



Configuring a DX to support Modbus TCP Slave to a Modbus Serial Master using the DX Modbus gateway feature

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DX40 Modbus TCP/Modbus Serial Gateway configuration steps

This example steps through the various configuration screens to a Serial Port on a DX40 for use in a Modbus Gateway application where a remote IP based Modbus TCP Slave wants to connect to a Modbus Master Serial device which is attached to the DX40 serial port. Whilst this example shows the steps using a DX40 the configuration steps would be identical across all DX platforms including the DX940, 10ETS and 10XTS models.

Summary of steps

- Define IP address
- Set Router Default Gateway
- Serial Port Settings
- Activate Serial ports
- Modbus Gateway Configurations
- Save Configuration Changes

1.0 Protocol overview

The MODBUS over Serial Line protocol is a Master-Slave protocol. This protocol takes place at level 2 of the OSI model. A master-slave type system has one node (the master node) that issues explicit commands to one of the "slave" nodes and processes responses. Slave nodes will not typically transmit data without a request from the master node, and do not communicate with other slaves.

At the physical level, MODBUS over Serial Line systems may use different physical electrical interfaces (RS485, RS232). TIA/EIA-485 (RS485) Two-Wire interface is the most common. As an add-on options for RS485 Four-Wire interface may also be implemented as well as TIA/EIA-232-E (RS232) serial interface may also be used as an interface, when only short point to point communication is required.

In applications where the Modbus Slave uses Ethernet based Modbus TCP but the Host Master is a serial device then you need to include a ModbusTCP/Serial Gateway device that actually does some protocol translation.

Unlike many SCADA protocols that can adopt simple IP Terminal server devices where the protocol encapsulated in an Ethernet frame is identical to the serial payload, Modbus requires protocol translation since the protocol encapsulated inside a Ethernet packet is NOT the same as the serial PAYLOAD. The Modbus TCP uses the Ethernet frame for payload integrity (CRC) but on Serial Modbus there are additional bytes in the Modbus message to provide message integrity.

In simple terms Modbus TCP/Serial gateway needs to adjust the serial payload by adding or removing these special CRC integrity bytes, something an ordinary Terminal Server function cannot provide.

2.0 IP address Assignment

If this is a new unit the factory default IP address is 192.168.1.2, also note that all ports on a factory default setting will be disabled with the exception of the **highest** Ethernet port number. So for a DX40 connect your PC initially to E2.

If you can't access the DX40 via the Ethernet port, because its address is unknown, then the IP address can be set via the Console port BOOT application. The DX40 does not have a dedicated Console port, but a BOOT console application can be temporarily activated by connecting a terminal device to Serial Port S1 (38,400 bps, no parity, 8 data bits and 1 stop bit) using a standard cross over cable and holding down the SPACE bar after a DX40 power cycle.

GarrettCom, Inc.
MNS-DX ROM version 1.3.3 (RC1)

Starting boot menu...

MNS-DX Boot Menu

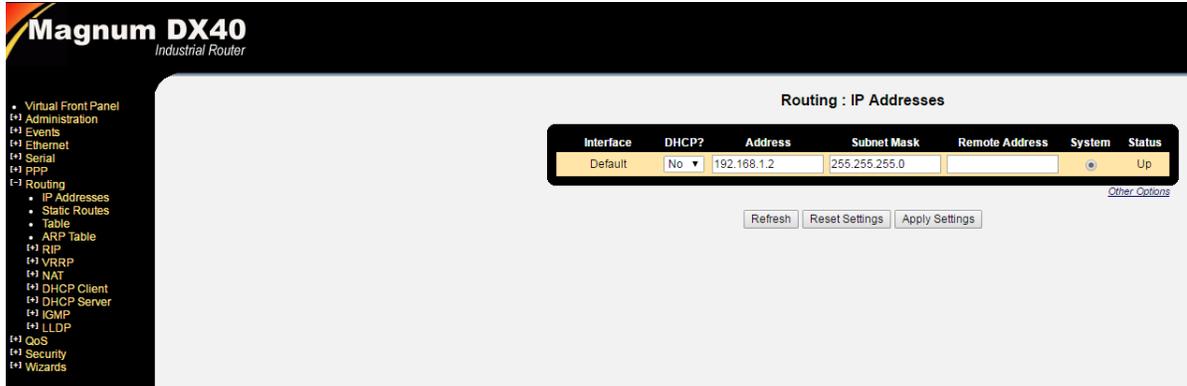
- 1: View System Information*
- 2: Assign System IP Address*
- 3: Install Initial Software Image from FTP Server*
- 4: Install Initial Software Image via TFTP*
- 5: Install Initial Software Image via XMODEM*
- 6: Load Temporary Image from FTP Server*
- 7: Load Temporary Image via TFTP*
- 8: Load Temporary Image via XMODEM*
- 9: Restore System to Factory Defaults*
- n: Select Active Network Interface for Boot Menu*
- c: Boot Once with Console on Port S1*
- b: Boot*

MNS-DX>

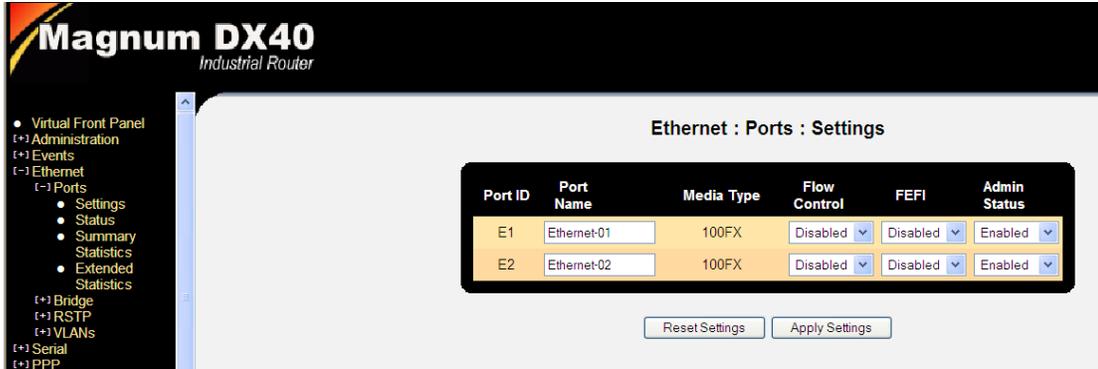
Simply use Option 2: to define the initial IP address, then Option b: to boot. From the factory the initial IP address of the DX40 should be 192.168.1.2.

Once the address is defined then launch a HTTPS: session to the address that was defined. For this example we are using 192.168.1.2 Mask 255.255.255.0.

Please note that if the unit is in its default configuration then only the highest Ethernet port is admin enabled and also only HTTPS or secure web browsing is enabled. Port E1 is disabled and HTTP will not respond.



If the plan is to use both Ethernet ports then you can go to Ethernet port administration and change the Admin status of E1 to enabled.



3.0 Default Gateway Assignment

If there are no plans to use automatic IP discovery protocols like RIP to automatically populate the routing table then we need to define a default gateway which is an address of another upstream router. For DX and most other networking equipment, the default gateway is signified by entering a static route defined as Route Destination 0.0.0.0, Route Mask 0.0.0.0, and Next Hop for example 192.168.2.254

Routing : Static Routes

Add Static IP Route

Route Destination	Route Mask	Next Hop	Administrative Distance
0.0.0.0	0.0.0.0	192.168.2.254	1

Existing Static IP Routes

Route Destination	Route Mask	Next Hop	Administrative Distance	Delete
0.0.0.0	0.0.0.0	192.168.2.254	1	<input type="checkbox"/>

The routing table will then look like this.

Routing : Table

Route Destination	Route Mask	Next Hop	Administrative Distance	Metric	Age	Type
0.0.0.0	0.0.0.0	192.168.2.254	1			Management
127.0.0.1	255.255.255.255	127.0.0.1	0			Local
192.168.2.0	255.255.255.0	192.168.2.2	0			Local

4.0 Serial Port Settings

When configuring serial ports we first start by defining a profile, the profile describes various parameters associated with the serial port to include speed, parity, electrical interface etc.

Following are the reference profiles created for specific application at San Jose Water facility. Set the interface type (RS232), Speed and Stops bits and Parity to match the attached serial device. The other settings we recommend are: "Ignore DSS" set to YES, this overrides the normal requirement to have an active incoming "data set signal" from the attached device and also modify the "Pkt Time" parameter from 200 to 20 (20ms forwarding timer).

Serial : Ports : Profiles

Add New Profile

Profile Name	Interface Standard	Speed	Data Bits	Stop Bits	Parity	Ignore DSS	Flow Control	Pkt Char	Pkt Time (msecs)	Max Pkt Size (bytes)	T/A Time (msecs)
New Profile	RS232	9600	8	1	None	No	None	None	200	1024	0

Reset Settings Apply Settings

Existing Profiles

Profile Name	Interface Standard	Speed	Data Bits	Stop Bits	Parity	Ignore DSS	Flow Control	Pkt Char	Pkt Time (msecs)	Max Pkt Size (bytes)	T/A Time (msecs)	Delete
Default	RS232	9600	8	1	None	No	None	None	200	1024	0	<input type="checkbox"/>
SJ0405	RS232	9600	8	1	None	Yes	None	None	20	1024	0	<input type="checkbox"/>
console	RS232	38400	8	1	None	Yes	None	None	20	1024	0	<input type="checkbox"/>

Reset Settings Apply Settings

5.0 Serial Port Admin Status

In order to meet some of the new security requirements for this type of equipment the DX40, by default, disables any serial ports that have not been explicitly activated. So this step is required to activate the appropriate ports, S1 and S2 and also to apply the PORT Profile to each of the ports. In this case S2 will use the "SJ0405" profile and don't forget to change the Admin Status to Enabled on both ports to prepare them for operation.

Serial : Ports : Settings

Port ID	Port Name	Profile	Admin Status
S1	Serial-01	console	Enabled
S2	Serial-02	SJ0405	Enabled

Reset Settings Apply Settings

6.0 Terminal Server Settings

In the default configuration all the serial ports are predefined and attached to the terminal server application, since we cannot use the standard terminal server for the Modbus application we need to release the serial port we plan to use from this table so we can use the port in the Modbus gateway.

Simply click on the “delete” radio button for the port you want to use and hit “apply settings”, the port will then disappear from this table..

Before:

Magnum DX Secure Web Management GarrettCom

Serial : Terminal Server : Channel Settings

Add New Channel

Port ID	Call Direction	Session Type	Priority (DiffServ)	Local IP	Local TCP	Remote IP	Remote TCP	Maximum Connections	Retry Time (secs)
S1	In	Raw	Default	172.31.249.50	0	0.0.0.0	0	5	30

Reset Settings Apply Settings

Existing Channels

Port ID	Call Direction	Session Type	Priority (DiffServ)	Local IP	Local TCP	Remote IP	Remote TCP	Maximum Connections	Retry Time (secs)	Delete
S1	In	Raw	Default	172.31.249.50	10201	0.0.0.0	0	5	30	<input type="checkbox"/>
S2	In	Raw	Default	172.31.249.50	10202	0.0.0.0	0	5	30	<input type="checkbox"/>

Reset Settings Apply Settings

After:

Serial : Terminal Server : Channel Settings

Add New Channel

Port ID	Call Direction	Session Type	Priority (DiffServ)	Payload Offset	Local IP	Local TCP	Remote Name or IP	Remote TCP	Maximum Connections	Retry Time (secs)
S1	In	Raw	Default	Yes	Any	0		0	5	30

Reset Settings Apply Settings

Existing Channels

Port ID	Call Direction	Session Type	Priority (DiffServ)	Payload Offset	Local IP	Local TCP	Remote Name or IP	Remote TCP	Maximum Connections	Retry Time (secs)	Delete
S1	In	Raw	Default	Yes	Any	10201		0	5	30	<input type="checkbox"/>

Reset Settings Apply Settings

If you don't do this step you will get an error message similar to this

Serial : Modbus : Local Slaves

Serial port S1 is already in use by Terminal Server

Add New Device

Port ID	Device Address	Protocol Variant	Priority (DiffServ)	Response Timer (msec)	Send Gateway Exceptions
S1	2	RTU	Default	500	Yes

Existing Devices

Port ID	Device Address	Protocol Variant	Priority (DiffServ)	Response Timer (msec)	Send Gateway Exceptions	Delete
S2	1	RTU	Default	500	Yes	<input type="checkbox"/>

7.0 Modbus Configurations

There are 2 steps to configuring the Modbus gateway, step one is to define which serial port we are going to use to the Local Master RTU device, S2 in this case, then which variant of the Modbus serial format (RTU or ASCII), whether you want to assign a DIFF SERV priority and finally if you want to report exceptions.

Serial : Modbus : Local Masters

Add New Device

Port ID	Protocol Variant	Priority (DiffServ)	Forward Gateway Exceptions
S1	RTU	Default	Yes

Existing Devices

Port ID	Protocol Variant	Priority (DiffServ)	Forward Gateway Exceptions	Delete
S2	RTU	Default	Yes	<input type="checkbox"/>

Second step is to define the remote SLAVE information; this is where you define the TCP Modbus Slave IP address that is associated with the serial port Modbus Device Address, so the device address in this box should match the device address used in the serial port definition in the last step. The IP address is the IP address of the Modbus Slave. Two of the very important configuration parameters mentioned here are Idle Time (0 – 604800 secs) and Response Time (10 – 10000 msecs).

An Idle Time of 0 seconds means that a TCP connection is immediately made to the remote (that is, the client does not wait for a request) and it is always kept open. This special mode eliminates the connection latency associated with the initial Modbus request.

A Response Time of 10000 msecs means the client will wait this amount of time before giving up on a request. If the client times out, it closes down the current TCP connection for the remote device. So in order to prevent frequent connection breaks, this value should be kept to a high number.

Serial : Modbus : Remote Slaves

Add New Device

Device Address	Remote Name or IP	Idle Time (secs)	Response Time (msecs)
<input type="text"/>	<input type="text"/>	<input type="text" value="10"/>	<input type="text" value="1000"/>

Existing Devices

Device Address	Remote Name or IP	Idle Time (secs)	Response Time (msecs)	Delete
1	192.168.1.7	0	10000	<input type="checkbox"/>

8.0 Final Step, save configurations

Saving Configuration: Click on the highlighted Save button at the bottom of the page to ensure all changes are saved and will survive any unit power cycles.



9.0 DX40 Electrical Information

The DX40 uses DB9 (female) connectors and is setup to support RS232/RS485/RS422 electrical standards, and is configured as a DTE device.

For RS232 connections the pin assignments are:

Table 1-10. DB9 RS232 Pinout

Pin	Name	Dir.	Description
1	DCD	In	Data Carrier Detect from DCE.
2	RXD	In	Receive Data from DCE.
3	TXD	Out	Transmit Data to DCE.
4	DTR	Out	Data Terminal Ready to DCE.
5	GND	Pwr	Signal Ground.
6	DSR	In	Data Set Ready from DCE.
7	RTS	Out	Request To Send.
8	CTS	In	Clear To Send.
9	RI	In	Ring Indicator from DCE.



For RS485/422 connections the pin assignments are:

Table 1-11. DB9 RS485 Pinout

Pin	Signal	Direction
1	RX-	In
2	RX+	In
3	TX-	Out
4	TX+	Out
5	GND	Power
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	



10.0 Download and Support Information

The latest MNS-DX manuals and firmware files are available at the following URL: <https://garrettcom-support.belden.eu.com>.

For technical questions, support, quote, contact details and RMA requests, please visit <http://info.belden.com/garrettcom/technical-support>