DEB

Installation and Programming Manual

This manual covers the DEB, DIN rail mount Ethernet Bridge.

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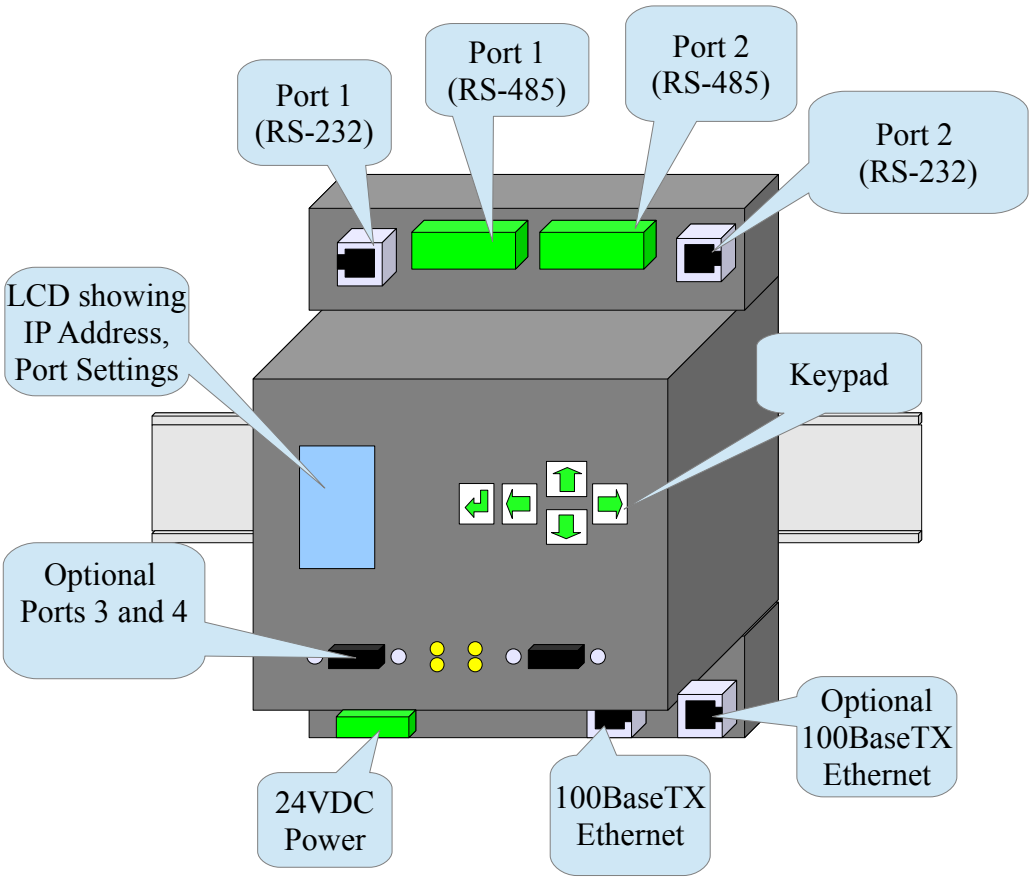
1 Introduction

The Niobrara DEB is a stand-alone DIN rail mount Serial to Ethernet Bridge. It features a 10/100BaseTX Ethernet port, two isolated serial ports, and optionally two additional serial ports. The DEB allows simultaneous pass-through routing data messages from one port to another. All ports are independently configurable for protocol, baud rate, data bits, parity, etc. Full support of PLC programming message pass-through is also provided on all communication ports including Unity Pro, Concept, ProWORX, and Modsoft.

Figure 1.1 DEB Front Panel



The DEB features at least one 100BaseTX Ethernet port that supports Modbus/TCP as both a client and a server at the same time. The DEB can support up to 64 simultaneous Modbus/TCP connections. A routing table is used to map the incoming Modbus/TCP Destination Index (Slave Address) from a client to a downstream route that determines where the message is directed. This route may point to a slave on one of the DEB's serial ports, or even back out the Ethernet port to a different device. The Ethernet port also supports the older SY/MAX 802.3 protocol for smoothly integrating legacy Square D Model 650 and 450 PLCs into a Modbus/TCP system.

The DEB+201 model includes two 100BaseTX Ethernet ports that support Rapid Spanning Tree Protocol (RSTP) allowing the DEB to be used in a copper ring network for redundant Ethernet cable connections. It may also be used in a daisy-chain Ethernet network as well.

There are two isolated serial ports on the DEB. Each port may be selected to use its RJ-45 connector for RS-232 or a removable 5-pin screw connector for RS-485. The RS-485 port may operate in 4-wire RS-422, 4-wire RS-485, or 2-wire RS-485 modes with selectable termination and bias. The two serial ports may be independently configured for one of 18 different protocols including Modbus RTU, Modbus ASCII, and SY/MAX. The default mode supports Modbus RTU and can dynamically switch between being a master or a slave.

The DEB may be optionally ordered with two additional serial ports, either both RS-232 or both RS-485. These ports are also independently isolated and configurable.

Table 1.1 DEB Part Numbers

Part Number	Ethernet	Port 1		Port 2		Port 3	Port 4
		RS-232	RS-485	RS-232	RS-485		
DEB+101	One	Yes	Yes	Yes	Yes	No	No
DEB+121	One	Yes	Yes	Yes	Yes	RS-485	RS-485
DEB+131	One	Yes	Yes	Yes	Yes	RS-232	RS-232
DEB+201	Two	Yes	Yes	Yes	Yes	No	No
DEB+221	Two	Yes	Yes	Yes	Yes	RS-485	RS-485
DEB+231	Two	Yes	Yes	Yes	Yes	RS-232	RS-232

The DEB features a front panel backlit LCD and keypad that may be used for configuration and troubleshooting. The IP Address and most serial port settings may be configured through this interface which may be password protected to prevent unauthorized changes.

2 Installation

WARNING: Do not connect the DEB to any Ethernet or serial network before configuring the appropriate network addresses. Duplicate network address may lead to improper network communication, equipment damage, injury, or death.

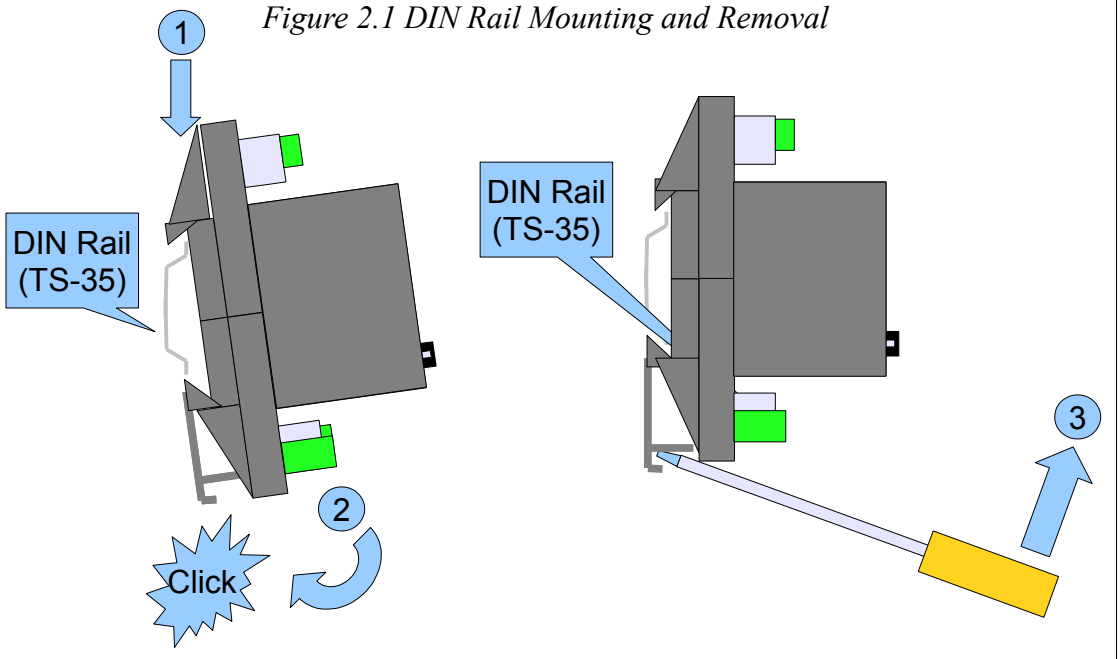
Device Mounting/Removal

(1) Hook the top notch on the upper lip of the DIN rail.

(2) Rotate the DEB until the lower latches click tight.

(3) Use a screw driver to unclip the lower latches to remove the DEB from the DIN rail.(See Figure 2.1 DIN Rail Mounting and Removal)

Figure 2.1 DIN Rail Mounting and Removal

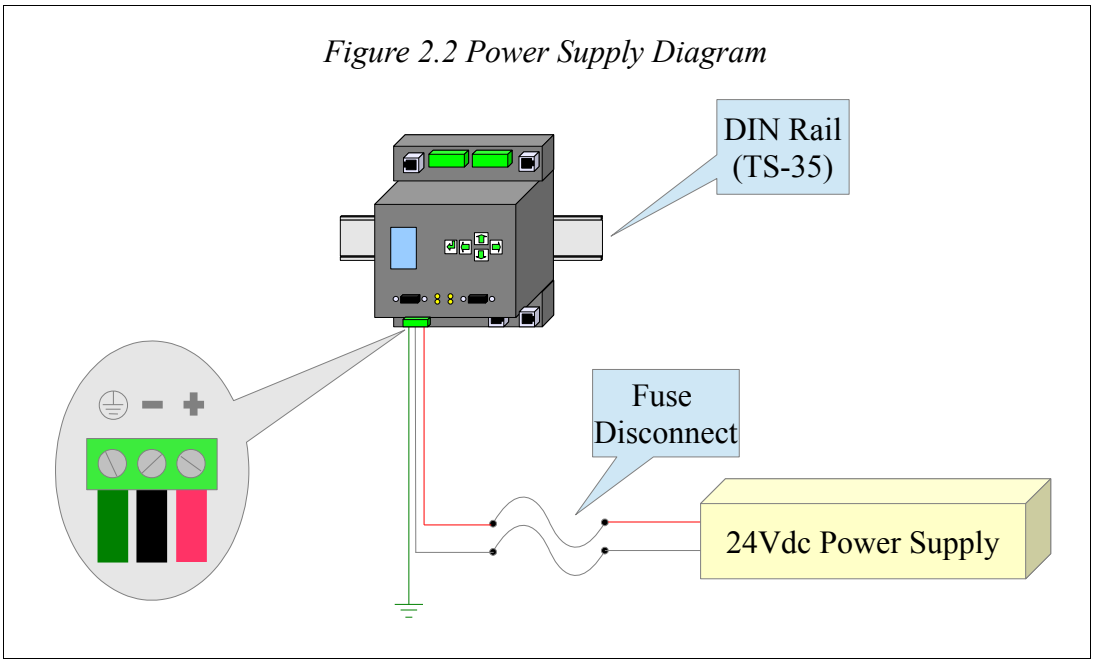


Power Supply

Connect a suitable 24VDC power to the three position removable connector. The DEB requires a 5W minimum supply and will operate on 9-30Vdc but 24Vdc is recommended. (See Figure 2.2 Power Supply Diagram) An external fuse is recommended. Typical power supply wire colors are:

- Red = 24Vdc (+)
- Black = 24Vdc (-)
- Green = Earth Ground

Figure 2.2 Power Supply Diagram



Ethernet

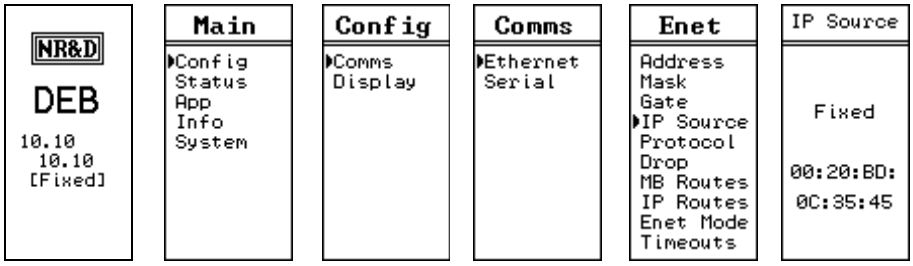
Setting the IP Address

The DEB defaults to a fixed IP Address of 10.10.10.10. This is easy to change through the use of the front panel keypad. The DEB supports fixed IP Address, DHCP, or BOOTP. Press the ➡ key four times to step through the "> Main > Config > Comms > Ethernet >" pages.

If BOOTP or DHCP is desired, ⬇ arrow to the IP Source menu item, and then press the ➡ key. The ⬆ and ⬇ arrows are used to select FIXED, DHCP, or BOOTP. The ↵ key is used to accept the new value and return to the previous menu.

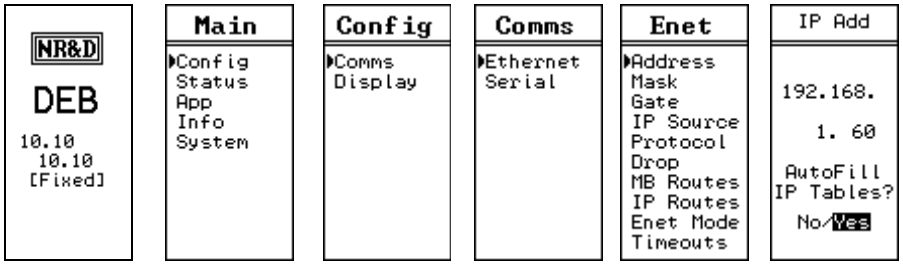
NOTE: BOOTP and DHCP operation usually requires that the server be configured for the MAC Address of the DEB. The DEB's MAC address is printed on the serial number label and is also shown on IP Source screen. The example below shows a MAC Address of 00:20:BD:0C:35:45.

Figure 2.3 IP Address Source Screen



If a fixed address is required, make sure that the IP Source is set to Fixed, then select the Address page. The ⬆ and ⬇ arrows are used to adjust the values while the ➡ and ⬅ arrows move between fields. The ↵ key is used to accept the new value.

Figure 2.4 Fixed IP Address Screen

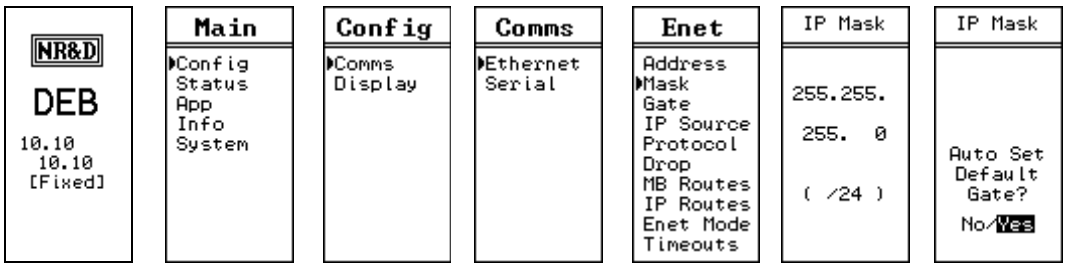


The "Autofill IP Tables?" offers the automatic filling of the TCP client table. Each of the 200 entries in the TCP table will be set to the first three octets of the DEB's IP Address and the last octet will be set to the index number 0-199.

Setting the Subnet Mask

The Subnet Mask edit page is designed to quickly step through the valid bit-mapped options. Pressing the ⬆ and ⬇ arrows adjusts the mask value. The ↵ key is used to accept the new value.

Figure 2.5 Subnet Mask Screens

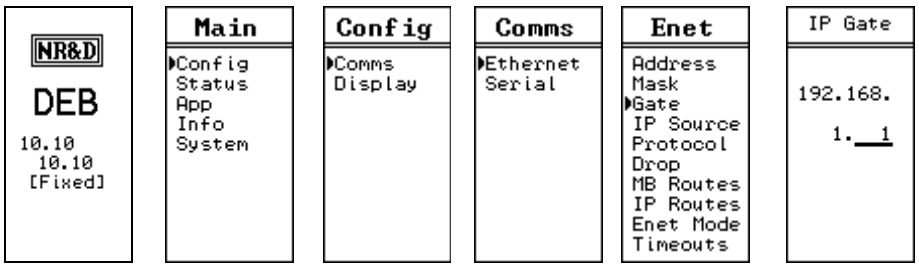


The "Auto Set Default Gate?" applies the new subnet mask to the current IP Address to preset the Default Gate.

Setting the Default Gate

The Default Gate edit page functions just like the IP Address edit page.

Figure 2.6 Default Gate Screen



Ethernet Connection

After the IP Address is configured for the DEB, it is safe to connect the Ethernet port to the network. The DEB includes a standard RJ-45 Ethernet connector with indicators for Link/Activity (green LED) and 100Mb (amber LED). (See Figure 2.7 Ethernet Port) The green Link/Activity light illuminates when the DEB has a valid link to the attached network port and blinks off while experiencing network traffic. The 100Mb amber LED is illuminated when the Ethernet port has negotiated 100Mb operation and off while configured for 10Mb operation.

The DEB's Ethernet port supports 10/100BaseTX auto-crossover operation. Standard CAT5 cables may be used to connect the DEB to Ethernet switches and hubs.

Figure 2.7 Ethernet Port

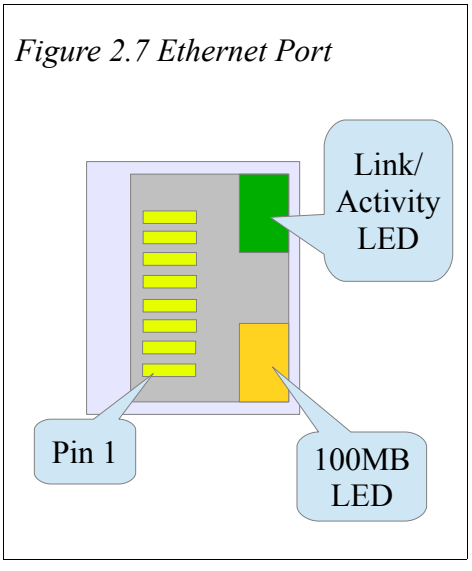
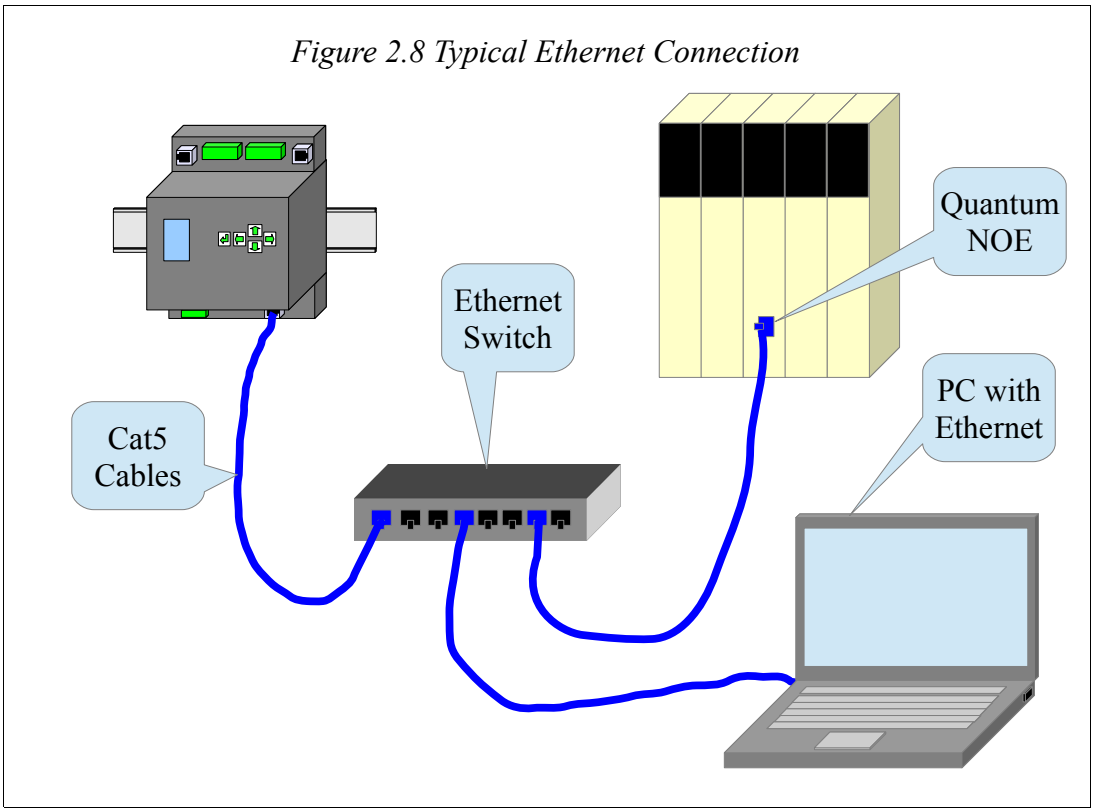


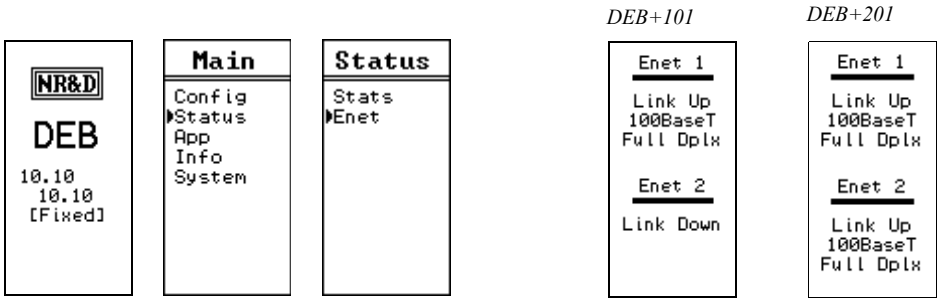
Figure 2.8 Typical Ethernet Connection



The status of the Ethernet port may be inspected through the front panel LCD by choosing "> Main > Status > Enet >"

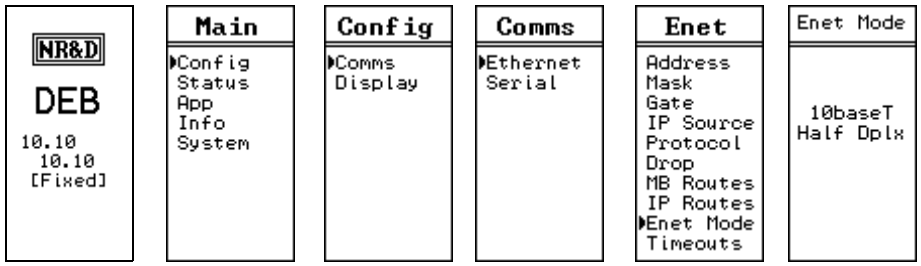
NOTE: DEB+101will always show "Enet2 Link Down".

Figure 2.9 Ethernet Port Status



The Ethernet port 1 defaults to "Auto" mode but may be manually set to a fixed 10BaseT or 100BasetT with fixed Full or Half Duplex operation. Ethernet port 2 (if present) is always "Auto".

Figure 2.10 Ethernet Mode Configuration for Enet Port 1



DEB+201 Second Ethernet Port

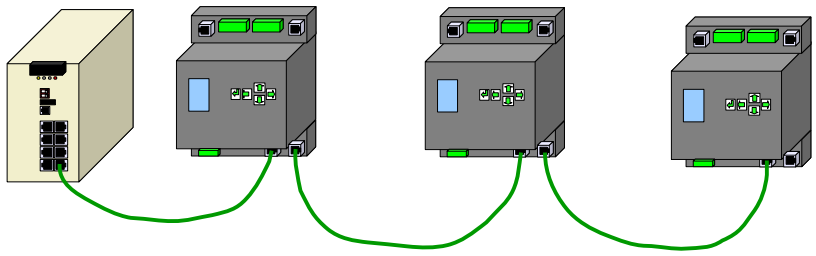
The DEB+201 includes two Ethernet ports. The current firmware of the DEB+201 supports this second port as daisy-chain or copper ring operation. A future firmware upgrade will allow the second port to operate independently with a second IP Address.

Daisy-Chain Operation

The DEB+201 may have its ethernet ports connected in a daisy-chain fashion.

Note: Communication to downstream Ethernet devices may be lost if one of the daisy-chain units fail or loses power.

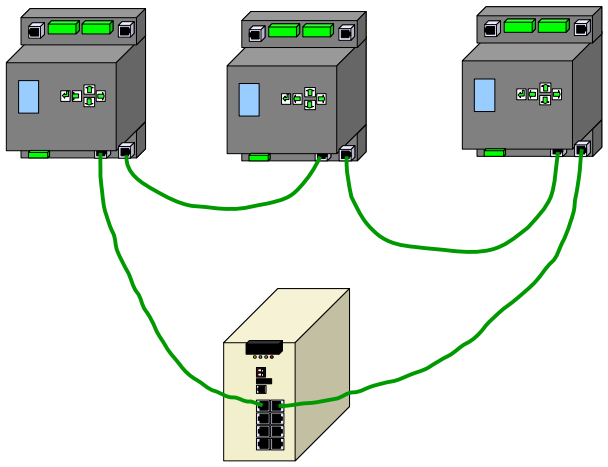
Figure 2.11 Daisy-Chain Ethernet Connection



Copper Ring Operation

The DEB+201 may be used in a copper RSTP ring with an appropriate Ethernet switch such as the Schneider-Electric ConneXium TCSESM08F23F0. This ring operation provides redundant cable paths to each DEB.

Figure 2.12 Copper Ring Operation



Serial Ports

The DEB includes two isolated serial ports. Separate connectors are provided for each port with an RJ-45 connector for RS-232 and a removable 5-position screw terminal connector for RS-485/422.

NOTE: Port 1 is electrically isolated from Port 2. The RS-232 connector of a given port is not isolated from the RS-485 connector of the same port.

RJ-45 RS-232 Ports

Figure 2.14 RS-232 Port 1

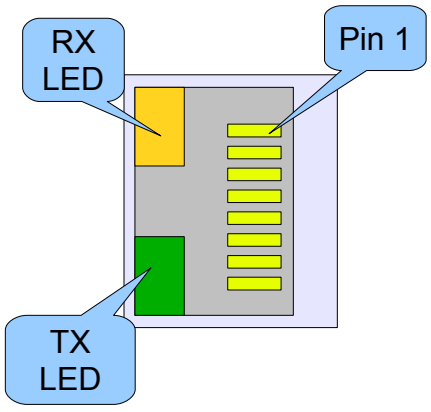
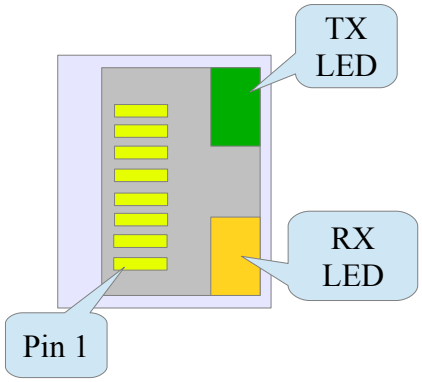


Figure 2.13 RS-232 Port 2

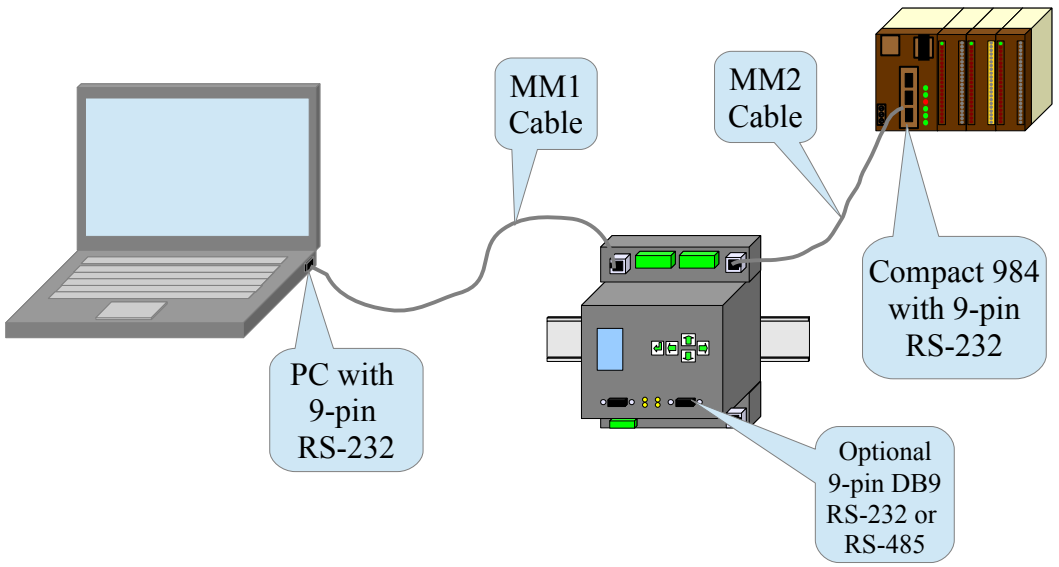


The RJ-45 connectors are used for RS-232 operation. The pin configuration is shown in Table 2.1 RJ-45 RS-232 Pinout. The Niobrara MM1 cable is used to connect an one of these ports to the a standard 9-pin serial port on a PC. (See Figure 7.1 MM1 Serial Cable)

Table 2.1 RJ-45 RS-232 Pinout

Pin	Function
1	No Connection
2	DSR (pulled high)
3	Data TX
4	Data RX
5	Signal GND
6	RTS
7	CTS
8	Chassis GND

Figure 2.15 Typical RJ-45 RS-232 Connections



DB9 RS-232 Ports

DEB units with with the optional DB9 RS-232 ports have a standard PC style male 9-pin connector. A null modem cable would be used to connect a PC port to the DEB connector.

Figure 2.16 RS-232 DB9 Pinout

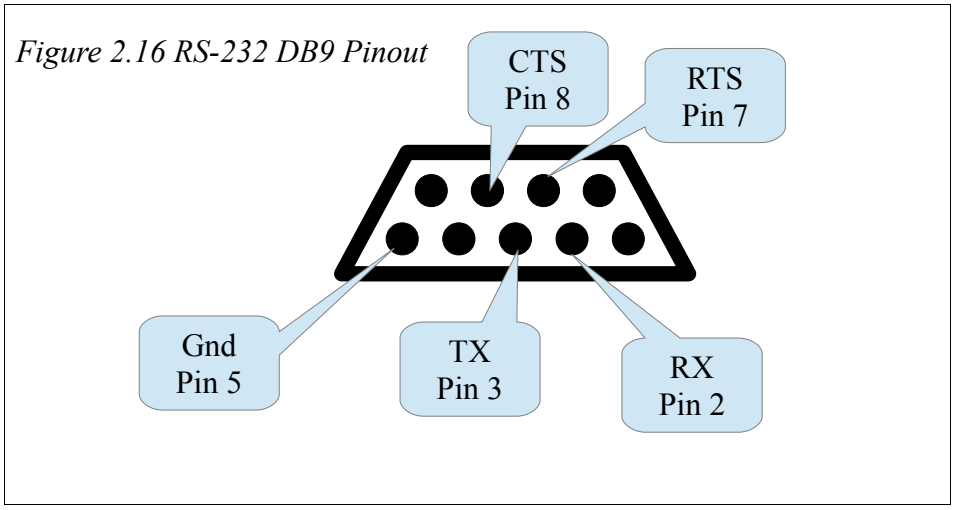
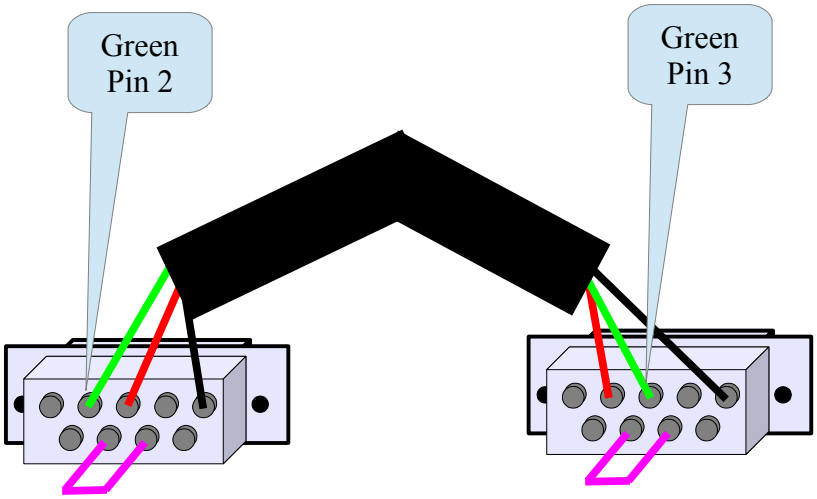


Table 2.2 DB9 RS-232 Pinout

Pin	Function
1	No Connection
2	Data RX (IN)
3	Data TX (OUT)
4	DTR (pulled up)
5	Signal GND
6	DSR (No Connection)
7	RTS
8	CTS
9	No Connection

Figure 2.17 Simple RS-232 DB9 Null Modem



RS-485 Ports

Port 1 and 2 may be used for RS-485 (4-wire or 2-wire) and RS-422 operation. A 5-pin removable screw terminal connector is provided. The pinout is shown in Figure 2.18 RS-485 Port.

Table 2.3 5-position RS-485 pinout

Pin	Function
Shield	No internal connection
RX-	(-) data into DEB
RX+	(+) data into DEB
TX-	(-) data out from DEB
TX+	(+) data out from DEB

Figure 2.18 RS-485 Port

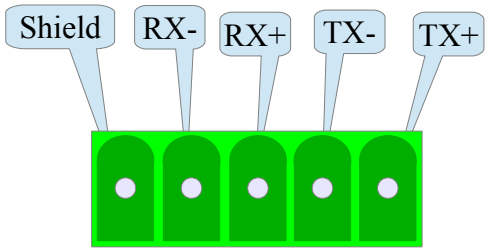
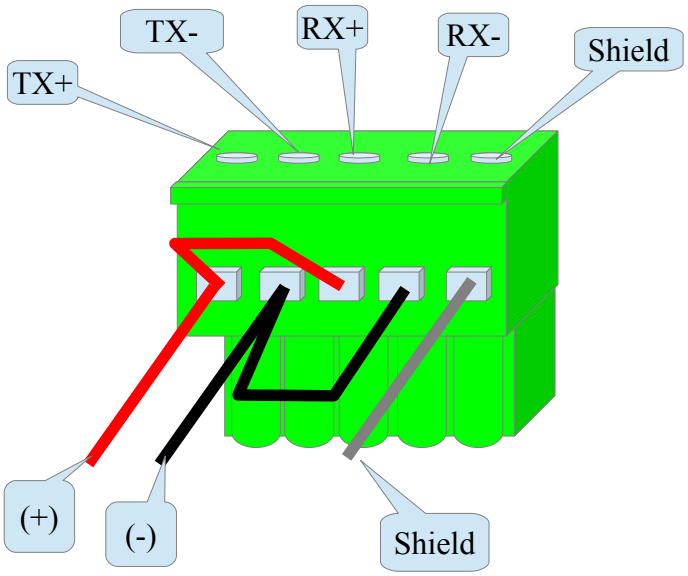
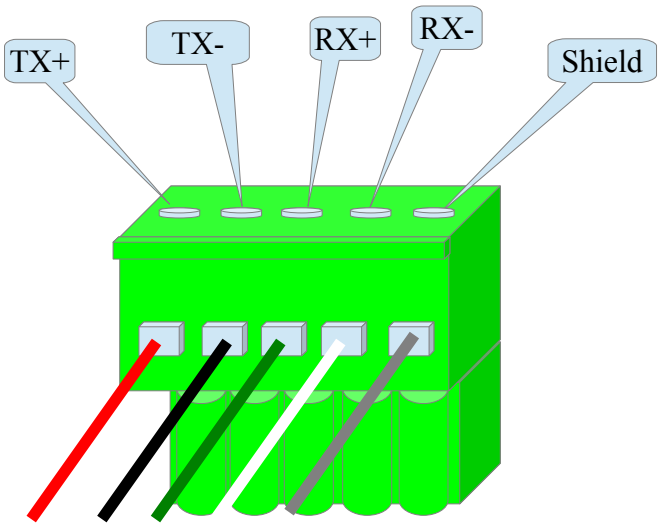


Figure 2.19 Jumper for 2-wire RS-485



For 2-wire RS-485 operation, jumper the TX+ to RX+ to make the (+) connection, then jumper the TX- to RX- to make the (-) connection.

Figure 2.20 4-wire RS-485 Wiring



DB9 RS-485 Ports

DEB units with with the optional DB9 RS-485 ports have the standard SY/MAX style female 9-pin connector.

Note: for 2-wire operation, jumper pins 1+3 to make the (-), 2+4 to make the (+), and then also jumper 5+6, and 7+8.

Figure 2.21 RS-485 DB9 Pinout

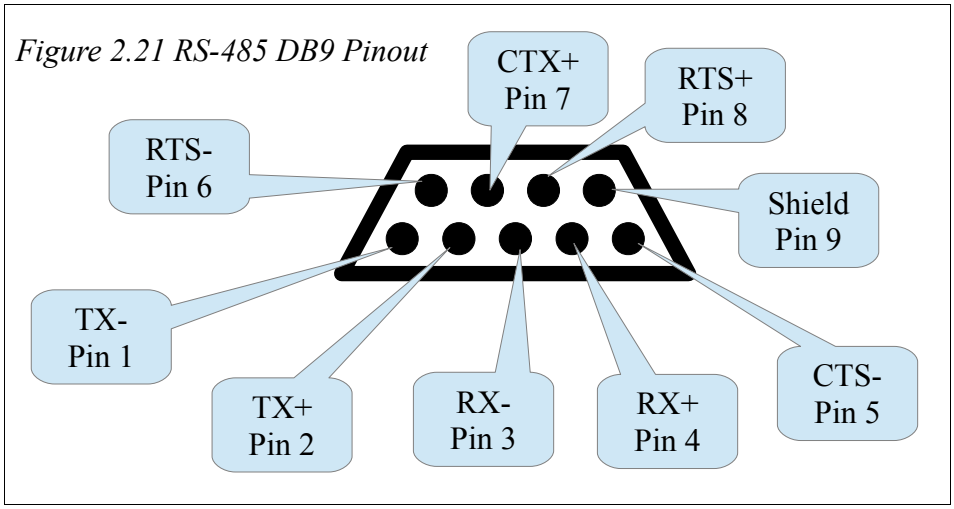


Table 2.4 DB9 RS-485 Pinout

Pin	Function
1	TX- (data OUT)
2	TX+ (data OUT)
3	RX- (data IN)
4	RX+ (data IN)
5	CTS-
6	RTS-
7	CTS+
8	RTS+
9	Shield

Figure 2.22 Jumper for 4-wire RS-485

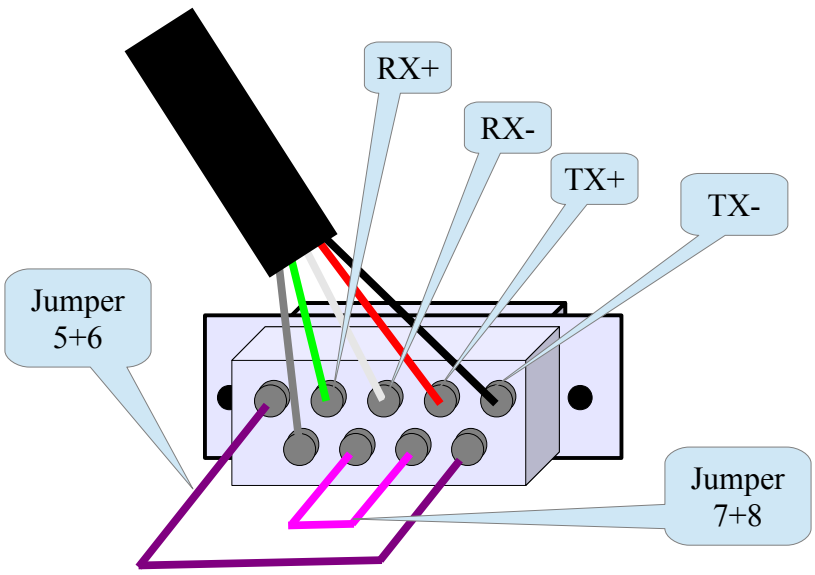
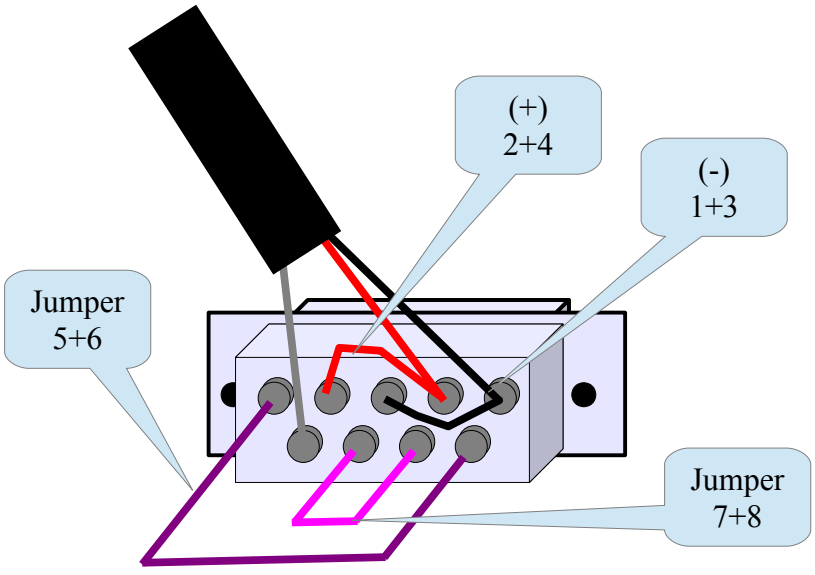
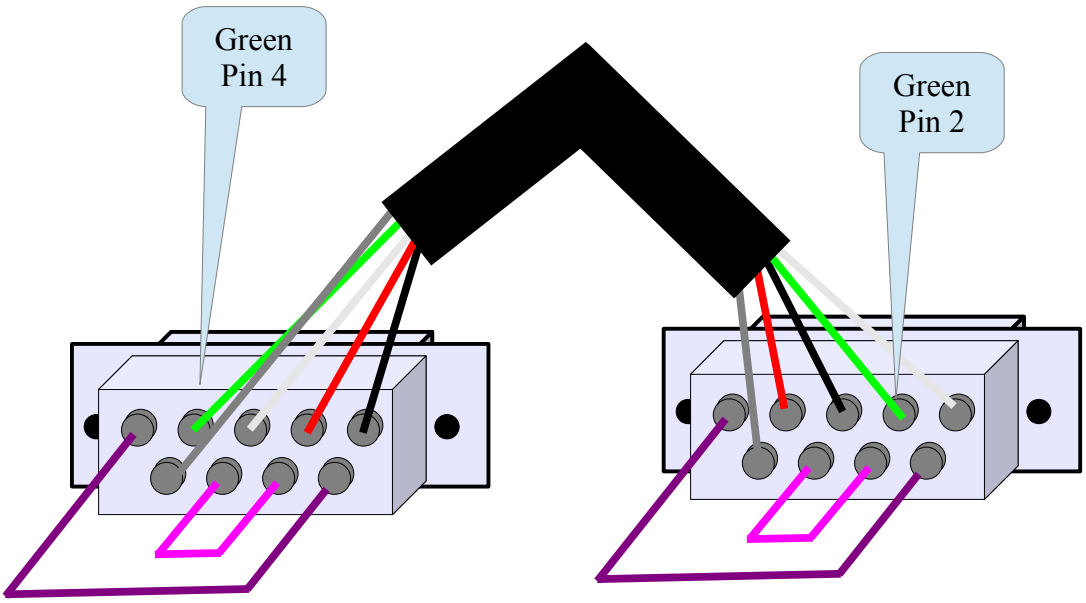


Figure 2.23 Jumper for 2-wire RS-485



To connect one of the DB9 RS-485 ports of the DEB to a standard SY/MAX (PLC) port use the NR&D DC1 or Square D CC-100 cable as shown in Figure 2.24.

Figure 2.24 SY/MAX RS-422 crossover cable DC1 (CC-100)



Software Installation

The DEB_SETUP.EXE file includes this user manual, the DEB firmware files, the RPCLOAD.EXE firmware loader utility, the NRDTOOL.EXE register viewer utility, The latest version of this file is located at www.niobrara.com. Follow the link for "Download Area", select "Module Software" and then "DEB_SETUP.EXE".

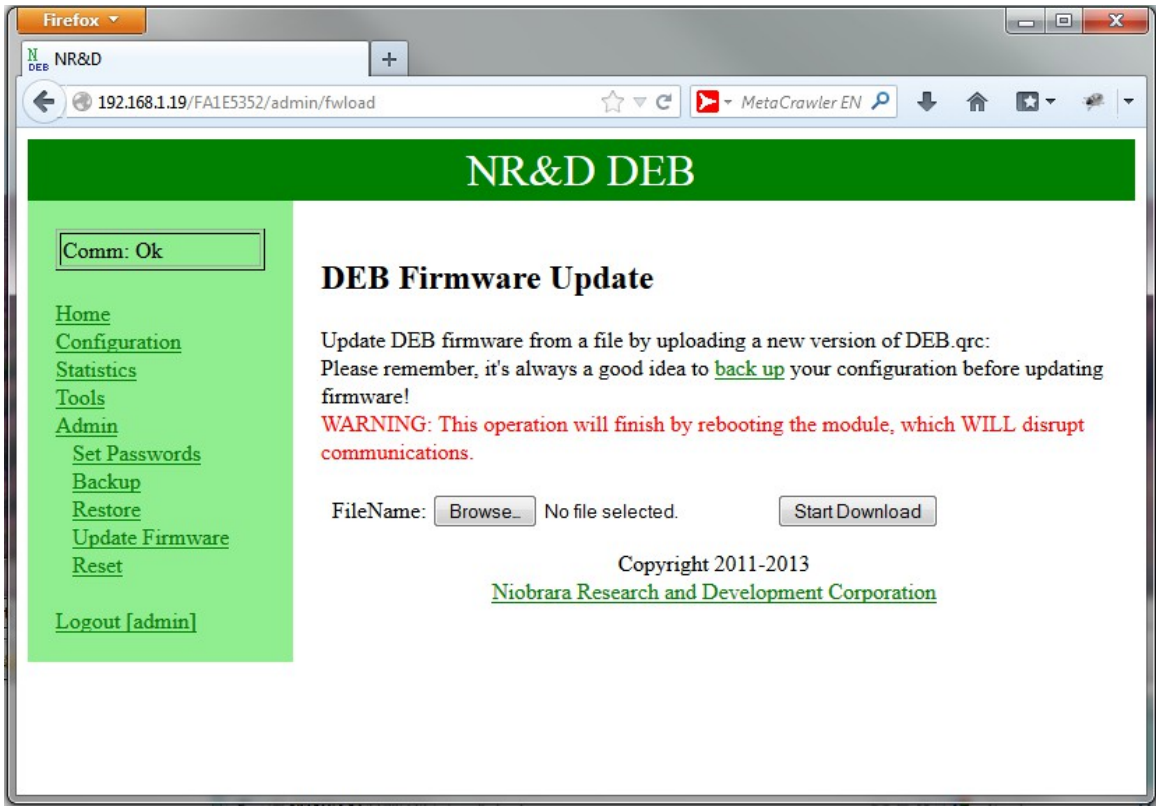
Updating the DEB Firmware

On occasion it may be necessary to update the operating system of the DEB.

Updating Firmware though the Web server

This action may be quickly done through the built-in web server.

1. Log into the DEB's web server as Username: admin Password: master.
2. Click on the "Admin" link in the left green menu column.
3. Click on the "Update Firmware" link in the left green menu column.
4. Click on the "Browse" button and select the "C:\Niobrara\Firmware\DEB.qrc" file.
5. Press the "Start Download" button to begin the update.

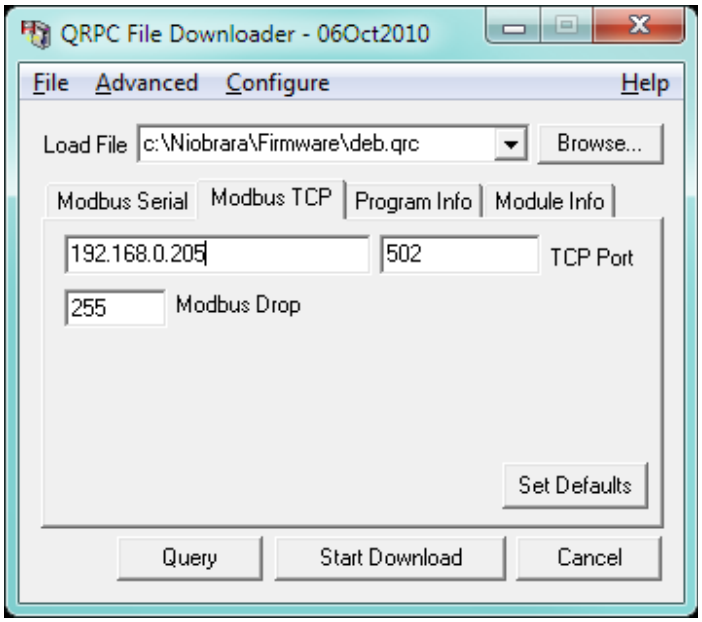


Updating Firmware using RPCLOAD

The RPCLOAD program is used to install the DEB firmware through the Ethernet connection.

1. Make sure the DEB is powered and running.
2. Start RPCLOAD.EXE. The Windows Start Menu link is “Start, Programs, Niobrara, DEB, RPCLOAD DEB Firmware”.
3. Click on the Browse button and select DEB.qrc.
4. Select the Modbus TCP tab.
5. Enter the IP Address of the target DEB (i.e. 192.168.0.205)
6. Make sure that the TCP port is set to 502.
7. Make sure that the Modbus Drop is set to 255.
8. Press the “Start Download” button. RPCLOAD will open a progress bar to show the status of the download.

Figure 2.25 RPCLOAD Screen



3 Modbus/TCP Operation

The DEB can operate as both a Modbus/TCP Server (slave to external masters) and Client (master to external slaves) at the same time. Up to 64 simultaneous TCP/IP connections may be made to the DEB. These connections are dynamically split between client and server operation.

Server Operation

The DEB listens for Modbus/TCP connections on the standard Modbus/TCP port number of 502. Modbus/TCP commands or queries generated by a client are processed by the DEB by examining the Destination Index (Modbus Slave Address) of the message.

A look-up table is used to map the Destination Index to a route that tells the DEB where to send the message. This table consists of a column for the Destination Index, a translation description (from legacy SY/MAX operation), and a downstream route.

The example in Figure 3.1 shows a PC connected via Ethernet to an DEB. A Quantum PLC is connected to the DEB's port 2 (drop 102) at Modbus address 15. A network of power meters is connected to port 1 (drop 101) of the DEB. The three power meters are addressed as Modbus slaves 1, 2, and 3.

Table 3.1 gives a Modbus Routing table for this example. The PC would use index 1 to communicate with the Quantum PLC . Index 2 will reach power meter #1. Index 3 will reach power meter #2. Index 4 will reach power meter #3.

NOTE: Index 0 has a route of NONE. The DEB will internally process incoming Modbus/TCP messages with no route, the special index 255, or any route that doesn't leave the DEB. This action may result in unexpected reply data since this data is from the DEB itself.

Figure 3.1 Ethernet Modbus Routing Example

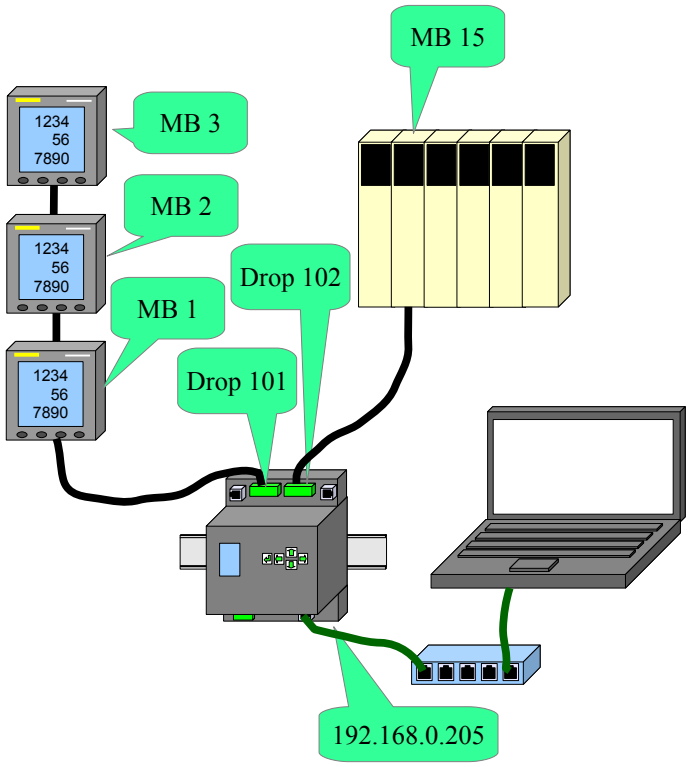


Table 3.1 Ethernet Modbus Routing Table Example

Index	Type	Route	Comments
0	Other	NONE	DEB Itself
1	Modbus	102,15	Quantum PLC
2	Modbus	101,1	Power Meter at address 1
3	Modbus	101,2	Power Meter at address 2
4	Modbus	101,3	Power Meter at address 3

Default Modbus Routing Table

The default Modbus Routing table for the Ethernet port maps Modbus/TCP destination

index values 1-128 to potential slaves 1-32 connected to serial ports 1, 2, 3, and 4. Table entries 1 through 32 are set to have the first drop be the drop number of Port 1 and the second drop be the same as the target slaves 1 through 32. Entries 33 through 64 use Port 2's drop number, 1 through 32. Entries 65 through 96 use Port 3's drop number, 1 though 32. Entries 97 through 128 use Port 4's drop number, 1 though 32.

NOTE: The default settings are there to potentially simplify the configuration. Any of these routes may be modified by the user to suit the particular installation.

Figure 3.2 Default Modbus/TCP Routing

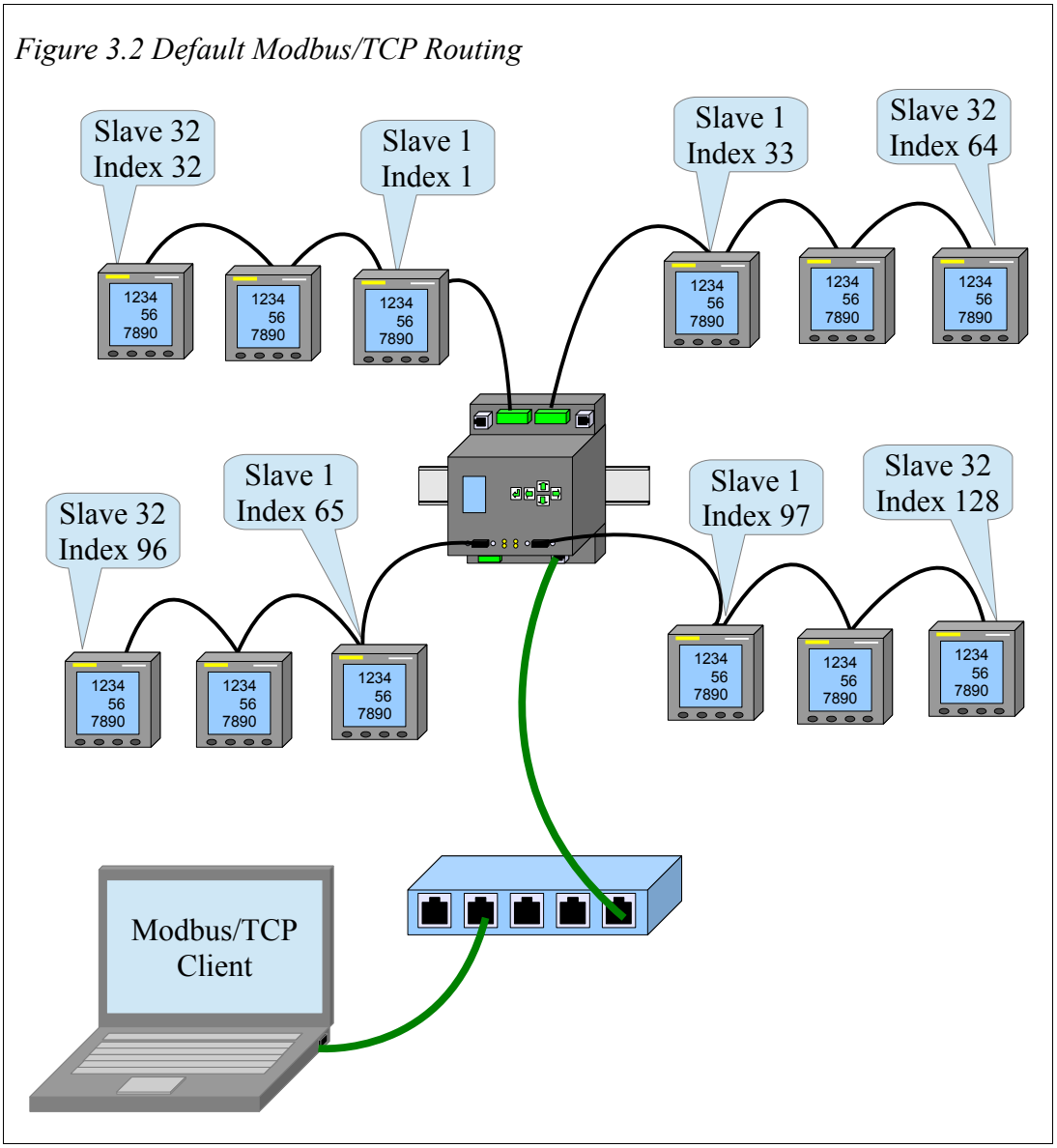


Table 3.2 Default Ethernet Modbus Routing Table

Index	Type	Route	Description
0	OTHER	NONE	
1	MODBUS	101,1	Port 1, Slave 1
2	MODBUS	101,2	Port 1, Slave 2
3	MODBUS	101,3	Port 1, Slave 3
...	MODBUS	...	Port 1, Slaves 4 - 31
32	MODBUS	101,32	Port 1, Slave 32
33	MODBUS	102,1	Port 2, Slave 1
34	MODBUS	102,2	Port 2, Slave 2
35	MODBUS	102,3	Port 2, Slave 3
...	MODBUS	...	Port 2, Slaves 4 - 31
64	MODBUS	102,32	Port 2, Slave 32
65	MODBUS	103,1	Port 3, Slave 1
66	MODBUS	103,2	Port 3, Slave 2
67	MODBUS	103,3	Port 3, Slave 3
...	MODBUS	...	Port 3, Slaves 4 - 31
96	MODBUS	103,32	Port 3, Slave 32
97	MODBUS	104,1	Port 4, Slave 1
98	MODBUS	104,2	Port 4, Slave 2
99	MODBUS	104,3	Port 4, Slave 3
...	MODBUS	...	Port 4, Slaves 4 -3 1
128	MODBUS	104,32	Port 4, Slave 32
129	OTHER	NONE	
...	OTHER	NONE	
255	OTHER	NONE	

AutoFix Modbus Table

The DEB offers to “AutoFix” the Modubs Routing tables after the drop number of a serial port is altered. The Ethenet and all serial port Modbus Routing tables are examined and entries where the first drop of the route matches the old drop number are changed to match the new drop number.

The Ethernet Modbus Routing tables may be modified from the front panel. The "Index" field may be changed with the UP and DOWN arrows. Pressing the ENTER button on the Index field will exit this screen.

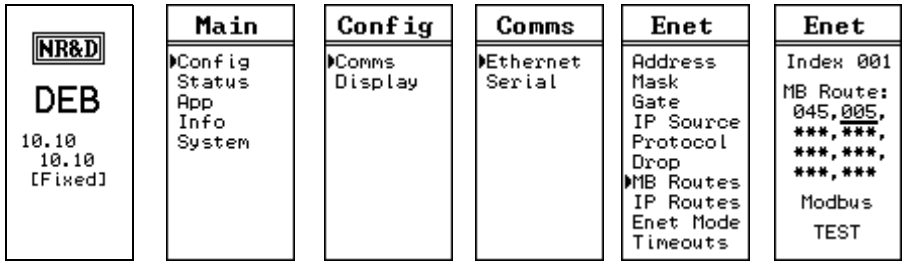


Figure 3.3 Modbus Route Edit Screen

Pressing ENTER button on the TEST field will cause the DEB to generate a Modbus opcode 03 Holding Register read of the target device. The test will report PASS or FAIL A "Downstream Timeout" is a failure but an Error 01 (Illegal Opcode) or Error 02 (Illegal Register) are PASS because the target device responded with the error.

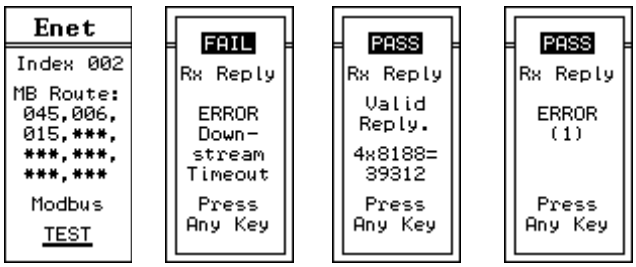


Figure 3.4 Modbus Route Edit TEST Screens

Ethernet Routing Example

The example in Figure 3.5 shows a PC connected via Ethernet to an DEB.

A network of power meters is connected to port 1 (drop 101) of the DEB. The three power meters are addressed as Modbus slaves 1, 2, and 3.

A second network of power meters is connected to port 2 (drop 102) of the same DEB. These meters are also addressed as Modbus slaves 1, 2, and 3.

Table 3.3 gives the default Modbus Routing table for this example. Communication with the meters on Port 1 would be done with Modbus/TCP Index values 1, 2, and 3. Port 2 meters would be accessed with Index values 33, 34, and 35.

NOTE: Index 0 has a route of NONE. The DEB will internally process incoming Modbus/TCP messages with no route, the special index 255, or any route that doesn't leave the DEB. This action may result in unexpected reply data since this data is from the DEB itself.

Figure 3.5 Ethernet Modbus Routing Example

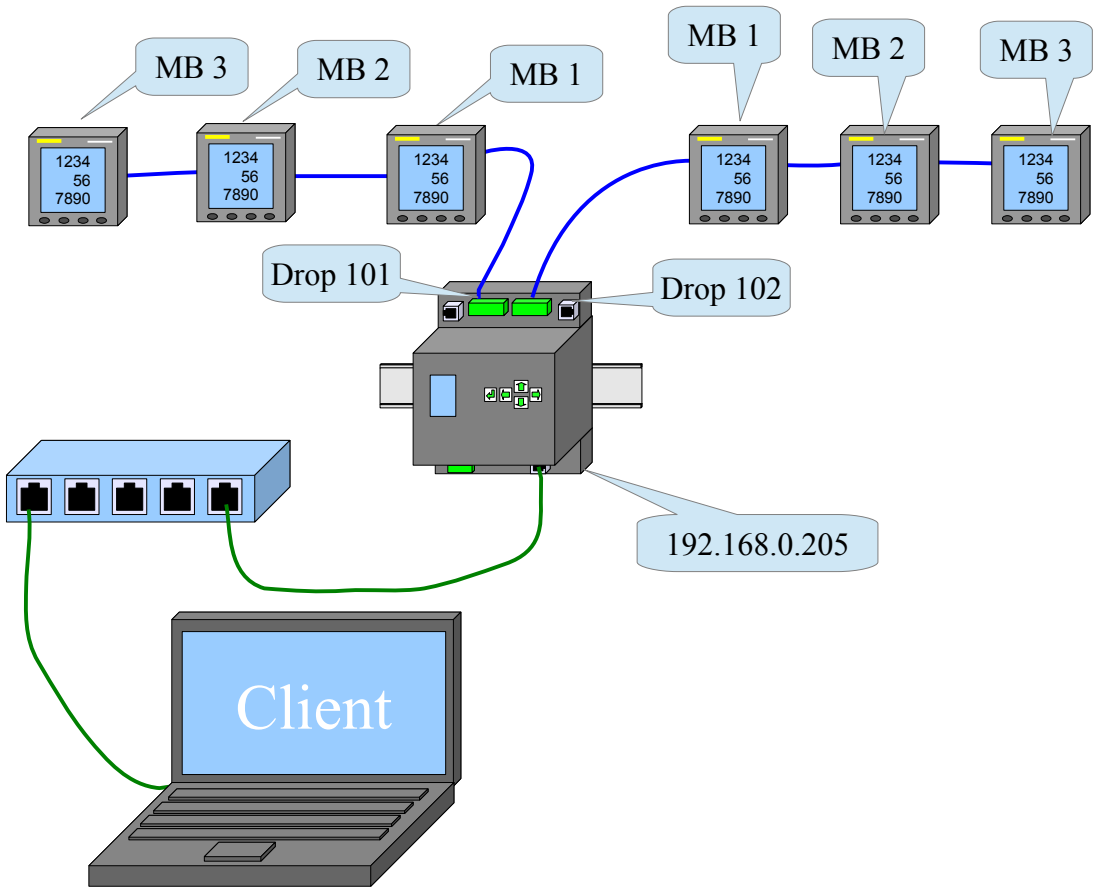


Table 3.3 Ethernet Modbus Routing Table Example

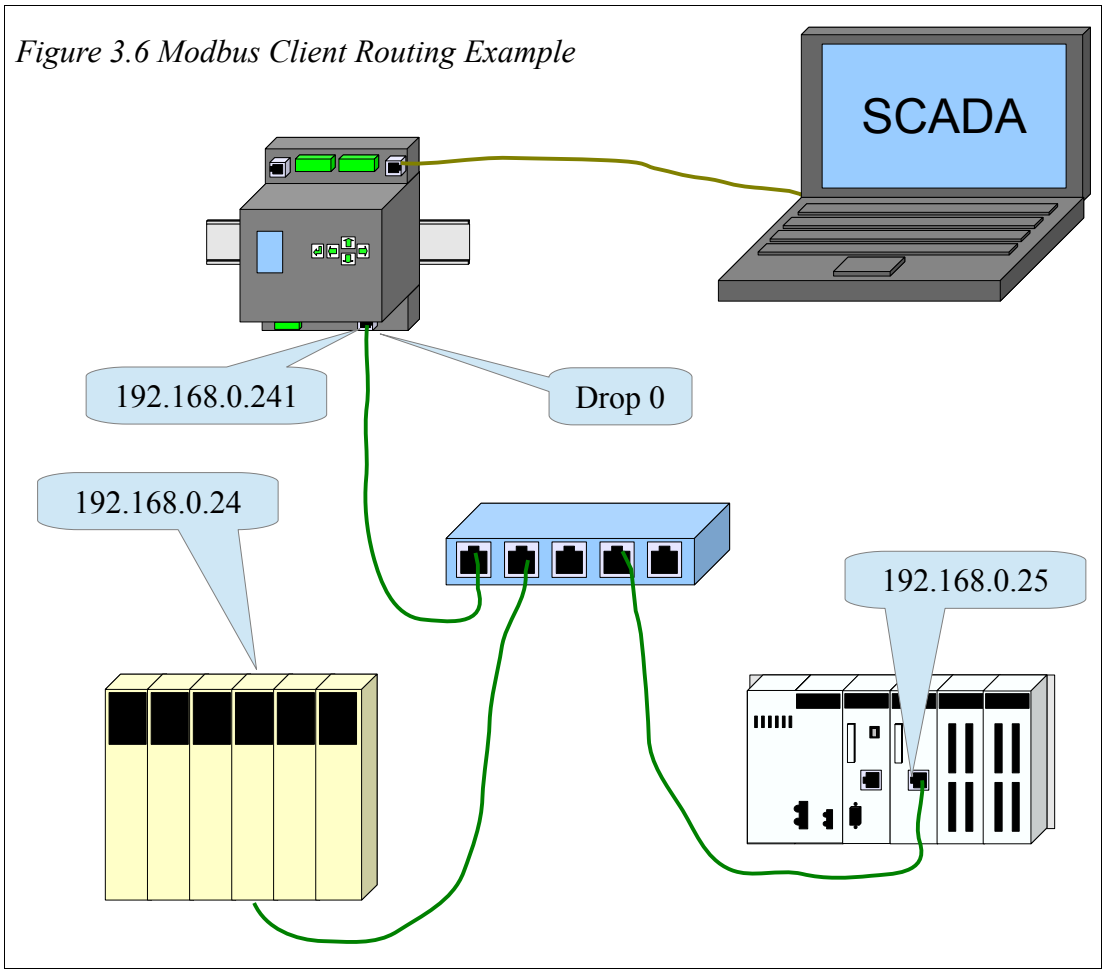
Index	Type	Route	Comments
0	OTHER	NONE	DEB Itself
1	MODBUS	101,1	Port 1, Power Meter 1
2	MODBUS	101,2	Port 1, Power Meter 2
3	MODBUS	101,3	Port 1, Power Meter 3
33	MODBUS	102,1	Port 2, Power Meter 1
34	MODBUS	102,2	Port 2, Power Meter 2
35	MODBUS	102,3	Port 2, Power Meter 3

Client Operation

The DEB uses a look-up table to map routing drop numbers to TCP/IP addresses. This table consists of a drop number, target IP Address, and an optional Downstream Route. Messages passing through the DEB from one of its serial ports (or the Ethernet port itself) that are directed out the Ethernet port are sent to the TCP Routing Table to determine the target device.

Figure 3.6 shows an DEB connected to a serial SCADA via Modbus RTU. The Ethernet port is set to be drop 0 and is connected to a Quantum PLC at IP Address 192.168.0.24 and an M340 PLC at 192.168.0.25.

Figure 3.6 Modbus Client Routing Example



The default TCP table for the DEB is auto-filled with the first three octets of the IP Address and the last octet set for 0 through 199. In this example, entries 24 and 25 already point to the target Quantum and M340 PLCs.

Table 3.4 DEB TCP Table Example

Drop	IP Address	Downstream Route	Comments
0	192.168.0.0	NONE	
1	192.168.0.1	NONE	
2	192.168.0.2	NONE	
...	192.168.0....	NONE	
24	192.168.0.24	NONE	Quantum PLC
25	192.168.0.25	NONE	M340 PLC

The table 3.5 shows routes for the SCADA in this example.

- The first drop (0) in the route is the drop number of the Ethernet port of the DEB.
- The second drop (24 and 25) is the TCP table look-up drop. This number defines the target IP Address. By default, the last octet in the route matches the drop number.
- The third drop (0) is the destination index for the Modbus/TCP message sent to the target IP device. The local M340 and Quantum NOEs don't care about the value of this number. This number would be important if the target device need a destination index.

Table 3.5 Modbus Routes for DEB Port 2

DCS Target Slave	Port 2 Route	Target
1	0,24,0	Quantum at 192.168.0.24
2	0.25,0	M340 at 192.168.0.25

There are a few subtle issues of note in this example:

- The DEB chooses to open new client sockets based on the entry in the TCP table. When a message arrives at the Ethernet port, the drop following the Ethernet port is examined to determine the the target IP Address. If there is already a client socket opened to this target then the new message then this new message will be sent on this socket. Client sockets are single-threaded by the DEB. In other words, only one outstanding message is allowed on a client socket at a time. Newly arrived messages are held in a queue and sent when one at a time.
- There are 200 entries in the TCP table. This feature may be exploited to cause the DEB to open multiple client connections to a given target by simply adding the same IP Address to multiple table entries. Use caution with this method as there are only 64 total sockets available.

NOTE: When the DEB's Ethernet port is in Modbus+SYMAX mode, the TCP table is how the unit decides to connect a client message via Modbus/TCP or SY/MAX 802.3. If the IP Address for a given drop number is 0.0.0.0 then the message is sent out as SY/MAX 802.3 to that drop number. See SY/MAX Routing in Chapter 5.

AutoFill TCP Table

Changing the IP Address from the front panel keypad will prompt the user to automatically adjust the TCP Routing Table. This feature will automatically fill in the first three bytes of the local IP Address and have the fourth byte match the drop number.

Table 3.6 Default Ethernet TCP Routing Table

Drop	IP Address	Route
0	0.0.0.0	NONE
1	0.0.0.0	NONE
2	0.0.0.0	NONE
3	0.0.0.0	NONE

Table 3.7 Ethernet TCP Routing Table for 206.223.51.155 after AutoFill

Drop	IP Address	Route
0	206.223.51.0	NONE
1	206.223.51.1	NONE
2	206.223.51.2	NONE
3	206.223.51.3	NONE

Front Panel Edit of TCP Table

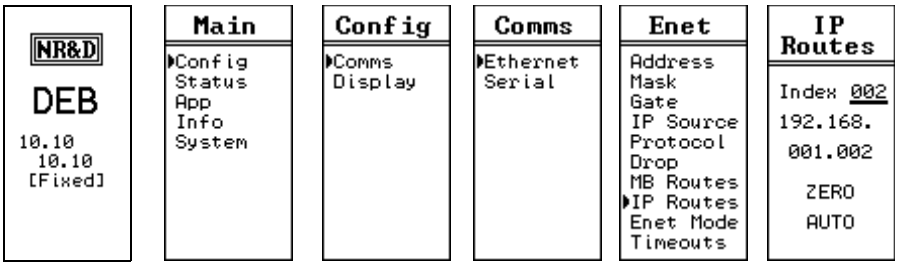


Figure 3.7 IP Route Edit Screen

The IP Routes may be edited from the front panel. The UP and DOWN buttons on the INDEX field scroll through the 200 entries. Pressing the ENTER button while on the INDEX field exits the screen.

Pressing the ENTER button while on the ZERO field will zero the IP Address. This is useful in SY/MAX Ethernet applications.

Pressing the ENTER button while on the AUTO field will auto load the AutoFill value for this Index.

4 Modbus Serial Operation

The DEB serial ports can operate as both a Modbus Master and Slave using either Modbus RTU and Modbus ASCII protocols. The protocol modes are labeled “Modbus RTU” and “Modbus ASCII”. All Modbus serial modes can dynamically switch between functioning as a Master or a Slave.

NOTE: The mode “MODBUS HOST” is a version of the RTU mode with special message translation features.

Slave Operation (External Master)

A Modbus mode port on the DEB listens for Modbus serial messages whenever it is idle. When a message arrives and has a good checksum, the Modbus Slave Address in the message is examined and compared to entries in the Modbus Routing Table for that serial port. If the entry for that drop number is not empty, then the DEB will forward that message according to this defined route. If the entry is empty (NONE), then the message is ignored.

A look-up table is used to map the Slave Address (Index) to a route that tells the DEB where to send the message. This table consists of a column for the Index, a translation description (from legacy SY/MAX operation), and a downstream route.

Default Modbus Routing Tables

The default Modbus Routing table for each serial port maps Modbus Slave Address (Index) values 1 through 32 use Port 1's drop number, 1 through 32 (port 2 only) . Entries 33 through 64 use Port 2's drop number, 1 though 32 (port 1 only).

Table 4.1 Default Serial Port Modbus Routing Table for Port 1 drop 101, and Port 2 drop 102

Index	Type	Route for Port 1	Route for Port 2
1	MODBUS	NONE	101,1
2	MODBUS	NONE	101,2
3	MODBUS	NONE	101,3
4	MODBUS	NONE	101,4
...	MODBUS	NONE	...
31	MODBUS	NONE	101,31
32	MODBUS	NONE	101,32
33	MODBUS	102,1	NONE
34	MODBUS	102,2	NONE
35	MODBUS	102,3	NONE
36	MODBUS	102,4	NONE
...	MODBUS	...	NONE
63	MODBUS	102,31	NONE
64	MODBUS	102,32	NONE

AutoFix Modbus Table

The DEB offers to “AutoFix” the Modubs Routing tables after the serial port drop number is altered. The Ethenet and both serial port Modbus Routing tables are examined and entries where the first drop of the route matches the old serial drop number are changed to match the new drop number.

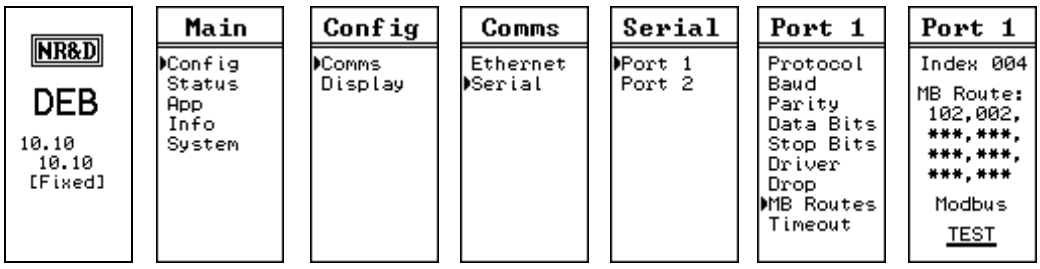


Figure 4.1 Edit Modbus Serial Route

Pressing ENTER button on the TEST field will cause the DEB to generate a Modbus opcode 03 Holding Register read of the target device. The test will report PASS or FAIL A “Downstream Timeout” is a failure but an Error 01 (Illegal Opcode) or Error 02 (Illegal Register) are PASS because the target device responded with the error.

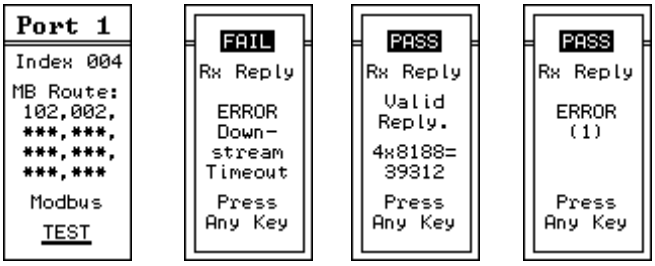


Figure 4.2 Modbus Route Edit TEST Screens

Master Operation (External Slave)

The DEB inspects the route of a message arriving at a serial port in one of the Modbus modes and takes the next drop number in the route and sends the message to the slave represented by that drop number.

Figure 4.3 shows a string of power meters connected to RS-485 port 1 of the DEB. Port 1 is configured for Modbus RTU mode and set to match the baud rate and parity of the meters. The drop number of port 1 is 101(default).The normal routing to reach each meter is the route to reach port 1, followed by the slave address of the meter.

Figure 4.3 Modbus Routing Example

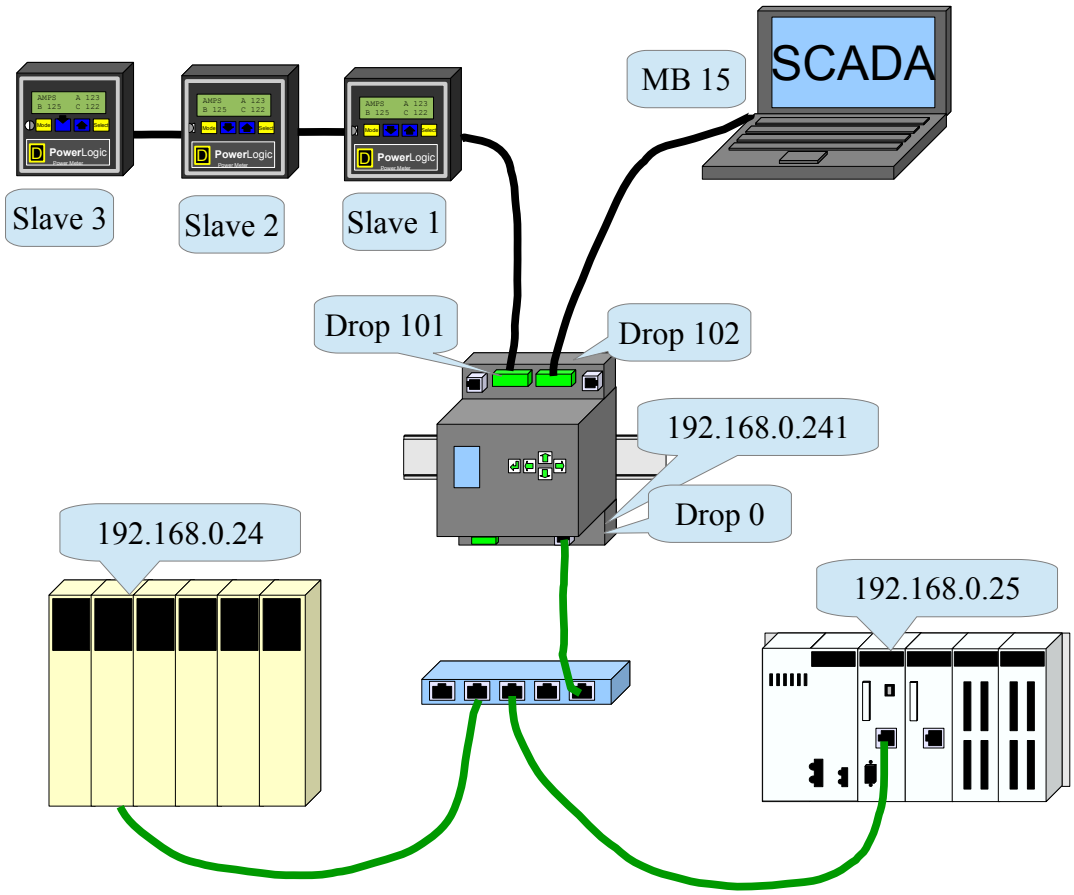


Table 4.2 DEB TCP Routing Table

Drop	IP Address	Downstream Route	Comments
0	0.0.0.0	NONE	
1	192.168.0.24	NONE	Quantum PLC
2	192.168.0.25	NONE	M340 PLC
3	192.168.0.241	NONE	DEB from Figure 4.3
4	0.0.0.0	NONE	

The tables 4.3 & 4.4 show routes for MSTRs for the SCADA system in this example.

TCP Routing:

- The first drop (102) in the route is the Modbus address of port 2 in the DEB.
- The second drop (0) is the drop number that tells the DEB to route the message out of the Ethernet port.
- The third drop (1, 2, and 3) is the TCP table look-up drop. This number defines the target IP Address.
- The fourth drop (0, 1, 2, 3, 4, 5, and 255) is the destination index for the Modbus/TCP message sent to the target IP device. The local M340 and Quantum NOEs don't care about the value of this number. This number is used in the Modbus Routing table in the remote DEB to determine the target for the MSTR message.

Table 4.3 Modbus/TCP MSTR Routes for SCADA System in Figure 4.3

MSTR Route	Target
102,0,1,0	Quantum at 192.168.0.24
102,0,2,0	M340 at 192.168.0.25
102,0,3,255	DEB in Figure 4.3

Serial Routing:

- The first drop (102) in the route is the Modbus address of port 2 in the DEB.
- The second drop (101) is the drop number that tells the DEB to route the message out of the port 1.
- The third drop (1, 2, 3) is the Modbus address of the meters on port 1.

Table 4.4 Serial MSTR Routes for SCADA System in Figure 4.3

MSTR Route	Target
102,101,1	Power Meter 1 in Figure 4.3
102,101,2	Power Meter 2 in Figure 4.3
102,101,3	Power Meter 3 in Figure 4.3

There are a few subtle issues of note in this example:

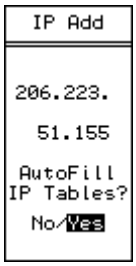
- The DEB chooses to open new client sockets based on the entry in the TCP table. When a message arrives at the Ethernet port, the drop following the Ethernet port is examined to determine the the target IP Address. If there is already a client socket opened to this target then the new message then this new message will be

sent on this socket. Client sockets are single-threaded by the DEB. In other words, only one outstanding message is allowed on a client socket at a time. Newly arrived messages are held in a queue and sent when one at a time.

- There are 200 entries in the TCP table. This feature may be exploited to cause the DEB to open multiple client connections to a given target by simply adding the same IP Address to multiple table entries. Use caution with this method as there are only 64 total sockets available.

NOTE: When the DEB's Ethernet port is in Modbus+SYMAX mode, the TCP table is how the unit decides to connect a client message via Modbus/TCP or SY/MAX 802.3. If the IP Address for a given drop number is 0.0.0.0 then the message is sent out as SY/MAX 802.3 to that drop number. See SY/MAX Routing in Chapter 5.

AutoFill TCP Table



Changing the IP Address from the front panel keypad will prompt the user to automatically adjust the TCP Routing Table. This feature will automatically fill in the first three bytes of the local IP Address and have the fourth byte match the drop number.

Table 4.5 Ethernet TCP Routing Table for Address 10.10.10.10

Drop	IP Address	Route
0	0.0.0.0	NONE
1	10.10.10.1	NONE
2	10.10.10.2	NONE
3	10.10.10.3	NONE

Table 4.6 Ethernet TCP Routing Table for 206.223.51.155 after AutoFill

Drop	IP Address	Route
0	0.0.0.0	NONE
1	206.223.51.1	NONE
2	206.223.51.2	NONE
3	206.223.51.3	NONE

5 Legacy SY/MAX Operation

The DEB serial and Ethernet ports can operate in a variety of modes to support legacy Square D SY/MAX PLCs and older PowerLOGIC meters.

Translations

The DEB translates Modbus messages to SY/MAX (and vice versa) as each message passes through the device.

NOTE: Some Modbus devices may refer to Holding Register 100 as 4x0100, 4:0100, 40100, or 4000100. The 4 at the beginning simply means it is a Holding Register. Analog Input registers (3x) are shown as 3x0001, 3:0001, 300001, or 300001. Output coils (0x) may be shown as 0x0025, 0:0025, 25. Input bits (1x) start with a 1 like 1x1234, 1:1234, 11234, or 101234.

NOTE: Some Modbus devices may start at register 0 instead of register 1. (This is commonly referred as JBUS.) It may be necessary to offset each register number by 1 to access the proper data.

NOTE: SY/MAX bit numbers are 1 to 16 with bit 1 as the least significant bit. This manual will note bit references as Sxxxx-yy where xxx is the SY/MAX register number and yy is the bit number. For example, register 20, bit 14 will be shown as S20-14.

Modbus to SY/MAX Translations

- Holding Registers (4x) – Holding Registers (read/write) are directly mapped 1-to-1 to SY/MAX registers. A Modbus client wanting the data from SY/MAX register 1503 would send a Holding Register Read (FC03) to remote register 1503. Modbus single (FC06) and multiple register writes (FC16) are supported with the target register chosen simply as the SY/MAX register number.
- Analog Input Registers (3x) – Modbus clients may access SY/MAX registers as though they are Modbus 3x data (read only). The mapping is just like 4x registers and is simply the target SY/MAX address.
- Coils (0x) - Modbus coils (read/write) may be mapped into SY/MAX registers. The translation starts as SY/MAX register 1, bit 1 (S1-1) = Modbus coil 0x1. S1-

16 = 0x16. S2-1 = 0x17. The formula to determine the Modbus coil from a SY/MAX bit is: COIL = ((REG – 1) * 16) + (BIT).

- Input Bits (1x) – Modbus discrete inputs (read only) are mapped exactly the same as 0x coils.

Incoming Modbus commands (4x, 3x, 1x, 0x) are translated into Non-Priority SY/MAX Read or Write messages. Coil write messages (FC05 and FC15) are translated as bit-masked NP writes when possible to allow single SY/MAX bits to be modified.

NOTE: FC15 multiple coil write message may not be able to be processed when the bits span multiple SY/MAX registers. The SY/MAX bit-masked NP Write message cannot handle this type of masking operation. The DEB will send back a Modbus Exception code 5 error when this condition occurs.

NOTE: A few SY/MAX end devices (NIMs for example) do not support Non-Priority messages. It may not be possible for a Modbus client to be able to directly communicate with these devices.

SY/MAX to Modbus Translations

SY/MAX Priority and Non-Priority Read and Write command messages are translated into Holding Register Read (FC03) and Write (FC16) messages. SY/MAX Random Access Read messages are translated into PowerLOGIC's Modbus Random Access Read (FC100).

If the SY/MAX client needs to access other memory spaces on a Modbus serial server, the Modbus Host serial mode may be used. This mode allows the user to manually configure the translation for both the read and the write. Supported Modbus Function Codes are 03 (4x read), 04 (3x read), 02 (1x read), 01 (0x read), 05 (0x single write), 06 (4x single write), 15 (0x multiple write), and 16 (4x multiple write).

NOTE: Standard Priority and non-bit-masked Non-Priority SY/MAX write messages will translate into 16 FC05 coil messages or one 16-bit FC15 message. All 16 bits will be forced.

NOTE: SY/MAX Read and Write messages support up to 128 registers. Modbus messages are limited to a maximum of 125 registers on a read and 120 registers on a write. Individual servers may have additional register count restrictions.

Error Translations

Modbus and SY/MAX do not share the same error messages. Table 5.1 shows the DEB's translations.

All other errors are passed straight through with no translation.

Modbus Exception Code	SY/MAX Error Code	Meaning
2	3	Illegal Address
3	5	Illegal Value
10	29	Illegal Route
11	17	Device Not Responding

Table 5.1 Modbus and SY/MAX Error Translations

SY/MAX Serial

DEB serial ports may be configured to SY/MAX mode to directly connect to a SY/MAX PLC. The green RS-485 port is typically used along with the MU7 (DEB to SY/MAX) cable. If the optional RS-485 ports 3 and 4 are installed, then a standard DC1 or CC-100 cable may be used.

Default values for SY/MAX ports are 9600, EVEN, 8, 1, RS-422, and BCC.

The drop number of the SY/MAX mode port will be the last drop of an incoming route and the first drop of an output TREAD, TWRITE, or TALARM message from the SY/MAX PLC.

SY/MAX mode ports are full duplex and allow the PLC to be both a master and a slave at the same time.

Figure 5.1 SY/MAX Serial Routing Example shows a SY/MAX Model 400 PLC connected with an MU7 cable to the RS-485 port 1 of an DEB. This port is set to SY/MAX at drop 101.

An entry in the Ethernet Modbus Routing table must be modified to access the Model 400 PLC. For this example, Entry 1 was chosen. The new route is shown in Table 5.2 Modbus Routing Table for Ethernet Port. The type set to OTHER since this is not a MODBUS target.

A Modbus/TCP client such as the M340 PLC in this example would simply use Modbus/TCP index 1 to access the SY/MAX PLC.

Table 5.2 Modbus Routing Table for Ethernet Port

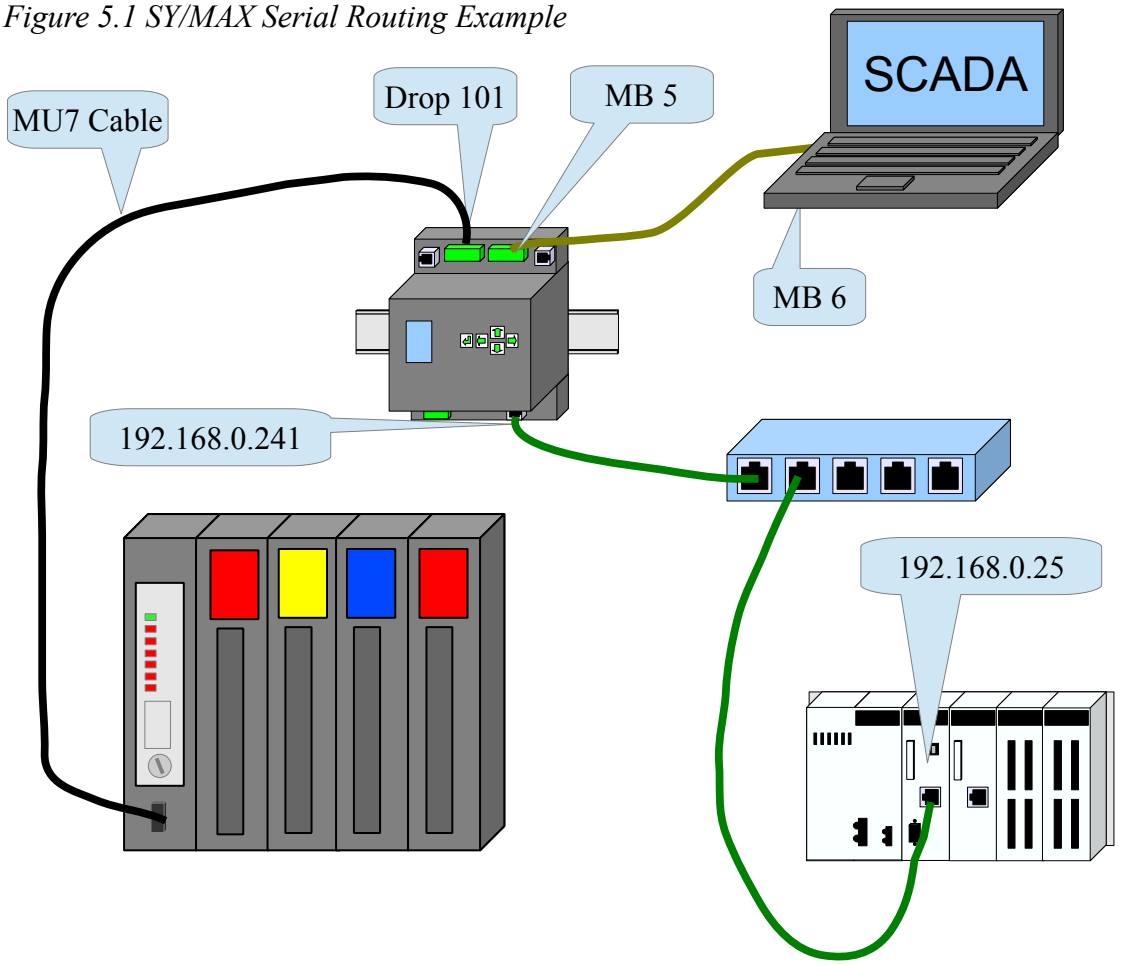
Index	Type	Route	Comments
0	OTHER	NONE	
1	OTHER	101	Model 400 PLC
2	MODBUS	5,2	
3	MODBUS	5,3	
4	MODBUS	5,4	
5	MODBUS	5,5	
6	MODBUS	5,6	SCADA
7	MODBUS	5,7	

The SCADA can read and write the SY/MAX PLC using MSTR Read and Write messages. In this example, the MSTR route would be 5,1 since the message needs to go out DEB port 1. The remote register in the MSTR is simply the SY/MAX target register.

The SY/MAX PLC may also use TREAD and TWRITE messages to access both the M340 and Compact PLCs.

The route to the SCADA would be 101,5,6 while the route to the M340 would be 101,0,25,1 assuming that the Ethernet port on the DEB is set to 0 and TCP table entry 25 has the IP Address of the M340.

Figure 5.1 SY/MAX Serial Routing Example



NET-TO-NET Mode

The DEB may be connected to a SY/NET network using the NET-TO-NET mode. This mode is used to connect the DEB to an RS-422 port on a CRM-510 NIM, RS-422 port on a SY/LINK (SFI-510) PC card, Niobrara SPE4, EPE5, or even DEB modules.

The following rules apply to NET-TO-NET ports:

- Both ports must be set to NET-TO-NET mode. This may involve setting DIP switches on the NIM.
- Both ports must be set to the same SY/NET drop number. Set the DEB port to match the NIM.
- Both ports must have the same baud rate, parity, data bits, stop bits, and

checksum. Most NIMs use BCC but the CRM-511 and 512 may be set to use CRC-16.

The route message includes the NET-TO-NET drop number only once for the port pair.

Figure 5.2 NET-TO-NET Serial Routing Example

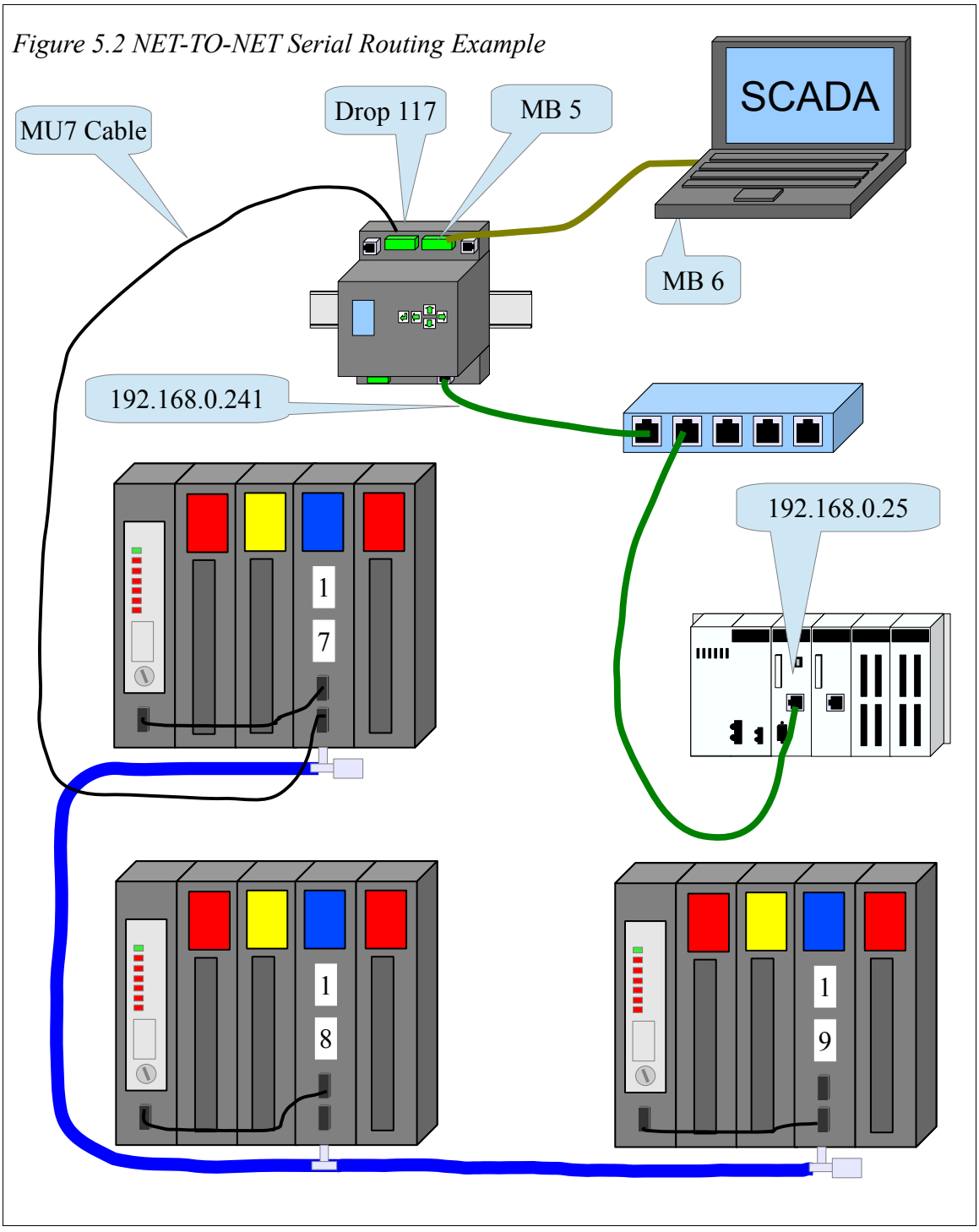


Figure 5.2 NET-TO-NET Serial Routing Example show an DEB port 1 connected NET-TO-NET to a CRM-510 set to node 17. This NIM is on a small “Blue Hose” SY/NET with two other NIMs set to 18 and 19. NIMs 17 and 18 have a PLC connected to the 0xx port with a CC-100 cable. NIM 19 has the PLC connected to port 119. The DEB is connected to the 117 port so the drop number of the DEB port 1 must also be set to 117. Both the NIM port and DEB must be set to NET-TO-NET mode.

Table 5.3 Modbus Routing Table for Ethernet Port

Index	Type	Route	Comments
0	OTHER	NONE	
1	MODBUS	5, 1	
2	MODBUS	5, 2	
3	MODBUS	5, 3	
4	MODBUS	5, 4	
5	MODBUS	5, 5	
6	MODBUS	5, 6	SCADA
7	MODBUS	5, 7	
...	...	...	
16	MODBUS	5, 16	
17	OTHER	117, 17	PLC on NIM port 17
18	OTHER	117, 18	PLC on NIM port 18
19	OTHER	117, 119	PLC on NIM port 119
20	MODBUS	5, 20	

The Modbus/TCP Ethernet routing table shows the Modbus/TCP Index values of 17, 18, and 19 that will allow clients to access the SY/MAX PLCs.

The SCADA can access any of the SY/MAX processors with MSTR routes of 5.117.17 or 5.117.18 or 5.117.119. Notice that the second drop of the MSTR route is always 117 because it is DEB port 1 connected to the NIM.

Any of the SY/MAX PLCs may access devices through the DEB with TREAD or TWRITE messages.

Table 5.4 SY/MAX NET-TO-NET Routes

Source	Target	Route
PLC 17	SCADA	17,117,5,6
PLC 18	SCADA	18,117,5,6
PLC 119	SCADA	119,117,5,6
PLC 17	M340	17,117,0,25,1
PLC 18	M340	18,117,0,25,1
PLC 119	M3340	119,117,0,25,1

SY/MAX Ethernet

The DEB's Ethernet port may be configured to support Modbus/TCP and SY/MAX 802.3 protocols at the same time. Thus the user may bridge older SY/MAX Ethernet enabled PLCs (Model 450 and Model 650) to Modbus/TCP, Modbus Plus, and various serial networks.

> NOTE: Always check that the SY/MAX 802.3 node number is unused on the LAN before setting the DEB's address. SY/MAX Ethernet devices that detect duplicate drops remove themselves from the LAN and in many cases must be power cycled before they function again. This action may result in equipment damage, personal injury, or death.

The SY/MAX 802.3 protocol supports up to 100 physical node addresses (0-99). Logical Node numbers 100-199 are possible on Niobrara devices (DEB, EPE5, RPC) by setting a serial port to “On Ethernet YES”. Node numbers above 100 also consume the node modulo 100. For example, if the DEB's Ethernet port is set to 55 then node 155 is also required to be within this DEB. Therefore serial port 1 may be set to drop 155 and have “On Ethernet YES” configured.

SY/MAX Routing

The DEB in the combination Modbus/TCP+SY/MAX Ethernet mode simply becomes another drop in the SY/MAX route between the source and the target. Inbound Ethernet messages include the DEB's Ethernet port drop number as the next drop in the route.

Figure 5.3 SY/MAX Ethernet Routing Example

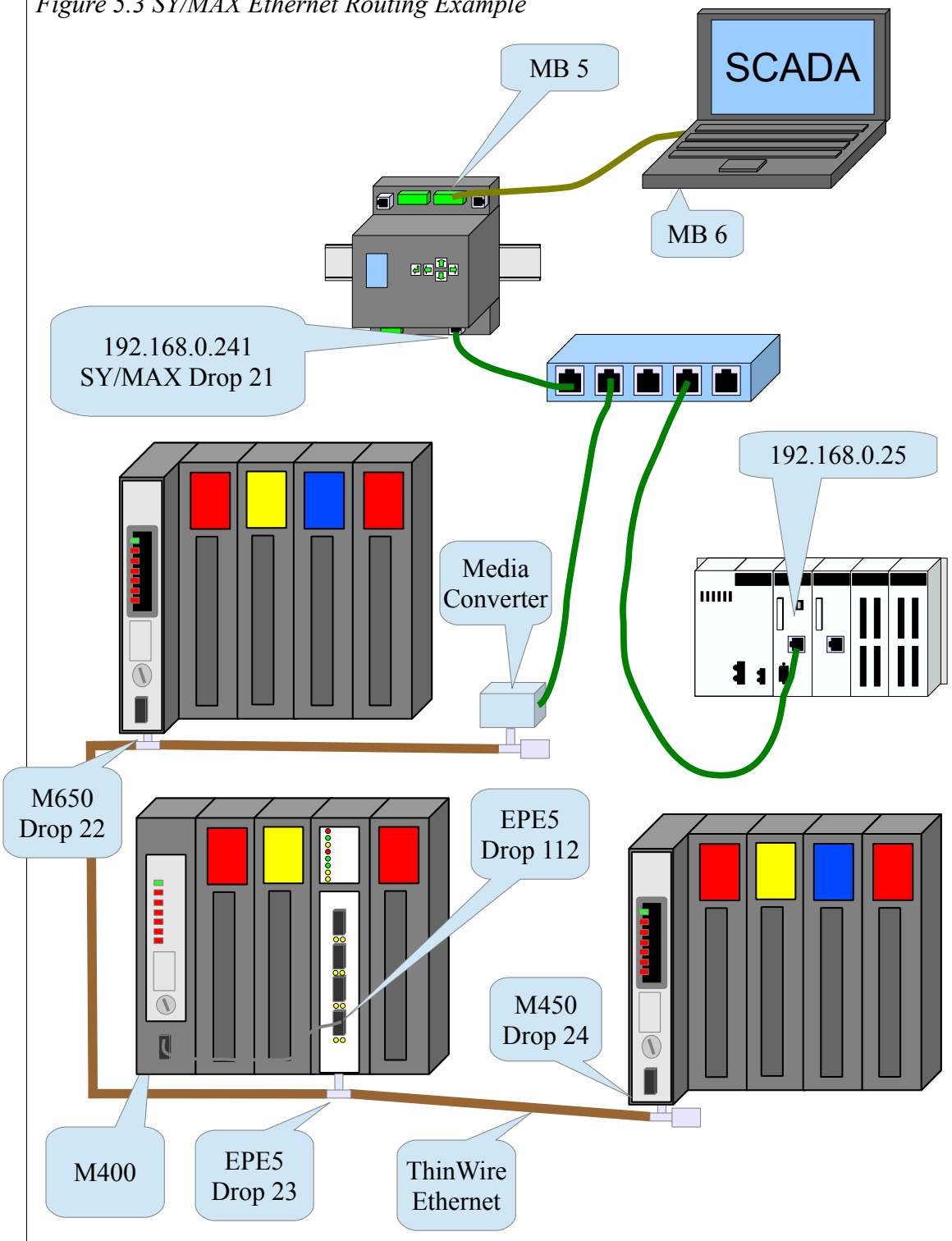


Table 5.5 SY/MAX Ethernet Routes

Source	Target	Route
Model 650	SCADA	22,21,5,6
Model 400	SCADA	112,23,21,5,6
Model 450	SCADA	24,21,5,6
Model 650	M340	22,21,21,25,1
Model 400	M340	112,23,21,21,25,1
Model 450	M340	24,21,21,25,1
SCADA	Model 650	5.4.22 (second drop must be 4-8 for Enet)
SCADA	Model 400	5.5.23.112
SCADA	Model 450	5.6.24
M340	Model 650	192.168.0.241 index 22
M340	Model 400	192.168.0.241 index 23
M340	Model 450	192.168.0.241 index 24

The outbound messages to the M340 PLC have the DEB's Ethernet drop number in the route twice. The first entry to select the DEB, the next entry to route the message back out the Ethernet port. The drop following the second entry is the TCP Table entry of the M340 PLC.

The DEB uses the entry in the TCP routing table to decide to send the message out as Modbus/TCP (entry not 0.0.0.0) or SY/MAX 802.3 (entry is 0.0.0.0).

Table 5.6 Modbus Routing Table for Ethernet Port

Index	Type	Route	Comments
0	OTHER	NONE	
1	MODBUS	5,1	
2	MODBUS	5,2	
3	MODBUS	5,3	
4	MODBUS	5,4	
5	MODBUS	5,5	
6	MODBUS	5,6	SCADA
7	MODBUS	5,7	
...	...	...	
21	MODBUS	5,21	
22	OTHER	21,22	Model 650
23	OTHER	21,23,112	Model 400
24	OTHER	21,24	Model 450
25	MODBUS	5,25	

Table 5.7 Ethernet TCP Routing Table

Drop	IP Address	Route	Description
0	0.0.0.0	NONE	SY/MAX node 0
1	192.168.0.1	NONE	Modbus/TCP
2	192.168.0.2	NONE	Modbus/TCP
3	192.168.0.3	NONE	Modbus/TCP
...	...	...	
20	192.168.0.20	NONE	Modbus/TCP
21	192.168.0.21	NONE	Modbus/TCP
22	0.0.0.0	NONE	SY/MAX node 22
23	0.0.0.0	NONE	SY/MAX node 23
24	0.0.0.0	NONE	SY/MAX node 24
25	192.168.0.25	NONE	Modbus/TCP
26	192.168.0.26	NONE	Modbus/TCP
...	...	...	
200	192.168.0.200	NONE	Modbus/TCP

PowerLogic Serial Modes

All newer Square D PowerLogic electric meters and breaker panels communicate with Modbus serial and Modbus/TCP Ethernet protocols. Older meters like the CM2000 and PowerLink AS units use the SY/MAX based PLOGIC and PNIM protocols. The DEB supports all of these protocols plus a mixed mode called CHEVRON which allows both PNIM and Modbus RTU devices to reside on the same daisy-chain.

Note that some PowerLogic devices only support 4-wire RS-485, some only support 2-wire RS-485, and some may be used in either mode.

Note that some PowerLogic devices only support EVEN parity, some only support NONE, and some support both settings.

Table 5.8 Common PowerLogic Devices

	Device Series	Protocols	RS-485	Parity	Notes
	CM100 CM200	PLOGIC PNIM	4-wire	EVEN	Must cycle power when changing between PNIM and PLOGIC
	CM2000	PLOGIC PNIM	4-wire	EVEN NONE	Dynamically switches between PNIM and PLOGIC
	CM3000 CM4000	Modbus RTU Modbus ASCII	4-wire 2-wire	NONE EVEN ODD	
	PM600	PLOGIC PNIM Modbus RTU	4-wire 2-wire	EVEN NONE	Dynamically switches between PNIM and PLOGIC
	PM700 PM800	Modbus RTU Modbus ASCII	2-wire	NONE EVEN ODD	
	Enercept	Modbus RTU	2-wire	NONE	
	BCM	Modbus RTU	4-wire 2-wire	NONE EVEN ODD	
	BCPM	Modbus RTU	4-wire 2-wire	NONE EVEN ODD	
	PowerLink AS	PLOGIC PNIM	4-wire only	EVEN	Must cycle power when changing between PNIM and PLOGIC
	PowerLink G3	Modbus RTU Modbus ASCII	4-wire 2-wire	NONE EVEN ODD	

PowerLogic Routing

In this example a string of power meters are connected to port 2 of the DEB making the data available on serial and Ethernet. Since the PowerLogic Circuit Monitors will communicate with the PLOGIC and PNIM modes, it is recommended that the PNIM mode be used when connecting to PowerLogic Circuit Monitors. The PNIM mode will return an error 17 if the slave does not respond while PLOGIC mode simply times out.

Figure 5.4 PowerLogic Routing Example

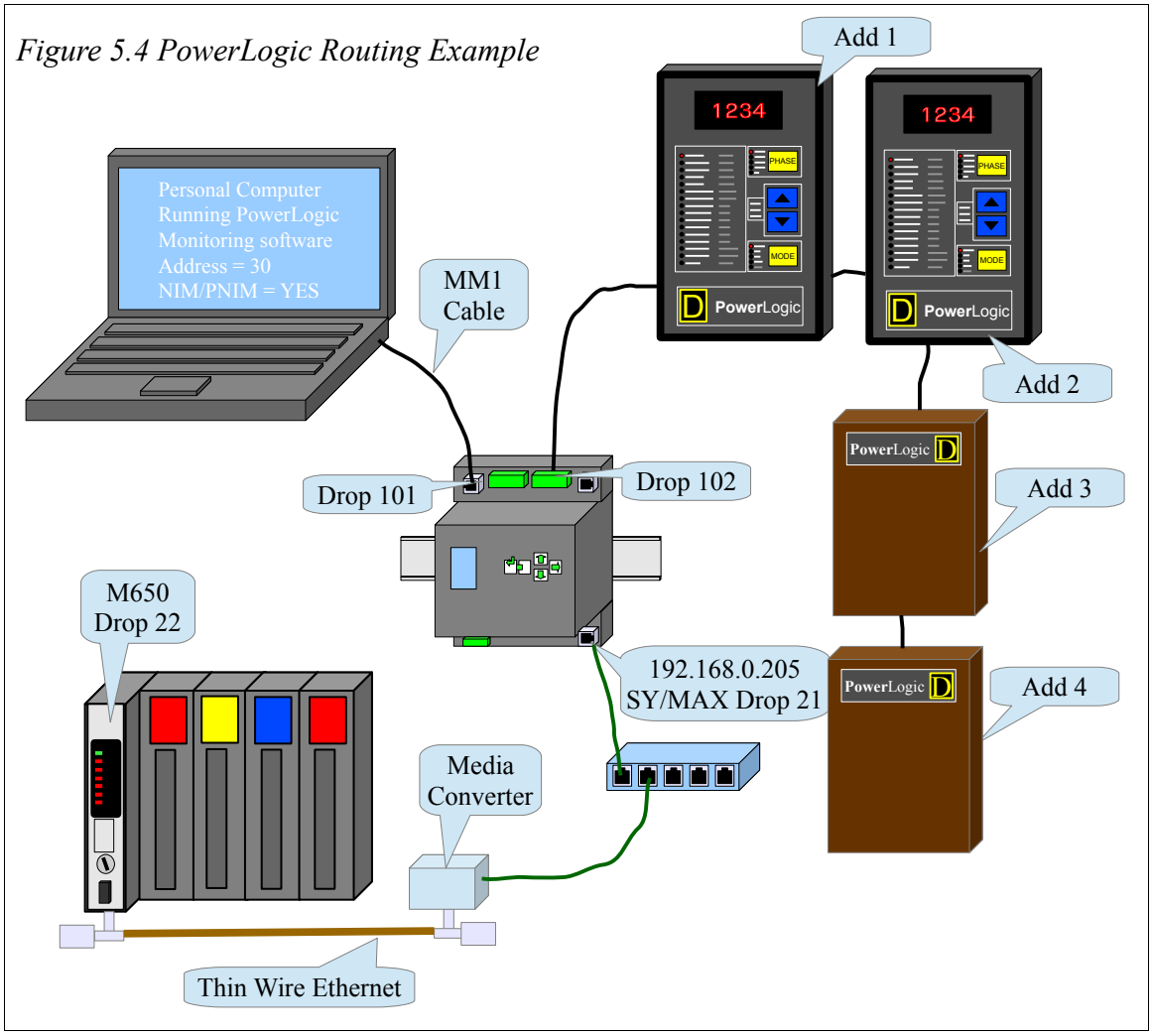


Table 5.9 DEB Port Setup for PowerLogic Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	21	Modbus/TCP & SY/ENET	NA	NA	NA	NA
1	101	SY/MAX	9600	E	8	1
2	102	PLOGIC	9600	E	8	1

Table 5.10 PowerLogic Routing Examples

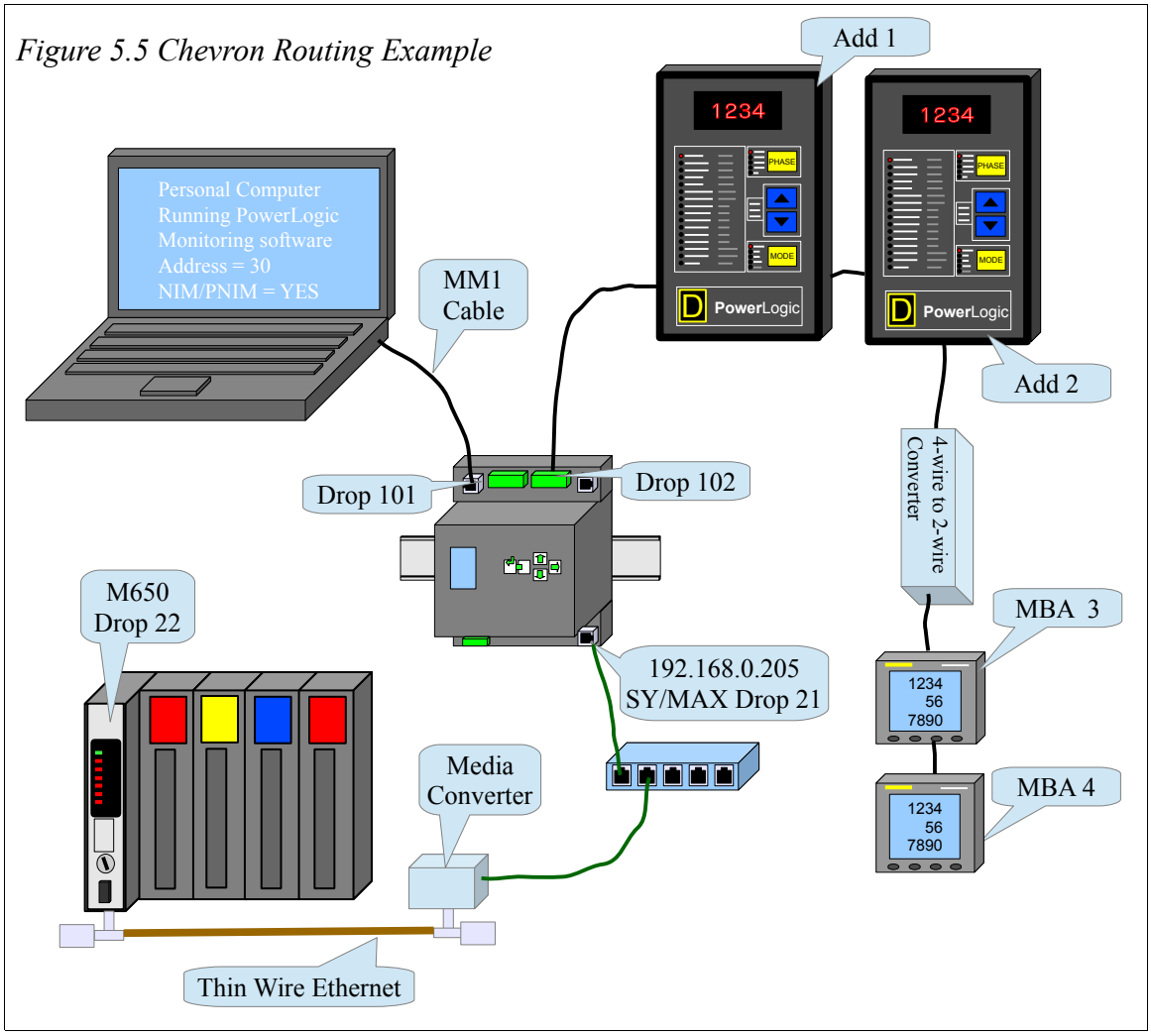
Origin	Target	Route
M650 PLC	CM1	22, 21, 102, 1
M650 PLC	CM2	22, 21, 102, 2
M650 PLC	CM3	22, 21, 102, 3
M650 PLC	CM4	22, 21, 102, 4
Personal Computer	CM1	30, 101, 102, 1
Personal Computer	CM2	30, 101, 102, 2
Personal Computer	CM3	30, 101, 102, 3
Personal Computer	CM4	30, 101, 102, 4

Chevron Routing

The Chevron mode is a combination of RNIM Master and Mobus Gate modes to allow the integration of remote SY/MAX and Modbus devices on the same multidrop (RS-485, modem, or radio) network. Incoming messages with the drop number following the Chevron Port's drop number within the range of 0 through 99 are sent out as RNIM packets. Messages with the drop in the range of 100 through 199 are sent out as Modbus RTU packets where the Modbus slave address is the drop number minus 100.

An example application of the Chevron mode is displayed in Figure 5.5. The DEB has port 2 in Chevron mode with drop number of 102. This port is wired with a 4-wire RS-485 cable to a couple of POWERLOGIC Circuit Monitors and then to a 4-wire to 2-wire converter to a couple of POWERLOGIC Power Meters. The Circuit Monitors are

Figure 5.5 Chevron Routing Example



configured for PNIM Addresses of 1 and 2 while the Power Meters are at Modbus RTU addresses 3 and 4. All of the devices are configured for the same baud rate, parity, data bits and stop bits (9600,EVEN,8,1). The setup for the CHEVRON port is as follows:

Table 5.11 DEB Port Setup for POWERLOGIC CHEVRON Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	21	Modbus/TCP & SY/ENET	NA	NA	NA	NA
1	101	SY/MAX	9600	E	8	1

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
2	102	CHEVRON	9600	E	8	1

Table 5.12 Specific setup for the CHEVRON port

Setting	Value
Drop	102
On Ethernet	NO
Protocol	CHEVRON
Baud Rate	9600
Parity	EVEN
Data Bits	8
Stop Bits	1
Buffer Limit	16
Driver Mode	PT TO PT
NetWork ID	0
CTS Timer	0
Reply Timeout	200
Bid Interval	0
Attempts	1
Pause Time	0
Message Count	0
Bid Address	0

Table 5.13 POWERLOGIC CHEVRON Routing Examples

Origin	Target	Route
M650 PLC	CM1	22, 21, 102, 1
M650 PLC	CM2	22, 21, 102, 2
M650 PLC	CM3	22, 21, 102, 103
M650 PLC	CM4	22, 21, 102, 104
Personal Computer	CM1	30, 101, 102, 1
Personal Computer	CM2	30, 101, 102, 2
Personal Computer	CM3	30, 101, 102, 103
Personal Computer	CM4	30, 101, 102, 104

6 Front Panel Operation

Keypad Buttons

The front panel includes five push buttons.

- The RIGHT arrow advances to the next screen or field. In many cases, it has the same behavior as the ↵ key.
- The LEFT arrow escapes to the previous screen or field. Changes are saved when the left arrow is pressed.
- The UP arrow moves up in a list or increments a selection.
- The DOWN arrow moves down in a list or decrements a selection.
- The ENTER key accepts the values on a screen and exits to a previous screen.

LCD Screen

The DEB includes a high resolution LCD screen main screen to assist the user in configuring and troubleshooting the device. Ethernet, MB+, and serial port parameters and may be observed and modified. Statistical information is also provided through the front panel interface.

Backlight

The LCD backlight will illuminate on any button press. The timeout for the backlight is configured through Modbus drop 255 register 7003 and defaults to 300 seconds.

Operating Screens

Splash Screen

The main page shows the IP Address of the DEB and the IP source as well as the SY/MAX 802.3 drop number (if enabled).

Error conditions may be displayed on the splash screen as they occur. Indications for duplicate IP Address, duplicate SY/MAX 802.3 node descriptions are shown. Certain errors will flash the backlight until a key is pressed to draw attention to the DEB.

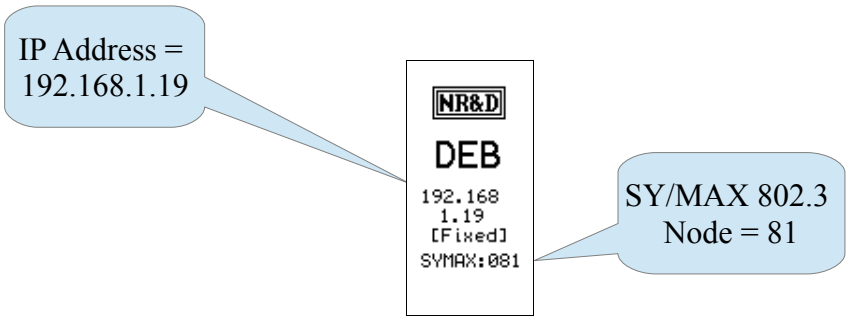


Figure 6.1 Splash Screen

Main Menu Screen

Pressing a key while the splash screen is displayed will move to the Main menu page. A pointer along the left margin indicates the sub-menu to be chosen. Pressing the UP or DOWN arrows will move the pointer. Pressing the RIGHT arrow or ENTER buttons will select the sub-menu. Pressing the LEFT arrow will return to the splash screen page.

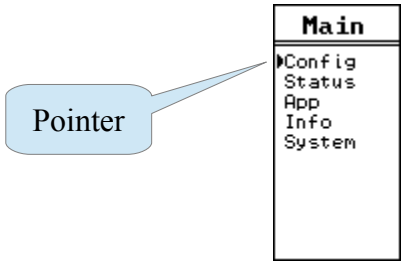


Figure 6.2 Main Menu Screen

Configuration Menu

Selecting the Config item leads to the Config menu and a choice of Comms and Display. The Comms sub-menu moves on to Ethernet, serial port, and MB+ options while the Display sub-menu allows the user to adjust the screen contrast.

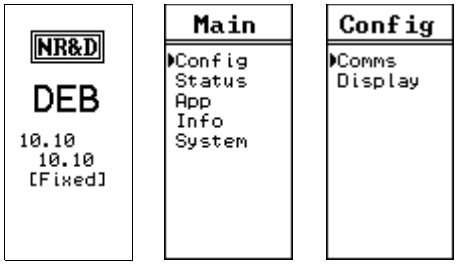


Figure 6.3 Config Menu Screen

Comms Menu Screen

The Comms menu allows the selection of editing the settings for the Ethernet, Serial ports.

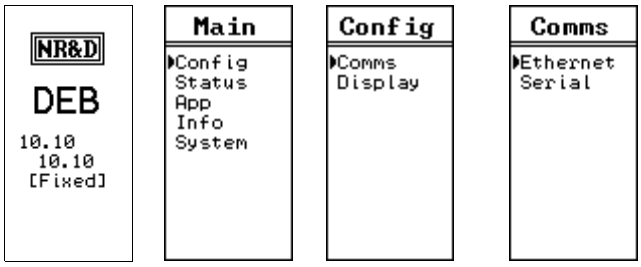


Figure 6.4 Comms Menu Screen

Ethernet Configuration Menu

The Ethernet menu allows the selection of editing the settings for the IP Address, Subnet Mask, Default Gateway, IP Source, Ethernet Protocol, port drop number, Modbus Routes, IP Route table, the physical Ethernet port mode, and Timeout settings.

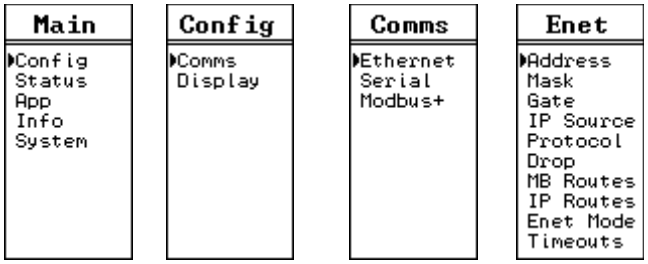


Figure 6.5 Ethernet Menu Screen

IP Addr Screen

The IP Address of the DEB may be quickly changed using the IP Addr screen. Move the cursor with the LEFT and RIGHT arrows and adjust the octet with the UP and DOWN arrows. Holding the UP or DOWN key will scroll the value quickly. When the new address is finished, press the ENTER key and a prompt for "AutoFill IP Tables?" is presented. Select "Yes" to have the DEB automatically fill the TCP table with the first 3 octets of this IP Address and the fourth octet the index value.

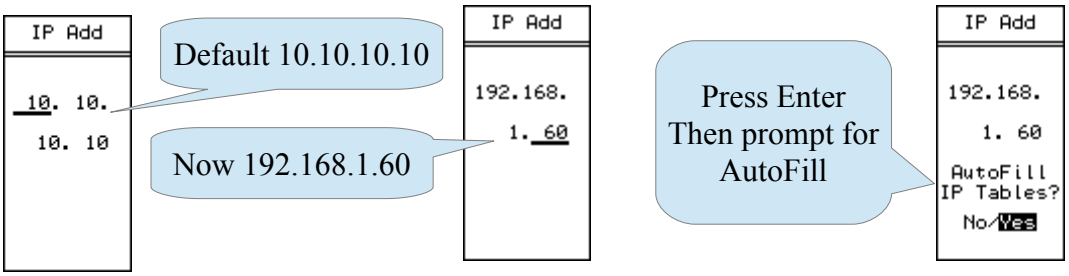


Figure 6.6 IP Address Screens

Subnet Mask Screen

The Subnet Mask of the DEB may be quickly changed using the Mask screen. The UP and DOWN buttons are sued to adjust the number of bits in the mask. When the new mask is finished, press the ENTER key and a prompt for "Auto Set Default Gate?" is presented. Select "Yes" to have the DEB automatically apply the subnet mask to the IP Address to generate most of the default gateway setting..

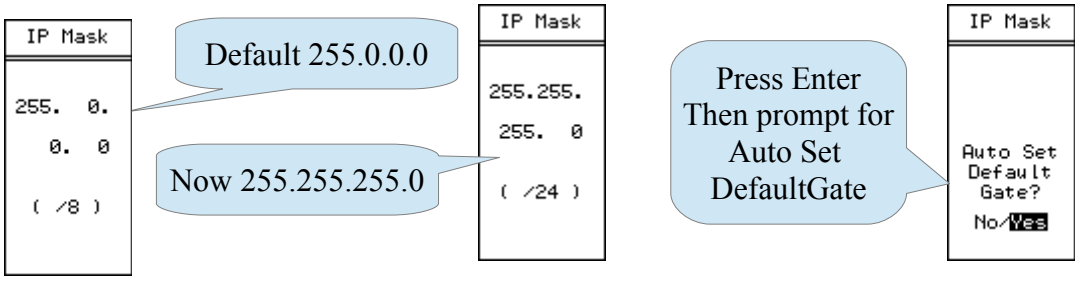


Figure 6.7 Subnet Mask Screens

Default Gate Screen

The Default Gateway of the DEB is edited just like the IP Address. The LEFT and RIGHT buttons move the cursor while the UP and DOWN buttons are sued to adjust the value. Press ENTER to accept the new value.

Set the Default Get to 0.0.0.0 to disable routing operation outside the local subnet.

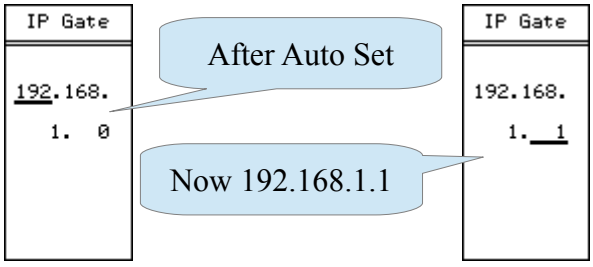


Figure 6.8 Default Gate Screen

IP Source Screen

The DEB may have a fixed IP Address or use BOOTP or DHCP to have its IP settings configured. The IP Source screen allows the user to configure the appropriate setting. Use the UP and DOWN buttons to select the setting. DHCP and BOOTP typically require the server to be configured for the MAC address of the DEB's Ethernet port.

This MACC address is shown on the screen in hexadecimal (00:20:BD:0C:35:04).

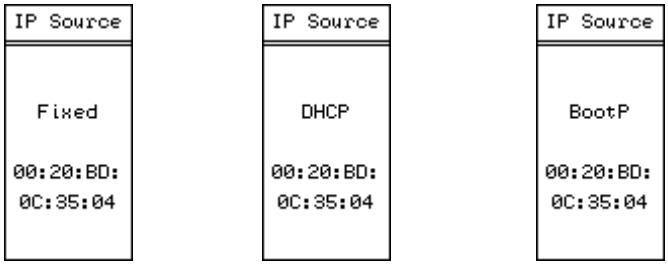


Figure 6.9 IP Source Screen

Ethernet Protocol Screen

The Ethernet port may be configured for only Modbus/TCP or a combination of Modbus/TCP plus SY/MAX 802.3 for support of legacy SY/MAX Ethernet devices. The Protocol screen allows the setting of the mode.

WARNING: Set the drop number of the Ethernet port to SY/MAX 802.3 drop that is **not** present on the connected network before setting the port to MB+SYMAX mode. Choosing a duplicate drop on the network will result in both nodes halting SY/MAX communication which may result in equipment damage, injury, or death.

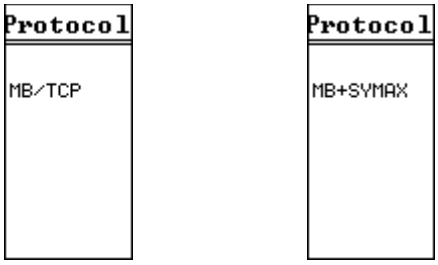


Figure 6.10 Ethernet Protocol Screens

Ethernet Drop Screen

The drop number of the Ethernet port defaults to 0 and rarely needs to be changed. This drop number is used to set the SY/MAX 802.3 Ethernet node number when the Ethernet port is set to MB+SYMAX protocol mode.

WARNING: Set the drop number of the Ethernet port to SY/MAX 802.3 drop that is **not** present on the connected network before setting the port to MB+SYMAX mode. Choosing a duplicate drop on the network will result in both nodes halting SY/MAX communication which may result in equipment damage, injury, or death.

After selecting the new drop number by pressing the Enter button, a prompt for "Auto-Fix Routing Tables?" is presented. Selecting Yes will automatically adjust entries in the Ethernet and serial ports 1 and 2 Modbus Routing tables. Route entries with the old drop number as the first drop in the route will be changed so the new drop number replaces the old value .

Figure 6.11 Ethernet Drop Screen

Modbus Route Screen

The Modbus Routing table for the Ethernet port may be edited through the Modbus Route screen. This screen shows a single entry from the table with the index on the top line. The cursor is moved with the left and right arrows. Values are altered with the up/down buttons.

The enter button exits the screen when on the index field.

The enter button on the TEST field causes a test message to be sent using the route to the target device.

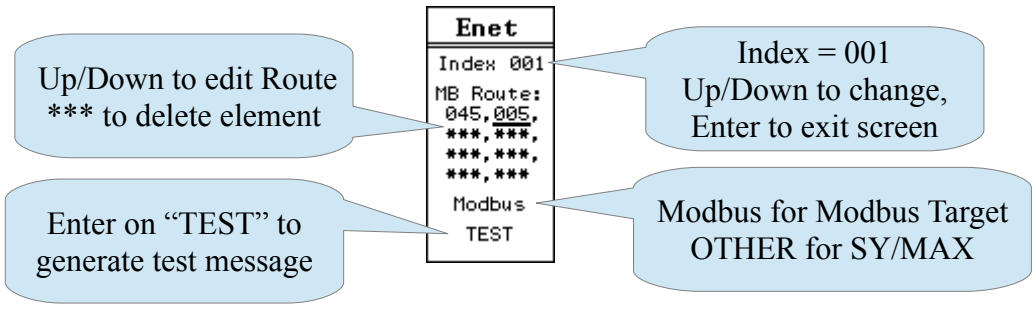


Figure 6.12 Modbus Route Edit Screen

The TEST message is an opcode 03 Modbus Holdign Register read of remote regsiters 8188. Possible results from this read are:

- A valid reply is received from the target slave. The screen will show PASS along with the decimal value of the remote register 4x8188. On older SY/MAX PLCs, this value is the PLC model number.
- A valid error reply is received from the target slave. The screen will show PASS along with the returned error code. Possible errors are:
  - Error 01 = Illegal Opcode. This means that the slave does not support Modbus opcode 03 (Holding Register read). The slave is replying to the test message, it just does not support the test message.
  - Error 02 = Illegal register. This means that the slave does not have Holding Register 4x8182. This is also a PASS condition, it just means that the test message asked for a register that does not exist in the slave.
- The network was unable to receive a reply from the slave. This is a FAIL condition with the error message Downstream Timeout.
- The DEB was unable to generate the query because the first drop in the route was not a valid drop number of another port in the DEB. The FAIL message will show

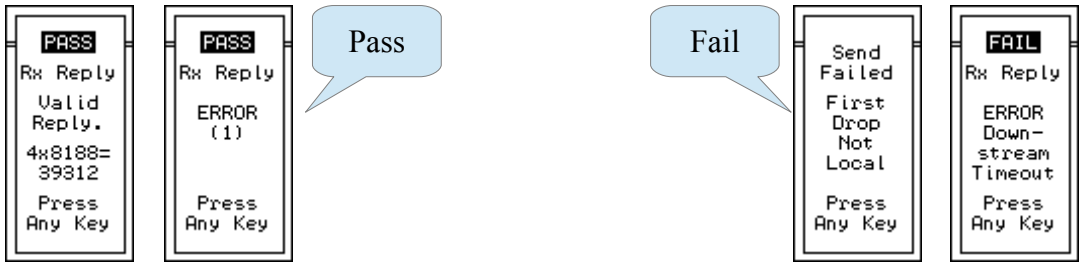


Figure 6.13 Modbus Route Test Results Screens

IP Route Screen

The IP Routing table for the Ethernet port may be edited through the IP Route screen. This screen shows a single entry from the table with the index on the top line. The cursor is moved with the left and right arrows. Values are altered with the up/down buttons.

The enter button exits the screen when on the index field.

The enter button on the ZERO field causes the IP Address to be set to 0.0.0.0. This is handy for zeroing an entry for SY/MAX 802.3 Ethernet entries.

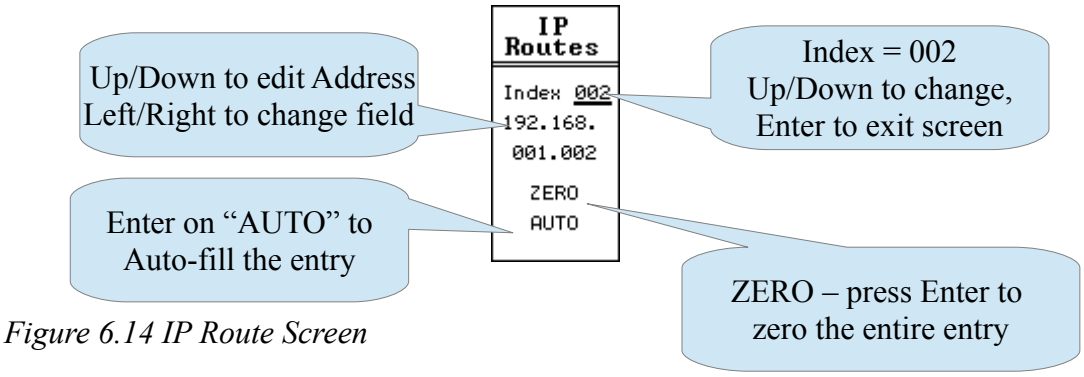


Figure 6.14 IP Route Screen

The AUTO field sets the entry to the DEB's IP Address with the last octet set to match the index.

Ethernet Mode Screen

The Ethernet Mode screen allows the physical configuration of the Ethernet port. The port defaults to "AUTO" mode which automatically sets itself to match the attached device. The possible settings are:

- AUTO
- 10BaseT – Full Duplex
- 10BaseT – Half Duplex
- 100BaseT – Full Duplex
- 100BaseT – Half Duplex

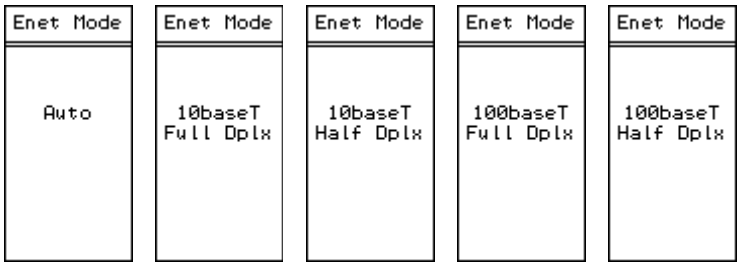


Figure 6.15 Ethernet Port Mode Screens

Serial Port Menu

The Serial menu allows the selection a particular serial port to edit. Choices are Port 1 and Port 2.

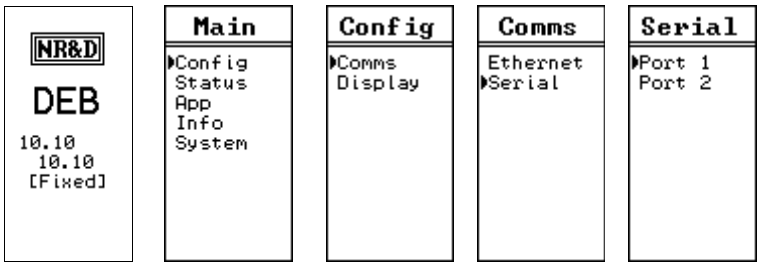


Figure 6.16 Serial Pot Menu Screen

Port 1 Menu

Both serial port share the same menu list.

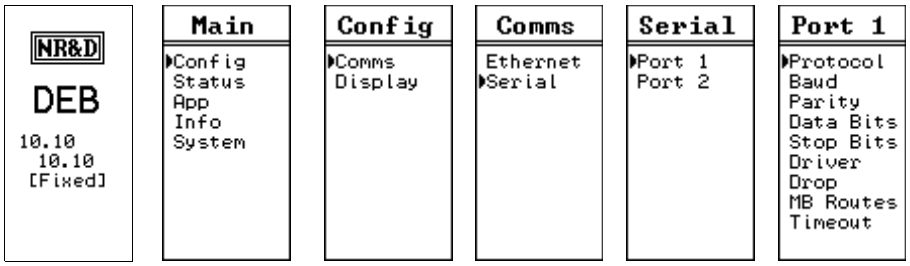


Figure 6.17 Serial Pot 1 Menu Screen

Settings available for the two serial ports are:

- Protocol
  - Modbus RTU (default)
  - Modbus ASCII
  - Modbus Host (RTU with special translations)
  - Chevron (combination Modbus RTU master with RNIM master)
  - Dual Slave (combination Modbus RTU slave and SY/MAX slave)
  - Hot Modbus Plus (Port 2 only)

- SY/MAX, NET-TO-NET, RNIM Master, RNIM Slave (legacy Square D PLC serial protocols)
- PNIM and PLOGIC (legacy PowerLOGIC protocols)
- IDEC (legacy Square D Model 50 and Micro-1)
- Transfer (legacy Square D PLC Hot Backup)
- Peripheral, Share, Transfer (legacy Square D ASCII)
- Gateway (legacy Niobrara ASCII)
- Multidrop (legacy Niobrara serial network)

- Baud Rate – 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 7200, 9600 (default), 19200
- Parity – EVEN (default), ODD, NONE
- Data Bits – 8 (default), 7 (ASCII modes only)
- Stop Bits – 1 (default), 2
- Driver – RS-232 (default), RS-422, RS-485 + Bias, RS-485 - Bias
- Drop – 101 (default for port 1), 102 (default for port 2)
- Modbus Routes – See Modbus Route Screen on page 76

Display Edit Screen

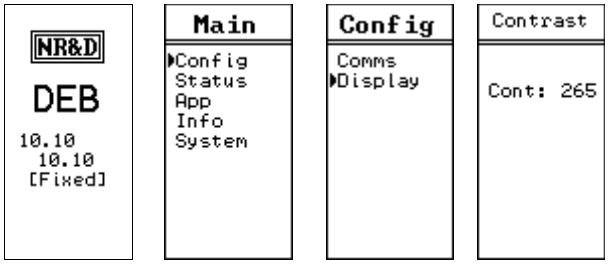


Figure 6.18 Display Contrast Edit Screen

The Display screen allows the user to adjust the contrast value for the display. The UP and DOWN arrows allow the changing of the setting. The ENTER or LEFT arrows accept the new value.

Status Menu Screens

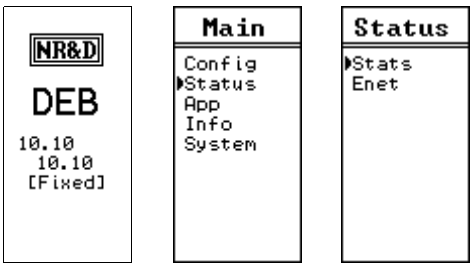


Figure 6.19 Status Menu Screen

The Status menu item gives access to physical status and communication statistics for all ports.

Stats Screen

Each port has multiple screens to give statistical counters about communication through the port. LEFT and RIGHT arrows change between ports. UP and DOWN move between pages for a given port. ENTER returns to the previous menu.

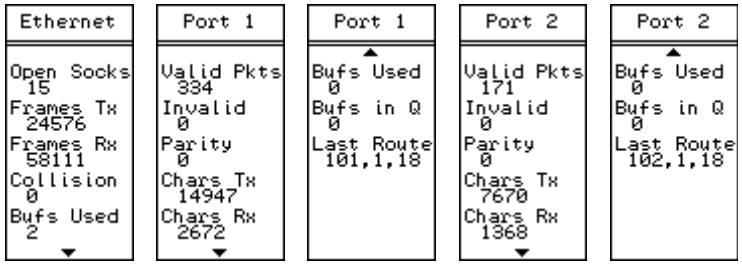


Figure 6.20 Stats Screens

Enet Status Screen

The Enet status screen shows the current physical connection status of the Ethernet port.

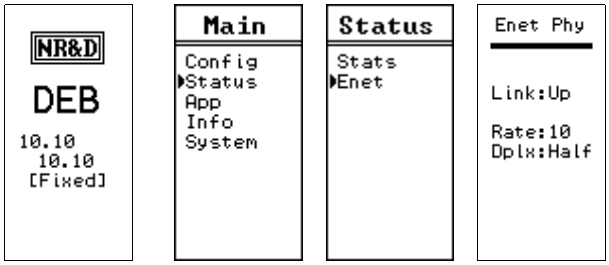


Figure 6.21 Status Menu Screen

App Menu

The APP menu allows the user to halt the DEB application. This feature should only be used when directed by Niobrara Technical Support.

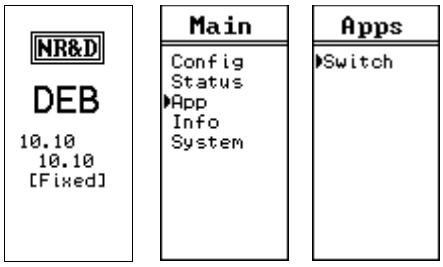


Figure 6.22 App Menu Screen

Switch Screen

The Switch screen allows the user to HALT or RUN the DEB application. The MEM PROT setting is ignored at this time and is the same as RUN.

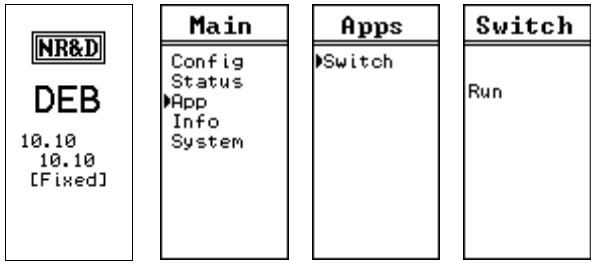


Figure 6.23 Switch Screen

Info Menu

The Info Menu provides access to various information about the DEB firmware and network connections.

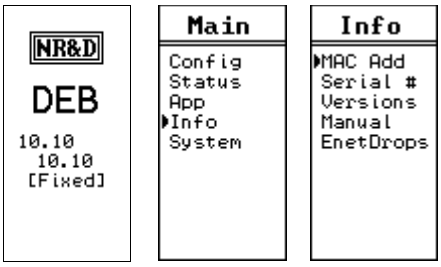


Figure 6.24 Info Menu Screen

MAC Address Screen

The MAC address screen shows the hardware address of the Ethernet port in hexadecimal. This information is useful when the IP Address is set by BOOTP or DHCP.

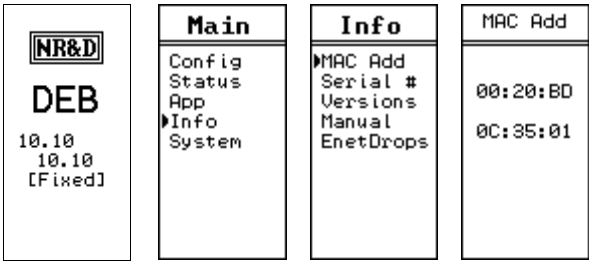


Figure 6.25 MAC Address Screen

Serial Number Screen

This screen shows the serial number of the DEB.

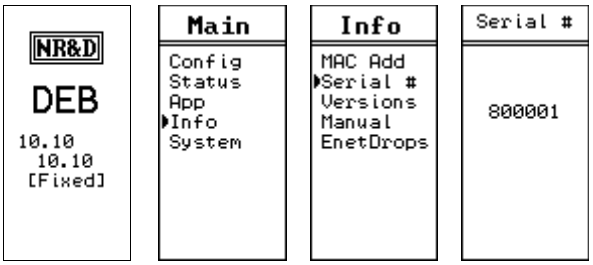


Figure 6.26 Serial Number Screen

Versions Screen

The Versions menu gives access to the DEB firmware, DUCM firmware, and boot version.

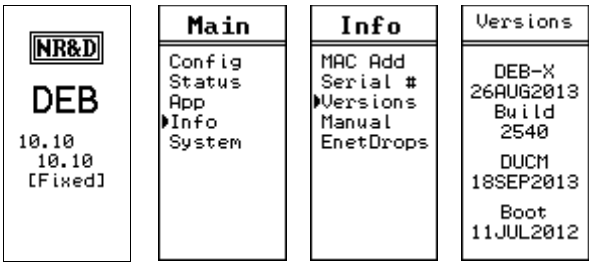


Figure 6.27 Versions Screen

Enet Drops Screen

The Enet drops screen will show the SY/MAX 802.3 drops accessible to the DEB. This page may extend beyond a single screen and the UP and DOWN buttons are used to move between screens.

Any drop numbers local the DEB are highlighted. This includes the Ethernet port and any other port with “ON ETHERNET” set to YES.

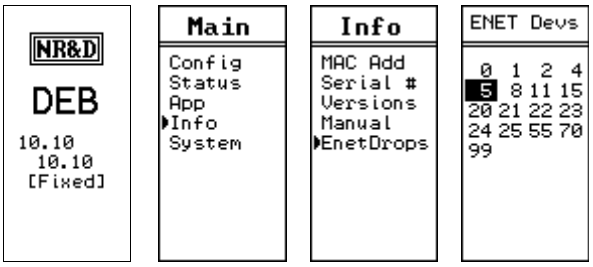


Figure 6.28 SY/MAX Ethernet Drops Screen

System Menu

The System menu provides access to the front panel password, reboot, and reset to factory defaults.

Reboot Screen

This screen allows the user to force a hardware reboot of the DEB without physically removing the power.

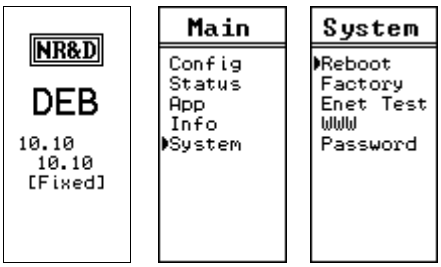


Figure 6.29 Reboot Screen

Factory Defaults Screen

The Factory screen allows the user to quickly reset the DEB to factory defaults. The reset process also includes a reboot. Selecting "NO" will return to the previous menu without altering the current setup.

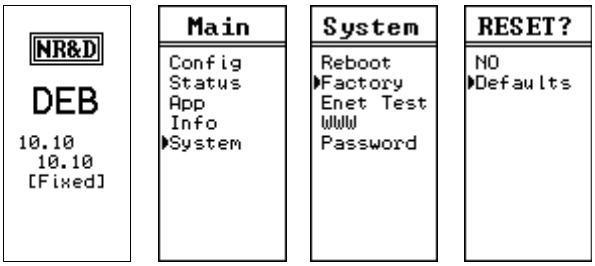


Figure 6.30 Factory Defaults Screen

Password Screen

The DEB may have a password enabled to limit front panel operation. The password is a four digit number (0000-9999) that must be entered before settings are altered. Once the password is entered, it settings may be altered until a reboot or the backlight timeout occurs.

Setting the password to 0000 disables the feature.

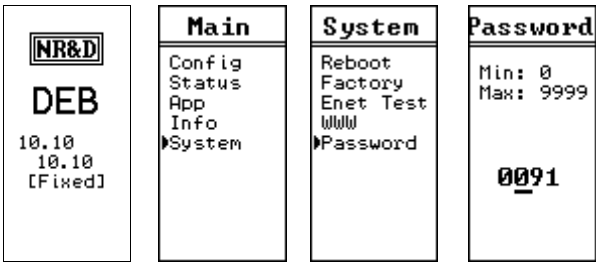


Figure 6.31 Password Screen

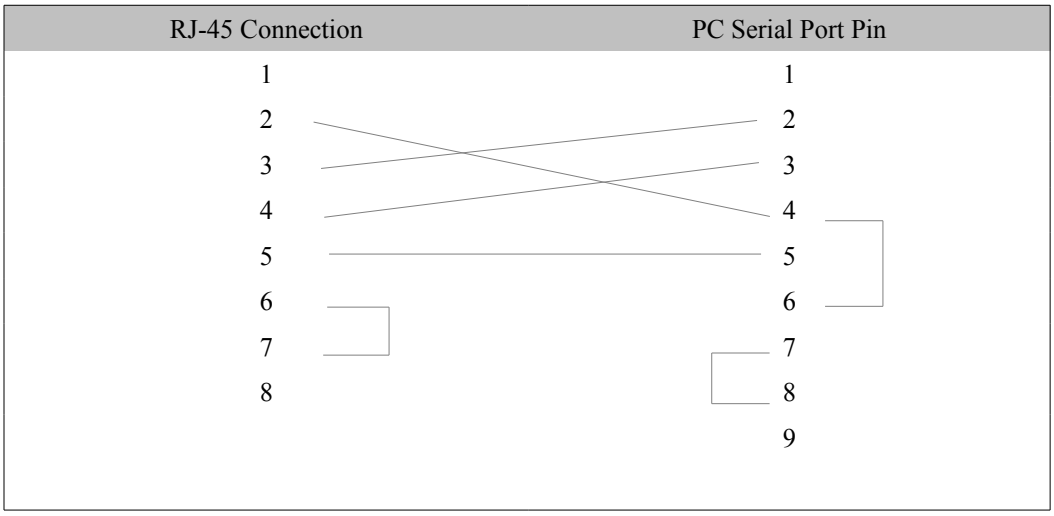
7 Recommended Cables

RS-232 Cables

MM1 (PC to DEB)

The Niobrara MM1 cable may be used to connect the DEB RS-232 port to a standard PC 9-pin male port. The pinout is shown in Figure 7.1 MM1 Serial Cable.

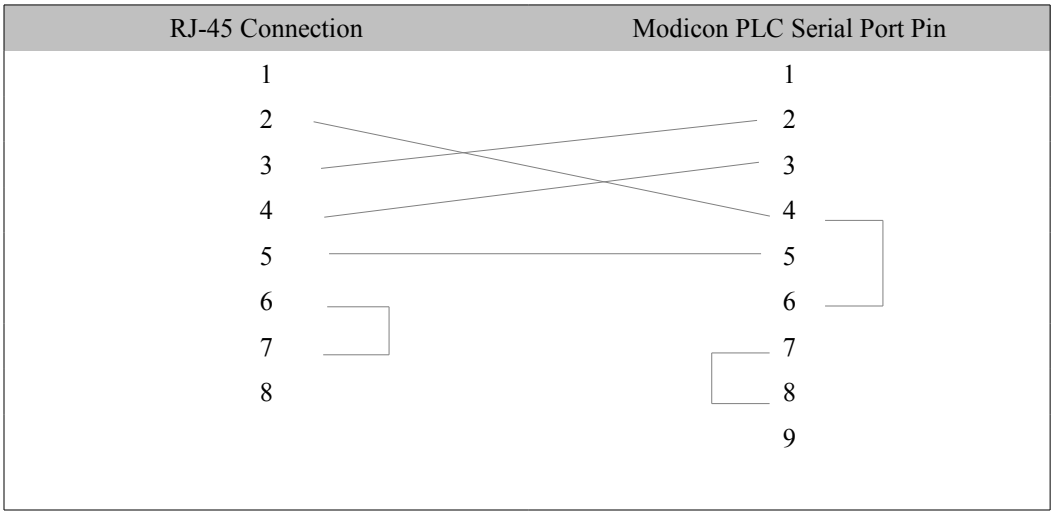
Figure 7.1 MM1 Serial Cable



MM2 (Modicon PLC to DEB)

The Niobrara MM2 cable may be used to connect the DEB RS-232 port to a standard Modicon 9-pin female PLC programming port. These ports are common on the Quantum PLC, Compact 984, 984, BM85 Bridge Mux, and other older Modicon products. This is the same cable as the MM1 with a male 9-pin connector. The pinout is shown in Figure 7.2 MM2 Serial Cable.

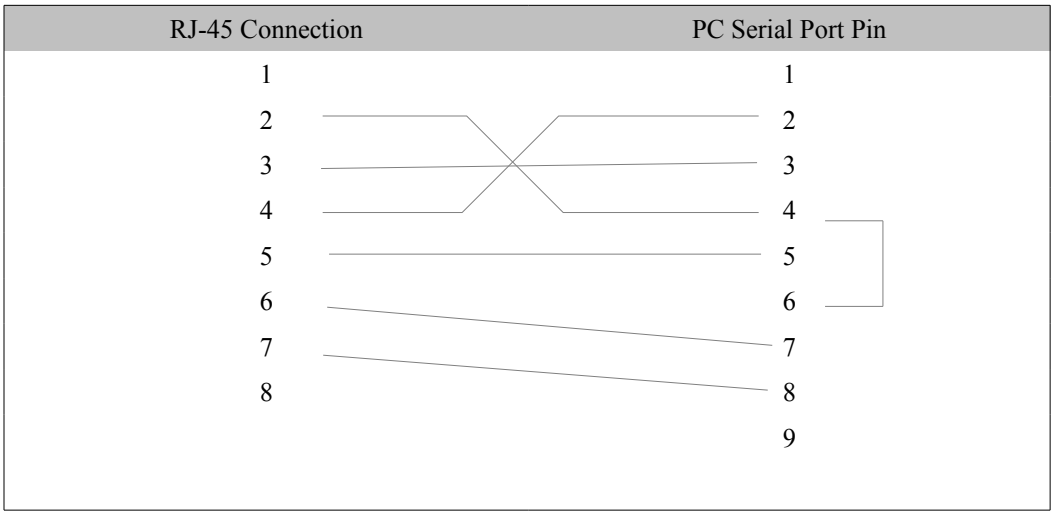
Figure 7.2 MM2 Serial Cable



MM3 (DEB to emulate a 9-pin PC port)

The Niobrara MM3 cable may be used to make the DEB RS-232 port appear as a standard PC 9-pin male port. This cable is often used along with an MM1 cable to connect two RJ-485 RS-232 ports together such as an DEB to a newer Compact 984 PLC. The pinout is shown in Figure 7.3 MM3 Serial Cable.

Figure 7.3 MM3 Serial Cable



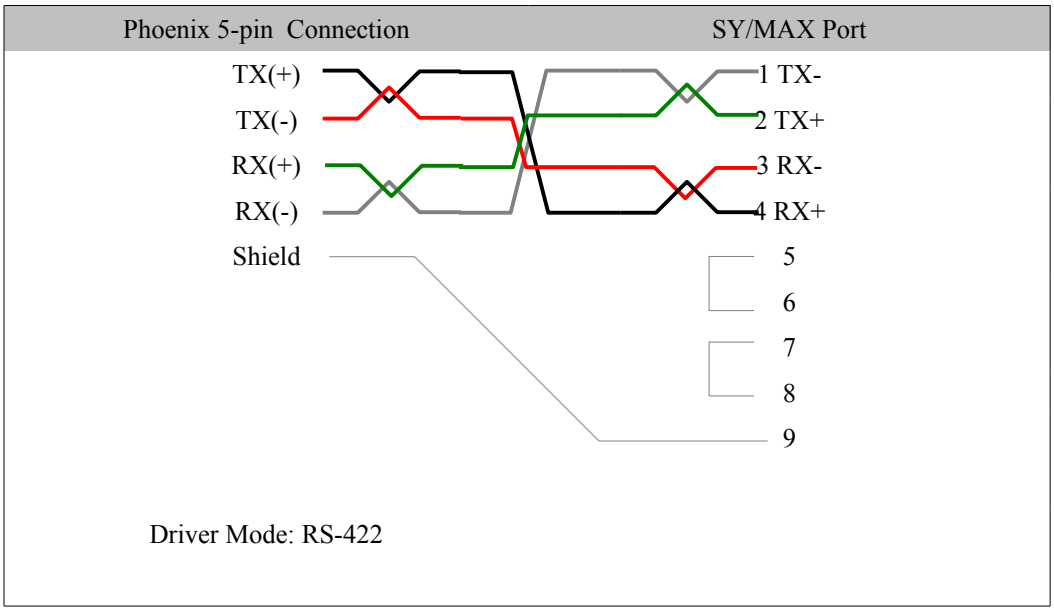
RS-485 Cables

MU7 (DEB to SY/MAX)

The Niobrara MU7 cable is used to connect the RS-485 port of the DEB to a standard SY/MAX DB9 female port. This cable is normally used to connect the DEBI directly to a SY/MAX PLC or NIM module.

NOTE: The DEB port driver mode is normally set to RS422 when connected to a SY/MAX serial port.

Figure 7.4 MU7 Serial Cable



DEB Master to 4-wire RS-485 Slaves

The DEB may be used to be a master on a 4-wire RS-485 network. An example of this network is a string of PowerLogic meters attached to the DEB.

An external terminator should be used at the last slave across its RX pair. Normally, this is a 120 ohm resistor or the PowerLogic MCT-485.

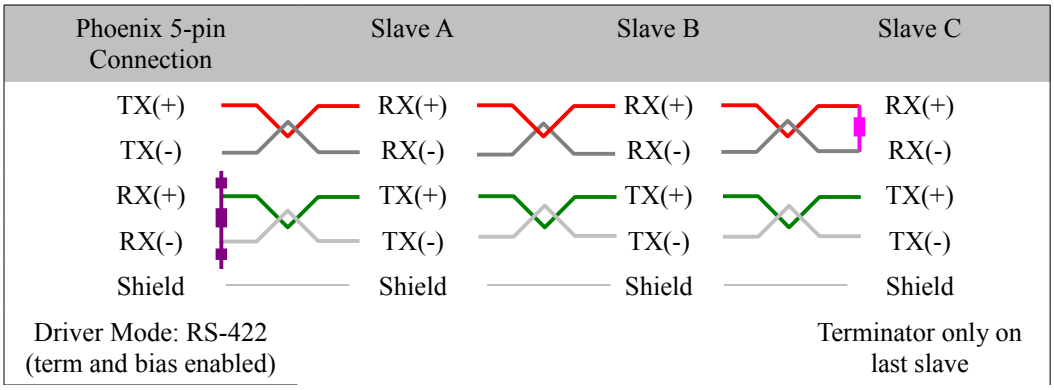
The Driver Mode for the DEB port should be set to RS-422. This mode enables the transmitter of the port at all times to bias the receivers of all of the slaves. This mode also enables the internal termination and bias of the DEB's receiver.

Belden 8723 or equivalent is recommended for this type of network.

The shield wire should only be grounded at one location - usually at the master. A simple

method of grounding the shield is to connect the Shield terminal of the DEB's RS-485 connector to the Earth Ground terminal of the DEB's power supply connector.

Figure 7.5 4-wire RS-485 Master



DEB to 2-wire RS-485

The DEB may be used as a master or slave on a 2-wire RS-485 network. An example of this network is a string of 2-wire RS-485 PowerLogic meters attached to the DEB.

The DEB must have the TX(+) and RX(+) lines jumpered together to make the (+) connection on a 2-wire network. The TX(-) and RX(-) lines must also be jumpered together to connect to the (-) line.

Terminator should be used at the last slave on each end of the daisy-chain. Normally, this is a 120 ohm resistor.

Bias should only be enabled on one device of the 2-wire network. Typically, the bias is enabled at the Master device since it is required to be active on the network.

If the DEB is the Master of the network, then it should be located at one end of the daisy-chain and the Driver Mode should be set to RS485+Bias. The RS845+Bias mode enables the internal bias and termination resistors.

> NOTE: RS485+Bias mode always enables both the internal termination and bias resistors. If another device on the 2-wire network is providing the bias then the DEB port must be set for RS485-Bias and an external termination resistor must be used.

Belden 9841 or equivalent is recommended for this type of network.

The shield wire should only be grounded at one location - usually at the master. A simple method of grounding the shield is to connect the Shield terminal of the DEB's RS-485 connector to the Earth Ground terminal of the DEB's power supply connector.

Figure 7.6 2-wire RS-485 Network with internal Bias

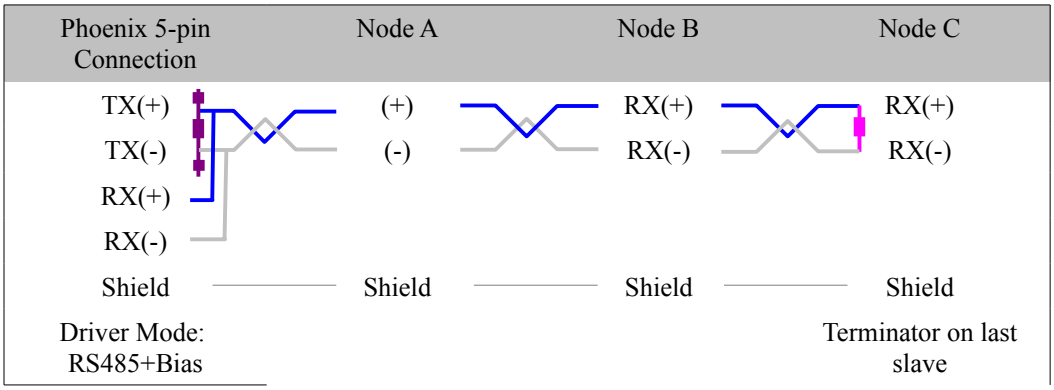
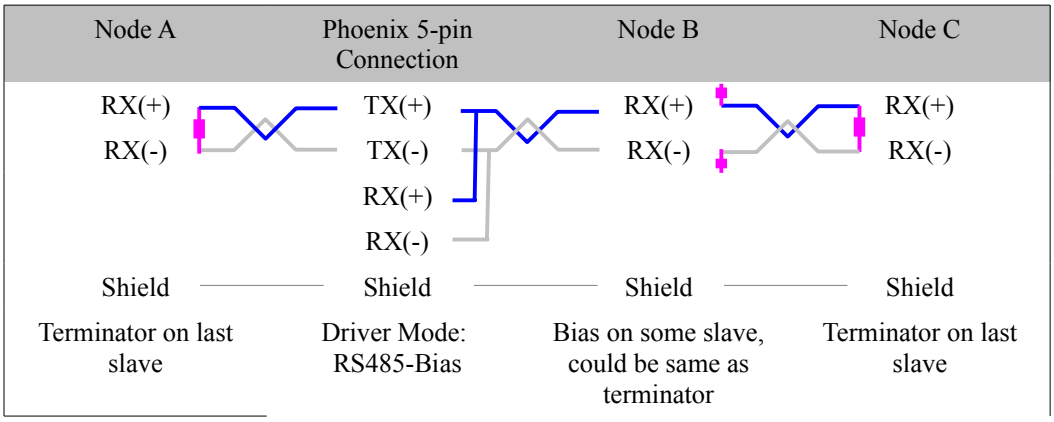


Figure 7.7 2-wire RS-485 Network without internal Bias



8 Web Server

The DEB uses a built-in Web server for remote configuration over the Ethernet network. This Web server requires the use of Javascript.

Login

The DEB Web server supports two user access levels: “User” and “Admin”. These usernames are not changeable and are not case sensitive. “User” provides read-only access to view the configuration of the DEB. “Admin” provides full configuration edit capabilities as well as backup/restore and firmware upgrade.

The Default Password for each user is shown below and are not case sensitive:

Username: user

Password: user

Username: admin

Password: master

Figure 8.1 shows the Login page. Enter the appropriate username and password to gain access to the DEB.

If the “User” account is used and the operator attempts to modify a setting in the DEB, a pop-up notification will appear to announce that modifications are not allowed for this user level. (See Figure 8.2)

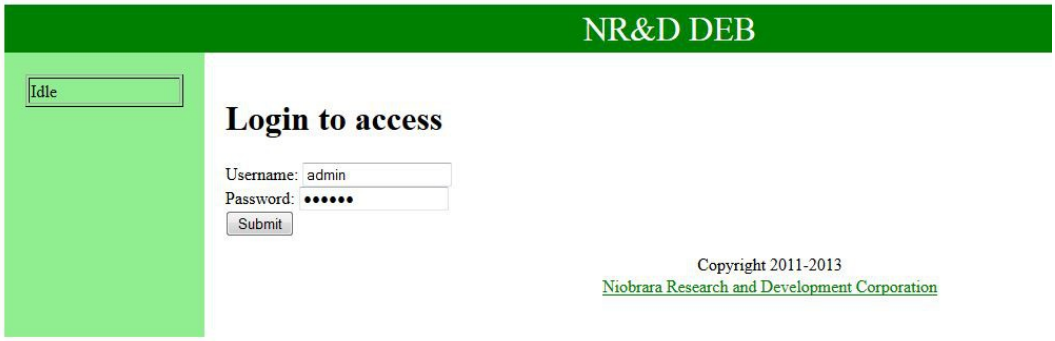


Figure 8.1 Login Screen

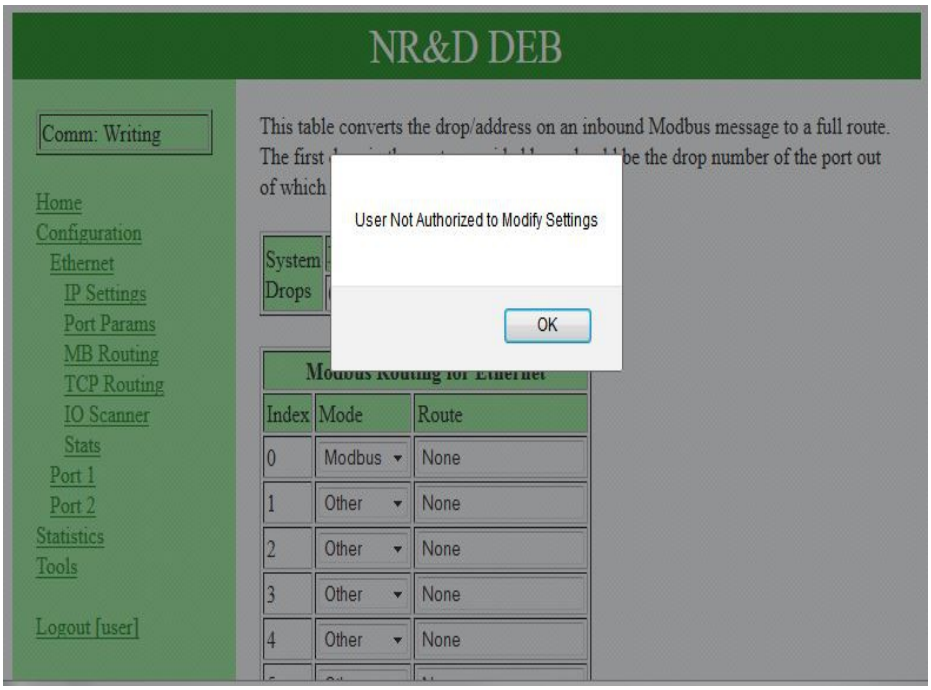
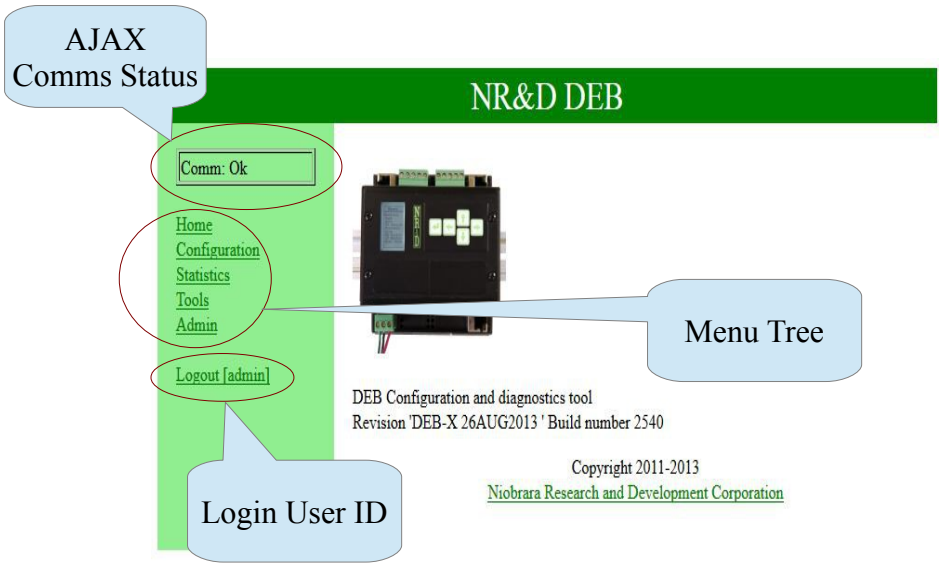


Figure 8.2 "User" attempting to modify settings

Home

Figure 8.3 Home



The typical web page includes an AJAX status box showing the state of the Javascript communication between the browser and the DEB. The background of this box turns red when comm errors are occurring.

The menu tree may has the following branches: Home, Configuration, Tools, and Admin.

NOTE: Admin is not present when logged in as “user”.

Configuration

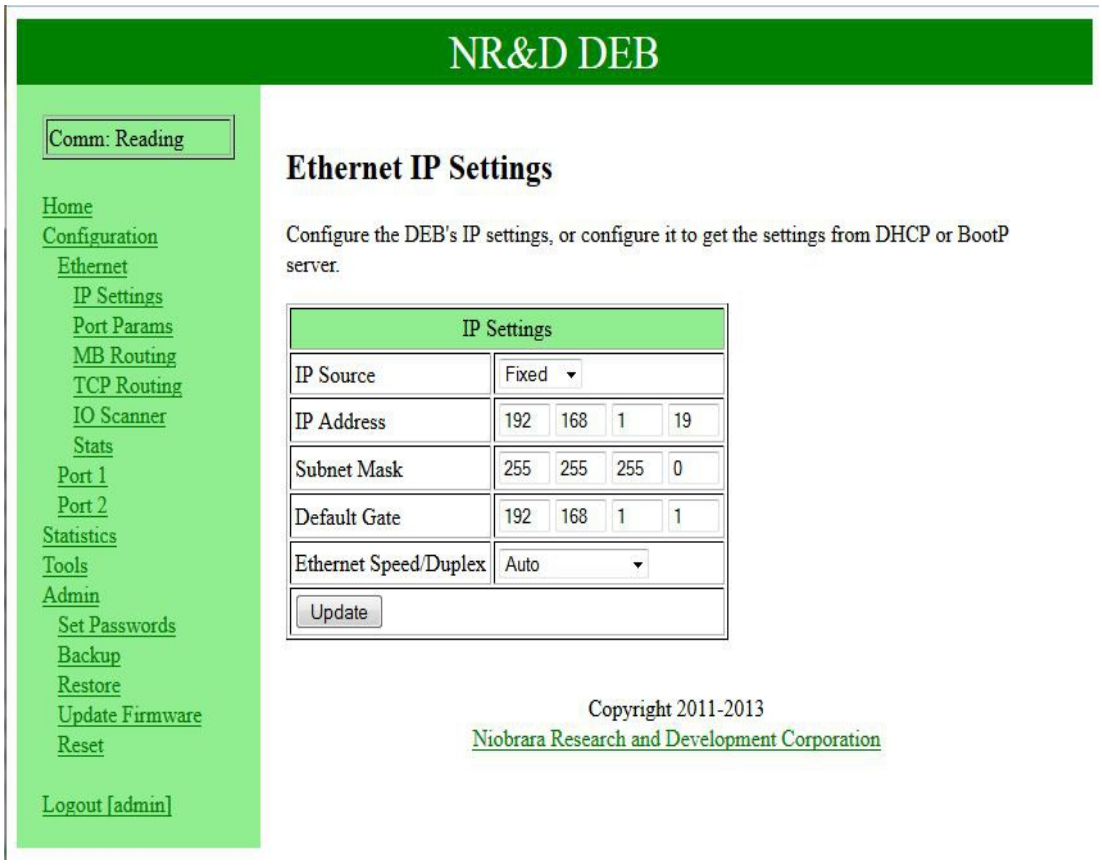
The Configuration menu provides access to the settings for Ethernet, Port 1, Port 2, and Modbus Plus.

Ethernet

There are pages for setting the IP Address, Ethernet Protocol, Modbus Routing, TCP Client Routing, and I/O Scanner.

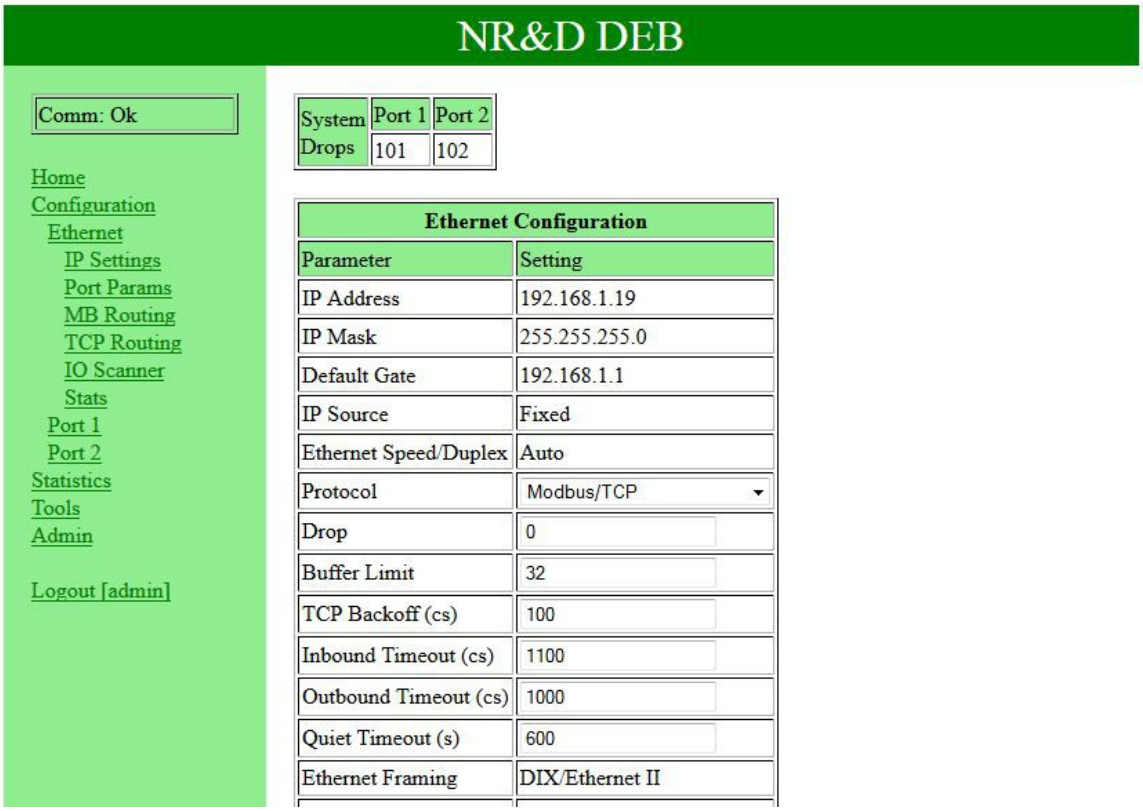
IP Settings

The IP Settings page allows the Admin to select the IP Parameters for the module.



Ethernet Port Parameters

This page allows the Admin to configure the DEB to operate in Modbus/TCP or SY/AMX+Modbus/TCP mode and set the SY/MAX 802.3 drop number.



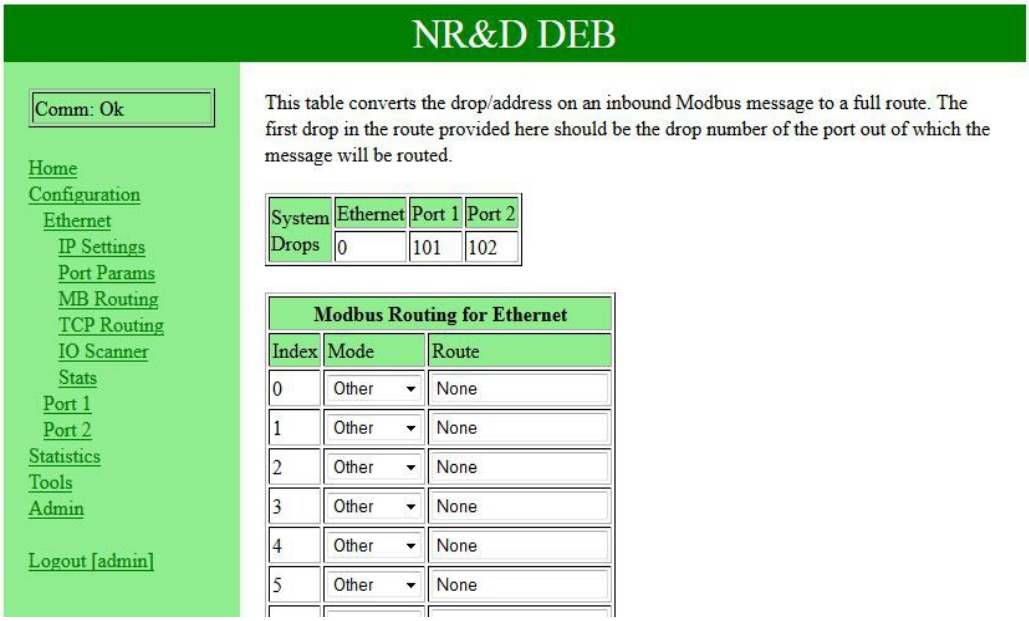
Modbus Routing for Ethernet Port

The Ethernet port has 254 entires in its Modbus Routing table. The Route typically consists of the drop number of the outbound DEB port followed by any additional drops needed to reach the target.

NOTE: Entries with no route will allow that index to access the DEB's internal registtters.

NOTE: Entries with the first drop in the route that does not match a drop number of any port on the DEB will access the DEB's internal registers.

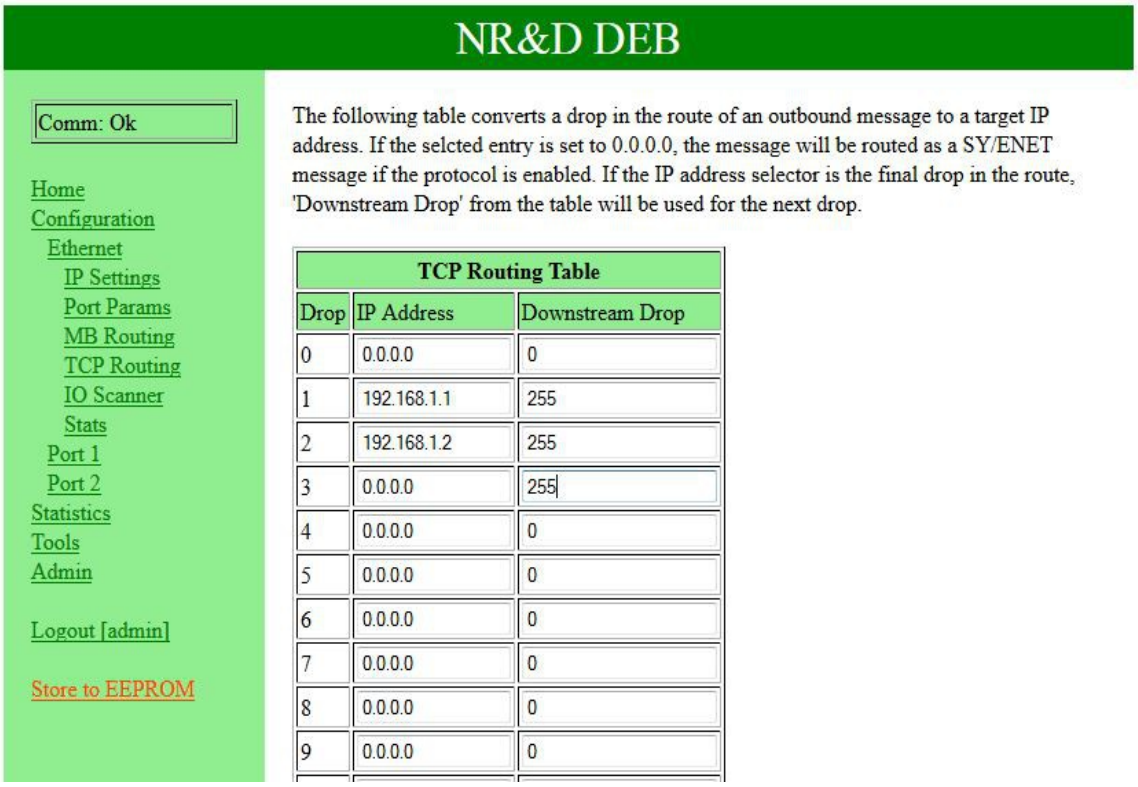
NOTE: Using the Ethernet port's drop number as the first drop in the route will cause the message to be routed back out the Ethernet port. This feature allows the DEB to translate between Modbus/TCP and SY/MAX 802.3 Ethernet.



TCP Routing Table

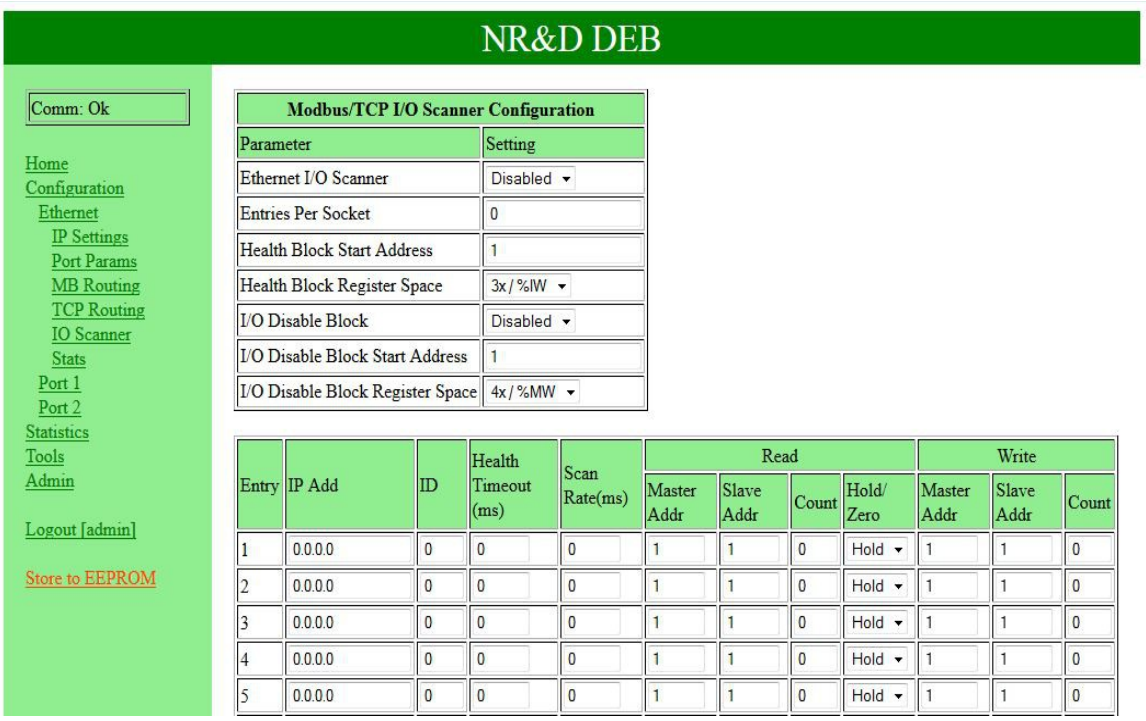
The TCP Routing table is used for Modbus/TCP Client operation.

NOTE: SY/MAX 802.3 Ethernet client operation is selected by setting the drop number IP Address to 0.0.0.0.



I/O Scanner

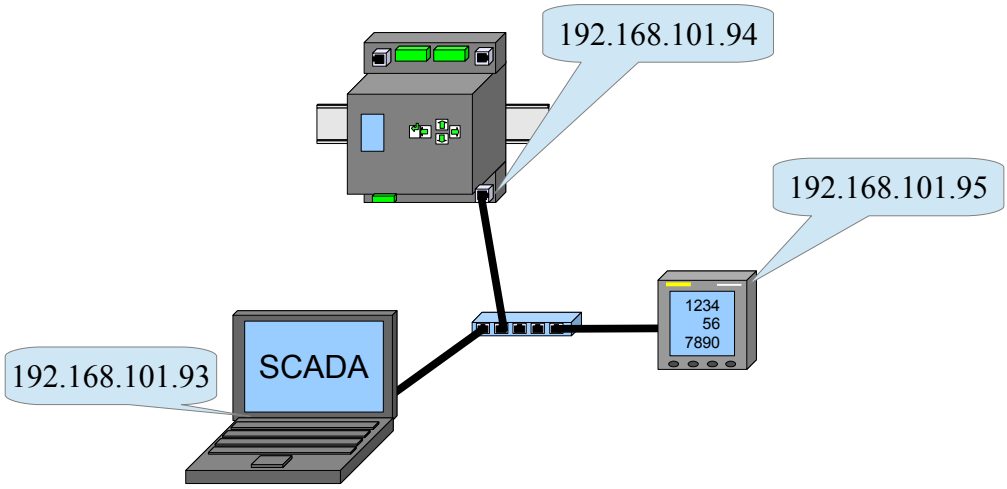
The DEB includes a Modbus/TCP I/O Scanner. This scanner allows automatic Read, Write, and Read+Write time based messages to be generated between the DEB and up to 128 Modbus TCP servers. The I/O Scanner operates on the Mailbox registers (1-2048) in the DEB's internal registers.

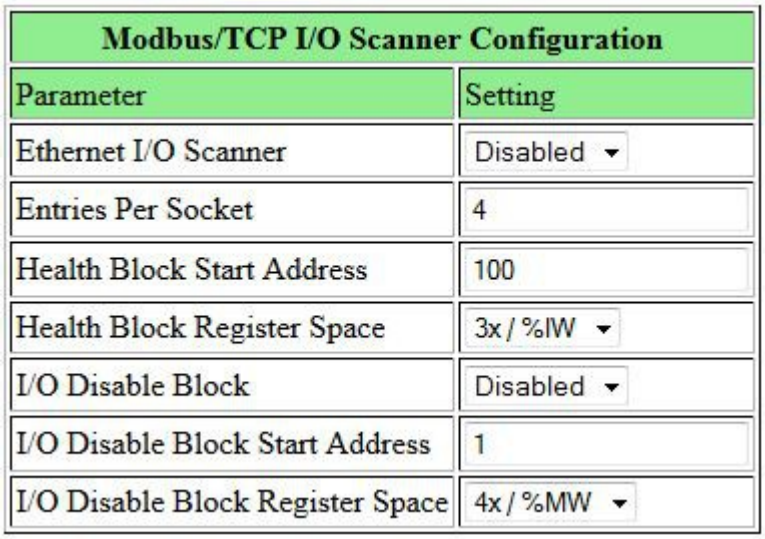


I/O Scanner Table Description and Simple Example

The following examples will illustrate the use of the Modbus/TCP I/O Scanner. In this first example the DEB shown in Illustration 1 will be used to describe the Modbus TCP I/O Scanner Configuration and I/O entry.

Illustration 1 Simple Example





Modbus/TCP I/O Scanner Configuration	
Parameter	Setting
Ethernet I/O Scanner	Disabled
Entries Per Socket	4
Health Block Start Address	100
Health Block Register Space	3x / %IW
I/O Disable Block	Disabled
I/O Disable Block Start Address	1
I/O Disable Block Register Space	4x / %MW

Figure 8.4 Ethernet I/O Scanner Configuration

Modbus/TCP I/O Scanner Configuration shown in Figure 8.4 is used to set Ethernet I/O Scanner properties. Values in parentheses are current settings.

- **Ethernet I/O Scanner** is set to Disable which halts scanning and allows the table to be edited. It would be undesirable to edit an I/O scan entry while the scan was active. Consequently, the I/O Scanner table cannot be edited while enabled.
- **Entries Per Socket** (4) this setting specifies the span of entries that the DEB will compare for a common IP address. All entries within that span will share a single socket to the specified IP address. When polling devices that have limited numbers of available sockets, this number should be set to something large enough to accommodate that limit. However, for devices that can handle unlimited connections, the user may experiment with this number to achieve maximum throughput of data.
- **Health Start Address** (100) is the start register in memory where the health block should be placed. Health Block is a group of eight registers, each containing 16 bits that report the health of the I/O scanner entries. The user can select the starting register address. The bits read from left to right, so I/O scan entry 1 is the most significant bit of the first register. Eight registers should be set aside for the Health Block. These registers will only be updated when one of the bits in the block changes state.
- **Health Block Register Space** (3x/%IW) The Health Block Register Space will be the mailbox registers inside the DEB.
- **I/O Disable Block** (Disabled) is a bitmap of the scan tables 128 entries which

allow each entry to be disabled individually. The I/O Disable Block is a group of eight 4x registers that creates an ON/OFF bit for each I/O Scanner entry. The user can configure whether the I/O Disable Block is enabled and the starting register address of the block. When the block is enabled, the user can disable a single entry by setting its associated bit to 1, rather than having to erase the entry from the table.

- **I/O Disable Block Start Address** (1) is the start register in memory where the I/O Disable Block will be placed if the I/O Disable Block is Enabled. if the I/O Disable Block is Disabled this setting is ignored.
- **I/O Disable Block Register Space** (4x/%MW) will be placed in the mailbox registers inside the DEB if the I/O Disable Block is Enabled. If the I/O Disable Block is Disabled this setting is ignored.

The I/O scan table shown in Figure 8.5 is a list of 128 possible entries that the DEB can use to access data on the Ethernet.

Entry	IP Add	ID	Health Timeout (ms)	Scan Rate(ms)	Read				Write		
					Master Addr	Slave Addr	Count	Hold/ Zero	Master Addr	Slave Addr	Count
1	192.168.101.95	10	2000	1000	110	1000	10	Hold	1	1	0
2	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
3	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
4	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
5	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
6	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
7	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
8	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
9	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
~~											
123	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
124	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
125	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
126	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
127	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0
128	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0

Figure 8.5 I/O scan table

Each entry consists of an IP Address, an ID, a Health Timeout, a Scan Rate, the addresses of the data to be manipulated, the number of registers to be manipulated, and a selection of what to do with the current data on comms failure. The I/O scan table, reading from left to right,

- **Entry** is a number representing the number of the entry in the table. This number can not be changed

- **IP Add** (192.168.101.95) is the IP address of the slave device
- **ID** (10) is the unit ID or Modbus address or the drop number or destination index of the device to be scanned
- **Health Time Out** (2000) is the time in milliseconds that the DEB considers the data to be good or healthy
- **Scan Rate** (1000) is the time in milliseconds between scans. If set to zero, the DEB will poll the device as fast as possible
- **Read Master Addr** (110) is the starting register in the DEB where the received data will be placed. The valid range is 1 through 2048
- **Slave Addr** (1000) is the starting register address in the slave device. The valid range is 1 through 65536
- **Count** (10) is the count of registers to be read. The valid range is 1 through 120. A count of zero disables the read portion of this I/O scan entry
- **Hold/Zero** (Hold) Controls whether the DEB resets the slave data when a Health Time Out occurs. If set to Hold, the DEB will hold the value of the last read when the next read times out. If set to Zero, the DEB will reset the registers to 0 if a timeout occurs.
- **Write Master Addr** (1) is the starting address of the registers in the master which will be written to the slave. The valid range is 1 through 2048
- **Slave Addr** (1) is the starting address in the slave device which will be written. The valid range is 1 through 65536
- **Count** (0) is the count of registers to be written. The valid range is 1 through 120. A value of zero disables the write portion of this I/O scan entry

NOTE: If a read and a write are configured in the same I/O scan entry, the DEB will use Modbus opcode 23, or 0x17, to issue a read/write in the same message. If the downstream device does not support this opcode, the user must configure the reads and writes in separate entries.

Using the setup in this example when the Ethernet I/O Scanner is enabled the DEB will begin scanning the devices in the table. Figure 8.6 Shows the scanner running the simple setup.

Modbus/TCP I/O Scanner Configuration

Parameter	Setting
Ethernet I/O Scanner	Enabled
Entries Per Socket	4
Health Block Start Address	100
Health Block Register Space	3x / %IW
I/O Disable Block	Disabled
I/O Disable Block Start Address	1
I/O Disable Block Register Space	4x / %MW

Entry	IP Add	ID	Health Timeout (ms)	Scan Rate(ms)	Read				Write			Last Error [Count]
					Master Addr	Slave Addr	Count	Hold/ Zero	Master Addr	Slave Addr	Count	
1	192.168.101.95	10	2000	1000	110	1000	10	Hold	1	1	0	f1 [0]
2	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]
3	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]
4	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]
5	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]
6	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]

Figure 8.6 Running Example of Simple Setup

While the I/O scanner is running the Entry column uses color to indicate the connection status to the device. A blue background color indicates a good connection. An orange background color indicates there is no connection. The new column on the right side of the table Last Error [Count] indicates the last error condition as well as the count of that error. Hovering the mouse over the error will reveal a mouse over text box containing a more descriptive explanation of the error. For example error F1 is Initialization (Power-up) State. See Table 8.1 for a complete list of errors.

Error	Description
0x00	No Error
0x23	Invalid local register address specified
0x3N	Received Modbus exception response N
0x73	Waiting for socket to connect
0x74	Connection actively refused by target (received a Reset)
0x75	Message timeout
0x76	No response to connect request
0xF1	Initialization (powering up) state
0xFF	I/O Scanner disabled

Table 8.1 Last Error Received

Using a register viewer to look at the data in the mailbox registers of the DEB, see Figure 8.7, shows up at registers 100-107, the Health Block, shows bit 15 in register 100 is set to 1. This shows healthy data. The data from entry one in the table appears in registers 110-119. The I/O Disable Block, in this example is disabled.

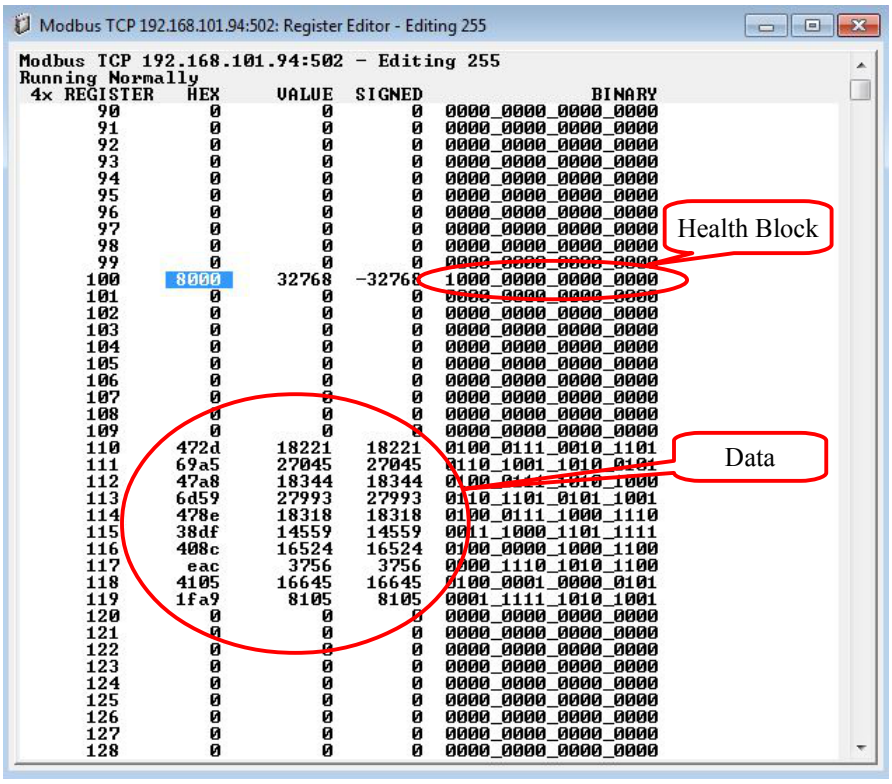
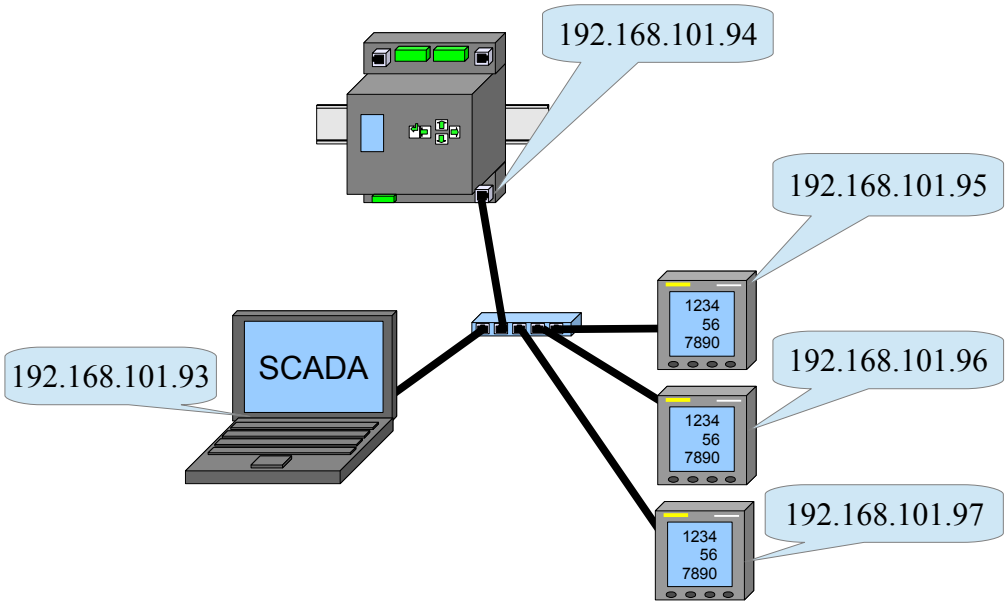


Figure 8.7 Register Viewer capture of example data

Example 2 shown in Illustration 2. The DEB will be used to poll multiple Modbus/TCP devices on the ethernet network and place the data in mailbox registers. The SCADA system can get the data from the mailbox registers in the DEB.

Illustration 2 DEB Setup



Example 2 Modbus/TCP I/O Scanner Configuration

Modbus/TCP I/O Scanner Configuration in Figure 8.8 shows three devices being polled. Entry one and entry two are being polled at the same IP address and ID so the data is from the same device but from different areas of memory. Entries three and four are different devices. In the event of comms loss the data of each device will hold the value of the last read. The last error condition is Error f1 is Initialization (Power-up) State. This is typical for a device with good communications and is not a cause for concern. The blue background color of entry one indicates a good connection to the devices. The orange background color of the rest of the entries indicates no connection on these entries.

Modbus/TCP I/O Scanner Configuration

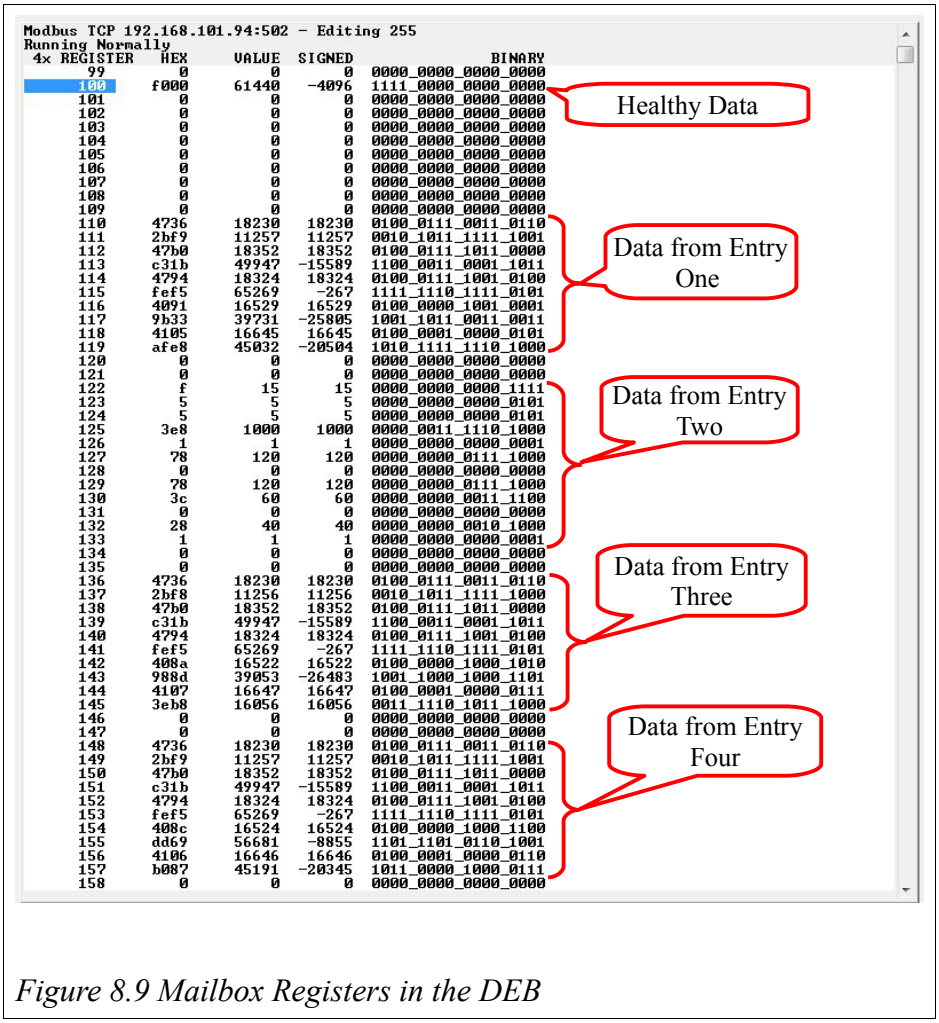
Parameter	Setting
Ethernet I/O Scanner	Enabled
Entries Per Socket	4
Health Block Start Address	100
Health Block Register Space	3x / %IW
I/O Disable Block	Disabled
I/O Disable Block Start Address	90
I/O Disable Block Register Space	4x / %MW

Entry	IP Add	ID	Health Timeout (ms)	Scan Rate(ms)	Read				Write			Last Error [Count]
					Master Addr	Slave Addr	Count	Hold/ Zero	Master Addr	Slave Addr	Count	
1	192.168.101.95	10	2000	1000	110	1000	10	Hold	1	1	0	f1 [0]
2	192.168.101.95	10	2000	1000	122	4117	12	Hold	1	1	0	f1 [0]
3	192.168.101.96	11	10000	5000	136	1000	10	Hold	1	1	0	f1 [0]
4	192.168.101.97	12	10000	3000	148	1000	10	Hold	1	1	0	f1 [0]
5	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]
6	0.0.0.0	0	0	10	1	1	0	Hold	1	1	0	f1 [0]

Figure 8.8 Running Example of the Modbus/TCP I/O Scanner

The data will show up in the 4x mailbox registers in the DEB. Using a register viewer, see Figure 8.9, to look at the data in the mailbox registers of the DEB shows at registers 90-97, the I/O Disable Block, all the bits are set to zero indicating that all the entries in the I/O scan table are allowed to poll. Registers 100-107, the Health Block, show all connected entries have healthy data. The data from entry one in the table appears in registers 110-119 and 122-133. The data for entries three appear in registers 136-145. The data for entries four appear in registers 148-157.

Note: In this example we chose to have the DEB to "Hold" the value of the last good read. In the event of a communications failure the Health Block will be the only indication of the failure. Monitoring the Health Block will ensure you can detect a failure in communication.



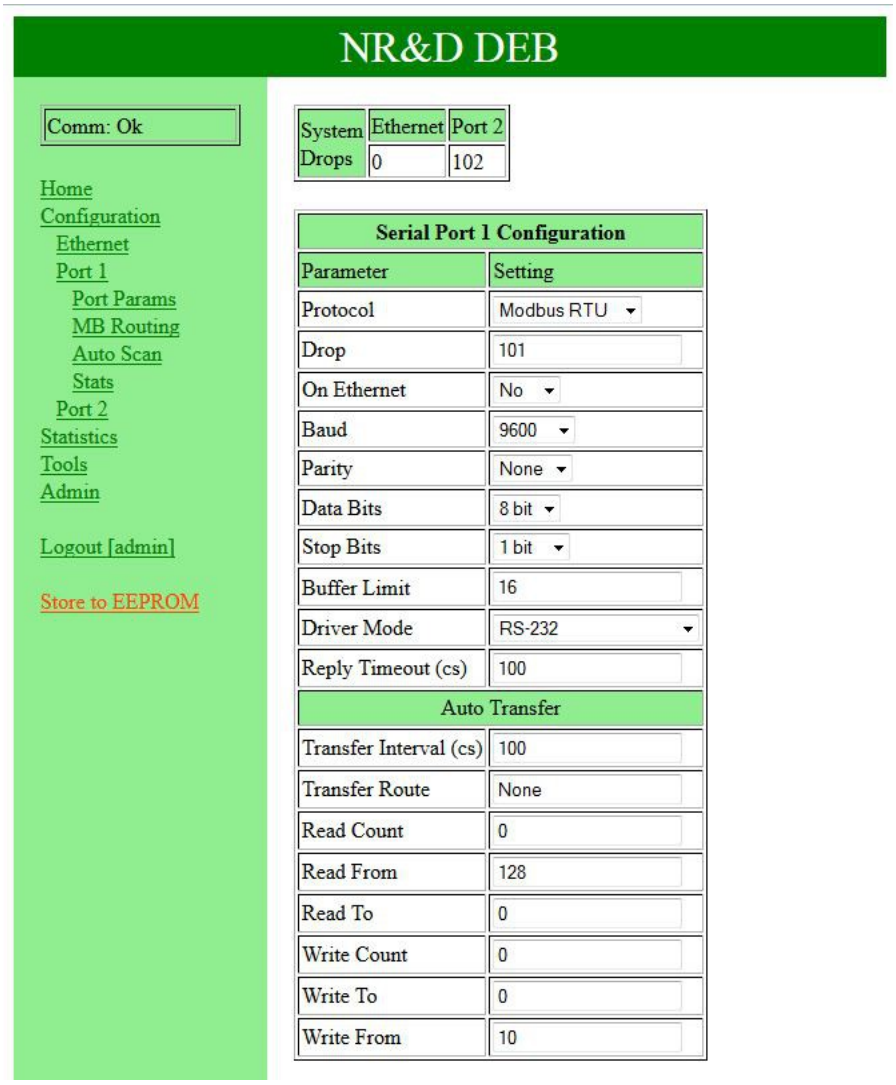
4x REGISTER	HEX	VALUE	SIGNED	BINARY
99	0	0	0	0000_0000_0000_0000
100	f000	61440	-4096	1111_0000_0000_0000
101	0	0	0	0000_0000_0000_0000
102	0	0	0	0000_0000_0000_0000
103	0	0	0	0000_0000_0000_0000
104	0	0	0	0000_0000_0000_0000
105	0	0	0	0000_0000_0000_0000
106	0	0	0	0000_0000_0000_0000
107	0	0	0	0000_0000_0000_0000
108	0	0	0	0000_0000_0000_0000
109	0	0	0	0000_0000_0000_0000
110	4736	18230	18230	0100_0111_0011_0110
111	2bf9	11257	11257	0010_1011_1111_1001
112	47b0	18352	18352	0100_0111_1011_0000
113	c31b	49947	-15589	1100_0011_0001_1011
114	4794	18324	18324	0100_0111_1001_0100
115	fef5	65269	-267	1111_1110_1111_0101
116	4091	16529	16529	0100_0000_1001_0001
117	9b33	39731	-25805	1001_1011_0011_0011
118	4105	16645	16645	0100_0001_0000_0101
119	afe8	45032	-20504	1010_1111_1110_1000
120	0	0	0	0000_0000_0000_0000
121	0	0	0	0000_0000_0000_0000
122	f	15	15	0000_0000_0000_1111
123	5	5	5	0000_0000_0000_0101
124	5	5	5	0000_0000_0000_0101
125	3e8	1000	1000	0000_0011_1110_1000
126	1	1	1	0000_0000_0000_0001
127	78	120	120	0000_0000_0111_1000
128	0	0	0	0000_0000_0000_0000
129	78	120	120	0000_0000_0111_1000
130	3c	60	60	0000_0000_0011_1100
131	0	0	0	0000_0000_0000_0000
132	28	40	40	0000_0000_0010_1000
133	1	1	1	0000_0000_0000_0001
134	0	0	0	0000_0000_0000_0000
135	0	0	0	0000_0000_0000_0000
136	4736	18230	18230	0100_0111_0011_0110
137	2bf8	11256	11256	0010_1011_1111_1000
138	47b0	18352	18352	0100_0111_1011_0000
139	c31b	49947	-15589	1100_0011_0001_1011
140	4794	18324	18324	0100_0111_1001_0100
141	fef5	65269	-267	1111_1110_1111_0101
142	408a	16522	16522	0100_0000_1000_1010
143	988d	39053	-26483	1001_1000_1000_1101
144	4107	16647	16647	0100_0001_0000_0111
145	3eb8	16056	16056	0011_1110_1011_1000
146	0	0	0	0000_0000_0000_0000
147	0	0	0	0000_0000_0000_0000
148	4736	18230	18230	0100_0111_0011_0110
149	2bf9	11257	11257	0010_1011_1111_1001
150	47b0	18352	18352	0100_0111_1011_0000
151	c31b	49947	-15589	1100_0011_0001_1011
152	4794	18324	18324	0100_0111_1001_0100
153	fef5	65269	-267	1111_1110_1111_0101
154	408c	16524	16524	0100_0000_1000_1100
155	dd69	56681	-8855	1101_1101_0110_1001
156	4106	16646	16646	0100_0001_0000_0110
157	b087	45191	-20345	1011_0000_1000_0111
158	0	0	0	0000_0000_0000_0000

Figure 8.9 Mailbox Registers in the DEB

Serial Ports

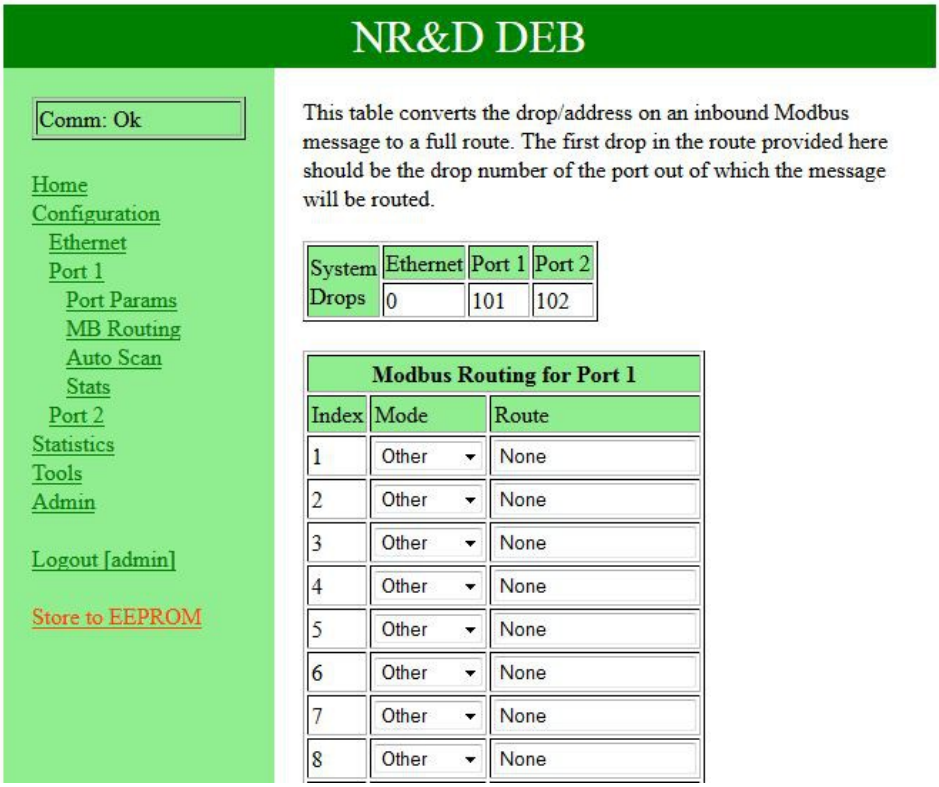
Port Parameters

The Port Parameters page will show the settings for a given serial port. Various protocol modes have different settings that may be displayed. Changing the protocol mode will prompt the "Admin" to "Apply typical settings" for the new mode. Selecting "OK" will change many of the settings to match the normal usage of the new mode.



Serial Port Modbus Routing Table

Each serial port includes its own 254 entry look-up table for Modbus Slave operation. The first drop in the Route field is the drop number of the outbound DEB port.

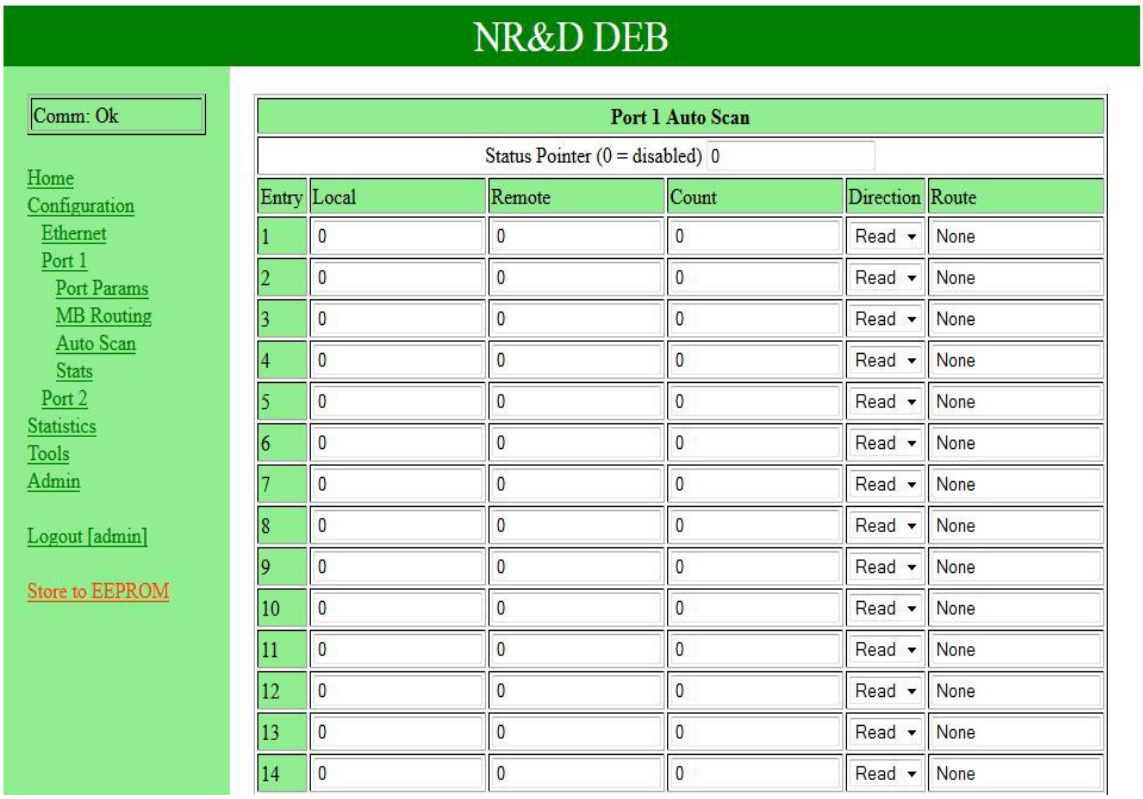


Serial Port Auto Scan

Each serial port may be configured to automatically poll attached slave(s) on a timed interval. This table provides the configuration for each of the 48 possible entries.

NOTE: The Auto Scan Table for port 2 is disable when the DEB is in Hot Modbus Plus operation.

NOTE: Port 2 Auto Scan may be used to generate read/write messages onto MB+ by entering the MB+ port drop number as the first entry in the Route field.



Statistics

Pages are provided for statistical counter pages for each port.

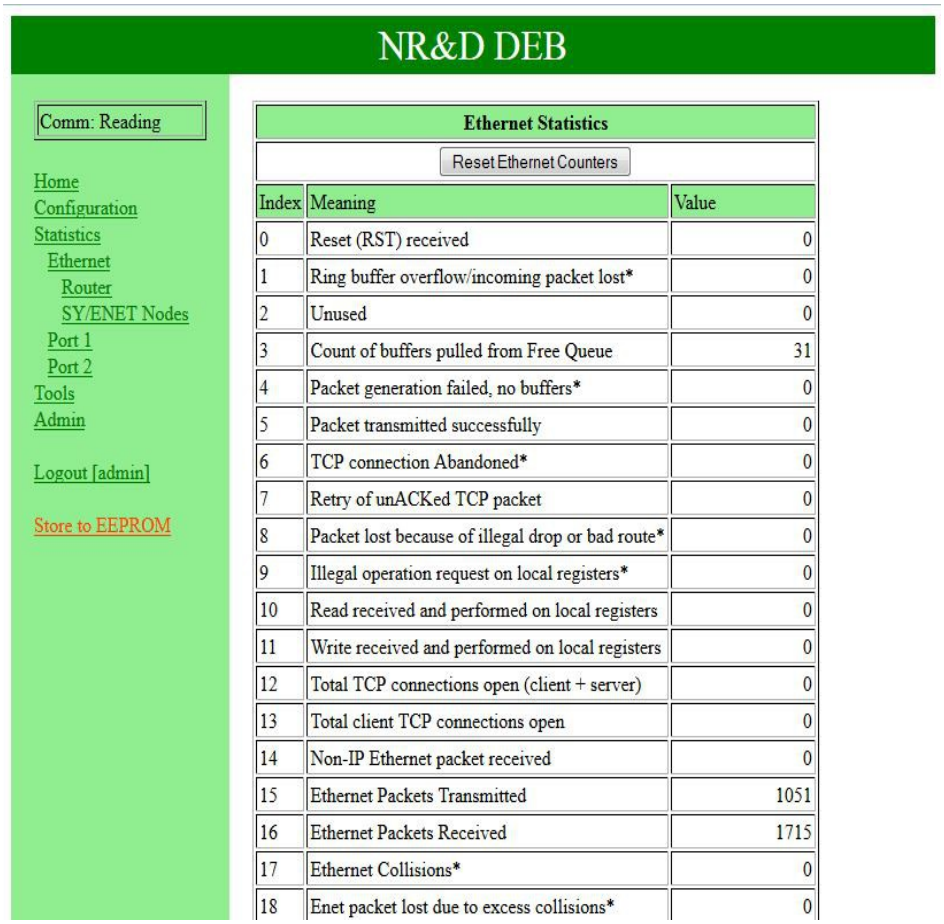
Many of these pages have “Reset Counter” buttons that allow either the “User” or “Admin” to zero the counters.

NOTE: These counters are typically unsigned words and will roll over from 65535 to 0 with no indication that a rollover has occurred.

NOTE: These counters do not survive a power cycle/reboot.

Ethernet Router Stats

The Ethernet Router page shows counters for the SY/MAX / Modbus router for this port.



NR&D DEB

Comm: Reading

Home
Configuration
Statistics
Ethernet
Router
SY/ENET Nodes
Port 1
Port 2
Tools
Admin

Logout [admin]

Store to EEPROM

Ethernet Statistics

Reset Ethernet Counters

Index	Meaning	Value
0	Reset (RST) received	0
1	Ring buffer overflow/incoming packet lost*	0
2	Unused	0
3	Count of buffers pulled from Free Queue	31
4	Packet generation failed, no buffers*	0
5	Packet transmitted successfully	0
6	TCP connection Abandoned*	0
7	Retry of unACKed TCP packet	0
8	Packet lost because of illegal drop or bad route*	0
9	Illegal operation request on local registers*	0
10	Read received and performed on local registers	0
11	Write received and performed on local registers	0
12	Total TCP connections open (client + server)	0
13	Total client TCP connections open	0
14	Non-IP Ethernet packet received	0
15	Ethernet Packets Transmitted	1051
16	Ethernet Packets Received	1715
17	Ethernet Collisions*	0
18	Enet packet lost due to excess collisions*	0

SY/MAX 802.3 Ethernet Nodes

This table shows all of the visible SY/MAX Ethernet devices on the DEB's local Ethernet network.

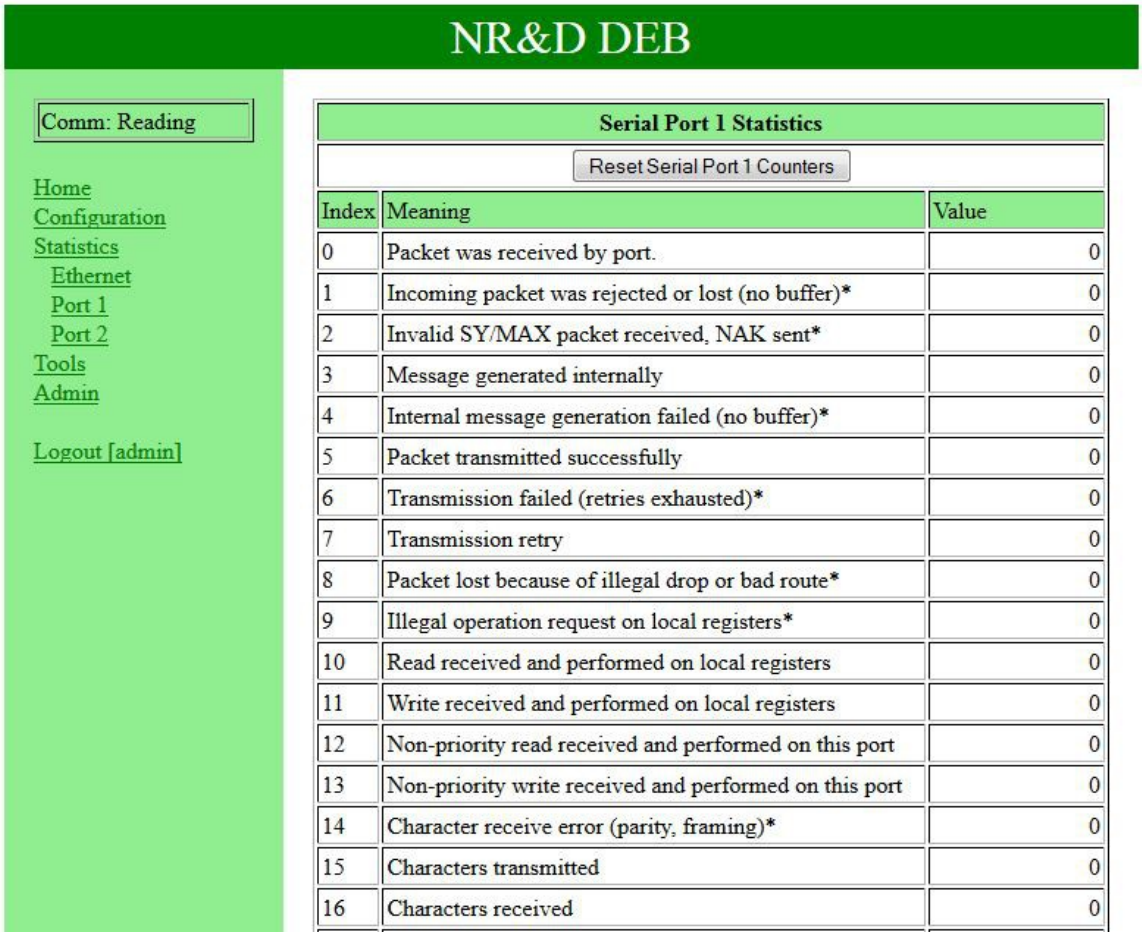
NOTE: The DEB Ethernet port must be set for SY/MAX+Modbus mode for this table to be accurate.

Any SY/MAX Ethernet drop number occupied by this DEB is highlighted in green. This includes any serial port or the MB+ port that is set for “ON Ethernet YES”. Serial ports that have a drop number greater than 100 and configured for “ON Ethernet YES” will also consume the SY/MAX drop number minus 100.

Drop Number of peer devices are highlighted in blue.

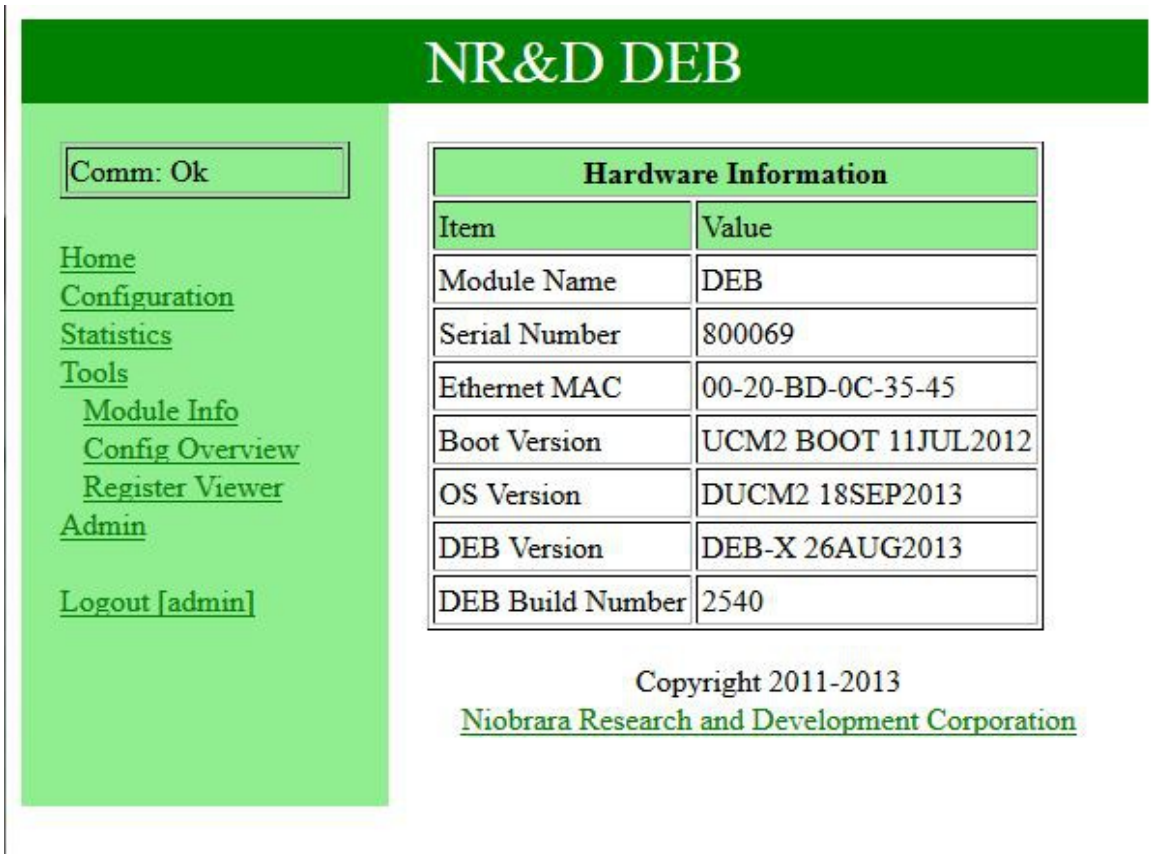
Serial Port

Serial ports 1 and 2 have counter pages to show the SY/MAX / Modbus router information associated with that port.



Module Info

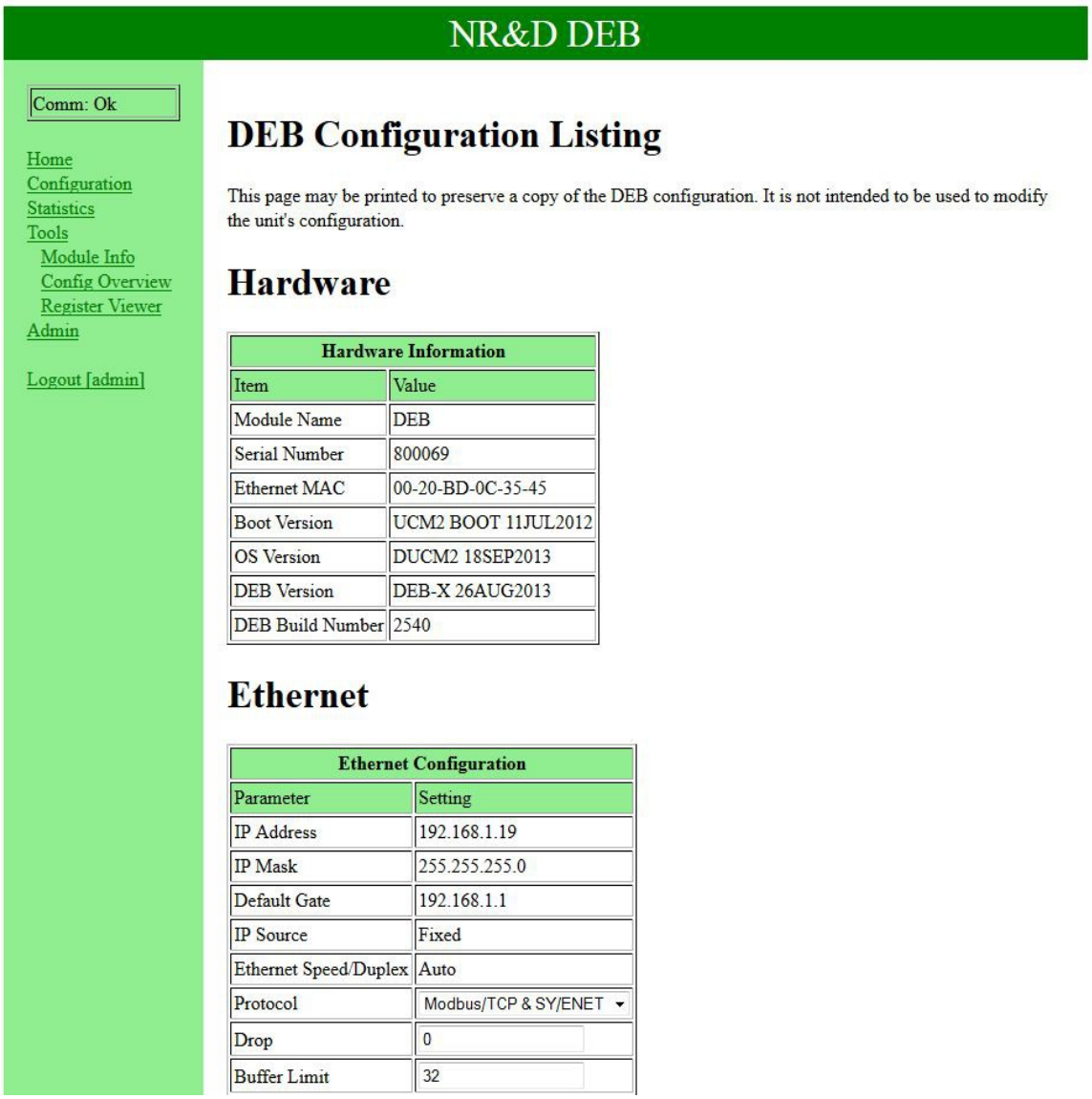
The Module Info page shows the DEB's serial number and various firmware versions.



Config Overview

The Config Overview page provides a complete listing of all of the configuration of the DEB. This page may be printed to provide a hard copy of the module's setup.

Note: This page takes several seconds to populate. At the end of the configuration is a text line “This is the end of the Configuration Listing.”



NR&D DEB

Comm: Ok

Home
Configuration
Statistics
Tools
Module Info
Config Overview
Register Viewer
Admin

Logout [admin]

DEB Configuration Listing

This page may be printed to preserve a copy of the DEB configuration. It is not intended to be used to modify the unit's configuration.

Hardware

Hardware Information	
Item	Value
Module Name	DEB
Serial Number	800069
Ethernet MAC	00-20-BD-0C-35-45
Boot Version	UCM2 BOOT 11JUL2012
OS Version	DUCM2 18SEP2013
DEB Version	DEB-X 26AUG2013
DEB Build Number	2540

Ethernet

Ethernet Configuration	
Parameter	Setting
IP Address	192.168.1.19
IP Mask	255.255.255.0
Default Gate	192.168.1.1
IP Source	Fixed
Ethernet Speed/Duplex	Auto
Protocol	Modbus/TCP & SY/ENET
Drop	0
Buffer Limit	32

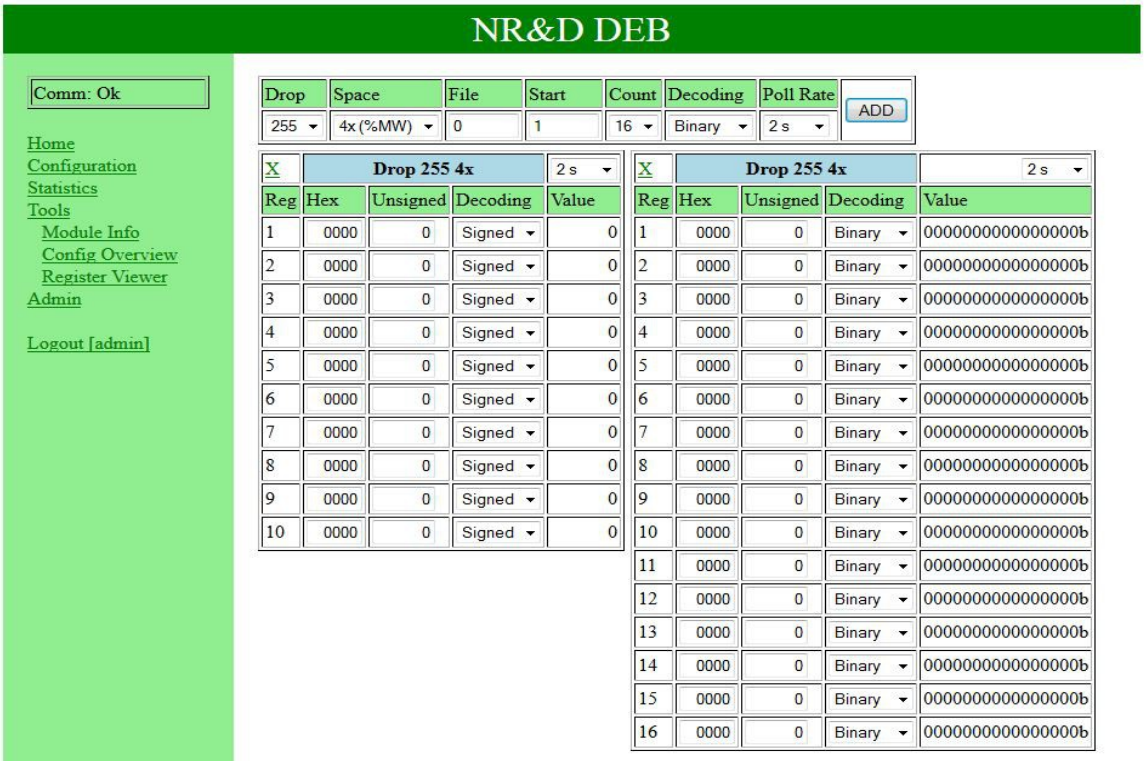
Register Viewer

The Register Viewer allows the User or Admin to view/modify register data in a target. The Target is determined using the Modbus Routing Table Index for the Ethernet Port.

NOTE: The present fimware only allows access to Modbus Index 255 (the DEB itself).

Access to 4x (Holding Registers) or 6x (Files) are supported.

Multiple viewing windows may be opened. Windows may be closed by clicking the "X" in the upper left corner of the window. The polling rate of each viewing window is adjustable with the pull-down in the upper corner of each window.

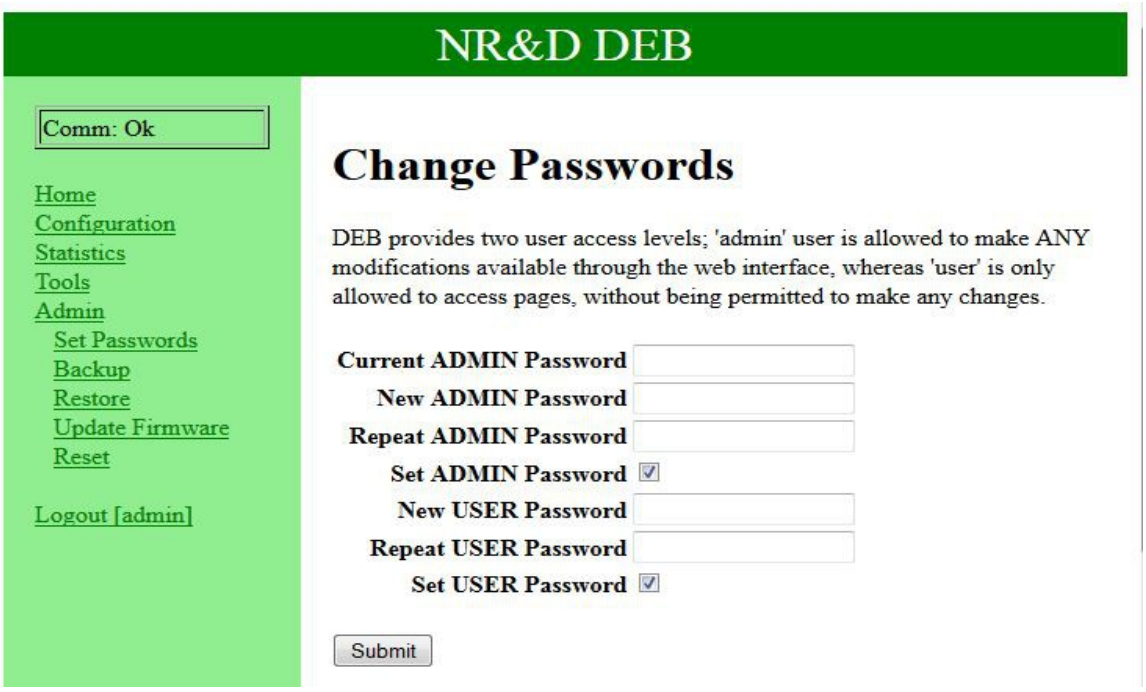


Admin Menu

The Admin menu heading is only shown when the “Admin” account is used for the web login.

Change Passwords

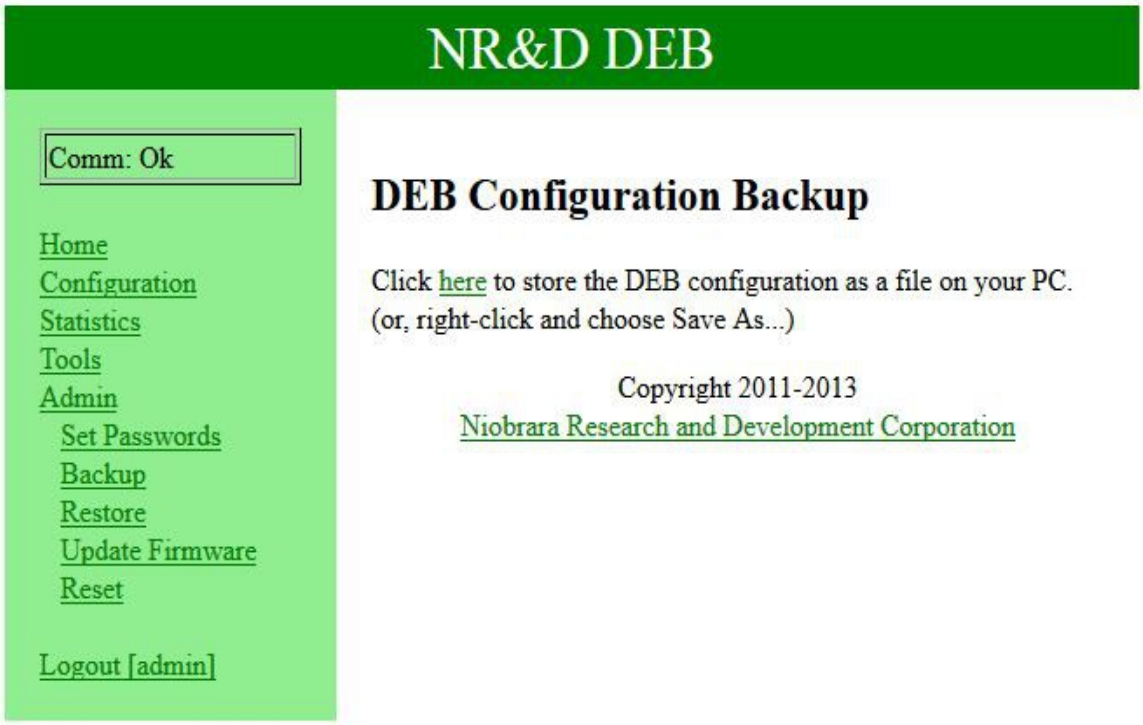
The Change Password page allows the Administrator to modify the “Admin” and/or “User” passwords.



Configuration Backup

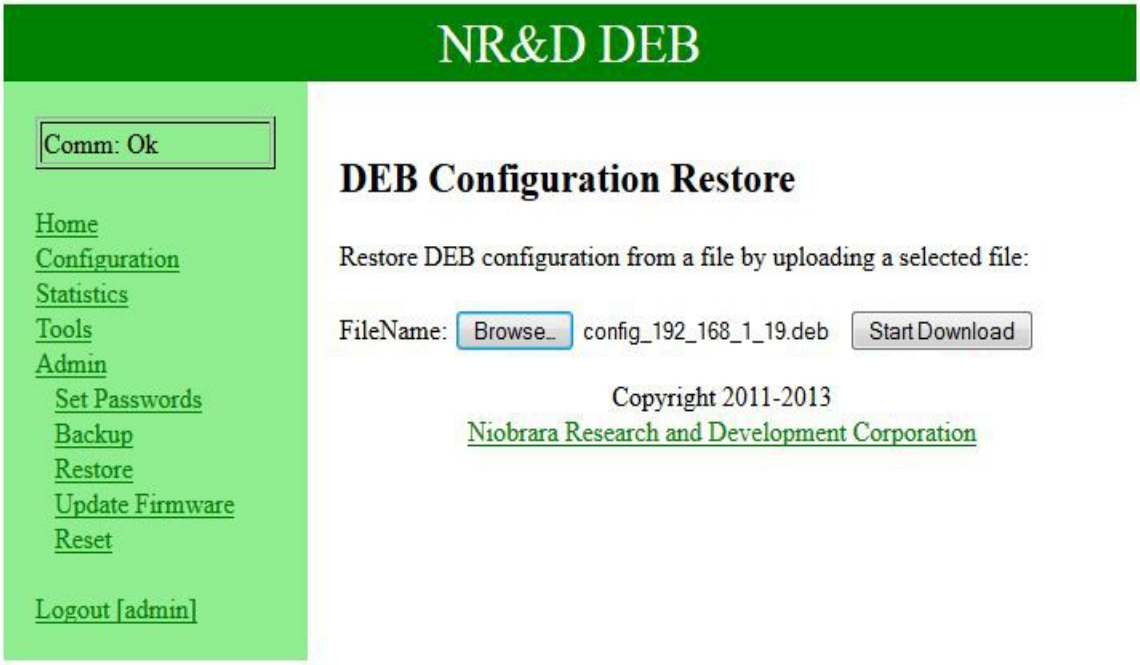
The configuration of the DEB may be pulled from the DEB and saved as an XML file on the PC. The common method is to right click the “here” link and choose “Save Link As...” or “Save Target As...” and then save the file.

The default filename is of the form: config_192_168_1_14.DEB where 192.168.1.14 is the IP Address of the DEB in question.



Configuration Restore

The Restore link will allow the Admin to restore a previously saved backup file to the DEB.



Firmware Update

The Firmware Update page allows the Admin to install a new version of the DEB.qrc file.

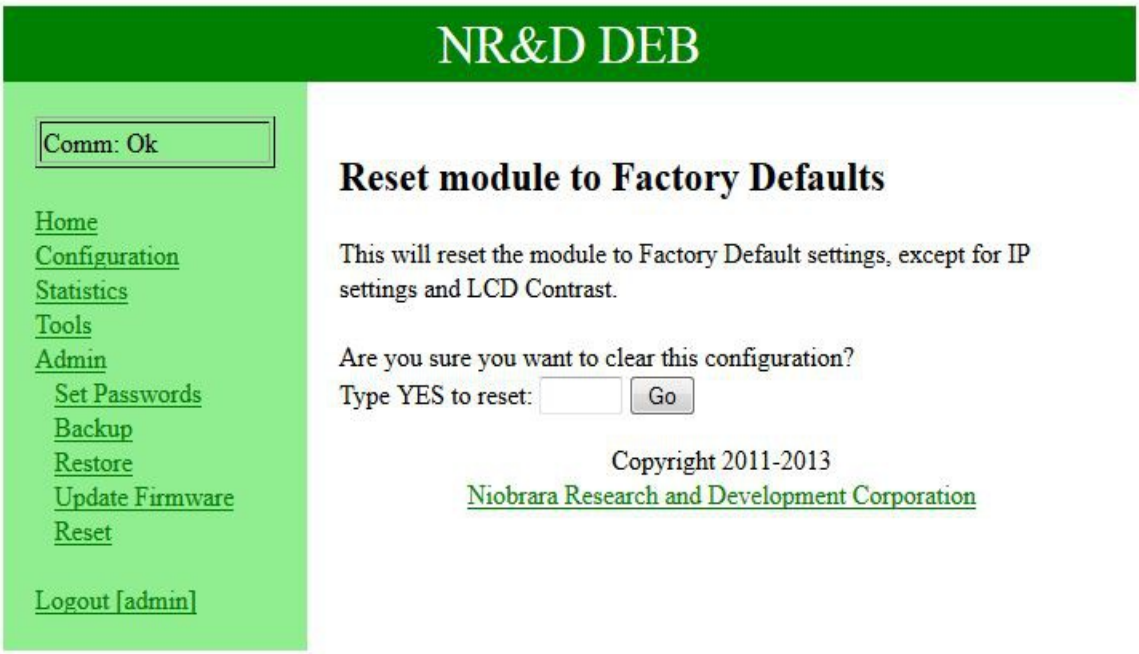
NOTE: It is always recommended that a new backup of the DEB configuration be done before updating the firmware.

The new firmware is usually installed in the c:\Niobrara\Firmware\ folder.

Reset to Factory Defaults

The DEB may be reset to Factory Defaults by typing “YES” into the text field. Resetting to Factory using this web page will keep the current Ethernet settings (IP Address, Subnet Mask, and Default Gateway) but will revert all other settings to factory default.

NOTE: Resetting the DEB to Factory Default using the front panel LCD will also revert the IP settings to 10.10.10.10.



9 RPCSW32

NOTE: RPCSW32 does not offer full support of the features in the DEB-X (webserver) versions. The DEB-X features full 254 entry Modbus routing tables for Ethernet and both serial ports, as well as the I/O Scanner configuration.
Do not rely on the RPCSW32 offline configuration for backup. Use the backup/restore feature of the web server.

RPCSW32 is a MS Windows32 console application to allow online/offline configuration of the DEB and older DEB hardware.

Startup Screen

Figure 9.1 Startup Screen

The fist time that RPCSW32 is started, it will show a screen like Figure 9.1. The date in the upper right corner (03Aug2012) is the revision of RPCSW32. The Error notification in the lower right corner indicates that the program is unable to locate the setup file.

Note: Press the F10 key or the Escape (ESC) to move past an error notification.

This particular error will not be displayed if the setup file is saved. Clearing this error will immediately drop into the “Setup, Serial communication” screen.

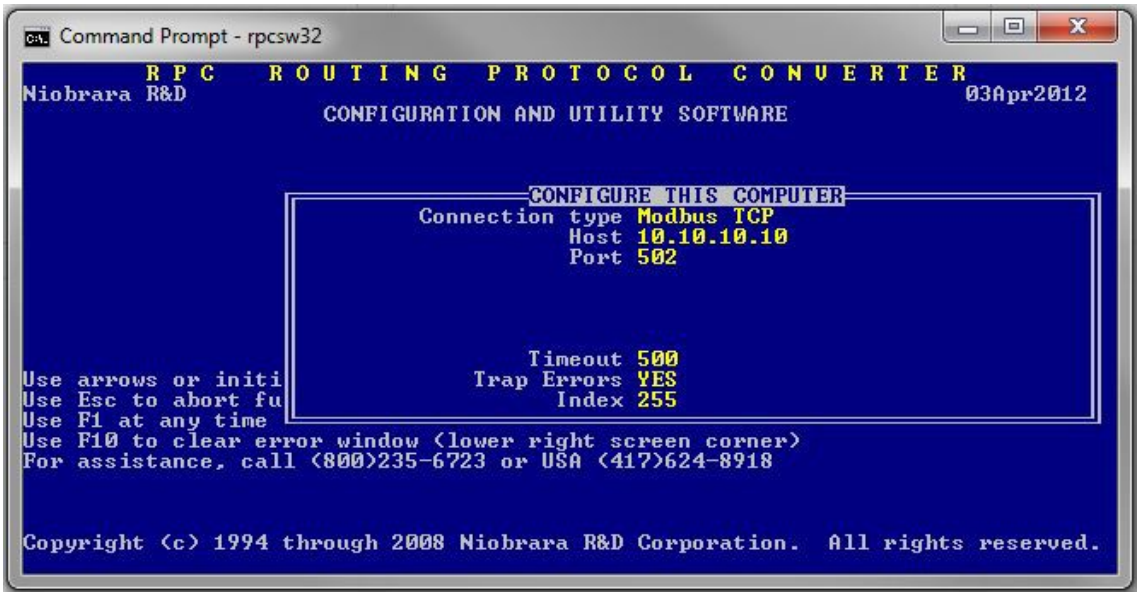


Figure 9.2 Setup Serial Screen

This screen is used to configure the connection between the PC and the target DEB. In this case, the connection is Modbus/TCP Ethernet to the target 10.10.10.10 using index 255. See section Serial communication on page 148 for more information.

Pressing “Enter” after selecting the Index field will pop up the “Write setup to startup file?” window. Pressing “Enter” or “y” will save the file and avoid the error on the next startup.

Figure 9.3 Setup Serial Screen

Main Menu

The Main Menu is shown in Figure . All menu items may be selected by using the arrow keys to move around or by using the yellow shortcut letter.

- "N" for oNline – Edit the configuration directly in the DEB in real time.
- "F" for oFfline – Edit, Save, Print offline copies of the DEB's configuration.
- "U" for Utility – View registers, statistics, MB+ station lists.
- "S" for Setup – Configure the PC connection.
- "Q" for Quit – Exit the RPCSW32 program.

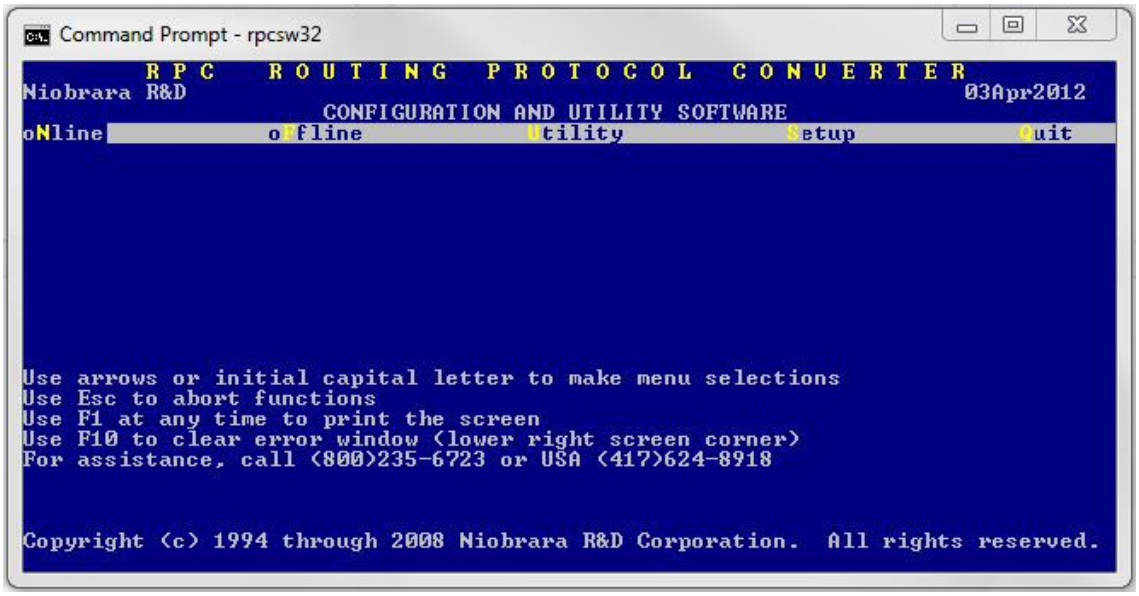


Figure 9.4 Setup Serial Screen

oNline Menu

The oNline menu is used to directly edit parameters in the DEB.

- Edit port parameters – Adjust settings for the Ethernet, and Serial ports.
- edit Modbus routing – Configure routing tables for the Ethernet and serial ports.
- edit Auto scan table – Configure the automatic polling tables for the serial and MB+ ports.
- edit TCP routing – Modify the Modbus/TCP client IP Address table.

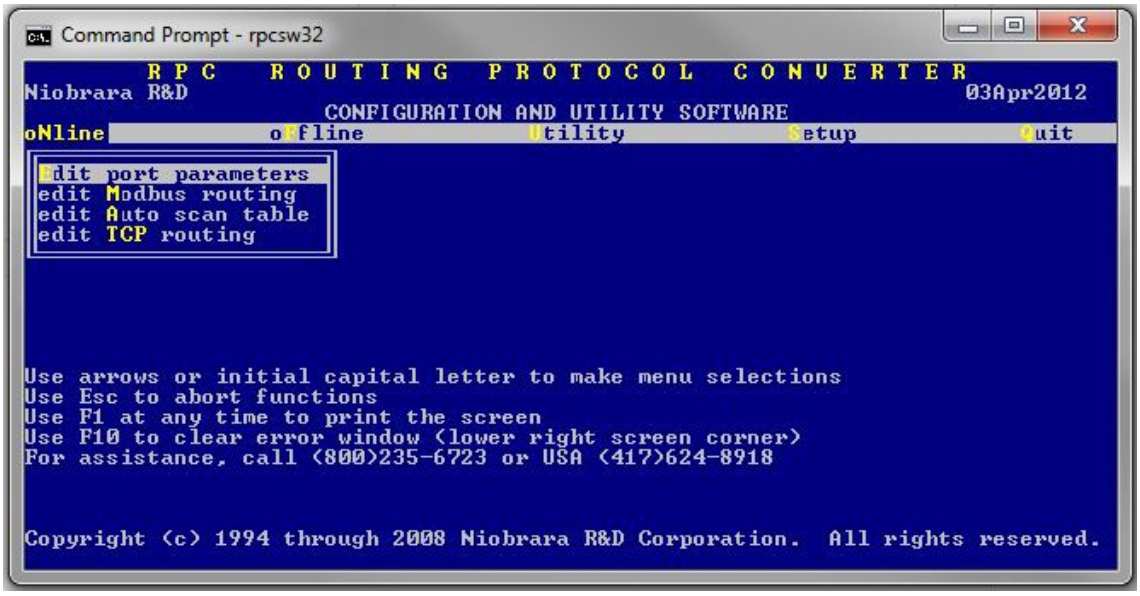


Figure 9.5 oNline Menu

Edit port parameters

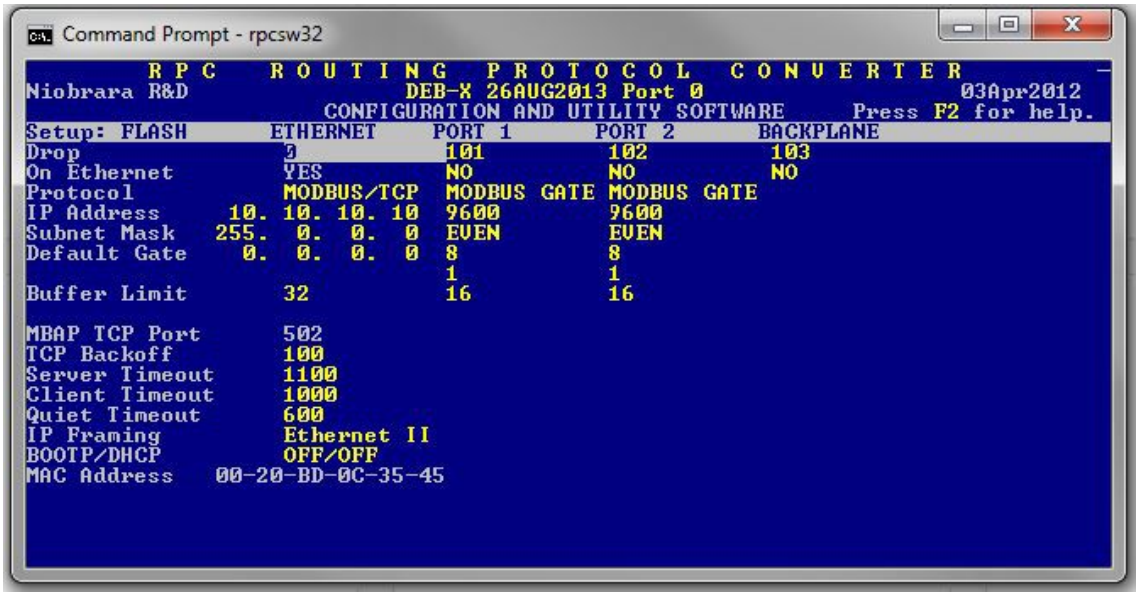


Figure 9.6 oNline edit port parameters Screen

The oNline edit port parameters screen has a column for the Ethernet port, each serial port, and the Backplane port. The arrow keys are used to move the highlighted cell around. The space bar and + and – keys are used to modify the values.

NOTE: Care must be exercised while editing online parameters. Changing settings on the port the computer is using will result in a loss of communication.

Edit Modbus routing

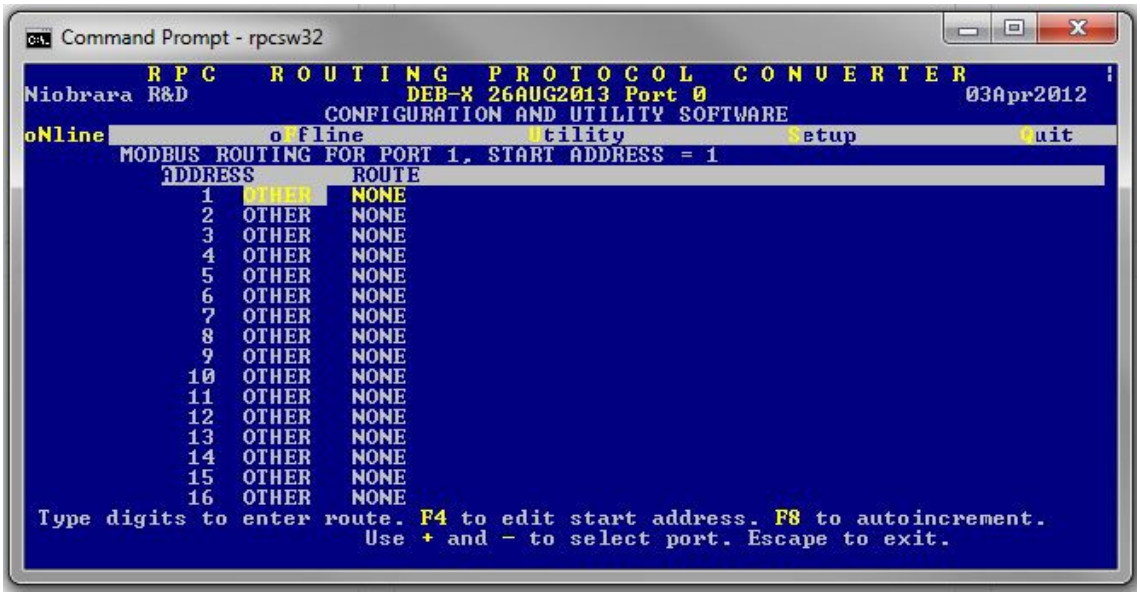


Figure 9.7 Modbus Routing Screen

The Modbus Routing screen is used to set the lookup tables for Ethernet clients and serial Modbus master.

The left column is the Modbus slave or Modbus/TCP Index. The Ethernet port has 255 possible entries. Each serial port supports 128 entries. The F4 key is used to alter the starting slave address for the serial port tables. The F4 key also allows the selection of "Micrologic Support".. Micrologic support is a special feature that takes the route for each of the first 50 drop numbers in the table and automatically support the same route for 50+x, 100+x, and 150+x drops.

The center column is either "MODBUS" or "OTHER". MODBUS is used when the target device is a Modbus slave. OTHER is used when the target slave is SY/MAX or some other device that is not Modbus.

The ROUTE field is used to define the path to the target. The first drop in the route should be the drop number of the DEB port heading towards the target slave. The example above shows routes of 1,x where 1 is the drop number of the MB+ port and x is the MB|drop number of the target PLC.

Auto Scan Edit

The Auto Scan feature allows a serial port to automatically generate up to 48 sequential messages on a fixed time interval. The messages may be either a read or a write. Each message includes the starting local mailbox register, the starting remote register, the count, the direction (READ or WRITE), and the route.

F4 edits the Status bit map registers. These registers provide 48 bits to indicate the success or failure of the scan.

F8 auto increments the next entry.

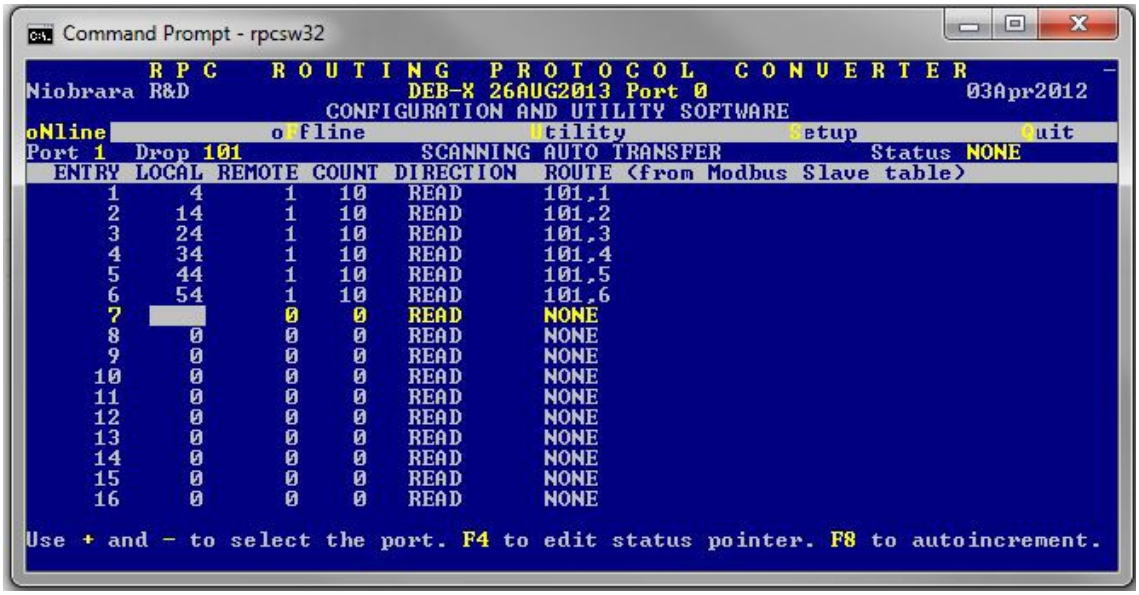


Figure 9.8 Auto Scan Screen

TCP Routing

The TCP Routing screen gives access to the 200 entries the table. This table is used to associate the drop number in the route following the Ethernet port drop number to an IP Address. The Downstream Route feature may be used to add the Modbus/TCP Destination Index in the rare situation where all 5 MB+ drops in the route are already used by the time the message reaches the TCP table.

The Auto-Fill feature of the IP table on the DEB's front panel will automatically place the first three octets of the new IP Address in each of the 200 entires of this table. The fourth octet will simply be the index value for the entry.

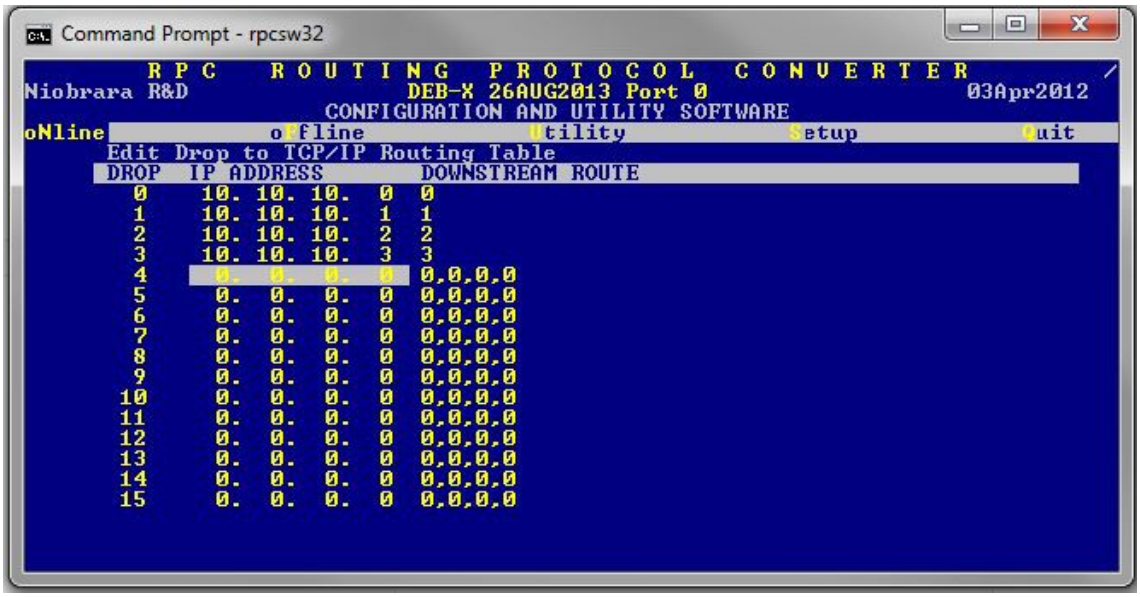


Figure 9.9 TCP Routing Screen

oFfline Menu

The oFfline menu allows DEB configuration without a physical connection to the hardware.

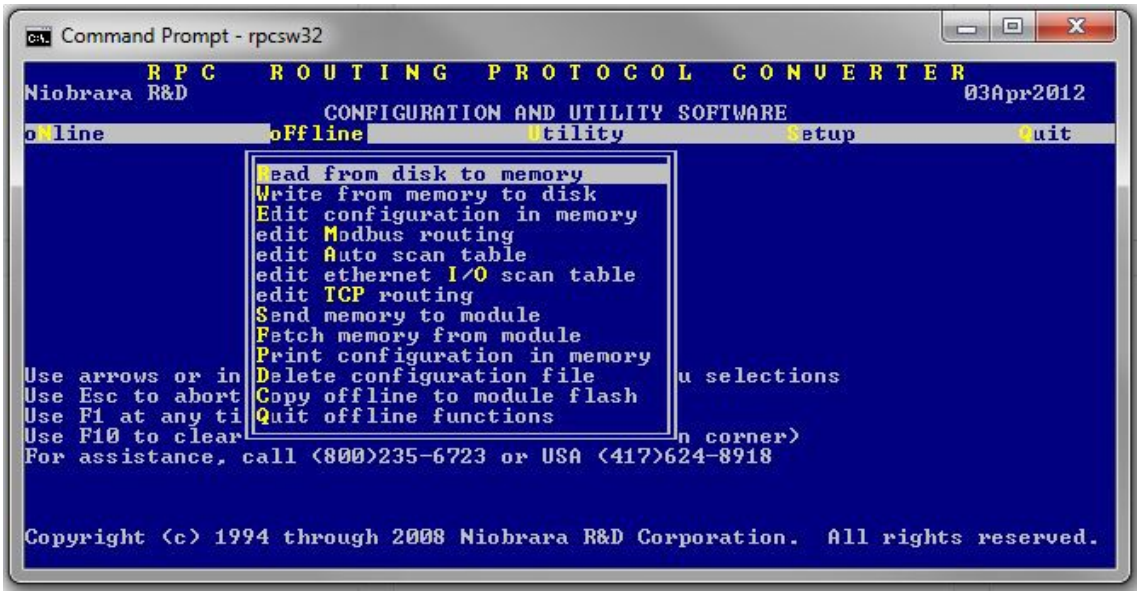


Figure 9.10 Offline Menu

Screen

Read from disk to memory

The oFline, Read from disk to memory menu item allow the RPCSW32 program to read a previously saved configuration file from the computer's hard disk into the offline memory. This file may then be viewed, modified, printed, saved, or sen to an DEB. The filename must be a maximum of 8 characters and is chosen from files with the extension .DEB.

The arrow keys may be used to move around the list of stored files or the filename may besimply typed into the File to read: box. Moving the cursor around to an item encased by [] will choose that drive letter or folder name.

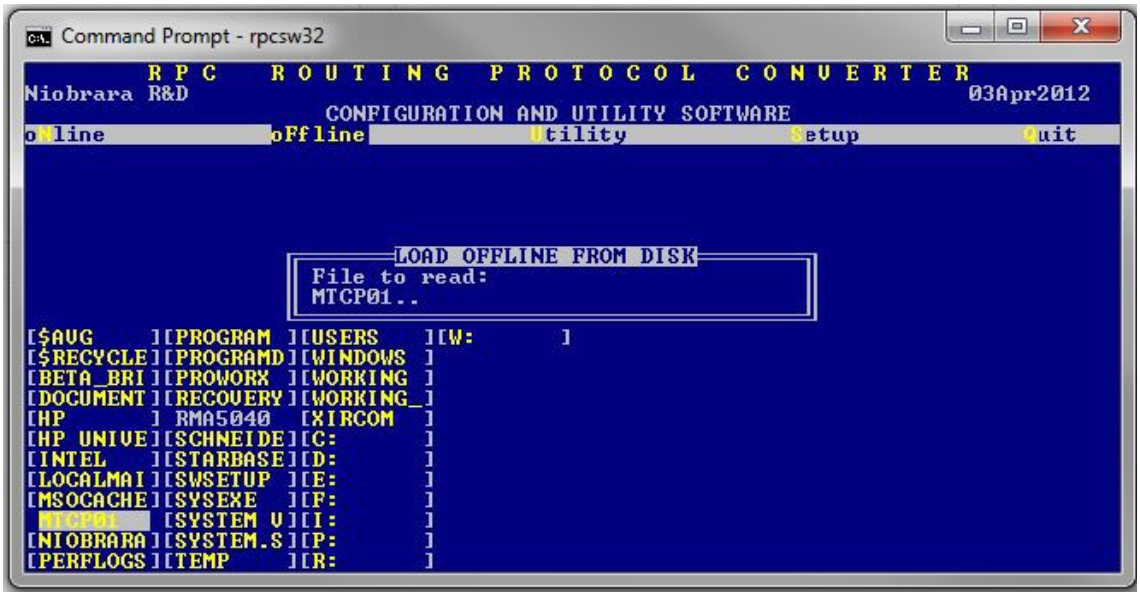


Figure 9.11 Read File from Disk Screen

Write from memory to disk

The oFfline, Write from memory to disk is used to save the current offline memory to a file on the PC. The navigation and file name operation is the same as the “Read from disk to memory”.

Edit configuration in memory

The oFfline, Edit configuration in memory screen works just like the oNline Edit port parameters version on page 134.

edit Modbus Routing

The oFfline, edit Modbus routing screen works just like the oNline Edit Modbus routing on page 135.

edit TCP routing table

The oFfline, edit TCP routing table screen works just like the oNline, TCP Routing on page 137

Send memory to module

The oFfline, Send memory to module screen sends all of the oFfline data to the DEB.

> NOTICE: This action will overwrite all data in the DEB and may potentially cause the PC to lose communication with the DEB.

Note: The data sent to the DEB will not be saved in the module until Utility, Write setup to EEPROM is completed.

Fetch memory from module

This menu item copies all of the configuration from the DEB to the oFfline section of RPCSW32.

Print configuration in memory

A hard copy of the oFfline configuration may be created using the Print configuration in memory. Choose LPT1: to print directly to port LPT1. A text file name may also be entered to print directly to a file.

Delete configuration file

This screen is used to remove a .DEB file from the computer. Select the file and pres enter to delete the file from the computer.

Copy offline to module flash

This menu item is to supported by the DEB. It is only used with the older SY/MAX versions of the DEB.

Quit offline functions

This menu item returns to the main menu. Pressing the ESC key performs the same task.

Utility Menu

The Utility menu offers several handy features to troubleshoot a system.

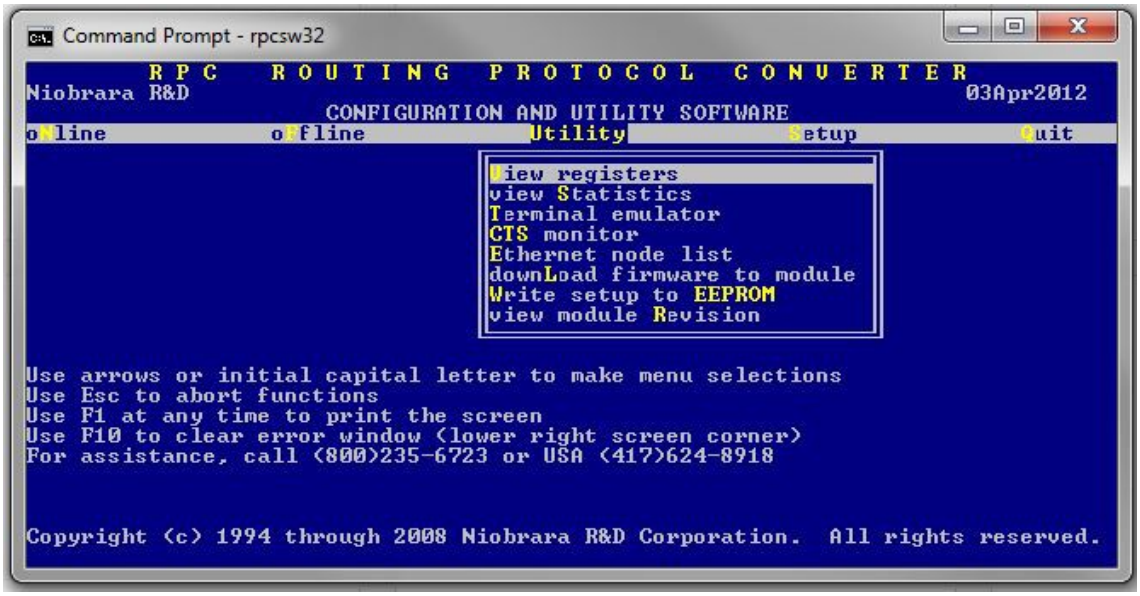


Figure 9.12 Utility Menu Screen

View registers

The View registers screen gives a Modbus register viewer/modifier screen that may access Holding (4x) or Analog Input (3x) registers in the target device. Use the Serial communication and Register viewer pages to choose the target device and viewable register type and range.

The register data is shown in Hex, unsigned, signed, and binary form. Use the arrow, page up and down, and home keys to move the cursor around. Use the number keys to modify the register's content. Pressing Enter will send the new data to the target.

> NOTE: Writing data to a target device may cause unexpected behavior, equipment damage, personal injury or death.

Jump to a particular register location by typing in a new number while the cursor is in the far left column.

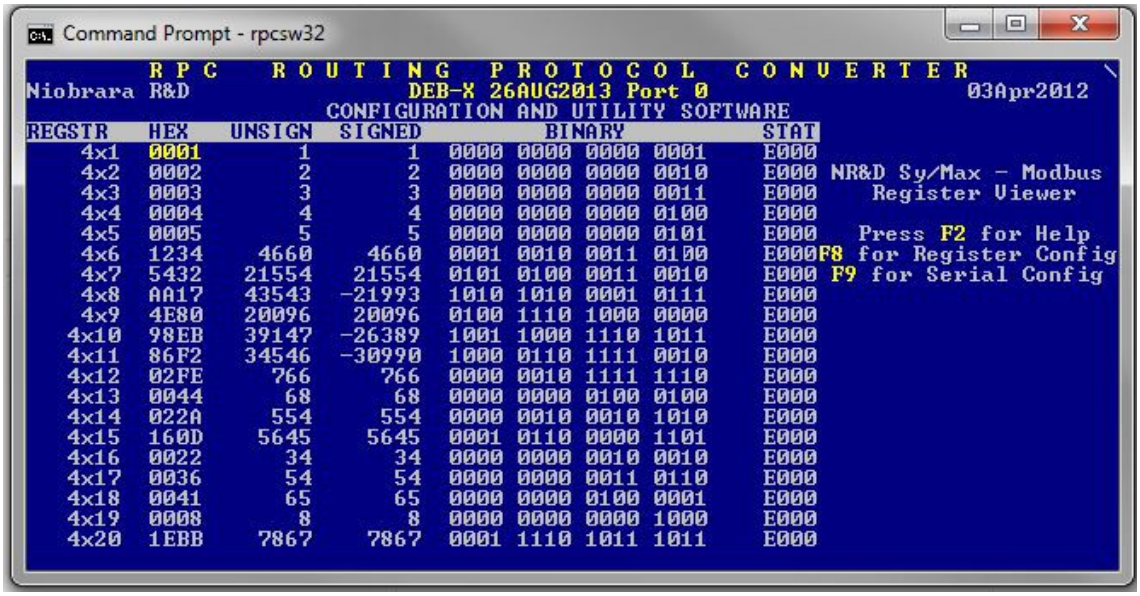


Figure 9.13 View Registers Screen

view module Revision

The view module Revision screen will show the DEB's current firmware revision.

Figure 9.14 Module Revisions Menu Screen

view Statistics

The DEB contains many pages of statistical information about the operation of its various ports. There are pages for the Ethernet port, both serial ports, and the MB+ port. Most port pages include multiple screens accessed with the Page Up and Page Down buttons. Pressing the + and – or "space bar" buttons will move between port pages. Use the "z" or "0" key s to zero the counters for a given port.

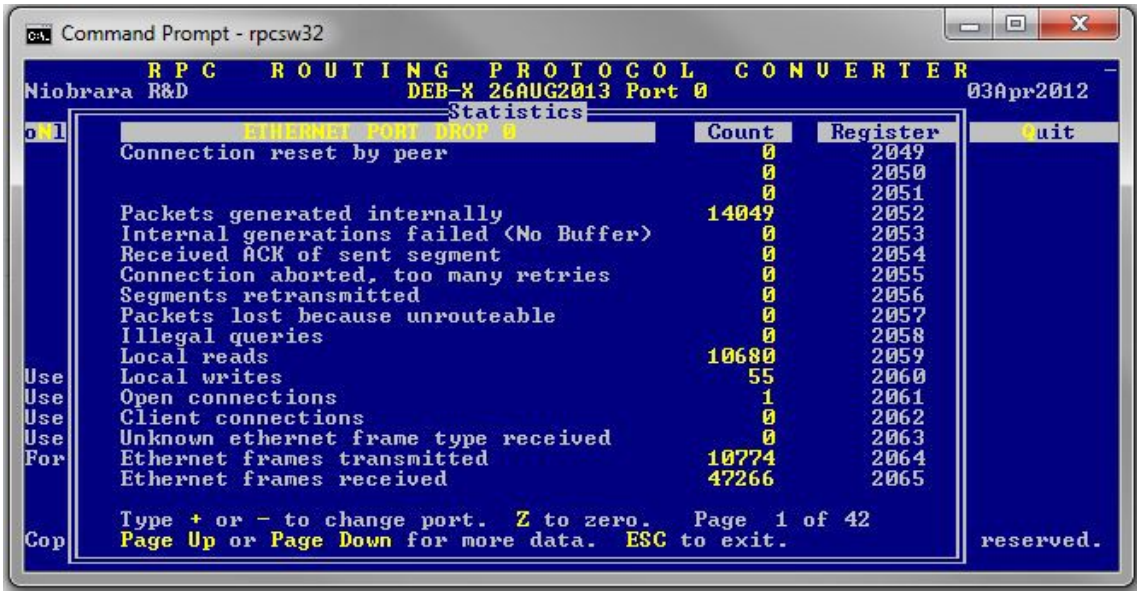


Figure 9.15 Ethernet Statistics Screen

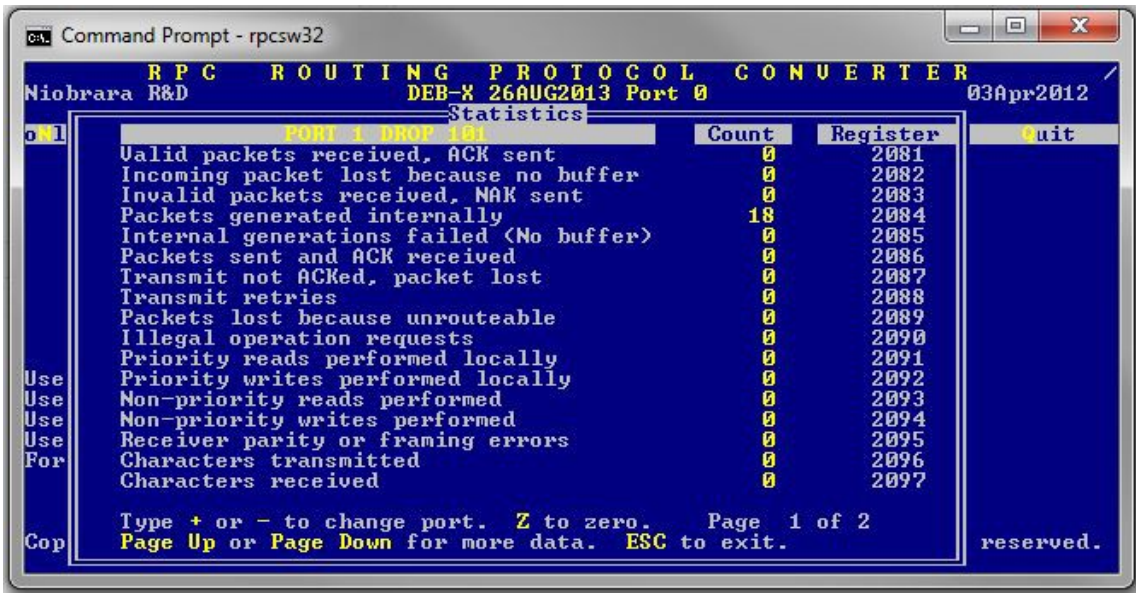


Figure 9.16 Port 1 Statistics Screen

Terminal emulator

RPCSW32 includes a simple terminal emulator that works with the PC's serial ports. Characters typed on the screen are sent directly out the serial port. Characters received on the serial port are displayed on the screen. Non-printable characters are shown as their hexadecimal values enclosed in <xx> such as <0D> for a carriage return.

The terminal emulator may be exited by pressing Ctrl+End keys at the same time.

Use the F7 key to select a text file to capture all received characters.

F5 key will toggle the screen to hex only display mode.

The Insert key will prompt the user to type in two digit hex codes separated by space characters to send.

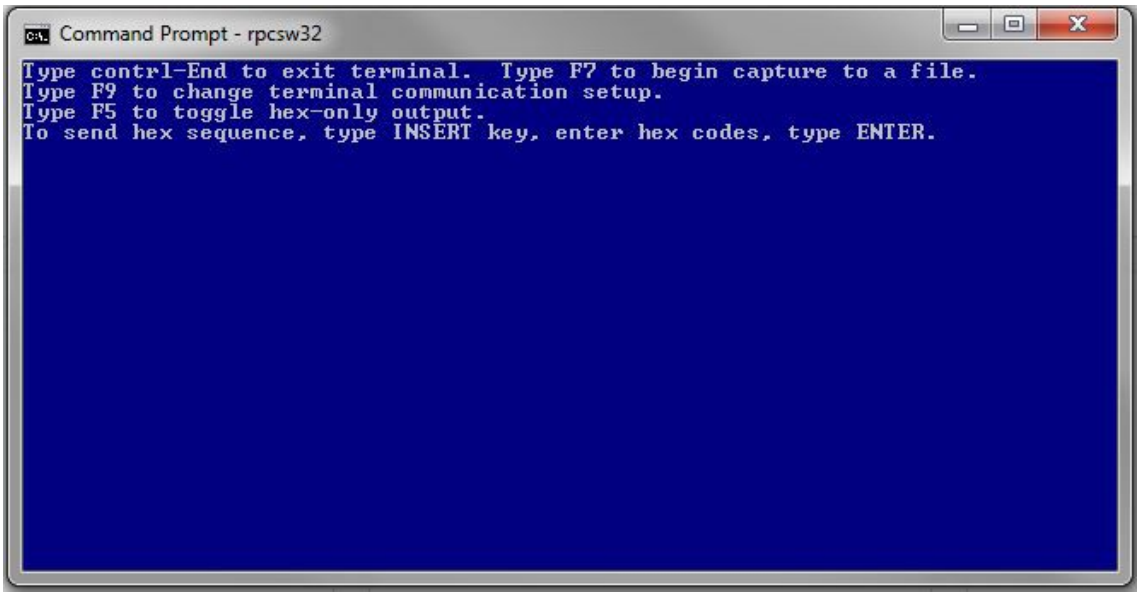


Figure 9.17 Terminal Emulator Screen

CTS monitor

This screen shows the state of the Clear To Send line of the RS-232 ports on the DEB.

NOTE: the port needs to be in RS-232 mode for this value to make sense.

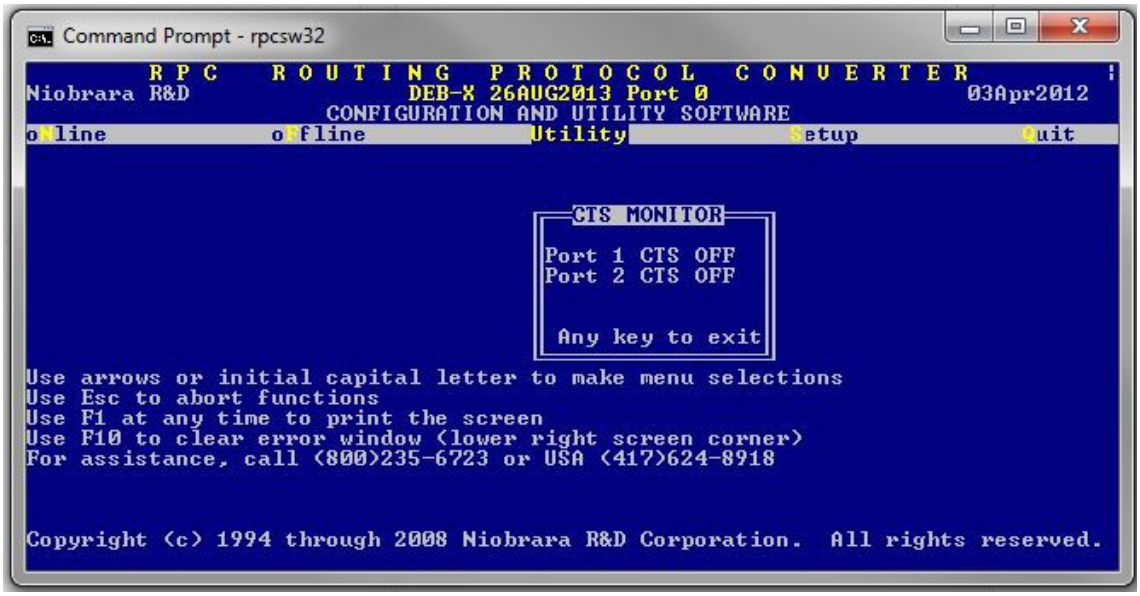


Figure 9.18 CTS Monitor Screen

Ethernet node list

This screen shows the connected SY/MAX 802.3 Ethernet drop numbers on on the local network. The possible nodes 0-99 are viewable.

NOTE: The Ethernet port must be set to MBTCP+SYMAX mode to enable the DEB to communicate with SY/MAX 802.3 devices.

Press the F2 key to generate a new global poll.

Nodes that are in the DEB are inverted. Note, this may include serial and MB+ ports set to "On Etherent = YES".

Figure 9.19 SY/MAX 802.3 Station List Screen

downLoad firmware to module

This menu item is not used with the DEB but is kept in the software for very old module support. The Web server or RPCLOAD.EXE program is used to upgrade the DEB's software (See page 32).

Write setup to EEPROM

Select this menu item to store the current settings to EEPROM.

> NOTE: This operation is required when values are changed using this software. Otherwise the new settings will be lost on a power cycle.

Setup Menu

The Setup menu allows the user to configure the PC's connection to the DEB.

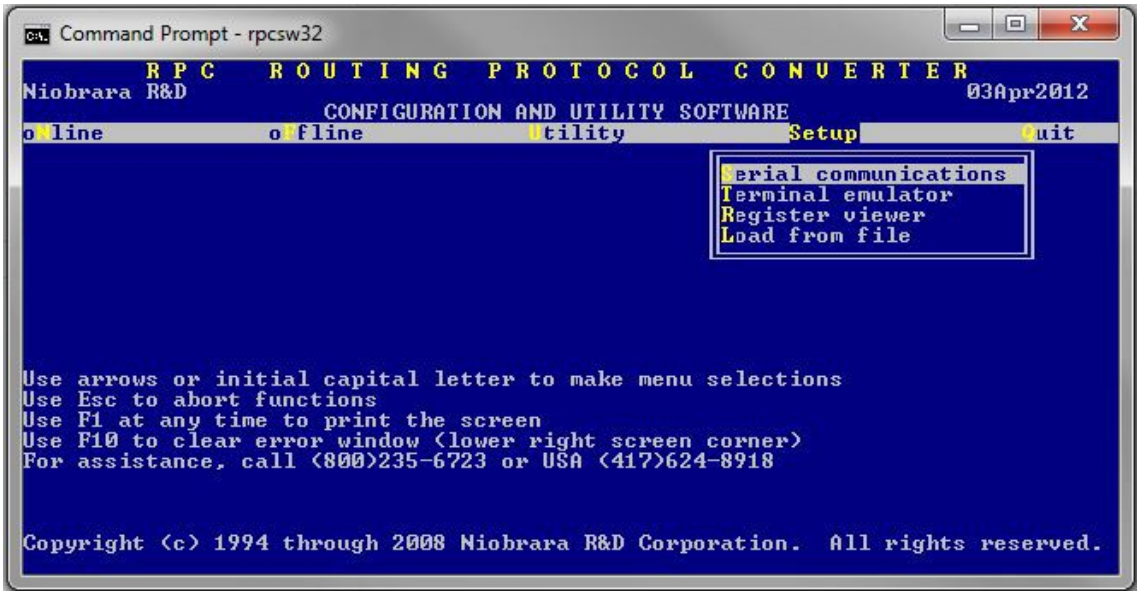


Figure 9.20 Setup Menu Screen

Serial communication

The Setup, Serial communication screen configures the Modbus or SY/MAX connection between the PC and the DEB or other target device.

The PC must have its serial port configured to match the attached port of the DEB or other network device.

The default serial port connection to an DEB would be Modbus RTU at 9600,EVEN,8,1 with a drop number of 255.

Modbus/TCP connections use the IP Address of the DEB in the “Host” field and Index 255.

A typical SY/MAX serial direct connection to an DEB port in SY/MAX mode will be at 9600,EVEN,8,1 with a route of NONE.

A typical Net-to-Net connection will be at 9600,EVEN,8,1 with a route of the drop number of the Net-to-Net port.

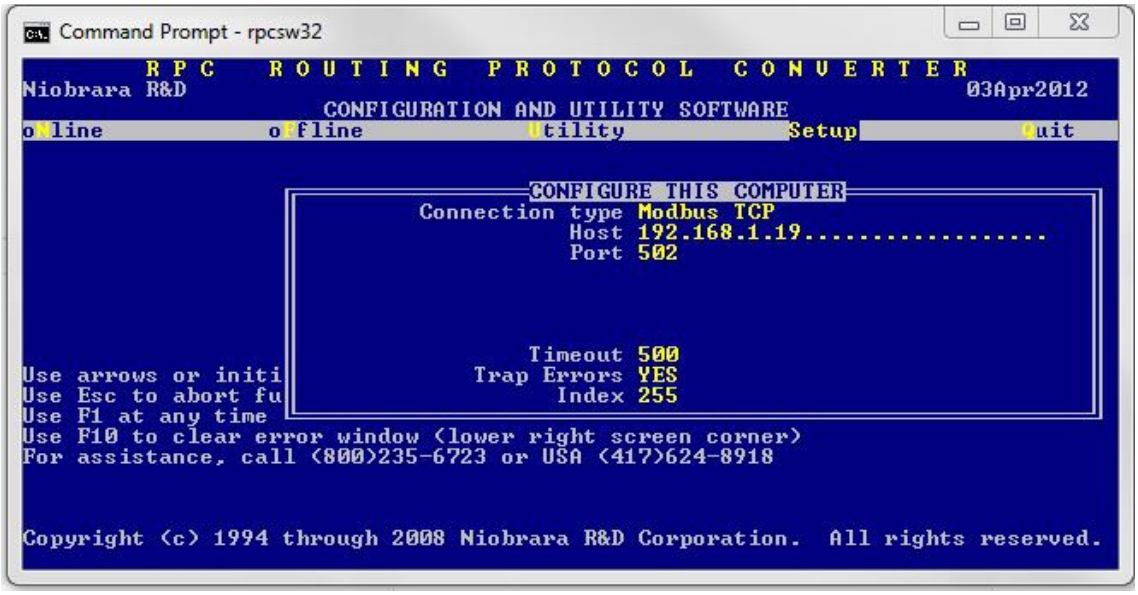


Figure 9.21 Setup Serial Screen for Modbus/TCP connection

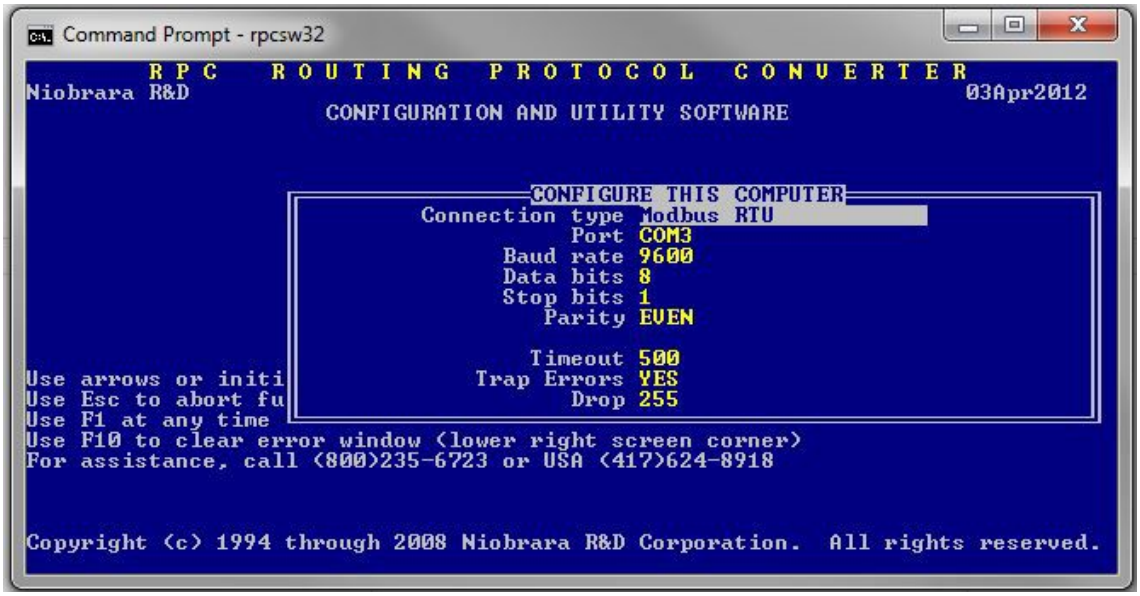


Figure 9.22 Setup Serial Screen for Modbus RTU connection

Terminal emulator

The setup screen for the terminal emulator configures the PC's serial port for use with the Utility, Terminal emulator.

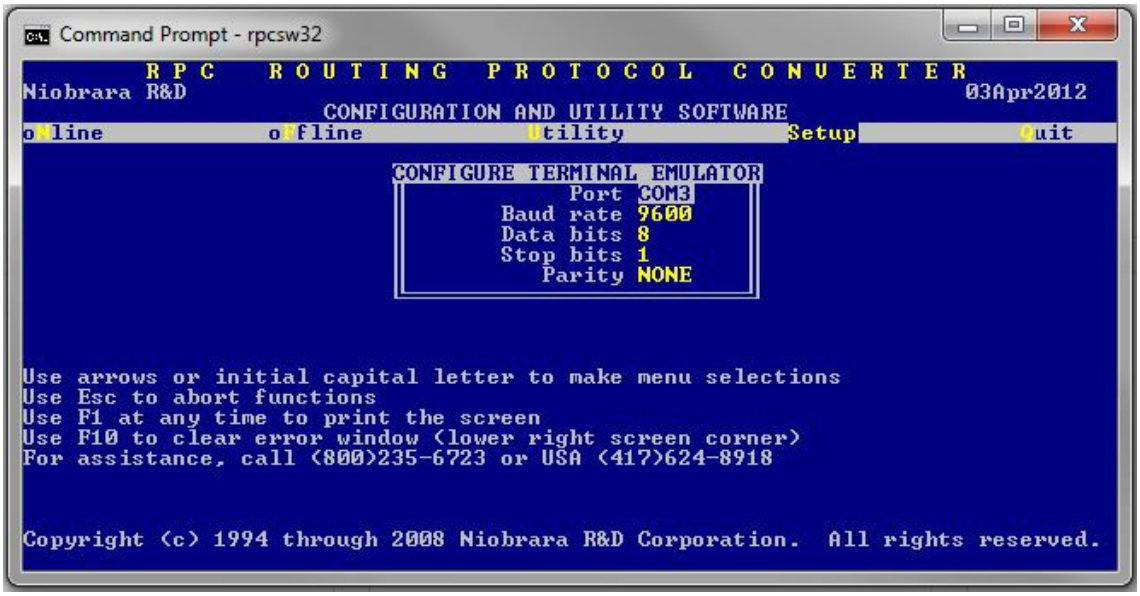


Figure 9.23 Setup Terminal emulator connection

Register viewer

The Utility Register Viewer setup screen allows the configuration of several aspects of the the viewer.

- Priority – SY/MAX mode messages may be Priority or Non-Priority
- Status Registers – Yes or No for SY/MAX PLCs
- Screen Size – Number of registers queried (default = 20)
- Starting Register – defaults to 1
- Register Set – 4x = Modbus Holding Registers, 3x = Modbus Analog Inputs
- Identify Module – Poll register 8188 and show the value at the top of the screen

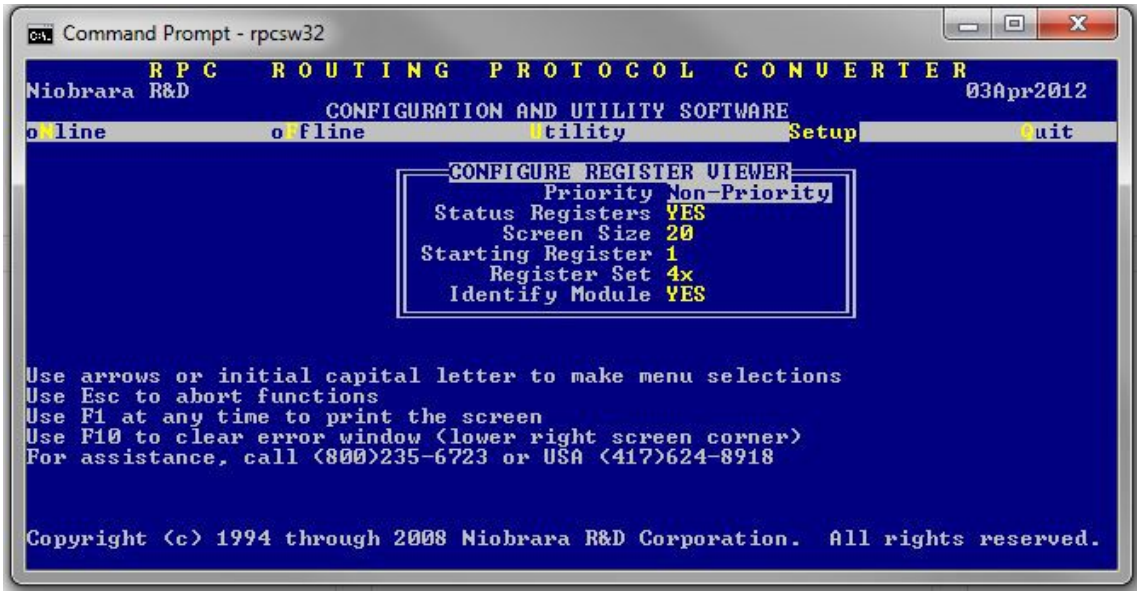


Figure 9.24 Setup Register Viewer

Quit Menu

Press Enter to exit the RPCSW32 program.

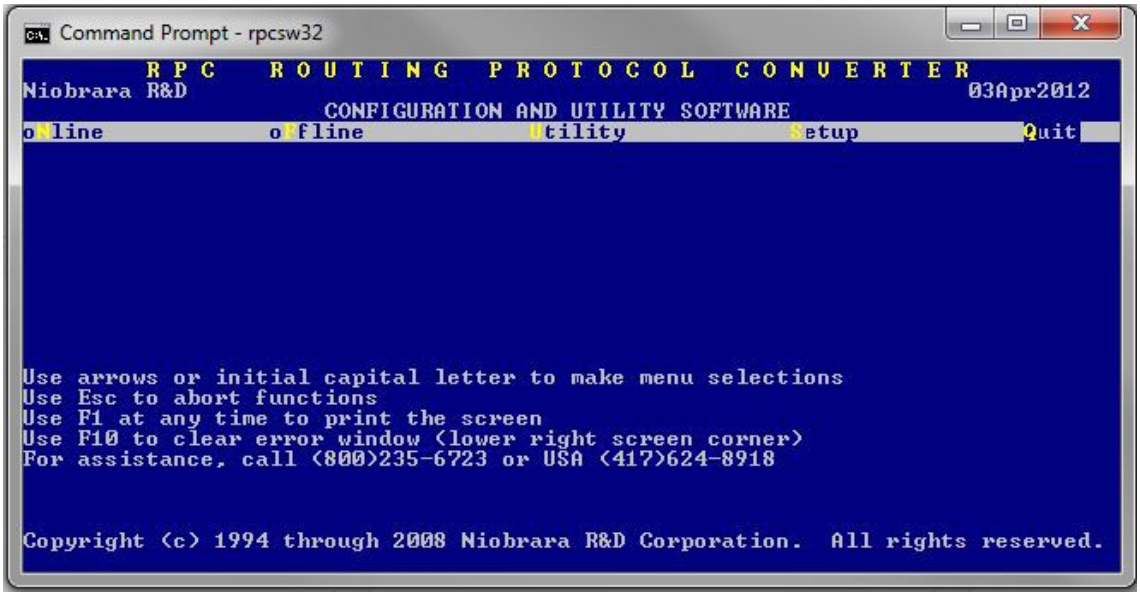


Figure 9.25 Quit Menu