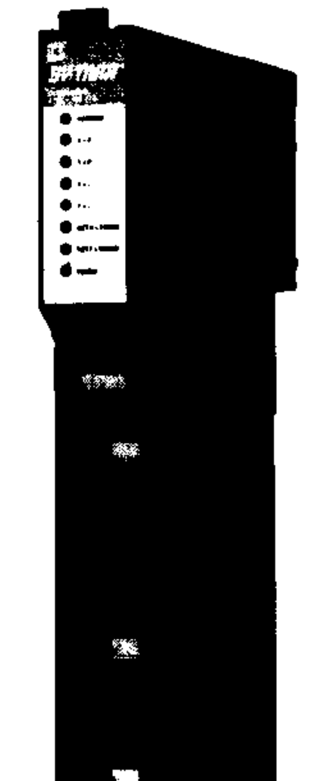
Instruction Bulletin

Subject: **SY/NET**
CLASS 8030 TYPE CRM-510
NETWORK INTERFACE MODULE

DESCRIPTION:

This product provides a very flexible and powerful communication system which allows many SY/MAX Programmable Controller Family devices to communicate with each other. Control functions such as I/O status, I/O forcing, and register values can be altered over the network. All programs should be designed with the above in mind. The user must read and become familiar with the enclosed information before applying this product.

The following information is subject to change without notice. Square D can accept no liability for actual use based upon illustrations and examples within this bulletin.



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Supersedes 30598-257-01, 11/84
Minor Corrections, 4/89

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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 plastic 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.

Antistatic (metallized plastic) bags can be obtained from the following manufacturers:

- 3M Company (800-328-1368) Type 2100 bag
- Static, Inc. (800-782-8424) 8000 Series bag
- Charles Water (617-964-8370) CP-303 bag

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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1.0 DESCRIPTION

1.1 Introduction

The Class 8030 Type CRM-510 Network Interface Module (NIM) is a communications interface, which allows PCs, CRTs, printers, computers, and other SY/MAX Family devices to communicate with each other, exchanging register data and I/O status. When a CRT Programmer is connected to the SY/NET Network, you can program, monitor, force I/O and UP/DOWN load ladder diagram programs to any SY/MAX PC on the Network.

Each Network Interface Module (NIM) can support two devices. Up to 100 NIMs can be connected to a single network, allowing up to 200 devices on one network. With the SY/NET network, you can also link several networks together. Network linking provides network expansion and opens the door for distributed networks and network redundancy.

The SY/NET Network has been designed with simplicity in mind without sacrificing flexibility. Communicating between two PCs can be accomplished by utilizing a single rung of the ladder diagram. To communicate the same data OVER THE SY/NET NETWORK all that is needed is to add two route values; source device number and destination device number. Once these route values are added to a communication rung, the same message will then be sent "OVER THE NETWORK".

The SY/NET Network, in addition to supporting the SY/MAX Family, also supports communications with the 8881 PC, computers, printers, bar code readers, and other ASCII devices.

1.2 Specifications

1.2.1 NETWORK SPECIFICATIONS

A.	Cable	-baseband twinaxial cable, Belden 9463, or equivalent.
B.	Connectors	-dual concentric twist lock. Tees, cable ends, adapters, etc. are available from Square D.
C.	Terminators	-required on each end of the Network cable.
D.	Clock frequency	-1 megahertz.
E.	Cable length	-Communication baud rate dependent (cable length vs BAUD rate).
F.	Transmission type	-Manchester encoded HDLC.
G.	Message format	-packet type similar to ANSI 3.28
H.	Collision avoidance	-token passing, based on time windows
I.	Priority	-based on module number (lowest number has highest priority).
J.	Error checking	-CRC (cyclic redundancy code) on all network transmissions.
K.	Message routing	-source/destination message routes are placed in the command for each device wishing to communicate
L.	Number of devices	-200 devices per Network maximum
M.	Expansion	-Net-to-Net linking - standard, no limit

1.2.2 INTERFACE MODULE SPECIFICATIONS

A. Plugs into any "REGISTER" slot.
B. Requires 950ma at 5 VDC through back plane rack connection.
C. Single high speed (SY/NET) connector per module.
D. Two independent low speed RS-422 receptacles per module. Baud rates switch-selectable to 9600 Baud.
E. Four operating modes per low speed port: SY/MAX Family devices, 8881 Programmable Controller, Net to Net, and peripheral devices. Dip switch selectable.
F. Module "address" selected by tool operated thumbwheel switches.
G. Various special commands such as broadcast. See Section 9.0.

2.0 INSTALLATION AND HARDWARE

2.1 Installation

The Network Interface Module consists of a single module similar in size to the Model 300 Processor. This module can be plugged into the register slot of an I/O rack or any slot in a register rack. A Network Interface Module can be inserted in the following racks:

Class 8030	Type	Type
	CRK-100	GRK-110
	CRK-200	GRK-210
	CRK-210	HRK-100
	CRK-300	HRK-200
	DRK-210	RRK-100
	DRK-300	RRK-200

The Network Interface Module operates on 5 VDC and obtains this power from an I/O or register rack. No other signals exist between the Network Interface Module and the rack except for power connections.

2.1.1 MODULE KEYING

Each register slot, whether on a digital or register rack, has two keying pins which are installed at the factory. These are located between slot location 4 and 6 and location 96 and 98. These pins insure 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 CBP-104, 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 2.1. The keying pin is simply inserted manually into the slot of the rack connector, using the keying pin insertion tool provided with the kit. See Figure 2.2.

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.

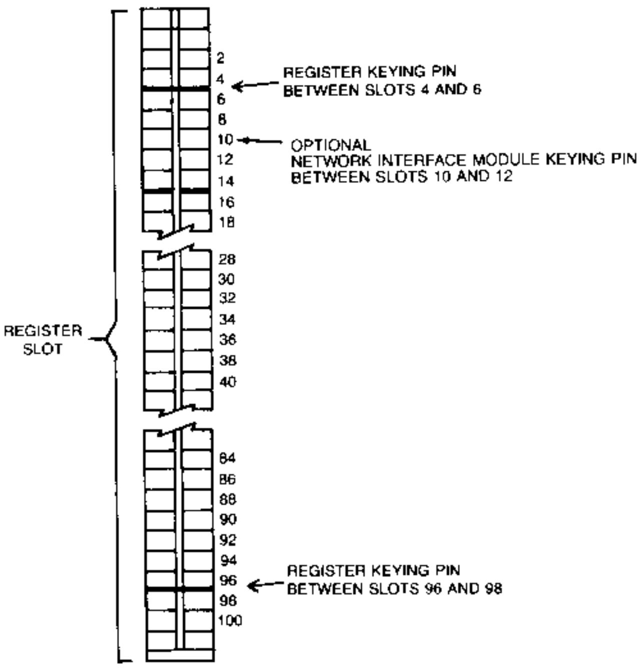


Figure 2.1 - Module Keying

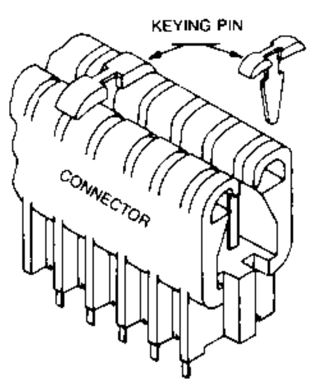


Figure 2.2 - Keying Pin Insertion

2.2 Hardware

The Network Interface Module (NIM) consists of a module 2 inches wide by 11 inches high by 7 inches deep. Located on the front of the NIM are 8 indicator lights, 2 thumbwheel switches and 2 communication ports - for PC's, CRT's, printers, etc. See Figure 2.3 Module Overview.

Click here to view graphic.

Figure 2.3 — Module Overview

On the bottom is a receptacle for the Network Communication Cable. See Figure 2.4. This is where the network cable is attached (Cable type is Belden 9463).

Click here to view graphic.

Figure 2.4 - Network Connector

At the rear of the module, near the edge connector, are three sets of switches labeled S3, S4, and S5. These switches are used to select mode of operation, baud rate, and other operational functions. See Figure 2.5.

Click here to view graphic.

Figure 2.5 - Side View, Cover Removed

2.2.1 INDICATOR LIGHTS

The Network Interface Module has eight indicator lights which help in troubleshooting. The lights are:

NETWORK
Rx 0
Tx 0
Rx 1
Tx 1
NET Rx ERROR
NET Tx ERROR
POWER

Click here to view graphic.

Figure 2.6 - NIM LEDs

NETWORK — This AMBER light when **on**, indicates activity on the 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 Network Interface Module is **receiving** data from the device connected to Port 0.

Tx 0 — This AMBER light indicates that the NIM is **transmitting** data to the device connected to Port 0.

Rx 1 — Same as Rx 0 except for Port 1.

Tx 1 — Same as Tx 0 except for Port 1.

NET Rx ERROR — This RED light indicates that a communication error has occurred on received network data. Typically this light indicates that all buffers are full.

NET Tx ERROR — This RED light indicates that an error has occurred when the NIM attempted to send a message on the Network. Typically this occurs when a message is routed to a NIM that does not exist.

POWER — This GREEN light indicates that the NIM has power applied. The Power LED is wired directly to the incoming 5 VDC power to the card.

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

2.2.2 SWITCHES

The NIM has 2 types of switches; 2 thumbwheel switches and 3 groups of rocker switches. These switches select various options of the NIM.

2.2.2.1 Thumbwheel Switches

On the front of the Network Interface Module are two thumbwheel switches. These switches are used to select the module address on the network.

On the right side of the module - next to the thumbwheels - are two access holes. These holes allow setting of the thumbwheels using a small screwdriver. Once set, you should write the number of the thumbwheels onto the write-in areas on the front of the module. This number defines the network device number for COMM ports 0 and 1. See Section 5.2 for more information.

Click here to view graphic.

Figure 2.7 - Thumbwheel Switches

2.2.2.2 Printed Circuit Board Mounted Switches

On the rear of the Network Interface Module are three groups of switches labeled S3, S4, and S5. See Figure 2.8.

Click here to view graphic.

Figure 2.8 - Printed Circuit Board Mounted Switches

Each switch group contains 4 or more individual switches numbered 1-4 or 1-7. These switches are used to set NETWORK baud rate, COMM port baud rate, mode of operation for Ports 0 and 1, and other special functions.

Manufacturers supplying DIP switches have not standardized on the physical position of a DIP switch and its corresponding electrical state. This has caused a lot of confusion as to which way a switch should be set. Complicating the situation further, are the numerous state descriptions used to describe whether a switch is conducting or not. See Table 2.1

X		UP	↑	OPEN	0	OFF
	X	DOWN	↓	CLOSE	1	ON

Table 2.1 - Switch Label Options

Throughout this manual two switch conventions will be used, (1) physical and (2) description.

A physical switch setting refers to the position of the switch handle with respect to the printed circuit board. The letter "X" will denote handle position, for example, the following will refer to switches 1, 4 and 7 up and 2, 3, 5, and 6 down.

1	2	3	4	5	6	7
X			X			X
	X	X		X	X	

Description switch settings of "UP" and "DOWN" will be used when a combination of switches are being discussed. For example:

SWITCH 4	SWITCH 5	SWITCH 6	BAUD RATE
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300

S4 or S5

The above table describes BAUD rate options for the COMM ports. A BAUD rate of 9600 could also be described as:

SWITCH

1	2	3	4	5	6	7
			X			
				X	X	

9600 BAUD

Switch Group S3 - NETWORK BAUD RATE

Switch group S3 selects the baud rate for the network. 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 change from 500K to 62.5K baud. See Table 2.2.

SWITCH 1	2	3	4	BAUD RATE	MAX LENGTH (Cable Feet)
UP	DOWN	DOWN	DOWN	500,000	2,400 MAX
DOWN	UP	DOWN	DOWN	250,000	4,250 MAX
DOWN	DOWN	UP	DOWN	125,000	9,250 MAX
DOWN	DOWN	DOWN	UP	62,500	15,000 MAX

Table 2.2 - Network BAUD rate

Note: Set only one switch UP otherwise the fastest baud rate will be active.

By providing a selectable baud rate, the user can adapt the SY/NET system to many geographical layouts.

Note: Reducing the baud rate by 50% does not cut network performance by 50%, there is only a 7% change in performance. See Section 10.0 for more performance information.

Switch Groups S4 and S5 - COMM PORT 1 AND 0

Switch groups S4 and S5 are used to select:

- Mode of operation for COMM ports
- Baud rate for COMM ports
- Self test
- 100/30 network size

Switch groups S4 and S5 each contain 7 switches.
Switches 1-6 on switch group S5 control COMM Port 0.
Switches 1-6 on switch group S4 control COMM Port 1.

Switch #7 on switch groups S4 and S5 select self test and network size respectively.

The following is a description of all switches (1-7) on switch groups S4 and S5.

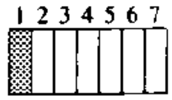
Switch 1

This switch selects several options depending on the mode you are in.

SY/MAX Family and 8881 Mode

This switch selects whether broadcast messages on the network should be received.

Up	Disable Receive Broadcast
Down	Receive Broadcast.



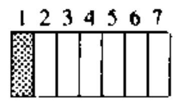
See Section 9.1 for more broadcast information.

Net-to-Net Mode - Switch reserved for future use

Peripheral Mode

In the peripheral mode, you have the option to select parity for each communication port.

Up	Eight Bit Word, No Parity
Down	Seven Bit Word, Odd Parity

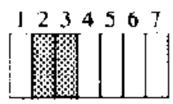


When a SY/MAX Family CRT is used in the peripheral mode, this switch should be in the DOWN position.

Switch 2 and 3 - Mode

MODE	SWITCH 2	SWITCH 3
SY/MAX	DOWN	DOWN
Net To Net	UP	DOWN
8881	DOWN	UP
Peripheral	UP	UP

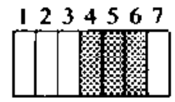
S4 or S5



Switches 4, 5, and 6 - Select Baud Rate

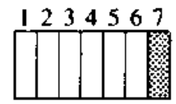
SWITCH 4	SWITCH 5	SWITCH 6	BAUD RATE
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300

S4 or S5



Switch 7 On switch group S4
When UP allows normal operation. - when DOWN, enables self-test. See Section 8.1.3.

Switch 7 On switch group S5
When UP sets network size to 100 - DOWN sets network size to 30. See Section 10.1



By setting baud rate and mode switches, the user can adapt the Network Interface Module to a variety of devices, i.e. CRT's, Programmable Controllers, modems, printers, computers.

Figure 2.9 provides a summary of Switch settings.

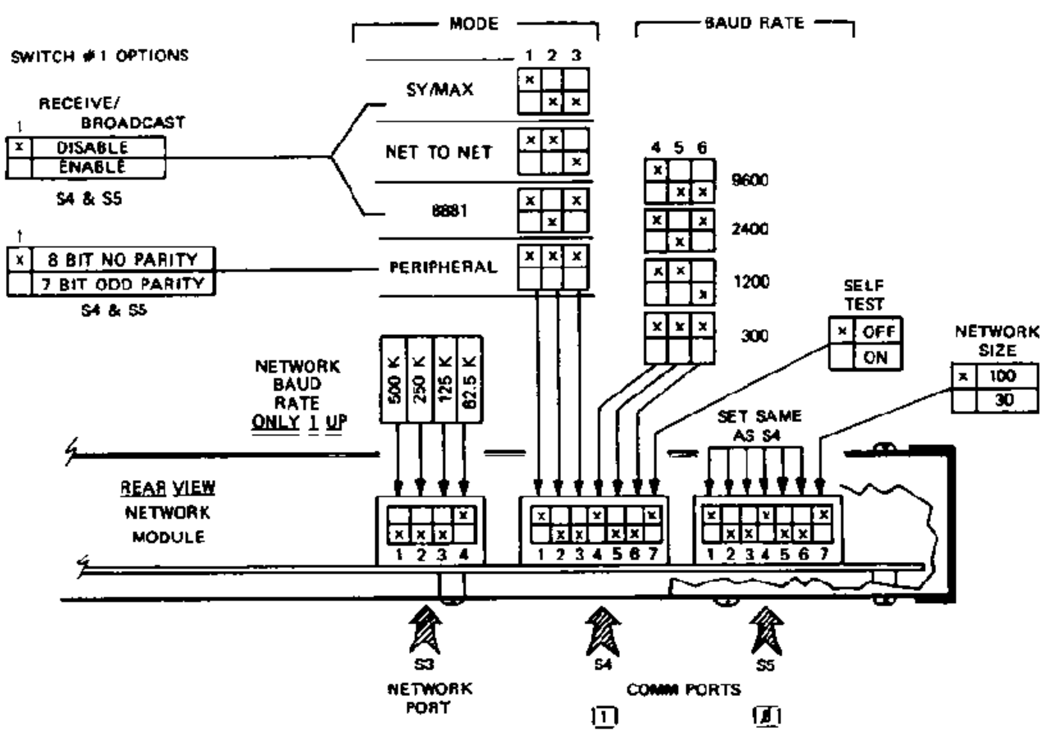


Figure 2.9 - Summary of Switch Settings

Note: As shipped from the factory, switches S3, S4, and S5 are set as follows:

S3

1	2	3	4
			X
X	X	X	

S4

1	2	3	4	5	6	7
X			X			X
	X	X		X	X	

S5

1	2	3	4	5	6	7
X			X			X
	X	X		X	X	

Mode	- SY/MAX Family
Ports 0 and 1	- 9600 Baud
Network Port	- 62.5K Baud
Self Test Mode	- Off
Network size	- 100 Modules

2.2.3 NETWORK PORT

On the bottom of the Network Interface Module (NIM) is a network port. This male connection is where the network cable will be connected. Recommended cable type is Belden 9463.

2.2.4 COMM PORTS

On the front of the NIM are two COMM ports. These ports are used to interface with the SY/MAX Family and other devices. These ports operate as RS-422 ports and will not support RS-232C devices directly. With a special cable, RS-422 can interface directly with current loop devices. Each port operates independently and supports handshaking (Request to Send - Clear to Send) signals. Adaptors are available for RS232C (Class 8010 Type CRM-600).

3.0 CABLING - WIRING

3.1 COMM Port

The COMM ports on the front of the Network Interface Module utilize RS-422 signal levels and also support hardware handshaking (Clear to send - Request to send) signals.

The following is a description of the signals available at the 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	

3.1.1 SY/MAX FAMILY

When connecting a Network Interface Module to a SY/MAX Family device, you can use a standard Class 8010 Type CC-100 Series cable. This cable can be purchased in several lengths. These lengths are:

Class	Type	Length
8010	CC-100	10 Ft.
8010	CC-101	30 Ft.
8010	CC-102	2 Ft.

When an application requires a cable length longer that 30 feet, you can purchase a connector kit and assemble your own cable. See Figure 3.1.

Cable Kit: Class 8010 Type CCK-102, consists of:

2 - 9 pin connector DB9P
2 - connector covers
18 - pins

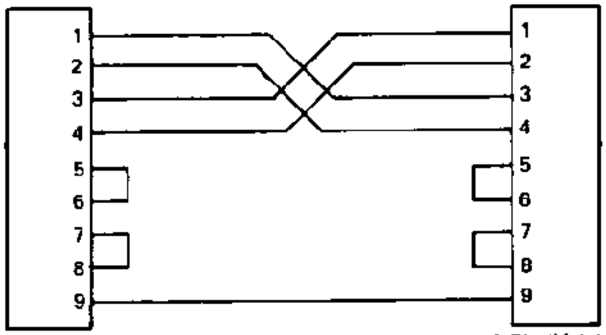


Figure 3.1 - CC-100 - Series Cable Wiring Diagram

The maximum recommended cable length is 10,000 feet. Recommended cable type is Belden 8723 or equivalent (2 pairs shielded, with ground).

The Network Interface Module COMM ports also support handshake signals (Clear to Send - Request to Send). These signals are not needed when a SY/MAX Family device is used, and therefore are jumpered in the CC-100 Series cables. The CC-100 Series cables can be used with a variety of devices:

NIM to CRT	CRT to PC
NIM to PC	D-LOG to PC
NIM to D-LOG	PCM to PC
NIM to PCM	NIM to NIM
NIM to Loader/Recorder	

3.1.2 LOADER/MONITOR, 8881, AND OTHER PERIPHERAL DEVICES

3.1.2.1 Loader/Monitor To Network Interface Module

The loader/monitor, when used in the message mode, can be connected to a Network Interface Module (NIM) to display alarm or data messages. The NIM would be set for the peripheral mode. Although the loader/monitor does communicate using RS422 signals, the loader/monitor will need to obtain power from a separate power supply (the NIM COMM ports do not provide power). See instruction bulletin 30598-163-01.

RS422 to RS232

When it is necessary to connect an RS232 device to a NIM, a Class 8010 Type CRM 600 RS422 to RS232 adaptor can be used. The cable used to connect the CRM-600 to the NIM should be a Class 8010 Type CC-130. See Figure 3.2.

For additional cable/hardware information, see instruction bulletin 30598-180-01 (printers).

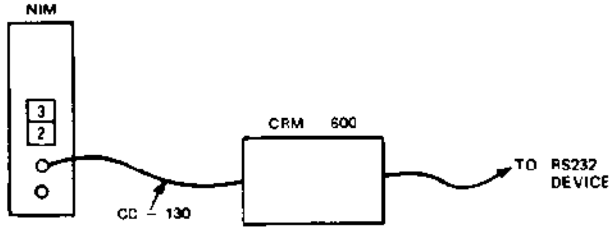


Figure 3.2 - CRM-600 - RS422 to RS232 Adapter

3.1.2.2 8881 To Network Interface Module

When an 8881 PR-3 is connected to a NIM, an RS232 to RS422 adaptor would normally be required. If the distance between the 8881 PR-3 and the NIM is 50 feet or less, a special RS232/current loop cable can be used. See section 6.4.1 for specific cable information.

3.2 Network Port

On the bottom of the Network Interface Module is a network port. This port provides communications between Network Interface Modules. When you connect two or more NIMs together, you will form a communications network.

3.2.1 HARDWARE, CONNECTORS, TEE'S, TERMINATORS

Connecting Network Interface Modules together involves several parts. The following is a description of these parts.

Connectors

When building a Network cable, you will need four types of connectors. These connectors are:

Connector	Class	Type
Cable End	8030	CCK-211
Tee Connector	8030	CCK-212
Terminator (set of two)	8030	CCK-213
Cable Extension	8030	CCK-214

Cable End

The cable end consists of a female socket and can be used with Belden 9463 or equivalent twinax cable. Two cable ends are required for each length of network cable.

Factory assembled cables have been made in two lengths. These lengths are:

2 foot length Class 8030 Type CC-201
10 foot length Class 8030 Type CC-202

When an application requires a cable length longer than 10 feet, you can purchase a connector kit and assemble your own cable. Connector kit is a CLASS 8030 type CCK-211 (two required).

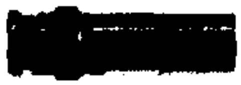
Recommended cable type is Belden 9463 or equivalent twinax cable.

See Appendix B for cable assembly instructions.

Tee Connector

The Tee connector consists of two male plugs and one female socket. The female end, plugs in under the Network Interface Module. The two male plugs allow connections to a network cable.

Terminator



The terminator consists of a female socket and an internal 78 ohm resistor. One terminator is required at each end of the network cable. Only two terminators are required per network system.

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 Network Interface Module is removed, (3) used to provide the splice for a future Network Interface Module (replace the cable extension with a tee connector) and (4) used to extend the distance between the Network Interface Module and the tee connector.

3.2.2 MULTIDROP CONFIGURATION

The SY/NET communication system consists of a baseband-bus configuration. What this means is that a single cable is extended across a plant or building and then all devices that wish to talk on the network simply splice into the network, sharing this common cable. See Figure 3.3.

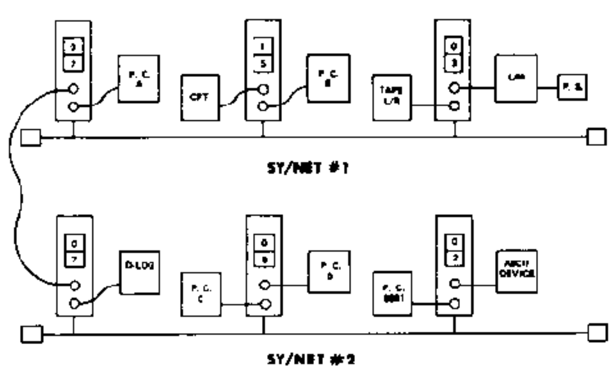


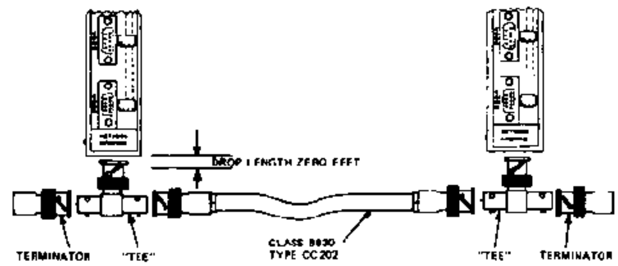
Figure 3.3 - Sample Network Layout

3.2.2.1 Network Cable Length

By changing the BAUD rate of the network, you can vary the maximum overall length of the network cable and the distance between the Network Interface Module and the Network Tee Connector (drop length). The following table describes the maximum network cable length based on network BAUD rate.

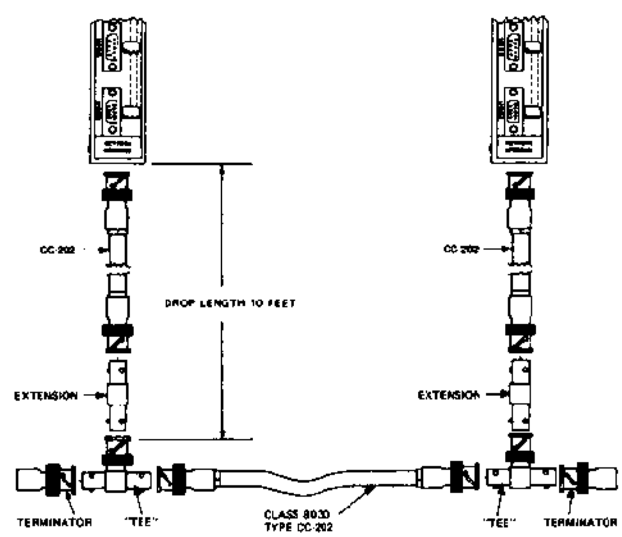
Network BAUD rate	Maximum Network Length (in feet)
62.5 K BAUD	15,000
125 K BAUD	9,250
250 K BAUD	4,250
500 K BAUD	2,400

Drop length equals 0 feet.



These maximum network cable lengths are based on connecting the network "T" connector directly to the Network Interface Module (drop length equals 0 feet). When it is necessary to extend the distance between the network "T" connector and the Network Interface Module 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 Net Length (ft.)
500 K	100	0	2,400
250 K	100	0	4,250
125 K	100	0	9,250
62.5 K	100	0	15,000
62.5 K	25	100	10,250
62.5 K	100	100	950



3.2.3 INSTALLATION CONSIDERATIONS

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

1. Provide a minimum of six inch distance between the network cable and 120 volts AC, 12 inches at 240 volts AC, and 24 inches at 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 (RS422). Routing of the network cable should be done in accordance with standard wiring practices for low level switching signals. See Instruction Bulletin 30598-175-01 (Planning Installation Guide).

4.0 MODULE OPERATION

4.1 Power Cycling

When power is applied to the Network Interface Module (NIM) it will automatically go into a self test sequence. This sequence tests the internal PROM memory for checksum, clears the built in RAM memory and performs a read/write test on this memory. During this startup sequence, the NET RX ERROR and NET TX ERROR lights will flash on and off. If the module passes these tests, the module will then go into a normal operational mode. If an error is detected the module will flash the RX and TX indicating lights in a pattern which indicates the type of error found. Cycling power will reset the module.

Note: Any messages received by the Network Interface Module during power-up will be ignored. Initiating devices i.e. processors, CRT's, will receive an error.

Power Down Sequence

When the Network Interface Module senses that power is being removed (AC fail signal from the power supply drops below .3 volts) the Network Interface Module will go into a shut down sequence.

During this shut down sequence the NIM will halt all communications, turn off the network port - disconnecting it from the network - and then halt until power is re-applied.

Note: Any messages stored in the Network Interface Module will be lost!

4.2 Message Handling

The Network Interface Module basically supports two types of communications: (1) Network communications, NIM to NIM and (2) COMM Port communications; PC to PC, CRT to PC, etc. It also coordinates the communication between the COMM ports, the NET port, and the SY/NET network.

Network Communication consists of a synchronous data stream from one Network Interface Module to another. This data structure is in the form of a protocol known as HDLC. (High Level Data Link Control).

HDLC provides data transfer, message acknowledgements, and error recovery. All SY/NET network ports communicate (talk) to each other using HDLC.

COMM Port Communication consists of an asynchronous data stream from the Network Interface Module to a PC, CRT, 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.

The Network Interface Module, when it receives a message from **either** COMM port, will check 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 address data received from the incoming message.

4.2.1 MESSAGE COORDINATION

As messages are received by the Network Interface Module, it will either, 1) send the message to another port, 2) build an error message and send it to the initiating device, or 3) hold the message for later use. In all cases, the Network Interface Module will reply to the initiating device.

Network Module Number

On the front of the Network Interface Module are two thumbwheels and two COMM ports.

The thumbwheels can be set to any value between 00 and 99. Access holes located on the right side of the Network Interface Module allow thumbwheel switch changes.

The thumbwheel number selected refers to:

A. Network module number or address (used with COMM port)
B. Network time slot
C. Network module priority

The top	COMM port has a prefix of 0	0 — —
The bottom	COMM port has a prefix of 1	1 — —

The thumbwheel number, when used with the COMM port number will define a "Network device number" or address. For example:

Thumbwheel number #15 has device numbers
Top COMM port 015
Bottom COMM port 115

Since the thumbwheel number can be set from 00 to 99 and each Network Interface Module supports two COMM ports, then up to 200 unique network devices may be connected to a single SY/NET network.

If you need to connect more than 200 devices see Section 5.2 (Net to Net mode).

Any device that is plugged into a COMM port on the Network Interface Module will assume the COMM port's "network device number".

Once every device on the Network Interface Module contains a "network device number", this device number can be used to route messages from one device to another.

4.2.2 NETWORK ACCESS

Before a message is sent "On the Network", the Network Interface Module will hold the message and wait for its turn to communicate.

Since all network communications occur over the same twinax cable (Belden 9463), network access by all NIM's has to be controlled in order to prevent message collisions.

Network access is controlled by a time sharing method which, 1) allows every module a chance to "talk" on the network, 2) prevents any module from hogging the network, and 3) provides device priority for important (alarm) messages.

The thumbwheels on the front of the Network Interface Module select the time slot when the NIM is allowed to send a message.

How is this done?

Within each Network Interface Module is a timer. On power-up and at the end of every message these timers are reset and then start timing. (Noise will also reset all timers). At a value of 0, module 0 is allowed to talk on the network. If module 0 has no message to put on the network, the timer continues timing and module 1 is allowed to send a message. This sequence continues to a count of 99; allowing every module the opportunity to talk on the network. When the timers reach a count of 100, all modules will reset their timers to 0 and the sequence will start over.

The time slot for each Network Interface Module is approximately 200 us for a total slot time of 20 ms for 100 Network Interface Modules. If the network contains less than 30 modules, the total slot time or loop around time can be reduced to 6 ms. See Section 10.1 for switch settings (switch 7 DOWN on switch group S5).

4.2.3 PRIORITY

Priority refers to the ability of one network device to send a message before another lower priority device can gain access. Network priority is controlled by the thumbwheel number on the front of each Network Interface Module. The lower the number, the higher the priority.

The SY/NET Network supports 100 priorities (thumbwheel settings). For example: Module #18 will talk on the network before Module #19; Module #30 before Module #31, etc. Since the time slot timer starts at 0 and advances to 99, module 0 will get first access to the network.

At the end of **any** message on the network, **all** timers are reset and the priority devices (lower thumbwheel numbers) again get first chance to talk on the network. For example: If module 22 is sending a message and module 23 has a message waiting to be sent, module 23 will have to wait its turn. When module 22's message **ends**, all timers will reset to 0 and begin timing. If no other modules (0 thru 22) have a message to send, the timer will advance to 23 allowing module 23 to send its message.

If any module 0 thru 21 did have a message to send, module 23 would have to wait.

Note: You cannot interrupt a message already in progress.

4.2.3.1 Automatic Priority Shifting or Round Robin System

Initially the SY/NET network will operate under the 100 priority system referred to as SET priority. As network activity increases the set priority system shifts into an EQUAL priority or round robin system.

Under an equal priority system all modules have the same priority.

Why equal priority?

With a SET priority system, module 7 for example, gains access to the network before module 29. When module 7's message is done all NIM timers are reset to 0 and start timing. If module 7 has multiple messages to send and its time slot comes up, it could hog the network.

Instead, Network Interface Module #7 will skip its turn giving up its priority until the timer reaches a value of 100 (or 30).

What this means is that as other modules communicate (get their turn) and the module timers get reset, module 7 will be blocked - prevented from sending messages - until all modules have a chance to send one message. By doing this you can predict the worst case network access delays through any module and insure that all devices will have access to the network even with very high message counts.

Once the module timers reach a value of 100 or 30, all modules that were blocked will be unblocked and the network will revert to a set priority system.

4.2.4 BUFFERING

Another function performed by the Network Interface Module is buffering. Buffering refers to 1) message communications speed conversion and 2) the holding of messages for later use

As messages are received thru the network port, the Network Interface Module waits until the complete message is received, acknowledges the message, and then retransmits the message out a COMM port.

During this retransmitting, a Baud rate change takes place. The message received at 62.5-500K baud (network speed) is retransmitted at 300-9600 Baud (Comm port speed).

The same conversion is made when messages are sent to the Network Interface Module via the COMM ports. Upon receiving a complete message, the Network Interface Module acknowledges the message and then retransmits the message over the network at 62.5-500K Baud.

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 Network Interface Module (NIM) the NIM may have to save the messages in a buffer until they can be retransmitted.

The NIM has 16 buffers shared by both COMM ports. When more than 16 messages are received, the NIM's buffer will overflow and a Network Receive Error will occur. Typically this error is indicated by a flashing NET Tx error light. As soon as the message has been sent by the NIM, one buffer becomes available for another message.

4.3 Error Handling

In addition to parity, checksum, and CRC checks associated with each message, every message on the network is acknowledged. Which means, that for every command message, there is a reply message.

If a message is not acknowledged, or a negative acknowledgment is received, the network port will automatically re-transmit the message up to four times. If after four attempts, a negative acknowledgment or no acknowledgment is received, a message will be sent back to the initiating device; also the Net TX LED will flash on the NIM that originated the message.

The same message acknowledgment applies to the COMM Ports. If an error is detected, the NIM will automatically re-transmit the message up to eight times.

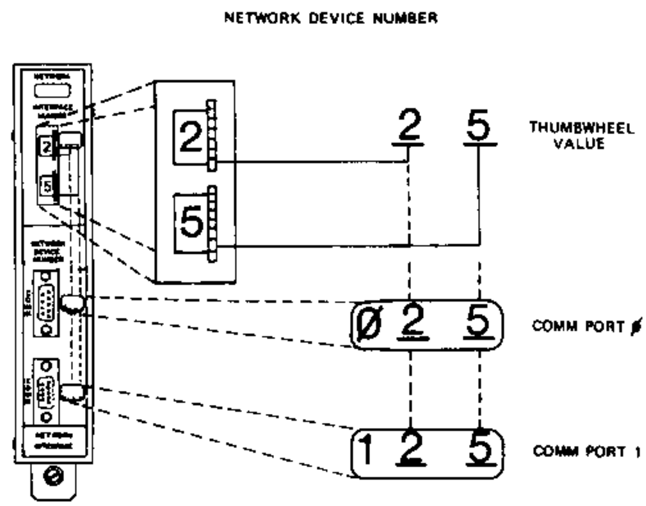
By automatically re-transmitting messages when an error occurs, messages are allowed to get thru the network even under noisy electrical conditions.

5.0 DEFINING THE NETWORK

5.1 Routing

In order to direct communications from one device to another "over the network" each device on the network must contain a "network device number". Once defined, two or more network device numbers can be added to communication rungs creating a path or ROUTE the message will take over the network.

For single-network communications, only two network device numbers are required to route the message over the network. The first route value defines where the message will originate (source), and the last route value defines which device will receive the message (destination). Once you have defined a source and destination or ROUTE; normal communication can take place.



5.2 How To Determine Network Device Number

On the front of the Network Interface Module (NIM) are two thumbwheel switches. These switches can be set from 00 to 99 (access holes are located on the right side of the module).

The network device number is determined by reading the thumbwheel value on the front of the NIM and adding a 0 or 1 in front of the NIM number for Comm Port 0 or 1 respectively.

Basically the top Comm Port has a network device number equal to the thumbwheel value, and the bottom Comm Port has a network device number equal to the thumbwheel value plus 100. For example: a NIM/thumbwheel value of 25 will define:

Top	Comm Port device number equals 025
Bottom	Comm Port device number equals 125

Since the thumbwheels can be set from 00 to 99 and each NIM supports two Comm Ports, a total of 200 devices can be connected on a single network.

NOTE: Any device that is plugged into a Comm Port on the Network Interface Module will assume the Comm Ports' network device number.

5.3 How To Use Routing

With direct PC to PC communications, you would use a "READ" or "WRITE" rung, as in Figure 5.1.

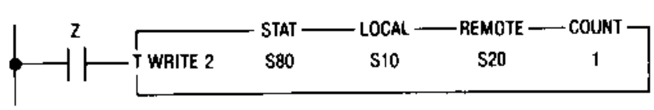


Figure 5.1 - WRITE Rung Without Routing

In Figure 5.1, PC A will write register 10 to register 20 in PC B.

To route messages over the network, you need to first determine the network device number of the PC initiating the WRITE rung and the network device number of the receiving PC. Next, you need to add these network device numbers to the communication rung.

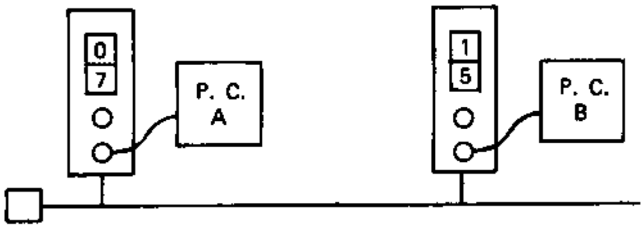


Figure 5.2 - Defining Network Device Number

In Figure 5.2, PC A is connected to NIM number seven, Comm Port one and has a network device number of 107. PC B is connected to NIM 15, Comm Port one and has a network device number of 115. Adding these network device numbers to the WRITE rung allows the same communications to occur, but now will be routed over the network. See Figure 5.3.

```
 Z     ROUTE  ROUTE  STAT  LOCAL  REMOTE  COUNT
T WRITE 2   107    115    S80   S10    S20     1
```

Figure 5.3 - WRITE Rung With Route Values Added

5.4 Net-to-Net Routing

Network to Network routing allows several networks to be linked together. See Figure 5.4.

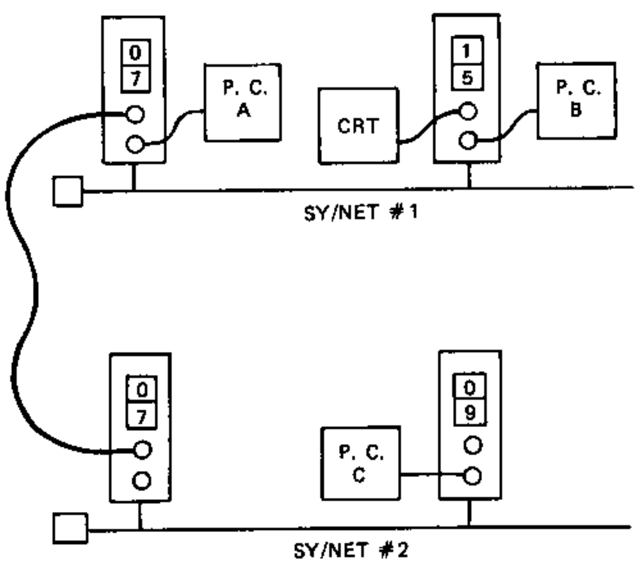


Figure 5.4 - Sample Net-To-Net Layout

When communicating over a net-to-net link, you will need to put an additional network device number into your communication rungs. In Figure 5.4, PC A has a network device number of 107, the network device number of the net-to-net link is 007, and PC C has a network device number of 109. A net-to-net link has been established by connecting two network Comm Ports together and setting both NIMs to the net-to-net mode. See Section 6.2.

NOTE: Both Network Interface Modules involved with the net-to-net link must have the same thumbwheel settings and network device numbers.

> CAUTION: On any network, each module must have a unique thumbwheel setting. If two NIMs have the same number — the network will not operate properly.

Using the rung in Figure 5.5, PC A will route its message through the net-to-net link to PC C.

```
 Z     ROUTE  ROUTE  ROUTE  STAT  LOCAL  REMOTE  COUNT
T WRITE 2   107    7      109    S81   S11    S21     1
```

Figure 5.5 - Sample WRITE Rung With Net-To-Net Route Values

The first route value always defines the source device, the second route value defines net-to-net link and the last route value always defines the destination device.

As more route values are added to the communication rung, further net-to-net linking can take place.

Within the PC, five to six route values can be programmed. Within the CRT programmer, up to eight route values can be defined. See Section 6.2 for more net-to-net mode information.

6.0 MODES OF OPERATION

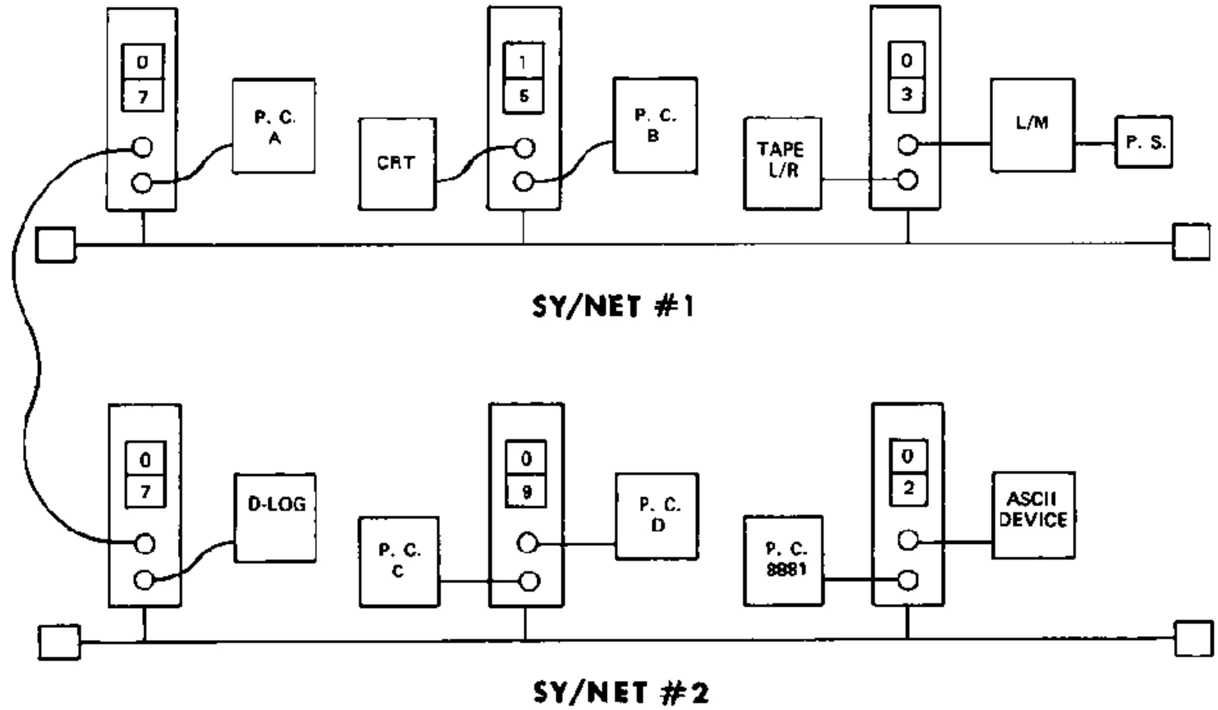


Figure 6.1 - Sample Network Layout

The Network Interface Module offers four modes of operation. These modes are:

1. SY/MAX Family	CRT's, PC's, Process Controllers, Loader/Recorders, Data Controllers, etc.
2. NET - NET	Two or more networks can be connected together.
3. Peripheral	Communicate with ASCII device, CRT's, Printers, bar code readers, etc.
4. 8881 PC	Read/Write I/O and register data.

Each COMM port is independent and can operate in any of these four modes.

A typical network will consist of several PC's, CRT's etc. See Figure 6.1.

The following sections describe the use of the network.

6.1 SY/MAX-Family Mode

This mode allows I/O status, register data, and ladder rungs to be exchanged/transferred between two or more SY/MAX Family devices. Compatible devices are:

Model 100, 300, 500, 700 processors
CRT Programmers
Data Logging equipment
Process Control equipment
Cartridge Tape Loader/Recorder

Non compatible devices are:

Hand-Held Programmer
*Loader/Monitor

*The Loader/Monitor can be used on the network in the message mode only. For additional information see Section 5.3.

6.1.1 CABLE REQUIREMENTS

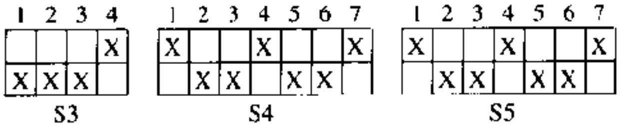
Any SY/MAX Family compatible device can be connected to the Network Interface Module (from COMM port to COMM port) using the Class 8030 Type CC-100 Series cable. This cable can be purchased in different lengths. These lengths are:

CLASS	TYPE	LENGTH
8010	CC-100	10 feet
8010	CC-101	30 feet
8010	CC-102	2 feet

When an application requires a cable longer than 30 feet, you can purchase a connector kit and assemble your own cable. See Section 3.1.1.

6.1.2 SWITCH SETTINGS

On the back of the Network Interface Module are three groups of switches labeled S3, S4, and S5.



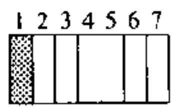
SY/MAX Family Mode

Switch group S3 Selects the network port baud rate (Set to 62.5K See Section 2.2.2)

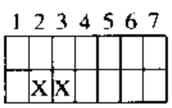
Switch groups S4 and S5 each have seven switches. Switches on switch groups S4 and S5 perform the same function for COMM Ports 1 and 0 respectively.

Switch Functions

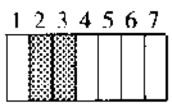
Switch 1 Selects option to receive broadcast messages. See Section 9.1 (Normally set UP (off)).



Switches 2 & 3 Select mode



S4 or S5

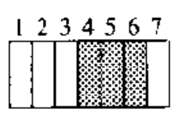


Switches 2 & 3 down Select SY/MAX Family mode.

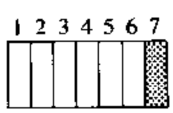
Switches 4, 5, & 6 Select COMM port baud rate

SWITCH 4	5	6	BAUD RATE
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300

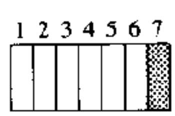
Switch group S4 or S5



Normal setting is 9600 baud (Switch 4 UP, Switch 5 & 6 DOWN).



Switch 7 on switch group S4 Selects self-test mode - set UP (off).



Switch 7 on switch group S5 Selects network size = 100 Modules (Set UP).

See Appendix D for summary of switch settings.

Once all switches have been set, you can then connect your PC, CRT, etc. to the Network Interface Module.

6.1.3 OPERATION

This section describes how the Network Interface Module can be used with the PC, CRT, D-LOG module and Cartridge Tape Loader/Recorder.

6.1.3.1 PC to PC

When you need to communicate I/O and register information between two PC's **without** using SY/NET, the following hardware layout can be used.

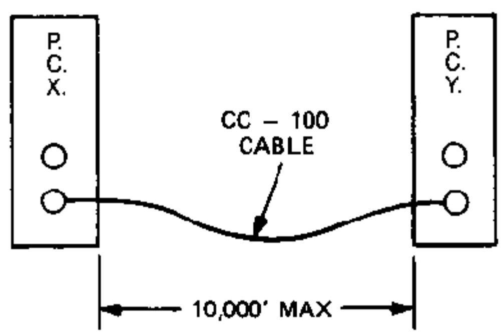


Figure 6.2 - PC To PC Hardware Layout

In order for PC X to write its Register 40 into PC Y's Register 50, you need to program the following rung into Processor X.

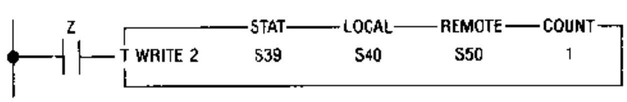


Figure 6.3 - Sample WRITE Rung

Where:

WRITE: Refers to the command to send data to another PC.

2: Refers to communications using processor Port #2 (comm).

STAT: A register which contains information on the progress of the communication message.

LOCAL: A register inside the initiating PC which contains data to be sent.

REMOTE: A register in the remote PC where data will be stored.

COUNT: Refers to the number of consecutive registers that will be sent.

When contact Z closes in example 6.3, processor X will write the contents of its Register 40 into Processor Y's Register 50. Since the example rung has a count of one (1), no other registers will be affected. The Communication message is enabled once for each closure of Z because the Write rung is transition sensitive.

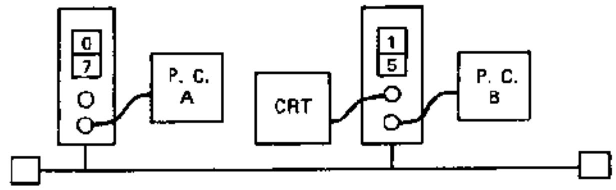
Communication Progress

During communications (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.

STATUS REGISTER BIT	DESCRIPTION
Bit 1	ON – error in communication
Bits 1-14	Error code (1 thru 16383-all error codes are odd numbers). If an error is encountered in communications an odd number error code will be put into the status register. See Section 8.1 for a list of error codes.
Bit 15	RUN/HALT status of remote processor. Bit 15 indicates RUN/HALT status of remote processor. ON = RUN, OFF = HALT. (Only valid when BIT 16 is ON-message complete.)
Bit 16	ON = Communication Complete! This bit can be used to initiate automatic repeat of communication rungs.
Bit 17	ON = Communications 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 elements for control functions. For additional programming examples, see Section 7.0.

When you need to perform PC - PC communications with two or more PC's, a SY/NET communication network can be used.



Routing

When using a SY/NET system you need to provide additional information in the communication rung describing where the communication message originated from and where it will end up. These extra commands are otherwise referred to as source and destination or the ROUTE.

For example if PC A is connected to NIM #7 Port 1 it would have a network device number of 107. If PC B is connected to NIM #15 Port 1 it would have a network device number of 115. (If Port 0 was used, PC A would have a network device number of 007 and PC B a number of 015.) See Section 5.1 for additional routing information.

Taking Example 6.3 and adding the route values provides:

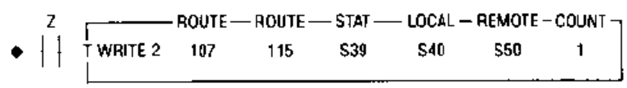
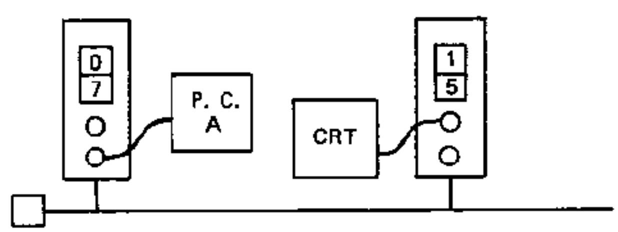


Figure 6.4 - WRITE Rung With Route Values Added

Once the ROUTE values are added to the communication rung, NORMAL communications can take place "OVER THE NETWORK".

6.1.3.2 SY/MAX Family CRT Programmer to PC

Typically when you program, monitor, edit, or load/record programs using a CRT, all that is needed is to connect a CRT directly to the processor using a Class 8010 Type CC 100 cable.



In order to select which PC you wish to communicate with on the network, you need to enter routing information into the CRT. See above example.

Entering Route Into The CRT Programmer

Once the CRT is connected to a NIM's COMM Port, (and therefore the network) and power is applied, the CRT will perform its start-up test. Following this test the CRT should display the SY/MAX line programmer menu. If no display is shown:

1. Check Mode switches on the NIM. (Should be set for SY/MAX Family.)
2. Check baud rate switch setting. (Should be set for 9600 BAUD.)
3. Cycle power on NIM and CRT.

On the CRT are 10 soft keys; one key is labeled "ROUTE". Depressing this key will display:

Click here to view display.

Enter in the network device number of the CRT (15). This is determined by adding the NIM port number to the thumbwheel number on the NIM. Example:

NIM #15 Port 0 has a device number of 015.
Port 1 has a device number of 115.

See Section 5.1 for more routing information.

Next type a "," (comma) followed by the device number of the PC you wish to communicate with (107).

Finally, depress the LOAD softkey. When the LOAD softkey is pressed the CRT will return to the main menu. Any CRT operations performed will now occur "over the network". No CRT capability is lost by using the network.

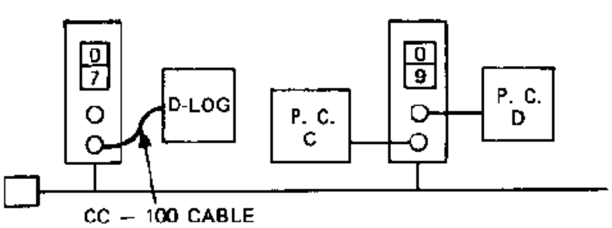
To communicate with another PC, simply change the route numbers in the CRT.

NOTE: The CRT will loose its routing information when powered down.

6.1.3.3 D-LOG To PC

Using the Class 8030 Type DLM-110 (or 120) D-LOG module, you can "GET" and "PUT" I/O and register data over the network to any PC on the network.

Using a standard CC-100 series cable, connect the D-LOG module's COMM port to a NIM COMM port.



All that is needed to communicate on the network, is to enter "ROUTE" values into the D-LOG program. In the D-LOG program, type in the following instructions:

10 ROUTE A,B

Where:

10	=	any line number 1-65529
Route	=	Communication Instruction used for the SY/NET network
A	=	Network device number where D-LOG module is connected
B	=	Network device number where you will "GET", or "PUT" I/O and register data

See Section 5.1 for additional routing information

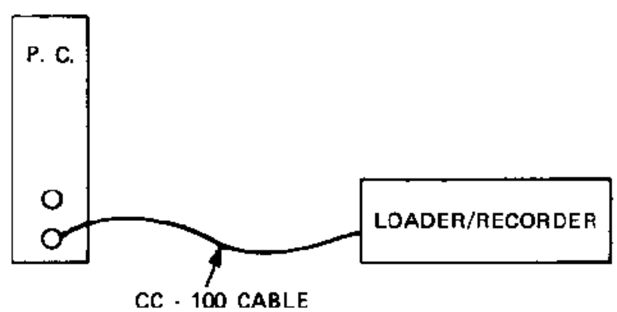
Once the D-LOG module executes line 10, all D-LOG COMM port communications will contain routing information.

It is acceptable to put multiple route commands in a D-LOG program. See Instruction Bulletin 30598-272-01.

Note: For direct D-LOG to PC communications no routing information is needed.

6.1.3.4 PC to Cartridge Tape Loader/Recorder (Class 8010 Type SLR-100)

By programming READ and WRITE rungs into a PC, you can write PC register data onto the tape and later read data from the tape into the PC's registers. All that is required is a Class 8010 CC-100 series cable.



Within the Cartridge Tape Loader/Recorder, there are 530 registers. Registers 1 thru 512 allow PC register data to be saved and recalled; and appear to the PC as programmable controller registers.

Register 513 through 530 are used to control the operation of the Cartridge Tape Loader/Recorder.

When the PC "writes" to register 519 for example, the loader/recorder will rewind the tape. See Example 6.5.

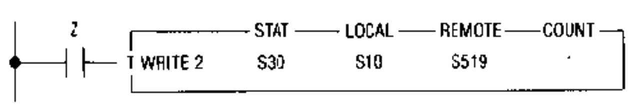
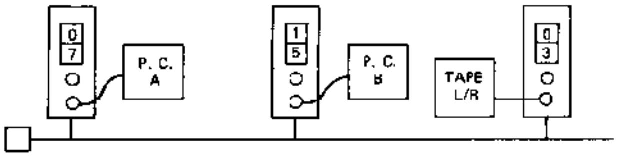


Figure 6.5 - WRITE Rung To Loader/Recorder

Closing Contact Z will command the PC to write into Register 519 of the loader/recorder.

Since register 519 is a control register, the command to rewind the tape will be performed (without regard to the data in Register 10). When a loader/recorder is connected to a Network Interface Module, a single loader/recorder can contain data from several PC's or data logging modules.



Communication to a loader/recorder on the network requires that "ROUTE" values be added to the communication rung.

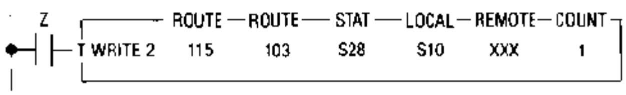


Figure 6.6 - WRITE Rung With Route Values Added

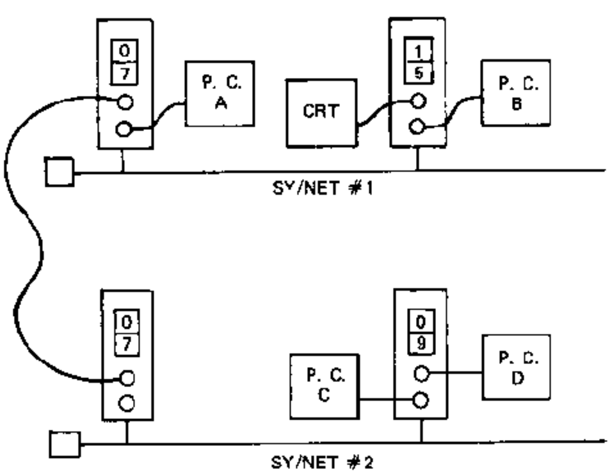
Where:

WRITE	=	Command to the loader/recorder
ROUTE 115	=	Network device number of PC initiating communications
ROUTE 103	=	Network device number of remote loader-/recorder
STATUS	=	Register which contains information on the progress of the communication rung
LOCAL	=	PC register inside the initiating PC
REMOTE	=	XXX - data or control register number of receiving device
COUNT	=	Number of consecutive registers affected (set to 1 for control register commands).

See Bulletin 30598-162-01 for additional information on the operation of the Cartridge Tape Loader/Recorder.

6.2 NET to NET Mode

The NET to NET mode allows two or more SY/NET networks to be linked together to form distributed networks, a large capacity network, or network redundancy.



Utilizing the NET to NET capability requires consideration of three steps.

1.	Cable Requirements	(8010 CC-100 series cable or equivalent).
2.	Switch settings	(mode, baud rate, and thumbwheels must match).
3.	Operation	(additional route values needed).

6.2.1 CABLE REQUIREMENTS

The connection between two networks is via the COMM ports on the front of the Network Interface Modules (ports 0 or 1). A standard CC-100 series cable can be used. Three lengths are available.

CLASS	TYPE	LENGTH
8010	CC-100	10 Ft.
8010	CC-101	30 Ft.
8010	CC-102	2 Ft.

When an application requires a cable longer than 30 Ft., you can purchase a connector kit and assemble your own cable. See Section 3.1.1.

NOTE: When connecting the 2 NIMs together, the COMM port numbers, and switch settings must be the same. Port 0 to port 0 or port 1 to port 1.

6.2.2 SWITCH SETTINGS

On the back of the Network Interface Module are three groups of switches labeled S3, S4, and S5.

S3

1	2	3	4
			X
X	X	X	

S4

1	2	3	4	5	6	7
	X		X			X
		X		X	X	

S5

1	2	3	4	5	6	7
	X		X			X
		X		X	X	

Net to Net Mode

Switch group S3 - selects the network port baud rate as previously described.

Switch groups S4 and S5 each have seven switches. Switches on groups S4 and S5 perform the same function for COMM ports 1 and 0 respectively.

Switch Functions

Switch 1 Not Used in Net to Net Mode.

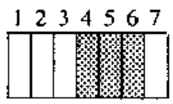
Switches 2 & 3 Select mode.

S4 or S5

Switch 2 UP and switch 3 DOWN Selects NET to NET mode.

Switches 4, 5, & 6 Select COMM port baud rate.

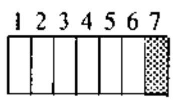
SWITCH			BAUD RATE
4	5	6	
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300



Switch group S4 or S5

Normal setting is 9600 Baud (Switch 4 UP. Switch 5 & 6 DOWN).

Switch 7 on switch group S4 Selects self-test mode - set UP (off).



Switch 7 on switch group S5 Selects network size = 100 modules set UP.

See Appendix D for summary of switch settings.

Once all switches have been set you can then plug the Network Interface Module into the rack.

NOTE: The switch settings of both NIM COMM ports that will be connected together must be the same (Net-to-Net Mode and BAUD rate).

6.2.3 THUMBWHEEL SWITCH SETTING

Once settings for S3, S4, and S5 have been made, it is necessary to set the thumbwheel switches on the front of the Network Interface Module. (thumbwheel switch access holes are on the right side of the module).

Set the thumbwheels on the NIM's that will be linked together to the "same number" i.e. Network #1 Module 20 must connect to Network #2 Module 20.

When using the net to net capability the thumbwheels of the two net to net NIM's modules must be set alike and the same relative Comm ports must be used (e.g. 2 to 2, 106 to 106).

> CAUTION: On any network, each module must have a unique thumbwheel setting. If two NIM's have the same number - the network will not operate properly.

Routing

Routing communications over a NET to NET link requires one or more additional route values.

For example, in Figure 6.7, if PC A needs to communicate with PC C the new route would be:

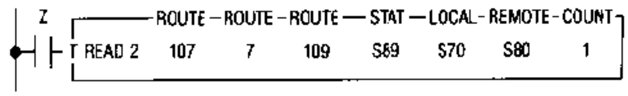


Figure 6.7 - READ Rung With Net-To-Net Route Values

Where:

ROUTE 107 = Network device number of PC that will send data.

ROUTE 7 = Network device number of NET to NET link.

ROUTE 109 = Network device number of remote PC where information will be received.

When three or more route values are put into a communication rung, the first Route value refers to the source or initiating device. The last route value refers to the destination device that will receive the communication. Any additional route values will instruct the network to perform message passing (NET to NET communications).

Within the PC, five to six route values can be programmed and with the CRT programmer, up to 8 route values can be defined.

A typical application of NET to NET communications would be in a multi-level manufacturing facility. Each floor could contain a single network. Then all floors could be linked together using a single network of NET to NET links.

EXAMPLE:

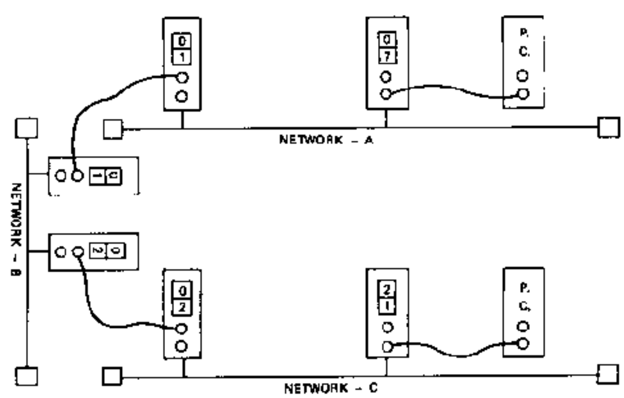
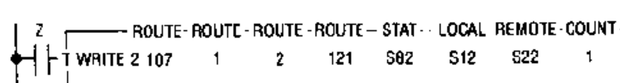


Figure 6.8 - Sample Layout For Net-To-Net Communications

For PC #107 to communicate with PC #121 the route would be: Route 107, 1, 2, 121.



In the above example:

ROUTE 107 = Network device number of PC initiating communications (local PC).

ROUTE 1 = Network Device Number of NET to NET link (Network A to Network B).

ROUTE 2 – Network Device Number of NET to NET link (Network B to Network C).

ROUTE 121 = Network Device Number of destination PC that will receive message. (Remote PC).

See section 5.1 for additional routing information.

6.3 Peripheral Mode

The Peripheral Mode allows CRT's, printers, and other ASCII devices to be connected to the network. This mode is primarily used by the D-LOG Data Controller Module, Class 8030 Type DLM-110 (or 120).

The D-LOG Data Controller can print out alarm messages, reports, and machine faults to any ASCII device connected to the Network Interface Module. An added capability exists whereby a CRT keyboard or other ASCII Device can also be read as an input to the Data Logging module over the network.

6.3.1 CABLE REQUIREMENTS

Each COMM port of the NIM communicates using RS422. In order to communicate with an RS232-C or current loop device, a signal conversion has to be made.

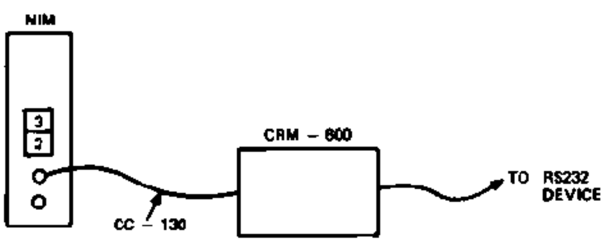
NIM TO RS232

To convert RS422 to RS232, a standard interface can be used.

CLASS 8010 TYPE CRM-600

The cable used to connect the CRM-600 to the NIM should be a:

CLASS 8010 TYPE CC-130



For additional cable/hardware information, see instruction bulletin 30598-180-01 (printers).

6.3.2 SWITCH SETTINGS

On the back of the Network Interface Module are three groups of switches labeled S3, S4, and S5.

S3

1	2	3	4
			X
X	X	X	

S4

1	2	3	4	5	6	7
X	X	X	X			X
				X	X	

S5

1	2	3	4	5	6	7
X	X	X	X			X
				X	X	

Peripheral Mode

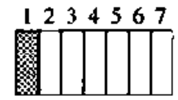
Switch group S3 Selects the network port Baud rate (set for 62.5K, see Section 2.2.2)

Switch groups S4 and S5 each have seven switches. Switches on switch groups S4 and S5 perform the same function for COMM Ports 1 and 0 respectively.

Switch Functions

Switch 1 Selects word size and parity of COMM ports.

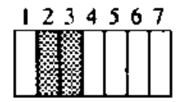
UP	Selects 8 bit no parity
DOWN	Selects 7 bit odd parity (compatible) with SY/MAX Family CRT).



Switches 2 & 3 Select mode

1	2	3	4	5	6	7
	X	X				

S4 or S5



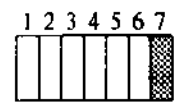
Switches 2 & 3 UP Select Peripheral Mode.

Switches 4, 5, & 6 Select COMM port Baud rate

SWITCH 4	5	6	BAUD RATE
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300

Normal setting is 9600 Baud (Switch 4 UP, Switch 5 & 6 DOWN.)

Switch 7 on switch group S4 Selects self-test mode - set UP (off).



Switch 7 on switch group S5 Selects network size - 100 Modules (Set UP).

See Appendix D for summary of switch settings.

NIM to Current Loop

When the Network Interface Module is connected to a current loop capable device, a special cable must be used. This cable, however, does not support handshaking signals and can only be used to output data from the NIM to a peripheral device.

The following cable will allow the NIM to communicate with a current loop device. (The COMM port sources current).

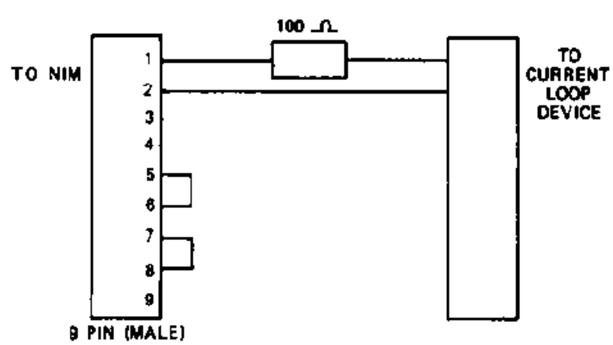


Figure 6.9 - NIM To Current Loop Cable

6.3.3 OPERATION

The peripheral mode basically is a protocol simplifier. As data is sent to the NIM from a D-LOG module or other device using the SY/MAX Family protocol, the data is stripped away from the message and then sent out to the COMM port. Any device connected to the COMM port will then receive only the ASCII data from the message. Receiving devices could be printers, CRT's, or any ASCII compatible device.

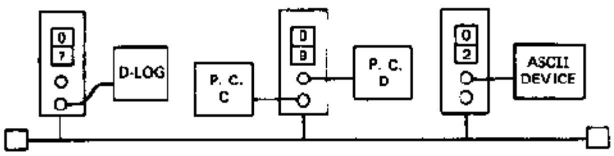


Figure 6.10 - Network To ASCII Device

6.3.3.1 D-LOG Print ASCII Data Over the Network

The following D-LOG program will print a single message on a CRT located at NIM #2 Port 0 and then direct printed data back to the programmer. The D-LOG module is connected to NIM #7 Port 1.

```
10 Route 107, 2
20 Assign LO = COM
30 PRINT "Remote Message"
40 Assign LO = PGR
```

Program Description

Line	Function
10 -	Defines route for printed message.
20 -	Directs all printed data to the COMM port.
30 -	Prints message.
40 -	Directs printed data back to the programmer port.

NOTE: The NIM can only store one message destined for a printer at a time. If additional PRINT messages are received by the NIM an overflow error (Error 15) will be returned to the initiating device.

If a processor attempts to WRITE to the NIM, a capability error (Error #5) will be returned to the processor (Writing to a NIM configured in the peripheral mode is not allowed).

6.3.3.2 Input ASCII Data Over The Network

The peripheral mode of the NIM can be used to receive or "INPUT" data over the network.

As ASCII data is received by the NIM module, it will be saved until a D-LOG module or processor reads this ASCII data.

Input Data Using a D-LOG Module from a Peripheral Device

The following D-LOG program will print the message ("REMOTE MESSAGE") to a remote CRT and then wait for an input response from the remote ASCII device on the network.

```
10 Route 107, 2 (from example in Section 6.3.3.1)
20 Assign LO = COM
30 Print "Remote Message"

40 Assign CO = COM
50 Input A$
60 Assign CO = PGR
70 Assign LO = PGR
```

Program Description

Line	Function
10	Defines route for the printed message
20	Directs all printed data to the COMM port
30	Print sample message
40	Directs console input from the COMM port
50	Input data from the COMM port
60	Direct console input back to programmer port
70	Direct printed data back to programmer port

When the D-LOG module requests data from the NIM using an "INPUT" command the NIM will accept ASCII data and send it to the initiating D-LOG module. If data is received by the NIM faster than the D-LOG module can accept it, the NIM will buffer the data. The buffer size of the NIM is approximately 240 characters.

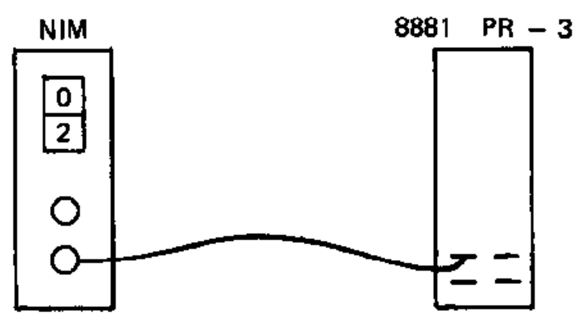
If ASCII data is sent to the NIM before a request for this data is made, the NIM will buffer the data.

NOTE: Since the NIM's buffer may have received information previously, the buffer must be cleared by sending a PRINT before an INPUT instruction is initiated.

6.4 8881 Mode

The 8881 mode allows SY/MAX Family devices (PC's, D-LOG modules, etc.) to read or alter register data and I/O status from the Class 8881 PC system thru the use of the 8881 PR-3 programmer.

NOTE: The 8881 programmable controller can only respond to requests of data and cannot initiate a message.



6.4.1 CABLE REQUIREMENTS

Each NIM COMM port communicates using RS-422. When interfacing with an 8881 PR-3, the computer port of the PR-3 will be used. This port supports RS-232 and current loop operation. RS-422 is not supported. However, a special cable can be used to adapt the PR-3's signals to RS-422. See Figure 6.11. This cable allows a direct connection between the PR-3 and the NIM.

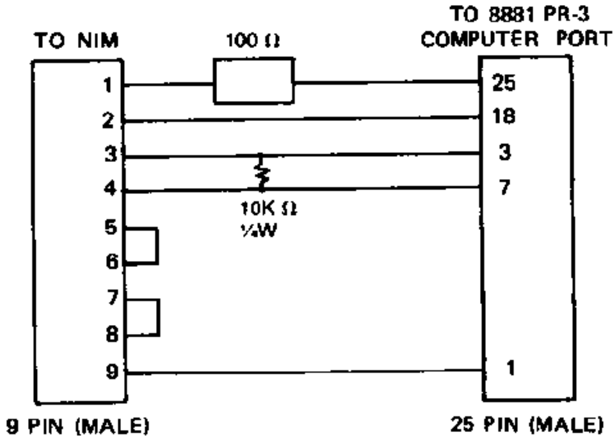


Figure 6.11 - Direct NIM To 8881 PR-3 Cable

The cable length between the PR-3 and the NIM using the above cable configuration should not exceed 50 feet.

When the application requires the distance between the NIM and the 8881 PC to be greater than 50 feet, the Class 8010 Type CRM-600 (RS-232 to RS-422 convertor) can be used.

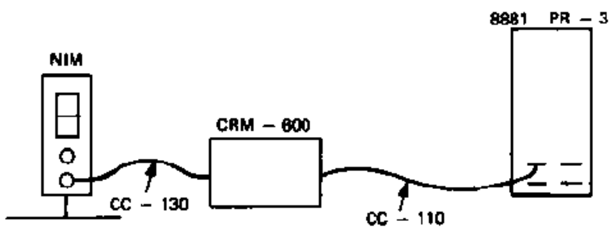


Figure 6.12 - NIM To 8881 PR-3
Using CRM-600 Adapter

In Figure 6.12 the NIM communicates to the CRM-600 using a Class 8010 Type CC-130 cable. This cable comes in a standard 10 foot length.

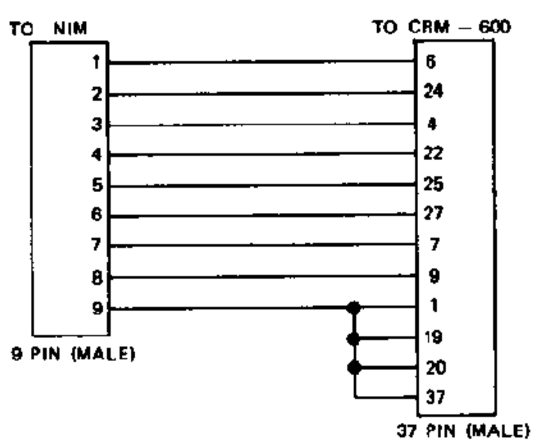


Figure 6.13 - CC-130 Cable Wiring Diagram

The maximum cable length should not exceed 10,000 feet.

The connection between the CRM-600 and the 8881 PR-3 requires a special RS-232 cable.

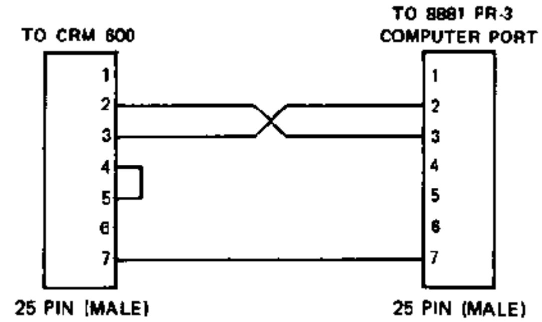


Figure 6.14 - CRM-600 To 8881 RS232 Cable

The maximum cable length should not exceed 50 feet.

6.4.2 SWITCH SETTINGS

On the back of the Network Interface Module are three groups of switches labeled S3, S4, and S5.

S3

1	2	3	4
			X
X	X	X	

S4

1	2	3	4	5	6	7
X		X	X			X
	X			X	X	

S5

1	2	3	4	5	6	7
X		X	X			X
	X			X	X	

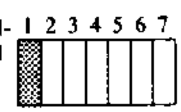
8881 Mode

Switch group S3 Selects the network port Baud rate (set for 62.5K, see section 2.2.2)

Switch groups S4 and S5 each have seven switches. Switches on switch groups S4 and S5 perform the same function for COMM Ports 1 and 0 respectively.

Switch Functions

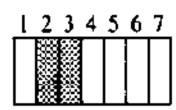
Switch 1 Selects option to receive broadcast messages. See Section 9.1 (Normally set UP (OFF)).



Switches 2 & 3 Select mode

1	2	3	4	5	6	7
		X				
	X					

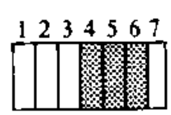
S4 or S5



Switch 2 DOWN and switch 3 UP Selects 8881 mode.

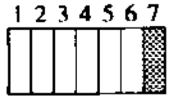
Switches 4, 5, & 6 select COMM port baud rate.

SWITCH 4	5	6	BAUD RATE
UP	DOWN	DOWN	9600
UP	DOWN	UP	2400
UP	UP	DOWN	1200
UP	UP	UP	300



Normal setting is 9600 Baud (Switch 4 UP, Switch 5 & 6 DOWN).

Switch 7 on switch group S4 Selects self-test mode - set UP (off).



Switch 7 on switch group S5 Selects network size = 100 Modules (Set UP).

See Appendix D for summary of switch settings.

6.4.2.1 8881 PR-3 Switch Settings

The 8881 PR-3 contains 3 sets of switches. These switches are located behind a gold cover plate on the front of the PR-3.

The top switch affects the CRT port.
The middle switch affects the printer port.
The bottom switch affects the computer port.

When connecting the 8881 PR-3 to the NIM, the computer port switch settings should be set as follows:

	OPEN	CLOSED
7	X	
6		X
5		X
4		X
3	X	
2	X	
1	X	

Switches 1-4 select baud rate.

SWITCH	BAUD RATE
4	9600
3	1200
2	300
1	110

Note: only 1 CLOSED

Switch 5 selects parity

Open = no parity Closed = **odd parity**

Switch 6 = current loop mode select
Open = current loop off Closed = **current loop active**

Switch 7 = RS232 mode select
Open = **RS232 off** Closed = RS232 active

Note: For proper operation the baud rate of the 8881 PR-3 and the NIM must be the same.

6.4.3 OPERATION

The 8881 mode of the Network Interface Module allows PC and D-LOG modules to READ and WRITE register data and I/O status from the 8881 PC.

Note: The 8881 system cannot initiate communication messages and therefore acts as a slave device.

When communicating with an 8881 system there are 2,048 available addresses. These addresses can be subdivided into sections of I/O's, registers, and internal relays. See 8881 Product Data Bulletins for additional information. A typical 8881 system could be:

ADDRESSES	FUNCTION
0 thru 767	I/O's
768 thru 991	MLU Registers
992 thru 1023	Not useable (MLU)
1024 thru 2047	I/O's or Relays

When I/O or relay status is requested from the 8881, the value of 1 for ON or 0 for OFF will be returned.

When REGISTER DATA is requested from the 8881, the NIM will read the contents of the 8881's registers and will return the bit pattern of the registers selected. This bit pattern could represent two types of data from the 8881. (1) numeric data with values 0 to 999, or (2) bit/shift register data 000000000000 To 111111111111.

The following are some examples for getting and putting register data from an 8881 PC system. For examples on how to decode bits of a register, see the D-LOG instruction manual 30598-272-01.

6.4.3.1 Getting Register Data From an 8881 PC

When a D-LOG module or processor gets register data from an 8881 PC, a conversion has to be made on the data. This is necessary because the 8881 stores data in a BCD format while the D-LOG and processors operate on data in a BINARY format.

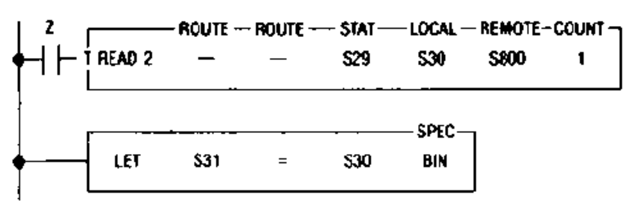
Therefore, when you request data values from the 8881 PC you must perform a BCD to BINARY conversion on the data received from the 8881 PC.

EXAMPLE OF A "GET" USING A D-LOG MODULE.

```
10 Route Y,Z             : where Y and Z are the network
                           device numbers of the D-LOG
                           module and 8881 PR-3.
20 GETN A,800            : where A will contain the BCD
                           data from an 8881 Register
30 A = VAL (HEX$(A))     : Perform BCD to BINARY con-
                           version
40 PRINT "Register 800 equals":A
```

In the above program, the HEX$ function will perform a BCD to BINARY conversion on the data within the parenthesis.

Example of a Read Command Initiated By a SY/MAX Processor



In the above example, SY/MAX Processor register 31 will contain the converted data from register 800 of the 8881 PC.

6.4.3.2 Sending Register Data to the 8881 PC

When a D-LOG module or SY/MAX processor puts register data into an 8881 PC, a conversion has to be made to the data. This is necessary because the D-LOG and processor operate on BINARY data while the 8881 system operates on BCD data. Therefore, when you put data into an 8881 system you must perform a BINARY to BCD conversion on the data before the data is sent to the 8881 PC.

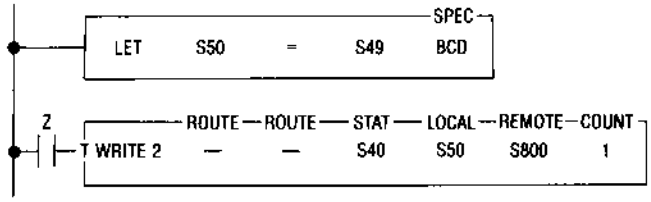
Example of a "PUT" Using a D-LOG Module

10 Route Y, Z	:	where Y and Z are the network device numbers of the D-LOG module and 8881 PR-3.
20 A = Q	:	where Q contains the data to be sent to the 8881 PC.
30 GOSUB 100	:	Perform BINARY to BCD conversion.
40 PUTN A,800	:	Send data to the 8881 PC.
50 END		

```
100 IF A < 0 OR A > 999 THEN PRINT "DATA ERROR":
END
110 B = INT (A/10): C = INT (B/10):
D=B-C*10:B=A-B*10:A=C*256+D*16+B:RETURN
```

In the above program, lines 100 thru 110 perform the BINARY to BCD conversion. When the conversion is complete, variable 'A' will contain the corrected data ready to be sent to the 8881 PC.

Example of a "WRITE" Using a SY/MAX Processor



In the above example, rung 1 converts the data in register 49 to BCD. Then in rung 2 this converted data is sent to the 8881 PC.

The above examples illustrate one approach to communications for the 8881 PC.

> Caution must be exercised when writing to the 8881 PC. Data values greater than 999 will be interpreted by the 8881 PC as shift register (bit type) information.

Note: Only the data values need be converted, no conversion is necessary for addresses.

7.0 APPLICATION PROGRAMMING

There are many ways to program PC to PC communication rungs. The following section provides several examples to help describe programming of communication rungs.

7.1 Communication Rung Operation

The communication rung consists of three parts: (1) rung information - registers involved, (2) status register, (3) an initiating contact.

7.1.1 RUNG INFORMATION

Rung information contained in a read or write rung describes which registers will be transmitted/received between PCs and how many registers will be communicated at once.

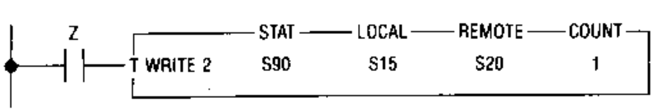


Figure 7.1 - Sample WRITE Rung

In Figure 7.1 the communication rung contains three information areas. These areas are local, remote, and count.

Local - refers to registers in the PC that will initiate the communication rung.

Remote - refers to registers in the PC that will receive the data.

Count - defines how many consecutive registers will be involved.

NOTE: Model 300 PC maximum count is 16.
Model 500 PC maximum count is 64.

The word READ or WRITE refers to the direction of the data exchange.

READ - Data is read from the remote PC register and put into the local PC register.

WRITE - Data from the local PC is written into the data register of the remote PC.

In example 7.1 register 15 will be written into register 20 of the remote PC.

7.1.2 STATUS REGISTER

The status register keeps track of the communication rung and will provide information on:

1. Rung continuity - power flow up to the box (bit 22)
2. Message progress - has message been sent (bit 17)
3. Communications error detected (bits 1 through 14)
4. Communication message completed (bit 16)
5. Remote device HALT/RUN status (bit 15)

The status register contains data which refers to communication progress, and any errors that were encountered. This data is sent by the remote device to the initiating device, in response to a Read or Write command.

The above status information will be available until the rung is opened. Any time the rung is opened the status register will be cleared (set to 0).

NOTE: Each communication rung must have a unique status register number.

7.1.3 INITIATING CONTACT

The initiating contact can consist of a single normally open or normally closed contact or several contacts.

When the initiating contact is closed, the communication rung will be enabled and bit 22 of the status register will turn on. Any time the initiating contact is opened, the rung will be reset and the status register will be cleared (set to 0).

When performing communications, it is recommended that the initiating contact be closed until the communication rung has finished communicating (bit 16 turned on). If the initiating contact will only be present for one scan, it is recommended that you put in a seal circuit to maintain the rung continuity until the communication rung is finished.

7.2 Communication Rung Examples

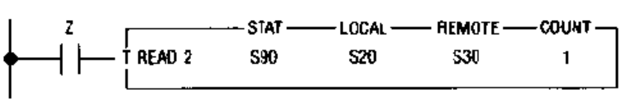
This section describes several communication rungs. They are:

1. Single register READ rung
2. Multiple register READ rung
3. Enabling multiple communication rungs
4. Efficient communications (write on data change)

Al. examples have been designed using the following rules:

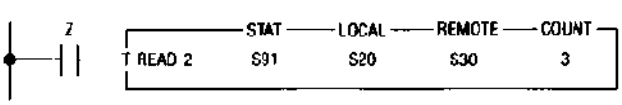
1. Each rung must have a unique status register number.
2. The initiating contact must remain closed until the communication rung has finished.
3. Registers are grouped together whenever possible.

7.2.1 SINGLE REGISTER READ



The above example will READ the contents of register 30 from the remote PC and put the data into register 20 of the local PC (LOCAL PC - refers to the PC containing the communication rung).

7.2.2 MULTIPLE REGISTER READ



The above rung will READ the contents of register 30, 31, and 32 from the remote PC and put the data into registers 20, 21, and 22 of the local PC.

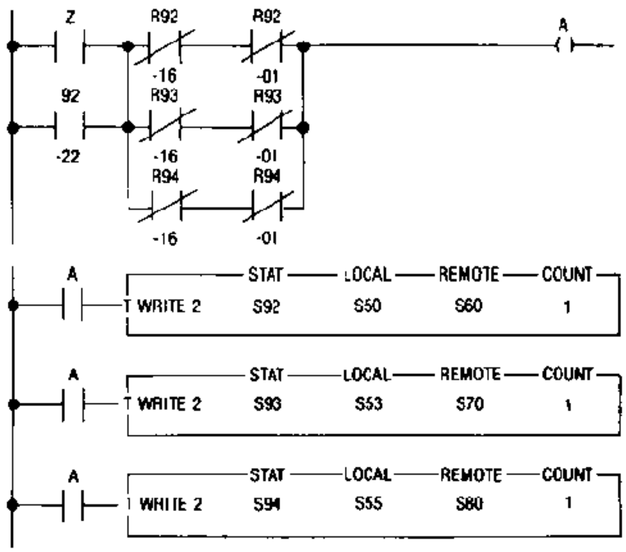
LOCAL		REMOTE
20	←	30
21	READ	31
22	←	32

If the above rung were a WRITE rung, the data exchange would be in the opposite direction.

LOCAL		REMOTE
20	→	30
21	WRITE	31
22	→	32

7.2.3 MULTIPLE COMMUNICATION RUNGS

Enabling multiple communication rungs refers to sending more than one communication message using a single initiating contact.



In the above example, contact Z will start all communications. Contact 92-22 will seal in the initiating contact until all three communication rungs have been completed.

7.2.4 EFFICIENT COMMUNICATIONS

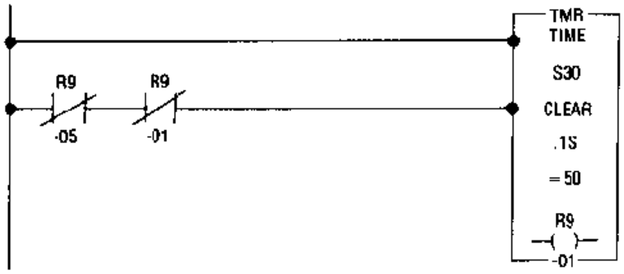
It is often times not necessary to perform communications continuously. Instead it may only be necessary to communicate once a second, minute, or hour. The following rungs have been designed to WRITE data from one PC to another only when a change in data has occurred. By sending only the data changed, you minimize the activity on the network allowing other network devices a turn to get on the network sooner.

Additional rungs were added to:

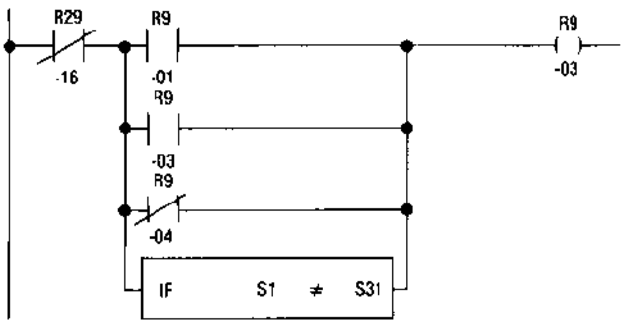
1. Detect a communication fault.
2. Automatically re-send the communication message if a fault is detected or if the message was not completed in a specified time.
3. Periodically send data (update) the remote PC, even though no change in data has occurred.

This last feature allows the remote PC to determine the active state of the local PC. (No update - local PC may have a fault).

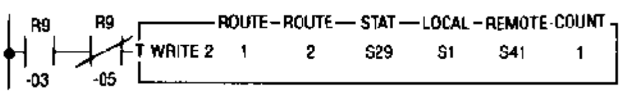
RUNG 1



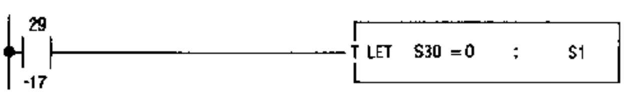
RUNG 2



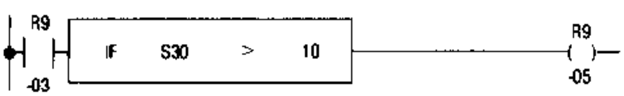
RUNG 3



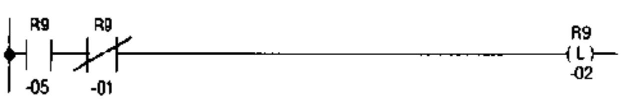
RUNG 4



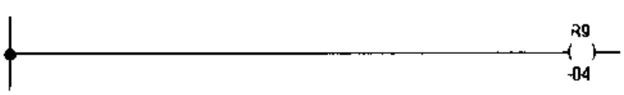
RUNG 5



RUNG 6



RUNG 7



Goals for this circuit were:

1. Send data only when data changes - reduce communications.
2. Recover from any communications fault
   - loss of power
   - open cable
   - no acknowledge from remote device.
3. Periodically send and update if no changes have taken place.
4. Alert operator when fault is detected.

The WRITE on a change circuit utilizes:

- three registers S29, S30, and S31
- five relays 9-1, 9-2, 9-3, 9-4, and 9-5

S1 and S41 are arbitrarily chosen register values.

The following is a description of rung functions.

Rung 1

Provides master timing function for (1) fault detection and (2) periodic update. The decode should be set to the maximum delay between communication updates (periodic update time).

When the timer reaches the decode, coil 9-1 will turn ON for one scan.
- enabling rung two
- resetting rung one (timer)

Normally closed contact 9-5 also resets the timer when a communication fault is found.

Rung 2

Coil 9-3 when ON, indicates that an update should be sent. Coil 9-3 will seal itself ON until normally closed 29-16 opens up, signifying the WRITE rung (rung 3) has finished. Other conditions that will cause an update are:
- contact 9-1, periodic update
- contact 9-4, halt/run update
- if S1 ≠S31, comparison of data change

Rung 3

The WRITE rung sends an update when rung two turns ON. The processor will communicate using port two and WRITE register 1 to register 41 in the remote device.

CAUTION: This rung will change the contents of register 41 in the remote device.

When the WRITE rung is sent, bit 17 of status register 29 will turn ON (29-17) enabling rung four.

Normally closed contact 9-5 will reset the WRITE rung if a fault is detected in rung five. When the WRITE rung is done communicating, bit 16 of status register 29 will turn ON (29-16); resetting rung two.

Rung 4

When normally open contact 29-17 is ON (indicating the WRITE rung is in progress) the timer (S30) will be reset and S1 will be copied into register 31; updating register 31 to the latest change. Once this rung is solved, the 'IF' comparison in rung two will turn off.

Rung 5

Coil 9-5 when ON, indicates a communication fault. Once detected, the timer in rung one will reset and start timing. The communication rung will be reset and enabled again. Finally, latch coil 9-2 (rung 7) will turn ON, indicating a fault had taken place.

Since the timer in rung one was reset, rung five will also turn OFF until the IF box is solved true again.

The comparison IF S30 > 10 is used to detect a loss of communication. The value compared to register 30 should be large enough to allow the WRITE rung to finish its communication cycle. If for any reason the WRITE rung does not finish, the IF comparison will become true, turning ON coil 9-5.

Rung 6

Latch coil 9-2 when ON, indicates a fault was detected from rung five.

This coil will remain ON until reset by an unlatched coil 9-2, or a data entry.

Rung 7

This rung is used to send an update during the first scan of the processor. During scan one coil 9-4 will be OFF, enabling the normally closed contact in rung two. After the first scan, coil 9-4 will turn ON, disabling the same contact in rung two.

The following is a summary of register and I/O usage.

SEND REGISTER DATA ON A CHANGE

ADDRESS USAGE

S29, S30, S31
-0- 9-1, 9-2, 9-3, 9-4, 9-5

S30 - Master Timer
S31 - Register change memory; holds old I/O or register data
S29 - STATUS register for "WRITE" rung

9 - 01 when ON, enables periodic update

9 - 02 when ON, indicates a Comm. fault

9 - 03 when ON, enables "WRITE" rung

9 - 04 when ON, enables update for one scan

9 - 05 when ON, sets fault latch and resets communications rung.

29 - 16 when ON, resets $\boxed{\text{Send Update}}$ rung 2

8.0 TROUBLESHOOTING THE NETWORK INTERFACE MODULE

8.1 Module Troubleshooting

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

8.1.1 INDICATING LIGHTS

On the front of the NIM are eight indicating lights, the basic function of these lights are:

Light Description	Function
NETWORK	ON = Busy/Activity
Rx0	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 Table 8.1 for error description.

8.1.2 COMMUNICATIONS

The Rx0, Tx0 and Rx1, Tx1 lights indicate communications activity through COMM ports 0 and 1 respectively. Any time the Network Interface Module transmits data out a COMM port the Tx LED will light. Also anytime data is received by the NIM's COMM port the Rx LED will light. During PC to PC, or CRT to PC communications these LED's will flash.

When the Network Interface Module is set for the SY/MAX Family or Net to Net mode, an automatic communications check is made every two seconds. This check is made when no communications are taking place, otherwise referred to as an idle state. During this idle state, the NIM will send a small message to the device connected to each COMM port. (This message is an inquire.) If the attached device is a SY/MAX Family device, it will respond with a small message back to the NIM. This message exchange occurs every two seconds, and occurs 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 the following chart to isolate the problem.

Action	Possible Cause
1. Rx and Tx lights do not flash.	1. Check power on NIM. 2. Is NIM in SY/MAX Family or Net to Net mode? Note: The NIM COMM ports support handshaking signals (CTS-RTS). These signals are jumpered allowing the NIM to communicate when the following cables are attached. CC-100 CC-103 CC-101 CC-130 CC-102 CC-120 series B See Section 3.0 for additional information

	3. Is cable plugged into NIM COMM port? 4. Perform self-test on NIM and connected device (Section 8.1.3).
2.	Tx LED flashes ON 1 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 NIM and remote device. 4. Remote device is not a SY/MAX Family device.
3	Tx and Rx LED's flashing independently similar to #2 above.	1. Check baud rates of NIM and remote device. 2. Perform self-test on NIM and remote device.

8.1.2.1 Communication Error Codes

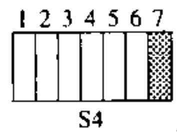
When using READ, WRITE, or ALARM rungs, the status register of these rungs will contain a number which describes the results of the communication. When the number is between 1 and 16,000 the number represents an error code.

The following section describes several common error codes and their possible causes. See Appendix C for a complete summary of error codes.

Error Codes	Description	Cause
Error #3	Illegal Address	- Out of range Example: Register 150 on Model 300 PC.
Error #5	Illegal Operation	- Parity Error - 8881 mode.
Error #7	WRITE to protected Register	- WRITE to control register 8100-8192.
Error #9	WRITE to READ only Register or Input	- Write to register in I/O rack that contains an input card.
Error #13	Link Error	- Parity error or wrong baud rate - 8881 mode, loose cable - SY/MAX mode
Error #15	Communication Overflow	- Remote device to busy to respond.
Error #17	Remote device inactive	- No NIM exists. Remote NIM COMM port not connected.
Error #19	READ count too large	- Model 300 maximum count is 16. Model 500 maximum count is 64.
Error #23	WRITE to fenced register	- Register is protected by processor and cannot be written into.
Error #29	Illegal Route	- Not enough route numbers. Connected to wrong NIM (first number) - Middle route number directed to NIM which is not set up for Net-to-Net mode.

8.1.3 SELF-TEST

For a more thorough test of the Network Interface Module's memory, COMM ports and network port, use the following procedure.



1. Remove power to the NIM.
2. Remove cables from COMM and Network ports.
3. Remove NIM from rack.
4. Set switch 7 on switch group S4 (DOWN) to enable self-test
5. Replace NIM.
6. Put test plugs into both COMM ports of NIM.
7. Reapply power to NIM.

NOTE: Test plug is Class 8010 Type CTP-11 (two required). No test plug is required for the network port.

When power is applied to the NIM, the Tx1 and Rx1 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 Rx and Tx ERROR lights will 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 sequence takes approximately 90 seconds.

If an error is detected in the NIM, the NET Rx and Tx LED's will flash on and off together, pause and then repeat the same flashing sequence until power is removed. Refer to table 8.1.

Self Test Errors (Indicated by both Net Rx and Tx Leds Flashing)

One flash	- ROM checksum error.
Two flashes	- RAM error.
Three flashes	- serial port 0 or 1 error.
Four flashes	- network port error.

Table 8.1 -Network Error Lights

To turn the self test mode OFF set switch 7 UP on switch group S4.

8.2 System Troubleshooting

If it has been determined that the Network Interface Module is in operating order and the devices connected to it are ok, the following procedure can be used to isolate a 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 on the NIMs

Basic Tools

For troubleshooting some basic pieces of hardware will be required, they are:

- One SPR-200 or SPR-300 CRT
- One PC Model 100, 300, 500, 700
- Two CC-100 Series Cables
- Two Network Interface Modules
- Appropriate Network Cables

Basic Layout

Figure 8.1 shows a basic minimum network layout that will be used for troubleshooting. It is suggested that the two Network Interface Modules connected be isolated from the overall network. This removes the possibility of a defective network cable, duplicate Network Interface Module numbers, or conflicting network communications.

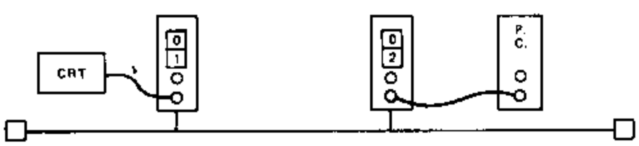


Figure 8.1 - BASIC Network Layout

Basic Operation

In our basic system layout, we have a PC, a CRT and two NIMs. A total of two NIMs have been connected together using tee connectors and terminators (See Section 3.2.2). 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 PC and CRT.

A - Connect CRT to PC using CC-100 series cable.
B - Turn on CRT (SY/MAX menu must be displayed).
C - Depress STATUS softkey (leftmost key).

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

STEP 2: Check PC to NIM operation.

Now that proper non-network operation has been verified:

A - Connect the PC to the NIM using a CC-100 series cable.
B - Turn the processor key to HALT.
C - Apply power to PC and NIM.
D - Monitor NIM RX and TX LEDs for the Comm Port where the processor is connected.

The RX and TX LEDs should flash on, then off, once every two seconds, this is normal. If you do not have proper LED indications, correct before continuing (See Section 8.1.2 for LED operation).

STEP 3: Check CRT to NIM operation.

A - Connect CRT to other NIM Module.
B - Apply power to CRT and NIM (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 PC over the Network.

A - Depress ROUTE softkey on CRT.
B - Enter network device numbers of CRT and PC (do not use special route addresses 200 and above).
C - Depress STATUS softkey on CRT to display processor status.

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

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

Error 29 - Illegal Route

Error 29 refers to an illegal route value. This occurs when the network device number of the CRT does not match the thumbwheel number on the NIM where the CRT is connected.

Error 17 - Inactive Device

Error 17 refers to a failure to communicate with a remote network device. Several causes of this error are:

1 - The network device number does not exist.
  A. Route number may be incorrect.
  B. No NIM on the network has this number.
  C. Remote NIM does not have power.
  D. NIM network port is not connected (loose).

2 - NIM Comm Port specified by route is not working.
  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

When the above step by step troubleshooting procedure has not resulted in an operating network, you have now reached the point where 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 - NIM 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 Network Interface Modules involved.

9.0 ADVANCED CAPABILITIES

The Network Interface Module supports route addresses from 000 to 254. Route addresses 000 to 199 are used for point to point communications, ie. from PC to PC or CRT to PC etc.

9.1 Special Route Values

Route addresses above 199 are SPECIAL FUNCTION ROUTES. These special route values allow the following functions:

Route	Function
200	Read NIM module status
201	Don't care source route (first route)
202	Port to port (in-out same module)
203	Module pair (last route)
204	Don't care-no action taken
205-232	Unused
233-254	Broadcast capability

CAUTION: Care must be taken when using these advanced route instructions, as more than one module may be affected.

9.1.1 ROUTE 200-NIM STATUS

This route allows the status of the Network Interface Module to be read in the form of register data. See Table 9.1 for available data.

Register	Description
1	Type number (510)
2	Software revision
3	Module number - thumbwheel setting
4	Port 0 switch S5
5	Port 1 switch S4
6	Serial port # - if the message originates from the COMM ports this indicates which port the message came from (0 or 1). If the message originated from the network, then the returned data is to be ignored.
7	Partitioned broadcast port 0 address
8	Partitioned broadcast port 1 address
9	Number of Rx errors
10	Number of Tx errors

TABLE 9.1 - NIM STATUS

The route value 200 indicates NIM status will be read. The route number following the route 200 instruction, indicates which Network Interface Module status will be read. For example, to read NIM number 14 status, you would use a route of:

ROUTE A, 200, 14

Where: A - is the route number of the initiating device.
200 - is the NIM status command.
14 - is the number of the NIM to be read

The 200 route must be the second to the last route instruction.

9.1.2 ROUTE 201 - DON'T CARE SOURCE ROUTE

This route instruction allows an initiating device to communicate over the network without knowing its own route address otherwise referred to as "WHOEVER - I - AM".

For example, if a PC wishes to communicate to device 22 all that is needed is:

ROUTE 201, 22

Where: 201 - is the network device number of the initiating PC
22 - is the network device number of the destination device.

The route 201 instruction must be the first route instruction programmed.

NOTE: A special case exists where the last route instruction could be route - - -, 200, 201. This allows the reading of the status registers of the Network Interface Module you are connected to without knowing the module number.

9.1.3 ROUTE 202 - PORT TO PORT (IN-OUT, SAME MODULE)

This route allows communications to occur between two devices connected to the same module; without knowing the module number. For example:

Route 4, 104 - can be replaced with

ROUTE 201, 202

The above example provides communications from port 0 to port 1 or from port 1 to port 0, within the same module.

The route 202 instruction must be the second route instruction. No additional route values can be used.

9.1.4 ROUTE 203 - MODULE PAIR

This route allows communication between a pair of Network Interface Modules, without knowing either module number. A pair of Network Interface Modules consists of an even numbered module and its module number plus 1 (or an odd numbered module number, minus 1). For example:

ROUTE 6, 203

Routes communications between device 6 and device 7 (even number plus 1).

ROUTE 7, 203

Routes communications between modules 7 and 6 (odd number minus 1).

The route 203 instruction must be the second route instruction, no additional route values can be used.

9.1.5 ROUTE 204 - DON'T CARE (NO ACTION TAKEN)

When route 204 is used, no action is taken by the Network Interface Module. The route is ignored and the next route instruction is used. For example:

ROUTE 3, 204, 25

Is the same as: ROUTE 3, 25. This instruction allows increased flexibility with the data logging module when used with redundant networks.

9.2 Route 233 - 254 Broadcast

Broadcast consists of sending one communication message to several devices on the network. With point to point communications, all messages are acknowledged. The nature of broadcast messages does not allow acknowledgement of the message and therefore broadcast capability should be used with caution.

> CAUTION: Model 300 processors do not support the broadcast function.

9.2.1 SENDING A BROADCAST MESSAGE

Sending a broadcast message can consist of a WRITE or ALARM - for PCs or a PUTN command - for a D-LOG module. See Figure 9.1.

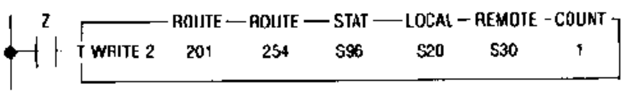


Figure 9.1 - WRITE Rung Using A Broadcast Route

The above WRITE rung will send register 20 to register 30 in all devices connected to port 1 of the SY/NET Interface Module.

Broadcast route instructions must be the LAST route instruction.

NOTE: Broadcast messages are only sent "over the network". Broadcast messages will not be received by the same module that initiated the broadcast message.

When performing net-to-net broadcasts, the module containing the net-to-net link will pass the broadcast message to the network, the opposite COMM port in the same module will not receive the broadcast message.

> CAUTION: Broadcast messages are not acknowledged. It is the user's responsibility to determine which devices should be affected.

9.2.2 RECEIVING A BROADCAST MESSAGE

Every device on the network has the option to turn off (prevent receiving) a broadcast message.

This option to disable receiving broadcast messages is set by setting switch 1, UP on S4 or S5.

Once set to disable receiving broadcast messages, the Network Interface Module will ignore all broadcast messages.

NOTE: You may also prevent registers from being altered by using the register protect bit (8176-4) or register fencing.

9.2.3 BROADCAST ROUTE VALUES

Broadcast routes can be broken into two categories: (1) general and (2) module group.

9.2.3.1 General Broadcast

General broadcast allows messages to be sent to ALL Network Interface Modules on a single network. The general broadcast is broken into two areas. One route value refers to port 0 of all NIMs, and another to port 1 of all NIMs, these values are:

ROUTE 253	BROADCAST TO ALL, PORT 0
ROUTE 254	BROADCAST TO ALL, PORT 1

9.2.3.2 Module Group Broadcast

20 broadcast route instructions have been set up to allow isolation of broadcast messages to a group of ten devices.

The following chart describes broadcast route number and module group effected.

Route Number	Port	Module Group Receiving
233 234	0 1	0 - 9
235 236	0 1	10 - 19
237 238	0 1	20 - 29
239 240	0 1	30 - 39
241 242	0 1	40 - 49
243 244	0 1	50 - 59
245 246	0 1	60 - 69
247 248	0 1	70 - 79
249 250	0 1	80 - 89
251 252	0 1	90 - 99
253 254	0 1	GENERAL

> CAUTION: Broadcast messages are not acknowledged! The device initiating a broadcast will not receive a reply (Bit 16) Also, there is no guarantee that all devices received the message.

For example, a route value of 235 will broadcast to all network device numbers 10 thru 19. A route value of 236 will broadcast to all device numbers 110 thru 119.

10.0 NETWORK PERFORMANCE CONSIDERATIONS

From the factory, the Network Interface Module is set for the most general operating conditions. These conditions are:

SY/MAX Family mode
COMM ports set to 9600 BAUD
Network BAUD rate set to 62.5 K BAUD
Network size set to 100 modules

10.1 Network Baud Rate

The network BAUD rate has been set to 62.5 K BAUD to provide the most noise tolerant system with the maximum network cable length. By increasing the network BAUD rate to 125 K BAUD, you can increase the network speed (throughput) by seven percent. Each increase in the network BAUD rate will improve throughput by seven percent up to a maximum BAUD rate of 500 K. See Section 3.2.2 for maximum network cable length based on BAUD rate.

10.2 100/30 Switch-Switch 7 on Switch Group S5

The 100/30 switch, switch 7, located on switch group S5 of the Network Interface Module controls the network size and NIM timers. From the factory this switch is set UP. What this means is the network size could contain up to 100 modules numbered 00-99.

By setting the 100/30 switch to 30, the maximum number of modules for the network is 31; numbered 00-30. Also the module timers are altered and will not time beyond 30 time periods (modules 31-99 will not gain access to the network).

Reducing the network size to 30 modules will improve network access by a factor of three.

NOTE: All modules on the network must have the same setting for the 100/30 switch. If any modules have switch 7 set DOWN on switch group S5, (30 modules) the network size will be set to a maximum of 30 modules

APPENDIX A
AN INTRODUCTION TO NETWORKS

This introduction is intended to provide a general overview of how industrial networks came to be and to familiarize the reader with some of the terminology, problems, and benefits derived from the technology. The first part is intended to be generic. For more detailed information, a short bibliography is included.

Glossary of Communication Terms:

Access:	Allowed availability to information on network
Base Band:	Single frequency channel used for data transmission (low cost)
BAUD Rate:	Speed at which bits of information are transmitted
Bridge:	Connection between similar devices, no protocol manipulation required.
Broad Band:	More than one frequency is used for data transmission on a single cable
CSMA/CD:	Carrier Sense Multiple Access with Collision Detection
Data Network:	Path for information to travel
Gateway:	A device that does protocol conversion
IEEE 802:	IEEE's standard for LAN's
ISO:	International Standards Organization
ISO DIS7498:	ISO's proposed standard for LAN's
LAN:	Local Area Network
Layer:	Phase within proposed standards dealing with a specific function.
OSI:	Open Systems Interconnection. Network model developed by The International Standards Organization (ISO).
Peripheral:	Those devices which support but are not directly involved in the control operation.
Protocol:	The language or word configuration used for communication. Usually involves format for interaction and error detection.
Redundancy:	Duplication of either hardware or software for reliability assurance.
Throughput:	The "effective" message rate, not the data rate (quantity of data vs. time)
Token:	Code that gives authority to devices to "speak" on the network.

When first introduced, the programmable controller was intended to replace relays with a solid state device which would improve reliability and greatly increase flexibility. This device needed less panel space than was previously required. Installation costs were reduced, with the larger more complex systems providing the greatest pay back.

The simplicity of this device led to complexity of application when management realized that many tasks formerly thought of as unassociated could be, and probably should be united. Product flow through factories was recognized as interrelated, even though the individual work stations had separate control needs. From this realization, the need for networks was born.

In its simplest concept an industrial network is a group of two or more programmable controllers communicating with each other. Originally this was accomplished with a "cross-talk" module which took the outputs of one PC into the neighboring PC as inputs, and vice-versa. In cases where this module was not available, I/O racks and modules had to be dedicated to this task which resulted in increased wiring costs and more complex programming. Data transfer could be accomplished only by dedicating four I/O's for each digit to be transferred, and then writing a BCD decode program in the receiving processor to load a register with the incoming value.

But the pressure from management was for information, such as the number of parts produced, amount of run time, and amount of down time associated with the run, all to be accumulated at one location, formatted for intelligent assimilation, and distributed as hardcopy. Maintenance people found they could use total run time to help them with preventive maintenance programs. The interest grew. Using I/O, this integration of P.C.s proved to be cumbersome and difficult to implement.

A single data cable strung around the perimeter of the plant was desirable. Devices had to be developed to tap into this cable and pick off or insert the data of interest at that point. Several types of cable were utilized: Coaxial cable where broadband transmission was used; twin axial cable where baseband transmission was used; and even fiber optic cable was used.

Once this selection was made by a PC supplier, compatible gateways could be installed by the user to enable the data to be inserted on the network by the individual devices wherever they were located. Programming could now be done from any location to any device (at least with the Square_D network), and the whole process could be centrally coordinated.

But PC's were not designed to gather data and process it into meaningful reports. It became apparent that this information needed to be fed into the large mainframe computers being used by the financial people.

Since there was much diversity among components from various vendors, certain societies and groups decided to address the problem of standardization so that all might connect amicably along a data network and so an ISO standard was developed. The ISO standard DIS7498 has defined seven layers for network communications. The first two layers deal with data line connections within the network. The next two deal with the movement of the data within the network. The remaining three layers are for operator interaction within the network.

The IEEE 802 seems to be concentrating on the first two layers of the ISO standard DIS7498. The higher layers in general deal with the larger mainframe computers and less with PC to PC communication. Standardization, everyone agrees, is desirable; however it is not as yet a reality.

Let us assemble a generic network example of three programmable controllers from a single manufacturer, each controlling a separate specific function. These three functions deal with a single product and the functions are progressive. Each processor should be able to examine anothers I/O status and register information. This is an example of a bridge. There is no protocol problem here, since all are of common manufacture. Bridges like this are connected by inexpensively installed low voltage cable. In many cases interface cards are required for each PC. The distances involved may be from a few feet to many thousands of feet.

This is also an example of distributed control, because the controllers operate independently of each other yet communicate together as a network. The obvious advantage is that one component - one work station - may fail, but the whole factory isn't shut down as it would be if all stations were controlled from one PC.

The next base of complexity results from a desire to accumulate the data in the registers once a day for production records and inventory control. A host computer may be required. Often times, protocol and interconnection problems will make communication impossible. A gateway is probably needed. This device will act as a translator in two directions, and allow the devices to communicate. The gateways are typically connected by a coaxial or twin axial cable, requiring a minumum of installation costs and providing for easy access should future devices be added to the system. With some systems, a tee can be cut into the wire and a drop established to another gateway at a minimal cost.

BAUD rates must also be compatible. Each device is programmed to send and/or receive information at a certain data rate. This is usually provided by dip switch settings in particular steps: 110, 300, 600, 1200, 2400, 4800, 9600, 19.2K BAUD. Modems transmitting over phone lines are typically set at 300 BAUD. Processor to processor links are usually set at 9600 BAUD. Networks usually transfer data at rates from 19.2K BAUD to 1 MEGABAUD. Obviously, this requires the gateway to provide some communication transmission speed matching, so that the throughput of the network can be kept at its optimum rate.

Up to this point the network has been small enough and simple enough that communication will probably take place every time a device wishes to talk. But what happens if everyone decides to talk at once!

The problem of keeping multiple devices from trying to communicate at the same time can be handled by one of two commonly used methods: CSMA/CD or token passing. The first method services the requests on a first come first served basis. If there is a large number of devices with a large number of messages, access decreases quickly from about 40% utilization. There is also a very real possibility of data collisions. (That's where the name comes from, Carrier Sense Multiple Access with Collision Detection.) The method requires that in the event of a collision all devices stop transmitting, ignore the data, wait a random amount of time and attempt to send again. This method can result in lower throughput rates.

A different approach to the problem is token passing, where only one device talks at a time. A token or code is passed among the devices on the network. Whichever device picks up the token is the master and remains so until done with its message. A danger in this approach is that the temporary master may be doing something mundane while a crisis is occurring at another device. Another danger is a lost token.

A good solution to these problems is to have a time supervised token passing network (Square D approach). The token can never be indefinitely lost, nor can one device hold it for an indefinite amount of time. Integrity is an important factor in data transmission. Typically, the transmitting device checks to see if the receiving device is ready to receive. This established, the transmitting device sends its message. The receiving device acknowledges receipt of the information and indicates how many bits were received. If it is the same as the number sent, all is assumed to be well. But what happens if the receiving device gets something less, or nothing? Does the transmitting device repeat the procedure? If so, how many times? All these questions have to be addressed by the network designer. Redundancy of processors, bridges, gateways, routes, and software checks will provide additional integrity. Any system utilized must be designed to address data integrity.

As we progress toward total factory automation, networks become increasingly important. They allow for data collection, storage and reporting. They can provide for central programming where programs can be uploaded, downloaded, modified or monitored. They can allow troubleshooting to be done remotely at distances of several miles.

As more and more devices become available the complexity will increase. But from the work being done by IEEE and ISO and others in the field on standardization - compatibility, amicability, and usability will come.

General Information

The SY/NET is a high performance, token passing type network designed to communicate with a variety of devices in an industrial environment.

General Capabilities

Layer 1 - Physical

Connection into the system is accomplished utilizing a concentric twinax receptacle located at the bottom of each Network Interface Module. Network cable is Belden 9463 terminated as described in Section 3.2. Total cable length is Network speed dependent.

Layer 2 - Data Link

This layer handles basic message format which consists of HDLC. Error detection is performed by using a Cyclic Redundancy Check (CRC) and Manchester encoding schemes.

Layer 3 - Network

The SY/NET Network utilizes a unique Masterless time token passing technique which eliminates message collisions while providing predictable access to any device connected to the system. The lower numbered Network Modules have a higher priority. As the network becomes busy to the point of continuous message flow, all devices will still have regular access.

Layer 4 - Transport

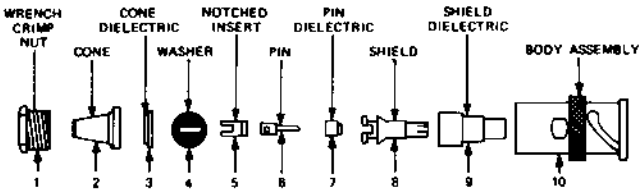
Routing of messages is accomplished utilizing a simple sequence of numerical values representative of the point to which the end devices are connected (PC, CRT, etc.) Messages consist of packets of information of variable length, depending upon the function and amount of data to be sent.

Layers 5, 6 and 7

Read, Write, and Alarm Communication rungs within the PC further define layers 5, 6, and 7 which describe the data to be communicated, direction of data exchange, and error detection.

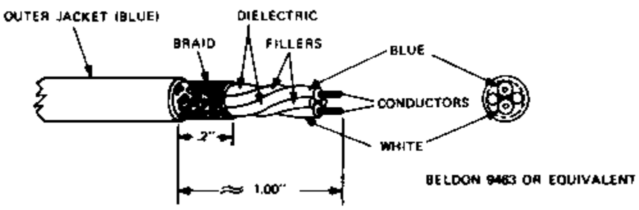
APPENDIX B
INSTALLING A NETWORK CABLE END

The network cable end (Class 8030 Type CCK-211) consists of ten parts.



NETWORK CABLE END

The twinax cable (Beldon 9463 or equivalent) consists of seven parts.



TWINAX CABLE

The following is a procedure for assembling a network cable end to the twinax cable.

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

STEP 2 - Strip approximately one inch of insulation from end of cable, be careful not to damage shield wires.

STEP 3 - Cut back BRAIDED shield to within .2 inches of cable jacket.

STEP 4 - Cut off filler cords to cable jacket.

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

STEP 6 - Place small end of CONE DIELECTRIC (3) over wires and seat inside CONE (2).

STEP 7 - Place red WASHER (4) over wires and seat against CONE DIELECTRIC (3).

STEP 8 - Cut blue and white wires to a length of .35 inches (measured from red washer (4)).

STEP 9 - Strip insulation off blue wires .2 inches.

STEP 10 - Tin BLUE wire.

STEP 11 - Bend WHITE wire at a right angle away from BLUE wire.

STEP 12 - Place white NOTCHED INSERT (5) over BLUE wire and press until flush with red WASHER (4). (WHITE wire should fit into notched insert.)

STEP 13 - Place PIN (6) over BLUE wire. Pin should be flush with NOTCHED INSERT (5).

STEP 14 - Carefully solder pin (6) to BLUE wire (apply solder bead to hole in side of pin).

STEP 15 - When solder cools, test connection by lightly pulling pin (6) with pliers - common problem found with cable is cold solder joints.

STEP 16 - Place pin dielectric (7) over pin (6).

STEP 17 - Place shield (8) over PIN assembly and seat against red WASHER (4). Thread WHITE wire thru notch in SHIELD (8).

STEP 18 - Strip WHITE wire back .25 inches.

STEP 19 - 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.

STEP 20 - Place SHIELD DIELECTRIC (9) over shield (8) until flush with red WASHER (4).

STEP 21 - Place BODY ASSEMBLY (10) over shield assembly.

STEP 22 - Thread WRENCH CRIMP NUT (1) into BODY ASSEMBLY (10).

STEP 23 - Perform continutity 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, opposite cable end.

NOTE: Resistance measurements should be made:
(1) without Network Modules attached
(2) without Terminator attached.

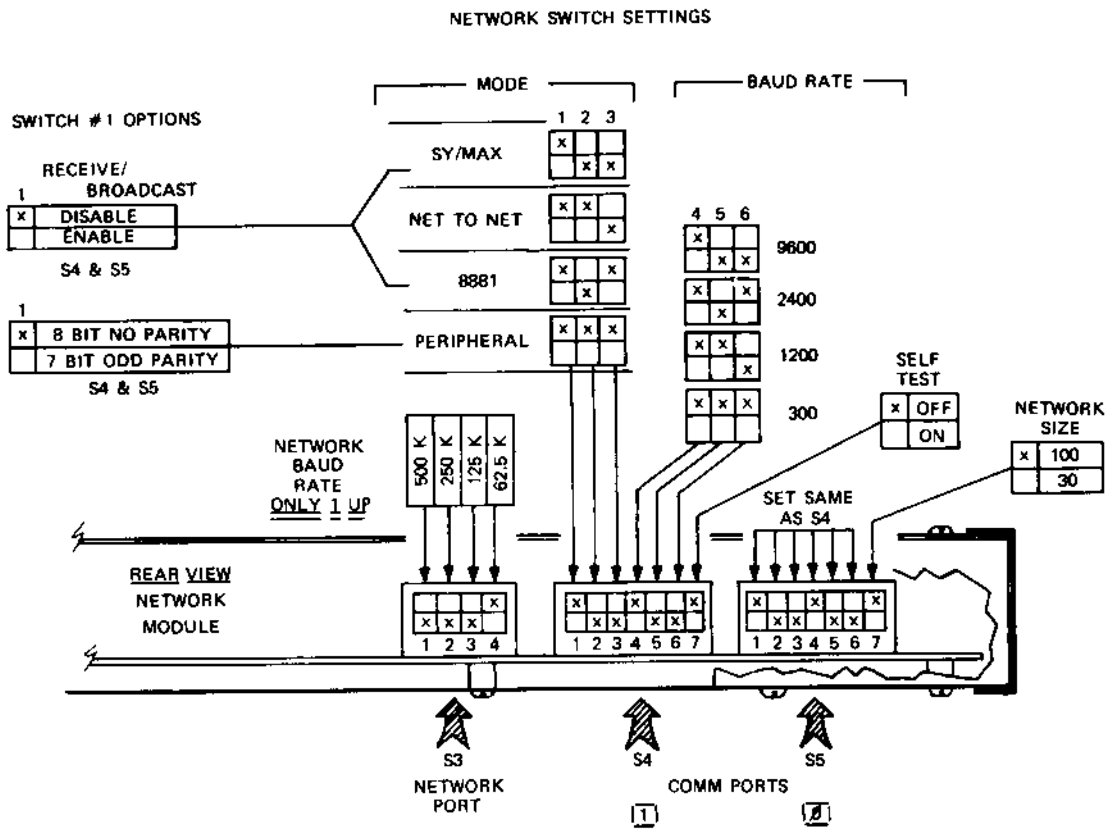
APPENDIX C
COMMUNICATION ERROR CODES

The following is a list of error codes that will be annunciated during communications. All communication error codes are odd numbers ie: 1, 3, 5, etc. For a complete list of error codes see Instruction Bulletin 30598-105-01 (Processor).

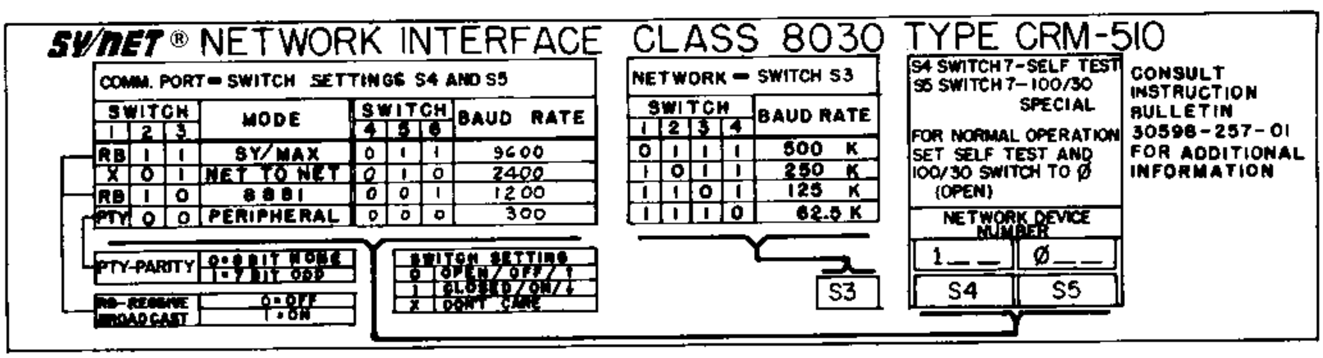
ERROR CODE NO.	ERROR DESCRIPTION
01	Illegal protocol opcode, the device does not recognize the instruction.
03	An illegal address has been attempted.
05	An illegal instruction has been attempted which is not allowed. (Example: Write to NIM set to peripheral mode.)
07	An attempt has been made to alter 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.
23	An attempt has been made to alter data in a fenced register.

ERROR CODE NO.	ERROR DESCRIPTION
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 and 544 RAM/PROM Processor.
51	Undefined register - a module is not seated properly or missing.
53	Illegal tape format - erase track required.

APPENDIX D
SUMMARY OF SWITCH SETTINGS



NETWORK INTERFACE MODULE SIDE LABEL



SY/NET® NETWORK INTERFACE CLASS 8030 TYPE CRM-510

COMM. PORT — SWITCH SETTINGS S4 AND S5

	SWITCH 1	2	3	MODE	SWITCH 4	5	6	BAUD RATE
	RB	1	1	SY/MAX	0	1	1	9600
	X	0	1	NET TO NET	0	1	0	2400
	RB	1	0	8881	0	0	1	1200
	PTY	0	0	PERIPHERAL	0	0	0	300

PTY-PARITY	0 = 8 BIT NONE
	1 = 7 BIT ODD

RB-RECEIVE	0 = OFF
BROADCAST	1 = ON

SWITCH SETTING	
0	OPEN/OFF/↑
1	CLOSED/ON/↓
X	DON'T CARE

NETWORK — SWITCH S3

SWITCH 1	2	3	4	BAUD RATE
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

S3

S4 SWITCH 7 - SELF TEST
S5 SWITCH 7 - 100/30
SPECIAL

FOR NORMAL OPERATION SET SELF TEST AND 100/30 SWITCH TO Ø (OPEN)

NETWORK DEVICE NUMBER

1__	Ø__
S4	S5

CONSULT INSTRUCTION BULLETIN 30598-257-01 FOR ADDITIONAL INFORMATION

Addendum

Subject: SY/NET® **Class 8030 Type EQ5166 Network Interface Module for Toledo® Scale Corporation Model 8142 Digital Scale Indicator**
(Addendum for Instruction Bulletin 30598-257)

DESCRIPTION

The EQ5166 network interface module (NIM) has been designed to permit acquisition of weight and related data via the SY/NET network from a Toledo Scale Corporation Model 8142 Digital Scale Indicator. The Type EQ5166 Toledo Scale Corporation Network Interface Module (TSC-NIM) can use both the COMM Port 0 and COMM Port 1 to communicate with up to two (2) Model 8142 digital scale indicators.

The TSC-NIM is based on the existing SY/NET Class 8030 CRM510 NIM. The CRM510 firmware has been altered to recognize the character streams unique to the Model 8142 JN Port Toledo Continuous Format. This format is defined in the Peripheral Mode (refer to DIP switch settings and special cable requirements on page 2). In this mode, the data acquired from the two COMM ports is only character data. The predefined format identifies the start and end of each message block into a response buffer which will be sent back over SY/NET to the requesting device(s). If another message block begins while the TSC-NIM is processing one, the new message block is appended to the input buffer to prevent losing it. When the response is completed, the TSC-NIM verifies the computed checksum value using the checksum sent from the Model 8142. If the checksum is correct, the response is sent to the requesting device. If not, an error code of decimal 33 (Hex 21) is sent to the requesting device. The error code 33 would indicate a File Data Detected which describes the block of data involved in the READ operation was faulty. This is usually detected through the TSC-NIM during comparisons of checksum.

DATA FORMAT

The data sent in the response packet will consist of sixteen (16) contiguous registers. Each seven (7) bit value acquired from the Model 8142 will be right justified in the sixteen (16) bit SY/MAX® register. The first three (3) registers will contain binary status information. The next six (6) registers will contain the ASCII code for the six (6) decimal digits of the displayed weight data. The next six (6) registers will contain the ASCII code for the six (6) decimal digits of the tare weight data. The last register will have the ASCII code for a carriage return (Decimal value - 13, Hexadecimal value - 0D).

REGISTER NO.	DATA	FORMAT
1	Status	Binary
2	Status	Binary
3	Status	Binary
4	Weight	ASCII
5	Weight	ASCII
6	Weight	ASCII
7	Weight	ASCII
8	Weight	ASCII
9	Weight	ASCII
10	Tare	ASCII
11	Tare	ASCII
12	Tare	ASCII
13	Tare	ASCII
14	Tare	ASCII
15	Tare	ASCII
16	CR	ASCII

PORT CONFIGURATIONS - TOLEDO SCALE

The Toledo Scale Model 8142 JN port configuration must be as follows:

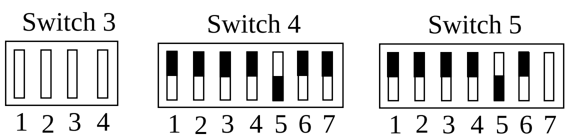
Output Mode - Toledo Continuous Mode
RS-422 Input Selection = RS-422
Baud Rate = 2400
Checksum = Enabled
Minimum Print Increment = 0
ASCII Remote Command Input = Disabled
Print Interlock / Autoprint = Disabled

SY/NET NIM

The TSC-NIM COMM port switch settings must be set in the following configuration for both ports:

8 data bits
No parity
Peripheral mode
2400 Baud rate

NIM SWITCH SETTINGS

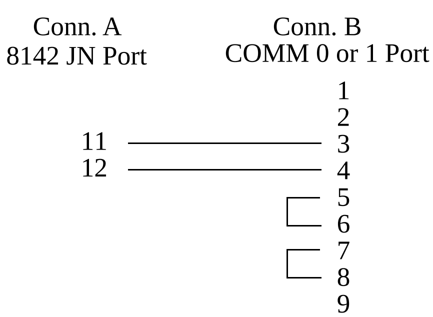


Note - Please refer to the Type 8030 CRM510 Instruction Bulletin 30598-257 for a full description of the switch settings, physical locations and other general information.

CABLE REQUIREMENT

A cable must be prepared to permit communications between the Model 8142 JN port and the COMM 0 or COMM 1 port of the TSC-NIM. The recommended cable type is Belden 9535 or equal. The Model 8142 JN port requires a male 25 pin miniature D connector (A) and the COMM port of the TSC-NIM uses a male 9 pin subminiature D connector (B). The wire connections are as shown below:

JN PORT TO NIM PORT CABLE



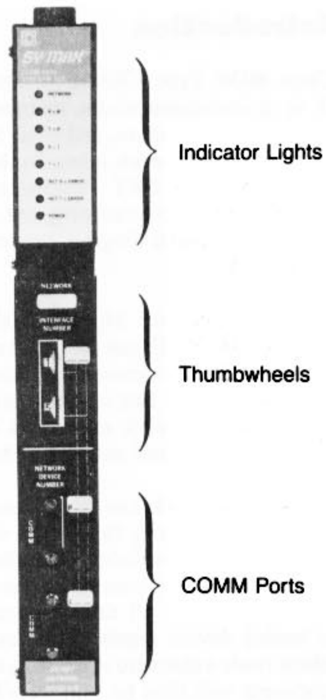


Figure 2.3 — Module Overview

Figure 2.4 - Network Connector

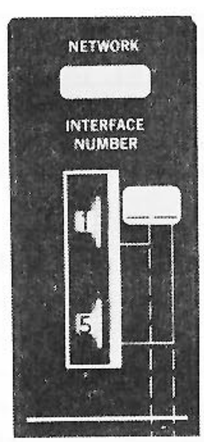


Figure 2.7 - Thumbwheel Switches

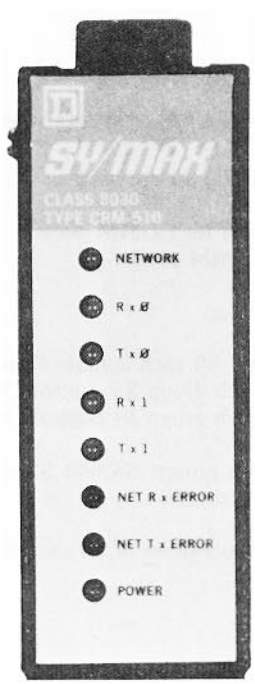


Figure 2.6 - NIM LEDs

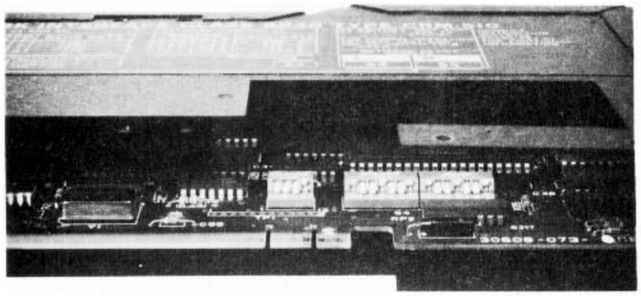


Figure 2.5 - Side View, Cover Removed

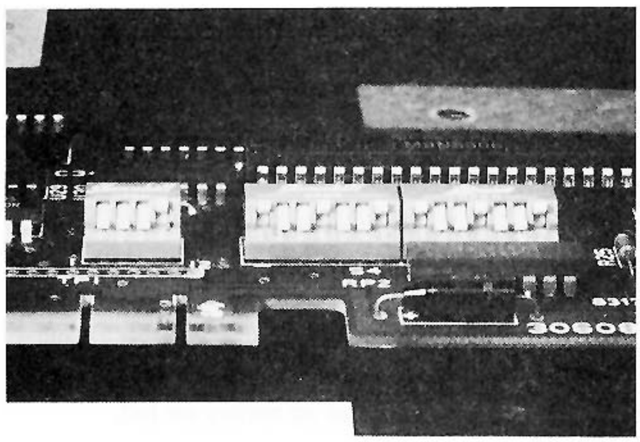


Figure 2.8 - Printed Circuit Board Mounted Switches