INDUSTRIAL CONTROL DIRECT
A B&D Industrial Company

TRAINING

i³ ...Display, Control, Communicate

Tutorial

Modbus Master

IMO

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Introduction

The purpose of this tutorial is to demonstrate the Modbus Master communication functions of the ***i***^{3}. Modbus has been an industry standard for many years with more and more devices being Modbus enabled. Thus almost any device from Pressure transducers, to remote I/O and inverter drives can be controlled by an ***i***$^{3.}$

In this tutorial we will demonstrate the ***i***^{3} as a Modbus master, controlling a network of Modbus devices. The ***i***^{3} can read and write to and from single and multiple registers and is easily configured.

We will demonstrate the ***i***^{3} as a Modbus master controlling 2 Modbus slave enabled devices: an IMO Temperature controller and an IMO Jaguar Inverter Drive.

We will read and write the set point and current temperature to a DTP40A and read and write the Frequency, and start and stop the Jaguar inverter.

Network Parameters:	Baud Rate	9600
	Data bits	8
	Stop bits	2
	Parity	None
	RS485, two wire.	

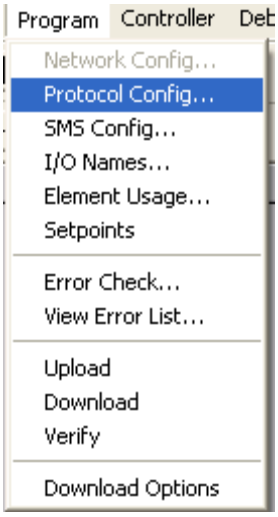
Please note the Drive and temperature controller will both have to have their own parameters set up to accept the Modbus communication and network parameters. Refer to the individual product manuals for this information.

*i*³ Modbus Map

Modbus Master Mapping					
Internal Reference	**Maximum Range**	**Traditional Modbus Reference**	**Expanded Modbus Reference**	**Modbus Command(s)**	**Modbus Offset**
%Q1	2048	00001	000001	Read Coil Status (1) Force Single Coil (5) Force Multiple Coils (15)	00000
%M1	2048	03001	003001		03000
%T1	2048	06001	006001		06000
%QG1	256	09001	009001		09000
%I1	2048	10001	100001	Read Input Status (2)	00000
%IG1	256	13001	103001		03000
%S1	256	14001	104001		04000
%K1	256	15001	105001		05000
%AI1	512	30001	300001	Read Input Register (4)	00000
%AIG1	32	33001	303001		03000
%SR1	32	34001	304001		04000
%AQ1	512	40001	400001	Read Holding Registers (3) Preset Single Register (6) Preset Multiple Registers (16)	00000
%R	9999	(Previously 43001 for 2048 registers)	410001		03000
					06000
%AQG1	32	46001	406001		10000

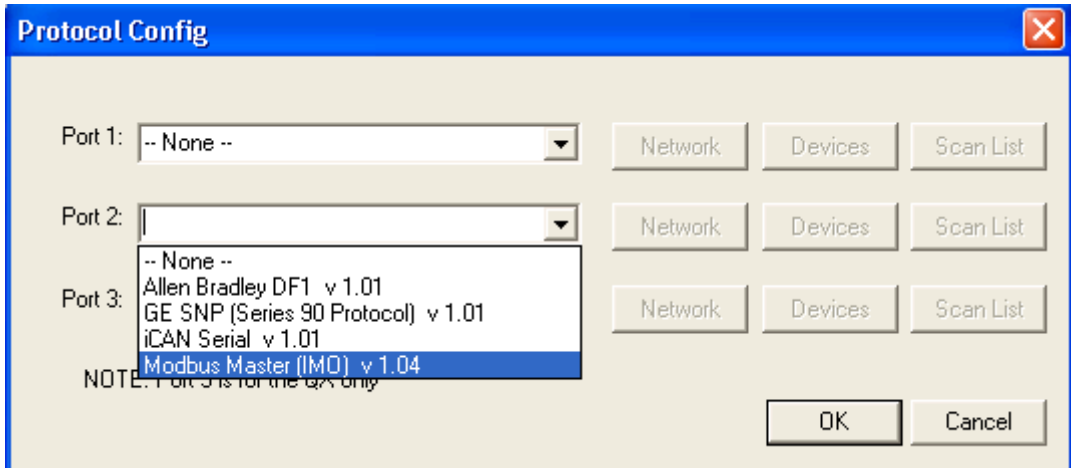
Protocol Configuration

The Modbus master is configured in the Program drop down menu.



We can then configure the programmable ports of the ***i***³. Select either Port 1 or Port 2, however it is easier in this case to configure port 2 and leave port 1 to solely programming. Each port can have different protocols and therefore the ***i***³ can be utilised as a data exchanger.

To configure the ***i***³ as a Modbus Master select the protocol.

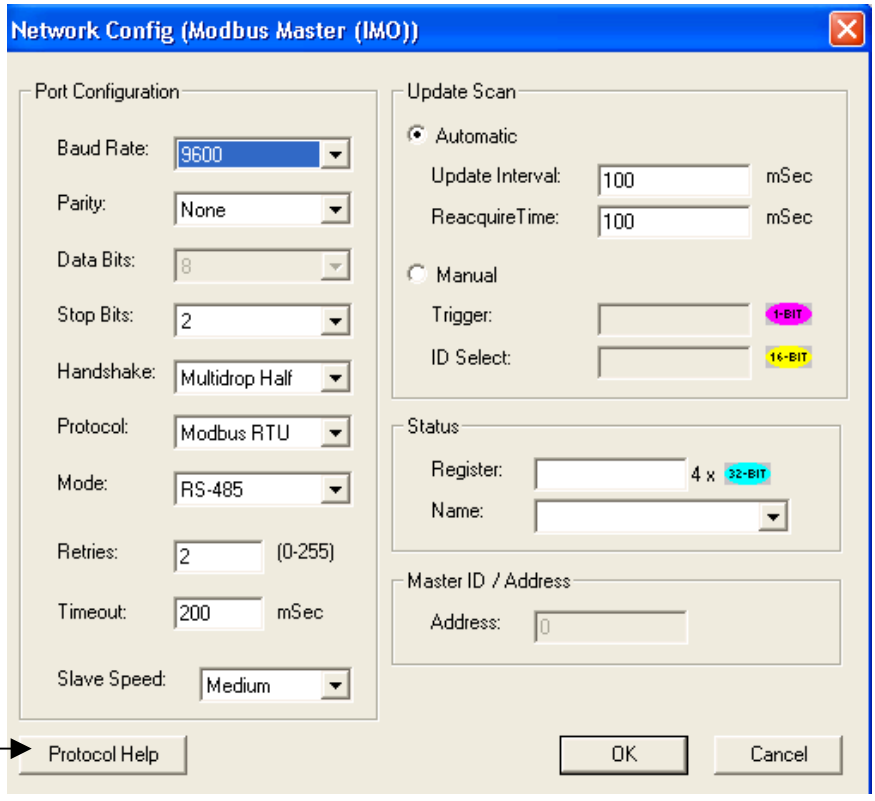


The Modbus master protocol utilises the Modbus function codes 03 to read single and multiple registers, 10 to write to multiple registers and 06 to write to single registers. Most Modbus slave devices only use the function codes 03 to read and 06 to write. Therefore the ***i***^{3} can communicate with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

Now the protocol has been selected the 3 buttons can now be selected. Start by setting up the network.

The network has to match the slowest device, so checking the equipments' capabilities before setting up the network is essential. All devices on the network must be configured to the same parameters.

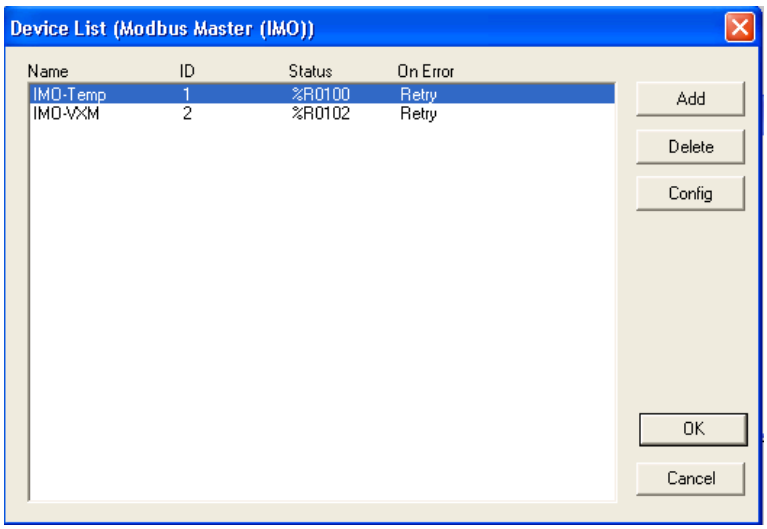
In this small example the Network parameters to suit all devices will be:
Baud Rate = 9600, RS485 (Half Duplex), Modbus RTU, 8 data bits, 2 stop bits.



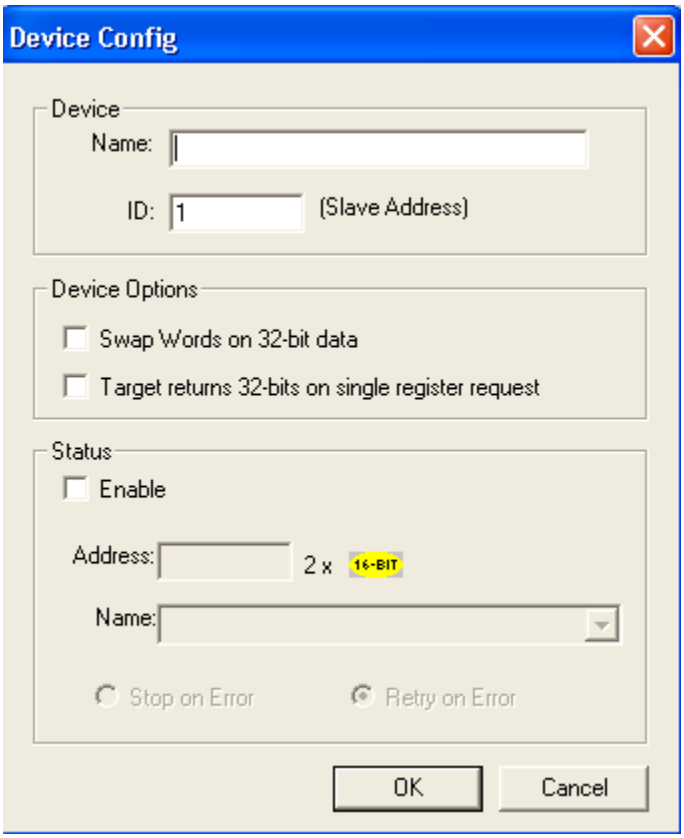
Protocol help can be accessed here by pressing the button. Once complete please click the OK button.

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.



This screen will initially be blank until you set it up. To add devices click on the Add button.



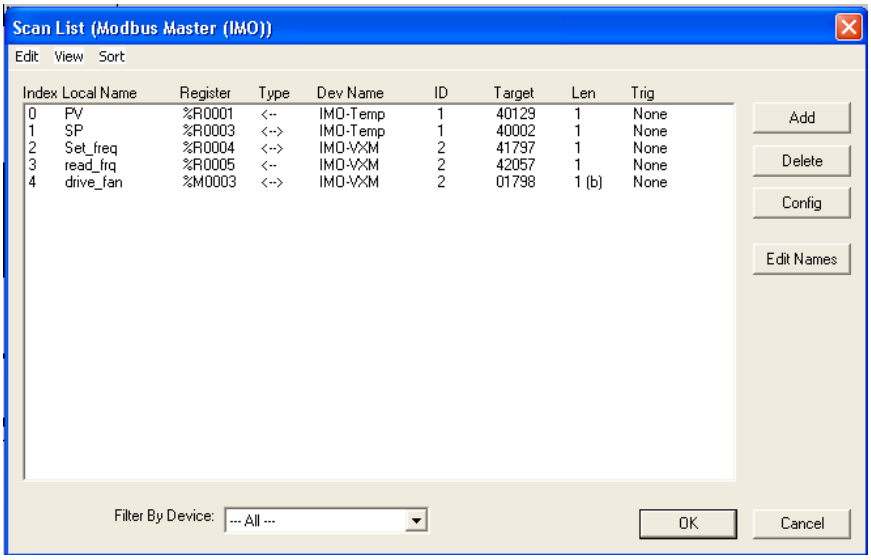
Enter a name for the device and assign it a Modbus address (1-255)

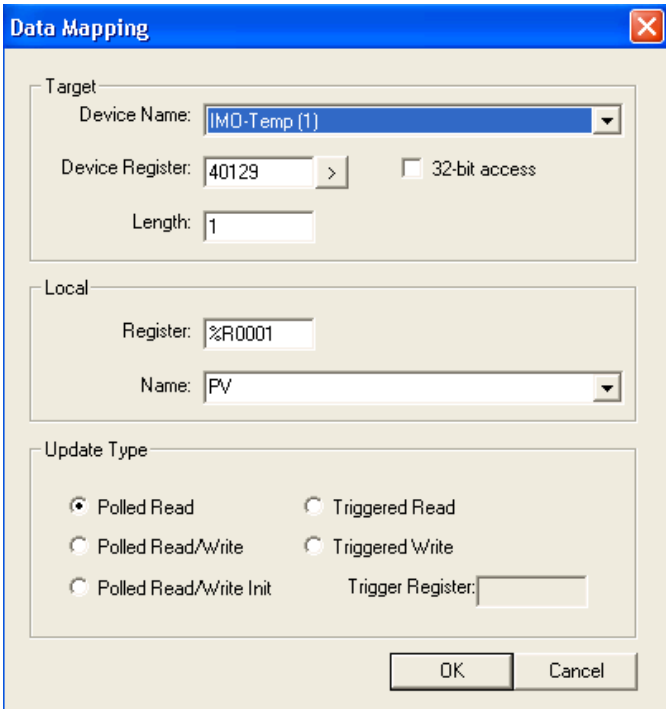
Some slave devices require special options.

Just like in the network the individual devices can have a register set up to monitor and control the status information of the device.

Set up the two IMO devices to be:
Temperature Controller: ID 1, status register %R10.
VXM Inverter Drive: ID 2, no status register.

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





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.

In the Temperature controller we want to Read the Current Value (CV) and write to the Set Point (SP). These addresses are:

We are going to read and write to similar in the VXM Drive. We want to read the current frequency, write the set point, but also start and stop the drive. The associated addresses are:

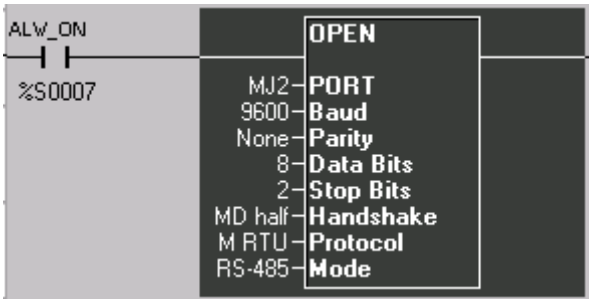
Device Addressing

Function	Device	Modbus Address	*i*³ Local Register
Set Value	DTP40A	40002	%R3
Present Value	DTP40A	40129	%R1
Set Frequency	VXM	41797	%R4
Current Frequency	VXM	42057	%R5
Start Drive	VXM	01798	%M01

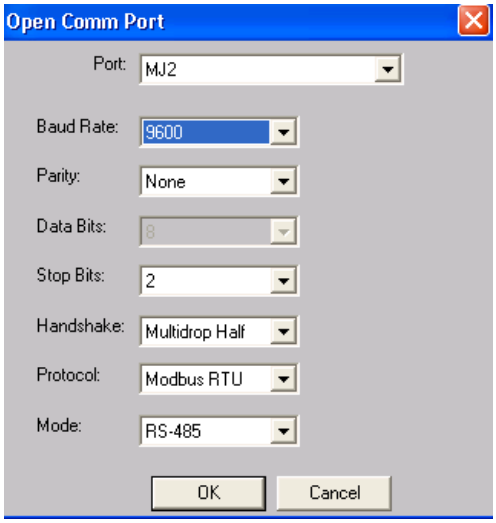
Ladder Logic Programming

Now that the protocol has been configured. We need to control the process. The user will be able to set the desired temperature in the PID controller and then the ***i***³ will drive the VXM that controls a fan. The user can enter the frequency at which the inverter will drive and also check the communication status of the network.

With the protocol set up in the Protocol Config, for the communications all we are required to do is to open the port. Click the “open port” icon  from the Communication functions menu and insert it in a rung with an “always on” contact

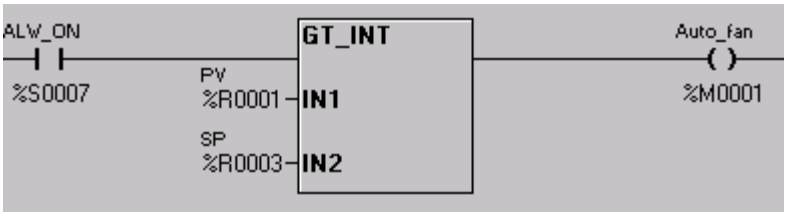


Enter the details as shown opposite to configure the port to the desired communication parameters.



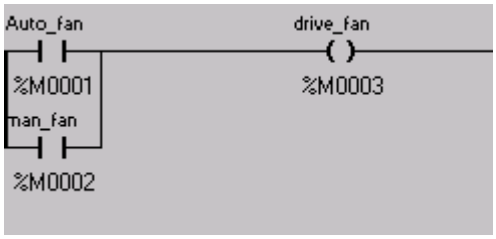
Next we have to enter the logic to control the fan for the reading of the temperature controller. If the Present Value is greater than the Set Point then we need the fan to switch on.

Select the Greater than icon from the Compare functions menu and insert it in a rung with a N/O contact assigned to “always on”. Set up the function so that the inputs are PV and SP. Have the output of the function driving a bit, %M1 named “Auto_Fan”.



Lastly we need to insert the logic for the manual override. The user will be able to switch on the fan even when the temperature doesn’t demand it. To do this we are going to “OR” the Auto_fan bit with a Man_Fan bit that then operates the Drive_Fan bit, that is communicated to the VXM drive.

Insert a N/O contact and assign to %M1. using the Vertical line tool  draw two lines and the beginning and end of the previous contact. Insert a N/O contact in the gap just created and assign to %M2. Connect this OR gate to a N/O coil and allocate to %M3.



That is all the ladder logic required, thanks to the protocol config option.

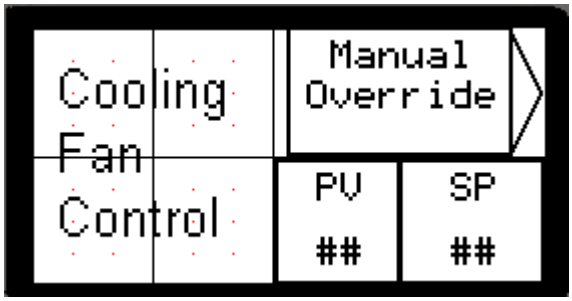
Screen Editor Programming

We need to set up three screens:

1. For entering the set point temperature and monitoring the present temperature
2. Frequency entry to the drive and manual override operation of the drive.
3. Communication status monitoring.

Screen 1

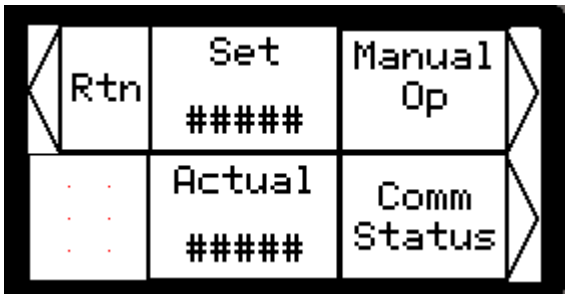
Insert a static text item an edit the legend to display “Cooling Fan Control”. Next add two numeric data function. Assign the one to SP, with the following parameter settings: digits set to two, limits 0-99, engineering units ‘degrees Celsius’ and editable. Assign the second numeric function to PV with the same basic parameters, except that it will not be editable. Finally insert a screen jump button, editing the legend to display “Manual Override”, jumping to screen 2.



Screen 2

On screen two the user will be able to monitor the output frequency of the drive, set the frequency to the drive and manually start the drive if need be.

Insert two numeric functions. The first will be editable and assigned to “Set_Freq”, with parameters of: 4 digits, limits of 0 – 9999, legend = “Set”. The second will be assigned to “Read_frq”, with the parameters of: non-editable, 4 digits, limits of 0-9999 and a legend displaying “Actual”.
Finally there will be two screen jumps, one to return to the previous screen and the second to jump to the communication status screen.

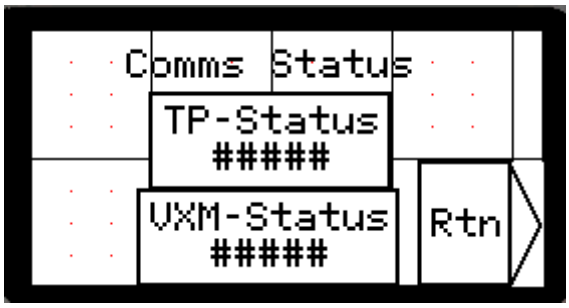


Screen 3

The third and last screen will display the communication status of the two devices as set up in the protocol config.

Place two numeric data functions on the screen and one screen jump function two go back to the first screen.

Assign one numeric function to the temperature controller status and the second to the drive status, both will be none editable. Enter a static text field to inform the user of what screen they are on.

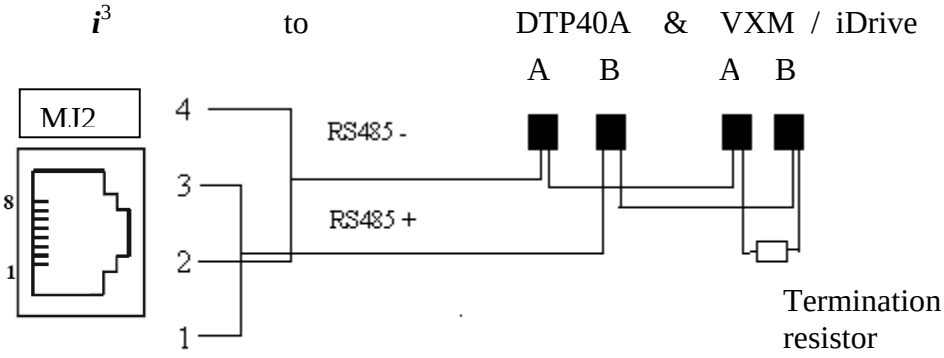


Wiring Diagram

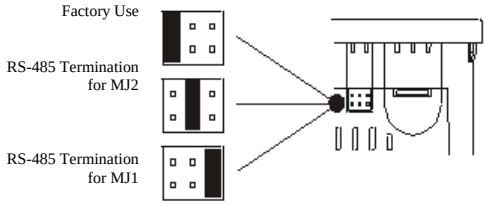
We are using Port 2 on the ***i***^{3} as a RS485, 2 wire to connect to the PMU330TT. The wiring for this is as follows.

Port 2 connections.

Pin	MJ2 Pins	
8	TXD	OUT
7	RXD	IN
6	0 V	Gnd
5	N/C	N/C
4	TX-	OUT
3	TX+	OUT
2	RX-	IN
1	RX+	IN



Remember to connect the RS-485 termination jumper as shown



Running the Program

Please connect the network as shown. Also note that the temperature controller and drive need to have their communication parameters set appropriately.

Please use the program: Modbus_master.csp by clicking on the paperclip below.

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