MEB

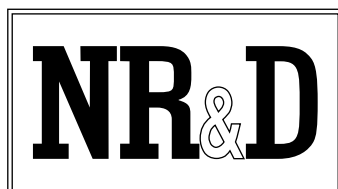## Installation and Programming Manual

This Manual describes the MEB Modbus Ethernet Bridge Module, its uses and set up. It also describes the use of the MEBSW programming software.

Effective: 24 September, 1997

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Introduction

The Niobrara MEB is a Modbus Plus and SY/MAX® Ethernet compatible communication switching and translating module mounted in and powered by the SY/MAX register rack. The Ethernet port of the MEB conforms to the SY/MAX 802.3 Communication Protocol. The Modbus Plus port of the MEB conforms to the Modicon Modbus Plus protocol. The two RS-422/485 ports retain all of the features of the popular **EPE5/SPE4** *PLUS* SY/MAX Port Expanders.

The ThinWire Ethernet Port complies with IEEE 802.3 standards and provides a high speed connection (10Mbit/sec) to host computers, Square D Model 450 and 650 processors, SFI-610 cards, EPE5s, and other MEBs. The MEB and Square D processors can coexist on existing Ethernet networks with other devices and protocols such as DECnet and TCP/IP.

The Modbus Plus port complies with the ModConnect program for the 1Mbit/sec high speed network. This Modbus Plus port is compatible with all Modbus Plus devices including 984 PLCs, Quantum PLCs, and SA-85 personal computer cards.

All operational parameters are set by internal registers within the MEB. (There are no DIP switches on the MEB.) Each parameter may be monitored and modified by standard SY/MAX or Modbus READ and WRITE messages; from the front data ports, the Modbus Plus port, or from the Ethernet port. A MS-DOS compatible program, MEBSW, is provided with the module for ease of configuration.

The MEB is available in the following standard configuration:

- (2) RS-422/485 ports, one Modbus Plus port, and one ThinWire Ethernet port, the MEB-D. The serial ports are user configurable for 4-wire RS-422, 4-wire multidrop RS-485, or 2-wire multidrop RS-485 use.

    NOTE: The MEB is also available with support for TCP/IP Ethernet protocols: the MEB-TCP-D. This version allows Ethernet communication using the SY/MAX 802.3 protocol, NRD/TCP protocol, and Modbus TCP/IP protocol. The MEB-TCP has its own manual and is not addressed in this document.

The front panel layout is displayed in Figure 1-1.

As a port expander, the MEB is capable of routing SY/MAX protocol messages between its four ports (two data ports, one Modbus Plus port, and one Ethernet port) according to SY/MAX routing conventions. Applications for this function include:

- Interconnecting multiple SY/MAX processors
- Interconnecting non-Ethernet SY/MAX devices to Ethernet
- Allowing redundant Ethernet networks for Ethernet processors

- Connecting one programming terminal to multiple processors
- Connecting multiple operator interfaces to one processor
- Connecting multiple printers or displays to a single processor port
- Using one remote service modem to multiple devices

a protocol translator, the MEB is capable of:

- Changing baud rate and word structure
- Connecting PowerLogic Circuit monitors to SY/MAX devices
- Connecting PowerLogic Circuit monitors to Ethernet
- Connecting PowerLogic Circuit monitors to MODBUS RTU or ASCII
- Connecting PowerLogic Circuit monitors to MODBUS Plus devices
- Translating SY/MAX read and write messages to the Micro-1 network
- Translating SY/MAX read and write messages to the Model 50 network
- Translating SY/MAX read and write messages to the MODBUS network (MODBUS Master)
- Translating MODBUS network messages to SY/MAX read and write messages (MODBUS Slave)
- Translating Modbus Plus network messages to SY/MAX read and write messages
- Translating SY/MAX network messages to Modbus Plus network messages
- Generating SY/MAX read and write messages from simple ASCII commands
- Routing SY/MAX packets over multidrop lines, radios, or modems
- Routing non-SY/MAX information through SY/MAX, SY/NET$^{®}$, or Modbus Plus media
- Bridge two Modbus Plus segments over Ethernet
- Bridge two Ethernet segments over Modbus Plus
- Bridge either high speed network over serial media

The MEB provides similar functionality of the Modicon BM85. The Modbus Gate and Modbus Host modes provide Modbus Silent Master and Network Slave operation from Modbus Plus as well as SY/MAX Ethernet. Support for Modbus RTU and Modbus ASCII is provided.

The MEB provides 2048 processor equivalent mailbox registers accessible through any port including the Ethernet and Modbus Plus ports.   The MEB allows bi-directional access to the register rack backplane for the first 512 registers. This function can be used to off-load communication from a processor by allowing attached devices to poll the mailbox in the MEB and letting the processor write new data as it changes. Thus allowing external devices a high speed path to the PLC without being channeled through the PLC's communication port.

The MEB also offers an E-PEER mode for the Ethernet port that allows a high speed peer to peer data exchange between MEB and EPE5 units on the Ethernet network. The E-PEER feature is functionally similar, but not compatible with, the SY/PEER network on the Square D Model 600 processor. On an independent Ethernet network with no other traffic, the E-PEER network is deterministic. The E-PEER may also be used on a normal Ethernet network with SY/NET, DECNet, NOVEL, and other traffic to provide a convenient method for sharing data between processors without processor intervention.

The MEB may be thought of as an Ethernet NIM and Modbus Plus BM85, with two serial ports. Communication packets arrive at one of its ports and go through a transformation to become a SY/MAX protocol packet. That packet is then routed to the appropriate destination according to SY/MAX conventions. The exact nature of the packet depends upon the mode of the incoming port.

SY/MAX, Net-to-Net, and Plogic mode ports expect the incoming data to already conform to the SY/MAX protocol and they simply route that data to its proper destination. Gateway mode ports expect a certain ASCII command protocol to determine the appropriate packet configuration, i.e. read, write, print. Transparent mode ports take incoming ASCII and build SY/MAX network print packets.

If the destination of a routed packet is an MEB port, that packet may be translated into another communication format. For example, MODBUS mode ports convert SY/MAX register read and write packets into MODBUS RTU format packets. The MODBUS reply is then converted back to SY/MAX and returned to the originator.

The result is that many previously incompatible protocol devices may now be easily connected in a cost effective manner. A personal computer may be connected to an MEB in Gateway mode and through simple programming be allowed to collect data from a network of Model 50 PLC, MODBUS peripher-

als, SY/MAX processors, PowerLogic Circuit monitors, other NR&D Modules such as the AIM4 or CAM500. This list is by no means complete. Of course it does not have to be a personal computer, it could be another PLC of a different make with ASCII capabilities.

The MEB's two serial ports may be configured for a variety of modes and the list below provides a brief description of each mode.

- SY/MAX - The SY/MAX mode is used to connect SY/MAX compatible devices such as PLCs, DLOGs, AIM4s, CAM500s, IBSMs, and personal computers running SY/MAX communication protocols.

- NET-TO-NET - The Net-to-Net protocol mode is used when connecting the MEB to other SY/NET networks via a serial port. This mode is used to connect to NIMs, SY/LINK cards, SPE4s, EPE5, and other MEBs.

- PERIPHERAL - The Peripheral mode is used to connect output only devices such as printers and displays to the network.

- TRANSPARENT - This mode accepts data from the attached device and encapsulates that data within a SY/MAX Network Print message and sends that data to a predetermined target.

- SHARE - The Share mode is the same as Transparent with the exception that the RTS handshake line operates in Push-to-Talk mode.

- PLOGIC - The Plogic mode is used to connect networks of PowerLogic equipment to the MEB. The Plogic mode utilizes a single-threaded SY/MAX protocol that may be sent through SY/MAX compatible modems such as the RM14K.

- IDEC - The Idec mode is used to attach networks of Micro-1, Model 50, and other Idec FA series PLCs to the MEB.

- GATEWAY - This mode provides a simple ASCII interface to SY/NET, Modbus, and Modbus Plus devices. The Gateway allows simple basic applications to read and write data to any device through the MEB.

- MULTIDROP - The Multidrop mode may be used to provide an inexpensive multidrop SY/NET using the built in two-wire RS-485 feature of the MEB, EPE5, and SPE4 modules.

- MODBUS HOST - This mode provides a translation from SY/MAX to Modbus RTU. Use the Host mode when specific control of the Modbus Opcode or Register Bias is required. The Host mode also provides Modbus Slave functionality.

- PNIM - The PNIM mode is used with PowerLogic devices that require the PNIM protocol rather than the SY/MAX (PLOGIC) protocol. This is the same protocol used by the Square D CRM-565 PNIM.

- RNIM MASTER - This mode provides the RNIM protocol master function for multidrop radio applications. Fully compatible with the Square D CRM-560, the MEB's RNIM master also includes several enhancements on timeout settings and automatic BIDding.

- RNIM SLAVE - This mode provides the RNIM protocol slave function for multidrop radio applications. This mode is fully compatible with the Square D CRM-560.

- MODBUS GATE - The Modbus Gate mode provides a reversible SY/MAX <> Modbus RTU serial translation. Modicon BM85 Silent Master and Network modes of operation are supported. Unless specific control of the translated opcode or register bias is required, this is the Modbus mode for general use.

- TRANSFER - This feature allows "TNIM like" operation over the Ethernet for redundant "Hot Backup" PLC systems.

- CHEVRON - This feature is a combination of the RNIM Master and Modbus Gate Master to allow Modbus RTU and RNIM slaves on the same multidrop (radio) network.

- MODBUS ASCII - Operates like Modbus Gate but in ASCII mode.

This manual provides a few examples of applications for each of the modes available for the ports. Further technical notes of exact applications are also available. Consult your distributor for further details.

Status Indicators (LEDs)

MEB

Power

Active

Error

Modbus Act

Modbus Er

E-net Act

E-net Er

Power (Green) - lights when power is applied to the module

Active (Yellow) - lights when the module is active.

Error (Red) - lights to indicate an error occurring on one of the serial ports.

Modbus Act (Green) - blinks to indicate Modbus Plus activity. If the token is being passed properly, this light blinks every 160ms. See Page 29.

Modbus Er (Red) - Indicates an error in routing the Modbus Plus messages.

E-net Act (Yellow) - lights to indicate Ethernet communication.

E-net Er (Red) - Indicates an error in the routing or communication problems on the Ethernet channel.

1

TX○ ○RX

2

TX○ ○RX

Communication Ports 1-2

Female (DE9S) RS-422/RS-485

Serial communication ports for connection to peripheral devices. Feature full RTS/CTS handshaking, and support all available modes. When in RS-485 mode, ports are 2- and 4-wire compatible

Communication Indicators (LEDs)

RX (Yellow) - Lights when data is received at port.

TX (Yellow) - Lights when data is transmitted from port.

Modbus Plus

Modbus Plus Port

Fully compatible with Modbus Plus protocol; Modicon supplied driver.

Ethernet

NR&D

Ethernet Port

Thin-wire Ethernet. SY/MAX 802.3 compatible

Figure 1-1   MEB Front Panel

2
Installation

This chapter is divided into seven sections:

- MEBSW configuration software installation.

- MEB module installation.

- MEB Ethernet port configuration.

- Ethernet network installation.

- Modbus Plus port configuration.

- Modbus Plus network installation.

- Module Rack Addressing by the SY/MAX PLC.

It is important to follow these procedures exactly to avoid Ethernet and Modbus Plus address conflicts which could result in stoppage of network traffic. If the MEB is connected to a live Ethernet without having a unique SY/MAX address, stoppage of communication to the other device will immediately occur.

WARNING

Connecting two SY/MAX Ethernet devices with the same SY/NET address on the same network will result in both devices halting network communication. Both units must be manually reset to clear this condition. The halting of communication may effect equipment under control of the programmable control system. Make sure that all network devices have different address. Use Table D-1 on Page 216 to keep an accurate record of network devices in use.

MEBSW Installation

1   The MEBSW software is included on a 3.5" 1.2M MS-DOS diskette along with all NR&D PLC related software. For ease of installation, use the INSTALL program on the floppy. Select the MEBSW file for installation and allow the INSTALL program to perform the decompression.

2   To manually install MEBSW, run the PKUNZIP program with the following parameters:
         A:>PKUNZIP -d MEBSW.ZIP C:\MEB*.*

This will run PKUNZIP from the floppy, create the directory MEB on the c drive, expand all files from MEBSW.ZIP into the \MEB\ directory.

3   To start the MEBSW after installation, perform the following:

> **C:**

> **CD \ MEB**

> **MEBSW**

The screen should look like Figure 2-1.


```
    M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                    13Aug97
                   CONFIGURATION AND UTILITY SOFTWARE
oNline           oFfline            Utility          Setup          Quit




Use arrows or initial capital letter to make menu selections
Use Esc to abort functions
Use F1 at any time to print the screen
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918


Copyright (c) 1994 through 1997 Niobrara R&D Corporation.  All rights reserved.
```

Figure 2-1   MEBSW Startup Screen

4   Press S for Setup. A sub-menu will appear which allows the selection of the Sy/Max connection or Terminal Emulator Connection configuration parameters. These setup parameters affect only the configuration of the personal computer, not the MEB.

5   Press S for Sy/Max. The screen should appear as in Figure 2-2.

6   Determine the type of connection from the personal computer to a RS-422 port of the MEB. For most cases this will involve a direct connection from a COM port of the computer to the MEB. If this is the case, the default settings in the SY/MAX setup will work. Make sure that the COM port selected is the one used to make the connection to the MEB.

7   When the configuration parameters are entered, press Enter until a window appears to prompt to save the setup to disk file. Press Y for yes.

The MEBSW configuration software is now installed and ready for communication to the module. For more information about the setup parameters of MEBSW see page 146.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                        13Aug97
                       CONFIGURATION AND UTILITY SOFTWARE
 oNline              oFfline              Utility            Setup        Quit

                              ┌─CONFIGURE THIS COMPUTER─┐
                       Connection type Sy/Max COM:
                                  Port COM1:
                             Baud rate 9600
                             Data bits 8
                             Stop bits 1
                                Parity EVEN
                           Error Check BCC
                                 Route NONE

Use arrows or initi
Use Esc to abort fu
Use F1 at any time to print the screen
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918



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```

Figure 2-2   MEBSW SY/MAX Configuration Screen

MEB Module Installation

WARNING

DO NOT remove or install the MEB with power applied to the rack. Turn OFF the power at the power supply. Damage to the equipment may occur if power is not removed prior to installation or removal of modules.

1   Remove power from the register rack.

2   Mount the MEB module in an available slot in the register rack. **Do not connect the Ethernet cable to the module yet.**

3   Apply power to the rack. The lights on the top panel of the module should flash to indicate that the module is active. The Active light should be green and the Busy may flash periodically. The lights beneath ports 1 and 2 illuminate only when data is passing through the port.

Ethernet Port Configuration

1   Connect the personal computer to the MEB using a RS-422 connection. The MEB should receive its initial configuration by direct connection from an MS/DOS® personal computer COM: port (See Figure 2-3). Niobrara's SC406 (or SC902) RS-232 to RS-422 converter cable can be used to make this connection. Ports 1 and 2 provide full handshaking of the RTS/CTS pins and do not provide power for the smart cable. **The external power supply for the Smart Cable must be used**. The

factory default configuration for the module is that all ports are SY/MAX, 9600 baud, 8 data bits, EVEN parity, 1 stop bit so any port may be used for configuration.
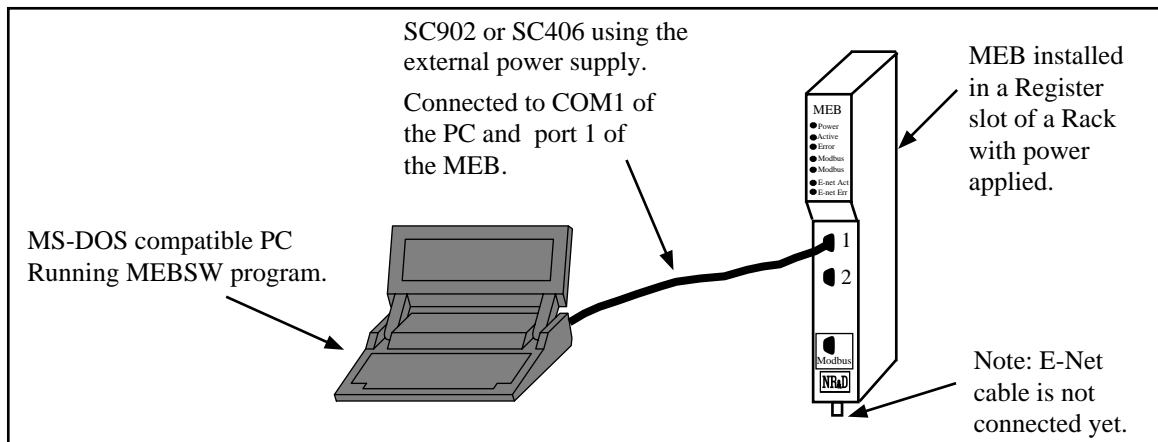
Figure 2-3   MEB Initial Configuration Setup

2   Start MEBSW on the personal computer.

3   Press N for oNline followed by E for Edit. The MEBSW will attempt to communicate to the MEB and display the parameters of the module. The yellow TX and RX lights under the MEB serial port should be flashing quickly. The yellow busy light at the top of the module should be slightly brighter. If the setup parameters are correct, the screen should appear as in Figure 2-4.

   If an error occurs in communicating with the MEB, an error window will open in the lower right corner. F10 will clear the error. Check the COM port setting, route setting, and your cabling. For a direct connection as in Figure 2-3, the default settings should work. For more information about the setup parameters of MEBSW see page 146.

4   The arrow keys are used to maneuver from cell to cell. The gray +, and - keys and space bar are used to toggle through the available values for each cell. This is an online process and each change made occurs in the module and stored in its nonvolatile memory.

5   Move the cursor to the upper left hand area to set the Ethernet Address.

6   Set the Ethernet Address to a value not used elsewhere on the network an press Enter. The MEB is now ready to be connected to the Ethernet Network.

WARNING

Connecting two SY/MAX Ethernet devices with the same SY/NET address on the same network will result in both devices halting network communication. Both units must be manually reset to clear this condition. The halting of communication may effect equipment under control of the programmable control system. Make sure that all network devices have different address. Use Table D-1 on Page 216 to keep an accurate record of network devices in use.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                      13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE    Press F2 for help.
                    ETHERNET    PORT 1      PORT 2      MODBUS+
Drop                0           2           102         1
On Ethernet         YES         NO          NO          NO
Protocol            SY/MAX 802  SY/MAX      SY/MAX
Baud Rate                       9600        9600
Parity                          EVEN        EVEN
Data Bits                       8           8
Stop Bits                       1           1
Buffer Limit        16          16          16          16

Error Check                     BCC
Route Appendix                  NONE
Route Replacement               OFF

Transfer Interval               100
Transfer Route                  NONE
Read Count                      0
Read From                       128
Read To                         0
Write Count                     0
Write To                        0
Write From                      10
```
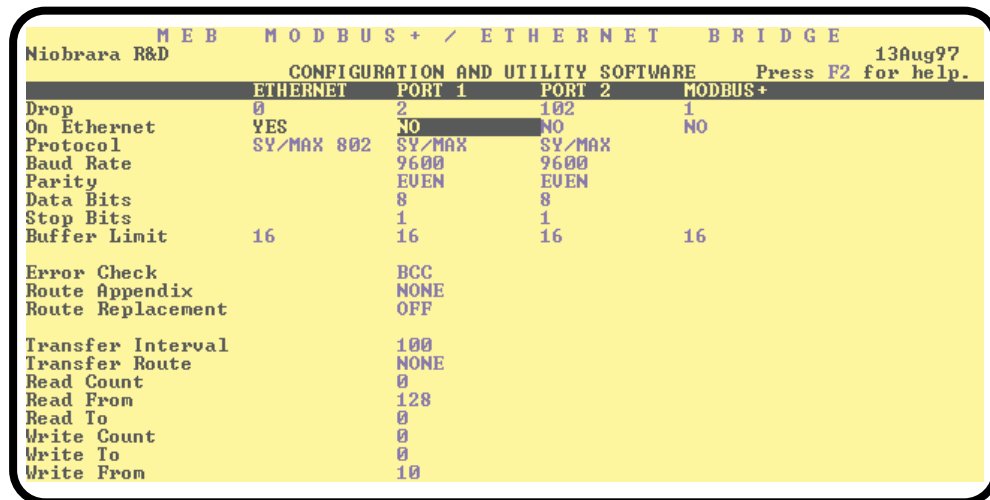
Figure 2-4   oNline Edit Screen

Ethernet Network Installation

The MEB is connected to other Ethernet devices by way of cables and connectors to form a Local Area Network. The following table provides the NR&D part number of connectors and cables for constructing the network:

Table 2-1   Ethernet Connectors and Cables

NR&D Part Number	Square D Equivalent Part Number	Description
EN1	CC601	Ethernet Cable (thin wire 6ft long)*
EN611	CCK611	Ethernet Cable End
EN612	CCK612	Ethernet Cable TEE Connector
EN613	CCK613	Ethernet Cable Terminator
EN614	CCK614	Ethernet Cable Extension (Barrel)

* The standard length for the EN1 is 6 feet. Other lengths are available from the factory. Order special lengths with the following number: EN1-x where x is the length in feet for the cable. For example, EN1-100, would represent a 100 foot long EN1 cable. For custom assembly by the customer, use two (2) EN611 Ethernet Cable Ends and an appropriate length of Belden® 9907 or 89907 or equivalent. This is a 50 ohm impedance coaxial cable for use on IEEE 802.3 10 Base 2 trunks.

The following figures illustrate the products in Table 2-1.

Ethernet Cable End (EN611)

Figure 2-5   Ethernet Cable End (EN611)

The EN611 is a female socket and provides a locking connection for the cable to a TEE or barrel connector. Two cable ends are required for each cable.

Ethernet TEE Connector (EN612)
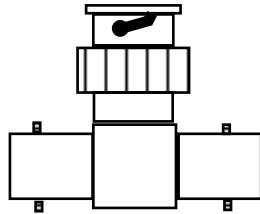
Figure 2-6   Ethernet TEE Connector (EN612)

The EN612 is a TEE connector for connecting the MEB to the network. It consists of a female and two male connectors. The female connector attaches to the male extending from the MEB. The male connectors mate with the female cable ends on a cable as well as the terminators.

Ethernet Terminator (EN613)
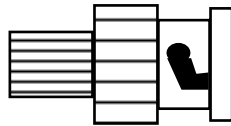
Figure 2-7   Ethernet Terminator (EN613)

The terminator is a female socket with an internal 50 ohm resistor. The terminator is used to terminate the end of a network. The terminator attaches to one of the male connectors on a TEE connector. Two terminators are required for each network; one at each end.

Ethernet Cable Extension or Barrel (EN614)
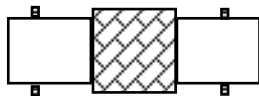
Figure 2-8   Ethernet Cable Extension or Barrel (EN614)

The Barrel connector consists of two male connectors back to back. The barrel is used to connect two network cables together to make a longer cable. The barrel may also be used to replace a TEE for future expansion or replacement of an Ethernet unit.

A small Ethernet thin wire network without repeaters will be something like Figure 2-9.
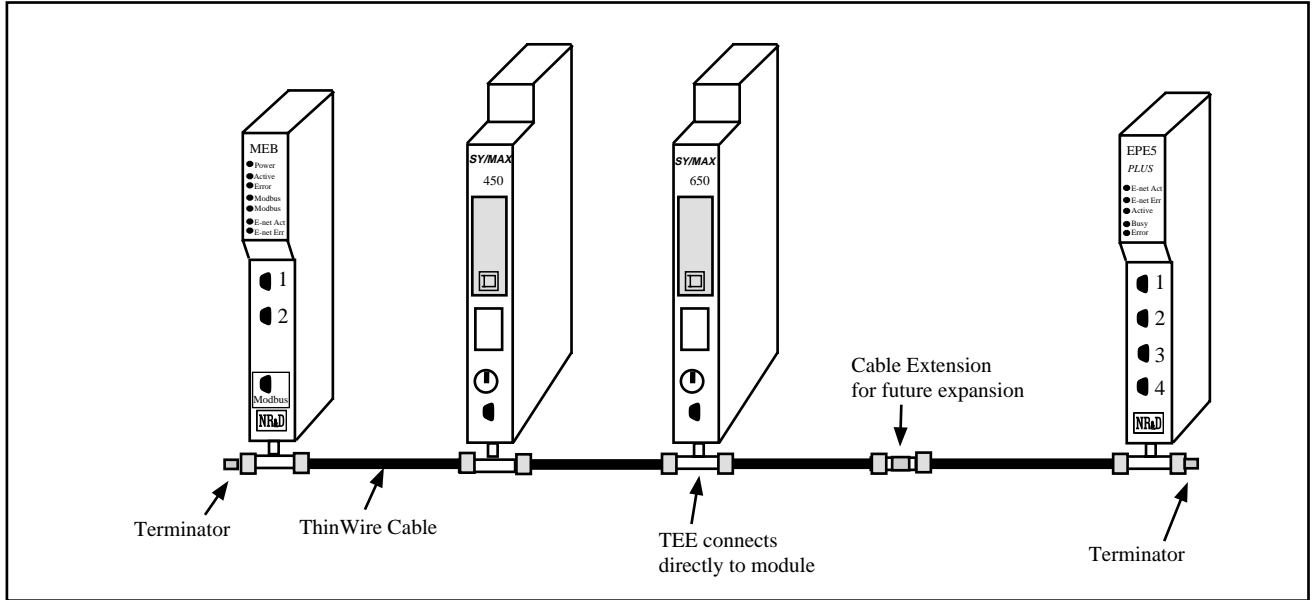
Figure 2-9   ThinWire Ethernet network

See **Appendix A Ethernet Communication Overview** on page 191 for an overview of Ethernet including discussions of repeaters, hubs, and network limitations.

Ethernet Connection

1   Connect a coaxial TEE to the connector on the bottom of the MEB. This connection must be made directly. It is not permitted to use any length of cable from the TEE to the connector on the MEB. A direct connection without the use of TEEs and Terminators are also not permitted. See Figures 2-10, 2-11 and 2-12.

OK!

Correct Attachment of the
TEE to the module connector.
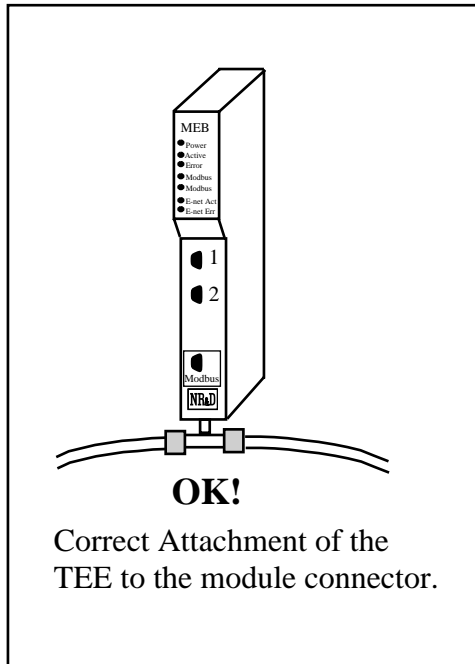
Figure 2-10 Correct TEE connection

WRONG!
TEE must be connected
Directly to module!
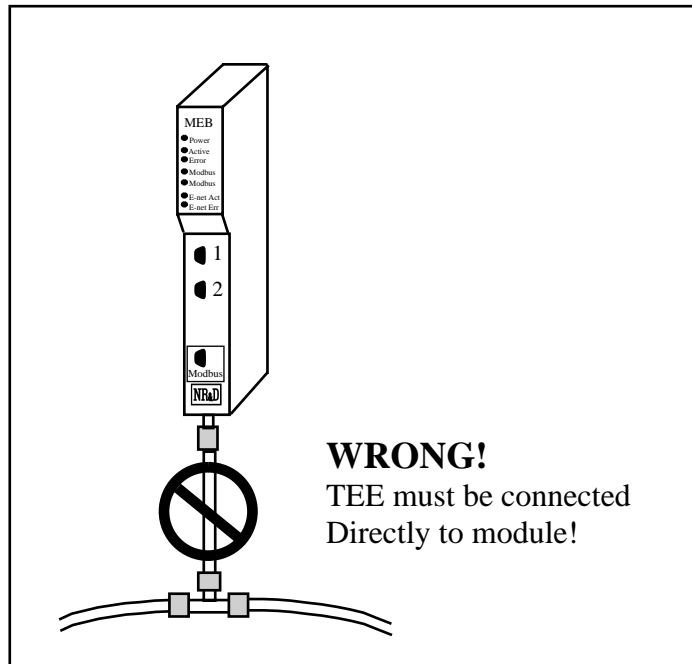
Figure 2-11 Incorrect TEE connection

2   Cycle power on the rack containing the MEB. (Turn OFF then ON the Power supply.)

3   If the MEB's Ethernet address has been well chosen (different from all other address on this network) then the E-NET Error light should not be flashing. If this light is flashing, then there is another unit on the network with this address. Using MEBSW, go oNline and change the address of the Ethernet port to one that is not on the network. The red light should quit blinking. The other device with the same network address must be manually reset also.

4   Attach one or more devices to the MEB ports. Refer to Chapters 22 and 23 for port and cable pinout diagrams. An RS-422 breakout box is useful in verifying the correct connection of input devices.

5   Use the MEBSW program to configure port parameters for the devices attached.
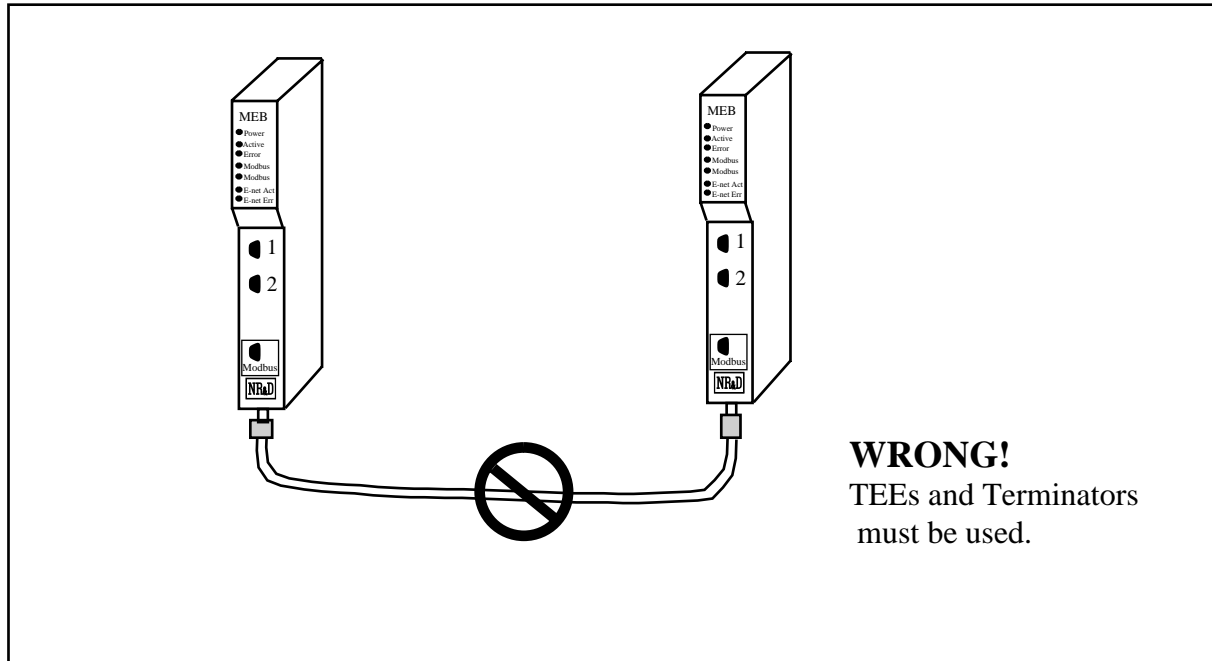
Figure 2-12 Incorrect coax connection

Modbus Plus Port Configuration

The Modbus Plus network port on the MEB usually only requires the setting of its drop number for proper operation. This drop number factory defaults to 01.

WARNING

If the MEB is connected to a MB+ network in which another unit has the same address, the Modbus Plus port will go to the DUPLICATE_OFFLINE state and wait for its address to be changed or until the other device is inactive for 5 seconds. During this time, the Modbus Act. light will flash 4 times and be off for 1.4 seconds. This type of operation may cause unpredictable operation of a control system and should be avoided. Make sure that all network devices have different address. Use Table E-1 on Page 219 to keep an accurate record of network devices in use.

Modbus Plus Network Installation

The Modbus Plus network is a 3-wire (one pair and a shield) twisted pair cable with the nodes connected in a daisy-changed configuration. There is no polarity requirement at the node's transceiver, so the data cable pair may be connected either way at a node. A 220 ohm terminator is required at each end of the network cable. There are limits upon the maximum number of nodes per segment, the number of repeaters, and the lengths of cable segments on the Modbus Plus network. For more information, refer to the **Modicon Modbus Plus Network Planning and Installation Guide (GM-MBPL-001).**

The user should configure the node address of the Modbus Plus port on the MEB before connecting the MEB to the network. This should avoid possible duplicate address problems with other units on the network.

The connection to the MB+ network is made just like with any MB+ device. The Modbus Active LED on the MEB is controlled by the MB+ microprocessor and may be used to diagnose the network.

Modbus Active LED

The green Modbus Act LED on the MEB flashes repetitive patterns to display node status.

Table 2-2   Modbus Active LED

Blinking Pattern	Description
flash every 160ms	Normal Operation. This node is successfully receiving and passing the token. All nodes should blink at this rate under when working properly.
flash every 1 sec	This node is in the MONITOR_OFFLINE state. It must remain in this state for 5 seconds and is not allowed to transmit messages onto the network. While in this state, the node is listening to all other nodes and building a table of the known nodes.
2 flashes, off 2 sec.	This node is in the MAC_IDLE state. It is hearing other nodes get the token but it is never receiving the token itself. This node may have a bad transmitter.
3 flashes, off 1.7 sec.	This node is not hearing any other nodes. and it is periodically claiming the token and finds no other nodes to pass it to. This node may be the only active node on the network or it may have a bad receiver.
4 flashes, off 1.4 sec	This node has heard a duplicate address packet. There is another node on the network with the same address as this node. This node is now in the DUPLICATE_OFFLINE state where it will passively monitor the link until it does not hear the duplicate node for 5 seconds.

Module Rack Addressing

To allow the PLC to access the mailbox registers through the backplane, the module must be rack addressed. Using Square-D programming software, allocate rack address register space to the module. You may allocate as few as 0 or as many as 512 registers depending on the needs of the application.

> **Note:** The scan time of the processor is directly related to the number of externally addressed registers. Allocating more registers than needed can have an adverse impact on the speed of the system. See the manual for the processor for more information on optimizing scan speed.

3
Configuration

Each port of the MEB is independently configured for the desired drop number, baud rate, number of data bits, parity bit, protocol mode and other parameters.

Modification of the configuration registers may be accomplished by writing to them with any device capable of generating SY/MAX write messages but is most conveniently accomplished with the MS/DOS compatible program MEBSW provided with the module at no cost. MEBSW must be used through a module data port configured as SY/MAX or Net-to-Net, or Gateway, or through the Ethernet port, or through the Modbus Plus port. The computer running MEBSW can be connected directly to the module, through the SY/NET network, through the Ethernet network, or through the Modbus Plus network.

The configuration and mailbox registers are maintained in nonvolatile memory. This memory is powered by batteries in the rack power supply in the absence of AC power and by an internal capacitor for at least a week when the module is removed from the rack.

Each port must have certain parameters configured for proper operation. These parameters include:

- **Drop Number** - The drop number is the SY/MAX address for that port. The drop number is included in the Route portion of all SY/MAX communication messages and helps to determine the particular units involved in the communication. There are three types of drop numbers:

  — **Ethernet Drop Number** - The Ethernet Drop Number must fall within the range of 00 through 99. This number must be unique from all other SY/MAX Ethernet units on the network. If two Ethernet ports have the same Ethernet Drop Number, they will stop communicating and must be manually reset. It is recommended that Table D-1 on Page 216 be used to keep an accurate record of all Ethernet Drop Numbers on the network. The factory default Ethernet Drop Number is 00.

  — **Modbus Plus Drop Number** - The Modbus Plus port must be numbered within the range of 01 to 64. The factory default value is 01.

  — **Data Port Drop Number** - The Data Port Drop Number must fall within the range of 000 through 199. This number must only be unique with a particular MEB. It is permissible to have other MEB units on the same network with similar Data Port Drop Numbers as long as their Ethernet Drop Number is different.

    The factory default Data Port Drop Numbers for Ports 1 and 2 of the MEB are 002, and 102. For most circumstances these need not be changed. When connecting to a NIM (CRM-510) in Net-to-Net mode, the Data Port Drop Number must be set to match the NDN of the NIM port.

- **On Ethernet -** The On Ethernet setting determines whether the Data Port or Modbus Port drop number also appears on the Ethernet network. When set to YES, the MEB accepts messages on the Ethernet targeted for this port as well as messages targeted to its own E-Net port. The "On Ethernet" port drop number must be unique to the Ethernet. This option is valid in SY/MAX Ethernet mode only.

- **Protocol Mode** - The Protocol setting controls the operation of the Data Port. Possible values are SY/MAX, Net-to-Net, Peripheral, Transparent, Share, PLogic, Idec, Gateway, Multidrop, Modbus Host, PNIM, RNIM Master, RNIM Slave, and Modbus Gate, Transfer, Chevron, and Modbus ASCII. The factory default value is SY/MAX mode. These modes are described in later chapters.

- **Baud Rate** - The Baud Rate setting must be made to match the peripheral device. Possible values are 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 7200, 9600, and 19200. (NOTE: If one port is set for 50 or 7200 baud, then the other port may not be set for 75, 150, 1800, or 19200 baud.) The factory default value is 9600 baud. Most SY/MAX and Modbus devices operate at 9600 baud.

- **Parity** - The Parity setting must match the attached peripheral. Possible settings are EVEN, ODD, and NONE. The factory default value is EVEN. Most SY/MAX devices operate at EVEN parity.

- **Data Bits** - The Data Bits setting must match the attached peripheral. Possible settings are 7 bits and 8 bits. The factory default value is 8 bits. All SY/MAX devices must operate with 8 data bits.

- **Stop Bits** - The Stop Bits setting must match the attached peripheral. Possible settings are 1 and 2. The factory default value is 1. Most SY/MAX devices operate with 1 stop bit.

- **Buffers** - The Buffers setting reflects the number of internal message buffers allocated to each port. The possible range is 2 to 32 buffers. The factory default value is 16. There is seldom a need to adjust the number of buffers available to a port.

- **Error Check** - The MEB allows the option of choosing the checksum type for the SY/MAX, NET-TO-NET, and MULTIDROP protocols. The PNIM protocol must be set to CRC, all other modes default to the BCC. The CRC mode allows communication with the CRM-512 multimedia NIM, and SY/MATE PLUS ver. 2.x in parity= NONE setting. The CRC checksum provides a higher level of message security when the parity bit is not being used. When communicating to most SY/MAX devices, the BCC checksum must be used.

- **Driver Mode** - Certain modes of the MEB-D allow control of the RS-485 driver and receiver operation.

  — The default parameter is point to point (**PT to PT**) where the RS-485 driver and receiver is always enabled . The PT to PT mode operates as a standard RS-422 port and may be used as a 4-wire RS-485 Master. The PT to PT mode allows full duplex operation. This driver mode is available in PERIPHERAL, SHARE, MULTIDROP, RNIM, and MODBUS port modes.

  — The **FOUR WIRE** mode allows the RS-485 transmitter to tri-state (high impedance) when the CTS line is not asserted. This mode is used when the MEB port is a slave on a 4-wire network and is available in PERIPHERAL, SHARE, MULTIDROP, RNIM, and MODBUS modes.

  — The **HALF DUPLEX** driver mode has the transmit driver enabled at all times, but disables the receiver while transmitting. This mode is useful when canceling an echo from an attached device. This mode is available in PERIPHERAL, SHARE, RNIM, and MODBUS modes.

  — The **TWO WIRE** driver mode allows the RS-485 transmitter to tri-state (high impedance state) when the CTS line is not asserted. The receiver is also disabled while transmitting for a half duplex, multidrop operation. The TWO WIRE mode is suited for a 2-wire multidrop network and is available in the PERIPHERAL, SHARE, MULTIDROP, RNIM, and MODBUS port modes.

- **Route Appendix** - The Route Appendix allows the modification of the route of a SY/MAX packet arriving at the port. The route appendix is activated by having the special drop number 205 somewhere in the incoming packet. The drop number 205 is then replaced with the target route placed in the Route Appendix field. For example: A SY/MAX mode port with a drop number of 101 has the Route Appendix set for 016, 018, 001. An external device attached to that port sends a READ

message with the route 101,205. The SY/MAX mode port replaces the 205 drop with the Route Appendix and the resulting route would be 101, 016, 018, 001. The Route Appendix is useful for devices such as the EATON PanelMate operator interface which can only handle 2 drop numbers in its route.

- **Route Replacement** - The Route Replacement is an extension of the Route Appendix feature. When the Route Replacement feature is ON, any incoming route on a SY/MAX message is ignored and the route in the Route Appendix is used instead. This feature may be used to adjust the target of operator interfaces without reprogramming the OI.
The Route Replacement/Appendix may be enhanced to include up to 128 eight-drop routes by using Options bit 2. When this Options bit is set for the SY/MAX mode port, incoming route of the form 205,X will have the route located in the Modbus Slave Address Table entry X used for the replacement. The reply will be returned to the sender with the reversed route X,205. This feature may only be used on single-threaded SY/MAX ports and is primarily intended to be used with the PanelMate operator interface.

- **Auto-Transfer** - The Auto-Transfer settings control the operation of the automatic READ, and WRITE, functions for the automatic transfer of data from the peripheral device to the Mailbox register. The Auto-transfer features include Transfer Interval, Transfer Route, Read Count, Read From, Read To, Write Count, Write To, and Write From. The Auto-transfer features are available only on SY/MAX, NET-TO-NET, PLOGIC, IDEC, MODBUS, and PNIM modes.

Accessing mailbox and configuration registers

Reading and writing the MEB module's local registers is straightforward and is equivalent to reading and writing the registers in a SY/MAX processor. One case requires some special attention. When an MEB is connected to SY/NET through a Net-to-Net connection to a NIM, the NIM will not pass packets whose terminal drop is that of the Net-to-Net port itself. To overcome this, append a dummy drop to the route to the MEB which is not the drop of any port in the module. For example, consider a SY/NET configuration with NIM modules number 0 and 1. If an MEB is connected to port 101, the drop of port 0 of the MEB must be set so that the Net-to-Net port (connected to the NIM) also has drop 101. The route from the top port of NIM 0 to the MEB's local registers could be 000,101,1. Any drop on SY/NET could also reach the MEB with a route of 201,101,1 where 201 is the don't care originating drop.

Accessing the MEB's registers over the Modbus Plus network simply involves using Path 3 of the MB+ port. The MB+ route should include the drops to reach the MEB where the next to last drop is the MEB's address and the last drop is 3. This will select the internal registers as the target for the message.

MEB mailbox registers

The first 512 mailbox registers within an MEB may be rack addressed by the PLC and used as PLC inputs or PLC outputs. By default, all mailbox registers are recognized by the PLC as outputs. Data written to these registers by the PLC appears in the associated mailbox register and may be read by an external device through a port of the MEB. A mailbox register is converted to a PLC input when an external device writes data to that register. That register will remain as a PLC input until the module is reset by cycling power. A typical application will involve assigning a group of registers as PLC outputs and a different group of registers as PLC inputs.

NOTICE

 Register 8174 also has control over the direction of data on the Rack Addressed registers and may also be used to zero input registers. See Page 176 for more information.

The register number of the mailbox register is determined as follows:

- PORT: The mailbox registers are registers 1 through 2048.

- PLC RACK: The mailbox registers are 1 through 512 plus the start address for that slot minus 1. For example if the module is located in slot 3 of the rack and that slot has registers 245-260 as-

signed to it, register 250 to the PLC will be register 6 when accessed through a front port of the MEB.

The PLC will only be able to write (or read) the first 15 registers within the mailbox area since these are the only registers assigned to the module. The other 1536 registers are still available to the front ports.

NOTICE

The scan time of the processor is directly related to the number of externally addressed registers. Allocating more registers than needed can have an adverse impact on the speed of the system. Only Rack Address those registers needed for the particular application. See the processor's manual for more information on optimizing scan speed.

For more information, see the **Mailbox Registers** section on **Page 152.**

RTS/CTS Handshaking

CTS Operation

In all modes, the CTS input of MEB ports one and two is available to restrain the MEB transmitter. If these pins are left open or driven with active polarity (CTS+ more positive than CTS-), the port will transmit any time it has a message to send. If the CTS pair is driven with inactive polarity (CTS+ less positive than CTS-), the port will hold characters and not transmit them. CTS may be used by slower peripherals such as printers or displays to restrain the MEB while the peripheral catches up. CTS restraint cannot be held indefinitely with incoming data as the MEB has finite internal buffer capacity.

In Multidrop, Peripheral, Share, Modbus, and RNIM modes, there is and adjustable delay between when CTS is raised and when the port transmits. The RNIM CTS delay is controlled by registers 8042 and 8074 for Ports 1 and 2 respectively. The other modes are controlled by the value in registers 8064 and 8096. These register values are in 10mS units.

In certain Driver Modes, CTS also controls the enabling of the RS-485 transmit driver. In the FOUR WIRE and TWO WIRE modes, the state of CTS determines whether the transmit driver is tri-stated or enabled. If these CTS pins are left open or driven with active polarity (CTS+ more positive than CTS-), the port will enable its transmit driver. If the CTS pair is driven with inactive polarity (CTS+ less positive than CTS-), the port will tri-state its transmit driver and allow the transmitter to go to a high impedance state. For these driver modes, it is recommended that the RTS of the port be connected to the CTS of the port to allow the transmit driver to only be enabled when data is to be sent. In all other modes, the transmit driver is always enabled.

RTS Operation

The operation of the RTS pair depends on the mode of the port. In SY/MAX, Net-to-Net, PowerLogic, Idec, Gateway, and Transparent mode the RTS pair is used to restrain the attached device sending to the MEB and inform it that the MEB's internal buffers are filling faster than the received messages can be processed or retransmitted. In these port modes, the RTS pair is normally active (RTS+ more positive than RTS-) unless the MEB wishes the attached device to stop sending to it in which the pair will go inactive (RTS+ less positive than RTS-) until the MEB can catch up.

In Multidrop, Peripheral, RNIM, Share, and Modbus modes, the RTS pair acts in Request to Send fashion. In these port modes, the pair remains inactive (RTS+ less positive than RTS-) until the port has information to transmit and then goes active (RTS+ more positive than RTS-) until all current data has been transmitted. An external device such as a modem or radio normally accepts the RTS pair as a "push to talk" and uses the CTS pair to tell the MEB to "go ahead" and transmit.

MNIM Compatibility

The SY/MAX, Net-to-Net, and PLOGIC modes now have the ability (REV 26DEC95 and later) to adjust the number of PAD characters to define the amount of time that the MEB port will wait for a response before sending an ENQ. The normal (default) and minimum number of PAD characters sent is

10 characters. Values less than 10 will be ignored and 10 PADs will actually be sent. Registers 8064, and 8096 set the number of PAD characters for Ports 1 and 2 respectively.

The Message Inquire Delay Time (number of PADs) should be set to a value that is slightly longer than the actual turnaround time of the transmission media. Table 3-1 displays settings that have been found to work for a few Hayes compatible modems. Use these values as a fine tuning starting point.

Table 3-1   Suggested Number of PADs for Hayes Modem Operation

Baud Rate	Number of PADs
2400	30
9600	60
14400	90

Firmware revisions 12Feb96 and later include the SY/MAX serial port channel delay statistic at registers 2072, and 2104 for Ports 1 and 2 respectively. These registers display the number of bytes sent between the checksum at the end of the SY/MAX packet and the acknowledgment. Add 10 to this value to determine the number of PADs to set to for that channel.

Pressing the "T" key on the keyboard within MEBSW while viewing the second Statistics page on a serial port will automatically update the PAD count for the monitored channel.

4

SY/MAX and Modbus Message Routing

This chapter provides an overview for SY/MAX and Modbus communication routing.

SY/MAX Routing

SY/MAX Serial Routing

The Square D SY/MAX communication protocol provides a robust full-duplex, peer-to-peer communication between PLCs, programming equipment, data collection equipment, and other peripheral devices. SY/MAX serial devices may communicate with each other directly in a point-to-point fashion. SY/MAX devices do not include network addresses and typically have RS-422 ports with a maximum baud rate of 19,200 baud.

When more than two devices are to be interconnected, external network routing hardware is required. This hardware may include Square D SY/NET Network Interface Modules (NIMs), Niobrara SPE4s, EPE5, and MEBs. Each serial port on these routing devices has a SY/NET network drop number assigned to it. These drop numbers are used to develop a path (ROUTE) between the SY/MAX device initiating the message and the target device.

In its simplest form this route is empty (NONE) when the source and target are directly connected. (Figure 4-1)
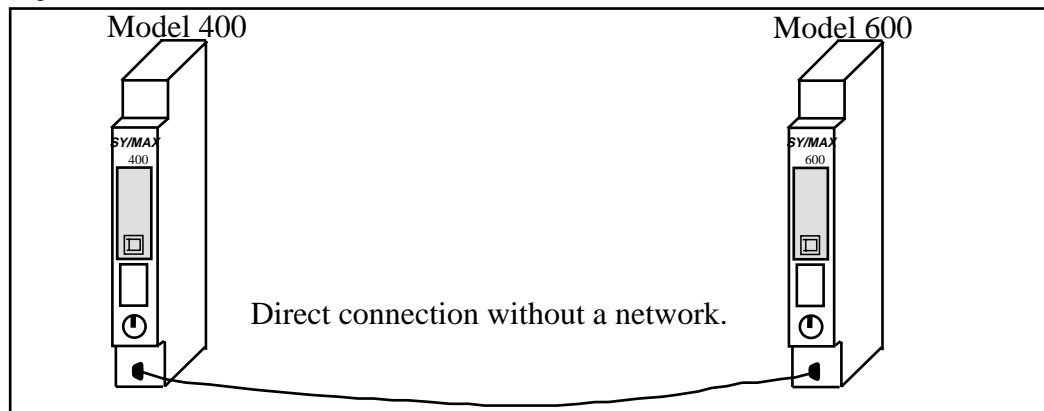
Figure 4-1   Direct connection without route

Table 4-1   Direct connection routes

Source	Target	Route
Model 400	Model 600	NONE
Model 600	Model 400	NONE

When an external network is required, the route contains at least two drops: the first drop is the source's network port, the second drop is the target's network port. In Figure 4-2 a Niobrara SPE4-1D is used as the network device with Port 0 having a network drop number of 50, Port 1 = 51, Port 2 = 52, Port 3 = 53, and Port 4 = 54.
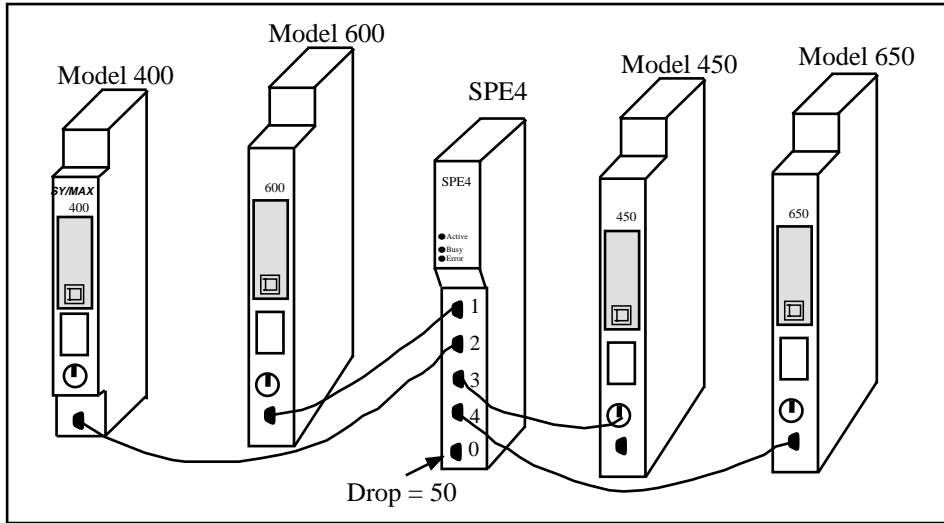
Figure 4-2   Single Network Example

Table 4-2   Single Network Connection Routes

Source	Target	Route
Model 400	Model 600	52, 51
Model 400	Model 450	52, 53
Model 400	Model 650	52, 54
Model 600	Model 400	51, 52
Model 650	Model 450	54. 53

Multiple networks may be connected together and each of these inter-network connections requires an additional drop in the route. (Figure 4-3) The SY/MAX protocol allows for up to 8 total drops in the route.
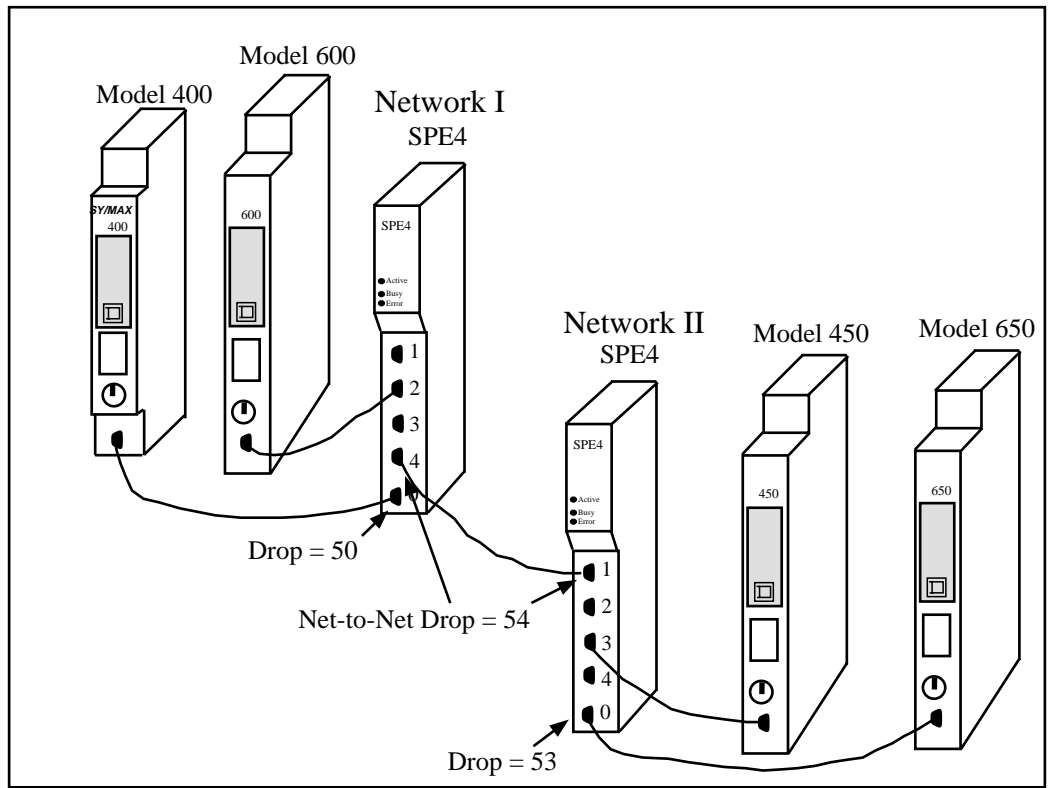
Figure 4-3   Multiple Network Example

Table 4-3   Multiple Network Connection Routes

Source	Target	Route
Model 400	Model 600	50, 52
Model 400	Model 450	50, 54, 56
Model 400	Model 650	50, 54, 53
Model 450	Model 650	56, 53
Model 450	Model 600	56, 54, 52
Model 650	Model 400	53, 54, 50

Connections between multiple networks may include SY/MAX networks, Ethernet networks, or translations between SY/MAX and other network protocols such as Modbus, Modbus Plus, PowerLogic, RNIM, or IDEC.

SY/MAX Ethernet Routing

The SY/MAX 802.3 Ethernet protocol developed as an extension of the SY/MAX serial protocol for high-speed networking (10Mb/sec). Square D PLCs such as the Model 450 and Model 650 processors include an Ethernet port (and virtual NIM) directly within the CPU module. With the network hardware embedded within the processor, the Ethernet port on the PLC has its own drop number. NOTE: This is different than the RS-422 serial ports on Square D PLC which have no built in networking address.

In the simple SY/MAX Ethernet case, devices may communicate by sending messages out their E-Net ports with a two drop route: the first drop is the source's E-Net port and the second drop is the target E-Net Port. (Figure 4-4)
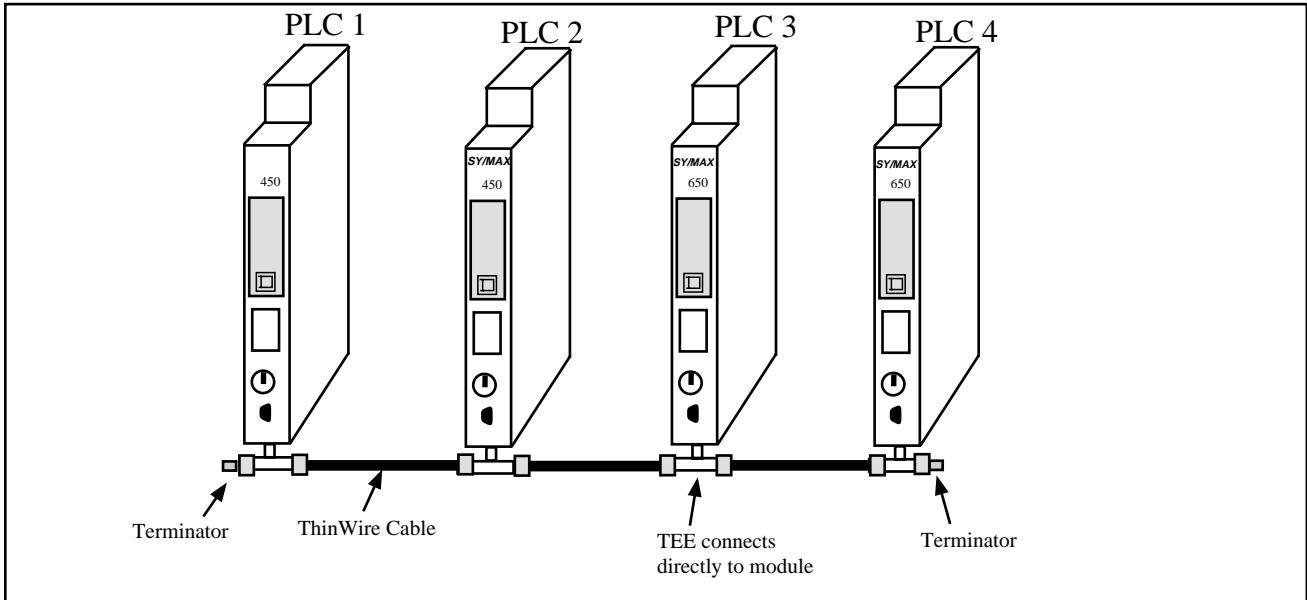
Figure 4-4   Simple Ethernet Network

Table 4-4   Simple Ethernet Network Routes

Source	Target	Route
PLC 1	PLC 2	1, 2
PLC 1	PLC 3	1, 3
PLC 1	PLC 4	1, 4
PLC 2	PLC 4	2, 4
PLC 4	PLC 3	4, 3
PLC 4	PLC 2	4, 2

It is sometimes necessary to connect other SY/MAX serial devices to the Ethernet network so NR&D has developed Ethernet routing modules such as the EPE5 and the MEB. These router devices treat the

Ethernet as one network and the other serial (and Modbus Plus) ports as other networks. Therefore additional drop numbers are required within the route to negotiate through the router.
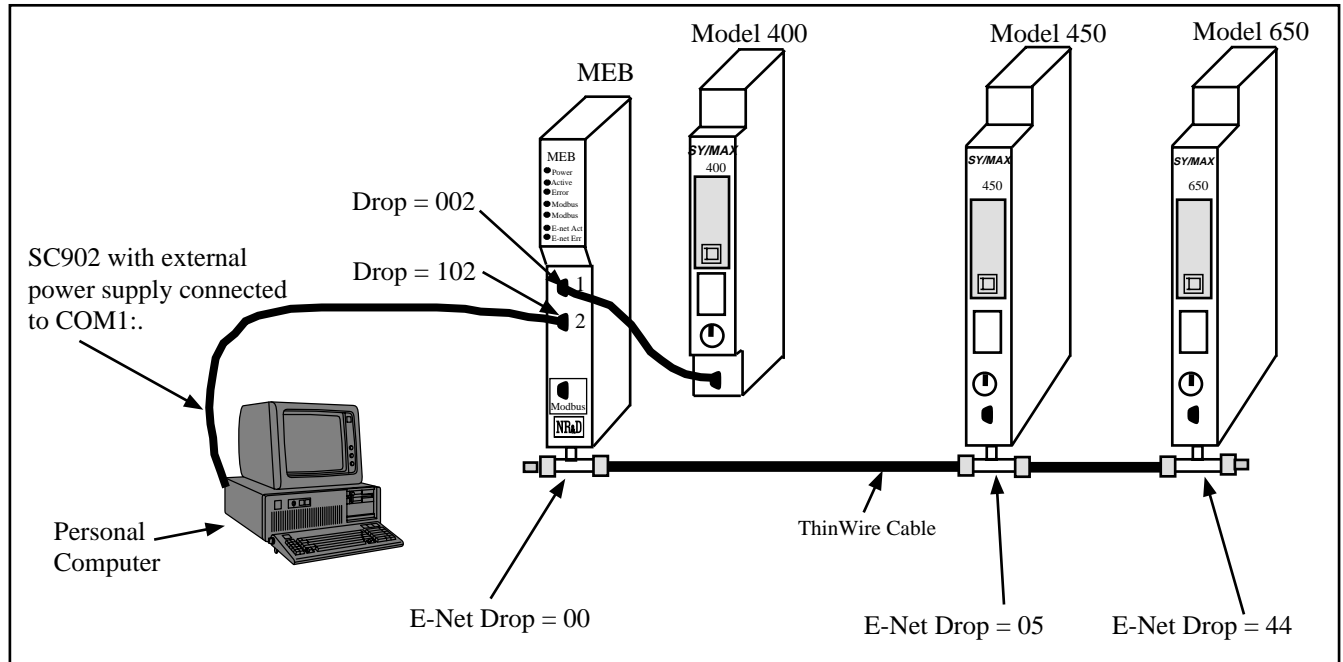
Figure 4-5   Ethernet Router Example

Table 4-5   MEB Routes

Source	Target	Route
Personal Computer	Model 400	102, 2
Personal Computer	MEB	NONE
Personal Computer	Model 450	102, 0, 5
Model 400	Model 650	2, 0, 44
Model 650	Model 450	44, 5

Certain modes of the ports on the Ethernet routers require additional drops in the route. Up to 8 total drop numbers are permitted in the route of a SY/MAX message.

Modbus Routing

Modbus Serial Routing

The Modbus serial protocol provides a master-slave method for programming and data transfer between programmable controllers and peripheral devices. Only the master can initiate the communication. The slaves are only capable of responding to messages sent from the master. Only one master is allowed on a network at one time. Each slave device is configured for a unique address. Each message sent by the master includes the address of the target slave. This technique allows multiple slaves to be placed on the same network.

The Modbus serial protocol has two transmission modes: ASCII and RTU. The ASCII protocol uses a 7-bit data structure and is intended for use with modems. The RTU protocol is the standard 8-bit binary message structure and offers a higher character density and better throughput than the ASCII version.

The two protocols are not compatible on the same network at the same time. Modbus ports tend to be RS-232 or sometimes RS-485 and usually have a maximum baud rate of 19,200 baud.
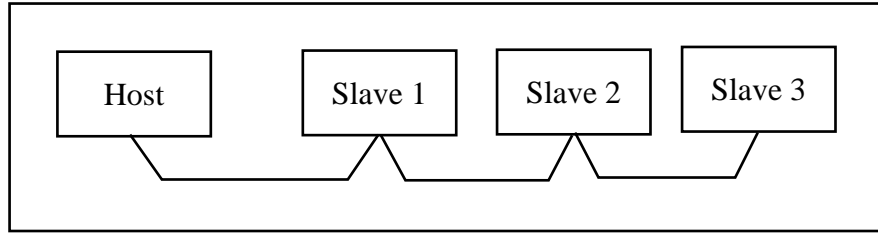
Figure 4-6   Modbus Network Example

Table 4-6   Modbus routes

Source	Target	Route
Host	Slave 1	1
Host	Slave 2	2
Slave 1	Slave 3	Not Directly Possible

Since the Modbus network operates as a master-slave system, it is not possible for slaves to directly communicate with each other. All information transfers must be managed by the host. For instance, if data from Slave 1 must be transferred to Slave 3, then the Host must read the data from Slave 1 and then write that data to Slave 3.

Modbus Plus Routing

The Modbus Plus system evolved from the Modbus serial protocol as a high-speed (1Mb/sec) peer-to-peer local area network. Modbus Plus allows any device on the network to initiate communication with other nodes on the network. The nature of the master-slave aspect of the embedded Modbus message requires the Modbus Plus device to hold multiple internal paths to allow concurrent processing of master and slave transactions.

This master-slave mentality follows in the routing of messages on the Modbus Plus network. As in the Modbus serial protocol, the route simply includes the path to the target. This route may be up to five layers deep. In the simple case of two PLCs on the same network, the route only includes one drop; that of the target. All other drops are zero.
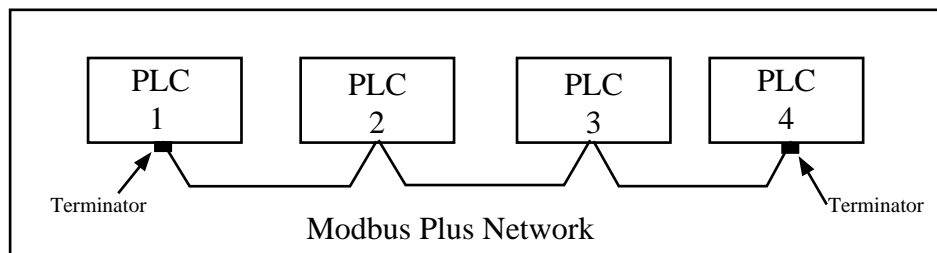
Figure 4-7   Simple Modbus Plus Network

Table 4-7   Simple Modbus Plus Network Routes

Source	Target	Route
PLC 1	PLC 2	2.0.0.0.0
PLC 1	PLC 3	3.0.0.0.0
PLC 1	PLC 4	4.0.0.0.0
PLC 2	PLC 4	2.0.0.0.0
PLC 4	PLC 3	3.0.0.0.0
PLC 4	PLC 2	2.0.0.0.0

Modbus Plus allows for up to 64 nodes on a single network. Additional networks may be joined through the use of Modicon Bridge Plus devices. The Bride Plus devices includes two MB+ network connections and has a drop numbers on each of the networks. To route through these nodes, the down-stream target is the only drop added to the five drop route.
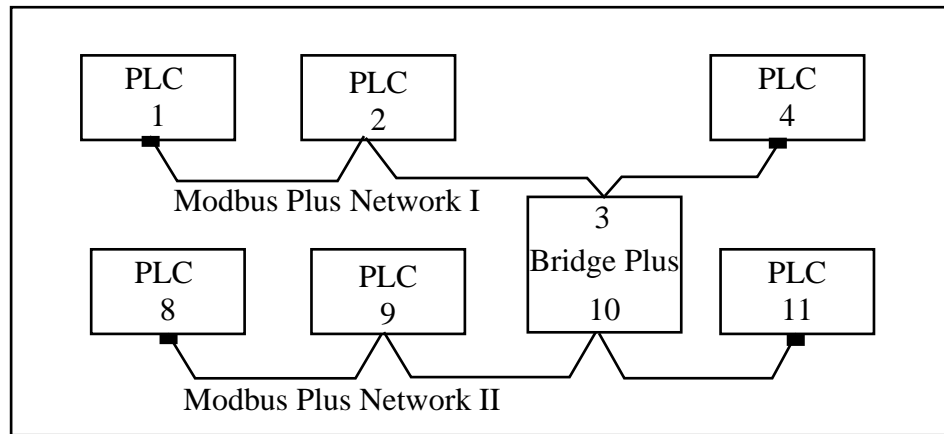
Figure 4-8   Bridged Modbus Plus Networks

Table 4-8   Modbus Plus Bridge Plus Network Routes

Source	Target	Route
PLC 1	PLC 2	2.0.0.0.0
PLC 1	PLC 4	4.0.0.0.0
PLC 1	PLC 9	3.9.0.0.0
PLC 2	PLC 11	3.11.0.0.0
PLC 8	PLC 1	12.1.0.0.0
PLC 9	PLC 8	8.0.0.0.0

Modbus Plus Translators

When it is necessary to add Modbus serial devices to a Modbus Plus network, the Modicon Bridge Mux (BM85) or the NR&D MEB is used. Both units allow Modbus Plus devices to communicate to serial Modbus devices and vice versa. The MEB also allows the translation of Modbus Plus to SY/MAX and conversely SY/MAX to Modbus Plus. Thus the MEB will allow all SY/MAX devices to communicate with all Modbus devices.

The Modbus mode ports on the BM85 offer the following operating modes: Master (the port acts as a slave and responds to all incoming messages), Silent Master (the port acts as a slave and only responds to messages with address corresponding to entries in its look-up table), Slave (the port acts as a master to a single slave), and Network (the port acts as master to multiple slaves).

The Modbus mode ports on the MEB offer the following operating modes: MODBUS HOST, and MODBUS GATE. The Modbus Host acts as a master to a network of slaves. (This is similar to the Network port on a BM85.) The Modbus Gate will act as a Silent Master or Network Slave, depending on the source of the message. As a master, the port translates SY/MAX messages to Modbus messages with the target being a slave connected to the port. (Similar to the Network port on a BM85). As a slave, the port translates Modbus messages to SY/MAX messages based upon entries in a look-up table of Modbus address (like a Silent Master port on the BM85).

The routing of messages from the SY/MAX side of the MEB out through the Modbus Plus port of the MEB, is just like using the E-Net port. The route will include the starting drop on the SY/NET, any Net-to-Net drops or E-Net drops to reach the MEB, the drop number of the MB+ port on the MEB, and any other drops required on the MB+ network to reach the desired target.

The routing of messages from the MB+ side of the MEB is somewhat different than what might be expected due to a limitation imposed by the ModConnect program. In order to meet the requirements of the ModConnect program, Niobrara must implement its Modbus Plus port using an approved design and software from Modicon. A limitation of this software requires the source of a Modbus Plus message to designate which of the eight paths that the Modbus Plus port uses for the incoming message. This designation is placed as the next drop in the route following the drop number of the MB+ port of the MEB. These paths are numbered 1 through 8. Since it would not be feasible to require the other ports on the MEB to be limited to drop numbers within this range, the following standard has been settled upon:

- Path 1 will route messages out serial port 1 of the MEB.

- Path 2 will route messages out serial port 2 of the MEB.

- Path 3 will route messages to the MEB itself. This path is used to gain access to the configuration, statistics, and mailbox registers within the MEB.

- Paths 4, 5, 6, 7, and 8 will route messages out the Ethernet port on the MEB.

This arrangement has been chosen to allow the greatest potential throughput for the MB+ to E-Net connection. The multiple paths to the Ethernet allow up to 5 simultaneous transactions to occur. The user is advised to split the incoming MB+ traffic across multiple paths to insure the highest throughput.

The method of assigning paths to specific ports is the same technique used by the BM85.

In Figure 4-9 a Modicon 984 PLC, a Quantum PLC, a BM85, and an MEB are on the same Modbus Plus network. The BM85 has Port 1 in Master mode with Master A attached and Port 2 in Network with Slaves 50 and 51 attached. The MEB has Port 1 (SY/MAX drop 101) in Modbus mode with Master B attached, Port 2 is in SY/MAX mode (SY/MAX drop 102) with a Model 400 PLC attached, and the E-Net port is connected to a Model 650.
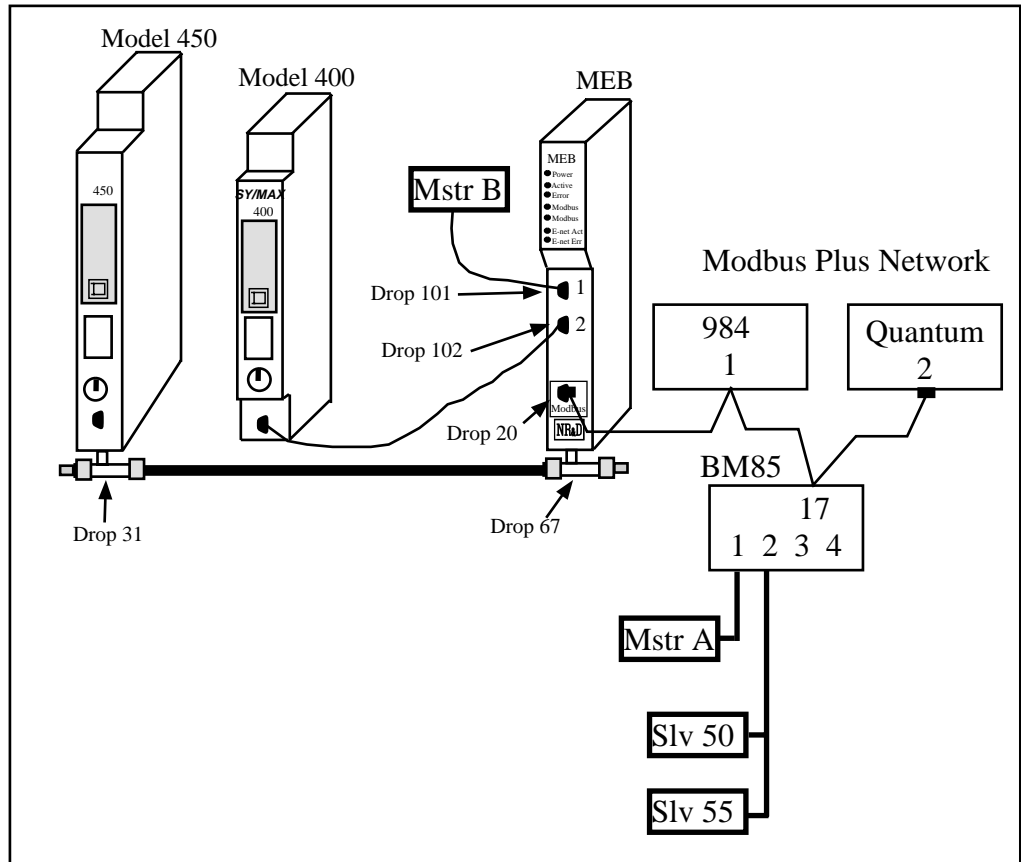
Figure 4-9   MEB Routing Example

Master B is using mapped routes stored in the look-up table for Port 1 of the MEB. Master A is using mapped routes stored in the BM85's look-up table for its Port 1.

Table 4-9   Modbus Plus Bridge Plus Network Routes

Source	Destination	Route
984	Quantum	2.0.0.0.0
984	Slave 50	17.2.50.0.0
984	Model 400	20.2.0.0.0
984	Model 650	20.4.31.0.0
Quantum	984	1.0.0.0.0
Quantum	Slave 55	17.2.55.0.0
Quantum	Model 400	20.2.0.0.0
Quantum	Model 650	20.5.31.0.0
Master A	984	1.0.0.0.0
Master A	Quantum	2.0.0.0.0
Master A	Slave 50	0.2.50.0.0
Master A	Model 650	20.6.31.0.0
Master B	984	101, 20 1
Master B	Slave 55	101, 20, 17, 2, 55
Master B	Model 400	101, 102
Master B	Model 650	101, 67, 31
Model 650	Quantum	31, 67, 20, 2

5
SY/MAX MODE

Mode 1: SY/MAX

Either of the MEB's two data ports can be set to SY/MAX mode for connection to a PLC, programming terminal, personal computer, operator interface, or other SY/MAX compatible device. Messages received on one MEB SY/MAX port are processed according to the route in the message. If the message is routed to another SY/MAX or Net-to-Net port within the same module, the packet will be retransmitted from that port. If the message has no route or is addressed to a null drop (204) or other drop not within the same MEB module, it is processed by the MEB itself and, if it is a read or write message, can access internal mailbox or configuration registers.

SY/MAX Routing Example

Figure 5-1, is an example of connecting three SY/MAX rack PLCs, a Modicon Quantum and a Personal computer together so that they may exchange data and be programmed by a single personal computer by means of the proper routing of communication packets.
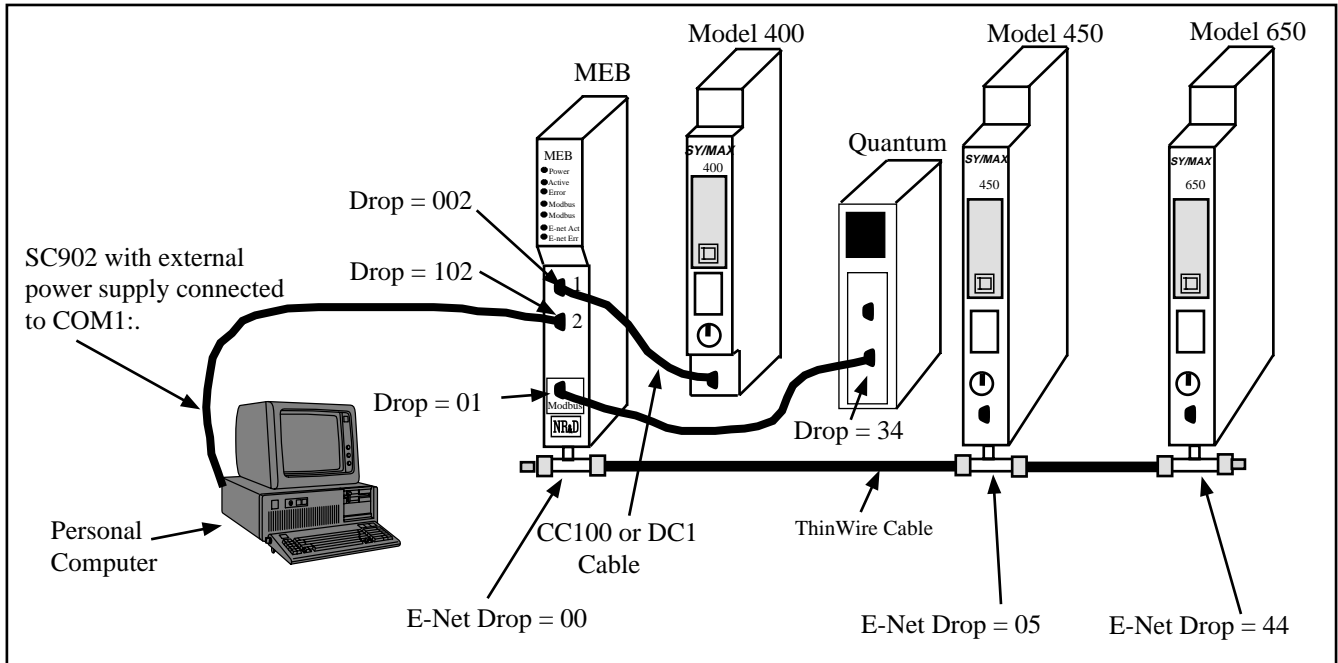
Figure 5-1   SY/MAX Mode Example

The Personal computer is connected to Port 2 of the MEB using a SC902 cable to its COM1: port. (The external power supply for the SC902 must be used.) The MEB has the factory default setup shown in Table 5-1 below:

Table 5-1   SY/MAX Mode MEB Setup Example

Port	Drop Number	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	00	SY/MAX	NA	NA	NA	NA	NA
1	002	SY/MAX	9600	E	8	1	BCC
2	102	SY/MAX	9600	E	8	1	BCC
MB+	01	MB+	NA	NA	NA	NA	NA

The Model 400 is connected to Port 1 of the MEB with a DC1 (CC100) type cable. The Model 450 is connected to an Ethernet cable to the MEB and Model 650. The Model 450 has an E-Net address of 05. The Model 650 has an E-Net address of 44. The Quantum PLC has a Modbus Plus address of 34 and is connected to the MEB via a Modbus Plus network.

The personal computer may be used to program each of the SY/MAX processors and MEB, as well as the monitor registers in the Quantum. Table 5-2 gives the route required for the personal computer to reach each of the devices.

Table 5-2   SY/MAX Mode Personal Computer Route Examples

Origin	Target	Route
Personal Computer	Model 400	102, 002
Personal Computer	Model 450	102, 000, 005
Personal Computer	Model 650	102, 000, 044
Personal Computer	MEB	NONE
Personal Computer	Quantum	102, 001, 034

Each of the PLCs may also use the MEB to share information between themselves, by use of the SY/MAX Network WRITE and READ ladder rungs and the Modbus MSTR block in the Quantum. Table 5-3 shows the routes required for a few of these combinations.

Table 5-3   SY/MAX Mode PLC Route Examples

Origin	Target	Route
Model 400	Quantum	002, 001, 034
Model 400	Model 450	002, 000, 005
Model 400	Model 650	002, 000, 044
Model 400	MEB	NONE
Model 450	Model 400	005, 000, 002
Model 450	Quantum	005, 000, 001, 034
Model 450	Model 650	005, 044
Model 450	MEB	005, 000
Model 650	Model 400	044, 000, 002
Model 650	Quantum	044, 000, 001, 034
Model 650	Model 450	044, 005
Model 650	MEB	044, 000
Quantum	Model 400	01.01.00.00.00
Quantum	Model 450	01.04.05.00.00
Quantum	Model 650	01.05.44.00.00
Quantum	MEB	01.03.00.00.00

Notice that the route from one SY/MAX processor, for instance the Model 400, to another SY/MAX processor, say the Model 650, is the reverse of the route from the 650 to the 400. This reversibility is not possible with the Modbus Plus connection as the drop following the MEB's MB+ port must be the path number and fall within the range of 1-8.

It should be noticed that the path numbers from the Quantum to the Model 450 and 650 processors were chosen to be different numbers. These paths must fall within the values 4, 5, 6, 7, or 8 and the paths were chosen to allow for the possibility of having both messages triggered at the same time.

As mentioned before, several SY/MAX routes are available to access the registers in the MEB. The routes listed above are all valid but are not all of the possibilities. If the serial SY/MAX message arriving at the MEB port has no route, the last drop in the route is the drop of that port, the last drop in the route is 204 with the next to last drop being the port, or a drop that is not assigned to the module is encountered, then the message will act on the registers in the module. Table 5-4 below illustrates a few examples of equivalent routes to the MEB.

Notice, only one route from the Modbus Plus network is valid for the Quantum to access the MEB's internal registers. On any route from the Modbus Plus network, the last drop in the route must be 3 to select the path to the internal registers.

Table 5-4   MEB Equivalent routes for accessing internal registers

Origin	Target	Route	Route	Route	Route
Personal Computer	MEB	NONE	102, 204	102, 155	121
Model 400	MEB	NONE	003, 204	003, 099	055, 043
Model 450	MEB	005, 000	005, 000, 204	005, 000, 006	005, 000, 015, 145
Model 650	MEB	044, 000	044, 000, 204	044, 000, 112	044, 000, 044
Quantum	MEB	01.03.00.00.00			

All communication may occur simultaneously and the available possible paths are not limited to the lists above.

NET-TO-NET MODE

Mode 2: Net-to-Net

If a data port of the MEB is connected to a NIM (CRM-510), the RS-422 port of a SY/LINK board, or to another MEB, EPE5 or SPE4 port, both ports must be configured in Net-to-Net mode and both ports must have the same drop number. By using the Net-to-Net mode the MEB may be used as a bridge between SY/NET and Ethernet and Modbus Plus.

NIM Net-to-Net Example
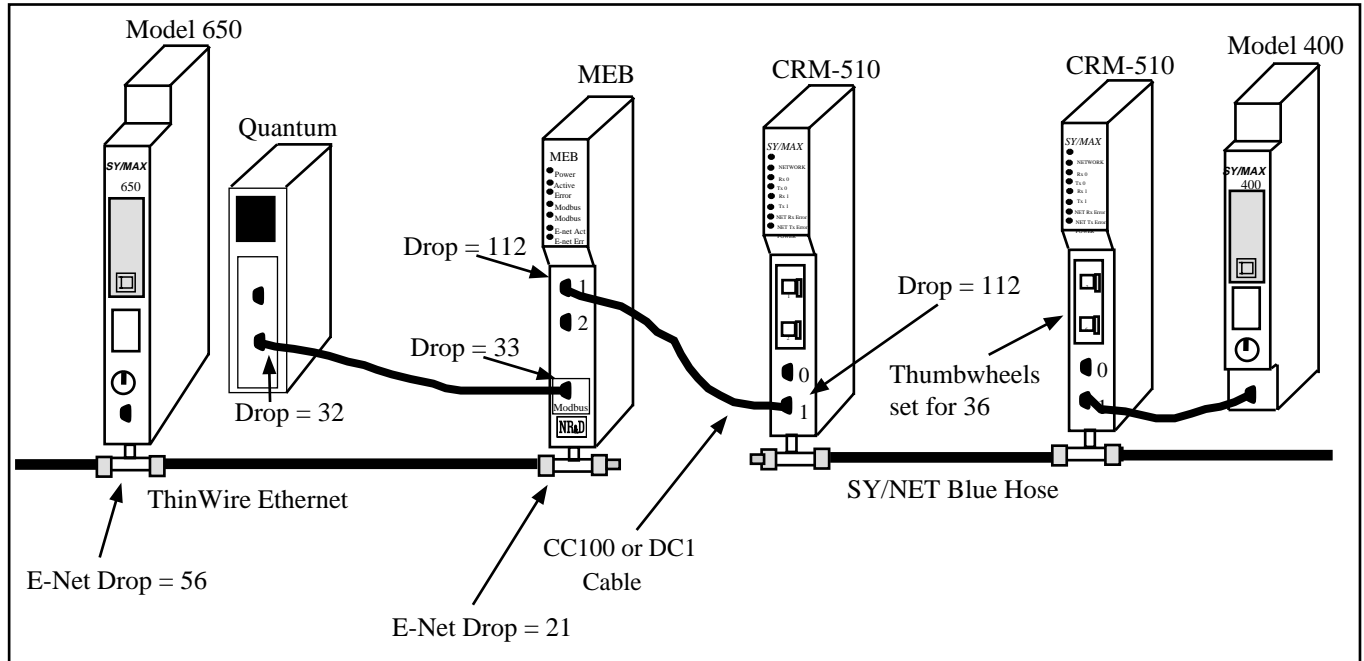
Figure 6-1   NIM Net-to-Net Example

Figure 6-1 displays a Blue Hose network connected to an MEB with a 9600 baud Net-to-Net connection. The MEB is connected to a Model 650 via E-Net and a Quantum via MB+. This example displays the integration of all three Schneider high-speed networks.

Table 6-1   NIM Net-to-Net Routing

Origin	Target	Route
Model 650	Model 400	056, 021, 112, 136
Model 650	Quantum	056, 021, 033, 32
Quantum	Model 400	33.01.136.00.00
Quantum	Model 650	33.07.56.00.00
Model 400	Model 650	136, 112, 021, 056
Model 400	Quantum	136, 112, 33, 32
Model 400	MEB	136, 112, 99

Table 6-2   MEB Setup for NIM Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	21	SY/MAX	NA	NA	NA	NA	NA
1	112	Net-to-Net	9600	E	8	1	BCC
MB+	33	MB+	NA	NA	NA	NA	NA

The use of the "On Ethernet" option of the Net-to-Net port on the MEB could allow several other routing possibilities including those listed in Table 6-1 and Table 6-3. Notice that since the Net-to-Net drop number is 112, the MEB will place drop number 12 on the Ethernet. Therefore drop number 12 must not reside on the Ethernet in any other device excluding this MEB. To take advantage of this, Port 2 might be set to drop number 12 and placed "On Ethernet" at no expense.

Table 6-3   NIM Net-to-Net Routing with "On Ethernet"

Origin	Target	Route
Model 650	Model 400	056, 112, 136
Model 650	Quantum	056, 021, 033, 32
Quantum	Model 400	33.01.136.00.00
Quantum	Model 650	33.07.56.00.00
Model 400	Model 650	136, 112, 056
Model 400	Quantum	136, 112, 33, 32
Model 400	MEB	136, 112, 99

SY/LINK SFI-510 Example

The Square D SFI-510 SY/LINK is a NIM that fits into a full length slot in an IBM compatible computer. Like the CRM-510 NIM, the SY/LINK card has a high speed network port for connection to the "blue hose" SY/NET cable. The SY/LINK has one external RS-422 port and one internal "bus port". The bus port may be considered to be the edge connector on the card that mounts in the personal computer bus. The RS-422 port is like Port 1 of the NIM and the bus port is like Port 0. When a connection is made to the MEB, the RS-422 port of the SY/LINK card is used. This port must be set to Net-to-Net mode and have the same drop number of the MEB port. The settings for the SY/LINK board are made by software on the personal computer. For information regarding the setup of the SY/LINK board consult the Instruction Bulletin 30598-277-01A2 from Square D.
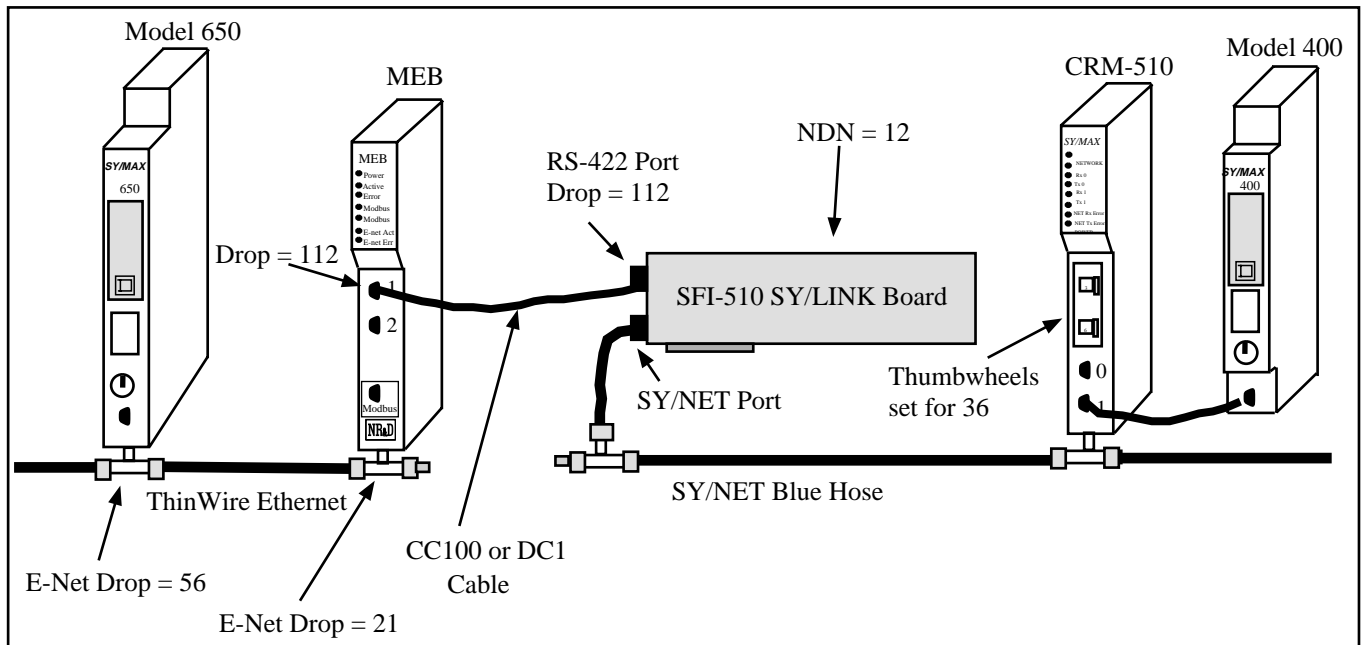
Figure 6-2 SY/LINK Net-to-Net Example

Table 6-4   SY/LINK Net-to-Net Routing Examples

Origin	Target	Route
Model 650	Model 400	056, 021, 112, 136
Model 650	MEB Mailbox	056, 021
Model 650	SY/LINK Mailbox	056, 021, 112
Model 400	Model 650	136, 112, 021, 056
SY/LINK	650	012, 112, 021, 056
SY/LINK	400	012, 136
SY/LINK	MEB Mailbox	012, 112, 021

Table 6-5   MEB Setup for SY/LINK Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	21	SY/MAX	NA	NA	NA	NA	NA
1	112	Net-to-Net	9600	E	8	1	BCC

EPE5 Net-to-Net Example

When the SY/MAX limit of 100 nodes is reached on a SY/MAX Ethernet extended LAN, a bridge must be used to further extend the network. A pair of MEB units (or EPE5) connected in Net-to-Net fashion will serve as this type of bridge. See Figure 6-3.

Additional throughput may be realized by increasing the baud rate to 19200, changing the parity to NONE, and using the CRC Error check. Adding an additional connection between another pair of ports on the MEBs, (EPE5s) and splitting the routing load across two ports will also increase throughput.

This type of arrangement is also useful if a modem link is required between Ethernet LANs. The modems may be placed between the MEB (EPE5) ports allowing great distances between Ethernet LANs.

The Niobrara RM14K rack mount SY/MAX compatible modem is ideal for this application, permitting baud rates of up to 14400 on dial-up, leased line, and radio links.
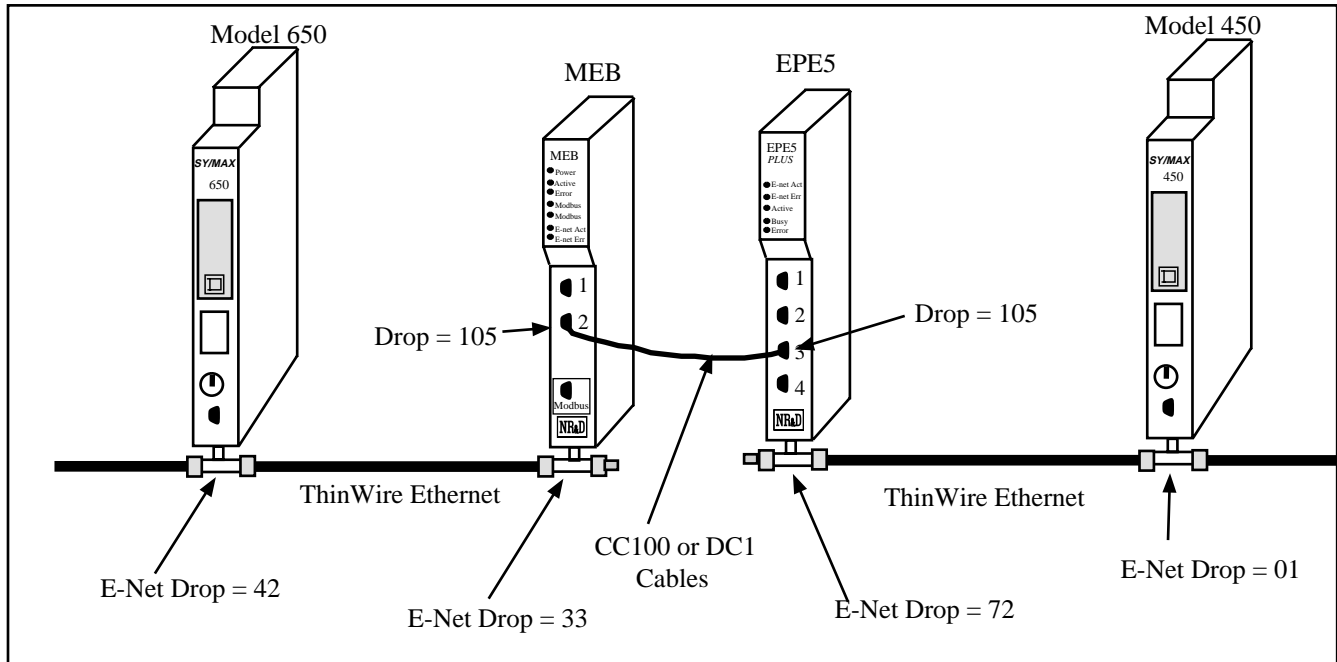
Figure 6-3   EPE5 Net-to-Net Example

NOTE: Another way of bridging two Ethernet is to use the Modbus Plus ports on two MEBs. This can provide a high speed connection for greater throughput. See Example 3: High Speed E-Net Bridge on page 188.

Table 6-6   EPE5 Net-to-Net Routing Examples

Origin	Target	Route
Model 650	Model 400	042, 033, 105, 072, 001
Model 650	MEB Mailbox	042, 033
Model 650	EPE5 Mailbox	042, 033, 105
Model 450	Model 650	001, 072, 105, 033, 042
Model 450	MEB Mailbox	001, 072, 105
Model 450	EPE5 Mailbox	001, 072

Table 6-7   MEB Setup for EPE5 Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	33	SY/MAX	NA	NA	NA	NA	NA
2	105	Net-to-Net	19200	None	8	1	CRC

Table 6-8   EPE5 Setup for EPE5 Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	72	SY/MAX	NA	NA	NA	NA	NA
3	105	Net-to-Net	19200	None	8	1	CRC

The use of the "On Ethernet" option of the Net-to-Net ports on the MEB and EPE5 could allow several other routing possibilities including those listed in Table 6-6 and Table 6-9. Notice that since the Net-to-Net drop number is 105, the MEB will place drop number 05 on its Ethernet and the EPE5 will place the drop number 05 on its Ethernet. Therefore drop number 05 must not reside on either Ethernet in any other device. To take advantage of this, another port in each module may be set to drop number 05 and placed "On Ethernet" at no expense.

Table 6-9   EPE5 Net-to-Net Routing Examples with "On Ethernet"

Origin	Target	Route
Model 650	Model 400	042, 105, 001
Model 650	MEB Mailbox	042, 033
Model 650	EPE5 Mailbox	042, 033, 105
Model 450	Model 650	001, 105, 042
Model 450	MEB Mailbox	001, 072, 105
Model 450	EPE5 Mailbox	001, 072

SPE4 Net-to-Net Example

When connecting an SPE4 to an MEB, both ports must be in Net-to-Net mode and have the same Drop number. See Figure 6-4. Unlike the MEB, the SPE4 ports are not individually configurable for Drop Number. The drop numbers of Ports 1..4 are based off of the drop number of Port 0. So Set the Drop number of the MEB port to match the port of the SPE4 to be connected. It is recommended that the SPE4 Ports 1, 2, 3, or 4 be used for this connection as these ports may operate at 19.2K baud. Also for greatest throughput, select parity = NONE, and Error Check = CRC.
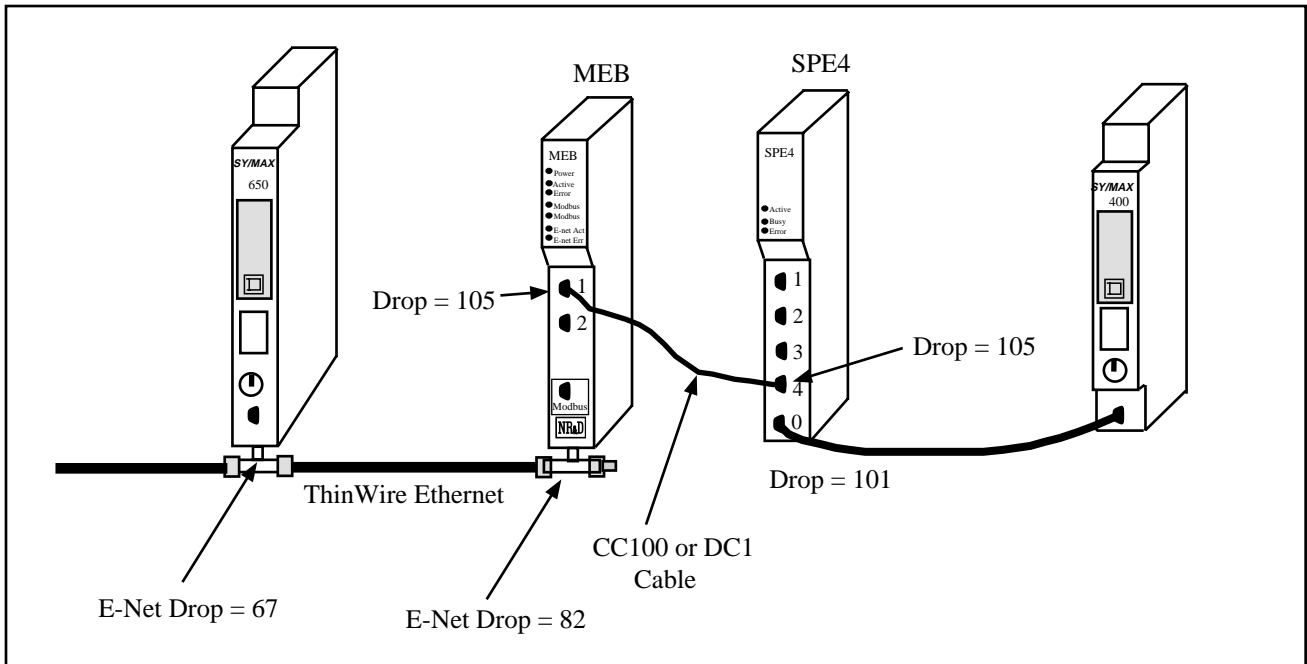
Figure 6-4   SPE4 Net-to-Net Example

Table 6-10   MEB Setup for EPE5 Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
E-Net	82	SY/MAX	NA	NA	NA	NA	NA
1	105	Net-to-Net	19200	None	8	1	CRC

Table 6-11   SPE4 Setup for MEB Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check
0	101	SY/MAX	9600	E	8	1	NA
4	105	Net-to-Net	19200	None	8	1	CRC

Table 6-12   SPE4 Net-to-Net Routing Examples

Origin	Target	Route
Model 650	Model 400	067, 082, 105, 101
Model 650	MEB Mailbox	067, 082
Model 650	SPE4 Mailbox	067, 082, 105
Model 400	Model 650	101,105, 082, 067
Model 400	MEB Mailbox	101, 105
Model 400	SPE4 Mailbox	NONE

7
Peripheral Mode

Mode 3: Peripheral

An MEB port set to peripheral mode is capable of receiving SY/MAX network print requests routed to it through the SY/MAX and Net-to-Net ports in the same module. These network print requests are translated to raw ASCII and transmitted by the port. Network print messages are generated by a PLC when a print rung is executed on a PLC communication port which has been configured for network mode by previously issuing either a read or write rung including a route. The baud rate, data width, and parity setting of the peripheral mode port should be set to match the attached peripheral device. The route should consist of the drop number of the port connected to the originating device, any net-to-net drops, and the drop number of the peripheral mode port. The terminal emulator provided in MEBSW may be useful for testing peripheral mode ports.

Driver Mode

The Driver Mode setting for the Peripheral mode allows the control of the RS-485 transmitter and receiver. For most applications, the PT to PT mode is the proper driver mode. This mode allows full duplex operation with the transmitter enabled at all times. This can be used to drive a 4-wire multidrop network as a master.

The FOUR WIRE mode causes the transmit driver to follow CTS. When CTS is active, the driver is enabled. When CTS is inactive, the driver is allowed to tri-state at a high impedance. This mode is useful when the port is acting as a slave on a 4-wire multidrop network.

The HALF DUPLEX mode has the transmitter enabled at all times, but the receiver is disabled while transmitting. This feature is useful for ignoring an echo from the attached device.

The TWO WIRE mode causes the transmit driver to follow CTS and the receiver to be disabled while transmitting. This mode allows the use of a 2-wire multidrop network.
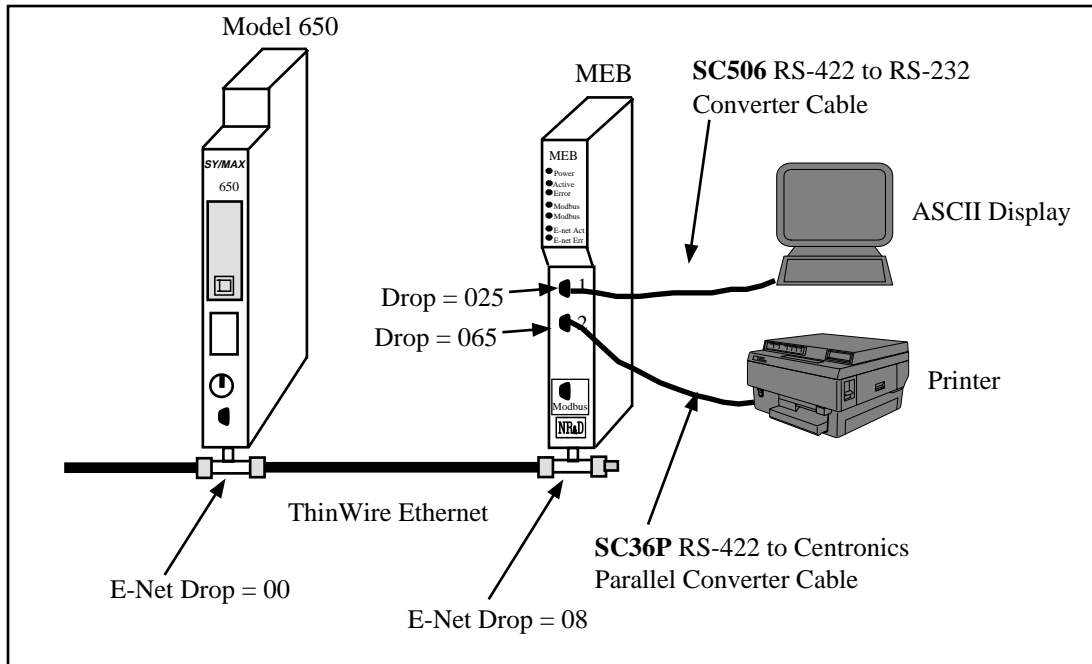
Figure 7-1 Peripheral mode example

Peripheral Mode Example

Table 7-1 Peripheral Routing Examples

Origin	Target	Route
Model 650	ASCII Display	000, 008, 025
Model 650	Printer	000, 008, 065

Table 7-2 MEB Setup for Peripheral Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
E-Net	08	SY/MAX	NA	NA	NA	NA	NA
1	25	Peripheral	9600	N	7	1	Pt to Pt
2	65	Peripheral	9600	N	7	1	Pt to Pt

The Niobrara SC36P serial to parallel converter cable may be used to interface a Centronics compatible parallel printer to an MEB Peripheral (or other SY/MAX RS-422) port.

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8
Transparent and Share Modes

</div>

Modes 4,5: Transparent, Share

Transparent and Share modes are identical except for the behavior of the RTS pin (see RTS/CTS Handshaking, on page below). These modes are used to interface non-SY/MAX devices to the SY/MAX environment so that their communications can be carried on the SY/NET network or through SY/MAX modems or routers such as the EPE5. Transparent mode communication between ports in the same module can be used for PLC controlled switching of serial data. Transparent communication between ports in different modules can be used to transmit non SY/MAX serial ASCII messages over SY/NET, SY/MAX, or Modbus Plus cabling along with other SY/MAX or non-SY/MAX traffic. Example applications of transparent mode include:

- Connecting serial terminals to non-SY/MAX computers through the SY/NET network.

- Connecting serial terminals to non-Modbus Plus computers through the Modbus Plus network.

- Connecting distributed printers to non-SY/MAX computers.

- Sharing a printer between a SY/MAX PLC and a non-SY/MAX computer.

- Sharing a printer between a Modbus PLC and a non-Modbus computer.

- Programming Micro-1 or Model 50 processors through SY/NET or Modbus Plus.

- Programming Micro-1 or Model 50 processors through SY/MAX modems (Niobrara 2496X or RM14K)

- Baud rate or word size conversion of non-SY/MAX data or Modbus data.

Each transparent port accepts ASCII input and processes it as a series of SY/MAX network print messages. Each packet is transmitted according to the target route of the originating port. The route should consist of the drop number of the originating port, any Net-to-Net drops, and the drop number of the receiving port. For two-way communication, the receiving port should be programmed with the the same drops in reverse order. The target route can be configured using MEBSW or dynamically by a write messages generated by a PLC or Gateway port.

Packet assembly is performed by accepting characters until either an ASCII carriage return is encountered, the transparent mode packet size limit is exceeded, or the transparent mode time limit is exceeded between characters. Setting the packet size to 1 will cause each character entering the port to be transmitted without delay but will result in slow throughput because of the large overhead of sending each character as a packet. Larger packets are more efficient but will not be transmitted until they are terminated by a carriage return or timeout. For full duplex interactive applications, set the timeout to just

slightly longer than the transmission time of a single character at the port's baud rate and word structure. For example, at 9600 baud a time limit of 2 (hundredths of a second) might be used.

TRANSPARENT Mode Example
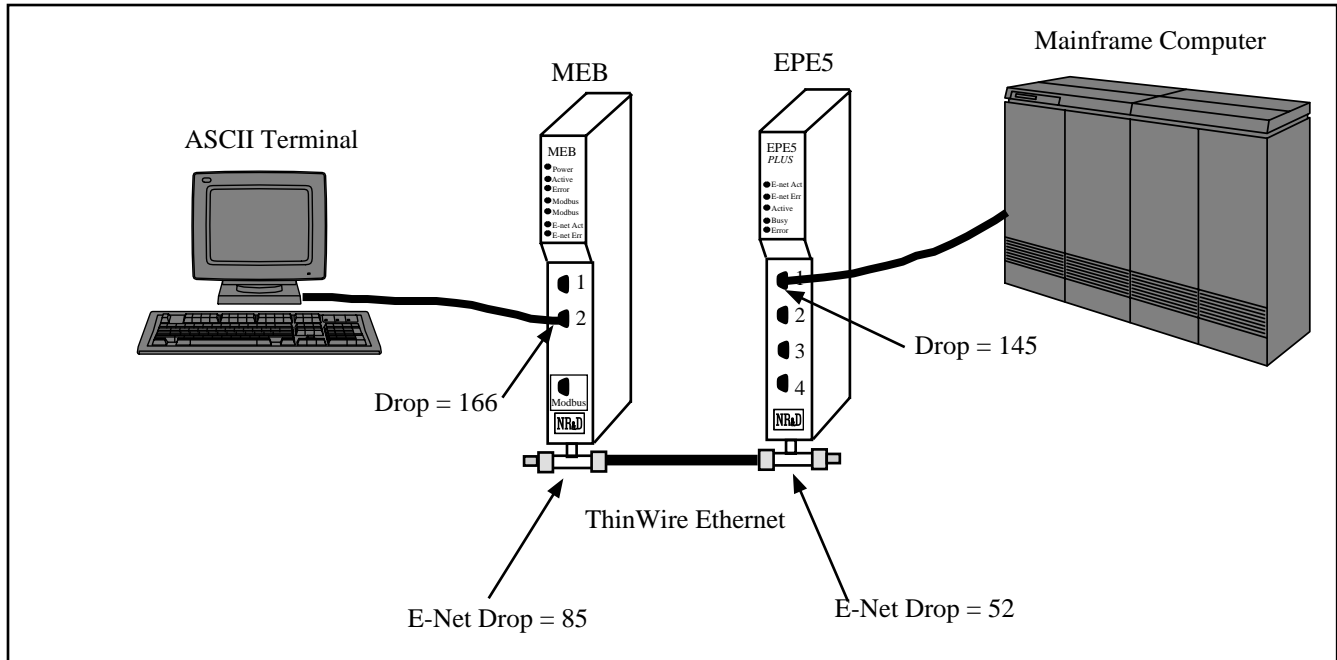
Figure 8-1   Transparent Mode Example

Table 8-1   Transparent Routing Examples

Origin	Target	Route
ASCII Terminal	Mainframe	166, 085, 052, 145
Mainframe	ASCII Terminal	145, 052, 085, 166

Table 8-2   MEB Setup for TRANSPARENT Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	85	SY/MAX	NA	NA	NA	NA
1	166	Peripheral	19200	N	7	1

Table 8-3   EPE5 Setup for TRANSPARENT Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	52	SY/MAX	NA	NA	NA	NA
2	145	Peripheral	19200	N	7	1

The ports connected to the terminal and the Mainframe computer should be set to the appropriate values of baud rate, parity, data bits, and stop bits, for those devices.

If the Devices are RS-232 but the EPE5 and MEB ports are RS-422, the SC406 **or SC902** cable may be used to connect the external devices to the network module.

Baud rates of 19200, may be used for higher throughput. Set the timeout to just slightly longer than the transmission time of a single character at the port's baud rate and word structure.

Another use for the Transparent mode is the remote programming of other PLCs over SY/NET. The Model 50 or Micro-1 processors may be programmed through transparent ports over Ethernet. Set the Port connected to the Personal Computer running SFW50 or SFW30 for Transparent mode. Set the Port connected to the processor to IDEC mode. The IDEC port will accept network print messages and pass those along to the PLC. The IDEC port will then send the reply back to the Transparent port to complete the message.

Driver Mode

The Driver Mode setting for the Share mode allows the control of the RS-485 transmitter and receiver. For most applications, the PT to PT mode is the proper driver mode. This mode allows full duplex operation with the transmitter enabled at all times. This can be used to drive a 4-wire multidrop network as a master.

The FOUR WIRE mode causes the transmit driver to follow CTS. When CTS is enabled, the driver is enabled. When CTS is not enabled, the driver is allowed to tri-state at a high impedance. This mode is useful when the port is acting as a slave on a 4-wire multidrop network.

The HALF DUPLEX mode has the transmitter enabled at all times, but the receiver is disabled while transmitting. This feature is useful for ignoring a hardware echo from the attached device.

The TWO WIRE mode causes the transmit driver to follow CTS and the receiver to be disabled while transmitting. This mode allows the use of a 2-wire multidrop network.

9
PLogic and PNIM Modes

Mode 6: PowerLogic

The MEB can be used to route SY/MAX read and write messages originated by a PLC, computer, Modbus Gate, or Modbus Plus device to a PowerLogic network of one or more PowerLogic modules. The MEB handles the difficult task of allowing one communication process to be allowed for only one circuit monitor at a time, permitting multiple accessors to poll the units independently.

There are two port modes that may be used for communicating with PowerLogic equipment: PLOGIC and PNIM. The PLOGIC mode uses the single-threaded SY/MAX protocol while the PNIM mode uses the PNIM version of the RNIM protocol. Since the PLOGIC mode conforms to the SY/MAX protocol, other SY/MAX devices may be used to extend the connection from the MEB port to the Circuit Monitors, including SY/MAX compatible modems like the 2496X and RM14K. The PNIM mode converts the SY/MAX protocol to the PNIM protocol. This protocol is not the same as SY/MAX and SY/MAX devices such as the 2496X may not be used to extend the connection.

Since the PowerLogic Circuit Monitors and PowerLink breakers will communicate with the PLOGIC and PNIM modes, it is recommended the the PLOGIC mode be used when possible. Since the PLOGIC mode ensures an acknowledgment from the network devices, network security is enhanced over the PNIM mode. The PNIM mode should only be used with ALTIVAR motor drive controllers and other PNIM only devices.

The route used should be the route from the source to the MEB port connected to the PowerLogic bus with an additional drop corresponding to the PowerLogic drop number set in the PowerLogic unit. The port should be configured for 8 data bits, even parity, 9600 baud, and PLOGIC mode for connecting with units "out of the box". The baud rate may be changed to other values to match the application.

The PowerLogic units operate on a 4-wire RS-485 network and may be connected directly to the RS-422 port of the MEB. The MEB supplies internal biasing for its receive data lines so the PowerLogic RS-485 Multipoint Communications Adapter (MCA-485) is not required for operation with the MEB. The network terminator (MCT-485) should always be used. See the recommended cabling section at the end of this manual.

PLOGIC Mode Example
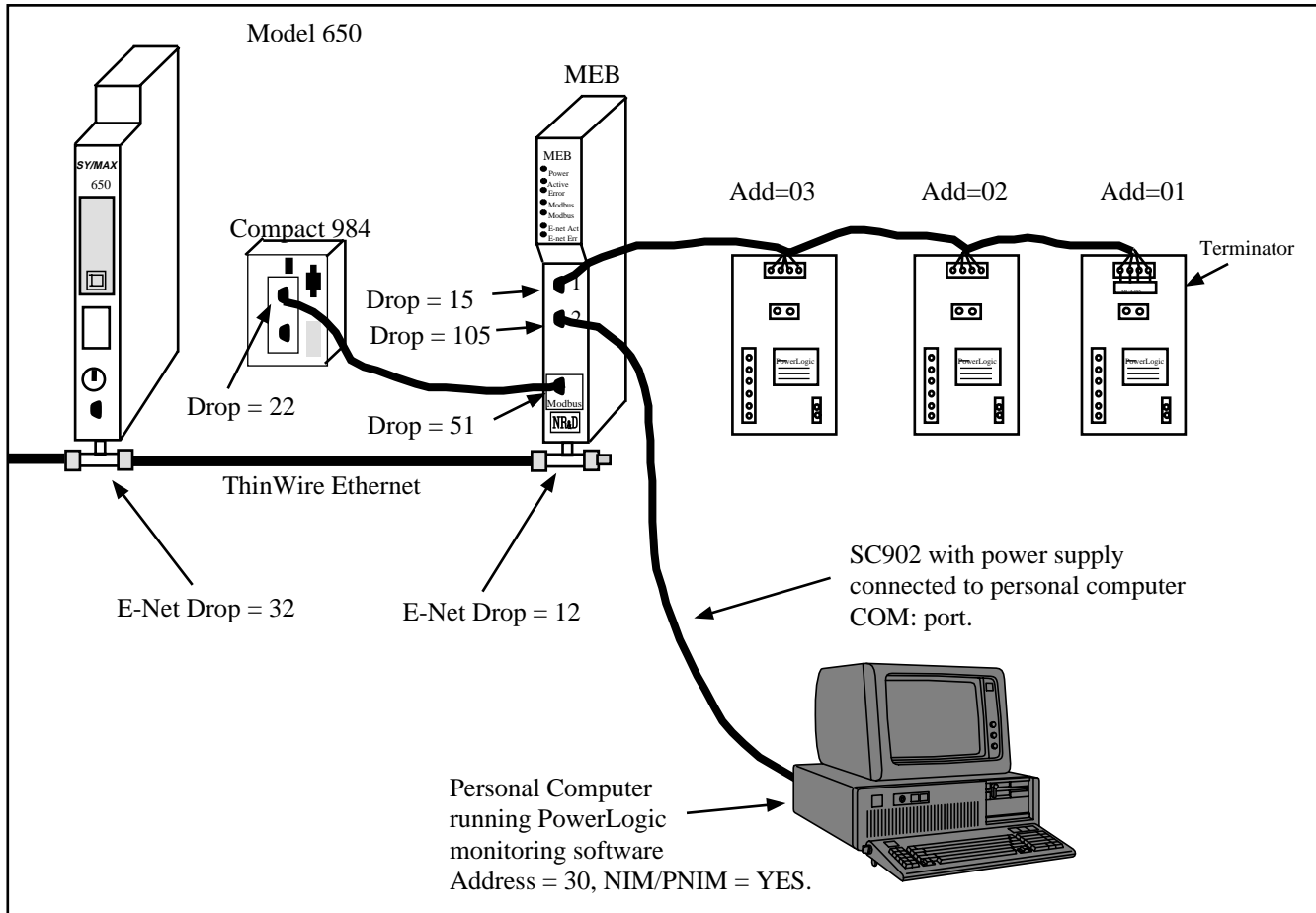
Figure 9-1   PowerLogic Example

Table 9-1   PowerLogic Routing Examples

Origin	Target	Route
Model 650	CM 1	032, 012, 015, 001
Model 650	CM 3	032, 012, 015, 003
Compact 984	CM 1	51.01.01.00.00
Compact 984	CM 2	51.01.02.00.00
Personal Computer	CM 1	30, 105, 015, 001
Personal Computer	CM 2	30, 105, 015, 002

Table 9-2   MEB Setup for PowerLogic Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	12	SY/MAX	NA	NA	NA	NA
1	015	PLOGIC	9600	E	8	1
2	105	SY/MAX	9600	E	8	1
MB+	51	MB+	NA	NA	NA	NA

The Personal Computer has an address of 30 and NIM/PNIM is set to YES.

Mode 11: PNIM

The MEB can be used to route SY/MAX read and write messages originated by a PLC, computer, or Modbus Plus to a network of one or more devices that communicate using the PNIM protocol. This includes PowerLogic Circuit monitors, Altivar motor drives, and other PNIM devices. The MEB handles conversion from SY/MAX protocol to PNIM protocol.

The PNIM mode is different from the PLOGIC mode. The PLOGIC mode uses the modified SY/MAX protocol that the PowerLogic Circuit monitors can use. Since the PLOGIC mode conforms to the SY/MAX protocol, other SY/MAX devices may be used to extend the connection from the MEB port to the Circuit Monitors, including SY/MAX compatible modems like the 2496X and RM14K. The PNIM mode converts the SY/MAX protocol to the PNIM protocol. This protocol is not the same as SY/MAX and SY/MAX devices such as the 2496X may not be used to extend the connection.

Since the PowerLogic Circuit Monitors will communicate with the PLOGIC and PNIM modes, it is recommended the the PLOGIC mode be used when connecting to PowerLogic Circuit monitors. Since the PLOGIC mode ensures an acknowledgment from the network devices, network security is enhanced over the PNIM mode. The PNIM mode should only be used with ALTIVAR motor drive controllers and other PNIM only devices.

The route used should be the route from the accessor to the MEB port connected to the PNIM bus with an additional drop corresponding to the drop number set for the attached PNIM device. The port should be configured for 8 data bits, even parity, 9600 baud, and PNIM mode for connecting with units "out of the box". The baud rate may be changed to other values to match the application.

The PNIM units operate on a 4-wire RS-485 network and may be connected directly to the RS-422 port of the MEB. The MEB supplies internal biasing for its receive data lines so the PowerLogic RS-485 Multipoint Communications Adapter (MCA-485) is not required for operation with the MEB. The network terminator (MCT-485) should always be used. See the recommended cabling section at the end of this manual.

PNIM Mode Example
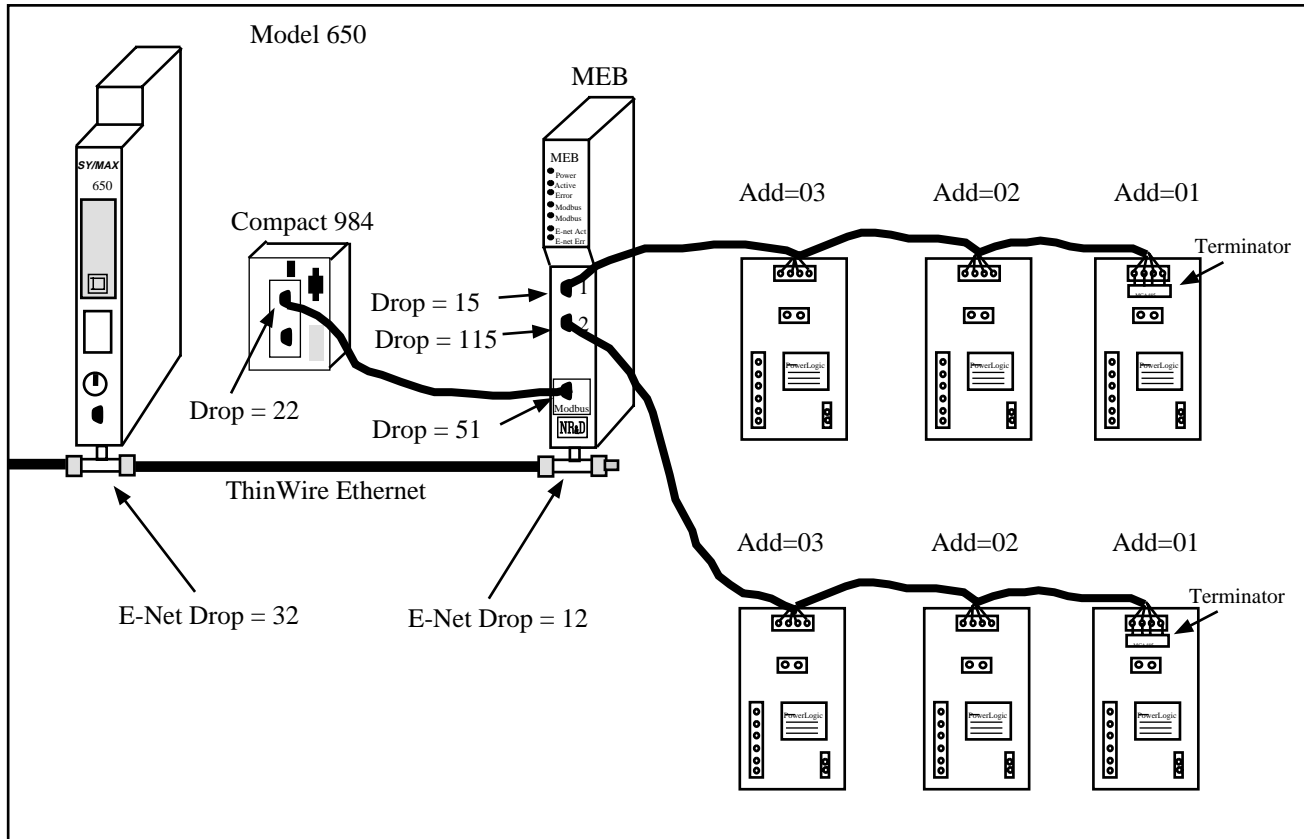
Figure 9-2   PowerLogic Example

Table 9-3   PNIM Routing Examples

Origin	Target	Route
Model 650	CM 1 on Port 1	032, 012, 015, 001
Model 650	CM 3 on Port 1	032, 012, 015, 003
Model 650	CM 1 on Port 2	032, 012, 115, 001
Model 650	CM 2 on Port 2	032, 012, 115, 002
Compact 984	CM 1 on Port 1	51.01.01.00.00
Compact 984	CM 2 on Port 1	51.01.02.00.00
Compact 984	CM 1 on Port 2	51.02.01.00.00
Compact 984	CM 2 on Port 2	51.02.02.00.00

Table 9-4   MEB Setup for PowerLogic Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	12	SY/MAX	NA	NA	NA	NA
1	015	PNIM	9600	E	8	1
4	105	PNIM	9600	E	8	1
MB+	51	MB+	NA	NA	NA	NA

The use of the "On Ethernet" option of the PNIM (or PLOGIC) ports on the MEB could allow several other routing possibilities including those listed in Table 9-3 and Table 9-5. Notice that since the PNIM drop numbers are 15 and 115, the MEB will place drop only number 15 on its Ethernet. Therefore drop number 15 must not reside on the Ethernet in any other device.

Table 9-5   PNIM routing with "On Ethernet"

Origin	Target	Route
Model 650	CM 1 on Port 1	032, 015, 001
Model 650	CM 3 on Port 1	032, 015, 003
Model 650	CM 1 on Port 2	032, 115, 001
Model 650	CM 2 on Port 2	032, 115, 002
Compact 984	CM 1 on Port 1	51.01.01.00.00
Compact 984	CM 2 on Port 1	51.01.02.00.00
Compact 984	CM 1 on Port 2	51.02.01.00.00
Compact 984	CM 2 on Port 2	51.02.02.00.00

Mode 7: IDEC

Micro-1 and Model 50 Interfacing

The MEB can translate SY/MAX read and write messages such as those generated by Read and Write rungs in a PLC ladder program to IDEC format read and write rungs compatible with the Micro-1 or Model 50. A network of either of these processors can be connected to a single MEB port and then accessed by devices connected to other ports on the module. The route for such messages should include all drops necessary to reach the MEB port and one additional drop corresponding to the drop number of the Micro-1 or Model 50 processor within the ring network. The MEB is not capable of translating IDEC format requests to SY/MAX requests.

This mode is useful when one or more Micro-1 or Model 50 processors are used as remote I/O blocks for a SY/MAX processor. Even if only one IDEC compatible processor is connected to the port, it must be assigned a drop number. A drop setting of zero or none cannot be used. A single Micro-1 or Model 50 processor can be conveniently connected to an MEB port with a Niobrara ID422 or MD422 cable respectively. To connect a network ring of multiple units, use the RIU-10 from Square-D.

When accessing I/O points, internal relays, and shift register bits, the register number in the SY/MAX read or write message is translated to a Micro-1 or Model 50 bit address. Sending a SY/MAX read message will return the state of the eight bits starting at the specified address. Therefore register 256 bit 8 is the same contact as register 257 bit 7. This also means that successive 8 bit registers are addressed at register numbers 8 registers apart. For example, the first internal relay register (8 bits) is found at address 512 but the second 8 bit internal relay register is at address 520, not address 513.

Timer, counter, and the Model 50 data registers are 16 bits wide and are addressed as words. This means the first data register is at address 1792 and the second at address 1793. When interfacing with the Model 50, the most efficient communications will result from reading and writing the data registers and programming the Model 50 to internally address inputs and outputs.

When accessing timer and counter registers, a Read access returns the current value of the timer or counter register. A Write access loads the associated preset register.

Micro-1 register addressing

To communicate with the Micro-1, the MEB port should be set to 9600 baud, even parity, 8 data bits, 1 stop bit, IDEC mode. This table shows the SY/MAX register number to use to access various Micro-1 resources.

Table 10-1 Micro-1 Processor Equivalent Register List

Micro-1 Register	SY/MAX Register Equivalent	Notes
Onboard Input	256	
Expansion Input	264	
Onboard Output	384	Bits 1 - 5 only
Expansion Output	392	
Internal Relays	512 - 760	
Shift Registers	768 - 888	
Timers	1024 - 1103	
Counters	1280 - 1326	

Model 50 register addressing

To communicate with the Model 50, the MEB port should be set to 9600 baud, no parity, 8 data bits, 2 stop bits, IDEC mode. This table shows the SY/MAX register number to use to access various Model 50 resources.

Table 10-2 Model 50 Processor Equivalent Register List

Model 50 Register	SY/MAX Register Equivalent	Notes
Inputs	256 - 376	
Outputs	384 - 504	
Internal Relays	512 - 744	
Shift Registers	768 - 888	
Timers	1024 - 1103	16 Bits / register
Counters	1280 - 1324	16 Bits / register
Data Register	1792 -1891	16 Bits / register

IDEC Mode Example
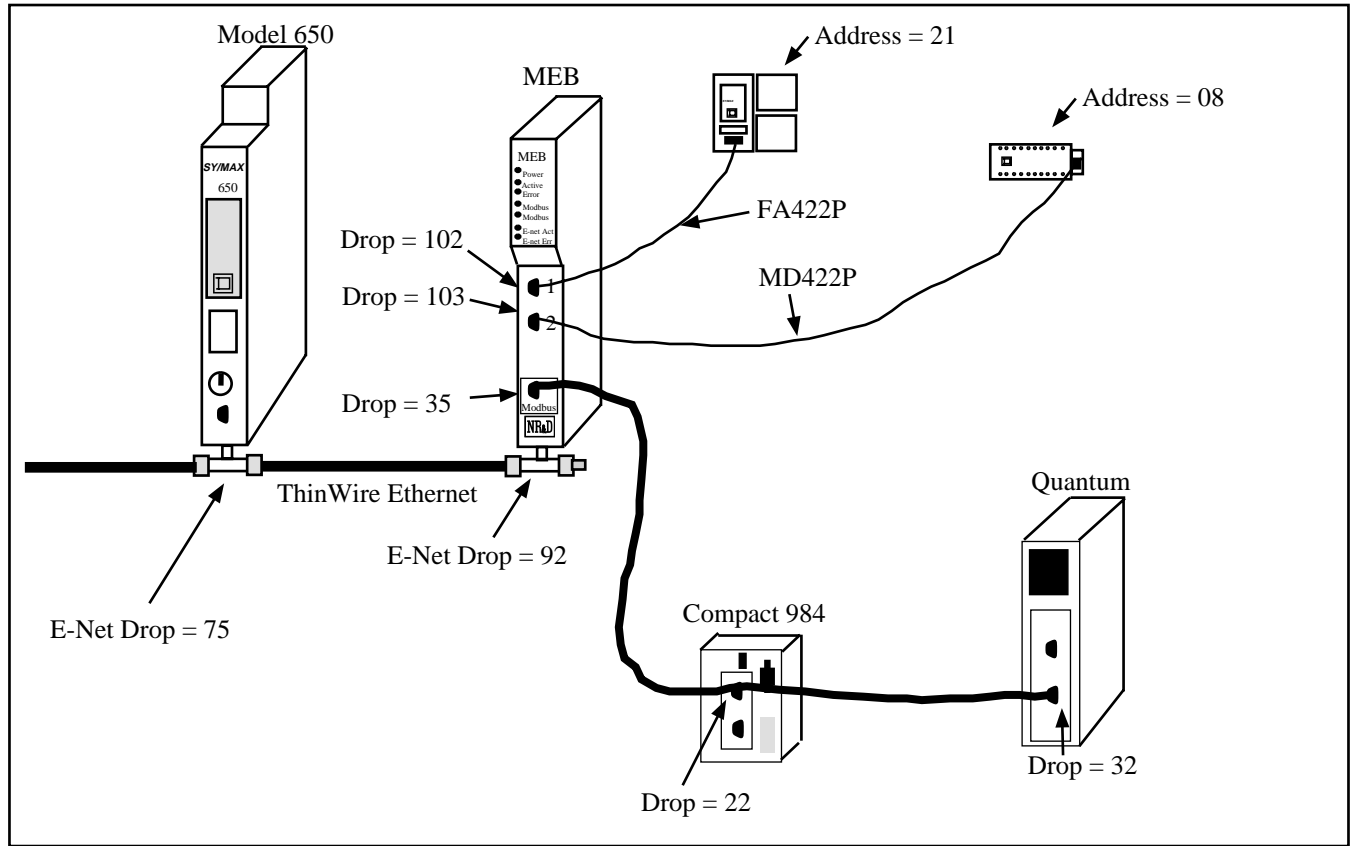
Figure 10-1 IDEC Mode Example

Table 10-3 IDEC Routing Examples

Origin	Target	Route
Model 650	Model 50	075, 092, 102, 021
Model 650	Micro-1	075, 092, 103, 008
Quantum	Model 50	35.01.21.00.00
Quantum	Micro-1	35.02.08.00.00
Compact 984	Model 50	35.01.21.00.00
Compact 984	Micro-1	35.02.08.00.00

Table 10-4 MEB Setup for IDEC Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	92	SY/MAX	NA	NA	NA	NA
1	102	IDEC	9600	N	8	2
2	103	IDEC	9600	E	8	1
MB+	35	NA	NA	NA	NA	NA

11
Gateway Mode

Mode 8: Gateway

ASCII Command Gateway Functions

To simplify access to SY/MAX devices such as PLCs, Niobrara's various modules, PowerLogic modules, and IDEC mode PLCs, the MEB provides a Gateway mode. A port in Gateway mode accepts simple ASCII commands and translates them to properly formatted SY/MAX read, write, and print messages. Using the MEB Gateway mode, any device with an ASCII serial port can communicate with the SY/MAX devices. This function facilitates interfacing BASIC or C programs or non-SY/MAX PLCs to SY/MAX devices (or, through an IDEC port, the Micro-1 or Model 50).

The target of all Gateway commands is determined by a route from the Gateway port to the destination device. If the destination is connected to the same module, the route may be the drop of the Gateway port followed by the drop of the destination port. If the target device is connected to another MEB or to a NIM connected to the Gateway MEB through SY/NET, the second drop will be that of the Net-to-Net port (or Modbus Plus port) within the Gateway module and additional drops will be added to route the message through the additional network devices. A null route with no drops will direct Gateway accesses to the local processor equivalent mailbox or configuration registers within the MEB module. The target route may be set by using MEBSW (or other means) to modify the Target Route configuration registers or through the Gateway by use of the Gateway ADDRESS command. The target port can also be a PowerLogic or IDEC mode port and accesses made to the registers of those devices. When addressing PowerLogic or IDEC devices, don't forget the final drop should be the drop of the target unit in the IDEC or PowerLogic network. If the target port is an IDEC mode MEB port connected to Micro-1 or Model 50 processors, the Set and Clear commands can be applied much more quickly than the Write command to I/O, IR, or SFR registers.

Each Gateway mode command consists of a letter, one or more decimal numeric parameters separated by non-numeric delimiters and either an ASCII carriage return or a time delay. The commands are described individually below. The command termination parameters of packet size limit and packet time limit are the same as for Transparent mode. Unless it is not possible to terminate each command with a carriage return, a packet size limit of 128 and time limit of 100 (1 second) are recommended.

The terminal emulator provided in MEBSW is useful for testing the gateway features.

Gateway READ command

To read from one or more registers of the addressed SY/MAX device, send the Read command to the Gateway port. The command consists of an 'R' followed by the register number optionally followed by

a register count. The 'R' may be immediately followed by the first digit of the register number or they may be separated by any number of non-numeric characters. The first non-numeric character encountered in the register number likewise delimits it.

The register count, if present is separated from the register by one or more non numeric characters and terminated by any non numeric character or the end of the packet. The reply to a successful read command will be the decimal value of the register followed by a carriage return. If multiple registers are read (i.e. a count field is present and is greater than 1), then the decimal values for the registers will be output separated by ASCII spaces and with a carriage return after the last value. The following are all valid read commands:

- R 100
- r100,10
- READ 100 FOR 10
- Ralph was here 100 years ago.

Gateway WRITE command

The Write command is used to transmit a new value to one or more registers in the target device. The write command is formatted as a letter 'W' followed by zero or more non-numeric characters, followed by the decimal register number, followed by one or more non-numeric characters, followed by the decimal value to be written. Multiple registers can be written by appending additional values to the command delimited by strings of one or more non-numeric characters. The command packet may be terminated by a carriage return or by a time delay. The following are examples of valid Gateway write commands:

- W 100 2
- w100=2,3
- WRITE 100 WITH THE VALUE 2 AND ONE-HUNDRED ONE WITH THE VALUE 3
- We can use anything to separate 100 from 2.

Gateway SET command

The Gateway set command sends a modified write message which will set a single bit in the specified register of the target device to one. The command is an ASCII "S" followed by the register number and bit number. The following are valid bit set commands:

- S 200.3
- s200 16
- SET 200-3

Gateway CLEAR command

The Gateway clear command sends a modified write message which will clear a single bit in the specified register of the target device to zero. The command is an ASCII "C" followed by the register number and bit number. The following are valid bit clear commands:

- C 200.3
- c200 16
- Clear 200-3

Gateway BIT command

The Gateway bit test command sends a read message to the target device and evaluates the returned value to determine the state of the specified bit. The Gateway port will output an ASCII "1" if the bit is

set or a "0" if not. The command is an ASCII "B" followed by the register number and bit number. The following are valid bit set commands:

- B 200.3
- b200 16
- Bit 200-3

Gateway PRINT command

The Gateway print command formats an ASCII message as a SY/MAX network print message and forwards it to the target device. The target should be a NIM port in peripheral mode or an MEB port in Peripheral, Transparent, or Share mode, or another Gateway port. The print command is any string starting with an ASCII "P". All characters following the "P" will be emitted by the destination port followed by a carriage return line feed sequence.

Note: A carriage return and line feed will be appended to the message regardless. If a carriage return is sent at the end of the string from the Gateway device, then the string emitted from the peripheral port will have two carriage returns and a line feed. If this presents a problem, use the character limit an inter-character time limits to terminate the message from the Gateway device. If the carriage return and line feed sequence is not desirable, use the Omit print command.

The following are valid Gateway Print commands:

- PHello
- pNow is the time for all good men...

Gateway OMIT Print Command

The Gateway Omit command is a network print command that omits the carriage return and line feed sequence. This allows the printing of exact characters from a peripheral port without the addition of the carriage return and line feed. If no terminator is needed, use the inter-character timeout or character limit settings for the Gateway port to terminate the string. An example of using the Omit command is to send the attention command to a Hayes modem to return it to the command mode. This is accomplished by pausing one second, sending +++, and pausing one second. The three plus signs must not have any other characters with them. The valid command would be: O+++

Gateway ADDRESS command

The target for Gateway commands may be set with the Gateway address command. This command is an ASCII "A" followed by up to eight decimal drops separated by strings of one or more non numeric characters. Remember that the first drop should be the drop number of the Gateway port itself. The following are valid Gateway ADDRESS commands:

- A8,10
- ADDRESS 008 102 104

Gateway Mode Example
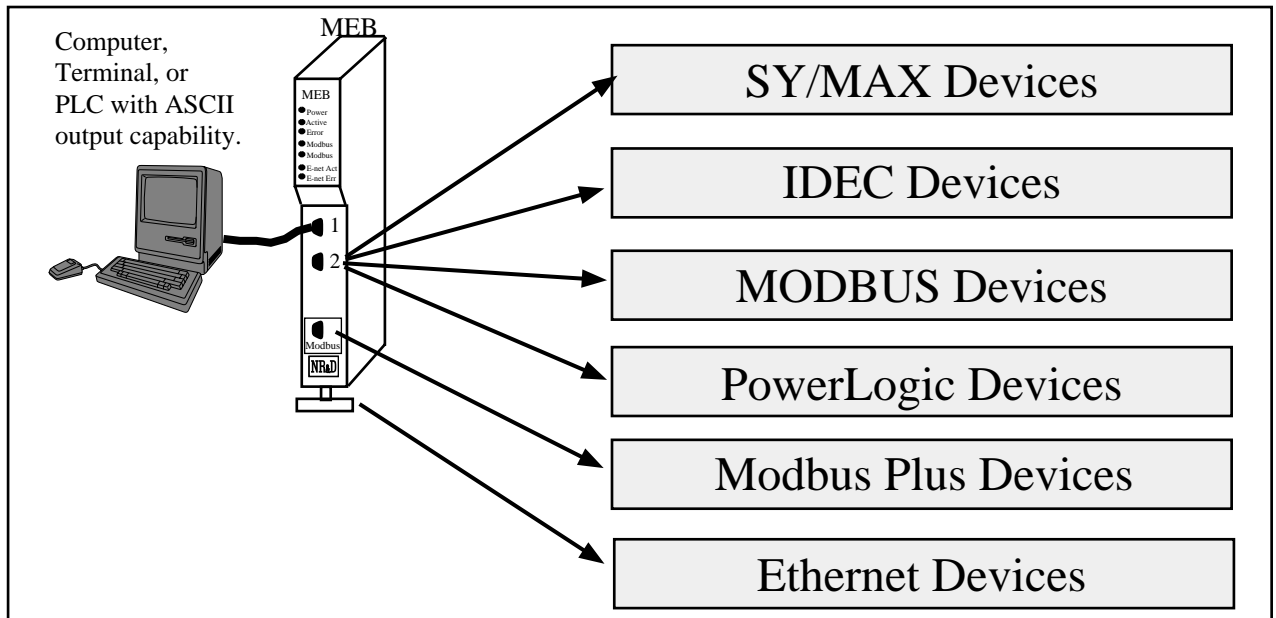
Figure 11-1 GATEWAY Example

The Gateway mode simplifies access to SY/MAX devices, such as PLCs, NR&D's various modules, the MEB itself, and any other external mode of the MEB (IDEC, PLogic, MODBUS, etc.). A Gateway port accepts simple ASCII commands and translates them to properly formatted SY/MAX read, write, and print messages. Any device with an ASCII serial port may be used to communicate with SY/MAX devices

Figure 11-2 represents a view of the Terminal Emulator from MEBSW connected to an MEB Gateway port.

```
Type contrl-End to exit terminal.  Type F7 to begin capture to a file.
Type F9 to change terminal communication setup.
To send hex sequence, type INSERT key, enter hex codes, type ENTER.
r1<0D>
0<0D>
r1,10<0D>
0 0 32768 0 0 0 0 4660 65278 1234<0D>
w12,55,67<0D>
<0D>read12<0D>
55<0D>
s12.1<0D>
<0D>r12<0D>
55<0D>
s12.16<0D>
<0D>r12<0D>
32823<0D>
c12,1<0D>
<0D>r12<0D>
32822<0D>
Enter hex codes to send: 10 05
<10><05>
```

Figure 11-2   Terminal Emulator connected to Gateway port

Table 11-1 Gateway Command Examples

Command	Description	Example
READ	Reads one or more registers from addressed device.	R 8001.10
WRITE	Writes one or more registers to addressed device.	W 100,2,5
SET	Sends modified write to set a single bit.	S 200-3
CLEAR	Sends modified write to clear a single bit.	C 315,2
BIT	Sends read to determine state of bit.	b375 15
PRINT	Sends ASCII message, adds CR and LF.	PHello
OMIT	Sends ASCII message without CR and LF.	oHello
ADDRESS	Sets the target route for the Gateway port.	A8,10

BASIC Language Example Program

This sample program should run on a PC using most BASIC interpreters. Set the Gateway port to 9600,N,8,1 and connect to COM1 of the PC.

```
10    OPEN "COM1,9600,N,8,1" for RANDOM as 1  'Open the PC's  COM port.
20    PRINT #1, "A 3,4"          'Set the route for the Gateway port.
30    INPUT #1, A$               'Receive the MEB's  CR reply.
40    PRINT #1, "R 5,10"         'Read registers 5 through 15 in the target.
50    INPUT #1, B$               'Receive the reply data.
60    PRINT B$                   'Print data to screen.  Format:  Reg5 Reg6 Reg7...
70    CLOSE 1                    'Close PC's COM port
80    END
```

12
Multidrop Mode

Mode 9: Multidrop

The MEB multidrop port mode can be used to route packets between three or more MEB/EPE5/SPE4 modules over a single communication medium such as an RS-485 pair or multidrop modems or radios. In Multidrop mode, the units on the network use a time division scheme to arbitrate access to the line. When an individual MEB desires to transmit, it asserts its RTS pair and waits for the modem to respond with CTS. Then it transmits the packet and waits for a response from the receiving unit. All units monitor the line and watch for packets with their individual address.

> **NOTICE:** The MULTIDROP mode is ideally suited for use with a 2-wire RS-485 multidrop network. If a radio or multidrop modem network is to be used, it is recommended that the RNIM mode be used. It is better suited for radio and other multidrop modem applications.

To configure a multidrop network, you must set the Number of Nodes, Time Slice and Node Priority of each node. The Number of Nodes and Time Slice are set the same for all modules. The Node Priority of each module is set to a unique value between 1 and the Number of Nodes. The value of Time Slice is calculated based on the speed of transmission and the RTS to CTS delay of the modem or other network interface. The time slice should be the transmission time for four characters plus the worst case RTS to CTS delay and rounded up to the next highest hundredth of a second. In any case, the time slice should not be less than 5. If you are having trouble with a multidrop configuration, increase the time slice.

The number of nodes in a multidrop configuration is limited only by available drop numbers and by the limits of the transmission medium but the larger the network, the slower will be the throughput for a given packet.

The modem, network controller, or radio type used must be such that all units receive data transmitted by any one unit and that any unit can accept transmit data when its CTS pair is active. It is unimportant whether or not the transmit data is echoed to the transmitting MEB port.

Multidrop Mode Example
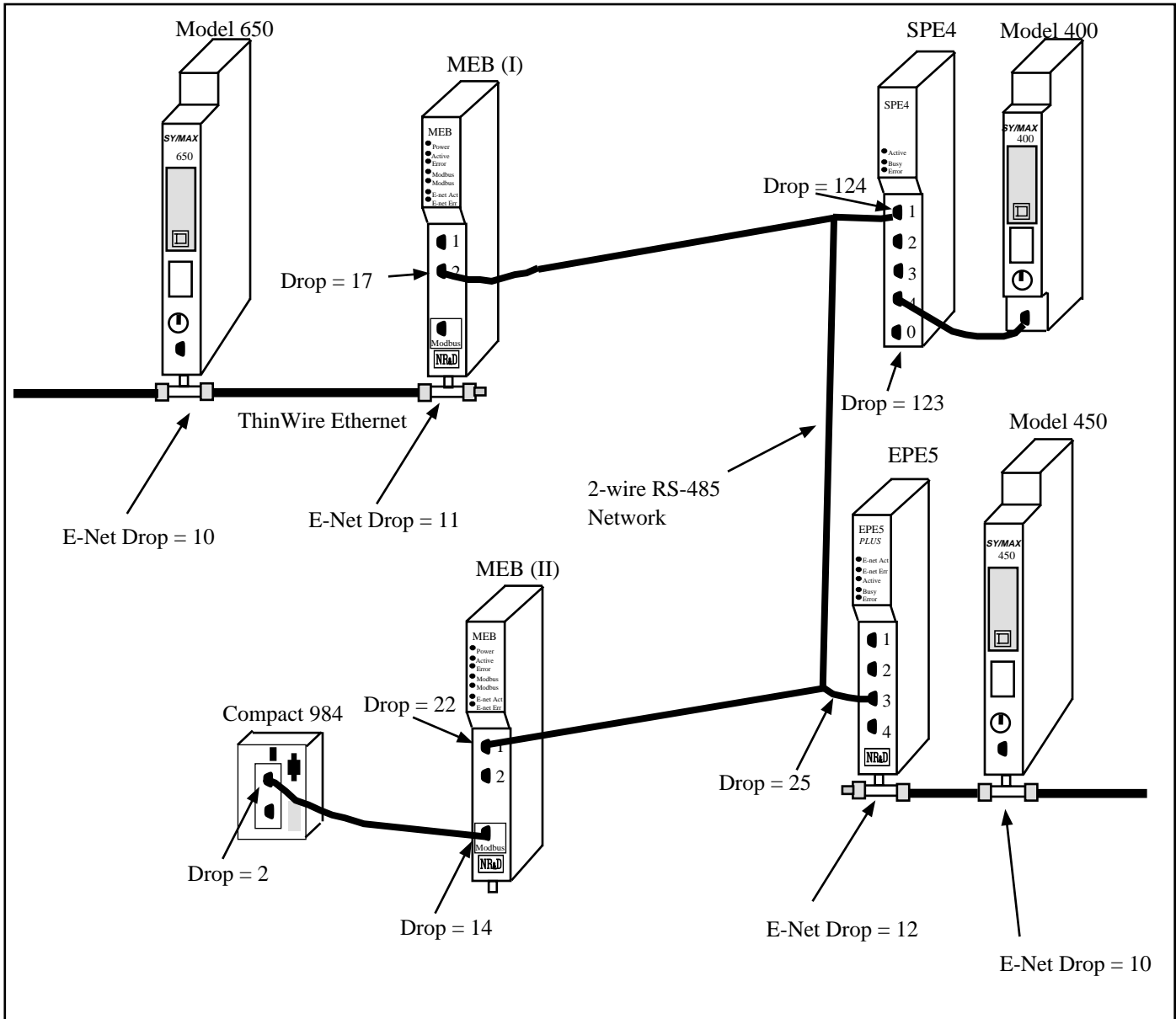
Figure 12-1 Multidrop Example

Table 12-1 MULTIDROP Routing Examples

Origin	Target	Route
Model 650	Model 400	10, 11, 17, 124, 127
Model 650	Model 450	10, 11, 17, 25, 12, 10
Model 650	Compact 984	10, 11, 17, 22, 14, 02
Model 400	Model 650	127, 124, 17, 11, 10
Model 400	Model 450	127, 124, 25, 12, 10
Model 450	Compact 984	10, 12, 25, 22, 14, 02
Model 450	Model 650	10, 12, 25, 17, 11, 10
Model 450	Model 400	10, 12, 25, 124, 127
Model 450	Compact 984	10, 12, 25, 22, 14, 02
Compact 984	Model 650	14.01.17.11.10
Compact 984	Model 450	14.01.25.12.10
Compact 984	Model 400	14.01.124.127.00

Table 12-2 MEB(I) Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
E-Net	11	SY/MAX	NA	NA	NA	NA	NA	NA
3	17	MULTIDROP	19200	None	8	1	CRC	TWO WIRE

Table 12-3 SPE4 Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
1	124	MULTIDROP	19200	None	8	1	CRC	TWO WIRE
4	127	SY/MAX	9600	E	8	1	BCC	NA

Table 12-4 EPE5 Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
E-Net	12	SY/MAX	NA	NA	NA	NA	NA	NA
3	25	MULTIDROP	19200	None	8	1	CRC	TWO WIRE

Table 12-5 MEB(II) Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
MB+	14	MB+	NA	NA	NA	NA	NA	NA
1	22	MULTIDROP	19200	None	8	1	CRC	TWO WIRE

Driver Mode

The Driver Mode setting for the MULTIDROP mode allows the control of the RS-485 transmitter and receiver. For most MULTIDROP applications, the TWO WIRE mode is the proper driver mode. This mode allows half duplex operation with the transmitter enabled when transmitting and the receiver disabled while transmitting.

The HALF DUPLEX mode has the transmitter enabled at all times, but the receiver is disabled while transmitting. This feature is useful for ignoring a hardware echo from the attached device.

The Point-to-Point driver mode allow full duplex operation with the transmitter enabled at all times. This mode would be used with a full duplex modem .

13
MODBUS Modes

The Modbus protocol is implemented in a wide variety of products including Modicon PLCs, temperature controllers, flowmeters, intelligent valve systems, etc. The MEB provides a gateway translation from the SY/MAX protocol to/from Modbus RTU (or ASCII) protocol with the Modbus Gate, Modbus Host, and Modbus ASCII modes. The MEB Modbus Gate and ASCII modes provide reversible translations from SY/MAX messages to Modbus messages and vice versa using a defined series of rules. The Modbus Host mode is used when an explicit opcode and bias is required for a specific master application.

Modbus Overview

The Modicon addressing scheme is somewhat different than SY/MAX. In the SY/MAX PLC there is only one memory address space for data. Input registers, output registers, discrete input bits, and discrete output bits are all treated as registers and bits within these registers. Because of this treatment of memory, the SY/MAX communications protocol requires only one type of message to read, and another to write data to and from external devices.[1]

The Modicon addressing method involves separate memory locations for input bits, output bits, input registers, and output registers. These different areas are denoted by the first character in the number that identifies the bit or register. Output bits (coils) are described by values in the range of 0xxxxx. Input bits (coils) are described by values in the range 1xxxxx. Input registers have values 3xxxxx and Output registers have values of 4xxxxx. Consequently the Modbus protocol requires separate messages to access the data in each of these areas. See Table 13-1.

For example, the first output bit in a Modicon PLC is addressed as 00001. The 150th output bit in the PLC is 00150 and is accessed using Function code 1 and written with Function codes 5 and 15. The seventeenth input bit is 10017 and is read by Function code 2. The 2381st input register is addressed by 32381 and is read with Function code 4. And the 52nd holding register is 40052 and read by Function code 3 and written with Function codes 6 and 16.

---

[1] The SY/MAX protocol includes both Priority and Non-priority READ and WRITE messages, but the different messages still operate on the same memory address space.

Table 13-1   MODBUS Function Code List

Function Code	Description	MODBUS Address Range
01	Read Coil Status	0XXXXX
02	Read Input Status	1XXXXX
03	Read Holding Register	4XXXXX
04	Read Input Registers	3XXXXX
05	Force Single Coil	0XXXXX
06	Preset Single Register	4XXXXX
15	Force Multiple Coils	0XXXXX
16	Preset Multiple Registers	4XXXXX

SY/MAX Message Addressing

The SY/MAX protocol supports a variety of operations for transferring data from device to device.

Table 13-2   SY/MAX Messages

Opcode (hex)	Description	Notes
20	Priority Read	Used by SY/MAX PLCs.
00	Non-Priority Read	
04	Non-Priority Random Access Read	
1e	Priority Write	Used by SY/MAX PLCs.
02	Non-Priority Write	
1e	Priority Alarm	Special version of Priority Write.
22	Priority Print ASCII	

In the SY/MAX family of processors, only the Priority messages listed above are supported. These are the messages sent when a TWRITE, TALARM, TREAD, or network TPRINT is issued.

The Non-Priority WRITE message has the provision for a bit mask. This means that specific bits may be written to the remote device in a register without modifying other masked bits within that register. The Priority WRITE statement available in the PLC has no provision for a bit mask.

Message Translations

When messages cross from SY/MAX to Modbus media or vice-versa with a Niobrara bridge product (SPE4, EPE5, MEB) they are either reversibly translated or encapsulated and sent transparently. Trans-latable messages may be sent by one brand of device and operate successfully on another. By means of Niobrara's other translations, Modbus messages translated to SY/MAX operations may also operate on IDEC, PLOGIC, PNIM, and RNIM devices. Untranslateable SY/MAX or Modbus messages should only be directed to a device of the same brand to avoid unpredictable results. SY/MAX, PLOGIC, PNIM, and IDEC serial ports will return an encapsulated error to encapsulated Modbus messages. Modbus Host and Modbus Gate serial ports will return an encapsulated error to encapsulated SY/MAX messages. Net-to-Net, RNIM, MULTIDROP, ETHERNET, SY/NET, and Modbus Plus ports forward all messages transparently.

SY/MAX to Modbus Translations

SY/MAX originated messages which can be reversibly translated are listed in Table 13-3.

Table 13-3 SY/MAX to Modbus Translations

SY/MAX Message	Modbus Message
Priority Read (0x20)	Read Holding Registers (3)
Non-Priority Read (0x00)	Read Holding Registers (3) Registers 1 ..8192 detranslated as Priority Read
Priority Write (0x1E)	Write Multiple Registers (16)
Non-Priority Write (0x02) with mask all zeroes	Write Multiple Registers (16) registers 1..8192 detranslate as Priority Write
Non-Priority Write (0x02) with mask all zeroes	Force Multiple Coils (15) with bit and byte counts = 0
Non-Priority Write (0x02) with mask containing < 16 contiguous ones, count = 1, and register < 2048	Force Multiple Coils (15)
Non-Priority Write (0x02) with a mask a single one, register count = 1 and register < 2048	Force Single Coil (5)

All other SY/MAX commands will be encapsulated following Modbus opcode 17 (0x11) with a single parameter 0x01 and sent transparently over the Modbus media. Replies to encapsulated SY/MAX queries are encapsulated with opcode 17 and parameter 0x02. This opcode normally has no parameters, so the presence of parameters allows the router to determine that the message is an encapsulated SY/MAX command and not a valid Modbus opcode 17.

Modbus to SY/MAX Translations

Modbus originated messages which can be reversibly translated are as follows. Note that accessing registers 8193..16384 reads or writes that status portion of SY/MAX register 1..8182.

Modbus devices should preferably use opcodes 3 and 16 to access registers in SY/MAX devices because these queries translate with legal status register addresses. Other Modbus opcodes may be used but are not guaranteed to be accepted by all SY/MAX end nodes (i.e. PowerLink). All Niobrara SY/MAX ports will accept the SY/MAX translation of any translatable Modbus query. Table 13-4 lists the Modbus to SY/MAX translations.

Table 13-4 Modbus to SY/MAX Translations

Modbus Message	SY/MAX Message
Read Coil Status (1)	Priority Read (0x20) with status register address 0xMN03 where M is the start bit modulo 16 and N is the bit count modulo 16
Read Input Status (2)	Priority Read (0x20) with status register address 0xMN05 where M is the start bit modulo 16 and N is the bit count modulo 16
Read Holding Registers (3) register 1..8192	Priority Read (0x20) with status register address 0x0006
Read Holding Registers (3) register 8193..16384	Non-Priority Read (0x00) status field with Transnum 0x03
Read Input Registers (4) register 1..8192	Priority Read (0x00) with status register address 0x0009
Force Single Coil (5)	Non-Priority Write (0x02) with Transnum 0x05 and single bit set in mask
Preset Single Register (6) register 1..8192	Priority Write (0x1e) with status register address 0x00d
Preset Single Register (6) register 8193..16384	Non-Priority Write (0x02) status field with Transnum 0x06
Force Multiple Coils (15) if start coil on word boundary and bit count integral multiple of 16.	Priority Write (0x1e) with status register address 0x001f
Force Multiple Coils (15) if all coils lie in one register and count < 16. Force multiple coils with coil count = 1 may be detranslated as force single coil.	Non-Priority Write (0x02) with Transnum 0x0f and appropriate (not 0xffff) mask
Write Multiple Registers (16) register 1..8192	Priority Write (0x1e) with status register address 0x0020
Write Multiple Registers (16) register 8193..16384	Non-Priority Write (0x02) with Status field with Transnum 0x10

All other Modbus messages will be encapsulated for transmission of SY/MAX media in a Print command (0x22) with status register address 0xBAD5. This normally illegal status register value enables downstream translations to distinguish the encapsulated messages from an actual SY/MAX print message (which must be encapsulated to ride Modbus media). Replies to untranslatable Modbus messages are encapsulated as the Print Reply (0x92) with the same, illegal, status register address. Encapsulated Modbus query and response packets include a byte for the Modbus address following the status register address bytes. This byte is unused but is required for compatibility with existing Niobrara Modbus to SY/MAX translations. Niobrara translator conforming to this specification set this unused byte to zero on transmission and ignore it on reception.

Master Operation

The Modbus Gate and Modbus Host modes may be used to connect Modbus slaves and networks of slaves to SY/NET. The Modbus Gate mode uses the translations in Table 13-3 to convert SY/MAX messages to Modbus serial messages. The Modbus Host mode allows the user to select the Modbus opcode and register bias (offset) for the translation. It is recommended that the Modbus Gate mode be used unless the user explicitly needs to alter the normal translation.

Register Bias

Modbus address values may fall outside the valid SY/MAX range of 1..8192. The MEB Modbus Host port provides an offset value called the Register Bias. The Register Bias may be set for any 16 bit value from 0 to FFFF hex (-23768 to 32767 dec). The Register Bias is only applied to Modbus Host Master

translations and is not applied on Modbus messages incoming to an MEB Modbus Host or Gateway Slave port.

Register Calculations

The Modbus commands which are register operations, (3, 4, 6, 16) are related to the SY/MAX REMOTE address specified in the READ or WRITE by the following formula:

MODBUS address = (SY/MAX REMOTE address) + (Register Bias)

NOTE: The Modbus Gate port always has Register Bias = 0. Also, the SY/MAX register address generated in a Modbus Slave translation always uses the Register Bias = 0

> Example: A SY/MAX read is routed to a Modbus Host (Master) port of an MEB. The Read Opcode is set for 4 because it is desired to read input register 300121 in a Modbus Slave PLC. The Register Bias is set to 0. The Modbus Address to be read is 121. The SY/MAX remote address for the READ is therefore: (121) - 0 = 121.

> Example: A SY/MAX multiple register write is routed to a Modbus Host (Master) port of an MEB. The Write Opcode is set to 16. The target registers in the Modbus devices start at 49175. The value 9175 is outside the range of the SY/MAX 8192 limit so the Register Bias must be set to a larger number such as 4000. With this value, the SY/MAX remote register number will be: (9175) - 4000 = 5175.

Table 13-5 displays the SY/MAX register to Modicon Register relationship for the MEB Modbus Host Master translation.

Table 13-5 SY/MAX Register to Modbus Register Relationship

SY/MAX Register	Modbus Register Bias = 0	Modbus Register Bias = 1	Modbus Register Bias = 500
1	1	2	501
2	2	3	502
3	3	4	503
4	4	5	504
5	5	6	505
6	6	7	506
7	7	8	507

Bit Calculations

Since the SY/MAX family does not differentiate between bit address and register address, the MEB MODBUS port must perform a translation to accomplish this task. The SY/MAX READ and WRITE messages support 16 bits per register address, so the translation to MODBUS coil address occurs in sections of 16 coils and occur on 16 bit boundaries. The MODBUS commands which are coil (bit) operations (1, 5, 15) are related to the REMOTE address specified in the READ or WRITE by the following formula:

Coil Start Address = (((SY/MAX REMOTE address) + (Register Bias) - 1) * 16) + 1

The start address refers to the address of bit 1 of the SY/MAX register. Table 13-6 displays the SY/MAX bit relationship to the Modbus coils for the MEB Modbus Master.

Table 13-6 SY/MAX Bit to Modbus Coil Relationship

SY/MAX Register	SY/MAX Bits	Modbus Bits Bias = 0	Modbus Bits Bias = 1	Modbus Bits Bias = 500
1	1...16	1...16	17...32	8017...8033
2	1...16	17...32	33...48	8034...8049
3	1...16	33...48	49...64	8050....8065
4	1...16	49...64	65...80	8066...8081
5	1...16	65...80	81...96	8082...8097
6	1...16	81...96	97...112	8098...8113
7	1...16	97...112	113...128	8114...8129

Modbus Retries

If a Modbus packet is transmitted from the MEB port and a valid reply is not received from the Modbus device, the MEB will wait for the amount of time specified in the MODBUS RETRY timeout register for that port. The MEB will then rebroadcast the message and wait for a valid reply. The MEB will retry only twice after the initial message.

Driver Mode

The Driver Mode setting for the Modbus modes allows the control of the RS-485 transmitter and receiver. For most applications, the PT to PT mode is the proper driver mode. This mode allows full duplex operation with the transmitter enabled at all times. This can be used to drive a 4-wire multidrop network as a master.

The FOUR WIRE mode causes the transmit driver to follow CTS. When CTS is enabled, the driver is enabled. When CTS is not enabled, the driver is allowed to tri-state at a high impedance. This mode is useful when the port is acting as a slave on a 4-wire multidrop network.

The TWO WIRE mode causes the transmit driver to follow CTS and the receiver to be disabled while transmitting. This mode allows the use of a 2-wire multidrop network.

Modbus peripherals are available in a variety of configurations. For most applications, you should set the port to 9600 baud, 8 data bits, EVEN parity (sometimes ODD) and 1 stop bit.

RS-485 MODBUS Host Master Mode Example
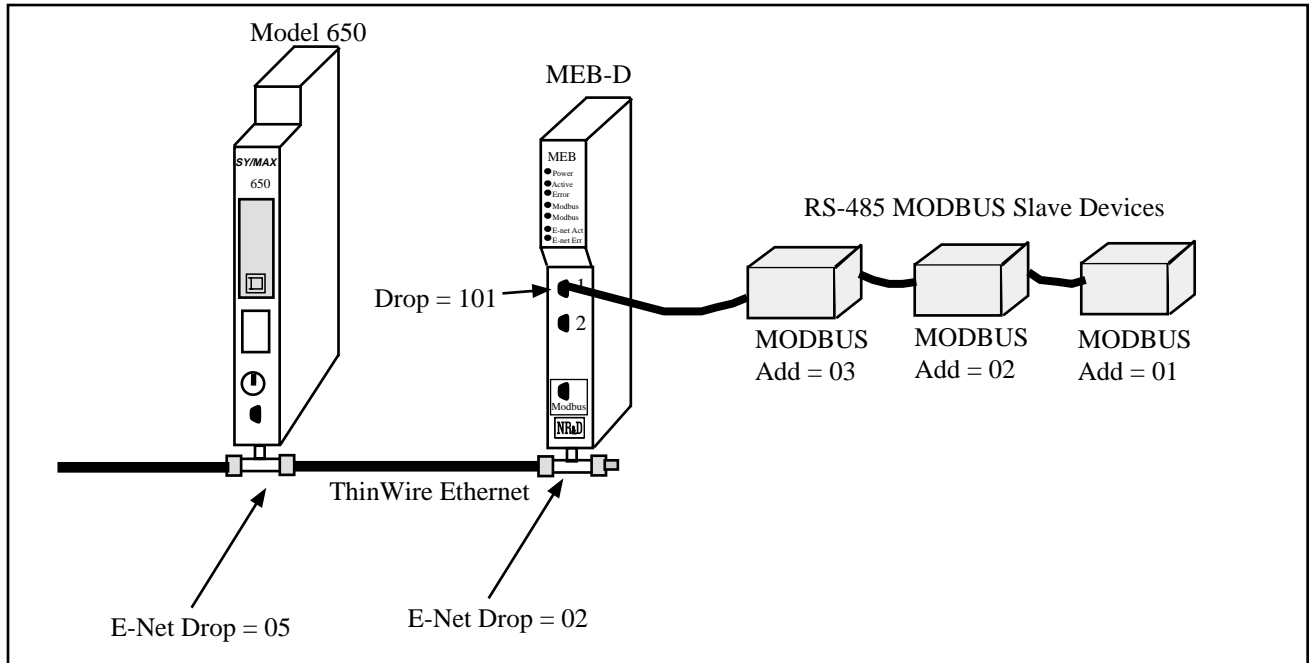
Figure 13-1 MODBUS Master Mode Example

Table 13-7 MULTIDROP Routing Examples

Origin	Target	Route
Model 650	MODBUS Slave 1	005, 002, 101, 001
Model 650	MODBUS Slave 3	005, 002, 101, 003

Table 13-8 MEB Setup for MULTIDROP Master Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
E-Net	02	SY/MAX	NA	NA	NA	NA	NA
1	101	Modbus Host	9600	E	8	1	Pt to PT

If the MODBUS peripherals are equipped for 4-wire RS-485 operation, up to 32 units may be connected to a single MEB RS-422 port. Set the Options bits for that Modbus port for Multidrop False and FULL Duplex.

If a 2-wire RS-485 network is required, set the Options bits for that port for Multidrop TRUE and HALF Duplex.

Modbus Slave Operation

The MEB Modbus Slave operation allows a Modbus Master to read and write data into SY/MAX devices via SY/NET. The MEB Modbus Slave port listens to the Master for messages that have Addresses that match entries in its Modbus Address table. Messages that do not correspond to addresses in the table are ignored. This functionality is similar to the operation of the Modicon BM-85 in Silent Master configuration.

The SY/MAX route generated for the translated message is determined by the setting in the Modbus Address table for that MEB port. Each MEB RS-422 port has its own table that is capable of holding 128 eight drop SY/MAX routes that correspond to 128 consecutive Modbus Slave addresses. The starting point of these 128 entries is adjustable using the Base Drop for that port. Therefore, two MEB ports connected in a multidrop fashion are able to respond to all 255 Modbus addresses.
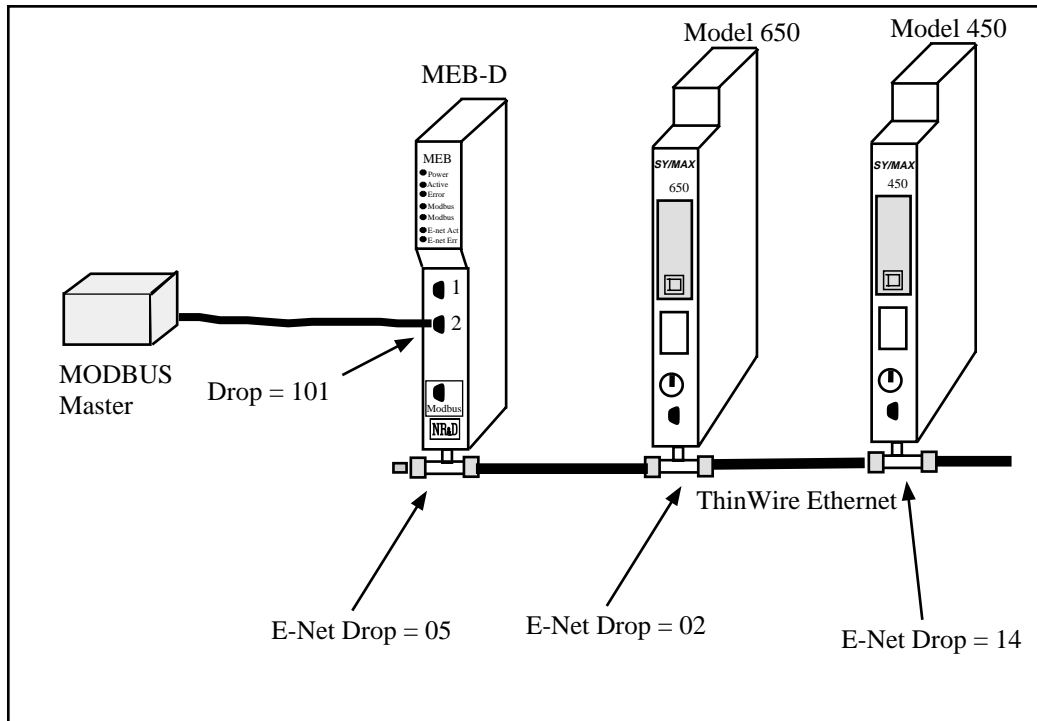
Figure 13-2 OTHER Modbus Slave Example

Table 13-9 Modbus Slave Example Setup

Origin	Target	Modbus Address	SY/MAX Route in the Modbus Address Table
Modbus Master	Model 650	1	101, 005, 002
Modbus Master	Model 450	2	101, 005, 014
Modbus Master	MEB Mailbox	3	101, 204

Table 13-10 Modbus Example Configuration

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
E-Net	05	SY/MAX	NA	NA	NA	NA	NA
2	101	Modbus Gate	9600	E	8	1	Pt to Pt

Since the incoming Modbus message is translated to SY/MAX, it is possible to have any this message routed to any other type of port on the SY/NET for further translation. This includes target devices such as PowerLogic units on PNIM ports, PLOGIC ports, IDEC units, and other speciality NIMs.
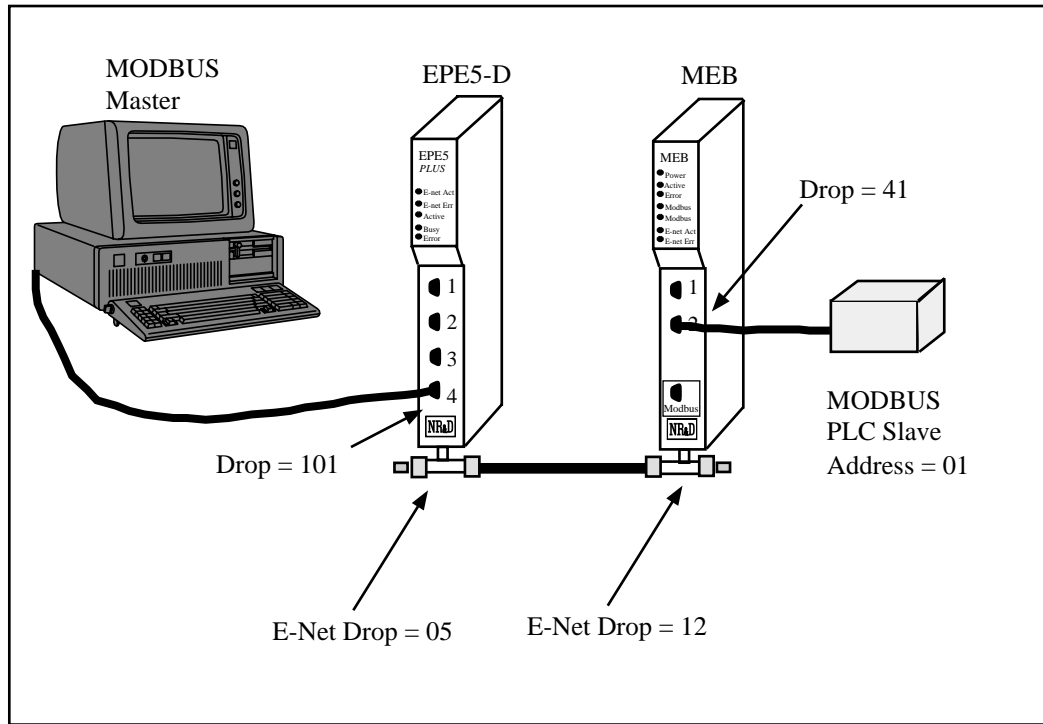
Figure 13-3 Modbus through SY/MAX Example

Table 13-11 Modbus Example Setup

Origin	Target	Modbus Address	SY/MAX Route in the Modbus Address Table
Modbus Master	Modbus PLC Slave	15	101, 005, 012, 041, 001

Table 13-12 EPE5 configuration

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
E-Net	05	SY/MAX	NA	NA	NA	NA	NA
4	101	Modbus Gate	9600	E	8	1	Pt to Pt

Table 13-13 MEB configuration

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
E-Net	12	SY/MAX	NA	NA	NA	NA	NA
3	41	Modbus Gate	9600	E	8	1	Pt to Pt

Figure 13-4 displays a Modbus Routing table for the previous application from the Edit Modbus Routing screen of MEBSW.

```
    M E B    M O D B U S +  /  E T H E R N E T    B R I D G E       \
Niobrara R&D                MEB 13NOV95 Port 0                      13Nov95
                     CONFIGURATION AND UTILITY SOFTWARE
oNline           oFfline           Utility          Setup           Quit
       MODBUS ROUTING FOR PORT 1, START ADDRESS = 1
           ADDRESS        ROUTE
              1          101,5,2
              2          101,5,14
              3          NONE
              4          NONE
              5          NONE
              6          NONE
              7          NONE
              8          NONE
              9          NONE
             10          NONE
             11          101,5,104,41,1
             12          NONE
             13
             14          NONE
             15          NONE
             16          NONE
                     Type digits to enter route. Home to edit start address.
                     Use + and - to select port. Escape to exit.
```

Figure 13-4 MEBSW Modbus Routing Editing Screen

PowerLogic Software use with Modbus Devices

The Modbus Host mode acting as a Master may be used to connect Modbus compatible devices to SY/NET for use with operator interfaces such as PowerLogic's System Manager software.

Register 8188

The entire suite of PowerLogic software packages includes the "feature" that they use a Read of register 8188 to determine if a device is online. Unfortunately, not all Modbus devices have registers that extend to 8188 and an error will be returned on the translation. If it is possible, Niobrara recommends that the user assign 8192 registers to the address space to be read in the target device. Otherwise, Bit 9 of the Options register for the port may be set to enable the Modbus port to recognize the single read of register 8188 and translate that read into the Modbus opcode 17 (11hex) to determine the PLC ID of the Modbus Device.

The Modbus PLC ID message returns a one byte ID, a run/halt byte, and a variety of other information about the PLC. The Modbus Host port will return the PLC ID in the LSB of the R[8188] reply. Bit 15 of R[8188] will always be set in this reply. Bit 16 of R[8188] will indicate the run/halt state of the PLC; if set, the PLC is in run and if clear, the PLC is in halt. Table 13-14 displays the currently used PLC IDs from Modicon.

Table 13-14 Modicon PLC ID Values

ID Value	PLC Type
0	Micro 84
1	484
2	184/384
3	584
8	884
9	984/Quantum

For example, if a Modicon 984 is attached to a Modbus Host port with Bit 9 of the Options register set, if the PLC is in run, a read of R[8188] will return the data C009 (hex) and if the PLC is in halt, the data 4009 (hex) will be returned.

Non-Priority Random Access Reads

The PowerLogic softwares all make extensive use of the SY/MAX Non-Priority Random Access Read message. This is a highly efficient use of the SY/MAX protocol and can provide excellent throughput for gathering large amounts of non-contiguous data. Unfortunately, the Modbus (and Modbus Plus) protocol has no version of a random access read. Therefore it is not possible to translate a SY/MAX Random read to a single Modbus read. Because of this incompatibility, the Modbus Host mode must be used to connect Modbus devices with PowerLogic software networks.

The Modbus Host mode translates each element of a random read to the corresponding Modbus read. So, an update of a custom table in System Manager with 60 entries, may very well translate to 60 Modbus RTU messages.

The Modbus Gate and Modbus Plus translations encapsulate SY/MAX Random Access Reads into transparent packets for shipment across the Modbus media and hence require another Modbus Gate or Niobrara Modbus Plus translation to dencapsulate the SY/MAX read. This technique allows the full use of the Random Read with SY/MAX and PowerLogic equipment.

The drawback is that it is not possible to directly access Modbus Plus devices from System Manager. There are two possible solutions to this problem: connect a Modbus Host port to the serial port of the MB+ device, or use the Global Data feature of the MEB to gather important data from several MB+ devices within the MEB and have the System Manager read the data from the MEB's mailbox.

NOTICE: Firmware revisions 05Feb96 and later support Random Access Reads to local MB+ devices. If a Non-Priority Random Access Read is routed onto the Modbus Plus network where the MEB's MB+ drop number is the next to last drop in the route, then the MEB will intelligently translate the random read into one or more standard Modbus reads, perform these reads on the Modbus Plus target, and assemble a Random Access Reply to send back to the SY/MAX device. The Option bit 9 for the Modbus Plus port should probably be set to ensure register 8188 spoofing on the MB+ devices.

This feature only works when there is only one drop following the MEB's MB+ drop number. If there is more than one drop following the MEB's drop number, the random read is encapsulated instead of translated. This is noteworthy for systems that have Bridge Plus devices or for PLC's on BM85 units, since these devices would require at least two more drop numbers in the route.

The RNIM mode provides compatibility with the Square D CRM-560 RNIM. Two modes of RNIM operation are RNIM Master (Mode 12) and RNIM Slave (Mode 13). The RNIM protocol provides remote network access to SY/MAX devices using a half-duplex connection via radio/microwave/fiber optic/telephone links with the addition of a modem device. For a twisted pair RS-485 link, it is recommend that the MULTIDROP Mode be used rather than RNIM. (See page 79.) The RNIM protocol is designed for Master/Slave operation while the Multidrop protocol is intended for Peer-to-Peer communication.

The RNIM mode makes use of the RTS/CTS handshake lines in Push-to-Talk mode. This mode is not available on Port 0 of any SPE4. The RNIM protocol may be used in conjunction with other SPE4s, EPE5s, MEBs, MPE3s, CRM-560s, and other RNIM compatible devices.

The RNIM protocol provides a single Master device to communicate with up to 99 Slave devices. Communication may occur through any of four mechanisms:

• Direct Master originated to Slave (NORMAL operation)

• Slave originated to Master (BID operation)

• Slave to Slave command relaying (STORE/FORWARD operation)

• Master originated broadcasting (BROADCAST operation)

Full SY/MAX message support, including all types of READs, WRITEs, and Programming is provided over the RNIM link.

NORMAL Operation

In general communication occurs by way of devices on the Master's local network sending messages routed to devices on a Slave's local network. The Master is usually located in a base station or control room and the Slaves are at the remote sites.

Under NORMAL operation, messages from the network of the Master are routed to a device on the network of a Slave. The SY/MAX route from the originator determines the exact path to the target device. In Figure 14-1, the Master RNIM is the CRM-560 and the MEB, SPE4 and EPE5 units are acting as Slave devices. If a PLC on the "Blue Hose" at NIM address 134 needs to read a register in the Model 400 connected to the SPE4, a route of 134, 36, 24, 27 would be used. To communicate with the Model

450, the route 134, 36, 19, 12, 10 is required. The Compact 984 may be reached with the route 134, 36, 22, 14, 2.
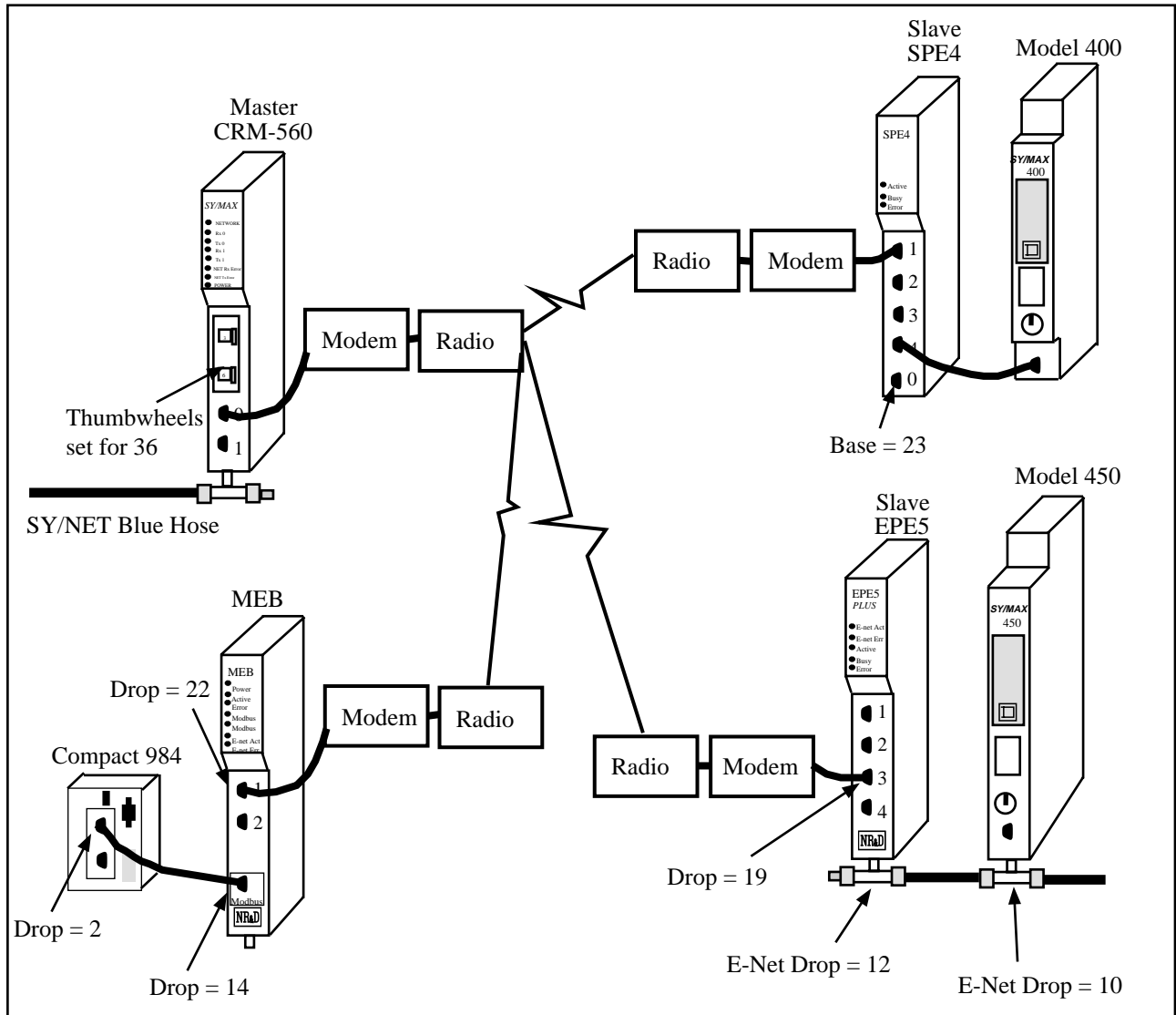
Figure 14-1 NORMAL RNIM Example

The RNIM protocol is a single-threaded half-duplex system. Single-threaded refers to the fact that only one message may be outstanding at any given time. Half-duplex refers to the fact that the transmission media only supports communication in one direction at a time. When a message arrives at the Master, it places that message in a buffer until the current message on the remote network is completed. Once the current message is complete, the new message is sent.

BID Operation

Under NORMAL operation, any device on the Master's network may communicate to any device on either Slave network. If a device on a Slave network attempts to send a message to a device on the Master's or another Slave's network, the Slave will buffer the message until a BID operation from the Master allows it to send the message.

In a BID operation, the Master temporarily releases its control of the remote network and allows individual Slaves the opportunity to transmit a stored message. A BID message is a special message sent from the Master to the Slave. The Slave has a limited amount of time to send its message.

NOTE: In the MEB RNIM Slave, this time is set by the Reply timeout setting. This time is fixed at 2 seconds in the CRM-560.

NOTE: A CRM-560 Slave will not respond to consecutive BIDs within 30 seconds of a successful BID. The MEB RNIM Slave does not include this restriction. The MEB will respond to any BID if it has a message in its Command buffer.

NOTE: The MEB Master will allow Slave to Slave automatic BIDs if the Reply timeout is large enough.

Single Slave BID Operation

When a Master BIDs a Slave, it relinquishes its control of the remote network to the slave. On a CRM-560, a BID is sent by writing the Drop number of the Slave to register 21 of the Master RNIM. On the MEB, SPE4 or EPE5, the drop number is written to the setup register for the RNIM Master mode port. When the Slave unit receives a BID, if it has one or more messages in its "buffer" it will transmit that message as though it is a Master. If more than one message is in the buffer, the message that has been in the buffer the longest will be transmitted. After the Slave completes its message transaction, control of the network returns to the Master.

The Slave is allowed to send only one message per BID regardless of the number of buffered messages.

If the Slave has no message to send, it simply ignores the BID and the Master will time out after 2 seconds (CRM-560 Master) or Reply timeout (MEB Master).

NOTE: To BID Slave address 00, use the BID address 100.

Automatic BID Operation (100 + n)

It is possible to automatically BID consecutive Slaves by writing the highest Slave drop number plus 100 to the BID register in the Master. The Master will BID the Slave and after a complete message cycle (or timeout), the Master will decrement the drop number by 1 and BID the next slave. This will continue for each drop number until 0 is reached. All drop numbers will be BID regardless if a Slave with that number is present on the network.

For example, if the number 134 is placed in the BID register, the Master will bid unit 34, then unit 33, 32, 31, ... 1, 0.

The BID interval setting is used to control the rate of bidding. The Reply timeout is used to control the time that the Master waits for a BID to be completed. The Masters timing sequence is as follows:

1   A value is written to the Bid address register.

2   A BID is sent to that address - 100.

3   The Master waits for the Reply timeout amount of time.

4   The Master waits for the BID interval amount of time. All queued NORMAL messages will be sent during the BID interval delay.

5   If the BID address is 100 then the automatic BID ends.

6   The BID address is decremented by one and flow returns to step 2.

If the Master receives a NORMAL message(s) while performing an Automatic BID, the process will be interrupted at the end of the current BID (during the BID interval) and the NORMAL message(s) will be sent. After the NORMAL message(s) is complete (or retries exhausted), the Automatic BID will be resumed.

Automatic BID Operation (200 + n)

It is possible to continuously automatically BID a single Slave by writing the Slave drop number plus 200 to the BID register in the Master. The Master will BID the Slave and after a complete message cycle (or timeout), the Master will BID the Slave again.

For example, if the number 207 is placed in the BID register, the Master will bid unit 07, then unit 07, 07, ...

The BID interval setting is used to control the rate of bidding. The Reply timeout is used to control the time that the Master waits for a BID to be completed. The Masters timing sequence is as follows:

1   A value is written to the Bid address register.

2   A BID is sent to that address - 200.

3   The Master waits for the Reply timeout amount of time.

4   The Master waits for the BID interval amount of time. All queued NORMAL messages will be
     sent during the BID interval delay.

5   Flow returns to step 2.

If the Master receives a NORMAL message(s) while performing an Automatic BID, the process will be
interrupted at the end of the current BID (during the BID interval) and the NORMAL message(s) will
be sent. After the NORMAL message(s) is complete (or retries exhausted), the Automatic BID will be
resumed.

Automatic BID Operation (300 + n)

It is possible to continuously automatically BID consecutive Slaves by writing the highest Slave drop
number plus 300 to the BID register in the Master. The Master will BID the Slave and after a complete
message cycle (or timeout), the Master will decrement the drop number by 1 and BID the next slave.
This will continue for each drop number until 0 is reached. After the 00 Slave is BID, the BID restarts
at the starting address. All drop numbers will be BID regardless if a Slave with that number is present
on the network.

For example, if the number 334 is placed in the BID register, the Master will bid unit 34, then unit 33,
32, 31, ... 1, 0, 34, 33, 32, ... 1, 0, 34, 33, 32,...

The BID interval setting is used to control the rate of bidding. The Reply timeout is used to control the
time that the Master waits for a BID to be completed. The Masters timing sequence is as follows:

1   A value is written to the Bid address register.

2   A BID is sent to that address - 300.

3   The Master waits for the Reply timeout amount of time.

4   The Master waits for the BID interval amount of time. All queued NORMAL messages will be
     sent during the BID interval delay.

5   If the BID address is 300 then the BID address is reset to the initial value.

6   The BID address is decremented by one and flow returns to step 2.

If the Master receives a NORMAL message(s) while performing an Automatic BID, the process will be
interrupted at the end of the current BID (during the BID interval) and the NORMAL message(s) will
be sent. After the NORMAL message(s) is complete (or retries exhausted), the Automatic BID will be
resumed.

Data Store and Forward Operation

In addition to the NORMAL and BID operations, all Slave units can function as a repeater. If a Master
is located where it cannot reach a Slave unit because of excessive distance or some other barrier, a
Slave that is within reach of the Master and the final target Slave may be used as a repeater.

The STORE and FORWARD feature of the RNIM Slave is used by simply including the drop number of the repeater Slave plus 100 in the route.
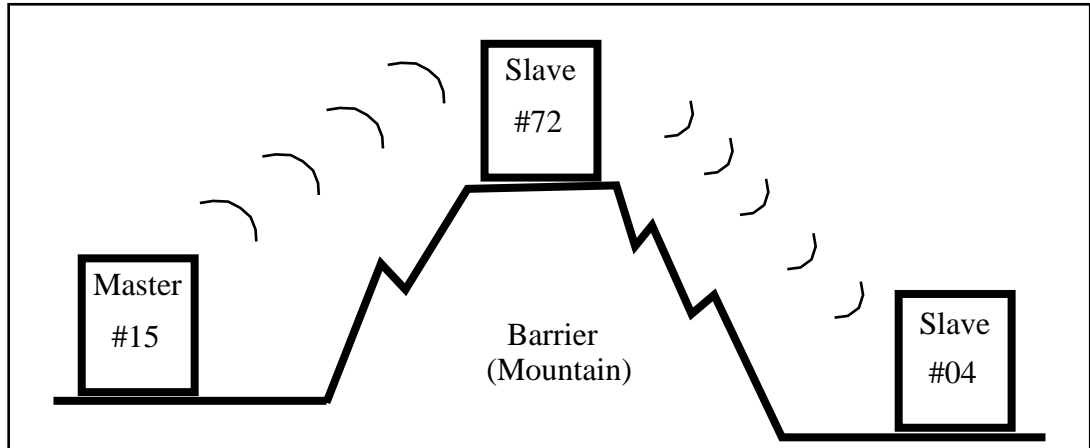
Figure 14-2 RNIM Repeater Example

Figure 14-2 displays an RNIM Master (15) on one side of a mountain, a Slave (04) on the other side of the mountain, and a Slave (72) at the top that can communicate with the other two. If a source on the Master's network (16) wants to send a READ to a PLC (87) on the Slave's network on the other side of the mountain, the route would be: 16, 15, 172, 4, 87.

The repeater unit can still function as a normal Slave if it is the target of the route. For instance, if the same source targets a PLC (21) on the network of the Slave at the top of the mountain, the route would be: 16, 15, 72, 21.

NOTE: It is not possible to perform an indirect BID using the STORE and FORWARD feature of an intermediate Slave.

Broadcast Operation

Due to physical differences between the Square D CRM-560 and MEB, the Broadcast Operation implementation varies. The MEB RNIM Slave will respond equally to either the even or odd Broadcast message that correspond to Table 14-1 and this response will be acting upon the internal registers within the MEB.

Table 14-1 Broadcast Route Values

	Slave Drop #	CRM-560 Slave Port	MEB Response	Broadcast Route Value
General Broadcast	00-99	#1 Twin-ax	Internal Internal	254 253
Partial Broadcast	90-99	#1 Twin-ax	Internal Internal	252 251
	80-89	#1 Twin-ax	Internal Internal	250 249
	70-79	#1 Twin-ax	Internal Internal	248 247
	60-69	#1 Twin-ax	Internal Internal	246 245
	50-59	#1 Twin-ax	Internal Internal	244 243
	40-49	#1 Twin-ax	Internal Internal	242 241
	30-39	#1 Twin-ax	Internal Internal	240 239
	20-29	#1 Twin-ax	Internal Internal	238 237
	10-19	#1 Twin-ax	Internal Internal	236 235
	00-09	#1 Twin-ax	Internal Internal	234 233

If it is desired to route a broadcast message to all MEB RNIM Slaves with Drop numbers in the fifties and send a broadcast message our all of the other SY/MAX mode ports on the MEB, simply use the route number 244 in the position normally held by the Slave address and 254 for the last drop in the route.

Mode 12: RNIM Master

Several operational parameters of the RNIM Master in the MEB are adjustable. Table 14-2displays the control registers in the MEB and the equivalent registers in the Square D CRM-560. The MEB retains the previous setup parameters upon power-up while the CRM-560 always returns to the factory default settings.

It is important that the Master and all Slave units on the same network be set for the same parameter values. If CRM-560s are included in the network, it is important to note that the BID response timeout is fixed at two seconds in the CRM-560 while it is adjustable in the MEB.

Bit 9 of the Options register for a RNIM Master controls the Enable of the Master. If this bit is set (on), the RNIM Master is disabled. This allows multiple Masters to be connected to the Remote Network for redundancy.

Table 14-2 RNIM Master Register Summary

CRM-560 Register	MEB Register		Description	Notes
	Port 1	Port 2		
18	8041	8073	Identification number.	Must be the same for all RNIMs on the same network. CRM-560 defaults to 0 on power-up.
19	8042	8074	Clear to Send (CTS) Delay (10mS units)	CRM-560 defaults to 500mS on power-up.
20	8043	8075	Message Response timeout (10mS units)	CRM-650 defaults to 20 seconds on power-up. The MEB also uses this value as the BID timeout.
21	8044	8076	BID address number	00 to 99 Single BID. 100 to 199 Automatic BIDs. 200 to 299 Continuous Single BIDs 300 to 399 Continuous Automatic BIDs.
22	8045	8077	Number of Retries (when no ACK received)	CRM-560 defaults to 3 on power-up.
23	8062	8094	Master Disable	Set bit 9 in the SPE4/EPE5/MEB options register to disable the Master. Set the CRM-560 register to decimal 123 to disable the Master.
25	8058	8090	Pause Time (10mS units)	CRM-560 defaults to 15 seconds on power-up.
26	8059	8091	Message Count (between Pause Time)	CRM-560 defaults to 4 on power-up.
NA	8060	8092	BID Reply Interval	This value determines the amount of time between successive automatic BIDs.
NA	2103	2135	Number of messages in Command Buffer	Read Only Statistic that displays the number of queued messages waiting in the Command buffer.

Mode 13: RNIM Slave

Several operational parameters of the RNIM Master in the MEB are adjustable. Table 14-3 displays the control registers in the MEB and the equivalent registers in the Square D CRM-560. The MEB retains the previous setup parameters upon power-up while the CRM-560 always returns to the factory default settings.

It is important that the Master and all Slave units on the same network be set for the same parameter values. If CRM-560s are included in the network, it is important to note that the BID response timeout is fixed at two seconds in the CRM-560 while it is adjustable in the MEB.

Bit 9 of the Options Register for a RNIM Slave allows the Command Buffer to be cleared. Set this bit to clear the queued messages. Clear this bit to resume normal operation. The Number of Queued Messages statistic register may be used to determine the number of messages in the Command Buffer.

Table 14-3 RNIM Slave Register Summary

CRM-560 Register	MEB Register		Description	Notes
	Port 1	Port 2		
18	8041	8073	Identification number.	Must be the same for all RNIMs on the same network. CRM-560 defaults to 0 on power-up.
19	8042	8074	Clear to Send (CTS) Delay (10mS units)	CRM-560 defaults to 500mS on power-up.
20	8043	8075	Message Response timeout (10mS units)	CRM-650 defaults to 20 seconds on power-up. The ME also uses this value for the BID timeout.
24	8062	8094	Clear Command Buffer	Set bit 9 in the MEB options register to clear the Command buffer. Set the CRM-560 register to decimal 210 to remove stored commands from the buffer.
NA	2103	2135	Number of messages in Command Buffer	Read Only Statistic that displays the number of queued messages waiting in the Command buffer.

Driver Mode

Pt to Pt

RNIM Master and Slave modes on ports 1 and 2 offer the ability to operate on RS-485 networks in 4-wire and 2-wire modes. When the port is set to Pt to Pt it is in its normal RS-422 mode for point to point operation. This is the default state for the module and it is the only state available on Port 0 and the RS-232 ports. In Pt to Pt mode, the RS-485 transmit drivers are always enabled. Choose Pt to Pt when the Multidrop port is the master on a 4-wire multidrop network.

Half Duplex

RNIM Master and Slave modes on ports 1 and 2 offer the ability to operate on RS-485 networks in 4-wire and 2-wire modes. Half Duplex mode allows the port to ignore any echo that may be returned from the attached device. The Half Duplex mode is the same as the Pt to Pt mode with the exception that the receiver is disabled when the unit is transmitting. The transmit drivers are always enabled.

NOTE: It is recommended that the Half Duplex mode be used with RNIM Multidrop networks such as when the RM14K is being used.

Two Wire

RNIM Master and Slave modes on ports 1 and 2 offer the ability to operate on RS-485 networks in 4-wire and 2-wire modes. Two wire setting allows the port to operate on a 2-wire RS-485 peer-to-peer network. The transmit driver is normally tri-stated and is dependent upon the state of CTS. The receiver is disabled when the transmitter is enabled. The two wire setting sets bits 7 and 8 of the options register for that port.

RTS/CTS Operation

It is important to note that the RTS/CTS operation of the MEB RNIM is slightly different than that of the CRM-560. If CTS is not present at the end of the CTS delay, the CRM-560 will post an error message to the originator, while the MEB will wait for the attached device to assert CTS. This true handshaking feature of the MEB allows the CTS delay setting to be set to the smallest allowable time for the best throughput while allowing a longer than normal handshake response if required. The CRM-560 must be set to the largest delay possible to avoid excessive timeout errors.

The MEB handshake sequence is as follows:

1   The MEB asserts the Request to Send (RTS) signal when it has data to send.

2   The MEB will wait for the CTS delay time and for CTS to be asserted before it will send the data. If the CTS delay time is set for zero, the MEB will just wait for CTS to be asserted.

It is recommend that in modem applications (including the RM14K), that the CTS delay time be set for a minimum value of 10.

15

Transfer Mode

The Transfer mode allows re-routing of SY/MAX messages to the Primary PLC in a redundant system. This feature may be used for re-directing messages through any port but is most useful for Ethernet devices.

> **NOTE:** The Transfer mode is available only on serial ports 1 or 2. When a port is in Transfer mode, the actual serial port is disabled and may not be used for external communication.

Incoming command messages routed to the Transfer port have their routes modified by the addition of the Transfer Route to the end of route. The message is then re-routed to the destination directed by the Transfer Route. Reply messages from the destination target have the Transfer Route removed as they are routed through the Transfer port and are then sent back to the original source. The Transfer Route is stored in the Auto-Transfer Route configuration registers for the appropriate serial port.

The "On Ethernet" feature may be used to reduce the number of drops needed in the route.

Transfer Example

Figure 15-1 displays a pair of Model 650 PLCs in a Hot-Backup system, an MEB, a Quantum PLC, and a computer acting as an operator interface. The Model 650s are controlling a critical system and one be the Primary and actually running the system. The other Model 650 is the Secondary (Standby) unit and upon failure of a component in the Primary, it assumes control and becomes the new Primary.

This oscillation of the Primary usually spells trouble for the Operator Interface (OI). The Model 650's E-net address is fixed by dip switches and it is not able to modify it while running. Therefore, the OI must continuously decide which PLC is the Primary by polling additional registers in the PLC and switch between the two E-net addresses on the transfer of control.

With the Transfer mode in the MEB, it is possible to set up the OI (and other devices on the network) to poll a single E-net drop and have the MEB redirect the messages to the Primary. The OI doesn't care which PLC is the Primary, it always sends its messages to the MEB.

When the transfer occurs the new Primary sends a TWRITE to the MEB to change the "Transfer Route" within the MEB to point to its E-net address.
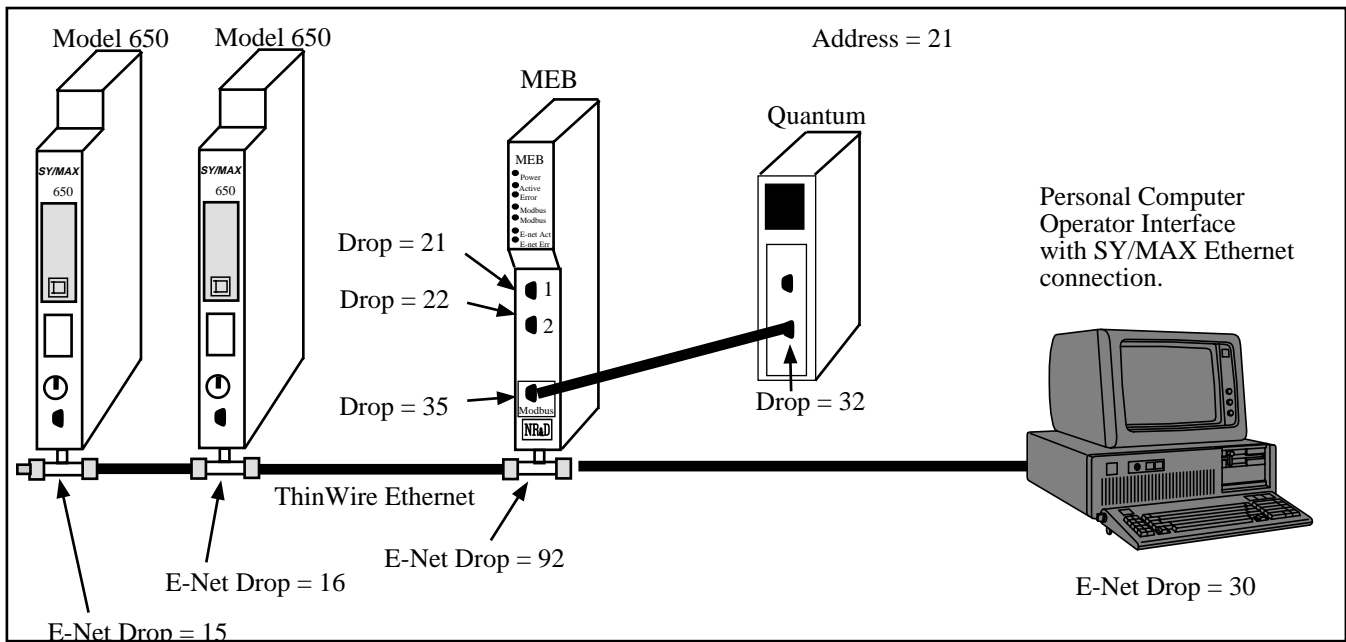
Figure 15-1 TRANSFER EXAMPLE

The MEB Port 2 is set for TRANSFER protocol. The "On Ethernet" feature is set to NO. The Transfer Route will be set to 92, 15 when the left Model 650 is Primary and 92, 16 when the right 650 is Primary. The route from the OI will always be 30, 92, 22 to reach the Primary.

The route from the Quantum will always be 35.02.00.00.00 since it will always point to the Transfer port (Port 2) and the transfer port will redirect the message to the appropriate Model 650,.

The Transfer Route for Port 2 is stored in registers 8078 through 8086 in the MEB. Register 8078 contains the number of drops in the route to the Primary from the Transfer port. The registers following contain the 8 drops of the route.

Table 15-1 Transfer Route Registers

MEB Register	Description	Settings for 15 as Primary	Settings for 16 as Primary
8078	# of drops in route	2	2
8079	Drop 1	92	92
8080	Drop 2	15	16
8081	Drop 3	0	0
8082	Drop 4	0	0
8083	Drop 5	0	0
8084	Drop 6	0	0
8085	Drop 7	0	0
8086	Drop 8	0	0

When the hot-backup transfer occurs and the old Secondary becomes the new Primary, the new Primary writes its Ethernet address to meb register 8080. It is usually important to write the application in a redundant system such that both PLCs run the exact same program. Register 8093 in the Model 650 contains the 650's Ethernet drop number.

NOTE: The value in register 8078 sets the number of drops in the Transfer Route for Port 2. Since it is set to 2 in this example, it doesn't matter what the values are in registers 8081 through 8086.

PLC Ladder Rungs

Both Model 650s could have the following ladder rungs in their programs to perform the communications switch.

```
   8161                                                           000x
 ---| |-----------------------------------------------------( )---|
   -20                                                           -0x

   000x                      +-------ROUTE-ROUTE-STAT-LOCAL-REMOTE-COUNT-+
 --| |-----------------------TWRITE   201     92   S222 S8093 S8080    1  |
   -0x                       +----------------------------------------+
```
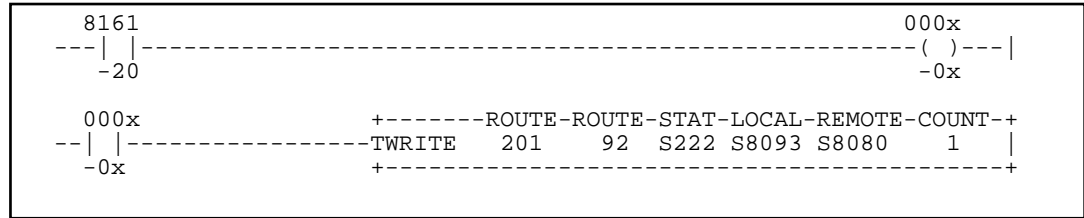
Figure 15-2 Transfer Communication Rungs

As the backup PLC assumes the role of Primary, status bit 8161-20 is set to 1 (ON) by the LTI. This energizes coil 000x-0x. Upon scanning this contact in rung 2, the TWRITE is executed. The first drop in the route is set to the special "don't care" drop number 201. The second drop in the route is set for the MEB's E-net port of 92. The STAT register is a unique communication status register within the PLC. The LOCAL register contains the Ethernet SY/MAX drop number of the PLC. The REMOTE register is the target in the MEB for the write. And finally, the COUNT is set to 1 because only one register needs to be sent.

With the use of the 201 route and registers 8093, the above rungs become generic and may be used in both PLCs.

```
┌─────────────────────────────────────────────────────────────────┐
│                         CAUTION                                    │
│                                                                    │
│  Do not attempt to program the Primary PLC through the Transfer route.  A system │
│  transfer could occur during the program load and cause the program to load incorrectly. │
│  Programming should always be performed directly to the PLC's E-net address.  │
└─────────────────────────────────────────────────────────────────┘
```

"On Ethernet" Example

The above example could be changed to use the "On Ethernet" feature of the Transfer port to reduce the number of drops in the routing. The following changes would take place:

- The "On Ethernet" option would be set to YES for Port 2 of the MEB.

- The value in R[8078] would need to be changed to 1 since there will only be one drop in the Transfer Route.

- The remote register in the ladder logic TWRITE would now need to be 8079 to place the target Model 650 address in the first drop of the Transfer Route.

- The Route from the OI is now simply 30,22.

- The Route from the Quantum is still 23.02.00.00.00 to still point to the Transfer Port.

- Extra care must be used to avoid setting one of the drop numbers of a port in the MEB to a potential target of the Transfer Route to avoid routing errors.

16
Chevron Mode

The Chevron mode is a combination of the RNIM Master and Modbus Gate modes to allow the integration of remote SY/MAX and Modbus devices on the same multidrop 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 following drop in the range of 100 through 199 are sent out as Modbus RTU packets where the Modbus slave address is 100 minus the drop number.

All SY/MAX messages are supported through the RNIM messages structure including PLC programming. Also, all Modbus RTU messages are supported including PLC programming. All RNIM Slave devices may be used in a Chevron network including CRM-565 RNIMs, SPE4s, EPE5s, and MEBs. Any Modbus RTU slave device with active RTS/CTS handshaking may also be used in a Chevron network as a Slave.

The following restrictions apply to the Chevron mode:

- All devices (RNIM and Modbus) must operate with the serial parameters. Typically this will be 9600 baud, 8 data bits, 1 stop bit, and EVEN parity.

- All Modbus Slave PLCs must not be in "Bridge" mode if they are also on a Modbus Plus network. The Slave devices must not respond to Modbus messages are not targeted to their address. PLCs in Bridge mode pass messages onto the Modbus Plus network which may result in multiple replies from different units and/or error replies from non-existent units.

- Modbus address 16 decimal (10 hex) may not be used. It is possible that unit 16 would try to respond to the RNIM messages.

- RNIM repeater features are not allowed. Drop numbers greater than 100 will be sent as Modbus RTU messages and not RNIM repeater routes.

- The Chevron port operates as a Modbus Gate mode as a master only. The port will not accept messages as a Modbus Slave.

- The Chevron port handles bit-masked non-priority SY/MAX writes differently than the Modbus Gate port. The Gate port translates bit-masked writes as coil writes while the Chevron port sends a Holding Register write. The Holding Register write sets all unmasked bits to zero.

- The values for the CTS timer, Pause Time, and Message Count are used for both Modbus and RNIM messages.

- The Modbus messages do not retry if a response is not received before the Reply Timeout. No error message is posted to the originating device. It is up to the originating device to timeout and retry the message. This action was implemented to accommodate MODSOFT and allow PLC pro-

gramming across a Chevron type network. RNIM messages follow the normal retry mechanism of the standard RNIM Master.

- Like a normal RNIM network, all RNIM devices must use the same Network ID.

- RNIM BIDding and automatic BIDding is permitted and operates like a normal RNIM Master port.
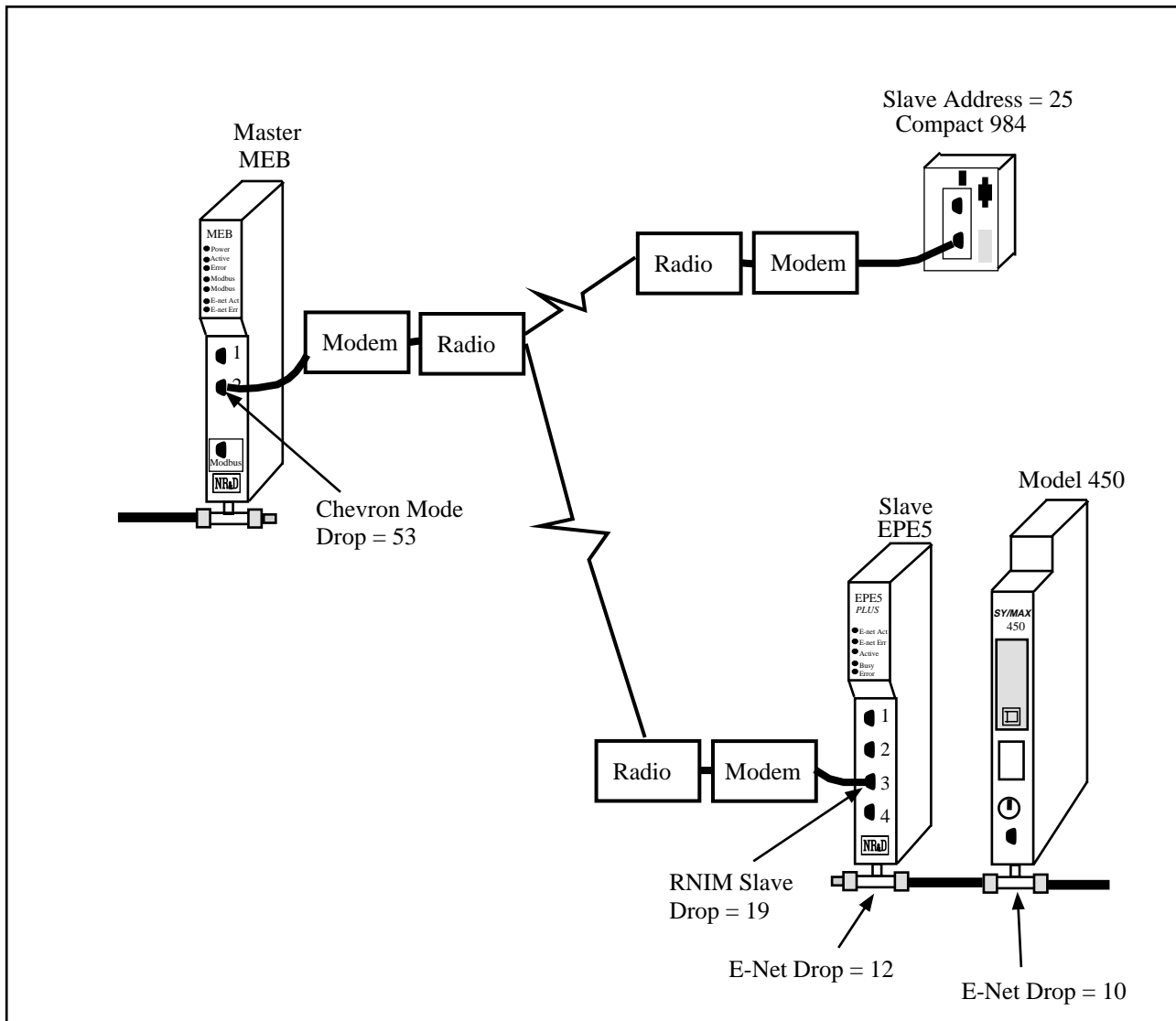
Figure 16-1 Chevron Example

An example application of the Chevron mode is displayed in Figure 16-1. The Master MEB on the left has Port 2 in Chevron mode with a drop number of 53. This port is connected via radio modems to another EPE5 and a Compact 984 PLC. The remote EPE5 has its Port 3 set for RNIM Slave with a drop number of 19. The Compact 984 is configured for RTU mode with and address of 25.

To route to the Model 450, the portion of the route from the Master MEB would be:
$$..., 53, 19, 12, 10$$

while the route to the Compact 984 from the Master MEB would be:
$$..., 53, 125$$

Notice that the Modbus device was accessed by adding 100 to its slave address.

17

Auto-transfer and Auto-Scan

The MEB has the ability to originate READ and WRITE messages on a timed interval using the Auto-transfer and Auto-Scan features. The READ messages move information from an external device to the MEB's internal mailbox registers. The WRITE messages move information from the MEB's mailbox registers to an external device.

Auto-Transfer

The Auto-transfer is available on the serial ports in the following protocol modes: SY/MAX, NET-to-NET, IDEC, Modbus Host, Modbus Gate, PLOGIC, and PNIM. The use of Auto-transfer in Modbus modes implies that the EPE5 port is the Master. The Auto-transfer feature is available on the Ethernet port as long as the E-PEER feature is disabled.

The Auto-transfer has the ability to perform a single READ and/or WRITE with a single fixed route to the target device on a timed interval. Adjustable parameters include:

- Transfer Interval - This value sets the amount of time between successive messages in 10mS units. If only READs or only WRITEs are enabled, this interval determines the amount of time between the sending of each messages. If both READs and WRITEs are enabled, the READs and WRITEs are alternated. For example if both READs and WRITEs are enabled and the Transfer Interval is set to 100, then a READ will be sent, one second later a WRITE will be sent, one second later a READ will be sent...etc.

  The Transfer Interval should be set to a large enough number to allow a message to be sent and the response to be received before the next message is sent. If the Transfer Interval time has expired and the reply from a previous poll has not been received, that EPE5 port will insert a delay of two seconds before the next transfer. It is good practice to allow for at least three times the actual transmission time of the command and reply message for retries and additional network traffic. A Transfer Interval of zero (0) will disable the Auto-transfer.

- Transfer Route - The Transfer Route determines the path to the target device. The first drop in the route is usually the drop number of the Auto-transfer port. Additional drops are used to point to the specific target. For example, if a PNIM port has a drop number of 125 and the target of the Auto-transfer is Circuit Monitor 4 then the route would be 125,004.

- READ Count - The READ Count determines the number of registers returned by the READ. The maximum Count is 128 for SY/MAX messages. A setting of zero (0) disables the Auto-transfer READ.

- READ From - The READ From value is the starting register for the read in the remote device.

- READ To - The READ To value is the starting register for where the data from the external device is placed in the MEB's mailbox registers. This value must be within the range of 1 through 2048.

- WRITE Count - The WRITE Count value is the number of registers transferred from the MEB's Mailbox registers to the external device. The valid range is 0 through 128 where 0 disables the WRITE transfer.

- WRITE From - The WRITE From value is the starting register in the MEB's Mailbox from which the data is sent to the external device.

- WRITE To - This value is the starting point in the external device where the data is written.

Auto-Scan

The Auto-Scan is an enhancement of the Auto-transfer feature to allow up to 48 independent READs or WRITES to be operated on external devices. Each serial port on the MEB includes its own Auto-Scan table. The Auto-Scan feature is not available on the Ethernet port nor the MB+ port. Each entry in the Auto-Scan table is configured for its own local, remote, count, read or write type, and route parameters.

- TRANSFER INTERVAL - This value sets the amount of time between successive non-empty messages in 10mS units. The Transfer Interval should be set to a large enough number to allow a message to be sent and the response to be received before the next message is sent. If the Transfer Interval time has expired and the reply from a previous poll has not been received, that MEB port will insert a delay of two seconds before the next transfer. It is good practice to allow for at least three times the actual transmission time of the command and reply message for retries and additional network traffic. A Transfer Interval of zero (0) will disable the entire Auto-Scan table.

- LOCAL - The local value is a pointer to a register in the MEB's mailbox. On READ operations, this register is the starting register where the data from the external device is placed upon completion of the read. On WRITE operations, this is the starting point of the data from the MEB to the external device. The valid range of this parameter is 1 through 2048. A setting of zero will disable an individual Auto-Scan entry.

- REMOTE - The remote value is a pointer to a register in the external device. On READ operations, this is the starting register in the remote device. On WRITE operations, this is the starting register for the data from the MEB. The valid range of this parameter is 1 through 8192. A setting of zero will disable an individual Auto-Scan entry.

- COUNT - The count value determines the number of registers to be included in the READ or WRITE. The valid range is normally 1 through 128. A setting of zero will disable an individual Auto-Scan entry.

- DIRECTION - The direction determines whether the operation will be a READ (from the external device to the Mailbox) or a WRITE (from the Mailbox to the external device).

- ROUTE - The Route determines the path to the target device. The first drop in the route is usually the drop number of the Auto-Scan port. Additional drops are used to point to the specific target. For example, if a PNIM port has a drop number of 125 and the target of the Auto-Scan is Circuit Monitor 4 then the route would be 125,004.

Notice: The Auto-Scan feature uses the Timer Interval from the Auto-transfer feature so therefore the Auto-transfer feature is disabled if a valid entry in the Auto-Scan is found by the MEB. In order to be classified as a valid entry, the local, remote, count and route entries must be non-zero and fall within their respective valid ranges.

Notice: The Auto-Scan feature uses the route table from the Modbus Slave Table for a given serial port. If the Auto-Scan feature is enabled on a Modbus mode port, that port will be a Master and Slave operation will not be allowed.

Auto-Scan Status

The Auto-Scan feature includes the option of having a group of three mailbox registers to display the status of each Auto-Scan entry. Each Auto-Scan entry has a status bit which is set if the scanned message has a successful reply and cleared if the scan entry is disabled or an error occurs in the reply. The

first Status register is for Scan entries 1 through 16, the second register is for entries 17 through 32 , and the third Status register is for entries 33 through 48.

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18

High-Speed Peer Modes

</div>

EPEER Mode

Niobrara MEB and EPE5 Ethernet port expanders with firmware revision 21Apr95 or later are equipped with a peer-to-peer feature that allows a number of MEB and EPE5 units to distribute a range of rack-addressed registers among themselves. This feature is similar to the Sy/Peer feature of the Square-D model 600 or the Global Data Peer Cop function of Modicon PLCs. In comparison, Sy/Peer is higher in performance and can synchronize the scan of the linked PLCs but the EPEER is more flexible and uses standard Ethernet protocols so can be mixed with a small amount of ordinary traffic. For instance, PLCs can be programmed over the same cabling that carries the EPE5 peer-to-peer traffic. The EPE5 peer mode is faster than ordinary Sy/Net 802 operations because all nodes in the network are updated by a single multicast Ethernet packet instead of individual write transactions.

To design an EPEER peer network, determine how many registers each node will provide (broadcast) to the other nodes, the number of nodes, the total number of registers involved and the required update interval. Unlike Sy/Peer, the EPEER network is not restricted to broadcasting the same number of registers from each node, nor does the number of registers broadcast need to be a power of two. Any number of registers from 1 to 128 can be broadcast by any node. For an example, let us assume a network of eight EPE5 equipped nodes each transmitting 50 registers. This is a total of 400 registers that would be rack-addressed to each EPE5 unit.

Each node is assigned a node number, in this case 1 through 8. This node number is not related to the Sy/Net 802.3 drop number of the EPE5. For our example, let us imagine that the register map of each EPE5 looks like this:

Table 18-1 E-PEER Register List Example

MEB Registers	Supplying Node
1..50	1
51..100	2
101..150	3
151..200	4
201..250	5
251..300	6
301..350	7
351..400	8

Write the following values to the setup registers in each EPE5:

MEB Register	Function	Example Value
8026	Number of peer nodes	8
8012	Number of this node	1 through 8
8013	Start of register range to transmit	(R[8012] - 1) * 50 + 1
8027	Number of registers to transmit	50
8028	Destination register (in other peers)	same as R[8013]
8011	Update interval in milliseconds	24 (3mS per node)
8030	Bit 6 enables E-PEER operation	32

Rack address 400 registers to the EPE5 in each PLC rack.

The bits of read-only register 3303 correspond to those of the first sixteen nodes in an EPE5 peer network which are active. If unit x is active on the network, bit x is set. If node x is powered off, disconnected from the cable, or otherwise disabled, bit x will be cleared. Loss of one node has no effect on the timing of the other nodes. They will detect the absence of the node and clear the corresponding bit in their register 3303. If the peer network has more than sixteen nodes, node numbers 17 and beyond have no associated active bit.

The update interval should be selected depending on system requirements and PLC scan time. As a rule of thumb, don't attempt to update faster than 1 or 2 milliseconds per node. There is no point in updating the peer-to-peer network much faster than the PLC can scan, but bear in mind that there is no synchronization between PLC scanning and peer-to-peer updating. Attempting to update too many registers too fast will result in Ethernet collisions that will reduce the throughput of the network and render it non-deterministic. Check the collision statistics (register 2066 and 2067) to determine if your update rates are too ambitious or consult Niobrara for maximum update rates for a given system design. Use the Ethernet packet counters (registers 2064 and 2065) and a stopwatch to verify that throughput is what you expect. Note that no acknowledge packet is sent for EPE5 peer operations and it is your responsibility to avoid overloading the available throughput.

With no other traffic on the cable, the network will operate deterministically. Each node will time its register broadcast to occur in its time slot. Depending on the amount of network bandwidth and processing resources used up by the peer-to-peer transmissions, non-peer traffic (i.e. Sy/Max programming or reads and writes) can cause a temporary loss of deterministic behavior. This is not usually a problem when the network is being used to program the PLCs. Peer operations have priority over other MEB transactions.

As of 5 June, 1995 it is possible to set up an MEB to receive E-Peer broadcasts without transmitting any. Any number (up to Ethernet limits) of MEB units may listen to one or more broadcasting units. To configure a listen-only E-Peer node, set bit 6 of register 8030 to 1 and set register 8012 (number of this node) to 0. An MEB with 8030.6 clear will ignore E-Peer broadcasts but, like any IEEE 802 compliant

device, can coexist on the Ethernet with E-Peer configured units. A receive-only or non E-Peer unit is not counted in the number of nodes programmed into register 8026 of the E-Peer units.

The E-Peer parameters may be easily configured within MEBSW. See page 125 for more information.

Figure 18-1 displays the timing relationship for an E-peer network with three nodes, A, B, and C. Notice that the Update Interval is based upon the time between broadcasts of the same unit.
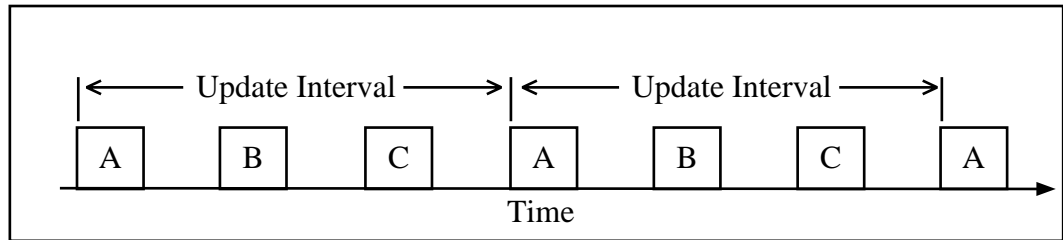
Figure 18-1 EPEER Update Interval Timing

Modbus Plus Global Data

The MEB implementation of the Global Data allows distribution of global data over Modbus Plus. The MEB can broadcast up to 32 contiguous registers from its mailbox registers to the other Modbus Plus nodes and receive up to 32 registers to its mailbox from each of up to 63 other Modbus Plus nodes on its network.

NOTICE: Global data cannot travel through Bridge Plus devices.

By assigning the Global Data registers within the rack addressable portion of the mailbox registers, a SY/MAX PLC can participate in the Global Data network. Note that, in conjunction with EPEER, this feature can be used to bridge EPEER and Global Data or to bridge limited Global Data between two Modbus Plus segments via Ethernet.

Global input and output are controlled by pairs of registers. Each pair comprises a length register and a pointer register. The length register may be set to a value 1 through 32 and indicates how many registers will be sent to other nodes or received from a specific node. The pointer register indicates the start register within the mailbox area from which data is read for global output or to which global input data will be written. The pointer register may be in the range 1 through 2048 with the restriction that the sum of the pointer plus the length must not exceed 2049. Setting either or both of the length and pointer register to zero disables global output or reception of global data for the associated node. The length and pointer registers are located in a block between register 3800 and 3929 inclusive. The global input entry associated with the MEB's own Modbus Plus drop number should be zero.

Programming the Global Output registers is not alone sufficient to assure data distribution to other nodes. The receiving nodes must be programmed to accept the global data from the MEB.

Table 18-2 MB+ Global Data Control Registers

MB+ Node	Direction	Length Register	Pointer Register
MEB's	OUTPUT	3800	3801
1	INPUT	3802	3803
2	INPUT	3804	3805
3	INPUT	3806	3807
4	INPUT	3808	3809
...	INPUT	...	...
N	INPUT	$3800 + N * 2$	$3801 + N * 2$
...	INPUT	...	...
64	INPUT	3928	3929

19
On Ethernet Option

Each of the serial ports and the Modbus Plus port have the option of being mapped to the Ethernet as a "Virtual E-Net Node". This feature is called "On Ethernet". By placing the drop numbers of the serial ports or Modbus Plus ports on the Ethernet, the number of drops in the Route may be reduced. This may be especially helpful in cases of Net-to-Net, Modbus, and PowerLogic protocol modes.

> NOTE: The "On Ethernet" option only applies to the SY/MAX 802.3 Ethernet proto-col. The "On Ethernet" setting is ignored in NRD/TCP and Modbus/TCP protocols.

The MEB treats ports with the "On Ethernet" option set with the following rules:

- Messages arriving at serial ports have their routes inspected to determine if the next drop in the route is one of the other ports in the MEB. If the next drop number matches another port in the module then the message is routed to that port.

- Messages arriving at serial ports with the next drop number not in the Module are routed out of the Ethernet port as the next drop is assumed to be on the E-Net.

- Messages arriving at the Modbus Plus port are routed according to the path number just like normal.

- Ethernet Messages routed to the standard E-Net port are routed as normal.

- Ethernet Messages targeted to an "On Ethernet" port are immediately sent out the appropriate port.

- The SY/MAX Ethernet addresses are limited to the range 00 through 99. "On Ethernet" drop numbers in the range 100 through 199 will appear on the E-Net as the drop number - 100. For example, if drop 154 is placed "On Ethernet" then the MEB will place the drop number 54 on the Ethernet. Thus messages routed to the E-Net address 54 and 154 will both be processed by the same MEB. This feature may be used to reduce the number of E-Net drop numbers consumed by "On Ethernet" ports.
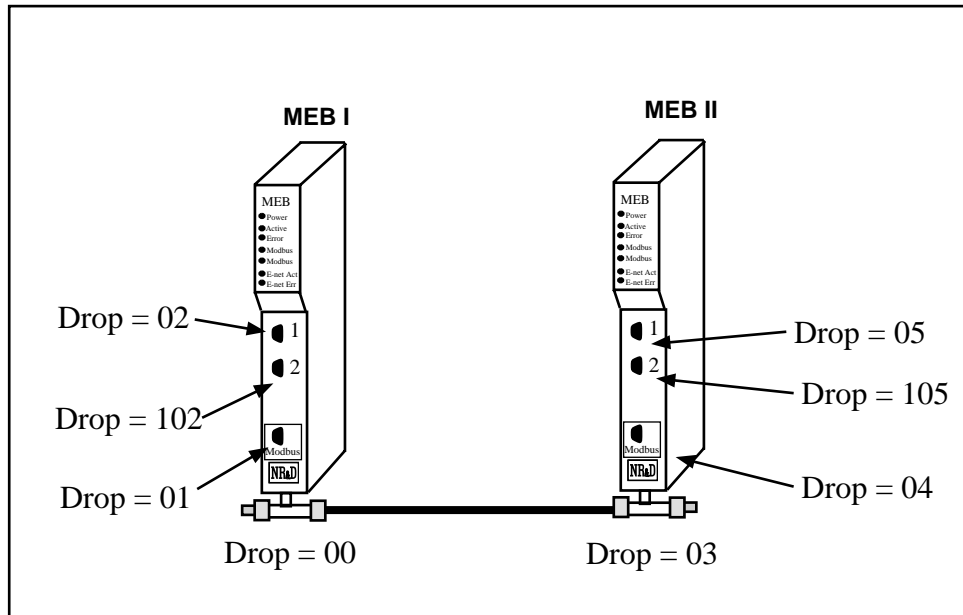
Figure 19-1 On Ethernet Example

In Figure 19-1 if all of the ports are placed on the Ethernet then the MEBs would respond to E-Net messages with target drop numbers of 00, 01, 02, 03, 04, 05, 102, and 105. Therefore none of the other devices on the SY/MAX Ethernet may have these drop numbers or a duplicate drop number error condition will occur.

Consider that all of the serial ports are in SY/MAX mode. Table 19-1 shows several possible routes for communication.

Table 19-1 On Ethernet Routing Examples

Source	Target	Route
MEB I Port 1	MEB II Port 1	2, 0, 3, 5
MEB I Port 1	MEB II Port 1	2, 0, 5
MEB I Port 1	MEB II Port 1	2, 3, 5
MEB I Port 1	MEB II Port 1	2, 5
MEB II Port 2	MEB 1 Port 2	105, 3, 0, 102
MEB II Port 2	MEB 1 Port 2	105, 0, 102
MEB II Port 2	MEB 1 Port 2	105, 3, 102
MEB II Port 2	MEB 1 Port 2	105, 102

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20

Configuration Software MEBSW

</div>

MEBSW

The MEBSW software program is provided free of charge to MEB users. This software is used to configure the operational parameters of the MEB. MEBSW can be operated in either online or offline modes.

> NOTE: MEBSW supports all versions of the MEB including those with TCP/IP. Although they may be edited offline, the TCP/IP features will not be supported online in a non-TCP/IP MEB.

MEBSW uses the SY/MAX protocol for the configuration; thus allowing remote service of the MEB through SY/NET, and other SY/MAX devices such as Niobrara's 2496X or RM14K modems. Full support for the SY/LINK SFI-510 Network Interface Card and SFI-610 Ethernet Card is also provided.

In online mode, MEBSW presents the user with a screen of data describing the operation all of the module's ports. The arrow keys are used select the port parameters to be modified and the space bar and + and - keys are used to change the parameters of that port. Changes made in the online mode are transferred to a connected MEB module and are effective immediately.

In offline mode, MEBSW allows a copy of the configuration to be uploaded from the MEB to an image in offline memory. The offline copy can be edited without affecting the MEB in real time. The offline copy can be saved to a named disk file for later retrieval, or listed on a hard copy printer. An MEB need not be connected to perform most offline operations. The offline copy of the configuration parameters may be downloaded to an MEB module at any time.

Because the MEB has an internal nonvolatile parameter memory, the configuration parameters normally will not need to be reloaded unless a change has been made.

The startup screen of MEBSW is shown in Figure 20-1 on page 122. The operational modes are selected by the highlighted menu bar on the fourth line. Selection can be made by moving the cursor to the desired option using the arrow keys and pressing **ENTER**. A short cut is provided, simply type "**N**" for online, "**F**" for offline, "**U**" for Utility, "**S**" for setup or "**Q**" to quit.

```
         M E B   M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                    13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE
 oNline           oFfline              Utility          Setup          Quit





Use arrows or initial capital letter to make menu selections
Use Esc to abort functions
Use F1 at any time to print the screen
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918


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```

Figure 20-1 MEBSW Startup Screen

If offline mode is selected, a second menu appears as shown in Figure 20-2 on page 122. This menu presents the available functions for manipulating the offline image of the configuration parameters and for transfer of configuration data to and from the MEB module. Use the up and down arrows to move the highlight, **ENTER** to select the highlighted choice, or the initial capital letter to quickly select an option.

The online and offline parameter editing screens are nearly identical. The difference is in operation. Every time a change is made in the online mode, the modified parameter is transmitted to the MEB. In offline mode, changes are made to the parameter image in offline memory. Changes made in the online screen affect only the configuration stored in the attached MEB, not the offline copy. Likewise, changes made in offline mode have no effect on a connected MEB until they are explicitly sent to it using the "Send memory to MEB" function.

MEBSW also contains several convenient utilities for general use, a SY/MAX Register Viewer, a Terminal Emulator, a Statistics Viewer, and a CTS monitor. The Register Viewer, Statistics Viewer, and CTS monitor use the same setup as the oNline and oFfline functions. The Terminal Emulator has its own setup characteristics.

```
         M E B   M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                    13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE
 oNline           oFfline              Utility          Setup          Quit
                 ┌──────────────────────────────┐
                 │Read from disk to memory       │
                 │Write from memory to disk      │
                 │Edit configuration in memory   │
                 │edit Modbus routing            │
                 │edit Auto scan table           │
                 │edit Global data table         │
                 │edit TCP routing               │
                 │Send memory to module          │
                 │Fetch memory from module       │
                 │Print configuration in memory  │
Use arrows or in │Delete configuration file      │u selections
Use Esc to abort │Quit offline functions         │
Use F1 at any ti └──────────────────────────────┘
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918


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```

Figure 20-2 MEBSW oFfline Menu

Data Entry Keys

Whenever data entry is allowed by the program, certain keys can be used to facilitate data entry. They are:

BACKSPACE	Move cursor left and remove character there
LEFT ARROW	Move cursor to the left one character
RIGHT ARROW	Move cursor to the right one character
DEL	Remove the character under the cursor
INS	Change between insert and overstrike modes of entry
HOME	Move cursor to the left edge of the field
END	Move cursor to the end of the data
Control-F	Move cursor right (Forward) one word
Control-R	Move cursor left (Reverse) one word
Control-D	Delete from the cursor to the end of the field
Control-U	Delete from cursor to the beginning of the field
Control-Y	Delete all characters in the field
ESC	Exit the field without modifying it
ENTER	Accept the contents of the field

When a field is opened for input, the cursor is positioned at the left side of the field. If data is already present in the field, typing any character other than those listed above will cause the field to be blanked allowing entry of new data without first deleting the old. If it is desired to retain the previous data for editing, make sure the first key you type is an editing key such as a left or right arrow.

Most data fields in MEBSW do not allow direct entry of the parameter, instead a series of choices is presented. The following keys are used:

GRAY +	Increments options to the next available choice
GRAY -	Decrements options to the previous choice
SPACE BAR	Increments options and rolls back to first option after last

The arrow keys are used to maneuver between fields.

Online and Offline Editing Screen

In either the online or offline mode, parameters are changed by moving the highlighted cursor to the desired field using the arrow keys and by pressing the +, -, or space bar to toggle through available parameters.

```
        M E B   M O D B U S +  /  E T H E R N E T   B R I D G E
Niobrara R&D                                               13Aug97
                     CONFIGURATION AND UTILITY SOFTWARE   Press F2 for help.
                   ETHERNET     PORT 1     PORT 2     MODBUS+
Drop               0            2          102        1
On Ethernet        YES          NO         NO         NO
Protocol           SY/MAX 802   SY/MAX     SY/MAX
Baud Rate                       9600       9600
Parity                          EVEN       EVEN
Data Bits                       8          8
Stop Bits                       1          1
Buffer Limit       16           16         16         16

Error Check                     BCC
Route Appendix                  NONE
Route Replacement               OFF

Transfer Interval               100
Transfer Route                  NONE
Read Count                      0
Read From                       128
Read To                         0
Write Count                     0
Write To                        0
Write From                      10
```

Figure 20-3 MEBSW oNline Edit Screen

The oNline Edit (and oFfline Edit) screen is presented as a matrix of parameters, see Figure 20-3. Each column represents one of the ports of the MEB. The lower half of the screen will change to present the available parameters for each protocol mode. The parameters are described below.

Drop Number

(Ports 1,2, E-NET, MB+) This value determines the route drop number of the port. All ports must have unique drop numbers within the module. The drop number of the Ethernet port must be unique for the entire Ethernet network. The Ethernet drop number must fall within the range of 00 through 99. The drop numbers for Ports 1 and 2 must fall within the range 000 through 199. The drop number for the Modbus Plus port must be within the range of 01 through 64. The default drop number for the Ethernet port is 0, MB+ port is 01, Port 1 is 2, and Port 2 is 102.

On Ethernet

(Ports 1,2 and MB+) This setting allows the MEB to place the drop number of the port on the Ethernet as a virtual Ethernet SY/NET address. No other device on the E-Net may have the same drop number or drop number - 100 as the port. This option is valid in SY/MAX 802 Ethernet mode only and is ignored in TCP/IP protocols.

Protocol

(Ports 1,2) This value determines the mode of the individual communication port. Possible values are SY/MAX, Net-to-Net, Peripheral, Transparent, Share, PLogic, Idec, Gateway, Multidrop, Modbus Host, Modbus Gate, PNIM, RNIM Master, and RNIM Slave. The default mode is SY/MAX.

(E-net) The standard MEB only supports the SY/MAX 802 protocol. The MEB-TCP modules support SY/MAX 802, NRD/TCP, and Modbus/TCP. The default for the TCP/IP modules is Modbus/TCP.

Baud Rate

(Ports 1,2) Controls the baud rate of the individual port. This value should be set to match the baud rate of the device attached to the port. The default value is 9600.

Parity

(Ports 1,2) Controls the parity of the individual port and should be set to match the attached device. Available choices are EVEN, ODD, and NONE. The default value is EVEN.

Data Bits

(Ports 1,2) Set to 7 or 8 to match the data bits transmitted by the connected device. The default value is 8.

Stop Bits

(Ports 1,2) Set to 1 or 2 to match the stop bits used by the connected device. The default value is 1.

Buffer Limit

(All Ports) The buffer limit sets the maximum amount of available buffers for each port. The default value is 16 with a minimum value of 2 and a maximum value of 16. Then E-Net port has a maximum value of 32. It is not recommended to alter the number of buffers available unless the equipment requires a small number of buffers.

Mode Specific Sub-menus

Certain mode values require additional parameters and other fields will appear in the middle area of the screen. These parameters are explained as follows:

Driver Mode

(Peripheral, Share, Multidrop, Modbus Host, Modbus Gate, RNIM Master, RNIM Slave) These settings control the action of the transmit driver and receiver action of the RS-485 port. Possible settings include **Pt to Pt** for Point to Point (RS-422 operation), **FOUR WIRE** for 4-wire RS-485 slave operation, **HALF DUPLEX** for 4-wire Pt to Pt half duplex operation, and **TWO WIRE** for 2-wire half duplex operation.

IP Address

(E-net Port only, NRD/TCP and Modbus/TCP protocol only) The IP Address is entered in dotted-decimal notation. This address should be provided by the Network Administrator of your corporate Ethernet. Each IP device on the network must have a unique IP Address. The devault IP Address for the MEB is based on the MAC of the MEB and will be in the range 206.223.51.x.

Subnet Mask

(E-net Port only, NRD/TCP and Modbus/TCP protocol only) The Subnet Mask is entered in dotted-decimal notation. This address should be provided by the Network Administrator of your corporate Ethernet. The default mask is 255.255.255.0.

Default Gate

(E-net Port only, NRD/TCP and Modbus/TCP protocol only) The Default Gate is the IP address of the default gateway for the subnet that the MEB is located on. The Default Gate is entered in dotted-decimal notation with the factory defaulte as 0.0.0.0.

E-Peer

(E-Net Port only) The E-Peer item allows the enabling of the MEB's Peer-to-Peer mode. If set to OFF the E-Peer is disabled on this MEN and the Auto-Transfer settings for the E-Net port are displayed. If set to ENABLE, the Auto-Transfer settings for the E-Net port change to show the settings for the E-Peer.

Error Check

(SY/MAX, Net-to-Net, PLOGIC, Multidrop, PNIM) The Error Check item allows the selection of the standard BCC error check or the CRC error check. Normal SY/MAX operation requires the BCC error

check. The SY/MATE PLUS software provides the CRC checksum as an option for use with no parity, thus allowing 10 bit modem programming. The CRM-512 NIM also uses the CRC checksum.

Route Appendix

(SY/MAX) The Route Appendix allows SY/MAX devices with limited network capabilities, such as the EATON PanelMate operator interface, to increase the number of drops available. SY/MAX packets arriving at the port with the last drop in the route being 205 will have the Route Appendix attached to the incoming route in place of the 205 drop number. To disable the Route Appendix feature, set the Route Appendix to NONE by deleting all drops in the route field.

Route Replacement

(SY/MAX) The Route Replacement is an extension of the Route Appendix feature. If the Route Replacement is ON, any incoming SY/MAX packet on the port will have its route ignored and the route described in the Route Appendix will be used instead. The replies from sent messages will have their original route reversed and inserted as they leave the port. The default value is OFF.

The Route Replacement/Appendix may be enhanced to include up to 128 eight-drop routes by using Options bit 2. When this Options bit is set for the SY/MAX mode port, incoming route of the form 205,X will have the route located in the Modbus Slave Address Table entry X used for the replacement. The reply will be returned to the sender with the reversed route X,205. This feature may only be used on single-threaded SY/MAX ports and is primarily intended to be used with the PanelMate operator interface.

Packet size limit

(Transparent, Share, Gateway) This value determines the number of characters which will accumulate without receiving an ASCII carriage return or exceeding the Packet time limit, and result in the formation of a SY/MAX packet being formed. Setting the packet size to 1 will cause each character entering the port to be transmitted without delay but will result in slow throughput because of the large overhead of sending each character as a packet. The default value is 128 characters.

Packet time limit

(Transparent, Share, Gateway) This integer value determines the number of hundredths of a second which will pass between characters before a packet is formed of the characters already received. The default value is 100.

Target Route

(Transparent, Share, Gateway) The route should consist of the drop number of the originating port, any Net-to-Net drops, and the drop number of the receiving port. For two-way communication, the receiving port should be programmed with the same drops in reverse order. In Gateway mode, the route may be easily modified by using the Address command. The default value is NONE.

Control Character

(Transparent, Share, Gateway) The Control Character field determines whether control characters (carriage return, line feed, etc.) will be used to terminate the message before the packet time limit or packet size limit is met. The default value is ON.

Echo

(Transparent, Share, Gateway) The Echo field determines whether the port will echo all characters received back to the sending device. This may be useful in applications involving terminals. The default value is OFF.

Highlight

(Gateway) The Highlight field determines whether the Gateway port provides the ANSI highlight control characters before and after each message returned from the Gateway port. The default value is OFF.

Node Priority

(Multidrop) This value determines the priority for the port within the multidrop scheme. Each port on the multidrop circuit should have its own unique priority value and should fall within the range of 1 to the number of nodes.

Number of Nodes

(Multidrop) This value should be set to equal the number of multidrop MEB, EPE5 or SPE4 ports included within the network. This value must be at least equal to 2.

Time Slice

(Multidrop) The time slice value determines the amount of time that each unit will wait from the receipt of the last character on the network before transmitting a new request. This value is expressed in units of n/100 seconds

READ command

(MODBUS Host) This value is required in the MODBUS Host mode. SY/MAX read requests are translated to the MODBUS function code defined in the MODBUS READ register for that port. Possible values are 1, 2, 3, or 4. The default value is 4.

WRITE command

(MODBUS Host) This value is required in the MODBUS Host mode. SY/MAX write requests are translated to the MODBUS function code defined in the MODBUS WRITE register for that port. Possible values are 5, 6, 15, or 16. The default value is 16.

Retry timeout

(MODBUS Host and Gateway) This value expressed in units of n/100 seconds determines the delay time between retries for failed transmissions from a MODBUS mode port. The default value is 100.

Register Bias

(MODBUS Host) Since it is not possible to read or write MODBUS registers outside of the legal SY/MAX range of 1 through 8192., an offset value has been added. This offset value allows the translation from the SY/MAX range to another valid range in MODBUS. The MODBUS register addressed will the result of the following formula:

MODBUS value = SY/MAX register + Offset value - 1

If the offset value equals 0 then reading the SY/MAX register 1 will translate to reading the MODBUS register 0. If the offset value equals 20001 then reading the SY/MAX register 10 will translate to reading the MODBUS register 20010. The default value for the offset is 1.

Transfer Interval

(Auto-transfer, Auto-Scan) This value determines the periodic interval between Auto-transfer READS/WRITES. The value is expressed in units of n/100 seconds (i.e. 100 = 1 sec). Some consideration must be taken in selecting the interval. Too small of a value will result in the filling of the buffers and possible rejection of reads/writes. If the application is time critical, this value should be set to a value slightly longer than the transmission + reception time of the largest expected packets. If both read and write are selected, the transmission time must be calculated for each worst case and added together for the final interval.

Transfer Route

(Auto-transfer) The route describes the path that any Auto-transfer reads and/or writes will require to reach the desired peripheral device. If the device is directly attached to the MEB port a route may not be necessary. If this is the case simply press the DEL key and the route will be set to NONE.

If the attached device requires a unit number (MODBUS, IDEC, PLOGIC) then two drops are required. The first must be the drop number of the MEB port, the second must be the unit number of the attached device.

READ Count

(Auto-transfer) This value determines whether the Auto-transfer read will operate. A value of zero will disable the Auto-transfer read. A value of one will cause a read to occur at the time interval. A value greater than one will cause a multiple register read to occur starting at the READ From register.

READ From

(Auto-transfer) This is the register number located within the peripheral device that is of interest. On multiple register reads, READ Count > 1, this is the starting register of the multiple register read.

READ To

(Auto-transfer) This is the register number in the mailbox where the data from the peripheral device will be stored. On multiple register reads, this is the first register of the multiple registers.

WRITE Count

(Auto-transfer) This value determines whether the Auto-transfer WRITE will operate. A value of zero will disable the Auto-transfer write. A value of one will cause a write to occur at the time interval. A value greater than one will cause a multiple register write to occur starting at the WRITE From register.

WRITE To

(Auto-transfer) This is the register number located within the peripheral device that is of interest. On multiple register writes, this is the starting register of the multiple register write.

WRITE From

(Auto-transfer) This is the register number in the mailbox where the data for the peripheral device is stored. On multiple register writes, this is the first register of the multiple registers.

Total E-Peer Nodes

(E-Peer) This value determines the total number of MEB/EPE5 modules on the E-Peer. This value must be in the range of 2..100 and must be the same for all MEB/EPE5 modules using the E-Peer.

E-PEER devices with This Node's Number set to zero are not included in the total E-PEER nodes count.

This Node's Number

(E-Peer) This value sets this MEB's E-Peer number. This number must be unique among the E-Peer members and must also fall within the range of the Total E-Peer Nodes.

NOTE: This value has no relationship to the SY/NET drop number of the E-Net Port.

A special case of This Node's Number is when it is set for zero. When This Node's Number is set to zero and the E-PEER is enabled, this MEB will accept E-PEER messages, but will not transmit any data. This allows E-Peer devices to listen to all of the data on the network but not consume any of the available bandwidth because they have nothing to transmit. E-PEER devices with This Node's Number set to zero are not included in the total E-PEER nodes count.

Start Register

(E-Peer) This is the register number in the mailbox where the data for the other E-Peer members is stored. On multiple register writes, this is the first register of the multiple registers.

Register Count

(E-Peer) This value determines the number of registers broadcasted from this MEB to the other members of the peer. The register count is not required to be the same among the members of the peer.

Destination Reg

(E-Peer) This is the register number in the other members of the peer where the data from this MEB will be transferred. This value is commonly the same as the Start Register.

Update Interval

(E-Peer) The amount of time in milliseconds allotted for a complete cycle of the peer. It is recommended that the Update Interval be an integer multiple of the total number of units where the multiple has a minimum value of 2. For example, if there are 8 nodes in the peer and 3mS is allowed for each node, set the Update Interval to 24.

Network Id

(RNIM Master and Slave) This number must be the same for all RNIM devices on the same Remote Network. The Network Id allows multiple Remote Networks to operate within close range on the same frequency. RNIM devices only respond to messages that match their own Network Id. The Valid data range is 0 through 255.

NOTE: The Square D CRM-560 always defaults to a Network Id of 0 upon power-up.

CTS Timer

(RNIM Master and Slave) The CTS timer provides a minimum amount of time to wait for the Clear to Send hardware handshake line to become active after the Request to Send (RTS) line has been asserted. The unit of time is 10mS. A value of 50 provides a 500mS delay. The valid data range is 0 through 65535 (655.35 seconds max).

NOTE: The Square D CRM-560 CTS timer has units of 50mS and defaults to a value of 10 (for a delay of 500mS) upon power-up.

Packet response

(RNIM Master and Slave) This value sets the message response timeout in 10mS units. This value determines the amount of time that the RNIM port will wait for a response before a message is retransmitted. (The number of retries is governed by the Retries setting.) This value also covers the response time allotted to a BID. The valid data range is 0 through 65535 (0 sec to 655.35 sec).

NOTE: The Square D CRM-560 Message response timeout is in 1 second units and defaults to 20 seconds upon power-up. Also the CRM-560 has the BID response fixed at 2 seconds.

Bid interval

(RNIM Master) This value sets the interval between successive automatic BIDs in 10mS units. This value determines the amount of time that the RNIM Master port will wait between sending one BID and sending the next after the Message response timeout has elapsed. During this interval any queued NORMAL messages are sent. The valid data range is 0 through 65535 (0 sec to 655.35 sec).

NOTE: The Square D CRM-560 does not allow this parameter to be adjusted. It is fixed at 2 seconds.

Retries

(RNIM Master) This value sets the number of retries by the Master (without a valid reply from the Slave) before an error message is returned to the originating device. The valid range is 0 through 65535 for Masters and 0 for Slaves.

NOTE: The Square D CRM-560 Number of Retries has a valid range of 0 through 3 for Masters and 0 for Slaves and defaults to 3 upon power-up.

Pause time

(RNIM Master) This value determines the amount of time that will be inserted after a specific number of messages or BIDs have been sent to rest the transmitter. Valid data range is 0 through 65535.

NOTE: The Square D CRM-560 Pause time is in 1 second units and defaults to 15 upon power-up.

Message Count

(RNIM Master) The Message Count is the number of messages and/or BIDs that will be transmitted by the Master before the Pause Time will be inserted to give the transmitter a chance to rest. Valid range is 0 through 65535.

NOTE: Most modern transmitters will operate at 100% duty so set this value to 0 if your transmitter can handle it.

NOTE: The Square D CRM-560 defaults this value to 4 upon power-up.

Bid Address

(RNIM Master) This number determines the type of BID operation.

1 to 99 - If the value falls within the range of 1 through 99, the RNIM Master will issue a single BID to that Slave address. The Slave has the amount of time set by the Message response setting to respond to the BID.

NOTE: To send a single BID to Slave 00, use the value 100.

100 to 199 - If the value falls within the range of 100 through 199, the RNIM Master will issue a BID to the Slave address that corresponds to the number minus 100. The Slave has the amount of time set by the Message response setting to respond to the BID. After the Message response timeout has occurred (regardless if a response was sent), the Master will wait for the BID Interval delay. After the BID Interval delay, the Master will subtract 1 from the address and issue a BID to that new Slave address minus 100. This new address will be displayed in the BID Address register in the Master. The address will be automatically decremented at the end of the Bid response timeout (or reply) until the address 00 BID has been issued. All addresses between the starting address and 00 will be BID. It is not possible to skip any addresses. NORMAL messages received while performing an automatic BID take precedent over the automatic BID and will be inserted during the next BID Interval delay.

200 to 299 - If the value falls within the range of 200 through 299, the RNIM Master will issue continuous BIDs to that address minus 200. After sending the BID, the Master will wait for the Message response timeout before processing any other messages. After the Message response timeout, the Master will wait for the BID Interval time before sending the next BID. During the BID Interval delay, all queued NORMAL messages will be sent over the remote network.

300 to 399 - If the value falls within the range of 300 through 399, the RNIM Master will issue continuously decrementing automatic BIDs from that address minus 300 to address 00. After the BID for address 00 is sent, the BID resumes at the starting address. This works just like the 100 to 199 that automatically resets itself when it gets to zero.

NOTE: Unlike the 100 to 199 operation, the value displayed in the BID address register always stays at the 300 range value. This is to allow the automatic BID to resume upon power loss.

Transfer Route

(Transfer) The route should consist of the route from the Transfer port to the Primary PLC.

HOTKEYS

F1 Print Screen hotkey

Pressing the F1 key at any time will allow for printing of the screen to a printer or text file. Pressing the F1 key will produce a window similar to Figure 20-4.

```
         M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
  Niobrara R&D                                                    23Oct95
                     CONFIGURATION AND UTILITY SOFTWARE     Press F2 for help.
  oNline          oFfline            Utility             Setup          Quit
                   ETHERNET    PORT 1      PORT 2    MODBUS+
  Drop            0           2           102       1
  Protocol                    SY/MAX      SY/MAX
  Baud Rate                   9600        9600
  Parity                      EVEN        EVEN
  Data Bits                 ═══════PRINT SCREEN═══════════
  Stop Bits              │  Output file:                                    │
  Buffer Limit          │  PRN_____            │
                         └────────────────────────────────────────────────┘
  Error Check                 BCC
  Route Appendix              NONE
  Route Replacement           OFF

  Transfer Interval           0
  Transfer Route              NONE
  Read Count                  0
  Read From                   128
  Read To                     0
  Write Count                 0
  Write To                    0
  Write From                  10
```

Figure 20-4 F1 Print Screen

The new window prompts for an output filename. The default is PRN which prints to the DOS default printer. If a valid DOS filename is typed into the field, MEBSW will print the information to that filename as an ASCII text file.

F2 Help Window

Pressing the F2 key will present the help window shown in Figure 20-5. Pressing any key will return to the previous location

```
         M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
  Niobrara R&D                                                    23Oct95
                     CONFIGURATION AND UTILITY SOFTWARE     Press F2 for help.
  oNline          oFfline            Utility             Setup          Quit
                   ETHERNET    PORT 1      PORT 2    MODBUS+
  Drop            0        ═══════════PARAMETER EDITOR HELP═══════════
  Protocol               │                                               │
  Baud Rate              │                                               │
  Parity                 │  Use Up and Down arrows, Page Up, and Page Down│
  Data Bits              │  to select a field.                           │
  Stop Bits              │  Use Left and Right arrows, Home, and End to  │
  Buffer Limit    16     │  select a port.                               │
                         │                                               │
  Error Check            │  In multiple choice fields, + key increases, -│
  Route Appendix         │  decreases, and spacebar increases to the last│
  Route Replacement      │  choice and then wraps to the first choice.   │
                         │  In numeric fields, type new value and ENTER. │
  Transfer Interval      │                                               │
  Transfer Route         │  Type ESC to exit offline parameter editor.   │
  Read Count             │  Type F10 to clear error window.              │
  Read From              │                                               │
  Read To                │                                               │
  Write Count            │                                               │
  Write To               │  Press any key to close help window.          │
  Write From             └───────────────────────────────────────────────┘
```

Figure 20-5 F2 Help Window

F3 Statistic Viewer

Pressing the F3 key while on a port will invoke the statistic register viewer. This window will display the statistical registers for a specific port. The port selection may be changed by pressing the space bar or the + or - keys. Pressing the 0 (zero) or the z key will result in the clearing of all of the statistical parameters for the selected port. Press the ESC key to exit back to the main screen.

The Statistics Registers are quite helpful for debugging an application. Each data port has a group of 32 registers which are incremented when a specific action occurs.

The Ethernet port has its own set of statistics as shown in Figures 20-6 and 20-7.

Pressing the Page Down key will advance the statistic viewer to a new page of statistics. Pressing the Page Up key will return to the first page. Pressing the left arrow key, right arrow key, - key, + key, or space bar will change the port displayed. Pressing the F9 key will provide a shortcut to the SY/MAX setup window for changing the route etc.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                     MEB 13NOV95 Port 0                      13Nov95
                            Statistics                                  for help.
Dro        ETHERNET PORT DROP 41             Count   Register
Dro     Valid Command/Reply packets received    205    2049
On      Incoming packet lost because no buffer     9    2050
Pro     Retry packets received                     0    2051
Bau     Packets generated internally               0    2052
Par     Internal generations failed (No Buffer)    0    2053
Dat     Packets sent and ACK received            204    2054
Sto     Transmit not ACKed, packet lost            0    2055
Buf     Transmit retries                           0    2056
        Packets lost because unrouteable           0    2057
E-P     Illegal operation requests                 0    2058
        Priority reads performed locally           0    2059
        Priority writes performed locally          0    2060
        Non-priority reads performed             205    2061
Tra     Non-priority writes performed              0    2062
Tra     Non-Sy/Max Ethernet frames received        0    2063
Rea     Ethernet frames transmitted              420    2064
Rea     Ethernet frames received                 621    2065
Rea
Wri     Type + or - to change port.  Z to zero.
Wri     Page Down for more data.  ESC to exit.
Wri
```

Figure 20-6 Ethernet Port Statistical Screen (Page 1)

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                     MEB 13NOV95 Port 0                      13Nov95
                            Statistics                                  for help.
Dro        ETHERNET PORT DROP 41             Count   Register
On
Pro     Last route received                      102    2076
Bau                                                0    2076
Par                                               41    2077
Dat                                             ---      2077
Sto                                             ---      2078
Buf                                             ---      2078
                                                ---      2079
E-P                                             ---      2079
        Buffers in internal queue                  0    2071
        Ethernet collisions                        0    2066
        Packets lost because excess collisions     0    2067
Tra     Receive packets lost for CRC error         0    2068
Tra     Receive packets lost for framing error     0    2069
Rea     Sequence error, NAK TRANS                  0    2070
Rea     Buffers currently in use                   1    2080
Rea
Wri     Type + or - to change port.  Z to zero.
Wri     Page Up for more data.  ESC to exit. .
Wri
```

Figure 20-7 Ethernet Port Statistical Screen (Page 2)

Below is a list of the currently active registers for the Ethernet Port and the conditions which cause them to be incremented. For a complete table of these registers see page 155. When one of the error registers is incremented, the RED E-NET ERROR light on the module will be lit for one second.

- **Valid Command/Reply packets received.** This register is incremented when a valid packet is received from another SY/MAX Ethernet device.

- **Incoming packet lost because no buffer.** This register may be incremented as a result of trying to exceed the throughput of the port. This may happen if several high baud rate sources are routed to a low baud rate target. Try slowing down the polling of the high baud rate sources. Also check the buffer limit setting. The default value is 16. If this setting is set to a lower value, A burst of a

few messages may fill the available allocated buffers. Check the *Buffers currently in use* statistic to see how many buffers are full.

- **Retry packets received.** This register increments when another Ethernet device request a retry of the message that this port routed to it.

- **Packets generated internally.** This register is incremented when the port generates a message to be transmitted from the port to the attached device. This may occur from an Auto-transfer READ or WRITE.

- **Internal generations failed (No buffer).** Check the Auto-transfer interval and slow it down. (increase the value)

- **Packet sent and ACK received.** A valid transmission has occurred to the attached Ethernet device.

- **Transmit retries exhausted, packet lost..** If errors occur on the transmission, eventually the retries will be exhausted and the transmission will fail. Check the cabling and make sure that a 50 ohm terminator is on each end of the coax..

- **Transmit retries.** Incremented when a negative acknowledgment or the failure of a positive acknowledgment has occurred after a transmission.

- **Packets lost because unrouteable.** Check the route of the sending devices routed to the port. Use the *Last route received* statistics to determine the route incoming on the port.

- **Illegal operation request.** Check the command being sent to the port.

- **Priority reads performed locally.** Incremented when a Priority read has been received on the port from an external device. This means that the read was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Priority writes performed locally.** Incremented when a Priority write has been received on the port from an external device. This means that the write was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Non-Priority reads performed.** Incremented when a Priority read has been received on the port from an external device. This means that the read was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Non-Priority writes performed.** Incremented when a Non-Priority write has been received on the port from an external device. This means that the write was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Non-Sy/Max Ethernet frames received.** Incremented when packets are routed to the MEB in TCP/IP mode. (Not implemented yet.)

- **Ethernet frames transmitted.** Incremented when a command, reply, ACK, NAK, or BUSY frame has been transmitted to the Ethernet.

- **Ethernet frames received.** Incremented when a command, reply, ACK, NAK, or BUSY frame has been received from the Ethernet.

- **Last route received.** These eight fields display the route of the last incoming message received by the port. If fewer than eight drop numbers are included in the route, --- will be displayed for each location after the last drop. If messages are received with no route --- will be displayed in all eight locations. If a port has not received any messages, all locations may display 0. When several messages arrive with different routes, this display may jump back and forth between the routes.

  It should be noted that since the MEB is a multitasking system, it may be possible for it to be updating the Last route received while the personal computer is reading those values. The result may be that a route is displayed that is a combination of two or more routes and is therefore not valid. The Last route received is intended for troubleshooting systems where it is unsure what the route is from a particular device.

- **Ethernet collisions.** Incremented when the MEB has detected a collision between a packet it is sending and other traffic on the network.

- **Packets lost because excess collisions.** When the collision limit of 16 collisions on a single packet has been exceeded the MEB will report an error and stop sending the packet.

- **Receive packets lost for CRC error.** Incremented when a receive packet has an error in the checksum.

- **Receive packets lost for framing error.** Incremented when a packet received from the Ethernet has an error in the framing.

- **Sequence error, NAK TRANS.** The MEB keeps a table of the SY/NET Ethernet Sequence numbers from every active SY/NET Ethernet unit on the network. If the MEB port receives a packet with an incorrect Sequence number from another device this register is incremented and a NAK TRANS is sent to the offending device.

- **Buffers currently in use.** This number displays the number of buffers that this port is currently using. This number should remain low (0-3). If the Buffers currently in use climbs to near the Buffer limit, the system should be inspected because there is a bottle neck somewhere. Use the percent of throughput statistic on the ports included in the route statement to see if any are near 100%. If so try to increase the throughput by increasing the baud rate on that section, lowering the baud rate or polling interval of the previous sections, or routing through alternate paths.

Ports 1 and 2 have the same types of statistics which are shown in Figures 20-8 and 20-9.

Figure 20-8 Port 1..2 Statistical Screen (Page 1)

Figure 20-9 Port 1,2 Statistical Screen (Page 2)

Below is a list of the currently active registers for Ports 1 and 2 and the conditions which cause them to be incremented.

For a complete table of these registers see page 157. When one of the error registers is incremented, the RED ERROR light on the module will be lit for one second.

- **Valid packets received, ACK sent.** This register is incremented when a valid packet is received from an external source connected to the port.

- **Incoming packet lost because no buffer.** If this register increments, check the cabling on that port or the target port for the routed message. If CTS is not properly jumpered, the port will not be able to transmit and the buffers will fill. Use the *Utility, CTS Monitor* to check the state of CTS it should be ON.

  This register may also be incremented as a result of trying to exceed the throughput of the port. This may happen if several high baud rate sources are routed to a low baud rate target. Try slowing down the polling of the high baud rate sources. Check the *percent of capacity* on the transmit and receive lines on the ports that the message is routed through. Also check the buffer limit setting. The default value is 16. If this setting is set to a lower value, A burst of a few messages may fill the available allocated buffers. Check the *Buffers currently in use* statistic to see how many buffers are full.

- **Invalid packet received, NAK sent.** If this register increments, check the parity settings, or the BCC/CRC settings on the module and the attached devices. Telephone line interference or flow control settings (XON/XOFF) on a modem might cause NAKs to be sent.

- **Packets generated internally.** This register is incremented when the port generates a message to be transmitted from the port to the attached device. This may occur from an Auto-transfer READ or WRITE or by a translation like IDEC or MODBUS.

- **Internal generations failed (No buffer).** Check CTS wiring. Check the Auto-transfer interval and possibly slow it down. (increase the value)

- **Packet sent and ACK received.** A valid transmission has occurred to the attached device.

- **Transmit retries exhausted, packet lost..** If errors occur on the transmission, eventually the retries will be exhausted and the transmission will fail. Check the cabling, and communication parameters (baud rate, parity, data bits, stop bits, mode).

- **Transmit retries.** Incremented when a negative acknowledgment or the failure of a positive acknowledgment has occurred after a transmission.

- **Packets lost because unrouteable.** Check the route of the sending devices routed to the port. Use the *Last route received* statistics to determine the route incoming on the port.

- **Illegal operation request.** Check the command being sent to the port.

- **Priority reads performed locally.** Incremented when a Priority read has been received on the port from an external device. This means that the read was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Priority writes performed locally.** Incremented when a Priority write has been received on the port from an external device. This means that the write was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Non-Priority reads performed.** Incremented when a Priority read has been received on the port from an external device. This means that the read was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Non-Priority writes performed.** Incremented when a Non-Priority write has been received on the port from an external device. This means that the write was routed to the module and operated on the setup register, mailbox register, or statistics registers.

- **Receiver parity or framing.** Check the baud rate, parity, data bits, and stop bits.

- **Characters transmitted.** Incremented when a BYTE of information is transmitted from the port.

- **Characters received**. Incremented when a BYTE of information is received to the port.

- **Transmit percent of capacity.** This is a time averaged calculation of the percent of theoretical throughput of the port. This calculation is based upon the Characters transmitted within a certain time and takes into account the baud rate, number of data bits, stop bits, and parity bits.

  This average is reset each time page 2 of the statistics is entered, when the port monitored is changed, or when the z or 0 key has been used to zero the statistics fields. Due to the latency between the personal computer performing the read and the reply returning, it is possible to witness values greater than 100%. Since each reading by the personal computer is included in the average allowing this statistic to run for a few minutes will report a more accurate value.

- **Receive percent of capacity.** This is a time averaged calculation of the percent of theoretical throughput of the port. This calculation is based upon the Characters received within a certain time and takes into account the baud rate, number of data bits, stop bits, and parity bits.

  This average is reset each time page 2 of the statistics is entered, when the port monitored is changed, or when the z or 0 key has been used to zero the statistics fields. Due to the latency between the personal computer performing the read and the reply returning, it is possible to witness values greater than 100%. Since each reading by the personal computer is included in the average allowing this statistic to run for a few minutes will report a more accurate value.

- **Last route received.** These eight fields display the route of the last incoming message received by the port. If fewer than eight drop numbers are included in the route, --- will be displayed for each location after the last drop. If messages are received with no route --- will be displayed in all eight locations. If a port has not received any messages, all locations may display 0. When several messages arrive with different routes, this display may jump back and forth between the routes.

  It should be noted that since the MEB is a multitasking system, it may be possible for it to be updating the Last route received while the personal computer is reading those values. The result may be that a route is displayed that is a combination of two or more routes and is therefore not valid. The Last route received is intended for troubleshooting systems where it is unsure what the route is from a particular device.

- **Channel Delay byte count.** This value displays the number of bytes including PADs and ENQs sent after the checksum of a SY/MAX message and before an acknowledgement is received. This value is quite helpful in fine-tuning modem applications as it displays the delay time in the modem circuit. Pressing the "T" key on the keyboard will take the reading from the Channel Delay byte count register, add 10 to this value, and write this new value to the PAD count control register for that serial port.

- **Buffers in internal Queue.** This value displays the number of messages in queue waiting to be sent out of this port. On a single-threaded protocol mode such as PNIM, PLOGIC, RNIM, Modbus Host or Gate, or Chevron, this value will show how many messages are waiting to be sent out the port and a value larger than 0 or 1 may appear.

- **Buffers currently in use.** This number displays the number of buffers that this port is currently using. This number should remain low (0-3). If the Buffers currently in use climbs to near the Buffer limit, the system should be inspected because there is a bottle neck somewhere. Use the percent of throughput statistic on the ports included in the route statement to see if any are near 100%. If so try to increase the throughput by increasing the baud rate on that section, lowering the baud rate or polling interval of the previous sections, or routing through alternate paths.

Modbus Slave Routing

MEB serial ports in Modbus Host, Modbus Gate, or Modbus ASCII modes are capable of operating as a MODBUS RTU (or ASCII) Slave as well as a Master. As a Slave, the MEB port will respond to Modbus messages based upon a look-up table. Each entry of the look-up table is indexed off of the Modbus Slave address of the incoming message. If the entry in the look-up table is non-empty, the MEB will translate the Modbus message into a SY/MAX message with the SY/NET route from the entry in the table. If the entry is empty, the MEB port will ignore the message. Each MEB port has a

Modbus address look-up table with 128 possible entries. These entries consist of a SY/MAX route that may have up to 8 drops and for each Modbus Slave address.

When the oNline, edit Modbus routing screen or the oFfline, edit Modbus routing screen is selected, the Modbus Slave look-up table may be easily edited. Figure 20-10 displays an example of this screen for serial port 1 of the MEB. This screen allows the editing of the table for each MEB port, the range of Modbus address that the table covers, and the entries for each of the covered addresses.

```
         M E B    M O D B U S +  /  E T H E R N E T    B R I D G E       \
Niobrara R&D                  MEB 13NOV95 Port 0                    13Nov95
                      CONFIGURATION AND UTILITY SOFTWARE
oNline|        o f line          Utility          Setup          Quit
      MODBUS ROUTING FOR PORT 1, START ADDRESS = 1
         ADDRESS        ROUTE
            1           101,5,2
            2           101,5,14
            3           NONE
            4           NONE
            5           NONE
            6           NONE
            7           NONE
            8           NONE
            9           NONE
           10           NONE
           11           101,5,104,41,1
           12           NONE
           13           █
           14           NONE
           15           NONE
           16           NONE
              Type digits to enter route. Home to edit start address.
              Use + and - to select port. Escape to exit.
```

Figure 20-10Edit Modbus Slave Routing

Port Number

Each MEB serial port has its own Modbus Slave look-up table. The + and - keys are used to select the MEB port table for editing.

Starting Address

The MEB Modbus port look-up table covers a range of 128 consecutive addresses. The starting point of this range may be adjusted with the Starting Address value. The Home key is used to edit the Starting Address. The lowest setting allowed is 0 and the highest setting should be 129. Normally this value will be set for 1 or 129.

Address

The Address column displays the Modbus Address for which the entry corresponds. The starting and ending point of this column is governed by the Starting Address setting.

ROUTE

The Route column determines the SY/NET route to the target device. The entries are separated by commas. The first entry should be the SY/NET drop number of this Slave port.

In Figure 20-10 above, incoming Modbus messages to slave #1 will be translated to SY/MAX messages with the route 101, 5, 2. Modbus messages to slave # 2 will be sent out as SY/MAX messages with the route 101, 5, 14 while messages to Slave 11 will have the route 101, 5, 104, 41, 1. Messages to addresses 2, 3, 4...10 and 12, 13, 14, 15 and 16 will be ignored by the MEB.

Modbus Server Routing for Ethernet Port

```
       M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                    13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE
 oNline           oFfline            Utility          Setup          Quit
      MODBUS SERVER ROUTING FOR ETHERNET PORT
              INDEX      ROUTE
                0        NONE
                1        24,5
                2        24,61,3
                3        NONE
                4
                5        NONE
                6        NONE
                7        NONE
                8        NONE
                9        NONE
               10        NONE
               11        NONE
               12        NONE
               13        NONE
               14        NONE
               15        NONE
                    Type digits to enter route. F4 to edit start address.
                    Use + and - to select port. Escape to exit.
```

Figure 20-11 Modbus Server Routing for Ethernet Port

(Modbus/TCP only) The MEB-TCP can act as a Server as well as a Client for Modbus TCP/IP protocols. As a Server, incoming Modbus TCP/IP messages are handled in a fashion like incoming Modbus serial messages; the Destination Index of the incoming message is checked for an entry in the Modbus Routing table for the Ethernet port and if present, routes the message appropriately. This screen is selected by "edit Modbus routing" and pressing the "-" key until the Ethernet port is displayed.

> **NOTE:** Since the IP address of the MEB-TCP is unique, there is no possibility that incoming messages are intended for another device. Therefore, all incoming messages with Index values that have empty entries will be acted upon locally by the MEB. This is different than the Modbus serial implementation where empty addresses are ignored.

Index

The Index column displays the Modbus Destination Index for which the entry corresponds.   The Destination Index is a single byte of routing information with a valid range of 0-255. The MEB supports all 256 entries for this index. Messages with empty Index values will be treated as local operations.

ROUTE

The Route column determines the SY/NET (MB+) route to the target device. The entries are separated by commas. The first entry should be the SY/NET drop number of the outgoing port of the MEB (such as the MB+ or Port 1 or 2).

> **Note:** This is also different from the Modbus Serial slave implementation. The MEB-TCP supplies its own drop number for the return route to the E-net port.

In Figure 20-11 above, incoming Modbus TCP/IP messages to Index #1 will be translated to SY/MAX messages with the route 101, 5, 2. Modbus messages to slave # 2 will be sent out as SY/MAX messages with the route 101, 5, 14 while messages to Slave 11 will have the route 101, 5, 104, 41, 1. Messages to addresses 2, 3, 4...10 and 12, 13, 14, 15 and 16 will be ignored by the MEB.

Auto-Scan Table

The MEB serial port modes which may be used with Auto-Scan may also be configured for Auto-Scan. The Auto-Scan entries include pointers to the Local (MEB mailbox register), Remote (peripheral device register), Count, type of operation (READ or WRITE), and the Route to the peripheral. Up to 48 entries may be include per port. Figure 20-12 displays an example of the Auto-Scan edit screen.

Figure 20-12 Edit Auto-Scan Table

Local

This value determines the mailbox register in the MEB that is the starting register for the operation. The valid range is 1 through 2048. A value of 0 disables the Auto-Scan entry.

Remote

This value determines the register in the Peripheral device that is the starting register for the operation. The valid range is 1 through 8192. A value of 0 disables the Auto-Scan entry.

Count

The Count field determines the number of consecutive registers moved in the operation. The valid range is 0 through 128. A value of 0 disables the Auto-Scan entry.

Operation

This setting is set to READ or WRITE depending on the operation desired. READ operations copy data from the peripheral device to the MEB's mailbox. WRITE operations copy data from the MEB's mailbox to the peripheral device.

ROUTE

The Route column determines the SY/NET route to the target device. The entries are separated by commas. The first entry should be the SY/NET drop number of this Slave port.

Modbus Plus Global Data

The "edit Global data table" screen allows the determination of where Global Data from other Modbus Plus nodes is placed within the MEB's mailbox registers as well as which MEB registers are to be transferred to the other nodes. Each node includes a COUNT value for the number of registers transferred, and a REGISTER value for the MEB's mailbox register starting point.

Count

The Count value must be set to match the number of registers broadcasted by that specific node. This value must fall within the range of 0 through 32.

Register

The Register value determines the starting register within the MEB for the block of data from this specific node. This value must fall with the range 0 through 2048 with the limitation that the (Register

+ Count) <= 2048 for a node. It is up to the user to chose the starting register as to prevent overlaps in data from other nodes. Figure 20-13 displays an example of Global Data from several nodes.

Figure 20-13Edit Modbus Plus Global Data

Outgoing TCP Routing

(NRD/TCcommon.P and Modbus/TCP only) The "edit Tcp routing" screen allows editing of the table that maps SY/MAX drop numbers (0-199) to IP addresses. The drop in the route following that of the Ethernet port of the MEB is used as an index in this table to point to a specific IP device.

Figure 20-14Edit TCP Routing

Drop

The Drop entry refers to the SY/MAX drop number 0 through 199.

IP Address

The IP Address is the dotted decimal representation for the target server.

Downstream Route

The Downstream Route is an optional additional route that is added after the index drop number and may be up to four layers deep in NRD/TCP and one layer deep in Modbus/TCP.

Offline Functions

"Read from disk to memory"

This function reads an MEB configuration file into the offline memory. The file should have been created by the "Write from memory to disk" function described below and must have a .MEB extension. When "Read from disk to memory" is selected, a window will open and ask for the name of the file to read. The bottom part of the screen will show a list of all files with the extension .MEB in the current directory. Any subdirectories will be shown in square brackets. Any drive names will also be shown in square brackets, [b:]. The parent directory (of which the current directory is a subdirectory) is shown by the word "parent" in square brackets. You may either type the name of the file to read or you may use the arrow keys to move the highlight to the desired filename. Pressing **ENTER** with the highlight on a filename will select that file for reading. Pressing **ENTER** with the highlight positioned on a directory (drive) name (either a subdirectory or [parent]) will change the current directory (drive) to that directory (drive) and will show the .MEB files in the new directory (drive). If there are more files than will fit on the screen, pressing the right arrow with the highlight at the right edge of the screen will scroll the display sideways to show more files. Typing the **ESC** key will return to the offline function menu without loading a file or otherwise modifying offline memory.
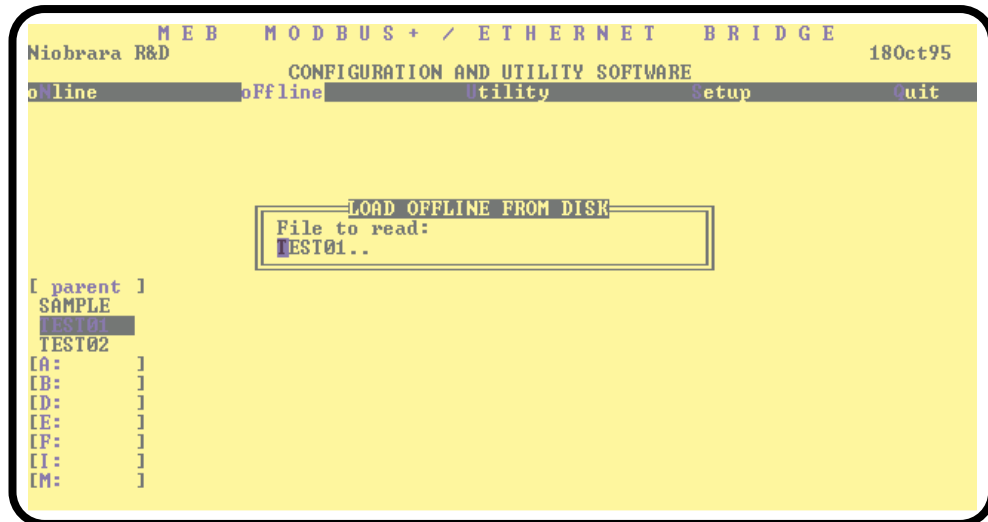
Figure 20-15 oFfline Read from Disk to Memory

"Write from memory to disk"

This function saves a copy of the four ports and global configuration parameters from the offline memory to a disk file. "Write from memory to disk" uses the same point and shoot file selection described for "Read from disk to memory" above. To create a new file you must type the name. The name should be a valid MS/DOS filename but should not include any path name or extension. The program will append an extension of .AIM to the name and the file will be placed in the directory which is shown in the bottom half of the screen. To create a file in a directory other than the current one, use the arrow and **ENTER** keys to traverse the directory tree until a listing of the desired directory is shown in the bottom half of the screen. Then type in the file name and press **ENTER**. If you specify (either by typing or by pointing) a file that already exists, you will be prompted for approval before that file is overwritten.

"Edit configuration in memory"

Just like the online portion of the program, this function displays a screen with the parameters for a single port. As described above, changes here effect the offline memory and not any attached MEB.

"Send memory to module"

This function will send the configuration in memory to the MEB module by way of the SY/MAX setup parameters. In order to send the configuration to the MEB it is necessary for the personal computer to communicate with the MEB. Try going oNline before sending a configuration.

Be cautious when sending a configuration. Go oNline and notice which port the connection is being made to the module. Examine the configuration before sending to make sure that the port connecting to the personal computer will not change from the current settings, otherwise communication may be lost during the send.

"Fetch memory from module"

Use this function when you wish to copy the configuration parameters from a connected MEB module to the offline memory for editing, printout, or saving on disk. "Send memory to the MEB"

This function transfers all five ports' configuration parameters from offline memory to the MEB. This function can be used to load configuration back into the MEB after it has been Fetched and Edited or if it has been read from a previously saved disk file.

"Print configuration in memory"

This function will produce a report showing the settings of all parameters in offline memory. When this function is selected, you will be prompted for an output filename with the default value of PRN shown. To send the report to the PRN device (normally the parallel printer port), simply press **ENTER**. To send the report to a different port or to a file, type the name and then press **ENTER**. Online configurations may be printed with the **F1** print screen key.

"Delete configuration file"

This function will show a point and shoot menu of the available MEB configuration files. Select the file to be deleted and press ENTER.

"Quit offline functions"

Selecting the quit item will cause a return to the main menu bar. Pressing the ESC key will have the same effect.

Utilities

The Utilities menu provides access to useful maintenance and testing functions of the MEBSW software.

View registers

Selecting the View registers menu item will invoke a SY/MAX register data viewer/modifier. This viewer continuously performs a block read of 20 registers and displays the contents of those registers in hex, unsigned integer, signed integer, and binary. The status register associated with the data register is also displayed in hex. Like any other oNline or oFfline function involving communication, the register viewer is dependent on the values located in the SETUP Sy/Max menu. Mode, Baud rate, Parity, Route, etc. must be properly set for proper communication.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                    MEB 18OCT95 Port 1                    18Oct95
                       CONFIGURATION AND UTILITY SOFTWARE
REGSTR   HEX    UNSIGN  SIGNED          BINARY           STAT
     1   0000        0       0   0000 0000 0000 0000     A000
     2   007B      123     123   0000 0000 0111 1011     E000      NR&D Sy/Max
     3   FDC9    64969    -567   1111 1101 1100 1001     E000      Register Viewer
     4   ABCD    43981  -21555   1010 1011 1100 1101     E000
     5   0000        0       0   0000 0000 0000 0000     A000      Press F2 for Help
     6   0000        0       0   0000 0000 0000 0000     A000
     7   0000        0       0   0000 0000 0000 0000     A000
     8   0000        0       0   0000 0000 0000 0000     A000
     9   0000        0       0   0000 0000 0000 0000     A000
    10   0000        0       0   0000 0000 0000 0000     A000
    11   0000        0       0   0000 0000 0000 0000     A000
    12   0000        0       0   0000 0000 0000 0000     A000
    13   0000        0       0   0000 0000 0000 0000     A000
    14   0000        0       0   0000 0000 0000 0000     A000
    15   0000        0       0   0000 0000 0000 0000     A000
    16   0000        0       0   0000 0000 0000 0000     A000
    17   0000        0       0   0000 0000 0000 0000     A000
    18   0000        0       0   0000 0000 0000 0000     A000
    19   0000        0       0   0000 0000 0000 0000     A000
    20   0000        0       0   0000 0000 0000 0000     A000
```

Figure 20-16View Registers

The Up and Down arrow keys are used to move from register to register.

The Page Up and Page Down keys move in increments of 10 registers.

The Left and Right arrows move from column to column on the same register.

Pressing the F9 key will present the SY/MAX setup window. This is useful for changing the route or other parameters without returning to the main menu.

This register viewer is highly useful in that it allows easy editing of the data in the register being viewed. By pressing 0..9 in the decimal fields or 0..9, or A..F in the hex field, an editing mode is entered. New data may be entered at this time. Pressing the Enter key or moving to a new field with the arrow keys will cause the new data to be written to the edited register. If the curser is located in the REGISTER column the block of registers being viewed may be adjusted by entering a new register number. To edit the binary values, press HOME when on the binary field. Move the cursor to the desired bit and enter a '0' or a '1' and press enter to accept.

Pressing Esc will exit from the Register viewer and return to the main menu. Pressing Esc while editing a data field will result in canceling the edit and the modified data will not be written to the register.

The STAT field displays the status register associated with the data register. The STATUS field is a read only display and can not be modified by the Register Viewer. Two common values are E000 and A000. A000 is the hex representation that the PLC recognizes as a PLC OUTPUT register. E000 is for a PLC INPUT register. This allows easy recognition of registers controlled by the MEB as inputs and used by the PLC as outputs.

Terminal Emulator

Selecting the Terminal emulator from the Utilities menu will invoke a terminal emulator according to the setup selected in the Setup menu. The terminal emulator opens as shown in Figure 20-17.

```
Type contrl-End to exit terminal.  Type F7 to begin capture to a file.
Type F9 to change terminal communication setup.
To send hex sequence, type INSERT key, enter hex codes, type ENTER.
r1<0D>
0<0D>
r1,10<0D>
0 0 32768 0 0 0 0 4660 65278 1234<0D>
w12,55,67<0D>
<0D>read12<0D>
55<0D>
s12.1<0D>
<0D>r12<0D>
55<0D>
s12.16<0D>
<0D>r12<0D>
32823<0D>
c12,1<0D>
<0D>r12<0D>
32822<0D>
Enter hex codes to send: 10 05
<10><05>█
```

Figure 20-17 Terminal Emulator

The terminal sends the ASCII code for the alpha-numeric characters out the selected COM port. Functions keys F1 through F4 and the keypad arrows send ANSI (i.e. VT100) codes. F7 is reserved for starting a file capture. F8 will close the capture file. The backspace key sends ASCII BS (08 hex). The Delete key sends and ASCII DEL (7F hex). The Insert key allows the transmission of ASCII hexadecimal characters directly from the hex numbers separated by spaces.

The terminal displays printable ASCII characters which are received on the port. Non-printable characters are displayed as the hexadecimal value enclosed in <>, such as <0D><0A> indicates the carriage return, line feed characters. The terminal is always in this "monitor" mode and therefore ANSI output emulation is not provided.

Pressing F9 will invoke the Terminal Emulator Setup window. This is useful for changing the port parameters without returning to the main menu.

Download New Firmware to Module

The Download new firmware to MEB utility allows the field installation of upgrades provided by Niobrara via the Port 1 RS-422 serial port.   To load new firmware into the MEB, perform the following steps:

1   Remove power from the register rack.

2   Remove the MEB from the register rack.

3   Locate the Load/Normal toggle switch on the back of the MEB. (See Figure 20-18) Move this switch to the LOAD position.
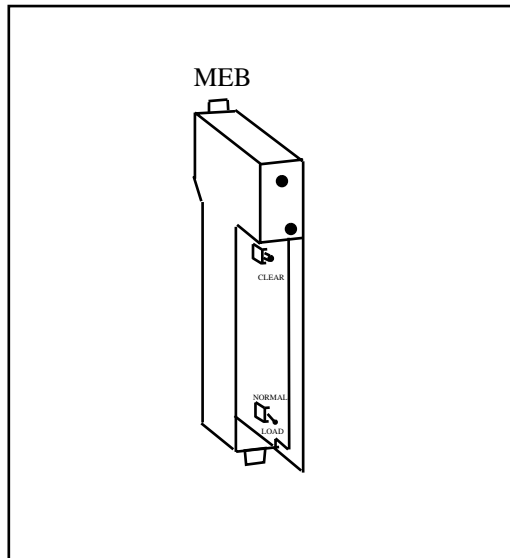
Figure 20-18MEB Firmware Load Switch

4   Install the MEB back into the register rack.

5   Apply power to the rack. The MEB should perform its startup sequence flash the lights at the top of the module leaving the Power, Ethernet Act lights, and perhaps the Modbus Plus Err lights on.

6   Connect the personal computer to the Port 1 of the MEB. An SC902 cable provides a convenient method for the RS-232<>RS-422 conversion. (See Figure 20-19)

   NOTE: It is important to directly connect the MEB to the personal computer. The Firmware Download utility uses the same personal computer COM port as the normal SY/MAX settings, but the baud rate, parity, and protocol is different. The Firmware Download uses 19200 baud, NONE parity and a custom protocol that is not SY/MAX compatible. It is not possible to download new firmware over normal SY/NET networks.
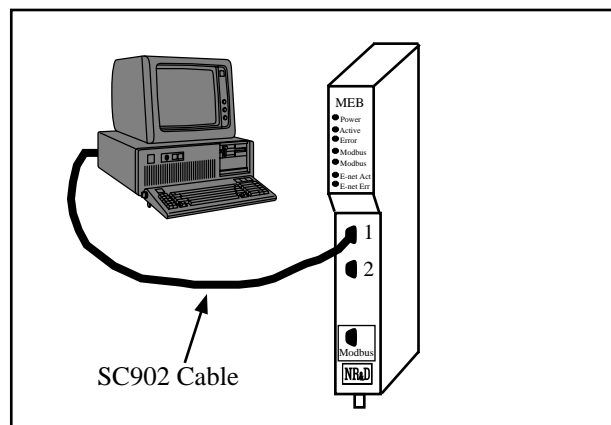
Figure 20-19MEB Firmware Download

7   From MEBSW's main menu, select Utility, Download New Firmware to MEB. A window prompting for the file to download will appear. Select the new revision for the firmware and press Enter.

8   Wait for the firmware download to be completed. A message indicating completion will be displayed on the personal computer.

9   After the completion of the download, remove power from the register rack.

10   Remove the MEB from the rack.

11   Change the LOAD/NORMAL switch back to NORMAL.

12   Install the MEB back into the register rack.

13   Connect power back to the register rack. The MEB should go back through its startup checks and now function normally.

SETUP

The setup menu accesses the setup parameters for the personal computer to enable it to communicate with the MEB and the terminal emulator. The parameters chosen will depend on the exact equipment involved in making the connections.

SY/MAX SETUP

The connection type is mainly determined by the method of connection to outside world and may be broken into several groups: the personal computer's COM: port, the SFI-610 Ethernet card, and the SY/LINK Network Interface Card.

Personal Computer COM: port

If the connection from the personal computer is made through one of its serial ports then the Connection type should be one of the following:

• Sy/Max COM:

• Net-to-Net COM:

• Gateway COM:

Sy/Max COM: is the default and most likely will be the one used. In this mode the personal computer will communicate through one of its COM: ports as though it were a SY/MAX device such as a PLC. The full SY/MAX protocol is supported including routing so SY/MAX COM: may be used through SY/MAX mode ports on NIMs and Niobrara Routing Modules with appropriate routing. This mode is to be used when a direct connection from the personal computer COM: port is made to the MEB. In most cases an RS-232<>RS-422 conversion is required and the Niobrara SC406 or SC902 cables make this conversion very convenient. Note: The SC406 and SC902 cables require the use of the provided power supply with the cable.

Net-to-Net COM: is used when connecting to a NIM, SY/LINK, MEB, EPE5, or SPE4 that is set to Net-to-Net mode. The first drop number in the route will be that of the address of the Net-to-Net port.

Gateway COM: is used when connecting to an SPE4/MEB/EPE5 port that is in Gateway mode. For more information about Gateway mode see on page 73.

Port - When one of the COM: connection types is selected a particular port of the personal computer must be selected. Available choices are: COM1:, COM2:, COM3:, and COM4:. Select the port which will be used to connect to the MEB.

Baud rate - The Baud rate selected here is the baud rate of the personal computer serial port selected. This value should be set to match the device connected to the personal computer. An MEB has a default baud rate of 9600 and if a direct connection is made to the MEB this is the setting that should be made on the personal computer. If the baud rate of the port of the MEB has been changed this value may need to be adjusted.

```
      M E B     M O D B U S + / E T H E R N E T     B R I D G E
Niobrara R&D                                                        13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE
 oNline            oFfline           Utility           Setup            Quit


                         ┌CONFIGURE THIS COMPUTER┐
                         Connection type Sy/Max COM:
                                    Port COM1:
                               Baud rate 9600
                               Data bits 8
                               Stop bits █
                                  Parity EVEN
                             Error Check BCC
                                   Route NONE
 Use arrows or initi
 Use Esc to abort fu└
 Use F1 at any time to print the screen
 Use F10 to clear error window (lower right screen corner)
 For assistance, call (800)235-6723 or USA (417)624-8918



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```

Figure 20-20 SY/MAX Setup Screen

Data bits - When in SY/MAX or Net-to-Net modes the data bits is required to be 8 and may not be changed. The SY/MAX protocol requires 8 data bits. The Gateway mode uses ASCII messages which do not require the full 8 data bits and may be set to 8 or 7 depending on the attached device.

Stop bits - The stop bits are normally set to 1 but may be adjusted to 2 for some particular application. The communication ports of the MEB are normally set for 1 stop bit.

Parity - SY/MAX and Net-to-Net modes normally use EVEN parity and that is the default for the communication ports on the MEB. Other choices are ODD and NONE.

Route - The route is used to determine the path from the personal computer to the MEB. If a direct connection is made from the personal computer to the MEB, i.e. without going through a SY/NET network, an Ethernet network, another MEB, or an SPE4, this value is set to NONE by pressing the Delete key. If a SY/MAX connection is made to a SY/MAX mode port on an NIM or SPE4 the first drop will be that of the drop number of the NIM or SPE4 port. If any Net-to-Net drops are included between the port connected to the personal computer and the port connected to the MEB, they must be included in order of occurrence from the personal computer to the MEB. The last drop number listed will be that of the NIM or SPE4 SY/MAX mode port that is connected to the MEB. Up to 8 total drops are supported by the SY/MAX protocol.

If the personal computer is in Net-to-Net mode the first drop will be that of the Net-to-Net port of the NIM, SY/LINK, EPE5, or SPE4 that the personal computer is connected to. Subsequent drops will be included as above.

The Gateway mode route will include the Gateway port on the MEB, EPE5 or SPE4 that the personal computer is connected and any subsequent Net-to-Net and SY/MAX drops to reach the MEB.

SY/LINK Connection

MEBSW provides full support of the Square D SY/LINK network interface card. Setup for the network interface is provided along with setup for the RS-422 port on the card.

```
        M E B     M O D B U S +  /  E T H E R N E T     B R I D G E
Niobrara R&D                                                    13Nov95
                    CONFIGURATION AND UTILITY SOFTWARE
 oNline              oFfline            Utility         Setup          Quit

                        ═CONFIGURE THIS COMPUTER═
                        Connection type Sy/Link Direct
                           Base address CA000-CA3FF
                        RS422 Baud rate 9600
                        RS422 Data bits 8
                        RS422 Stop bits 1
                           RS422 Parity EVEN
                           Sy/Net speed 62.5 KB
                            Sy/Net size 31
                                  Route 30,5,51▮
 Use arrows or initi
 Use Esc to abort fu
 Use F1 at any time to print the screen
 Use F10 to clear error window (lower right screen corner)
 For assistance, call (800)235-6723 or USA (417)624-8918



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```

Figure 20-21 SY/LINK Setup Screen

Connection type - The RS-422 port may be set to SY/MAX or Net-to-Net modes. For a direct connection to the MEB from the RS-422 port of the SY/LINK card choose the Sy/Link Direct mode. If an indirect connection from the RS-422 port of the card is made through other Net-to-Net ports choose Sy/Link Net-to-Net. If the RS-422 port is not used and the connection is make through the SY/NET network to another NIM, the choice does not matter.

Base address - This is a hex value that represents the SY/LINK's cards address range selected by DIP switches on the card. Select the same range that is set on the card.

RS422 Baud rate - Select the baud rate to match the external device, normally 9600.

RS422 Data bits - Select the data bits to match the external device, normally 8.

RS422 Stop bits - Select the stop bits to match the external device, normally 1.

RS422 Parity - Select the parity to match the external device, normally EVEN.

Sy/Net speed - Select to match the speed settings of the other devices on the SY/NET.

Sy/Net size - Select to match the setting on the other SY/NET devices.

Route - The first drop in the route defines the network address of the SY/LINK board. Since the personal computer is connected to the SY/LINK card through the edge connector of the card, port 0, the drop number must start with 0. The remaining two digits of that drop should be selected not to match any other device on the SY/NET. For instance, there are three NIMs on the network addressed 01, 02, and 03. It seems logical to make the SY/LINK card be at address 04 so the first drop in the route field will be 004. The next drop will be that of the NIM port connected to the MEB, or another Net-to-Net port. If Sy/Link Direct was selected and the MEB is connected directly to the RS-422 port of the SY/LINK card the full route statement would be 004 104 as the RS-422 port is considered to be port 1.

SFI-610 SETUP

MEBSW provides support for the SFI-610 Ethernet card for the personal computer. The SFI-610 card requires initialization with the SFI610.EXE program before it may be used with MEBSW. This initialization configures the SFI-610 card for a specific SY/NET drop number.

The only adjustable setting of the SFI-610 is the Route. The first drop number in the Route must be the drop number for which the SFI-610 has been configured. The remaining drops will include the path to the target.

Terminal Emulator SETUP

The Terminal Emulator setup allows an individual setup for the operation of the terminal emulator. For instance, this separate setup will allow COM1 to be used for the MEB SY/MAX connection and COM2 to be used for a terminal emulator connection.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                      18Oct95
                    CONFIGURATION AND UTILITY SOFTWARE
oNline           oFfline           Utility           Setup          Quit
                     ┌─CONFIGURE TERMINAL EMULATOR─┐
                     │      Port COM1:             │
                     │ Baud rate 9600             │
                     │ Data bits 8                │
                     │ Stop bits 1                │
                     │    Parity NONE             │
                     └────────────────────────────┘



Use arrows or initial capital letter to make menu selections
Use Esc to abort functions
Use F1 at any time to print the screen
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918


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```

Figure 20-22 Terminal Emulator Setup Screen

Port - Available choices are: COM1:, COM2:, COM3:, and COM4:. Select the port which will be used to connect to the external device.

Baud rate - The Baud rate selected here is the baud rate of the personal computer serial port selected. This value should be set to match the device connected to the personal computer.

Data bits - Selects the number of data bits for the message packet. Choices are 8 or 7 depending on the attached device.

Stop bits - The stop bits are normally set to 1 but may be adjusted to 2 for some particular application.

Parity - Choices are EVEN, ODD, and NONE.

Register Viewer Setup

The Register Viewer Setup allows an individual setup for the operation of the Utility Register Viewer.

```
        M E B    M O D B U S +  /  E T H E R N E T    B R I D G E
Niobrara R&D                                                      13Aug97
                    CONFIGURATION AND UTILITY SOFTWARE
oNline           oFfline           Utility           Setup          Quit
                   ┌──CONFIGURE REGISTER VIEWER──┐
                   │        Priority Non-Priority│
                   │ Status Registers YES        │
                   │      Screen Size 20         │
                   │ Starting Register 1         │
                   │   Identify Module YES       │
                   └──────────────────────────────┘



Use arrows or initial capital letter to make menu selections
Use Esc to abort functions
Use F1 at any time to print the screen
Use F10 to clear error window (lower right screen corner)
For assistance, call (800)235-6723 or USA (417)624-8918


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```

Figure 20-23 Terminal Emulator Setup Screen

Priority - The Priority setting allows the choice of Priority or Non-Priority SY/MAX messages for the read and write operations of the register viewer. The default is Non-Priority.

Status Registers - This setting allows the reading of the status bits (bits 17 through 32) of a SY/MAX register. If set to YES, the Priority setting must be NON-PRIORITY when the target is a SY/MAX PLC. The default setting is YES.

Screen Size - Selects the number registers to be read per operation and displayed on the screen. The valid range is 1 through 20 inclusive. The default value is 20.

Starting Register - The starting register value determines the first register polled when the register viewer is entered. The valid range is 1 through 8192 inclusive with the default value of 1.

Identify Module - This option determines if the register 8188 is read in the target device to determine the SY/MAX ID of the target. The default value is YES.

Load from File

The Load from File option allows the user to select from multiple SY/MAX setups. Simply enter the filename of the setup desired and MEBSW will use that setup. MEBSW always saves the current setup as MEBSW.STP regardless if a new setup has been loaded.   The idea is that you configure the setup as you like, save it to MEBSW.STP by selecting Y for yes when prompted, quit MEBSW to DOS, and copy MEBSW.STP to a new filename with the extension .STP. The following DOS command copies the MEBSW.STP to a new name MEB01.STP:

> C:\MEB> copy mebsw.stp meb01.stp

Command Line Parameters

MEBSW may be started from the DOS command line with a sequence of letters which represent the keystrokes necessary to perform any operation. This allows batch processing of various commands such as downloading of stored setup files. The special characters /R, /D, and /E refer to the Return key, Delete key, and Escape key respectively. The parameters are not case sensitive. The following example loads a new SY/MAX setup MEB01.STP, to perhaps change the route to the MEB, loads the configuration file TEST.MEB into an MEB, then quits. It is assumed that the MEB is connected to the computer and the rest of MEBSW setup is correct.

>MEBSW SLmeb01/RFRtest/RFSQ

The S selects Setup, the L selects Load setup file, meb01 is the filename of the setup, /R is the return to accept the filename, the F is for oFfline, the R is to Read a configuration file, test is the filename, /R is the return to accept the filename, F selects oFfline again, S sends the configuration to the module, and finally Q for Quit.

Local Registers

The MEB configuration is controlled by writing to a set of processor equivalent registers local to the MEB module. These registers may be read or written by sending SY/MAX (or Modbus) read and write messages to the module itself. These messages may be generated by ladder program read and write rungs in a processor, by a SY/LINK card, a D-LOG module, or a computer program such as the MEBSW program provided with the module. In order for the module to know that a SY/MAX message is for the module itself and not to be routed to another port, the route should be empty, should end with the drop number of the MEB port it enters, or should be terminated with either the null drop 204 or a drop number not found in the module. The Register Viewer located in the Utility section of the MEBSW program is a convenient interface to the module's registers.

Module Register Overview

Table represents an overview of the local registers present within the MEB. Notice that only registers 1..512 may be rack addressed by the PLC. All other registers must be read or written through the serial, MB+, or E-Net ports.

Table 21-1 Module Register Overview

Register	Function
1..512	Rack Addressable Mailbox registers for user applications
513..2048	Mailbox registers for user applications
2049..2176	Statistics Registers (See Tables 21-4 and 21-6)
2177..2899	Reserved for future use, do not modify
2900..2995	TCP/IP Address Table
2996..2999	TCP/IP Tuning Parameters
3000..3302	Ethernet Addresses (See Table 21-9)
3303	E-Peer Active Nodes Register
3304	Ethernet Address Poll Register
3410..3699	Auto-Scan Tables
3700..3753	Modbus Plus Network Statistics (See Table 21-9)
3800..3929	Modbus Plus Peer Cop Configuration (See Table 21-9)
4640..7199	Modbus Slave Address Look-up Tables (See Table 21-4)
7200..7999	TCP/IP Routing Table
8001..8162	Setup and Configuration (See Tables 21-18, 21-19, 21-20)
8176..8188	Module identification (See Table 21-30)

Mailbox Registers

The MEB contains 2048 Mailbox registers numbered 1..2048. Each of these registers may be written or read from any of the 4 ports on the module. In addition, the first 512 of these registers may be rack addressed by the PLC; therefore each of the 4 ports may read and write values directly to the PLC without using the PLC's COMM port.

The mailbox registers correspond to to the registers in the PLC by the following formula:
$$PLC\ Register = Rack\ Start\ Address + Mailbox\ Register - 1$$

The direction of data flow is determined by the MEB. Upon power-up all rack addressable Mailbox registers are considered PLC outputs. This means that the PLC may write data to the Mailbox registers. When a register is a PLC output, its Status register will have a value of A000 in hexadecimal. By using PLC output registers, the processor may write data to the MEB Mailbox registers that are rack addressed and external devices may then read that data from the Mailbox.

When it is desired to have the external device write data to the PLC, the MEB handles the change in direction of data flow automatically. When an external WRITE is received onto the Mailbox, the Status of the effected register is changed from A000 to E000 and the PLC now recognizes that register as a PLC Input. Once a register has been changed to an Input it will remain an Input until the MEB is reset

by cycling power or by using the function clear register. Once a register is an Input, the PLC may now only read the data in the register. The external devices may both read and write the data.

NOTICE

The scan time of the processor is directly related to the number of externally addressed registers. Allocating more registers than needed can have an adverse impact on the speed of the system. Only Rack Address those registers needed for the particular application. See the processor's manual for more information on optimizing scan speed.

It should be noted that any Mailbox registers that are not rack addressed are still available to the external devices for Mailbox use, they just are not scanned by the PLC.

Mailbox Example

Consider the PLC setup in Figure 21-1. The Model 400 is in slot 1 and has registers 19..4000 assigned to it. A 64 point output module is in Slot 2 and has been rack addressed for registers 1 through 4. The MEB has been rack addressed for registers 5 through 14. A 64 point Input module is in slot 4 and has been rack address for registers 15 through 18.
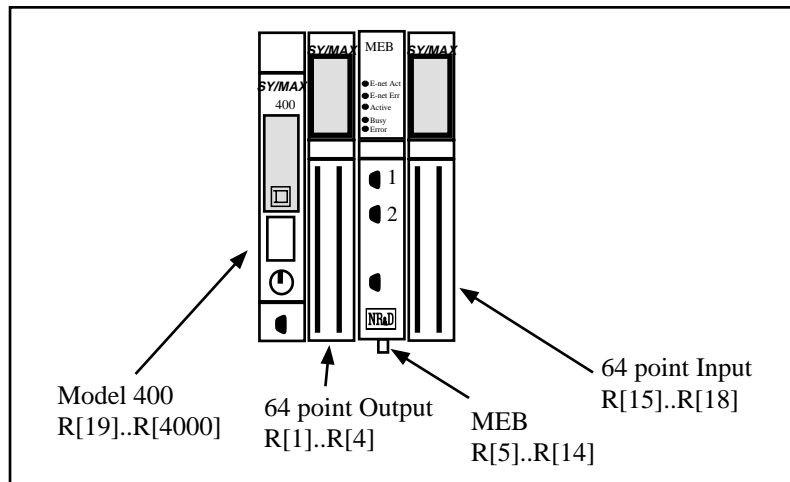
Figure 21-1 Mailbox Setup Example

The rack addressed registers within the MEB mailbox will correspond to the PLC registers in the Model 400 as follows:

Table 21-2 Mailbox Example Register List

PLC Register #	MEB Register #	Status Register Value (Hex)
5	1	A000
6	2	A000
7	3	A000
8	4	A000
9	5	A000
10	6	A000
11	7	A000
12	8	A000
13	9	A000
14	10	A000

For the external device to READ the PLC register 13, it needs to perform its READ on the Mailbox register 9. If the PLC copies data to its register 11, it will appear in the MEB register 7.

Notice that the Status Register of each register has the hexadecimal value A000. This value means that the register is a PLC output. All MEB mailbox registers default to PLC outputs upon power-up and consequently have a status of A000. As soon as an external device writes to the mailbox register, (from data ports 1..4, the Ethernet port, Auto-transfer, etc.) the register changes from a PLC Output to a PLC Input. The status register will change from A000 to E000. The register will remain as a PLC Input until the power is cycled on the MEB. When a register is a PLC Output, the PLC may write data to that register. When a register is a PLC Input, the PLC can only read that data and may not overwrite it. For this reason it is important to plan in advance which registers are to be used as PLC Inputs and which are to be used as Outputs.

It is recommended that the Inputs and Outputs be placed together in blocks of like registers. This allows multiple register WRITEs to be used by the external devices, thus increasing efficiency.

If in the above example, registers 5 through 9 are used as PLC Outputs (data output by the PLC) and 10 through 14 are used as PLC Inputs (data written by external devices), then the status of each register would look like Table 21-3 after each register has been written at least once.

Table 21-3 Mailbox Example Register List after External Writes

PLC Register #	MEB Register #	Status Register Value (Hex)	Who Writes
5	1	A000	PLC
6	2	A000	PLC
7	3	A000	PLC
8	4	A000	PLC
9	5	A000	PLC
10	6	E000	MEB
11	7	E000	MEB
12	8	E000	MEB
13	9	E000	MEB
14	10	E000	MEB

Statistics Registers

Ethernet Port Statistics

The Ethernet port has its own group of 32 statistics registers to give the user an idea of the activity on the Ethernet connection of the MEB. These registers may be cleared by writing a zero. The group of registers for SY/MAX 802 mode is shown in Table 21-4 while TCP/IP is shown in Table 21-5.

Table 21-4 SY/MAX Ethernet Port Statistics Registers

Register	Incremented when the following occurs:
2049	SY/MAX Ethernet commands/replies received.
2050	Incoming E-Net SY/MAX packet lost because no available buffer.
2051	Retry packets received.
2052	Packets generated locally. (Auto-transfer)
2053	Packet generation failed because no available buffer.
2054	Packet transmitted successfully.
2055	Transmission failed.
2056	Transmission retry.
2057	Packet lost because of unrecognized or illegal drop or bad route.
2058	Illegal SY/MAX operation request on local registers.
2059	Priority read received and performed upon local registers.
2060	Priority write received and performed upon local registers.
2061	Non-Priority read received and performed upon local registers.
2062	Non-Priority write received and performed upon local registers.
2063	Non-SY/MAX Ethernet packet received.
2064	Ethernet packets transmitted.
2065	Ethernet packets received.
2066	Ethernet collisions.
2067	Ethernet transmit packets lost to excess collisions.
2068	Ethernet receive packets with CRC error.
2069	Ethernet receive packets with framing error.
2070	Ethernet NAK TRANS sent (Sequence error).
2071	Reserved for future use.
2072	Reserved for future use.
2073	Reserved for future use.
2074	Reserved for future use.
2075	Reserved for future use.
2076	Last route received (drops 1,2).
2077	Last route received (drops 3,4).
2078	Last route received (drops 5,6).
2079	Last route received (drops 7,8).
2080	Buffers in use. Number indicates the buffers in use by this port.

Table 21-5 TCP/IP Ethernet Port Statistics Registers

Register	Incremented when the following occurs:
2049	TCP/IP RESET received..
2050	SNIC ran out of Ring Buffers.
2051	Reserved
2052	TCP Buffer pulled from Free Queue.
2053	Free Queue is Empty (out of buffers).
2054	Packet transmitted successfully and acknowledged by peer.
2055	Connection abandoned.
2056	Retransmitted un-ACKed packet.
2057	Packet lost because of unrecognized or illegal drop or bad route.
2058	Illegal TCP/IP Query request on local registers.
2059	Incoming TCP/IP Read performed upon local registers.
2060	Incoming TCP/IP Write received and performed upon local registers.
2061	Total number of TCP connections open.
2062	Total number of Client TCP connections open.
2063	Non-NRD or Modbus TCP/IP Ethernet packet received.
2064	Ethernet packets transmitted.
2065	Ethernet packets received.
2066	Ethernet collisions.
2067	Ethernet transmit packets lost to excess collisions.
2068	Ethernet receive packets with CRC error.
2069	Ethernet receive packets with framing error.
2070	Ethernet NAK TRANS sent (Sequence error).
2071	Reserved for future use.
2072	Reserved for future use.
2073	Reserved for future use.
2074	Reserved for future use.
2075	Reserved for future use.
2076	Last route received (drops 1,2).
2077	Last route received (drops 3,4).
2078	Last route received (drops 5,6).
2079	Last route received (drops 7,8).
2080	Buffers in use. Number indicates the buffers in use by this port.

Data Port Statistics

Each of the four data ports has its own group of 32 statistics registers. These are displayed in Table 21-6.

Table 21-6 Ports 1 and 2 Statistics Registers

Port 1	Port 2	Incremented when the following occurs:
2081	2113	Receipt of a packet on the port. In SY/MAX mode, packet was valid.
2082	2114	Incoming packet rejected (SY/MAX) or lost (other) because no available buffer.
2083	2115	Invalid SY/MAX packet received and negative acknowledge sent.
2084	2116	Message generated internally. (translation, Auto-transfer)
2085	2117	Internal message generation failed because no available buffer.
2086	2118	Packet transmitted (SY/MAX packet acknowledged by recipient.)
2087	2119	Transmission failed (SY/MAX retries exhausted).
2088	2120	Transmission retry.
2089	2121	Message lost because of unrecognized or illegal drop or bad route.
2090	2122	Illegal operation request for local command or translation.
2091	2123	Priority read received and performed upon this port.
2092	2124	Priority write received and performed upon this port.
2093	2125	Non-Priority read received and performed upon this port.
2094	2126	Non-Priority write received and performed upon this port.
2095	2127	Character receive error (parity, framing, etc.)
2096	2128	Characters transmitted
2097	2129	Characters received.
2098	2130	Reserved for future use.
2099	2131	Reserved for future use.
2100	2132	Reserved for future use.
2101	2133	Reserved for future use.
2102	2134	Reserved for future use.
2103	2135	Number of queued messages.
2104	2136	Number of bytes transmitted between SY/MAX checksum and ack returned.
2105	2137	Reserved for future use.
2106	2138	Reserved for future use.
2107	2139	Reserved for future use.
2108	2140	Last route received (drops 1,2).
2109	2141	Last route received (drops 3,4).
2110	2142	Last route received (drops 5,6).
2111	2143	Last route received (drops 7,8).
2112	2144	Buffers in use. Number indicates the buffers in use by this port.

Modbus Plus Port Statistics

These statistics are reported from the MEB. See page 162 for additional statistics reported by the MB+ chipset.

Table 21-7 Modbus Plus Port Statistics

Reg.	Incremented when the following occurs:
2145	Receipt of a Modbus Plus packet on the port
2146	Reserved for future use.
2147	Message unrouteable. by Modbus Plus, discarded.
2148	Reserved for future use.
2149	Reserved for future use.
2150	Successful transmission of Modbus Plus packet.
2151	Failure to transmit Modbus Plus packet.
2152	Transmission deferred because all paths allocated.
2153	Message unrouteable by SY/MAX router, discarded.
2154	Illegal local operation requested.
2155	Priority read performed on local registers.
2156	Priority write performed on local registers.
2157	Non-Priority read performed on local registers.
2158	Non-Priority write performed on local registers.
2159	Reserved for future use.
2160	Attempt to transmit Modbus Plus packet.
2161	Reserved for future use.
2162	Reserved for future use.
2163	Reserved for future use.
2164	Reserved for future use.
2165	Reserved for future use.
2166	Reserved for future use.
2167	Reserved for future use.
2168	Reserved for future use.
2169	Reserved for future use.
2170	Reserved for future use.
2171	Reserved for future use.
2172	Last route received (drops 1,2).
2173	Last route received (drops 3,4).
2174	Last route received (drops 5,6).
2175	Last route received (drops 7,8).
2176	Buffers in use. Number indicates the buffers in use by this port.

IP Routing Table

The MEB-TCP includes an internal IP router which is configured by a table with sixteen 12 byte entries including the IP addresses, subnet masks, and gateways. This table is held in registers 2900 through 2995.

The first two registers of each entry contain the IP address. For local IP address, an explicit address is set here and the Flag entry is set to 1 for KEEP. For subnet gateways, the masked IP address of the subnet should appear here.

The next two registers provide the Subnet Mask (or Default Gateway IP address.)

A subnet route has a Subnet Address in the first two registers and the full IP address for a gateway in the next two registers. Failing an exact match, the destination of the packet is ANDed with the local subnet mask and the resulting subnet address is searched for in the table.

A network route is treated the same as a subnet route, except that the subnet mask can be determined by whether the destination is a Class A, B, or C address.

A default route is a network route with a network address of all 0's. This will also serve to mark the end of the table.

The Port Number entry only allows the value 0 for the Ethernet port at this time. When serial IP protocol modes are added to the MEB-TCP, other port numbers will be allowed.

The Flag entry tells the router what to do with the incoming/outgoing IP packets. If set to 0, the router discards the packet. If set to 1, the router keeps the message and hands it up the protocol stack. If set to 2, the router forwards the IP packet to the port determined by the Port Number entry.

Table 21-8 below shows an example of the IP router table with the IP Address of the Ethernet port set to 199.186.195.20 and a Subnet Mask of 255.255.255.0 and a Default Gateway of 199.186.195.1.

Table 21-8 IP Router Table

Register	Description	Example (hex)	Notes	Entry
2900	IP Address MSW	C7BA	199.186	**IP Table Entry 1** This entry sets the IP address of the Ethernet port to 199.186.195.20 and the Subnet Mask to 255.255.255.0
2901	IP Address LSW	C314	195.20	
2902	Subnet Mask MSW	FFFF	255.255	
2903	Subnet Mask LSW	FF00	255.0	
2904	Port Number	0	Ethernet Port	
2905	Flag	1	Keep	
2906	IP Address MSW	0000	0.0	**IP Table Entry 2** This entry sets the Default Gateway to 199.186.195.1 so other packets not matching the subnet mask are sent to the gateway.
2907	IP Address LSW	0000	0.0	
2908	Subnet Mask MSW	C7BA	199.186	
2909	Subnet Mask LSW	C301	195.1	
2910	Port Number	0	Ethernet Port	
2911	Flag	2	Forward	
...	...	...	...	...
2990	IP Address MSW	0		**IP Table Entry 16**
...	...	...	...	
2995	Flag	0		

TCP/IP Port Number

The TCP/IP port number that the server listens on for new connections is controlled by register **2996** and has a default value of 6000 decimal. All NRD/TCP clients and servers on the same logical network

must use the same Port Number in order to gain connections. Modbus/TCP servers listen on port 502 and this value is fixed and not adjustable.

TCP/IP Step Size for Incremental Backoff

Register 2997 contains the decimal value in 100ths of a second, the step size for the TCP incremental backoff timer. If a TCP packet is transmitted on an open connection, it will expect an acknowledgment from the other device within this time value. If an ACK is not received, the message will be retransmitted and the incremental timer value is doubled. This will continue until an ACK is received or the downstream timer expires. The default value is 100 decimal (1 second) which will result in the following retransmit times: 1 sec, 2 sec, 4 sec, 8 sec, 16 sec...

TCP/IP Downstream Timeout

Register 2998 contains the setpoint for the amount of time a client waits for a response from a server (or further downstream device). This value is expressed in 100ths of a second and the default is 500 (5 seconds). When this timer expires, a SY/MAX error 29 is returned.

TCP/IP Quiet Timeout

Register 2999 contains the setpoint for the amount of time a socket will remain open with no traffic. The units are seconds with the default equal 600 (10 minutes).

Ethernet Addresses of Known Drops Registers

The IEEE 802.3 protocol requires each physical device on the Ethernet to have a unique address. (This address the address of the Ethernet controller and is not to be confused with the SY/MAX drop number 00..99.) This address is a 6 byte number and its value is governed by the IEEE. Each company that makes Ethernet devices is assigned a block of addresses by the IEEE. All NR&D Ethernet products will have addresses with the form 00-20-BD-XX-XX-XX.

The MEB provides a listing of the physical Ethernet 802.3 address of each known active SY/MAX device on the network (See Table 21-9). These values are placed in Registers 3000..3302 with three registers allocated for each address. The Ethernet address requires six bytes of data and this data is split into two bytes per register. The following formulas will provide the registers containing the Ethernet address of each of the 100 possible devices on the SY/MAX network:

$$3000 + Drop * 3 = \text{First two bytes of Ethernet Address}$$
$$3001 + Drop * 3 = \text{Middle two bytes of Ethernet Address}$$
$$3002 + Drop * 3 = \text{Last two bytes of Ethernet Address}$$

Registers 3300..3302 give the Ethernet address of the MEB.

Table 21-9 Ethernet Physical Address Registers

Register	E-Net Address Bytes	SY/MAX Drop Numbers
3000	First	Drop 00
3001	Middle	
3002	Last	
3003	First	Drop 01
3004	Middle	
3005	Last	
3006	First	Drop 02
3007	Middle	
3008	Last	
3009	First	Drop 03
3010	Middle	
3011	Last	
...	...	...
3297	First	Drop 99
3298	Middle	
3299	Last	
3300	First	Address of this MEB
3301	Middle	
3302	Last	

If the MEB recognizes another device on the Ethernet with the same SY/MAX Ethernet, it will go into Duplicate Drop mode and place the offending devices MAC in the table entry corresponding to the drop number of the MEB's port. This state is easily recognized by the E-net Error light flashing at a constant rate of 2 flashes per second.

E-Peer Active Register

The bits of read-only register 3303 correspond to those of the first sixteen nodes on an MEB peer network which are active. If unit x is active on the network, bit x is set. If node x is powered off, disconnected from the cable, or otherwise disabled, bit x will be cleared. Loss of the node has no effect on the timing of the other nodes. They will detect the absence of the node and clear the corresponding bit in their register 3303. If the peer network has more than sixteen nodes, node numbers 17 and beyond have no associated active bits.

E-Net Search

Register 3304 provides a mechanism for causing the MEB to send out connect messages to units on the Ethernet in order to build a complete table of all devices on the network. When the value 100 is written to register 3304, connect messages from unit 0 through 100 will be sent onto the network. MEBSW uses this technique to develop a complete listing of all of the possible nodes on the network.

Auto-Scan Table Registers

Each serial port has registers reserved for up to 48 entries in the Auto-Scan table. Registers 3410 through 3999 along with the Modbus Slave Address Tables are used to define the Auto-Scan table.

Table 21-10 Auto-Scan Configuration Registers

Port 1 Register	Port 2 Register	Data Bytes		Description
		MSB	LSB	
3410	3555			Status Pointer
3411	5281	Flag	Count	Drop 1 Flags/Count
3412	5282			Drop 1 Local Pointer
3413	5283			Drop 1 Remote Pointer
3414	5284	Flag	Count	Drop 2 Flags/Count
3415	5285			Drop 2 Local Pointer
3416	5286			Drop 2 Remote Pointer
...	...	...	...	...
3554	5915			Drop 48 Remote Pointer

Modbus Plus Network Statistics

The read-only MEB registers 3700 through 3753 display the Modbus Plus network statistics of the MEB's Modbus Plus interface in the format described in Modbus Plus documentation. Tables 21-11 through 21-13 describe these registers.

Table 21-11 Modbus Plus Network Statistics

MEB Register	Description	Notes
3700	Node type I.D.	0 - Unknown node type 1 - Standard PLC node 2 - Modbus bridge node 3 - PC Plus node 4 - Bridge Plus node
3701	Communications processor ver.	First release is version 1.00 and displays as 0100 hex.
3702	Network Address	For this station.
3703	MAC state variable	0 - Power up state 1 - Monitor offline state 2 - Duplicate offline state 3 - Idle state 4 - Use token state 5 - Work response state 6 - Pass token state 7 - Solicit response state 8 - Check pass state 9 - Claim token state 10 - Claim response state
3704	Peer status (LED code); provides status of this unit relative to the network	0 - Monitor link operation 32 - Normal link operation 64 - Never getting token 96 - Sole station 128 - Duplicate station
3705	Token pass counter	Increments each time this station gets the token.
3706	Token rotation time in ms	
3707	LO byte HIGH byte	Data master failed during token ownership bit map. Program master failed during token ownership bit map.
3708	LO byte HIGH byte	Data master token owner work bit map. Program master token owner work bit map.
3709	LO byte HIGH byte	Data slave token owner work bit map. Program slave token owner work bit map.
3710	LO byte HIGH byte	Data master/get master response transfer request bit map. Data slave/get slave command transfer request bit map.

Table 21-12 Modbus Plus Network Statistics (Continued)

MEB Register	Description	Notes
3711	LO byte HIGH byte	Program master/get master rsp transfer request bit map. Program slave/get slave command transfer request bit map.
3712	LO byte HIGH byte	Program master connect status bit map. Program slave automatic logout request bit map.
3713	LO byte HIGH byte	Retransmit deferral error counter. Receive buffer DMA overrun error counter.
3714	LO byte HIGH byte	Repeated command received counter. Frame size error counter.
3715	LO byte HIGH byte	Receiver collision-abort error counter. Receiver alignment error counter.
3716	LO byte HIGH byte	Receiver CRC error counter. Bad packet-length error counter.
3717	LO byte HIGH byte	Bad link-address error counter Transmit buffer DMA-underrun error counter.
3718	LO byte HIGH byte	Bad internal packet length error counter. Bad mac function code error counter.
3719	LO byte HIGH byte	Communication retry counter. Communication failed error counter.
3720	LO byte HIGH byte	Good received packet success counter. No response received error counter.
3721	LO byte HIGH byte	Exception response received error counter. Unexpected path error counter.
3722	LO byte HIGH byte	Unexpected response error counter. Forgotten transaction error counter.
3723	LO byte HIGH byte	Active station table bit map, nodes 1 ... 8 Active station table bit map, nodes 9 ... 16
3724	LO byte HIGH byte	Active station table bit map, nodes 17 ... 24 Active station table bit map, nodes 25 ... 32
3725	LO byte HIGH byte	Active station table bit map, nodes 33 ... 40 Active station table bit map, nodes 41 ... 48
3726	LO byte HIGH byte	Active station table bit map, nodes 49 ... 56 Active station table bit map, nodes 57 ... 64
3727	LO byte HIGH byte	Token station table bit map, nodes 1 ... 8 Token station table bit map, nodes 9 ... 16
3728	LO byte HIGH byte	Token station table bit map, nodes 17 ... 24 Token station table bit map, nodes 25 ... 32
3729	LO byte HIGH byte	Token station table bit map, nodes 33 ... 40 Token station table bit map, nodes 41 ... 48
3730	LO byte HIGH byte	Token station table bit map, nodes 49 ... 56 Token station table bit map, nodes 57 ... 64
3731	LO byte HIGH byte	Global data present table bit map, nodes 1 ... 8 Global data present bit map, nodes 9 ... 16
3732	LO byte HIGH byte	Global data present table bit map, nodes 17 ... 24 Global data present bit map, nodes 25 ... 32
3733	LO byte HIGH byte	Global data present table bit map, nodes 33 ... 40 Global data present table bit map, nodes 41 ... 48
3734	LO byte HIGH byte	Global data present table bit map, nodes 49 ... 56 Global data present table bit map, nodes 57 ... 64

Table 21-13 Modbus Plus Network Statistics (Continued)

MEB Register	Description	Notes
3735	LO byte HIGH byte	Receive buffer in use bit map, buffer 1 ... 8 Receive buffer in use bit map, buffer 9 ... 16
3736	LO byte HIGH byte	Receive buffer in use bit map, buffer 17 ... 16 Receive buffer in use bit map, buffer 25 ... 32
3737	LO byte HIGH byte	Receive buffer in use bit map, buffer 33 ... 40 Station management command processed initiation counter.
3738	LO byte HIGH byte	Data master output path 1 command initiation counter. Data master output path 2 command initiation counter.
3739	LO byte HIGH byte	Data master output path 3 command initiation counter. Data master output path 4 command initiation counter.
3740	LO byte HIGH byte	Data master output path 5 command initiation counter. Data master output path 6 command initiation counter.
3741	LO byte HIGH byte	Data master output path 7 command initiation counter. Data master output path 8 command initiation counter.
3742	LO byte HIGH byte	Data slave input path 41 command processed counter. Data slave input path 42 command processed counter.
3743	LO byte HIGH byte	Data slave input path 43 command processed counter. Data slave input path 44 command processed counter.
3744	LO byte HIGH byte	Data slave input path 45 command processed counter. Data slave input path 46 command processed counter.
3745	LO byte HIGH byte	Data slave input path 47 command processed counter. Data slave input path 48 command processed counter.
3746	LO byte HIGH byte	Program master output path 81 command initiation counter. Program master output path 82 command initiation counter.
3747	LO byte HIGH byte	Program master output path 83 command initiation counter. Program master output path 84 command initiation counter.
3748	LO byte HIGH byte	Program master output path 85 command initiation counter. Program master output path 86 command initiation counter.
3749	LO byte HIGH byte	Program master output path 87 command initiation counter. Program master output path 88 command initiation counter.
3750	LO byte HIGH byte	Program slave input path C1 command processed counter. Program slave input path C2 command processed counter.
3751	LO byte HIGH byte	Program slave input path C3 command processed counter. Program slave input path C4 command processed counter.
3752	LO byte HIGH byte	Program slave input path C5 command processed counter. Program slave input path C6 command processed counter.
3753	LO byte HIGH byte	Program slave input path C7 command processed counter. Program slave input path C8 command processed counter.

Modbus Plus Global Data Control Registers

The MEB implementation of the Global Data allows distribution of global data over Modbus Plus. The MEB can broadcast up to 32 contiguous registers from its mailbox registers to the other Modbus Plus nodes and receive up to 32 registers to its mailbox from each of up to 63 other Modbus Plus nodes on its network.

NOTICE: Global data cannot travel through Bridge Plus devices.

By assigning the Global Data registers within the rack addressable portion of the mailbox registers, a SY/MAX PLC can participate in the Global Data network. Note that, in conjunction with EPEER, this feature can be used to bridge EPEER and Global Data.

Global input and output are controlled by pairs of registers. Each pair comprises a length register and a pointer register. The length register may be set to a value 1 through 32 and indicates how many registers will be sent to other nodes or received from a specific node. The pointer register indicates the start register within the mailbox area from which data is read for global output or to which global input data will be written. The pointer register may be in the range 1 through 2048 with the restriction that the sum of the pointer plus the length must not exceed 2049. Setting either or both of the length and pointer register to zero disables global output or reception of global data for the associated node. The length and pointer registers are located in a block between register 3800 and 3929 inclusive. The global input entry associated with the MEB's won Modbus Plus drop number should be zero.

Programming the Global Output registers is not alone sufficient to assure data distribution to other nodes. The receiving nodes must be programmed to accepts the global data from the MEB.

Table 21-14 MB+ Global Data Control Registers

MB+ Node	Direction	Length Register	Pointer Register
MEB's	OUTPUT	3800	3801
1	INPUT	3802	3803
2	INPUT	3804	3805
3	INPUT	3806	3807
4	INPUT	3808	3809
...	INPUT	...	...
N	INPUT	3800 + N * 2	3801 + N * 2
...	INPUT	...	...
64	INPUT	3928	3929

Modbus Slave Address Tables

The is a table of translations for each async port in the module and the Ethernet port in Modbus/TCP mode. These tables are 640 registers long and comprise 128 entries with 5 registers each. The LSB of the first register en each entry is the number of drops in the entry or zero to indicate the entry is unassigned. Each of the remaining four registers of the entry contains two drops, one in each byte in MSB and LSB order. Up to eight drops may be included in the route. The table entries correspond to Modbus addresses in the range of N through N+127 where N is the Modbus address base value for that port and is programmed in another register. The serial port default is 1 making the table applicable to Modbus addresses 1 through 128. The E-net port default is 0 and the Ethernet port uses the tables for Port 0 and Port 4 giving it the full 256 possible Destination Indexes.

When a message is received from a Modbus master, the module checks the table entry associated with the address byte in the message. If the entry is unused (the drop count register is zero), the message is ignored. (It may be intended for another slave multidropped on the Modbus with this port.) If a valid route is found, the Modbus message is translated to SY/MAX and processed locally or forwarded according to the route from the table.

By setting the Modbus Slave Starting Address of two ports to 1 and 129 respectively, all 255 valid Modbus addresses may be recognized and routed by the module. Note that the module must be a -D type MEB, EPE5 or SPE4 to connect two ports in this way or to multidrop the Niobrara port with other slave devices on either a two or four wire bus.

The Modbus slave port retains the original Modbus address from the received slave command and uses it to format the reply to the attached Modbus master. Modbus is a single threaded protocol and only one request at a time may be outstanding from the port through the router.

Translation of commands received on the slave port depends on the settings of the same configuration registers that select the opcodes associated with Modbus Master operations. If the incoming packet has an opcode of 1, 2, 3, or 4 then the Modbus message is translated into a SY/MAX priority READ. If the

incoming packet has an opcode of 5, 6, 15, or 16 then the message is translated into a SY/MAX priority WRITE. The register offset is not applied to the incoming packet.

If the incoming message is not in the above list, it is encoded as a SY/MAX network PRINT and sent to the target device. The target port decodes the network print as a Modbus master and the Modbus reply is returned as a SY/MAX Network Print reply to be emitted at the slave port as the Modbus reply.

The table registers occupy addresses in the 4640 through 5919 range in the MEB.

Table 21-15 Modbus Slave Address Table

E-net Register 0-127	Port 1 Register	Port 2 Register	E-net Register 128-255	Data Bytes		Modbus Drop Numbers
				MSB	LSB	
4000	4640	5280	6560	Not Used	Number of Drops	Address Base + 1
4001	4641	5281	6561	Drop 1	Drop 2	
4002	4642	5282	6562	Drop 3	Drop 4	
4003	4643	5283	6563	Drop 5	Drop 6	
4004	4644	5284	6564	Drop 7	Drop 8	
4005	4645	5285	6565	Not Used	Number of Drops	Address Base + 2
4006	4646	5286	6566	Drop 1	Drop 2	
4007	4647	5287	6567	Drop 3	Drop 4	
4008	4648	5288	6568	Drop 5	Drop 6	
4009	4649	5289	6569	Drop 7	Drop 8	
...	...	...	...	...	...	...
4635	5275	5915	7195	Not Used	Number of Drops	Address Base + 128
4636	5276	5916	7196	Drop 1	Drop 2	
4637	5277	5917	7197	Drop 3	Drop 4	
4638	5278	5918	7198	Drop 5	Drop 6	
4639	5279	5919	7199	Drop 7	Drop 8	

The Modbus address base register is in the normal setup register area. (Table 21-16) The E-net port should always have its starting value set to zero.

Table 21-16 Modbus Slave Starting Address Register

MEB Port	Modbus Slave Starting Add. Reg.
E-net	8031
1	8063
2	8095

TCP/IP Routing Table

Outbound Ethernet TCP/IP messages are routed to the appropriate IP addresses by means of a 200 entry table that maps SY/MAX drop numbers 0 through 199 to IP addresses. Additionally, up to four down-stream route drops may be added to the IP address to extend the functionality of the IP routing. This table starts at register 7900 and includes 8 bytes (4 registers) per entry. The first four bytes (2 registers)

hold the destination IP address. The last four bytes (2 registers) hold the downstream route. The route is held in 1 drop per byte and is terminated by a hex FF value.

NOTE: In Modbus/TCP mode, only the last drop in the Down Stream Route is used as the Destination Index.

Table 21-17 Outbound TCP/IP Routing Table

Register	Description	Example (hex)	Notes	Entry
7900	IP Address MSW	C7BA	199.186	**Entry 0** Routes to IP address 199.186.195.21 with no additional route.
7901	IP Address LSW	C315	195.21	
7902	Downstream Rt	FF00	NONE	
7903	Downstream Rt	0000		
7904	IP Address MSW	C7BA	199.186	**Entry 1** Routes to IP address 199.186.195.22 with the additional drop of 10
7905	IP Address LSW	C316	195.22	
7906	Downstream Rt	0AFF	10	
7907	Downstream Rt	0000		
7908	IP Address MSW	C7BA	199.186	**Entry 2** Routes to IP address 199.186.195.23 with the downstream route of 154,17,1
7909	IP Address LSW	C317	195.23	
7910	Downstream Rt	9A11	154,17	
7911	Downstream Rt	01FF	1	
7912	IP Address MSW	C7BA	199.186	**Entry 3** Routes to IP address 199.186.195.23 with the downstream route of 154,17,2
7913	IP Address LSW	C317	195.23	
7914	Downstream Rt	9A11	154,17	
7915	Downstream Rt	02FF	2	
...	...	...	...	**Entries 4 ... 198**
7996	IP Address MSW	B670	182.112	**Entry 199** Routes to IP address 182.112.204.7 with no additional route
7997	IP Address LSW	CC07	204.7	
7998	Downstream Rt	FFFF	NONE	
7999	Downstream Rt	FFFF		

Setup and Configuration Registers

Registers 8001..8130 are provided for the setup and configuration for the ports of the MEB. Each Port of the MEB uses 32 registers to control its operational parameters. The first two registers concern the entire module and are shown in Table 21-18.

Table 21-18 Module Setup Identification Registers

Register	Legal Values	Function
8001	5001(hex)	Setup identification constant.
8002		Reserved for future use. Do not modify.

Ethernet Port Control Registers

Registers 8003 through 8034 control the parameters of the Ethernet port on the MEB. Table 21-19 provides a list of these registers.

Table 21-19 Ethernet Port Control Registers

Port 0	Legal Values	Function	
8003	0..99	Ethernet SY/MAX drop number.	
8004		Reserved	(IP sub-net mask)
8005		Reserved	(IP sub-net mask)
8006		Reserved	(IP address)
8007		Reserved	(IP address)
8008	2	Protocol Mode	(Presently 2, SY/MAX 802.3 only)
8009	1..8192	Auto-transfer Read Source Register	(Peripheral)
8010		Reserved	(TCP/IP port number).
8011	0..32767	Auto-transfer Interval in 10mS units	
		E-Peer Update Interval in 1mS units	
8012	1..2048	Auto-transfer Read Destination Register	(Mailbox)
	0..100	Number of this E-Peer Node	
8013	1..2048	Auto-transfer Write Source Register	(Mailbox)
		Start of register range to transmit from this E-Peer Node.	
8014	0..8	Number of drops in target route	(Auto-transfer)
8015	0..255	Target Route Drop 1	(Auto-transfer)
8016	0..255	Target Route Drop 2	(Auto-transfer)
8017	0..255	Target Route Drop 3	(Auto-transfer)
8018	0..255	Target Route Drop 4	(Auto-transfer)
8019	0..255	Target Route Drop 5	(Auto-transfer)
8020	0..255	Target Route Drop 6	(Auto-transfer)
8021	0..255	Target Route Drop 7	(Auto-transfer)
8022	0..255	Target Route Drop 8	(Auto-transfer)
8023		Reserved	
8024		Reserved	
8025	1..32	Buffer Limit	
8026	0..128	Auto-transfer Read Count	
	2..100	Number of E-Peer Nodes	
8027	0..128	Auto-transfer Write Count	
		Number of E-Peer register to transmit	
8028	1..8192	Auto-transfer Write Destination register	(Peripheral)
		Destination Register in other E-Peers	
8029		Reserved for future use, do not modify	
8030		Reserved for future use, do not modify	
8031		Options	(See Table 21-28 on Page 175)
8032		Reserved for future use, do not modify	
8033		Reserved for future use, do not modify	
8034		Reserved for future use, do not modify	

Data Port Control Registers

Each of the Data Ports may have independent settings for Drop Number, Baud Rate, Parity, Data bits, Stop bits, Mode, Auto-transfer, etc. These are controlled by register values listed in Table 21-20.

Table 21-20 Ports 1 and 2 Configuration Registers

Port 1	Port 2	Legal Values	Function
8035	8067	0..199	Drop Number
8036	8068	0..14	Baud Rate (See Table 21-23 on Page 173)
8037	8069	0,1	Data Bits (See Table 21-24 on Page 173)
8038	8070	0,1,2	Parity Bits (See Table 21-25 on Page 173)
8039	8071	0,1	Stop Bits (See Table 21-26 on Page 173)
8040	8072	1..11	Protocol Mode (See Table 21-27 on Page174)
8041	8073	0..256	Packet size limit (Modes 4, 5, and 8)
		1..8192	Auto-transfer Read Source Register (Peripheral)
		0..65535	RNIM Identification Number
8042	8074	0..32767	Time limit (Modes 4, 5, and 8)
		0..32767	MODBUS Host mode retry timeout
		0..65535	RNIM CTS Delay
8043	8075	0..32767	Multidrop window interval
		0..32767	Auto-transfer Interval
		0..65535	RNIM Message Response Timeout
8044	8076	0..200	Priority in Multidrop mode
		1..2048	Auto-transfer Read Destination Register (Mailbox)
		0..65535	RNIM BID Address
8045	8077	0..200	Number of nodes in Multidrop mode
		1..2048	Auto-transfer Write Source Register (Mailbox)
		0..65535	RNIM Number of Retries
8046	8078	0..8	Number of drops in target route (Modes 4,5,8 and Auto-transfer)
8047	8079	0..255	Target Route Drop 1 (Modes 4,5,8 and Auto-transfer)
8048	8080	0..255	Target Route Drop 2 (Modes 4,5,8, and Auto-transfer)
8049	8081	0..255	Target Route Drop 3 (Modes 4,5,8, and Auto-transfer)
8050	8082	0..255	Target Route Drop 4 (Modes 4,5,8, and Auto-transfer)
8051	8083	0..255	Target Route Drop 5 (Modes 4,5,8, and Auto-transfer)
8052	8084	0..255	Target Route Drop 6 (Modes 4,5,8, and Auto-transfer)
8053	8085	0..255	Target Route Drop 7 (Modes 4,5,8, and Auto-transfer)
8054	8086	0..255	Target Route Drop 8 (Modes 4,5,8, and Auto-transfer)
8055	8087	1,2,3,4	MODBUS Host equivalent READ command
8056	8088	5,6,15,16	MODBUS Host equivalent WRITE command
8057	8089	1..16	Buffer Limit

Table 21-21 Ports 1 and 2 Configuration Registers (Continued)

Port 1	Port 2	Legal Values	Function
8058	8090	0..128	Auto-transfer Read Count
		0..65535	RNIM Pause Time
8059	8091	0..128	Auto-transfer Write Count
		0..65535	RNIM Message Count
8060	8092	1..8192	Auto-transfer Write Destination register (Peripheral)
		0..65535	RNIM BID Reply Interval
8061	8093	0..65535	MODBUS Host Offset (Register Bias)
8062	8094		Options (See Table 21-28 on Page 175)
8063	8095	0..127	Modbus Slave Starting Address
8064	8096	0..65525	PAD Count in SY/MAX, N-T-N or CTS Delay in 10mS units for Modbus
8065	8097		Reserved for future use, do not modify
8066	8098		Reserved for future use, do not modify

Modbus Plus Port Configuration Registers

Table 21-22 provides the list of registers that controls the operation of the Modbus Plus port on the MEB.

Table 21-22 Modbus Plus Port Configuration Registers

Modbus Plus	Legal Values	Function
8099	1..64	Drop Number
8100		Reserved for future use, do not modify
8101		Reserved for future use, do not modify
8102		Reserved for future use, do not modify
8103		Reserved for future use, do not modify
8104		Reserved for future use, do not modify
8105	1..8192	Auto-transfer Read Source Register (Peripheral)
8106	0..32767	Retry timeout
8107	0..32767	Auto-transfer Interval
8108	1..2048	Auto-transfer Read Destination Register (Mailbox)
8109	1..2048	Auto-transfer Write Source Register (Mailbox)
8110	0..8	Number of drops in target route (Auto-transfer)
8111	0..255	Target Route Drop 1 (Auto-transfer)
8112	0..255	Target Route Drop 2 (Auto-transfer)
8113	0..255	Target Route Drop 3 (Auto-transfer)
8114	0..255	Target Route Drop 4 (Auto-transfer)
8115	0..255	Target Route Drop 5 (Auto-transfer)
8116	0..255	Target Route Drop 6 (Auto-transfer)
8117	0..255	Target Route Drop 7 (Auto-transfer)
8118	0..255	Target Route Drop 8 (Auto-transfer)
8119		Reserved for future use, do not modify
8120		Reserved for future use, do not modify
8121		Reserved for future use, do not modify
8122	0..128	Auto-transfer Read Count
8123	0..128	Auto-transfer Write Count
8124	1..8192	Auto-transfer Write Destination register (Peripheral)
8125		Reserved for future use, do not modify
8126		Options (See Table 21-28 on Page 175)
8127		
8128		Reserved for future use, do not modify
8129		Reserved for future use, do not modify
8130		Reserved for future use, do not modify

The above tables make reference to baud rate values, stop bit values, parity values, and mode values. The following tables define these values.

Table 21-23 Baud Rate Values

Baud Register	Baud Rate	Notes
0	50	(A)
1	75	(B)
2	110	
3	134.5	
4	150	(B)
5	300	
6	600	
7	1200	
8	1800	(B)
9	2400	
10		Illegal, but sets 9600
11	4800	
12	7200	(A)
13	9600	
14		Illegal, but sets 9600
15	19200	(B)

Notice: The two RS-422 ports on the MEB have mutually incompatible baud rates. If one port is set to any of the baud rates marked (A), the other port cannot be set to any of the rates marked (B). Before panicing, note that with either port set to 9600 (or other unmarked rate), the other port can be set to any supported rate. The most common combinations 9600 and 9600, 9600 and 19200, or 19200 and 19200 are among those allowed.

Table 21-24 Data Bits Values

Data Register	Data Bits
0	7
1	8

Table 21-25 Parity Values

Parity Register	Parity
0	None
1	Odd
2	Even

Table 21-26 Stop Bits Values

Stop Register	Stop Bits
0	1
1	2

Table 21-27 Port Mode Values

Mode Register	Protocol
1	SY/MAX
2	Net-to-Net
3	Peripheral
4	Transparent
5	Share
6	PLogic
7	Idec
8	Gateway
9	Multidrop
10	Modbus Host
11	PNIM
12	RNIM Master
13	RNIM Slave
14	Modbus Gate
15	Transfer
16	Chevron
17	Reserved
18	Modbus ASCII

Table 21-28 Options Register Values

Option Bit	Function when Bit CLEAR (Default)	Function when Bit SET
1	SY/MAX Block Check is single byte checksum (BCC)	SY/MAX Block Check is two byte cyclic redundancy check (CRC)
2	Gateway, Share, and Transparent do echo. Normal 205 Route Replacement	Gateway, Share, and Transparent do echo. PanelMate 205,X lookup table routing.
3	Gateway mode replies are terminated by CR only.	Gateway mode replies are terminated by CR/LF and are highlighted.
4	Gateway, Share, and Transparent messages are terminated by any control character as well as the time and count settings.	Gateway, Share, and Transparent messages are terminated only by time and count termination settings. All characters are treated the same.
5	Normal routing. (Route Replacement OFF)	Route Appendix replaces any existing incoming packet (Route Replacement ON).
6	Auto-Transfer Enabled for E-Net Port. Normal Routing for Ports 1..3	E-Peer Enabled for E-Net Port. On Ethernet Enabled for Ports 1..3
7	Multidrop False	Multidrop True
8	Full Duplex (For 4-Wire)	Half Duplex (For 2-Wire)
9	RNIM Master or Slave normal. Normal Modbus Host R[8188] reply.	RNIM Master Disabled. RNIM Slave buffer clear. SMS Register 8188 spoofing on Modbus Host.
10	Reserved.	If bit 10 and bit 9 are set, the value in R[options+1] is used as the remote register polled in SMS read of 8188.
11	Reserved.	Reserved.
12	Reserved.	Reserved.
13	Reserved.	Reserved.
14	Reserved.	Reserved.
15	Reserved.	Reserved.
16	Reserved.	Reserved.

NOTICE: Bits 6, 9, and 10 are the only active Options bits for the Modbus Plus port.

Options

The Options Register allows the modification of the normal operation of several features of the MEB.

- Bit 1 controls the error checksum used by SY/MAX, Net-to-Net, and Multidrop mode ports. If this bit is clear then the default single byte BCC is used. If set, the two byte CRC checksum is used. Normal SY/MAX messages use the BCC while the CRC is normally used on modem connections when the parity is disabled.

- Bit 2 determines whether the Gateway, Transparent, and Share ports echo all characters received. This may be useful when using a terminal on a Gateway port to see what is being typed. This feature is also useful when transparently programming Model 50 PLCs with an Idec Port.

  Bit 2 also controls the enhanced Route Appendix operation for use with Eaton PanelMate Operator Interfaces and other devices capable of only two drop routes. When Bit 2 is set on a SY/MAX mode port, if a command message is received with a route of 205,X the MEB will use the X entry in the Modbus Slave Routing table for the new route. The message will be routed according to this new route. When the reply from the new route is received at this SY/MAX port, the reversed route X,205 will be sent back to the PanelMate.

- Bit 3 determines whether the Gateway Mode terminates its messages (output) with a carriage return or with a carriage return and line feed and the reply is highlighted on ANSI terminals.

- Bit 4 determines whether Gateway, Transparent, and Share modes are terminated by control characters such as a carriage return or line feed.

- Bit 5 enables the Route Replacement feature on a SY/MAX mode port. When set, the incoming route is saved and is instead replaced by the route stored in the Target Route Registers. The reply message has the original route reversed and replaced to send back to the originator.

- Bit 6 Enables the E-Peer function on the Ethernet port. If this bit is cleared, then the normal Auto-transfer functions are enabled on the Ethernet port.

  Bit 6 also controls the "On Ethernet" status of the two serial ports and MB+ port.

- Bit 7 sets the Multidrop status of the serial port RS-485 driver. When clear, the TX driver is always enabled (i.e. RS-422). When set, the TX driver is controlled by the CTS signal. When CTS is enabled (ON), the transmit driver is enabled and when CTS is not enabled (OFF), the transmit driver is tri-stated and allowed to "float" thus allowing other devices on the multidrop network to transmit.

- Bit 8 sets the full/half-duplex mode of the serial port RS-485 receiver. When clear, the receiver is always enabled which allows full duplex operation. When this bit is set, the receiver is disabled whenever the port is transmitting. This feature is used on two-wire systems and on devices which echo to prevent the MEB port from hearing its own message.

- Bit 9 controls the disabling of the RNIM Master port. Only one RNIM Master may be active on a given RNIM network at a time. Redundant RNIM Masters may be placed on the system but disabled by setting this bit for the Master's port.

  Bit 9 also may be used in the RNIM Slave mode ports to clear the buffer of queued messages waiting for BIDding.

  Bit 9 also is used on Modbus Host ports (and MB+ port) to provide spoofing of PowerLogic System software. All PowerLogic softwares send a SY/MAX read to register 8188 to determine if the device is online. Not all Modbus devices may be configured to have an address within this range. When this bit is set, the Modbus Host port intercepts a single register SY/MAX read of register 8188 and translates that message to a Modbus Report Slave ID (opcode 17 decimal) message. The Slave ID and the Run/Halt status of the Modbus device are returned as the data to the register 8188 read. The Slave ID byte is returned as the LSB of register 8188. Bit 14 of 8188 will always be set to indicate that this translation has occurred. And Bit 15 of 8188 will be set if the Modbus device is in RUN and clear if the device is in Halt. This bit works on the serial ports as well as the Modbus Plus port.

- Bit 10 may be used in conjunction with bit 9 to have SMS poll non-PLC devices that don't support opcode 17. When bits 10 and 9 are both set, the value in R[options+1] is used as the remote register to poll in the Modbus Slave when a read of register 8188 is received on the port. For example, if Port 2 of the MEB is in Modbus Host mode, bits 9 and 10 of register 8094 in the MEB are set, and register 8095 has the decimal value of 10, then Holding register 10 in the Modbus slave will be read when SMS performs its health check of register 8188.

Clear Function Register

Register 8174 is the module clear register. When a specific bit pattern is written to it, the module clears the register after performing the requested operation.

Table 21-29 Clear Function bit-map

Bit Number	Description
1	Set all rack addressed registers to PLC outputs.
2	Clear all rack addressed inputs to zero.
3	Clear all rack addressed outputs to zero.
4	Clear all non-rack addressed mailbox registers.
5	Load factory default setup. (does not effect mailbox)
6	Reserved, must be zero if not supported.
7	Must be zero.
8	Must be one.

NOTE: Bits 9 through 16 must be the same as bits 1 through 8 respectively.

For example, the MEB may be reset to factory default settings, clear all mailbox registers, and set all rack addressable mailbox registers to PLC outputs by writing the value 9F9F hex (-24673 decimal) to register 8174. When the MEB has finished resetting, it will zero out register 8174.

Module Identification Registers

All NR&D modules contain a group of registers, 8176..8188, which may be used to determine the module type, the port being used to access the module, and certain operational parameters of the module. Table 21-30 provides an overview of these registers.

Table 21-30 Module Identification Registers

Register	Legal Values	Definition
8176	Bit 16, Bits 1..5	Port number (not drop number) that is being used to communicate with the module. Bit 16 is always set. Bits 1..5 indicate port number.
8177		Packed ASCII module identification. Space Padded.
8178		Packed ASCII module identification. Space Padded.
8179		Packed ASCII module identification. Space Padded.
8180		Packed ASCII module identification. Space Padded.
8181		Packed ASCII module identification. Space Padded.
8182		Packed ASCII module identification. Space Padded.
8183		Packed ASCII module identification. Space Padded.
8184		Packed ASCII module identification. Space Padded.
8185		Packed ASCII module identification. Space Padded.
8186		Packed ASCII module identification. Space Padded.
8187	Bits 0..4	Read state of CTS pins. DO NOT WRITE values to this register!! Writing values to this register may cause unpredictable action of RTS for ports 1..4 and may impede communication!
8188	9990 (hex)	Constant 9990(hex). Indicates NR&D module with name starting at Reg. 8177.

For example, if the MEB has a Firmware revision of 18OCT95, Registers 8177..8186 would have the values in Table 21-31.

Table 21-31 Module ID Example

Register	Values (hex)	Packed ASCII Values
8177	4D45	ME
8178	4220	B
8179	3138	18
8180	4F43	OC
8181	5439	T9
8182	354F	5O
8183	2020	
8184	2020	
8185	2020	
8186	2020	

Connector Pinouts

RS-422/485 data port (DE9S with slide lock posts) ports 1-2

1   TX- transmit data (inverted) from MEB to output device

2   TX+ transmit data (non-inverted) from MEB to output device

3   RX- receive data (inverted) from data source to MEB

4   RX+ receive data (non-inverted) from data source to MEB

5   CTS- must be more negative than pin 7 to allow MEB to transmit

6   RTS- driven low (0V) when MEB is ready to receive data

7   CTS+ must be more positive than pin 5 to allow MEB to transmit

8   RTS+ driven high (+5V) when MEB is ready to receive data

9   Shield ground.
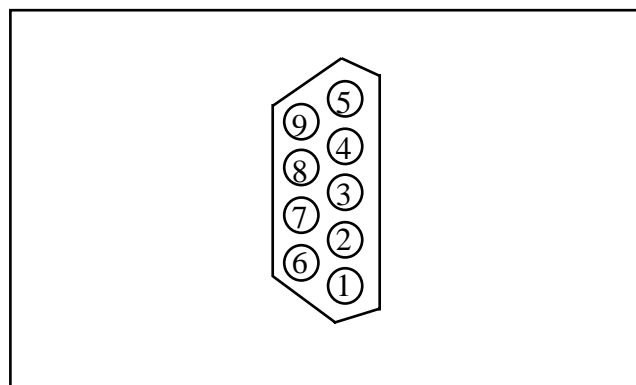
Figure 22-1 DE9S Pin configuration

Modbus Plus Port (DE9S with Screw locks)

1   Shield

2   Data B

3   Data A

4   No connection.

5   No connection.

6   No connection.

7   No connection.

8   No connection.

9   No connection.
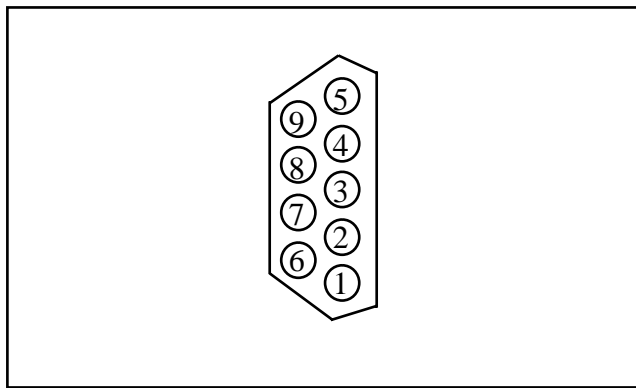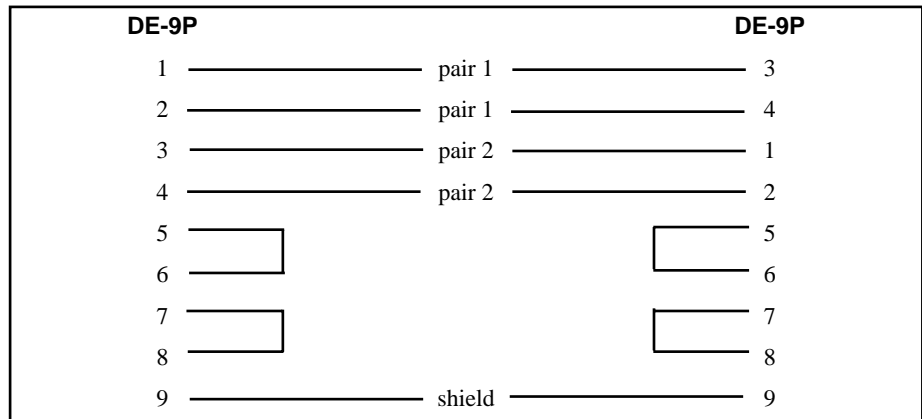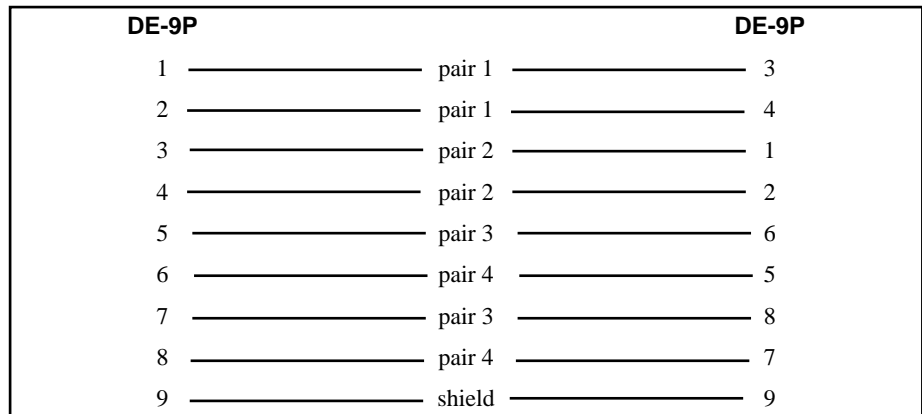

Figure 22-2 DE9S Pin configuration

Recommended Cabling

MEB RS-422 to SY/MAX RS-422 port (Without Handshaking)

```
          DE-9P                                              DE-9P

            1 ——————————— pair 1 ——————————— 3
            2 ——————————— pair 1 ——————————— 4
            3 ——————————— pair 2 ——————————— 1
            4 ——————————— pair 2 ——————————— 2
            5 ⌐                               ⌐ 5
            6 ⌐                               ⌐ 6
            7 ⌐                               ⌐ 7
            8                                   8
            9 ——————————— shield ——————————— 9
```

This is a Niobrara **DC1** cable. This cable is used for connecting an MEB port to a Square D PLC such as a Model 300, 400, 500, 600, 700 etc. This cable is also use for connecting MEB ports to NIMs, SY/LINK RS-422 ports, DLOGs, AIM4 Print/Prog ports, other MEBs, EPE5s, SPE4s, IBSMs, RM14Ks, 2496Xs, CAM500s, and other SY/MAX ports that do not require active handshake lines.
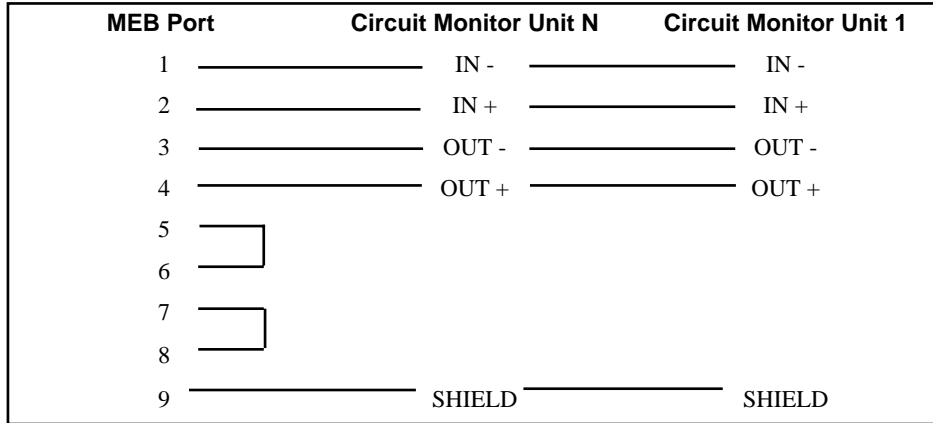
MEB RS-422 to SY/MAX RS-422 port (With Handshaking)

```
          DE-9P                                              DE-9P

            1 ——————————— pair 1 ——————————— 3
            2 ——————————— pair 1 ——————————— 4
            3 ——————————— pair 2 ——————————— 1
            4 ——————————— pair 2 ——————————— 2
            5 ——————————— pair 3 ——————————— 6
            6 ——————————— pair 4 ——————————— 5
            7 ——————————— pair 3 ——————————— 8
            8 ——————————— pair 4 ——————————— 7
            9 ——————————— shield ——————————— 9
```

This is a DC2 cable and it is used for connecting the MEB to devices that require active handshaking. These devices include: modems, other NIMs, other MEBs, EPE5s, SPE4s, RM14Ks etc.

NOTICE: Never use an active handshake line cable to connect to a SY/MAX port that has +5V for handheld or smart cable power. These ports include the Square D PLCs such as the Model 100, 300, 400, 500, 600, and 700 families, the Niobrara AIM4 Print/Prog port, the CAM500 RS-422 port, the UCM1-D port, Port 0 on any SPE4, the SY/MAX port on an IBSM.

MEB RS-422 port to PowerLogic RS-485 (4-wire Multidrop Master)

MEB Port	Circuit Monitor Unit N	Circuit Monitor Unit 1
1	IN -	IN -
2	IN +	IN +
3	OUT -	OUT -
4	OUT +	OUT +
5		
6		
7		
8		
9	SHIELD	SHIELD

When connecting to PowerLogic, or any other 4-wire multidrop network, always include proper termination at the far end of the network. The MEB's RS-485 ports have internal biasing and terminating resistor networks so there is no need for termination at the MEB end.

For 4-wire networks, such as the PowerLogic network, where the MEB is serving as the master, leave the Options bits for Multidrop off so Multidrop is set to FALSE. This will enable the MEB's transmit drivers continuously and force that line to a known state at all times. Also leave the Option for Duplex off for FULL duplex operation. These Options bits may be set with the Driver Mode = Pt to Pt within MEBSW.

Be certain to jumper the RTS/CTS pairs at the MEB port.

MEB RS-485 port to Modicon RS-485 (4-wire Multidrop Slave)

| Modbus Master	MEB Slave Port	Other Slave
IN -	1	OUT -
IN +	2	OUT +
OUT -	3	IN -
OUT+	4	IN+
	5	
	6	
	7	
	8	
Shield	9	SHIELD
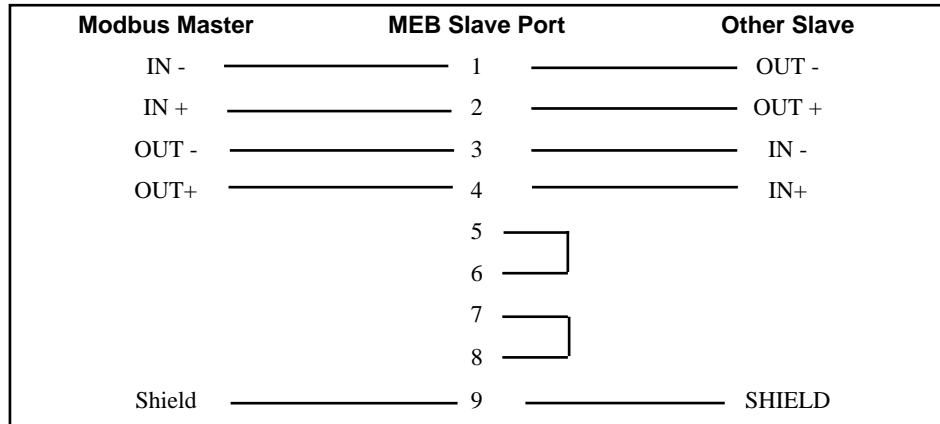
When connecting to Modicon 4-wire multidrop networks, always include proper termination at the far end of the network. The MEB's RS-485 ports have internal biasing and terminating resistor networks so there is no need for termination at the MEB site.

For 4-wire networks, such as the Modicon network, where the MEB is serving as a slave, set the Options bits for Multidrop on so Multidrop is set to TRUE. This will disable the MEB's transmit drivers and allow that line float so the other slaves may transmit when it is their turn. Also leave the Option for Duplex off for FULL duplex operation. These Options bits may be set with the Driver Mode = FOUR WIRE within MEBSW.

Be certain to jumper the RTS/CTS pairs at the MEB port.

MEB RS-485 port to Modicon RS-485 (2-wire Multidrop)
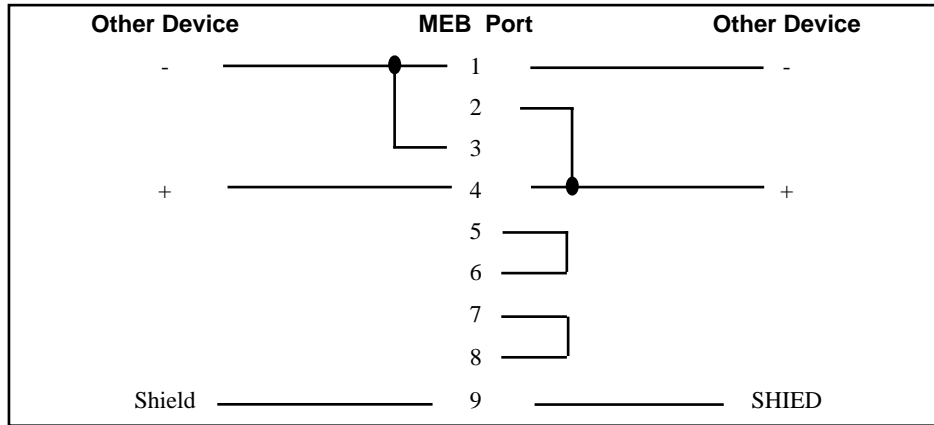
When connecting to Modicon 2-wire multidrop networks, always include proper termination at the far ends of the network. The MEB's RS-485 ports have internal biasing and terminating resistor networks so there is no need for termination at the MEB site.

For 2-wire networks, such as the Modicon network,, set the Options bits for Multidrop on so Multidrop is set to TRUE. This will disable the MEB's transmit drivers and allow that line float so the other slaves may transmit when it is their turn. Also Set the Option for Duplex on for HALF duplex operation. This will allow the MEB to not hear its own transmissions. These Options bits may be set with the Driver Mode = TWO WIRE within MEBSW.

Be certain to jumper the RTS/CTS pairs at the MEB port.

Personal Computer RS-232 to MEB RS-422 port

Use of a Niobrara SC406 or SC902 smart cable is recommended, although any RS-232 to RS-422 converter may be used.

Note: The included power supply with the SC406 or SC902 must be used when connecting to ports 1-2 of the MEB-D.

The SC406 and SC902 RS-232 to RS-422 converter cables may be used whenever a single RS-232 port is required on a MEB-D.

It should be noted that the SC406 and SC902 do not support handshaking and that functionality of certain modes of the MEB may not be implemented. But in most cases this will not be a concern.

24
Applications

This chapter describes a few actual applications for the MEB modules.

Example 1 : Blue Hose SY/NET programming through Ethernet

A personal computer with a Square D SFI-610 Ethernet card is used to program several Model 650 and 450 processors on a LAN using SY/MATE PLUS ver. 2.x software. The factory also includes a "Blue hose" SY/NET network consisting several Model 400 and 600 processors. It is desired to program the non-Ethernet processors from the Ethernet equipped personal computer. The MEB is used as a bridge between the Ethernet and Blue Hose SY/NET to allow programming and data exchange between networks.

The MEB is located in a rack where the Ethernet and a CRM-510 NIM are present. One of the RS-422 ports of the NIM is connected to a port on the MEB in Net-to-Net mode. The baud rates of each unit must be set to match. The drop number of the MEB Net-to-Net is set to match the drop number of the NIM port. The E-Net drop number of the MEB is set to be different than any other SY/NET Ethernet device on the network.

It should be noted that this application is not limited to programming. The other processors on each network could use this bridge to route packets to each other. This type of bridge could also be used in the opposite direction with a personal computer using a SFI-510 card. The SY/LINK card could be used to program the Ethernet processors through the SY/NET Blue Hose.
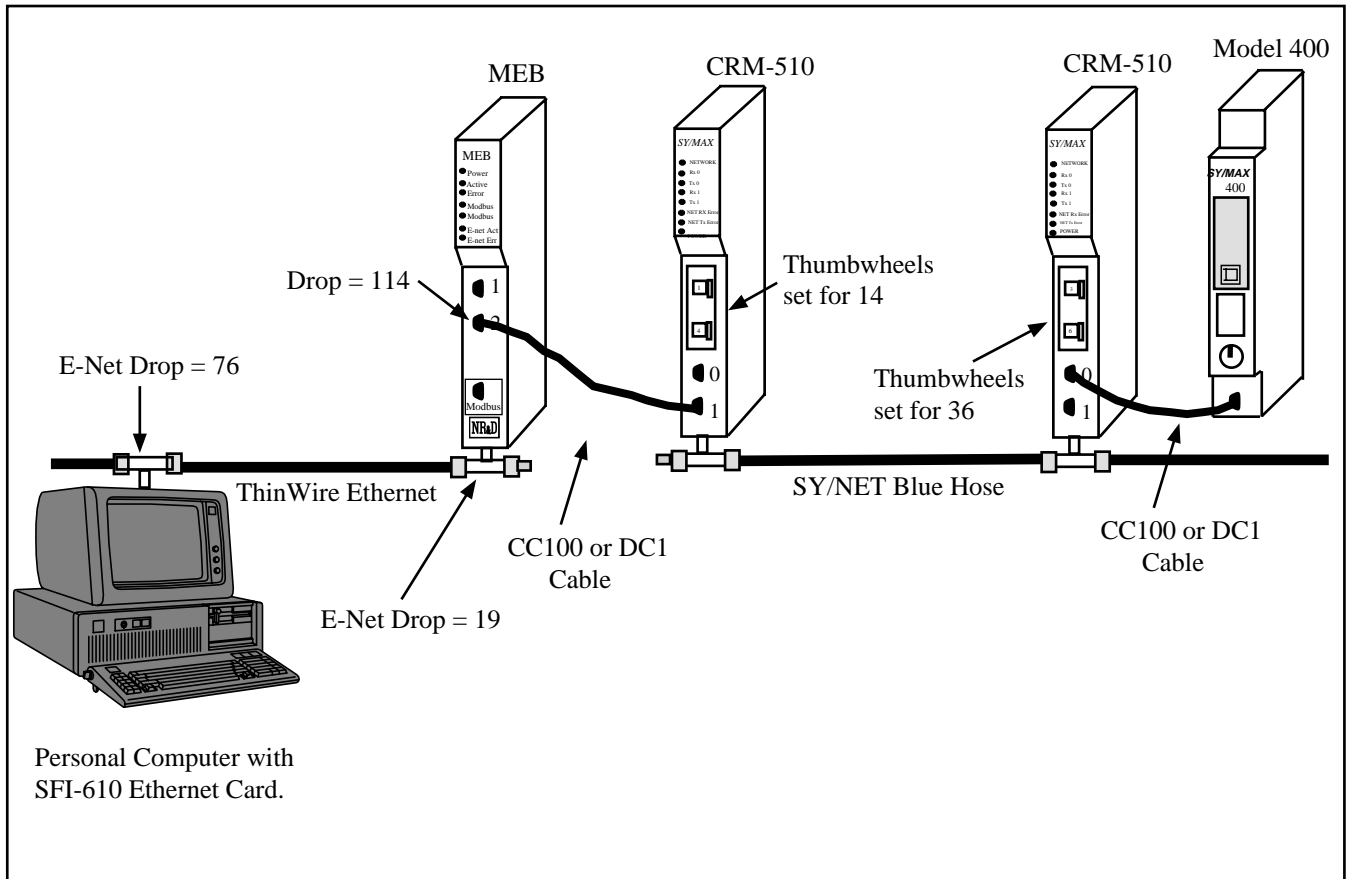
Figure 24-1 NIM Net-to-Net Example

Table 24-1   Personal Computer route

Origin	Target	Route
Personal Computer	Model 400	076, 019, 114 , 036

Table 24-2   MEB Setup for NIM Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	19	SY/MAX	NA	NA	NA	NA
2	114	Net-to-Net	9600	E	8	1

Example 2: PowerLogic CMs from SY/NET and MB+

A Model 650, a Quantum, and Compact 984 all require data from three PowerLogic Circuit monitors. The MEB is used to act as a bridge between MB+, SY/MAX E-Net, and the PowerLogic devices.
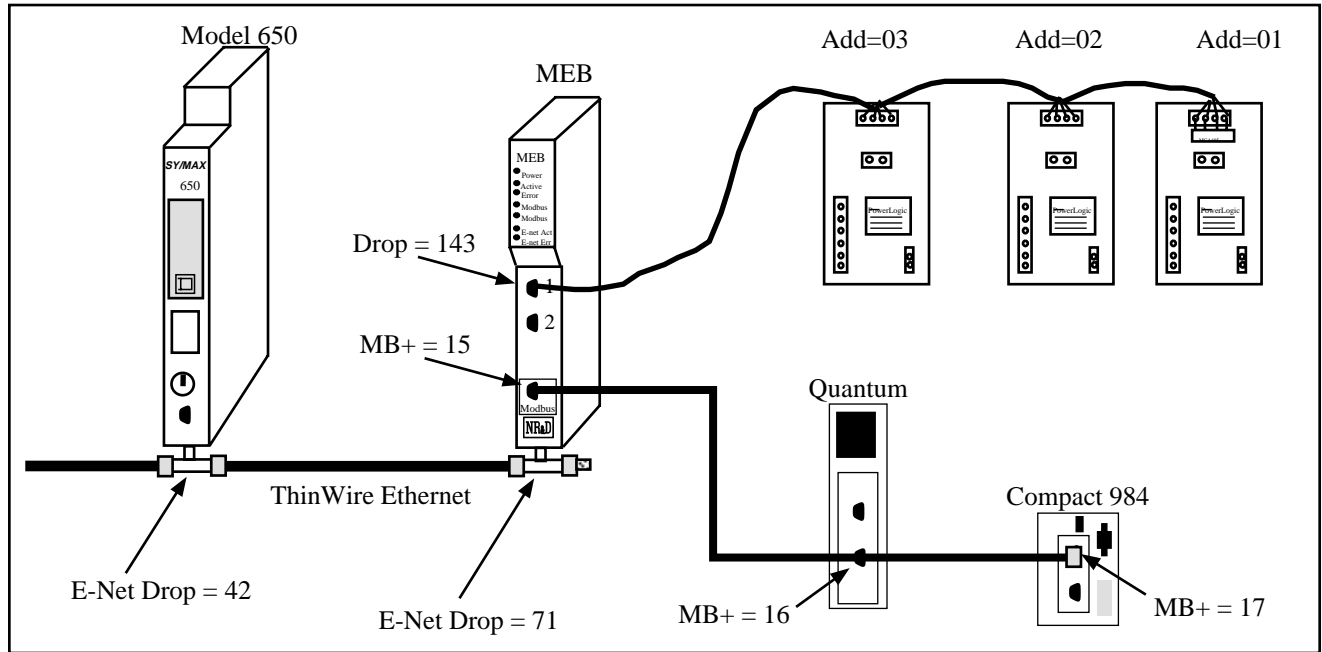
Figure 24-2 MEB SY/NET, MB+, PowerLogic Routing Example

Table 24-3   650, Quantum, Compact Routing Examples

Origin	Target	Route
Model 650	CM 01	042, 071, 143, 001
Model 650	Quantum	042, 071, 015, 016
Model 650	Compact	042, 071, 015, 017
Quantum	CM 01	15 . 01 . 01 . 00 . 00
Quantum	CM 03	15 . 01 . 03 . 00 . 00
Quantum	Model 650	15 . 06 . 42 . 00 . 00
Quantum	Compact	17 . 00 . 00 . 00 . 00
Compact	CM 01	15 . 01 . 01 . 00 . 00
Compact	CM 03	15 . 01 . 03 . 00 . 00
Compact	Model 650	15 . 07 . 42 . 00 . 00
Compact	Quantum	16 . 00 . 00 . 00 . 00

Table 24-4   MEB Setup

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
E-Net	71	SY/MAX	NA	NA	NA	NA
1	143	PLOGIC	9600	E	8	1
MB+	15	MB+	NA	NA	NA	NA

Example 3: High Speed E-Net Bridge

It is sometimes necessary to connect SY/NET 802.3 Ethernet networks together to allow more than 100 devices to communicate with each other. This may be accomplished using the serial ports and the Net-to-Net mode on the ports, but a significant improvement in throughput may be achieved by using the Modbus Plus ports.
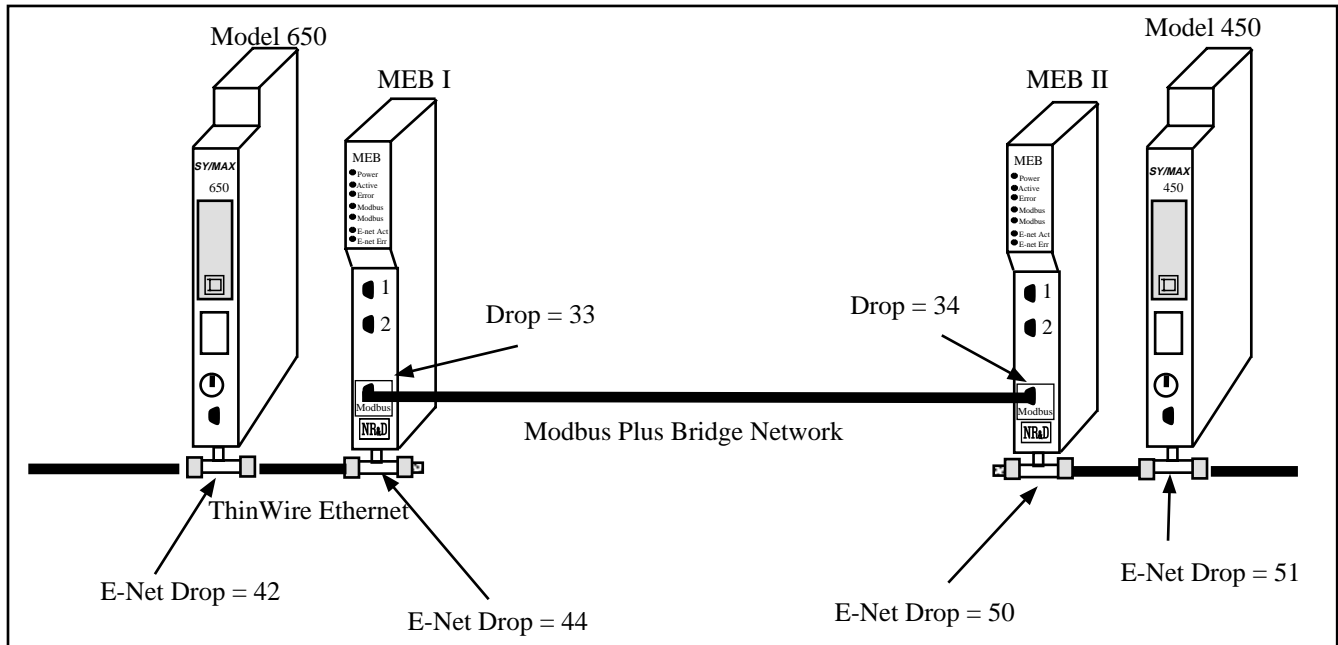
Figure 24-3 High speed E-Net Bridge

Table 24-5   650, Routing Examples

Origin	Target	Route	Notes
Model 650	Model 450	42, 44, 33, 34, 04, 51	Not using "ON E-net" Routing
Model 450	Model 650	51, 50, 34, 33, 04, 42	Not using "ON E-net" Routing
Model 650	Model 450	42, 33, 34, 04, 51	Using "ON E-net" Routing
Model 450	Model 650	51, 34, 33, 04, 42	Using "ON E-net" Routing

Table 24-6   MEB I Setup

Port	Drop #	Mode	On E-Net
E-Net	44	SY/MAX	NA
MB+	33	MB+	Yes

Table 24-7   MEB II Setup

Port	Drop #	Mode	On E-Net
E-Net	50	SY/MAX	NA
MB+	34	MB+	Yes

The ON E-Net feature allows the reduction of one drop in the route in these two examples. It must be remembered that the On E-Net port must be unique on its Ethernet. Also, split multiple

Example 4: Ethernet Bridge for Modbus Plus

In this example, two Modbus Plus networks are located in adjacent buildings and it is desired to link the two networks together using an existing plant-wide Ethernet. A pair of MEBs may be used to provide an easy connection to the Ethernet. This connection allows full support for programming with Modsoft as well as data transfer.
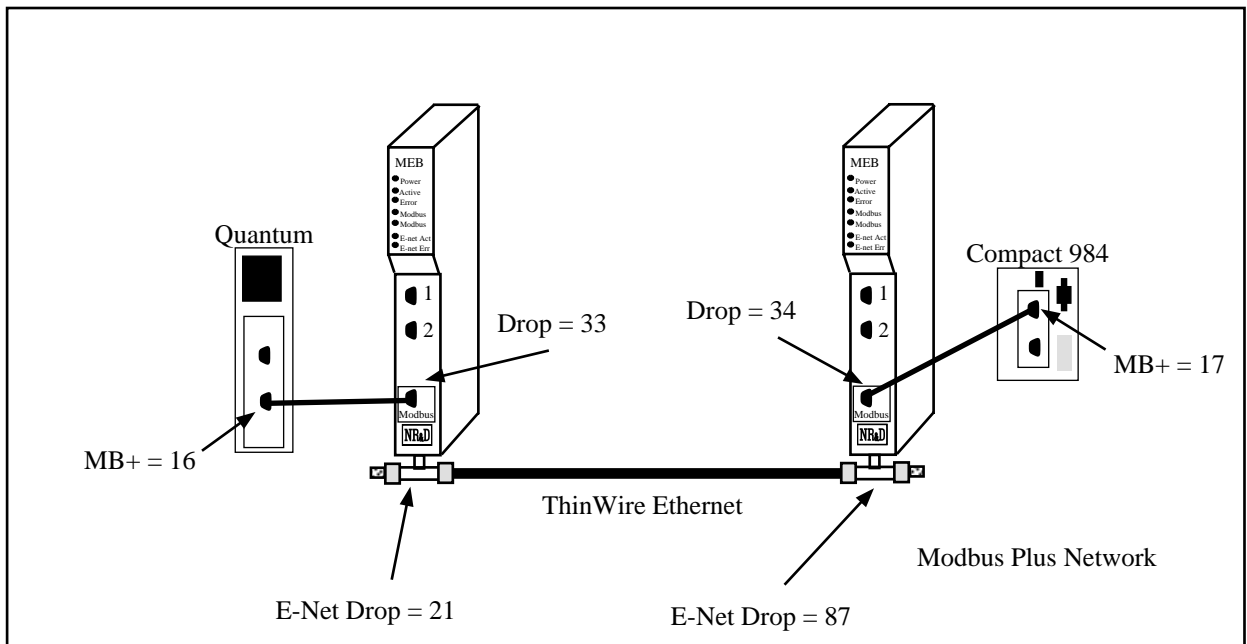
Figure 24-4 Ethernet Bridge for Modbus Plus

Table 24-8 Routing Examples

Origin	Target	Route	Notes
Quantum	Compact	33 . 04 . 87 . 34 . 17	Not using "ON E-net" Routing
Compact	Quantum	34 . 05 . 21 . 33 . 16	Not using "ON E-net" Routing
Quantum	Compact	33 . 04 . 34 . 17	Using "ON E-net" Routing
Compact	Quantum	34 . 05 . 33 . 16	Using "ON E-net" Routing

Table 24-9 MEB I Setup

Port	Drop #	Mode	On E-Net
E-Net	21	SY/MAX	NA
MB+	33	MB+	Yes

Table 24-10 MEB II Setup

Port	Drop #	Mode	On E-Net
E-Net	87	SY/MAX	NA
MB+	34	MB+	Yes

The ON E-Net feature allows the reduction of one drop in the route in these two examples. It must be remembered that the On E-Net port must be unique on its Ethernet.

Appendix A
Ethernet Communication Overview

This Appendix is meant to provide a general background for common types of Ethernet Local Area Network communication.

Hardware Overview

The IEEE 802.3 protocol may operate on a variety of wiring or cabling media. Networks may be comprised of standard baseband coaxial cable, ThinWire coaxial cable, and shielded and unshielded twisted pair cables.

ThickWire (10Base5)

The original IEEE 802.3 standard specified standard baseband and broadband coaxial cables. This cable is known as ThickWire and is the referenced by 10Base5. These cables were optimized for the 10Mb/s maximum speed and maximum distances of Ethernet.

The coaxial cable system allows daisy-chaining of devices to form a network by the use of clamp on transceivers. Clamp on transceivers are used because the ThickWire cable is too stiff to bend near the computer to allow a TEE connection. Since the cable could not be brought to the transceiver, the transceiver was moved from the computer to the cable. The transceiver is connected to the controller by means of a Transceiver Cable. This Transceiver Cable consists of four twisted-pair wires and has a 15 pin connector on each end. The port on the controller is sometimes called an AUI port.

The ThickWire coax is joined with barrel connectors to increase its length up to 500 meters (1640 feet). Each end of the cable must have a terminator to prevent unwanted echoes and restore the DC level of the cable.
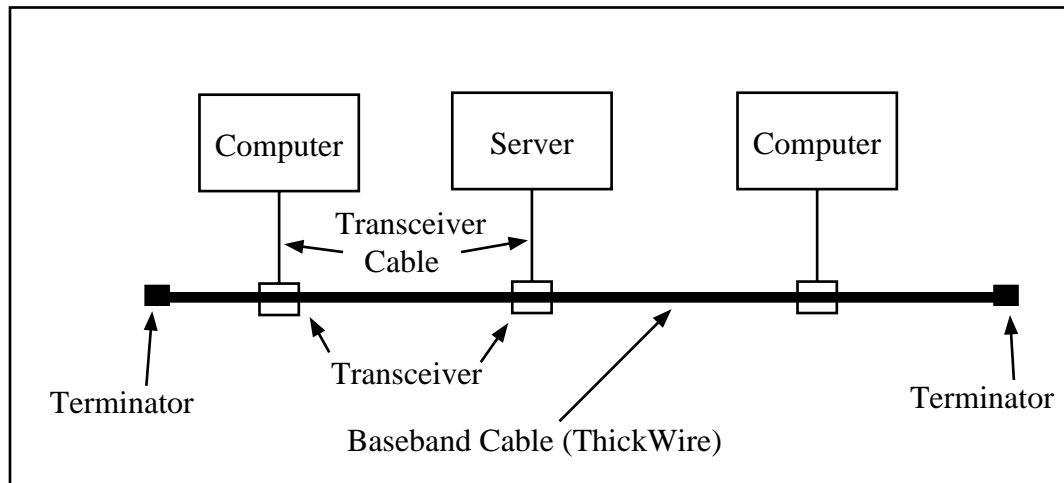
Figure A-1 ThickWire Network

ThinWire (10Base2)

ThinWire coax, sometimes called "thin net" or "cheaper net" is used more commonly today and is the standard for SY/NET 802.3 devices. ThinWire offers the same speed capability as the standard baseband, but at a shorter maximum distance. ThinWire allows longer segment/distance lengths than twisted-pair and has lower EMI than unshielded twisted-pair. The maximum length of a ThinWire segment is 185 meters (607 feet). A maximum of 30 devices can be connected to a single segment by daisy-chained connections. When a ThinWire Ethernet repeater is used, up to 29 stations can be connected to each segment of ThinWire cable.

Like ThickWire, ThinWire allows daisy-chaining of devices to form a network. But ThinWire is flexible enough to bend near the Ethernet controller so the transceiver is commonly mounted within the computer. Connection to the ThinWire is made with a TEE connector directly to the BNC connector on the controller. It is also possible to connect to ThinWire with an AUI port and a ThinWire transceiver.
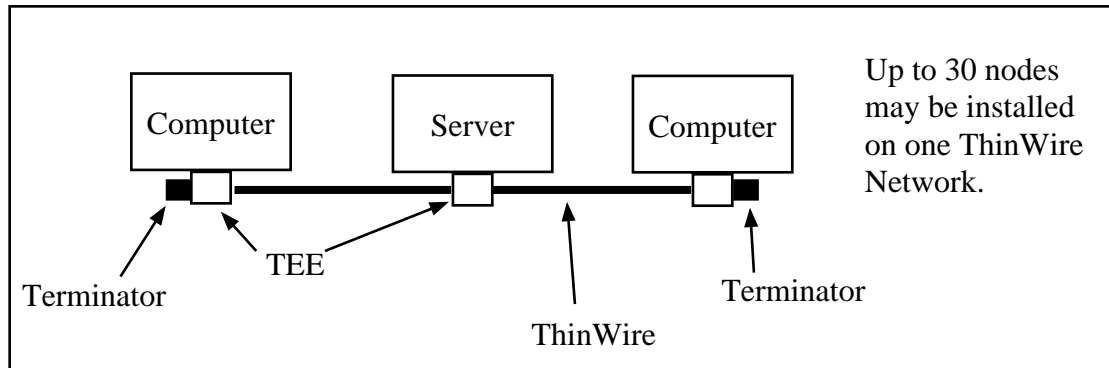
Figure A-2 ThinWire Network

This type of cable is used by Square D for its SY/NET 802.3 applications. The Model 650, 450, SFI-610 and Niobrara's MEB all support direct hardware connection to ThinWire.

Twisted-pair (10BaseT)

Twisted-pair cabling is also used extensively for connecting Ethernet equipment together. The twisted-pair cable may be shielded or unshielded, such as telephone wire. Twisted-pair may be used in a star-

wired configuration only. Daisy-chaining is not allowed. For this reason, twisted-pair is primarily used for connecting work-stations to repeaters/hubs.
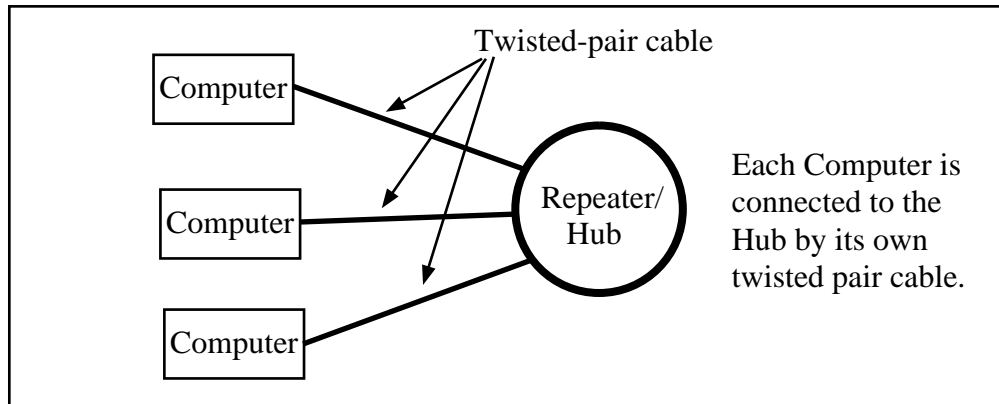

Figure A-3   10BaseT Network

Fiber Optic

Fiber optic cables are being employed for network backbones in large systems. The high noise immu-nity, electrical isolation, long distances, and security features (Fiber optic cables are difficult to tap.) make the fiber optic backbone attractive. With the use of a fiber optic hub, star configurations may be constructed as shown in Figure A-4.
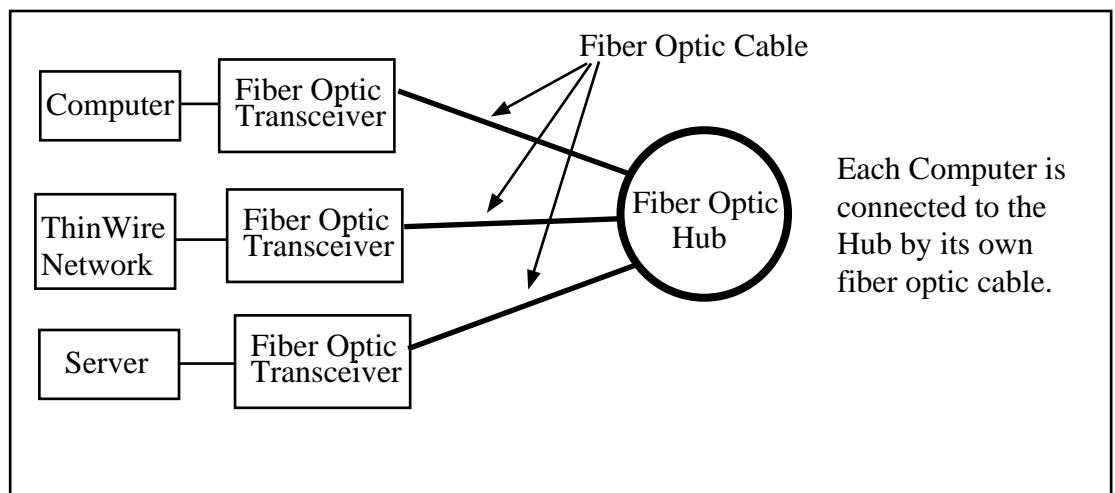
Figure A-4   Fiber Optic Hub Network

Ethernet Repeaters

When more Ethernet Devices are needed on a given network than are allowed, it becomes necessary to use a repeater to extend the network. Repeaters are available in various configurations including Singleport Repeaters and Multiport Repeaters. Repeaters may have AUI connections, ThinWire ports, 10BaseT ports, and fiber optic ports. Multiport repeaters may be referred to as Hubs. See Figure A-5.

Repeaters have the ability to detect faults on each side, or leg, of the network and prevent that fault from interfering with traffic on the fault-free network. A fault may be caused by disconnecting the net-work, removing the terminator, or broken equipment.

Singleport Repeaters offer a method for extending the LAN with a minimum of cost. A Singleport Re-peater acts as its name implies; it repeats all traffic from each side of the repeater to the other.
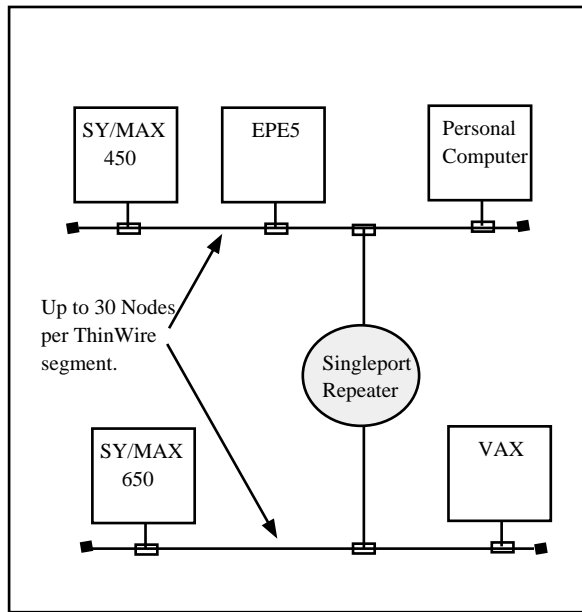
Figure A-5 ThinWire Singleport Repeater

Multiport Repeaters provide the function of several Singleport repeaters in one convenient package. Multiport Repeaters are available with 6, 8, and more ports.
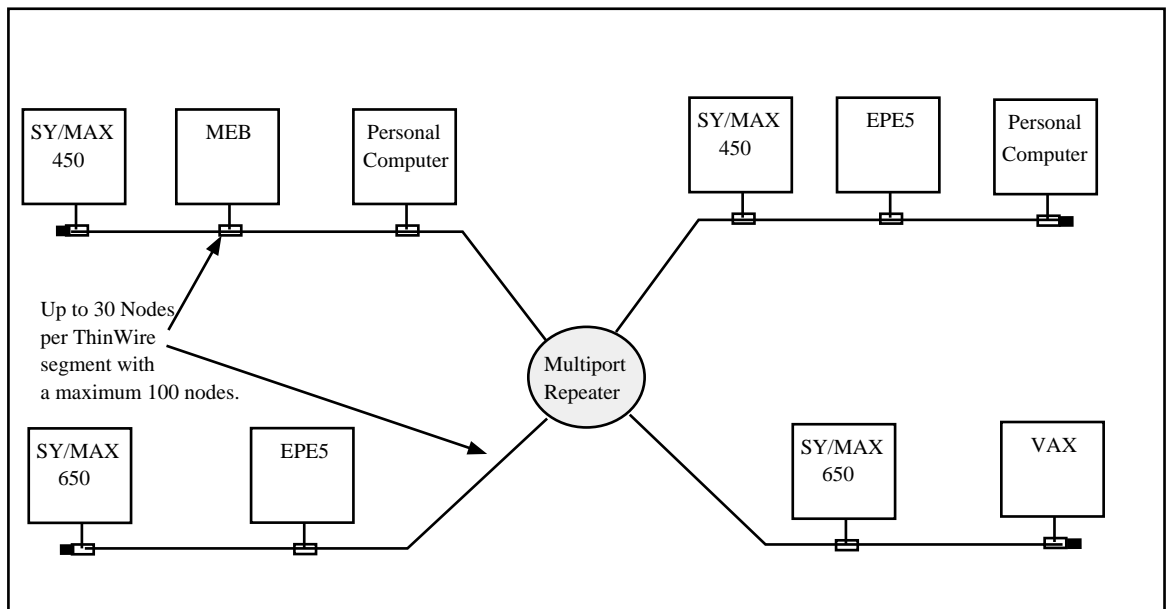

Figure A-6 ThinWire Multiport Repeater

There is a "Three Repeater Rule" which limits the number of repeaters a packet may travel through to its destination to three. This excludes special repeaters and bridges which re-time the packet.

Ethernet Bridges

Ethernet bridges are specialized computers which allow separate LANs to be connected, typically across large distances. Unlike Repeaters, Bridges keep a record of all node addresses on each side of the bridge and isolate traffic to the appropriate side. This is useful in areas where high traffic might exist on one side of the bridge and the low traffic on the other side is not affected.

Bridges are often used to connect LANs across long distances and may include other media between the halves of the bridge. Micro wave, fiber optic, modems, etc. may be used to link the LANs together.
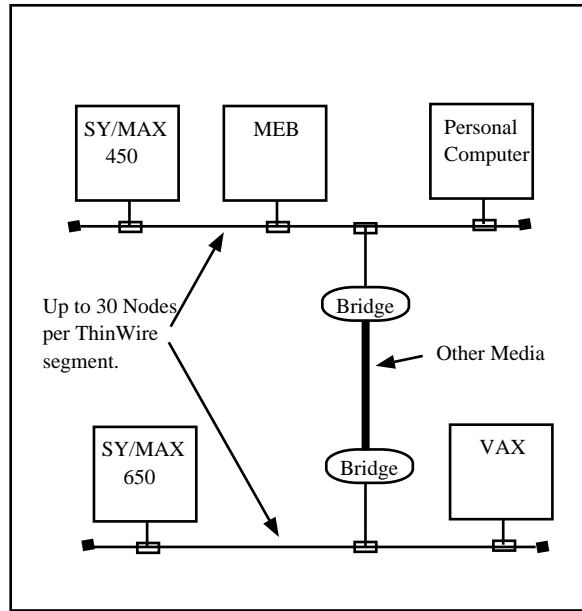

Figure A-7 ThinWire Bridge

ThinWire Components

The ThinWire units are connected together by way of cables and connectors to form a Local Area Network. The following table provides the NR&D part number of connectors and cables for constructing the network:

Table A-1   Ethernet Connectors and Cables

NR&D Part Number	Square D Equivalent Part Number	Description
EN1	CC601	Ethernet Cable (ThinWire 6ft long)*
EN611	CCK611	Ethernet Cable End
EN612	CCK612	Ethernet Cable TEE Connector
EN613	CCK613	Ethernet Cable Terminator
EN614	CCK614	Ethernet Cable Extension (Barrel)

* The standard length for the EN1 is 6 feet. Other lengths are available from the factory. Order special lengths with the following number: EN1-x where x is the length in feet for the cable. For example, EN1-100, would represent a 100 foot long EN1 cable. For custom assembly by the customer, use two (2) EN611 Ethernet Cable Ends and an appropriate length of Belden® 9907 or 89907 or equivalent. This is a 50 ohm impedance coaxial cable for use on IEEE 802.3 10 Base 2 trunks.

The following figures illustrate the products in Table 2-1.

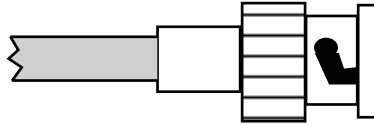## Ethernet Cable End (EN611)

Figure A-8 Ethernet Cable End (EN611)

The EN611 is a female socket and provides a locking connection for the cable to a TEE or barrel connector. Two cable ends are required for each cable.

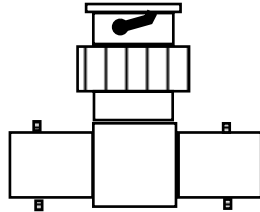## Ethernet TEE Connector (EN612)

Figure A-9 Ethernet TEE Connector (EN612)

The EN612 is a TEE connector for connecting the MEB to the network. It consists of a female and two male connectors. The female connector attaches to the male extending from the MEB. The male connectors mate with the female cable ends on a cable as well as the terminators.
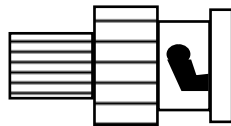
Ethernet Terminator (EN613)

Figure A-10 Ethernet Terminator (EN613)

The terminator is a female socket with an internal 50 ohm resistor. The terminator is used to terminate the end of a network. The terminator attaches to one of the male connectors on a TEE connector. Two terminators are required for each network; one at each end.

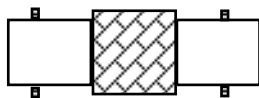## Ethernet Cable Extension or Barrel (EN614)

Figure A-11 Ethernet Cable Extension or Barrel (EN614)

The Barrel connector consists of two male connectors back to back. The barrel is used to connect two network cables together to make a longer cable. The barrel may also be used to replace a TEE for future expansion or replacement of an Ethernet unit.

NOTE: The barrel may not be used to connect a drop cable to a TEE!

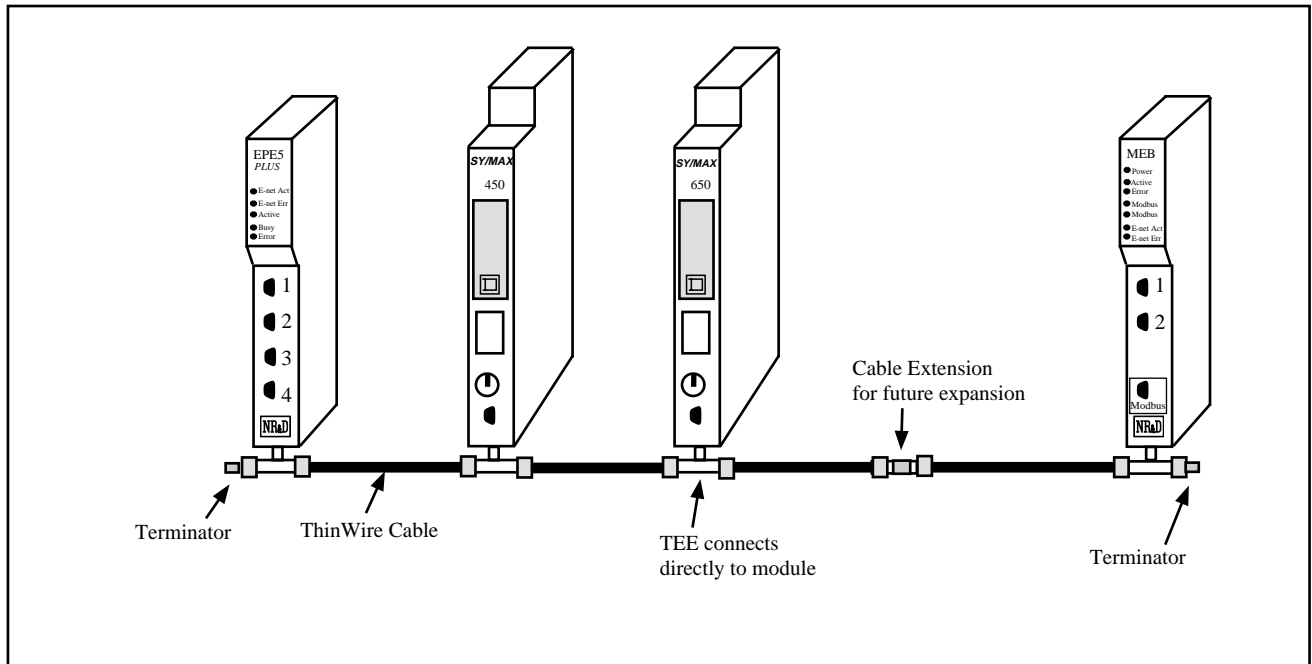A typical Square D Ethernet thin wire network will be something like Figure 2-9.

Figure A-12 ThinWire Ethernet network

The following table indicates the 802.3 Ethernet Specification for SY/NET.

Table A-2   SY/NET 802.3 Ethernet Specifications

Type	IEEE 802.3 10Base2 ThinWire Ethernet
Nodes per segment	30
Nodes per network	100 (using repeaters)
Maximum segment length	600 ft. (185 m)
Maximum end-to-end network length	3034 ft. (925 m), using repeaters.
Minimum cable length between nodes	20 inch (0.5 m)
Maximum drop length	Less than 1.5 in. (4 cm), directly connect TEE to male connector.

Appendix B
Serial Communication Overview

This Appendix is meant to provide a general background for common types of asynchronous serial communication.

Hardware Overview

The need for information to be exchanged between independent devices has brought about the development of several serial communication standards. The most commonly encountered are RS-232, RS-422, RS-485, and 20mA current loop.

RS-232

RS-232 is intended for connecting two devices together for serial communication for short distances (50 feet or less) and low baud rates (19200 baud or less).

RS-232-C has two main classes of devices: DTE (Data Terminal Equipment) such as terminals and personal computers, and DCE (Data Communication Equipment) such as modems.

The original implementation of the RS-232 connection was for connecting terminals to modems as shown in Figure B-1 The standard connectors were mounted on the equipment were DB25 females. Straight through cables with 25 pin male connectors were used to connect the DTE to DCE.
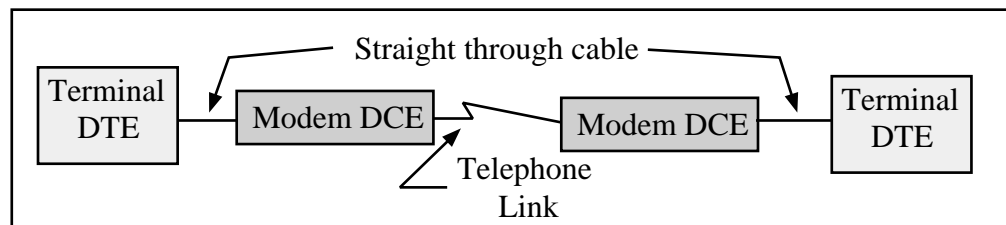

Figure B-1 DTE to Modem connection

Each pin on the DTE was connected to the same pin on the DCE. The most common pins and their definitions are listed below.

Pin 2: **TD** Transmit Data

This circuit is the path that serial data is sent from the DTE to the DCE.

Pin 3: **RD** Receive Data

This circuit is the path that serial data is sent from the DCE to the DTE.

Pin 4: **RTS** Request to Send

> This circuit is the signal that indicates that the DTE wishes to send data to the DCE. In normal operation the RTS line will be OFF (MARK). Once the DTE has data to send it asserts RTS (SPACE) and waits for the DCE to assert CTS. RTS will remain asserted until the data is completely sent. In a full duplex channel, RTS may be asserted at initialization and left in that state.

Pin 5: **CTS** Clear to Send

> This circuit is the signal that indicates that the DCE is ready to receive data from the DTE. In normal operation the CTS is not asserted. When the DTE asserts RTS, the DCE will do whatever is necessary to allow data to be sent. (This may mean raising the carrier and waiting until it is stabilized.) When the DCE is ready, it asserts CTS which allows the DTE to send data. When the DTE is finished sending data it will reset the RTS and the DCE will in turn reset its CTS.

> Note: Most DTE must have CTS asserted before it will transmit.

Pin 6: **DSR** Data Set Ready

> This circuit is the signal that informs the DTE that the DCE is active. It is normally asserted by the DCE at power-up and left that way.

> Note: Most DTE must have DSR asserted to operate properly.

Pin 7: **SG** Signal Ground

> This circuit is the ground to which all signals are referenced.

Pin 8: **DCD** Data Carrier Detect

> This circuit is the signal that the DCE informs the DTE that it has an incoming carrier.

> Note: Some DTE must have DCD asserted to operate properly. Also, some personal computer modems always assert DCD.

Pin 20: **DTR** Data Terminal Ready

> This circuit provides the signal that informs the DCE that the DTE is alive and well. It is normally asserted by the DTE at power-up and left in that state.

> Note: Most DCE must have DTE asserted to operate properly.

Pin 22: **RI** Ring Indicator

> This circuit provides the signal from the DCE to indicate that the modem is ringing. The line is asserted by the DCE during each ring cycle.

The full pinout for the standard 25 pin connector is shown in Figure B-1.

With the down-sizing of computers it became necessary to move to a 9 pin port to save room. Only the most commonly used functions were kept for the 9 pin configuration. The TYPE A and TYPE B configurations are shown in Figures B-2 and B-3. The only difference is pins 2 and 3.

Table B-1 25 pin RS-232 port

Pin	Name	DTE/DCE	Function
1	CG	<--->	Frame Ground
2	TD	--->	Transmitted Data
3	RD	<---	Received Data
4	RTS	--->	Request to Send
5	CTS	<---	Clear to Send
6	DSR	<---	Data Set Ready
7	SG	<--->	Signal Ground
8	DCD	<---	Data Carrier Detect
9*		<---	Positive DC Test Voltage
10*		<---	Negative DC test Voltage
11*	QM	<---	Equalizer Mode
12+	SDCD	<---	Secondary Data Carrier Detect
13+	SCTS	<---	Secondary Clear to Send
14+	STD	--->	Secondary Transmitted Data
15#	TC	<---	Transmit Clock
16+	SRD	<---	Secondary Receive Data
17#	RC	<---	Receive Clock
18	DCR	<---	Divided Clock Receiver
19+	SRTS	--->	Secondary Request to Send
20	DTR	--->	Data Terminal Ready
21*	SQ	<---	Signal Quality Detect
22	RI	<---	Ring Indicator
23*		<---	Data Rate Selector
24*	SCTE	--->	Data Rate Selector
25*		--->	Busy

In the above table, the character following the pin number means:

* rarely used
+ used only if secondary channel implemented
# used only in synchronous interfaces

Although originally all DB25 RS-232 ports were female, most personal computers which have a DB25 RS-232 connector use a male connector. The female DB25 connector on a personal computer is most likely the parallel printer port and should never be connected to any RS-232 device.

As is indicated above, the 25 RS-232 standard has the option of 2 data channels, each with their own handshake lines, and the option of synchronous link. These functions are rarely used and have been left off of the newer 9 pin ports.

Table B-2   Type A   9 pin RS-232 port

Pin	Name	Function
1	DCD	Data Carrier Detect
2	TD	Transmitted Data
3	RD	Received Data
4	DTR	Data Terminal Ready
5	SG	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Table B-3   Type B   9 pin RS-232 port

Pin	Name	Function
1	DCD	Data Carrier Detect
2	RD	Received Data
3	TD	Transmitted Data
4	DTR	Data Terminal Ready
5	SG	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

The TYPE B connection is the most common on 9 pin personal computer ports. These ports are usually male connectors.

Determining the type of RS-232 port with a voltmeter.

It is possible to determine the type of port with the use of a voltmeter using the following procedure:

1   Set the voltmeter for DC volts, 30 volt range. The voltage being read will likely be negative and be within the range of +3VDC to -15VDC.

2   Power up the equipment.

3   Place the negative probe (black) of the voltmeter on the SG pin of the port. (Pin 7 of a DB25 port or pin 5 of a DE9 port)

4   Place the positive probe (red) of the voltmeter on pin 2.

5   Write down that voltage.

6   Place the positive probe (red) of the voltmeter on pin 3.

7   Write down that voltage.

The TX voltage is within the range of -15V to -5V.

The RX voltage is within the range of -3V to +3V.

Therefore, if pin 2 is the more negative voltage of the two, the serial port is **TYPE A**. If pin 3 is the more negative voltage, the serial port is **TYPE B**.

Since almost every device that is not a modem is a DTE, it is quite common to connect DTE to DTE without a modem pair. A "null modem" connection has been established to simplify this situation. It simply reverses the transmit and receive connections from one side of the connector to another and jumpers some of the hardware handshake lines.
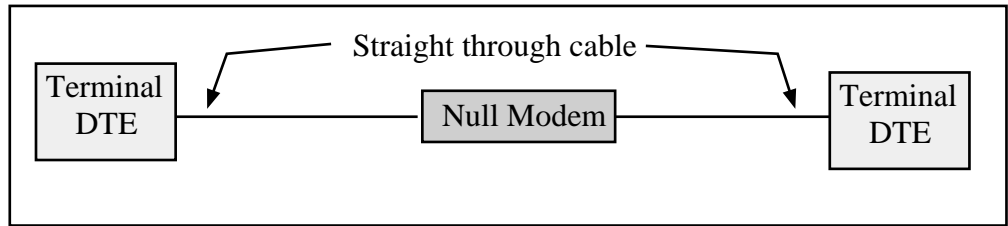

Figure B-2   Null Modem connection

The null modem is frequently a small enclosure with one male connector and one female connector. Sometimes the null modem is built into a single cable to connect the DTE device to another DTE device. In addition to the crossing of the transmit and receive pins, some additional connections to the hardware handshake pins is usually made the pinouts of null modems for 25 pin and 9 pin connections are shown below.

Table B-4   DB25 Null Modem

Male Connector		Female Connector
1		1
2		3
3		2
4		5
5		4
6		20
8		6
20		8
7		7

Table B-5   DE9 Null Modem

Male Connector		Female Connector
2		3
3		2
5		5
7		8
8		7
1		4
6		1
4		6

Electrical characteristics of RS-232

The RS-232 interface is an Single-Ended driver with an open ended receiver. The driver asserts a voltage between -5V and -15V relative to the Signal Ground to represent the MARK state (Logic TRUE). The driver asserts a voltage between +5V and +15V relative to the Signal Ground to represent a SPACE state (Logic FALSE). The fact that there may be a 30 volt swing between MARK and SPACE conditions may lead to problems with the slew rate of the signal due to the capacitance of the cable. If the cable run is long and communication problems are occurring, try lowering the baud rate.

RS-422

The RS-422 interface uses a closed ended driver and a closed ended receiver. The RS-232 interface is ground referenced. This can cause trouble in situations where a common mode induced noise may severely affect the signal by changing the reference. A better solution for noise immunity is to convert the ground referenced data at the transmission end into a differential signal and transmit this down a balanced, twisted-pair line. At the receiving end any induced noise voltage will appear equally on each line. If the receiver only looks at the differential signal, any induced common mode voltage will be rejected. This is the idea behind the RS-422 and RS-485 standards.

The RS-422 interface typically used in a point to point connection using a pair of wires from the transmitter of Unit 1 to the receiver of the Unit 2. Another pair of wires is from the transmitter of Unit 2 to the receiver of Unit 1. This connection allows for full duplex operation, i.e. the units can transmit messages while they are receiving messages. The Square D SY/MAX family of PLCs us RS-422 communication. Their standard pinout is as follows:

Table B-6   SY/MAX DE9S RS-422 Pinout

| Pin	Function	Description
1	TX -	Transmit Data from device. (Data OUT) (inverted)
2	TX+	Transmit Data from device. (Data OUT) (non-inverted)
3	RX-	Receive Data (Data IN) (inverted)
4	RX+	Receive Data (Data IN) (non-inverted)
5	CTS-	Clear to Send (inverted)
6	RTS-	Request to Send (inverted)
7	CTS+	Clear to Send (non-inverted)
8	RTS+	Request to Send (non-inverted)
9	Shield	Shield Ground. AC coupled to chassis.
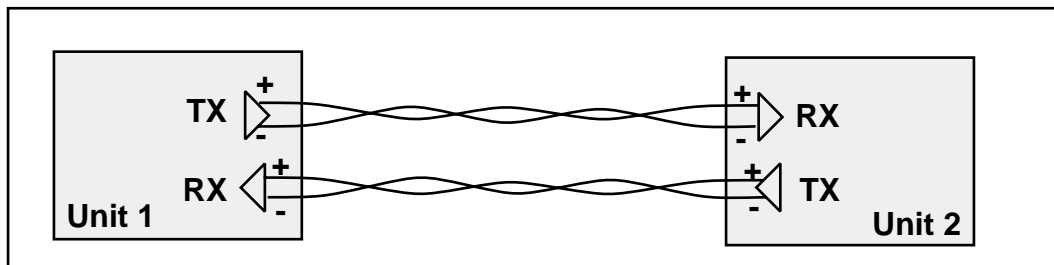
Figure B-3 RS-422 Setup

Like RS-485, the RS-422 protocol may be used in a multidrop configuration as shown in Figure B-4. The RS-485 standard requires a minimum capability of 32 receivers on the network. The RS-422 standard places no minimum requirement and therefore is typically used in point to point or as the host of a RS-485 network.

Always connect the + terminals on the TX to the + terminals on the RX. Similarly, connect the - terminals on the TX to the - terminals on the RX.

> **Note:** Occasionally the manufacture incorrectly labels the polarity of the connections. If the system is not working try exchanging the polarity of the TX pair and the RX pair on the host.

With the high noise immunity and low voltage swings, the RS-422 interface may have long runs of up to 10,000 feet.

Electrical Characteristics of RS-422.

The driver asserts a positive voltage across the receiver to represent a MARK state, a negative voltage to represent the SPACE state. The receiver triggers off of the transition through the zero voltage point.

RS-485 (four wire)

The RS-485 interface is like the RS-422 interface with the exception that the transmitters are able to tri-state, i.e. float. This allows up to 32 transmitters to be connected to a host receiver and multiple receivers to be connected to a host transmitter. This technique is called multidropping and is shown in Figure B-4. Square D PowerLogic Circuit monitors use this type of RS-485 for communication.
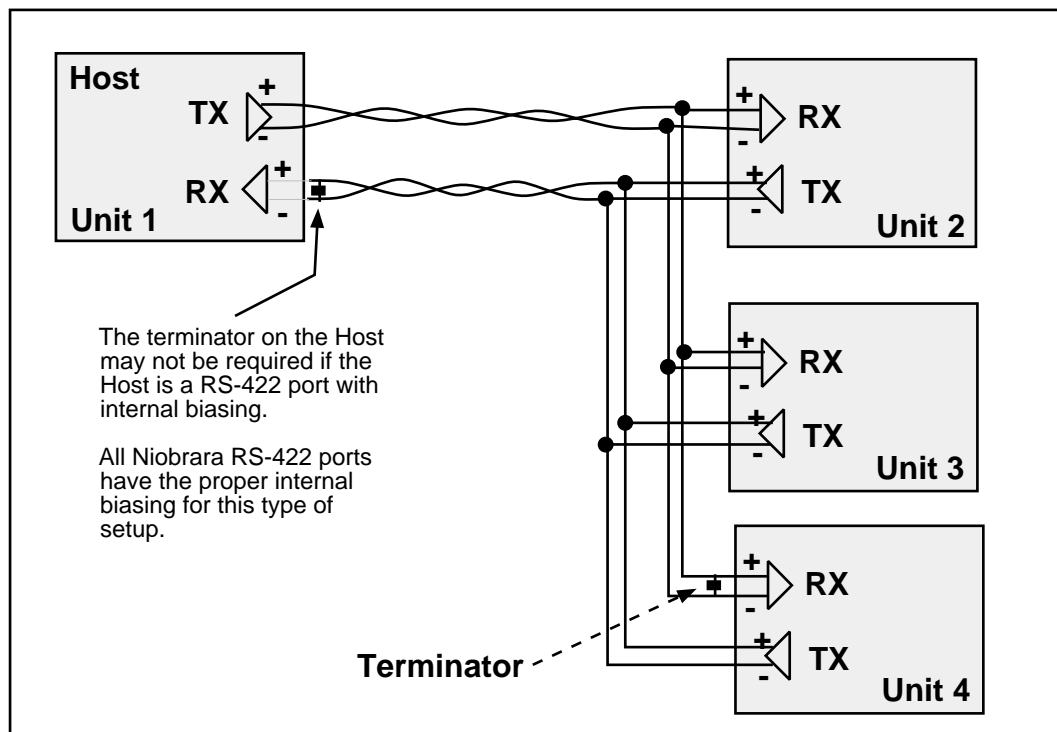

Figure B-4   RS-485 Four Wire Setup

As shown in Figure B-4, it is possible to use a 4 wire RS-422 port to drive a 4 wire RS-485 multidrop network. If the RS-422 port does not have internal biasing on the RX pair it may be necessary to add a terminator to that end of the network. The terminator is a resistor correctly matched to the line which reduces reflections on the network.

RS-485 (two wire)

Another version of the differential communication system is the RS-485 two wire network. The two wire system is a half-duplex connection where each unit transmits and receives on the same pair of wires. Only one transaction may occur on the network at one time as opposed to the four wire system where the units may transmit while they are receiving. The two wire system is inexpensive to install because only one twisted pair cable is needed. All the + terminals are connected together, all the - terminals are connected together. A terminating resistor is usually required on each end.

Since each unit can listen to the transmissions of every other unit on the network, peer to peer communication is available. The trade off is that the half-duplex connection has half of the throughput of the full duplex four wire system. A typical installation is shown in Figure B-5.

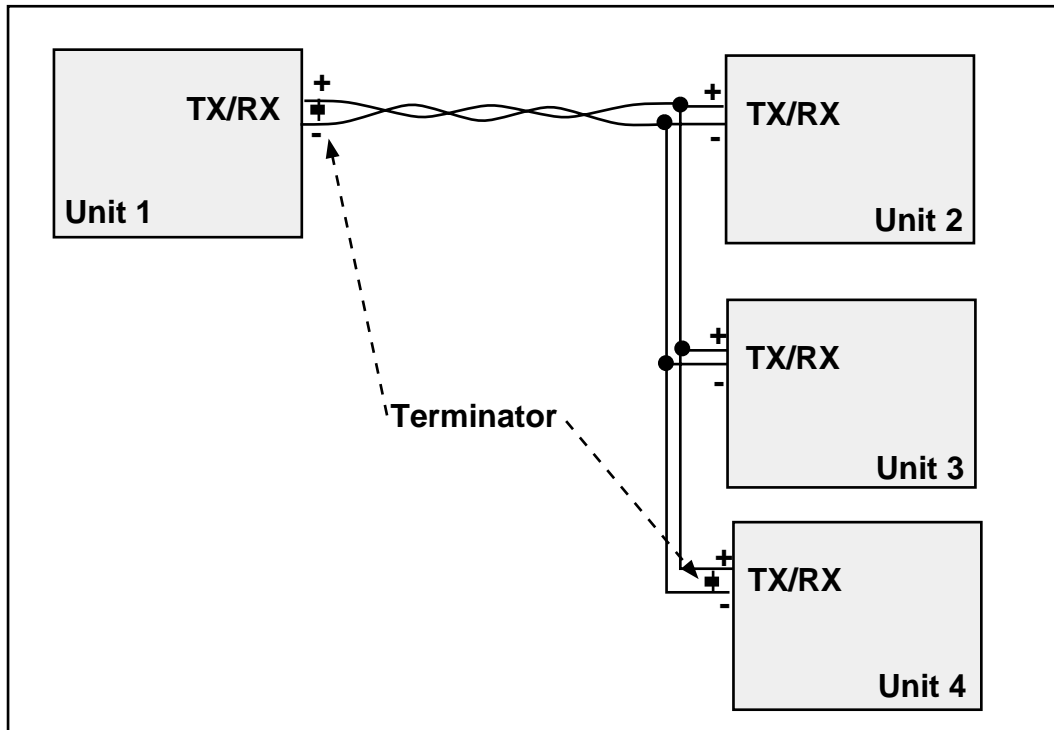The Allen-Bradley® Data Highway is an example of a two wire RS-485 multidrop network.

Figure B-5 RS-485 Two wire Multidrop Setup

> **Note:** Occasionally the manufacture incorrectly labels the polarity of the connections. If the system is not working try exchanging the polarity of the TX/RX pair on the unit.

20mA Current Loop

The 20mA Current Loop is another multidrop configuration derived from the Morse telegraph. The transmitting mechanism may be explained as simply opening a normally closed switch for the data bit transmission. The receiver is usually a optical isolator (LED/phototransistor) unit. Each loop is powered by a Constant Current Source. The source may be part of one of the units or may be a separate device as shown in Figure B-6.

As in other multidrop schemes, each unit watches the RX line for its messages with its address. The number of units on the network is dependent upon the addressing scheme as well as the voltage supply of the constant current source. Each RX receiver on the circuit will cause a voltage drop in the supply current. The series sum of these drops must be a value less than the available voltage from the current supply or none of the receivers will work.

To check, add up the voltage drops around the loop and make sure that the sum is less than the compliance voltage of the current source.

Some Red Lion Controls equipment such as the Apollo message centers use a 20mA current loop for serial communication.
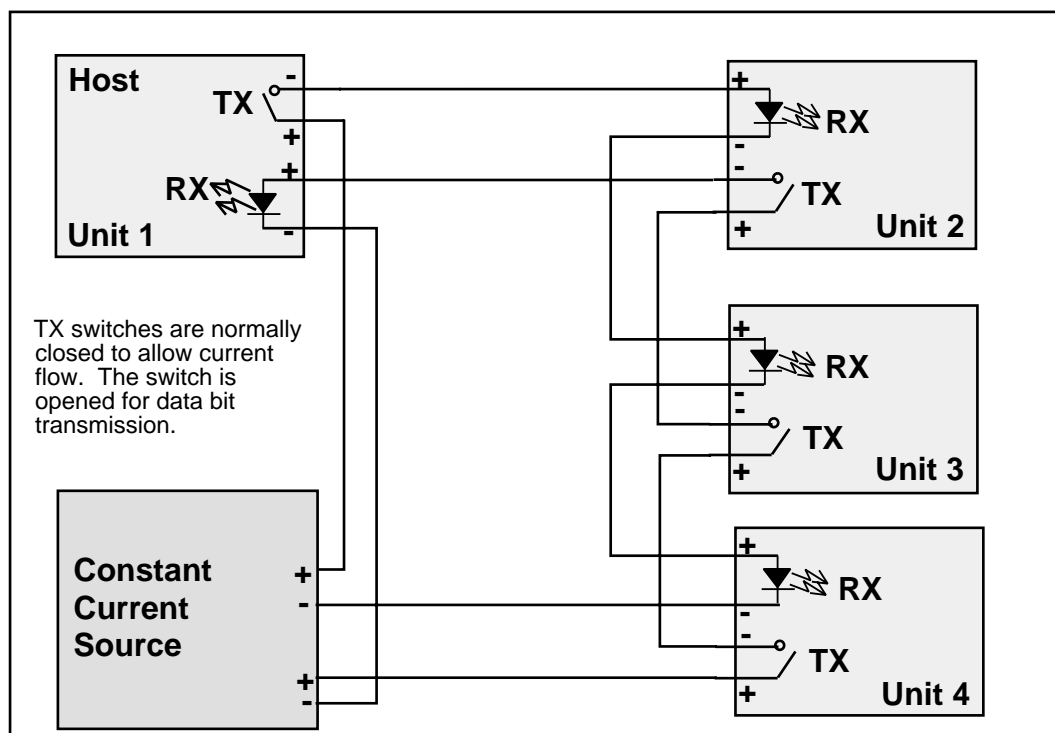
Figure B-6   20mA Current Loop (Full Duplex)

A half-duplex 20mA current loop may be formed by connecting the a single current supply through all RX and TX connections in series.

Hardware Handshaking

Sometimes it is necessary for the transmitting and receiving devices to signal each other to control the flow of data. This may be done with special characters in the software (see Software Handshaking on page 210.) or with physical connections to the hardware. This physical signaling system is known as hardware handshaking. The electrical characteristics of the handshaking lines are the same as the TX/RX lines of the system. It may be a single-ended, ground referenced signal in RS-232, or a differential pair in RS-422 or RS-485. The two most common types of hardware handshaking are: Request to Send (RTS) and Clear to Send (CTS).

Request to Send (RTS) is employed in two different modes: Request to Send (also known as Push to Talk) and Restraint.

> **Request to Send** (Push to Talk) mode is used by the transmitting device to signal the receiving device that it has data to send. This is typically used in modem and radio modem setups. When the transmitting device has data to send, it asserts its RTS. When the modem is ready, it asserts the CTS of the transmitting device to allow it to transmit. The transmitting device will keep RTS asserted until it has sent all of its data.
>
> Push to talk mode is the original mode of the RS-232 standard for connecting DTE to DCE. This mode of RTS usage is not commonly used in most serial communication situations and is usually restricted to modems and radios.
>
> **Restraint** mode is used by the receiving device to signal the transmit-

ting device that it is sending data too quickly for to be processed. When this situation occurs, the receiving device negates its RTS to signal the transmitting device to stop. When the receiving device has "caught up" it asserts its RTS line to signal the transmitting device to continue.

Restraint mode is the most common handshaking mode.

Sometimes if two RS-232 DTE devices are connected together, the DTR pin may be used as the restraint handshake line instead of RTS.

Clear to Send (CTS) is used to signal the transmitting device that the receiving device is ready to accept data. The transmitting device will not send data until its CTS is asserted.

In a typical hardware handshaking application RTS on the one device is usually connected to CTS on the other.

The vast majority of cases do not require active hardware handshaking. In this case it is common to jumper the RTS of each unit to its own CTS. This will allow each port to transmit at will.

Software Overview

Binary Representation of Data

With the implementation of an appropriate hardware system, a uniform system must be implemented to allow the data to be transferred.

In a synchronous serial system, each bit of data is transferred with a clock signal. This ensures that the receiving device "knows" when each bit is transferred so it can reconstruct the data. The throughput is determined by the number of data bits and the clock frequency. The data synchronization is accomplished by the transmission of a sync character which is an out-of-band character.

The more common type of serial communication is asynchronous. In an asynchronous system the character timing is determined by a local clock at each end. This clock usually runs at 16 times the baud rate. Each bit is to stay in its MARK or SPACE state for the time determined by the baud rate. Data is transmitted in packets of the following form: Start bit; Data Bits, Parity Bit, Stop Bits.

Start Bit

The Start bit is always a SPACE bit and signifies the beginning of the data packet.

Data Bits

Typically 7 or 8 bits. On rare occasions may be 5 or 6 bits. The if the data is logic true it is in the MARK state. If the data is false it is in the SPACE state. The data is transmitted LSB first.

Parity Bit

The parity bit is a bit that follows the last data bit. Its determination is based upon the type of parity selected. The most common types are ODD, EVEN, NONE, MARK, and SPACE. These parity selections are calculated as follows.

Odd: The parity bit is set to the MARK state if the number of data bits in the MARK state are even. Therefore the total number of data bits in the MARK state plus the parity bit is an **ODD** number.

Even: The parity bit is set to the MARK state if the number of data bits in the MARK state are odd. Therefore the total number of data bits in the MARK state plus the parity bit is an **EVEN** number.

None: No parity bit. The stop bit comes immediately after the last data bit.

Mark: Always logic high. Like an additional stop bit. The mark parity bit is usually used in conjunction with 7 bit ASCII data.

Space: Always logic low. The space parity bit is usually used in conjunction with 7 bit ASCII data.

Stop Bit

The Stop bit is always a MARK bit. There is always one stop bit, sometimes two stop bits, and on rare occasions 1.5 stop bits. The receiving device starts timing for the next start bit half way through the last stop bit in the message. A message with two stop bits is the same as a message with one stop bit plus one extra bit time worth of dead space between packets. Therefore a device set for 1 stop bit can also receive a message with 2 stop bits.

It is worth noting that the total number of bits in a packet is sometimes used to reference the type of communication. For instance, Square D SY/MAX packets have:

1 start bit + 8 data bits + 1 parity bit + 1 stop bit = 11 bits.

Most Hayes modems can only handle a 10 bit protocol. Now this may be:

1 start bit + 8 data + 0 parity + 1 stop = 10 bits
or 1 start bit + 7 data + 1 parity + 1 stop = 10 bits
or 1 start bit + 7 data + 0 parity + 2 stop = 10 bits

Since the Hayes modem is designed to handle only 10 bits per character, this explains why it is not possible to send an 11 bit protocol like SY/MAX across these modems. The bit count gets off when the 10th bit arrives at the modem and the modem expects a start bit instead of the stop bit. An 11 bit modem, like the Niobrara RM14K, is required for this type of communication.

Message Determination

With the above descriptions of an asynchronous serial packet, binary data may be sent from one device to another.

Hexadecimal numbers

Binary representation is somewhat cumbersome to deal with so hexadecimal numbers are often used. Hexadecimal (hex) numbers are base sixteen numbers. There are 16 digits in hex, the ten decimal digits 0 through 9 plus the six letters A through F which represent the decimal numbers 10 through 15. The following is a table of the decimal numbers 0 through 31, their hexadecimal equivalent and their binary equivalent.

Table B-7   Decimal, Hex, Binary

Dec	Hex	Binary		Dec	Hex	Binary
0	0	0000		16	10	0001 0000
1	1	0001		17	11	0001 0001
2	2	0010		18	12	0001 0010
3	3	0011		19	13	0001 0011
4	4	0100		20	14	0001 0100
5	5	0101		21	15	0001 0101
6	6	0110		22	16	0001 0110
7	7	0111		23	17	0001 0111
8	8	1000		24	18	0001 1000
9	9	1001		25	19	0001 1001
10	A	1010		26	1A	0001 1010
11	B	1011		27	1B	0001 1011
12	C	1100		28	1C	0001 1100
13	D	1101		29	1D	0001 1101
14	E	1110		30	1E	0001 1110
15	F	1111		31	1F	0001 1111

Notice that it takes four binary digits makes one hex digit. Conversion from binary to hex is straight forward and explains why hex is so popular in PLCs. Since the most PLC devices use 16-bit registers it takes 4 hex digits to represent one register i.e. 1A2F. The first two characters "1A" make up the most significant byte (8 bits) and the last two characters make up the least significant byte.

ASCII characters

ASCII is a set of 7-bit characters used in communication, computers and programmable logic controllers. The word ASCII is a acronym for American Standard Code for Information Interchange. ASCII is a way to interpret 7 bits (or 8 bits with a leading 0) as alphanumeric characters. There is an ASCII table following this section for your reference.

In ASCII. the small letter "p" is represented by the binary number 0111 0000. This is the hexadecimal number 70 or the decimal number 112.

Similarly, the capital letter "E" is represented by the binary number 0100 0101 which is the hexadecimal number 45 or the decimal number 69.

Software Handshaking

It is common for communicating devices to need to exert control over each other. Typically the receiving device will need to force the transmitting device to stop and wait for it to catch up. This may be done at the hardware level (See Hardware Handshaking on page 207.) or at the software level using special characters. A common way for devices communicating with ASCII is to use the X-ON/X-OFF characters.

X-ON

The X-ON character is the ASCII character DC1, which has the decimal value 17, hex value 11, and may be generated by pressing Ctrl+Q.

When a device receives an X-ON it starts sending data from the position at which it received an X-OFF character. The X-ON is only acted upon if the device is first halted with an X-OFF.

X-OFF

The X-OFF character is the ASCII character DC3, which has the decimal value 19, the hex value 13, and the may be generated by pressing Ctrl+S.

When a device receives an X-OFF it stops sending data. It will remain in this state until an X-ON character is received. At this time, it will resume sending the data.

Obviously software handshaking is only useful when devices are sending characters for the handshake which are out of the normal range of data. Sometimes certain protocols get around this by specifying special escape sequences that the receiving device will recognize. This is done by methods such as sending that special character once if is to be recognized as a control character and twice if it is to be included as data.

A similar but much rarer scheme uses the ENQ and ACK codes for flow control.

Table B-8   ASCII Table

Hex	Dec	Character	Description	Abrv		Hex	Dec	Char.		Hex	Dec	Char.		Hex	Dec	Char.
00	0	[CTRL]@	Null	NUL		20	32	SP		40	64	@		60	96	`
01	1	[CTRL]a	Start Heading	SOH		21	33	!		41	65	A		61	97	a
02	2	[CTRL]b	Start of Text	STX		22	34	"		42	66	B		62	98	b
03	3	[CTRL]c	End Text	ETX		23	35	#		43	67	C		63	99	c
04	4	[CTRL]d	End Transmit	EOT		24	36	$		44	68	D		64	100	d
05	5	[CTRL]e	Enquiry	ENQ		25	37	%		45	69	E		65	101	e
06	6	[CTRL]f	Acknowledge	ACK		26	38	&		46	70	F		66	102	f
07	7	[CTRL]g	Beep	BEL		27	39	'		47	71	G		67	103	g
08	8	[CTRL]h	Back space	BS		28	40	(		48	72	H		68	104	h
09	9	[CTRL]i	Horizontal Tab	HT		29	41	)		49	73	I		69	105	i
0A	10	[CTRL]j	Line Feed	LF		2A	42	*		4A	74	J		6A	106	j
0B	11	[CTRL]k	Vertical Tab	VT		2B	43	+		4B	75	K		6B	107	k
0C	12	[CTRL]l	Form Feed	FF		2C	44	,		4C	76	L		6C	108	l
0D	13	[CTRL]m	Carriage Return	CR		2D	45	-		4D	77	M		6D	109	m
0E	14	[CTRL]n	Shift Out	SO		2E	46	.		4E	78	N		6E	110	n
0F	15	[CTRL]o	Shift In	SI		2F	47	/		4F	79	O		6F	111	o
10	16	[CTRL]p	Device Link Esc	DLE		30	48	0		50	80	P		70	112	p
11	17	[CTRL]q	Dev Cont 1 X-ON	DC1		31	49	1		51	81	Q		71	113	q
12	18	[CTRL]r	Device Control 2	DC2		32	50	2		52	82	R		72	114	r
13	19	[CTRL]s	Dev Cont 3 X-OFF	DC3		33	51	3		53	83	S		73	115	s
14	20	[CTRL]t	Device Control 4	DC4		34	52	4		54	84	T		74	116	t
15	21	[CTRL]u	Negative Ack	NAK		35	53	5		55	85	U		75	117	u
16	22	[CTRL]v	Synchronous Idle	SYN		36	54	6		56	86	V		76	118	v
17	23	[CTRL]w	End Trans Block	ETB		37	55	7		57	87	W		77	119	w
18	24	[CTRL]x	Cancel	CAN		38	56	8		58	88	X		78	120	x
19	25	[CTRL]y	End Medium	EM		39	57	9		59	89	Y		79	121	y
1A	26	[CTRL]z	Substitute	SUB		3A	58	:		5A	90	Z		7A	122	z
1B	27	[CTRL][	Escape	ESC		3B	59	;		5B	91	[		7B	123	{
1C	28	[CTRL]\	Cursor Right	FS		3C	60	<		5C	92	\		7C	124		
1D	29	[CTRL]]	Cursor Left	GS		3D	61	=		5D	93	]		7D	125	}
1E	30	[CTRL]^	Cursor Up	RS		3E	62	>		5E	94	^		7E	126	~
1F	31	[CTRL]_	Cursor Down	US		3F	63	?		5F	95	_		7F	127	DEL

Appendix C
NR&D Internet Access

Niobrara is on the World Wide Web! Our Internet home page is at:

http://niobrara.com

where you will find product information, file downloads, and links to our distributors.

You may E-mail technical support at the following:

techsupport@niobrara.com

Appendix D
Ethernet Drop Number List

The following Tables are for record keeping of the Ethernet Drop numbers for a single network. Each of the available drop numbers 00 through 99 are listed with space for a brief description of the Ethernet device and location. Below is a typical example:

Ethernet Drop Number	Device Description	Device Location
00	Square D Model 650	Building C, Builder 1, Rack 1
01	NR&D MEB	Building C, Builder 1, Rack 3
02	Square D SFI-610	Building C, Maintenance Office, Jim's PC
03	DEC VAX 3200	Building B, Computer Room
04	NR&D EPE5	Building A, Builder 12, Rack 1

These tables are for the user's convenience and the information is very helpful when new network units are brought on-line.

Table D-1   Ethernet Drop Number Reference

Ethernet Drop Number	Device Description	Device Location
00		
01		
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
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32		
33		

Ethernet Drop Number	Device Description	Device Location
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
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46		
47		
48		
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64		
65		
66		

Ethernet Drop Number	Device Description	Device Location
67		
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80		
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Appendix E
Modbus Plus Drop Number List

The following Tables are for record keeping of the Modbus Plus Drop numbers for a single network. Each of the available drop numbers 01 through 64 are listed with space for a brief description of the Modbus Plus device and location. Below is a typical example:

MB+ Drop Number	Device Description	Device Location
00	Modicon 984 PLC	Building C, Builder 1, Rack 1
01	NR&D MEB	Building C, Builder 1, Rack 3
02	SA-85 PC Card	Building C, Maintenance Office, Jim's PC
03	NR&D MEB	Building B, Computer Room
04	Quantum PLC	Building A, Builder 12, Rack 1

These tables are for the user's convenience and the information is very helpful when new network units are brought on-line.

Table E-1   Modbus Plus Drop Number Reference

MB+ Drop Number	Device Description	Device Location
01		
02		
03		
04		
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06		
07		
08		
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10		
11		
12		
13		
14		
15		
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32		
33		

MB+ Drop Number	Device Description	Device Location
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