IMO

i^3 Intelligent Control Station

i^3C Lite User Manual

Think inside the box

PREFACE

This manual explains how to use the *i³C Lite*.

For user manual updates, contact Technical Support:

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LIMITED WARRANTY AND LIMITATION OF LIABILITY

IMO Precision Controls Ltd ("IMO") warrants to the original purchaser that the i³C Lite module manufactured by IMO is free from defects in material and workmanship under normal use and service. The obligation of IMO 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 three (3) years from the date of manufacture, such defect to be disclosed to the satisfaction of IMO after examination by IMO 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 IMO NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IMO, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS i³A Lite module. THIS WARRANTY SHALL NOT APPLY TO THIS i³C Lite module OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. IMO MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY IMO. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE i³C Lite 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 IMO 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, postpaid, insured, and in a suitable package.

ABOUT PROGRAMMING EXAMPLE

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any installation, IMO 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 i³C Lite module to appropriately design the end system, to appropriately integrate the i³C Lite 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.

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CHAPTER 1: SAFETY / COMPLIANCE

1.1 Safety Warnings and Guidelines

When found on the product, the following symbols specify:

Warning: Consult user documentation.

Warning: Electrical Shock Hazard.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.2 Grounding

Grounding is covered in various chapters within this manual.

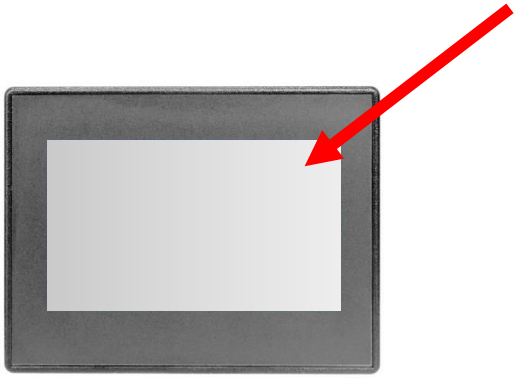
1.3 Compliance

To check for compliance and updates, visit the IMO website.
IMO Precision Controls Ltd: https://imopc.com

CHAPTER 2: INTRODUCTION

2.1 Visual Overview of *i*³C Lite

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



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

Figure 2.1 – Visual Overview of the *i*³C Lite

2.2 Where to Find Information about the *i*³C Lite

a) **Datasheet – The datasheet is the first document to refer to for key information related to specific *i*³C Lite models.**

1. The datasheets for all *i*³C Lite models are available on the IMO website.
2. Datasheets contain pin-outs, jumper settings, and other model specific information.

b) **User Manual – This manual provides general information that is common to *i*³C Lite models and can be downloaded from our website.** Visit the IMO website to obtain user documentation and updates.
IMO Precision Controls Ltd: http://www.imopc.com

2.3 Four Main Types of Information are covered in this Manual

a) Safety and Installation guidelines / instructions (Mechanical and Electrical)
b) Descriptions of hardware features – Serial ports, Removable Media, Communications, etc.
c) Configuration and Use of the *i*³C Lite.
d) Maintenance and Support

2.6 Connectivity to the *i*³C Lite.

The *i*³C Lite has excellent capability for connecting to a variety of devices. The diagram below shows some examples of devices that can be used with the *i*³C Lite..

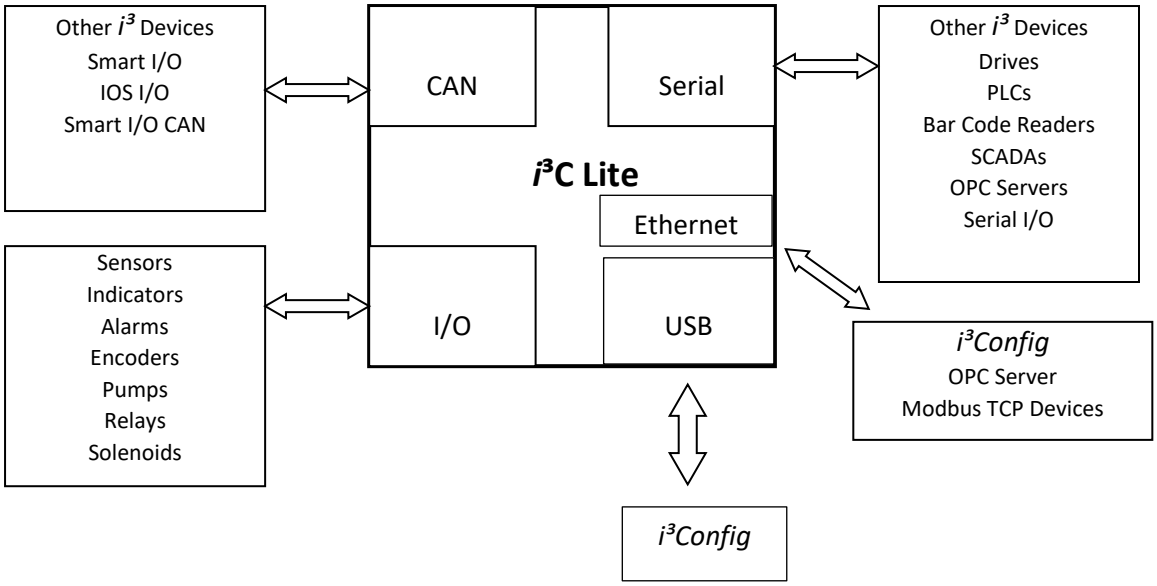


Figure 2.2 – Visual Overview of *i*³C Lite Connectivity

2.7 Features of the *i*³C Lite

The *i*³C Lite are all-in-one industrial control devices. They combine control, user interface, I/O and networking into a single, integrated package. Unique features of the *i*³C Lite includes the following:

- Small, sleek profile saves space and resources.
- Physical Specifications
    - mm: 96 tall x 125 wide x 331 deep
    - in: 3.79 tall x 4.92 wide x 1.22 deep
    - weight: 360g
- Bright color touch display
- Display of complex graphical objects including trends, gauges, meters and animations
- Advanced control capabilities including floating point, multiple auto-tuning PID loops and string handling capabilities
- Intuitive interface
- Removable media for storage of programs, data logging, or screen captures
- *iCAN* networking port for communication with remote I/O, other controllers or PCs
- *i*³ Config programming software that allows all aspects of the *i*³C Lite to be programmed and configured from one integrated application
- Fail – Safe System which allows an application to continue running in the event of "Soft" failures such as (Battery power loss or Battery Backed register RAM / Application flash corruption)
- Clone Unit allows the user to "clone" the *i*³. This feature "clones" application program and unit settings stored in Battery backed RAM of an *i*³. It can then be used to clone a different *i*³ (but must be the exact same model).
- Suited for most applications across a diverse range of industries

2.8 Accessories

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

IMO Precision Controls Ltd https://www.imopc.com/products/97660000

CHAPTER 3: MECHANICAL INSTALLATION

NOTE: The datasheet is the first document to refer to for model-specific information related to *i*³C Lite models and key installation information. Visit the IMO websites to obtain datasheets, user documentation, and updates.

3.1 Mounting Overview

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

3.2 Mounting Procedures (Installed in a Panel Door)

Once the panel design has been completed using the criteria and suggestions in the following sections, use the following steps to panel mount the *i*³C Lite.

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

1. Carefully locate an appropriate place to mount the *i*³C Lite. Be sure to leave enough room at the top of the unit for insertaion. Remove the microSD card to prevent damage to the panel edge.
2. Carefully cut the host panel per the measurements found in the datasheet .
3. Dimensions can also be found below in Section 3.5. If the opening is too large, water may leak into the enclosure, potentially damaging the unit. If the opening is too small, the I³ may not fit through the hole without damage.
4. Remove any burrs and/or shape edges and ensure the panel is not warped in the cutting process.
5. Make sure the gasket is installed on the *i*³C Lite and is free from dust and debris. Check that the corners of the gasket are secure.
6. Pass the unit through the panel.
7. Insert each of the four (**4**) mounting clips into the slots in the *i*³C Lite case. One composite plastic clip should be installed on each corner. Lightly tignten each screw so the clip is held in place.
8. Tighten the screws on the clips such that the gasket is compressed against the panel. Recommended torque is 2-3 in-lbs (0.23 – 0.34 Nm). If metal mounting clips are used in place of the plastic composite mounting clips, the recommended torque is 4-8 in-lbs (0.45-0.90 Nm).
9. Connect communications cables to the serial port, USB ports, and CAN port as required.

3.3 Mounting Clip Locations

Figure 3.1 – *i*³C Lite with Mounting Clip Location

3.4 Mounting Orientation

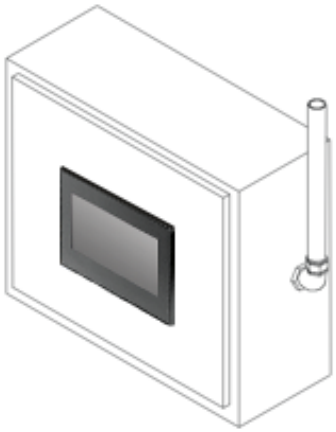


Figure 3.2 – Orientation of *i*³C Lite

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

3.5 Panel Cutout

For installations requiring NEMA 4X liquid and dust protection, the panel cutout should be cut with a tolerance of +/- 0.005” (0.1mm).

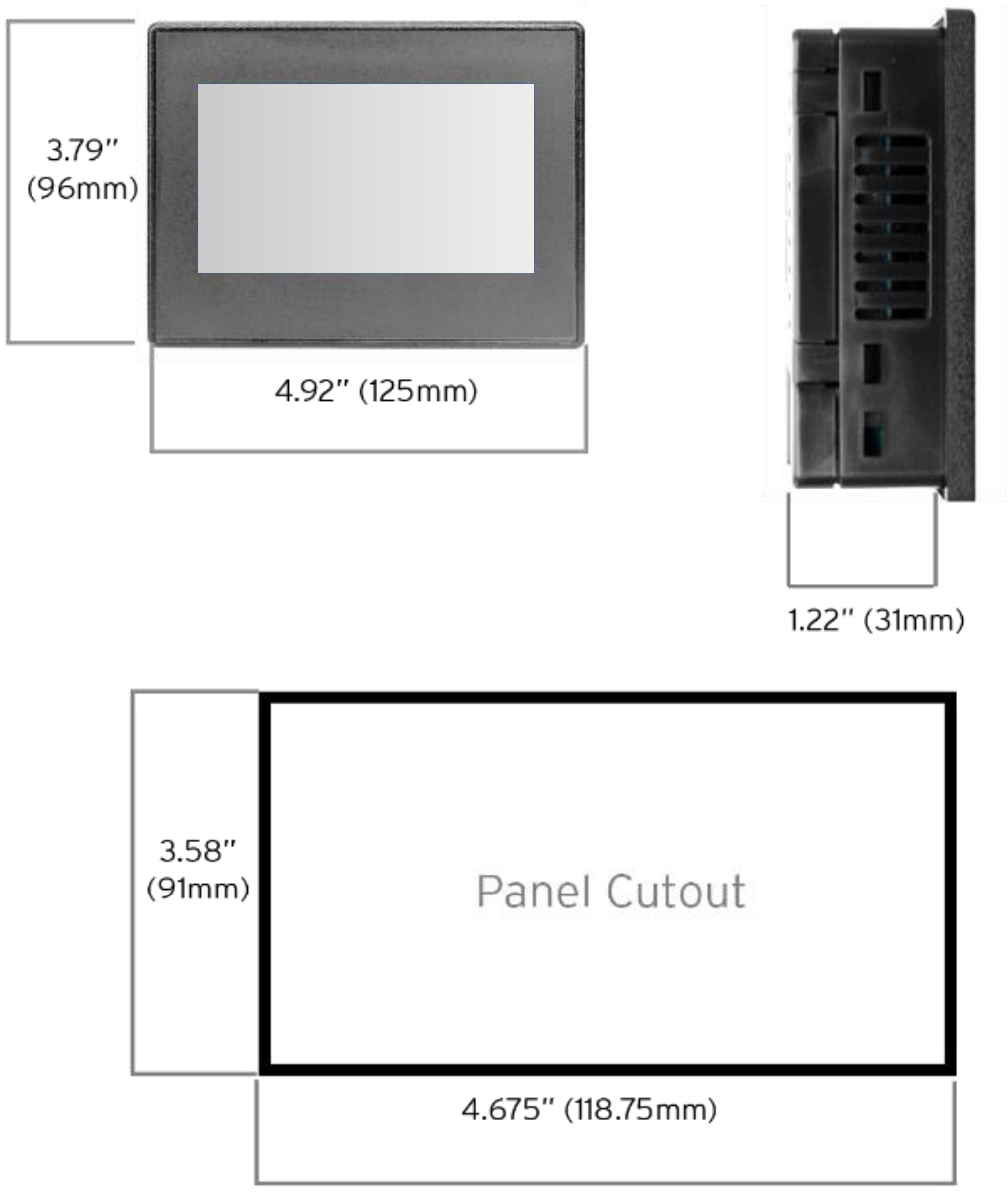


Figure 3.4 – *i*³C Lite Dimensions

3.6 Factors Affecting Panel Layout Design and Clearances

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

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

3.7 Clearance / Adequate Space

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

Table 3.1 – Minimum Clearance Requirements for Panel Box and Door	
Minimum Distance – between base of device and sides of cabinet.	2” (50.80mm)
Minimum Distance – between base of device and wiring ducts.	1.5” (38.10mm)
Minimum Distance - between bases of each device **if more than one device is installed in panel box or on door.**	4” between bases of each device (101.60mm)
Minimum Distance – between device and closed door **when door is closed**. (Be sure to allow enough depth for the I³.)	2” (50.80mm)

3.8 Grounding

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

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

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

3.9 Temperature / Ventilation

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

3.10 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 *i*³C Lite and noisy devices such as relays, motor starters, etc.

3.11 Shock and Vibration

The *i*³C Lite has been designed to operate in typical industrial environments that may inflict some shock and vibration on the unit. For applications that may inflict excessive shock and vibration, please use proper dampening techniques or relocate the *i*³C Lite to a location that minimizes shock and/or vibration.

3.12 Panel Layout Design and Clearance Checklist

The following list provides highlights of panel layout design factors:

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

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

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

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

____Is the panel box deep enough to accommodate the *i*³C Lite?

____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 *i*³C Lite 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?

CHAPTER 4: ELECTRICAL INSTALLATION

NOTE: The datasheet is the first document you need to refer to for model-specific information related to *i*³C Lite models such as pin-outs and other key installation information.

4.1 Grounding Definition

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

4.2 Ground Specifications

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

4.3 How to Test for Good Ground

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

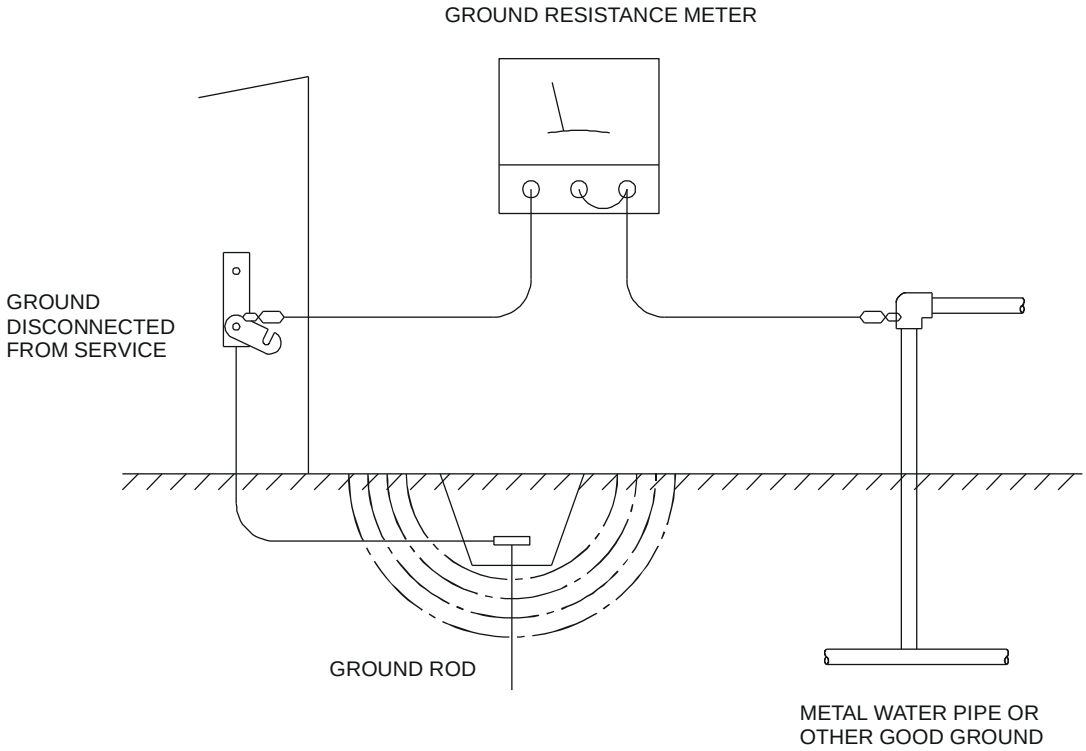


Figure 4.1 – Two-Point Ground Connection Test

4.4 Primary Power Port

Table 4.1 – Primary Power Port Pins		
Pin	**Signal**	**Description**
+	24VDC + / - 20%	Input Power Supply Voltage
–	0V	Input Power Supply Ground
⏚	⏚	Frame Ground

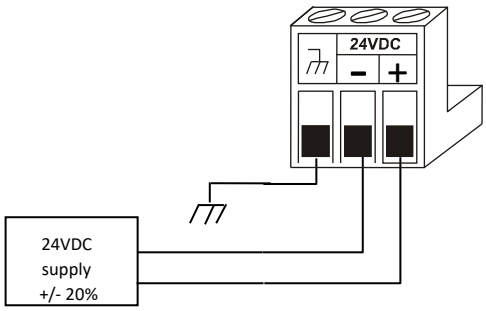
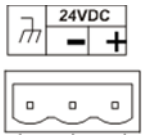


Figure 4.2– Power Connector (Primary Power Port)



DC INPUT / FRAME

Solid/Standard wire: 12-24 awg (2.05-0.511mm or 3.31-.205mm^2).
Strip length—0.28" (7 mm).

Torque rating: 4.5 – 7 in-lbs (0.50 – 0.78 N-m).

DC- is internally connected to I/O.

A Class 2 power supply must be used.

Figure 4.3– Primary Power Port as Viewed Looking at the *i*^{3}C Lite

CHAPTER 5: SERIAL COMMUNICATIONS

5.1 Overview

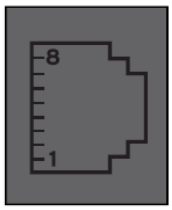
All *i*³C Lite models provide two serial ports, which are implemented with a single 8-position modular jack that is labeled **MJ1/2**. The MJ1 serial port is RS-232 while the MJ2 port is RS-485. MJ1 defaults to *i*³ programming by connecting it to the COM port of a PC running *i*³ Config. In addition, both MJ1 and MJ2 can be used for application-specific communication, using a variety of standard data exchange protocols.

5.2 Port Descriptions

The MJ1 serial port contains a RS-232 interface with RTS/CTS handshaking.

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

5.3 Wiring—MJ1/MJ2 Serial Ports



MJ1: RS-232 w/Full Handshaking
MJ2: RS-485 Half-Duplex

Table 5.1—MJ1/MJ2 Serial Ports

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

5.4 RS-485 Termination and Biasing

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

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

This termination is only in place when the *i*³C Lite is powered on. This would typically only be an issue if the *i*³C Lite is being used as a slave on the RS485 network. In that case, the electronic should not be used, but a physical external termination resistor should be used instead.

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

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

The "Set Serial Ports" option in the *i*³ System Menu can be used for termination and biasing. Also, an application graphics screen that writes to %SR can do the same thing.

Biasing Details:

- %SR152.3 enables RS485 Port Termination
- %SR164.1 enables RS485 Port Biasing

5.5 *i*³ Config Programming via Serial Port

MJ1 is the serial port available for programming. The connection is RS-232 and is compatible with the IMO programming cable kits I3PC45. Unlike some other *i*³ models, the MJ2 port cannot be configured as a programming port. The Mini-B USB port is also available for programming.

The "Set Serial Ports" option in the *i*³ System Menu contains an entry for Default Programming Port (Dflt Pgm Port). However, the entry is fixed at MJ1-232. Now i³ configuration is required to use either the MJ1 serial port or Mini-B USB port for programming.

NOTE: Only one *i*³ Configurator software connection is allowed at a time.

5.6 Ladder-Controlled Serial Communication

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

5.7 Configuration via Mini-B USB

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

It is possible to load the program and monitor data via the Mini-B USB. To load via Mini-B USB, configure the communications port in i³ Config as follows:
Select **Tools** from the toolbar → **Application Settings** → **Communications** → **USB** button

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

NOTE: It is advisable to use an isolated USB cable between the PC or laptop and the *i*³C Lite when third party devices are connected to the *i*³C Lite to avoid damage to the PC or laptop and/or the *i*³C Lite.

CHAPTER 6: CAN COMMUNICATIONS

NOTE: For additional CAN information, refer to the CAN Networks manual on the website.

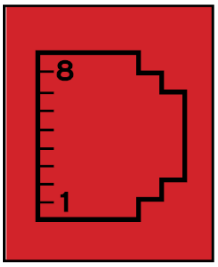
6.1 Overview

The i³C Lite provides a CAN networking port, which is implemented with an 8-position RJ-45 modular jack. The connector is labeled CAN and is red.

CAN Connector on the *i*³C Lite.

Figure 6.1 – CAN Connector

6.2 CAN Port Wiring



CAN

Modular jack
(8 posn RJ45)

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

6.3 *i*³ Config Programming via CAN

The CAN port supports ICAN Programming Protocol. If a PC has a CAN interface installed (via PCI card or USB), and the PC CAN port is connected to the *i*³C Lite CAN port, then *i*³ Config can access the *i*³C Lite for programming and monitoring.

In addition, the *i*³C Lite supports single-point-programming of all *i*³C Lite and other IMO controllers that are connected to a CAN network. If the PC COM port is connected to the *i*³C Lite programming port, then the *i*³C Lite can act as a pass-through gateway allowing *i*³ Config to access all *i*³C Lite and IMO controllers that are attached to the CAN network.

6.4 Ladder-Controlled CAN Communication

Using Put and Get Network Words function blocks, the CAN port can exchange digital and analog global data with other *i*³C Lite or IMO controllers attached to the CAN network.

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

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

Connecting remote I/O to the *i*³C Lite CAN port allows the *i*³C Lite I/O to be economically expanded and distributed. A variety of remote I/O modules is available for this purpose.

6.6 CAN and Termination and Bias

If there is a controller-to-controller communication on a network, and an *i*³C Lite will be at either end, then it is recommended that onboard electronic termination NOT be used. Physical external resistors should be used instead. In this case, utilizing RJ45 to open-style connector will make termination easier.

NOTE: %SR152 enables CAN port termination.

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

CHAPTER 7: ETHERNET COMMUNICATIONS

7.1 Ethernet Module Protocols and Features

The following table describes the Ethernet Module Protocols and features supported by the Ethernet port on the *i*³C Lite:

Table 7.1 – Ethernet Module Protocols & Features	
Protocol / Feature	**Protocol / Feature Description**
ICMP Ping	Internet Control Message Protocol
EGD (Peer)	Ethernet Global Data
ICAN TCP Server	IMO ICAN over Ethernet
Modbus TCP Slave	Modbus over Ethernet
Ethernet / IP Server	ODVA CIP over Ethernet
FTP Server	File Transfer Protocol
ASCII over TCP/IP Server	ASCII Data over Ethernet

7.2 Ethernet System Requirements

Full Ethernet functionality requires:

- PC running *i*³ Config Programming Software Version 9.8 or later (for configuration).
- *i*³C Lite controller with onboard Ethernet port.

7.3 Ethernet Module Specifications

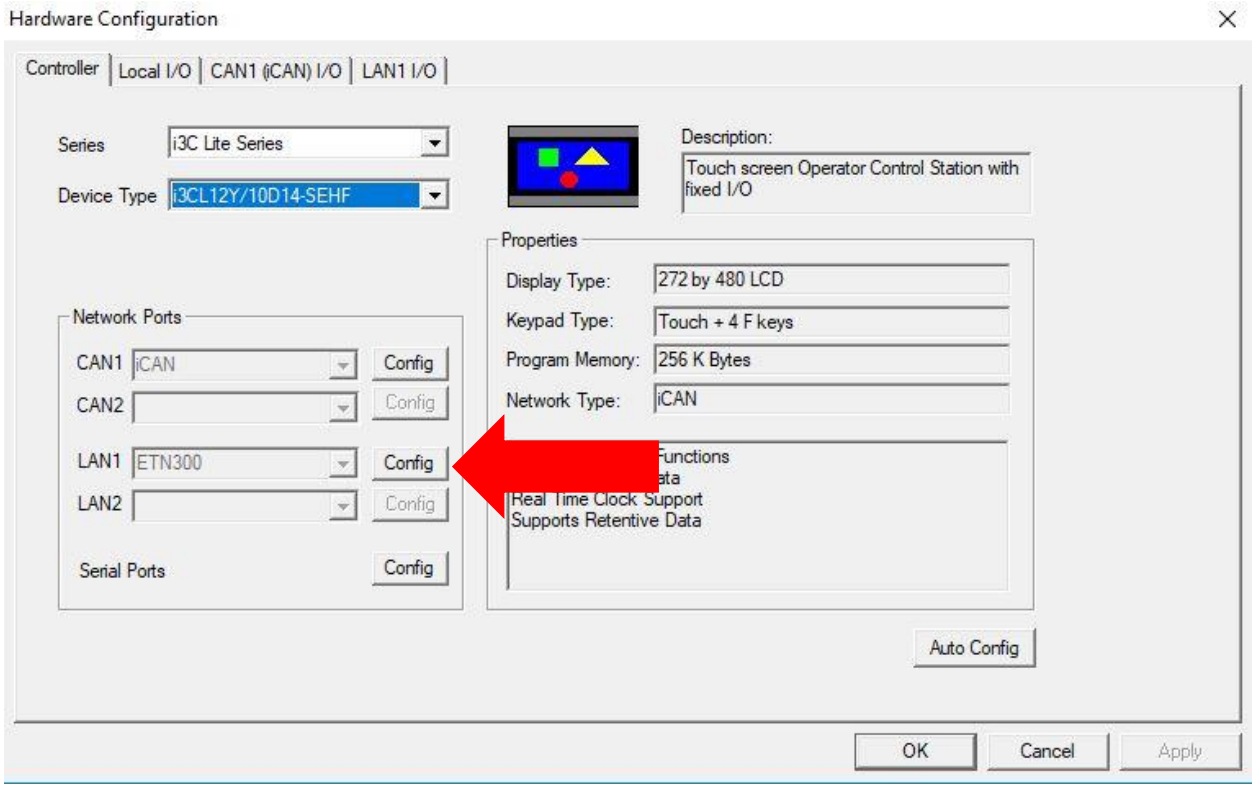
Table 7.2 – Ethernet Module Specifications	
Speeds	10 BaseT Ethernet (10Mbps) 100 BaseTx Fast Ethernet (100Mbps)
Modes	Half or Full Duplex
Auto-Negotiation	Both 10/100Mbps and Half/Full Duplex
Connector Type	Shielded RJ-45
Cable Type *(Recommended)*	CAT5 (or better) UTP
Port	Auto MDI/MDI-X (Auto Crossover)

7.4 Ethernet Module Configuration

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

To configure the Ethernet Module, use *i*³ Config Programming Software to perform the following steps:

1. On the main *i*³ Config screen, select the **Controller** menu and its **Hardware Configuration** sub-menu to open the Hardware Configuration dialog (Figure 8.1).
2. If configuring a different *i*³ Model than the one shown in the **Hardware Configuration** dialog, click on the topmost **Config** button, select the desired *i*³ Model, and then click **OK.**



3. Click the **Config** button to the right of LAN1, revealing the Ethernet Module Configuration dialog as shown in Figure 7.1

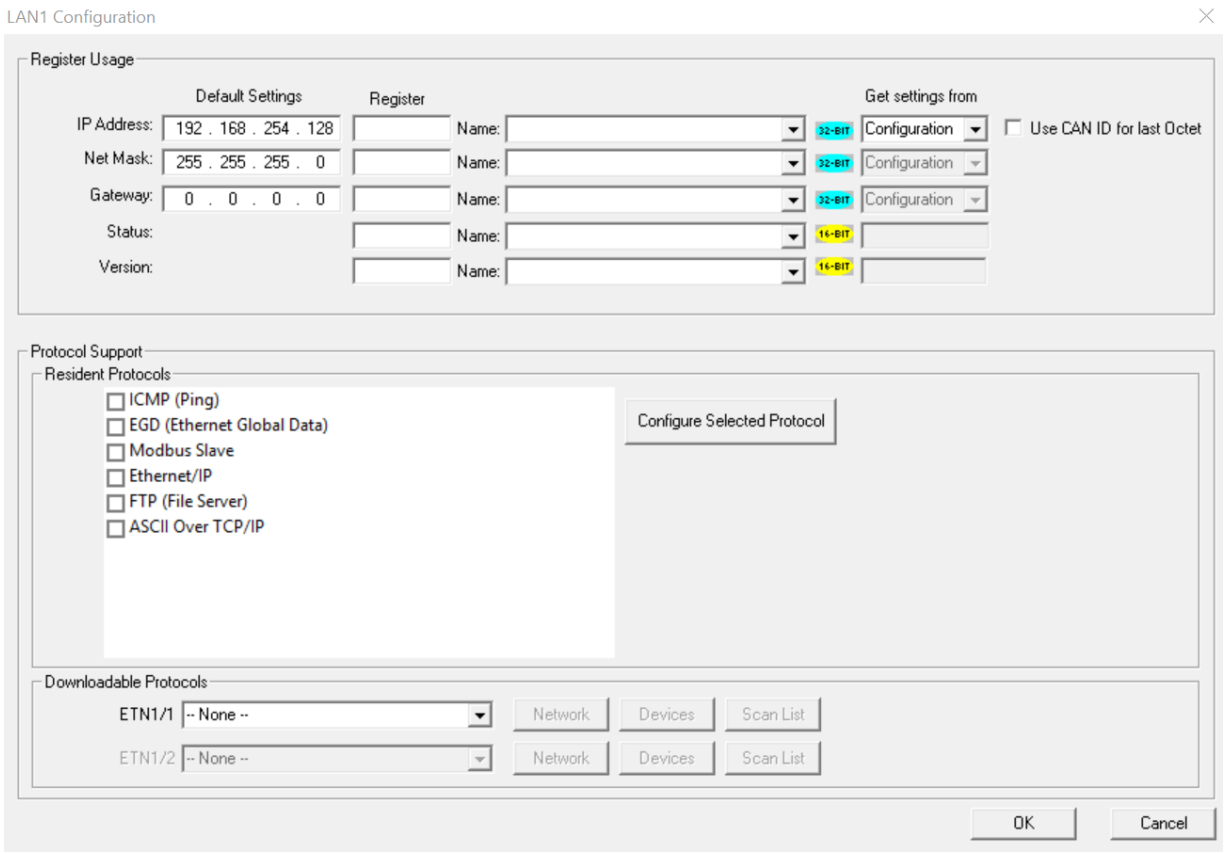


Figure 7.1 – Ethernet Module Configuration

Configure the Ethernet Module parameters as follows:

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

NOTE: IP Addresses are entered as four numbers, each ranging from 0 to 255. These four numbers are called octets and they are always separated by decimal points.

Net Mask: Enter the Net Mask (sometimes called Subnet Mask) being used by all nodes on the local network. Typical local networks use Class C IP Addresses, in which case the low octet (rightmost number) is used to uniquely identify each node on the local network. In this case, the default Net Mask value of 255.255.255.0 should be used.

Gateway: Enter the IP Address of a Gateway Server on the local network that allows for communication outside of the local network. To prevent the Ethernet Module from communicating outside the local network, set the Default Gateway IP Address to 0.0.0.0 (the default setting).

Status Register: Enter an *i*³ Register reference (such as %R100) to indicate which 16-bit *i*³ register will have the Ethernet Status word written to it. Table 7.3 shows how this register value is formatted and explains the meaning of each bit in the Status Word.

Table 8.3 - Ethernet Status Word Register Format

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

Status Bit(s)	Status Indication	Status Values	
		Minimum	**Maximum**
0	Reserved	Always 0	
Dup	Link Duplex (Auto-Negotiated)	0 = Half Duplex	1 = Full Duplex
Spd	Link Speed (Auto-Negotiated)	0 = 10MHz	1 = 100MHz
Rx	Receive State	0 = Inactive	1 = Active
Tx	Transmit State	0 = Inactive	1 = Active
Link	Link State	0 = Down	1 = Up
TCP Connections	Total Number of Active TCP Connections (ICAN, Modbus, EIP, FTP)	0	40

Version Register: Enter an *i*³ Register reference (such as %R101) to indicate which 16-bit I³ register will have the Ethernet Firmware Version written to it. The value stored in the Version Register is (Ethernet Firmware Version * 100). For example, for Ethernet Firmware Version 4.30, the Version register will contain 430.

Get Settings From:
"Get settings from" allows the programmer to either configure the IP Address, Net Mask, or Gateway for two functions: Configuration or Register.

1. Configuration – The configuration for the IP Address, Net Mask, or the Gateway will be assigned using the value in the Default Settings in this window.

2. Register – The configuration for the IP Address, Net Mask, or the Gateway will be assigned using the values in the registers assigned.

7.5 Ethernet Configuration – IP Parameters

For primary operation, the IP address, Net Mask, and Gateway should be set in the LAN config of the **I³ Config Hardware Configuration**. There are options to get IP parameters from the LAN Config or to get parameters from registers. It is possible to set the Ethernet IP parameters from the I³ System Menu, but only as a temporary measure. The following points on IP parameter configuration should be considered.

- **IP Parameters in Non-Volatile RAM:** The IP parameters of the I³ Config LAN Config are written to non-volatile RAM on power down. IP parameter settings made in the System Menu are not written to non-volatile RAM. Any IP parameters settings made in the system menu will be lost after cycling power to the unit. It will revert back to the last downloaded I³ Config LAN Config that was loaded into non-volatile RAM at power down.

- **"I³ Config LAN Config"/ "Get Settings from" Configuration**: When 'Get settings from' is set to Configuration, the IP parameters specified under 'Default Settings' is used after downloading to the controller. The IP parameters are represented in System Menu / Set Networks and can be edited. However, any edits made from System Menu / Set Networks is not retained through a power cycle. After power cycle, the unit reverts to the last downloaded I³ Config LAN Config that was loaded into non-volatile RAM at power down.

- **"I³ Config LAN Config" / "Get Settings from" Register**: When 'Get settings from' is set to Register, the IP parameters are retrieved from the I³ registers assigned in LAN Config. Configured registers must be populated with the desired IP parameters.
  The IP parameters are represented in System Menu / Set Networks.
  The IP parameters cannot be edited from System Menu / Set Networks while the unit is in run mode.
  The IP parameters always follow the values in the registers unless the I³ unit is placed in idle mode. Then the IP parameters can be edited in System Menu / Set Networks. When the I³ is placed back into run mode, it reverts to the registers for IP parameters.

7.6 Ethernet Module Protocol Configuration

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

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

For detailed information on individual protocol configuration refer to the latest version of the ETN 300 Manual **SUP0740.**

CHAPTER 8: DOWNLOADABLE COMMUNICATION PROTOCOLS

8.1 Overview

Through loadable protocol device drivers, certain models of the *i*³ family can provide the ability to exchange data with remote devices such as variable-frequency drives, PLCs, and remote I/O devices. This feature greatly expands the *i*³ 's control capability with negligible effect on the *i*³ 's ladder scan time.

Remote devices that communicate serially must do so under certain rules of data transfer known as a protocol. Many device manufactures have created their own protocol for communications with their device. For an *i*³ to communicate with a specific device, it must be loaded with the corresponding serial communications protocol device driver that supports that protocol.

A limited number of protocol device drivers are packaged with the *i*³ Config distribution; however, as more are developed, they will be made available as add-on packages. A device driver is typically distributed as a Windows module, which contains the Configuration Menus, Help Files and the Target Executable Driver Code. When updating device drivers, an install routine loads the device driver to the *i*³ Config directory structure and makes that driver available to *i*³ Config applications.

Once installed, the protocol device driver can be included as part of a *i*³ Config application by selecting it from a list of installed protocol device drivers and attaching it to the desired serial port (Program > Protocol Config menu). Only one protocol device driver can be associated with a serial port, though some I³ models support multiple protocols on a single Ethernet port.

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

Once the network is configured, each device on the serial communications network must be configured. For some communications (i.e. RS232), the network can be limited to one device. The devices are configured under the **Device Config** menu, which contains an arbitrary device name, the device ID and optionally an *i*³ status register that contains any device fault information.

Once each device(s) is configured, a **Scan List** of entries must be created which defines the transfer of data between a local (*i*³) register(s) and a remote device register(s). These entries are created under the **Data Mapping** menu, which contains an *i*³ register, a target device ID, a target device register address, the number of registers to transfer, and update type.

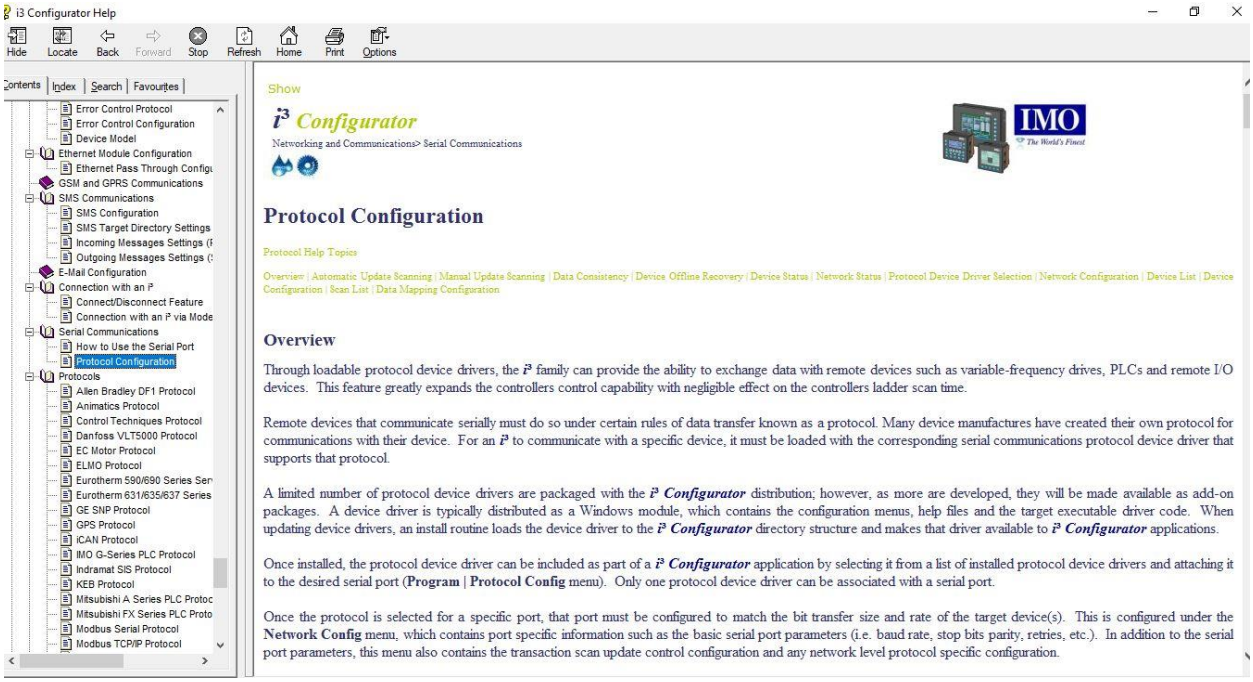
Each entry can be configured for one of two types of initiating a transaction: **Polled and Triggered.** Polled type entries initiate a transaction with the remote device on every transaction scan. Triggered type entries only initiate a transaction when a corresponding local (*i*³) binary trigger register is *set*. Once a triggered type transaction completes, the protocol device driver *resets* the local (*i*³) binary register to indicate completion. See Section 8.5 for more details on Polled and Triggered entries.

These basic types are also subdivided into Read or Write operations. For polled operations, a Read operation only reads from a remote device. Likewise, a Read/Write operation continuously reads from the remote device unless the target *i*³ register value changes from one ladder scan to another.

In this case, the new *i*³ value is written to the target device. For triggered operations, only a Read or Write action is available.

When downloaded to the *i*³ , the Scan List is scanned sequentially to generate data transactions with the remote device. This transaction scanning can be on a continual basis (**automatic**) or controlled from ladder logic (**manual**) once a complex connection is programmatically created (i.e., dialup modem). The specific transaction-scanning mode is selected from the **Network Config** menu.

Please refer to the *i*³ Config Help file for more information on Downloadable Protocols Configuration. After opening the *i*³ Config Help file, select **Contents → Networking and Communications → Protocol Configuration.**



8.2 Protocol Config

After opening I³ Config, choose **Program → Protocol Config**, and select the port drop-down box to select a protocol device driver. All protocol device drivers currently loaded in *i*³ Config are displayed in the dropdown selection. Some *i*³ models can be limited in the number of ports or number of protocol device drivers that can be selected. Once a protocol is selected, the Network, Devices, and Data (Scan List) must be configured through corresponding dialogs accessible through the respective buttons (Network, Device, and Scan List).

NOTE: If the MJ1 port is to be used in the Protocol Config, it will no longer be available for *i*³ Config programming unless the controller is put into IDLE mode.

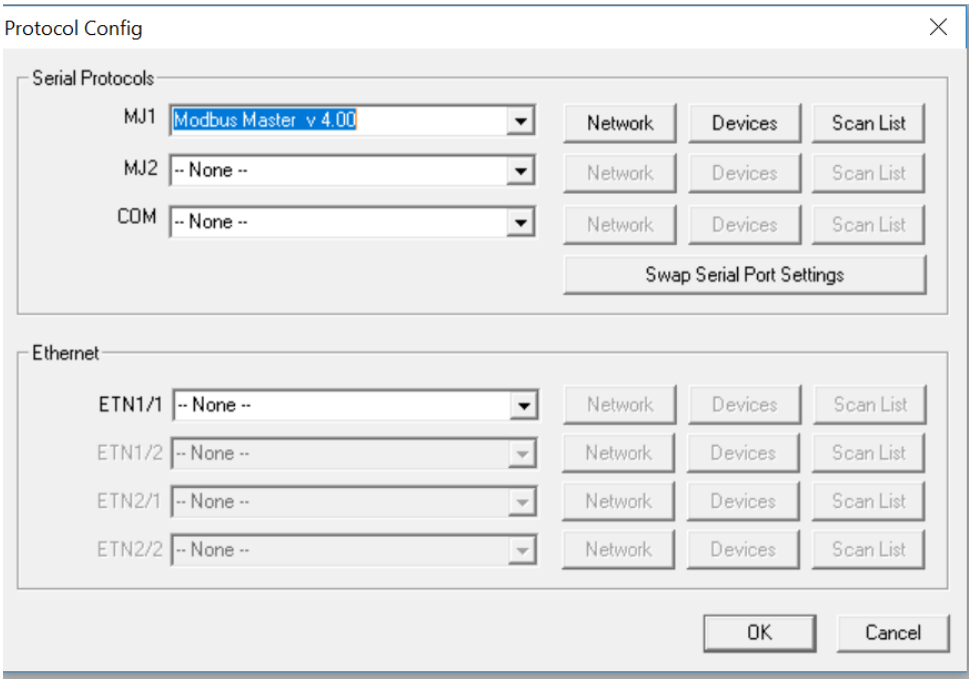
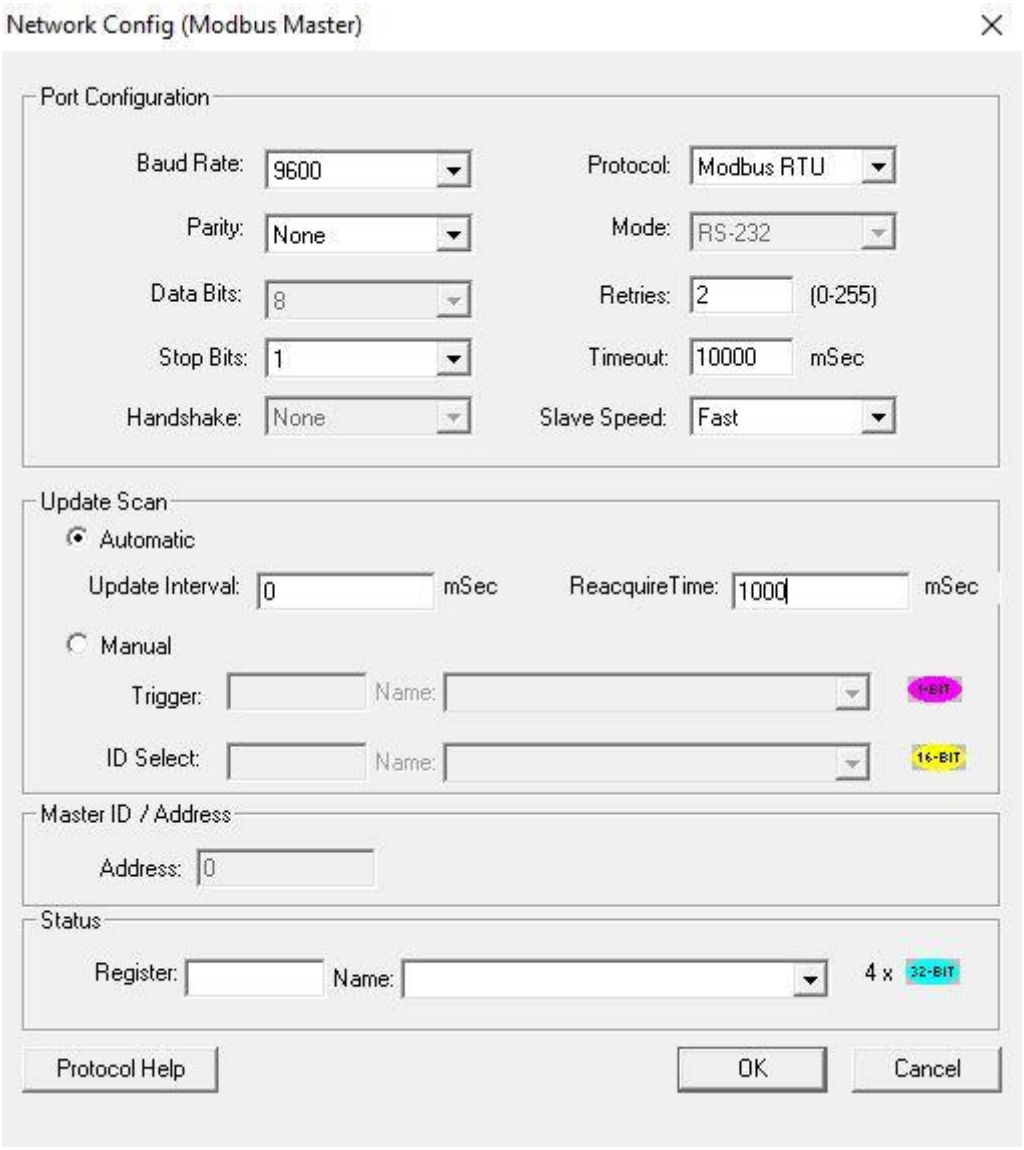


Figure 8.1 – Protocol Config Dialog

Three fields must be configured after a protocol is selected:

1. Network
2. Devices
3. Scan List

8.3 Network Configuration

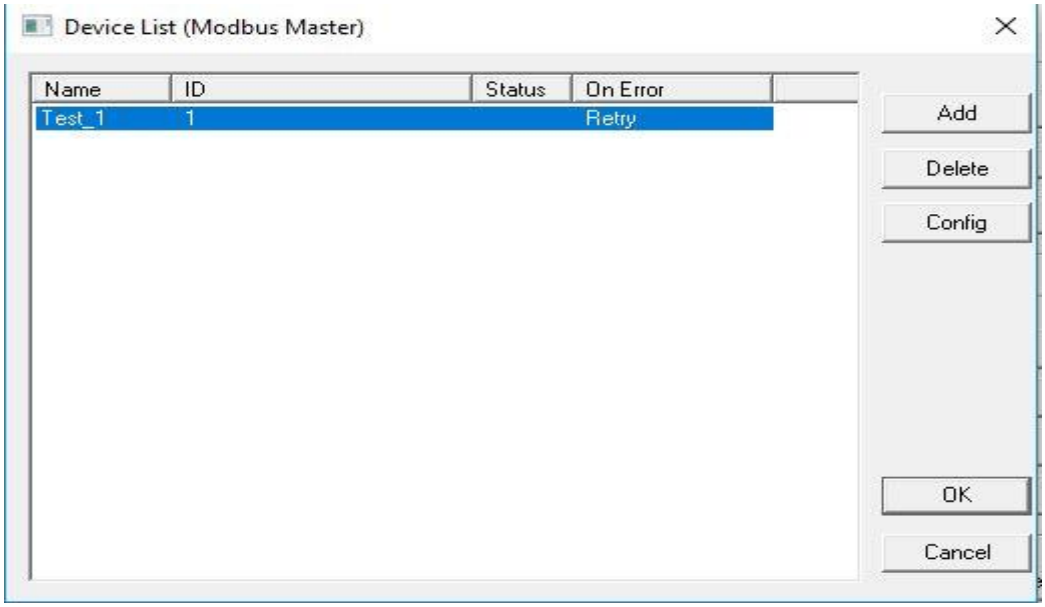


Network Configuration provides the required parameters to configure the network. Each protocol is different and may not require all the Network Config field. Please refer to the table below for the options in the Network Config field.

Table 8.1 – Network Protocols		
Baud Rate, Data Bits, Stop Bits, Parity	These field define the bit level transfer over the serial port.	
Handshake	**None** – No handshake lines are used **Multidrop Full** – Rx remains active while Tx is occurring. **Multidrop Half** – Rx is shut off while Tx is occurring. **Radio Modem** – Wait for CTS acknowledgement before transmitting (legacy radio modem support).	
Protocol	If a driver supports multiple protocols, it is selected here, (i.e. Modbus supports RTU or ANSI).	
Mode	Specifies if port operates in RS232 or RS485 mode.	
Retries	Specifies number of times a transaction is retried on a failed response.	
Timeout	Specifies the amount of time for a device to wait for a valid response.	
Update Scan	**Automatic**	**Update Interval** – Specifies the update interval at which all the mapped entries are executed.
		Reacquire Time – Specifies the amount of time to wait before attempting communications with an offline device.
	Manual	**Trigger** – Specifies the binary register that a single transaction scan of the Scan List.
		ID Select – If an analog is specified in the field, the ID Select filter is enabled.
Status Register	Specifies the starting I³ register of eight (8) consecutive registers (4-32bit counters), which provide an indication of the network health.	
Scanner Address	Specifies the I³'s device (network) ID if a master ID is required by the protocol.	
Protocol Help	Provides protocol specific help.	

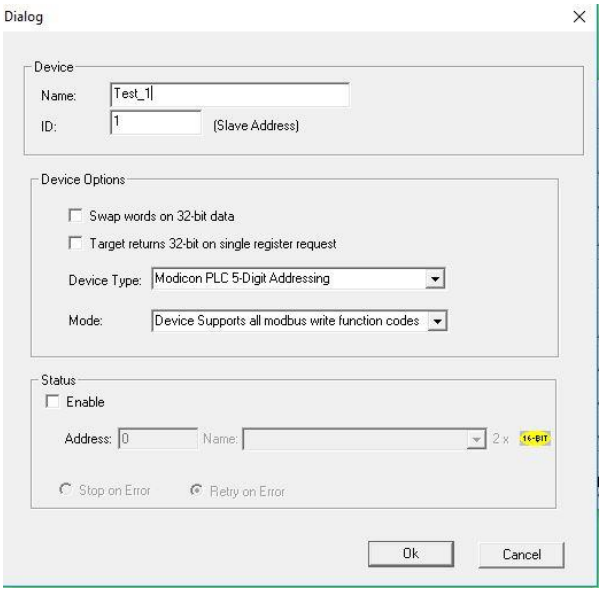
8.4 Device List and Device Configuration

Device List



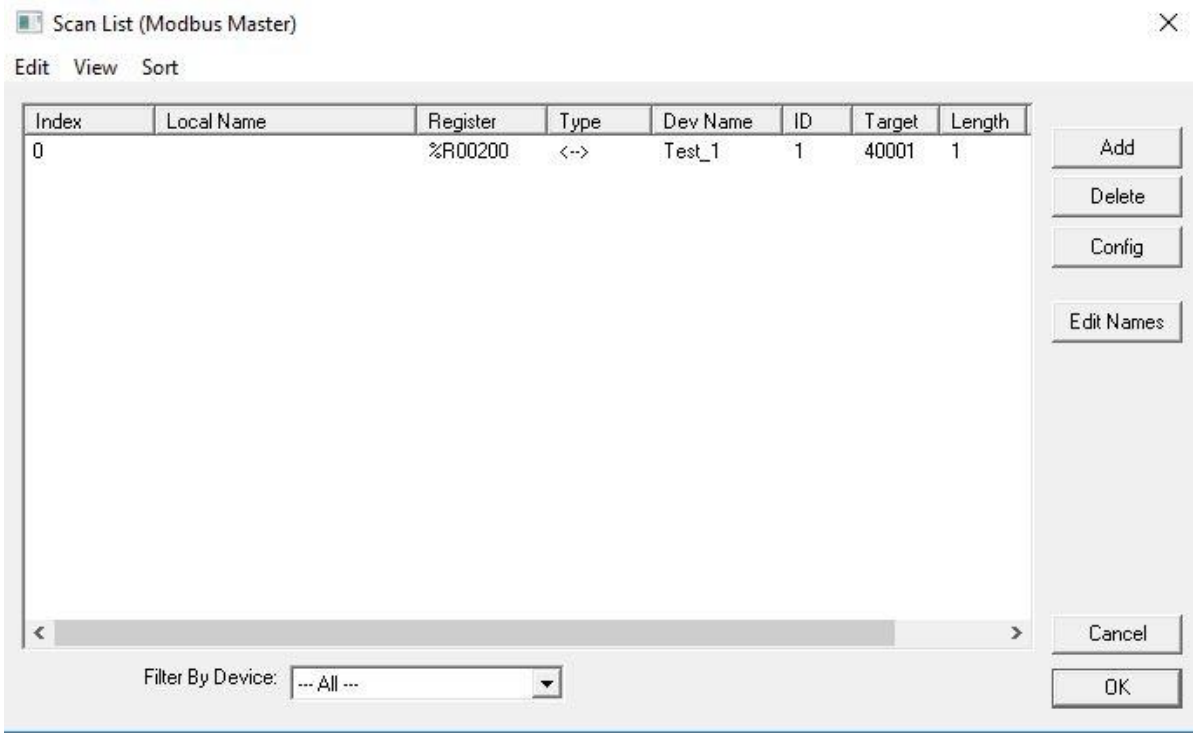
The Device List is reached from the Device button on the Protocol Config screen and provides a list of the configured devices on the Network. Devices must be created and exist in this list before corresponding Scan List entries can be created for this device. Typically, the number of entries is limited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

Device Configuration



This configuration is reached from the Device List when adding or modifying an existing device.

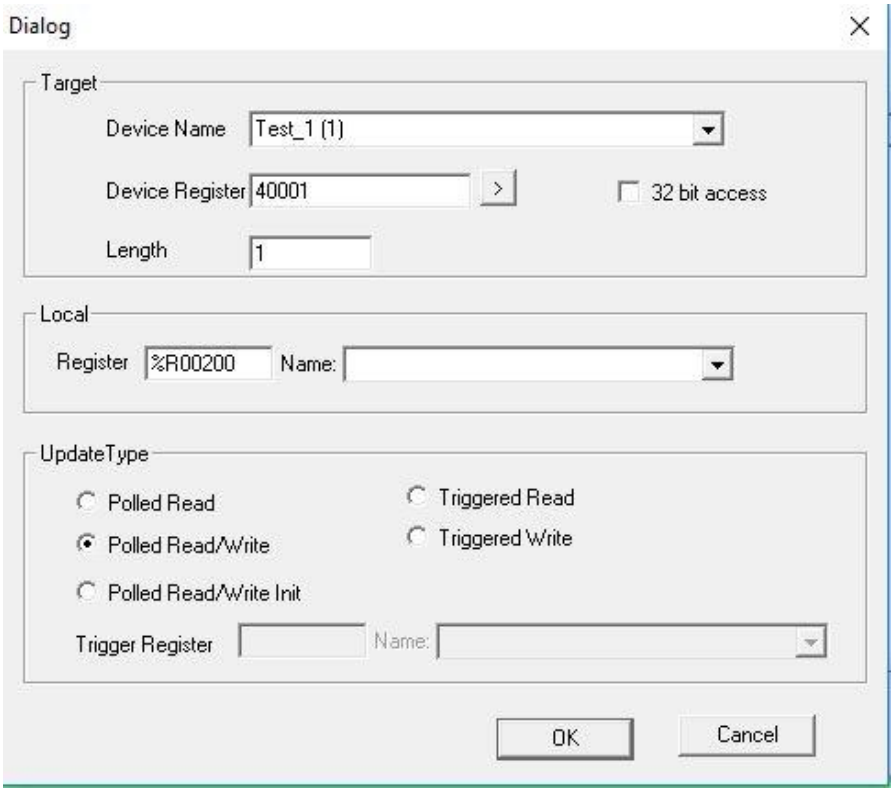
8.5 Scan List



This can be accessed from the Scan List button on the Protocol Config screen or the Mapping button on the Device List screen and provides a Scan List of the Data Mapping entries. To transfer data between the I³ and remote target, a Scan List must be created that defines each transaction. Each mapping entry (transaction) contains the source and destination registers, the number of consecutive registers transferred, the direction of the transfer and what triggers the transfer. Typically, the number of entries is **limited to 512**.

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

8.6 Data Mapping Configuration (Scan List Entry)



Update Type

This field specifies the direction and what triggers the transfer of data between the *i*³ and target device for a mapping entry.

Polled Read

On every transaction scan, a read-only target device register(s) transaction occurs.

Polled Read/Write

On every transaction scan, a read target device register transaction occurs unless a local register value has changed. The write transaction only updates those local registers that have changed in value. If several non-consecutive local registers (contained in a single mapping entry) change value between transaction scans, it takes several consecutive transaction scans to write each changed register.

When the I³ is placed in RUN mode, **the initial action for this mapping type is a read target register transaction.** This transaction initializes the local (*i*³) register(s) to match that of the remote device register(s). Thereafter, any change to the corresponding *i*³ register(s) triggers a write operation to the remote device.

Polled Read/Write/Init

On every transaction scan, a read target device register transaction occurs unless a local register value has changed. The write transaction only updates those local registers that have changed in value. If several non-consecutive local registers (contained in a single mapping entry) change value between transaction scans, it takes several consecutive scans to write each changed register.

When the *i*³ is placed in RUN mode, **the initial action for this mapping type is a write target register transaction.** This transaction initializes the target device register(s) to match that of the local (*i*³) register(s). Thereafter, any change to the corresponding I³ register(s) triggers a write operation to the remote device.

The initial write transaction does not occur until after the first logic scan of the *i*³. This allows registers to be initialized locally before Writing to the target device register(s).

Triggered Read

A read transaction is triggered by a high level on a separately designated *i*³ (binary) trigger register. Once the read transaction is complete (or the device is offline), the i³ trigger register is cleared by the *i*³. This update type can be used for occasion data accesses such as retrieving trend data.

NOTE: This operation increases the associated transaction scan time and can cause the **Update Interval Exceeded Counter** to increment on a tightly adjusted update interval.

Triggered Write

A write transaction is triggered by a high level on a separately designated *i* ³ (binary) trigger register. Once the write transaction is complete (or the device is offline), the I³ trigger register is cleared by *i*³. This function can be used for occasion data accesses such as sending recipe data.

NOTE: This operation increases the associated transaction scan time and can cause the **Update Interval Time Exceeded Counter** to increment on a tightly adjusted update interval.

CHAPTER 9: SYSTEM SETTING AND ADJUSTMENTS

9.1 System Menu - Overview

The *i*³C Lite controller has a built-in System Menu, which lets the user view System Settings and make adjustments. To start the System Menu, press the upper right corner of the touchscreen to bring out the function keys, then press the SYSTEM key (or set %SR3 to 1), which will display the Main Menu. Then use the ↓ and ↑ keys to select a **Main Menu** item and press **Enter** (Return Arrow) to display the item's Sub-Menu.

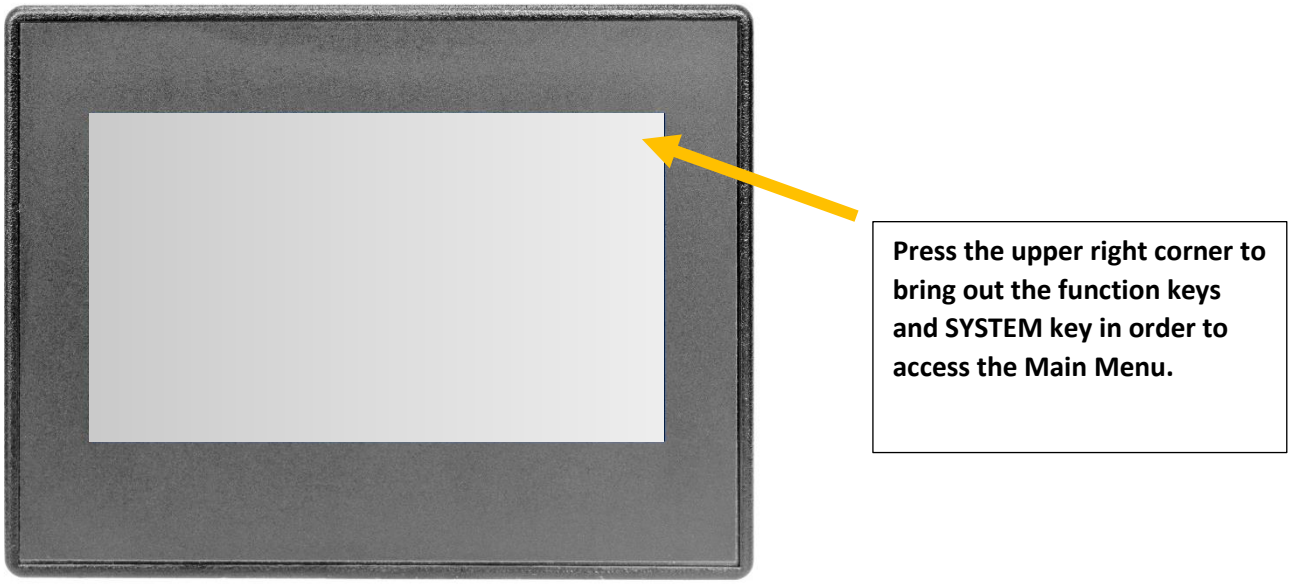
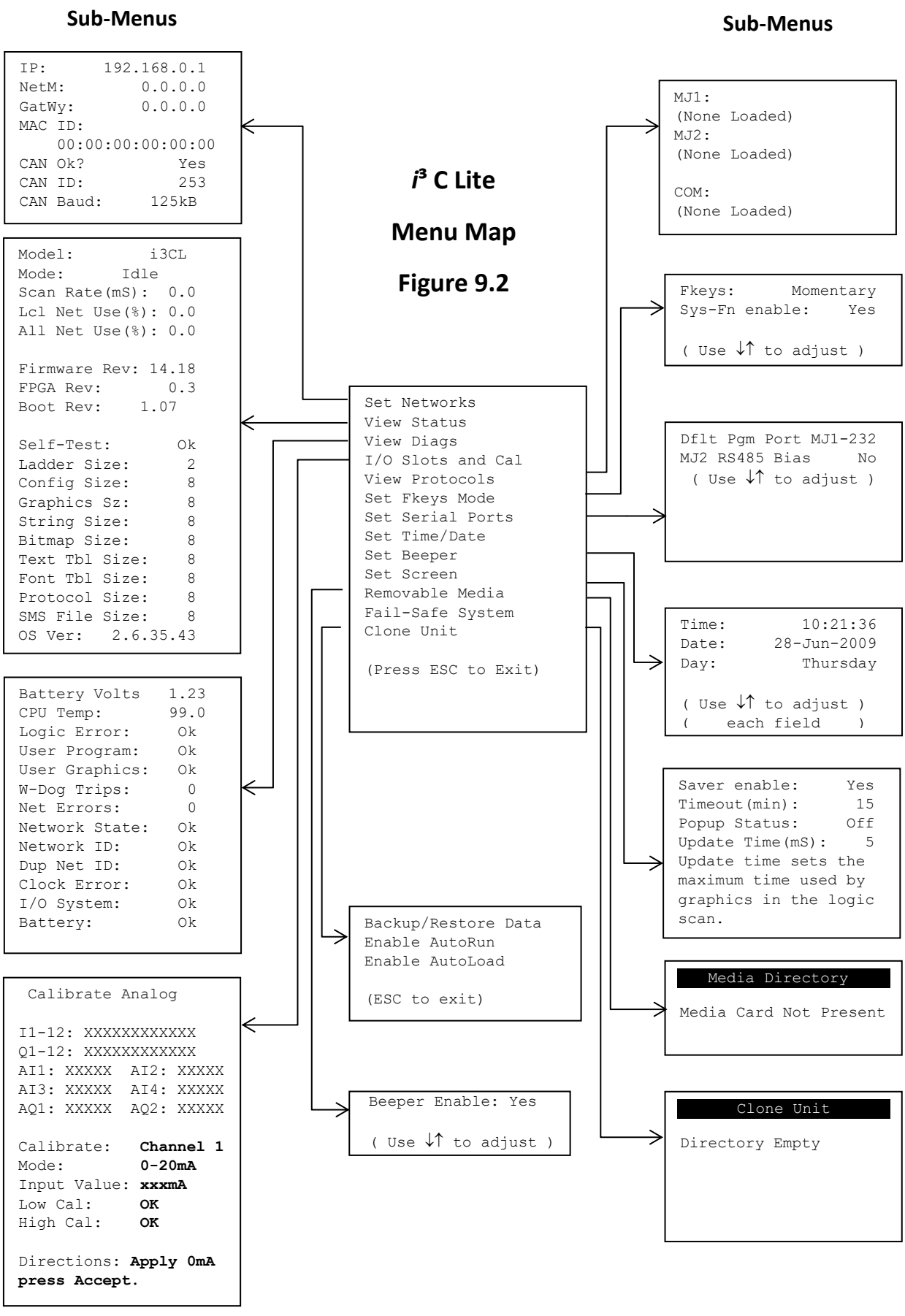
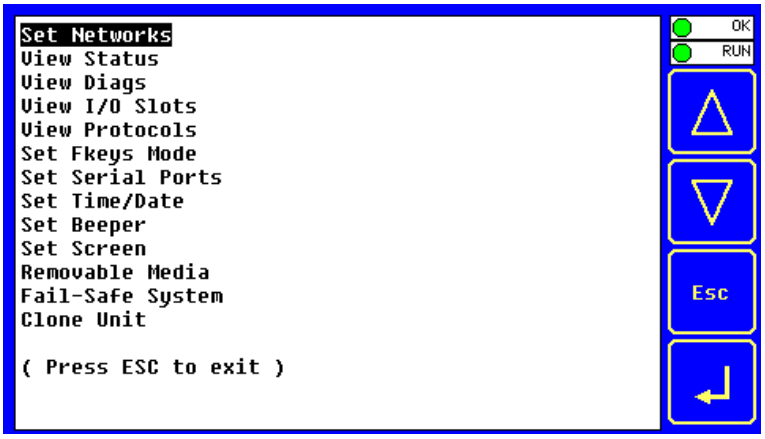


Figure 9.1—Opening System Menu


Sub-Menus
Sub-Menus
i³ C Lite
Menu Map
Figure 9.2
IP: 192.168.0.1
NetM: 0.0.0.0
GatWy: 0.0.0.0
MAC ID:
00:00:00:00:00:00
CAN Ok? Yes
CAN ID: 253
CAN Baud: 125kB
Model: i3CL
Mode: Idle
Scan Rate(mS): 0.0
Lcl Net Use(%): 0.0
All Net Use(%): 0.0
Firmware Rev: 14.18
FPGA Rev: 0.3
Boot Rev: 1.07
Self-Test: Ok
Ladder Size: 2
Config Size: 8
Graphics Sz: 8
String Size: 8
Bitmap Size: 8
Text Tbl Size: 8
Font Tbl Size: 8
Protocol Size: 8
SMS File Size: 8
OS Ver: 2.6.35.43
Battery Volts 1.23
CPU Temp: 99.0
Logic Error: Ok
User Program: Ok
User Graphics: Ok
W-Dog Trips: 0
Net Errors: 0
Network State: Ok
Network ID: Ok
Dup Net ID: Ok
Clock Error: Ok
I/O System: Ok
Battery: Ok
Calibrate Analog
I1-12: XXXXXXXXXXXX
Q1-12: XXXXXXXXXXXX
AI1: XXXXX AI2: XXXXX
AI3: XXXXX AI4: XXXXX
AQ1: XXXXX AQ2: XXXXX
Calibrate: Channel 1
Mode: 0-20mA
Input Value: xxxmA
Low Cal: OK
High Cal: OK
Directions: Apply 0mA
press Accept.
Set Networks
View Status
View Diags
I/O Slots and Cal
View Protocols
Set Fkeys Mode
Set Serial Ports
Set Time/Date
Set Beeper
Set Screen
Removable Media
Fail-Safe System
Clone Unit
(Press ESC to Exit)
Backup/Restore Data
Enable AutoRun
Enable AutoLoad
(ESC to exit)
Beeper Enable: Yes
(Use ↓↑ to adjust)
MJ1:
(None Loaded)
MJ2:
(None Loaded)
COM:
(None Loaded)
Fkeys: Momentary
Sys-Fn enable: Yes
(Use ↓↑ to adjust)
Dflt Pgm Port MJ1-232
MJ2 RS485 Bias No
(Use ↓↑ to adjust)
Time: 10:21:36
Date: 28-Jun-2009
Day: Thursday
(Use ↓↑ to adjust)
(each field)
Saver enable: Yes
Timeout(min): 15
Popup Status: Off
Update Time(mS): 5
Update time sets the
maximum time used by
graphics in the logic
scan.
Media Directory
Media Card Not Present
Clone Unit
Directory Empty



9.2 System Menu – Navigation and Editing

As mentioned above, the System Menu is started by pressing the System key on the *i*³C Lite. Then, either press ESC to exit the System Menu, or use the ↓ and ↑ keys to select an item and press **Enter** to display the item's Sub-Menu.

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

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

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

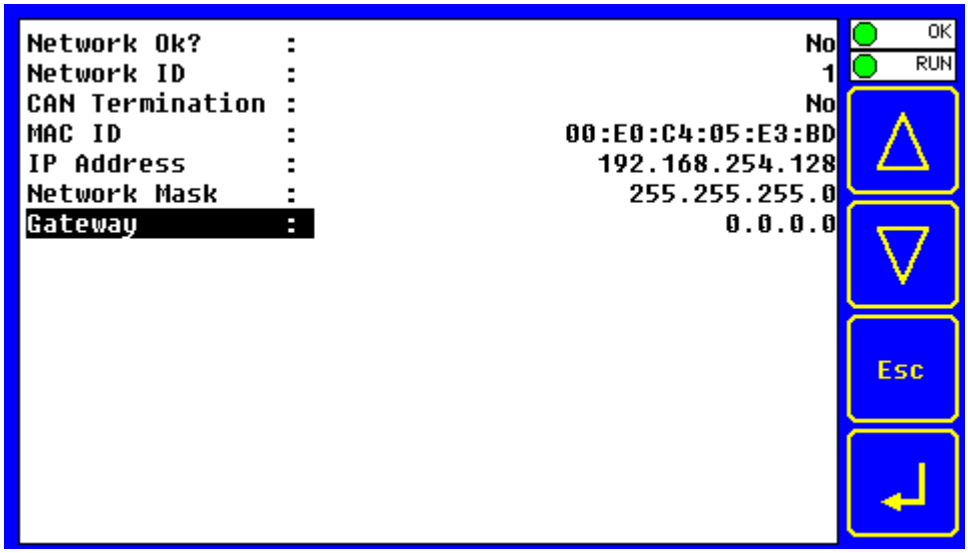
The arrow keys are used to edit System Settings that have just a few possible values. Each time the arrow key is pressed, a new possible value is displayed. When the desired value appears, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

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

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

9.3 System Settings Details

Set Network



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

IP:	Displays the Ethernet IP address of the unit
NetM:	Displays the Ethernet net mask of the unit
GatWy:	Displays the Ethernet gateway of the unit
MAC ID:	Displays the Ethernet MAC ID of the unit
CAN ID:	1 to 253 = This node's ICAN Network ID; must be unique on network
CAN Baud:	125 kB
CAN Ok?	**Yes** = CAN1 connected to a CAN network and functioning properly **No** = Not ready to communicate on CAN network

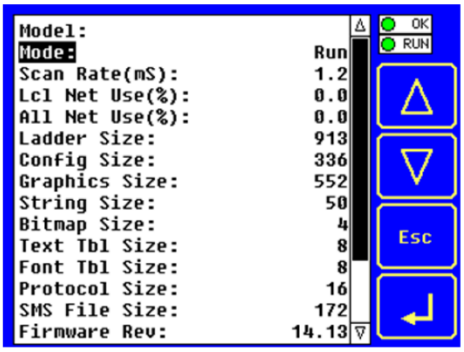
NOTE: The IP address, Net Mask, and Gateway can be changed from the System Menu. This is designed for commissioning or temporary field changes. The actual parameters are defined in *i*³ Config under the Ethernet Configuration.

Set Network Baud

The Network Baud Sub-Menu for both *i*³C Lite models. This sub-menu displays just one System Setting and it is editable

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

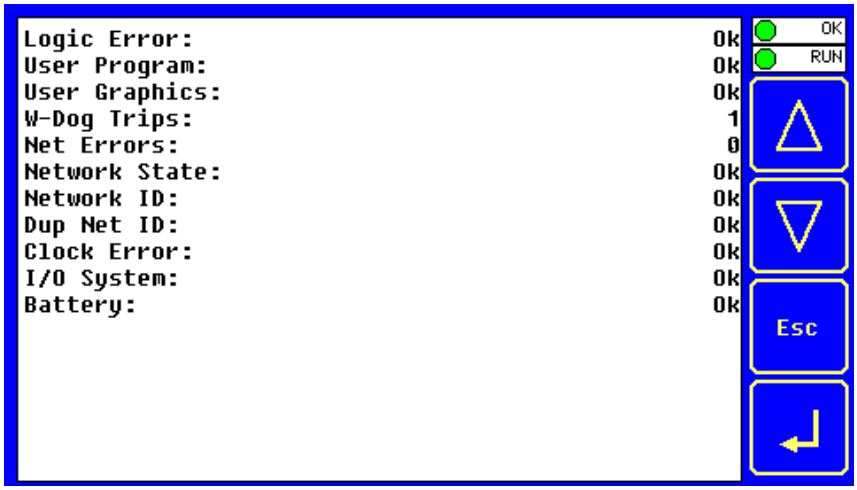
View Status



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

Model:	**Xxyyz** = 5 or 6 character model number of this *i*³C Lite unit **x** is 1 for models that have a CAN port; **0** = no CAN port **yy** indicates the installed I/O module; **00** = no I/O module **z** indicates the installed COM module; **N** = no COM module
Mode:	**Idle** = *i*³C Lite is in Idle mode **DoIO** = *i*³C Lite is in Do I/O mode **Run** = *i*³C Lite is in Run mode
Scan Rate(mS):	**0.0** = *i*³C Lite is not in Run mode **0.1 to 999.9** = Average number of mS for each ladder scan
Lcl Net Use %:	**0.0 to 100.0** = CAN network bandwidth % used by this *i*³C Lite node
All Net Use %:	**0.0 to 100.0** = CAN network bandwidth % used by all nodes
Firmware Rev:	**14.18** (xx.yy of current firmware version)
CPLD Rev:	**0.3** (x.y of current CPLD—Complex Programmable Logic Device)
Boot Rev:	**1.07**
Self-Test	**Ok** = All power-on self-tests passed **Fault** = One or more power-on self-tests failed
Ladder Size:	**2** (Number of bytes in application ladder program)
Config Size:	**8** (Number of bytes in application I/O configuration)
Graphics Sz:	**8** (Number of bytes in application graphic screens)
String Size:	**8** (Number of bytes in application string table)
Bitmap Size:	**8** (Number of bytes in application bitmaps)
Text Size:	**8** (Number of bytes in application text tables)
Font Size:	**8** (Number of bytes in application font tables)
Protocol Sz:	**8** (Number of bytes in application downloaded protocols)
SMS Msg Sz:	**8** (Number of bytes in application SMS protocol configuration)

View Diags



The View Diags Sub-Menu displays up to 11 System Diagnostics, none of which are editable.

The first two System Diagnostics are critical. If either of these indicate a Fault condition, then the *i*³C Lite will not enter or remain in Run mode, and the problem must be investigated and corrected.

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

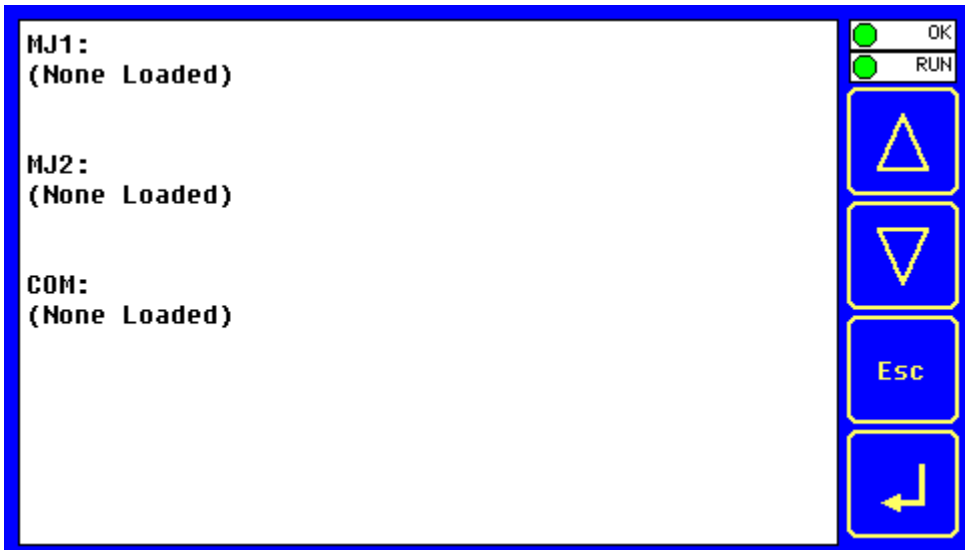
The first five System Diagnostics are critical. If any of them indicate a Fault condition, then the *i*³C Lite will not enter or remain in Run mode, and the problem must be investigated and corrected.

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

The last nine System Diagnostics are informational. If any of them indicate a Warning condition, then the *i*³C Lite can still enter and remain in Run mode, but the problem should be investigated and corrected.

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

View Protocols



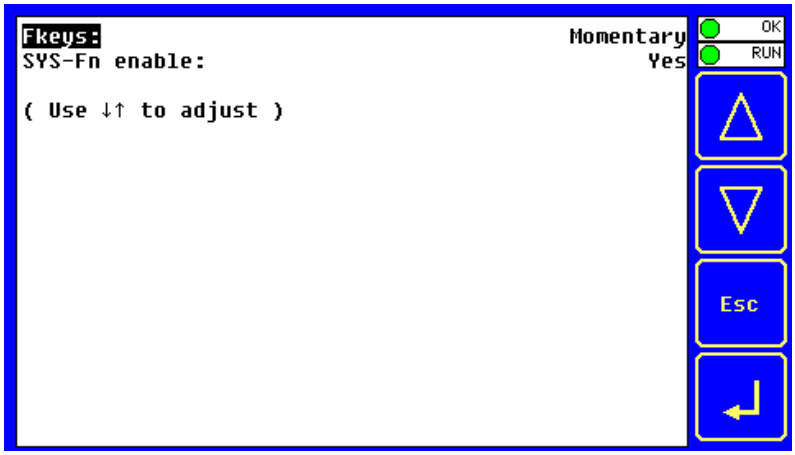
The View Protocols Sub-Menu displays two System Settings, both of which are not editable.

As mentioned in, both the MJ1 (Port 1) and MJ2 (Port 2) serial ports support downloadable protocols. To assign a downloadable protocol to an I³C LITE serial port, select the **Protocol Config** item in I³ Config's Program menu and then setup a protocol for Port 1 or Port 2 (or both).

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

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

Set Fkeys



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

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

Set Serial Ports

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

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

Set Time/Date

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

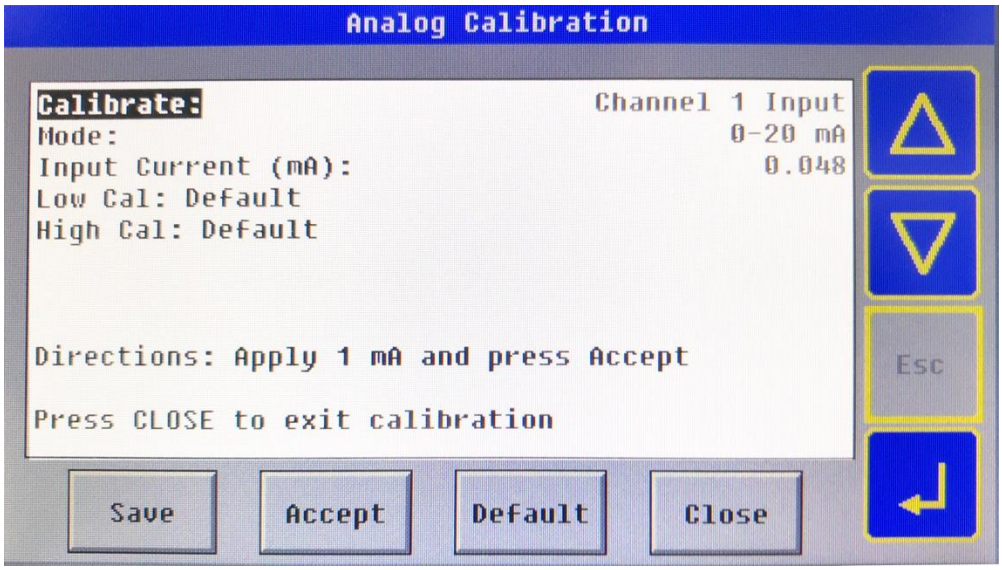
NOTE: Time and **Date** are split into three editable fields each. Use ← or → to select a field and then use ↓ or ↑ to edit the field.

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

NOTE: The *i*³C Lite must be power-cycled (or reset) before the changes take effect.
The *i*³C Lite System Menu contains an "I/O Status and Calibration" selection.

Calibrate Analog

When first entering this option, the user is presenting with information about the *i*³C Lite model and current state of the IO points. See Section 11.7 for more details.

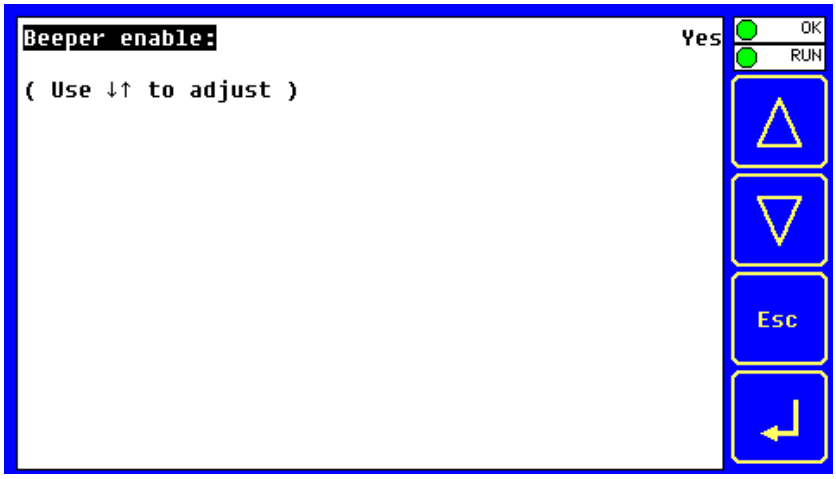



```
Model:      i³CL12Y-***
I12-1:      000000000000
Q12-1:      000000000000
AI1:  12345
AI2:  456
AI3:  789
AI4:  32100
AQ1:        33333
AQ2:        11111
Calibrate Analog
```

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

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

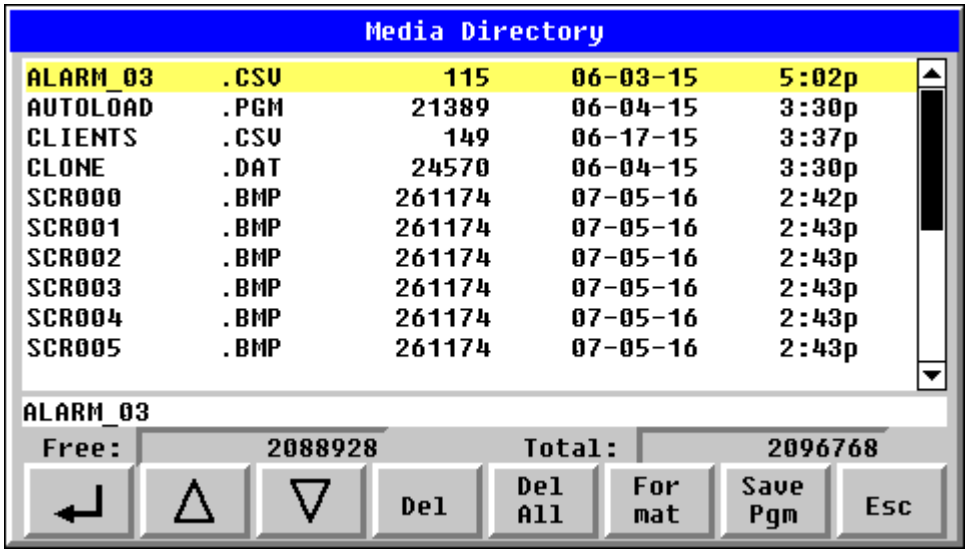
Set Beeper



The Set Beeper Sub-Menu displays one System Setting, which is editable.

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

Removable Media

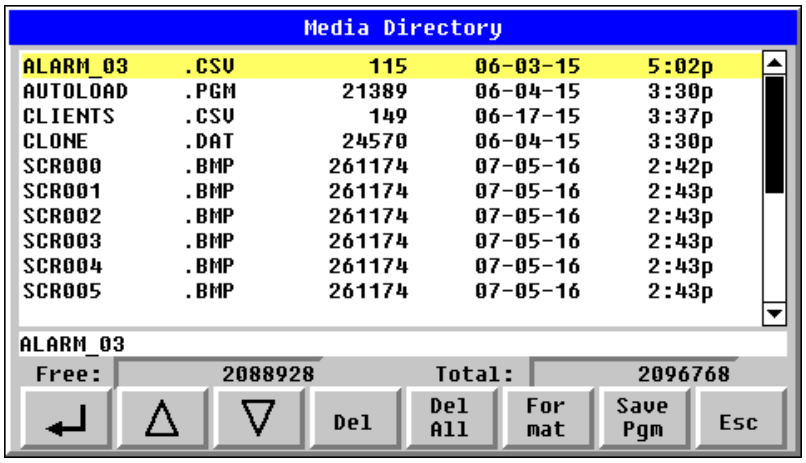


The Set Screen Sub-Menu displays four System Settings, all of which are editable.

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

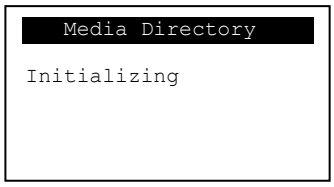
NOTE: The built-in screen saver function will not relight the screen unless the touchscreen is actually touched. There is no automatic re-light of the screen in case of alarms or other conditions that may need to be enunciated on the screen. For these instances, the application code may generate a positive-transition “1-shot” to %SR57.16 (1 bit only) to re-light the screen in case of alarms or other notifications.

Removable Media

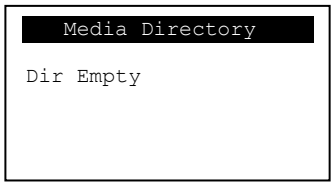


The Removable Media Sub-Menu displays the Removable Media Manager. After selecting Removable Media from the Main Menu, one of four Sub-Menu screens will appear:

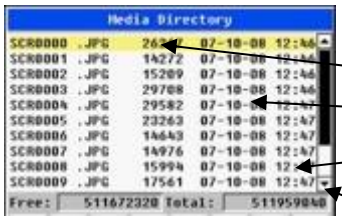
= No microSD card has been installed in the Memory Slot



= microSD card is installed, but it is still initializing



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



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

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

Scrollbar.

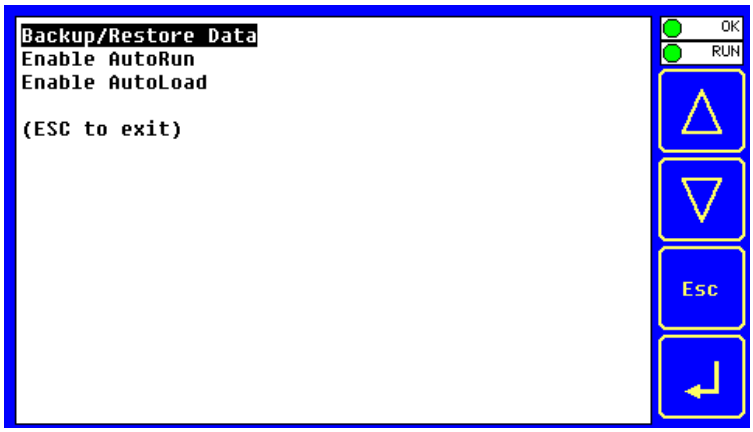
If a directory name is highlighted, pressing **Enter** will switch to that directory showing its files and sub-directories. In a sub-directory, highlighting **..** (dot dot) and pressing **Enter** will move up one directory.

Fail – Safe System

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

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

The fail-safe system can be accessed through the system menu of the controller. A new menu “Fail-Safe System” has been added at the end of the main system menu for this.

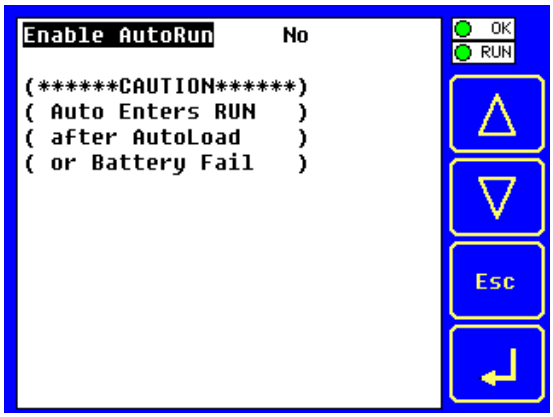


Selecting Backup/Restore Data displays the following screen in:

Backup	= Copies Battery Backed RAM contents on to the onboard flash memory of the I^3.
Restore	= Copies the backed-up data from onboard flash to the battery backed RAM.
Clear Backup	= The backup data will be erased from the onboard flash.
Exit	= Goes back to previous menu

Enable AutoRun

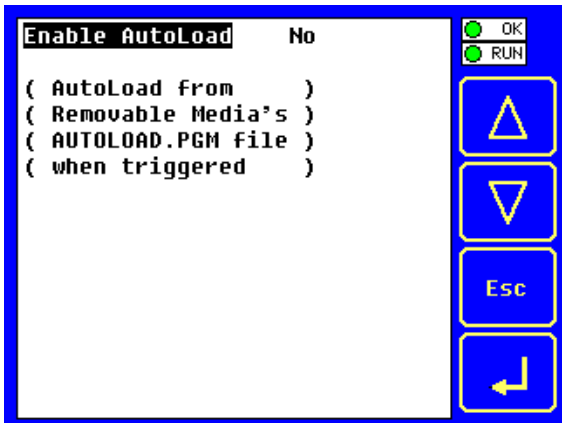
"Enable AutoRun" displays the following options which can be selected:



Enable AutoRun	**No** = *i*³ will be in IDLE mode after AutoLoad or Automatic Restore. **Yes** =*i*³ will automatically be placed into RUN mode after AutoLoad or Automatic Restore.

Enable AutoLoad

"Enable AutoLoad" displays the following options:



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

Clone Unit

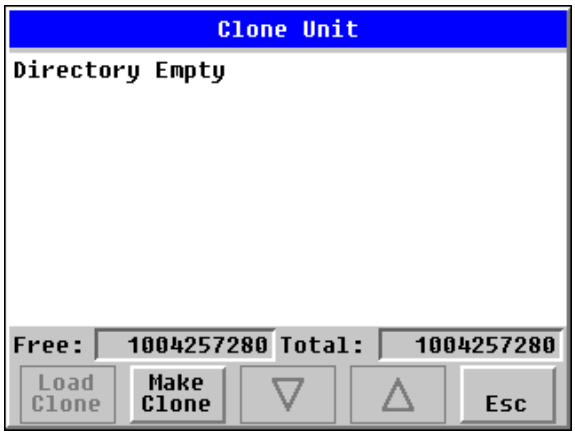
The 'Clone Unit' feature allows the user to "clone" the *i*³ of the exact same model. This feature "clones" application program and unit settings stored in Battery backed RAM of an I³ into the RM (refer Removable Media for details on using RM). It can then be used to clone a different I³ (exact same model).

This feature can be used for:

- Replacing an *i*³ by another unit of the same model.
- Duplicating or "clone" units without a PC.

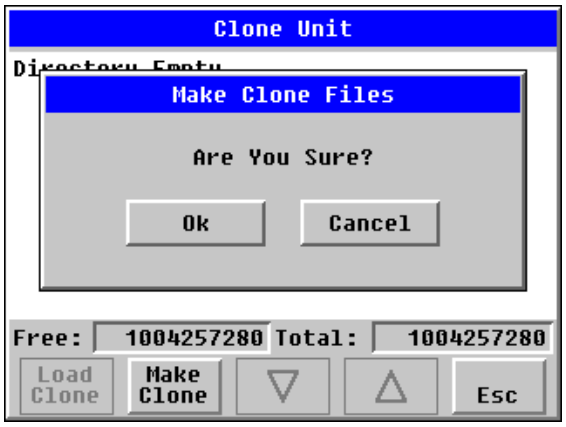
Make Clone

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



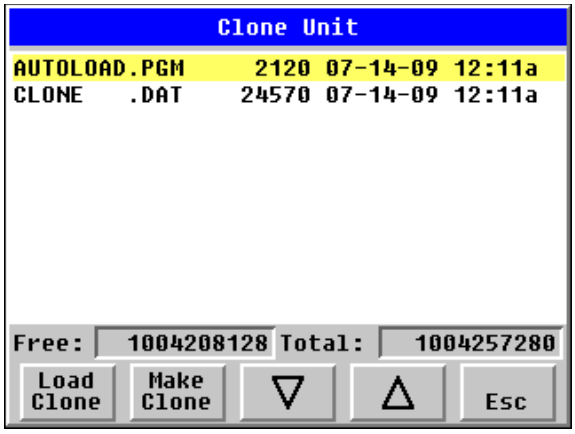
NOTE: Free/Total – displays number of free and total bytes in Removable Media.

Selecting “Create” will open the following screen:



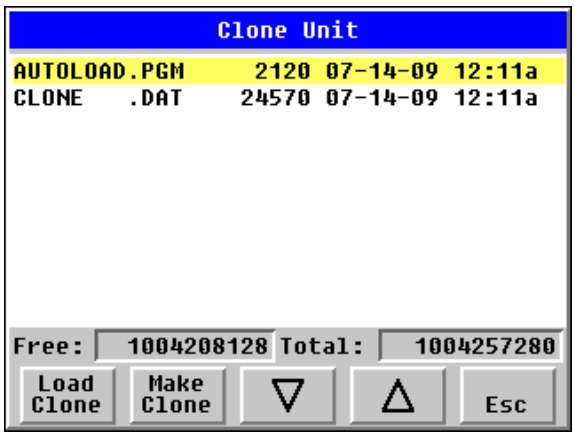
After confirmation, the *i*³ will create two new files in the root directory of the Removable Media Drive as shown below:

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



Load Clone

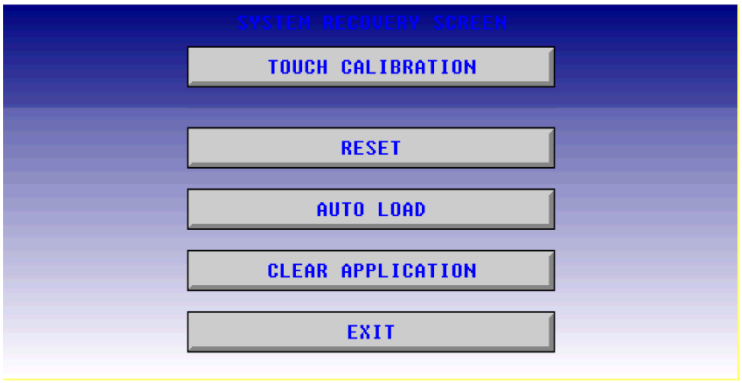
Selecting “Clone Unit” menu will open the following menu screen. Select “Load”.



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

9.4 Touch Screen Calibration

The touch screen is calibrated at the factory and rarely needs modification. However, if actual touch locations do not appear to correspond with responding objects on the display, field adjustment is available. To access the field adjustable touch screen calibration dialog, press the far upper right corner of the touchscreen to bring out the function keys, then press and hold the SYSTEM key for longer than five (5) seconds and a menu with several advanced functions will appear. Select TOUCH CALIBRATION to calibrate the touch screen.



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

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

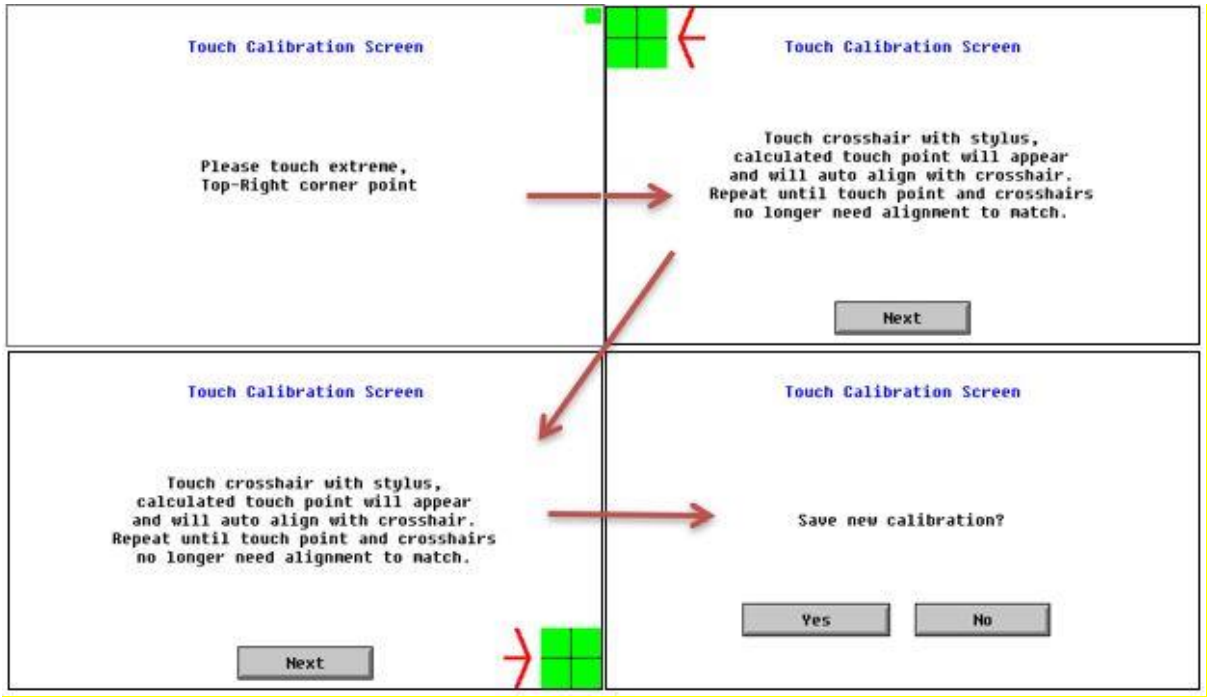


Figure 9.3—Screen Calibration

CHAPTER 10: REMOVABLE MEDIA

10.1 Overview

All *i*³C Lite models provide a Removable Media slot, labeled **Memory**, which supports standard microSD flash memory cards. microSD cards can be used to save and load applications, to capture graphics screens, and to log data for later retrieval.

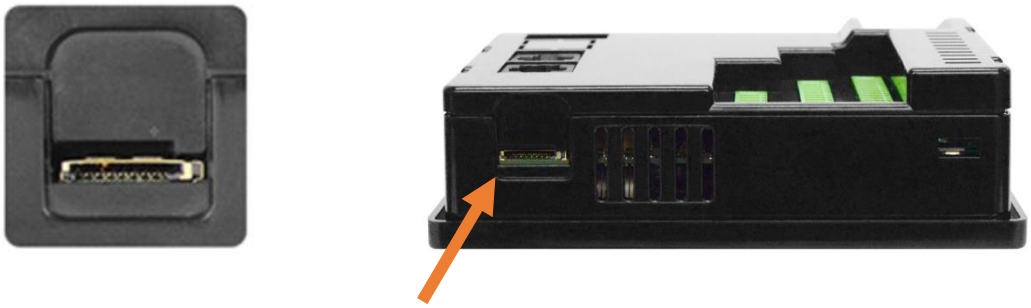


Figure 10.1 – Removable microSD Memory Card Slot

10.2 microSD Cards

The *i*³C Lite Memory slot is equipped with a "push-in, push-out" connector and a microSD card can be safely inserted into the memory card slot when the *i*³C Lite is powered On or Off.

To install a microSD card: Align its 8-pin gold edge connector down, facing the front of the *i*³C Lite; then carefully push it all the way into the memory card slot. Ensure that it clicks into place.

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

Figure 10.2 – Installing Removable Memory Card

10.3 microSD File System

The *i*³C Lite supports displaying files in the 8.3 format, i.e. filename.pgm. Files with up to 8 characters as a file name before the dot and up to 3 characters as a file extension after the dot will display in full on the *i*³C Lite screen. Filenames exceeding the 8.3 format will be truncated.

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

10.4 Using the Removable Media Manager

The Removable Media Manager can be accessed via the System Menu or by using *i*³ Config to place a Removable Media Manager object on an application graphics screen.

The Removable Media Manager is an interactive *i*³C Lite screen that performs the following functions:

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

The Removable Media Manager can be accessed via the System Menu (located on the function key slide-out) or by using I³ Config to place a Removable Media Manager object on an application graphics screen.

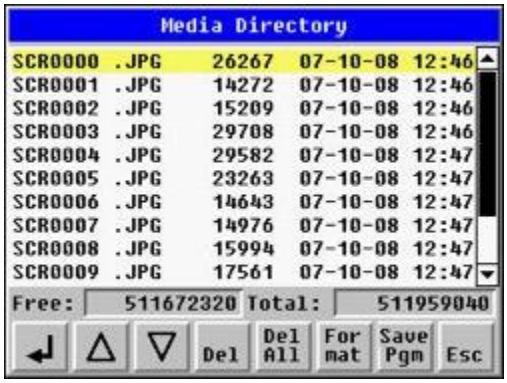


Figure 10.3– Removable Media Submenu

10.5 Using Removable Media to Log Data

Using Read and Write Removable Media function blocks, an application ladder program can read and write *i*³C Lite register data in the form of comma-delimited files, with a .CSV extension. These files are compatible with standard database and spreadsheet PC programs. In addition, an application ladder program can use Rename and Delete Removable Media function blocks to rename and delete files.

10.6 Using Removable Media to Load and Save Applications

A special file type, with a .PGM extension, is used to store *i*³C Lite application programs on microSD. To load an application from microSD to the *i*³C Lite, use the Removable Media Manager to find and highlight the desired .PGM file, and then press the **Enter** key. 

To save an application from the *i*³C Lite to microSD, open the Removable Media Manager in the System Menu and press the Save Pgm 

function key. The application will be saved in a file called **DEFAULT.PGM** in the microSD root directory

NOTE: Saving an application to microSD can only be done from the System Menu and is not available on a Removable Media Manager object that is placed on an application graphics screen by *i*³ Config.

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

*i*³ Config can also save an application directly to a microSD card, which is plugged into the PC's microSD compatible card reader by selecting the Export to Removable Media item on the **File** menu.

10.7 Using Removable Media to View and Capture Screens

The *i*³C Lite File System uses bitmap files with the .BMP extension or JPEG files with the .JPG extension to store *i*³C Lite graphic screen captures.

To view a captured *i*³ screen, use the Removable Media Manager to find and highlight the desired .BMP or .JPG file, and then press Enter. 

To capture an *i*³C Lite screen, turning On the assigned **Screen Capture Control Register** will capture the current I *i*³C Lite graphics screen and write it to the microSD card using the assigned **Screen Capture Filename**.

Before capturing an *i*³C Lite screen, *i*³ Config must first be used to assign a **Screen Capture Control Register** and **Filename** in the application. To do this, first open the Graphics Editor by selecting the **View / Edit Screens** item on the *i*³ Config **Screens** menu. Next, select the **Screen Capture** item of the Graphics Editor Config menu and then enter a **Control Register** and **Filename**.

10.8 Configuration of a Removable Media

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

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

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

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

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

10.9 Removable Media (RM) Features—Program Logic

NOTE: For detailed information regarding RM function blocks and parameters, refer to the help file in I³ Config Software. Refer to "USB Flash Media support for RM Functions" for USB flash drive access details.

The following RM function blocks are available in *i*³ Config Software. These function blocks will reference:

- microSD when filename is prefixed with 'A:' or nothing OR
- USB A flash Drive when filename is prefixed with 'B:'.

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

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

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

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

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

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

10.10 Removable Media (RM) Features— Program Features

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

b. Report Editor—This feature allows the I³ to be configured to generate text printouts which incorporate data from the registers embedded in the text. The reports can be printed using a serial interface printer through any of the serial ports of the *i*³ or can be saved on the removable media of the device.

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

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

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

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

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

10.12 Removable Media Features—Additional Configuration

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

b. Screen Capture—The screen capture function allows a bitmap or jpeg image of the displayed I³ screen to be written to the Removable Media card.

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

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

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

The *i*³C Lite supports displaying files in the 8.3 format, i.e. filename.pgm. Files with up to 8 characters as a file name before the dot and up to 3 characters as a file extension after the dot will display in full on the *i*³C Lite screen. Filenames exceeding the 8.3 format will be truncated.

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

When creating filenames and directories it is sometimes desirable to include parts of the current date or time, or even the screen number in the case of screen capturing. There are special symbols that can be entered into a filename that are replaced by the I³ as follows.

Table 10.1 – Filename Special Symbols

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

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

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

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

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

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

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

10.14 System Registers used with RM

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

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

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

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

Possible status values are shown in the table:

Table 10.2– RM Status Values	
0	RM interface OK
1	Card present but unknown format
2	No card in slot
3	Card present, but not supported
4	Card swapped before operation was complete
5	Unknown error
6	Access protected

10.15 Safe Removal of Removable Media Card

If the Removable Media card should need to be removed during operation, it can be safely removed by moving a one (1) into %SR174. This prevents corruption to the file system if the card is removed during a file-write sequence. The graphic objects should set *i*³ register %SR174.1 (when requesting the card be removed) and provide an indicator based on *i*³ register %SR174.2 (which indicates that it is safe to remove the removable media). %SR174 must be set back to zero after the card is reinserted.

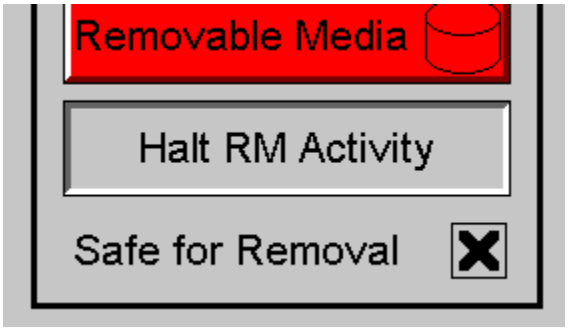


Figure 10.4 – Example application segment for safe removal of removable media

CHAPTER 11: GENERAL I/O

NOTE: Each *i*³C Lite unit is shipped with a datasheet in the box. The datasheet is the first document to refer to **for model-specific information related to i³C Lite models.** The web version of this manual has all of the *i*³C Lite datasheets attached to it.

11.1 Overview

The *i*³C Lite is a compact unit that contains high density and very versatile I/O. Using the I/O properly requires wiring to the proper terminals and configuring I³ Config properly. This section will offer some tips and suggestions to configure the I/O properly. For the register mapping of the I/O, refer to Chapter 12 on Registers.

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

Removing and Inserting Connectors:
Use a small screwdriver to gently pry up the connector. Gently press on connector to snap into place.

Wiring Details:
Solid/Stranded wire - 12-24 awg (2.5-0.2mm^2).
Strip length - 0.28" (7mm).
Torque rating: 4.5 - 7 in-lbs (0.50 - 0.78 N-m).

Table 11.1– I/O and Model Overview					
I³C Lite Models	**Solid State Digital Outputs**	**Relay Outputs**	**Digital Inputs**	**Analog Inputs**	**Analog Outputs**
*i*³C Lite 10D12	✓		✓	✓	✓
*i*³C Lite 10D14	✓	✓	✓	✓	✓

Table 11.1 shows the different types of I/O included with the two *i*³C Lite models. Specifications and wiring diagrams can be found on the data sheets. Descriptions and applications of the different type of I/O can be found below.

11.3 Solid-State Digital Outputs

I³C Lite: Solid-state digital outputs are generally used to activate lamps, low voltage solenoids, relays, and other low voltage and low current devices.

NOTE*:* The digital outputs used on the *i*³C Lite are "sourcing" outputs. This means the output applies a positive voltage to the output pin when turned ON. When turned off, the output applies approximately zero volts with respect to the I/O ground.

The digital outputs used in the *i*³C Lite have electronic short circuit protection and current limiting. While these electronic protections work in most applications, some applications may require external fusing on these outputs.

The digital outputs in the *i*³C Lite are typically controlled via %Q bits in the register mapping. Some of the outputs are designed for high-speed applications and can be used for PWM or frequency output applications. Please see the data sheet and Chapter 12 on High-Speed I/O for additional information.

When the controller is stopped, the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default, digital outputs turn off. For more information on Stop State see Chapter 15 on Configuration for I³ Config Settings.

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

Below are the Wiring Connectors for the Models :

Model -10D14 Digital Out

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

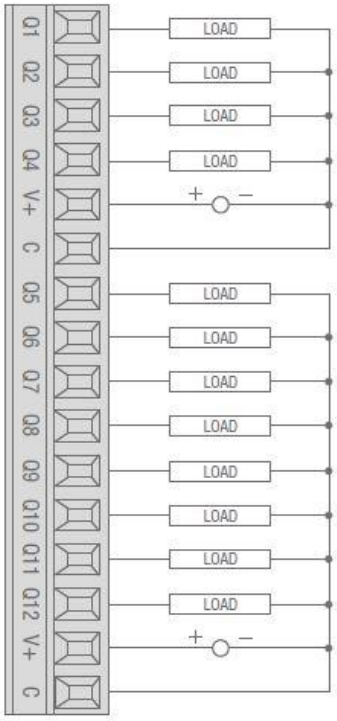
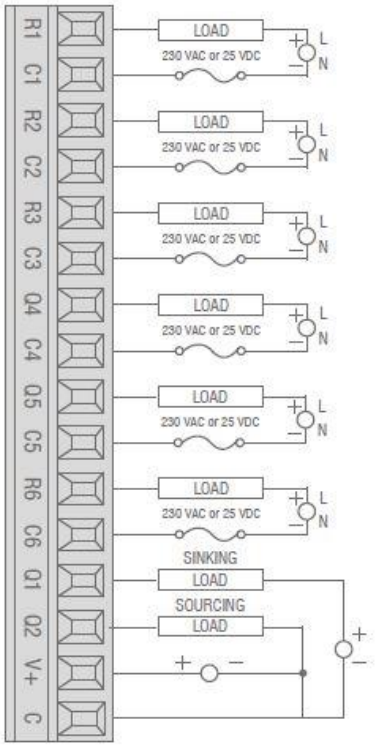


Figure 11.1 –Digital Output

Model -10D12 Relay & Digital Out

Position / Pin		Digital Model
1	R1	Relay 1 NO
2	C1	Relay 1 C
3	R2	Relay 2 NO
4	C2	Relay 2 C
5	R3	Relay 3 NO
6	C3	Relay 3 C
7	R4	Relay 4 NO
8	C4	Relay 4 C
9	R5	Relay 5 NO
10	C5	Relay 5 C
11	R6	Relay 6 NO
12	C6	Relay 6 C
13	Q1	Output 1 (PWM)
14	Q2	Output 2 (PWM)
15	V+	External V+
16	C	Common



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

Figure 11.2 –Relay and Digital Output

11.4 Relay Outputs

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

NOTE: The design of the *i*³C Lite does not require external coil power for the relays to function. The relays may be activated as long as the *i*³C Lite is powered.

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

- **Relay Life –** Relays are mechanical devices that have a long but limited life. Typically switching more current limits the life of relays.
- **Current / Temperature De-Rating** – Products containing relays often have total current limits based on the ambient temperature of the application. Please see the product data sheet for current / temperature de-rating information for relays.
- **Fusing –** External fusing is generally required to protect the relays, devices and wiring from shorts or overloads.

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

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

Protection for Inductive Loads – Inductive loads can cause reverse currents when they turn off that can shorten the life of relay contacts. Some protective measures must be determined by an engineer. Below are some recommendations that will work for many applications. If there are additional questions on protection from inductive load, consult IMO Technical Support.

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

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

Output State on Controller Stop – When the controller is stopped the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined state. By default, relay outputs turn off. For more information on stop state, see *i*³ Config Configuration (Chapter 15.6) for *i*³ Config settings.

11.5 Sinking and Sourcing Outputs

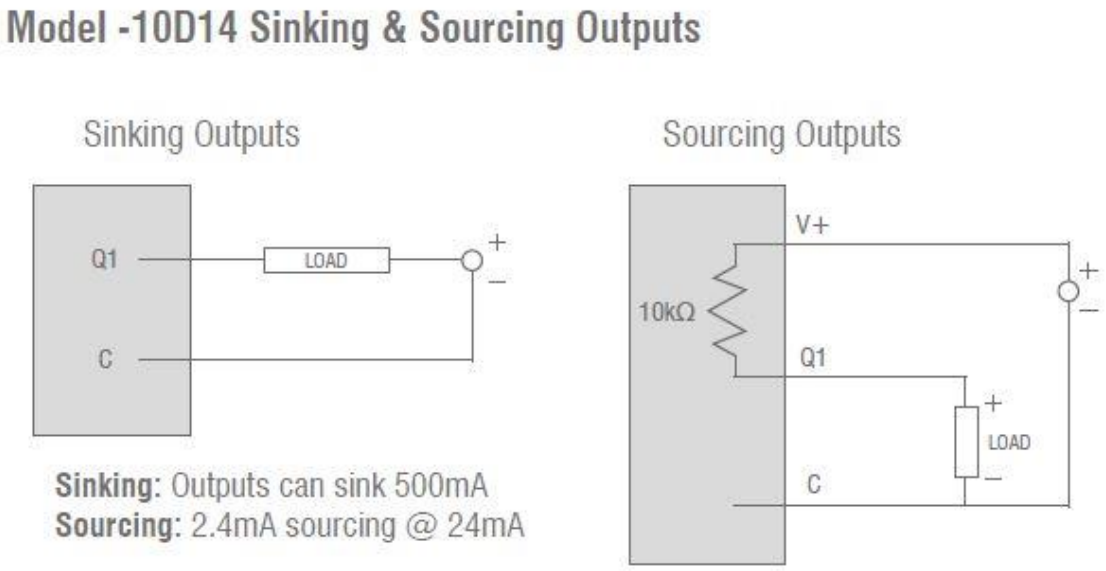


Figure 11.3 – Model-10D14: Sinking and Sourcing Outputs

11.6 Digital Inputs

NOTE: See Chapter 12 for High Speed I/O information and refer to the datasheet for *i*³C Lite model being used for details on jumper settings.

NOTE*:* The digital inputs on the i³C Lite are designed for low voltage DC inputs.

The inputs are designed to support both positive and negative input modes. The mode is set by software setting in *i*³ Config and a configuration parameter also in *i*³ Config. All the inputs on the unit must be configured to the same mode.

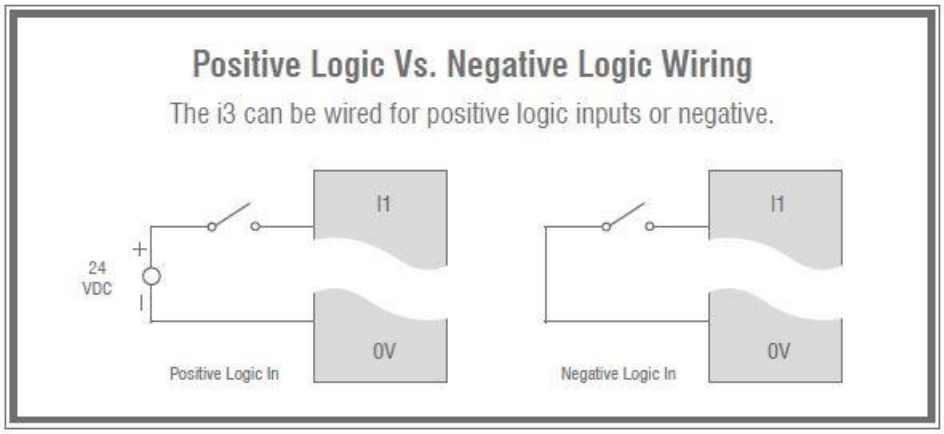


Figure 11.4 – Positive and Negative Inputs

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

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

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

Digital Input

Position / Pin		Digital Model
1	I1	Input 1 (HSC)
2	I2	Input 2 (HSC)
3	I3	Input 3 (HSC)
4	I4	Input 4 (HSC)
5	I5	Input 5
6	I6	Input 6
7	I7	Input 7
8	I8	Input 8
9	I9	Input 9
10	I10	Input 10
11	I11	Input 11
12	I12	Input 12
13	C	Common
14	C	Common

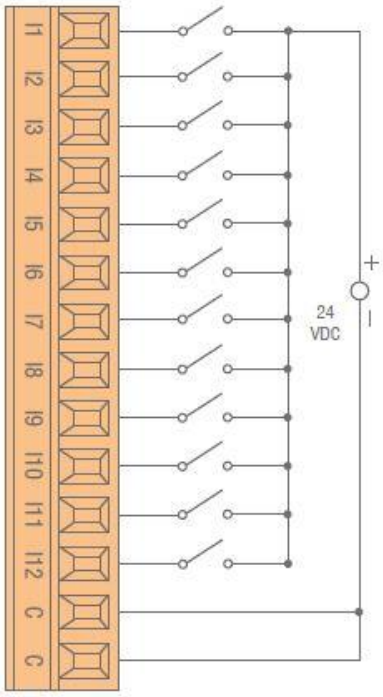


Figure 11.5 –Digital Input

11.7 Analog Inputs

NOTE: See the datasheet and Chapter 15 for details on how to use *i*³ Config to configure the digital filtering.

The analog inputs on the *i*³C Lite allow current measurement from a variety of devices.

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

11.8 I/O Status and Calibration

11.8.1 I/O Status

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

The *i*³C Lite System Menu contains an "I/O Status and Calibration" selection.

When first entering this option, the user is presented with information about the *i*³C Lite model and current state of the I/O points.

```
Model:      i³CL
I12-1:      000000000000
Q12-1:      000000000000
AI1:  12345
AI2:  456
AI3:  789
AI4:  32100
AQ1:        33333
AQ2:        11111
Calibrate Analog
```

11.8.2 I-O Calibration

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

Calibration of analog can only be performed when the controller is in idle mode. Analog output values will change so precautions show be taken such that changes in these outputs will not affect the system or the safety of those around the equipment. The calibration process applies changes to the analog inputs, so care must be taken that the calibration process will not adversely affect the operation of the attached equipment. Calibration should be performed by trained personnel with equipment that is designed for precise analog calibration. Ideally this equipment is also calibrated to a traceable standard.

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

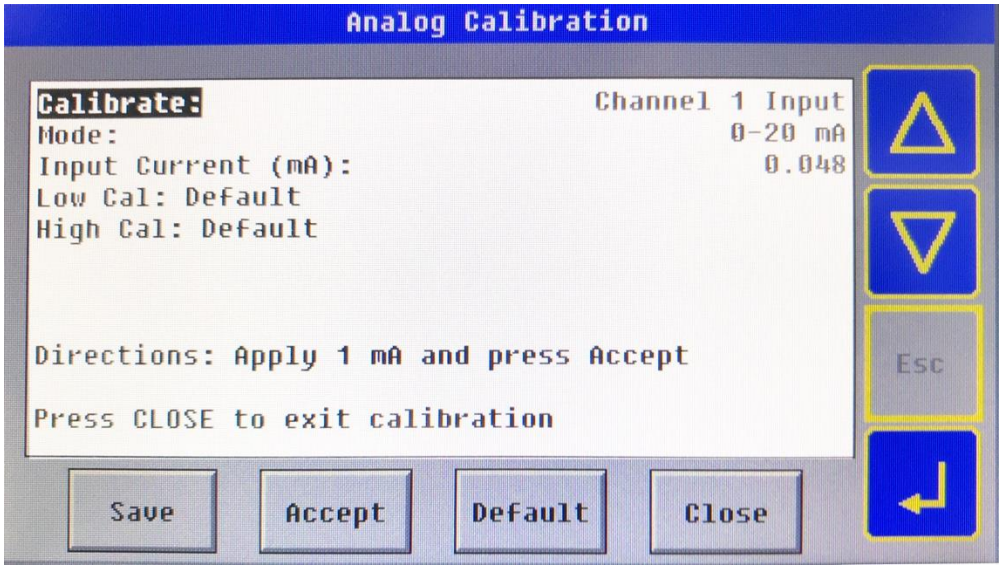


Figure 11.6 – Analog Calibration Screen on *i*^{3}C Lite

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

The "**Save**" button is used to save the calibration.

The "**Accept**" button is used to accept calibration values in the process.

The "**Default**" button is used to restore calibration to factory defaults.

The "**Close**" button is used to exit the calibration screen.

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

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

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

To calibrate 4-20mA Analog Outputs:

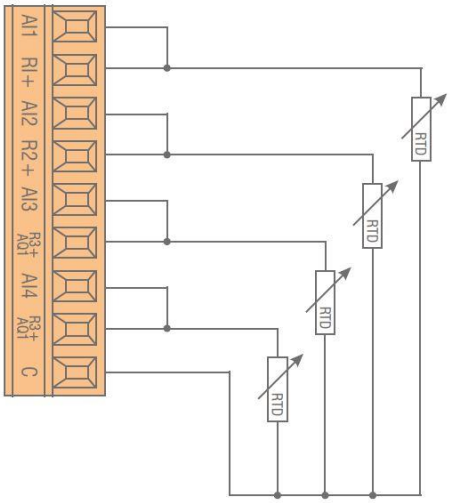
NOTE: During Calibration process, the application may be placed in Idle.

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

11.9 RTD Wiring on J3 Connector

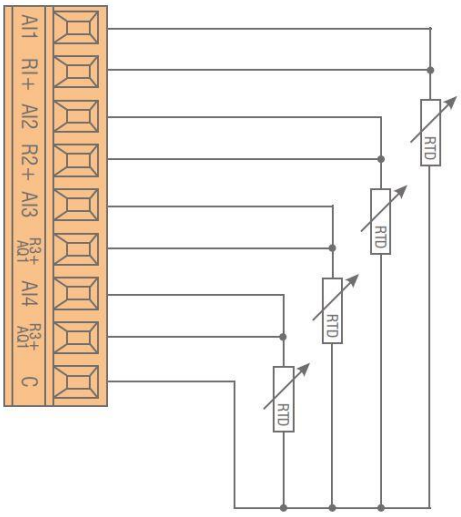
RTD: 4x2-Wire RTD Connection J3 Wiring

Pin	Digital Model
1	AI1
2	RTD1+
3	AI2
4	RTD2+
5	AI3
6	RTD3+/AQ1
7	AI4
8	RTD4+/AQ2
9	Common



RTD: 4x3-Wire RTD Connection J3 Wiring

Pin	Digital Model
1	AI1
2	RTD1+
3	AI2
4	RTD2+
5	AI3
6	RTD3+/AQ1
7	AI4
8	RTD4+/AQ2
9	Common



RTD: 2x3-Wire RTD Connection & 2x4-20mA Output J3 Wiring

Pin	Digital Model
1	AI1
2	RTD1+
3	AI2
4	RTD2+
5	AI3
6	RTD3+/AQ1
7	AI4
8	RTD4+/AQ2
9	Common

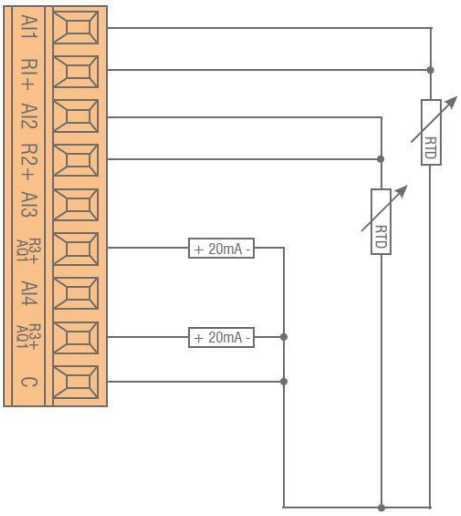


Figure 11.7 – RTD Wiring on J3

11.10 4i³C Lite-20mA Wiring for Input and Output

RTD: 4x4-20mA Input / 4-20mA Output J3 Wiring

Pin	Digital Model
1	AI1
2	RTD1+
3	AI2
4	RTD2+
5	AI3
6	RTD3+/AQ1
7	AI4
8	RTD4+/AQ2
9	Common

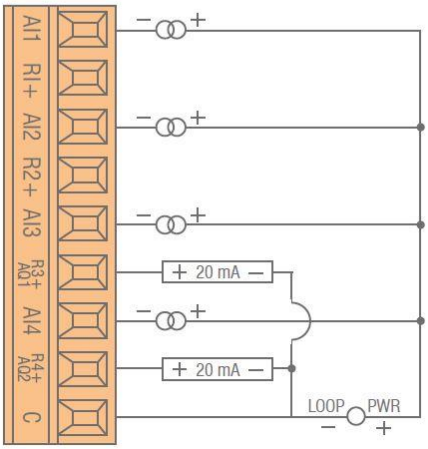


Figure 11.8 – 4-20mA Wiring on J3

11.11 Analog Inputs

NOTE: See the data sheet and Chapter 15 for details on how to use *i*³ Config to configure the digital filtering.

The analog inputs on the *i*³C Lite allow current measurement from a variety of devices.

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

11.12 Analog Outputs

NOTE: See Chapter 12 for high-speed I/O information and refer to the datasheet for *i*³C Lite model.

The analog outputs on *i*³C Lite devices provide high resolution current outputs.

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

When the controller is stopped, the operation of each output is configurable. The outputs can hold the state they were in before the controller stopped or they can go to a predetermined value. By default, analog outputs are set to a value of zero (0). For more information on Stop State, see Chapter 15 on I³ Config Configuration.

CHAPTER 12: HIGH SPEED I/O (HSC/PWM)

12.1 Overview

In addition to the compliment of simple analog and digital I/O, the *i*³C Lite supports High Speed Counting (HSC) I/O functions and may support Pulse Width Modulation (PWM) Output functions. The HSC functions include frequency, totalizing, pulse width, and quadrature measurement.

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

This chapter describes the operation of these high level I/O functions. For configuration details of these functions, see Chapter 15, *i*³ Config Configuration.

12.2 Glossary of High Speed I/O Terms

Table 12.1 – Glossary of High Speed I/O Terms

Accumulator	Register used to accumulate or store up a sum or count of many items or events.
Clear	A special function to zero out the value in a specific register. (Not used with Frequency or Period Measurement.)
Disable	A special function to prevent the counter from running.
Encoder	A sensor or transducer for converting rotary motion or position to a series of electronic pulses
Frequency Input	The number of times an electromagnetic signal repeats an identical cycle in a unit of time, usually one second.
Latch (strobe)	A special function that uses a digital logic circuit to store one or more bits. A latch has a data input, a clock input and an output. When the clock input is active, data on the input is "latched" or stored and transferred to the output register either immediately or when the clock input goes inactive. The output retains its value until the clock goes active again.
Marker	Input into the I³ that indicates a particular position. Typically, an encoder has a marker output that represents a specific point in the rotation.
Polarity	A Polarity pull-down box is associated with each function and indicates the manner in which the trigger happens (e.g., High level, Low Level, Falling Edge, Rising Edge).
Preload (load)	A special function used to trigger loading of a value into a register upon an event. (Not used with Frequency or Period Measurement.)
Quadrature	A high-speed device that expresses the phase relationship between two periodic quantities of the same period when the phase difference between them is one fourth of a period. A coupler in which the two output signals are 90° out of phase.
Totalizer	A counter that sums the total number of cycles applied to its input.

12.3 High Speed Counter (HSC) Functions

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

NOTE: While the high-speed input circuitry has a resolution of 1µs, measured edge transitions must not occur faster than 100µs for accurate measurements. Keep in mind that pulse width measurements utilize both the rising and falling edges of the waveform, thus the pulse width must exist longer than 100µs.

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

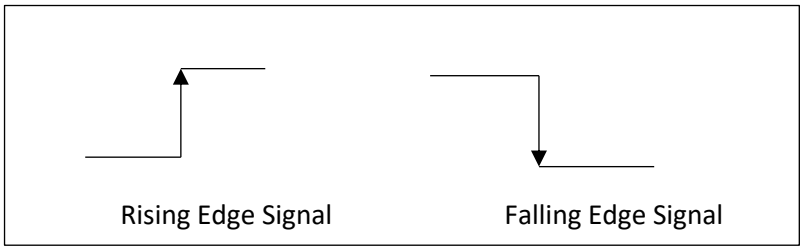
12.3.1 Frequency

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

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

12.3.2 Totalize

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



Three different options are available to reset the current count.

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

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

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

NOTE: Maximum direct digital reset latency is 100µs.

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

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

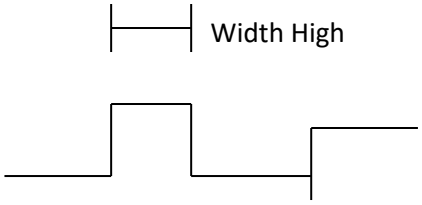
NOTE: Q1 and Q2 are PWM function outputs that may be configured independently as one of the following: standard digital output, PWM, or HSCx output.

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

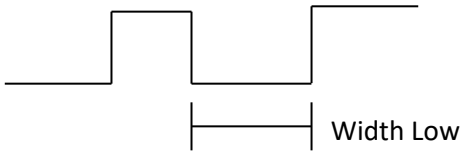
12.3.3 Pulse

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

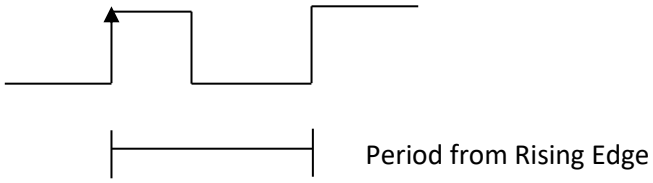
Width High 1µs Counts – In this sub-mode the accumulator value will contain the number of 1µs counts for which the pulse is high.



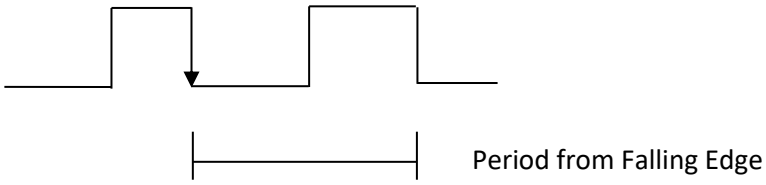
Width Low 1µs Counts - In this sub-mode the accumulator value will contain the number of 1µs counts for which the pulse is low.



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



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

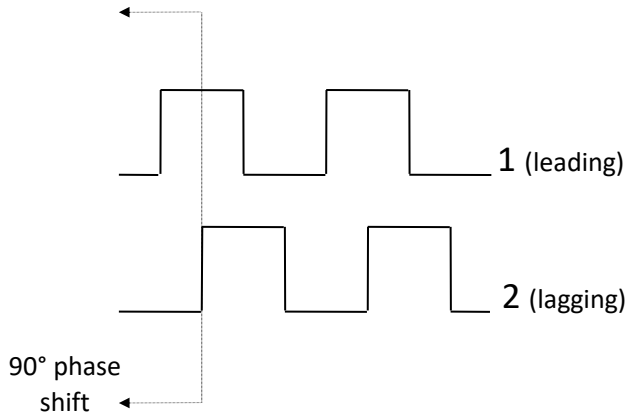


12.3.4 Quadrature

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

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

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



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

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

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

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

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

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

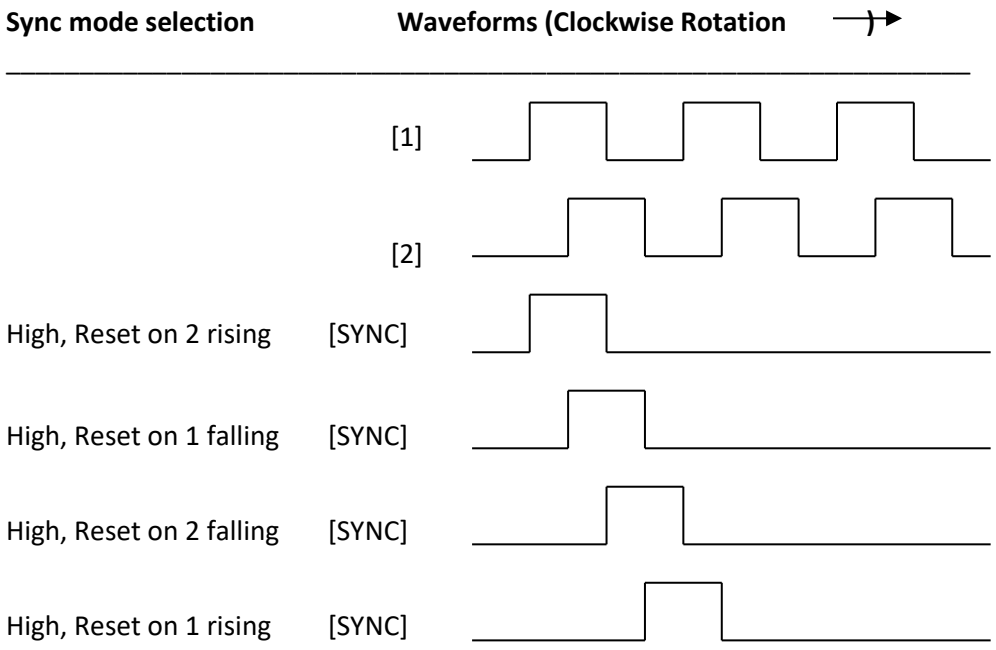
  Marker reset operation is enabled when HSC3 is configured for Marker type. Once selected, one of several modes is available for marker operation. These modes can be sub-divided into two groups of marker operation.

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

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

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

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



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

Figure 12.1 – Sync pulse mode illustration

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

Table 12.2 – Marker Function Table

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

12.4 HSC (High Speed Counter)

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

12.4.1 HSC Functions Register Map

Table 12.3 – HSC Functions Register Map

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

12.5 Pulse Width Modulation (PWM) Functions

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

NOTE: In *i*³ Config, the *i*³C Lite automatically defaults to Extended PWM Mode.

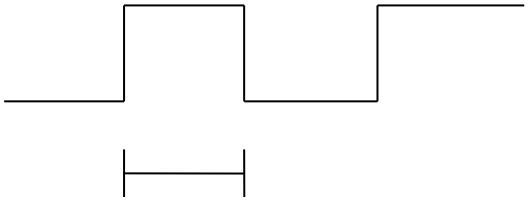
12.5.1 Normal

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

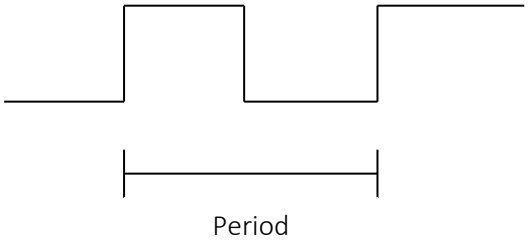
12.5.2 PWM

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

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



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



Figures 12.2 & 12.3 – PWM, two parameters, Duty Cycle & Frequency

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

12.5.3 PWM Output Waveform

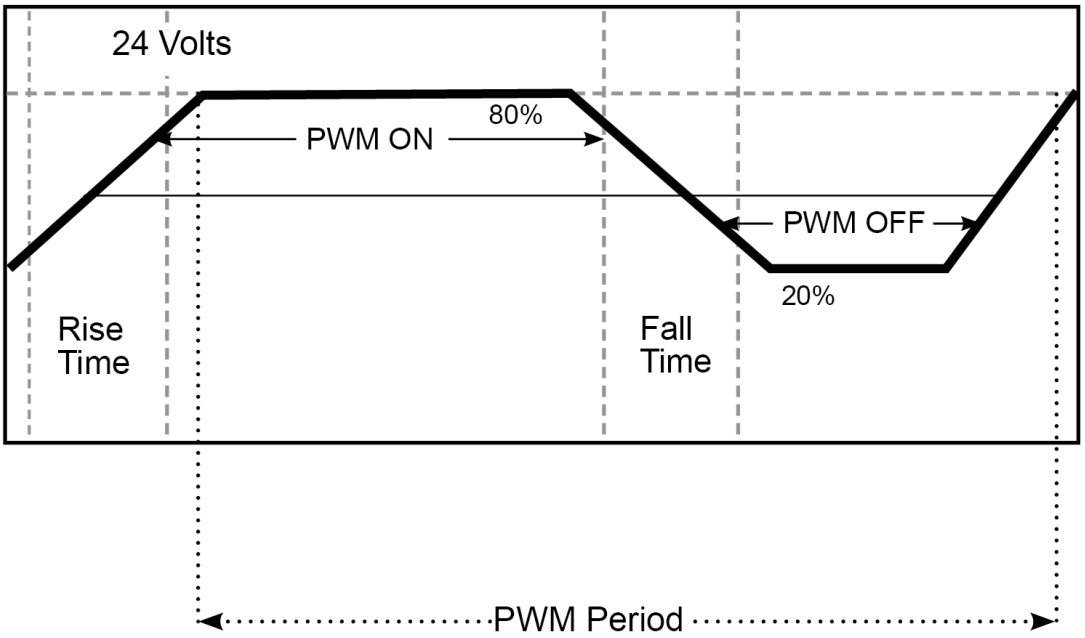


Figure 12.4 – PWM Output Waveform

Table 12.4 – PWM Output Waveform Table	
Rise Time	150ns Max
Fall Time	150ns Max
PWM Period	Frequency = $\frac{1}{Period}$

12.6 PWM Functions Register Map

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

Table 12.5 – PWM Functions Register Map

12.6.1 PWM Examples

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

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

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

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

Table 12.6 – PWM Examples

CHAPTER 13: USER INTERFACE

13.1 Overview

This chapter presents the user interface (or operator view) of the *i*³C Lite and some of the model specific characteristics of the *i*³C Lite as compared to the rest of the *i*³ line. This chapter does NOT cover building screens or using the *i*³ Config graphics editor. For instructions on creating screens and using the graphics editor, refer to the **Graphics Editor Help File** in *i*³ Config.

NOTE: The *i*³C Lite screen is a 4.3-inch diagonal LCD screen with an LED backlight.

13.2 Displaying and Entering Data

Figure 13.1 – Example Screen

Multiple objects are provided for displaying data such as virtual panel lights, push buttons, numeric value displays, bar graphs, meters, graphs, and animated bitmaps. On the *i*³C Lite, these graphical objects (through ladder manipulation of attribute bits) can change color, flash, or change visibility to attract operator attention.

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

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

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

13.3 Numeric keypad

To allow entry of a specific number, several of the input objects invoke a pop-up numeric keypad when the object is touched. An example of the numeric keypad invoked from a numeric input object is shown in Figure 12.2. Once invoked, the operator may touch the appropriate keys to enter a specific value. When entering a value, the numeric keypad is in one of two modes [new-value or edit-value].

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

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

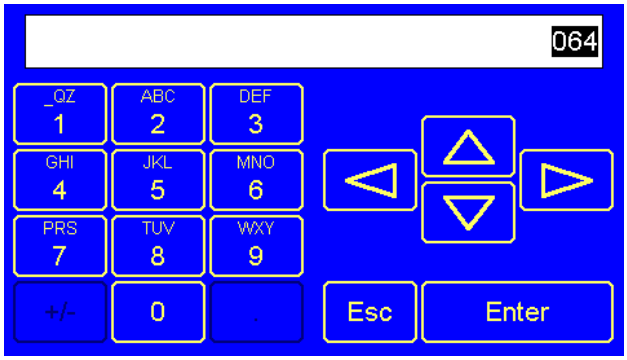


Figure 13.2– Numeric Keypad

Once the desired value is entered, pressing the **Enter** key moves that value into the object (and the corresponding *i*³ register) and the alpha-numeric keypad disappears. Alternately, pressing the **ESC** key any time before the **Enter** key cancels the operation, leaves the objects current value unchanged, and the alpha-numeric keypad disappears.

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

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

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

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

ASCII Object

When editing an ASCII value, an ASCII keypad is displayed as shown Figure 12.3. The ASCII keypad has three (3) modes, numeric, symbols, and alpha. In Alpha mode, the Caps Lock button may be pressed to access capital letters. When you first enter this editor, typing a character will overwrite the entire old string and start a new entry. You may press the backspace arrow to delete the previous character. Pressing Enter will save the entry, filling any unused space beyond the last character entered with NULL characters. Pressing ESC will cancel the edit and return the string to the previous value.

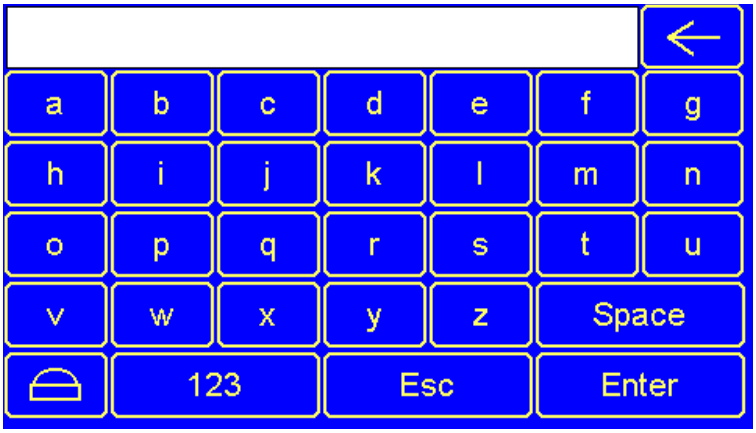


Figure 13.3–ASCII Keypad

Text Table Object

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

Time/Date Object

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

13.4 Screen Navigation

To allow the operator to change screens, a **screen jump object** is generally used. This object may be visually **represented as a 3-D button** (responding to touch) or remain invisible and logically tied to an I^3 register. An optional system ICON may be configured for display along with the legend, which aids in identifying the object as one that causes a screen change (shown below in figure 14.4).

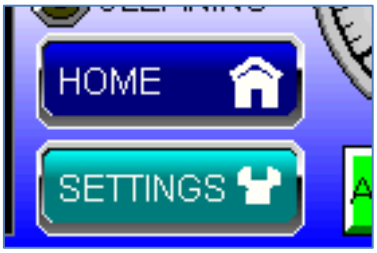


Figure 13.4– Typical Screen Jump Objects (i^3C Lite)

Screen jumps can also be triggered on other keys or based on control logic for more advanced applications. To allow the operator to change screens, a **screen jump object** is generally used. This object may be visually **represented as a button** (responding to touch) or remain invisible and logically tied to an i3 register. An optional system ICON may be configured for display along with the legend, which aids in identifying the object as one that causes a screen change.

13.5 Ladder Based Screen Navigation

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

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

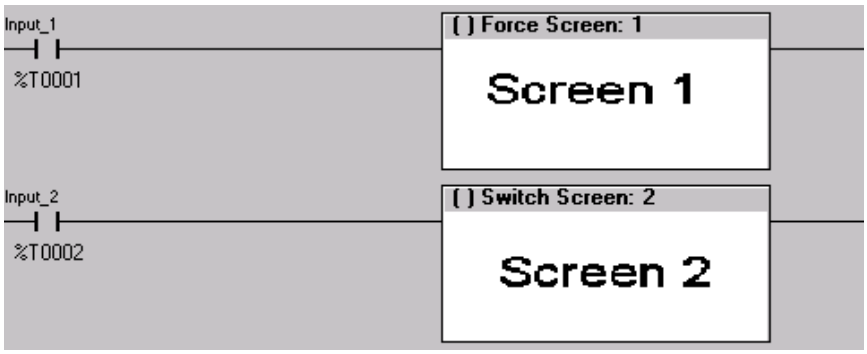


Figure 13.5– Force and Switch Coils in Ladder Programming

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

Refer to the on-line help in *i*³ Config for more information on control-based screen navigation.

13.6 Touch (Slip) Sensitivity

Touch *slip* sensitivity is preset to meet most applications; however, adjustment is available to reduce the sensitivity for touch release. That is, once a graphical object (button) is touched and held by a finger, the default touch *slip* sensitivity allows for a slight *slip* of the finger on the graphical object before the *i*³C Lite assumes touch been released (equates to approximately a quarter inch of movement with a stylus).

In some applications (such as jog buttons) where the operator is pushing a button for a period of time, the amount of *slip* while holding a button pressed may exceed the default sensitivity. To increase the amount of tolerable *slip* and prevent false releases of the button, the *i*³C Lite allows adjustment of the allowable *slide* up to 5x the default value.

To enable the touch (slip) sensitivity, first an *i*³ data register must be allocated through the Graphics Editor Configuration menu for Display Settings. Once a Touch Sensitivity register is assigned, that register may be modified [range = 1(Low) to 5 (High)] to the desired slide amount. If a value outside the valid range is entered in the touch sensitivity register, it is ignored, and the last valid value is used.

13.7 Alarms

Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. The alarm object is generally used to enunciate alarms to the operator. Alarm presentation to the operator is highly configurable and beyond the scope of this document to describe fully. For more information refer to the graphics editor help file in *i*^{3} Config. This section presents a typical configuration thereby providing an introductory description on what the operator should expect.

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

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

Figure 13.6– Alarm Object

To view, acknowledge and/or clear alarms, the operator must access the alarm viewer. This is accomplished by touching an (enabled) alarm object. When accessed, the alarm viewer is displayed as pop-up alarm viewer dialog similar to that shown in Figure 13.7.

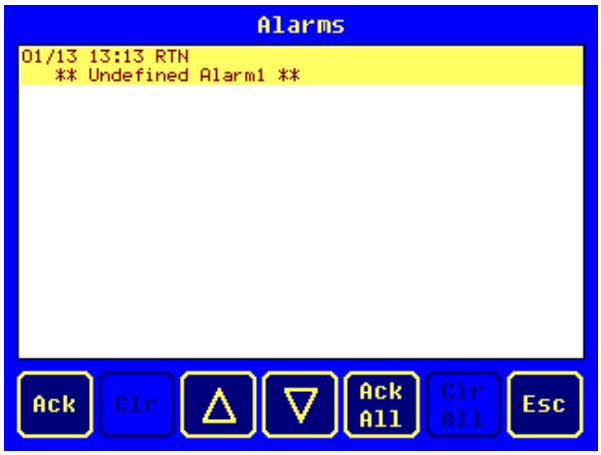


Figure 13.7– Alarm Viewer

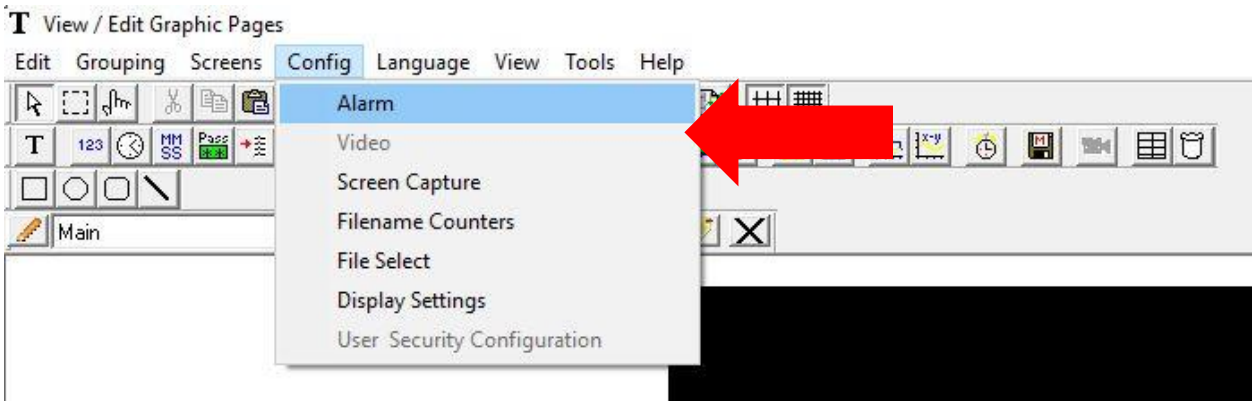
The currently selected entry is indicated by a yellow highlight which can be moved up or down by touching the arrow buttons or by directly touching an entry. If more entries exist than can fit on the page, a scroll bar is displayed on the right side that also indicates the current relative position.

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

NOTE: *i*³ registers %SR181 and %SR182 are available for ladder use, which indicate presence of unacknowledged or acknowledged alarm (respectively). The screen designer may implement these registers to switch screens or activate the beeper to attract the operator's attention.

For more information, refer to the **Graphics Editor Help** file in *i*³ Config.

Graphics Editor Button



Opening Alarm Configuration in Graphic Editor

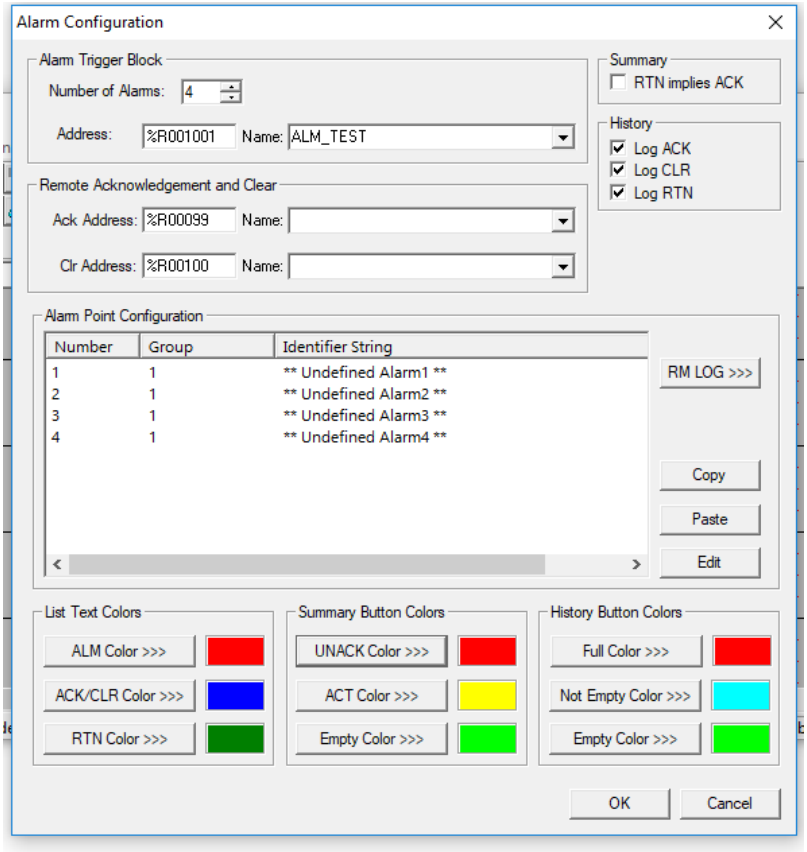


Figure 13.8—Alarm Configuration in *i*³ Config

13.8 Removable Media

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

- Highest (Red) - Device Error
- - (Yellow) - Device Full (threshold adjustable)
- Lowest (Green) - Device OK

Figure 13.9– Removable Media Object

To view and perform file operations, the operator must access the removable viewer. This is accomplished by either touching an (enabled) removable media object or through the system menu. When accessed, the removable media viewer is displayed as pop-up removable media dialog similar to that shown in Figure 13.9.

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

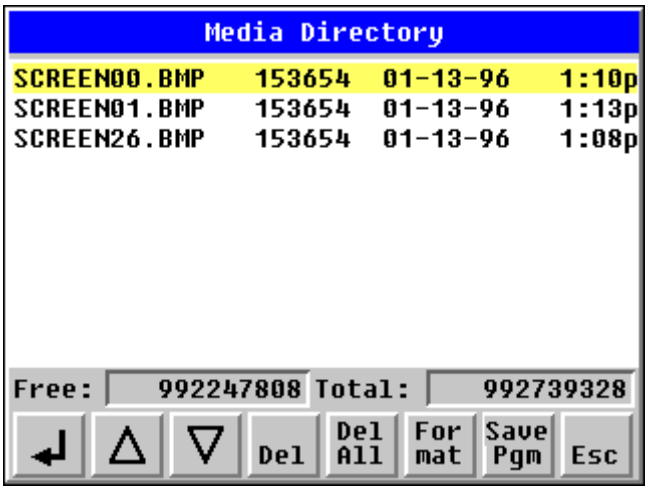


Figure 13.10– Removable media viewer

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

File operations are accomplished by pressing the appropriate button at the bottom of the removable media viewer. The configuration of the removable media object that invokes the removable media viewer defines what buttons are enabled and available to the user. A button is grayed and does not respond to touch if configured as disabled.

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

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

Alternately, the (enter) button can be configured to simply load the ASCII representation of the file path (including the file name) to a group of I³ registers. That pathname can then be used by ladder for opening and manipulating that file.

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

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

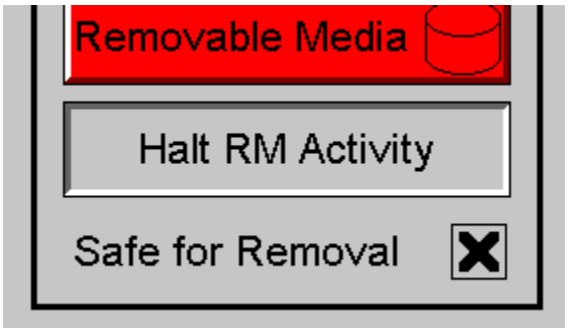


Figure 13.11– Example application segment for safe removal of removable media

13.9 Screen Saver

The *i*³C Lite screen backlight life remains sufficiently bright for five (5) years. It will dim to 70% brightness if it is left on continuously for five (5) years. If the application does not require interaction with the *i*³C Lite for long periods of time, the backlight life can be extended by using the screen saver function. When enabled through the System Menu, the backlight is shut off (screen goes black) after a specified time of no activity on the screen. When the screen saver shuts off the backlight, any key or button reactivates the backlight.

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

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

13.10 Screen Brightness

The *i*³C Lite provides a feature that allows screen dimming for night operation. To enable this feature, the application must access and control system register %SR57 (Display Backlight Brightness). Screen brightness is continuously variable by driving %SR57 through the range of 100 (full bright) to 0 (full off). It is left to the screen designer on if and how to present a Screen Brightness control to the user.

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

CHAPTER 14: REGISTERS

14.1 Register Definitions

When programming the *i*³C Lite, data is stored in memory that is segmented into different types. This memory in the controller is referred to as registers. Different groups of registers are defined as either bits or words (16 bits). Multiple registers can usually be used to handle larger storage requirements. For example, 16 single-bit registers can be used to store a word, or two 16-bit registers can be used to store a 32-bit value.

Table 14.1 - Types of Registers found in the i³C Lite	
%I Digital Input	Single-bit input registers. Typically, an external switch is connected to the registers.
%Q Digital Output	Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or other physical outputs.
%AI Analog Input	16-bit input registers used to gather analog input data such as voltages, temperatures, and speed settings coming from an attached device.
%AQ Analog Output	16-bit output registers used to send analog information such a voltages, levels or speed settings to an attached device.
%M Retentive Bit	Retentive single-bit registers.
%T Temporary Bit	Non-retentive single-bit registers.
%R General Purpose Register	Retentive 16-bit registers.
%D Display Bit	These are digital flags used to control the displaying of screens on a unit which can display a screen. If the bit is SET, the screen is displayed.
%K Key Bit	Single-bit flags used to give the programmer direct access to any front panel keys appearing on a unit.
%S System Bit	Single-bit bit coils predefined for system use.
%SR System Register	16-bit registers predefined for system use.

14.2 Useful %S and %SR registers

Table 14.2 – Common %S Register Definitions		
Register	**Name**	**Description**
%S1	FST_SCN	Indicate First Scan
%S2	NET_OK	Network is OK
%S3	T_10MS	10mS timebase
%S4	T_100MS	100mS timebase
%S5	T_1SEC	1 second timebase
%S6	IO_OK	I/O is OK
%S7	ALW_ON	Always ON
%S8	ALW_OFF	Always OFF
%S9	PAUSING_SCN	Pause 'n Load soon
%S10	RESUMED_SCN	Pause 'n load done
%S11	FORCE	I/O being forced
%S12	FORCE_EN	Forcing is enabled
%S13	NET_IO_OK	Network I/O is OK

Table 14.3 – %SR Registers				
Register	**Name**	**Description**	**Min Val**	**Max Val**
%SR1	USER_SCR	Current User Screen Number	1	1023
%SR2	ALRM_SCR	Current Alarm Screen Number (0=none)	0	1023
%SR3	SYS_SCR	Current System Screen Number (0=none)	0	21
%SR4	SELF_TEST	Bit-Mapped Self-Test Result	0	65535
%SR5	CS_MODE	Control Station Mode (0=Idle, 1=Do I/O, 2=Run)	0	2
%SR6	SCAN_RATE	Average Scan Rate (/ 10)	-	1000
%SR7	MIN_RATE	Minimum Scan Rate (/ 10)	-	1000
%SR8	MAX_RATE	Maximum Scan Rate (/ 10)	-	1000
%SR9	TCH_PRESSURE	Current Touch Pressure	0	3000
%SR10	TCH_PRESSURE_T…	Threshold Touch Pressure	0	3000
%SR11-12		Program Size Low & High		
%SR13-14		User Text Screen Size Low & High		
%SR15-16		System Text Screen Size Low & High		
%SR17-18	IO_SIZE	I/O Configuration Table Size Low & High	16	127K
%SR19-20	NET_SIZE	Network Configuration Table Size Low & High	34	1K
%SR21-22	SD_SIZE	Security Data Table Size Low & High		
%SR23	LADDER_CRC	Ladder Code CRC	0	65535
%SR24		User Text CRC		
%SR25		System Text CRC		
%SR26	IO_CRC	I/O Configuration Table CRC	0	65535
%SR27	NET_CRC	Network Configuration Table CRC	0	65535
%SR28	SD_CRC	Security Data Table CRC	0	65535
%SR29	NET_ID	This Station's Primary Network ID	1	253
		ICAN Mode	1	253
		DeviceNet Mode	0	63
		CANOpen Mode	1	127
		J1939		
%SR30	NET_BAUD	Network Baud Rate (0=125KB; 1=250KB; 2=500KB; 3=1MB)	0	3
		ICAN Mode	0	3
		DeviceNet Mode	0	2
		CANOpen Mode	0	3
		J1939	1	1
%SR31	NET_MODE	Network Mode (0=network not required; 1=network required; 2=network optimized; 3=network required and optimized)	0	3
%SR32	LCD_CONT	LCD Display Contrast setting	0	255
%SR33	FKEY_MODE	Function Key Mode (0=Momentary; 1=Toggle)	0	1
%SR34	SERIAL_PROT	RS232 Serial Protocol Mode (0=Firmware Update (RISM); 1=ICAN; 2=Generic (Ladder- Controlled); 3=Modbus RTU; 4=Modbus ASCII)	0	4
%SR35-36	SERIAL_NUM	This Station's 32-bit Serial Number Low & High	0	2^{32}-1
%SR37	MODEL_NUM	This Station's Binary Model Number	0	65535
%SR38	ENG_REV	Firmware Rev Number (/ 100)	0000	9999
%SR39	CPLD_REV	BIOS Rev Number (/ 100)	000	255
%SR40	FPGA_REV	FPGA Image Rev Number (/ 10)	000	255
%SR41	LCD_COLS	Vertical Pixel Count		
%SR42	LCD_ROWS	Horizontal Pixel Count		
%SR43	KEY_TYPE	Keypad Type		
%SR44	RTC_SEC	Real-Time-Clock Second	0	59
%SR45	RTC_MIN	Real-Time-Clock Minute	0	59
%SR46	RTC_HOUR	Real-Time-Clock Hour	0	23
%SR47	RTC_DATE	Real-Time-Clock Date	1	31

Table 14.3 – %SR Registers				
Register	**Name**	**Description**	**Min Val**	**Max Val**
%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
%SR53-55	Reserved			
%SR56	LAST_KEY	Key Code of Last Key Press or Release	0	255
%SR57	BAK_LITE	LCD Backlight Dimmer Register 0 = 0% On; 25=25% On; 100-255 = 100% On	0	255
%57.16		Temporarily disable Screen Saver		
%SR59		Build Number	-	-
%SR60		Build Option Build Test = 0, Build Beta = 1, Build Product = 2		
%SR61	NUM_IDS	This Station's Number of Network IDs	1	253
%SR62		Port Test Register Serial Port Test = 0 Serial Port Loopback Test Init = 769		
%SR63-135	Reserved			
%SR136 -137		Communication Time Out		
%SR138-163	Reserved		-	-
%SR152.1		MJ2 Termination make High		
%SR152.2		MJ3 Termination make High		
%SR152.3		MJ1 Termination make High		
%SR152.4		MJ1 Biasing make High		
%SR164.1		MJ2 Biasing make High		
%SR164.2		MJ3 Biasing make High		
%SR164.3	AUTO_RESTRD	Read bit indicating Auto Restore of Register Data has been performed (Fail Safe)		
%SR164.4	BCKUP_TAKN	Read bit indicating Backup of Register Data has been performed (Fail Safe)		
%SR164.5	EN_AUTO_RN	Enable AUTORUN (Fail Safe)		
%SR164.6	EN_AUTO_LD	Enable AUTOLOAD (Fail Safe)		
%SR164.7	STRT_BCKUP	Backup trigger bit		
%SR164.8	CLR_BACKUP	Clear Backup trigger bit		
%SR164.9	MAKE_CLONE	MAKE_CLONE trigger bit		
%SR164.10	LOAD_CLONE	LOAD_CLONE trigger bit		
%SR164.11	MK_CLN_FL	Status indicating Make Clone Fail (This bit goes high when Make / Create clone fails)		
%SR164.12	LD_CLN_FL	Status indicating Load Clone Fail (This bit goes high when Load clone fails)		
%SR165-166	Reserved			
%SR167		Screen Update Time	2	50
%SR168-173	Reserved			
%SR174	Removable Media	Removable Media Protect		
%SR174.1		Requesting Media Card be Removed		
%SR174.2		Indicates safe removal of Removable Media		
%SR175	Removable Media	Current Removable Media interface status	0	6
%SR176-177	Removable Media	Indicates free space on the Removable Media card in K bytes.	0	2^{31}
%SR178-179	Removable Media	Indicates the total card capacity in K bytes.	0	2^{31}
%SR180	Reserved	-	-	-
%SR181	ALM_UNACK	Unacknowledged Alarm (high bit indicates what group #)		
%SR182	ALM_ACT	Active Alarm (high bit indicates what group #)		
%SR183	SYS_BEEP	System Beep Enable (0=disabled; 1=enabled)	0	1
%SR184	USER_BEEP	Software configurable (0=OFF; 1=ON)	0	1
%SR185	SCR_SAVER	Screen Saver Enabled (0=disabled; 1=enabled)	0	1

Table 14.3 – %SR Registers				
Register	**Name**	**Description**	**Min Val**	**Max Val**
%SR186	SCR_SA_TM	Screen Saver Time in minutes (delay)	5	1200
%SR187	NET_USE	Average Net Usage of all units on the CAN network	0	1000
%SR188	NET_MIN	Minimum Net Usage of all units on the CAN network	0	1000
%SR189	NET_MAX	Maximum Net Usage of all units on the CAN network	0	1000
%SR190	NT_TX_AVG	Average Net Usage of this unit	0	1000
%SR191	NT_TX_MIN	Minimum Net Usage of this unit	0	1000
%SR192	NT_TX_MAX	Maximum Net Usage of this unit	0	1000

For additional information on system bits and registers, refer to the online help found in I³ Config.

14.3 Register Map for *i*³C Lite I/O

Table 14.4 – Register Map for i³C Lite I/O			
Fixed Address	**Digital/Analog I/O Function**	**i³C Lite Models**	
		R	**A**
%I	Digital Inputs	1-12	1-12
	Reserved	13-32	13-32
%Q	Digital Outputs	1-2	1-12
	Relay Outputs	3-8	--
	Reserved	9-16	13-16
%AI	Analog Inputs	1-4	1-4
	Reserved	5-12	5-12
%AQ	Analog Outputs	1-2	1-2
	Reserved	3-14	3-14

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

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

14.4 Resource Limits

Resource	Value	Resource	Value
%I	1024	**ICAN**	125kBd, 250kBd, 500kBd, or 1MBd
%Q	1024	**Serial Ports**	1 RS232, 1 RS485 Ports (Single Connector)
%AI	256	**IDs Per ICAN Network**	64 w/o repeat (253 w/ 3 repeaters)
%AQ	256	**Keypad**	Slide Keys (Touch)
%M	1024	**Display**	4.3” Color Transmissive
%T	1024	**Screen Memory**	256kB
%R	5,000	**User Screens**	250
%D	250	**No. of Objects per Page**	30
%K	4	**Ladder Code**	256kB
%S	13	**Ethernet**	ICAN, Ping, Modbus TCP Master (Downloadable protocol) & Slave, Ethernet IP, FTP, or EGD (EGD does not support Multicast.
%SR	192		

CHAPTER 15: *i*³ CONFIG CONFIGURATION

15.1 Overview

*i*³C Lite hardware is programmed with a Windows based PC application called *i*³ Config. This application can be used to program, configure, monitor, and debug all aspects of the *i*³C Lite unit. Please see the on-line help provided with *i*³ Config for additional details.

15.2 *i*³ Config Status Bar

When the I *i*³C Lite is connected to a PC using *i*³ Config software a Status Bar appears at the bottom of the screen. The *i*³ Config Status Bar can be used to determine if communications have been established between the *i*³C Lite and the *i*³ Config program. Components of the *i*³ Config Status Bar are explained below.

Message Line -

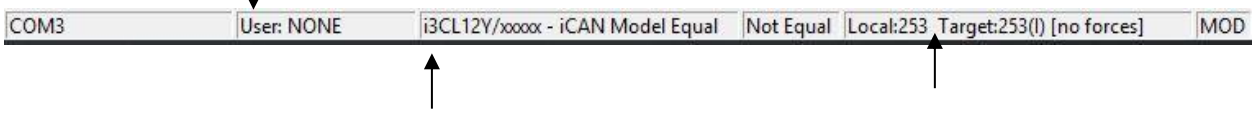
The contents of these messages are context sensitive. The Message line can be empty.

Equal Indicator – indicates whether the current program in *i*³ Config is equal to the program stored in the Target Controller.

- If ***Equal***, the program in *i* ³ Config is the same as the program stored in the Target Controller.
- If ***Not Equal***, the program in I³ Config is not the same as the program stored in the Target Controller.
- If **Unknown**, there may have been a change since the last time the program in *i*³ Config was compared to the Target Controller.

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

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



Controller Model - Network (Model Confirmation)

- **Controller Model** indicates the controller model for which the program in i³ Configurator is configured.
- **Network** indicates the type of network that the program in i³ Configurator expects to use (e.g., *i*CAN).
- **(Model Confirmation)** provides the following indications:
- **(Model=)** – the actual Target Controller matches the configured Controller Model and Network.
- **(Model Not=)** – the actual Target Controller does not match the configured Controller Model and Network.
- **(Model ?)** – there may have been a change since the last time the Target Controller was compared to the configured Controller Model and Network.

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

- **Local: xx** – indicates the Network ID of the i³ to which the I³ Config program is physically connected through its serial port. It can serve as a pass-through device to other nodes on the network.
- **Target: yy(R)** – indicates the Network ID of the device with which the I³ Config program is exchanging data.
  Note: The **Local** unit and **Target** unit can be the same unit, or they can be separate units.

The following are status indicators:
(R) – Running
(D) - Do I/O
(I) – Idle
(?) – I³ Config is not communicating with the remote unit.
[no forces] – Indicates no I/O has been forced.

Figure 15.1 – *i*³ Config Status Bar

15.3 Establishing Communications

The *i*³C Lite can communicate with *i*³ Config using USB to USB, USB to serial adapters, serial port communications via MJ1 Port, Ethernet (with an Ethernet adapter board), onboard Ethernet Port, CAN (*i*CAN), or modems. For *i*³C Lite, use *i*³ Config Version 9.80 or newer.

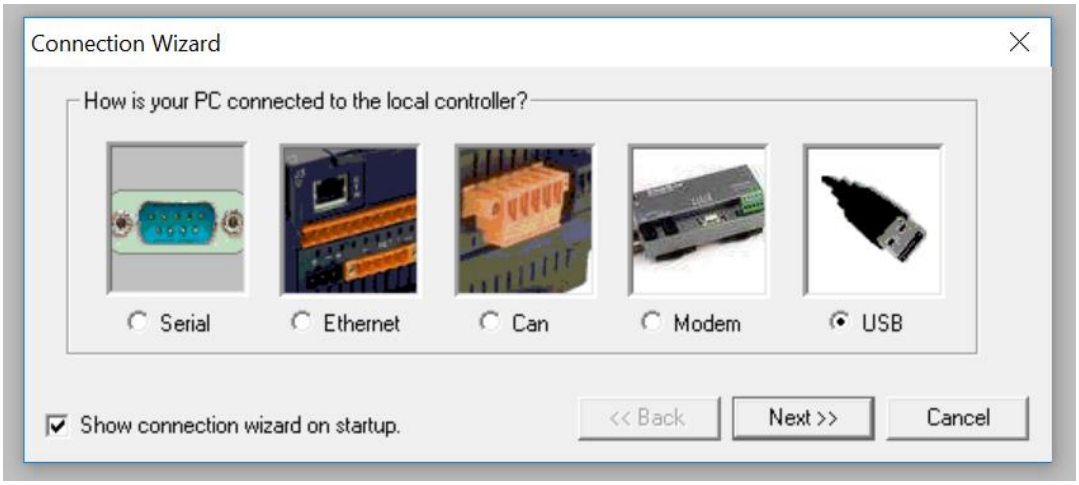
To communicate with the *i*³C Lite via USB you will need the Automated Driver Installer located on the Microsoft website .

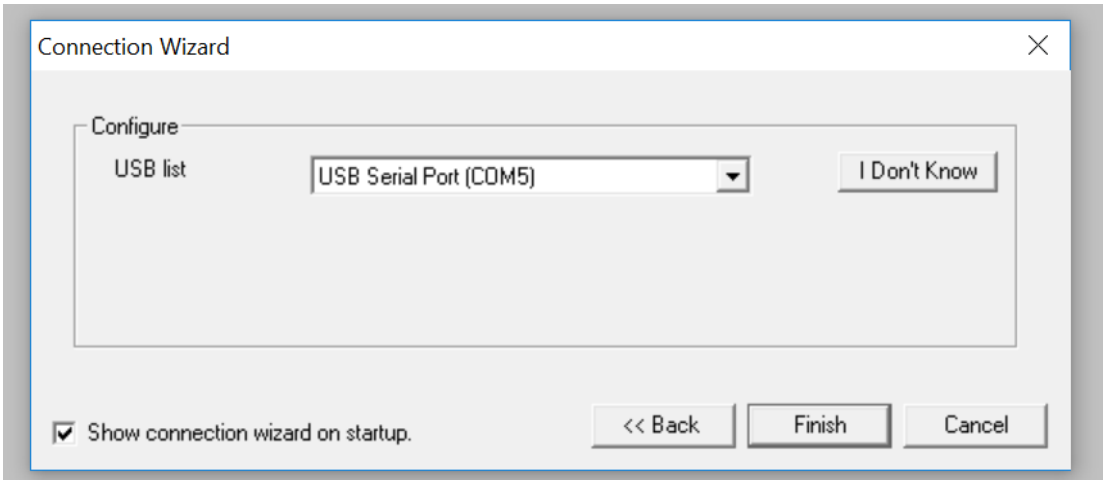
Next, connect a PC's (Personal Computer running a Windows Microsoft operating system) USB port via USB cable to the USB mini B port on the *i*³C Lite.

Figure 15.2 – USB Programming Connector

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

Open *i*³ Config and the first screen to open will be the Connection Wizard. Select USB and **Next>>** then **Finish.**





If the Connection Wizard does not pop up upon opening I³ Config, then select **Controller** (in the I³ Config tool bar) → **Connection Wizard**, choose your connection method. If you are connecting for the first time, we suggest connecting via USB.

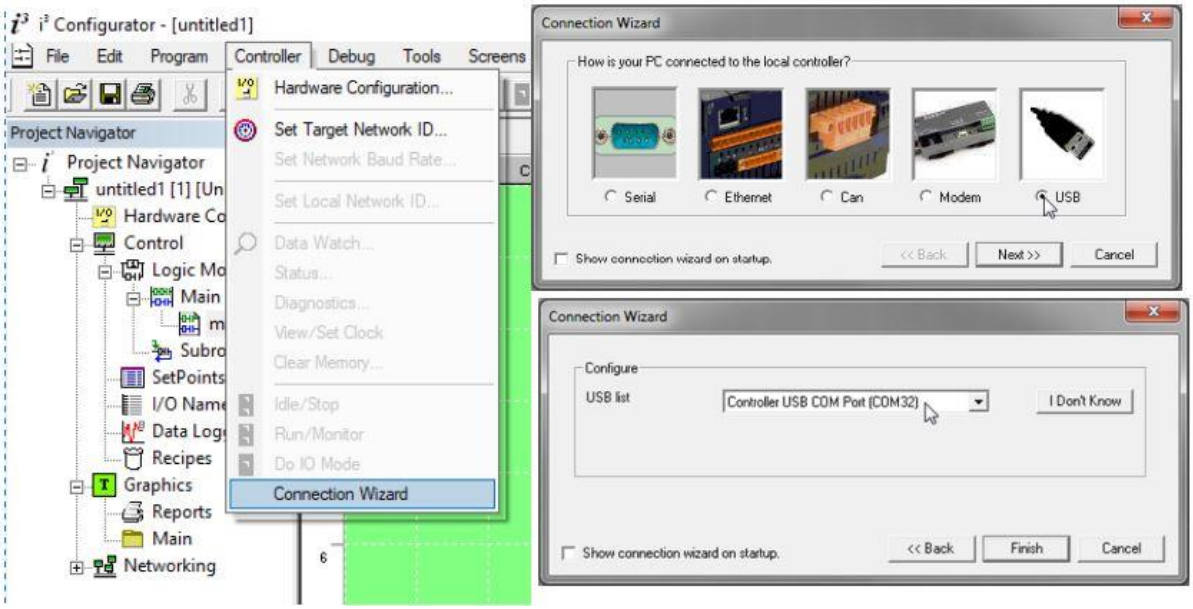


Figure 15.3 – I³ Config Connection Wizard Screenshots

If **Controller USB COM Port** is not present in the dropdown list, the Windows operating system has not yet recognized the I³ as an installed device. Be sure the installation process is complete and that the correct drivers are installed. The Connection Wizard must be completely closed and reopened to refresh the USB dropdown list.

An alternate way to select the COM setting is to go to ***i*³ Config → Tools → Application Settings → Communication → Configure** and choose connection method in **Add Target**.

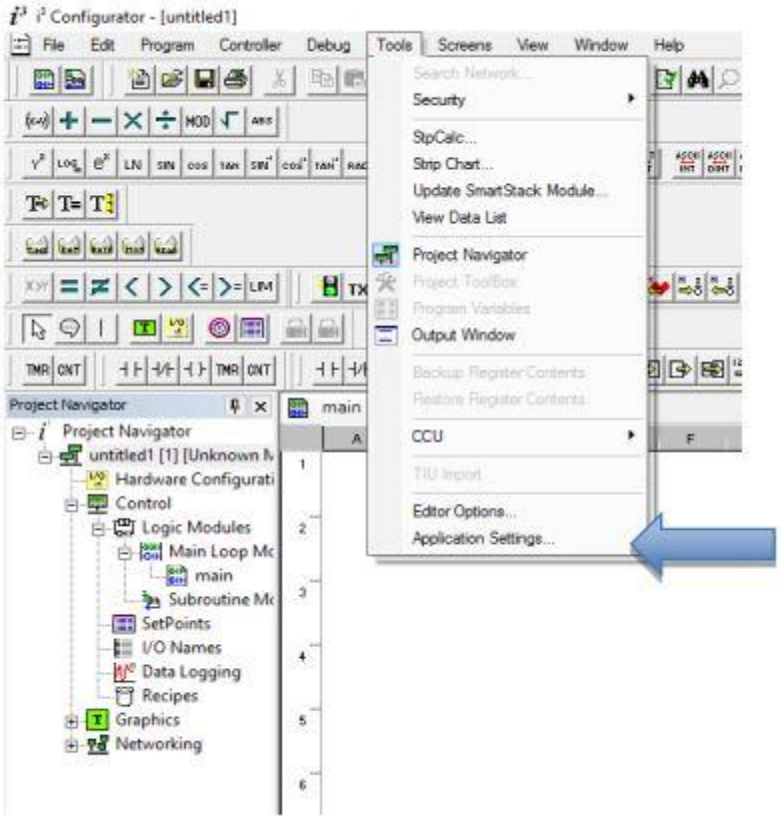


Figure 15.4 – *i*³ Config: Alternative Connection Method Screenshot

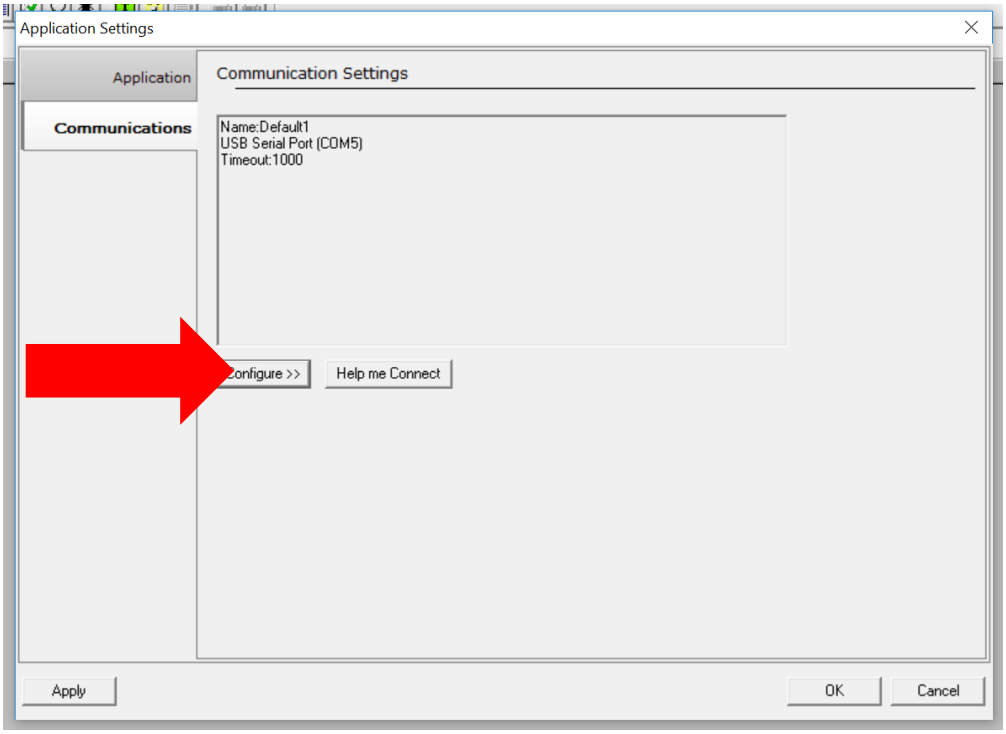
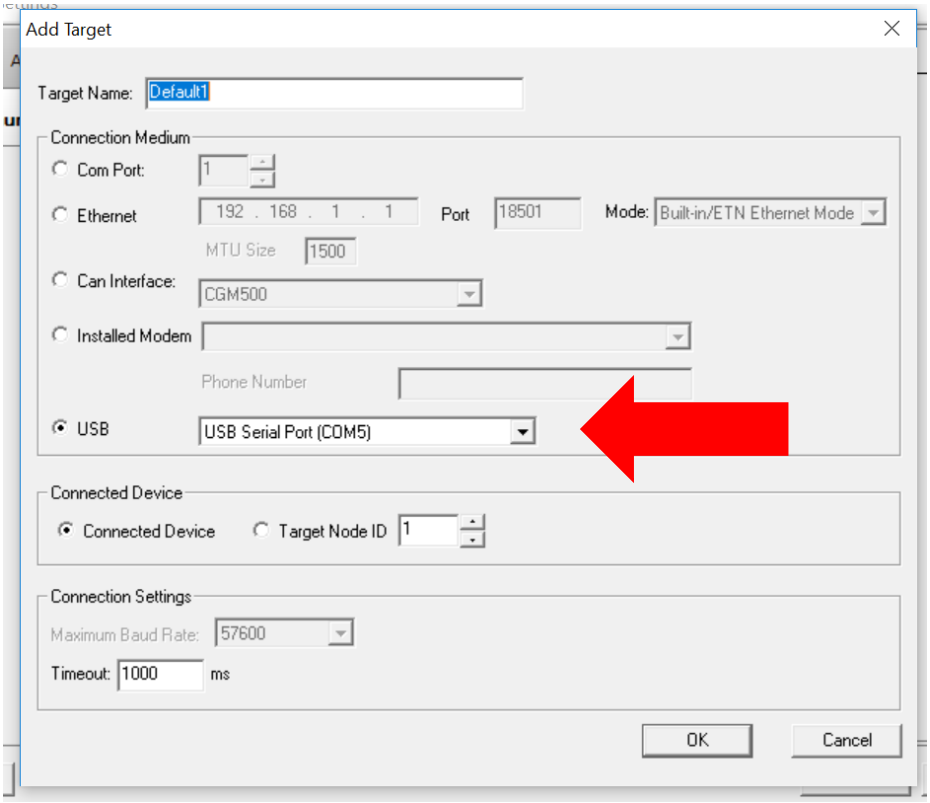


Figure 15.5 – Add Target Screenshot in I³ Config



NOTE: The following fields need to be filled for communication configuration if *i*³ Config Connection Wizard was not used. Table 15.1 explains the information needed in each field.

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

Table 15.1 – Communication Configuration Dialog	
Target Name	Name for connection. This is not a mandatory column to be filled, by default I³ Config will populate 'Default1' in edit box.
Connection Medium	
Com Port	Select this option to communicate over serial communication with the device. The port number can be configured here.
Ethernet	Select this option to communicate over Ethernet. Provide the IP address of the device and select the mode: HE GSM GPRS mode, Built in/ ETN Ethernet mode, or i3CL Ethernet mode. Select **HE GSM GPRS mode** if communication with *i*³ controller on GPRS is required and the device has GSM modem installed in *i*³ controller. Select **Built in/ ETN Ethernet mode** if the device has on-board Ethernet port. Select **i3CL Ethernet mode** if the device has Ethernet comm. option board installed in *i*³ controller. **NOTE:** For GPRS connectivity, GPRS configuration from **Programs → Messaging → GPRS** needs to be done. **NOTE:** The controller should support the type of connectivity selected and configured for Ethernet communication.
CAN Interface	Select this option to communicate over CAN. This option requires additional hardware to be installed with the PC to be able to do so. Select the type of hardware installed from the dropdown.
Installed Modem	Select this option to communicate to the device through the internal modem of the computer. *i*³ Config will automatically detect the internal modem attached with PC and list in the attached drop down. User can select modem and telephone number for target controller. **NOTE**: *i*³ Config will do necessary initialization for the selected internal modem.
USB	Select this option to communicate over USB. Now IMO devices and IMO USB to serial converters are recognized and can be specifically selected.
Connected Device	
NOTE: This configuration is required if the controller to which *i*³ Config is communicating is connected to an iCAN network.	
Connected Device	By default, this option is selected and networking feature of *i*³ Config is disabled.
Target Node ID	On selecting this option, Networking feature of *i*³ Config is enabled. iCAN ID for the target controller to be provide here.
Connection Settings (General Communication Settings)	
Maximum Baud Rate	Select the baud rate for serial communication.
Timeout	Select the communication timeout. **NOTE**: Select a larger timeout for GPRS and installed modem communication configuration

If communication is established, the target indicator will show the mode of the controller **Target: yy(R)** as shown in the status section above in this chapter, section I³ Config Status Bar.

When connected directly to the controller to which *i*³ configurator communications are required, the **Local ID and the Target ID should match.**

Local ID and Target ID Match

If the controller is not communicating, you may need to set the Target ID of the controller in *i*³ Config or change the controllers ID on the unit itself. The **Target ID** allows directing communications to a unit when multiple units are connected via an iCAN network. Units without ICAN network ports respond to any network ID and do not require the ID to be configured.

The main method for communicating between *i*³ Config and an *i*³C Lite is RS-232 serial. The controller can communicate with *i*³ Config using USB to serial adapters, CAN (iCAN) or modems. For communications other than RS-232 serial please refer to the manual that ships with the adapter hardware being used for programming.

NOTE: The following fields need to be filled for communication configuration if *i*³ Config Connection Wizard was not used. Table 15.1 explains the information needed in each field.

5. Target Name
6. Connection Medium
7. Connected Device
8. Connection Settings

15.4 Communicating via MJ1 Serial Port

Start by configuring *i*³ Config to use the correct communications port. This can be done using the **Tools → Application Settings → Communication** dialog in I³ Config.

Next connect the PC serial port to the port labeled MJ1 on the *i*³C Lite.

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

If the controller is not communicating you may need to set the target ID of the controller in *i*³ Config or on the unit. The **Target ID** allows directing communications to a unit when multiple units are connected via an iCAN network. Units without ICAN network ports respond to any network ID and do not require the ID to be configured.

To check or change the ID on the *i*³C Lite, press the far upper right corner of the touch screen to bring out the function keys, then press the System Menu key.

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

To point *i*³ Config at the correct controller, change the Target ID using the **Controller → Set Target Network ID** dialog.

15.5 Communicating via On Board Ethernet Port

The *i*³C Lite Ethernet address may be set from the System menu depending on the program currently loaded into the *i*³C Lite. To check or change the Ethernet address on the *i*³C Lite, press in the far upper right corner of the touch screen to bring out the function keys, then press the System Menu key.

Select **Set Networks** and press Enter.

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

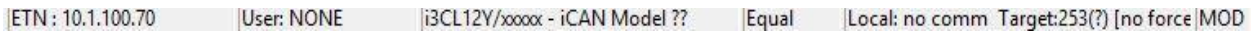
From the factory, the *i*³C Lite is set to the IP Address 192.168.254.128. To obtain Ethernet communications between *i*³ Config and the *i*³C Lite using a single Ethernet cable between a PC and the *i*³C Lite, or through an unmanaged Ethernet Switch, the PC will also need to be manually configured as follows (may require Administrator access on PC):

1. Access the Network Connections in the Control Panel (Shortcut: Press the Windows key  and type Network Connections… select the resulting filtered link).
2. Double-click the connection being used to directly connect to the *i*³C Lite to bring up the Connection Status.
3. Click **Properties.**
4. Double-click **Internet Protocol Version 4 (TCP/Ipv4)** in the list of available protocols.
5. The PC may normally be set to "Obtain an IP address automatically". Click next to **Use the following IP address:**
6. Use the IP address 10.1.100.40 or something other than that of the *i*³C Lite.
7. The Subnet Mask (255.255.255.0) should fill in automatically once the IP address has been entered.
8. The Default Gateway is not required for a direct connection.
9. Click **OK** all the way back to the Network Connections dialog.
10. Confirm the *i*³C Lite is set to the default 192.168.254.128 address or something on the same network.
11. In *i*³ Config, click **Tools→ Application Settings → Communications → Configure**
12. Select Ethernet, then enter the IP address of the *i*³C Lite.

IMPORTANT: The MTU setting defaults to the maximum 1500. It needs to match the PC's MTU setting for the best results. A PC may be set to an MTU of 1300 or something other than the default maximum setting by a network administrator.

13. The **Port** for ICAN over Ethernet is **18501**.
14. The **Mode** for any controller with built-in Ethernet is **Built-in/ETN Ethernet Mode**.
15. Change the **Timeout** value to **3000** for direct connections. Timeout values of 5000-30000+ may be common for access over the internet or via VPN or other more complex networks.

16. Click **OK** all the way back to the main *i*³ Config window. It may take a moment to initialize the communications.
17. Check the status bar for successful communications.



Examples of the PC Ethernet setup and the *i*³ Config Ethernet setup mentioned in the above steps.

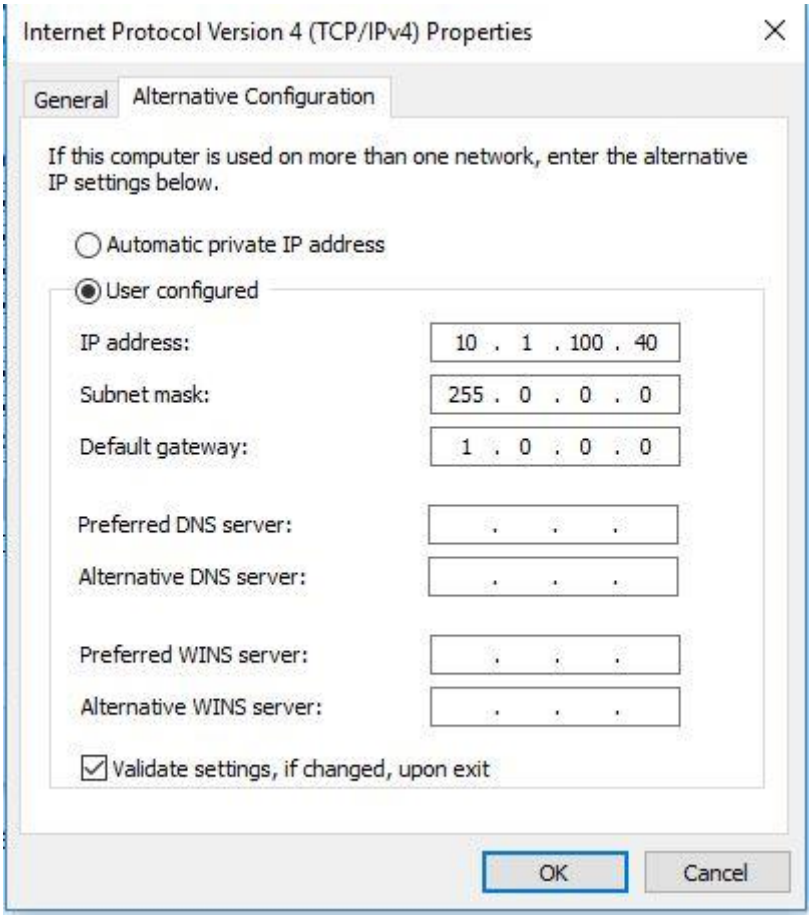


Figure 15.7 – Internet Protocol Screenshot

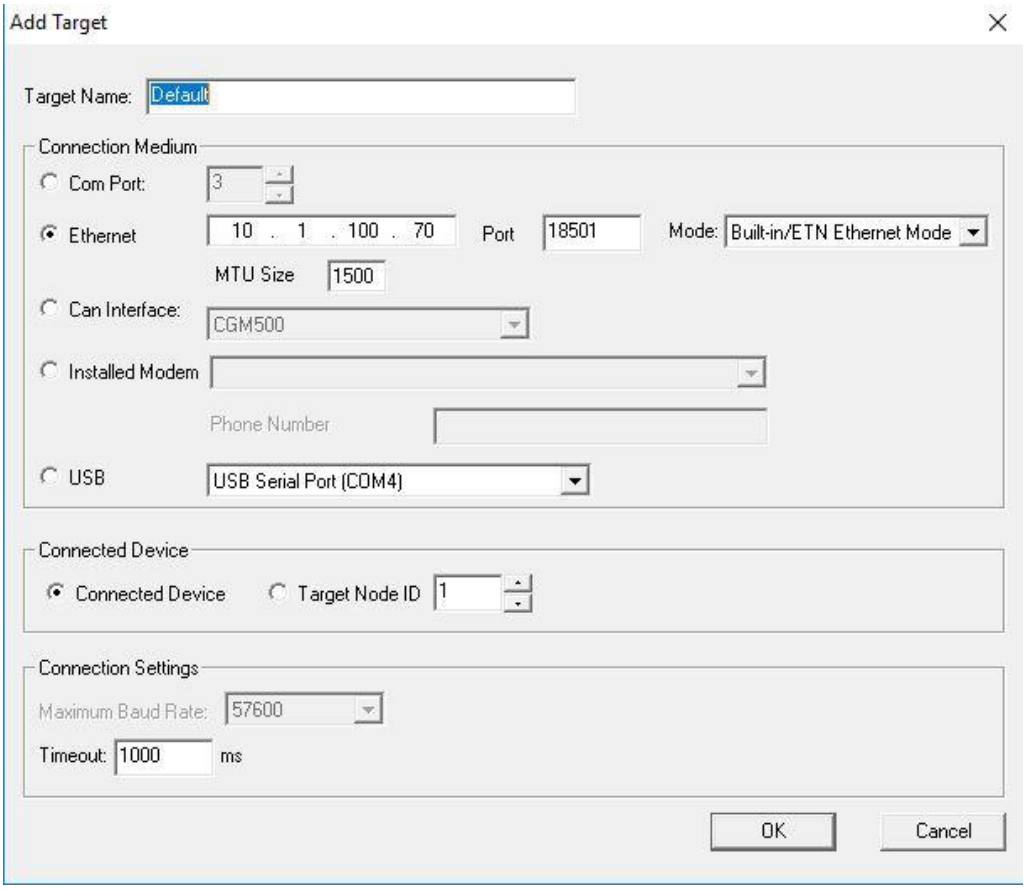


Figure 15.8 – I³ Config Ethernet Settings

To configure the Ethernet settings of the *i*³C Lite using *i*³ Config, go to **Controller → Hardware Configuration**. If not already done, select the correct connected controller, or use the **Auto Config** button to automatically recognize a controller that is already successfully connected to I³ Config.

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

In the LAN1 Configuration, fill in the network setup for the I³C LITE. It may be required to consult IT personnel to determine proper settings if connection to a corporate network is required.

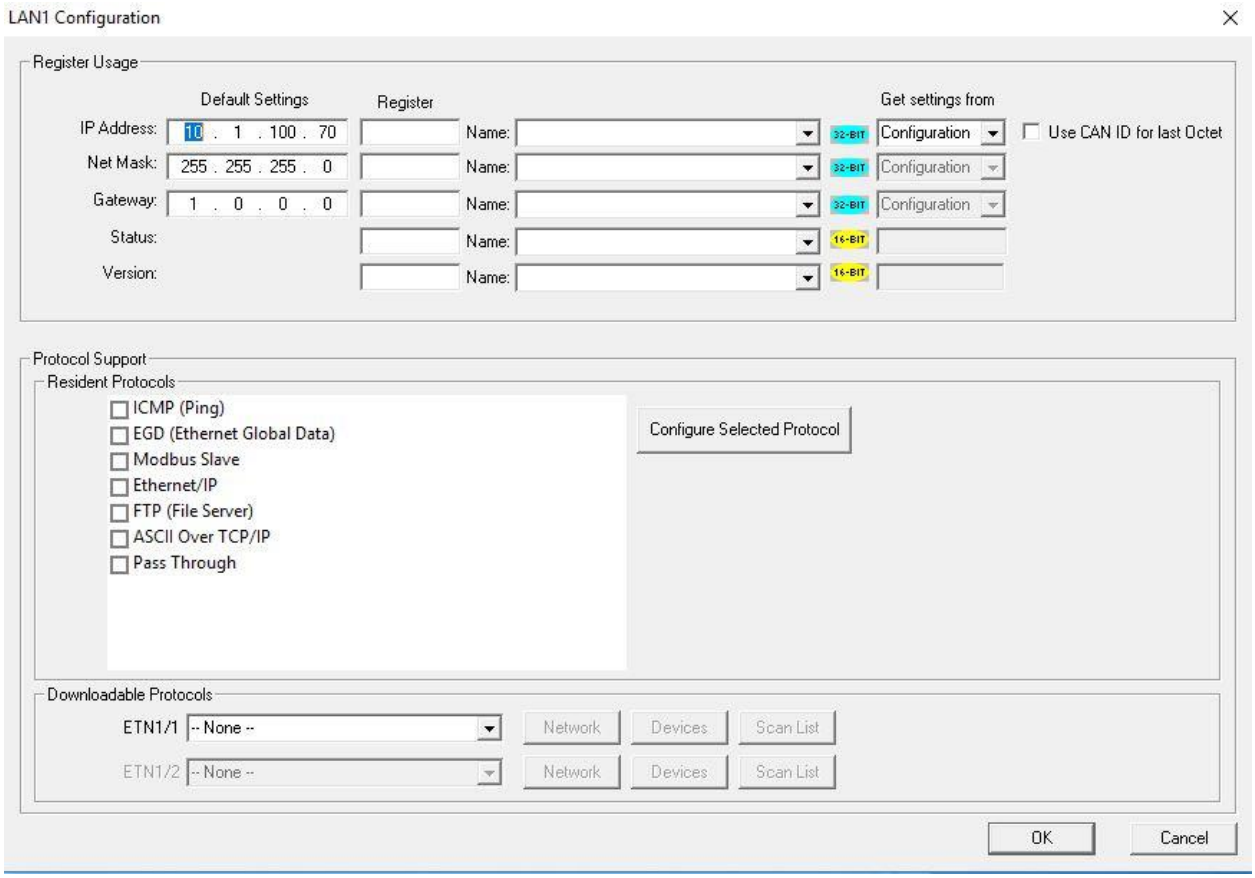


Figure 15.9 – LAN1 Configuration Dialog

If **Get settings from** is set to **Configuration** for any parameter, the addresses in the **Default Settings** column will take place when this program is loaded and every time this controller enters RUN mode. Registers may optionally be defined that will reflect the settings. These settings may temporarily be changed via the SYSTEM menu but will revert to the I³ Config-configured settings at any transition into RUN mode, i.e. a program download or at power-up.

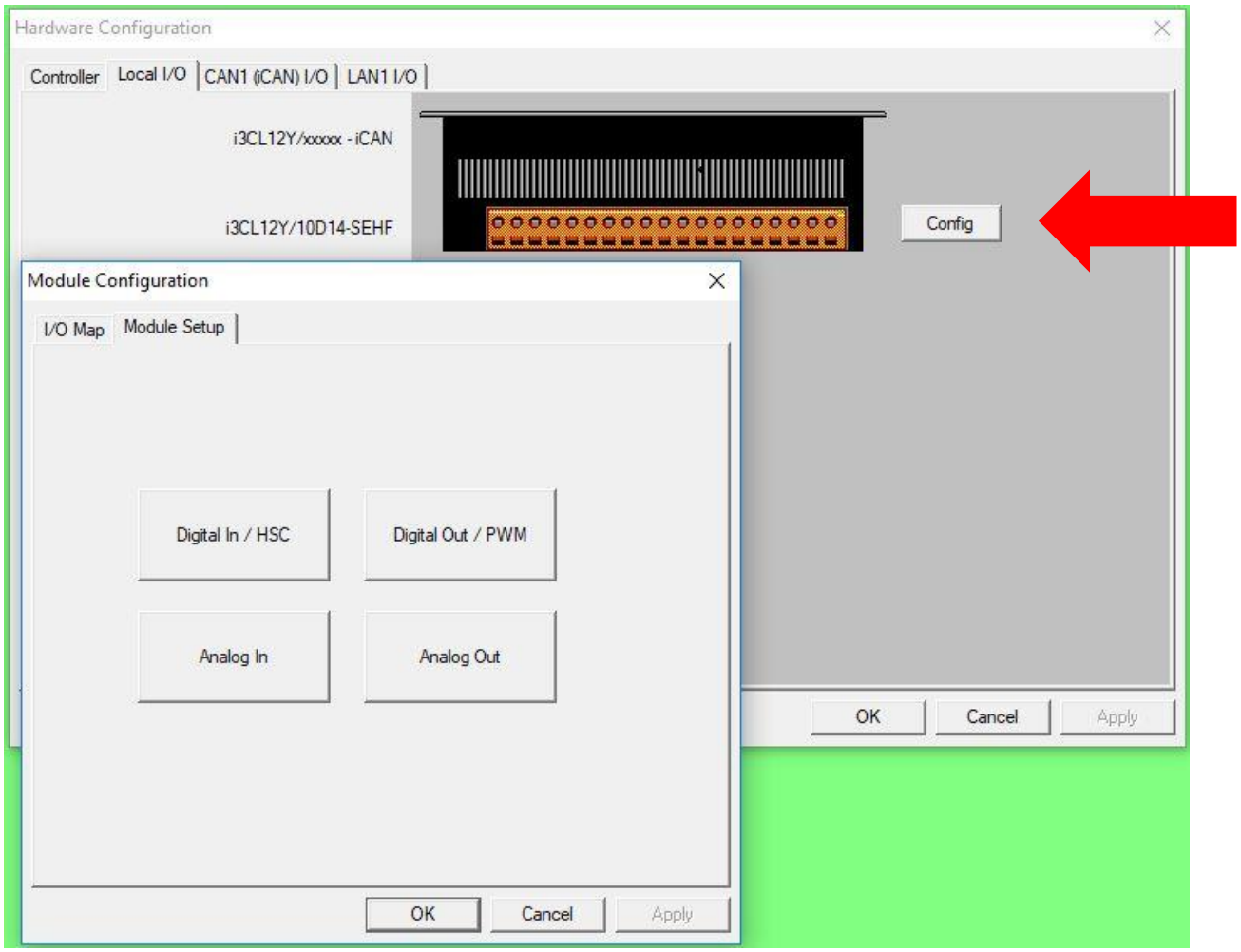
If **Get settings from** is set to **Register** for any parameter, the addresses in the **Default Settings** column are ignored entirely. The addresses instead must come from the configured registers. It is not possible to change these settings via the SYSTEM menu in this case.

15.6 Configuration

An overview of configuration:

An overview of configuration:

(1) Start the configuration by selecting the **Controller → Hardware Configure** menu item.
(2) If the *i*³C Lite is connected to the PC press the **Auto Config System** button to automatically detect the Base model, I/O and any communication options.
(3) If the *i*³C Lite is NOT connected:
    a. Select **Series → i3C Lite Series**
    b. Select **Device Type → i3C LITE**
    c. Select **Model # → i3CL12Y/10D14-SEHF or i3CL12Y/10D12-SEHF**
(4) Select **Local I/O → Module Setup**.
(5) The I/O Module Configuration dialog (Specifically the **Module Setup** tab) provides four buttons to configure all the I/O. Configure each I/O feature as needed.



(6) Once done configuring the I/O, select OK.

Configuring the *i*³C Lite I/O has four main portions that are covered in this chapter. For additional information on I/O, refer the chapters covering General I/O (Chapter 11) or High Speed I/O (Chapter 12) in this manual.

The four areas of I/O configuration are:

- Digital In / HSC
- Digital Out / PWM
- Analog In
- Analog Out

15.7 Digital / HSC Input Configuration

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

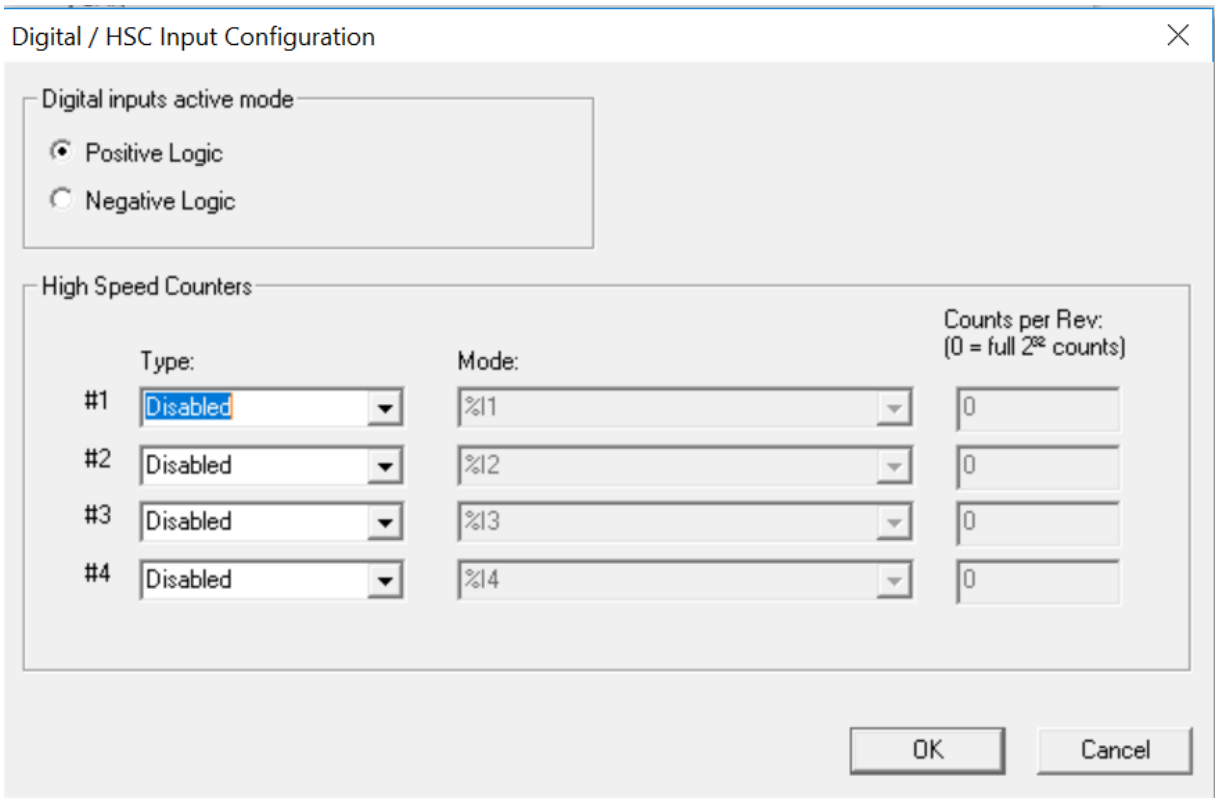


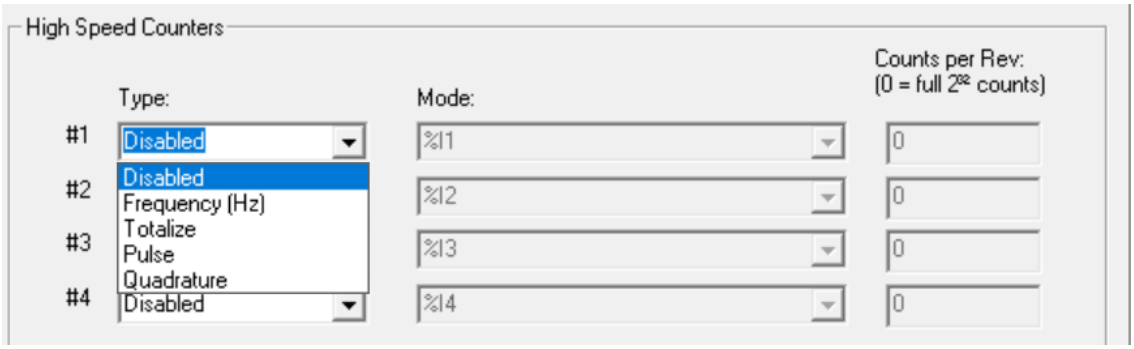
Figure 15.10– Digital / HSC Input Configuration Dialog

The Digital Input Active Mode group box allows the user to select if inputs are active high (Positive logic) or active low (Negative logic).

The **High-Speed Counters** group box contains all of the windows that are used to configure the four available high-speed counters on the *i*³C Lite. To configure a counter, the user needs to set the type, mode, and counts per rev.

The type drop down includes the following options:

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



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

15.8 Digital / PWM Output Configuration

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

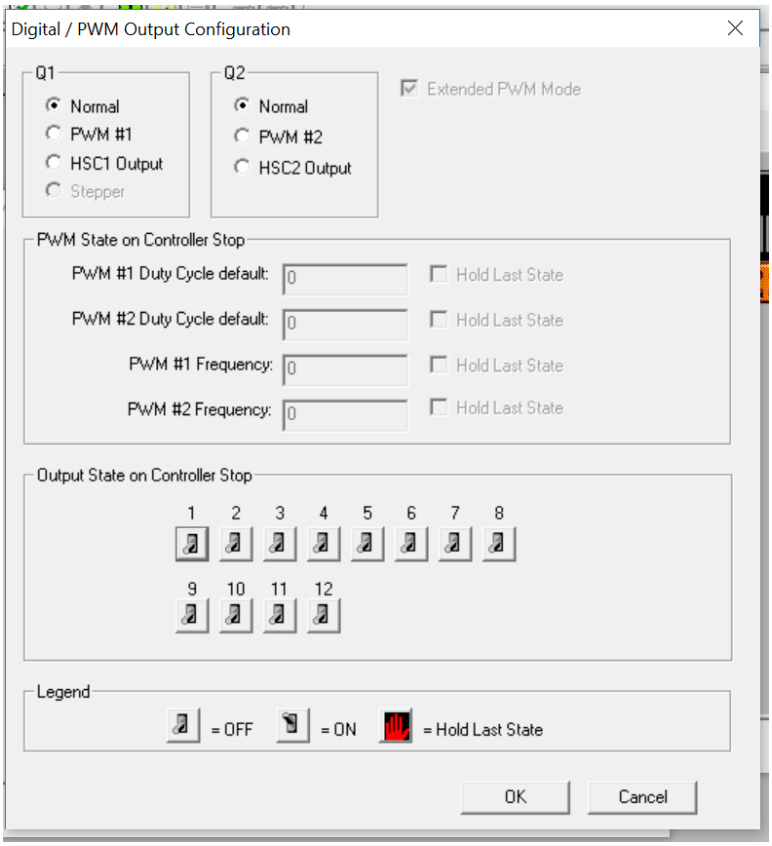


Figure 15.11 – Digital / PWM Output Configuration Dialog

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

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

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

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

15.9 Analog Input Configuration

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

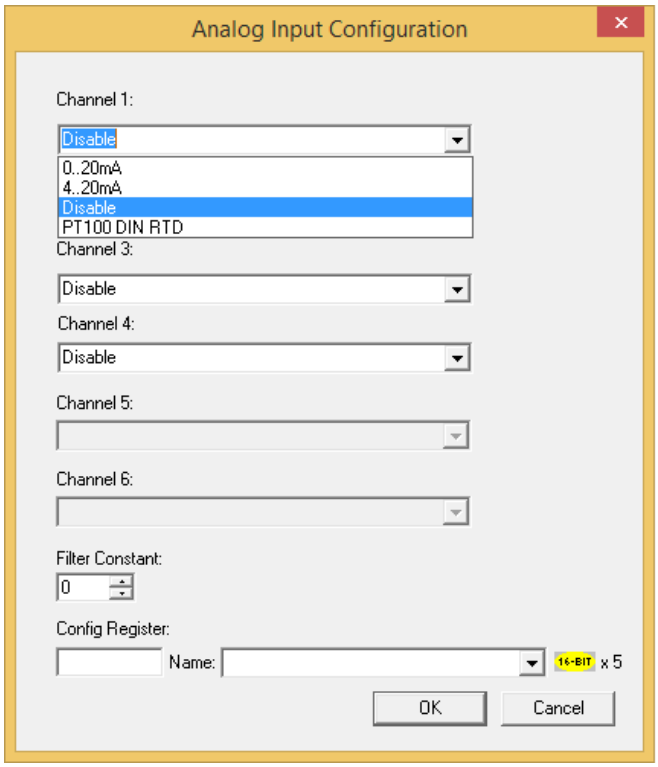


Figure 15.12– Analog Input Configuration Dialog

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

- 0..20mA
- 4..20mA
- RTD

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

15.10 Analog Output Configuration

The following figure illustrates the **Analog Output Configuration** dialog. [**Controller → (Select Series & Device Type) → Local I/O → Config → Module Setup → Analog Output Configuration}**

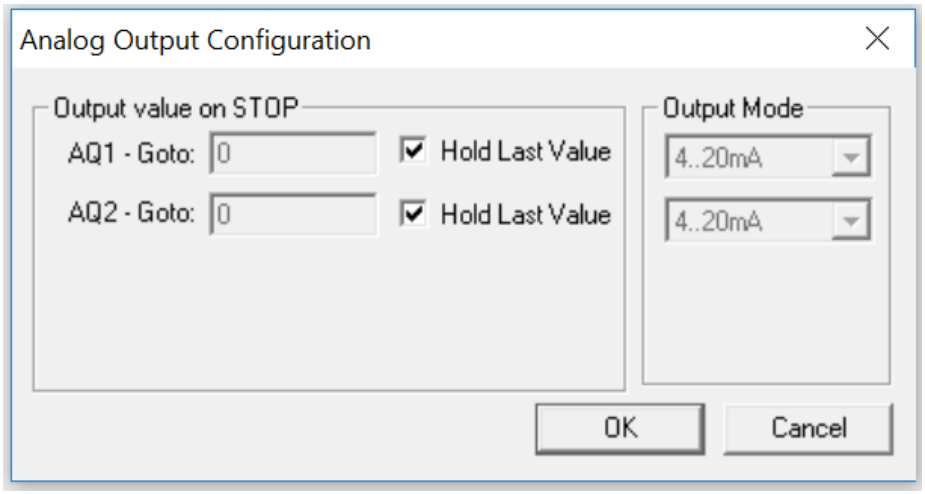


Figure 15.13 – Analog Output Configuration Dialog

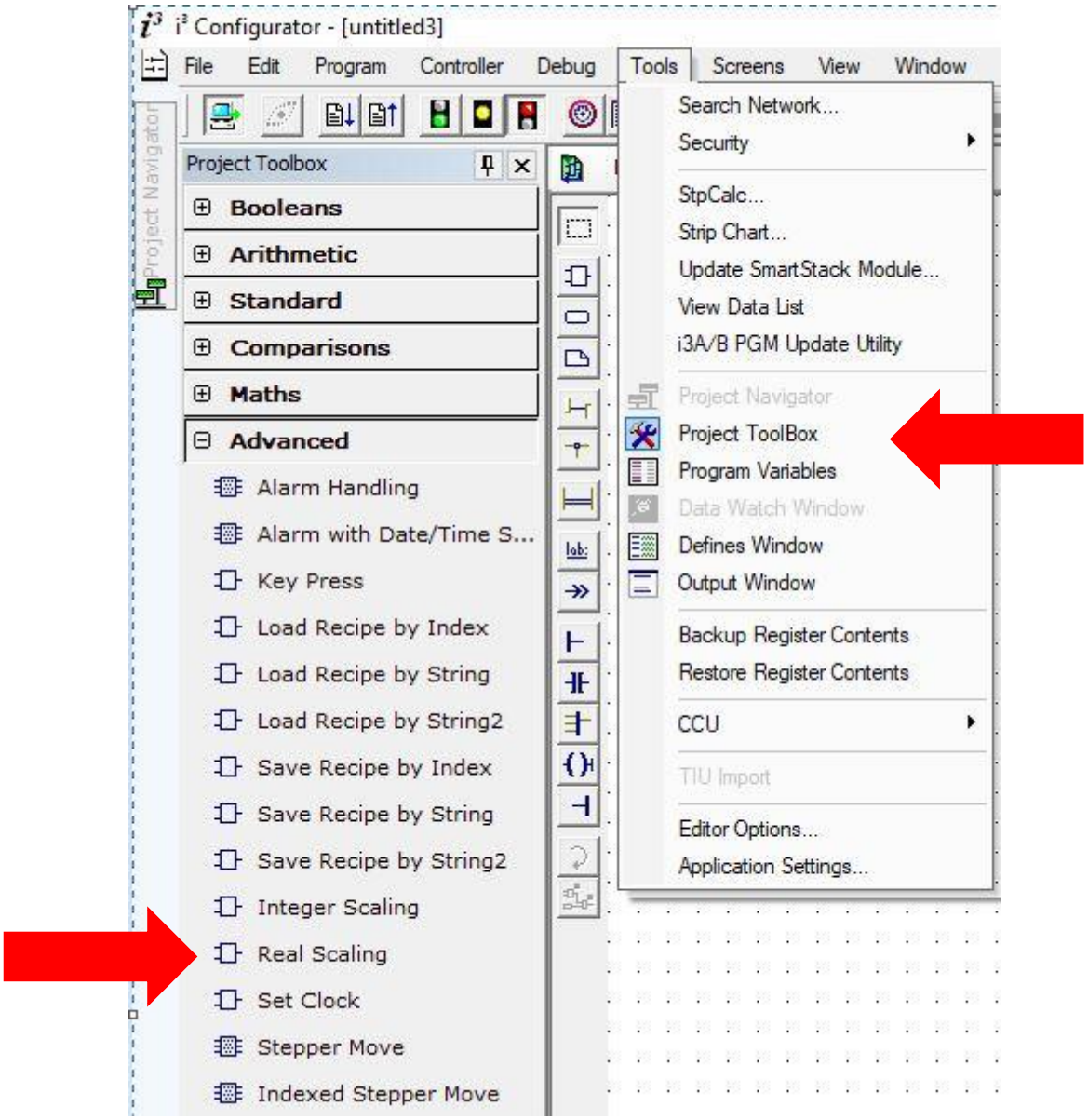
The **Output value on Stop** group box contains items that allow the user to specify how the analog output channels behave when the controller is stopped. The outputs can either hold their value or default to a value when the controller is stopped.

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

The **Filter Constant** provides digital filtering to all channels. Valid filter values are 0-7.

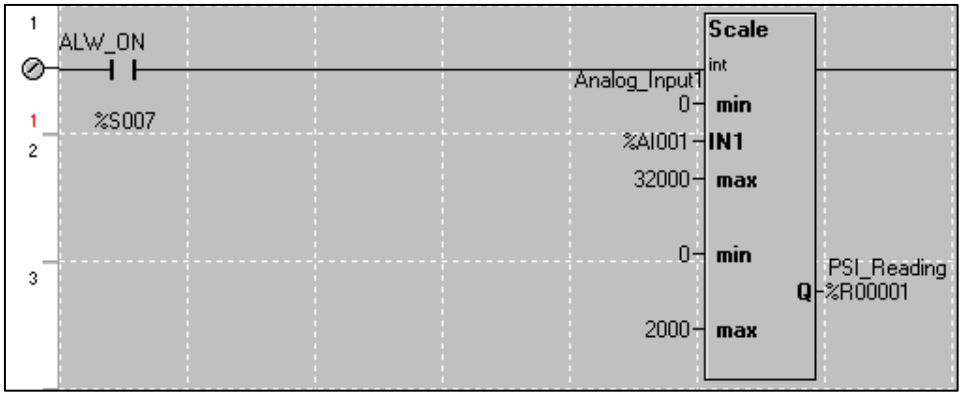
15.11 Scaling Analog Inputs

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



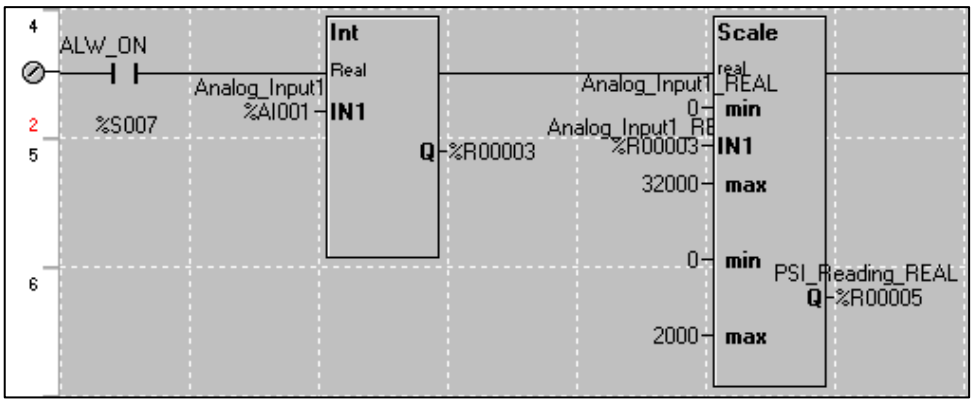
Example 1

The *i*³ Config Scale function, found in the Advanced Math functions, allows for very easy conversion of the raw input value into a meaningful reading. For example, a pressure transducer may be specified as a 4-20mA signal to signify a 0-2000 psi pressure reading. With the analog channel set to the 4..20mA range, the raw analog input value, which is in INT format ranges from 0 to 4mA to 32000 for 20mA. Use the Scale function to obtain an Integer pressure reading using the 0-32000 raw input range and the sensor's 0-2000psi output range.



Example 2:

If readings with fractions are required, the raw Integer input value must first be translated in REAL, or Floating-Point format. The I³ Config INT-to-REAL Conversion function may be used to convert the raw input value from INT to REAL format in an intermediate memory location. The SCALE function, specified as REAL type, may be used to scale the converted raw value into a reading that supports digits beyond the decimal place, i.e. 475.25psi.



CHAPTER 16: FAIL – SAFE SYSTEM

16.1 Overview

The Fail-Safe System has the following capabilities:

- Manually backup the current Battery-Backed RAM Register Settings into flash memory.
- Manually restore Register Settings from the values previously backed up in flash to Battery-Backed RAM.
- Detect corrupted Register Settings at power-up and then automatically restore them from flash.
- Detect corrupted or empty application in flash memory at power-up and then automatically load the AUTOLOAD.PGM application file from Removable Media (Compact flash or microSD).
- If an automatic Register Restore or Application Load occurs, the *i*³ can automatically be placed in RUN mode

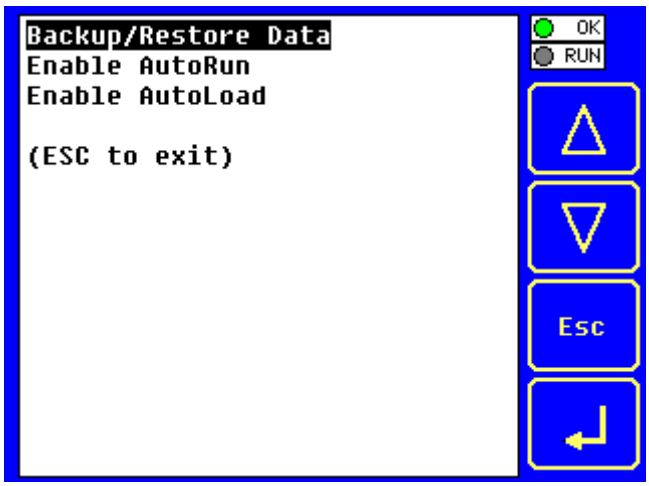


Figure 16.1– Fail – Safe System Menu

16.2 Settings

To use the fail – safe feature, the user must do the following:

1. Backup the current Battery-Backed RAM Register contents in On-Board flash memory using System Menu options.
2. From I³ Config, create AUTOLOAD.PGM for the application program using 'Export to Removable Media'.
3. Place the Removable Media with AUTOLOAD.PGM in the device.
4. Set the 'Enable AutoLoad' option in the device to YES.
5. Set the 'Enable AutoRun' option to YES if the controller needs to be placed in RUN mode automatically after automatic restore of data or AutoLoad operation.

16.3 Backup / Restore Data

Selecting this option brings up a screen having four operations:

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

Figure 16.2 – Backup / Restore Data

Backup *i*³ Data:

When initiated, this will allow the user to manually copy Battery-Backed RAM contents on to the onboard flash memory of the *i*³. This will have the effect of backing up all the registers and controller settings (Network ID, etc.) that would otherwise be lost due to a battery failure.

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

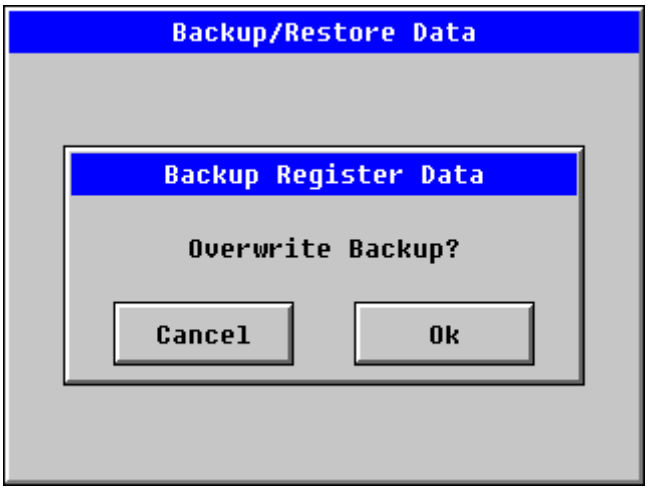


Figure 16.3 – Backup Registers

Restore *i*³ Data:

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

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

The following process is implemented to restore data:

- The controller will be placed in IDLE mode.
- Data will be copied from onboard flash memory to *i* ³ Battery-Backed RAM
- The controller will reset.
- The controller will be put in RUN mode if the AutoRun setting is 'Yes' else it will remain in IDLE mode.

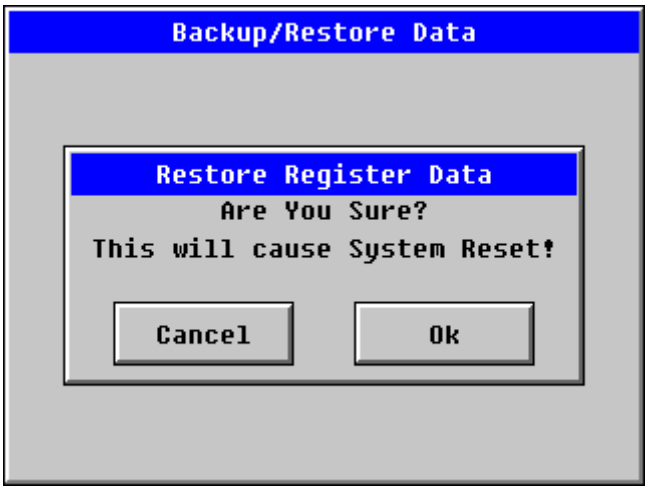


Figure 16.4 – Restore I³ Data

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

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

This will cause the controller to reset.

Clear Backup Data:

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

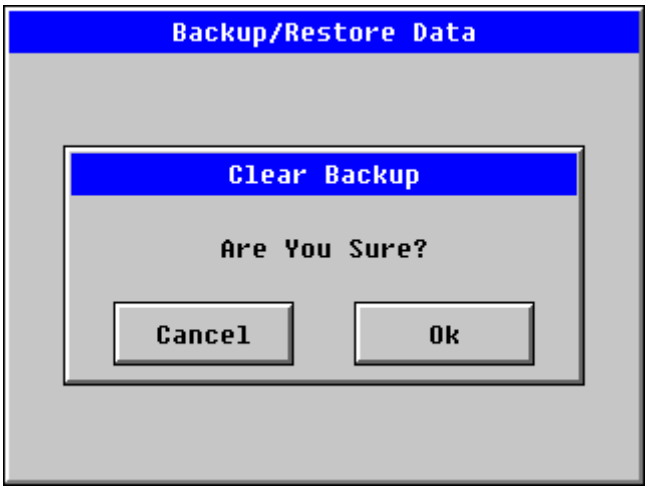


Figure 16.5 – Clear Backup Data

Exit: Goes back to the previous screen.

The *i* ³ follows the following sequence in execution of Automatic Restore:

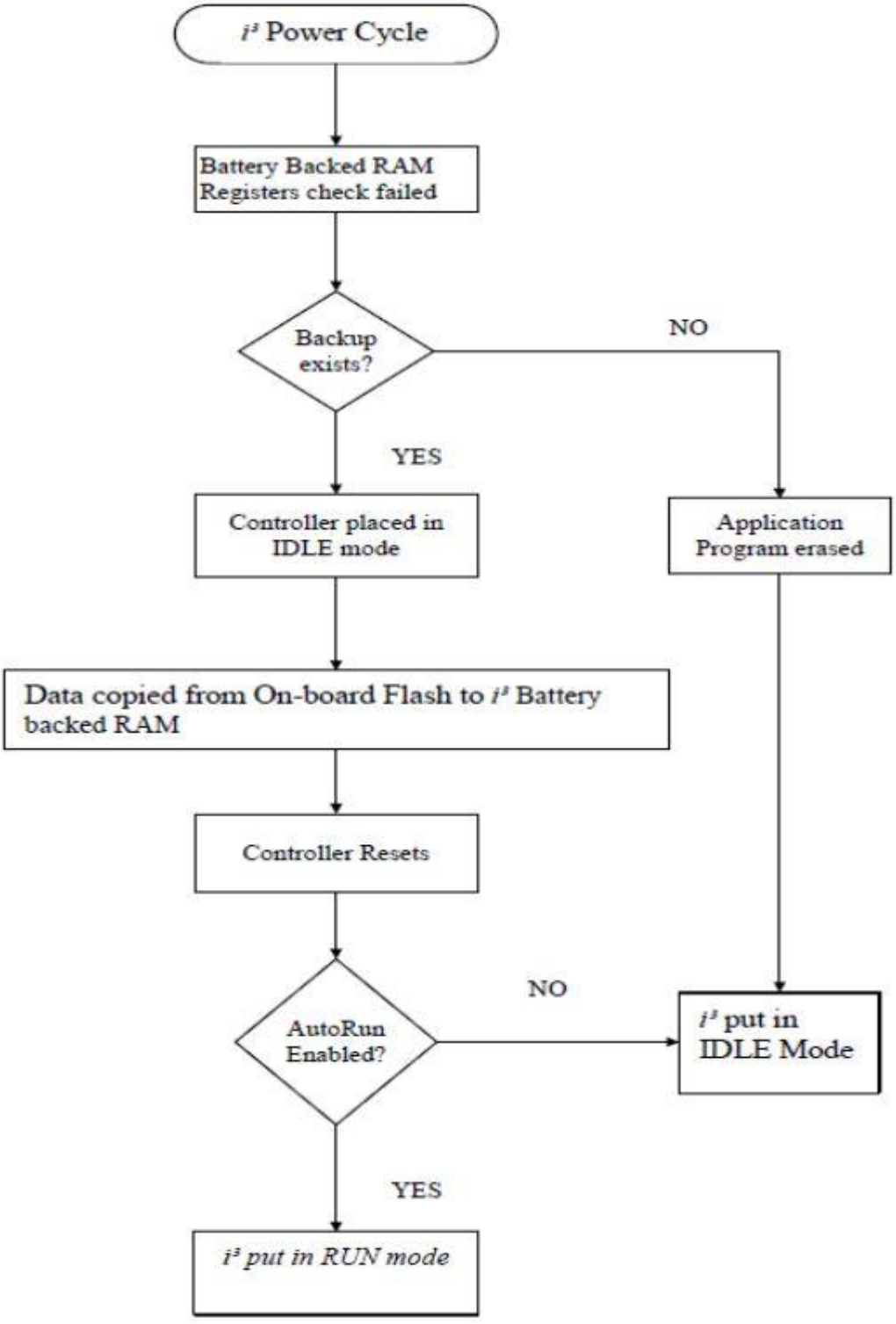


Figure 16.6 – Flow Chart for Automatic Restore

16.4 AutoLoad

This system menu option allows the user to specify whether the *i*³ automatically loads the application AUTOLOAD.PGM located in Removable Media.

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

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

- When there is no application program in the *i*³ and a valid AUTOLOAD.PGM is available in the removable media of the device.
- When the program residing in onboard memory is corrupted and a valid AUTOLOAD.PGM is available in the removable media of the device.

AutoLoad can be manually initiated when the SYS-F3 key is pressed (I³ can be in any of the following mode – Idle / Run / DOIO). This also requires a valid AUTOLOAD.PGM to be present in the removable media of the device.

When the AutoLoad setting is not enabled (set to NO), *i*³ will be in IDLE mode and the application is not loaded.

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

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

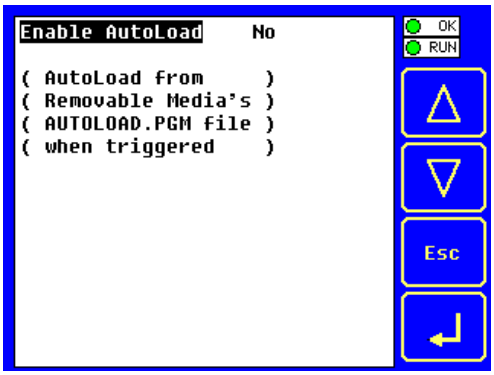


Figure 16.7 – AutoLoad Menu

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

The *i*³ implements the following sequence to execute the AutoLoad function:

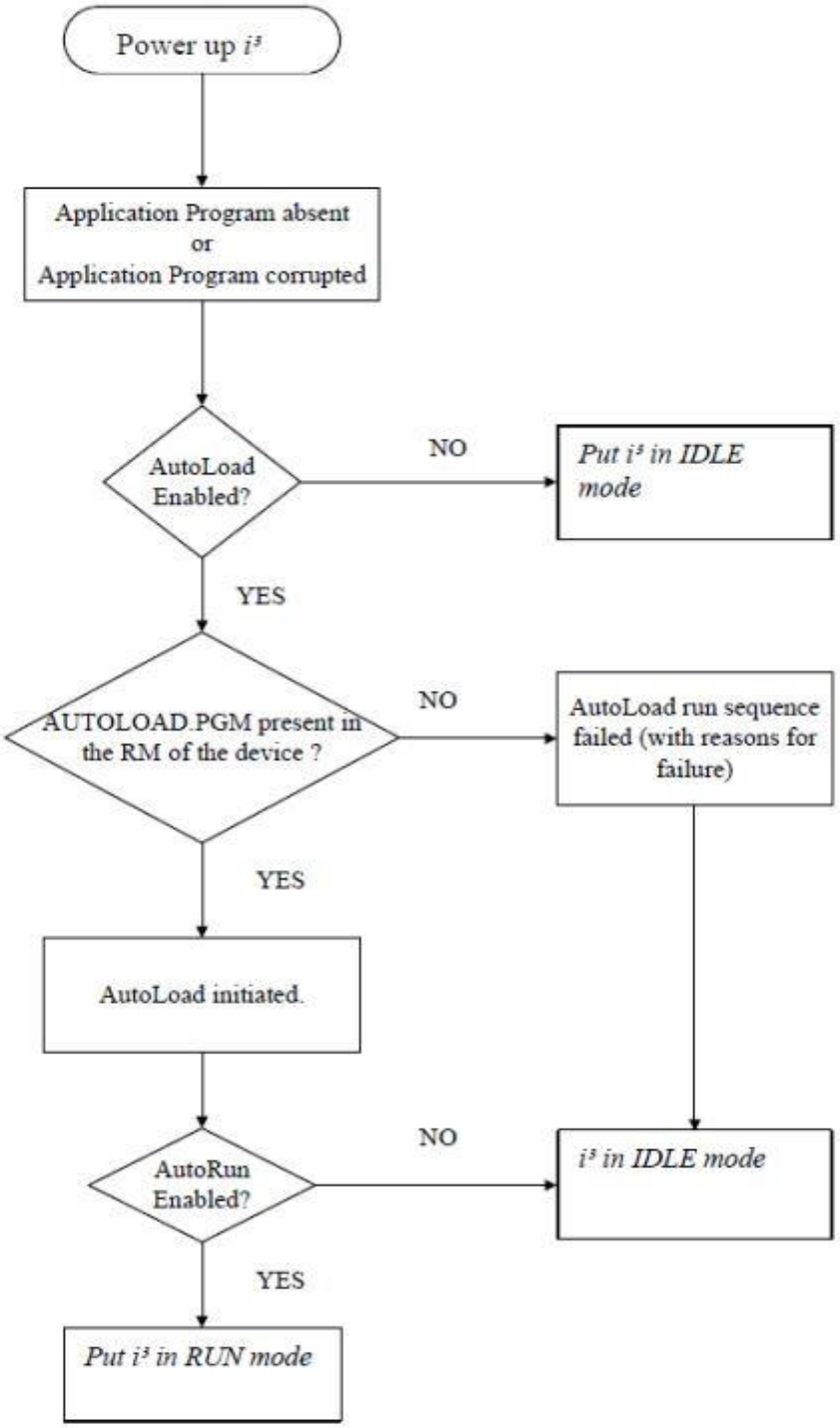


Figure 16.8 – Flow Chart for AutoLoad

16.5 AutoRun

This system menu option, when enabled (YES), allows the user to automatically place the *i*³ into RUN mode after the AutoLoad operation or automatic Restore Data operation.

When the AutoRun setting is disabled (NO), the *i*³ remains in the IDLE mode after a Restore Data or AutoLoad operation.

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

If for any reason the AutoLoad-Run (Loading the AUTOLOAD.PGM automatically and I³ put in RUN mode) sequence does not succeed, a pop-up message box saying "AUTO-LOAD-RUN SEQUENCE FAILED" will be displayed. It will also show the reason for its failure. On acknowledging this message box, the AutoLoad-Run sequence will be terminated, controller will return to the first user-screen and will be placed in IDLE mode.

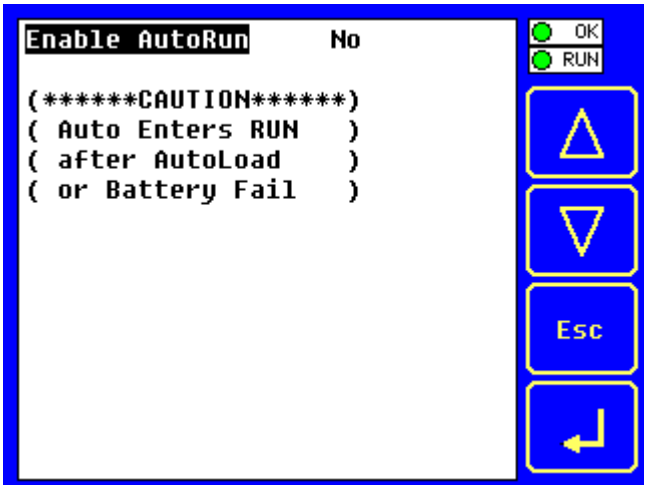


Figure 16.9 – AutoRun Menu

Enable AutoRun	**No** = *i*³ will be in IDLE mode after AutoLoad or Automatic Restore. **Yes** = *i*³ will automatically be placed into RUN mode after AutoLoad or Automatic Restore.

“Enable AutoLoad” displays the following options:

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

CHAPTER 17: CLONE UNIT

17.1 Overview

The 'Clone Unit' feature allows the user to "clone" the *i*³ of the exact same model. This feature "clones" application program and unit settings stored in Battery backed RAM of an *i*³ into the RM. It can then be used to clone a different *i*³ (exact same model). Refer to Removable Media (Chapter 10) for details on using RM.

This feature can be used for:

- Replacing an *i*³ by another unit of the same model.
- Duplicating or "clone" units without a PC.

17.2 Clone

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

1. The 'Clone Unit' can be accessed by going to the 'System Menu' of the *i*³. A new menu "Clone Unit" has been added at the end of the main system menu as shown below:

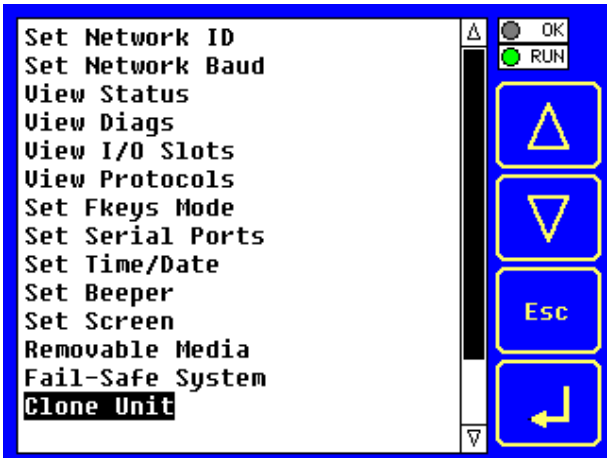


Figure 17.1 – System Menu

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

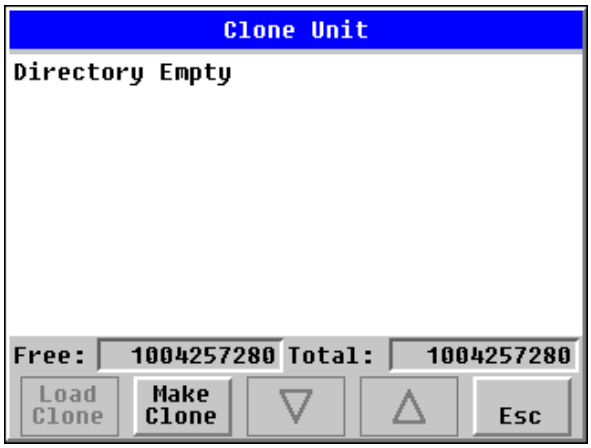


Figure 17.2 – Clone Unit Menu before Cloning

NOTE: In the above Figure 17.2, F3 and F4 are inactive in the clone Unit.

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

   Selecting Make Clone brings up the screen below:

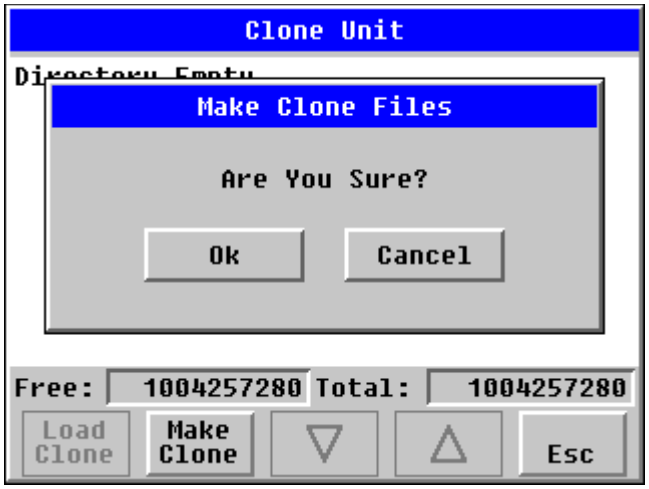


Figure 17.3 – Clone Unit Confirm Screen

After confirmation, the *i*³ will create two new files in the root directory of the Removable Media Drive as shown below:

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

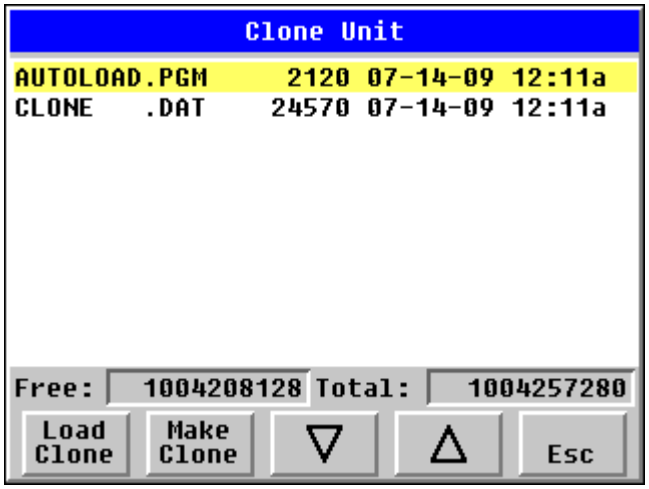


Figure 17.4 – Clone Unit Files

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

4. Once the cloning is successful, the *i*³ gives a message as below:

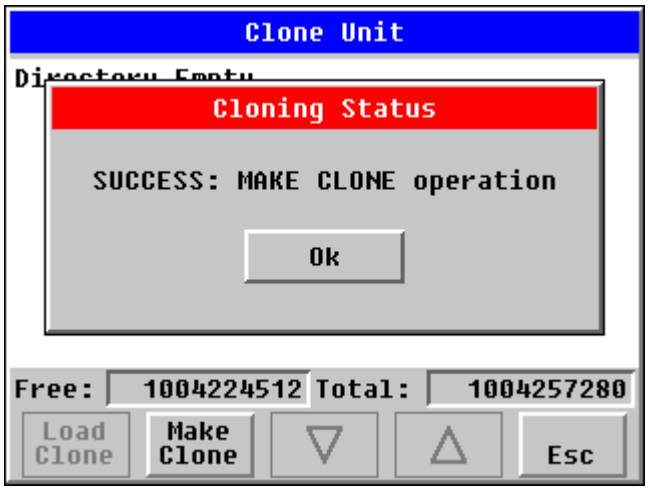


Figure 17.5 – Cloning Status

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

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

NOTE: Backup of registers in flash memory is not performed by the Clone Feature. If user desires, backup should be done as explained in Chapter 15 (Fail – Safe System).

17.3 Load Clone

This option loads the application, all unit settings and register values from Removable Media to the battery-backed RAM (regardless of AutoLoad settings), and then resets the *i*³ for the settings to take effect.

User must perform the following to Load the Clone:

1. Select “Clone Unit” from main system menu of *i*³ as shown below:

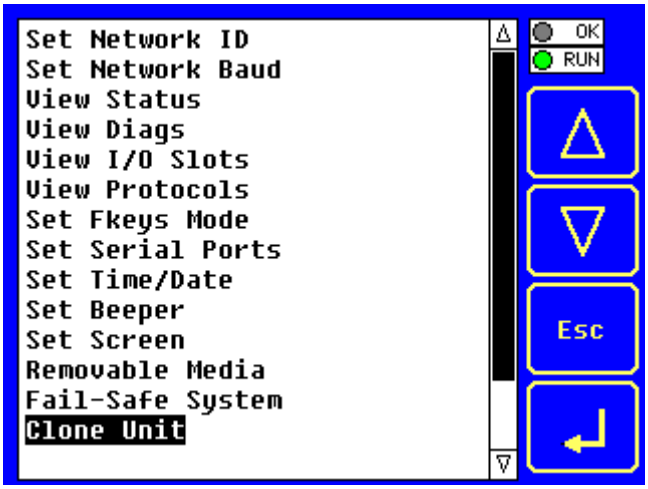


Figure 17.6 – System Menu

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

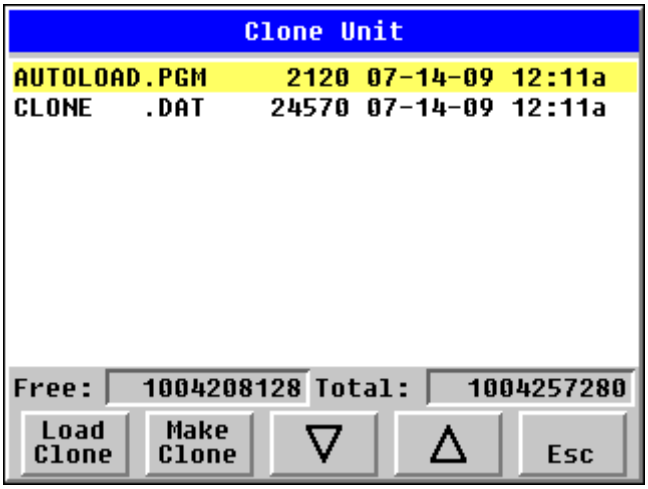


Figure 17.7 – Clone Unit Menu after Cloning

3. User must confirm Load Clone as shown below:

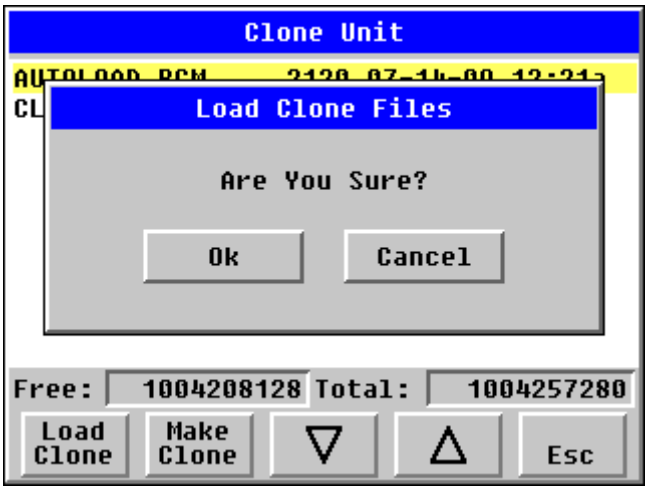


Figure 17.8 – Load Clone Confirm Screen

4. After confirmation, all unit settings and register values will be loaded from the Removable media to the Battery backed RAM (Regardless of AutoLoad settings) and then the *i*³ resets at which stage the settings take effect.

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

Load Clone can also be triggered by setting %SR164.10 bit to "1" from Ladder program or graphics. Once the operation is completed, this bit is made zero by the firmware. When the Load Clone operation is triggered by this SR bit, it does not ask the user for confirmation to load the clone. The success / failure of the operation is not notified on the screen to the user.

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

CHAPTER 18: MAINTENANCE

18.1 Firmware Updates

The *i*³C Lite. products contain field updatable firmware to allow new features to be added to the product at a later time. Firmware updates should only be performed when a new feature or correction is required.

> **WARNING:** Firmware updates should only be performed when the equipment being controlled by the *i*³C Lite is in a safe, non-operational state. Communication or hardware failures during the firmware update process can cause the controller to behave erratically resulting in injury or equipment damage. Make sure the functions of the equipment work properly after a firmware update before returning the device to an operational mode.

Steps for updating the firmware:

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

Preventing Program Loss: An available option to prevent the loss of program should the battery be drained is to use the Backup/Restore function which is part of the Fail-Safe System. This feature is highly recommended and is accessible from the System Menu and from program logic. Backup/Restore DOES NOT require the installation of a microSD card in order to prevent program loss. Please see Chapter 16 for complete details on the Fail-Safe System.

18.2 Backup Battery

The *i*³C Lite. contains a run-time battery monitor that checks the voltage of the internal lithium battery. This battery is used to run the real-time clock and maintains retentive registers when power is disconnected. Under normal conditions the battery in the *i*³C Lite should last 7 to 10 years. Higher operating temperatures or variations in batteries may reduce this time.

18.3 Indications the battery needs replacing

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

18.4 Battery Replacement

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

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

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

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

The *i*³C Lite uses a 3V Lithium Coin battery which can be ordered from IMO.

Below are the steps to replace the battery.

1. Make sure the user program and any data stored in retentive memory is backed up.
2. Disconnect all power from the *i*³C Lite. unit including I/O power.
3. Remove all connectors, and then use a flat head screwdriver to press and release the four (4) clips. Remove the back cover.
4. Remove the old battery. It may require a small flat blade screwdriver to lift it from the holder.
5. Dispose of the battery properly; see the above warning on disposal regulations.
6. Slide the new battery into the holder. Make sure the battery is inserted with the proper polarity. The top tab of the battery holder should contact the positive (+) terminal of the battery.
7. Place the back cover over the unit and gently press each corner evenly in order to snap the clips back into place.
8. Apply power to the unit. Check that the battery error is no longer reported. If the unit still reports the error, remove the battery immediately and contact Technical Support.

CHAPTER 19: MODBUS COMMUNICATIONS

19.1 Modbus Overview

For complete Modbus instructions, please refer to the Help file in I³ Config.

Modbus (serial) is a popular, de-facto standard protocol that allows industrial devices from multiple manufacturers to easily share data in real-time. For Modbus serial communications, the *i*³C Lite. can act as either a Master or a Slave.

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

19.2 Modbus Slave Overview

For complete Modbus Slave instructions, **please refer to the Help file in *i*³ Config**.

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

Section 19.5 describes the supported Modbus Commands as well as the Modbus Map for *i*³C Lite. References (%R, %M, etc.).

19.3 Modbus Master Overview

For complete Modbus Master instructions, please refer to the Help file in I³ Config.

When acting as a Modbus master, there are two primary mechanisms used by the *i*³C Lite. to allow the user to specify the data to be read/written from/to the slaves.

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

Protocol Config—The Protocol Config is configured in the Hardware Configuration dialog box in I³ Config (serial) – See Section 18.5. This is the preferred method in most applications.

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

- **Network**—Parameters, such as the polling rate of the data scan, are specified along with timeout values, retry, and re-acquisition settings. Serial configuration, baud rate, parity, etc. are also set here.
- **Devices—**For every slave to be polled, configuration details are added in the Devices dialog box. This includes Slave ID (serial). Under Device Type, the Modbus addressing style matching that specified in the slave's user documentation may be selected. For instance, some slaves specify Modbus addresses (i.e. 40,001), and others specify offsets (i.e. 0000).
    - **Hex or Decimal—**Some specify addresses in hex, and others in decimal. By allowing the user to select the Modbus addressing style for each slave on the network, minimal address conversion is required. Also, if the slave is another IMO product (i.e. another I³), the "Native Addressing" option can be selected (i.e. %R1, %M17, etc.), and this skips the conversion to Modbus style altogether.
- **Scan List—**This is where the specific Modbus addresses to be read/written from/to each slave are specified. Up to 32 words of data can be read at the same time.

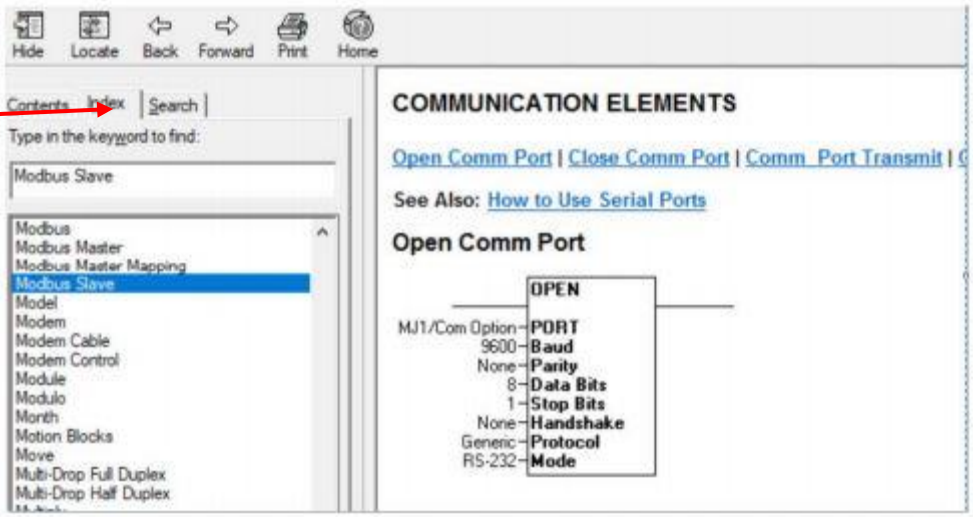
  NOTE: Once configuration has been completed on the Network and Devices level, Modbus data can be directly read/written from graphics objects in the *i*³ Config screen editor. This is available even if the Modbus register is not listed on the scan list.

The above information is just an introduction to the topic. For more detailed information, please consult the *i*³ Config Help file.

19.4 Opening I³ Config Help File

After opening the *i*³ Config Help file, select the Index table and search for “Modbus Slave” or “Modbus Master”, as shown below.

Select “Index” tab.



19.5 Modbus Addressing Table for *i*³C Lite Units

To access *i*³C Lite registers, a Modbus Master must be configured with the appropriate register type and offset. This is usually accomplished with one of two methods:

Method 1: The first method uses **Traditional Modbus References**, in which the high digit represents the register type and the lower digits represent the register offset (starting with Register 1 for each type). Since only four register types can be represented in this manner, *i*³C Lite Modbus Function Blocks pack several I *i*³C Lite register types into each Modbus register type. Starting addresses of each *i*³C Lite register type are shown in the **Traditional Modbus Reference** column of the Table 19.1.

Method 2: The second method requires the Modbus Master to be configured with a specific **Modbus Command** and **Modbus Offset.** The supported Modbus commands and the associated offsets are also illustrated in Table 19.1.

Table 19.1 – Modbus Master Mapping

I³C LITE Reference	Maximum Range	Trad. Modbus Ref. (5 digits)	Expanded Modbus Ref. (6 Digits)	Modbus Commands	Modbus Offset
%I1	1024	10001	010001	Read Input Status (2)	0
%IG1	256	13001	013001		3000
%S1	256	14001	014001		4000
%K1	10	15001	015001		5000
%Q1	1024	00001	000001	Read Coil Status (1) Force Coil (5) Force Multiple Coils (15)	0
%M1	1024	03001	003001		3000
%T1	1024	06001	006001		6000
%QG1	256	09001	009001		9000
%AI1	256	30001	030001	Read Input Register (4)	0
%AIG1	32	33001	033001		3000
%SR1	200	34001	034001		4000
%AQ1	256	40001	040001	Read Holding Register (3) Load Register (6) Load Multiple Registers (16)	0
%R1	2488	40513	040513		0
%R1	2048	43001	043001		3000
%AQG1	32	46001	046001		6000
%R1	5000	--	410001		10000

CHAPTER 20: TROUBLESHOOTING / TECHNICAL SUPPORT

Chapter 20 provides commonly requested **troubleshooting information and checklists** for the following topics.

20.1 Connecting to the *i*³C Lite

I³ Config connects to the local controller automatically when the serial connection is made. The status bar below shows an example of a successful connection. This status bar is located in the bottom right hand corner of the I³ Config window.

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

Determine connection status by examining feedback next to **Local** & **Target** in the status bar of *i*³ Config.

Local: ###	If a number shows next to **Local,** then communication is established to the local controller.
Local: No Port	*i*³ Config is unable to access the COM port of the PC. This could mean that *i*³ Config is configured for a COM port that is not present or that another program has control of the COM port. Only one *i*³ Config window can access a port at a time. Subsequent instances of I³ Config opened will indicate No Port.
Local: No Com	*i*³ Config has accessed a PC COM port but is not communicating with the controller. This typically occurs when the controller is not physically connected.
Local: ???	Unknown communication error. Close *i*³ Config, power cycle the controller and reopen I³ Config with a blank project. Check Local.
Target: #(I,R,D)	If I (idle), R (run), or D (do I/O) shows next to **Target number** then communication is established to the target controller.
Target: #(?)	Communication is not established to the target controller. Check node ID of controller and set Target to match. Make sure **local** connection is established.

20.2 Connecting Troubleshooting Checklist (serial port – MJ1 Programming)

1. Controller must be powered up.
2. Ensure that the correct COM port is selected in *i*³ Config. **Tools → Applications Settings → Communications** .
3. Ensure that a cable with proper pinout is being used between PC and controller port MJ1.
4. Check that a Loaded Protocol or ladder is not actively using MJ1. Taking the controller out of Run Mode from the System Menu on the controller will make MJ1 available to *i*³ Config.
5. Successful communications with USB-to-serial adapters vary. If in doubt, IMO offers a USB to serial adapter. Part numbers PC501

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

1. Controller must be powered up.
2. Ensure that the correct COM port is selected in i³ Config. **Tools → Applications Settings → Communications**.
3. Be sure that the USB cable is connected between the PC and the controller. Check Windows Device Manager to ensure that the USB driver is properly installed and to verity the port number.

20.4 Connecting Troubleshooting Checklist (ETN port programming)

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

20.5 Local Controller and Local I/O

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

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

To view the system menu, press the UP and DOWN arrow keys simultaneously. See Chapter 9 for full details on the System Menu diagnostic capabilities.

20.6 Local I/O Troubleshooting Checklist

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

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

20.7 iCAN Network

For complete information on setting up an iCAN network, refer to CAN Networks manual by visiting our website for the address to obtain documentation and updates.

Network status, node ID, errors, and baud rate in the controller System Menu are all in reference to the iCAN network. These indications can provide performance feedback on the iCAN network and can also be used to aid in troubleshooting. Refer to Chapter 9 for full details on the System Menu.

20.8 ICAN Network Troubleshooting Checklist

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

20.9 Basic Troubleshooting

Description	Action
*i*³C Lite does not read media card.	The media card should be formatted.
*i*³C Lite will not download project file.	Make sure the project file is saved as a .pgm file and not a .csp file.

20.10 Technical Support Contacts

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

IMO Precision Controls Ltd:
Tel: +44 (0) 1707 414 444
Web: https://www.imopc.com
Email: automation@imopc.com

IMO Worldwide Offices

IMO Precision Controls Limited
The Interchange
Frobisher Way
Hatfield, Herts AL10 9TG
United Kingdom

Tel: 01707 414 444
Fax: 01707 414 445
Email: imo@imopc.com
Web: www.imopc.com

IMO Jeambrun Automation SAS
5, Rue Alfred De Musset
94100
Saint-Maur-Des-Fosses
France

Tel: 0800 912 712 (nº gratuit)
Fax: 0145 134 737
Email: imo-fr@imopc.com
Web: www.imojeambrun.fr

IMO Automazione
Via Belfiore 10,
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Tel: 800 930 872 (toll free)
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Web: www.imopc.it

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Ontario L6T 4Y2
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Fax: 905 799 0450
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Web: www.imopc.com

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Cumming, GA 30040
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Web: www.imoautomation.com

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G16 Centurion Business Park
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Web: www.imopc.co.za

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