table 1.5- %SR Registers				
Register	**Name**	**Description**	**Min**	**Max**
%SR46	RTC_HOUR	Real-Time-Clock Hour	0	23
%SR47	RTC_DATE	Real-Time-Clock Date	1	31
%SR48	RTC_MON	Real-Time-Clock Month	1	12
%SR49	RTC_YEAR	Real-Time-Clock Year	1996	2095
%SR50	RTC_DAY	Real-Time-Clock Day (1=Sunday)	1	7
%SR51	NET_CNT	Network Error Count	0	65535
%SR52	WDOG_CNT	Watchdog-Tripped Error Count	0	65535
%SR53-54	BAD_LADDER	Bad Ladder Code Error Index	0	65534
%SR55	F_SELF_TEST	Filtered Bit-Mapped Self-Test Result	0	65535
%SR56	LAST_KEY	Key Code of Last Key Press or Release	0	255
%SR57	BAK_LITE	LCD Backlight On/Off Switch (OCS3xx): (OCS451,551,651):	0 (=off) 0 (=off)	1 (=on) 100 (=on)
%SR58	USER_LEDS	User LED Control / Status	0	65535
%SR59	S_ENG_REV	Slave CPU Engine Firmware Rev Number x 100	0000	9999
%SR60	S_BIOS_REV	Slave CPU BIOS Firmware Rev Number x 100	0000	9999
%SR61	NUM_IDS	This Station's Number of Network IDs (CsCAN)	1	253
		This Station's Number of Network IDs (DeviceNet)	1	1
%SR62-174	Reserved	-	-	-
%SR180	Reserved	-	-	-
%SR181	ALM_UNACK	Alarms Unacknowledged	-	-
%SR182	ALM_ACT	Alarms Active		
%SR183	SYS_BEEP	System Beep	0	1
%SR184	USER_BEEP	User Beep	0	1
%SR185	N/A	Screen Saver	0	1
%SR186	N/A	Screen Saver Time	1	1200
%SR187	NET_USE AVG	Network Usage (Avg)	0	1000
%SR188	NET_USE MIN	Network Usage (Min)	0	1000
%SR189	NET_USE MAX	Network Usage (Max)	0	1000
%SR190	NET_TX_USE AVG	Network TX Use (Avg)	0	1000
%SR191	NET_TX_USE MIN	Network TX Use (Min)	0	1000
%SR192	NET_TX_USE MAX	Network TX Use (Max)	0	1000

User Registers (%T, %M and %R)

User registers are used to store application-specific LX data. This data can be accessed via User Screens and/or by Ladder Code.

1. %T Register

A %T Register is a non-retentive 1-bit memory location, used to store application-specific state information.

2. %M Registers

A %M Register is a retentive 1-bit memory location, used to store application-specific state information.

3. %R Registers

A %R Register is a retentive 16-bit memory location, used to store application-specific values.

HMI Registers

HMI registers give the user access to the LX keypad and display.

The LX has a touch-screen keypad and a graphics-based LCD display, but it does not yet support the Cscape Remote Display Terminal function. An operator is able to enter and display general and application-specific information using a virtual display and keypad.

1. %K Registers

A %K Register is a non-retentive 1-bit memory location (contact), used to store the state of a function key on the Control Station's keypad. If the function keys are set for momentary mode, a function key's associated %K register will be ON as long as the function key is pressed. If the function keys are set for toggle mode, a function key's associated %K register will toggle each time the function key is pressed.

2. %D Registers

A %D Register is a non-retentive 1-bit memory location (coil), which can be turned ON by Ladder Code to cause the corresponding User or Alarm Screen to be displayed.

3. User Screens

A User Screen is a combination of fixed text or graphics, along with variable Data Fields (called Graphics Objects in the LX), which together fill the LCD display screen. These screens are defined via Cscape dialogs and are then downloaded and stored into the controller's Flash memory. User Screens can be selected for display by operator entries on the keypad or by Ladder Code.

4. Data Fields

A Data Field is an area on a User Screen where variable data is displayed and edited. The source data for a Data Field can be any of the Control Station's Register resources as defined above. The field size and display format is programmable via Cscape dialogs.

Network Port

The CsCAN Network is based on the Bosch Control Area Network (CAN), and implements the CsCAN Protocol, which is designed to take maximum advantage of the global data broadcasting capability of CAN. Using this network protocol, up to 64 Control Stations can be linked without repeaters, and up to 253 Control Stations can be linked by using 3 repeaters. For more information regarding CsCAN Protocol, refer to the **CsCAN Protocol Specification** document.

Ladder Code

The Ladder Code, stores ladder instructions generated by Cscape. This Ladder Code is downloaded and stored into the Control Station's Flash memory, to be executed each controller scan, when the controller is in RUN mode.

1.6 References

For further information regarding products covered in this manual, refer to the following reference:

> *Cscape Programming and Reference Manual* (**MAN0313**) – Topics in this manual have been selected to assist the user through the programming process. It also covers procedures for creating graphics using the LX.

1.7 Technical Support

For assistance, contact Technical Support at the following locations:

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

Europe:
(+) 353-21-4321-266
www.horner-apg.com

NOTES

CHAPTER 2: INSTALLATION

2.1 General

CHAPTER 2 covers general installation information that applies to all models of the LX. For model-specific information pertaining to LX280 and LX300, see CHAPTER 3 (Page 39).

2.2 Mounting Requirements

2.2.1 Mounting Procedures (Installed in a Panel Door)

Note: The following instructions apply to all LX models. The LX280 is depicted as an example.

The LX is designed for permanent panel mounting. To install the LX, follow the instructions below.

1. Prior to mounting the LX, observe requirements for the panel layout design and adequate clearances. (A checklist is provided on page 22.)

2. Cut the host panel.

3. Insert the LX through the panel cutout (from the front). The gasket material needs to lie between the host panel and the LX panel.

Caution: Do not force the LX into the panel cutout. An incorrectly sized panel cutout can damage the LX touchscreen.

4. Install and tighten the mounting clips (provided with the LX) until the gasket material forms a tight seal. Refer to Figure 2.1.
   Note: For 6-inch units (LX280 /LX300): If using a torque wrench, tighten to 80 In/ozs.

Caution: Do not over-tighten. Over-tightening will damage the case.

5. Connect cables as needed such as communications, programming, power and fiber optic cables to the LX ports using the provided connectors.

6. Begin configuration procedures for the LX models.

2.2.2 LX Mounting Clip

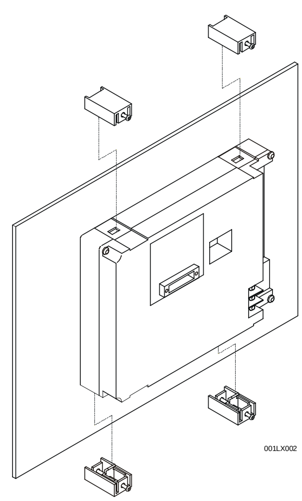
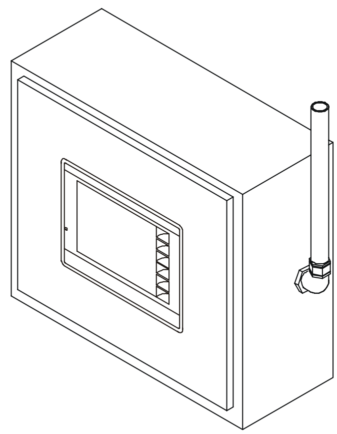


Figure 2.1 – Side View of LX with Mounting Clip (Shown as an Example)

2.2.3 LX Mounting Orientation



NOTE: There are NO orientation restrictions on the LX. *However, the above orientation provides for optimum readability of the screen and ease of use of the keypad.*

Figure 2.2 – Orientation of LX

2.3 Factors Affecting Panel Layout Design and Clearances

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

The designer of a panel layout needs to assess the requirements of a particular system and to consider the following design factors. *A convenient checklist is provided on page 22.*

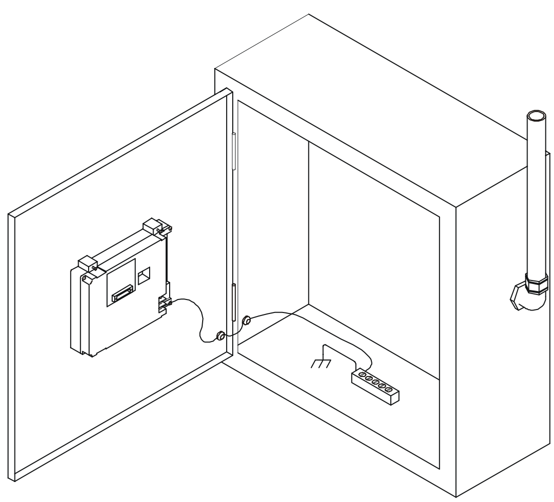


Figure 2.3 – Back view of LX (Shown On Panel Door)

a. Clearance / Adequate Space

Install devices to allow sufficient clearance to open and close the panel door. Note that the LX is mounted on a panel door and the LX is mounted in a panel box.

Table 2.1 – Minimum Clearance Requirements for Panel Box and Door

Minimum Distance between base of device and sides of cabinet	2 inches (50.80mm)
Minimum Distance between base of device and wiring ducts	1.5 inches (38.10mm)
<u>If more than one device installed in panel box (or on door):</u> Minimum Distance between bases of each device	4 inches between bases of each device (101.60mm)
<u>When door is closed:</u> Minimum distance between device and closed door (Be sure to allow enough depth for LX.)	2 inches (50.80mm)

b. Grounding

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

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

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

c. Temperature / Ventilation

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

d. Orientation

There are no orientation restrictions on the LX. However, the orientation shown in Figure 2.3 provides for <u>optimum readability</u> of the screen and <u>ease of use</u> of the keypad.

e. Noise

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

Note: Fiber Cables can be routed in the same conduit as the power wires.

2.3.1 Panel Layout Design and Clearance Checklist:

The following list provides highlights of panel layout design factors.

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

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

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

____Are minimum clearance requirements met? (See **Table 2.1**.) Can the panel door be easily opened and closed? Is there adequate space between device bases as well as the sides of the panel and wiring ducts?

____Is the panel box deep enough to accommodate the LX?

____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 LX 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?

2.4 Ports, Connectors, Cables, and Wiring

Note: For a detailed view of locations of **ports** and **connectors** for each LX model, refer to the appropriate product chapter:

LX280 / LX300: 6-inch OCS (Page 39)

2.4.1 Primary Power Port / Grounding

Table 2.2 – Primary Power Port Pins

Signal Pin	Description
V+	Input power supply voltage
V-	Input power supply ground
⏚	Frame Ground

Note: Power Supply Voltage Range is from 24VDC ±10%.

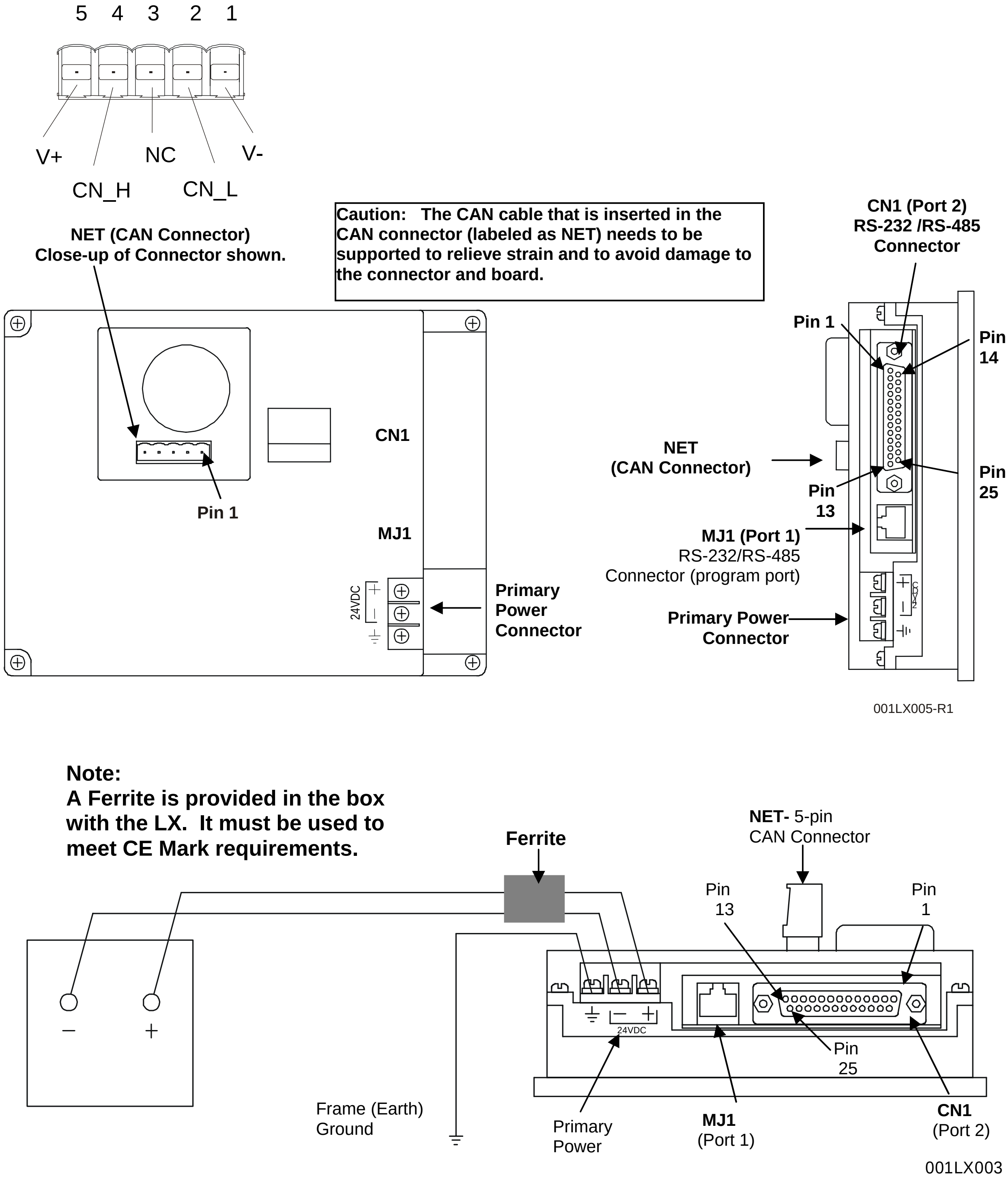


Figure 2.4 – LX Connectors and Grounding

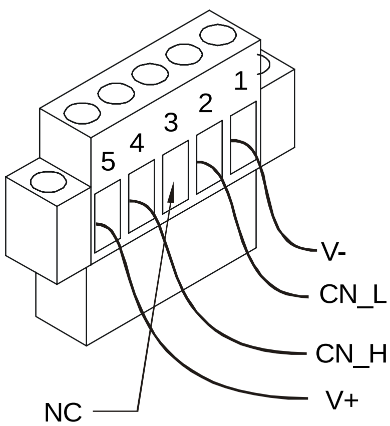
Figure 2.4 depicts the connectors and grounding for the LX. The grounding procedure is similar for all LX models.

2.4.2 CAN Network / DeviceNet Network Port and Wiring

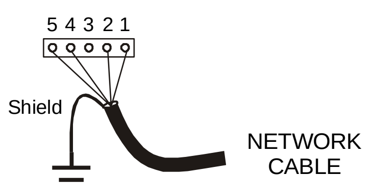
a. Connector (labeled as NET)

Table 2.3 – CAN Port Pins

Pin	**Signal**	**Description**
1	V-	Power -
2	CN_L	Signal -
3 *	**NC**	**NC**
4	CN_H	Signal +
5	V+	Power +



*** Note:**
Ensure that the Shield wire of Network cable is connected to earth ground. It is <u>not</u> connected to the connector.



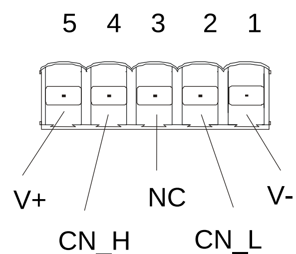
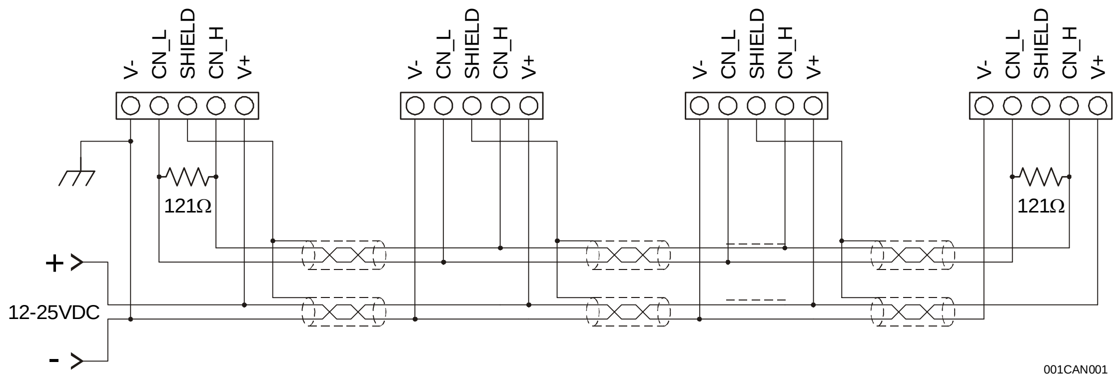


Figure 2.5 - Network Connector

Figure 2.6 (CAN port) – As Viewed looking at the LX

Note: To optimize CAN network reliability in electrically noisy environments, the CAN power supply needs to be isolated (dedicated) from the primary power. **The CAN Shield must be attached to the panel as close to the OCS/LX as possible.**

b. **CAN Wiring**



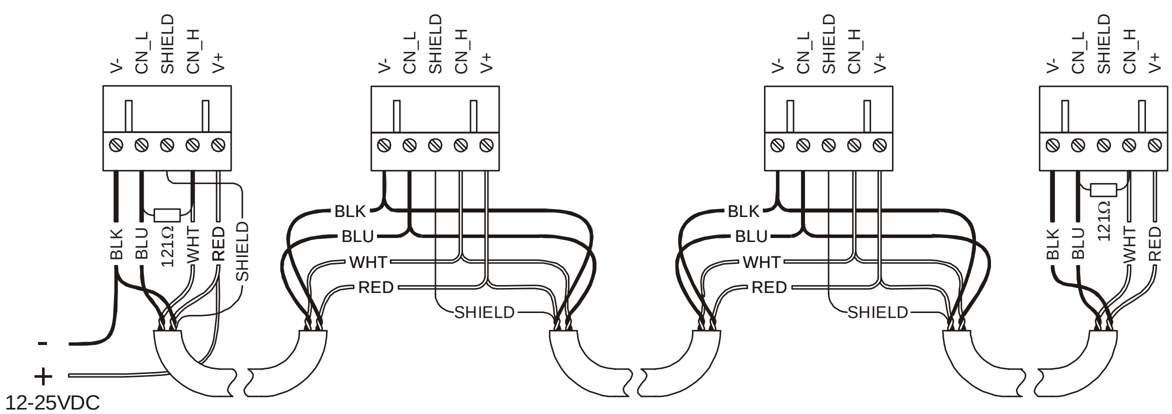


Figure 2.7 – CAN Wiring

Note: To optimize CAN network reliability in electrically noisy environments, the CAN power supply needs to be isolated (dedicated) from the primary power.

c. **CAN Wiring Rules** (See Figure 2.7)

Note: To optimize CAN network reliability in electrically noisy environments, the CAN power supply needs to be isolated (dedicated) from the primary power.

1. Wire the CAN network in a daisy-chained fashion such that there are exactly two physical end-points on the network.
2. The two nodes at the physical end-points need to have 121 ohm 1% terminating resistors connected across the CN_L and CN_H terminals.
3. Use data conductors (CN_L and CN_H) that are 24 AWG shielded twisted pair for “thin cable” and 22 AWG shielded twisted pair for “thick cable.” They must also have 120-ohm characteristic impedance. In typical industrial environments, use a Belden wire #3084A (“thin”). Use #3082A (“thick”) for network cable lengths greater than 100 meters environments where noise is a concern. Place data conductors (CN_L and CN_H) into a twisted pair together.
4. Use power conductors (V- and V+) that are 18 AWG twisted-pair for “thin cable” and 15 AWG twisted-pair for “thick cable.” Place power conductors (V- and V+) into a twisted pair together.

5. If local codes require the local CAN power supply to be earth grounded, connect the V- power conductor to a good earth ground **at one place only** on the network, preferably at a physical endpoint. If multiple power supplies are used, only one power supply must have V- connected to earth ground. The remaining power supplies need to be isolated.
6. For a section of cable between two nodes, the cable shield is connected to the cable shield input at *one end of the cable only.*
7. A CAN network (without repeaters) is limited to 64 nodes (with 63 cable segments) with a maximum combined cable length of 1500 ft. at 125KBaud.
8. Up to four CAN network segments, which adhere to the above rules, may be connected together using three CAN repeaters. In this manner, a CAN network may be extended to 253 nodes with a total cable distance of 6000 ft. at 125KBaud.

d. Additional CAN INSTALLATION Requirements Affecting LX Models

In addition to general CAN wiring and rules, the following CAN requirements apply to LX models as well as other Touch Screen OCS products. Refer to the drawings that follow for wiring examples.

Caution: The CAN cable that is inserted in the CAN connector (labeled as NET) needs to be supported to relieve strain and to avoid damage to the connector and board.

1. The CAN shield is connected to ground at one end only.

2. A 121 Ω resistor is required at the beginning <u>and</u> the end of the CAN cable.

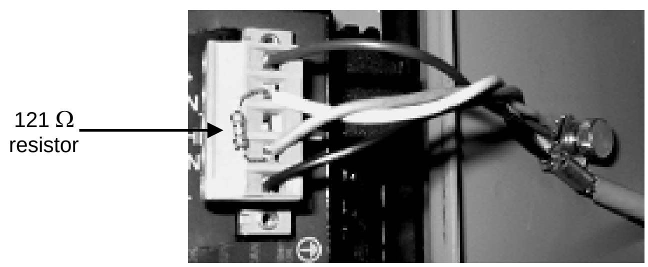


Figure 2.8 – 121 Ω resistor Attached as Close to OCS as Possible
(Required at the beginning <u>and</u> the end of CAN cable)

3. CAN shield must be attached to the panel as close to the OCS as possible at those locations indicated in the drawings with the ground symbol. See Figure 2.8.

4. Only the last Touch Screen OCS (where the CAN shield is <u>not</u> grounded and the CAN cable does <u>not</u> continue on to another CAN device) requires the HE200CRF005.

5. For added RF and Surge suppression, the HE200CRF005 can be added to any OCS.

6. The V- terminal of the DC power supply that provides power to the Analog SmartStix module must be connected to cabinet ground.

Examples of CAN Wiring Drawings for LX

Drawings are provided in this section to depict typical CAN configurations using various models of Touch Screen OCS controllers and other devices. Examples of controllers and devices include:

Controller	Examples
Touch-Screen OCS	• Color Touch OCS (OCS451, OCS551, OCS651) • LX (LX280, LX300)
Text OCS	• OCS1xx, OCS2xx
Graphic OCS	• OCS250
RCS	• RCS116, RCS2xx
SmartStix	• Analog I/O modules • Digital I/O modules
RF and Surge Suppression **(Required to meet CE EMC requirements)**	• HE200CRF005

Note:
If configuring only two units: Ignore the center device(s) in the following drawings by covering them with a piece of paper. Wire the two remaining units accordingly.
If configuring more than three units: Instructions are provided in drawings to wire multiple units.

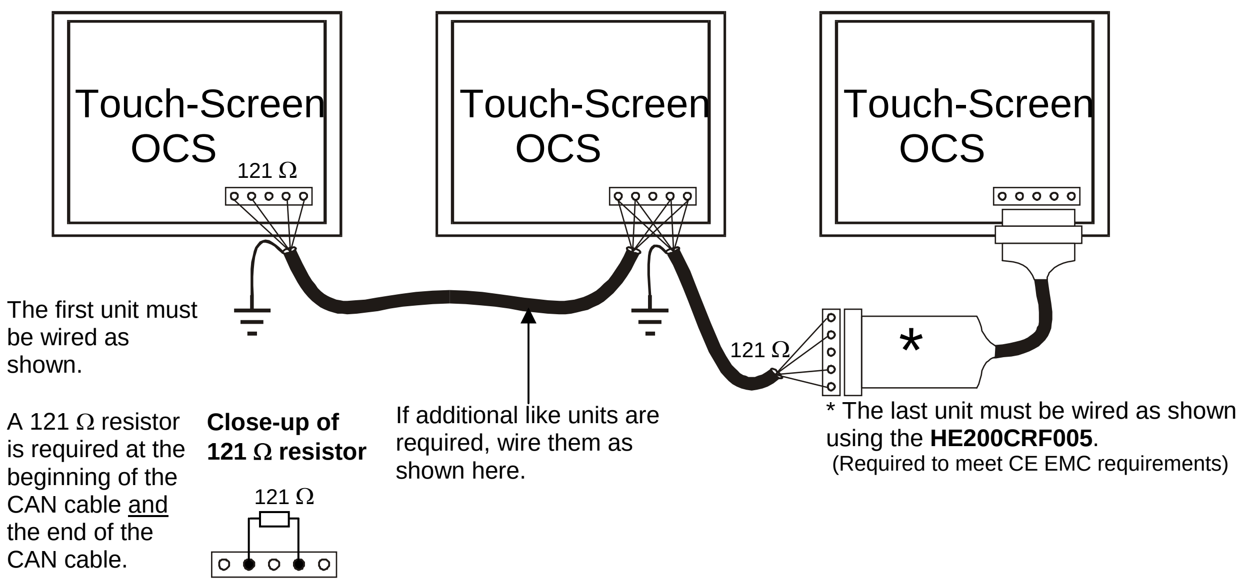


Figure 2.9 –CAN Wiring Between Touch Screen OCS Units

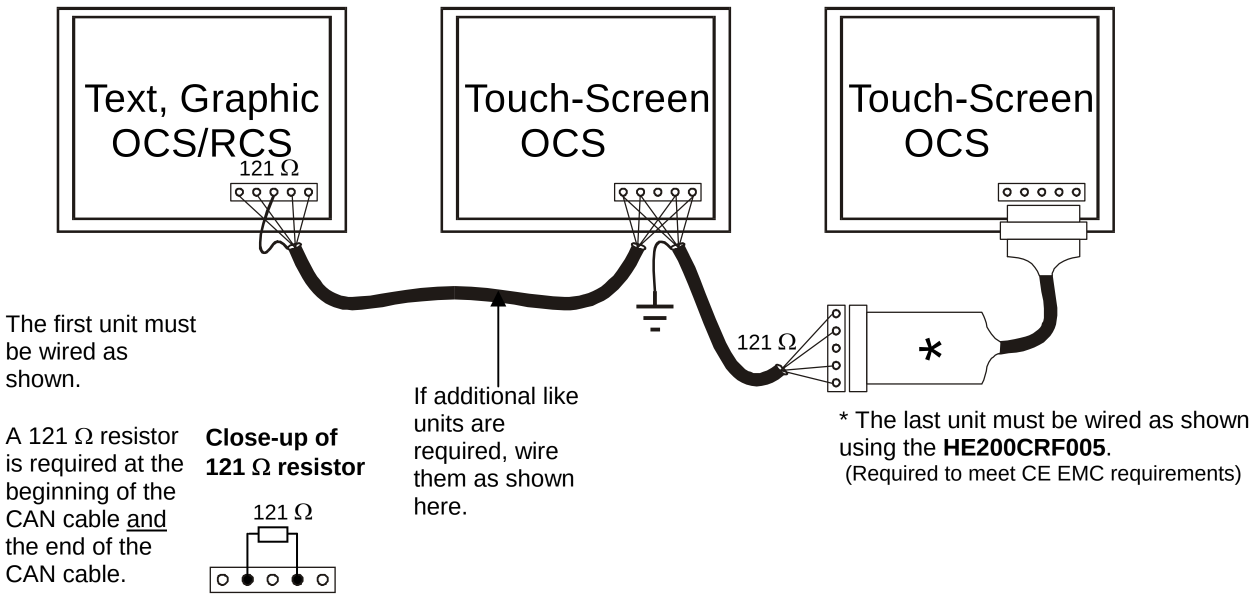


Figure 2.10 – CAN Wiring Between Text OCS/GraphicOCS/RCS and Touch Screen OCS Units

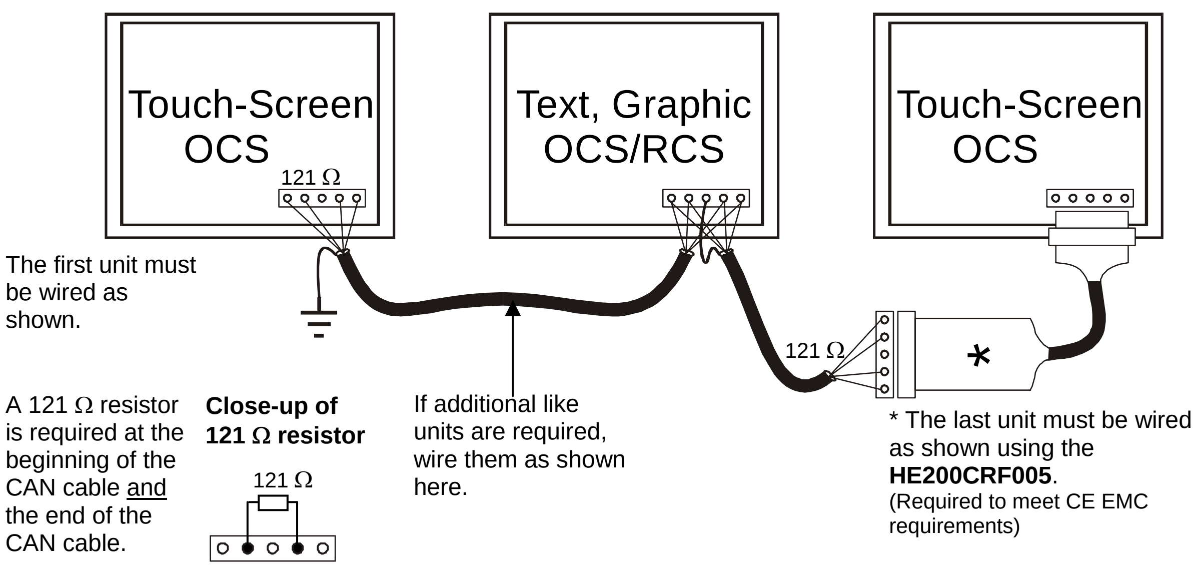


Figure 2.11 - CAN Wiring Between Touch Screen OCS and Text OCS/GraphicOCS/RCS Units

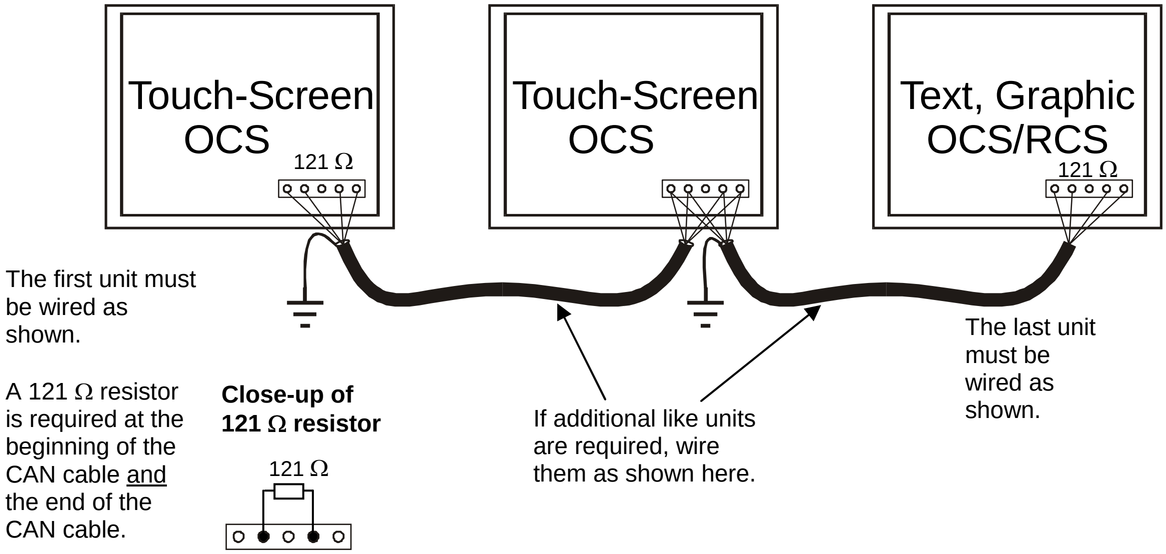


Figure 2.12 - CAN Wiring Between Touch Screen OCS and Text OCS/ GraphicOCS/ RCS Units

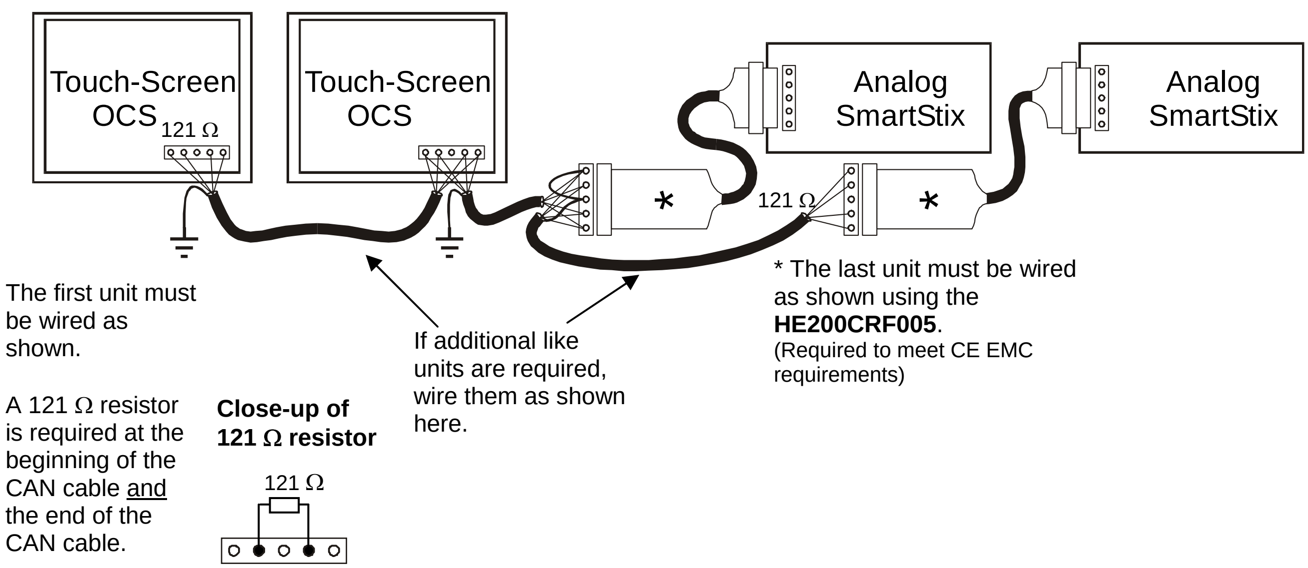


Figure 2.13 - CAN Wiring between Touch Screen OCS and Analog SmartStix Modules

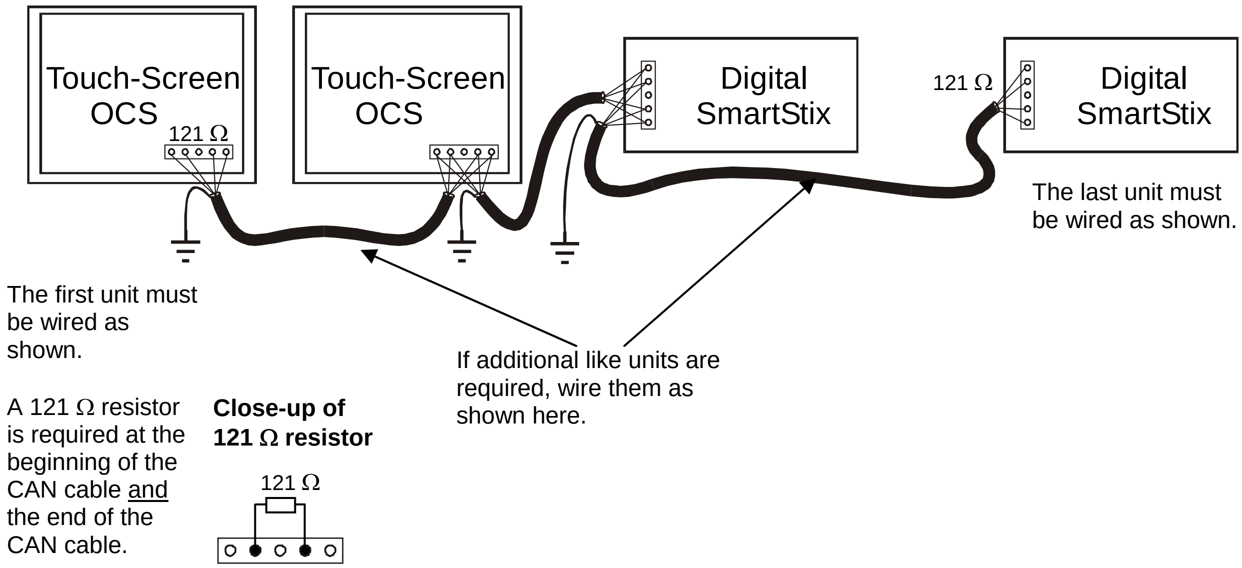


Figure 2.14 - CAN Wiring between Touch Screen OCS and Digital SmartStix Modules

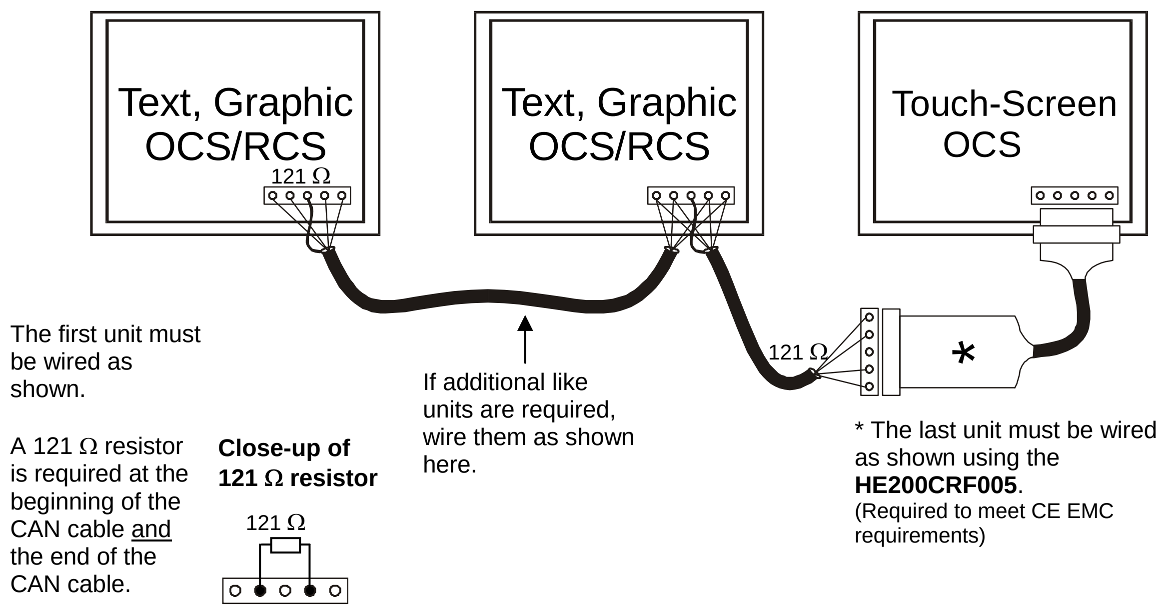


Figure 2.15 - CAN Wiring between Text, GraphicOCS, RCS and Touch Screen OCS

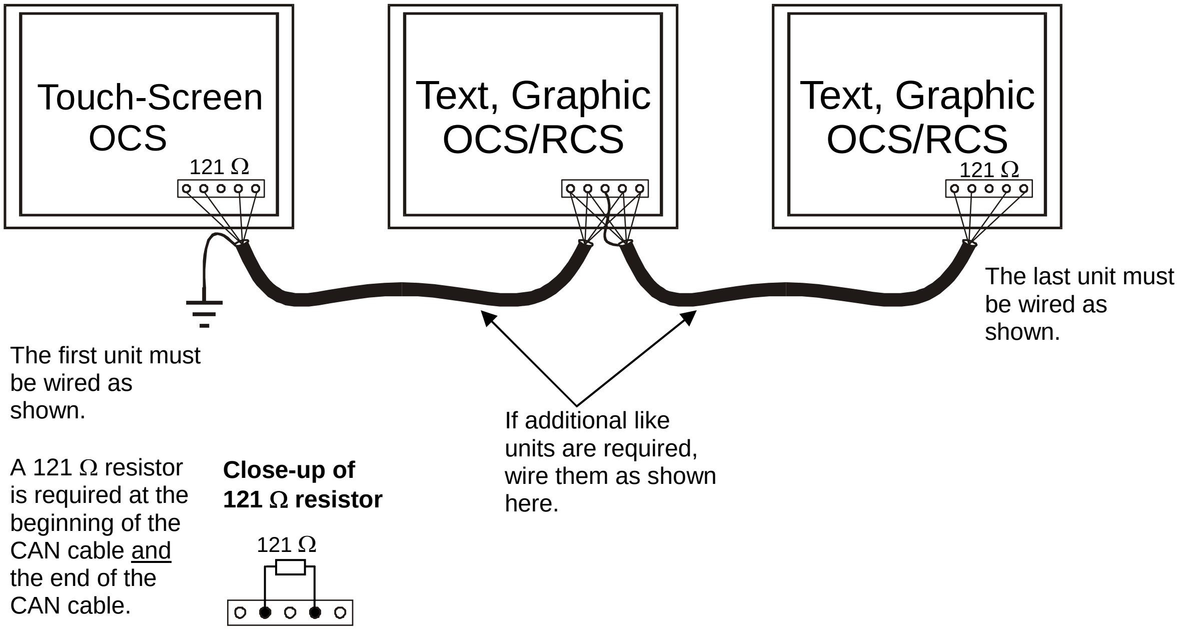


Figure 2.16 - CAN Wiring between Text, GraphicOCS, RCS and Touch Screen OCS

e. CsCAN

The 5-wire, multi-conductor copper cable used in CsCAN network include:

1. Two wires used as a transmission line for network communications.
2. Two wires used to transmit network power.
3. One conductor used as an electromagnetic shield.

Cabling is available in a variety of current-carrying capacities. On a CsCAN, every device may power its network transceivers from the network power supply. Some devices draw all of their power from the network supply. In CsCAN, thick and thin cable is used as indicated:

1. **Thick cable:** Use for long distances and more power. Usually used for Trunk cable.
2. **Thin cable:** Use for shorter distances. Usually used for drop cables or where cable flexibility is needed.

Table 2.4-CsCAN Cable Specifications

Thick Cable – general specifications (e.g., Belden 3082A)	Two twisted shielded pairs –Common axis with drain wire in center. One signal pair (#18), blue/white; One power power pair (#15) black/red. Separate aluminized mylar shields around power pair and signal pair. Overall foil/braid shield with drain wire (#18), bare*. High Speed (Vp=75% min), low loss, low distortion, data pair (to keep propagation delays to a minimum). 8 amp maximum current capacity. PVC insulation on power pair. Industrial temperature range. High flexibility.
Thin Cable – general specifications (e.g., Belden 3084A)	Two twisted shielded pairs –Common axis with drain wire in center. One signal pair (#24), blue/white; One power power pair (#22) black/red. Separate aluminized mylar shields around power pair and signal pair. Overall foil/braid shield with drain wire (#22), bare*. High Speed (Vp=75% min), low loss, low distortion, data pair (to keep propagation delays to a minimum). 3 amp maximum current capacity. PVC insulation on power pair. Industrial temperature range. High flexibility
Network Topology	Bus with limited branching (truckline / dropline)
Redundancy	Not Supported
Network Power for Node devices	Nominal 24 VDC ±4%
Allowed Nodes (Bridging excluded)	64 nodes
Data Packet Size	0-8 bytes with allowance for message fragmentation
Duplicate Address Detection	Addresses verified at power-up
Error Detection / Correction	CRC – retransmission of message if validity not acknowledged by recipient.
* The drain wire connects shields within the cable and serves as a means to terminate the shield into the connector.	

f. Bus Length

Several factors affect the maximum length of the bus including the accumulated length of drop lines, cable type, transfer rate and the number of drop lines. Although a branch is limited to one network per drop, it can have multiple ports. A branch can <u>not</u> exceed 6 meters.

Table 2.5 - CAN Network Baudrate vs. Total Cable Length

Thick Cable: Network Data Rate	Maximum Total Cable Length
1Mbit / sec.	40m (131 feet)
500Kbit / sec.	100m (328 feet)
250Kbit / sec.	200m (656 feet)
125Kbit / sec.	500m (1,640 feet)

g. Bus Power and Grounding

When using CsCAN:

1. A power supply of 24VDC (±4%) at 16A maximum is required for use in a CsCAN network
2. With thick cable, a single network segment can have a maximum of 8A. To do this, the power supply needs to be located in the center of two network segments.
3. Thin cable has maximum of 3A.
4. To ground the cable shield, connect to pin 3 as shown in Figure 2.7.
5. If local codes require the local CAN power supply to be earth grounded, connect the V- power conductor to a good earth ground **at one place only** on the network, preferably at a physical endpoint. If multiple power supplies are used, only one power supply must have V- connected to earth ground. The remaining power supplies need to be isolated.

h. CAN Repeater (Using the HE200CGM100)

The HE200CGM100 (CGM100) is an intelligent CAN network isolating repeater. The following guidelines are provided for using the CGM100. For additional information, refer to **MAN0008.** In a typical CAN network, each device is assigned a unique CAN node address (ID) to arbitrate network communication. Depending on the application protocol used, these IDs are assigned in the range of 0 to 253. Therefore, up to 254 devices may be logically attached to a CAN network.

However, the use of standard CAN transceiver chips limits the number of physically attached devices to 64. Thus, to reach the logical limit of 254 devices, up to three smart CAN repeaters are used to connect groups of devices together. A CAN network (without repeaters) is usually limited to a maximum cable length of 1,500 feet (assuming a Baud rate of 125 kHz). With repeaters, this limit can be extended to 6,000 ft.

Using CGM100’s 1000V isolation virtually eliminates problems associated with ground potential differences that are inherent in long cable drops on many local area networks.

2.4.3 RS-232 Port / RS-485 Port

There are a variety of ways to connect to the RS-232 and RS-485 ports. One modular jack MJ1 (Port 1) and one serial connector CN1 (Port 2) are available for use. **Table 2.6** indicates the ports and functions associated with each type of modular jack and connector. Physical locations are shown in **Figure 2.4.**

Note: Each serial port can be configured for a maximum baud rate of 115,200K; however if CN1 (Port 2) is used consecutively with the other port within an application, do <u>not</u> exceed a baud rate of 57,600K for CN1 (Port 2).

Table 2.6 – Ports and Functions)

Ports Used		Functions
RS-232	**RS-485**	
MJ1 (Port 1)	MJ1 (Port 1)	Programming, Debugging, Monitoring, Configuring. **(Note: The Modem can be used to perform these functions through MJ1.)**
MJ1 (Port 1) CN1 (Port 2)	MJ1 (Port 1) CN1 (Port 2)	Ladder Logic-Controlled Serial Communications (e.g. communications to printers, bar code scanners, terminals, Modbus, and other types of applications.
CN1 (Port 2)	CN1 (Port 2)	Modems

a. MJ1 (Port 1) Modular Jack

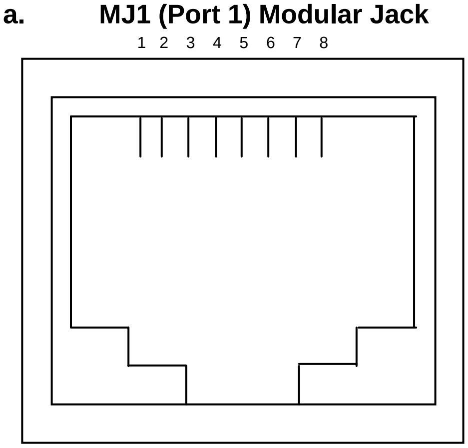


Figure 2.17 – Close-up of MJ1 (Port 1)

Table 2.7 – MJ1 (Port 1) Pins

Port 1 Pin	Signal
1	+SD/RD (RS-485)
2	-SD/RD (RS-485)
3	+5V
4	+5V
5	0V
6	0V
7	RXD (RS-232)
8	TXD (RS-232)
Output power supply: Max. 150mA	

b. CN1 (Port 2 Connector)

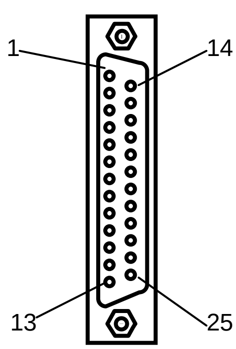


Figure 2.18– RS-232 / RS-485 Connector CN1 (Port 2)

Table 2.8– CN1 (Port 2) Pins

Pin #	Signal	Pin #	Signal
1	FG	**14**	+RTS (RS-485)
2	TXD (RS-232)	**15**	Not Used
3	RXD (RS-232)	**16**	Not Used
4	RTS (RS-232)	**17**	-RTS (RS-485)
5	CTS (RS-232)	**18**	-CTS (RS-485)
6	Not Used	**19**	+CTS (RS-485)
7	SG	**20**	Not Used
8	Not Used	**21**	Not Used
9	+5V	**22**	Not Used
10	Do Not Connect	**23**	Not Used
11	Not Used	**24**	+RD (RS-485)
12	+SD (RS-485)	**25**	-RD (RS-485)
13	-SD (RS-485)		

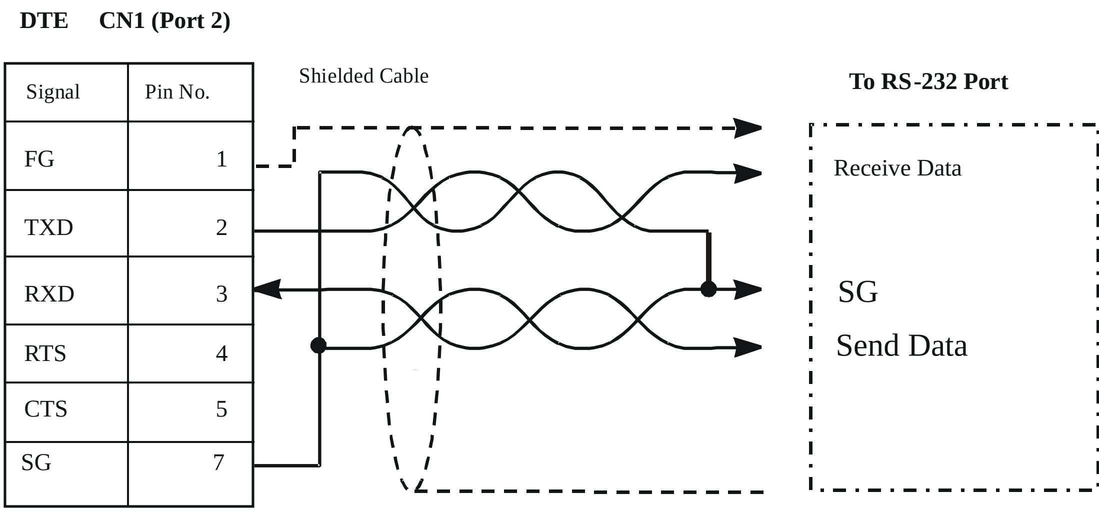


Figure 2.19 - RS-232 CN1 (Port 2)

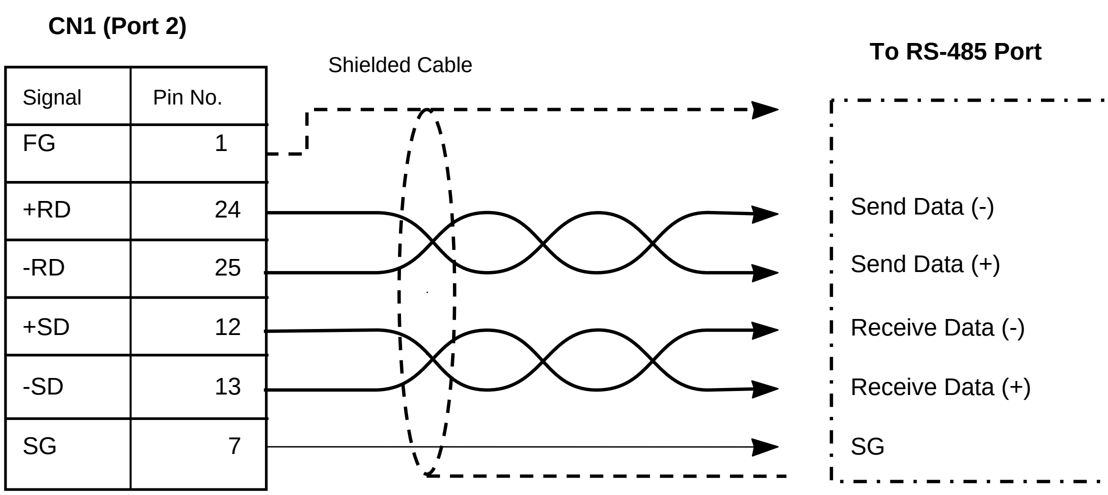


Figure 2.20 - RS-485 CN1 (Port 2)

2.4.4 Modem Setup

A modem can be used for remote communications between a computer (using Cscape Software) and the LX. The modem must operate at 9600 baud or higher.

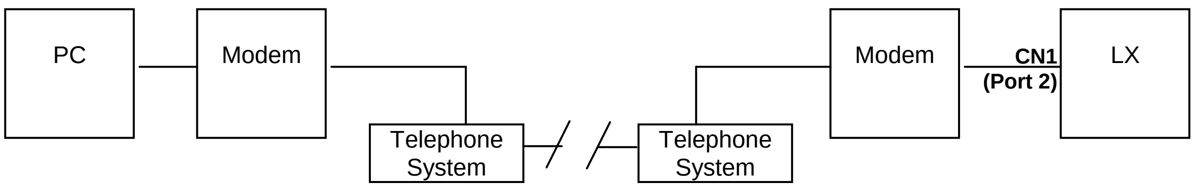


Figure 2.21 – Modem Setup

a. Setup

Setup the modems to match the default serial port characteristics of the LX.

9600 baud
8 data bits
No parity
1 stop bit
disable error checking
disable compression

b. Cable Wiring

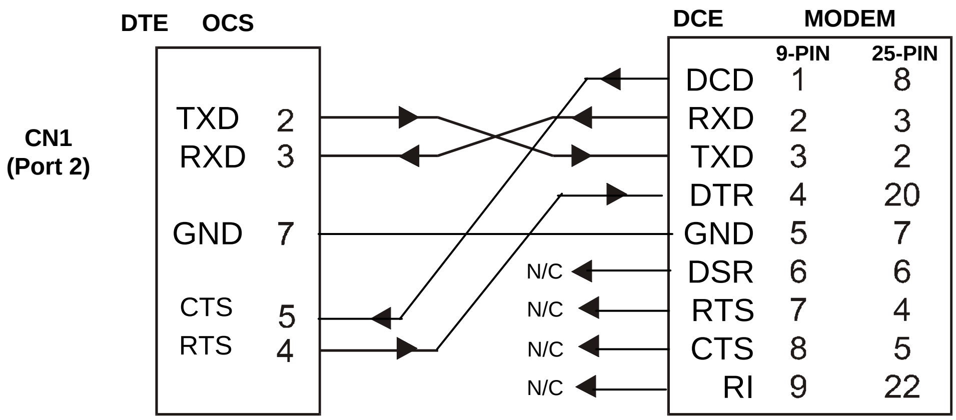


Figure 2.22 – Modem Wiring

The wire type used is <u>not</u> overly critical except where the length of the cable must be between 30 and 50 feet (10 to 15 meters). In all cases, the cable must be shielded multi-conductor with conductors of at least 20 gauge. The length of the cable must be as short as possible, and in no case, longer than 50 feet (15 meters).

The modem must be located as close as possible to the LX, preferably less than one meter. However, EIA-232 specifications allow for cable runs up to 50 feet (15 meters). If cable lengths longer than 30 feet (10 meters) are required, a special low capacitance cable must be used.

Warning: To connect a modem to the LX the controller to modem cable must be constructed or purchased. Using a Null Modem cable can cause damage to the LX, modem or both.

c. Recommended Modem

Selection of a telephone modem for use with the OCS is highly dependent on environment. For a relatively benign, low-noise environment, an off-the-shelf external modem like a U.S. Robotics Sportster Modem may work well. For a more industrial environment, however, it is appropriate to use a telephone modem designed for that environment. Check with Technical Support for the availability of an industrial modem from Horner APG (page 17). Other manufacturers such as Datalinc have models, which have been known to work in more harsh environments at a higher cost. ***If a modem is used which is <u>not</u> appropriate for the environment, there may be little that can be done to correct the situation other than change to a more appropriate model.***

For detailed information regarding the use of modems with Control Station Products, contact Technical Support (page 17). You can also find specific application information (cabling, modem commands, etc.) in the Cscape Help file as well.

2.5 LX LEDs

2.5.1 LEDs

LEDS are not physically located on the front panel of the LX. However, virtual RUN and OK LEDS can be accessed by pressing the SYSTEM key. Physical RUN, OK, and CAN OK LEDs can be viewed on the back of the LX.

Table 2.9 – LX 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.
CAN OK	Randomly flashes during CAN communications.

NOTES

CHAPTER 3: LX280 AND LX300

3.1 General

Chapter Three covers information specific to the LX280 and LX300. Refer to CHAPTER 2 for general installation information. The LX280 and LX300 are essentially the same units except that LX300 has a color display. The following information covers both products.

3.2 LX Panel Cut-out and Dimensions

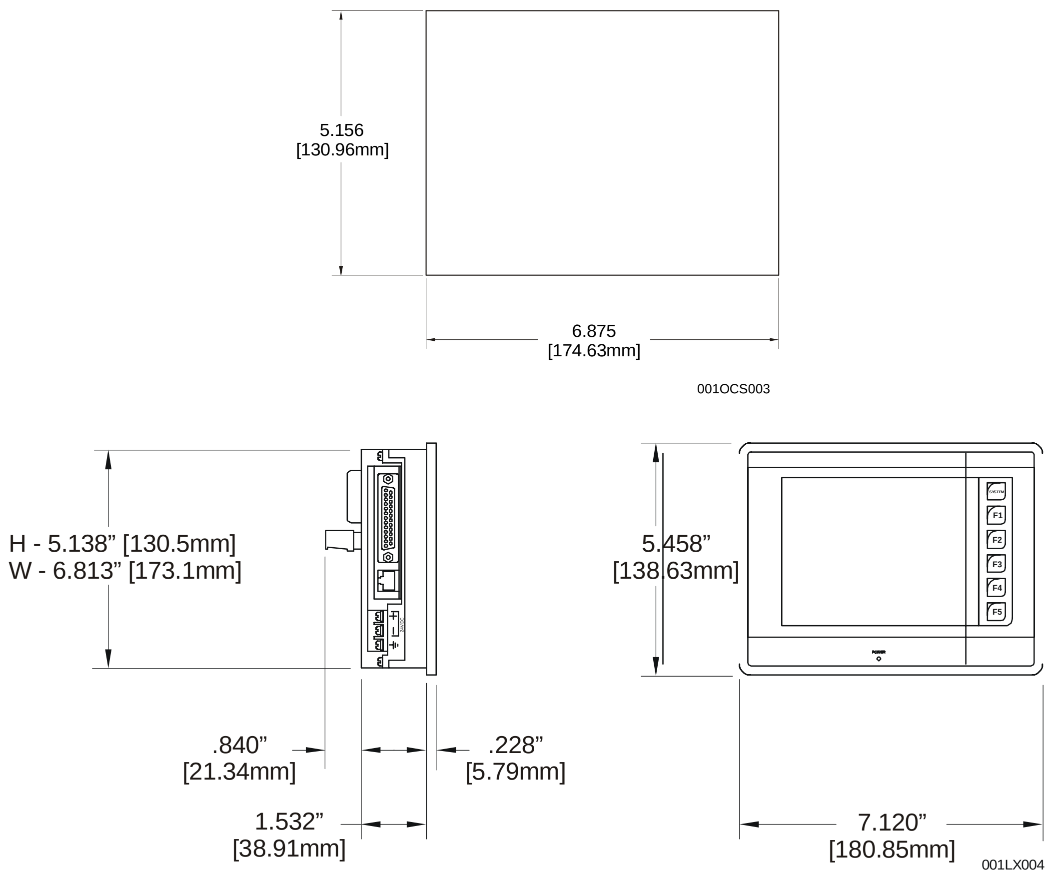


Figure 3.1 – Panel Cut-out and Dimensions

NOTES

CHAPTER 4: CsCAN I/O EXPANSION and RCS116

4.1 Connecting SmartStack I/O over CsCAN using the RCS116

The CsCAN I/O Expansion system on the LX supports both SmartStix I/O and SmartStack I/O options. SmartStix I/O is DIN-rail mounted. SmartStack I/O is accessed by LX over CsCAN I/O Network via the **HE800RCS116**. For larger I/O counts, multiple RCS116s can be used to increase the overall I/O capacity of the system.

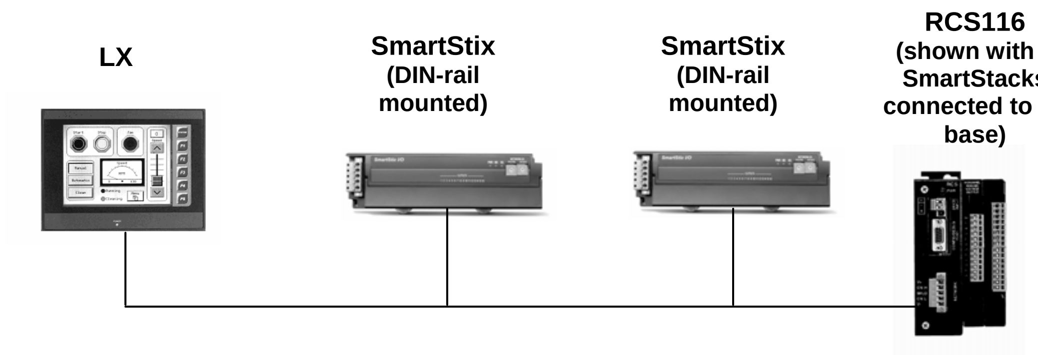


Figure 4.1 - CsCAN I/O Expansion shown with RCS116

The RCS116 is a low-cost co-processor that provides power, a network connection, and capacity for 4 SmartStack modules. Its 16K of ladder logic capacity is used for network communications and can also be used to supplement the logic performed in the LX as a co-processor.

4.2 RCS116 Logic Requirements

As a co-processor, the RCS116 requires an application (ladder) file which contains configuration and ladder logic information. This ladder file is created by Cscape, is downloaded to the RCS116, and is a *separate* file from the main application file residing in the LX. To make system integration simple, an example RCS116 ladder file is provided in the "Cscape/Examples/" folder created during the Cscape 6.5 installation. This file is named **RCS116_IO.csp**.

The RCS116 example program allows the RCS to become a network I/O device controlled by the LX. The example program supports the following amount of I/O (maximum):

- 64 digital inputs (%I)
- 64 digital outputs (%Q)
- 32 analog inputs (%AI)
- 32 analog outputs (%AQ)

This I/O is updated on a change-of-state basis. To implement this logic in the RCS116, follow this procedure:

- Open the **RCS116_IO.csp** file in Cscape
- Under Program > I/O Configuration, add the SmartStack I/O modules for the application. This can be done manually, or using AutoConfigure.
- Edit the Move Function Block in Rung 1 (see Figure 4.2 below). This rung copies the CAN_ID assigned to the LX into register %R2001 in the RCS116. For instance, if the LX is node 1, move a value of 1 to %R2001.
- Under Program > Network Coniguration > Options Tab, check to ensure that the following parameters are set:

  - o Network Required is Selected
  - o Network Optimized is Selected
  - o Number of Network IDs is 1
  - o Max Packets per Scan is 9.
- Save the file
- Download the file to the RCS116 Controller
- Put the RCS116 into Run mode.

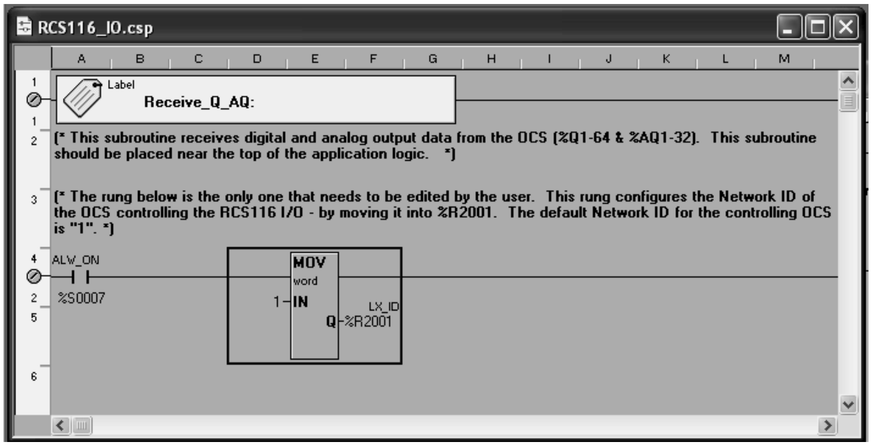


Figure 4.2 – **Setting the Node ID in Rung 1**

The RCS116 is now configured as a remote I/O drop, ready to be controlled by the LX. The RCS116 inputs are continuously scanned, and the RCS116 outputs will remain off until the LX is programmed to control them.

4.3 LX Logic Requirements for the RCS116 I/O

In order for the I/O in the RCS116 to be controlled by an LX, network configuration and ladder code must be added to the LX as well. An example program, **RCS116_LX.csp** also resides in the Cscape/Examples folder. In most cases, the logic in this example program will be ADDED to an existing LX program. However, if desired the user may start from this program when developing the LX application. This example program maps the I/O in the RCS116 into the following real-world I/O references:

- %I1025-%I1088 (64 digital inputs)
- %Q1025-%Q1088 (64 digital outputs)
- %AI257-%AI288 (32 analog inputs)
- %AQ257-%AQ288 (32 analog outputs)

These I/O references were chosen in the example program so that they will not interfere with other I/O (such as SmartStix) that is mapped into the lower I/O reference numbers.

4.3.1 LX Network Configuration

To scan the RCS116 I/O most efficiently, the LX Network Configuration Parameters should be adjusted. From the Cscape “Program” menu, select Network Config. Set the parameters as follows:

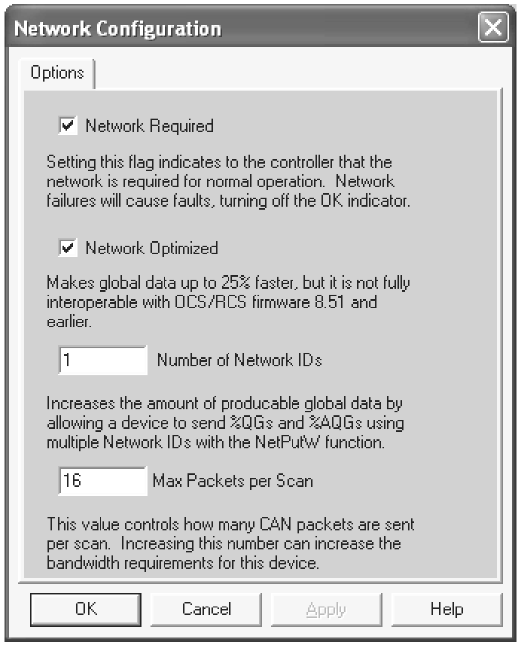


Figure 4.3 - Network Configuration Dialog Box for LX

Network Required. Since the LX is dependent on the network for I/O, it is recommended that the I/O Required option be selected. This will cause the OK LED on the LX to be extinguished if the Network is not OK.

Network Optimized. By selecting this option, the network data is broadcast most efficiently. All OCS and RCS units on the network must be configured with this option selected for proper operation.

Number of Network IDs. This parameter should be set equal to the number of RCS116 units connected to the LX. Note that if this data is set greater than 1, the LX will occupy multiple CAN_IDs on the network – one mapped to each RCS116. So if the CAN_ID of the LX is set to 1, and the Number of Network IDs is 3, the LX will occupy nodes 1, 2, and 3. Node 1 should be mapped to the first RCS116, node 2 to the second RCS116, and node 3 to the third RCS116.

Max Packets Per Scan. For efficient operation, it is recommended that this value be set to 16. This allows the LX to send out up to 16 CsCAN transmission packets per scan. This will help ensure that under normal circumstances the CsCAN broadcast buffer in the LX will be emptied every I/O scan.

4.3.2 LX Ladder Requirements

The logic that resides in the LX to scan the RCS116 I/O is contained in the RCS116_LX.csp program. This logic consists of two sections:

- Logic that Accepts the RCS116 Inputs (%I, %AI). This logic is housed in a subroutine called RCS116_Inputs. This logic should be inserted at the top of the LX application logic program. This will ensure that all the inputs will be updated prior to the main logic scan in the LX program.
- Logic that Controls the RCS116 Outputs (%Q, %AQ). This logic is housed in a subroutine called RCS116_Outputs. This logic should be inserted at the bottom of the LX application logic program. This will ensure that the outputs will be updated immediately after the main logic scan in the LX program.

Inserting the RCS116_Inputs Subroutine

- Make sure there is sufficient open space at the top of the LX application program. In the RCS116_LX.csp program, copy the entire subroutine (Rungs 1-6). Paste the 6 rungs at the top of the LX application program.
- Edit the Move Function Block in the first inserted rung. This function block moves the RCS116 Cscan node ID into register %R2001 in the LX.

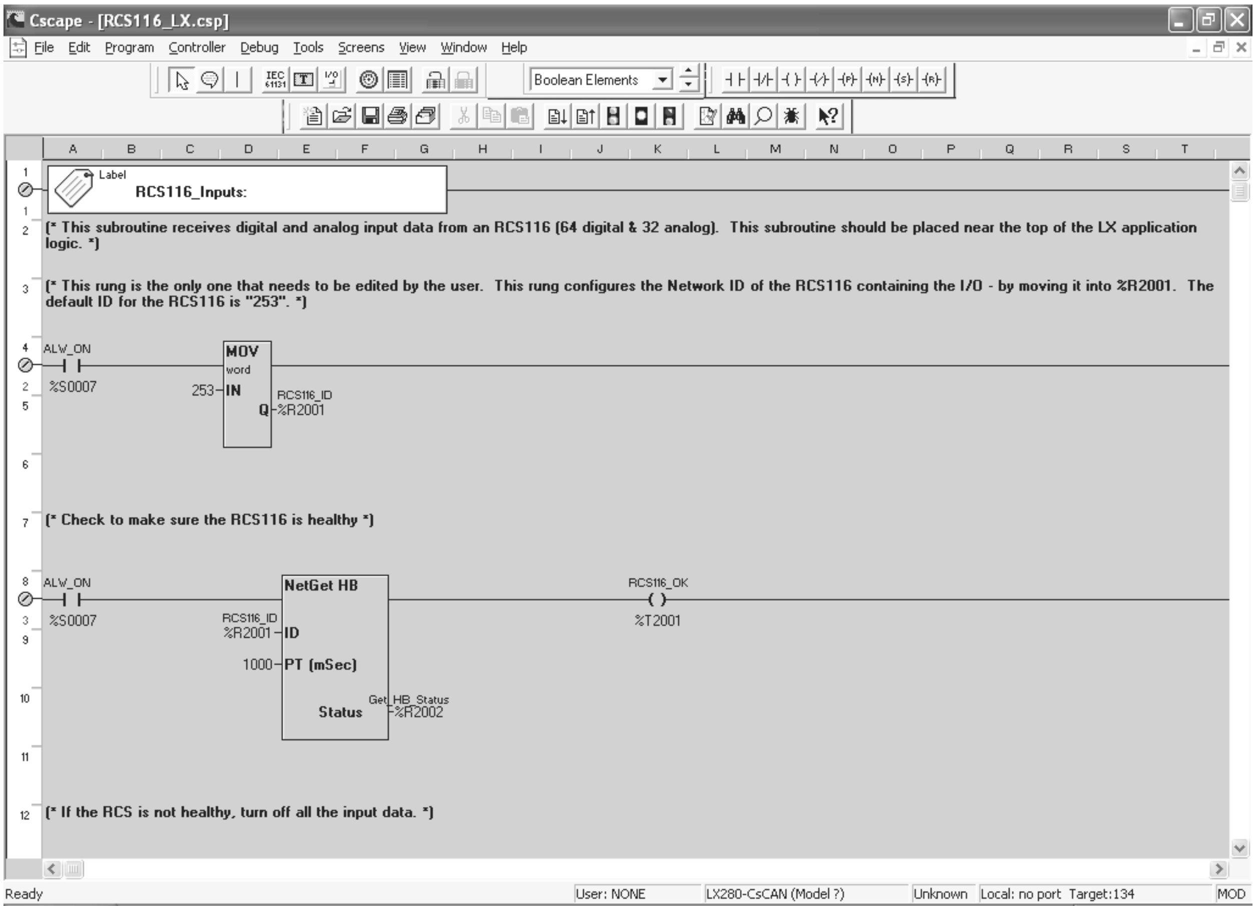


Figure 4.4 – RCS_Inputs Subroutine Screen Capture

Inserting the RCS116_Outputs Subroutine

- Make sure there is sufficient open space at the bottom of the LX application program. In the RCS116_LX.csp program, copy the entire subroutine (Rungs 7-18). Paste it into the LX application program near the bottom.

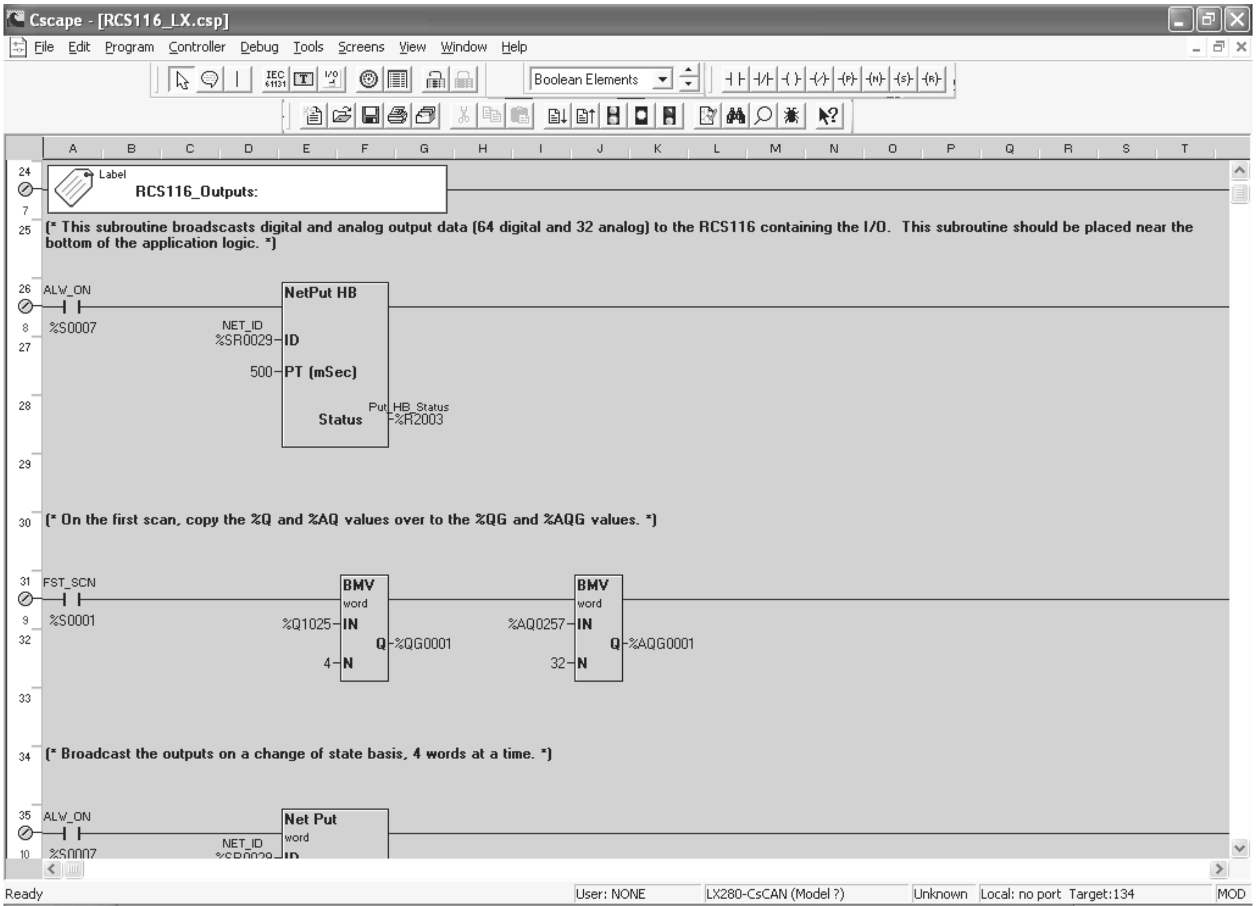


Figure 4.5 - RCS116_Outputs Subroutine Screen Capture

After inserting this logic into the LX application program, save the File and download the logic into the LX. When the LX is put into RUN mode, the RCS116 I/O should be controlled by the LX.

4.4 LX Scanning of the RCS116 I/O

If the logic is applied as described in the sections above, all the real-world I/O residing on the RCS116 (%I, %AI, %Q, and %AQ) will automatically be updated in the LX I/O table. The RCS116 and the LX scans are asynchronous.

Table 4.1 shows the expected update rate in the LX for the RCS116 I/O based on this asynchronous operation. The data for Table 4.1 is based on a ladder scan rate of approximately 10mS. The I/O Update times shown (Average and Maximum) reflect the amount of time it takes for an input to be recognized by the LX logic engine, or for an output to be physically engergized by the LX. For moderately trafficked networks, average update rates of <20mS, and maximum update rates of <30mS are to be expected. Even with a network at 90% capacity, update rates are below 25mS average and 50mS maximum. However, when the network approaches capacity (>95%), the update rates are significantly longer. This points out the importance of not overly taxing the network.

Table 4.1 – Expected LX Update Time for RCS116 I/O

Network Usage %SR187	LX Scan Rate %SR6	Avg. I/O Update	Max. I/O Update
30%	9.6mS	13.2mS	23.0mS
60%	10.6mS	15.0mS	28.0mS
90%	11.6mS	22.5mS	47.5mS
>95%	11.6mS	265mS	418mS

The activity level on the CsCAN network is expressed in terms of Average Network Usage. This parameter is reported in the RCS and OCS in status register %SR187. In the CsCAN network (at 125Kbaud), the bandwidth is approximately 1000 messages / second. Each message can update up to four, 16-bit registers or 64-bits of digital data. So a network that is showing a usage of 25% has a traffic level of approximately 250 messages / second – which corresponds to about 1000 registers per second.

Table 4.2 – I/O Contribution to Network Usage - Guideline

SmartStack I/O Type	Register Size	Typical Network Usage*
Digital In	Up to 64%I	5%
Digital Out	Up to 64 %Q	2.5%
Analog In	4 %AI	5%
Analog Out	4 %AQ	2.5%
**assumes 10mS scan rate in LX and 3mS scan rate in RCS116*		

Table 4.2 shows the estimated impact on network usage for the addition of different I/O options to the CsCAN network. This can be used as a guideline to determine the bandwidth requirements for a given system. As an example, for an RCS116 with 32 digital In, 16 digital out, 8 analog in, and 4 analog out, the estimated network usage would be as follows:

Digital ins 1-64	5%
Digital outs 1-64	2.5%
Analog ins 1-4	5%
Analog ins 5-8	5%
Analog out 1-4	2.5%
Estimated total	20%

Based on the above I/O complement, after consulting with Tables 4.1 and 4.2, the user could expect average update rates around 13mS, with a maximum update rate around 23mS.

CHAPTER 5: SYSTEM MENU (CONFIGURATION)

5.1 General

This chapter describes the LX System Menu. This menu provides access to configuration parameters and displays status, warning and fault conditions.

The system menu provides access to system configuration parameters. Each of the following parameters need to be considered during system setup.

- Setting Network ID and Baud Rate
- Setting Display contrast
- Setting Function key operation (toggle or momentary)
- Setting time and date
- Setting Beeper operation
- Setting Screen operation

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

- Self-test results
- RUN and OK status
- Network status and usage
- Average logic scan rate
- Application memory usage
- Loaded firmware versions

5.2 Accessing the System Menu

To enter the System Menu, press the **System** key on the front panel of the LX. The System Menu main screen appears. It contains a virtual keypad and a list of options..

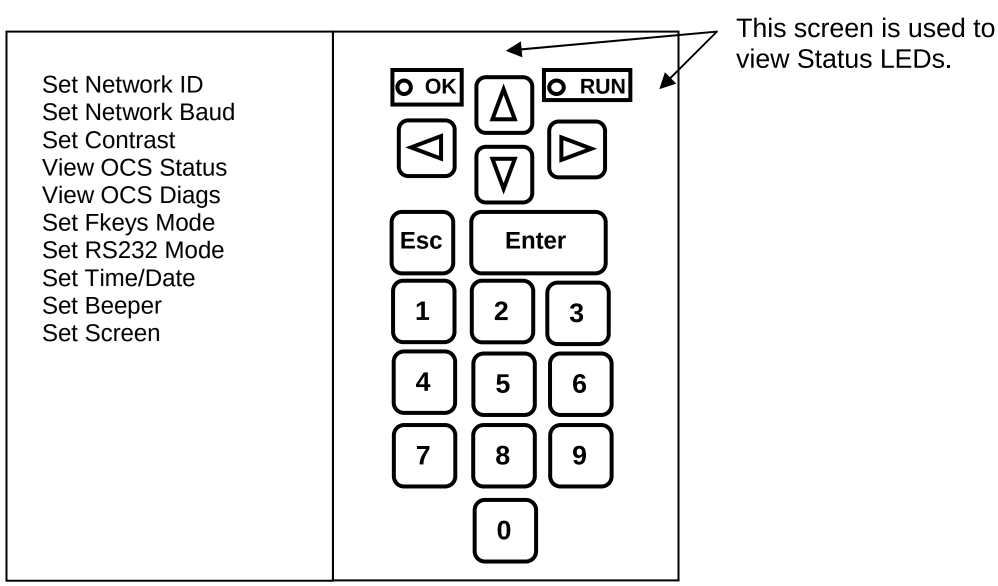


Figure 5.1 – System Menu

Note: Accessing the system menu causes the system menu page number to be written to %SR3. It is possible for the application to make use of this function and force SR3 back to zero to prevent the operator from accessing the system menu. If the application makes no other provision for allowing access to the system menu, CSCAPE must be used to stop the application by placing the LX in IDLE mode. With the application stopped, it is no longer possible to block the system menu from being displayed.

5.3 Navigating Through the System Menu

Prior to configuration, it is important to understand how to navigate through the System Menu using the following guidelines. After pressing the **System** key on the front panel of the LX, the System Menu main screen appears. It contains a virtual keypad and a list of options.

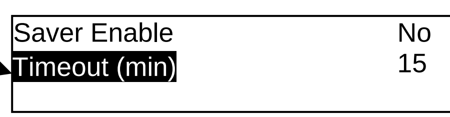
1. Touch the screen over the desired menu option or press the ↑ and ↓ keys to scroll up or down through the menu options. Press **Enter** to select the desired menu.
2. The selected menu is displayed with a list of one or more parameter names and associated parameter values. If any parameter on the selected menu is editable, the first editable parameter name is highlighted. To modify that parameter, press **Enter**.
3. The selected parameter value field is now highlighted. Use the ↑ and ↓ keys or numeric keys to edit the parameter value. Once complete, press **Enter** to accept the new value and to move the highlight from the parameter value back to the parameter name.
4. If multiple parameters are available for editing, use the ↑ and ↓ keys to scroll through parameters. If the menu contains more parameters that can be contained on the display, a scroll bar is displayed to the right of the parameter list. To access parameters scrolled off the screen, simply use the ↑ and ↓ keys until the screen scrolls in the correct direction.
5. While in a system screen, press **ESC** (if not currently modifying a field) to return to the main System Menu. It may be necessary to press **ESC** more than one time to return to the main System Menu screen.
6. Once completed, press **ESC** from the main System Menu to remove the System Menu from the display.

5.4 Editing System Menu Screen Fields

Prior to configuration, it is important to know how to edit the System Menu screen fields using the following guidelines.

1. There are two types of fields; Property Fields and Value Fields.

A **Property Field** is highlighted when selected using the arrow keys. A Property Field indicates the name of a property - it is not editable.



Value Fields allow a property value to be edited.

2. To change a value in an editable field, press the **Enter** key to select **Edit Mode**. The LX indicates Edit Mode by highlighting the value field *.
3. In Edit Mode, the fields require one of the following methods for modifying the value. Refer to the field description to determine which method to use.

Enumerated entry	- use ↑ and ↓ keys to select appropriate value.
Numeric entry	- use Numeric keys or ↑ and ↓ keys on the appropriate digit.
Bar graph entry	- use ← and → keys to adjust value.

4. After the value is correctly entered, press the **Enter** key to accept the new value.
5. Should the user not wish to accept the value before the **Enter** key is pressed, the **ESC** key can be pressed instead. This action restores the original value to the display. The LX also immediately exits Edit Mode.

5.5 Set Network ID Menu

Network Ok? [status]

This status field contains the current network status. If this value is NO, the LX is currently unable to establish a connection with any other device on the CsCAN network. If the network is not Ok due to a fault, access the **View OCS Diags** menu to obtain more specific information.

Network ID: [numeric]

Each unit on the network **needs a unique ID number**. This parameter is provided to assign the correct Network ID number to this unit. The Network ID should be configured before physically attaching this unit to the network. This ID applies to both the serial programming port and the CsCAN port.

CsCAN node range: [1 – 253]

Note: If the Network ID setting is changed, the unit stops executing the ladder code (for up to 1 second) while the network is re-tested. If the "Network OK?" status changes from "Yes" to "No," the new Network ID is a duplicate, and another ID needs to be selected.

5.6 Set Network Baud Menu

Network Baud: [enumerated]

This parameter provides the ability to select the current baud rate of the network.

CsCAN baud range: [125K, 250K, 500K, 1M]

Note: All devices on the network must be at the same baud rate. A device configured for the wrong baud rate can shut down the network entirely. SmartStix are limited to 125K baud only.

5.7 Set Contrast Menu

Contrast: [bar graph]

This parameter provides the ability to change the screen contrast. Press "Enter" and use the ← and → keys to modify this value (bar graph). A color scale (gray scale for LX280) located on the screen provides a visual indication of the effect of the new contrast value.

5.8 View OCS Status Menu

This screen contains one enumerated editable parameter that sets the LX scan mode **and** several non-editable status parameters that display information about the internal state of the LX

Model: [status]

Displays the (short) model number of the unit

Mode: [enumerated]

Allows the user to view or modify the scanning mode (**Idle**, **Run**, **DoIO**). The scanning mode is modified by highlighting the mode parameter and using the ↑ and ↓ to change modes.

Table 5.1 - Modes

Mode:	Logic Scan	I/O Scan	Run LED	Comments
Run	yes	yes	solid	
DoIO	no	yes	flash	I/O controllable from CSCAPE
Idle	no	no	off	Faults may prevent mode change

Scan-Rate (ms.): [status]

Shows the average number of milliseconds for a complete scan. The scan-rate is the sum of the time required to execute the following items:

1. Scan inputs
2. Solve logic
3. Write outputs
4. Handle network communications
5. Handle host communications request
6. Update operator interface (see Set Screen\Update Time(ms))

OCS Net Use (%): [status]

Shows the percentage of the network used by the LX.

All Net Use (%): [status]

Shows the percentage of the network used by all devices on the network.

Ladder Size:
Config Size:
Graphics Size:
String Size:
Bitmap Size: .
Text Tbl Size:
Font Tbl Size: [status]

Indicates the table size of each of the application components. This provides an indication of remaining memory for future application modifications.

Firmware Rev: [status]

Shows the execution engine firmware version.

BIOS Rev: [status]

Shows the BIOS firmware revision.

CAN Rev: [status]

Shows the CAN co-processor firmware version.

Self-Test: [status]

Shows if the power-up self-test passed or failed by displaying **Ok** or **Fault**.

5.9 View OCS Diags Menu

This screen displays a list of self-test diagnostics results (no editable parameters). Each item describes a test and shows a result of **Ok** if the test passed or **Fault/Warn** if an error was found while running the test. **Fault** indications will prevent the loaded application from running. **Warn(**ing) indications allow the application to run but inform the user that a condition exists that needs correction.

System RAM: This test checks the functionality of the controller RAM at power up.
- **Ok** The RAM is functioning correctly.
- **Fault** The RAM is not functioning correctly.

System BIOS: This test checks for a valid BIOS portion of the controller firmware.
- **Ok** The loaded BIOS firmware is valid
- **Fault** The loaded BIOS is invalid.

Engine Firmware: This test validates the controller firmware.
- **Ok** The firmware is valid.
- **Fault** The controller firmware is invalid.

Logic Error: This test checks for problems with the user application while running.
- **Ok** No errors have been encountered while running a user application.
- **Fault** Indicates the user program contained an instruction that was invalid or unsupported.

User Program: This tests for a valid logic and configuration portion of the user application
- **Ok** The ladder and configuration portion is valid.
- **Fault** The ladder and/or configuration portion is not valid.

User Graphics: This tests for a valid graphics portion of the user application.
- **Ok** The user graphics portion is valid
- **Warn** The user graphics portion is invalid and will not be displayed (ladder may continue to run)

W-Dog Trips - This test checks for resets caused by hardware faults, power brownouts or large amounts of electrical interference.
- **0** No unintentional resets have occurred.
- **xx** Indicates a fault with xx showing the number of occurrences.

Net Errors - This test checks for abnormal network operations while running.
- **0** No network errors were counted
- **xx** Indicate serious networking problems exist, xx indicates the number of occurrences.

Network State - This test checks that the network sub-system is powered and operating correctly.
- **Ok** The network system is receiving power and has determined other devices are communicating on the network.
- **Warn** Power is not being applied to the network or no other devices were found to be communicating on the network.

Network ID - This test checks that the network ID is valid.
- **Ok** The network ID is valid.
- **Warn** The network ID is not valid for the selected protocol.

Dup Net ID - This test checks for duplicate IDs on a network.
- **Ok** This controller's ID was not found to be a duplicate.
- **Warn** Another controller on the network was found with the same ID as this controller.

Clock Error: This test checks that the real time clock contains valid data.
- **Ok** The real time clock contains valid data.
- **Warn** Indicates invalid data in the real time clock.

Network I/O : This test checks that the Network I/O configuration downloaded and the physical devices (SmartStix) attached to the controller match.
- **Ok** The I/O configuration matched the installed modules.
- **Warn** Indicates the downloaded configuration and attached modules do not match. (Use Cscape Data Watch to check the individual status words of configured Network I/O devices.)

5.10 Set F(unction) Keys Mode Menu

Fkeys: [enumerated]

This parameter allows the Function keys to be configured to operate in one of two modes.

- **Momentary**: The associated %K variable is maintained in the ON state only while its corresponding function key is being pressed (default).
- **Toggle**: The state of the associated %K register is toggled each time its corresponding function key is pressed.

This configuration applies to all function keys regardless of the downloaded program or the current screen being displayed. This parameter should be set to reflect the expected operation of the function keys as anticipated in the downloaded program.

Note: The application program can override this setting %SR33 (0 for momentary, 1 for toggled).

SYS-Fn enable: [enumerated]

This parameter allows the system-combination-function keys to be enabled (default) or disabled. Certain key combinations are provided for system management type functionality:

SYS-F1: Calibrate screen – if touch alignment is ever required.
SYS-F2: Reset Unit – quick restart of system.
SYS-F4: Delete program and reset unit – recovery for misbehaved program that prevents user access.
CAUTION: This function clears the application program, which must then be downloaded again using Cscape.

Note: To activate system key combinations, both keys must be pressed simultaneously and held for 2 seconds.

After the unit is placed in field operation, it is often desirable to prevent operators from activating these functions. Setting this parameter to NO disables system-combination key operations until explicitly re-enabled from this menu.

5.11 Set RS232 Mode Menu

RS232 mode: [enumerated]

This parameter is provided for legacy purposes and does not typically require modification. The MJ1 programming (serial) port operations is in one of two modes.

CsCAN: Normal operation (allows program download and control from CSCAPE) [default]
Update: Forces firmware loader mode to allow firmware updates.

Note: When using CSCAPE to perform firmware updates, setting this parameter to **Update** mode is <u>not</u> necessary.

5.12 Set Time/Date Menu

Time: [enumerated]
Date: [enumerated]
Day: [status]

This screen contains two editable enumerated parameters for displaying and modifying the LX's time and date. Each field is subdivided and allows the ↑ and ↓ key to modify the value.

- Battery maintains time/date during power-off
- Leap year compensation is supported.
- Daylight Savings time correction is <u>not</u> supported.

5.13 Set Beeper Menu

Beeper enable: [enumerated]

This parameter allows the Beeper to be enabled (default) or disabled. When enabled, there are two types of beeps.

Short Beep - beeps when a key or object enabled for input is pressed.
Long Beep – beeps when object input is disabled when pressed.

It is also possible to have the Ladder Program write to the %SR184 Register, which causes beeps to occur. Any value higher than zero activates the beeper. The beeper remains on until %SR184 is cleared to zero. The beeper activation from %SR184 is not disabled by this parameter.

5.14 Set Screen Menu

Saver enable: [enumerated]
Timeout(min): [numeric]

These parameters enable or disable and set the duration of time to activate the screen saver function. The screen saver function allows the life of the backlight to be extended by turning it off when not needed. Once enabled and after the configured Timeout period of no touch activity and no screen changes, the backlight shuts off. To re-enable the backlight, the user must press either the screen or a function key. To prevent inadvertent activation of an object or a function key, touch actions are ignored by the LX while (and for during a 1 second duration after restoration) the backlight is deactivated.

Popup Status: [enumerated]

This parameter provides the ability to enable an optional pop-up message that indicates RUN and OK status changes to the user.

The following **three modes** are available:

- **OFF** - No pop-up message occurs(default).
- **ON** – Any mode change triggers a pop-up display screen showing the condition of the controller. For example, after the controller is initially powered up, a display screen pops up whenever **any mode change** occurs. The user is required to press the OK button in the pop-up message to remove the pop-up from the display.
- **WARNING** –A pop-up display screen is triggered **only if the mode changes to an abnormal condition**.

Any of the following are defined as an **abnormal condition**:

- Mode != RUN
- Status != OK
- No logic present
- I/O forced

For example, if the controller transitions to IDLE due to a fault condition, a screen pops up to depict the condition of the controller. The user is required to press the OK button in the pop-up message to remove the pop-up from the display. However, on a change from an abnormal-to-normal condition (faults corrected, controller commanded to RUN mode), the pop-up is removed automatically after a short delay of showing the new condition.

Update Time(mS): [numeric]

This parameter is downloaded from CSCAPE (graphics Config\Screen Update Time parameter) as part of the program. However, access to this parameter is provided in the LX System Menu to allow for field tuning. If this parameter is modified in the field, the original application must be uploaded or modified to preserve the modified value.

This parameter provides the ability to specify the maximum amount of time that the screen update may consume from the overall scan time. For example, a screen filled with large animated objects (i.e. bitmaps, trends, bargraphs) can require up to 150mS of processor time to completely draw. With the default Update Time setting of 5mS, it takes approximately 30 passes of the logic engine before the screen is completely drawn (30 x 5mS = 150mS).

With small ladder scan times, the default of 5mS is typically acceptable in terms of screen response time and has a negligible effect on the overall scan time. For example, if the ladder portion consumes 5mS and the screen update consumes 5mS, then the overall scan time is 10mS. If 30 passes are required to complete a screen update, then the response time of a screen is 300mS (30 x 10mS).

However, as the ladder portion of the scan time increases, it begins to affect screen update and touch responsiveness. In this case, the **Update Time** can be increased to allocate more time per scan for screen updating. It is up to the application programmer to determine the best trade-off between screen responsiveness and overall scan rate. Note also that update time is a maximum time per scan for screen updating. Simpler screens use less time than the maximum, increasing the overall scan rate.

NOTES

CHAPTER 6: SMARTSTIX I/O

6.1 General

Chapter Six covers SmartStix I/O programming and configuration parameters.

6.2 SmartStix I/O Introduction

SmartStix I/O is a family of low-cost Remote I/O devices that are designed to extend the I/O capabilities of **Control Station** products, such as **MiniOCS**, **OCS** and **RCS**. SmartStix I/O Modules connect to Control Station devices via the **CsCAN Network** and communicate using **CsCAN Protocol**.

Devices with **CsCAN Network** ports that are connected to each other for peer-to-peer communication are called **CsCAN Nodes**. A device that is connected to a CsCAN Node's programming port for master-slave supervisory communication is called a **CsCAN Host**. For example, SmartStix I/O Modules and OCS Control Stations are CsCAN Nodes while a PC running Cscape is a CsCAN Host.

6.3 SmartStix I/O Modules

SmartStix I/O Modules are devices that exchange data with Control Stations over the CsCAN Network and control and monitor physical I/O points.

To control physical outputs, data is sent by a Control Station to the SmartStix I/O Module using CsCAN Directed Data Messages. To monitor physical inputs, a Control Station receives data from the SmartStix I/O Module using CsCAN Global Data Messages.

In addition to I/O control and monitoring, configuration and status data can be exchanged between a Control Station and a SmartStix I/O Module.

For example, a Control Station can send configuration data to a SmartStix I/O Module to tell it how often to expect output control data, and what to do if the Control Station stops sending output control data. Also, a Control Station can receive status data from a SmartStix I/O Module indicating if it needs configuration or if a fault has been detected.

All this is accomplished by using the PC-based Cscape programming tool to program the Control Station. Since the Control Station dynamically configures the SmartStix I/O Module, SmartStix I/O Modules can be readily deployed without having to configure them first.

6.4 Preliminary Configuration Procedures (Example)

The following example provides preliminary configuration procedures that are applicable to all SmartStix Modules. The SmartStix Modules use Cscape Software for configuration.

Note: Because the configuration parameters are different for each SmartStix Module, refer to the data sheet information that is specific to the selected module.

1. From the Main Menu, select **Controller|I/O Configure**. In this example, the following screen appears.

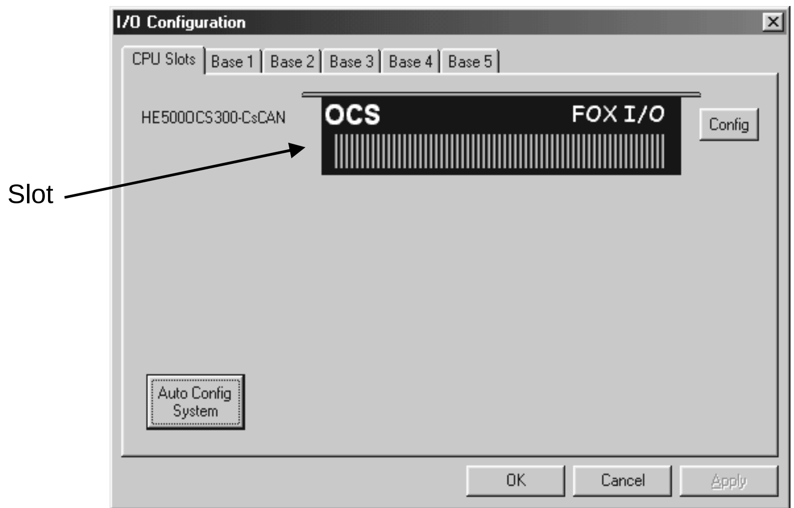


Figure 6.1 - Main Configuration I/O Screen

2. First, ensure that the desired controller is selected. Because you are using an LX, you need to select the correct model. Continue with Step 2.

Note: The **Auto Config System** button can be pressed *prior* to selecting the desired controller. *However, it is not used to configure I/O*. By pressing the button, the settings are deleted from any controller that is physically connected to the PC. A dialog box appears and indicates that settings will be deleted from currently configured models. If OK, press **Yes**. Then press **OK**.

Selecting a Different Controller

a. Ensure that the **CPU Slots** tab is pressed in Figure 6.1. Also, click on the slot or the **Config** button to open a dialogue screen.
b. When the new screen appears, click on the **Type** list box and select the desired controller. Then press OK. If satisfied with the controller selection, press **OK**.

3. The following screen appears. Click the **Network I/O** tab.

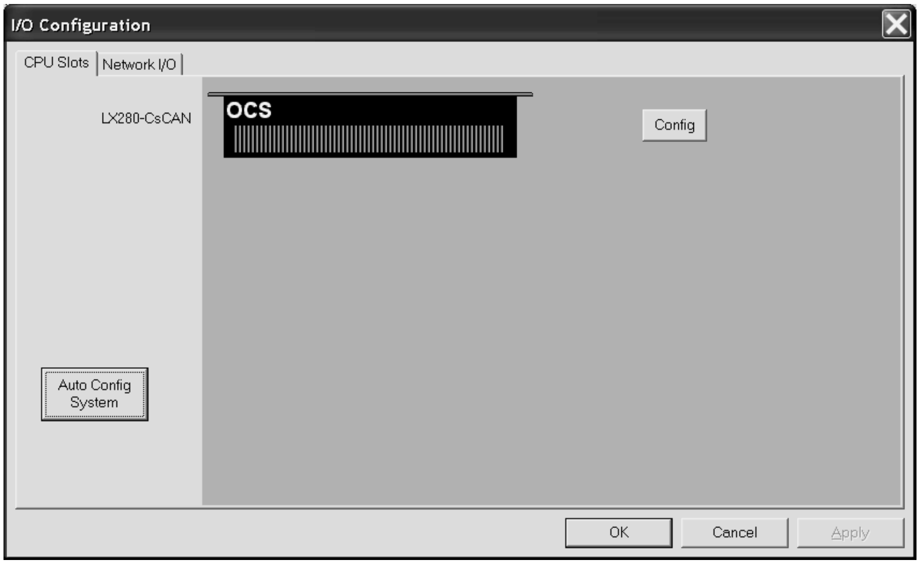


Figure 6.2 – LX is Selected

6.5 Network I/O Configuration Management Screen

1. The **Network I/O Configuration** screen appears; it allows up to 99 SmartStix™ remote I/O devices to be easily configured and assigned to controller registers. The dialogue screen is used to manage the list of network I/O. The list shows the network ID, a brief description of the module, and the controller registers assigned to the inputs, outputs and status. *This list is always sorted by network ID.* There are several buttons used to manage this list of devices, which are further explained in this step

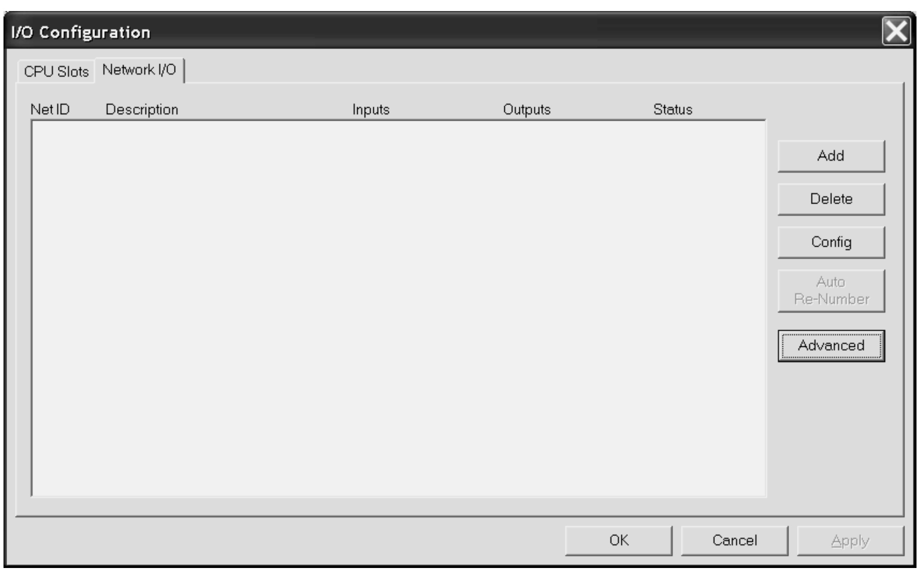


Figure 6.3 – Main Configuration Screen

Elements of the Network I/O Management Configuration Screen

- **Add I/O Device**

Press **Add**. You are prompted to choose a device. The <INS> key can also be used to add a device. Upon choosing a device, an I/O Configuration screen appears. See **Configuring Digital SmartStix I/O** or **Configuring Analog SmartStix I/O** in this chapter for further information.

- **Delete I/O Device**

Press **Delete** to remove the currently selected device from the list. Pressing the <DEL> key on the keyboard is equivalent.

- **Configure I/O Device**

Press **Config** to configure (edit) the currently selected device. This can also be accomplished by pressing the <ENTER> key or double clicking a device in the list. See **Configuring Digital SmartStix I/O** or **Configuring Analog SmartStix I/O** in this chapter for further information.

- **Auto Re-Number Registers**

Press **Auto Re-Number** to assign registers a new starting point and force a consecutive block of registers. **See Auto Re-Number** section in this chapter for further information.

- **Advanced Options**

Press **Advanced** to set advanced options (such as support for extended timeouts on digital modules).

The following is an example of a completed Network I/O screen.

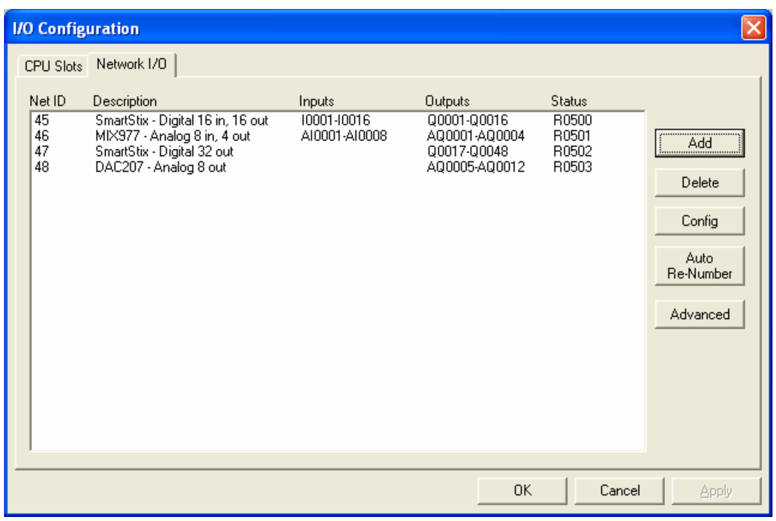


Figure 6.4 – Example of a Completed Network I/O Screen

6.6 Configuring Digital SmartStix

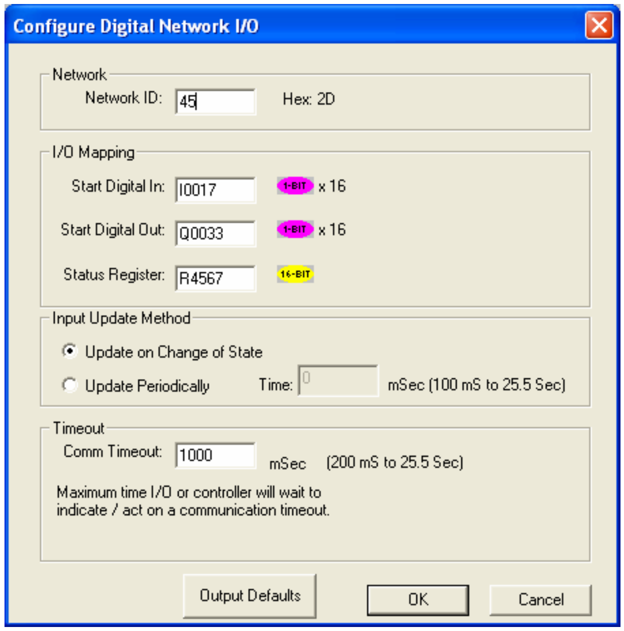


Figure 6.5 – Digital SmartStix Screen

<u>Elements of the Digital SmartStix</u>

- **Network ID**

This sets the network ID assigned to the Smart Stix module. This must be a constant.

- **I/O Mapping**

This sets the starting registers for inputs, outputs and the status registers. Not all modules have both inputs and outputs. The indicator next to the register entry always shows the number of registers used. One 16 bit status registers is always required. There are few restrictions on what registers can be assigned. System bits (%S) and system registers (%SR) can not be used for inputs, outputs or status registers.

- **Input Update Method**

This portion of the dialog determines how the inputs are transmitted from the Smart Stix module to the controller. By default the inputs are sent on change of state. Optionally, the inputs can also be sent periodically. By setting the inputs to transmit periodically, the inputs are sent at least as often as entered, but also sent on change of state.

- **Timeout**

This setting determines how long the controller or Smart Stix wait to determine if there is a communication error. If communications between the I/O and controller have stopped for the timeout entered, the Smart Stix will set all its outputs to default and indicate a lifetime error. The controller will set the off-line status bit and attempt to re-configure the module. The Smart Stix and controller will be programmed to exchange heart beat network message at twice the rate indicated by this timeout. When a controller is placed in IDLE mode, it stops communicating with the network I/O and this timeout will control how long it takes for the I/O to go to its default state.

- **Output Defaults**

Pressing this button brings up a dialog to set the default state for the outputs. These defaults are used if communications between the controller and I/O are interrupted for a period, determined by the timeout.

6.7 Configuring Analog SmartStix

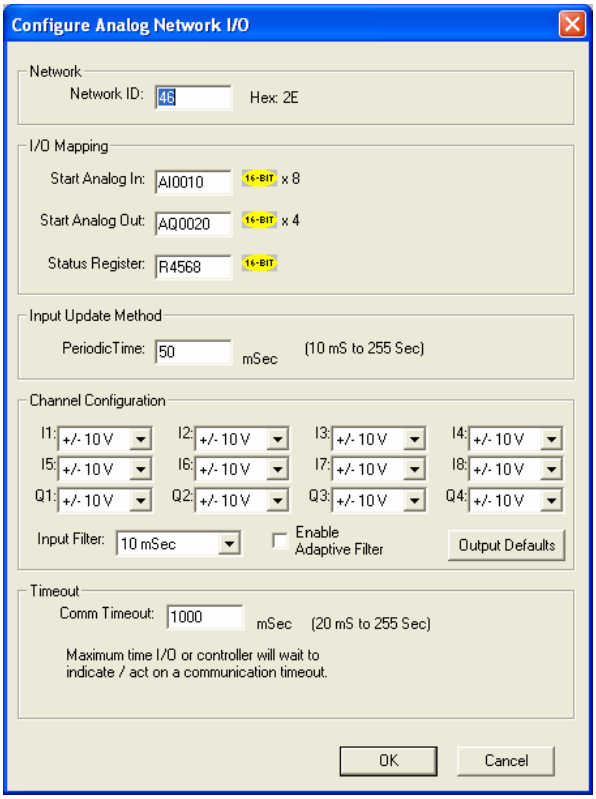


Figure 6.6 – Analog SmartStix Screen

<u>Elements of the Analog SmartStix</u>

- **Network ID**

This sets the network ID assigned to the Smart Stix module. This must be a constant.

- **I/O Mapping**

This sets the starting registers for inputs, outputs and the status registers. Not all modules have both inputs and outputs. The indicator next to the register entry always shows the number of registers used. One 16 bit status registers is always required. There are few restrictions on what registers can be assigned. System bits (%S) and system registers (%SR) can not be used for inputs, outputs or status registers.

- **Input Update Method**

Analog Smart Stix only transmit data periodically. This setting is used to determine how often to transmit the inputs from the network I/O to the controller.

- **Channel Configuration**

This section of the dialog is used to setup the inputs and outputs for the module.

- **Output Defaults**

Pressing this button brings up a dialog to set the default state for the outputs. These defaults are used if communications between the controller and I/O are interrupted for a period, determined by the timeout.

- **Timeout**

This setting determines how long the controller or Smart Stix wait to determine if there is a communication error. If communications between the I/O and controller have stopped for the timeout entered, the Smart Stix will set all its outputs to default and indicate a lifetime error. The controller will set the off-line status bit and attempt to re-configure the module. The Smart Stix and controller will be programmed to exchange heart beat network message at twice the rate indicated by this timeout. When a controller is placed in IDLE mode, it stops communicating with the network I/O and this timeout will control how long it takes for the I/O to go to its default state.

6.8 Auto Re-Numbering Feature

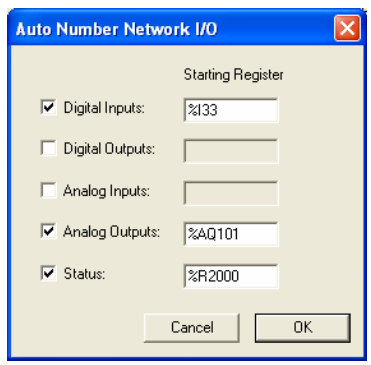


Figure 6.7 – Auto Re-Number Screen

The auto re-number feature allows one or more types of register assignments to be re-numbered at a specified starting point.

1. Select one or more types of register assignments to change by clicking the check box to the left. Next, enter the starting register for each type selected. Finally press OK, this re-numbers the selected configuration data, starting at the smallest network ID.

Before:

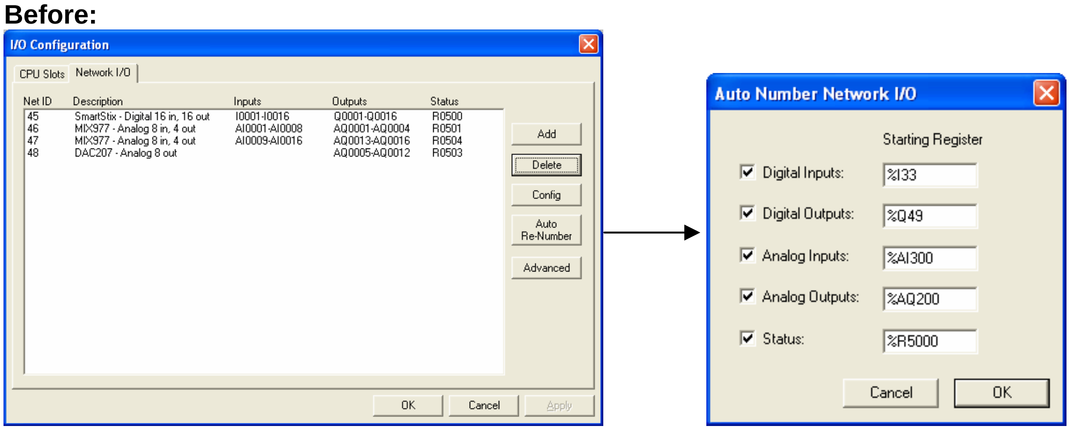


Figure 6.8 – Management Screen Before Changing Registers

After:

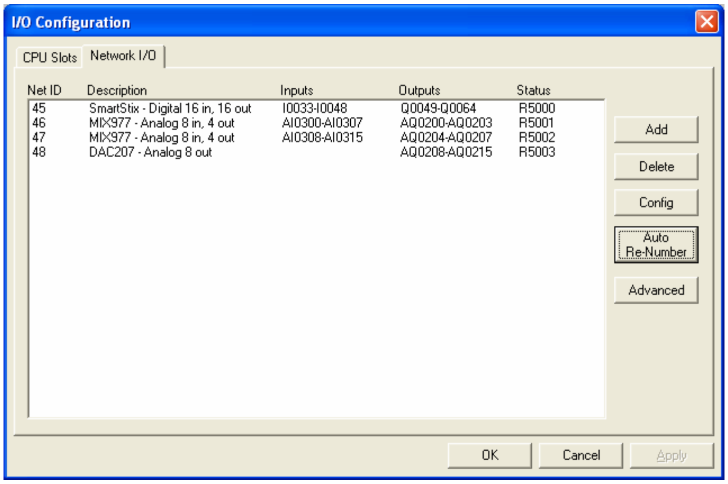


Figure 6.9 – Management Screen After Registers are Re-Numbered

CHAPTER 7: SMARTSTACK CONFIGURATION

7.1 General

Chapter Seven covers SmartStack configuration procedures.

Note: If SmartStack modules are used with an LX, an RCS116 is required.

7.2 Preliminary Configuration Procedures

Preliminary configuration procedures are provided that are applicable to all SmartStack Modules. The SmartStack Modules use Cscape Software for configuration.

Note: Because the configuration parameters are different for each SmartStack Module, refer to the data sheet that is specific to the selected module.

1. From the Main Menu, select **Controller|I/O Configure**. In this example, the following screen appears.

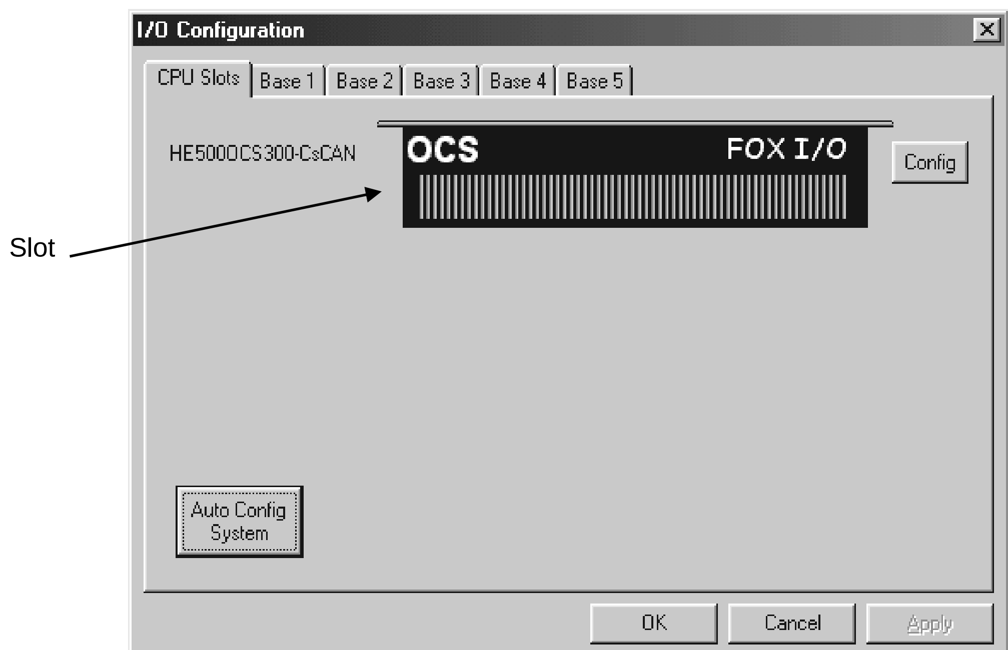


Figure 7.1 - Main Configuration I/O Screen

2. First, ensure that the desired controller is selected. Because you are using an LX and need to configure a SmartStack module, it is necessary to use and select an **RCS116**.

Note: The **Auto Config System** button can be pressed *prior* to selecting the desired controller *and* I/O. By pressing the button, the settings are deleted from any controller *and* I/O that is physically connected to the PC. A dialog box appears and indicates that settings will be deleted from currently configured models. If OK, press **Yes**. Then press **OK**.

Selecting a Different Controller (RCS116 is required)

To select an RCS116, click the **CPU Slots** tab. Then, click on the slot or the **Config** button. The following screen appears.

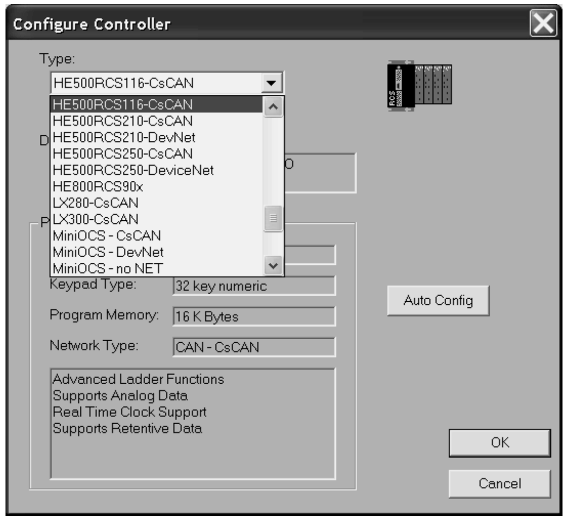


Figure 7.2 – Selecting RCS116

To select a different controller, click on the **Type** list box and select the desired controller. Then press OK.

Note: The **Auto Config** button can be pressed *prior* to selecting the desired controller. By pressing the button, the settings are deleted from any controller that is physically connected to the PC.

3. Figure 7.3 appears. Right-click or double-click on a slot or press the **Config** button located next to each slot to **add** a SmartStack module. A list eventually appears containing all SmartStack modules that are available for use. . Follow the prompts and make your selection. Note that a maximum of four SmartStack modules can be placed on each RCS116

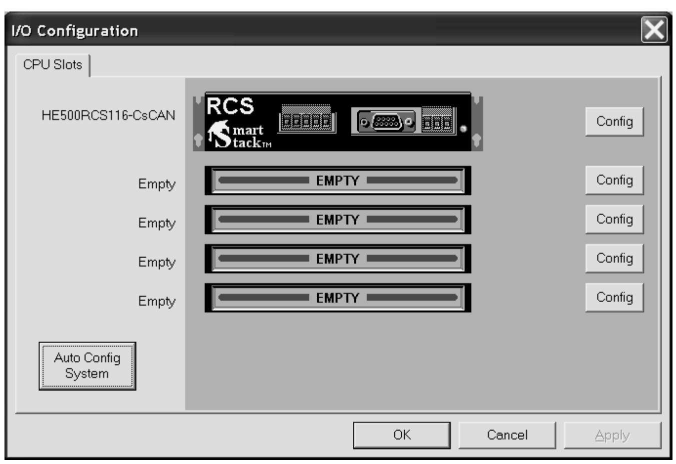


Figure 7.3 – RCS116 is Selected

Also, to delete or replace a SmartStack, right-click, or double-click on a slot or press the **Config** button located next to a slot. Follow the the prompts. Then press OK.

7.3 Configuration of Specific SmartStack Modules

When the desired module is selected, it can be configured.

1. Double-click on the picture of the module or click on the Config button just to the right of the picture. The Module Configuration Screen appears. Depending upon which module is selected, one or two tabs are available for selection.

Note: Because the configuration parameters are different for each SmartStack Module, refer to the data sheet that is specific to the selected module.

2. Refer to the following section for information about the screens used during the configuration process for individual SmartStack Modules.

7.3.1 Configuration Screens

The following information provides an explanation of the screens used to configure SmartStack Modules. The screens that appear depend upon which module is selected.

a. I/O Map Tab Screen

The I/O Map describes which I/O registers are assigned to specific SmartStack Modules. Although there are no user defined parameters, the user (i.e., programmer) needs to view the I/O Map to determine where the module is located in the point map. Upon pressing the I/O Map tab, a screen appears indicating the following module information:

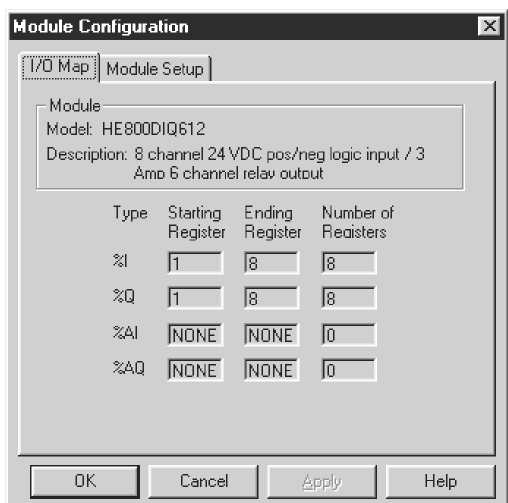


Figure 7.4 – I/O Map Tab Screen

- Model number — Provides the part number.
- Description — Describes the number of input and output channels and other key characteristics of the module.
- Type: — Displays the register types assigned to the module.
- Number: — Indicates the quantity of a particular register type.
- Starting Location: — Denotes the starting location of the register type.

Note: Do not confuse the described number of input and output channels with the numbers found in the Type column (i.e., %I and %Q). The numbers do not necessarily match.

Example I/O Map (For illustrative purposes only):

All %I and %Q registers are assigned in increments of eight bits regardless of the number of input or output channels.

Using DIQ512 (Figure 8.3) as an example, note that there are *four input* channels and *three output* channels per the description.

Four input channels: Channels not physically present show a low (zero) state.

%I8	%I7	%I6	%I5	%I4	%I3	%I2	%I1
0	0	0	0	In 4	In 3	In 2	In 1

Three output channels: Channels not physically present are ignored.

%Q8	%Q7	%Q6	%Q5	%Q4	%Q3	%Q2	%Q1
Ignored	Ignored	Ignored	Ignored	Ignored	Out 3	Out 2	Out 1

b. Module Setup Tab

Note: The Module Setup screen varies according to the module selected. Users make selections based upon requirements. Guidelines that are specific to the module are provided in individual data sheets. **It is important to consult the datasheet for specific details pertaining to the Module Setup tab.**

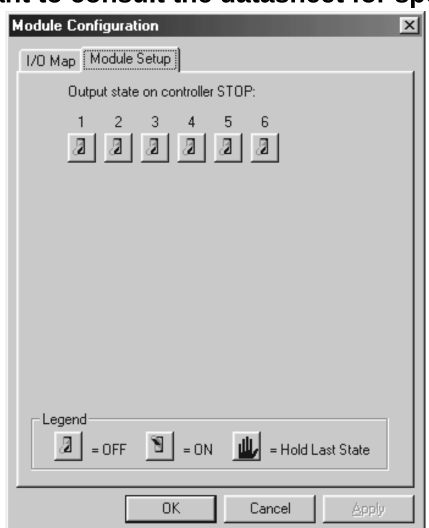


Figure 7.5 – Module Setup Tab Selected

The **Module Setup** is used in applications where it is necessary to change the default states of the outputs when the controller (e.g., OCS100) enters idle/stop mode. The default turns the outputs OFF when the controller enters idle/stop mode. By selecting the Module Setup tab, each output can be set to either turn ON, turn OFF or to hold the last state. Generally, most applications use the default settings.

Warning: The default turns the outputs OFF when the controller enters idle/stop mode. To avoid injury of personnel or damages to equipment, exercise extreme caution when changing the default setting using the **Module Setup** tab.

6. Depending upon the I/O module selected, additional configuration procedures can be required. Be sure to consult the individual data sheet to determine if a supplement is available for the specific module. Supplements provide configuration information and cover other important topics pertaining to a specific module.

CHAPTER 8: TROUBLESHOOTING

8.1 General

Chapter Eight covers numerous topics related to troubleshooting LX and Cscape.

8.2 Memory Overview

BIOS

BIOS is code developed at Horner, which provides the ability to perform field firmware updates. This code is stored in flash at the factory and is not field upgradeable. The current BIOS revision number is accessible in the System\View OCS Status menu.

Firmware

Firmware is code developed at Horner, which provides the basic functionality of the LX. This code is stored in flash at the factory and only needs field updated to support future added functionality. (see The CSCAPE Reference Manual\How to Update Firmware). This code is not affected by battery failure. The current firmware revision number is accessible in the System\View OCS Status menu.

Application

The ladder/graphics application (developed in CSCAPE) is also stored in flash; however, certain characteristics of the application are also stored in battery-backed RAM. Therefore, the application may be lost across power-cycles if the battery fails. CSCAPE is used to download the application through the serial programming port (MJ1) or alternately through another device connected with the LX on the CsCAN network.

Data registers

The user application typically manipulates data registers (i.e. %R1) that are stored in memory. Data registers are divided up between both volatile and non-volatile memory. Non-volatile data registers are stored in battery-backed RAM and the corresponding data may be lost across a power-cycle if the battery fails. (see The CSCAPE Reference Manual\Controller Register Types).

8.3 System Configuration

Configuration Parameters

The LX system configurations are performed from the LX System Menu. These parameters should be configured during installation of the LX and may need later modification based on operator preferences. The system menu activation and individual field descriptions are covered in the system menu chapter.

The following items are configurable:
1. Network Id and baud rate.
2. Contrast
3. Function key operation (momentary or toggle)
4. Time and date
5. Enable/disable Beeper enunciation (touch acknowledgement).
6. Enable/disable Screen saver operation (extend backlight life)
7. Portion of scan time to allocate to Graphics Display.

While these values are stored in %SRs, most are not modifiable from ladder logic.

Touch Screen Calibration

The touch screen is factory calibrated and is not expected to require field calibration through the life of the unit. However, should the unit appear to incorrectly interpret the correct location of the touched area, a field calibration procedure is available through Horner APG technical support.

8.4 Application Loading

Programming Port connection

Connection between the LX programming port and CSCAPE allows the user to: upload, verify or download applications, monitor the mode or status of the target, and debug current running applications. Connection requires a serial connection from a PC to either directly to the LX's MJ1 serial port or indirectly to a Horner APG controller attached to the target LX through CsCAN. Included with the LX is a programming cable that provides a connection between the modular connector (MJ1) and the PC (DB9).

Each LX must be configured with a Network ID. The same ID is used for both serial and network traffic. When accessing a connected target from CSCAPE, the specified target must match the Network ID of the target LX. CSCAPE contains a status bar indicator to verify the connection with the specified target.

Downloads

Download Considerations:

1. Downloads are sent at the maximum baud specified by the CSCAPE Tools\Options\Communications Port - maximum serial port baud field. Should downloads consistently fail due to a PCs limitation of baud rate, reduce the maximum baud rate value in this field.
2. Downloads may be password protected. This requires the user to login with the appropriate password before the downloading is allowed.

Uploads

Should the original application source become unavailable, in most cases it can be uploaded from the LX.

Upload considerations:

1. Generally, a downloaded application contains non-executable information to allow CSCAPE to reconstruct the program should an upload be required. However, should application memory become limited, this information may be removed (see CSCAPE Program\Download Options menu) to free more memory for ladder at the expense of not being able to upload an application.
2. Uploads may be password protected. This requires the user to login with the appropriate password before the upload is allowed.

8.5 Modes of operation

The modes of operation are:

RUN (RUN Led ON)
Ladder logic is scanned, I/O is updated
DoIO (RUN Led Flash)
Ladder logic is not scanned, I/O is updated
IDLE (RUN Led OFF)
Both ladder logic and I/O is not scanned

Determination of Mode

It is possible to determine the current mode of the LX by several different means. Either refer to the RUN Led on the back panel (near CsCAN connector), or the virtual RUN led on the LX System Menu screen from the front panel (see LX LEDs). In addition, the LX can be configured to pop-up a message on top of the current application screen notifying the operator of a mode or status change.

Setting the Mode

The mode can be changed either from CSCAPE or through the LX System Menu \ View OCS status menu. Changing the mode allows a process to be stopped for system maintenance. Additionally, the Do IO mode is available to manually manipulate and test I/O through CSCAPE before the process is started.

On completing application downloads to the LX, CSCAPE attempts to set the mode of the LX to that just prior to the download. On the first download, the mode remains in IDLE once the download is complete. The user can use either CSCAPE or the LX System Menu to set the current operation mode.

- A mode change to RUN is blocked if a fault condition exists.
- A currently RUNning process is stopped if a fault condition occurs.
- Warning conditions do not prevent or change RUN mode.

8.6 Status of Operation

The status generally indicates if an abnormal condition exists. The following are the three possible status states:

Ok (Ok Led ON)
No points forced and no warnings or faults exist
I/O point is forced (Ok Led Flash)
At least one I/O point is forced to a known state (by the CSCAPE editor)
Warnings or Faults exist (Ok Led OFF)
A warning or fault exists with the current configuration, hardware setup or application.

Determination of Status

It is possible to determine the current status of the LX by several different means. From the LX, either refer to the Ok Led on the back panel (near CsCAN connector), or the virtual Ok led on the System Menu screen from the front panel (see LX LEDs). In addition, the LX can be configured to pop-up a message on top of the current application screen notifying the operator of a mode or status change.

8.7 Power-up Self-Test Faults and Notifications

When the LX first powers-up, the BIOS performs a short series of tests on the hardware and firmware. If any of these tests fail, a Firmware Loader fault screen is displayed indicating the error, and the system is halted. The following errors may be generated:

FAULT: Ram Test Failed
FAULT: Firmware Loader CRC
FAULT: Application Firmware CRC
These faults are typically due to non-field repairable hardware failures. Contact Horner APG technical support for further assistance.

Once the BIOS tests complete successfully, the firmware is started which causes it to display its model number and a notification that it is running a self-test. Next, it performs a series of self-tests before the application is allowed to run. If any of these tests fail, an associated message is displayed on the screen for approximately 2 seconds for each failed test.

Once the self-test have completed and all fault messages have been displayed, a final message indicates if the self-test passed or failed.

Failed self-tests are classified as one of: notification, warning or fault. Notifications are not considered to affect application execution and do not set any field in the System Menu \ View OCS Diags screen. However, warnings and faults do set values in the System Menu\View OCS Diags screen for later reference. If a fault occurs, the LX is prevented from entering RUN mode.

Hardware Notifications:

Updating CAN Co-processor – (takes up to 20 seconds)
New network hardware has been detected and is being configured. No user interaction is required.

Invalid touch calibration data – Using default settings
Touch screen calibration file found to be corrupted. User needs to recalibrate touch screen from touch screen calibration menu (SYS-F1) once self-test is complete.

Battery – Low voltage or missing
See battery replacement section.

Waiting for Net (F1 Disable Net)
(If Network Required bit set) Start of applications delayed until network active.

Application Warnings (RUN mode allowed):

Real-time-clock - Defaults set
Invalid time or date was detected. Operator needs to update time/date in system menu once self-test is complete.

User Graphics
Graphics (screens) portion of program is missing or corrupt. Unit may still be placed in RUN if User Program portion is valid.

If network required:

No Network Power – Network Disabled

No power to CsCAN port detected.

No Network Response – Network Disabled
No response from any node on network.

Duplicate ID – Network Disabled
Duplicate network ID detected from another device on network

Application Faults (RUN mode is disabled until fault corrected)

User Program
Ladder or I/O configuration portion of program is missing or corrupted. Unit remains in IDLE mode when commanded to run.

8.8 Run-time Faults and Warnings:

Certain faults or warnings can occur while the process is running. Detection can be accomplished through the OK or RUN Leds. Should either indicate an error, the LX System Menu \ Diags screen provides an indication of what faults or warning exist.

If a fault occurs, the application is stopped (set to IDLE mode). However, a warning allows the LX to continue to run. Additionally, some %S system bits are available for the application to determine an alternate action.

%S2 - Net Ok
%S13 - Net I/O Ok

8.9 Battery Replacement

8.9.1 Battery Lifetime

The lifetime of the is approximately 5 years at 25C° (.

8.9.2 Battery Replacement Time

CAUTION: Replacement of battery must be done within three minutes after turning OFF power supply.

8.9.3 Battery Self-Test

The self-test indicates at power-up when the battery requires replacement. See Chapter Five: System Menu.

8.9.4 Battery Replacement Procedures

Note: Read Sections 8.91 –8.9.3 PRIOR to replacing the battery to determine critical battery times and self-test information.

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

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

1. Remove power to LX

Warning: Failure to remove power can cause damage to LX.

Note: A super-capacitor maintains power to the memory while the battery is being changed.

2. From back of unit remove CAN (network) connector (Figure 8.1).

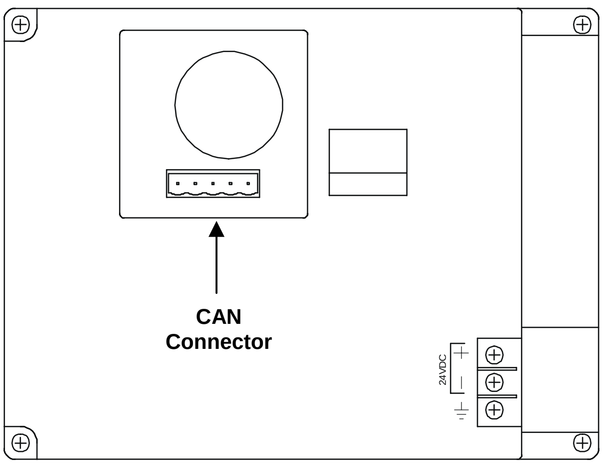


Figure 8.1- CAN Connector Location

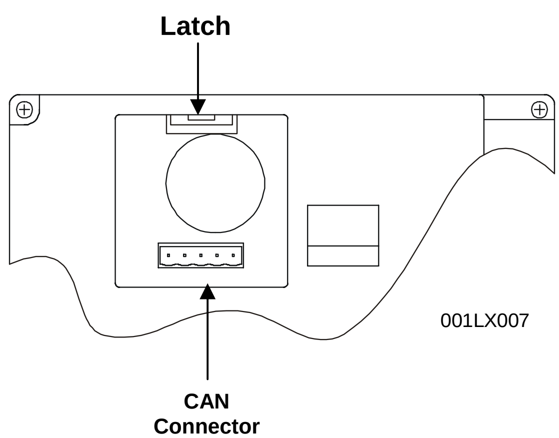


Figure 8.2 – Close-up of Latch

3. Press in and lift up on the latch at top of battery access door (above CAN connector). (Figure 8.2).
4. Carefully lift access door out using care not to over-extend battery cable.
5. Disconnect battery cable from LX.
6. Remove attached PCB from access door.
7. Remove the old battery from within the access door pocket and replace with new battery. (Discard old battery in a proper manner.)

8. Replace PCB into board snaps.
9. Reconnect battery cable to LX (connector is keyed to prevent incorrect alignment).
10. Replace access door using care not to pinch cable wires between the door and the case. Press down until latch snaps into case.

    Note: Be careful to line-up mating connectors between the PCB and LX unit when latching access door.

11. Reconnect CAN connector.

NOTES

APPENDIX A: NETWORKS

1 CAN and CsCAN Networks

Appendix A describes the Controller Area Network (CAN) and CsCAN / DeviceNet.

2 Controller Area Network (CAN) Overview

The controller area network (or CAN bus) is a serial communications bus that was originally developed in the late 1980's by a German company (Robert Bosch) for use in the automotive industry. CAN is an ISO (**I**nternational **S**tandards **O**rganization) - defined serial communications bus for real-time applications. Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. Specifically, CAN is documented in ISO 11898 (for high-speed applications) and ISO 11519 (for lower-speed applications).

a. CAN Features

CAN-based open automation technology successfully competes on the market of distributed automation systems because of the special features of the CAN protocol. The special features are CAN's producer-consumer-oriented (or peer-to-peer) principle of data transmission and its multi-master capability. The general design of CAN originally specified a high bit rate, high immunity to electrical interference and an ability to detect any errors produced. CAN networks have the following general attributes:

Automatic error detection
Easily configurable
Cost-effective to design and implement
Capable of operating in harsh environments

b. CAN Protocol

The CAN communications protocol simply describes the method by which information is passed between various devices. The CAN protocol conforms to the Open Systems Interconnection (OSI) model. An open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture. The OSI model is defined in terms of seven ordered layers. These layers consist of the Physical (bottom-most layer), Data Link, Network, Transport, Session, Presentation and Application (top-most layer). CAN architecture defines the bottom two layers of the model. These layers are the physical and data link layers.

The physical and data link layers are typically transparent to the system designer and are included in any component that implements the CAN protocols. The physical layer is responsible for functions such as physical signaling, encoding, bit timing and bit synchronization. The data link layer performs functions such as bus arbitration, message framing and data security, message validation, and error detection. The application levels are linked to the physical medium by the layers of various emerging protocols (such as DeviceNet) dedicated to particular industry areas plus a variety of custom protocols defined and developed by individual CAN users.

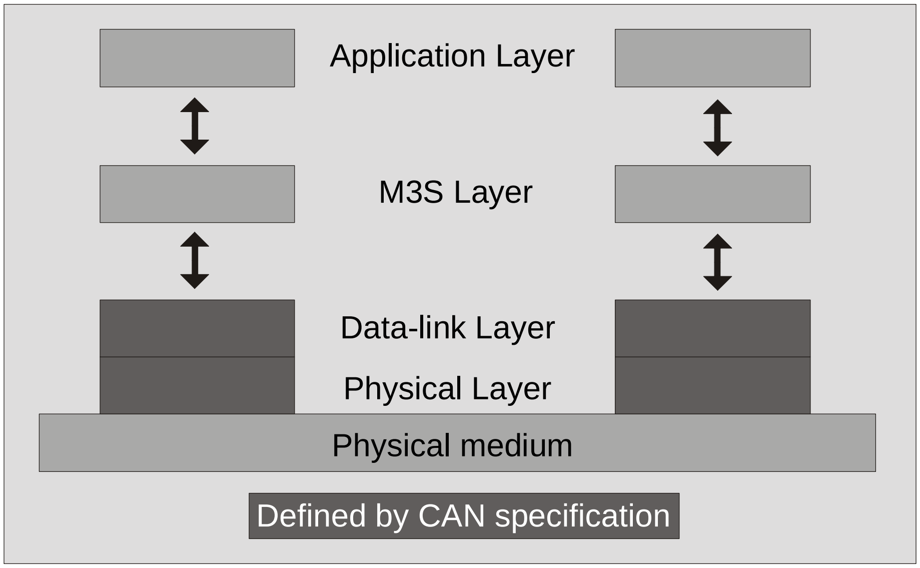


Figure 1 - OSI-Based Model

c. CAN Operation

CAN is capable of using a variety of physical media for transmission purposes. Two examples are twisted wire-pairs and fiber-optics. The most common physical medium consists of a twisted-pair with a termination resistance that is applicable to the cable in use (the CsCAN network typically calls for the use of a 121Ω resistor). CAN operates at data rates of up to 1 Megabits per second.

The signaling in CAN is carried out using differential voltages. The two signal lines are termed 'CAN_H' and 'CAN_L'. The use of voltage differentials allows CAN networks to function in very noisy environments. With the twisted pair, differential configuration, each wire is closer to the noise source (if a noise source is present) for half the time and farther away for the other half. Therefore, the cumulative effect of the interference is equal on both wires, thus canceling the interference.

The Full CAN protocol allows for two lengths of identifiers. These two parts are "Part A" and "Part B". Part A allows for 11 message identification bits, which result in 2032 different identifiers. Extended CAN (Part B) utilizes 29 identification bits, resulting in 536,870,912 separate identifiers.

Note: DeviceNet currently specifies Part A only, and the balance of this discussion is specific to Part A only.

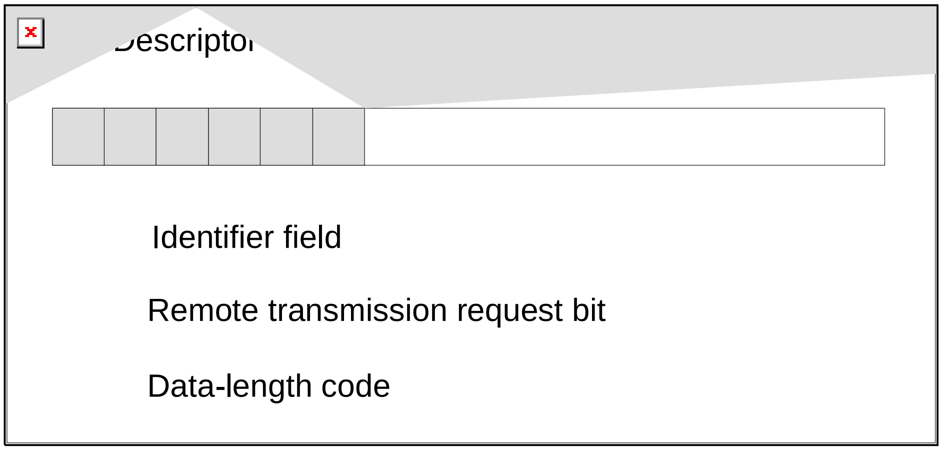


Figure 2 – Descriptor Bytes

There are 11 bits in the identifier field. The bits are used for identification of the message as well as determining its bus access priority. The priority is defined to be highest for the smallest binary value of the identifier. One very attractive quality of CAN is that it is capable of allocating priorities to messages. This feature makes it attractive for use within real-time control environments. All bits of the identifier field define the message priority. The CAN specification guarantees the latency time associated with priority values.

Since the CAN protocol specifies no rules for the assignment of message-identifiers, a variety of different, application-specific uses are possible. Assignment of the CAN message identifiers therefore is one of the most important decisions when designing a CAN-based communication system.

To summarize, CAN is currently being used in a very large number of applications in the automotive industry and in many other industrial applications. CAN is an excellent network to use in situations where microcontrollers need to communicate with each other or with remote devices. The popularity of CAN has been the result of the automatic error detection capabilities, the ability to operate in harsh environments, the relatively low-cost for development tools, and the wide availability of hardware.

3 CsCAN Network Overview

The CsCAN Network was first developed in 1993 by Horner. It was developed for use in a project that Horner completed for the United States Post Office. Horner developed its own network, because it needed a network that had a specific set of powerful peer-to-peer and host-to-node capabilities. The CsCAN Network has a “pass-through” feature whereby PC-based programs access other nodes connected to a network by passing the programming command through the serial port to the network port. (For a more detailed description, see below.) Horner found that by developing its own network, it satisfied several important needs. Horner continues CsCAN Network development to satisfy the requirements of today and the requirements of the future.

CsCAN Network Features

The CsCAN Network is based on CAN, which has many desirable features such as ruggedness, ease of configuration, etc. With Horner Controllers, data is passed at 125Kbps using a differential pair of wires plus a ground. It is important to note that the data rate is not limited to 125Kbps. The maximum data rate is 1Mbps (limited by the speed of light). The CAN implementation in the CsCAN controller allows up to 64 controllers to be networked with no additional hardware and up to 253 controllers with three CAN repeaters.

For the ladder programmer, little knowledge of networking procedures is needed. However for troubleshooting and optimizing, the following information is helpful. Instead of using master/slave or token passing, the hardware self-arbitrates based on the Network ID. **Controllers with lower Network ID numbers are given a higher priority than controllers with higher Network ID numbers.**

CsCAN Network Operation

When a controller needs to send data over the network, it first waits for the network to be idle (currently a maximum of 900μs). If two controllers start broadcasting information on the network at the same time, the "self-arbitration" causes the controller with the greater Network ID number to cease broadcasting without affecting the message-in-progress of the other controller.

In applications with a large number of networked controllers, better results may be achieved by assigning lower Network IDs to controllers that have more critical network data than other controllers. By assigning higher Network IDs to controllers that provide numerous network updates, the controllers are prevented from monopolizing the bus time.

Each controller is capable of broadcasting Global Digital Output bits (%QG) and Global Analog Output bits (%AQG), which are periodically broadcasted to the other controllers on the network. The coil representations %QG and %AQG can be used in ladder logic like any other coil or register reference.

All global outputs are broadcast to the network according to the way the programmer sets them up under the Program, Network Config in Cscape.

In addition to global data, the CsCAN Network is used to exchange data between a controller on the network and a PC-based Host Supervisory Tool such as the Cscape Ladder Editor or an OEM-specific cell controller.

A useful feature of the CsCAN network is that it supports a “Host-to-Node” protocol and has the ability to "pass through" programming commands. A programming package (like Cscape™), when attached to a Control Station serial port, can access other Control Station units connected to a network by passing the programming command through the serial port to the network port. In this way, one Cscape™ package connected to one Control Station unit can program all Control Station units on the network.

4 DeviceNet Overview

DeviceNet is an open network. The specification and the protocol are open. Vendors are <u>not</u> required to purchase hardware, software or licensing rights to connect devices to a system.

a. DeviceNet Features

DeviceNet is a low-cost communications link to connect industrial devices. It allows the interchangeability of simple devices while making interconnectivity of more complex devices possible. DeviceNet is based on CAN. It is an application layer protocol (ISO layer 7) and is defined in terms of an abstract object model, which represents the available communication services and the external visible behavior of a DeviceNet node.

The DeviceNet Model is application independent. DeviceNet provides the communication services needed by various types of applications. Many of today's lower level industrial control devices must retain their low cost/low resource characteristics even when directly connected to a network. DeviceNet takes this into consideration by defining a specific instance of the DeviceNet Model for communications typically seen in a Master/Slave application. This is referred to as the Predefined Master/Slave Connection Set. Some of the features and functionality of the DeviceNet network are described Table 1:

Table 1 - DeviceNet Features and Functionality

Network Size	**Up to 64 Nodes**
Network Length	Selectable end-to end network distance varies with speed Baud Rate — Distance 125 Kbps — 500m (1,640 feet) 250 Kbps — 250m (820 feet) 500 Kbps — 100m (328 feet)
Data Packets	0-8 bytes
Bus Topology	Linear (trunkline/dropline); power and signal on the same network cable
Bus Addressing	Peer-to-Peer with Multi-Cast (one-to-many); Multi-Master and Master/Slave special case; polled or change-of-state (exception-based)
System Features	Removal and replacement of devices from the network under power

b. DeviceNet Protocol

Some of the communication protocol features of DeviceNet consist of the following:

A DeviceNet product can behave as a Client, a Server or both.
Master/Slave operation.
Capable of Peer-to-Peer exchange capability exists in which any DeviceNet product can produce and consume messages.
Capable of supporting 64 node addresses
Each node can support an unlimited number of I/O.

DeviceNet requires packets to have identifier fields for the data. The DeviceNet specification defines two different types of messaging. These two different types are I/O Messaging and Explicit Messaging. These messages provide multi-purpose, point-to-point communications paths between two devices. Explicit messages use low priority identifiers and contain the specific meaning of the message in the data field. I/O messages are for time-critical, control-oriented data. They provide a dedicated, special-purpose communication path between a producing application and one or more consuming applications. They are exchanged across single or multi-cast connections and typically use high priority identifiers.

c. DeviceNet Operation

The following restrictions are placed on operations when using an LX that is configured as a DeviceNet slave.

Currently, communication between the PC and the controller is only possible to the device physically connected to the PCs' serial port. Ladder logic downloads, uploads, monitoring, and configuration **cannot currently take place** over a DeviceNet network. The **local node ID and target controller node ID must be the same**.

DeviceNet network nodes are in a range from 0 to 63. The controller is able to observe network responses (polled connections) from any slave to the DeviceNet Master . The first 16-words of these observed responses are made available for mapping on the **Network Input Assignments** page. These correspond to the available nodes 0 to 63 and registers AQG1 to AQG16. Node 64 is used for a special case. When data is sent to a controller from a DeviceNet Master (via the polled connection) this data is mapped to node 64. Relative addressing is limited to -64 to +64.

Note: Horner manufactures a DeviceNet Master module. The part number is HE800DNT450.

APPENDIX B: DISTRIBUTED CONTROL SYSTEMS (DCS)

1 General

A Distributed Control System (DCS) is defined as a system for the control and monitoring of an industrial process which shares the computer-processing requirement between several processors. With DCS, processing is distributed among a multitude of different processors instead of one very large processing system.

MIMD (multiple instruction, multiple data) parallel processing technique is used in the CsCAN network. Each processor is capable of sharing data in this system. Typically, the processors are located in a wide variety of devices. These devices may take the form of Micro PLCs, conveyor controllers, operator interfaces, etc. Each of these devices serves a specific function.

It is common in a DCS for several different modules to be physically distributed in some type of arrangement around a plant. This is typically the case with devices connected to plant instrumentation since this greatly reduces plant cabling costs. The name “Distributed Control System” is not a reference to a *physical* layout but rather to the distribution of the processing. The devices in DCS are connected together via a high-speed communication link. Links such as CsCAN and DeviceNet are typical in DCS.

2 Attributes Desirable in DCS Design

There are three attributes that are desirable in any DCS design:

a. Ease of Implementation

Modern Distributed Control Systems should be able to implement most control requirements without the need for complex or unusual design.

b. Intuitive to the Operator

The group of individuals that use DCS most frequently are the operators. It is important that applications are designed so that they are operable in a logical and consistent manner and in a way that complements the general operation of a plant.

c. Maintainable

Achieving the required functionality is only part of the solution. The design must also be maintainable. The system should be designed so that it can be maintained without the need for major re-engineering.

Distributed control is becoming ever-increasingly popular. As the presence of networks become more common in industrial automation, finding better ways to use the networks effectively will become much more important. Central to the DCS philosophy, control needs to be distributed out onto the network so that control is implemented where the process actually takes place. With DCS, the overall amount of data on the network is essentially reduced, because only data that has been processed is broadcasted on the network. This allows for more devices to be installed on a network that have a finite bandwidth.

3 Key Factors in Distributed Control Systems

All programmable nodes can be programmed via the network. Each node communicates data onto the network that is readable by any other node on the network in the Producer/Consumer network mode. (Also known as Peer-to-Peer Networking). Network medium is flexible. Currently, the Controller Area Network (CAN) is the preferred solution, but it is anticipated that Ethernet will likely be dominant within 1-3 years.

NOTES

INDEX

NOTES