Quantum Remote I/O Communication Modules

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At a Glance

Introduction

Quantum networking modules provide open, standards-based networking and fieldbus connectivity using Modbus, Modbus Plus, Ethernet, InterBus, SY/MAX and LonWorks networks. Specifications for these modules are included below.

What's in this Chapter?

This chapter contains the following topics:

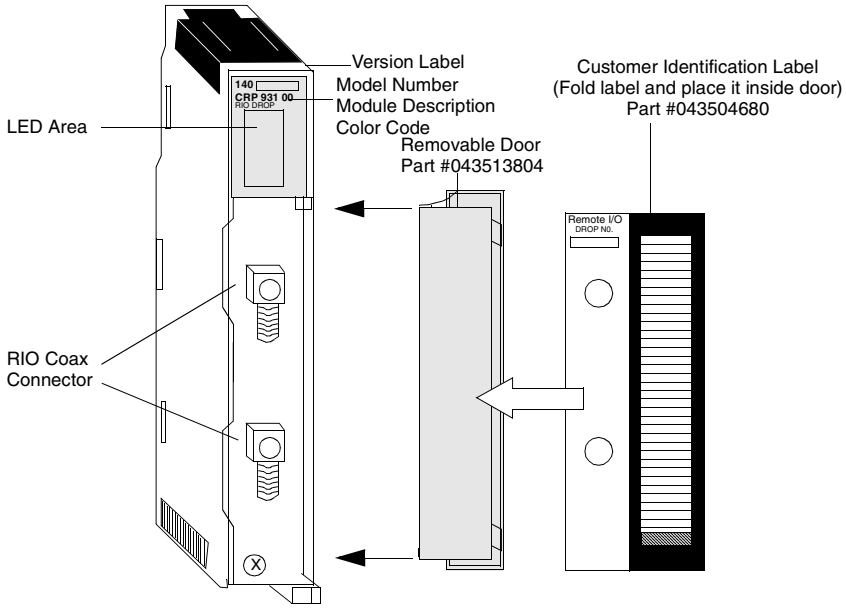
140CRP93X00 Remote I/O (RIO) Head Single and Dual Channel Module

Overview

The Remote I/O Head Single and Dual Channel modules are installed in the same backplane as the system controlling CPU modules. The RIO head is used to transfer data bi-directionally between the CPU and RIO drop modules installed in separate backplanes. A coaxial cable network is used to interconnect the RIO head module and one or more RIO drop modules.

RIO Head Module

The following figure shows the Remote I/O (RIO) module's parts. The specific module illustrated is the 140CRP93200.



Specifications

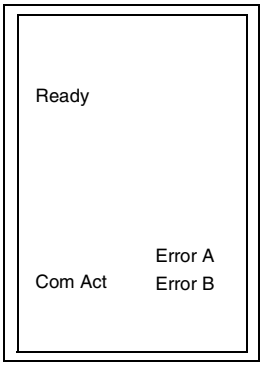
The following table shows the specifications for the Remote I/O Head Single and Dual Channel modules.

Specifications		
Drop Type	Quantum, 200 Series, 500 Series, 800 Series, or SY/MAX (any mix)	
Drops	31 max	
Words/Drop	64 In / 64 Out	
ASCII	2 ports/drop, 32 ports (16 drops) max	
	Requires the use of AS-P892-000, AS-J892-101/102, or AS-J290-0X0 at the RIO drops.	
Coax Termination	Internal 75Ω	
Coax Shield	Tied to chassis ground	
Data Transfer Rate	1.544 mb	
Dynamic Range	35 dB	
Isolation	500 Vdc coaxial cable center conductor to ground	
External Connections		
One Channel (CRP93100)	One "F" type female connector with a right angle adapter	
Two Channels (CRP93200)	Two "F" type female connectors with a right angle adapter	
General		
Diagnostics	**Power Up**	**Power Up and Runtime**
	Dual Port Memory Check	Executive Checksum
	LAN Controller Check	RAM Address/Data
Maximum Number of CRPs Supported by the Controller	1	
Bus Current Required (Typical)	Single Channel: 600 mA	
	Dual Channel: 750 mA	
Power Dissipation (Typical)	Single Channel: 3 W	
	Dual Channel: 3.8 W	

	**CAUTION** **Connectivity Compliance** To maintain CE compliance with the European Directive on EMC (89/336/EEC), the RIO head module must be connected using quad shielded cable (see the Remote I/O Cable System Planning and Installation Guide, 890USE10000, V2.0). **Failure to follow this precaution can result in injury or equipment damage.**

LED Indicators and Descriptions

The following figure shows the LED indicators for the RIO Head module.



The following table shows the LED descriptions for the RIO Head module.

LED Descriptions		
LEDS	**Color**	**Indication When On**
Ready	**Green**	**The module has passed powerup diagnostics.**
Com Act	Green	The module is communicating on the RIO network.
Error A	Red	There is a loss of communication on Channel A with one or more of the drops.
Error B	Red	There is a loss of communication on Channel B with one or more of the drops (dual cable only).

LED Error Codes

The Blinking Com Act LED error codes for the RIO Head module table show the number of times the Com Act LED on the RIO Head module blinks for each type of error and the crash codes for each (all codes are in hex).

LED Error Codes		
Number of Blinks	**Code**	**Error**
Slow (steady)	0000	Requested Kernel Mode
2	6820	hcb frame pattern error
	6822	head cntrl blk diag error
	6823	mod personality diag error
	682A	fatal start I/O error
	682B	bad read I/O pers request
	682C	bad execute diag request
	6840	ASCII input xfer state
	6841	ASCII output xfer state
	6842	I/O input comm. state
	6843	I/O output comm. state
	6844	ASCII abort comm. state
	6845	ASCII pause comm. state
	6846	ASCII input comm. state
	6847	ASCII output comm. state
	6849	building 10 byte packet
	684A	building 12 byte packet
	684B	building 16 byte packet
	684C	illegal I/O drop number
3	6729	984 interface bus ack stuck high
4	6616	coax cable initialization error
	6617	coax cable dma xfer error
	6619	coax cable dumped data error
	681A	coax cable DRQ line hung
	681C	coax cable DRQ hung
5	6503	ram address test error
6	6402	ram data test error
7	6300	prom checksum error (Exec not loaded)
	6301	prom checksum error
8	8001	Kernal prom checksum error
	8002	Flash prog / erase error

LED Error Codes		
Number of Blinks	**Code**	**Error**
	8003	Unexpected executive return

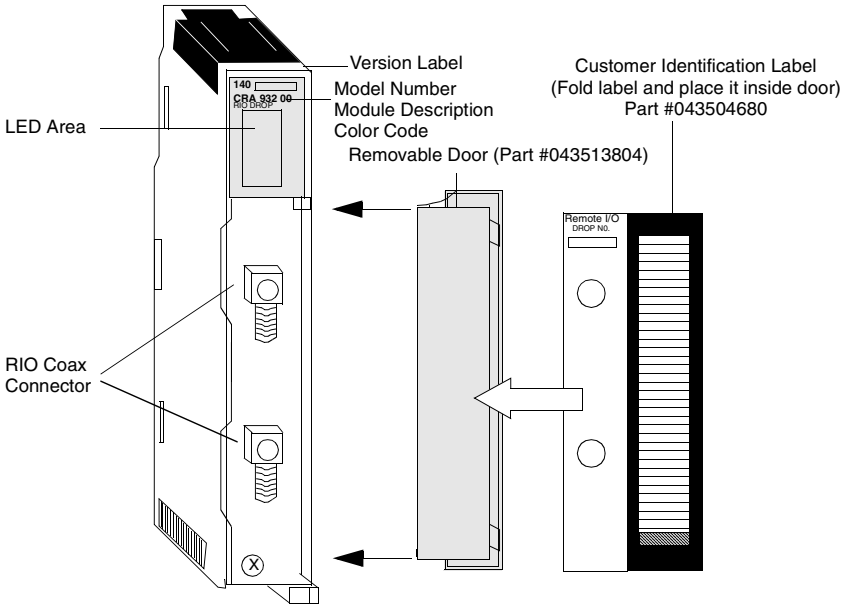
140CRA93X00 Quantum RIO Adapter Drop Single and Dual Channel Module

Overview

The Remote I/O Drop Single and Dual Channel modules are used to transfer data bi-directionally over a coaxial cable network between I/O modules installed in the same (RIO drop) backplane and the RIO head installed in the CPU backplane.

RIO Drop Module

The following figure shows the components of the Remote I/O (RIO) drop module. The specific module shown is the CRA93200.



Specifications

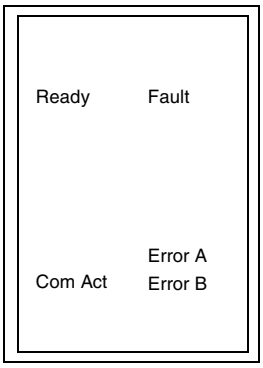
The following table shows the specifications for the Remote I/O Drop Single and Dual Channel modules.

Specifications		
I/O Type	Quantum	
Words/Drop	64 In / 64 Out	
Coax Termination	Internal 75 Ω	
Coax Shield	Capacitor to ground	
Data Transfer Rate	1.544 mb	
Dynamic Range	35 dB	
Isolation	500 Vdc coaxial cable center conductor to ground	
External Connections		
One Channel (CRA93100)	One "F" type female connector with a right angle adapter	
Two Channels (CRA93200)	Two "F" type female connectors with a right angle adapter	
General		
Holdup Time	Software configurable **Note:** In the event of a communication loss with the remote processor, this is the time that output modules will retain their last operating state. Input module data will be held in the system controlling CPU. After this time, output modules will assume their predefined time-out states, and inputs will be zeroed by the CPU.	
Diagnostics	**Power Up**	**Power Up and Runtime**
	Dual Port Memory Check	Executive Checksum
	LAN Controller Check	RAM Address/Data
Bus Current Required (Typical)	Single Channel: 600 mA	
	Dual Channel: 750 mA	
Power Dissipation (Typical)	Single Channel: 3 W	
	Dual Channel: 3.8 W	

	CAUTION
	Connection Compliance To maintain CE compliance with the European Directive on EMC (89/336/EEC), the RIO Head module must be connected using quad shielded cable (see the Remote I/O Cable System Planning and Installation Guide, 890USE10100, V2.0). **Failure to follow this precaution can result in injury or equipment damage.**

LED Indicators and Description

The following figure shows the LED indicators for the Drop module.



The following table shows the RIO Drop module LED descriptions.

LED Descriptions		
LEDS	**Color**	**Indication when On**
Ready	Green	The module has passed power-up diagnostics.
Com Act	Green	The module is communicating on the RIO network.
Fault	Red	Unable to communicate with one or more I/O modules.
Error A	Red	Communication error on Channel A.
Error B	Red	Communication error on Channel B (dual cable only).

LED Error Codes

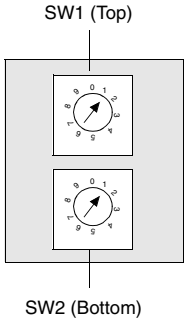
Blinking Com Act LED error codes for the RIO Drop module table show the number of times the Com Act LED on the RIO Drop module blinks for each type of error and the crash codes for each (all codes are in hex).

LED Error Codes		
Number of Blinks	**Code**	**Description of Error**
3	6701H	asic test failure
4	6601H	power down interrupt
	6602H	82588 lan chip test error
	6603H	receive abort timeout
	6604H	transmission loop timeout
	6605H	transmission dma error
	6606H	cable a initialization error
	6607H	cable a dma xfer error
	6608H	cable b dma xfer error
	6609H	cable a dumped data error
	660AH	cable a DRQ line hung
	660BH	cable b DRQ line hung
	660CH	cable a or b DRQ hung
	660DH	power-up lan controller error
5	6501H	ram address test error
6	6401H	ram data test error
7	6301H	prom checksum error

Rear Panel Switches

Two rotary switches are located on the rear panel of the RIO Drop Modules and are used for setting RIO drop addresses (refer to the following illustration and table).

SW1 (top switch) sets the upper digit (tens); SW2 (bottom switch) sets the lower digit (ones). The illustration below shows the correct setting for an example address of 11.



The following table shows the node addresses of the SW1 and SW2 switches.

SW1 and SW2 Address Settings		
Node Address	**SW1**	**SW2**
1 ... 9	0	1 ... 9
10 ... 19	1	0 ... 9
20 ... 29	2	0 ... 9
30 ... 39	3	0 ... 9
40 ... 49	4	0 ... 9
50 ... 59	5	0 ... 9
60 ... 64	6	0 ... 4

Note: If "0" or an address greater than 32 is selected, the module displays a flashing ERROR A and ERROR B LED indicating an error condition. Only addresses 2 - 32 are valid.

Quantum Modbus Plus Network Option Modules

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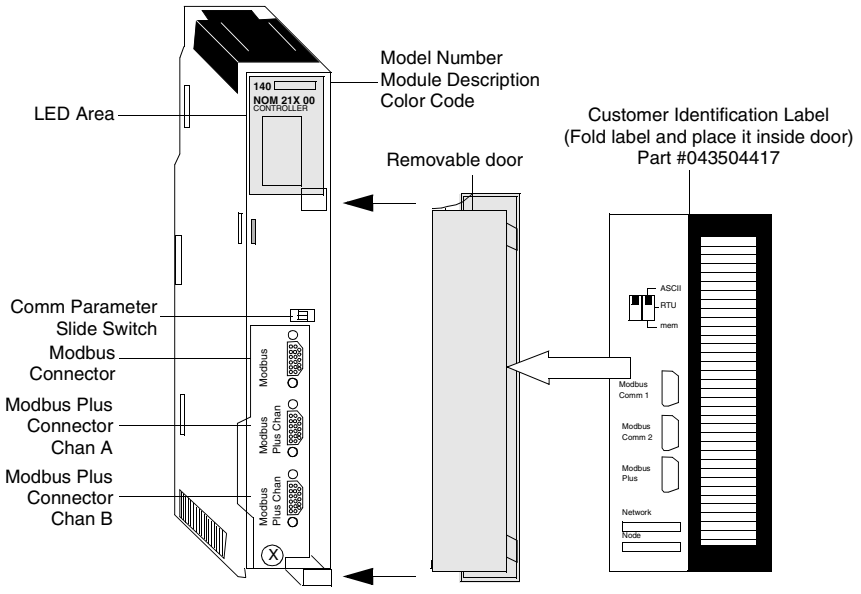
140NOM21X00 Quantum Modbus Plus Network Option Modules

Overview

The following information describes the single and dual channel twisted-pair cable NOM21X00 modules, which provide interface to Modbus Plus networks.

Modbus Plus Module

The following figure shows the components of the Modbus Plus 140NOM21X00 modules.



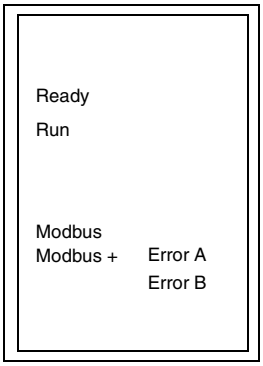
Specifications

The Modbus Plus Head Single and Dual Channel modules provide extended communication capabilities for the Quantum system within a Modbus Plus configuration. The following table shows the specifications show the Modbus Plus single and dual channel modules.

Specifications		
Communication Ports		
NOM21100	1 Modbus Plus network (RS-485) port (9-pin connector)	
NOM21200	2 Modbus Plus network (RS-485) ports (9-pin connectors) for dual connectivity on a single Modbus Plus network. These ports handle identical versions of all inbound and outbound transactions and keep track of the data paths used for these transactions.	
Both Modules	1 Modbus (RS-232) serial port (9-pin connector) A bridge mode capability in the module permits a panel device connected to this port to access nodes on the Modbus Plus network or to access the local PLC directly without having to go out onto the network.	
Diagnostics	**Power Up**	**Runtime**
	RAM	RAM
	RAM Address	RAM Address
	Executive Checksum	Executive Checksum
	Processor	
Power Dissipation (Typical)	4 W	
Bus Current Required		
NOM21100	780 mA	
NOM21200	780 mA	

LED Indicators and Descriptions

The following figure shows the Modbus Plus NOM LED indicators.



The following table shows the Modbus Plus NOM LED Descriptions.

LED Descriptions		
LEDs	**Color**	**Indication when On**
Ready	Green	The module has passed power-up diagnostics.
Run	Green	Indicates that the unit is in kernel mode–should always be OFF during normal operations.
Modbus	Green	Indicates communication is active on the single RS-232 serial port.
Modbus+	Green	Indicates communication is active on the Modbus Plus port.
Error A	Red	There is an error condition on Cable A of a dual cable Modbus Plus network (140NOM21200 only).
Error B	Red	There is an error condition on Cable B of a dual cable Modbus Plus network (140NOM21200 only).

LED Error Codes

The blinking Run LED error codes for the NOM module shows the number of times the Run LED on the NOM module blinks for each type of error and the crash codes for each (all codes are in hex).

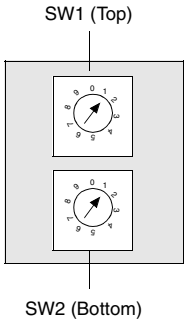
LED Error Codes		
Number of Blinks	**Code**	**Error**
Steady	014H	normal power down event
2	815	ram sequence error
3	49H	illegal data command received by bypass code
	4BH	diagnostics test pattern invalid in the icb block
	4CH	diagnostics test pattern invalid in the page 0
	4DH	icb address not the same as found in hcb
	4EH	bad code selected for mstrout_sel proc
	52H	config table exec_id is different than the sys table exec_id
	53H	got a pupinit hook for neither S985 nor S975 addr
	56H	did not get bus ack form 984 interface within 400 ms
	59H	unexpected modbus port state in send command to 680 proc
	5AH	system table missing
	5BH	bad DPM critical byte write
4	616h	bad or unexpected interrupt
	617h	loopback error on modbus port 1
	618h	parity error
	619h	set port greater than 21
	61AH	controller ram size is less than 8k
	621H	modbus cmd-buffer overflow
	622H	modbus cmd-length is zero
	623H	modbus abort command error
	624H	bad modbus state trn-int
	625H	bad modbus state rcv-int
	626H	bad comm state trn_asc
	627H	transmit underflow error
	628H	bad comm state trn_tru
	629H	bad comm state rcv_asc
	62aH	bad comm state rcv_rtu
	62bH	bad transmit comm state
	62cH	bad receive comm state

LED Error Codes		
Number of Blinks	**Code**	**Error**
	62dH	bad modbus state tmr0_evt
	62eH	bad uart interrupt
	631H	UPI timeout error
	632H	bad UPI response opcode
	633H	UPI bus diagnostic error
	634H	mbp bus interference error
	635H	bad mbp response opcode
	636H	timeout waiting for mbp
	637H	mbp out of synchronization
	638H	mbp invalid path
	639H	peer did not respond with complement of the opcode
	63AH	peer unable to come out of transitions at power-up
	681h	bad master state
	682h	bad slave state
	683h	unknown routing failure to send
	684h	bad port number in set () proc
	685h	bad port number in reset () proc
	686h	bad port number in getport () proc
	687h	bad port number in bitpos () proc
	688h	bad port number in enable_transmit_interrupt () proc
	689h	bad port number in enable_receive_interrupt () proc
	68ah	bad port number in disable_transmit_interrupt () proc
	68bh	bad port number in
	691h	privilege flag is not reset in the session timeout proc
	692h	bad port number in chkmst_hdw () proc
	6AIh	unknown controller type in reset busy flag
	6A2h	unknown function code in generate_poll_cmd () proc
	6A3h	unknown function code in generate_logout_msg () proc
	6A4h	slave link timeout on port other than port #9
	6A5h	illegal bypass command received by bypass code
5	513h	ram address test error
6	412h	ram data test error
7	311h	prom checksum error

Rear Panel Switches

Two rotary switches are located on the rear panel of the modules. They are used together to set the Modbus Plus node and Modbus port address for the unit.

Note: The highest address that may be set with these switches is 64.
Rotary SW1 (top switch) sets the upper digit (tens), and rotary SW2 (bottom switch) sets the lower digit (ones) of the Modbus Plus node address. The illustration below shows the setting for an example address of 11.



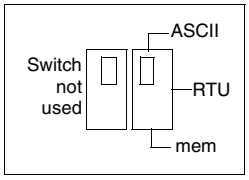
Note: If "0," or an address greater than 64 is selected, the Modbus + LED will be "on" steady, to indicate the selection of an invalid address.

The following table shows the address settings for the SW1 and SW2 switches.

SW1 and SW2 Address Settings		
Node Address	**SW1**	**SW2**
1 ... 9	0	1 ... 9
10 ... 19	1	0 ... 9
20 ... 29	2	0 ... 9
30 ... 39	3	0 ... 9
40 ... 49	4	0 ... 9
50 ... 59	5	0 ... 9
60 ... 64	6	1 ... 4

Front Panel Switches

Two, three-position slide switches are located on the front of the unit. The switch on the left is not used. The three-position slide switch on the right is used to select the comm parameter settings for the Modbus (RS-232) port provided with the Modbus Plus option module. Three options are available, as shown in the following illustration.



Note: The NOM hardware defaults to bridge mode when the front panel switch is set to RTU or ASCII mode. When networking controllers, a panel device connected to the NOM Modbus port can communicate with the controller to which it is conected, as well as log into any nodes on the Modbus Plus network.

Setting the slide switch to the top position assigns ASCII functionality to the port. The following comm parameters are set and cannot be changed.

ASCII Comm Port Parameters	
Baud	2,400
Parity	Even
Data Bits	7
Stop Bits	1
Device Address	Rear panel rotary switch setting

Setting the slide switch to the middle position assigns remote terminal unit (RTU) functionality to the port; the following comm parameters are set and cannot be changed.

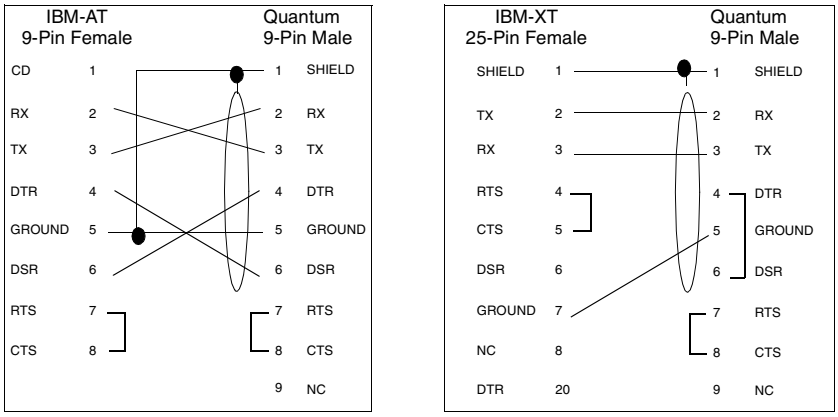
RTU Comm Port Parameters	
Baud	9,600
Parity	Even
Data Bits	8
Stop Bits	1
Device Address	Rear panel rotary switch setting

Setting the slide switch to the bottom position gives you the ability to assign comm parameters to the port in software; the following parameters are valid.

Valid Comm Port Parameters		
Baud	19,200	1,200
	9,600	600
	7,200	300
	4,800	150
	3,600	134.5
	2,400	110
	2,000	75
	1,800	50
Data Bits	7 / 8	
Stop Bits	1 / 2	
Parity	Enable/Disable Odd/Even	
Device Address	Rear panel rotary switch setting	

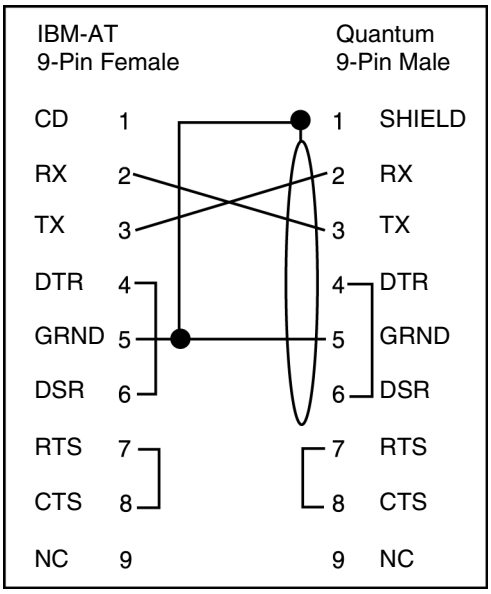
Modbus Connector Pinouts

The NOM modules are equipped with a nine-pin RS-232C connector that supports Modicon's proprietary Modbus communication protocol. The following figure shows the Modbus port pinout connections for 9-pin (left) and 25-pin (right) connections.



Modbus Ports Pinout Connections for Portable Computers

The following figure shows the Modbus port pinout connections for nine-pin portable (laptop) computers.



The following is the abbreviation key for the above figures.

TX: Transmitted Data	DTR: Data Terminal Ready
RX: Received Data	CTS: Clear to Send
RTS: Request to Send	NC: No Connection
DSR: Data Set Ready	CD: Carrier Detect

Quantum Modbus Plus Networking on Fiber Module

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140NOM25200 Quantum Networking Modbus Plus on Fiber Module

Overview

The following information pertains to the Modbus Plus on Fiber module, 140NOM25200. The Modbus Plus on Fiber module provides connectivity to Modbus Plus nodes by fiber cable.

There are many benefits that result from the use of fiber optics. Some of these benefits include:

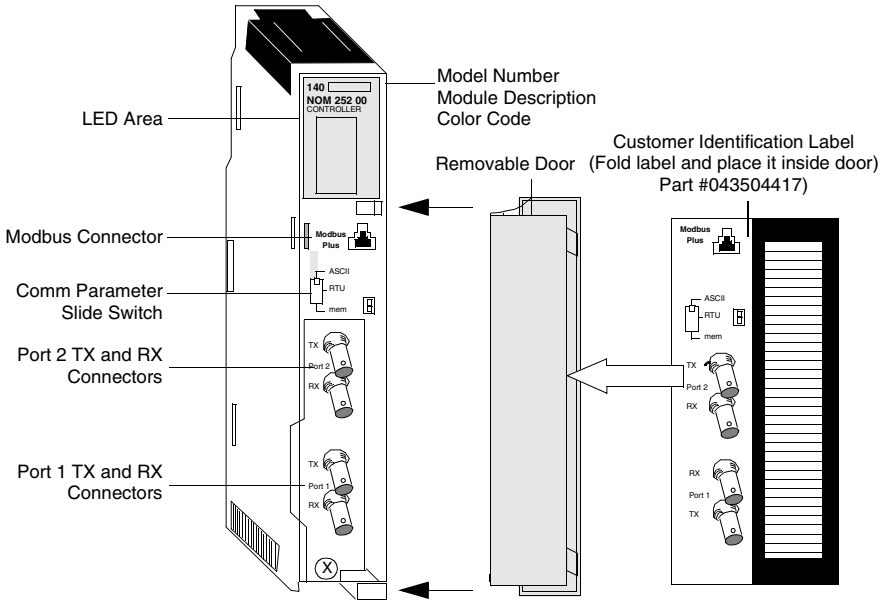
- Longer distances between nodes (up to 3 km), thereby, increasing the total length of the network.
- Fiber optic medium is not susceptible to the effects of electromagnetic interference, RF interference, and lightning.
- Intrinsically safe links that are required in many hazardous industrial environments.
- Total electrical isolation between terminal points on the link.

Related Documentation

For more detailed information on fiber optic network repeaters, see the *Fiber Repeater User Guide*, part number GM-FIBR-OPT.

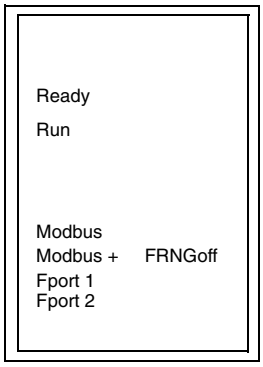
Modbus Plus on Fiber Module

The following figure shows the parts of the Modbus Plus 140NOM25200 module.



LED Indicators and Descriptions

The following figure shows the Modbus Plus on Fiber LED indicators.



The following table shows the Modbus Plus on Fiber LED descriptions.

LED Descriptions		
LEDs	**Color**	**Indication when On**
Ready	Green	The module has passed powerup diagnostics.
Run	Green	Indicates that the unit is in kernel mode – should always be OFF during normal operations. Note: The table for the NOM 21X 00 shows the number of times the RUN LED on the Modbus Plus on Fiber Module blinks for each type of error and the crash codes for each (all codes are in hex).
Modbus	Green	Indicates communication is active on the single RS-232 serial port.
Modbus+	Green	Indicates communication is active on the Modbus Plus port.
Fport1	Green	Indicates an optical signal has been received on fiber optic Port 1.
Fport2	Green	Indicates an optical signal has been received on fiber optic Port 2.
FRNGoff	Red	Indicates the first break in a self healing ring.

Specifications

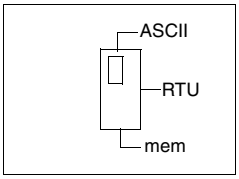
The following table shows the specifications for the NOM25200 module.

Specifications	
General Communication Ports	
Optical Ports	2 (consisting of an optical receiver and transmitter)
Modbus Port	1 RJ45 (phone jack-type) connector
Transmission/Data Rate	1 Mbit/second for Modbus Plus with Bi-Phase S encoded data
Optical Interface	ST-Type connectors
Pulse Width Distortions and Jitter	5 ns or better
Wavelength	820 nm
Power Loss Budget (includes 3 dB of system margins).	50/125 micron fiber - 6.5 dB
	62.5/125 micron fiber - 11 dB
	100/140 micron fiber - 16.5 dB
Maximum Distance for point-to-point connection	2 km over 50 micron fiber
	3 km over 62.5 micron fiber
	3 km over 100 micron fiber
Maximum System Length in Self Healing Ring Configuration	10 km over 62.5 micron fiber
Optical Transmitter Specifications	
Optical Power (Measured with 1 m test fiber)	-12.8 ... -19.8 dBm average power in 50/125 micron fiber cable
	-9.0 ... -16 dBm average power in 62.5/125 micron fiber cable
	-3,5 ... -10.5 dBm average power in 100/140 micron fiber cable
Rise/Fall Time	20 ns or better
Silence (OFF leakage)	-43 dBm
Optical Receiver Specifications	
Receiver Sensitivity	-30 dBm average power
Dynamic Range	-20 dB
Detected Silence	-36 dBm
Miscellaneous Specifications	

Specifications		
Diagnostics	**Power Up**	**Runtime**
	RAM	RAM
	RAM Address	RAM Address
	Executive Checksum	Executive Checksum
	Processor	
Power Dissipation	4 W	
Bus Current Required	750 mA max	
External Power	Not required for this module	

Front Panel Switch

A three-position slide switch is located on the front of the unit. This switch is used to select the comm parameter settings for the Modbus (RS-232) port. The three options that are available, as shown in the figure below, include setting the slide switch in the top position (ASCII), middle position (RTU), or bottom position (Valid mem comm port parameters).



Setting the slide switch to the top position assigns ASCII functionality to the port. The following table shows the ASCII comm port parameters, which are set and cannot be changed.

ASCII Comm Port Parameters	
Baud	2,400
Parity	Even
Data Bits	7
Stop Bits	1
Device Address	Rear panel rotary switch setting

Setting the slide switch to the middle position assigns remote terminal unit (RTU) functionality to the port; the following RTU comm parameters are set and cannot be changed.

RTU Comm Port Parameters	
Baud	9,600
Parity	Even
Data Bits	8
Stop Bits	1
Device Address	Rear panel rotary switch setting

Setting the slide switch to the bottom position gives you the ability to assign comm parameters to the port in software; the following parameters are valid.

Valid Mem Comm Port Parameters		
Baud	19,200	1,200
	9,600	600
	7,200	300

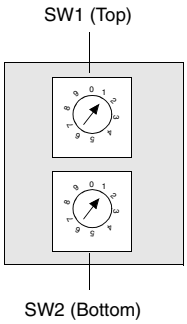
Valid Mem Comm Port Parameters		
	4,800	150
	3,600	134.5
	2,400	110
	2,000	75
	1,800	50
Data Bits	7 / 8	
Stop Bits	1 / 2	
Parity	Enable/Disable Odd/Even	
Device Address	Rear panel rotary switch setting	

Rear Panel Switches

Two rotary switches are located on the rear panel of the modules. They are used together to set the Modbus Plus node and Modbus port address for the unit.

Note: The highest address that may be set with these switches is 64.

Rotary SW1 (top switch) sets the upper digit (tens), and rotary SW2 (bottom switch) sets the lower digit (ones) of the Modbus Plus node address. The following illustration shows the setting for an example address of 11.



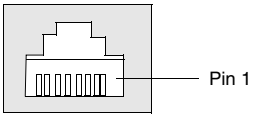
The following figure shows the node address settings for the SW1 and SW2 switches.

SW1 and SW2 Address Settings		
Node Address	**SW1**	**SW2**
1 ... 9	0	1 ... 9
10 ... 19	1	0 ... 9
20 ... 29	2	0 ... 9
30 ... 39	3	0 ... 9
40 ... 49	4	0 ... 9
50 ... 59	5	0 ... 9
60 ... 64	6	1 ... 4

Note: If "0" or an address greater than 64 is selected, the Modbus + LED will be "on" steady, to indicate the selection of an invalid address.

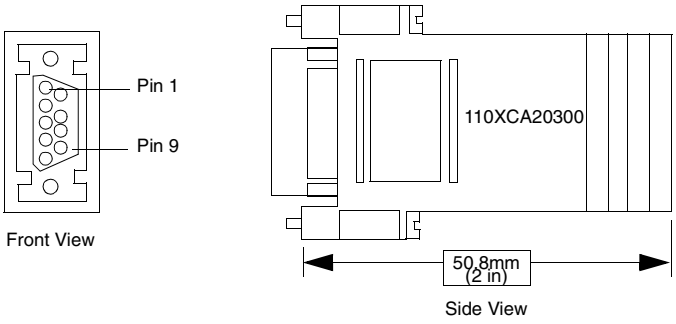
Modbus Connector

The NOM25200 module is equipped with an RS-232 port (see below) located on the front of the module. This port uses an eight-position RJ45 (phone jack-type) connector. The following figure shows the NOM25200 Pin 1 connector.

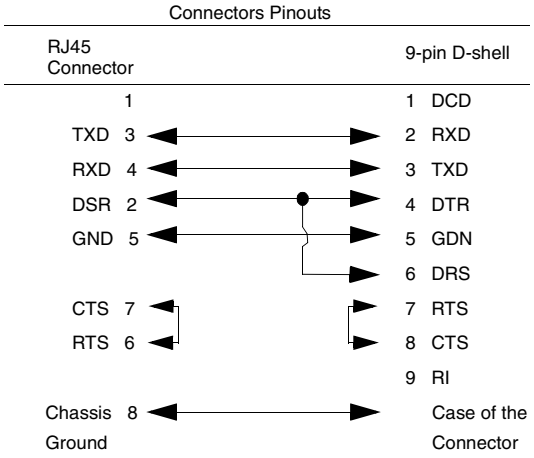


Note: A D-shell adapter is available from Modicon for NOM 252 00-to-computer connections: a (110 XCA 20 300) 9-pin adapter for PC-AT type computers (see the illustration pinout table below).

The following figures show the 9-pin adapter front view (left) and side view (right).

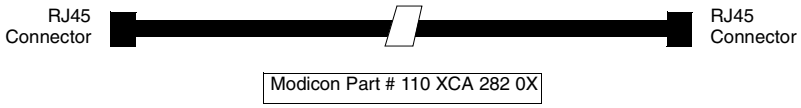


The following figure shows the 9-pin RJ45 connector schematic.



RJ45 Cable Types

This following figure shows the RJ45 connector, Modicon Part #110XCA2820X cable. The table provides part numbers and cable lengths..

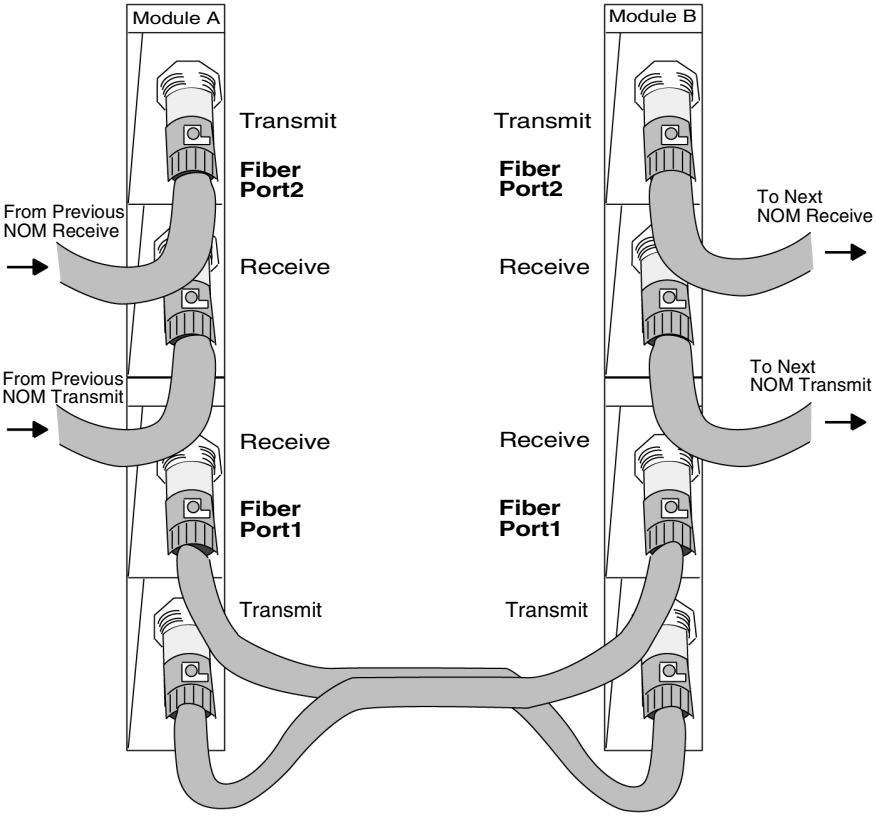


Cable Part Numbers	Cable Lengths
110XCA28201	3 ft. (0.91 m)
110XCA28202	10 ft. (3 m)
110XCA28203	20 ft. (6 m)

Fiber Optic Cable Connections

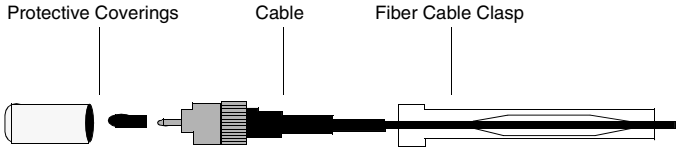
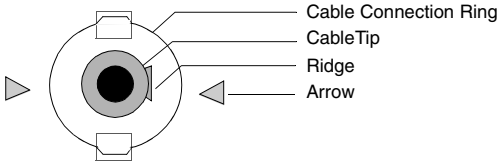
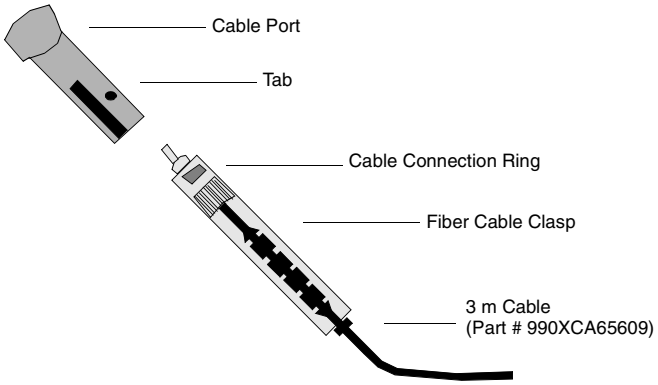
The NOM25200 module is connected in the Quantum system by a fiber optic cable (see the following figure). The cable has two strands. Each module transmits a signal in one direction. For this reason, each strand must be connected to the transmit port on one module and the receive port on the other.

One strand of the fiber optic cable is labelled every 10 inches with the manufacturer's name and the cable specifications. This is the only way to distinguish the two strands.



Connecting the Fiber Optic Cable

The following steps show how to connect the fiber optic cable.

Step	Action
1	Remove the protective plastic coverings from the cable ports and the tips of the cable. Snap one of the fiber cable clasps (shipped with the module) over the cable so that the wider end of the tool is closest to the cable end. 
2	Turn the connection ring so that one of the arrows on the side of the ring lines up with the ridge inside. 
3	a. Slide the tool up to the connection ring. b. Gripping the cable with the plastic cable clasp, slide the cable end onto the lower cable port. The arrow and the ridge on the connection ring should lineup with the slot on the left of the cable port. c. Use the clasp to push the cable over the tab on top of the port. d. Turn the cable to the right, so that the tab locks securely e. Remove the clasp. f. Repeat this process with the remaining strand of cable. 

Fiber Optic Configurations

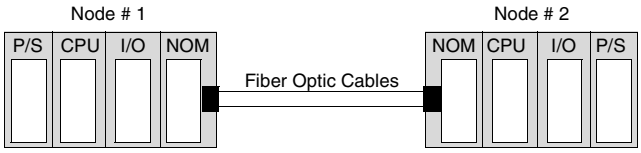
The following represent four typical configurations that show the wide range of the network architecture:

- Point-to-Point connection
- Bus configuration
- Tree and Star configurations
- Self Healing Ring configuration

Point-to-Point Configuration

Point-to-point configuration (see the following figure) allows communication over the distance of up to 3 km through harsh industrial environments. The following figure shows the point-to-point configuration.

Point-to-Point Configuration Example



Bus Configuration

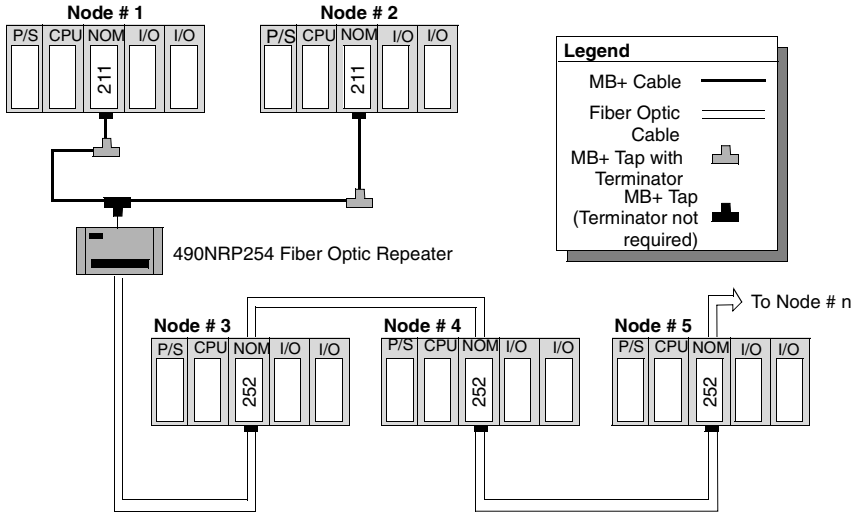
This type of configuration is used when it is required to connect a number of fiber nodes and can be used to increase the distance of a standard Modbus Plus network by changing to a fiber medium. This kind of network allows the connection of up to 32 Quantum NOM252 nodes over the distance of 5 km.

The following illustrations show the NOM25200 module in a mixed fiber optic/twisted pairs bus configuration network and a pure fiber optic bus configuration network.

	**CAUTION** **Equipment Failure** The loss of a single node in this configuration disables the rest of the network. It is suggested that the Self Healing Ring configuration be used to avoid this problem. **Failure to follow this precaution can result in injury or equipment damage.**

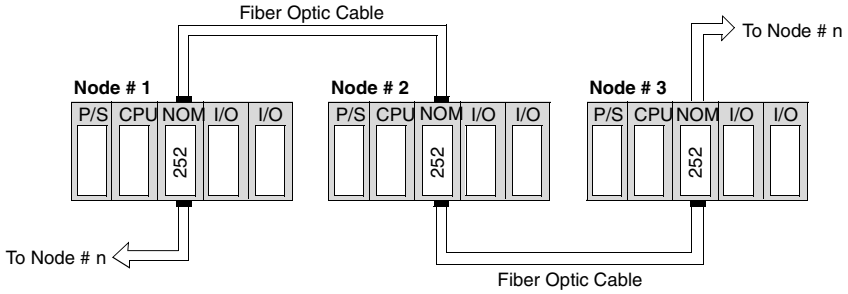
The following figure shows the mixed fiber optic/copper network.

Bus Configuration Example 1
(Mixed Fiber Optic/Copper Network)



The following figure shows the pure fiber optic network.

Bus Configuration Example 2
(Pure Fiber Optic Network)

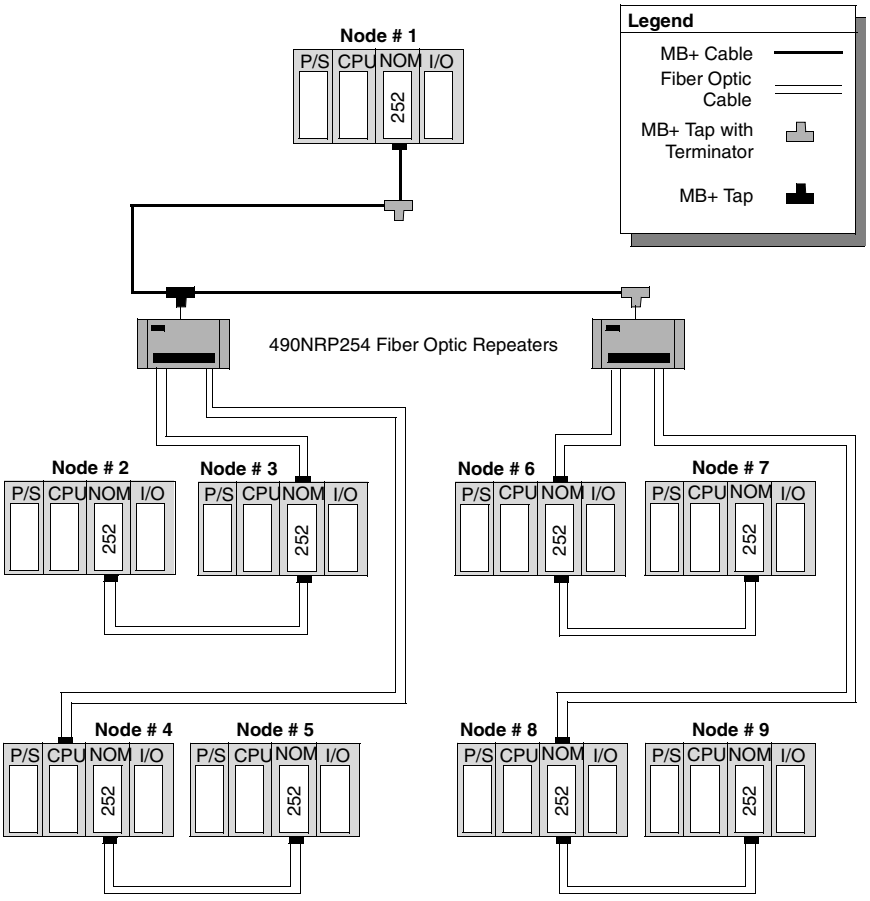


Note: The distance between nodes on fiber is limited by the maximum allowable power loss from end-to-end (3 km over 62.5 mm fiber). Power loss includes the fiber optic cable attenuation, connector losses at the Fiber Optic Receiver and Transmitter ports, and the system margin of 3 dB.
The end NOM25200 in this configuration will have the FRNGoff LED active and will display the Cable B Framing error in the MBPSTAT (in ladder logic).

Tree and Star Configurations

The use of tree and star configurations can provide flexibility in the layout of Modbus Plus and NOM 25200 networks. The following illustrations show examples of tree and star configurations. Additional repeaters can be connected in order to extend communication between electrical links.

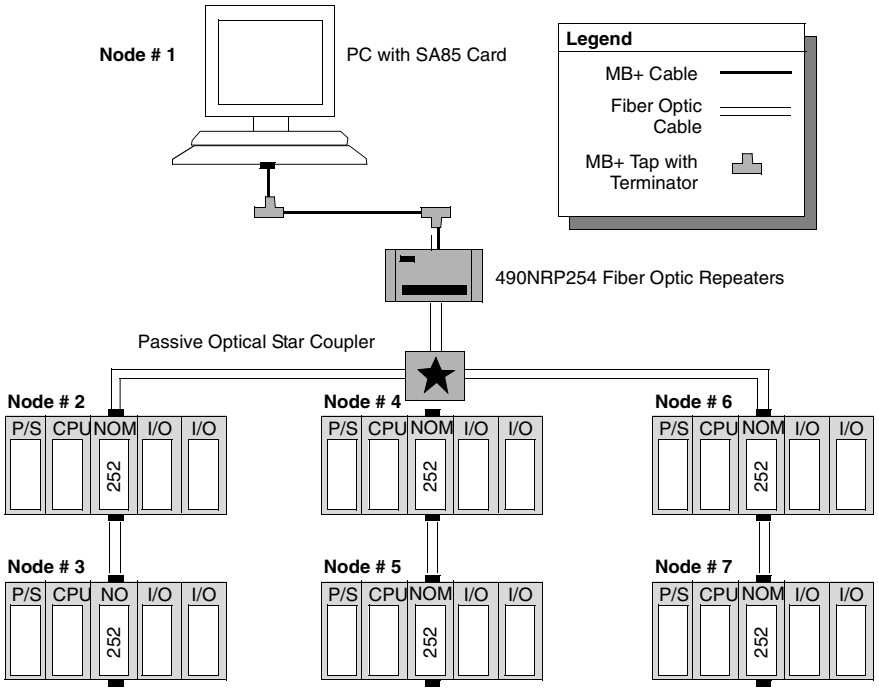
Tree Configuration Example



Star Coupler Configuration

Commercially available passive optical star coupler devices can also be introduced to the optical link to provide added flexibility to the NOM25200 network. A typical four-port star coupler could be used as follows on a NOM25200 optic link.

Star Coupler Configuration Example



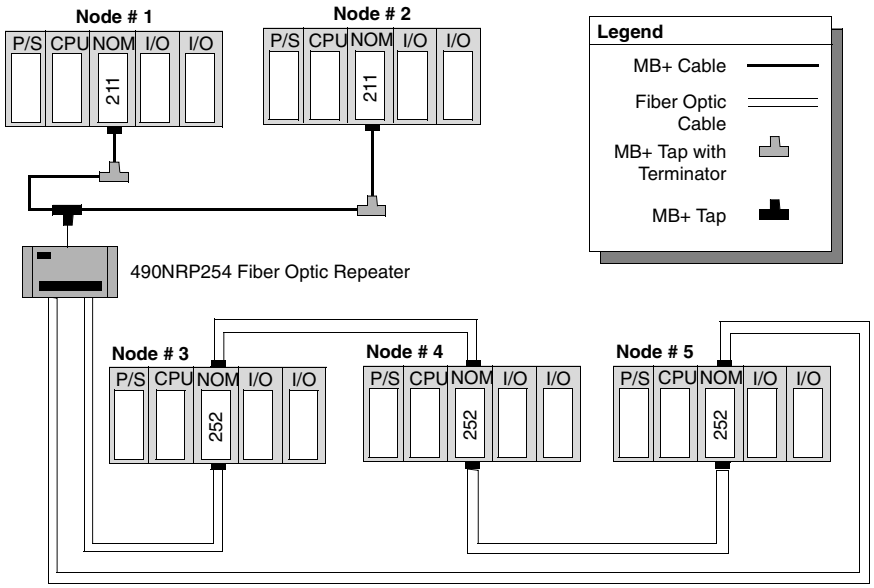
Note: If a passive optical star coupler is used:

- The number of repeaters and the length of each segment of fiber cable must be calculated separately and cannot exceed a maximum pulse width, distortions of 200 ns, between any nodes at the end of the branches.
- 100/140 mm fiber cable is recommended because of its higher available optical power.
- The use of a maximum of four ports of the passive optical star coupler is recommended.

Self Healing Ring Configuration

This configuration can be achieved by connecting the unused fiber optic ports of the first and last NOM25200 directly or through the fiber optic repeater, if a mixed fiber optic/twisted pairs network is used. This type of connection has all the advantages of the previously described configurations, along with built-in redundancy. A broken connection between any two Quantum modules in the ring will automatically reconfigure the network to the Bus Configuration and continue the communication.

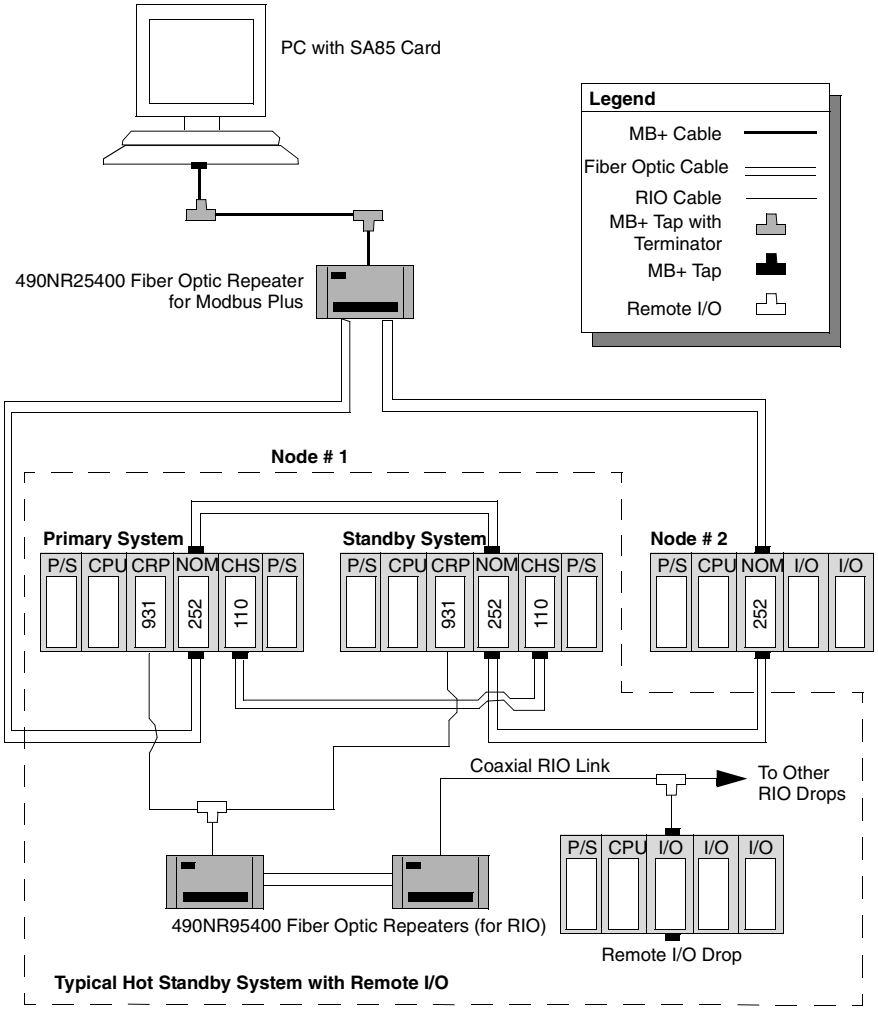
Self-Healing Ring Configuration Example



Hot Standby Systems

The following figure shows the self healing ring configuration for hot standby systems example.

Self Healing Ring Configuration for Hot Standby Systems Example



Network Status

The information about the condition of the network is presented in the form of Network Status. This information indicates the loss of connection (the first break in the self healing ring) and is similar to the way existing 140NOM21200 reports the loss of redundant cable.

The break of the fiber cable will be detected by the module not receiving the signal from the side where the cable is broken and will be reported as a Cable B Framing error by MBPSTAT. This condition will also activate the FRNGoff LED on the front of the module.

Recommended Materials for Fiber Optic Links

Modicon does not manufacture fiber optic products such as cables, connectors, or special tools. However, we have experience with third party suppliers of materials and can give some guidelines on what will work with our products.

Connectors

The following table shows the connector types

Connector Type	Part Number	Operating Temperature
ST Bayonet (Epoxy)	3M 6105	-40 ... +80° C
ST Bayonet (Hot Melt)	3M 6100	-40 ... +60° C
ST Bayonet (Epoxy)	AMP 501380-5 Series	-30 ... +70° C
ST Bayonet (Epoxy)	AMP 503415-1 Series	-20 ... +75° C
Light_Crimp ST Style	AMP 503453-1 Series	-20 ... + 60° C
Mechanical Line Splice (one size fits all)	3M 2529 Fiberlok1 II	-40 ... +80° C

Note: All connectors must have a short boot for strain relief.

Termination Kits

The following table shows the termination kits.

Kit Type	Part Number	Description
Bayonet ST (Epoxy)	AMP 503746-1	For all epoxy type ST style
Light_Crimp XTC	AMP 50330-2	For all Light_Crimp
Mechanical Line Splice	3M 2530	Fiber Splice Prep Kit, complete with cleaving tool
3M Hot Melt	3M 05-00185 3M 05-00187	110 V Termination Kit 220 V Termination Kit

Optical Star Passive Couplers

The AMP Model 95010-4 is a pig-tail option and must be used with an enclosure (use AMP Model 502402-4, a 19 in rack-mount enclosure, 1.7 in high).

Other Tools

The following table shows other tools that may be needed for fiber optic links.

Product	Part Number	Description/Use
3M (Photodyne) Optical Source Driver	9XT	Hand-held optical source driver (requires a light source)
3M (Photodyne) Optical Light Source	1700-0850-T	850 nm Light Source, ST Connectors for 9XT
3M (Photodyne) Power Meter	17XTA-2041	Hand-held Fiber Optic Power Meter
3M Optical Light Source, 660 nm, visible	7XE-0660-J	Use with 9XT to troubleshoot raw fiber, requires FC/ST patch cord
3M FC/ST Patch Cord	BANAV-FS-0001	Connects FC connector on 7XE to ST
3M Bare Fiber Adapter, ST-compatible	8194	Permits use of above source and meter to test raw fiber (two required)

Cables

It is recommended that you use 62.5/125 µm cable (such as AMP 503016-1, AMP 502986-1, or equivalent) with a maximum attenuation of 3.5 dB/km in most of the configurations.

Note: Modicon recommends using the 990XCA65609 cable.
When passive star couplers are used, 100/140 micron cable (such as AMP503016-3, AMP502986-3, or equivalent) with a maximum attenuation of 5.0 dB/km is recommended because higher optical power can be pumped in 100 µm cable and as a result, greater distance (up to 1 km) between units can be achieved.

Note: All cables must have a maximum cable diameter of not more than 3 mm at the terminal side.

Connections

The following information discusses connecting the NOM25200 on fiber cable, adding a new mode to the network, and repairing the break in the cable.

Note: When a new network is assembled, it is recommended that you connect all cables before powering up the system. Connect fiber optic cables as described previously in this section.

Adding a New Node to the Network

If a new node is added to an existing network in order to extend the network (at the end of any configuration), then a new node may be connected first by fiber cable and then hot-swapped to the backplane to avoid errors to the existing network.

If a new mode is added to the middle of the network, the fiber optic cables need to be disconnected from one side of the existing NOM252 module and connected to port 1 or 2 of a new node. Additional fiber optic cable then needs to be connected to the second port of the new NOM252 and to the next NOM252 in the network, the new NOM252 then has to be hot-swapped to the backplane.

Repairing the Break in the Cable

Because the NOM25200 will stop transmitting in the direction from which it is not receiving the signal, the replacement of a broken fiber optic cable and the reconnection of it will not re-establish communication over that segment. The hot swap of only one NOM252 at the repaired connections is required to complete the connection.

Note: The break of any fiber connectors or fiber optic cables is the equivalent to the break of the trunk cable in a Modbus Plus network on copper.

For the self healing ring configuration, the repair of the first break in the fiber optic network has to be scheduled to the time when one of the units on either side of the repaired break can be hot-swapped without creating the problem by disconnecting the node.

Note: Self healing configurations are not considered redundant networks. High system availability can be achieved with redundant networks.

Calculating Number of Modules in a Fiber Network

Calculate the number of NOM25200 modules in a fiber network using the following table:

Step	Action
1	The total allowable pulse width distortions and jitter are limited to 20% of the bit period and is 200 nsec for the full fiber optic network.
2	The jitter contributed by the NOM252 is 5 nsec max.
3	Jitter contributed by fiber optic repeaters (if used) is 40 nsec.
4	The formula to determine the number (N) of chained repeaters is: $N = \frac{200\text{nsec} - X(L)\text{nsec} - 40\text{nsec}}{5\text{nsec}} + 1$ where "L" is the total cable length (km), and "X" is the jitter (added by the fiber optic cable) in nsec/km: X = 3 ns/km for 50/125 µm 5 ns/km for 62.5/125 µm 7.5 ns/km for 100/140 µm