Instruction Bulletin

SY/MAX ®

Class 8030 Type CRM565
Network Interface Module
(For Square D PowerLogic™ Circuit Monitor)
Bulletin #30598-756-01A1
May, 1990

**Dedicated to Growth
Committed to Quality**

WARNING

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter, and apply this product. Potential bodily injury, death, or equipment damage could result if the product is improperly applied to any equipment application.

CAUTION

SY/MAX devices contain electronic components that are very susceptible to damage from electrostatic discharge. DO NOT handle this device by the gold edge contacts.

A static charge can accumulate on the surface of ordinary plastic wrapping or cushioning material. If any SY/MAX device must be returned to Square D, the following packaging instructions must be followed:

PREFERRED: Use the original packaging material as supplied by Square D. Place the device inside the metallized static-shielding bag.

ACCEPTABLE: Wrap the device in some type of antistatic material. Antistatic plastic material can be identified by its pink color, and can be obtained in sheet or bag form.

UNACCEPTABLE: Do not use ordinary plastic film, foam, or styrene chips ("popcorn" or "peanuts"). These materials can accumulate static charges in excess of 10,000 volts, resulting in possible damage to the SY/MAX electronic components.

CAUTION

Improper handling may cause permanent damage to this device.

1) Never remove this device from the rack while power is ON. Turn power supply switch to OFF and wait until all indicating lights are off before removing.
2) Do not subject to static discharge.
3) Do not touch gold edge contacts.

NOTICE

The products and services described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying the products and services described herein are responsible for determining their acceptability for each application. While efforts have been made to provide accurate information within this manual, the Square D Company assumes no responsibility for the application, completeness or usefulness of the information contained herein.

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Preface

The Class 8030 Type CRM565 PowerLogic Network Interface Module (PNIM) is a special SY/NET Network Interface Module (NIM) that allows complete monitoring, configuration, and control of a group or subnetwork of PowerLogic Circuit Monitors.

Square D's PowerLogic Circuit Monitor (CM) is a multifunction instrumentation, data acquisition and control device capable of replacing conventional power distribution metering, and data acquisition equipment. Its ability to communicate metering information via an RS-485 (RS-422 compatible) communication channel to a SY/MAX® Processor, or similar master, allows it to replace discrete meters.

The PowerLogic Circuit Monitor can be applied virtually anywhere standard current and voltage transformers can be used. Refer to Bulletin 63074-140-XX for detailed information concerning PowerLogic.

How to Use This Bulletin

First time users should start with Sections 1 and 2 of this bulletin which provide basic information about the PNIM. Section 3 describes the SY/NET local area network and can be skipped by those who have experience using SY/NET.

Section 4 covers the configuration of the PNIM and of PowerLogic networks in general. It provides an overview for those who wish to set up a PowerLogic network.

Section 5 discusses network communication programming while Section 6 covers PowerLogic Circuit Monitor network operations.

Section 7 describes how the PNIM operates.

Troubleshooting information is provided in Section 8.

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1.0 INTRODUCTION TO THE PNIM

1.1   What Is the PNIM?

The Class 8030 Type CRM565 PowerLogic Network Interface Module (PNIM) allows SY/MAX device communication with Square D PowerLogic Circuit Monitors. Using PNIMs, the transmission media between circuit monitors and SY/MAX devices can be twisted pair cable.

This manual is intended to be used with the PowerLogic Circuit Monitor Instruction Bulletin 63074-140-XX.

The PNIM provides a communications interface between one active SY/MAX compatible Master device (and/or SY/MAX network of devices), and up to 16 circuit monitors daisy chained (networked) on PNIM Port 0. Data exchange is accomplished by reading from and writing to registers in the circuit monitors.

PowerLogic Network operation is completely transparent, allowing reading and writing of circuit monitor register data and Input and Output Status. No special programming language is required other than standard ladder logic for SY/MAX processors, and advanced BASIC for the SY/MAX D-LOG Data Controller.

The PNIM is all that is required to link Square D PowerLogic Circuit Monitors with the SY/NET local area network. Each PNIM communicates with up to 16 circuit monitors using half-duplex single channel communication. Each PNIM may be connected to an entire network of SY/MAX or compatible devices.

The PNIM can be used in conjunction with the SY/MAX Class 8030 CRM510, CRM570 Network Interface Modules for applications requiring remote communications to ProVox*, Honeywell or other Modbus** compatible (via CRM570) systems.

The PNIM may also be used in conjunction with the Class 8030 CRM560 Remote Network Interface Module to obtain Remote Area Networking capability.

1.2   What Are Typical Applications?

The PNIM is useful for any monitoring or control application where PowerLogic Circuit Monitors are integrated with SY/MAX programmable controllers.

The following are typical applications where PNIMs are applied for data gathering and/or control:

- Energy Management
- Power factor correction
- Planning system loads

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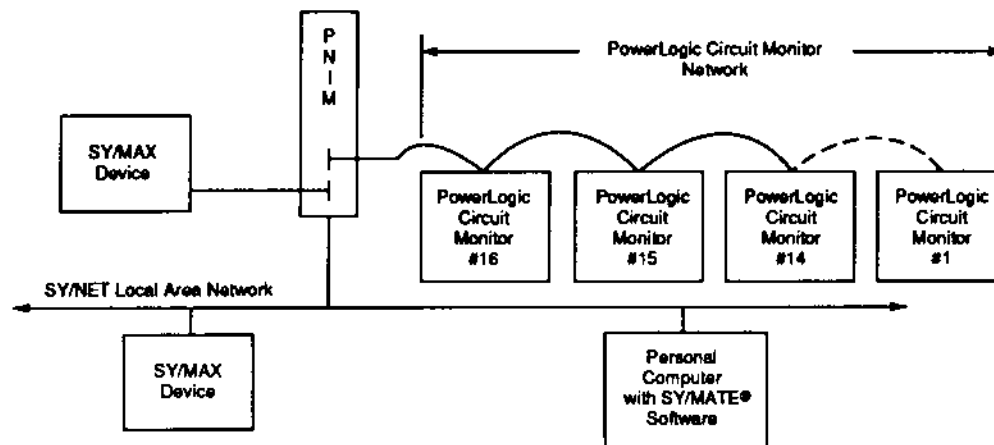
* ProVOX is a registered trademark of Fisher Controls.
** MODBUS is a registered trademark of AEG/Modicon Corp.

- Internal billings

- Power distribution system diagnostics

- Preventive maintenance

The following operations are possible:

- Reading and writing register data

- Reading and writing I/O status

- Circuit Monitor Configuration

1.3 Specifications

1.3.1 PNIM Specifications

Mounting Requirements

One register slot of a Class 8030 Type CRK, DRK, GRK, HRK, or RRK I/O rack assembly.

Current Draw on SY/MAX Power Supply

950 mA

Operating Temperature

32 - 140°F
(0 to 60°C)

Storage Temperature

-40 to +176°F
(-40 to +80°C)

Humidity Rating

5-95% noncondensing

Connectors:

Network Port

Connects PNIM to local (SY/NET) network.

COMM Port 0

9-pin female D-connector, RS-422 compatible. Selectable baud rate (see Section 3.5.1). Protocol depends on mode setting.

COMM Port 1

9-pin female D-connector, RS-422 compatible. Selectable baud rate (Section 3.5.1). Uses SY/MAX protocol.

Indicator Lights

8 LEDs: Network, Rx 0, Tx 0, Rx 1, Tx 1, NET Rx ERROR, NET Tx ERROR, POWER (see Section 2.2).

Physical Dimensions

Single-width module
Wt: 2.7 lb. (1.22 kg)
W: 1.5 in. (3.8cm.)
H: 12.8 in. (32.5cm.)
D: 6.6 in. (16.8cm.)

1.3.2 SY/NET Network Specifications

Topology

Bus

Bus Media

Baseband twinaxial cable, Belden 9272 or equivalent (for local network only).

Bus Connectors

Dual concentric twist lock. Tees, cable ends, joints, etc. are available from Square D. (See Section 3.4.1.)

Bus Terminators

Required on each end of the Local Network cable. (See Section 3.4.1.)

Bus Cable Length

Communication baud rate dependent (cable length vs BAUD rate). Max, 15,000 ft./4,572 m (See Section 3.4.2).

Transmission type

Manchester Encoded HDLC.

Access method

Time coordinated Access (TCA), based on time windows.

Priority

Based both on module number (lower number has higher priority), and on level of network activity.

Error checking

CRC (cyclic redundancy check) on all network transmissions.

Message routing

Source/destination message routes are placed in the command for each device wishing to communicate.

Number of devices per bus cable

Up to 100 compatible interface devices (see below) per SY/NET network. Each network interface device supports two additional devices, for a total capacity of 200 devices per network. Networks can be linked to provide access to over 10,000 devices.

1.3.3   Powerlogic Circuit Monitor Network Specifications

Topology   Master/slave* (M/S).

M/S media   RS-422 PORT: Dual twisted-pair cable, Belden 8723 or equivalent. Use a modem to adapt to other media such as Telco, radio, or fiber optics. NETWORK PORT: Same as Local Network. (Refer to 1.3.1)

M/S connectors   9-pin D connector, available from Square D Company.

M/S cable length   Maximum 10,000 feet of Belden** 8723, depending on device that is attached. Use of modem allows unlimited length, depending on modem used.

Transmission type   RS-422 half-duplex with CRC-16.

Access method   Master-initiated.

Error checking   Same as local network.

Message routing   Same as local network.

Number of devices   Maximum 16 circuit monitors.

Compatible devices Same as local network.

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*   The Master can be any SY/MAX or compatible device (i.e. SY/MAX processor, or SY/MATE software package such as ScreenWare2 or 234 Link).

** Belden is a registered trademark of Belden Electronic Wire and Cable Inc.

2.0   PNIM HARDWARE DESCRIPTION

2.1   General

The PNIM consists of a module that mounts in, and draws power from, a register slot in a SY/MAX I/O rack. Located on the front of the PNIM are eight indicator lights, two thumbwheel switches and two communication ports (COMM ports). On the bottom front of the module is a high speed network port. On the module circuit board are configuration DIP switches.

2.2   Indicator Lights

The PNIM has eight indicator lights (see Figure 2.1) which aid in troubleshooting. The lights are:

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┌─────────────────────────┐
│  ○ NETWORK              │
│  ○ Rx0                  │
│  ○ Tx0                  │
│  ○ Rx1                  │
│  ○ Tx1                  │
│  ○ NET Rx ERROR         │
│  ○ NET Tx ERROR         │
│  ○ POWER                │
└─────────────────────────┘
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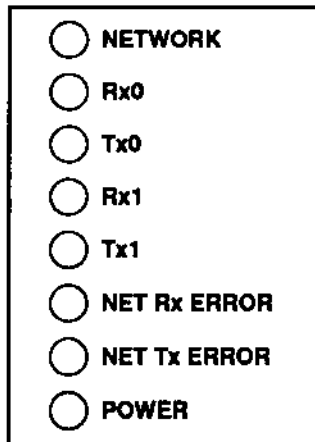
Figure 2.1 - PNIM LEDs

NETWORK - This AMBER light, when on, indicates activity on the Local Area Network. Typically this light is very dim; this is normal. As more and more devices communicate over the Network, this light will glow brighter.

Rx 0 - This AMBER light indicates that the PNIM is receiving data from the device(s) connected to COMM Port 0.

Tx 0 - This AMBER light indicates that the PNIM is transmitting data to the device(s) connected to COMM Port 0.

Rx 1 - Same as Rx 0 except for COMM Port 1.

Tx 1 - Same as Tx 0 except for COMM Port 1.

NET Rx ERROR - This RED light indicates that a communication error has occurred on received data. This light indicates an overflow condition (PNIM buffer is full), or an erroneous message has been received.

NET Tx ERROR - This RED light indicates that an error has occurred when the PNIM attempted to send a message on the Network. Typically this occurs when a message is routed to a NIM that does not exist, or an acknowledge to a message has not been received.

POWER - This GREEN light indicates that the PNIM has power applied. The Power LED is wired directly to the incoming 5 VDC power on the module.

Note: See Section 8.0 for additional information on operation of lights.

2.3   Network Address Thumbwheel Switches

On the front of the PNIM are two thumbwheel switches. These switches (see Figure 2.2) are used to assign a Network Interface Number (address) to the CRM565, and in turn a unique Network Device Number (NDN) to each device connected to the PNIM.

On the right side of the module are two access holes which allow the thumbwheels to be set using a small screwdriver.

2.5   Network Port

On the bottom of the PNIM is a network port. This female connector (Figure 2.4) is used to connect the PNIM to the Local (SY/NET) Network cable.

Click here to view graphic.

Figure 2.2 - Thumbwheel Switches

2.4   Circuit Board DIP Switches

On the rear of the PNIM are three groups of DIP switches labeled S3, S4, and S5. See Figure 2.3.

Click here to view graphic.

Figure 2.4 - Network Port

2.6   COMM Ports

On the front of the PNIM are two COMM ports (Figure 2.5). These ports are used to interface with the SY/MAX Family devices, modems, PowerLogic circuit monitors and other devices. These ports operate as RS-422 ports and will not support RS-232C devices directly. Each port operates independently and supports handshaking (Request to Send - RTS, and Clear to Send - CTS) signals. Adaptors for the conversion of RS-422 to RS-232 are available (Class 8010 Type CRM600 Single Channel Standalone and Class 8030 CRM601 Dual Channel Rack Mount).

Click here to view graphic.

Figure 2.3 - DIP Switches

DIP switch group S3 contains four individual switches (numbered 1 to 4) and is used to set the baud rate at which the high-speed network port is to operate. DIP switch groups S4 and S5 each contain seven individual switches (numbered 1 to 7) and are used to select the mode of operation, comm port baud rate and other special functions for communication ports 1 and 0, respectively.

See Section 4.2.2 for more information on DIP switch settings.

Only COMM Port 0 can be selected for PowerLogic Mode, and hence only this port can be used to establish communication link with circuit monitors. When in this mode, communication is half-duplex and CRC error checking is used. (Optionally, COMM Port 0 can be set for SY/MAX mode, but this setting prevents the PNIM from being used for circuit monitor network communication.)

COMM Port 1 can only be used in the SY/MAX Mode. This allows a SY/MAX Master (i.e. processor) or compatible device to communicate with 16 (max) PowerLogic Circuit Monitors connected to COMM Port 0.

The COMM ports can operate at baud rates of 1200, 2400, 4800 and 9600 when in the SY/MAX or Power-Logic Mode.

Maximum distance between either of the PNIM COMM ports and a connected device is 10,000 feet (3,048 M). In a typical application, COMM Port 1 is connected to a SY/MAX device while COMM Port 0 is connected to 1-16 Square D PowerLogic Circuit Monitor(s).

Click here to view graphic.

Figure 2.5 - COMM Ports

3.0   LOCAL AREA NETWORK CONFIGURATION AND CONNECTIONS

3.1   Introduction

This section presents general information about the SY/NET Local Area Network. Sections later in this manual will then describe how PowerLogic Circuit Monitor networks operate.

3.2   Local Network Configuration

The SY/NET Local Area Network (LAN) is a high speed industrial communication system which allows up to 200 SY/MAX devices to intercommunicate. The network has a bus configuration with a single twinaxial cable serving as the network communication bus. See Figure 3.1

SY/MAX Processors and other devices such as computers with SY/MAX protocol, printers, D-LOG modules, and other compatible devices are connected to the network through Class 8030 Type CRM5XX SY/NET Network Interface Modules (NIMs) or through SY/LINK Type SFI5XX personal computer network interface boards.
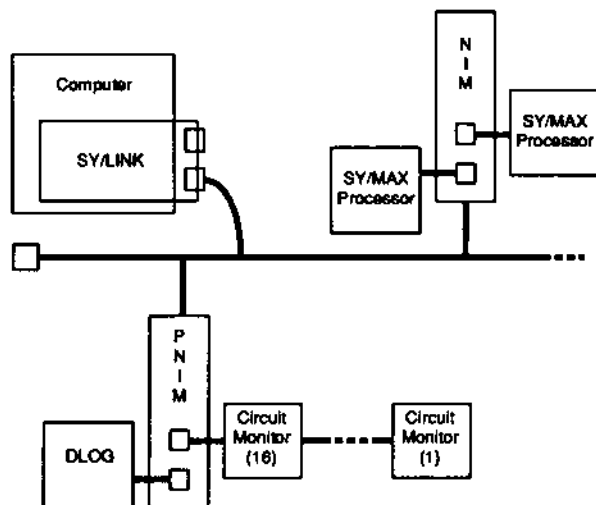
Figure 3.1 - Typical SY/NET Local Network Configuration

A maximum of 100 network interfaces (NIMs, PNIMs, or SY/LINK boards) can be connected to a single network. Each interface can connect two SY/MAX devices to the network. Therefore, a network can have a maximum of 200 SY/MAX devices.

However, even more devices can communicate by connecting multiple networks together.

A SY/NET Network Interface Module mounts in a register slot of a SY/MAX programmable controller I/O rack assembly. A NIM has a two digit thumbwheel for setting its Network Interface Number (address) between 00 and 99.

Click here to view graphic.

Figure 3.2 - Network Interface Module

A NIM has two RS-422 compatible COMM ports to which the programmable controllers or other devices are connected. The two ports are numbered 0 and 1. These port device numbers are combined with the NIM Network Interface Number to identify the devices for network communications. For example, the device connected to port 1 of NIM 55 would be identified by the number 155 in the route portion of network communication commands. The device connected to port 0 of the same module would have the number 055. (See Section 5.3 for a discussion of network route instructions.)

On the bottom of a NIM module is a high speed, network port to which the network cable is connected. This port is connected directly to a Tee connector on the network cable (see Figure 3.2) or to an extension cable which leads to a Tee connector.

Like a NIM, the SY/LINK board also allows two devices to be connected to the network. One device is the computer in which the board is mounted, a second device can be connected to the RS-422 port on the SY/LINK board. See Figure 3.1.

For network-to-network communication, a COMM port on one network is connected to a COMM port on another network using a CC100 series differential communication cable. The two COMM ports involved in the net-to-net connection must have the same address number and must both be set to the NET-TO-NET mode via the DIP switches. For example, port 007 on network 1 must be connected to port 007 on network 2. See Figure 3.3 The two ports must also be set for the same baud rate. See Section 5.3.1 for a discussion of the routing necessary for net-to-net communication commands.
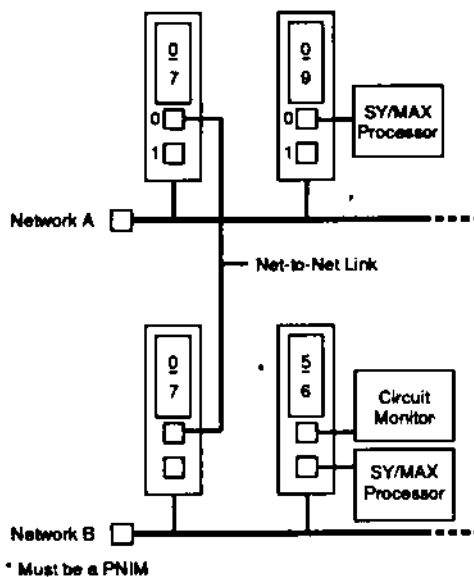
Figure 3.3 - Network-to-Network Configuration

3.3   NIM COMM Port Connections

The COMM ports on a NIM utilize RS-422 compatible signal levels.

The following signals are available at the NIM COMM ports.

Pin Number	Function	Direction
1	Transmit Data -	Out
2	Transmit Data +	Out
3	Receive Data -	In
4	Receive Data +	In
5	Clear to Send +	In
6	Request to Send +	Out
7	Clear to Send -	In
8	Request to Send -	Out
9	Shield	

3.3.1   NIM to SY/MAX Device

To connect a NIM COMM port to a SY/MAX family device, a Class 8010 Type CC100 series cable is re-

quired. This cable can be purchased in several lengths:

Class	Type	Length
8010	CC100	10 feet (3 meters)
8010	CC101	30 feet (9.1 meters)
8010	CC102	2 feet (0.6 meter)
8010	CC104	2 feet (0.6 meter)
8010	CC105	10 feet (3 meters)

Series CC100, 101, and 102 cables DO NOT support handshaking (RTS and CTS signals). Series CC104 and CC105 DO support handshaking.

When an application requires a cable length longer than 30 feet (9.1 meters), the user can purchase a connector kit and assemble a custom length cable of up to 10,000 feet (3,048 meters).

The cable connector kit (Class 8010 Type CCK102) consists of:

Qty	Description
2	DB9P, 9-Pin Connectors
2	DB9P Connector Covers
18	Connector / Pins

Recommended cable type is Belden 8723 or equivalent or Belden 9502 (UL/CSA Approved) (2 pairs shielded, with ground). Pin connection for Series CC100, 101 and 102 cables (no handshaking) is shown in Figure 3.4. Connection of Series CC104 and 105 (with handshaking) is shown in Figure 3.5.
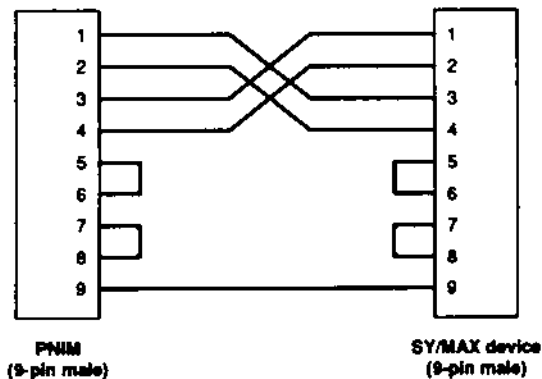
Figure 3.4 - Type CC100, 101 and 102 Series Cable Wiring Diagram (no handshaking)

Type CC series cables can be used for connecting a variety of SY/MAX devices. Consult the device Instruction Bulletins for the devices being used.
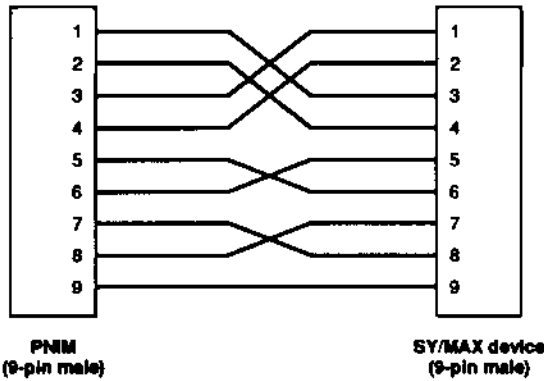
Figure 3.5 - Type CC104 and 105 Series Cable Wiring Diagram (with handshaking)

> # WARNING
> **Never connect the communication cables with handshaking to any SY/MAX processor port. The 5VDC power available on these ports (pins 5, 6, 7 & 8) may damage the other device the cable is connected to.**

3.3.2 RS-232 Device to NIM

When it is necessary to connect an RS-232 device to a NIM, and RS-232 to RS-422 adaptor can be used. Square D offers two such adaptors: the Class 8010 Type CRM600 and Class 8030 Type CRM601. The CRM601 is a dual channel device that mounts in a SY/MAX register slot, while the CRM600 is a single-channel freestanding unit. See Figure 3.5. Consult the CRM601 Instruction Bulletin 30598-152-XX and the Printer Instruction Bulletin 30598-176-XX for more information.
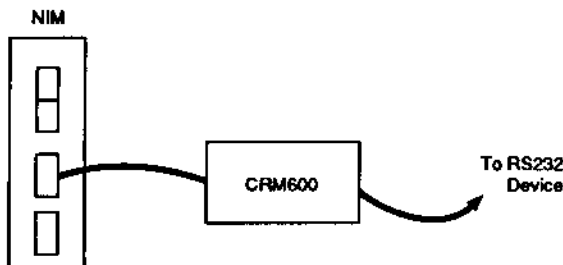
Figure 3.6 - Connecting an RS-232 Device

3.4 Network Port Connections

The network port on the NIM connects to a Tee connector in the network cable. See Figure 3.7
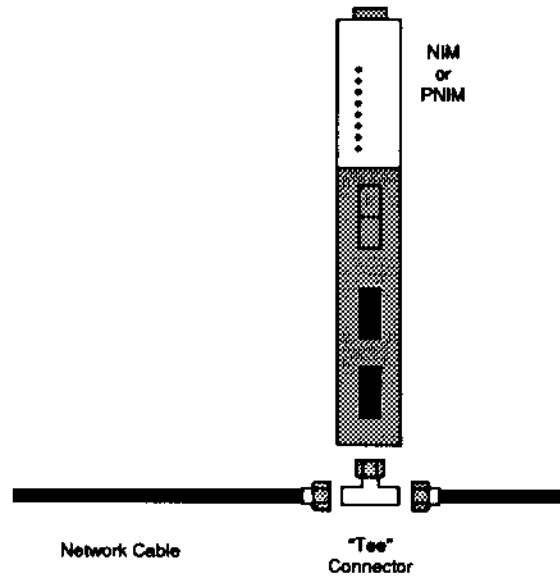
Figure 3.7 - Network Cable Connections

The NIM network port can also connect to a Type CC202 or similar cable which in turn connects to the Tee connector for an extended drop length (see Figure 3.8).

3.4.1 Network Cable and Connectors

The main network cable consists of Belden 9272 twinaxial cable or equivalent. Factory assembled cables (complete with cable ends) are available in two lengths:

Class	Type	Length
8030	CC201	2 feet (0.6 meter)
8030	CC202	10 feet (3 meters)

These cables are useful for connections between closely located network components. Most users, however, will find it necessary to assemble longer cables to meet specific application requirements.
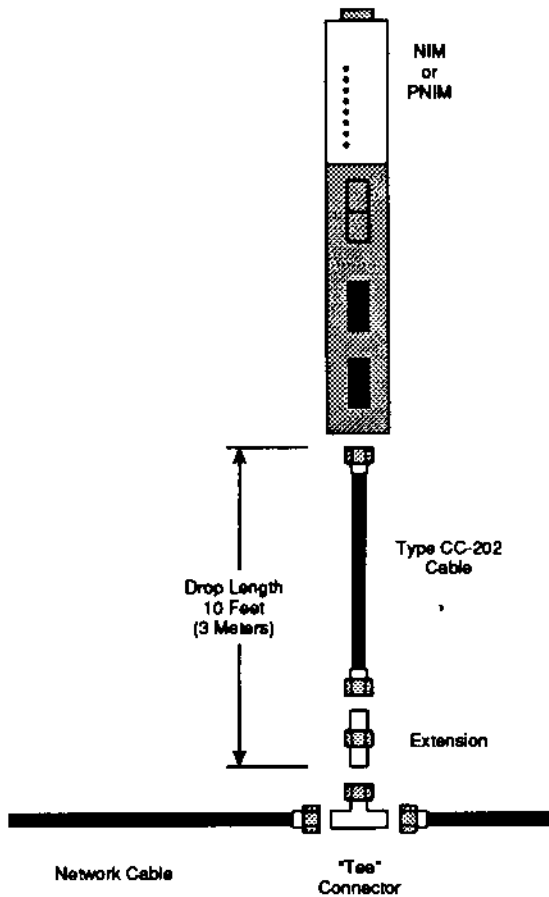
Figure 3.8 - Extended Network Cable Connection

When building a network cable, the following types of connectors are used:

Class	Type	Connector
8030	CCK211	Cable End
8030	CCK212	Tee Connector
8030	CCK213	Terminator (set of 2)
8030	CCK214	Cable Extension

Cable End - The cable end consists of a female socket. Two cable ends are required for each length of network cable.
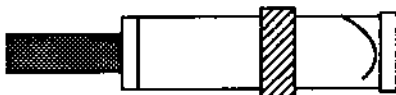
Figure 3.9 - Cable End

See Appendix A for cable assembly instructions.

Tee Connector - The Tee connector allows a NIM or SY/LINK board to tie into the network cable. The Tee connector has two male plugs which connect to the network cable and a female connector which connects to the NIM or SY/LINK board.
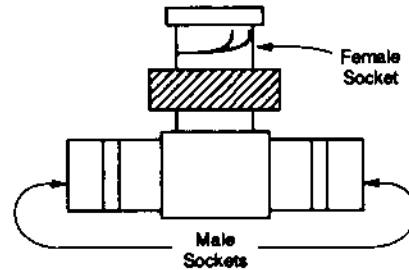
Figure 3.10 - Tee Connector

Terminator - A terminator is required at each end of the main network cable (two terminators required per network). The terminator consists of a female socket and an internal 78 ohm resister. It mates to a male plug on the Tee connector, or to a cable extension.

Figure 3.11 - Terminator

Cable Extension - The cable extension consists of two male plugs. This extension can be used to (1) connect two network cables together, (2) replace a Tee connector when a NIM or SY/LINK board is removed from the network, (3) provide the splice for the future installation of a NIM or SY/LINK board by replacing the cable extension with a Tee connector, and (4) extend the distance between a NIM and the Tee connector.
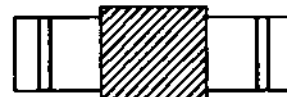
Figure 3.12 - Cable Extension

3.4.2   Network Cable Length

The maximum network cable length is dependent on the selected speed of network communication and on the drop lengths used on the network. The drop length is the cable distance between the NIM and the Tee connector.

The following table lists the maximum network cable length based on network baud rate.

Network Baud Rate	Maximum Network Length (Feet/Meters)
62.5 K Baud	15,000 / 4,572
125 K Baud	9,250 / 2,819
250 K Baud	4,250 / 1,295
500 K Baud	2,400 / 732

The above network cable lengths are based on connecting the network Tee connector directly to the NIM (drop length of 0 feet).

When it is necessary to extend the length of the network drop, the following chart can be used as a guide in determining the maximum possible network length.

Network Baud Rate	Number of Drops	Drop Length	Maximum Network Length (ft/m)
500 K Baud	100	0	2,400 / 732
250 K Baud	100	0	4,250 / 1,295
125 K Baud	100	0	9,250 / 2,819
62.5 K Baud	25	100	15,000 / 4,572
62.5 K Baud	100	100	950 / 290

3.4.3   Network Cable Installation Considerations

When installing the network cable, the following rules should be applied:

1. Provide a minimum six inch (15 cm) distance between the network cable and 120 VAC. Provide 12 inches (30 cm) distance from 240 volts AC and 24 inches (61 cm) from 480 volts AC.

2. When the network cable is routed through conduit, the conduit must be grounded to building steel.

The signal level on the network cable is approximately five volts DC (RS-422 voltage levels, Manchester encoded). Routing of the network cable should be done in accordance with standard wiring practices for low level switching signals. See Instruction Bulletin 30598-174-XX (Planning and Installation Guide).

3.5   Network Performance Considerations

A number of factors effect the efficiency with which messages are transmitted on the network. Network throughput can be negatively affected if many devices wish to speak on the network at the same time. This problem can be avoided by programming that ensures that devices communicate no more often than is truly necessary.

The hardware factors that effect network performance include network cable length, network baud rate, and network size setting.

Network cable length was discussed in Section 3.4.2.

3.5.1   Network Baud Rate

A network baud rate of 62.5K provides the highest noise-tolerance and the maximum network cable length. By increasing the network baud rate to 125K baud, network speed (throughput) is increased by seven percent. Each doubling of the network baud rate will improve throughput by seven percent up to a maximum baud rate of 500K. See Section 3.4.2 for maximum network cable length based on baud rate.

Note: Each SY/LINK Board, NIM, and PNIM on the network must be set for the same network baud rate.

3.5.2   Network Size Setting

The SY/NET network can have a maximum of 100 network interfaces (SY/LINK board or NIMs) on a single network. However, to improve information throughput/performance, the network size can be set for a maximum size of 31 (interface numbers 00 through 30).

This setting is only possible for networks having 31 interfaces or less. Any interfaces numbered 31 to 99 will not gain access to the network.

Note: All interfaces on the network must have the same network size setting.

Network performance and application programming are discussed more specifically in the SY/NET Network Interface Module Instruction Bulletin.

4.0 POWERLOGIC CIRCUIT MONITOR NETWORK CONFIGURATION AND CONNECTIONS

4.1 Circuit Monitor Network Configuration

The PNIM allows a SY/MAX device to be connected to COMM Port 1 while COMM Port 0 is used for PowerLogic circuit monitor network communication. See Figure 4.1. The PNIM can also be connected to a SY/NET network through its network port. This local network connection is optional (See Section 3).
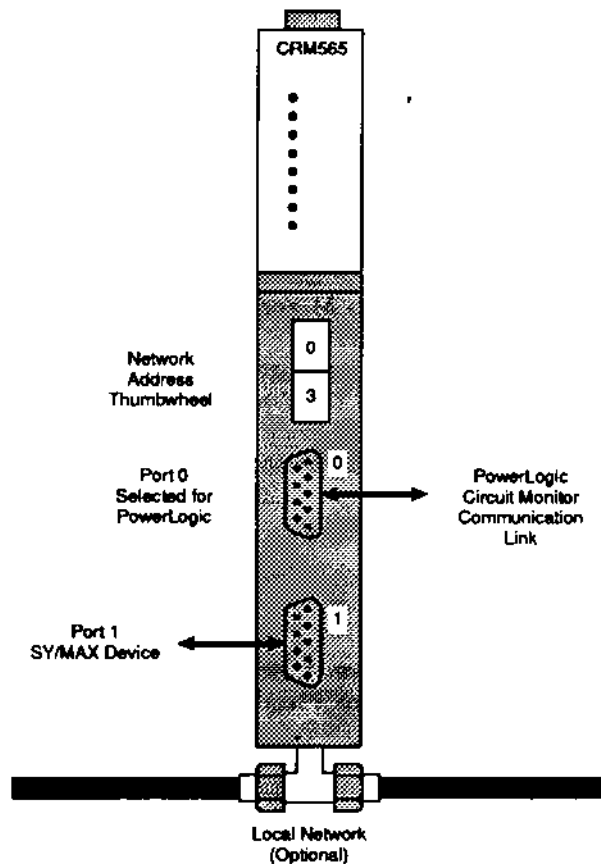
Figure 4.1 - PNIM Connections

Each network has up to 99 NIMs or PNIMs. In general, the PNIM initiates communication with circuit monitors. Typically, the PNIM is located on a power distribution lineup or in a control room, while the circuit monitors are placed at various circuit locations.

Each PNIM can be connected to its own local network. Figure 4.2 shows a typical circuit monitor network with a PNIM communicating to circuit monitors.

4.1.1 Circuit Monitor Mode (Port 0 Only)

The PowerLogic Mode enables a SY/MAX device connected either directly to the PNIM or connected to a SY/NET Local Area Network containing a PNIM to initiate communication commands over the network to circuit monitor(s). Communication commands include READ, and WRITE rungs (ALARM rungs cannot be used to communicate with a CM) for SY/MAX Programmable Controllers. When using a D-LOG Data Controller, communication commands include GETN and PUTN.

PowerLogic Mode is selected via DIP switch settings. See Section 4.2.2.
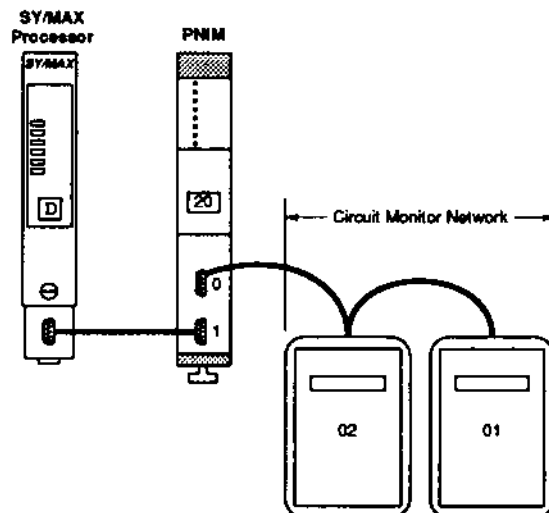
Figure 4.2 - Circuit Monitors on a Network

4.1.2 SY/MAX Mode (Port 1 or 0)

SY/MAX mode is selected for a PNIM COMM port to allow a SY/MAX device to connect to that port. Port 1 can only be set for SY/MAX mode. Port 0 can optionally be set for SY/MAX mode, but this prevents Port 0 from being used for a circuit monitor network link (in this case, the PNIM would function as a standard NIM, providing local network communication for two SY/MAX devices).

SY/MAX mode is selected via DIP switch settings. See Section 4.2.2

4.2 PNIM Configuration

To configure the Class 8030 Type CRM565 PNIM for operation with the PowerLogic Circuit Monitor, it is necessary to properly set the module address thumbwheels and the module DIP switches.

4.2.1 Network Address Thumbwheel Setting

Each PNIM (or NIM, or SY/LINK board) is assigned a two digit Network Interface Number (address) between 00 and 99.

This number is set using the thumbwheels visible on the front of the module. Access holes on the right side of the PNIM allow a screwdriver to be used for thumbwheel switch changes.

The number selected refers to:

- Network Interface Number (used with each of the COMM ports)

- Network time slot

- Network module communication priority

The Network Interface Number (thumbwheel address), when used with the COMM port number will define a Network Device Number or ROUTE address. For example, the PNIM with thumbwheel number 15 has Network Device Numbers

        015   (COMM Port 0)
        115   (COMM Port 1)

+--+
| ## CAUTION: |
| |
| **Within one network, a Network Interface Number can be used ONLY ONCE. If more than one NIM has the same interface number, the network will not operate properly.** |
+--+

The device number is used to route messages from one device to another. Any device that is plugged into a COMM port on the PowerLogic Network Interface Module (or NIM) will assume that COMM port's device number.

Since the thumbwheel number can be set from 00 to 99 and each PNIM or NIM provides two COMM ports, the total number of devices that may be connected over a single SY/NET Local Area Network (LAN) is 100 x 2 = 200. Exception: When the PNIM is in the PowerLogic Mode, a maximum of 16 circuit monitors can interface to Port 0.

Note: If you need to connect more than 200 devices, the 8030 CRM510 or CRM540 Network Interface Module can be used to interconnect networks via a NET-TO-NET approach. See Instruction Bulletin 30598-257-XX or 30598-523-XX for more information.

4.2.2 DIP Switch Settings

On the rear of the CRM565 PowerLogic Network Interface Module are three groups of DIP switches labeled S3, S4, and S5. See Figure 4.3.
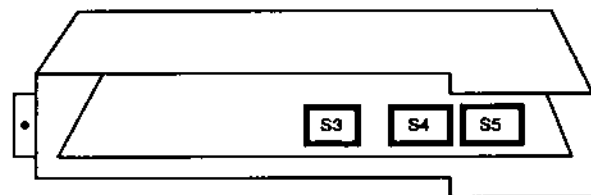
PNIM (Back)

Figure 4.3 - DIP Switch Location

DIP switch group S3 contains four individual switches (numbered 1 to 4) and is used to set the baud rate at which the SY/NET high speed network port is to operate. DIP switch groups S4 and S5 each contain seven individual switches (numbered 1 to 7) and are used to select the mode of operation, comm port baud rate and other special functions for communication ports 1 and 0 respectively.

Switch Group 3 - Network Baud Rate

Switch group S3 selects the communication baud rate of the SY/NET network port and *must* be set the same for *all* NIMs (or PNIMs) connected on the same network cable.

As the network baud rate is increased, it becomes necessary to limit the maximum overall length of the network cable in order to reduce noise susceptibility caused by signal reflections in the cable. For this reason, the network baud rate can be set for values from 62.5K to 500K baud. See Figure 4.4.

+--+
| ## CAUTION: |
| |
| **Remove power to the rack before removing or installing the CRM565 to change the DIP switches.** |
+--+

Switch Groups S4 and S5 - COMM Port Parameters

Each of the two PNIM COMM ports has a DIP switch group for setting communication parameters. Switch group S4 is for COMM port 1 and switch group S5 is for COMM port 0. These switches are used to select the following values:

- Broadcast Enable/Disable

- Mode of operation.

- Baud Rate

- Self test

- 100/31 network size
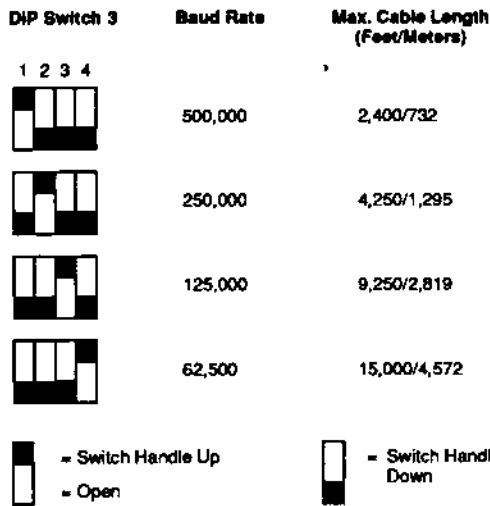
Figure 4.4 - DIP Switch 3 Baud Rate Settings

Switch groups S4 and S5 each contain 7 switches. (Each of these individual switches will be referred to by a group number followed by a switch number. For example, 4-1 switch is switch 1 of switch group 4.)

Switch 1 (Group 4 and 5) - Broadcast Enable (Not Applicable to PowerLogic Mode)

Switch 1 of switch group 4 and 5 select whether broadcast messages on the network port will be received by a COMM port. See Figure 4.5. Broadcast messages will only be accepted if COMM ports are setup for SY/MAX mode.

> ## CAUTION:
>
> Broadcast messages are NOT acknowledged by any Square D CRM-type module. The device sending the broadcast does not receive a reply, and therefore there is no guarantee the CRM-type module ever received it.

Switch 4-1 controls broadcast enable for port 1 while switch 5-1 serves the same function for port 0 (S5 is applicable only in SY/MAX mode).
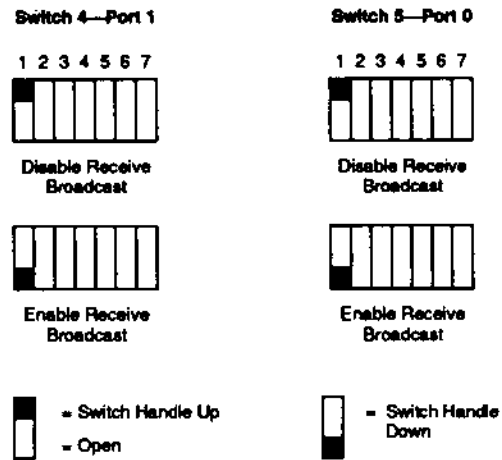
Figure 4.5 - Broadcast Enable Switch Setting

Switches 2 and 3 (Groups 4 and 5) - Operating Mode

The operating mode of the COMM ports is selected with switches 2 and 3 of switch groups 4 and 5. See Figure 4.6. Port 1 must be set for SY/MAX mode. Port 0 can be set for SY/MAX or PowerLogic mode.
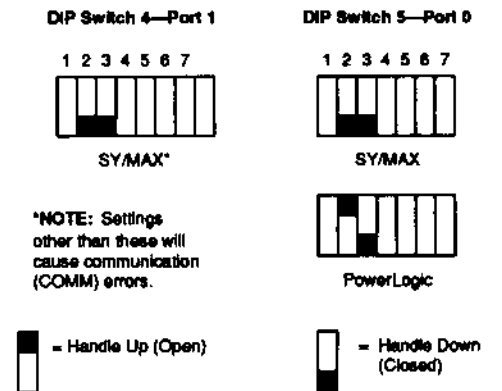
Figure 4.6 - Operating Mode Settings

Switches 4, 5 and 6 (Groups 4 and 5) - COMM Port Baud Rate

The baud rate of the COMM ports is selected with switches 4, 5 and 6 of switch groups 4 and 5. See Figure 4.7. The switch settings for Port 0 will vary depending on whether SY/MAX mode or PowerLogic mode has been selected. (Port 1 must be set for SY/MAX mode.)

DIP Switch 4—Port 1
(SY/MAX)

DIP Switch 5—Port 0
(SY/MAX or PowerLogic)

DIP Switch 5

1 2 3 4 5 6 7 9600

1 2 3 4 5 6 7 9600

1 2 3 4 5 6 7 100 Interfaces (0-99)

4800

4800

31 Interfaces (0-30)

2400

2400

■ = Switch Handle Up
□ = Open

□ = Switch Handle Down

1200

1200

Figure 4.9 - Local Network Size Settings

■ = Switch Handle Up (Open)

□ = Switch Handle Down (Closed)
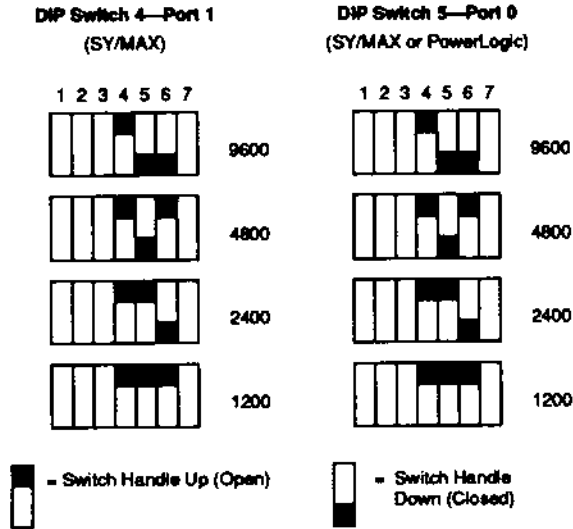
Figure 4.7 - COMM Port Baud Rate Settings

Switch Setting Summary

Figure 4.10 provides a summary of PNIM DIP switch settings.

Switch 7 (Group 4) - Self-Test Enable

Switch 7 of switch group 4 is set UP for normal PNIM operation, or DOWN to enable the self-test mode. See Figure 4.8.

DIP Switch 4

1 2 3 4 5 6 7 Normal

Self-Test

■ = Switch Handle Up
□ = Open

□ = Switch Handle Down
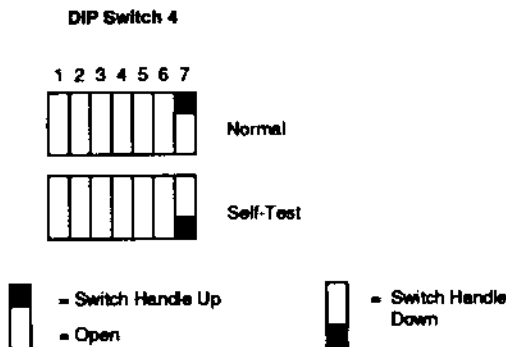
Figure 4.8 - Self-Test/Normal Settings

Switch 7 (Group 5) - Network Size

Switch 7 of switch group 5 is set UP for a local network size of 100 network interfaces (00 through 99), or DOWN to limit local network size to 31 interfaces (00 through 31). See Figure 4.9. Limiting local network size improves throughput (see Section 3.5.2). All NIMs and PNIMs on the same local network must be set for the same network size.

Figure 4.10 - DIP Switch Setting Summary

NIM Self-Test

To aid in toubleshooting, the CRM565 can run a self-test routine which checks internal ROM and RAM along with the two COMM ports and network port. To use this self-test, two test plugs (Class 8010 Type CTP-11) are required for the COMM ports.

Switch 7 on switchbank S4 activates the self-test sequences as shown on Figure 4.11.
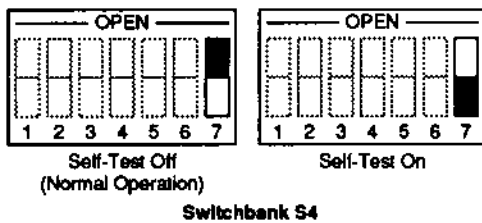
Figure 4.11 - Self-Test Activation

Note: The COMM ports MUST have the test plugs installed in them before the test sequence can be run.

Network Size

A SY/NET network can be configured for a maximum of either 31 NIMs or 100 NIMs (62 or 200 devices). When set for a maximum of 31 NIMs (network device numbers "00" to "30") network performance is improved 300% over the 100-NIM (00 to 99) setting. This is because internal timers within the NIMs no longer time to 100, but instead reset upon reaching network device number 30.

Switch 7 on switchbank S5 sets the network size as shown in Figure 4.12 below. If 31 or less NIMs are being used on a network, make sure this switch is set to the "30" position.
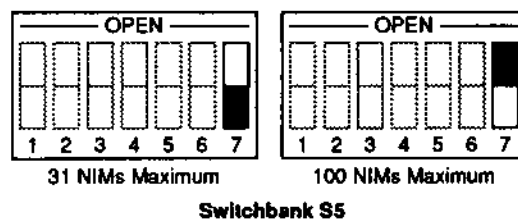
Figure 4.12 - Network Size Selection

Note: The side-panel label on the CRM565 shows network size selection as "30/100". The "30" here is the largest thumbwheel setting that can be used. When dealing with actual module count, interpret this as "31/100" since "00" is a valid network number.

> # CAUTION:
>
> **For proper operation, all modules on the SY/NET network MUST have the same network size number. If "SIZE 100" operation is desired and <u>even</u> <u>one</u> module on the network is set to "SIZE 30", the <u>entire</u> network operates as SIZE 30. All messages sent to modules with network device numbers of over "30" will not be acknowledged.**

4.3   Factory DIP Switch Settings

The CRM565 is shipped from Square D Company with the DIP switch configuration shown below in Figure 4.13.

The settings in Figure 4.13 configure the CRM565 to the following parameters:

**Network Baud
Rate** . . . . 62.5K baud

**COMM Port "1"
Operating Mode** . . . . . . SY/MAX

**COMM Port "0"
Operating Mode** . . . . .   SY/MAX

**COMM Port "1"
Baud Rate** . . . . 9,600 baud

**COMM Port "0"
Baud Rate** . . . . 9,600 baud

Self-Test . . . . Disabled

Network Size 100

Receive Broadcast . . . Disabled

■ Open/Off/Up   ☐ Closed/On/Down

S3   S4   S5
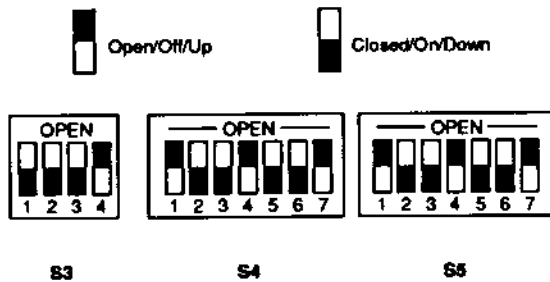
Figure 4.13 - Factory DIP Switch Settings

SY/NET® NETWORK INTERFACE CLASS 8030   TYPE CRM565

COMM. PORT SWITCH-SETTINGS S4 AND S5							NETWORK - SWITCH S3						S4 SWITCH 7 SELF-TEST	0 = OFF	CONSULT INSTRUCTION BULLETIN 30598-756-XX FOR ADDITIONAL INFORMATION

SWITCH			MODE	SWITCH			BAUD RATE
1	2	3		4	5	6	
RB	1	1	SY/MAX®	0	1	1	9600
				0	1	0	4800
X	0	1	POWERLOGIC™	0	0	1	2400
				0	0	0	1200

SWITCH				BAUD RATE
1	2	3	4	
0	1	1	1	500 K
1	0	1	1	250 K
1	1	0	1	125 K
1	1	1	0	62.5 K

S4 SWITCH 7 SELF-TEST	0 = OFF
	1 = TEST

S5 SWITCH 7 NETWORK SIZE	0 = 100
	1 = 31

SWITCH	
0	OPEN/OFF/UP
1	CLOSED/ON/DOWN
X	DON'T CARE

RB-RECEIVE BROADCAST	0 = OFF (DISABLED)
	1 = ON (ENABLED)

NETWORK DEVICE NUMBER	
1 _ _	0 _ _
S4	S5

Figure 4.14 - Network Interface Label

4.4   Module Installation and Keying

4.4.1   Installation

The PowerLogic Network Interface Module consists of a single module which can be plugged into the register slot of an I/O rack or any slot in a register rack. A PowerLogic Network Interface Module can be inserted in the following SY/MAX racks:

Class 8030 Type:

CRK100*	GRK210
CRK200*	HRK100
CRK210	HRK150
CRK300	HRK200
DRK210	RRK100
DRK300	RRK200
GRK110	RRK300

* These racks contain only *one* register slot.

The PowerLogic Network Interface Module operates on 5 VDC and obtains this power from a SY/MAX power supply when inserted in a register slot. No other signals exist between the PowerLogic Network Interface Module and the rack except for power connections.

4.4.2   Module Keying

Each register slot, whether on a digital or register rack, has a keying pin which is installed at the factory. This pin is located between slot location 4 and 6. Its function is to ensure that only register modules can be plugged into register slots.

Each SY/MAX register slot may be keyed to accept only one type of SY/MAX Register module. An optional keying pin kit, Class 8030 Type CBP104, is available for this purpose. The correct position of the keying pin for the Network Interface Module is between pins 14 and 16. See Figure 4.15. The keying pin is simply inserted manually into the slot of the rack connector.

CAUTION:

When inserting or removing the Keying pins, use care to avoid touching the contact fingers within the connector. Improper insertion/removal may damage the connector.

Register Slot

2
4
6
8

← Register Keying Pin Between Slots 4 and 6

14
16

← Optional Network Interface Module Keying Pin Between Slots 14 and 16
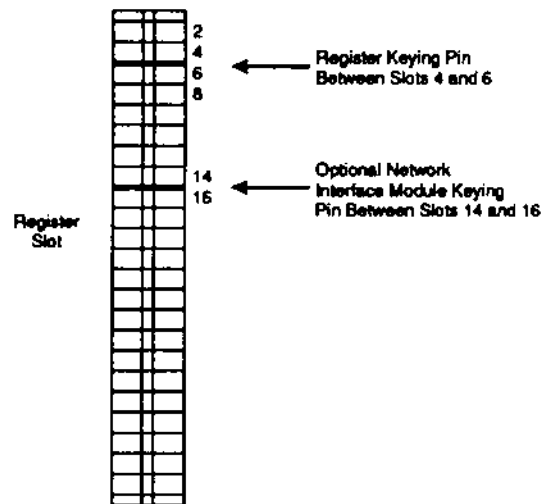
Figure 4.15 - Keying Pin Location

4.5 Circuit Monitor Communication Link Connections

Comm Port 0 of the PNIM is used for the circuit monitor communication link. See Figure 4.1

Port 0, when set to the PowerLogic mode, provides half-duplex RS-422 communication. The term half-duplex means that communication can occur in only one direction at a time (as opposed to a full-duplex which allows simultaneous two-way communication. Full-duplex is what occurs in the SY/MAX mode).

The differential, RS-422 signals provided at Port 0 are shown in the pinout diagram in Figure 4.16.
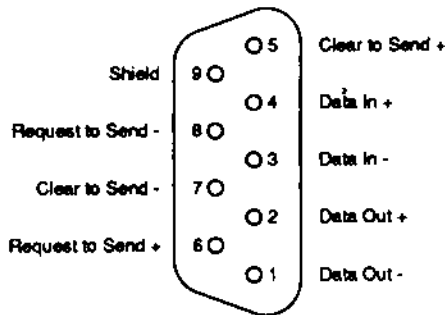
Figure 4.16 - PNIM COMM Port Signals

The Circuit Monitor requires a communication cable containing two shielded twisted pairs (Belden 8723 or equivalent). Communications wires are daisy-chained from one Circuit Monitor to the next, IN+ being wired to IN+, OUT- to OUT-, and shield to shield. The connection to a processor PNIM, or remote workstation is made using a 9-pin male (DB-9) connector. Figure 4-17 illustrates the required cable pinouts.
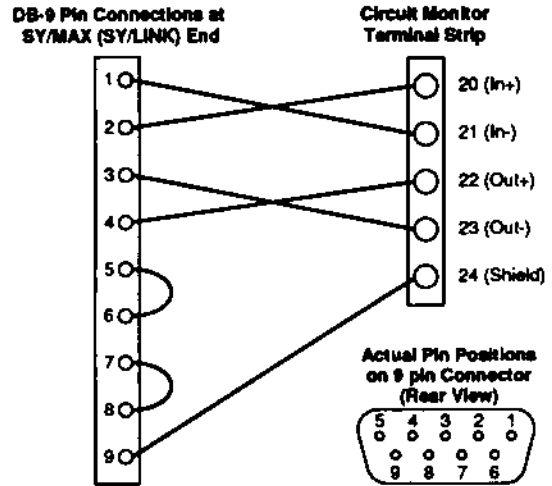
Figure 4.17 - Communication Cable Pinouts

5.0 SY/MAX COMMUNICATION PROGRAMMING

5.1 General

This section is intended to give the PNIM user an overview of programmable controller communication on the SY/NET network. Most of this information applies to circuit monitors as well as local networks. One notable difference is that an ALARM rung may not be used when communicating to a PowerLogic Circuit Monitor. Section 6 gives information on operations that are unique to circuit monitor networks. Additional information can be found in the following Instruction Bulletins:

30598-257-xx	SY/NET Network Interface Module (NIM)
30598-167-xx	SY/MAX Deluxe CRT Programmer
30598-272-xx	SY/MAX D-LOG Data Controller Module
30598-717-xx	SPR-350 Laptop Programmer

SY/MAX programmable controllers store and exchange information as register data. Timer and counter values are stored as register values. I/O status is stored as individual bits of data registers. SY/MAX processors also have control registers in which some bits identify current processor conditions and other bits control processor operating modes.

The activities of any processor, therefore, can be monitored or controlled by looking at or changing (reading or writing) the data in its registers. This can be done by devices connected directly to the processor or by devices communicating over the SY/NET network.

In addition, SY/MAX programming devices such as CRT Programmers and personal computers with SY/MATE programming software can send entire ladder programs to processors over the network.

5.2 SY/MAX Processor Communication Rungs

SY/MAX processors are able to initiate communication through communication rungs included in their ladder programs. When these rungs are activated, the specified information is sent or retrieved.

The following communication rung instructions are available:

READ - A READ rung is used to obtain the contents of one or more registers in a remote device and store this data in one or more registers in the device initiating the command (the local device).

WRITE - A WRITE rung is used to send register data values from the local device to registers in the remote device.

ALARM - An ALARM rung is used to send a single, programmed value from the local device to a storage register in a remote device. (Cannot be used with the Circuit Monitor.)

5.3 Routing

For communication over the SY/NET network, routing information must be added to the communication rungs. The route numbers identify which device is initiating the communication (source) and which device is receiving the communication (destination).

A route number is simply the Network Interface Number (thumbwheel address) of the PNIM to which the device is connected, preceded by a 0 or 1 depending on which COMM port the device is connected to. For example, in Figure 5.1, the device connected to port 1 of interface 56 has a route value of 156.

See Section 5.4 for additional examples.

5.3.1 Net-to-Net Routing (Net-to-Net cannot be used with the PNIM).

For communication from one network to another, more than two route numbers are required. Between the originating route and the destination route, a net-to-net route is placed. The net-to-net route is the interface and port number that connects the two networks; this number must be the same on both networks. A Class CRM510 or CRM540 NIM must be used if net-to-net operation is desired.

In Figure 5.1, a communication from the SY/MAX Processor on network A to the SY/MAX Processor on network B would use the following route values: 009 (originating), 012 (net-to-net), 156 (destination).

If more than two networks are connected, a series of net-to-net route values may be used to route a message through several networks.
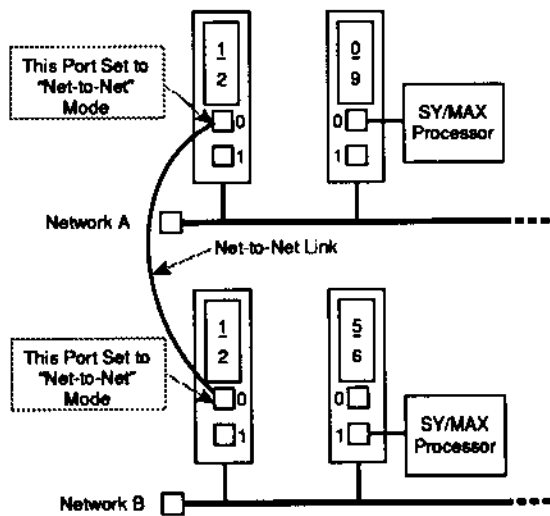
Figure 5.1 - Net-to-Net Communication

5.3.2 Circuit Monitor Network Routing

To communicate with a circuit monitor network, one route value is required in addition to SY/NET source and destination routes. This additional route value is the device number of the circuit monitor.

Note: Each PNIM on a SY/NET Local Area Network must have a unique address.
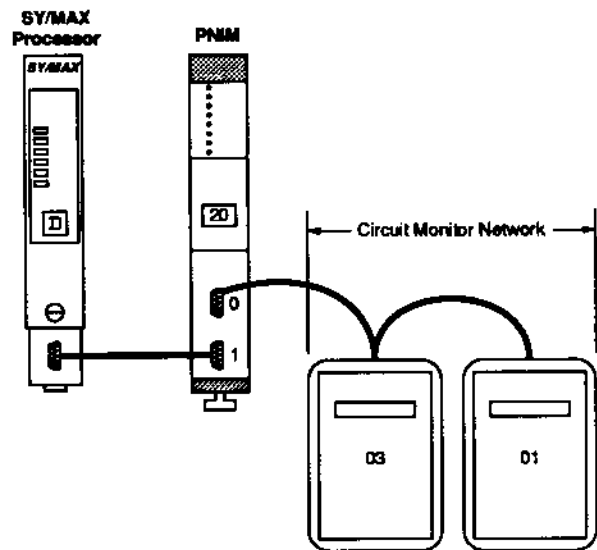
Figure 5.2 - Circuit Monitor Routing Example

For example, using the circuit monitor network shown in Figure 5.2, if the SY/MAX processor is to send a message to circuit monitor 3, the following sequence of route values must be used in the processor communication program:

120, 020, 03

where:

120   is the device number of the SY/MAX processor, the initiating device (port 1 of interface 20).

020   is the device number of the PNIM used for the circuit monitor communication link (port 0 of interface 20).

03   is the device number of circuit monitor 3, the destination device.

To communicate from the SY/MAX processor to circuit monitor 1, the following route sequence would be used:

    120,020,01

This would route the message over the circuit monitor network to circuit monitor 1.

Note: When multiple CMs are connected to a single communication channel, there must be one (and only one) CM whose device address switches are set to 01. This should be the *last* CM on the link. (See section 5.1 of the PowerLogic Manual 63074-140-XX.)

5.4 Example Rungs

Note that the only difference between implementing a SY/NET LAN (Local Area Network) and a Circuit Monitor Network in the following examples is in the routing used. See Section 5.3.2.

5.4.1 READ Rungs

Figure 5.3 shows a sample network layout. Suppose Processor A requires some register data from Processor B. This can be accomplished by programming the following READ rung in Processor A.
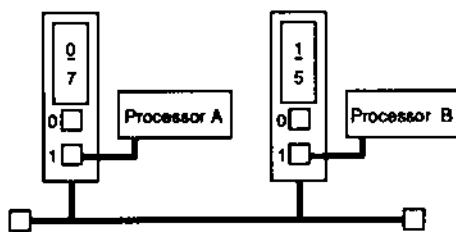
Figure 5.3 - Example Network Layout
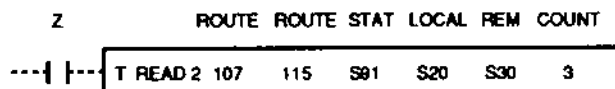
Figure 5.4 - Network READ Rung

The above rung will read the contents of registers 30, 31, and 32 from the remote Processor (Processor B) and put the data into registers 20, 21 and 22 of the local Processor (Processor A). The purpose of each element of the rung is as follows:

Z	The initiating contact which activates the rung.
READ	The command for getting data from another Processor.
2	Refers to communication using processor COMM port #2.
ROUTE 107	The network route number for initiating device (Processor A).
ROUTE 115	The network route number for the destination device (Processor B).
STAT S91	Use register S91 in Processor A as the status register. The status register contains information on the progress of the communication message.
LOCAL S20	The first register (starting address) in the local Processor to contain the data to be read.
REM S30	The first register in the remote from which data will be read.
COUNT 3	The number of consecutive registers that will be read.

The communication rung is enabled once for each closure of contact Z because the READ rung is transition sensitive.

Communication Progress

During communication (contact Z closed), the STAT (status) register will contain data on the progress of the communication rung. The following is a description of the status register data. (This information applies equally to READ and WRITE rungs.)

Status
Register Bit   Description

Bit 1   ON = error in communication

Bits 1-14   Error code (1 through 16383; all
               error codes are odd numbers).

               If an error is encountered in com-
               munications, an odd number
               error code will be put into the
               status register. See Appendix C
               for a list of error codes.

Bit 15   RUN/HALT status of remote
               processor.

               ON = Remote processor in Run
               mode. OFF = Remote processor in
               Halt mode. (Only valid when bit
               16 is on - message complete.)

Bit 16   ON = Communication is complete.

               This bit can be used to initiate
               automatic repeat of communica-
               tion rungs.

Bit 17   ON = Communication started,
               message is being sent.

Bit 22   ON = Rung enabled, continuity
               present up to the communication
               box.

These status bits can be used as ladder rung ele-
ments for control functions.

5.4.2   WRITE Rungs

Suppose Processor A (see Figure 5.3) must send
some register data to Processor B. This can be ac-
complished by programming the following WRITE
rung in Processor A.

```
  Z              ROUTE ROUTE STAT LOCAL  REM  COUNT

---| |---|T WRITE 2 107   115   S39   S40   S50    2 |
```
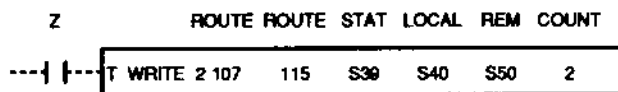
Figure 5.5 - Network WRITE Rung

The rung in Figure 5.5 will write the contents of
registers 40 and 41 from the local Processor (Proces-
sor A) and put the data into registers 50 and 51 of

the remote Processor (Processor B). The purpose of
each element of the rung is as follows:

Z   The initiating contact which ac-
               tivates the rung.

WRITE   The command for getting data
               from another Processor.

2   Refers to communication using
               processor COMM port #2.

ROUTE 107   The network route number for
               the initiating device (Processor
               A).

ROUTE 115   The network route number for
               the destination device (Proces-
               sor B).

STAT S39   Use register S39 in Processor A
               as the status register. The
               status register contains infor-
               mation on the progress of the
               communication message.

LOCAL S40   The first register (starting ad-
               dress) in the local Processor to
               be written (sent) to the remote
               Processor.

REM S50   The first register in the remote
               Processor in which data will be
               written.

COUNT 2   The number of consecutive
               registers that will be written.

5.5   Advanced Communication Routing

In addition to routing point-to-point with Network
Device Numbers 000 through 199, the CRM565 sup-
ports *Special Function* ROUTEs numbered 200
through 255. These Special Functions are listed in
Figure 5.6 and are described in the following sec-
tions.

```
+--------------------------------------------+
|  CAUTION:                                  |
|                                            |
|  Use care when programming the special     |
|  routes since more than one NIM on the     |
|  network may be affected by them.          |
+--------------------------------------------+
```

ROUTE	SPECIAL FUNCTION
200	READ CRM565 status and WRITE CRM565 Parameters.
201	Source's network number unknown
202	Port-to-port within the same NIM (not applicable to CRM565 in PowerLogic mode)
203	Source and target NIM numbers unknown
204	DON'T CARE, go to next ROUTE
205-232	NOT USED
232-254	Broadcast functions (SY/MAX mode only)

Figure 5.6 - Special Function Routes

A register is simply a small portion of memory that is used by a SY/MAX device to store data. Each register has an address to distinguish it from other registers. Though register memory is separate from the control program memory, register addresses can be used in the control program, allowing data stored in the registers to be accessed.

The PNIM internal registers contain status information about the PNIM and also parameters that control certain operations. In typical applications, the default parameters of the PNIM registers that control its operations are satisfactory. A description of the register, along with the type of operation required to access the information and default values is given in Figure 5.8.
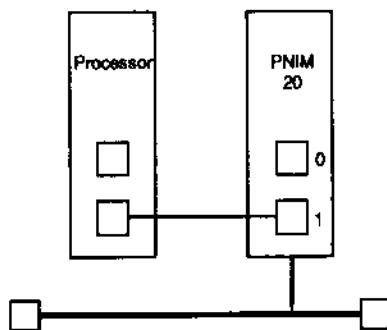
Figure 5.7 - Example of Internal Register Routing

5.5.1   READ PNIM Status (ROUTE 200)

ROUTE 200 is used to read the internal status of a NIM or PNIM. The NDN of the PNIM to be read is entered immediately after ROUTE 200 as shown below ("XXX" is the NDN of the Network device whose status is to be read, while "AAA" is the NDN number of the initiating device):

ROUTE AAA,200,XXX

Note: The "ROUTE 200" must be the second from the last ROUTE entry within a communication rung.

For example, if the SY/MAX Processor connected to the PNIM in Figure 5.7 needs to access the PNIM internal registers, it would use the route sequence:

120,200,20

The first value sends the command to the PNIM, the second value flags the PNIM that the command is intended for internal registers, and the final value indicates which PNIM or NIM is to be accessed.

A communication rung sent to a PNIM by a processor or programming device obtains the data from the readable registers of the target PNIM. Refer to Figure 5.8.

5.5.2   WRITE PNIM Parameters

The operational parameters of a PNIM can be changed by a priority WRITE or ALARM with a ROUTE of 200. The Write PNIM status is identical in format to a Read PNIM status with the exception that AAA and XXX routes are identical (source device). Figure 5.8 indicates the readable/writeable PNIM registers.

Note: When using a WRITE statement to set the value of an internal PNIM register, the value of the COUNT can only be 1. Each internal register to be configured requires an individual WRITE statement. All registers can be read in a single READ statement.

Note: If system power is lost, the PNIM internal registers return to their default values as indicated in Figure 6.4.

5.5.3   Source Network Number Unknown

ROUTE 201 allows a device to communicate on the network without knowing what its own network number is. For example, to have a device of unknown network number communicate with network device number 22, the following ROUTE statement is used:

ROUTE 201,022

INTERNAL REGISTER ADDRESS	READ/WRITE	DESCRIPTION
1	Read only	Network Interface Type Number Example: 510 for CRM-510 565 for CRM-565
2	Read only	Software Revision
3	Read only	Thumbwheel Setting 00 to 99
4	Read only	DIP Switch 5 Setting (Port 0 Mode, Baud Rate, etc.) Example: S5 Switch 1234567 (SW1 = 1, least significant - SW7 = 64) Binary 0010100 (0 = switch up, open) Decimal 20
5	Read only	DIP Switch 4 Setting (Port 1 Mode, Baud Rate, etc.)
6	Read only	Serial port number - if the message involving this module originates from either of the COMM ports, it will be indicated in this register as a 0 or 1.
7	Read only	N/A
8	Read only	N/A
9	Read/Write	Receive errors (local network port). See Sec. 7.2.
10	Read/Write	Transmit errors (local network port). See Sec. 7.2.
11	Read/Write	Receive error overflow (local network port). See Sec. 7.2.
12	Read/Write	Transmit error overflow (local network port). See Sec. 7.2.
13	Read/Write	User defined, cleared upon power-up, values from 0 to 65536.
14	Read/Write	User defined, cleared upon power-up, values from 0 to 65536.
15	Read/Write	User defined, cleared upon power-up, values from 0 to 65536.
16	Read only	Cable status, port 0
17	Read only	Cable Status, port 1
18	Read/Write	Special PNIM identification number. Programmable from 0 to 255. Defaults to zero on power-up.
19	Read/Write	Clear To Send (CTS) delay. Programmable from 0 to 2 seconds in 50 millisecond increments. On power-up defaults to a value of 0 (for no delay). Will delay issuing a CTS signal by the amount of time dictated by the value in this register times 50 (ms). Example: if register 19 = 3, time delay is 150 milliseconds.
20	Read/Write	Message response timeout (in seconds). Determines the time alloted for a response before the message is retransmitted (up to three times, see register 22). After three retries an error is generated. (Default = 2 seconds.)
21	Read/Write	N/A
22	Read/Write	Number of retries by PNIM (when no acknowledgement is received from the intended circuit monitor), before error message is posted in the status register of the communication rung (or assigned to the communication variable CERR of a D-LOG module) initiating the communication command (READ/WRITE/GETN/PUTN). On power-up, the default value is 0. Allowable value range is 0 to 3.
23	Read/Write	N/A
24	Read/Write	N/A
25	Read/Write	Pause time. Programmable from 0 to 60 seconds. Defaults to 0 seconds. Pause time will be inserted after a specified number of messages have been issued (see register 26).
26	Read/Write	Message count. Programmable from 0 to 250. Default value is 4. Message count is the maximum number of commands that can be transmitted before the minimum pause time (specified in register 25) will be inserted.

Figure 5.8 - PNIM Internal Register Summary

The ROUTE 201 entry must be the first ROUTE entry in the communication rung.

ROUTE 200 and ROUTE 201 can be combined to read the status of a device hose network number is unknown by using the following ROUTE entry:

5.5.4   Port-to-Port within the Same NIM

ROUTE 202 permits communications between two devices attached to the same Network Interface Module. This ROUTE must be the *second* entry in the rung.

ROUTE 202 can also be used in conjunction with ROUTE 201 to permit communication in a PNIM whose network device number is unknown. Use the following ROUTE to accomplish this:

ROUTE 201,202

Route 202 *must be the second ROUTE entry*. Other than ROUTE 201, NO OTHER ADVANCED ROUTE ENTRIES ARE PERMITTED WITH ROUTE 202.

5.5.5   Module "Pair" – Source and Destination NIM Numbers Unknown

ROUTE 203 allows two NIMs (or PNIMs) to communicate even if both of their network numbers are not known. A module pair to ROUTE 203 is an even-numbered module, along with its module number *plus one* OR an odd-numbered module along with its module number *minus one*.

Example

To route communication between the pair of modules at network location 06 and 07, use either of the following routing statements depending on which direction the communication is going (which processor is initiating the communication command):

ROUTE 201,203

(From 6 to 7. Even-numbered network number, plus one, creates module pair 6/7.)

ROUTE 201,203

(From 7 to 6. Odd-numbered network number, minus one, creates module pair 7/6.)

The ROUTE 203 must be the second ROUTE instruction in the rung. NO OTHER ROUTE VALUES ARE PERMITTED IN THE RUNG AFTER THE ROUTE 203.

5.5.6   Don't Care, Skip This Route Number

ROUTE 204 causes the NIM to jump over the ROUTE normally in this position, and act on the next ROUTE entry as if it were the second entry. For example, ROUTE 003, 204, 004 is executed simply as ROUTE 003,004. This is typically used in applications where the source device can assign routes through the use of variables (D-LOG module).

5.5.7   Broadcast Functions

Note: Not applicable to NIMs set to Model 50 or Net-to-Net Mode or PNIMs set to Power-Logic Mode.

A *broadcast* message is a message that is sent by one device to a number of other devices. The "other" devices can include *all* other devices on a particular network, or just some devices, or even certain ports on other devices.

> # CAUTION:
>
> **Broadcast messages are NOT acknowledged by the device receiving them; the sending device will NOT receive a reply. This means there is no way to be sure that all devices received the broadcast. Model 300 processors DO NOT support the broadcast function.**

Sending a Broadcast

To have all devices on a network receive a broadcast, ROUTE 253 or 254 is used. ROUTE 253 sends the message to all COMM port 0s, while 254 sends to all COMM port 1s. To have only certain devices on a network receive the broadcast, a ROUTE number from 233 to 252 is used. Figure 5.10 shows which ROUTE assigns which device.

Example

A broadcast message is to be sent to COMM port "1" of network devices 30 through 39. From Figure 5.10, the proper route to use is 240.

A broadcast message consists of a WRITE or ALARM rung in a processor/programmable controller, or a PUTN statement in a D-LOG program. A sample broadcast WRITE command appears in Figure 5.9.

ROUTE	ROUTE	STAT	LOCAL	REM	COUNT
T WRITE 1 201	254	S100	S20	S30	1

Figure 5.9 - Broadcast WRITE Command

The communication command in Figure 5.9, WRITEs register 20 to register 30 in all devices connected to NIM COMM port 1 from a device of unknown network number (ROUTE 201).

Note: Broadcast messages are only sent "over the network". It is not possible for the broadcast message to be received by the same module that transmitted it. Also, READ messages cannot be broadcast.

ROUTE #	NETWORK DEVICE NUMBERS AFFECTED	COMM PORT AFFECTED
233	0-9	0
234		1
235	10-19	0
236		1
237	20-29	0
238		1
239	30-39	0
240		1
241	40-49	0
242		1
243	50-59	0
244		1
245	60-69	0
246		1
247	70-79	0
248		1
249	80-89	0
250		1
251	90-99	0
252		1
253	ALL	0
254		1

Figure 5.10 - Partitioned Broadcast ROUTEs

Receiving a Broadcast

Every device on the network has the option of being disabled from receiving a broadcast message. On the CRM565 PNIM, set switch 1 of switchblock S4 and S5 to UP to disable broadcast to COMM port 1 and/or 0 respectively. Recall broadcasts are not supported when COMM Port 0 is in the PowerLogic mode. Once this switch is OFF, the PNIM will ignore all broadcast messages.

CAUTION:

A broadcast message WILL NOT travel through a net-to-net link.

A message broadcast on Network #1 will NOT be heard on Network #2 through a NET-TO-NET link. A broadcast-type ROUTE command can, however, be sent through the NET-TO-NET link. (Net-to-Net Broadcast).

Use care when programming ANY broadcast message.

Net-to-Net Broadcasts

It is possible to broadcast a message on one network from another network through the net-to-net link. When sending a broadcast net-to-net, the NIM in network #1 that contains the net-to-net link passes the broadcast message to network #2 through one of its COMM ports.

As an example, the following ROUTE entry sends a non-broadcast message from Network #1 to Network #2. Refer to Figure 5.11. Upon entering Network #2, the message becomes a broadcast message:
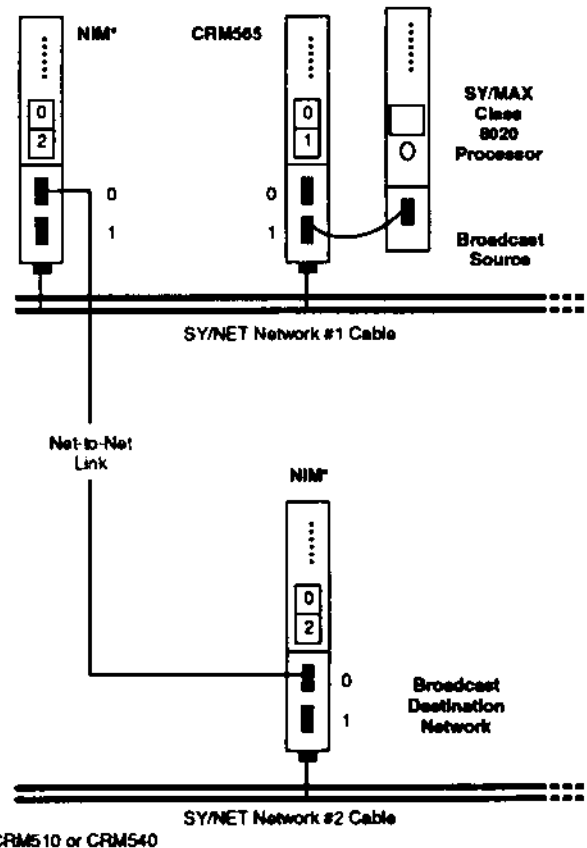
101, 002, 234

Figure 5.11 - Net-to-Net ROUTE Configuration

ROUTE	SPECIAL FUNCTION
000-999	Point-to-point through COMM port 0.
100-199	Point-to-point through Comm port 1.
200	Check status of this PNIM and change PNIM parameters
201	Source's network number unknown
202	Port-to-port within the same NIM (not applicable to CRM580)
203	Source and target NIM numbers unknown
204	DON'T CARE, go to next ROUTE
205-232	NOT USED
232-254	Broadcast functions (SY/MAX mode only)

Figure 5.12 - Special Function Routes

Figure 5-12 summarizes the ROUTE numbers which can be used in the CRM565.

5.6   D-LOG Module Communication

The SY/MAX D-LOG module is a rack-mounted data logging module which is programmed in Extended BASIC. It is capable of communicating with programmable controllers and other devices, either directly or over the SY/NET network.

While SY/MAX processors use READ and WRITE commands to communicate, D-LOG modules use GETN and PUTN commands. For network communication, each group of GETN or PUTN commands is preceded by a ROUTE statement that establishes the network communication pathway.

As with the other forms of SY/MAX communication, the only difference between implementing the following examples in a LAN and a circuit monitor network is in the routing used. See Section 5.3.2.

Figure 5.7 shows an example network with a D-LOG module connected to port 1 of interface 09 and a programmable controller connected to port 0 of interface 11.
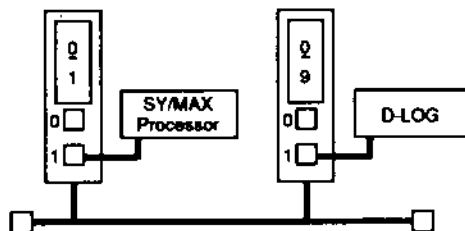
Figure 5.13 - Example Network With D-LOG Module

The following lines in the D-LOG module's BASIC program would perform communication to the programmable controller.

```
10 ROUTE 109,011
20 PUTN 66,95
30 GETN B(1),85,8
```

The function of each of these program lines is as follows:

Line 10 - Establishes the network communication route from the D-LOG module (network address 109) to the programmable controller (network address 011).

Line 20 - Places the value 66 into register 95 of the programmable controller.

Line 30 - Gets the values of programmable controller registers 85 through 92 (8 registers starting at register 85) and stores them in array variables B(1) through B(8).

6.0 CIRCUIT MONITOR NETWORK OPERATIONS

6.1 SY/MAX and Circuit Monitor Communications

The Circuit Monitor (CM) supports a protocol which allows it to be interfaced with SY/MAX® products. Circuit Monitor communications are made possible via an RS-485 electrical interface which offers RS-422 connectivity and allows multipoint communications from a single controlling source/master. The Circuit Monitor supports both the SY/MAX point-to-point protocol as well as the SY/MAX PNIM protocol. The Circuit Monitor will emulate a Slave device when it is in the PNIM mode. The PNIM should be selected to the PowerLogic mode. The Circuit Monitor will automatically select which protocol (SY/MAX point-to-point or PNIM) it will communicate with as it receives its first message after power is applied.

SY/MAX point-to-point protocol allows direct communication from one device to another, using RS-422 hardware. This means that a SY/MAX processor, for example, can communicate directly to a single device such as another processor or the PowerLogic Network Interface Module (PNIM). The PNIM's function is to allow multiple masters (via SY/NET) to communicate to a CM network.

The PNIM has a unique protocol that allows asynchronous, multipoint communication to a CM network or up to a maximum of 16 Circuit Monitors. This method of communication is accomplished with the use of routing. Section 5.3.2 offers a description of the use of "Routing" in Circuit Monitor communications. For additional information on CM routing, refer to Instruction Bulletin 63074-140-XX.

6.2 General PowerLogic Circuit Monitor Communication Rules
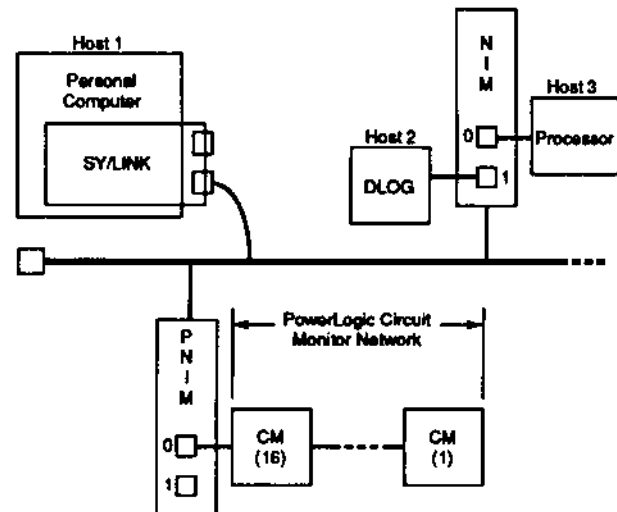
Figure 6.1 - CM Communication with Multiple Hosts

1. When laying out a Circuit Monitor (CM) network, only a single CM should be connected to a SY/MAX device (e.g., processor) communication channel. PNIMs are required if it is necessary to connect multiple CMs to multiple masters. Refer to Figure 6.1.

2. Only READ and WRITE commands will be recognized by the CM if the CM is connected to a processor or PNIM. ALARM commands cannot be used. If a personal computer is used as a host device, the user will need to determine what commands he will use to read from and write to the CM. (Refer to Instruction Bulletin 63074-140-XX.)

3. The CM will only respond to commuunications from the host. The CM cannot initiate any communications.

4. To ensure the fastest response time from CMs, utilize the lowest available CM addresses.

5. When multiple CMs are connected to a PNIM, there must be one (and only one) CM whose device address switches are set to 01. This should be the last CM on the link. For additional information, refer to the PowerLogic Manual 63074-140-XX.

6. When a single CM is connected to a communication channel, its device address

switches must be set to 00. However, its logical address will be 01. Refer to 63074-140-XX.

6.3   General SY/MAX Programming Information for Circuit Monitor Communication

Communications to the CM can be accomplished via a ladder program stored in a SY/MAX processor. A typical program may include the following functions:

- Initialization of User-defined parameters

- Establishment of Communications

- Control Commands

To ensure that the data returned from the CM is accurate, the user must define the CT and PT rating as well as the system configuration (3 wire or 4 wire). To 'setup' the CM, a write to the CM's registers must be done. Please refer to the Circuit Monitor Instruction Bulletin 63074-140-XX.

Processor communication instructions allow hosts to communicate directly with a CM or communicate with multiple CMs. For additional details, refer to 63074-140-XX

Control commands are executed by writing specific bits in the CM command register (register 237). To perform these commands, set the bit corresponding to the required task. For a full detailed description of the command capabilities of the CM, please read Circuit Monitor Instruction Bulletin 63074-140-XX.

Note: The only commands that may be performed directly on PowerLogic Circuit Monitor registers are the Priority READ/WRITE, non-priority READ/WRITE, and multiple register READ commands.

6.4   Registers Required to Maintain SY/MAX Compatibility

To maintain compatibility with other SY/MAX equipment the CM can respond correctly to read operations from specific registers. These read only registers are shown in Table 6.1 along with the default value that will be returned to the host.

Reg #	Register Description	Default Value
8172	Scan Time	0
8173	End Fenced Register	8176
8174	Begin Fenced Register	1
8175	Error Number	0
8176	Processor Control/Status Bits	0
8177	Password Register	0
8178	Restriction Register	0
1819-8180	Not Used	
8181-8182	Memory Size Available for ladder	0
8183-8184	Secondary Error Register,	0*
8185	Number of Rack Addresses	0
8186	Processor/Keyswitch Status	4
8187	Number of Rungs	0
8188	I.D. and revision	450
8189-8190	Memory Size in bytes	0
8191-8192	Memory Used in bytes	0

Note: Registers 8172-8192 are not saved at power fail but are initialized to default values on power-up / reset.

*further defines 8175

Table 6.1 - CM default values for SY/MAX compatibility registers

7.0   THEORY OF OPERATION

7.1   Power Cycling

Power-Up

When power is applied to the CRM565, it automatically enters a self-test sequence. This sequence, described fully in Section 8, Troubleshooting, does the following:

- Tests internal PROM for checksum.

- Clears internal RAM.

- Performs a READ/WRITE test on the RAM.

- Flashes the NET TX ERROR and NET RX ERROR lights to verify each portion of the self-test.

If the CRM565 passes the self-test, it automatically goes into normal operation. If any part of the self-test is failed, the NET TX ERROR and NET RX ERROR lights flash in a sequence which identifies the problem. See Section 8.1.4 to identify a particular sequence.

> **CAUTION:**
>
> **All messages received by the CRM565 during its power-up cycle are ignored, and the device that originated the message receives an error.**

Power-Down

When the CRM565 detects that incoming power is being removed (the AC-FAIL signal from the SY/MAX power supply drops below 0.3V), it goes into a shutdown routine. The CRM565 does the following:

- Communication in and out of all three ports is stopped.

- The network port is shut off, disconnecting the CRM565 from the SY/NET network.

- A "Halt" state is entered, and continues until proper power is restored.

> **CAUTION:**
>
> **When system power is lost, all messages stored within the CRM565 at the time power is removed are erased.**

7.2   Message Handling

The CRM565 (PNIM) supports two types of communications: (1) Local Area Network (LAN) communication over the high-speed network (NET) port and (2) COMM port communications.

It also coordinates the communication between the COMM ports, the NET port and the SY/NET network and can be interconnected with up to 99 other Network Interface Modules on a single LAN.

Data transmission over the network is accomplished by a synchronous data stream structured to conform to a standard protocol format known as Manchester Encoded HDLC. (High Level Data Link Control HDLC - used and defined by IBM Corporation). HDLC provides data transfer, message acknowledgments, and error recovery (CRC). All SY/NET network ports communicate to each other using HDLC.

The COMM ports are used to connect the PNIM to a SY/MAX device and/or circuit monitors. COMM port communication consists of an asynchronous data stream from the PNIM to a PC, CRT, circuit monitor, etc. The data structure is similar to ANSI 3.28 protocol. This protocol contains data which refers to ladder rungs, register data, I/O status, etc.

When the PNIM receives a message from *either* COMM port, it checks for a valid data format, message type, size, and checksum and then send the message out either the opposite COMM port or the NETWORK port. The port selected is determined by the ROUTE information contained in the incoming message.

Note: COMM Port 0 can operate in either the SY/MAX, or PowerLogic circuit monitor modes. COMM Port 1 (the lower communication port) operates *only* in the SY/MAX mode.

7.2.1   Network Messages

Description

Network communication occurs only between Network Interface Modules, and consists of a stream of synchronous data in a format known as HDLC (High-level Data Link Control). HDLC provides data transfer, message acknowledgement, and error recovery; all SY/MAX network ports "talk" with each other using HDLC.

When a network message is received by the CRM565, it does one of three things with the message:

- Sends it to one of the COMM ports (and hence to a SY/MAX device such as a processor) based on the message's internal ROUTE statement.

- Creates an error message in response to the received message.

- Holds the message internally for later use.

In all three scenarios, the CRM565 will always acknowledge a received network message (except a broadcast message).

Network Access

Since all network communication occurs over a single twinaxial cable, messages must be coordinated to prevent "collisions". The CRM565, and all other NIMS on a network, cannot transmit at random; they must first gain access to the network.

Access to the SY/NET network is controlled by a time-sharing scheme that accomplishes the following:

- Allows every NIM a chance to transmit a message.

- Prevents a single module from tying up the network.

   Within each NIM (and PNIM) is a timer that has an upper limit determined by which network size is selected on the DIP switches. (See Section 3.5.2)

- If network size is set to "100" (as it is set from the factory), the clock times to 20 milliseconds and then resets to zero.

- If a network size is "30", the timer times to six milliseconds before resetting.

For either network size, each module has a 200 microsecond window in which it can send a message (20 mS/100 NIMs or 6 mS/30 NIMs = 200 microseconds per NIM).

All the NIM timers on the network are synchronized with each other, since they are all reset at the same time. The timers reset either when power is applied to the NIM, or after any NIM on the network sends a message.

```
┌─────────────────────────────────────┐
│              CAUTION:                │
│ If noise is coupled into the network │
│ cable, the timers will reset.        │
└─────────────────────────────────────┘
```

Module Priority

Each NIM is assigned a Network Device Number (NDN) by dialing in a two-digit number on its front-panel thumbwheel. The lower this number is, the higher the transmission priority of that module. For example, module #17 transmits before module #26; the NIM with "00" as its NDN therefore gets the first chance to transmit its message. Refer to Figure 7.1 below.
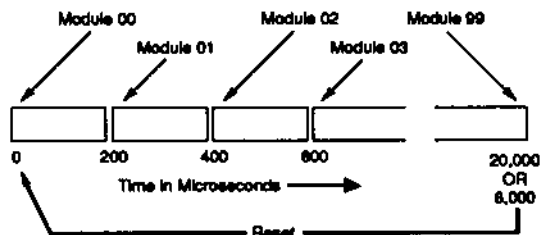
Figure 7.1 - Transmission Access to Network

System Power-up

The following sequence occurs when power is applied to any NIM (or PNIM):

1. When power is first applied to the network, all NIMS on the network reset their timers to zero and begin timing.

2. If, at the instant the timers are reset to zero, module #00 has a message to transmit, it does so. If it doesn't have a message by the end of its 200 microsecond window, the time window for module #01 opens and module #01 can transmit.

3. If module #01 does transmit a message, all module timers are reset to zero and module #00 time window opens. If module #01 does not transmit, the timers continue timing.

4. At the end of 400 microseconds, module #02's time window opens. As with module #01, if module #02 has a message to send it does so, and the timers reset to zero. After the timers reset, module #00 time window opens, followed by module #01, and then module #02.

5. After all modules on the network have transmitted and the timers reach 20,000 microseconds (100 NIMS × 200), or 6,000 microseconds (30 NIMS × 200) they reset to zero. All modules can once again transmit, and the sequence starts again.

Note: A message in progress CANNOT be interrupted.

Since the priority of transmission depends on the NDN of the NIM, a lower-numbered NIM could "hog" the network if it has numerous messages to send. The following example shows how this is avoided:

Example:

Under a strict "lowest NDN first" priority system, module #07 will always gain access to the network before module #20. All NIM timers reset to zero after module #07 transmits; if module #07 has multiple messages to send, module #20 may never get a chance to send its message. To prevent this, the SY/NET does the following:

1. Module #07 has several messages to transmit; module #20 has a single message to send.

2. When 1,400 microseconds has elapsed and module #07's time window opens it transmits one of its messages.

3. All NIM timers reset to zero, and begin counting again.

4. When 1,400 microseconds has again elapsed, module #07's time window is blocked. Module #08's window opens at 1600 microseconds.

5. After 4,000 microseconds, module #20 can transmit its single message.

6. After either 20,000 microseconds (100 NIMs) or 6,000 microseconds (30 NIMs), all timers reset to zero and the block on module #07 is removed.

7. When 1,400 microseconds elapses, module #07 sends the second of its messages and all timers reset to zero. The block on #07 goes

into effect again until all time windows are open.

This EQUAL priority blocking procedure guarantees that all NIMS on a network have at least one chance to send a message during the regular 20,000 or 6,000 microsecond cycle.

7.2.2 COMM Port Messages

The two COMM ports on the CRM565 PNIM's front panel handle all non-network communication, and are used to direct an incoming network message to the appropriate SY/MAX device or PowerLogic Circuit Monitor.

Each COMM port operates independent of the other; each can be set to one of two modes (see Section 3 for the pinout of the COMM ports). The ports support EIA standard RS-422 communication (with handshaking).

As shown in Figure 7.2, both COMM ports send messages to or receive messages from a 15-message buffer. When the buffer receives a 16th message, it overflows and illuminates the NET TX ERROR LED. A device attempting to send a message to either COMM port will not get through, and must re-transmit its message when the number of messages in the buffer drops below 15.
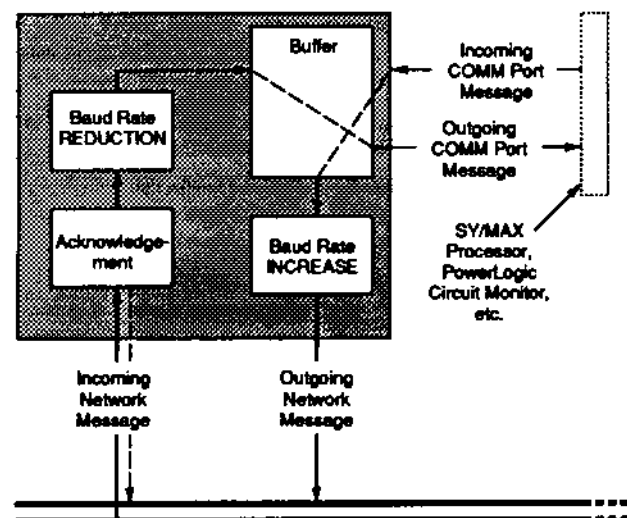

Figure 7.2 - CRM565 Buffer

For more information on errors, see Section 8, Troubleshooting.

7.2.3   Buffering

Another function performed by the PNIM is buffering of communication messages. Buffering refers to: (1) message speed conversion, and (2) the holding and storing of messages.

As messages are received through the network port, the PNIM waits until the complete message is received, acknowledges the message, and then retransmits the message out the designated COMM port to the destination device.

During this retransmitting, a baud rate change takes place. The message received at 62.5-500K baud (network speed) is retransmitted at 1200-9600 baud (COMM port 0 speed or COMM port 1 speed).

The same conversion is made when messages are sent to the Network Module via the COMM ports. Upon receiving a complete message from COMM port 1, the PNIM acknowledges the message and then retransmits the message over the network at 62.5-500K Baud. For PNIMs, no acknowledge will be sent out COMM Port 0 if COMM port 0 is set to Circuit Monitor mode.

This Baud rate conversion applies to all messages sent/received via the Network and COMM ports. As more and more messages are received by the PNIM, it may have to store the messages in a buffer until it is the PNIM's turn to transmit over the network.

The PNIM has 15 buffers total. When more than 15 messages are received, the PNIM buffer will overflow and a Network Overflow Error will occur. This error is indicated by a flashing NET Tx error light on the originating Network Module. As soon as the message has been sent by the PNIM, one buffer becomes available for another message.

Note: If more than 15 messages are received by the CRM565 simultaneously, the CRM565 buffer will overflow and the NET Tx ERROR lamp will flash. As soon as one of the 15 buffer positions opens up, the error is cleared. Since the device originating the error-causing message will re-transmit, the second try should successfully load the CRM565's buffer.

7.3   Error Handling

7.3.1   Network Port

For every command message (Read/ Write/ Alarm /Putn/ Getn) transmitted over the network, there will be a reply message. If a message transmitted over the network is not acknowledged, or a negative acknowledgment is received, the network port will automatically re-transmit the message up to three times. If, after the last attempt, a negative acknowledgement or no acknowledgement is received, an Error 17 will be sent back to the initiating device. The Next TX LED will flash on the PNIM through the message originated.

Note: Each retransmission must wait for an open time slot.

7.3.2   Communication Ports

Similar to the network port of the PNIM, messages transmitted from the COMM Port 1 or COMM Port 0 - set to SY/MAX mode will receive an acknowledgement. If the message transmitted by either of these ports is not acknowledged, or a negative acknowledgement is received, the communication port will re-transmit up to eight times. If after eight attempts a negative acknowledgement or no acknowledgement is received, an Error 17 will be sent back to the initiating device. The Net TX LED will flash on the Network Module through which the message originated. By automatically re-transmitting messages when an error occurs, messages can get through even under noisy electrical conditions.

8.0 TROUBLESHOOTING

Troubleshooting of the PNIM can be broken into two areas (1) hardware indicating lights and (2) communications errors.

8.1 Indicating Lights

On the front of the PNIM are eight indicating lights, which function as follows:

Light	Function
NETWORK	ON = Busy/Activity
Tx0 Receive	Data Thru port 0
Tx0 Transmit	Data Thru port 0
Rx1 Receive	Data Thru port 1
Tx1 Transmit	Data Thru port 1
NET Rx ERROR	Network Receiver Error
NET Tx ERROR	Network Transmit Error
POWER	5 Volts applied to module

During power-up, the NET Tx and Rx lights will flash ON and OFF in a defined sequence. This flashing indicates a self-test is being performed. When both NET Rx and Tx lights are OFF, the self test is complete and normal module operation can take place. If an internal fault is found, the power-up sequence will stop and the NET Rx and Tx lights will flash ON and OFF together, pause and then repeat until power is removed. See Figure 8.2 for error description.

8.1.1 Communications

The Rx0, Tx0 and Rx1, Tx1 lights indicate communications activity through COMM ports 0 and 1 respectively. Any time the PNIM transmits data out a COMM port the Tx LED will light. Also anytime data is received by the PNIM's COMM port the Rx LED will light. During SY/MAX Processor to SY/MAX Processor, or programmer node to SY/MAX Processor communications, these LEDs will flash.

When the PNIM is set for the SY/MAX Mode, an automatic communications check is made every two seconds. This check is made when no communications are taking place in other words, during an idle state. During this idle state, the PNIM will send a small inquiry message to the device connected to each COMM port. If the attached device is a SY/MAX device, it will send a small message back to the PNIM. This message exchange occurs every two

seconds, and is independent of the customer program (transparent to the user).

If during the idle communications state, the Rx and Tx lights do NOT flash, inquiries are not getting through and therefore, normal communications cannot occur. Use Figure 8.1 to isolate the problem.

Action	Possible Cause
1. Rx and Tx lights do not flash	1. Check power on PNIM. 2. Is PNIM in SY/MAX or PowerLogic modes. Note: The PNIM COMM ports support handshaking signals (CTS-RTS). These signals are jumpered allowing the PNIM to communicate when the following cables are attached. CC100 CC103 CC101 CC130 CC102 See Section 3.0 for additional information. 3. Is cable plugged into PNIM comms port? 4. Perform self-test on PNIM and connected device (Section 8.3).
2. Tx LED flashes ON one second and then turns off and repeats. Rx LED off.	1. Check power on remote device. 2. Check cable to remote device. 3. Check baud rate of PNIM and remote device. 4. Remote device is not a SY/MAX device.
3. Tx and Rx LED's flashing independently similar to #2 above.	1. Check baud rates of PNIM and remote device. 2. Perform self-test on PNIM and remote device.

Figure 8.1 - LED Checklist

Error Code	Description	Cause
3	Illegal Address	Out of range. Example: Register 150 on Model 300 PC
5	Illegal Operation	Parity Error
7	WRITE to protected register	WRITE to control register 8100-8192.
9	WRITE to READ only Register or Input	Write to register in I/O rack that contains an input card.
13	Link Error	Loose cable - SY/MAX mode.
15	Communication Overflow	Remote device too busy to respond.
17	Remote device inactive	No PNIM exists or PNIM COMM port not connected.
19	READ count too large	Model 300 maximum count is 15, pre-Series M Model 500 maximum count is 64, Series M or later model 500 maximum count is 128, model 700 maximum count is 64, all other devices maximum count is 128.
23	WRITE to fenced register	Register is protected by processor and cannot be written into.
29	Illegal Route	- Not enough route numbers. - Connected to wrong PNIM (first number) - Middle route number directed to PNIM which is not set up for circuit monitor mode.

Figure 8.2 - Error Code Summary

8.1.2   Communication Error Codes

When using READ, WRITE, or ALARM rungs, the status register of these rungs will contain a number which describes the results of the communication. When the number is between 1 and 16,000 the number represents an error code.

Figure 8.2 describes several common error codes and their possible causes. See Appendix B for a complete summary of error codes.

8.1.3   Self-Test

For a more thorough test of the PNIMs memory, COMM ports and network port, use the following procedure.

1. Remove power to the PNIM.

2. Remove any cables from the COMM and Network ports.

3. Remove the PNIM from the rack.

4. Set switch 7 on switch group S4 to the ENABLE SELF-TEST position. See Section 4.2.2

5. Replace the PNIM in the rack.

6. Insert Type CTP11 (Class 8010) test plugs into both COMM ports of the PNIM. The NETWORK port requires no test plug.

7. Reapply power to PNIM.

When power is reapplied to the PNIM, the Tx1 and Tx1 lights will flash ON and OFF, followed by the Tx0 and Rx0 lights. This pattern will repeat approximately 50 times. At the same time the NET Rx and Tx ERROR lights will also flash.

After approximately 75 seconds the NETWORK LED will turn on and off indicating data is being transmitted/received out the network port. This pattern will repeat four times. The above pattern will then repeat until power is removed. The total test takes approximately 90 seconds.

If an error is detected in the PNIM, the NET Rx and Tx LEDs will flash ON and OFF together, pause and then repeat the same flashing sequence until power is removed. Refer to Figure 8.3

Self Test Errors	(Indicated by both Net Rx and Tx LEDs Flashing)
One flash Two flashes Three flashes Four flashes	ROM checksum error. RAM error Serial port 0 or 1 error. Network port error.

Figure 8.3 - Network Error Lights

To turn the self test mode OFF, set switch 7 of switch group S4 DOWN.

8.2   System Troubleshooting

After determining the PNIM is operating properly, and that the devices connected to it are functioning correctly, the following procedure can be used to isolate any network system fault.

Assumptions

Before troubleshooting can begin, several assumptions have to be made. They are:

- SY/MAX Family devices are involved. (PC, CRT, D-LOG)

- Power is applied to rack and Network Interface Modules.

- No error lights are illuminated on the PNIMs.

Basic Tools

For troubleshooting, several basic pieces of hardware will be required. These include:

- One SPR250 or SPR300 CRT Programmer, or IBM compatible computer with SY/MATE programming software

- One PC Model 300, 400, 500, 600, 700

- Two CC100 Series Cables

- Two PowerLogic Network Interface Modules

- Appropriate Network Cables

Basic Layout

Figure 8.4 shows a basic minimum network layout that will be used for troubleshooting. It is suggested that the two PNIMs be isolated from the overall network. This removes the possibility of a defective network cable, duplicate PNIM numbers, or conflicting network communications.
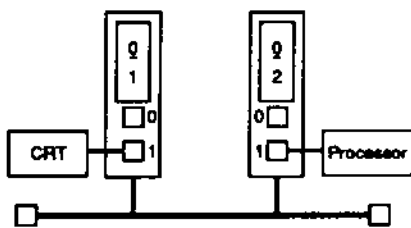

Figure 8.4 - Basic Network Layout

Basic Operation

The basic system layout shown in Figure 8.4 contains a SY/MAX Processor, a CRT (or similar programming device) and two PNIMs. Two PNIMs have been connected together using tee connectors and terminators. The intent is to start with a small network and expand to the full system. The following is a step by step procedure for network system troubleshooting.

STEP 1.
Verify correct operation of SY/MAX Processor and CRT.

  A. Connect CRT directly to the processor using CC100 series cable.

  B. Turn on CRT (SY/MAX menu must be displayed).

  C. Depress STATUS soft key (leftmost key).

The CRT should be showing the status of the processor. If an error is indicated, correct before continuing. Possible errors could reflect a bad CRT, SY/MAX Processor or cable.

STEP 2.
Check SY/MAX Processor to PNIM operation.

(Proper non-network operation has been verified at this point)

  A. Connect the processor to either PNIM using a CC100 series cable.

  B. Turn the processor key to HALT.

  C. Apply power to the processor and the PNIM.

  D. Monitor the PNIM RX and TX LEDs for the COMM Port the processor is connected to.

The RX and TX LEDs should flash ON, the OFF, once every two seconds - this is normal. If there is not proper LED indications, correct before continuing (See Section 8.1.2 for LED operation).

STEP 3.
Check CRT to PNIM operation.

  A. Connect the CRT to the PNIM.

  B. Apply power to the CRT and PNIM (SY/MAX menu must be displayed).

  C. Monitor the RX and TX LEDs as in step 2 above and verify proper operation.

STEP 4.
Route CRT to SY/MAX Processor over the Network.

  A. Depress the ROUTE soft key on CRT.

  B. Enter network device numbers of CRT and processor (DO NOT use special route addresses 200 and above).

  C. Depress the STATUS soft key on CRT to display processor status.

If the CPU status is displayed, the network system is working. Next, connect the network modules to the overall network system and again verify proper CRT to processor operation.

Common Errors

The most common errors that occur on the network are error code numbers 29 and 17.

Error 29 - Illegal Route. This error occurs when the network device number of the CRT does not match the thumbwheel number on the PNIM where the CRT is connected.

Error 17 - Inactive Device. This error refers to a failure to communicate with a remote device. Common causes of this error are:

1. The network device number does not exist, because:

   A. Route number is incorrect.
   B. No PNIM on the network has this number.
   C. PNIM does not have power.
   D. PNIM network port is not connected, or is loose.

2. PNIM COMM Port specified by route is not working, because:

   A. No cable is attached to the COMM Port.
   B. Attached device is not working.
   C. Attached device is not a SY/MAX Family device.

HELP

If the above step by step troubleshooting procedure has not been effective, local field support or headquarters support may be required. Before the call is made, several important pieces of information should be obtained. These are:

1. PNIM series number (A,B,C,D).

2. Was system on-line before failure occurred, or is this a new system (start-up) problem?

3. What are the switch settings for the Power-Logic Network Interface Modules involved?

Appendix A - Installing a Network Cable End

The network cable end (Class 8030 Type CCK-221) consists of ten parts.
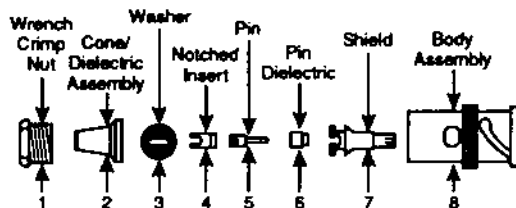
The twinaxial network cable (Belden* 9272 or equivalent) consists of seven parts.
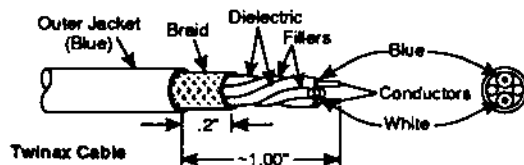
The following is a procedure for assembling a network cable end on the twinax cable.

1. Place WRENCH CRIMP NUT (1) onto network cable; threaded part of nut should face right.

2. Strip approximately one inch (2.5 cm) of insulation from end of cable, being careful not to damage shield wires.

3. Cut back BRAIDED shield to within 0.2 inches (0.5 cm) of the cable jacket.

4. Cut off filler cords to cable jacket.

5. Thread blue and white wires through small end of CONE (2) and press cone into cable until recessed into cable jacket (cable end will flare out).

6. Place red WASHER (3) over wires and against CONE/DIELECTRIC ASSEMBLY(2).

7. Cut blue and white wires to a length of 0.35 inches (0.9 cm) measured from red washer (3).

8. Strip insulation off blue wire 0.2 inches (0.5 cm).

9. Tin the BLUE wire.

10. Bend the WHITE wire at a right angle away from the BLUE wire.

11. Place white NOTCHED INSERT (4) over BLUE wire and press until flush with red WASHER (3). (WHITE wire should fit into notched insert.)

12. Place PIN (5) over BLUE wire. Pin should be flush with NOTCHED INSERT (4).

13. Carefully solder pin (5) to BLUE wire (apply solder bead to hole in side of pin).

14. When solder cools, test connection by lightly pulling pin (5) with pliers - a common problem found with cable is cold solder joints.

15. Place shield (7) over PIN assembly and seat against red WASHER (3). Thread WHITE wire through notch in SHIELD (7).

16. Strip WHITE wire back 0.25 inches (0.6 cm).

17. Wrap WHITE wire around shield (8) and solder. Let cool.

Note: Solder and wire must not extend beyond shield ridge - otherwise WHITE wire could come in contact with connector body.

18. Place BODY ASSEMBLY (8) over shield assembly.

19. Thread WRENCH CRIMP NUT (1) into BODY ASSEMBLY (8).

20. **Perform continuity check on cable - you should have 10K ohms or greater resistance between blue wire and white wire and either wire and shield. If a lower resistance is found, check for short in cable end, cable, or opposite cable end.**

Note: **Resistance measurement should be made WITHOUT network terminator or interfaces attached.**

* Belden is a registered trademark of Belden Electronic Wire and Cable Inc.

Appendix B - Communication Error Codes

The following is a list of the most common error codes that may be displayed during communications. All COMM error codes are odd numbers (1,3,5,etc). For a complete list of error codes, consult a SY/MAX processor instruction bulletin.

Error Code	Description
01	Illegal protocol opcode, the device does not recognize the instruction.
03	An illegal address has been attempted.
05	An illegal instruction has been attempted which is not allowed. (Example: Write to NIM set to peripheral mode.)
07	An attempt has been made to alter data in a protected register. Check Control Register 8176.
09	An attempt has been made to alter data in a READ only register or input.
11	Communications error (receiver overflow).
13	Communications error (link error). This error is generated by the processor. Check Control Register 8175 or the COMMs status register. Check cable connections between devices.
15	Communication overflow.
17	The remote device is inactive. This error code is generated by the network interface module. Check cable connections between devices.
19	An illegal READ parameter has been assigned.
21	Trying to change a forced bit or WRITE to an external output while the processor is in HALT.

Error Code	Description
23	An attempt has been made to alter data in a fenced register.
29	An attempt has been made to send a message with an illegal route.
31	The end of the tape was encountered before the operation could be completed.
33	Tape Data Error detected, the block of data involved in the Read or Write operation was faulty.
35	The cartridge is not seated properly or missing, or the "Record" tab on the cartridge has been set to the Write Inhibit position.
37	An attempt to Skip or Read a file was made when already past the last file on the tape.
39	Alarm already set within the D-LOG Module.
41	Communication error with D-LOG Module was encountered.
43	An illegal operation has been attempted — D-LOG Module protected.
45	Operation is not allowed — D-LOG Module's tape operation in progress.
47	Operation is not allowed — keyswitch violation
49	I/O, Register or Channel is safeguarded; used in Type SCP-344, 444 and 544 RAM/PROM Processor.
51	Undefined register — a module is not seated properly or missing.
53	Illegal tape format — erase track required.

Appendix C - Cable Wiring Diagrams

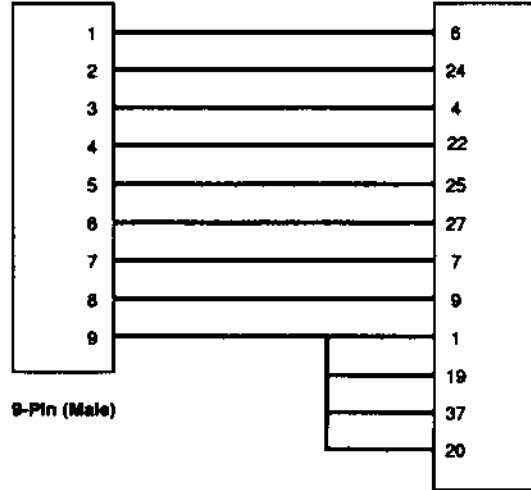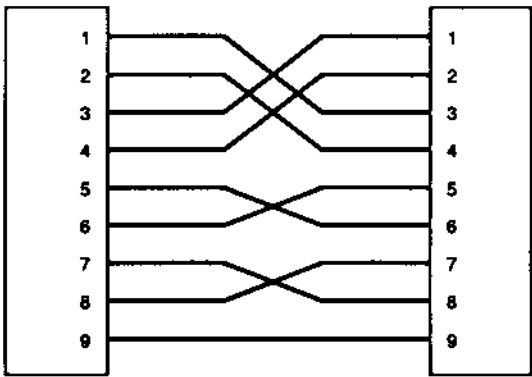**Type CC100 Series Cable Wiring Diagrams**
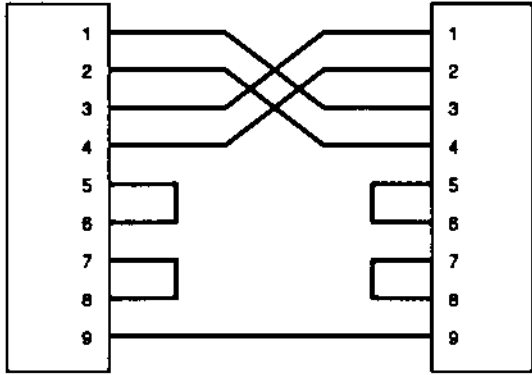
9-Pin (Male)   9-Pin (Male)

Type CC130 Series Cable Wiring Diagrams

9-Pin (Male)   25 Pin (Male)

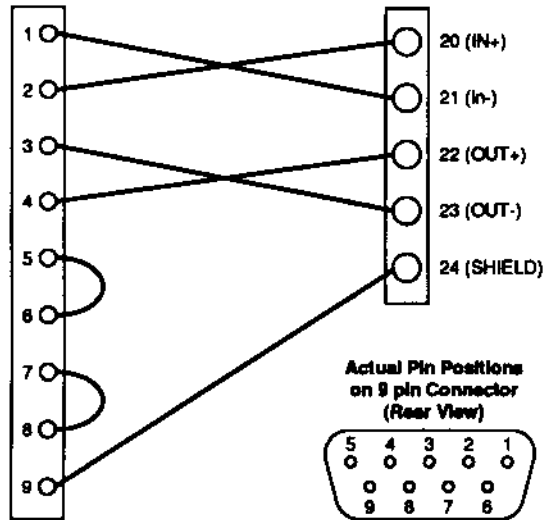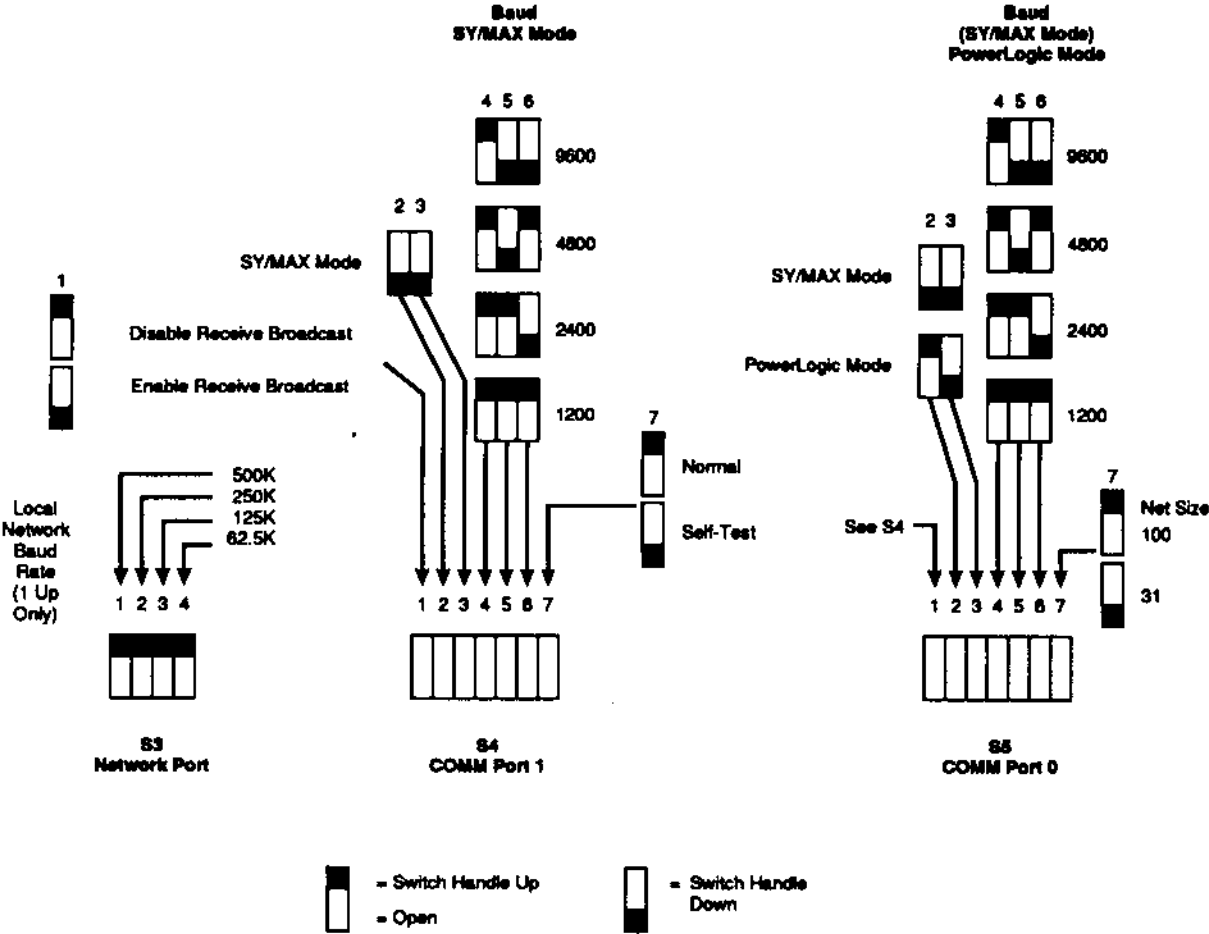**Type CC104 Series Cable Wiring Diagrams**

9-Pin (Male)   9-Pin (Male)

DB-9 Pin Connections at SY/MAX (SY/LINK) End

Circuit Monitor Terminal Strip

20 (IN+)
21 (In-)
22 (OUT+)
23 (OUT-)
24 (SHIELD)

Actual Pin Positions on 9 pin Connector (Rear View)

5 4 3 2 1
9 8 7 6

Appendix D - Summary of DIP Switch Settings

Baud SY/MAX Mode

4 5 6

9600
4800
2400
1200

2 3

SY/MAX Mode

Disable Receive Broadcast

Enable Receive Broadcast

1

7

Normal

Self-Test

Local Network Baud Rate (1 Up Only)

500K
250K
125K
62.5K

1 2 3 4

S3 Network Port

1 2 3 4 5 6 7

S4 COMM Port 1

Baud (SY/MAX Mode) PowerLogic Mode

4 5 6

9600
4800
2400
1200

2 3

SY/MAX Mode

PowerLogic Mode

See S4

7

Net Size

100

31

1 2 3 4 5 6 7

S5 COMM Port 0

= Switch Handle Up
= Open

= Switch Handle Down

DIP Switch Setting Summary
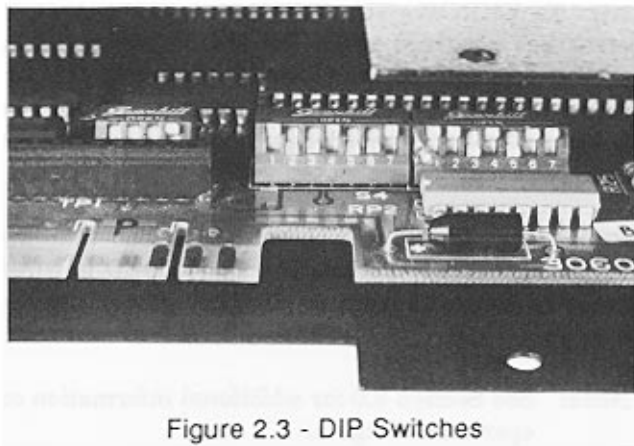
Figure 2.2 - Thumbwheel Switches
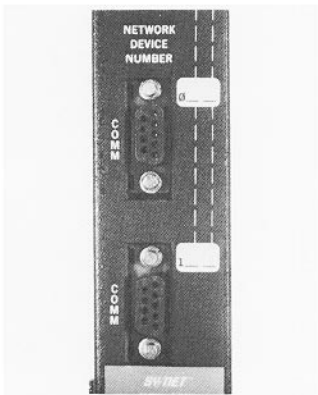

Figure 2.3 - DIP Switches

Figure 2.4 - Network Port

Figure 2.5 - COMM Ports

Figure 3.2 - Network Interface Module