i^3 Remote I/O Tutorial

Introduction

In this tutorial we will see how to connect an i^3 to 4 types of remote device – an iSmart, an iOS module, a Modbus RTU Smart I/O and an iCAN Smart I/O.

Connecting to these devices is a simple task, and to make it even easier, there is a demo program to accompany each device type. The steps must be followed carefully so please read carefully and try not to skip any!

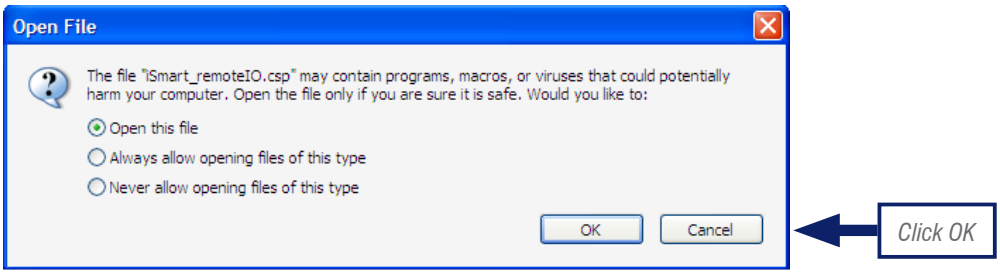
Connecting i3 to iSmart

STEP 1 - Getting Started

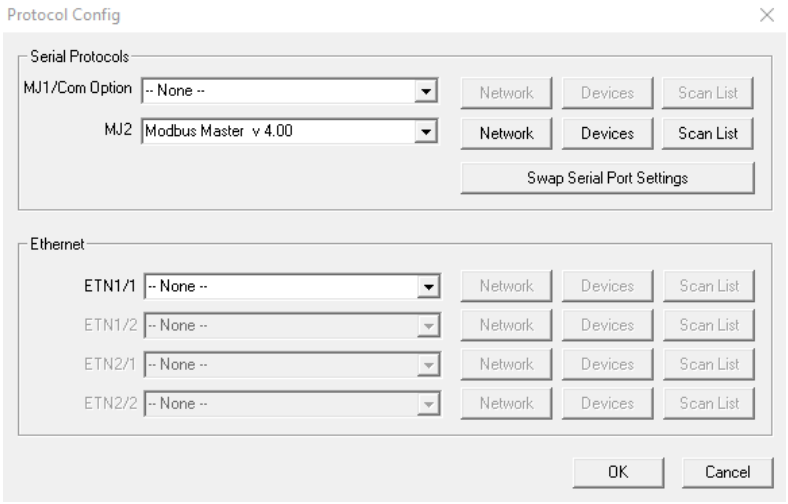
There are numerous i^3 Configurator demo files attached to this PDF document. They have been generated using i^3 Configurator V9.8, so please make sure this version (or later) is installed on your PC before going any further (visit www.imopc.com for a free download).

Open the attachment window in Adobe by clicking on the paperclip icon below, a list of demo files will appear, open the first:

The following message will appear:



The Modbus master protocol utilises the Modbus function codes 03 to read single and multiple registers, 10 to write to multiple registers and 06 to write to single registers. Most Modbus slave devices only use the function codes 03 to read and 06 to write. Therefore the i^3 can communicate with any Modbus enabled device.



The network has to match the slowest device, so checking the equipment's' capabilities before setting up the network is essential. All devices on the network must be configured to the same parameters. In this small example, the Network parameters to suit all devices will be: Baud Rate = 9600, RS485 (Half Duplex), Modbus RTU, 8 data bits, 1 stop bits.

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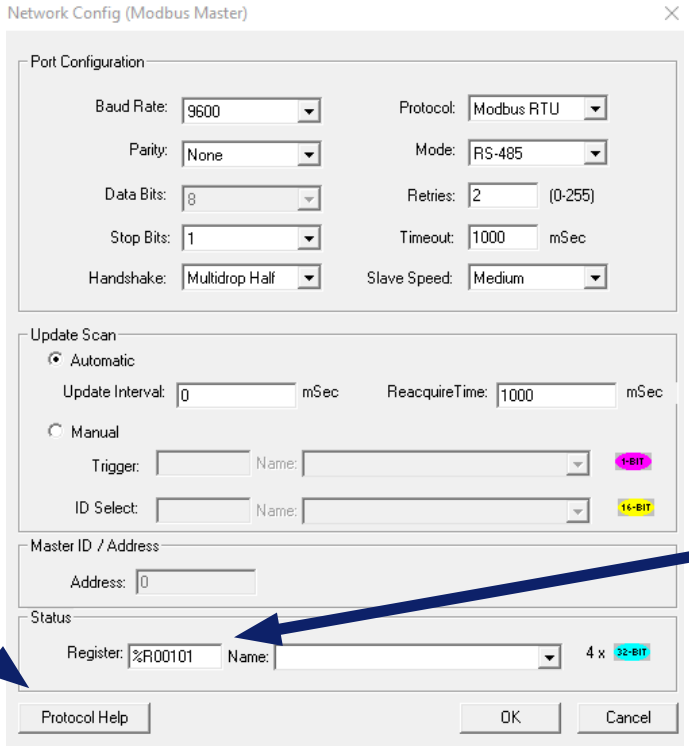
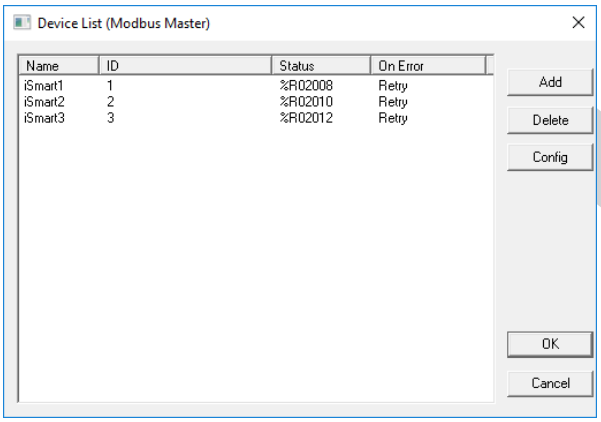


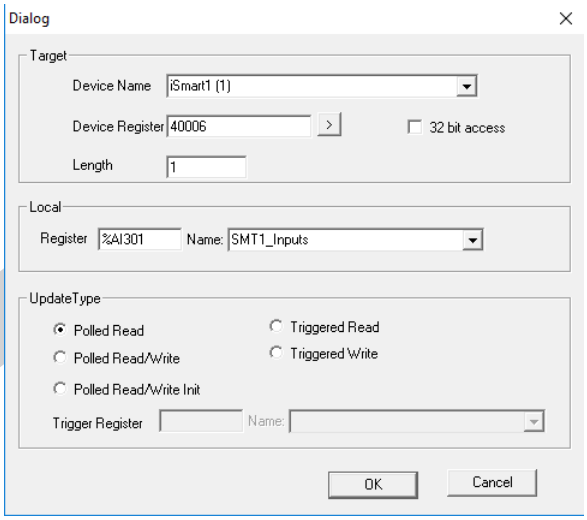
Protocol help can be accessed here by pressing the button. Once complete please click the OK button.

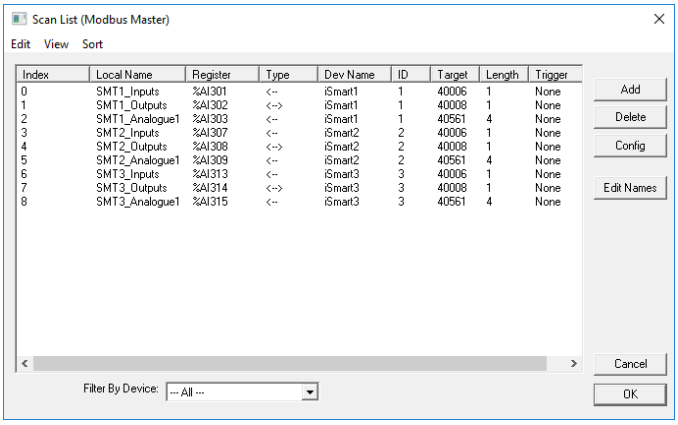
To see the status of the network assign a %R register here.

Now that the Network has been set up we need to add the slave devices. Select the Devices button to open up the editor.



Enter a name for the device and assign it a Modbus address (1-255).





Once the devices have been set up click OK.
Set up the address of the device we are going to read and write to.
Select Scan List

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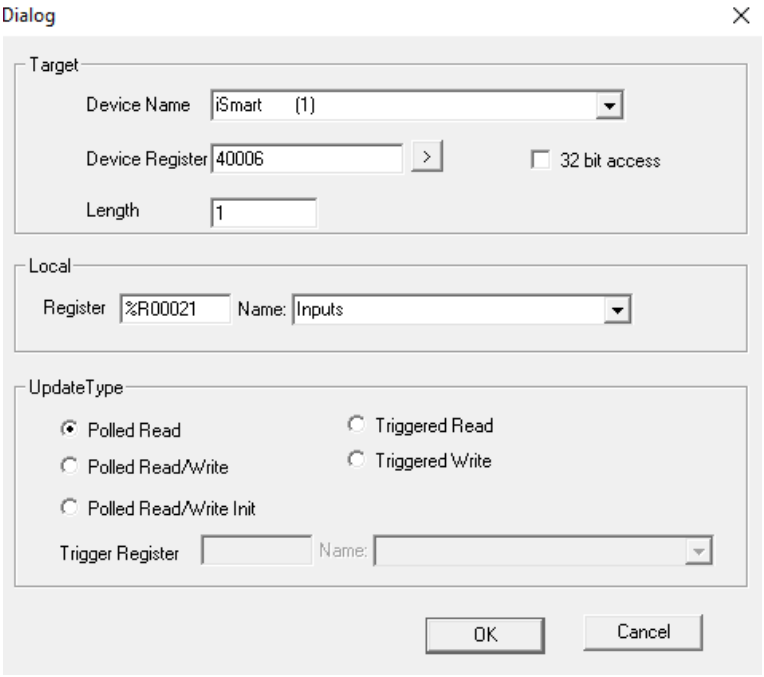


Select the Modbus device register address and the length of the data.

The data in the device address will be stored in the i^3 locally where specified in a particular register.

The type command and update type are define here. Whether the data is read or write and polled always or triggered on a bit.

STEP 2 – Download the program to the i³

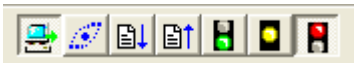
If you have never used an i^3 before, then sometimes it can be difficult to first establish a connection between it and the PC. There are two main causes of this difficulty:

- Most laptops no longer come with an in-built RS232 Serial Port, so a USB to serial converter must be used. Windows 10 assigns the first available com port when the USB device is plugged in – this is not always the same port and should be checked via Windows Device Manager if connection problems are occurring.
- The i^3 Configurator software is designed to connect up to 253 networked i^3 devices from any single point of connection. The network ID in the controller must match the ID in the i^3 Configurator project.

Connect the programming cable (i3-PC45) between the PC and MJ1 on the controller. If communication has been established the status buttons in the i^3 Configurator software will no longer be greyed out and one will sink into display the controller run status.

No connection to any device:

Connection all ok (and connected device in IDLE mode):



Connected to iCAN network, Target Node not found, unable to detect run status:

The final check is to ensure that the i³ model for which the project has been created is the same as the connected model. The project had been made for an entry level i3CX12Z/00000-SEHF and has been constructed in such a way to be compatible with all models of i3AX, i3BX, and i3CX.

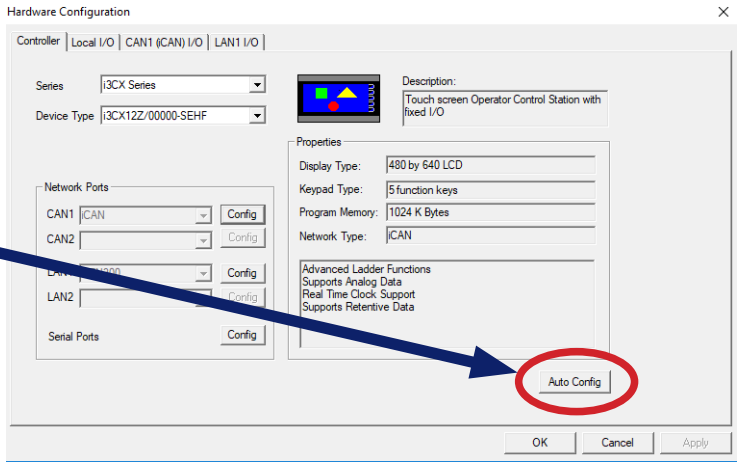
Press the I/O configure button 

Then press the Auto Config System button.

After a couple of seconds, your connected controller part number should appear.

The demo project is now ready to download.

Press the download button  *to transfer the project into the controller.*



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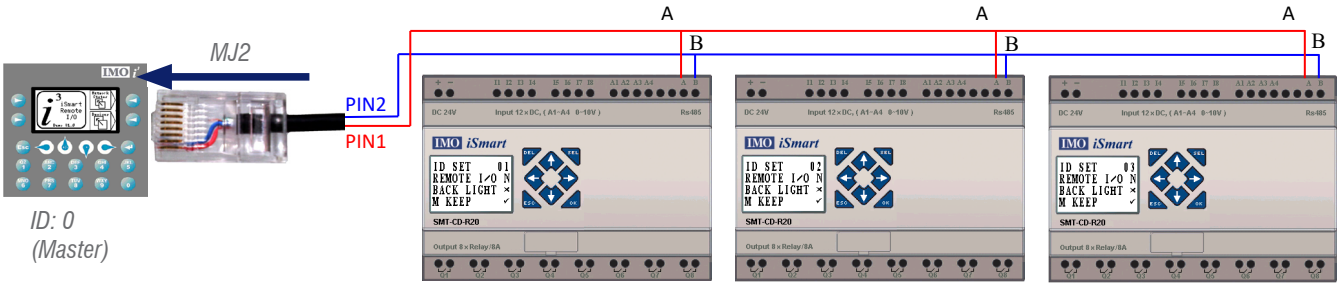
STEP 3 – Wiring between the i3 and iSmart

From the RJ45 connector of MJ2, use a twisted pair to loop through all of the iSmarts, connecting to the 'A' and 'B' Terminals (the furthest to the right along the top row). Also install a 120Ω termination resistor between the A and B terminals of the final Slave (ID3 position).

The network will appear as follows:



STEP 4 – Set up the iSmart

For each iSmart on the network 3 settings need to be made via the HMI screen on the iSmart. Firstly press the 'ESC' key on the iSmart to bring up the system menu. If the iSmart is in RUN mode, switch it to STOP by selecting this option from the menu using the up and down arrows and the 'OK' key to activate. Next, move down to the 'SET' menu and press the 'OK' key. Another menu will appear, and we are only interested in the first two options in this menu:

- Each iSmart must then have a unique ID Set. ID 1, 2 and 3 set respectively as shown above. (Use 'SEL' key and Up/Down arrows to change)
- In all iSmarts on the network, the REMOTE I/O setting must be 'N' for Normal operation. (Use 'SEL' key and Up/Down arrows to change)

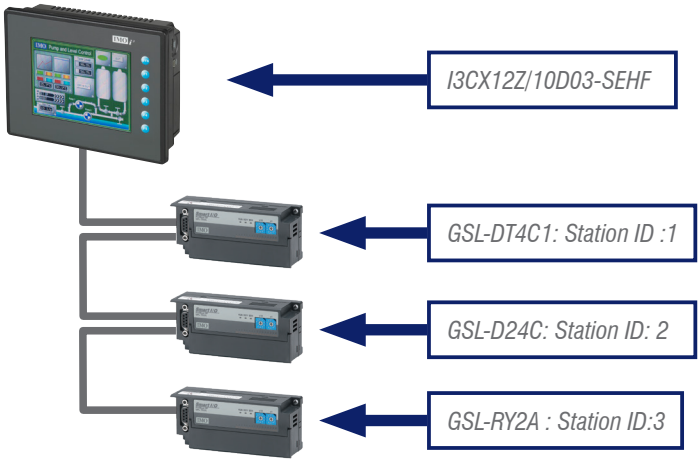
The iSmart must then be put back into RUN mode by pressing the 'ESC' key to return to the main menu then select

Connecting i3 to GSL

STEP 1 - Getting Started

The following program will demonstrate connecting an i3 controller to a network of 3 remote I/O blocks, GSL-DT4C1, GSL-D24C and a GSL-RY2A.

The example program is Modbus_remote_IO.csp



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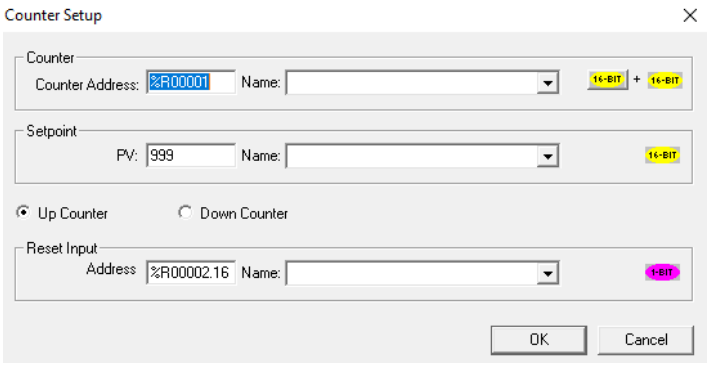
Ladder Logic Program

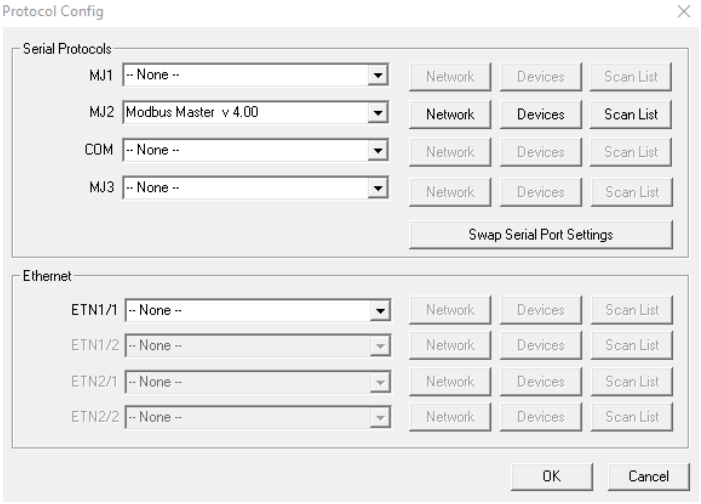
The ladder program will only consist of an up counter that will reset itself when it reaches the preset value. The counter will be operated on the internal one-second flag.

Insert a NO contact ⊣⊢ on the first rung, followed by a Counter function block CNT. Set up the counter function block as follows:



To configure the port MJ2 select the menu Protocol Configuration from the program drop down menu.

Select the protocol Modbus Master V4.00. Then click the network button to set the network parameters.



Network Configuration

In the network configuration the communication parameters are set. Set the parameters as shown below. We are going to use the protocol Modbus RTU and communicate on RS485, which is a multi-drop half duplex system.

It is important that the Slave speed is set to a maximum of Medium for good communications. A status register is not necessary but very useful for debugging.

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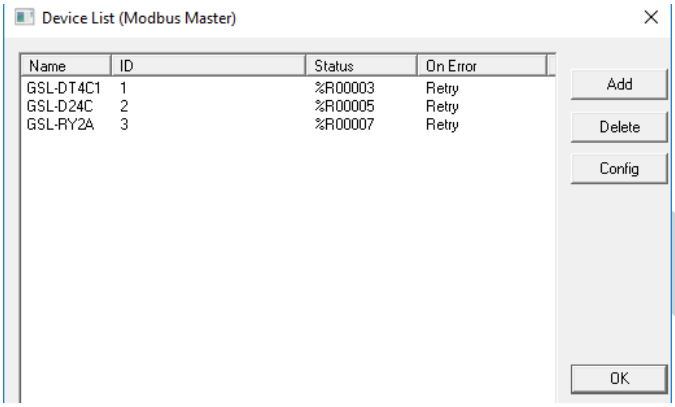
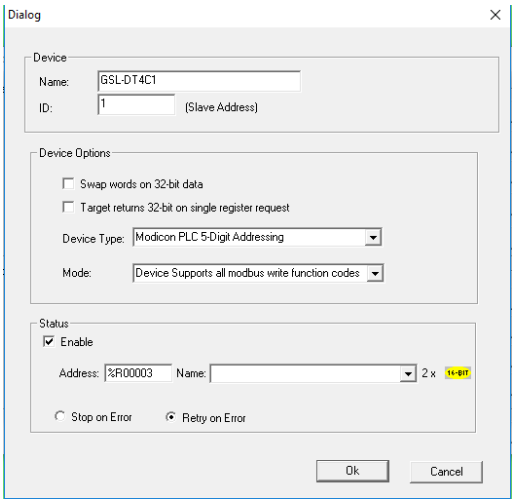
Communication Devices in the Network

Once the Network parameters have been set, the Devices need to be added to the network.



To insert a new device, click Add.

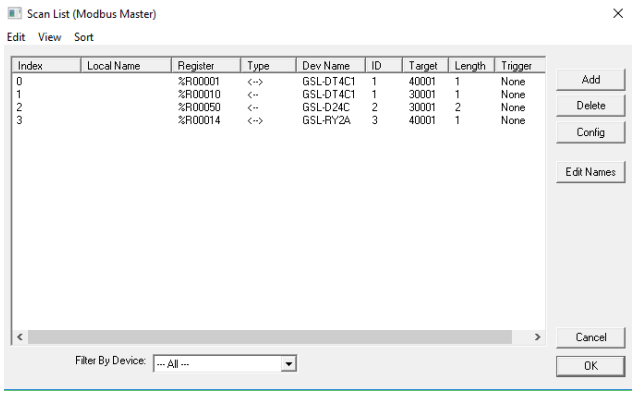


Name the device and give the device an ID. This ID should be unique and match the number on the rotary dial on the front on the Smart I/O.

Add the three individual devices as shown and click OK. Ensure that the ID has also been set on the front of the Smart I/O before powering up.

Scan List

Finally we need to add to the scan list the addresses we are going to read from and write to the Modbus slaves.



This is where we map across from the Modbus reference to the i3 memory reference. Once we have mapped across the references, we only need to consider the i3 memory reference, i.e. for the 16 relay output module we have mapped them across from ID 3 address 40001 to %R0001, if we want to switch on the individual bits on that output module then we use the bit reference of the word register, i.e. %R0001.1 is output 1.

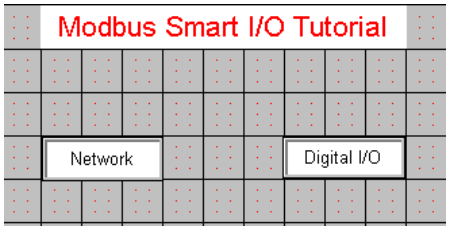
Now that the communication network has been set up we can program some screens.

Screen Editor Programming

For this program we are going to have 5 screens: Main Menu, a Communication Status and 3 screens, 1 for each Smart I/O module.

To enter the screen editor, click on the icon  . Please set up the screens as described below

Screen 1



Enter some static text at the top with two jump screen buttons below it. One button to take the user to the Network status information (screen 2) and the other to move to the start of the digital I/O (screen 3).

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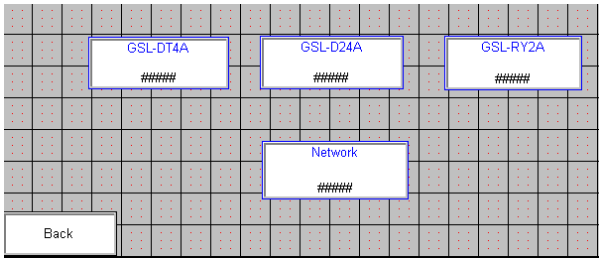
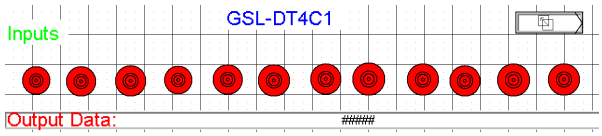
Screen 2



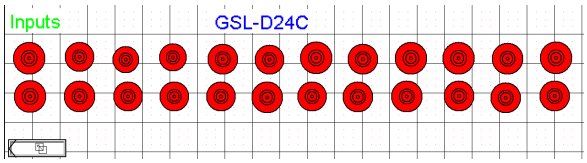
On the Network Status page, there will be 4 numeric data fields. One for each device and then a forth for the entire network. The numeric data fields will show the register value as set in the Network configuration. Add a screen jump to go back to the main screen (1)

Screen 3



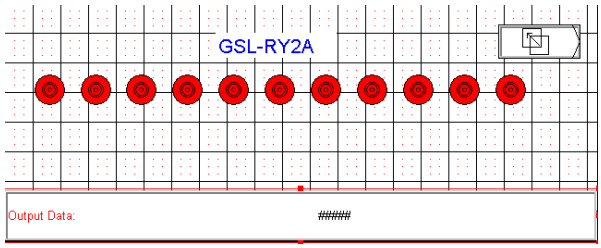
The first of the Smart I/O blocks will be the GSL-DT4C1. Add some lamps to represent the inputs from the module and add a numeric field to represent the output data. The I/O will be as we mapped in the Scan List. Inputs: %R10, Outputs %R1. Add a screen jump to move to the next block (screen 4)

Screen 4



The second of the Smart I/O blocks will be the GSL-D24C. This block is inputs only so add some lamps to represent this. The Inputs are mapped in the Scan List. Inputs word: %R11 & %R12, add a screen jump to move to the next block (screen 5)

Screen 5



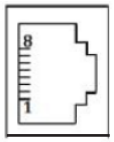
The final of the Smart I/O blocks will be GSL-RY2A. This block is outputs only bit we will use lamps and a numeric data field to indicate.

The Outputs are mapped in the Scan List. Output word %R1. Add a screen jump to move back to main screen (1).

Running the Program

Please connect the network as shown and remember to set the station number on the rotary dials on the Smart I/O bases. The communication LED's (Tx and Rx) on the Smart I/O stations should be flickering almost constantly when good communication is achieved.

Please see picture below for more information regarding the Dip Switches termination settings for the RS485 communication.

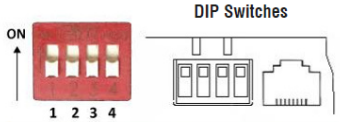


MJ1/2 Independent Serial Ports

MJ1: RS-232 with Full Handshaking

MJ2: RS-485 Half-Duplex

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



DIP Switches

Switch	Name	Function	Default
1	MJ3 RS-485 Termination	ON = Terminated	OFF
2	MJ3 Duplex	ON = Half	OFF
3		OFF = Full	
4	MJ2 RS-485 Termination	ON = Terminated	OFF

When all connected with communication established and in RUN mode the counter will directly output to the Smart I/O stations. The inputs can be monitored on the screens and the communication status of the network can be checked.

Please use the program:modbus_remote_io.csp

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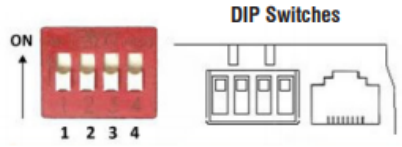
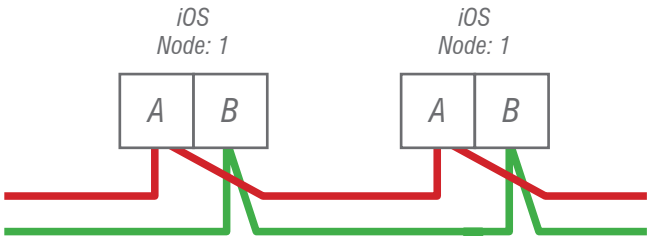
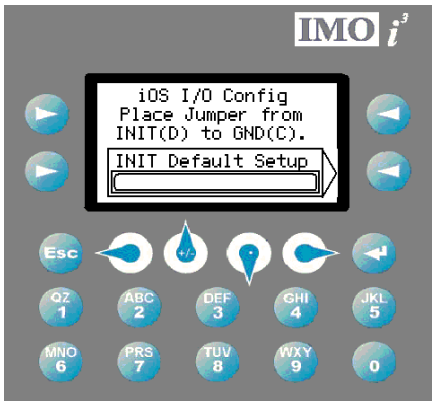
Connecting i3 to iOS

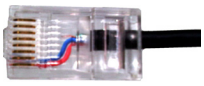


Switch	Name	Function	Default
1	MJ3 RS485 Termination	ON = Terminated	OFF
2	MJ3 Duplex	ON = Half	OFF
3		OFF = Full	
4	MJ3 RS485 Termination	ON = Terminated	OFF

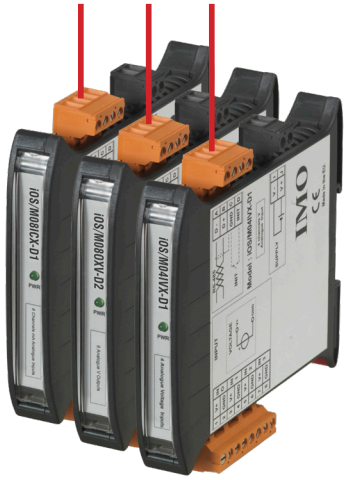


Modbus Network Diagram





2	RX- / TX-	IN / OUT
1	RX+ / TX+	IN / OUT



Using the iOS module has the following advantages:

1. Up to 16-bit resolution on analogue models.
2. Space-saving din rail mountable design.
3. Easy wiring with vibration resistant plug in connectors.
4. Jumper-free configuration using IMO's free configuration utility.

STEP 1

Open the file below in i3-Configurator. Connect the loader cable to the i3, run an I/O configuration  to make the project compatible with the i3 that you will be using. Then download to the i3.

STEP 2

Wire the iOS module to the i3 as shown in the example in the wiring section of this tutorial, plugging into MJ2 of the i3. Put in the link between Init and Ground on the iOS, and power it up.

STEP 3

On the first screen displayed on the i3, press the soft-key corresponding to the 'INIT Default Setup'. The i3 will then communicate briefly with the iOS module; you should see the light on the iOS flicker slightly. The next page appears:

The part number of the connected unit should appear here. If it does not then comms have not been established. Try cycling power on both units, check the 'INIT' jumper and try again.

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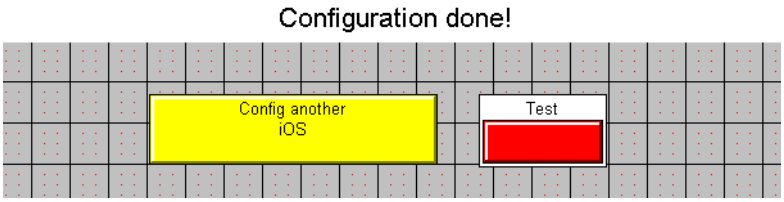
Once the correct part number is shown in the top field, use the cursor to select the following options:

- Modbus Parameters – here you set the network ID, Baud, Parity, Stop and Data bits of the iOS module ready for the i3 program and application, along with Modbus RTU or ASCII setting.
- Operational setting – here you configure the inputs and outputs. Enabled or disabled, voltage or current, RTD type, Thermocouple type etc.
- Save Parameters – Save the changes to the iOS module.
- Exit without Save.

STEP 4

Once the corresponding soft-key has been pressed to activate the Test Function, unplug the iOS from MJ2. Remove the 'INIT' link and cycle the power. Then, plug the iOS into MJ1. By that time the screen corresponding to the previously configured unit should appear.



If you selected 'Save Parameter' after altering your Operation Settings, then you will be brought to this screen. Here you caneither select another iOS to configure, or, test** the one you have just configured.

**Note: you can only use the test function if the iOS module is set to 19200, 8, 1, None, RTU. And all I/O options set for Voltage instead of Current.

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