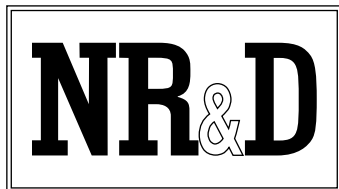


MUCM MRPC

Installation and Programming Manual

This Manual describes the MUCM application for implementing the standard NR&D routing and protocol conversion.

Effective: 2 April, 2003



Niobrara Research & Development Corporation
P.O. Box 3418 Joplin, MO 64803 USA

Telephone: (800) 235-6723 or (417) 624-8918
Facsimile: (417) 624-8920
www.niobrara.com

POWERLOGIC, SY/MAX, and Square D are registered trademarks of Square D Company.

Modicon, TSX Momentum, Modbus, and Modbus Plus are registered trademarks of Schneider Automation.

Subject to change without notice.

© Niobrara Research & Development Corporation 2001, 2002. All Rights Reserved.

Contents

1	Introduction	13
2	Installation	15
	Module Installation	15
	Software Installation	15
	Serial Connections to the MUCM	16
	Port 1 to the Personal Computer	16
	Loading the Application into the MUCM	17
	QLOAD MRPC	17
	17
3	Configuration	19
	Accessing mailbox and configuration registers	20
	MUCM mailbox registers	21
	RTS/CTS Handshaking	21
	CTS Operation	21
	RTS Operation	21
	MNIM Compatibility	21
4	SY/MAX and Modbus Message Routing	23
	SY/MAX Routing	23
	SY/MAX Serial Routing	23
	Modbus Routing	26
	Modbus Serial Routing	26
5	Peripheral Mode	27
	Mode 3: Peripheral	27
	Driver Mode	27
	Peripheral Mode Example	28
6	Transparent and Share Modes	29

Modes 4,5: Transparent, Share	29
TRANSPARENT Mode Example	30
Driver Mode	31
7 PLogic and PNIM Modes	33
Mode 6: PowerLogic	33
PowerLogic Mode Example	34
Mode 11: PNIM.....	35
PNIM Mode Example	36
8 IDEC Mode	39
Mode 7: IDEC	39
Micro-1 and Model 50 Interfacing	39
Micro-1 register addressing	39
Model 50 register addressing	40
IDEC Mode Example	41
9 Gateway Mode	43
Mode 8: Gateway	43
ASCII Command Gateway Functions	43
Gateway READ command	43
Gateway WRITE command	44
Gateway SET command	44
Gateway CLEAR command	44
Gateway BIT command	44
Gateway PRINT command	45
Gateway OMIT Print Command	45
Gateway ADDRESS command	45
Gateway Mode Example	45
BASIC Language Example Program	46
10 Multidrop Mode	49
Mode 9: Multidrop	49
Multidrop Mode Example	50
Driver Mode	52
11 MODBUS Modes	53
Modbus Overview	53
SY/MAX Message Addressing	54
Message Translations	55
SY/MAX to Modbus Translations	55
Modbus to SY/MAX Translations	55
Master Operation	57
Register Bias	57
Register Calculations	57
Bit Calculations	58
Modbus Retries	58

Driver Mode	58
RS-485 MODBUS Host Master Mode Example	59
Modbus Slave Operation	60
PowerLogic Software use with Modbus Devices	62
Register 8188	62
Non-Priority Random Access Reads	63
12 RNIM Mode	65
NORMAL Operation	65
BID Operation	66
Single Slave BID Operation	67
Automatic BID Operation (100 + n)	67
Automatic BID Operation (200 + n)	67
Automatic BID Operation (300 + n)	68
Data Store and Forward Operation	69
Broadcast Operation	69
Mode 12: RNIM Master	70
Mode 13: RNIM Slave	71
Driver Mode	72
Pt to Pt	72
Half Duplex	72
Two Wire	73
RTS/CTS Operation	73
13 Chevron Mode	75
14 Dual Slave Mode	79
SMS Example	79
15 Auto-transfer and Auto-Scan	83
Auto-Transfer	83
Auto-Scan	84
Auto-Scan Status	84
Auto-Scan Watchdog	85
Auto-Scan Watchdog Example	85
16 Configuration Software MEBSW	87
MEBSW	87
Data Entry Keys	89
Online and Offline Editing Screen	90
Drop Number	90
On Ethernet	90
Protocol	90
Baud Rate	90
Parity	90
Data Bits	90
Stop Bits	91

Buffer Limit	91
Mode Specific Sub-menus	91
Driver Mode	91
IP Address	91
Subnet Mask	91
Default Gate	91
MBAP TCP Port	91
TCP Backoff	91
Downstream Timeout	91
Quiet Timeout	91
IP Framing	91
MAC Address	91
E-Peer	91
Error Check	92
Route Appendix	92
Route Replacement	92
Packet size limit	92
Packet time limit	92
Target Route	93
Control Character	93
Echo	93
Highlight	93
Node Priority	93
Number of Nodes	93
Time Slice	93
READ command	93
WRITE command	93
Retry timeout	94
Register Bias	94
MB+ Programming Channel Timeout	94
Reply Timeout	94
Transfer Interval	94
Transfer Route	94
READ Count	94
READ From	94
READ To	94
WRITE Count	95
WRITE To	95
WRITE From	95
Total E-Peer Nodes	95
This Node's Number	95
Start Register	95
Register Count	95
Destination Reg	95
Update Interval	95
Network Id	95
CTS Timer	95
Packet response	95
Bid interval	96
Retries	96
Pause time	96
Message Count	96
Bid Address	96
Transfer Route	97
HOTKEYS	97
F1 Print Screen hotkey	97
F2 Help Window	97

F3 Statistic Viewer	98
Modbus Slave Routing	101
Port Number	102
Starting Address	102
Address	102
Target TYPE	102
ROUTE	102
Modbus Server Routing for Ethernet Port	103
Index	103
Target TYPE	103
ROUTE	103
Auto-Scan Table	104
Local	104
Remote	104
Count	104
Operation	104
ROUTE	104
Modbus Plus Global Data	105
Outgoing TCP Routing	105
Drop	105
IP Address	105
Downstream Route	105
Offline Functions	105
"Read from disk to memory"	105
"Write from memory to disk"	106
"Edit configuration in memory"	106
"Send memory to module"	106
"Fetch memory from module"	107
"Print configuration in memory"	107
"Delete configuration file"	107
"Copy offline to module flash"	107
"Quit offline functions"	107
Utilities	107
View registers	107
Terminal Emulator	108
Download New Firmware to Module	109
SETUP	109
Serial SETUP	109
Personal Computer COM: port	109
SY/LINK Connection	111
SFI-610 SETUP	111
Modbus/TCP Connection	112
Terminal Emulator SETUP	112
Register Viewer Setup	113
Load from File	113
Command Line Parameters	113

17 Local Registers 115

Module Register Overview	115
Mailbox Registers	115
Statistics Registers	116
Data Port Statistics	116
Auto-Scan Table Registers	117
Modbus Slave Address Tables	118
Setup and Configuration Registers	119

Options	124
Clear Function Register	125
Module Identification Registers	126
Global Options Register (Register 8190)	127
Global Options	128

18 Connector Pinouts 129

RS-232 port on MUCM (Screw Terminal)	129
RS-485 port on MUCM (Screw Terminal)	130

19 Recommended Cabling 131

Cabling required to configure an MUCM	131
MUCM RS-232 to personal computer cabling	131
MUCM RS-232 to 9-pin DTE	131
MUCM RS-232 to 25-pin DTE	132
MUCM RS-485/422 to SY/MAX 9-pin Port	132
Isolated Cabling to SY/MAX Port	133

20 Applications 135

Example 1 : Blue Hose SY/NET programming through Modems	135
---	-----

Appendix A NR&D Internet Access 139

Figures

Figure 2-1 MUCM Layout	16
Figure 2-2 MUCM to RS-232 PC DCE Port (9-pin) (MU1 Cable)	17
Figure 2-3 QLOAD of MRPC	17
Figure 4-1 Direct connection without route	23
Figure 4-2 Single Network Example	24
Figure 4-3 Multiple Network Example	25
Figure 4-4 Modbus Network Example	26
Figure 5-1 Peripheral mode example	28
Figure 6-1 Transparent Mode Example	30
Figure 7-1 PowerLogic Example	34
Figure 7-2 PNIM Modbus/TCP Example	36
Figure 8-1 IDEC Mode Example	41
Figure 9-1 GATEWAY Example	45
Figure 9-2 Terminal Emulator connected to Gateway port	46
Figure 10-1 Multidrop Example	50
Figure 11-1 MODBUS Master Mode Example	59
Figure 11-2 OTHER Modbus Slave Example	60
Figure 11-3 Modbus through SY/MAX Example	61
Figure 11-4 EPE5SW Modbus Routing Editing Screen	62
Figure 12-1 NORMAL RNIM Example	66

Figure 12-2 RNIM Repeater Example	69
Figure 13-1 Chevron Radio Example	76
Figure 13-2 Chevron POWERLOGIC Example	77
Figure 14-1 Dual Slave SMS Example	80
Figure 15-1 Auto-Scan Watchdog Example	85
Figure 16-1 MEBSW Startup Screen	88
Figure 16-2 MEBSW oFfline Menu	89
Figure 16-3 MEBSW oNline Edit Screen	90
Figure 16-4 F1 Print Screen	97
Figure 16-5 F2 Help Window	98
Figure 16-6 Port 1..2 Statistical Screen (Page 1)	99
Figure 16-7 Port 1,2 Statistical Screen (Page 2)	99
Figure 16-8 Edit Modbus Slave Routing	102
Figure 16-9 Modbus Server Routing for Ethernet Port	103
Figure 16-10 Edit Auto-Scan Table	104
Figure 16-11 Edit TCP Routing	105
Figure 16-12 oFfline Read from Disk to Memory	106
Figure 16-13 View Registers	108
Figure 16-14 Terminal Emulator	109
Figure 16-15 SY/MAX Setup Screen	110
Figure 16-16 Terminal Emulator Setup Screen	112
Figure 16-17 Terminal Emulator Setup Screen	113
Figure 18-1 Port 1 Screw Terminal	129
Figure 18-2 Port 2 Screw Terminal	130
Figure 20-1 NIM Net-to-Net Example	136

Tables

Table 3-1 Suggested Number of PADs for Hayes Modem Operation	22
Table 4-1 Direct connection routes	24
Table 4-2 Single Network Connection Routes	24
Table 4-3 Multiple Network Connection Routes	25
Table 4-4 Modbus routes	26
Table 5-1 Peripheral Routing Examples	28
Table 5-2 MUCM Setup for Peripheral Connection	28
Table 6-1 Transparent Routing Examples	30
Table 6-2 MUCM Setup for TRANSPARENT Connection	30
Table 6-3 EPE5 Setup for TRANSPARENT Connection	31
Table 7-1 PowerLogic Routing Examples	34
Table 7-2 EPE5 Setup for PowerLogic Connection	34
Table 7-3 SMS3000 Device Setup	36
Table 7-4 MUCM Setup for PNIM Connection	37
Table 8-1 Micro-1 Processor Equivalent Register List	40
Table 8-2 Model 50 Processor Equivalent Register List	40
Table 8-3 IDEC Routing Examples	41
Table 8-4 MUCM Setup for IDEC Connection	41
Table 9-1 Gateway Command Examples	46
Table 10-1 MULTIDROP Routing Examples	51
Table 10-2 MUCM (1) Setup for MULTIDROP Connection	51

Table 10-3 SPE4 Setup for MULTIDROP Connection	51
Table 10-4 MUCM (2) Setup for MULTIDROP Connection	51
Table 11-1 MODBUS Function Code List	54
Table 11-2 SY/MAX Messages	54
Table 11-3 SY/MAX to Modbus Translations	55
Table 11-4 Modbus to SY/MAX Translations with type = "OTHER"	56
Table 11-5 SY/MAX Register to Modbus Register Relationship	58
Table 11-6 SY/MAX Bit to Modbus Coil Relationship	58
Table 11-7 Modbus Routing Examples	59
Table 11-8 MUCM Setup for Modbus Master Connection	59
Table 11-9 Modbus Slave Example Setup	60
Table 11-10 Modbus Example Configuration	61
Table 11-11 Modbus Example Setup	61
Table 11-12 MUCM I configuration	62
Table 11-13 MUCM II configuration	62
Table 11-14 Modicon PLC ID Values	63
Table 12-1 Broadcast Route Values	70
Table 12-2 RNIM Master Register Summary	71
Table 12-3 RNIM Slave Register Summary	72
Table 13-1 POWERLOGIC CHEVRON Example	77
Table 14-1 POWERLOGIC Example DUAL SLAVE Port	80
Table 14-2 POWERLOGIC Example DUAL SLAVE Port Modbus Routing	80
Table 14-3 POWERLOGIC Example CHEVRON Port	81
Table 14-4 POWERLOGIC Example SMS Communications Connection - Serial	81
Table 14-5 POWERLOGIC Example SMS Setup Devices/Routing	82
Table 15-1 Auto-Scan Entries for both MUCM's	86
Table 17-1 Module 4x Register Overview	115
Table 17-2 Ports 1 and 2 Statistics Registers	117
Table 17-3 Auto-Scan Configuration Registers	118
Table 17-4 Modbus Slave Address Table	119
Table 17-5 Modbus Slave Starting Address Register	119
Table 17-6 Module Setup Identification Registers	119
Table 17-7 Ports 1 and 2 Configuration Registers	120
Table 17-8 Ports 1 and 2 Configuration Registers (Continued)	121
Table 17-9 Baud Rate Values	121
Table 17-10 Data Bits Values	122
Table 17-11 Parity Values	122
Table 17-12 Stop Bits Values	122
Table 17-13 Port Mode Values	123
Table 17-14 Options Register Values	124
Table 17-15 Clear Function bit-map	126
Table 17-16 Module Identification Registers	127
Table 17-17 Module ID Example	127
Table 17-18 Global Options Register Values	128
Table 18-1 RS-232 Pinout	129
Table 18-2 RS-485 Pinout	130
Table 20-1 Personal Computer route	136
Table 20-2 Local MUCM Setup for NIM Net-to-Net Connection	136
Table 20-3 Remote MUCM Setup for NIM Net-to-Net Connection	136

Table 20-4 Remote MUCM Modbus Routing Table for Port 1 137

Introduction

The Niobrara MUCM is a TSX Momentum[®] compatible module that is capable of running multiple applications for performing communication translations between serial protocols. This document covers an application that uses standard NR&D routing and protocol conversion. This setup allows the MUCM to emulate an MEB-TCP.

One application is required to be loaded into the MUCM: `mrpc.qcm` is the routing and protocol conversion Application. This Application must be running for the system to properly perform.

Port 1 and Port 2 of the MUCM are to be connected with an RS-232 cable or an RS-485 cable to many different serial devices. These ports may be configured to any one of 19 serial modes.

Module Installation

- 1 Mount the MUCM on a DIN rail, or use the mounting holes to screw it to a wall.

Software Installation

The application files for the MUCM are included in the MUCMSW32.ZIP file. This file must be unzipped using a utility such as PKUNZIP.EXE. A copy of PKUNZIP is included on the standard NR&D software disk and is also available at www.niobrara.com. The latest version of the MUCMSW32.ZIP file is located at <http://www.niobrara.com/ftp/module-sw/mucmsw32.zip>

The latest version of this document in pdf format is located at:

<http://www.niobrara.com/ftp/manuals/pdf/mrpc.pdf>

Serial Connections to the MUCM

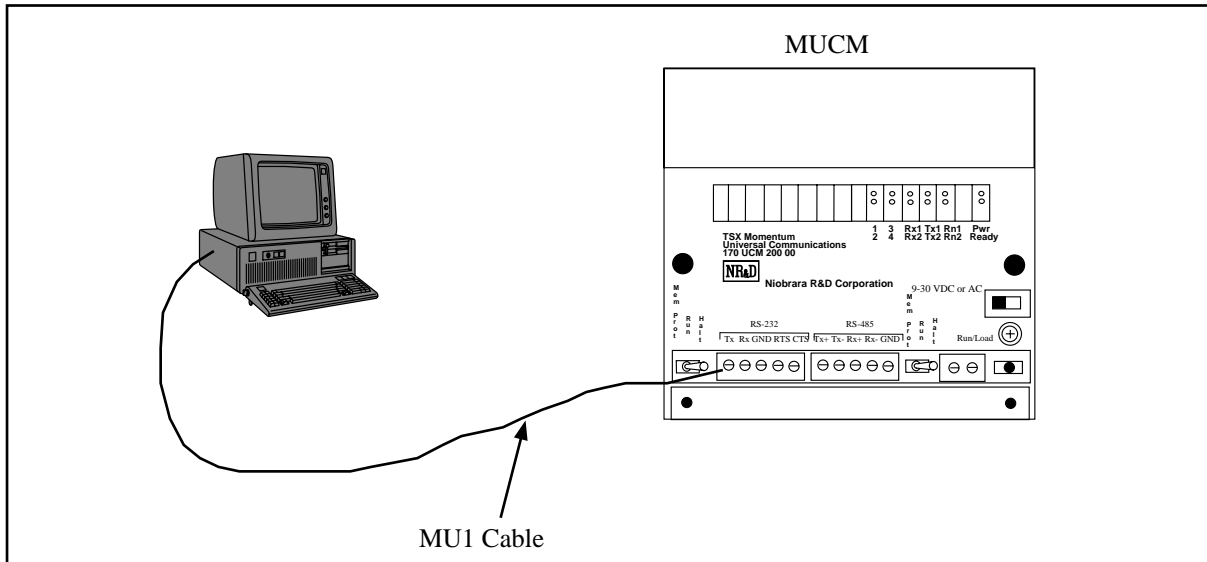


Figure 2-1 MUCM Layout

Port 1 to the Personal Computer

A physical connection must be made from the personal computer to the MUCM in order to download the applications. This link may be a serial connection from a COM port on the personal computer to the RS-232 port on the MUCM. The Niobrara MU1 cable may be used for this connection. This cable is shown in Figure 2-2.

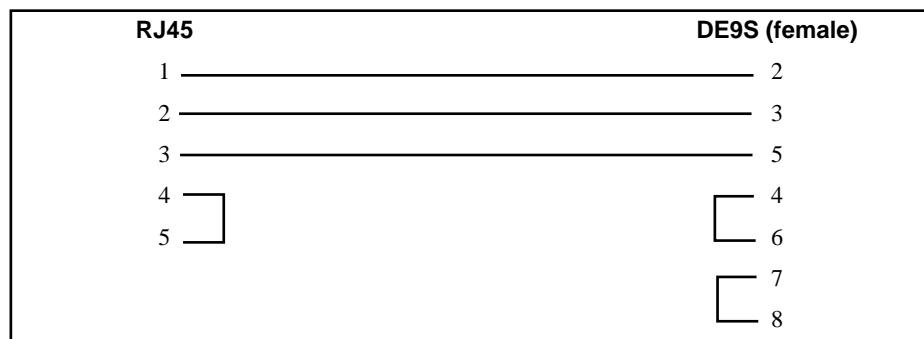


Figure 2-2 MUCM to RS-232 PC DCE Port (9-pin) (MU1 Cable)

Loading the Application into the MUCM

QLOAD MRPC

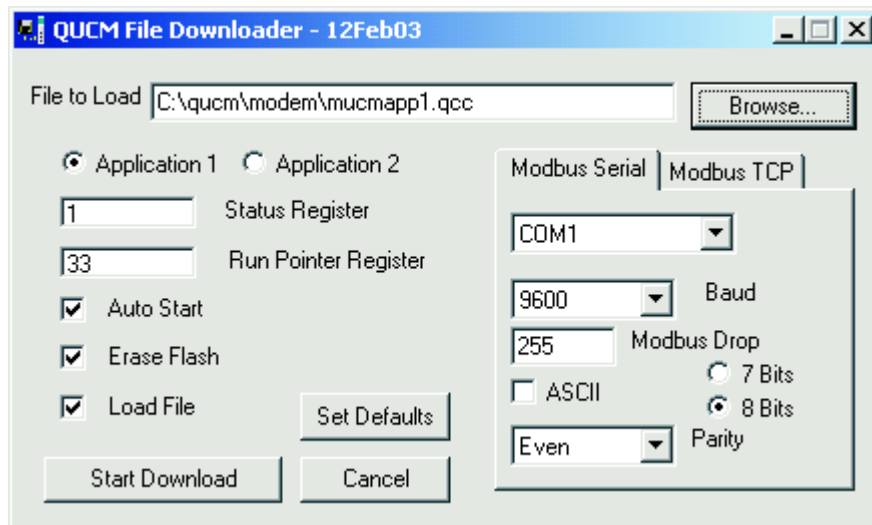


Figure 2-3 QLOAD of MRPC

- 1 Application 1 and 2 Switches must be in HALT.
- 2 Start QLOAD.EXE
- 3 Click on the Browse button and select the file MRPC.qcc.
- 4 Select the Application 1 Radio Button.
- 5 Verify the following:
 - a. Status Register = 1.
 - b. Run Pointer Register = 33.
 - c. Auto Start is checked.
 - d. Erase Flash is checked.
 - e. Load File is checked.
 - f. The Modbus Serial tab is selected.
 - (1) The COM port of the PC is selected in the pull-down.
 - (2) The baud rate is set to 9600.
 - (3) The Modbus Drop is set to 255
 - (4) The ASCII box is not checked.
 - (5) The 8 Bits button is checked.
 - (6) The Parity is set to EVEN.
- 6 Connect the PC to MUCM Port 1 with a MU1 cable..

- 7 Press the Start Download button. QLOAD will open a progress window to show the status of the download.

After downloading the application, move the Application Switch 1 to RUN. The RN1 light should be on. If Autoscans are to be run, move the Application Switch 2 to RUN. The RN2 light will light.

Configuration

Each port of the MUCM 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 MEBSW32, which is provided with the module at no cost. MEBSW32 must be used through a module data port configured as SY/MAX or Net-to-Net, or Gateway. The computer running MEBSW32 can be connected directly to the module, through a SY/NET network, or through an Ethernet network.

The configuration and mailbox registers are maintained in nonvolatile memory. This memory is powered 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 (Modbus) 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:
 - **Data Port Drop Number** - The Data Port Drop Number must fall within the range of 000 through 199. This number must only be unique within a particular MUCM. It is permissible to have other MUCM units on the same network with similar Data Port Drop Numbers.

The factory default Data Port Drop Numbers for Ports 1 and 2 of the MUCM 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.
- **Protocol Mode** - The Protocol setting controls the operation of both Data Ports.
 - Possible values are SY/MAX, Net-to-Net, Peripheral, Transparent, Share, PLogic, Idec, Gateway, Multidrop, Modbus Host, PNIM, RNIM Master, RNIM Slave, Modbus Gate, Transfer, Chevron, Modbus ASCII, and DUAL SLAVE. 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 MUCM 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 MUCM 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 MUCM 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 MUCM 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 MUCM 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 MUCM 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 a MUCM is connected to port 101, the drop of port 0 of the MUCM 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 MUCM's local registers could be 000,101,1. Any drop on SY/NET could also reach the MUCM with a route of 201,101,1 where 201 is the don't care originating drop.

MUCM mailbox registers

The first 64 mailbox registers within an MUCM may be rack addressed by the PLC and used as PLC inputs or PLC outputs. The first 32 registers appear as 3x registers, and 33 through 64 appear as 4x registers. Data written to the output registers by the PLC appears in the associated mailbox register and may be read by an external device through a port of the MUCM.

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 64. Registers 1 through 32 are inputs to the PLC, and 33 through 64 are output from the PLC.

RTS/CTS Handshaking

CTS Operation

In all modes, the CTS input of MUCM port one is available to restrain the MUCM transmitter. If these pins are driven with active polarity (CTS+ more positive than CTS-), the port will transmit any time it has a message to send. If CTS is left open or 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 MUCM while the peripheral catches up. CTS restraint cannot be held indefinitely with incoming data as the MUCM has finite internal buffer capacity.

In Multidrop, Peripheral, Share, Modbus, and RNIM modes, there is an 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.

RTS Operation

The operation of RTS 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 MUCM and inform it that the MUCM's internal buffers are filling faster than the received messages can be processed or retransmitted. In these port modes, RTS is normally active unless the MUCM wishes the attached device to stop sending to it in which it will go inactive until the MUCM can catch up.

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

MNIM Compatibility

The SY/MAX, Net-to-Net, and PLOGIC modes have the ability to adjust the number of PAD characters to define the amount of time that the MUCM 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

The SY/MAX serial port channel delay statistics are 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 MEBSW32 while viewing the second Statistics page on a serial port will automatically update the PAD count for the monitored channel.

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, MEBs, QUCMs and MUCMs. 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)

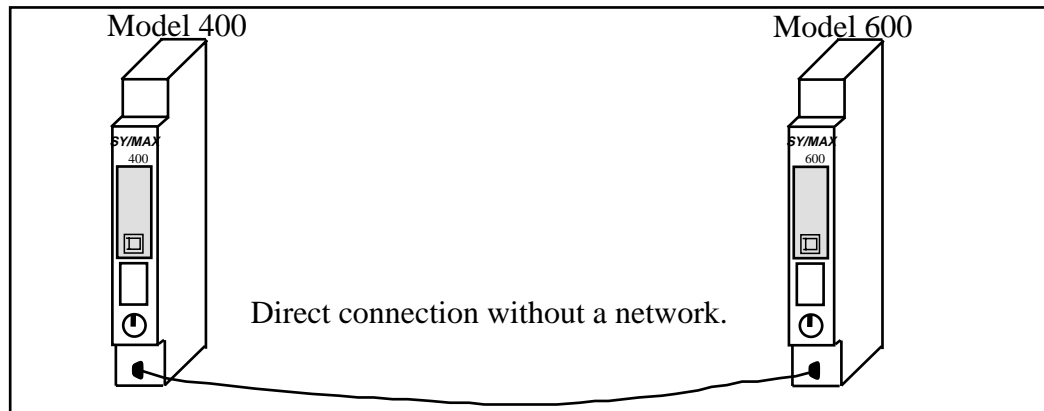


Figure 4-1 Direct connection without route

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.

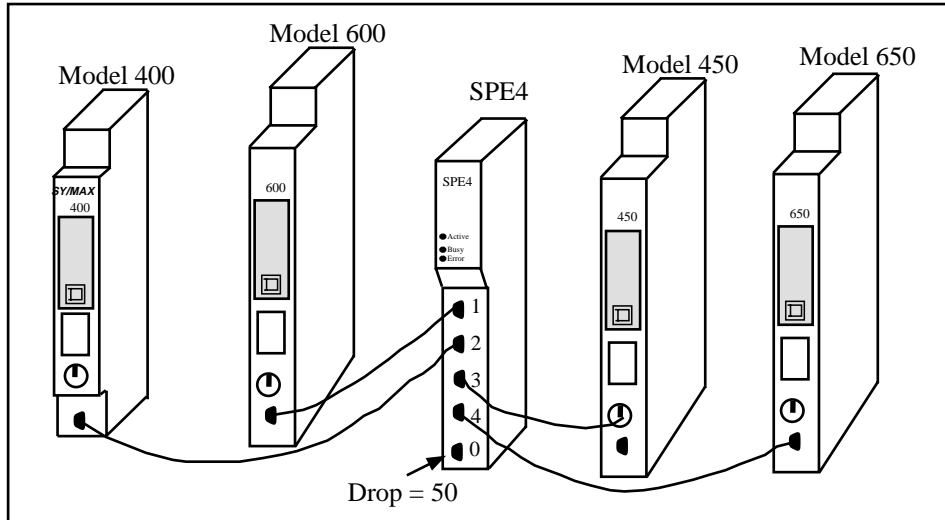


Figure 4-2 Single Network Example

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.

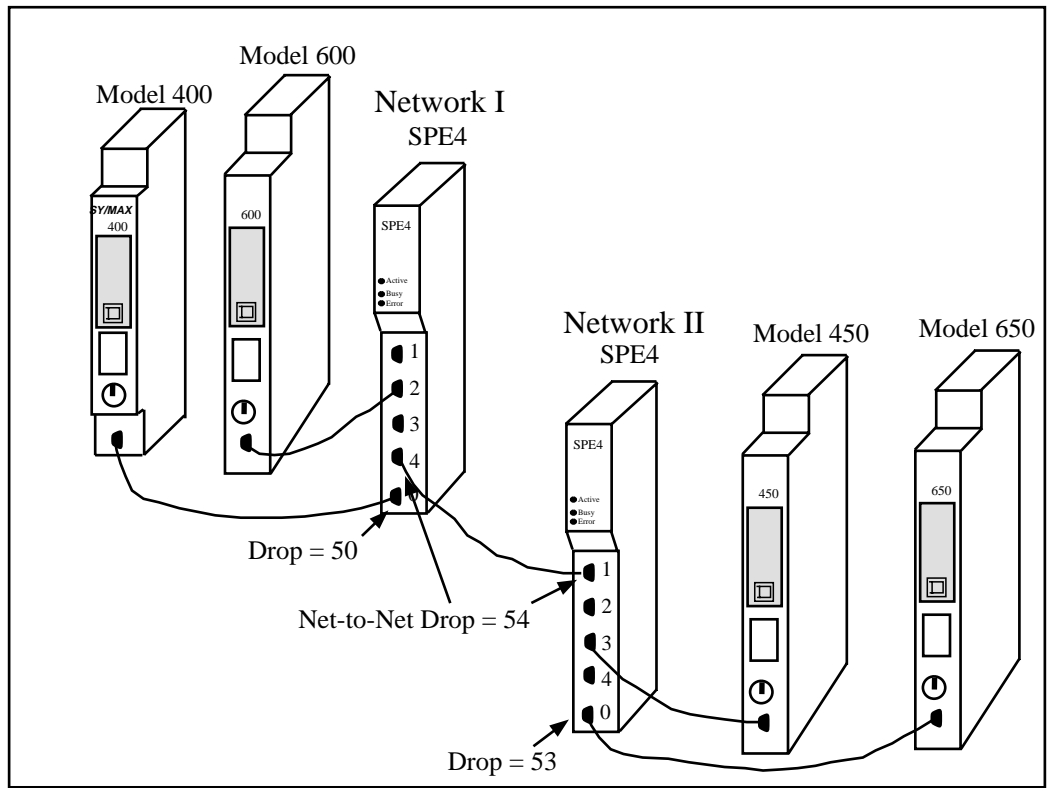


Figure 4-3 Multiple Network Example

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.

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.

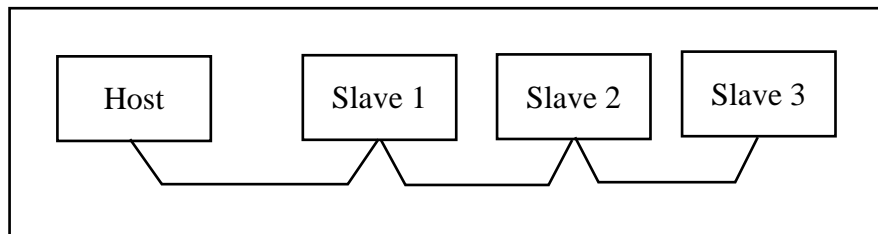


Figure 4-4 Modbus Network Example

Table 4-4 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.

Peripheral Mode

Mode 3: Peripheral

An MUCM 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.

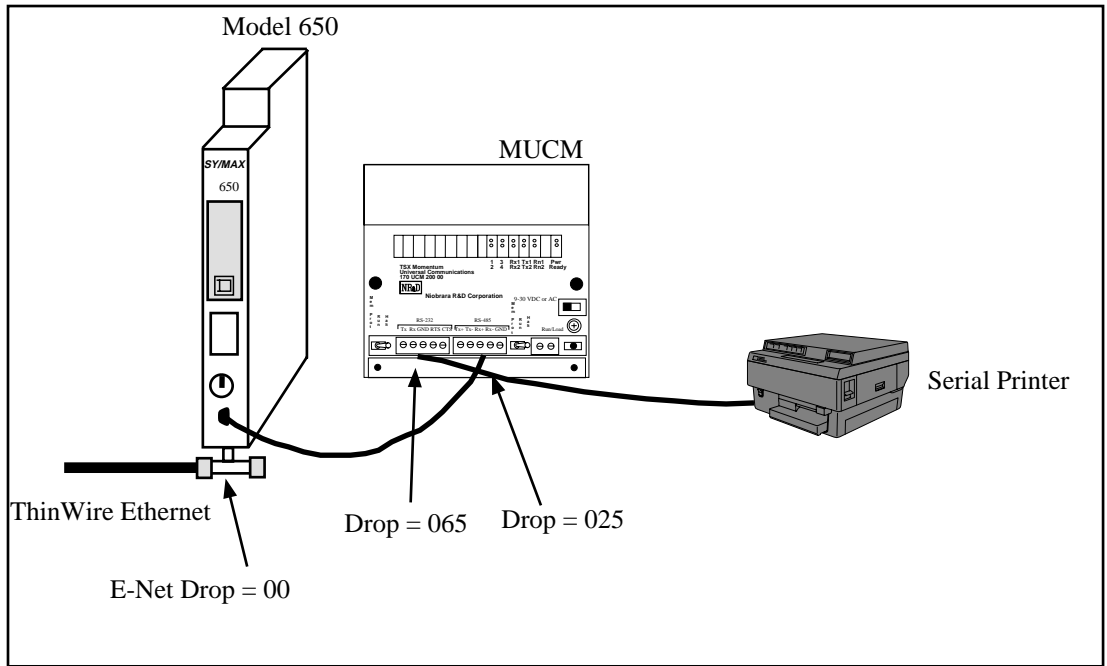


Figure 5-1 Peripheral mode example

Peripheral Mode Example

Table 5-1 Peripheral Routing Examples

Origin	Target	Route
Model 650	Printer	025, 065

Table 5-2 MUCM Setup for Peripheral Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
1	65	Peripheral	9600	N	7	1	Pt to Pt
2	25	SY/MAX	9600	E	8	1	Pt to Pt

Transparent and Share Modes

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 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.
- 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

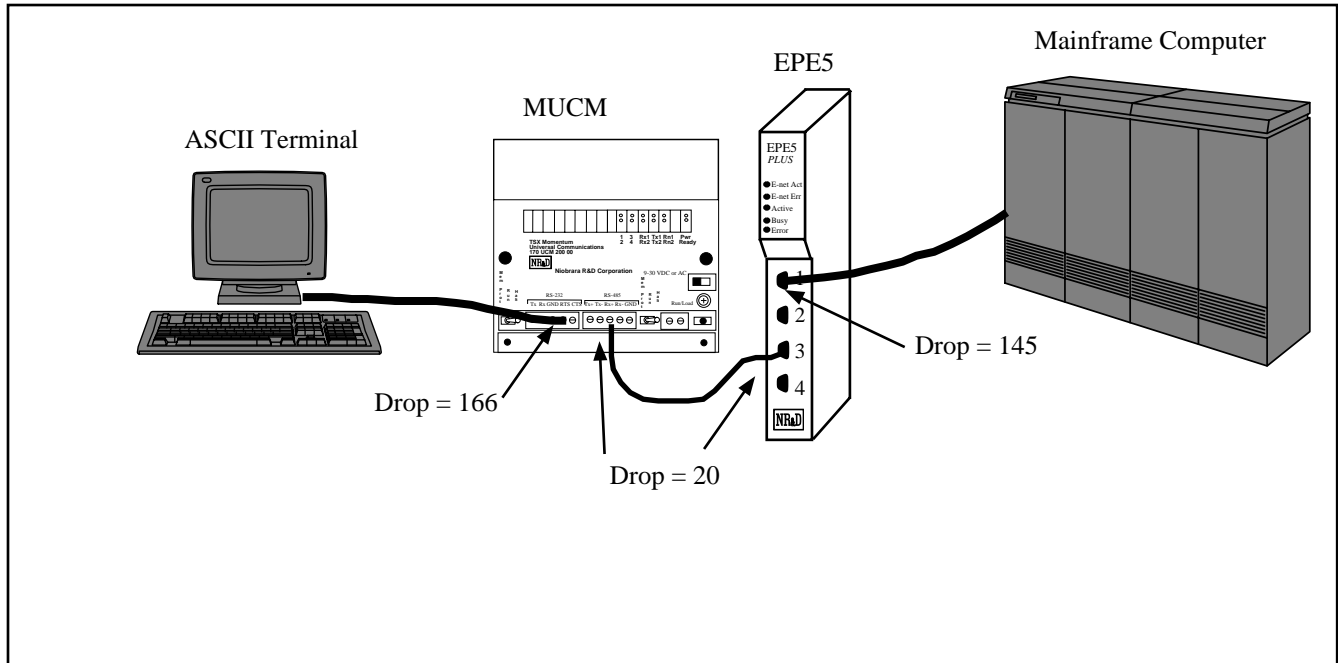


Figure 6-1 Transparent Mode Example

Table 6-1 Transparent Routing Examples

Origin	Target	Route
ASCII Terminal	Mainframe	166, 20, 145
Mainframe	ASCII Terminal	145, 20, 166

Table 6-2 MUCM Setup for TRANSPARENT Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	166	Peripheral	19200	N	7	1
2	20	Net-to-Net	19200	E	8	1

Table 6-3 EPE5 Setup for TRANSPARENT Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
2	145	Peripheral	19200	N	7	1
3	20	Net-to-Net	19200	E	8	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 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.

PLogic and PNIM Modes

Mode 6: PowerLogic

The MUCM can be used to route SY/MAX read and write messages originated by a PLC, computer, or MUCM Gateway port to a PowerLogic network of one or more PowerLogic modules. The MUCM 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.

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 MUCM 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 that the PNIM mode be used when connecting to PowerLogic Circuit monitors. The PNIM mode will return an error 17 if the slave does not respond while the PLOGIC mode simply times out.

The route used should be the route from the accessor to the MUCM port connected to the PowerLogic bus with an additional drop corresponding to the PowerLogic drop number set in the PowerLogic unit's rotary address switches. 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-485 port of the MUCM. The MUCM 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 MUCM. But the network terminator should always be used. See the recommended cabling section at the end of this manual.

PowerLogic Mode Example

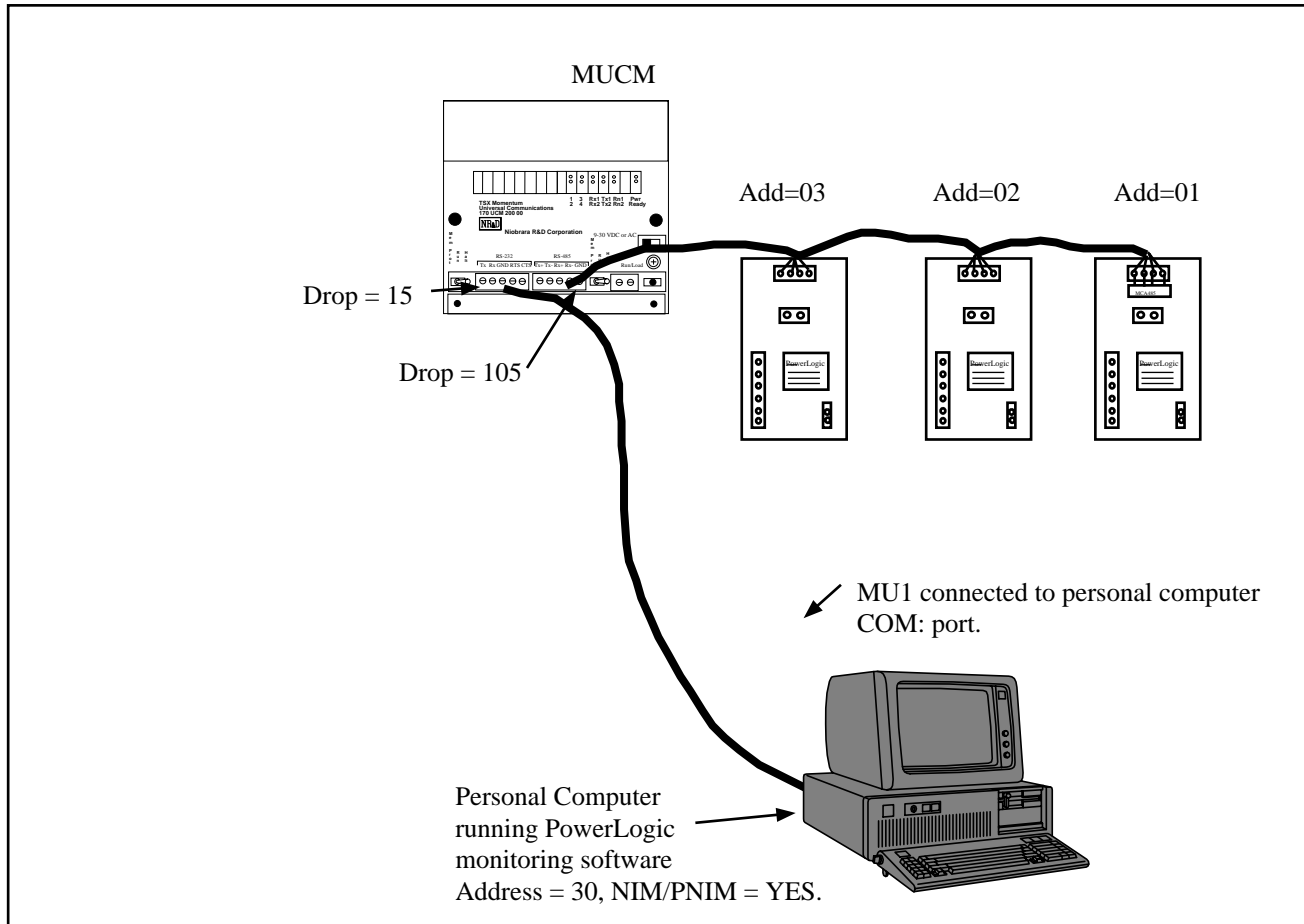


Figure 7-1 PowerLogic Example

Table 7-1 PowerLogic Routing Examples

Origin	Target	Route
Personal Computer	CM 1	30, 15, 105, 001
Personal Computer	CM 2	30, 15, 105, 002

Table 7-2 EPE5 Setup for PowerLogic Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	015	SY/MAX	9600	E	8	1
2	105	PLOGIC	9600	E	8	1

The PowerLogic units are set up as 4-wire. The Personal Computer has an address of 30 and NIM/PNIM is set to YES.

Mode 11: PNIM

The MUCM can be used to route SY/MAX read and write messages originated by a PLC, computer, or MUCM Gateway port 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 MUCM 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 MUCM 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 EPE5 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 MUCM. The MUCM 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 MUCM. But the network terminator should always be used. See the recommended cabling section at the end of this manual.

PNIM Mode Example

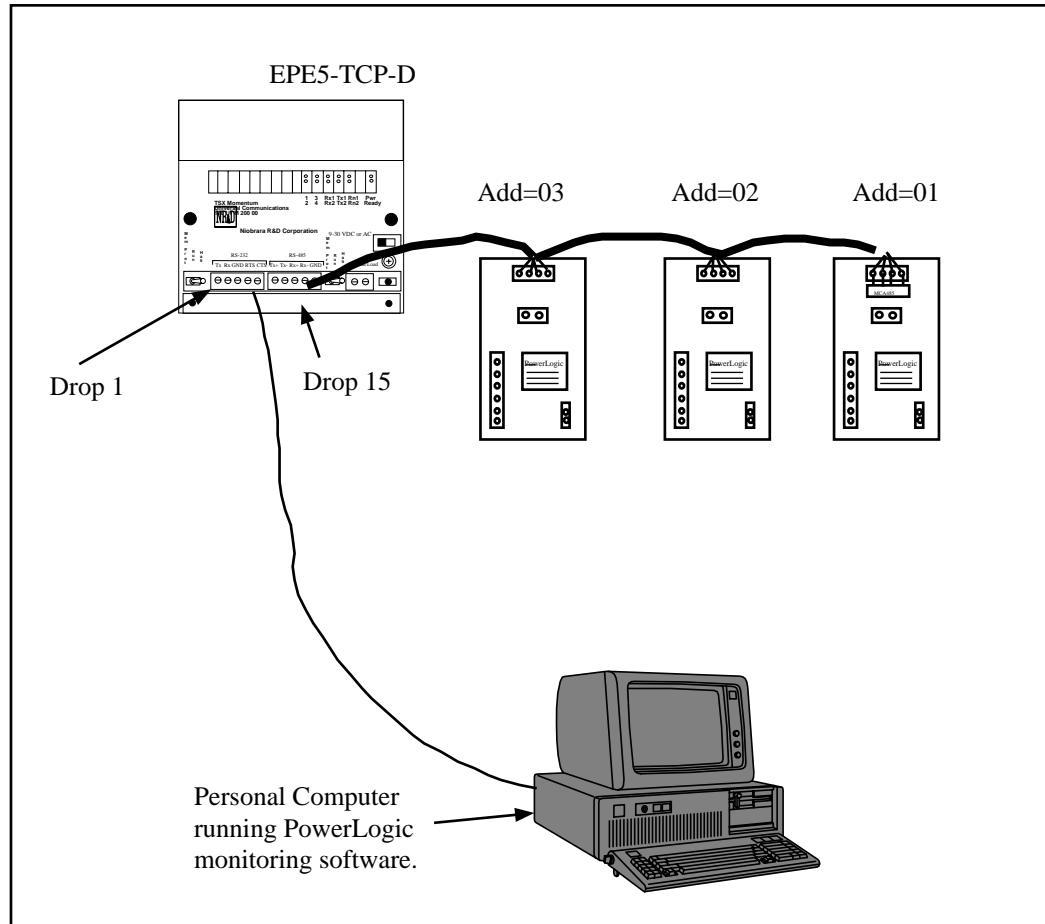


Figure 7-2 PNIM Modbus/TCP Example

Table 7-3 SMS3000 Device Setup

Device	Route
CM 1	030,001,015,001
CM 2	030,001,015,002
CM 3	030,001,015,003

Table 7-4 MUCM Setup for PNIM Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	1	SY/MAX	9600	E	8	1
2	15	PNIM	9600	E	8	1

Mode 7: IDEC

Micro-1 and Model 50 Interfacing

The MUCM 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 MUCM 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 MUCM port and one additional drop corresponding to the drop number of the Micro-1 or Model 50 processor within the ring network. The MUCM 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 connected to an MUCM port with a Niobrara ID422 or MD422 cable respectively. To connect a network ring of multiple units, use the RIU-10 or RIU-20 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 MUCM 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 8-1 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 MUCM 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 8-2 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

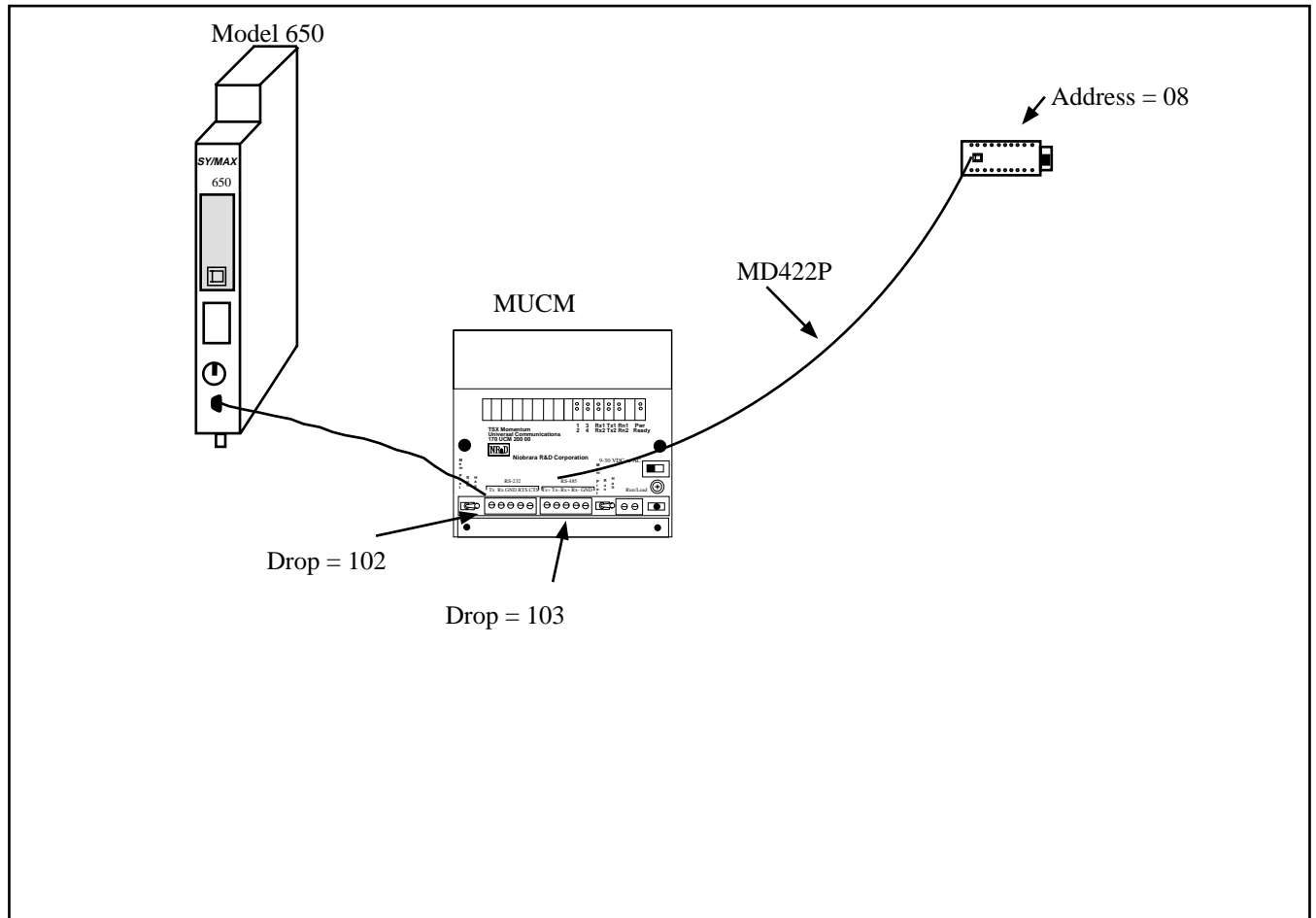


Figure 8-1 IDEC Mode Example

Table 8-3 IDEC Routing Examples

Origin	Target	Route
Model 650	Micro-1 on Port 2	102, 103, 008

Table 8-4 MUCM Setup for IDEC Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	102	SY/MAX	9600	E	8	1
2	103	IDEC	9600	E	8	1

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 MUCM 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 MUCM 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 MUCM or to a NIM connected to the Gateway MUCM through SY/NET, the second drop will be that of the Net-to-Net 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 MUCM 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 MUCM 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 MUCM 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

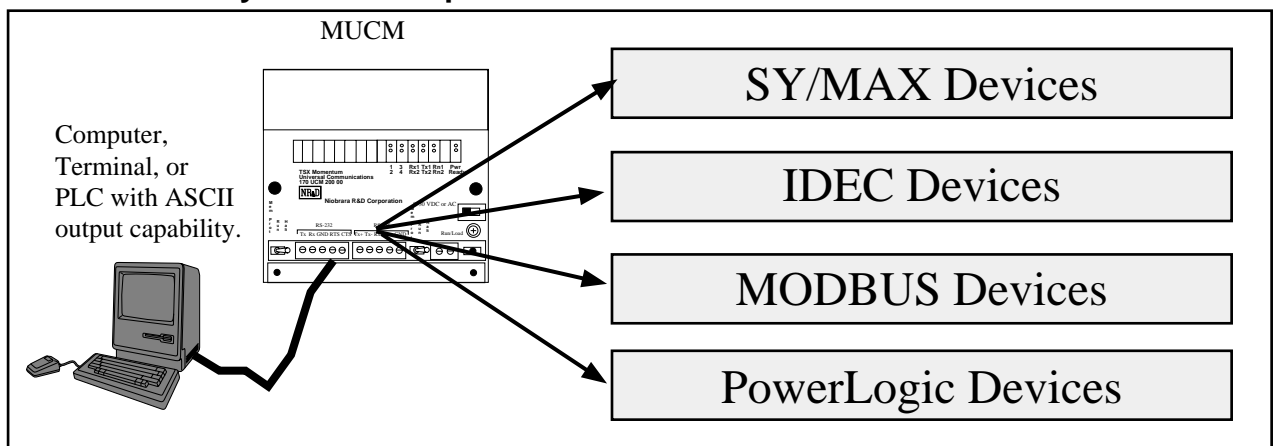


Figure 9-1 GATEWAY Example

The Gateway mode simplifies access to SY/MAX devices, such as PLCs, NR&D's various modules, the MUCM itself, and any other external mode of the MUCM (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 9-2 represents a view of the Terminal Emulator from EPE5SW connected to an MUCM Gateway port.

```
Type ctrl-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 9-2 Terminal Emulator connected to Gateway port

Table 9-1 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 MUCM'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	

Multidrop Mode

Mode 9: Multidrop

The MUCM multidrop port mode can be used to route packets between three or more MUCM/SPE4 modules over a single communication medium such as an RS-485 pair or multidrop modems or radios. In multidrop mode, the MUCM units on the line use a time division scheme to arbitrate access to the line. When an individual MUCM 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 MUCM port.

Multidrop Mode Example

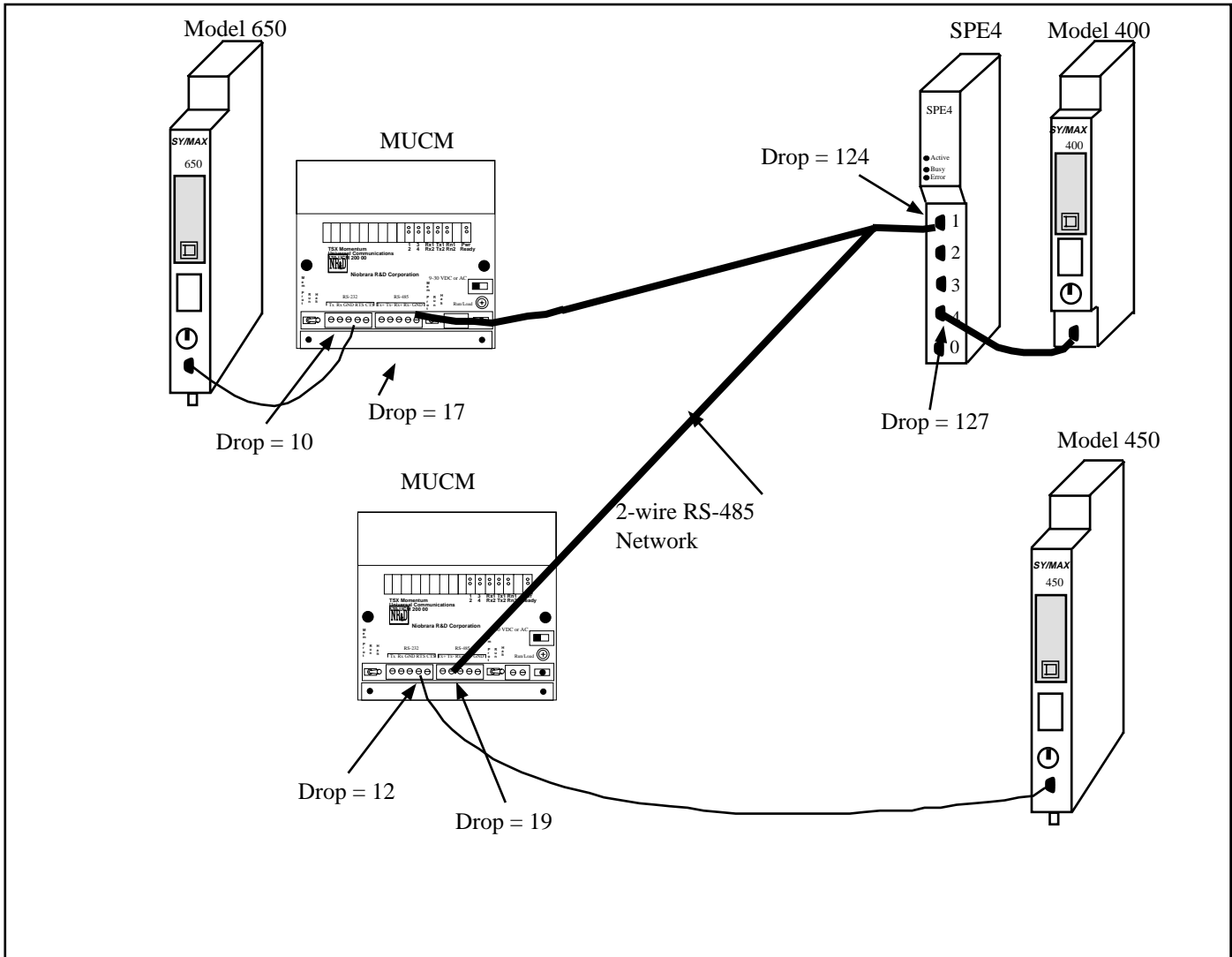


Figure 10-1 Multidrop Example

Multidrop mode is used to allow several MUCMs to communicate over a single medium such as a 2-wire RS-485 network. The MUCM units use a time division scheme to arbitrate access to the communication system that depends upon the number of nodes and the priority of its node. When ready to broadcast, the MUCM asserts RTS and waits for CTS from the modem before transmitting its packet. All other MUCMs monitor the incoming packets for their address and then route the packet accordingly.

Table 10-1 MULTIDROP Routing Examples

Origin	Target	Route
Model 650	Model 400	10, 17, 124, 127
Model 650	Model 450	10, 17, 19, 12
Model 400	Model 650	127, 124, 17, 10
Model 400	Model 450	127, 124, 19, 12
Model 450	Model 650	10, 17, 19, 12
Model 450	Model 400	12, 19, 124, 127

Table 10-2 MUCM (1) Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
1	10	SY/MAX	9600	Even	8	1	BCC	NA
1	17	MULTIDROP	19200	None	8	1	CRC	TWO WIRE

Table 10-3 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 10-4 MUCM (2) Setup for MULTIDROP Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Error Check	Driver Mode
1	12	SY/MAX	9600	Even	8	1	BCC	NA
2	19	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 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 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.

MODBUS Modes

The Modbus protocol is implemented in a wide variety of products including Modicon PLCs, temperature controllers, flowmeters, intelligent valve systems, etc. The MUCM 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 MUCM 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.

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 11-1.

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.

Table 11-1 MODBUS Function Code List

Function Code	Description	MODBUS Address Range	Notes
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	Write Single Register	4XXXXX	
15	Force Multiple Coils	0XXXXX	
16	Write Multiple Registers	4XXXXX	
22	Masked Write Register	4XXXXX	Not supported by all PLCs.
100	Random Read Holding Registers	4XXXXX	Used by Powerlogic, not supported in any PLCs.

SY/MAX Message Addressing

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

Table 11-2 SY/MAX Messages

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

The SY/MAX PLC processors will only generate the Priority messages for peer-to-peer communication. 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, MUCM) they are either reversibly translated or encapsulated and sent transparently. Translatable 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 <SY/MAX to Modbus Translations>.

Table 11-3 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)
Priority Write (0x1E)	Write Multiple Registers (16)
Non-Priority Write (0x02) with mask all ones.	Write Multiple Registers (16)
Non-Priority Write (0x02) with mask containing < 16 contiguous ones, count = 1.	Masked Write Register (22)

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.

Table 11-4 Modbus to SY/MAX Translations with type = "OTHER"

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)	Non-Priority Read (0x00) status field with Transnum 0x03
Read Input Registers (4)	Non-Priority Read (0x00) status field with Transnum 0x04
Force Single Coil (5)	Non-Priority Write (0x02) with Transnum 0x05 and single bit set in mask
Preset Single Register (6)	Non-Priority Write (0x02) status field with Transnum 0x06
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 0xfff) mask
Write Multiple Registers (16)	Non-Priority Write (0x02) with Status field with Transnum 0x10
Masked Write Register (22)	Non-Priority Write (0x02) with Transnum 0x10 and appropriate mask.
Random Read (100)	Non-Priority Random Read (0x04)

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.

If the target device type is set to "MODBUS" then only opcodes 03, 16, 22, and 100 are translated and all other opcodes will be encapsulated as above.

Master Operation

The Modbus Gate, Host, and ASCII modes may be used to connect Modbus slaves and networks of slaves to SY/NET. The Modbus Gate and ASCII modes use the translations in Table <SY/MAX to Modbus Translations> 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 MUCM 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 EPE5 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 MUCM. 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 EPE5. 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 11-5 displays the SY/MAX register to Modicon Register relationship for the MUCM Modbus Host Master translation.

Table 11-5 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 MUCM 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:

$$\text{Coil Start Address} = (((\text{SY/MAX REMOTE address}) + (\text{Register Bias}) - 1) * 16) + 1$$

The start address refers to the address of bit 1 of the SY/MAX register. Table 11-6 displays the SY/MAX bit relationship to the Modbus coils for the MUCM Modbus Master.

Table 11-6 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 MUCM port and a valid reply is not received from the Modbus device, the MUCM will wait for the amount of time specified in the MODBUS RETRY timeout register for that port. The MUCM will then rebroadcast the message and wait for a valid reply. The MUCM 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

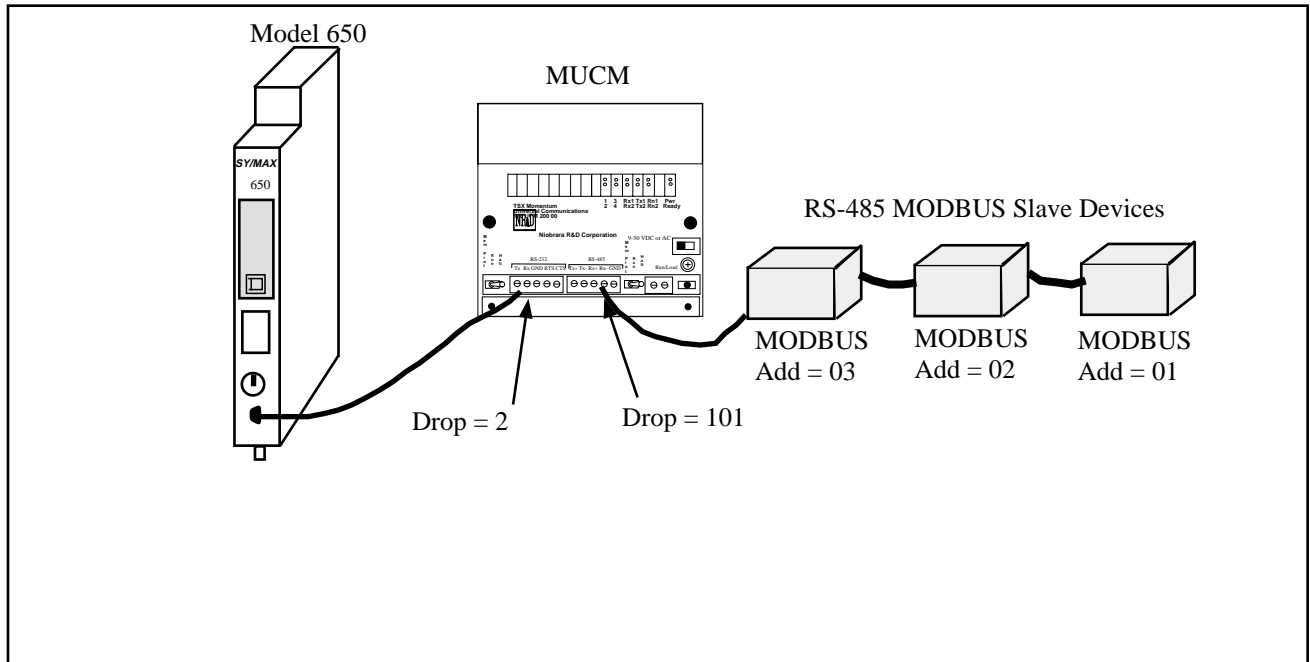


Figure 11-1 MODBUS Master Mode Example

Table 11-7 Modbus Routing Examples

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

Table 11-8 MUCM Setup for Modbus Master Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
1	02	SY/MAX	9600	E	8	1	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 MUCM RS-485 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 MUCM Modbus Slave operation allows a Modbus Master to read and write data into SY/MAX devices via SY/NET. The MUCM 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 MUCM port. Each MUCM RS-485 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.

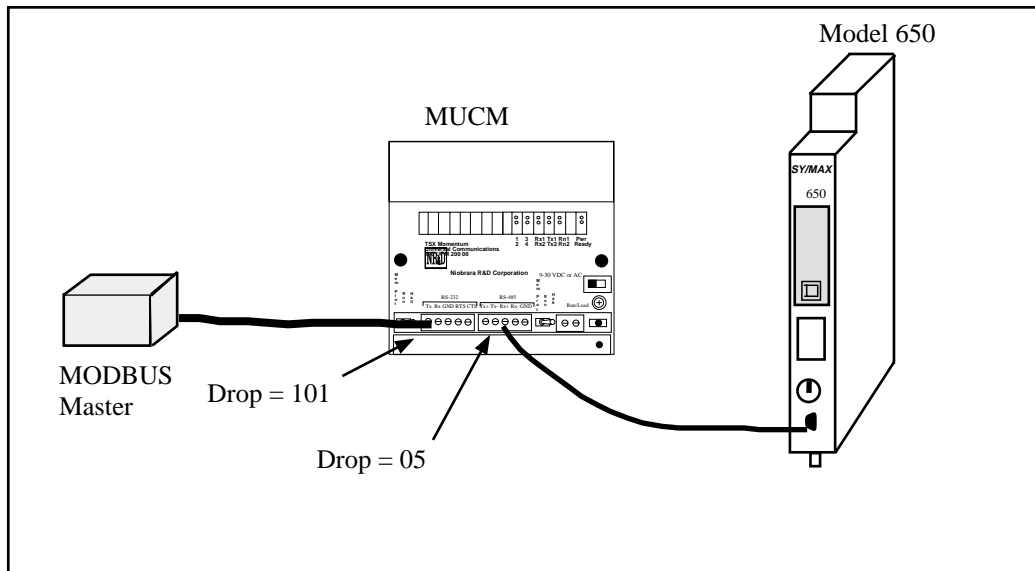


Figure 11-2 OTHER Modbus Slave Example

Table 11-9 Modbus Slave Example Setup

Origin	Target	Modbus Address	SY/MAX Route in the Modbus Address Table
Modbus Master	Model 650	1	101, 005
Modbus Master	MUCM Mailbox	3	101, 204

Table 11-10 Modbus Example Configuration

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

Since the incoming Modbus message is translated to SY/MAX, it is possible to have any 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.

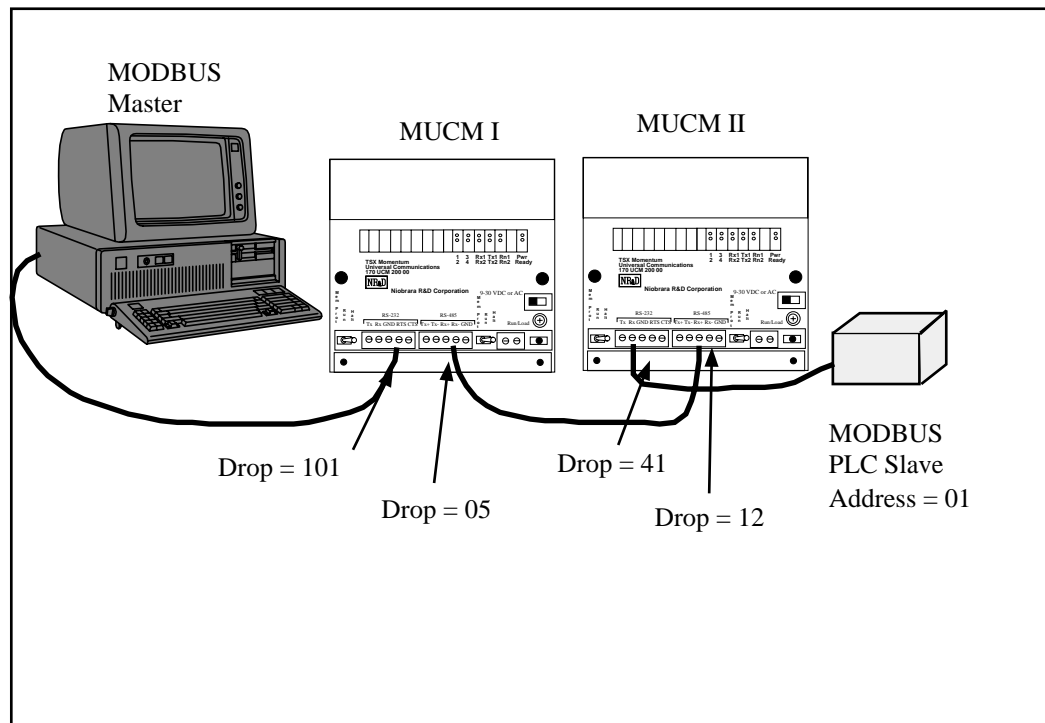


Figure 11-3 Modbus through SY/MAX Example

Table 11-11 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 11-12 MUCM I configuration

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

Table 11-13 MUCM II configuration

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop	Driver Mode
1	41	Modbus Gate	9600	E	8	1	Pt to Pt
2	12	SY/MAX	9600	E	8	1	NA

Figure 11-4 displays a Modbus Routing table for the previous application from the Edit Modbus Routing screen of EPE5SW.

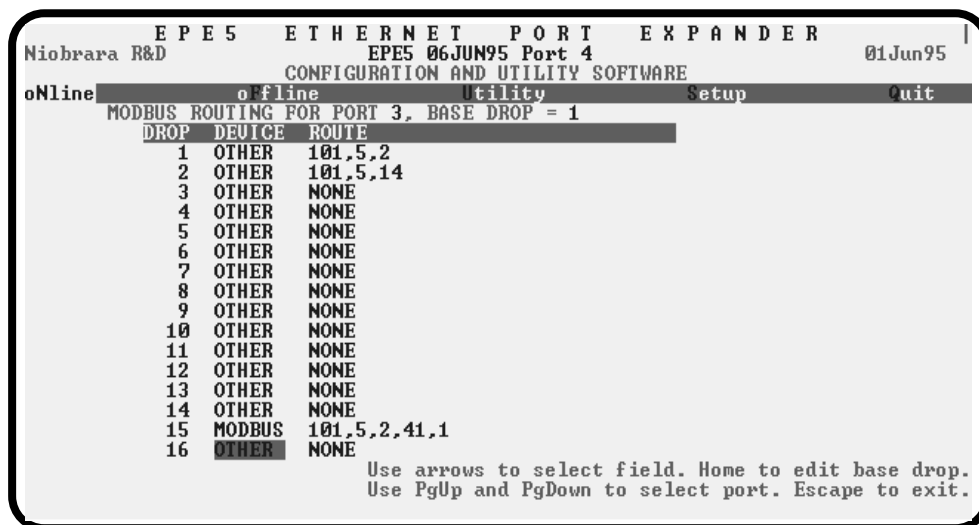


Figure 11-4 EPE5SW Modbus Routing Editing Screen

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 11-14 displays the currently used PLC IDs from Modicon.

Table 11-14 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. Niobrara and Square D have collaborated to develop a random read for the Modbus protocol. At the time of this writing only Niobrara and PowerLogic devices support opcode 100; Modicon PLCs do not. Because of this incompatibility, the Modbus Host mode must be used to connect most 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 translation translates SY/MAX Random Access Reads into Modbus Random Reads for shipment across the Modbus media and hence require another Modbus Gate translation to restore the SY/MAX read. This technique allows the full use of the Random Read with SY/MAX and PowerLogic equipment.

RNIM Mode

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 recommended that the MULTIDROP Mode be used rather than RNIM. (See page 49.) 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, MUCMs, 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 12-1, the Master RNIM is the CRM-560 and the SPE4 and MUCM 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.

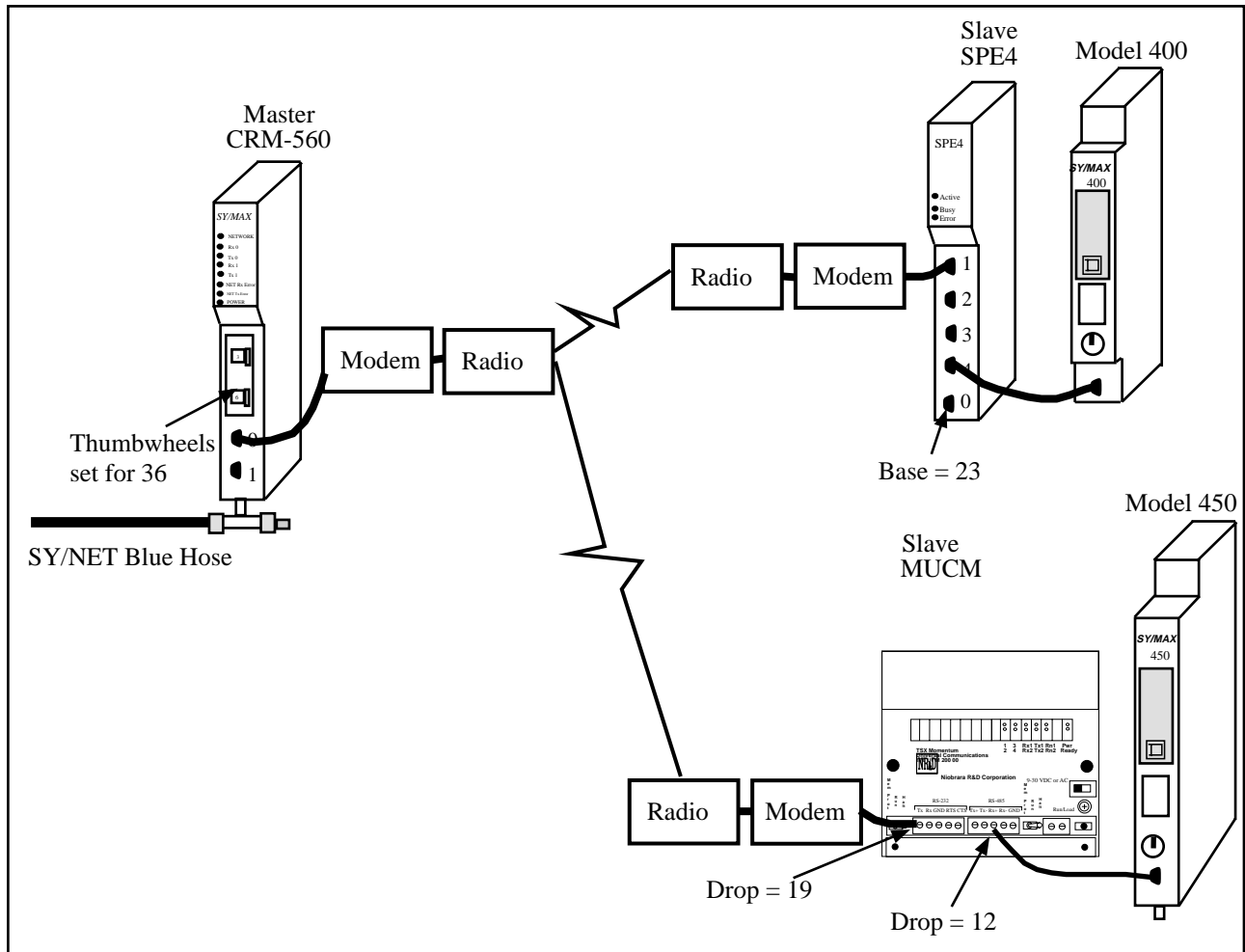


Figure 12-1 NORMAL RNIM Example

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 MUCM 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 MUCM RNIM Slave does not include this restriction. The MUCM will respond to any BID if it has a message in its Command buffer.

NOTE: The MUCM 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 SPE4 or MUCM, 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 (MUCM 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, ...

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.

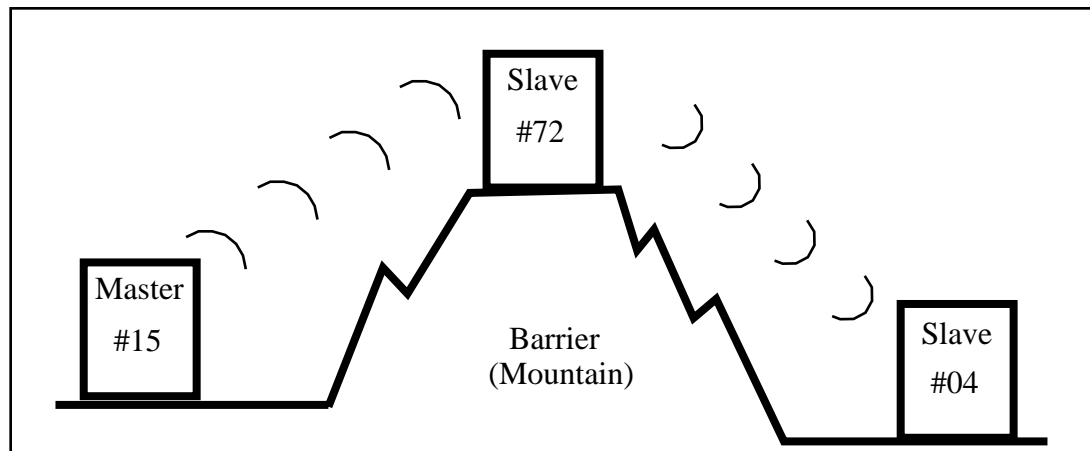


Figure 12-2 RNIM Repeater Example

Figure 12-2 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 MUCM, the Broadcast Operation implementation varies. The MUCM RNIM Slave will respond equally to either the even or odd Broadcast message that correspond to Table 12-1 and this response will be acting upon the internal registers within the MUCM.

Table 12-1 Broadcast Route Values

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

If it is desired to route a broadcast message to all MUCM RNIM Slaves with Drop numbers in the fifties and send a broadcast message out all of the other SY/MAX mode ports on the MUCM, 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 MUCM are adjustable. Table 12-2 displays the control registers in the MUCM and the equivalent registers in the Square D CRM-560. The MUCM 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 MUCM.

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 12-2 RNIM Master Register Summary

CRM-560 Register	SPE4/MUCM Register				Description	Notes
	Port 1	Port 2	Port 3	Port 4		
18	8041	8073	8105	8137	Identification number.	Must be the same for all RNIMs on the same network. CRM-560 defaults to 0 on power-up.
19	8042	8074	8106	8138	Clear to Send (CTS) Delay (10mS units)	CRM-560 defaults to 500mS on power-up.
20	8043	8075	8107	8139	Message Response timeout (10mS units)	CRM-650 defaults to 20 seconds on power-up. The MUCM also uses this value as the BID timeout.
21	8044	8076	8108	8140	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	8109	8141	Number of Retries (when no ACK received)	CRM-560 defaults to 3 on power-up.
23	8062	8094	8126	8158	Master Disable	Set bit 9 in the SPE4/MUCM options register to disable the Master. Set the CRM-560 register to decimal 123 to disable the Master.
25	8058	8090	8123	8155	Pause Time (10mS units)	CRM-560 defaults to 15 seconds on power-up.
26	8059	8091	8124	8156	Message Count (between Pause Time)	CRM-560 defaults to 4 on power-up.
NA	8060	8092	8125	8157	BID Reply Interval	This value determines the amount of time between successive automatic BIDs.
NA	2103	2135	2167	2199	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 MUCM are adjustable. Table 12-3 displays the control registers in the MUCM and the equivalent registers in the Square D CRM-560. The MUCM 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 MUCM.

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 12-3 RNIM Slave Register Summary

CRM-560 Register	SPE4/MUCM Register				Description	Notes
	Port 1	Port 2	Port 3	Port 4		
18	8041	8073	8105	8137	Identification number.	Must be the same for all RNIMs on the same network. CRM-560 defaults to 0 on power-up.
19	8042	8074	8106	8138	Clear to Send (CTS) Delay (10mS units)	CRM-560 defaults to 500mS on power-up.
20	8043	8075	8107	8139	Message Response timeout (10mS units)	CRM-650 defaults to 20 seconds on power-up. The EPE5 also uses this value for the BID timeout.
24	8062	8094	8126	8158	Clear Command Buffer	Set bit 9 in the SPE4/MUCM 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	2167	2199	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 port 2 offers 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 the RS-232 port. In Pt to Pt mode, the RS-485 transmit driver is 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 port 2 offers 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 port 2 offers 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 MUCM 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 MUCM will wait for the attached device to assert CTS. This true handshaking feature of the MUCM 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 MUCM handshake sequence is as follows:

- 1 The MUCM asserts the Request to Send (RTS) signal when it has data to send.
- 2 The MUCM 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 MUCM will just wait for CTS to be asserted.

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 (RS-485, modem, or radio) network. Incoming messages with the drop number following the Chevron Port's drop number within the range of 0 through 99 are sent out as RNIM packets. Messages with the following drop in the range of 100 through 199 are sent out as Modbus RTU packets where the Modbus slave address is the drop number minus 100.

All SY/MAX messages are supported through the RNIM message 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-560 RNIMs, SPE4s, EPE5s, MUCMs, and MEBs. Any Modbus RTU slave device with active RTS/CTS handshaking (or multidrop RS-485 ports) may also be used in a Chevron network as a Slave.

NOTE: The POWERLOGIC PNIM protocol supported by most POWERLOGIC equipment is a subset of the RNIM protocol and thus the CHEVRON mode may be used to integrate POWERLOGIC and MODBUS equipment on the same RS-485 network. Simply set the NETWORK ID to 0 and set the CTS DELAY to 0.

The following restrictions apply to the Chevron mode:

- All devices (RNIM and Modbus) must operate with the same 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 that 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 master only. The port will not accept messages as a Modbus Slave.
- 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. 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.

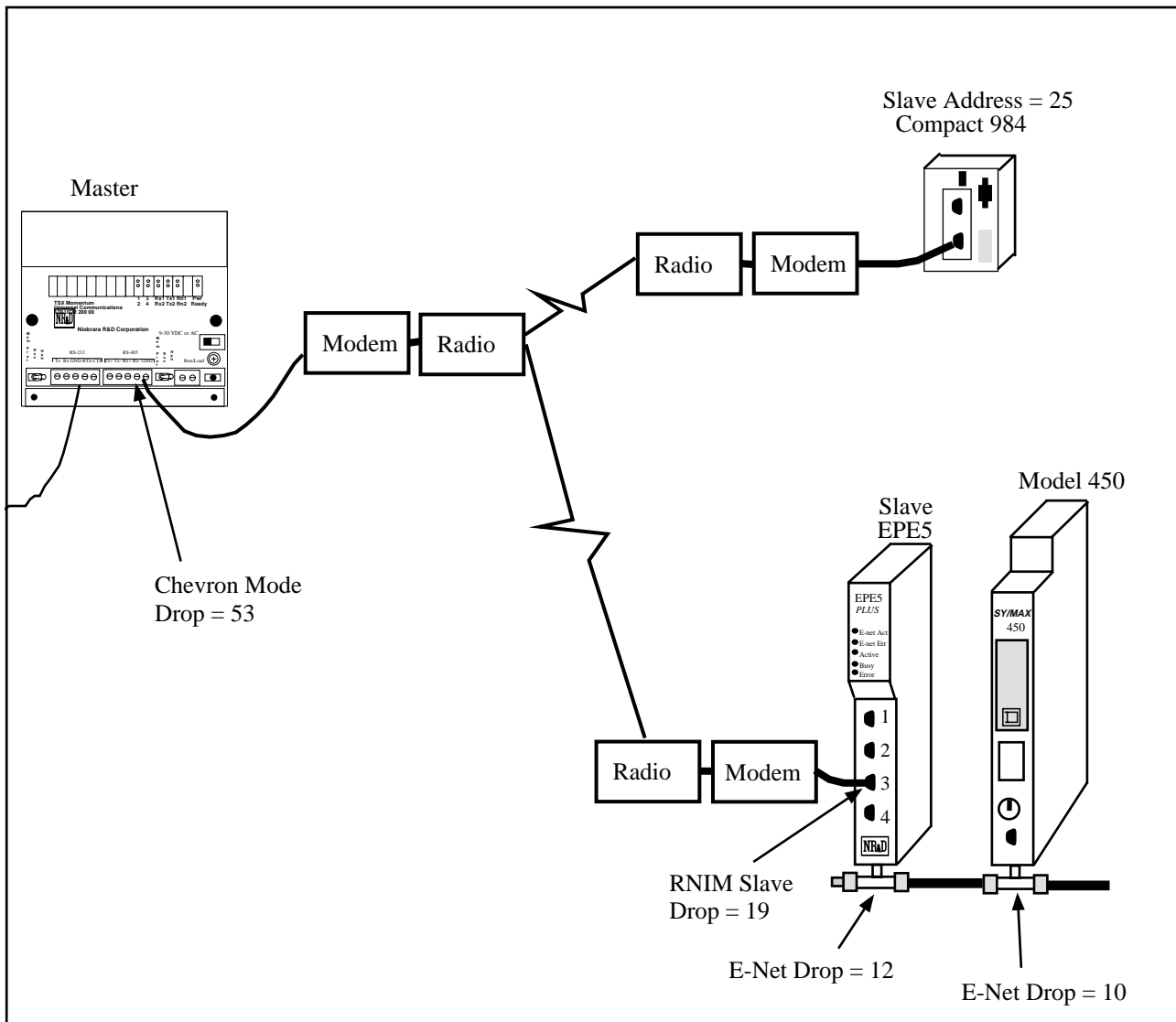


Figure 13-1 Chevron Radio Example

An example application of the Chevron mode is displayed in Figure 13-1. The Master MUCM on the left has Port 2 in Chevron mode with a drop number of 53. This port is connected via radio modems to an 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 an address of 25.

To route to the Model 450, the portion of the route from the Master MUCM would be:

..., 53, 19, 12, 10

while the route to the Compact 984 from the Master MUCM would be:

..., 53, 125

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

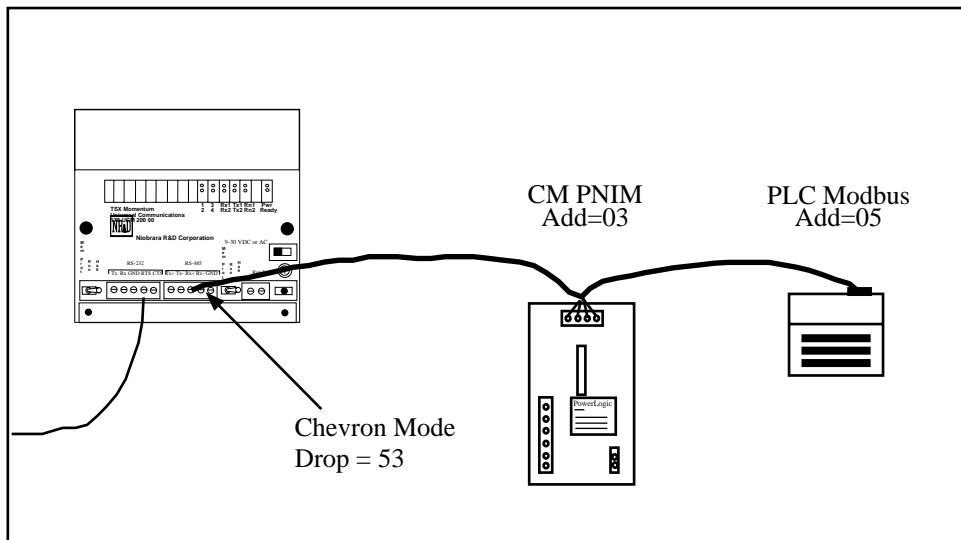


Figure 13-2 Chevron POWERLOGIC Example

An example application of the Chevron mode is displayed in Figure 13-2. The MUCM has Port 2 in Chevron mode with a drop number of 53. This port is wired with a 4-wire RS-485 cable to a POWERLOGIC Circuit Monitor and a Momentum PLC. The CM is configured for PNIM Address 03 while the PLC is at Modbus RTU Address 05. All three devices are configured for the same baud rate, parity, data bits, and stop bits (9600,EVEN,8,1). The PLC has its 9-pin port configured for RS-485.

The setup for the CHEVRON port is as follows:

Table 13-1 POWERLOGIC CHEVRON Example

Setting	Value
Drop	53
On Ethernet	NO
Protocol	CHEVRON
Baud Rate	9600
Parity	EVEN
Data Bits	8
Stop Bits	1
Buffer Limit	16
Driver Mode	PT TO PT
Network ID	0
CTS Timer	0
Reply Timeout	200
Bid Interval	0
Attempts	1
Pause Time	0
Message Count	0
Bid Address	0

To route to the CM, the portion of the route from the Master MUCM would be:
 ..., 53, 03

while the route to the Momentum PLC from the Master MUCM would be:
..., 53, 105

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

Dual Slave Mode

The Dual Slave mode is a combination of the Modbus Gate and SY/MAX modes to allow a single-threaded master connected to the port to use either Modbus RTU or SY/MAX to route through the port. This mode is most useful with POWERLOGIC's SMS's "SY/MAX to NIM/PNIM" serial driver since it will route messages targeted to both POWERLOGIC and MODBUS devices through a single communications port. This mode is also useful when a single connection from a computer is needed for running both SY/MAX and Modicon PLC programming softwares at different times.

There are a few limitations imposed by the Dual Mode:

- The device attached to the port must be the communication Master; it must initiate the communication.
- The connected Master must only issue one message at a time. SY/MAX messages will eventually return either a data reply or an error reply and the Master should wait for that reply. Modbus messages may or may not receive a reply and the Master should wait an appropriate amount of time before generating the next query.
- SY/MAX messages are routed just like a normal SY/MAX port. The first drop in the route should be either the drop number of Dual Mode port or the special "Don't Care" drop of 201. No route will result in local access of the Module.
- The Modbus Routing table is used for routing the Modbus messages just like in Modbus Gate mode. A drop number of 255 will always result in local access of the Module.
- Modbus Slave address 16 (decimal) and 254 (decimal) are not supported and should not be used in the Modbus Routing Table.

SMS Example

POWERLOGIC System Manager Software supports Modbus RTU devices as well as SY/MAX (POWERLOGIC Compatible) devices. When both Modbus and SY/MAX devices are configured within SMS to use the same serial communications port of the PC, SMS will send both the SY/MAX and Modbus messages out the serial port even if the port is configured only for SY/MAX mode. The Dual Mode now allows the MUCM to accept both types of messages on a single serial connection.

NOTE: The "Communications Wiring" setting within SMS must be set for "SyMax to NIM/PNIM" Do not choose "PowerLogic/Modbus/Jbus (4-Wire)" because the SY/MAX routing will not work.

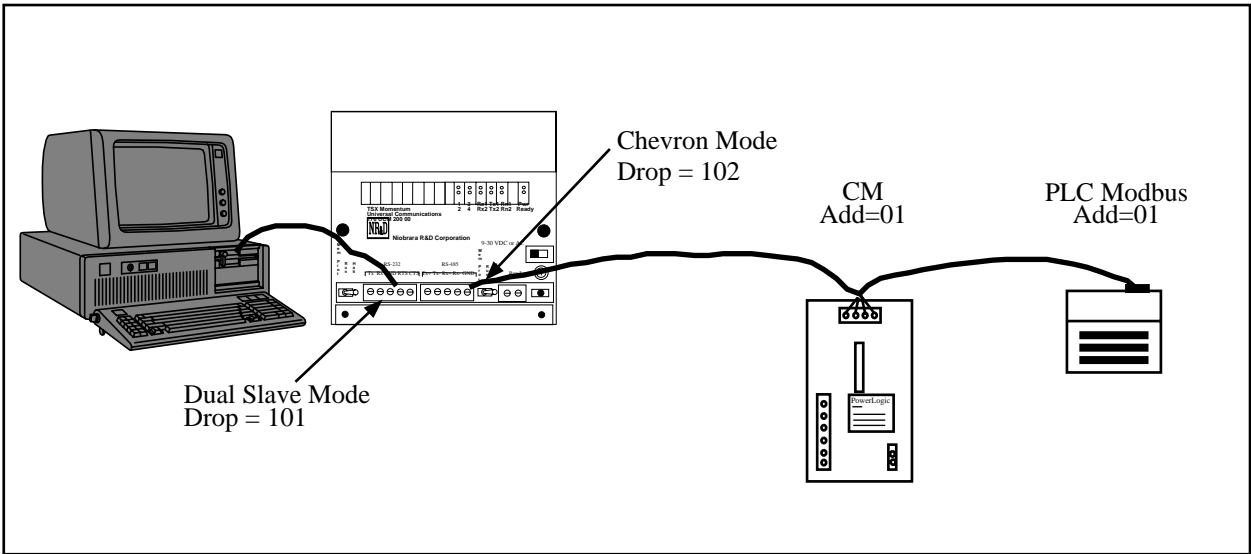


Figure 14-1 Dual Slave SMS Example

An example application of the Dual Slave mode is displayed in Figure 14-1. The MUCM has Port 1 in Dual Slave Mode with the SMS computer connected through an NR&D SC902 cable. Port 2 is in Chevron mode with a Circuit Monitor and a Momentum PLC.

Table 14-1 POWERLOGIC Example DUAL SLAVE Port

Setting	Value
Drop	101
On Ethernet	NO
Protocol	DUAL SLAVE
Baud Rate	9600
Parity	EVEN
Data Bits	8
Stop Blts	1
Buffer Limit	16

Table 14-2 POWERLOGIC Example DUAL SLAVE Port Modbus Routing

ADDR	DEVICE	ROUTE
1	MODBUS	101,102,101

Table 14-3 POWERLOGIC Example CHEVRON Port

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

Table 14-4 POWERLOGIC Example SMS Communications Connection - Serial

Setting	Value
Connection Name	Com1
Communications Wiring	SyMax to NIM/PNIM
Parity	Even
Using Modem	NO (Not Checked)
Serial Port	COM1
Baud Rate	9600
Attempts	2
Timeout	5000mS
Network Address	30

Table 14-5 POWERLOGIC Example SMS Setup Devices/Routing

Setting	CM 1 on Port 2	PLC 1 on Port 2
Device	CM_1	MOM_1
Connection Name	Com1	Com1
Protocol	PowerLogic	Modbus
Phone Number		
RT 1	30	30
RT 2t	101	1
RT 3	102	
RT 4	1	
RT 5		
Rt 6		
RT 7		
RT 8		

Auto-transfer and Auto-Scan

The MUCM 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 MUCM's internal mailbox registers. The WRITE messages move information from the MUCM'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, Modbus ASCII, PLOGIC, and PNIM. The use of Auto-transfer in Modbus modes implies that the MUCM port is the Master.

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 MUCM 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 MUCM'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 MUCM'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 MUCM'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 MUCM includes its own Auto-Scan table. The Auto-Scan feature is not available on the Ethernet 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 MUCM 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 MUCM'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 MUCM to the external device. The valid range of this parameter is 1 through 32, and 65 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 MUCM. The valid range of this parameter is 1 through 65535. 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 MUCM. 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 mes-

sage 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.

Auto-Scan Watchdog

The Auto-Scan feature includes a watchdog option that can turn off autoscan entries in specific ports when a user-specified timer expires. This option is only available in firmware revision 19JUN01, or later. Two registers control this option: 8189 and 8190. Register 8190 is the bitmask register. The first (least significant) five bits control each of the ports. Bit one (LSB) controls port 0, bit two controls port 1, etc. When any of these bits is set high, the corresponding port is affected by the watchdog timer. The timer register, 8189, can be set by any outside device. The decimal value written will indicate the time in 10 ms increments. The time will immediately begin to count down to 0, unless a new number is rewritten to the timer register. If the timer reaches 0, all autoscans on the specified ports will be discontinued, and the status bits, if any, will be set to zero. Since this option is designed to take effect in the event of a communications loss, the affected ports will also be shut down in the event of a power cycle. When the MUCM reboots, register 8189 will be reset to 0.

Auto-Scan Watchdog Example

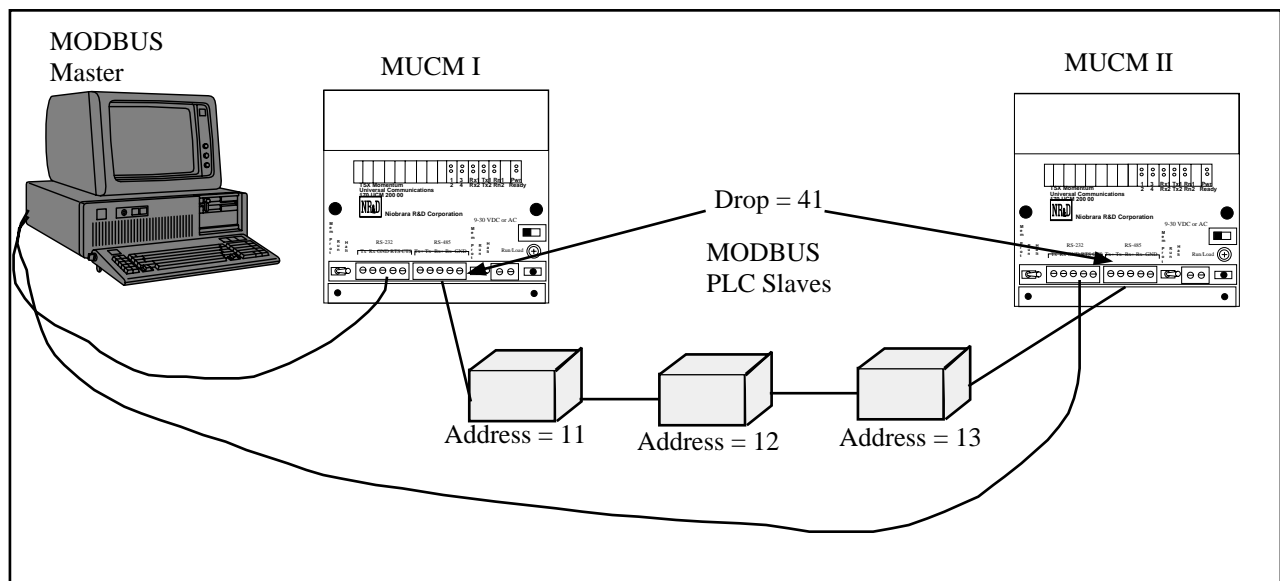


Figure 15-1 Auto-Scan Watchdog Example

In this example, an HMI package is monitoring registers that have been Auto-Scanned by MUCM I. The HMI is constantly writing a decimal value of 500 to register 8189. The HMI is also monitoring the status register for the Auto-Scans. If the value of the status register is ever zero, or if the HMI loses communication to MUCM I, the HMI must wait five seconds, then begin continuously writing decimal 500 to MUCM II. Waiting five seconds will allow the timer in MUCM I to run out, and there will be no conflicting queries on the serial line. As can be seen in the tables below, the Auto-Scan tables for both MUCM's are exactly the same, so only one should be Auto-Scanning at any given time.

Note: Since the Auto-Scan table uses the same routing registers as the Modbus Routing table, the programmer must be careful to select slave ID's that will be higher than the last entry in the Auto-scan table. Otherwise, the MUCM not Auto-Scanning would reply to the master's queries.

Table 15-1 Auto-Scan Entries for both MUCM's

Entry	Local	Remote	Count	Direction	Route
1	4	1	10	Read	41,11
2	14	1	10	Read	41,12
3	24	1	10	Read	41,13

MUCM 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.

Configuration Software MEBSW

MEBSW

The MEBSW and MEBSW32 software programs are provided free of charge to MUCM users. MEBSW is a 16-bit DOS application and may be run under MS-DOS or WIN3.x/95/98/NT/2000/ME/XP while MEBSW32 is a Windows 32-bit console application and may be run under WIN95/98/NT/2000/ME/XP only. They both look and act alike and may operate on the same MUCM setup files. The main difference between the two softwares are the support for connection type to the MUCM. These softwares are used to configure the operational parameters of the MUCM. They may be operated in either online or offline modes.

MEBSW may use the SY/MAX, Net-to-Net, Gateway, Modbus RTU, or Modbus ASCII serial protocols for the configuration of the MUCM; thus allowing remote service of the MUCM 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 when used under DOS or WIN95/98. SFI-510 and SFI-610 use is not supported under WIN/NT. Modbus and SY/MAX serial operation under WIN/NT may not be optimum and may result in timeouts and retries because of NT's control of the serial port for DOS applications.

MEBSW32 may also use the SY/MAX, Net-to-Net, Gateway, Modbus RTU, or Modbus ASCII serial protocols for the configuration of the MUCM. These serial drivers are written for Windows support and provide much improved operation in Win/NT over MEBSW. MEBSW32 may also use the TCP/IP stack native to WIN95/98/NT/2000/ME/XP for direct MODBUS/TCP connection to the MUCM. Support for the SY/LINK SFI-510 Network Interface Card and SFI-610 Ethernet Card is not 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 MUCM module and are effective immediately.

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

Because the MUCM 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 16-1 on page 88. 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.

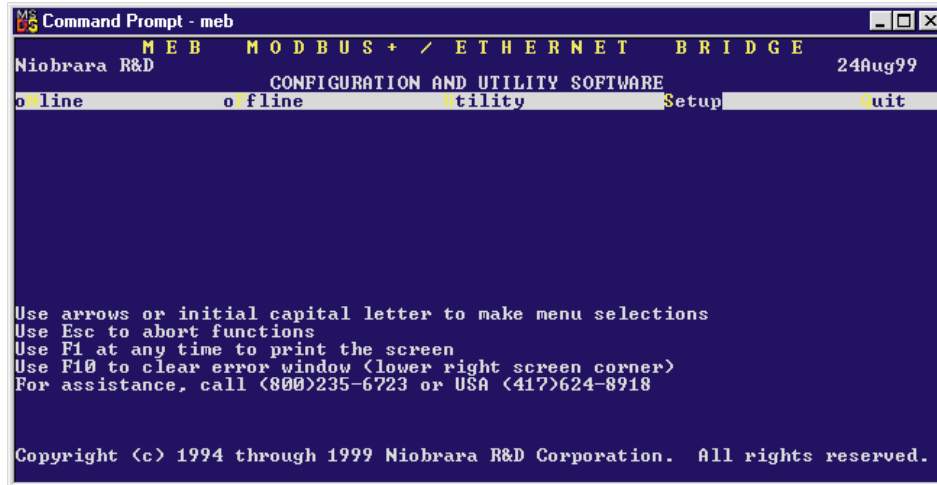


Figure 16-1 MEBSW Startup Screen

If offline mode is selected, a second menu appears as shown in Figure 16-2 on page 89. 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 MUCM 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 MUCM. 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 MUCM, not the offline copy. Likewise, changes made in offline mode have no effect on a connected MUCM until they are explicitly sent to it using the "Send memory to module" 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.

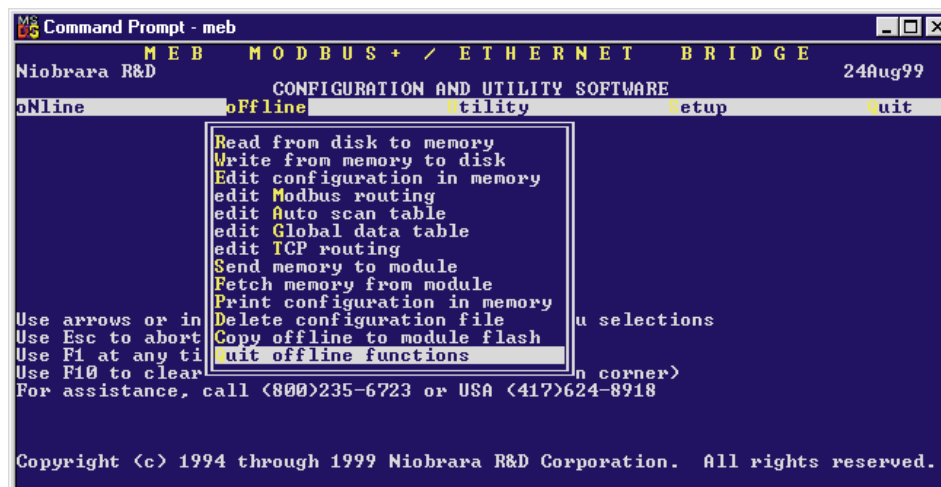


Figure 16-2 MEBSW oOffline Menu

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.

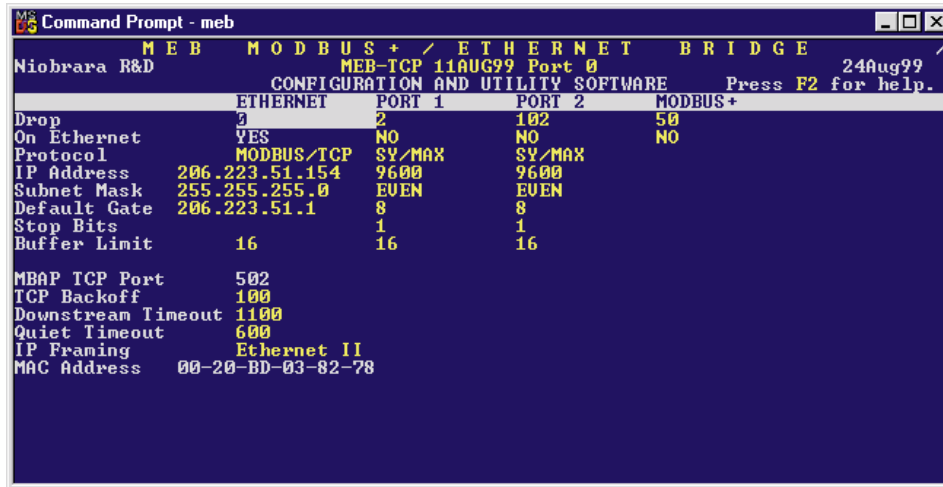


Figure 16-3 MEBSW oNline Edit Screen

The oNline Edit (and oFfline Edit) screen is presented as a matrix of parameters, see Figure 16-3. Each column represents one of the ports of the MUCM. 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) This value determines the route drop number of the port. All ports must have unique drop numbers within the module. The drop numbers for Ports 1 and 2 must fall within the range 000 through 199. The default drop number for Port 1 is 2, and Port 2 is 102.

On Ethernet

This feature not implemented with the MUCM.

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.

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

(Ports 1,2) 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. 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, Chevron)
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

This feature not implemented with the MUCM.

Subnet Mask

This feature not implemented with the MUCM.

Default Gate

This feature not implemented with the MUCM.

MBAP TCP Port

This feature not implemented with the MUCM.

TCP Backoff

This feature not implemented with the MUCM.

Downstream Timeout

This feature not implemented with the MUCM.

Quiet Timeout

This feature not implemented with the MUCM.

IP Framing

This feature not implemented with the MUCM.

MAC Address

This feature not implemented with the MUCM.

E-Peer

This feature not implemented with the MUCM.

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 MUCM, 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 be the result of the following formula:

$$\text{MODBUS value} = \text{SY/MAX register} + \text{Offset value} - 1$$

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.

MB+ Programming Channel Timeout

This feature not implemented with the MUCM.

Reply Timeout

(MB+) This feature not implemented with the MUCM.

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 MUCM 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 MUCM 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

This feature not implemented in the MUCM.

This Node's Number

(E-Peer) This feature not implemented in the MUCM.

Start Register

(E-Peer) This feature not implemented in the MUCM.

Register Count

(E-Peer) This feature not implemented in the MUCM.

Destination Reg

(E-Peer) This feature not implemented in the MUCM.

Update Interval

(E-Peer) This feature not implemented in the MUCM.

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) This feature not implemented in the MUCM.

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 16-4.

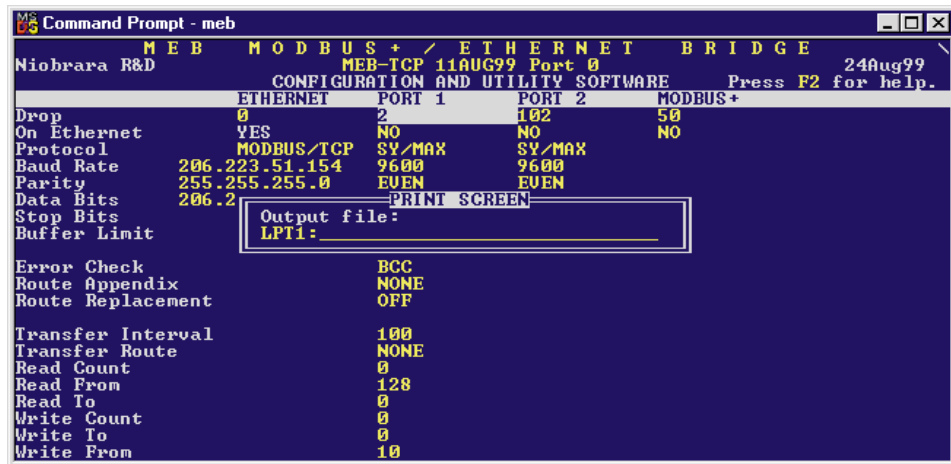


Figure 16-4 F1 Print Screen

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 16-5. Pressing any key will return to the previous location

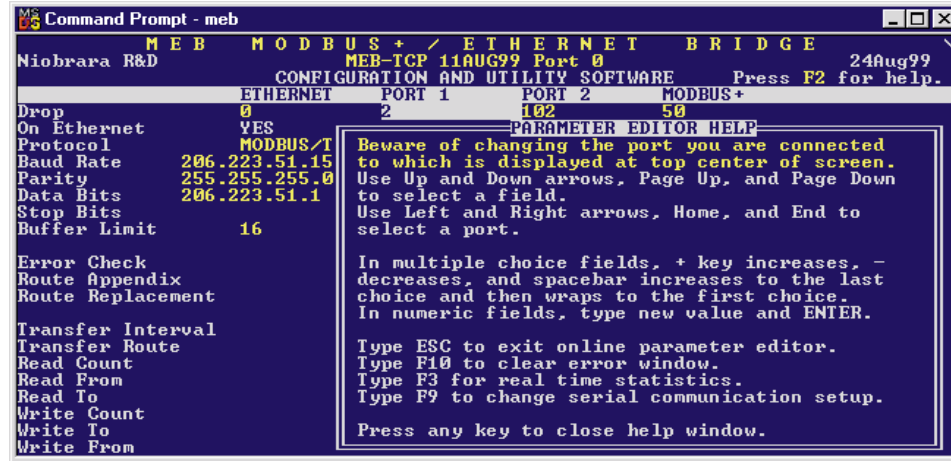


Figure 16-5 F2 Help Window

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.

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.

```

MS-DOS Command Prompt - meb
Niobrara R&D MEB MODBUS+ / ETHERNET BRIDGE MEB-TCP 11AUG99 Port 0 24Aug99
Statistics
Port 1 Status
Count Register
Valid packets received, ACK sent 234 2081
Incoming packet lost because no buffer 0 2082
Invalid packets received, NAK sent 0 2083
Packets generated internally 0 2084
Internal generations failed (No buffer) 0 2085
Packets sent and ACK received 235 2086
Transmit not ACKed, packet lost 0 2087
Transmit retries 0 2088
Packets lost because unrouteable 0 2089
Illegal operation requests 0 2090
Priority reads performed locally 0 2091
Priority writes performed locally 0 2092
Non-priority reads performed 0 2093
Non-priority writes performed 0 2094
Receiver parity or framing errors 0 2095
Characters transmitted 6041 2096
Characters received 14690 2097
Type + or - to change port. Z to zero.
Page Down for more data. ESC to exit. reserved.

```

Figure 16-6 Port 1..2 Statistical Screen (Page 1)

```

MS-DOS Command Prompt - meb
Niobrara R&D MEB MODBUS+ / ETHERNET BRIDGE MEB-TCP 11AUG99 Port 0 24Aug99
Statistics
Port 1,2 Status
Count Register
Transmit percent of capacity 19 2096
Receive percent of capacity 47 2097
Last route received 2 2108
0 2108
1 2109
--- 2109
--- 2110
--- 2110
--- 2111
--- 2111
Channel delay byte count 4 2104
Buffers in internal queue 0 2103
Buffers currently in use 1 2112
Type + or - to change port. Z to zero.
Page Up for more data. ESC to exit. reserved.

```

Figure 16-7 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 117. When one of the error registers is incremented, the RED and GREEN FAULT lights 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 MUCM 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 acknowledgment 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

MUCM 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 MUCM 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 MUCM 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 MUCM port will ignore the message. Each MUCM 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 16-8 displays an example of this screen for

serial port 1 of the MUCM. This screen allows the editing of the table for each MUCM port, the range of Modbus address that the table covers, and the entries for each of the covered addresses.

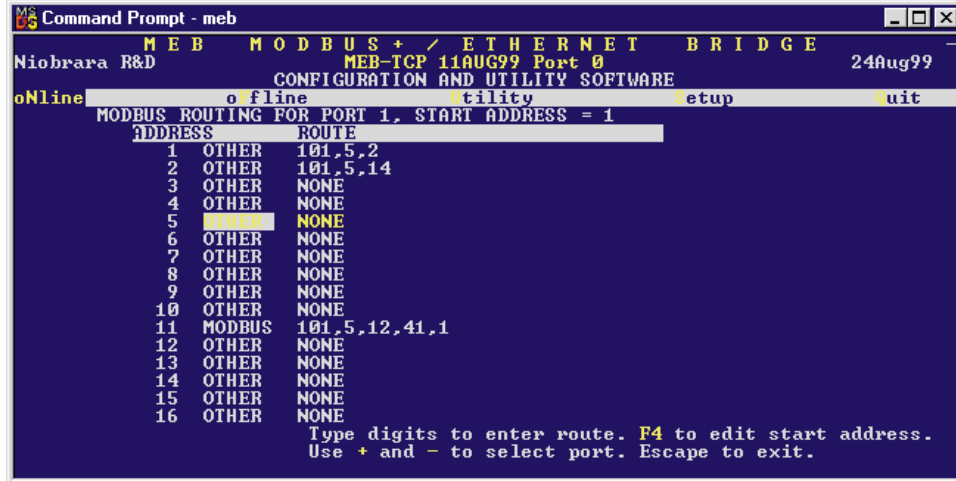


Figure 16-8 Edit Modbus Slave Routing

Port Number

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

Starting Address

The MUCM 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.

Target TYPE

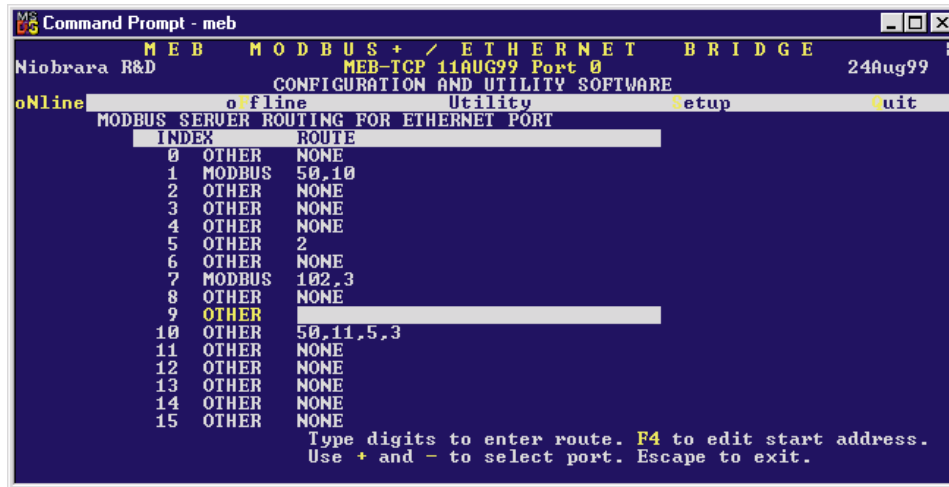
The target type may be set to MODBUS or OTHER. If the device is a SY/MAX device then set it to OTHER.

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 16-8 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 MUCM.

Modbus Server Routing for Ethernet Port



```
MS-DOS Command Prompt - meb
Niobrara R&D
MEB MODBUS + / ETHERNET BRIDGE
MEB-TCP 11AUG99 Port 0
CONFIGURATION AND UTILITY SOFTWARE
24Aug99
online offline Utility Setup Quit
MODBUS SERVER ROUTING FOR ETHERNET PORT
INDEX ROUTE
0 OTHER NONE
1 MODBUS 50.10
2 OTHER NONE
3 OTHER NONE
4 OTHER NONE
5 OTHER 2
6 OTHER NONE
7 MODBUS 102.3
8 OTHER NONE
9 OTHER
10 OTHER 50.11.5,3
11 OTHER NONE
12 OTHER NONE
13 OTHER NONE
14 OTHER NONE
15 OTHER NONE
Type digits to enter route. F4 to edit start address.
Use + and - to select port. Escape to exit.
```

Figure 16-9 Modbus Server Routing for Ethernet Port

(Modbus/TCP only) The MUCM 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 MUCM 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 MUCM. 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 MUCM supports all 256 entries for this index. Messages with empty Index values will be treated as local operations.

Target TYPE

The target type may be set to MODBUS or OTHER. If the device is a SY/MAX device then set it to OTHER.

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 the outgoing port of the MUCM (such as Port 1 or 2).

Note: This is also different from the Modbus Serial slave implementation. The

MUCM supplies its own drop number for the return route to the E-net port.

In Figure 16-9 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 MUCM.

Auto-Scan Table

The MUCM 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 (MUCM 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 included per port. Figure 16-10 displays an example of the Auto-Scan edit screen.

ENTRY	LOCAL	REMOTE	COUNT	DIRECTION	ROUTE (from Modbus Slave table)
1	1	1001	5	READ	102.10
2	6	1001	5	READ	102.11
3	11	2045	1	WRITE	102.10
4	12	2045	1	WRITE	102.11
5	0	0	0	READ	NONE
6	0	0	0	READ	NONE
7	0	0	0	READ	NONE
8	0	0	0	READ	NONE
9	0	0	0	READ	NONE
10	0	0	0	READ	NONE
11	0	0	0	READ	NONE
12	0	0	0	READ	NONE
13	0	0	0	READ	NONE
14	0	0	0	READ	NONE
15	0	0	0	READ	NONE
16	0	0	0	READ	NONE

Figure 16-10 Edit Auto-Scan Table

Local

This value determines the mailbox register in the MUCM 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 MUCM's mailbox. WRITE operations copy data from the MUCM'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

This feature not implemented with the MUCM.

Outgoing TCP Routing

(Modbus/TCP and MBTCP+SY/MAX 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 MUCM is used as an index in this table to point to a specific IP device.

DROP	IP ADDRESS	DOWNSTREAM ROUTE
0	0.0.0.0	NONE
1	206.223.51.155	NONE
2	206.223.51.154	NONE
3	0.0.0.0	NONE
4	0.0.0.0	NONE
5	206.223.51.145	NONE
6	0.0.0.0	NONE
7	0.0.0.0	NONE
8	0.0.0.0	NONE
9	0.0.0.0	NONE
10	199.186.195.30	NONE
11	0.0.0.0	NONE
12	0.0.0.0	NONE
13	0.0.0.0	NONE
14	0.0.0.0	NONE
15	0.0.0.0	NONE

Figure 16-11 Edit 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 MUCM 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.

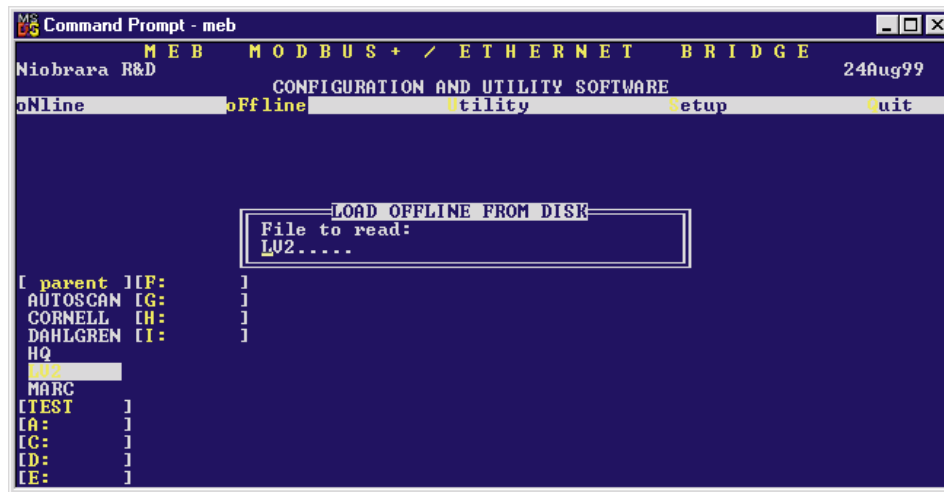


Figure 16-12 offline Read from Disk to Memory

"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 .MEB 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 MUCM.

"Send memory to module"

This function will send the configuration in memory to the MUCM module by way of the SY/MAX setup parameters. In order to send the configuration to the MUCM it is necessary for the personal computer to communicate with the MUCM. 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 MUCM module to the offline memory for editing, printout, or saving on disk. "Send memory to module"

This function transfers all five ports' configuration parameters from offline memory to the MUCM. This function can be used to load configuration back into the MUCM 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**.

"Copy offline to module flash"

This feature not implemented in the MUCM.

"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.

REGSTR	HEX	UNSIGN	SIGNED	BINARY	STAT
1	04D2	1234	1234	0000 0100 1101 0010	E000
2	FB2E	64302	-1234	1111 1011 0010 1110	E000
3	0001	1	1	0000 0000 0000 0001	E000
4	0002	2	2	0000 0000 0000 0010	E000
5	0003	3	3	0000 0000 0000 0011	E000
6	FFFF	65535	-1	1111 1111 1111 1111	E000
7	FFFE	65534	-2	1111 1111 1111 1110	E000
8	FFFD	65533	-3	1111 1111 1111 1101	E000
9	000A	10	10	0000 0000 0000 1010	E000
10	000B	11	11	0000 0000 0000 1011	E000
11	000C	12	12	0000 0000 0000 1100	E000
12	1234	4660	4660	0001 0010 0011 0100	E000
13	ABCD	43981	-21555	1010 1011 1100 1101	E000
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	000F	15	15	0000 0000 0000 1111	E000

Figure 16-13View 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 cursor 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 MUCM 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 16-14.

```
Type ctrl-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 16-14 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

This feature not implemented in the MUCM.

SETUP

The setup menu accesses the setup parameters for the personal computer to enable it to communicate with the MUCM and the terminal emulator. The parameters chosen will depend on the exact equipment involved in making the connections.

Serial 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:
- Modbus RTU COM:

- Modbus ASCII 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 MUCM.

Net-to-Net COM: is used when connecting to a NIM, SY/LINK, MUCM, 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/MUCM/EPE5 port that is in Gateway mode. For more information about Gateway mode see on page <Gateway Mode>.

Modbus RTU COM: is used when connecting to a port in MODBUS GATE or MODBUS HOST or a Modicon PLC or BM85 Bridge Mux. Only a single drop of routing information is allowed. Use drop 255 when connecting to a MUCM port directly. Modbus RTU mode has strict inter-character timing requirements and may not be suitable for use under Windows NT; try MODBUS ASCII instead.

Modbus ASCII COM: is used when connecting to a port in MODBUS ASCII mode or a Modicon PLC or BM85 Bridge Mux. Only a single drop of routing information is allowed. Use drop 255 when connecting to a MUCM port directly.

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. A MUCM has a default baud rate of 9600 and if a direct connection is made to the MUCM this is the setting that should be made on the personal computer. If the baud rate of the port of the MUCM has been changed this value may need to be adjusted.

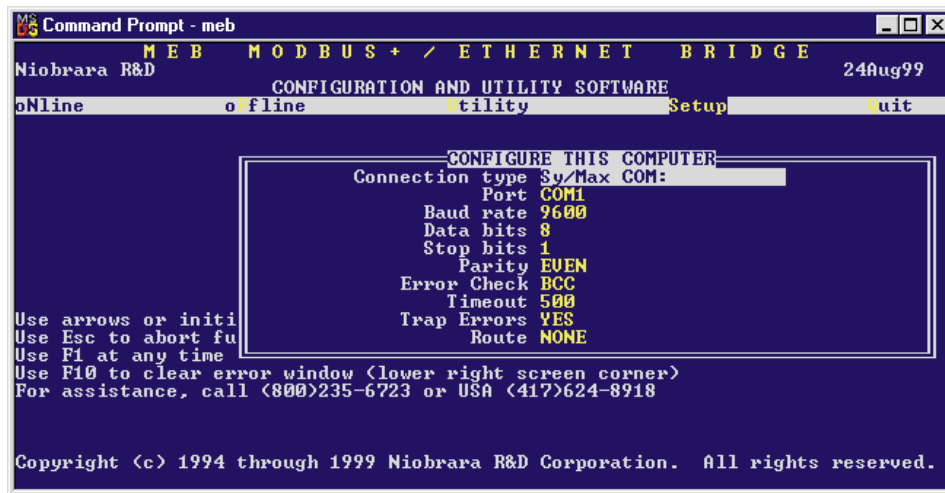


Figure 16-15 SY/MAX Setup Screen

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 and MODBUS ASCII modes use 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 MUCM are normally set for 1 stop bit.

Parity - SY/MAX, Net-to-Net, Modbus RTU, and Modbus ASCII modes normally use EVEN parity and that is the default for the communication ports on the MUCM. Other choices are ODD and NONE.

Route - The route is used to determine the path from the personal computer to the MUCM. If a direct connection is made from the personal computer to the MUCM, i.e. without going through a SY/NET network, an Ethernet network, another MUCM, 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 MUCM, 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 MUCM. 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 MUCM, EPE5 or SPE4 that the personal computer is connected and any subsequent Net-to-Net and SY/MAX drops to reach the MUCM.

SY/LINK Connection

MEBSW provides full support of the Square D SFI-510 SY/LINK network interface card. Setup for the network interface is provided along with setup for the RS-422 port on the card.

NOTE: Support for the SY/LINK card is provided under DOS or WIN95/98. Windows NT support for the SFI-510 is not provided.

Connection type - The RS-422 port may be set to SY/MAX or Net-to-Net modes. For a direct connection to the MUCM 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 made 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 MUCM, or another Net-to-Net port. If Sy/Link Direct was selected and the MUCM 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.

NOTE: Support for the SFI-610 card is provided under DOS or WIN95/98. Windows NT support for the SFI-510 is not provided.

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.

Modbus/TCP Connection

This feature not implemented with the MUCM.

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 MUCM SY/MAX connection and COM2 to be used for a terminal emulator connection.

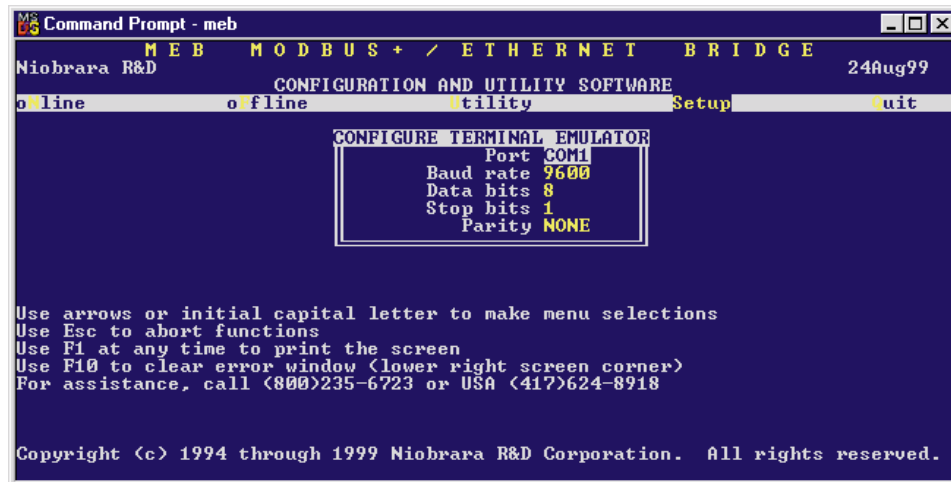


Figure 16-16 Terminal Emulator Setup Screen

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.

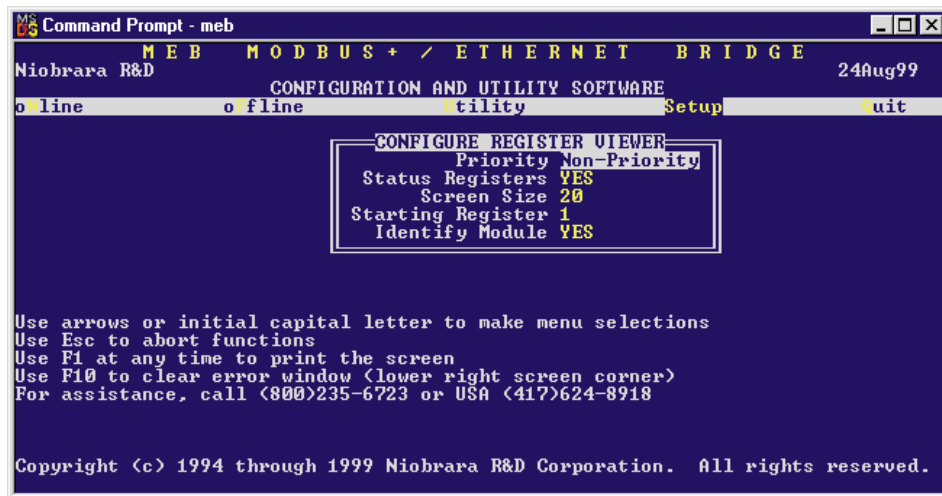


Figure 16-17 Terminal Emulator Setup Screen

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 NO.

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 a MUCM, then quits. It is assumed that the MUCM 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 MUCM configuration is controlled by writing to a set of processor equivalent registers local to the MUCM 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 MUCM 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 25-1 represents an overview of the local 4x registers present within the MUCM. Notice that only registers 1..32 may be rack addressed by the PLC. All other registers must be read or written through the serial ports.

Table 17-1 Module 4x Register Overview

Register	Function
1..32	Rack Addressable Mailbox registers for user applications
33..64	Copy of PLC 4X registers. Read only
65..2048	Mailbox registers for user applications
2049..2176	Statistics Registers (See Tables <Ethernet Port Statistics Registers> and 17-2)
2177..2899	Reserved for future use, do not modify
3410..3699	Auto-Scan Tables
4640..7199	Modbus Slave Address Look-up Tables (See Table <Ethernet Port Statistics Registers>)
8001..8162	Setup and Configuration (See Tables 17-6, <Ethernet Port Control Registers>, 17-7)
8176..8188	Module identification (See Table 17-16)

Mailbox Registers

The MUCM contains 2048 Mailbox registers numbered 1..32, and 65...2048. Each of these registers may be written or read from any of the 3 ports on the module. In addition, the first 32 4x and 32 3x of these registers may be rack addressed by the PLC; therefore each of the 3 ports may read and write values directly to the PLC without using the PLC's COM port.

The mailbox registers correspond to the registers in the PLC by the following formula:

$$\text{PLC Register} = \text{Rack Start Address} + \text{Mailbox Register}$$

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.

Statistics Registers

Data Port Statistics

Each of the four data ports has its own group of 32 statistics registers. These are displayed in Table 17-2.

Table 17-2 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.

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 17-3 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 Slave Address Tables

There is a table of translations for each port in the module. These tables are 640 registers long and comprise 128 entries with 5 registers each. The LSB of the first register in 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.

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 MUCM.

Table 17-4 Modbus Slave Address Table

Port 1 Register	Port 2 Register	Data Bytes		Modbus Drop Numbers
		MSB	LSB	
4640	5280	Not Used	Number of Drops	Address Base + 1
4641	5281	Drop 1	Drop 2	
4642	5282	Drop 3	Drop 4	
4643	5283	Drop 5	Drop 6	
4644	5284	Drop 7	Drop 8	
4645	5285	Not Used	Number of Drops	Address Base + 2
4646	5286	Drop 1	Drop 2	
4647	5287	Drop 3	Drop 4	
4648	5288	Drop 5	Drop 6	
4649	5289	Drop 7	Drop 8	
...
5275	5915	Not Used	Number of Drops	Address Base + 128
5276	5916	Drop 1	Drop 2	
5277	5917	Drop 3	Drop 4	
5278	5918	Drop 5	Drop 6	
5279	5919	Drop 7	Drop 8	

The Modbus address base register is in the normal setup register area. (Table 17-5)

Table 17-5 Modbus Slave Starting Address Register

MEB Port	Modbus Slave Starting Add. Reg.
1	8063
2	8095

Setup and Configuration Registers

Registers 8001..8130 are provided for the setup and configuration for the ports of the MUCM. Each Port of the MUCM uses 32 registers to control its operational parameters. The first two registers concern the entire module and are shown in Table 17-6.

Table 17-6 Module Setup Identification Registers

Register	Legal Values	Function
8001	5001(hex)	Setup identification constant.
8002		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 17-7.

Table 17-7 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 17-9 on Page 121)
8037	8069	0,1	Data Bits (See Table 17-10 on Page 122)
8038	8070	0,1,2	Parity Bits (See Table 17-11 on Page 122)
8039	8071	0,1	Stop Bits (See Table 17-12 on Page 122)
8040	8072	1..19	Protocol Mode (See Table 17-13 on Page 123)
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 17-8 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 17-14 on Page 124)
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	0..65535	Modbus RTU inter-character timing in mS. (default is 4 characters)
8066	8098		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 17-9 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 MUCM 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 panicking, 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 17-10 Data Bits Values

Data Register	Data Bits
0	7
1	8

Table 17-11 Parity Values

Parity Register	Parity
0	None
1	Odd
2	Even

Table 17-12 Stop Bits Values

Stop Register	Stop Bits
0	1
1	2

Table 17-13 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
19	Dual Slave

Table 17-14 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. BOOTP/DHCP Enabled on Ethernet port in TCP/IP Modes.	Gateway mode replies are terminated by CR/LF and are highlighted. Also, Disable BOOTP/DHCP on Ethernet Port in TCP/IP Modes.
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.

Options

The Options Register allows the modification of the normal operation of several features of the MUCM.

- 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 MUCM 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 is not used in the MUCM
- 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 MUCM 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 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.

- 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 MUCM is in Modbus Host mode, bits 9 and 10 of register 8094 in the MUCM 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 17-15 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 MUCM 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 MUCM 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 17-16 provides an overview of these registers.

Table 17-16 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 MRPC has a revision of 07FEB00, Registers 8177..8186 would have the values in Table 17-17.

Table 17-17 Module ID Example

Register	Values (hex)	Packed ASCII Values
8177	4D52	MR
8178	5043	PC
8179	5443	TC
8180	5020	P
8181	3037	07
8182	4645	FE
8183	4232	B2
8184	3030	00
8185	3020	0
8186	2020	

Global Options Register (Register 8190)

All MUCM's with a MRPC rev date of 20Dec00 or later come equipped with a global options register.

Table 17-18 Global Options Register Values

Option Bit	Function when Bit CLEAR (Default)	Function when Bit SET
1	Reserved	Reserved.
2	No Auto-Scan watchdog control for Port 1.	Gives control of Auto-Scans in Port 1 to timer in register 8189.
3	No Auto-Scan watchdog control for Port 2.	Gives control of Auto-Scans in Port 2 to timer in register 8189.
4	Reserved	Reserved
5	Reserved	.Reserved
6	Reserved	Reserved
7	Reserved	Reserved
8	Reserved	Reserved
9	All rack addressed registers are zeroed during a power cycle.	All rack addressed registers hold their value during a power cycle.
10	All rack addressed registers in normal bit order..	All rack addressed 3x and 4x registers are bit-swapped(bit 1 becomes bit 16, 2 becomes 15, etc.).
11	Reserved.	Reserved.
12	Reserved.	Reserved.
13	Reserved.	Reserved.
14	Reserved.	Reserved.
15	Reserved.	Reserved.
16	Reserved.	Reserved.

Global Options

The Options Register allows the modification of the normal operation of several features of the MUCM.

- Bits 2 and 3 turn control of the Auto-Scans in Ports 1 and 2 over to the timer set in register 8189. For more information, see the Chapter on Auto-Scan.
- Bit 9, when set, causes all rack addressable register to hold their last value during a power cycle.
- Bit 10 will bit-swap all rack addressable 3x and 4x registers. Bit 1 becomes bit 16, bit 2 becomes 15, etc.

Connector Pinouts

RS-232 port on MUCM (Screw Terminal)

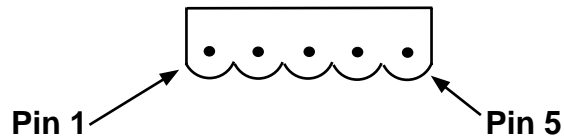


Figure 18-1 Port 1 Screw Terminal

Table 18-1 RS-232 Pinout

Pin	Function	Notes
1	TX	Transmit
2	RX	Receive
3	SG	Signal Ground
4	RTS	Push to Talk Request To Send
5	CTS	CTS must be high to transmit

RS-485 port on MUCM (Screw Terminal)

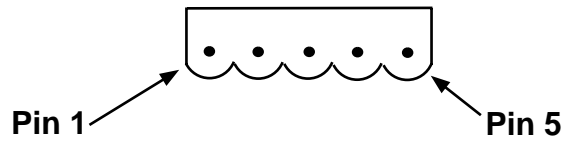


Figure 18-2 Port 2 Screw Terminal

Table 18-2 RS-485 Pinout

Pin	Function	Notes
1	Tx+	Output from MUCM
2	Tx-	Output from MUCM
3	Rx+	Input to MUCM
4	Rx-	Input to MUCM
5	SG	Signal Ground

For 2-wire RS-485 applications, Rx+ and Tx+ must be tied together outside the MUCM, and Rx- and Tx- must also be tied together outside the MUCM.

Recommended Cabling

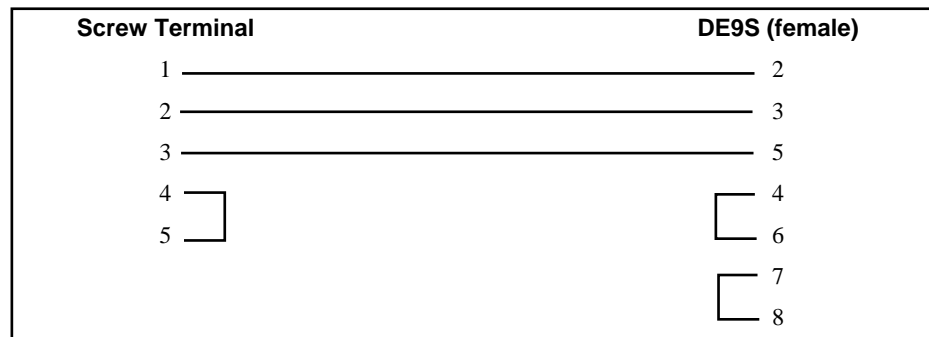
Cabling required to configure an MUCM

Configuration files are downloaded from an MS-DOS personal computer into the MUCM. The factory default configuration for the module is that all ports not running a user program are Modbus RTU, 9600 baud, 8 data bits, EVEN parity, 1 stop bit which may be used for downloading user programs or for viewing and modifying MUCM registers. The correct cabling needs to be installed to connect the personal computer to a MUCM port.

MUCM RS-232 to personal computer cabling

A connection to the RS-232 port of the PC may be made to either of the RS-232 ports of the module.

MUCM RS-232 to RS-232 PC DCE Port (9-pin) (MU1 Cable)

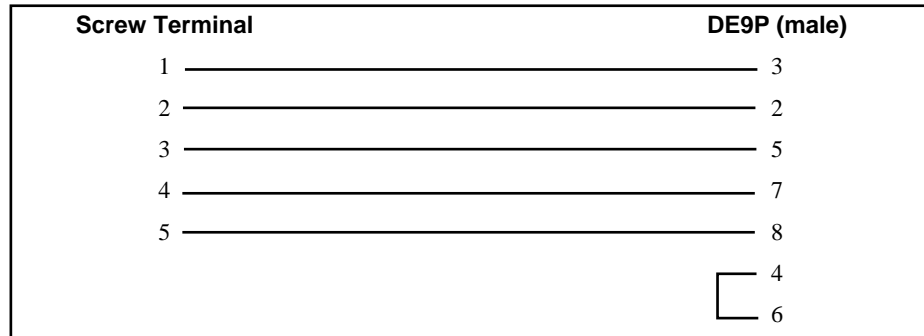


The Niobrara MU1 cable may be used for connecting the MUCM to a personal computer.

MUCM RS-232 to 9-pin DTE

The Niobrara MU3 cable may be used to connect the MUCM RS-232 port to a 9-pin DCE device. This cable gives the MUCM a standard PC type 9-pin male connector.

MUCM RS-232 to RS-232 DTE Port (9-pin) (MM3 Cable)

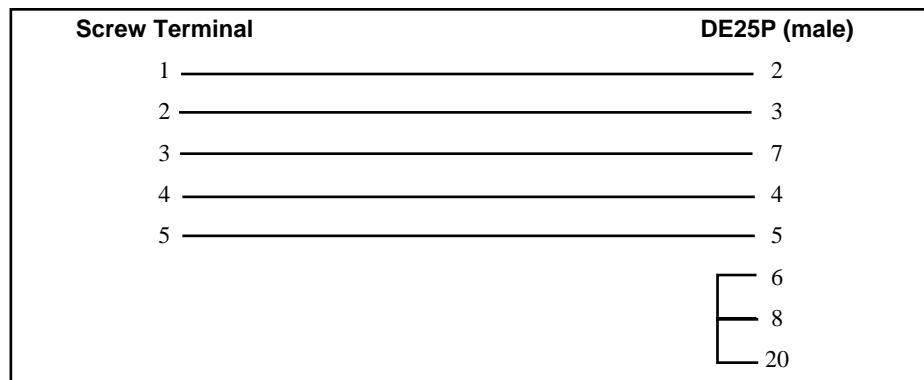


The Niobrara MU3 cable may be used for providing the MUCM with a 9-pin port that acts like a personal computer's serial port.

MUCM RS-232 to 25-pin DTE

The Niobrara MU4 cable may be used to connect the MUCM RS-232 port to a 25-pin DCE device such as a modem or a Cutler-Hammer MINT II.

MUCM RS-232 to RS-232 DTE Port (25-pin) (MU4 Cable)

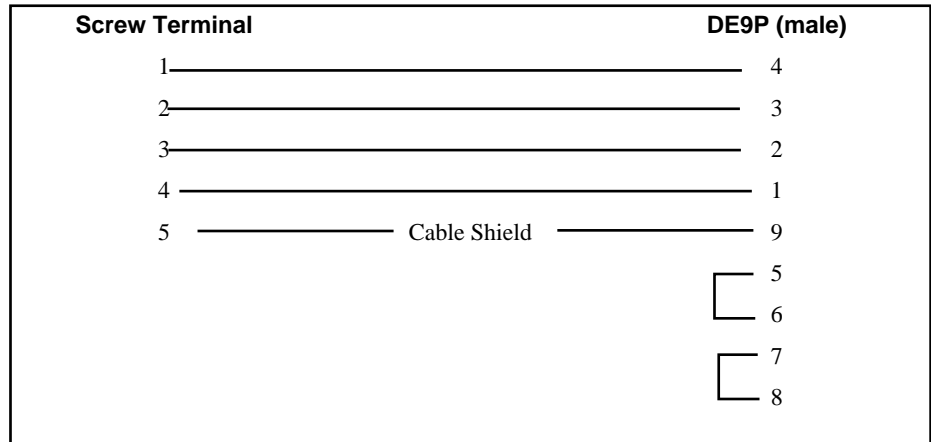


The Niobrara MU4 cable may be used to connect the MUCM to a modem.

MUCM RS-485/422 to SY/MAX 9-pin Port

When a non-isolated connection can be made between the MUCM and a SY/MAX pinout port, the following cable may be used.

MUCM RS-422/485 to SY/MAX pinout 9-pin port (MU7 Cable)



Isolated Cabling to SY/MAX Port

The Niobrara DDC2I Isolated RS-232<>RS-422/485 converter provides an optically isolated connection from the MUCM to a SY/MAX pinout device. A Niobrara MU0 cable is used to connect the RS-232 port on the MUCM to the RJ45 port on the DDC2I. A Niobrara DC1 cable is used to connect the 9-pin RS-422 port on the DDC2I to the SY/MAX device. The DIP switches on the DDC2I should be set for 4-Wire, Bias, and Termination. The DDC2I must be externally powered.

The Niobrara MU3 and SC902 cables may also be used together to provide a non-isolated connection between the MUCM and a SY/MAX port.

This chapter describes a few actual applications for the MUCM modules.

Example 1 : Blue Hose SY/NET programming through Modems

A personal computer is used to program several Model 650 and 450 processors over a phone line using SY/MATE PLUS ver. 2.x software. The remote location includes a "Blue hose" SY/NET network consisting of several Model 400 and 600 processors. It is desired to program all the processors from the personal computer. A pair of MUCM's is used as a bridge between the SY/MAX devices using an 11-bit data structure and the 10-bit modems.

The local MUCM is located with an external modem near the PC. The RS-232 Port of the MUCM is set for SY/MAX mode, while the RS-485 port is set for Modbus ASCII. To get to a 10-bit format, the Modbus ASCII port is set for 8 data bits and no parity. Most likely, a data level converter will be required, as most modems have RS-232 data ports.

The remote MUCM is located with another external modem near the rack where a CRM-510 NIM is present. The RS-232 port of the MUCM is connected to the modem. The RS-485 port of the MUCM is connected to one of the ports of the NIM in Net-to-Net mode. The baud rates of each unit must be set to match. The drop number of the MUCM Net-to-Net is set to match the drop number of the NIM port.

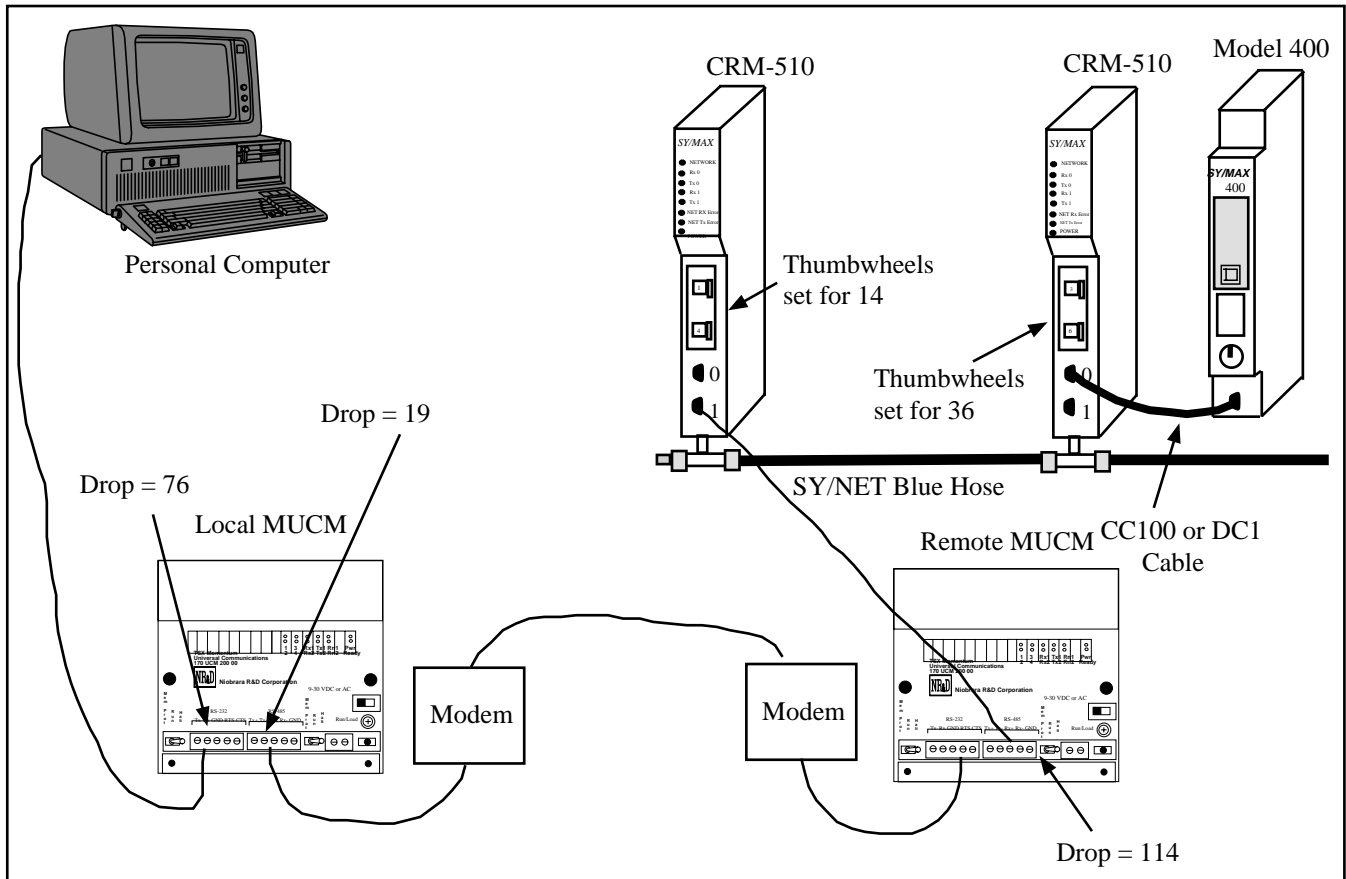


Figure 20-1 NIM Net-to-Net Example

Table 20-1 Personal Computer route

Origin	Target	Route
Personal Computer	Model 400	076 019 36

Table 20-2 Local MUCM Setup for NIM Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	76	SY/MAX	9600	E	8	1
2	114	Modbus ASCII	9600	N	8	1

Table 20-3 Remote MUCM Setup for NIM Net-to-Net Connection

Port	Drop #	Mode	Baud Rate	Parity	Data	Stop
1	77	Modbus ASCII	9600	N	8	1
2	114	Net-to-Net	9600	E	8	1

Table 20-4 Remote MUCM Modbus Routing Table for Port 1

Address	Device	Route
36	Other	77,114,36

Appendix A

NR&D Internet Access

Niobrara is on the World Wide Web! Our Internet home page is at:

<http://www.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

A

Auto-Scan, 104, 117
Auto-Transfer, 20

B

BID, 66
BID Address, 96
BID Response, 96
Broadcast, 69
Buffers, 101

C

Channel Delay, 101
Chevron, 75
Clear Function Register, 125
Command Line Parameters, 113
Control Character, 93
CTS Delay, 21
CTS Timer, 95

D

Default Gate, 91
Destination Register, 95
Downstream Timeout, 91
Driver Mode, 20, 91
Drop Number, 90

E

Echo, 93
E-PEER, 91

F

FOUR WIRE, 20

G

Gateway Mode, 43

Global Data, 105

H

HALF DUPLEX, 20
Highlight, 93

I

IDEC Mode, 39
Identification Registers, 126
IP Address, 91
IP Framing, 91

M

MAC Address, 91
Mailbox, 20, 115
MBAP Port, 91
MB+ Programming Channel Timeout, 94
MEBSW, 87
Message Count, 96
Micro-1, 39
Modbus Slave Table, 118
Modbus TCP Routing, 103
Model 50, 39
Multidrop Mode, 49

N

Network ID, 95
Node Priority, 93
Number of Nodes, 93

O

OFFLINE Functions, 105
On Ethernet, 90
Options Bits List, 124, 128

P

Packet Response, 95
Packet Size Limit, 92

Packet Time Limit, 92
PAD, 101
PanelMate, 20, 92
Pause Time, 96
Peripheral Mode, 27
PLOGIC Mode, 33
PNIM Mode, 35
Protocol Mode, 19
PT to PT, 20

Q

Quiet Timeout, 91

R

READ Command, 93
READ Count, 94
READ From, 94
READ To, 94
Register Bias, 94
Register Count, 95
Reply Timeout, 94
Retries, 96
Retry Timeout, 94
RNIM, 65
RNIM Master, 70
RNIM Slave, 71
Route Appendix, 20, 92
Route Replacement, 20, 92
RTS/CTS, 73

S

Setup and Configuration Registers, 119
SFI-610, 111
Share Mode, 29
Start Register, 95
Statistics, 116
Subnet Mask, 91
SY/MAX Setup, 109

T

Target Route, 93
TCP Backoff, 91
Terminal Emulator, 108
This Node's Number, 95
Time Slice, 93
Total E-Peer Nodes, 95
Transfer Interval, 94
Transfer Route, 94, 97
Transparent Mode, 29
TWO WIRE, 20

U

Update Interval, 95

V

View Registers, 107

W

WRITE Command, 93
WRITE Count, 95
WRITE From, 95
WRITE To, 95

