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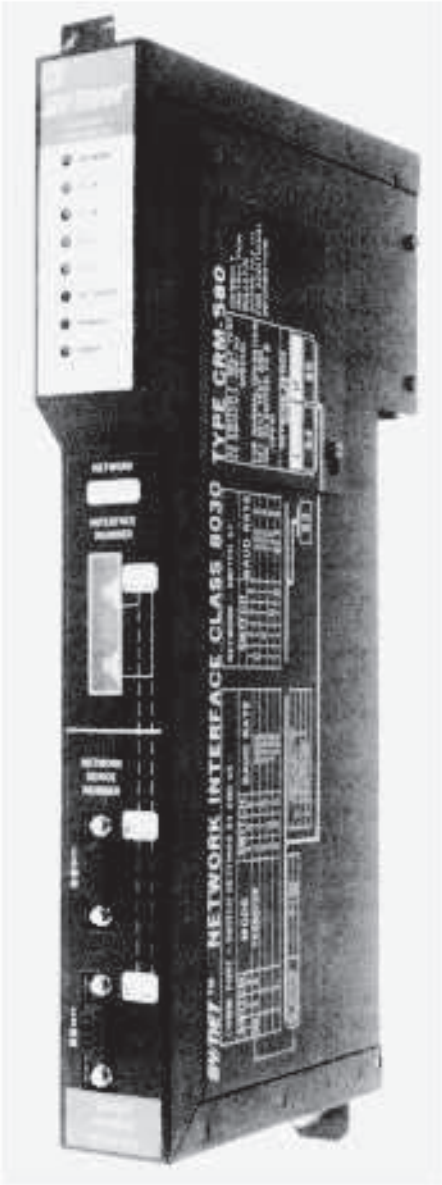
Bulletin: 30598-702-01A2
Date: July 1991

Instruction Bulletin

SY/NET®

Class 8030 Type CRM-580 Rev. 2.0
Transfer Network Interface Module (TNIM)

(Replaces Addendum 30598-702-01)



SQUARE D COMPANY

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Supersedes 30598-702-01A1, March 1989

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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.**

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CRM-580 Transfer Network Interface Module

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1 INTRODUCTION

1.1 General Information

Many critical applications demand a control system with redundant (hot backup) capability. A redundant control system has a pair of controllers; a primary and backup controller. For maximum reliability, each controller in a redundant system has an independent power supply and chassis (rack assembly) to house the associated components.

If the primary controller should fail due to power loss, component malfunction, etc., the backup controller immediately assumes input/output system control and primary status. When the failed controller (previous primary) returns to service, it does so as the backup controller.

If other devices require information from the redundant controller pair, the devices must be connected to a communication network such as SY/NET.

Usually, other devices on a network require only information from the primary controller. Because either controller could be the primary controller in a redundant system, the other devices requesting information must perform a two step process:

1. determine which is the primary and which is the backup controller,
2. after determining the primary controller, the device(s) has to activate communication commands within its program with the correct communication route for the current primary.

[Recall that a standard SY/NET Network Interface Module (NIM) has a unique route (Device Number) determined by its thumbwheel setting.]

Each network device requesting information from the transfer system would need to perform the two step procedure which can consume program memory and scan time. In addition, a transfer could occur after step one is completed. This would result in the device not communicating with the current primary controller.

NOTE: *The two step process does not guarantee communication to the primary controller. A system transfer could take place after determining the primary and backup controller (step 1).*

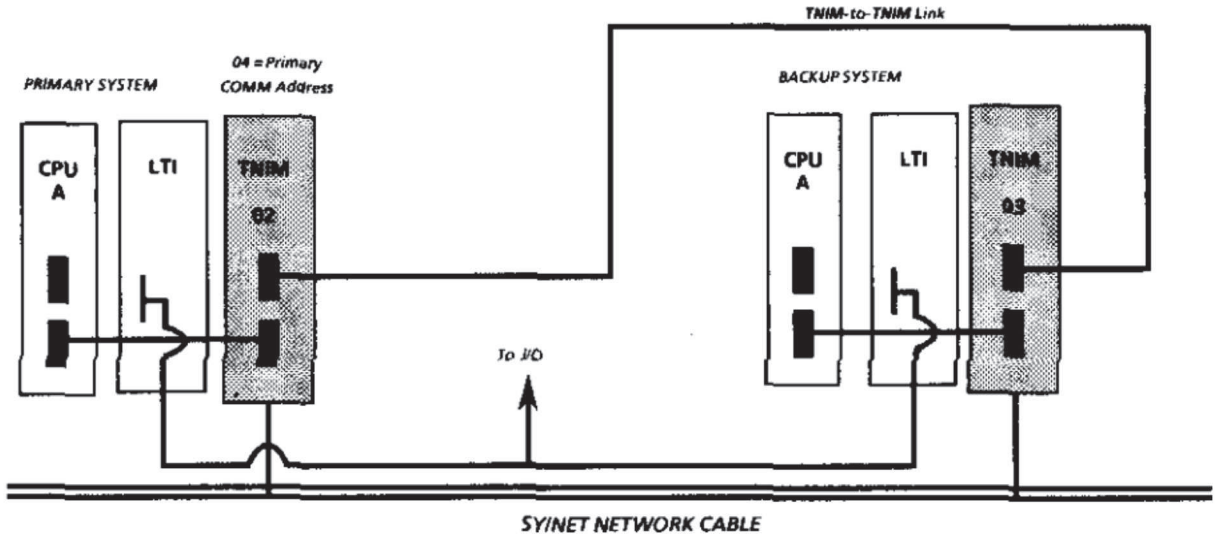


Figure 1.1 Redundant Control System

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The Class 8030 Type CRM-580 Transfer Network Interface Module (TNIM) eliminates this two step process and ensures communication to the primary controller because the communication route of the current primary controller will always be the same. The TNIM, upon failure of the primary controller, allows you to transfer the SY/NET communication route of the primary controller to the BACKUP controller. With the TNIM, any communication rungs in the redundant processor pair can be identical, thereby reducing program size and scan time.

The TNIM can operate with SY/MAX processors that use the Class 8030 Type CRM-230/232 Transfer Interface System. You can also use the TNIM with any SY/MAX controller or SY/MAX compatible device that can issue a priority WRITE or ALARM command with a communication route of 200.

1.2 Basic Operation of the TNIM

Two TNIMs, operating as a pair, transfer the primary controller's network communication route. The TNIM pair consists of an even addressed module and an odd addressed module (even address plus one). The address is assigned to each TNIM using the two thumbwheels accessed through the side of the module. (Refer to Figure 1.2).

The TNIM module differs from other SY/NET modules because the TNIM can assume two (2) address spaces (time slots) on the network. (Refer to Section 3.1 for examples of address assignments.)

The two addresses consist of:

- the module's thumbwheel address, and
- the primary address, (the odd thumbwheel address plus 1).

Communication from other devices on the network can always be directed to the actual Network Interface Number (thumbwheel address) of the TNIM, but only the TNIM currently in the primary state will accept communication messages directed to the primary address.

When a TNIM pair is configured with a Class 8030 Type CRM-230/232 Transfer Interface System (refer to Figure 1.1) and the primary SY/MAX controller fails, a flag is automatically set in the backup controller. This instructs the backup controller to assume primary control status. The new primary controller instructs the backup TNIM to switch to primary communication status and to switch the current primary TNIM to backup communication status.

When the TNIM pair is configured in a non-Transfer Interface System, the backup controller (Model 300, D-LOG, computer, etc.) polls the primary controller on a periodic basis for failure. If a failure is detected, the backup controller assumes primary control and commands the TNIM pair to switch primary/backup communication status.

Note that in both cases the transfer between backup to primary communication status is done under supervision of the backup (new primary) controller. An LED, on the front of the module, provides a visual indication of the primary/backup TNIM status (refer to Figure 1.2).

CAUTION

The CRM-580 contains static sensitive I.C.s and is subject to damage by electrostatic discharge. Do NOT handle the device by the gold edge connectors.

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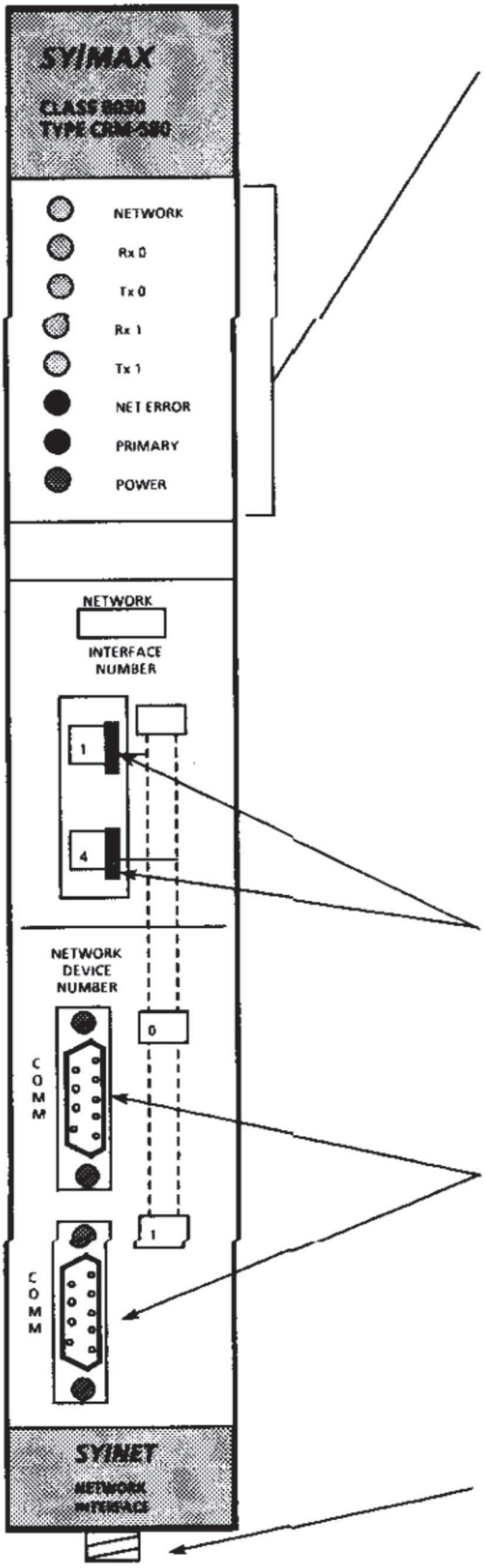


Figure 1.2 CRM-580 Front Panel Identificaion

1.3 Front Panel Features

INDICATOR LIGHTS

NETWORK: This amber light indicates activity on the SY/NET network. Typically very dim, it glows brighter as network activity increases.

RX 0: This amber light shows that data is being *received* through COMM *port 0.*

TX 0: This amber light shows that data is being *transmitted* out of COMM *port 0.*

RX 1: This amber light shows that data is being *received* through COMM *port 1.*

TX 1: This amber light shows that data is being *transmitted* out of COMM *port 1.*

NET ERROR: This red light shows a communication error has occurred while receiving or transmitting network data. Typically, this indicates that all CRM-580 buffers are full or that a message was sent to a non-existent or powered-down device.

PRIMARY: This red light indicates the current state of this TNIM:

ON STEADY	In PRIMARY state
OFF	In BACKUP state
FLASHING	In TRANSITION from BACKUP to PRIMARY

POWER: This green light shows the CRM-580 is receiving DC power from the SY/MAX rack assembly.

See Section 7.2, "Troubleshooting" for more information on the indicator lights.

THUMBWHEEL SWITCHES

Used to select the CRM-580's address on the SY/NET network, these switches are adjusted with a small screwdriver through the side of the module. *ASSIGN THE TNIMs AS AN EVEN/ODD PAIR (for example, 0/1, 10/11,* etc.)

See Section 3.0, "Switch Setup", for more information.

COMMUNICATION PORTS (LOW-SPEED)

COMM "0": This port *must* be used for the TNIM-to-TNIM link. Do not use this port for any other purpose.

COMM "1": For connecting SY/MAX processors, personal computers equipped with SY/MATE programming software, or other SY/MAX devices.

See Section 2, "Hardware Installation and Specifications", for details and required hardware.

NETWORK PORT (HIGH-SPEED), ON BOTTOM OF UNIT

For SY/NET network (LAN) cable attachment.

See Section 2, "Hardware Installation and Specifications" for details and required hardware.

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2 HARDWARE INSTALLATION AND SPECIFICATIONS

2.1 Hardware Requirements

This section describes the installation and network cabling for the Class 8030 Type CRM-580 TNIM. Device and network specifications are provided in Section 2.3, *Specifications*.

2.1.1 INSTALLING A TNIM INTO A RACK

The single-width, CRM-580 TNIM module can be inserted into any slot of a register rack (except slot #1) or any register slot of an I/O rack. The register slots provide the TNIM with DC power. Usually, the two TNIMs are housed in different racks (within cable length limits), however they can be housed in the same rack. Figure 2.1 lists compatible SY/MAX rack types and identifies appropriate register slots:

CLASS 8030 RACK TYPES	SLOT TYPE / LOCATION
CRK-210	Register Slot/Left of CPU Slot
CRK-300	Register Slot/Left of CPU Slot
DRK-210	Register Slot/Left of CPU Slot
DRK-300	Register Slot/Left of CPU Slot
GRK-110	Register Slot/Left of CPU Slot
GRK-210	Register Slot/Left of CPU Slot
HRK-100	Register Slot/Left of CPU Slot
HRK-150	Register Slots 2-4/Left of Slot 1
HRK-200	Register Slot/Left of CPU Slot
RRK-100	Register Slots 2-5/Right of Slot 1
RRK-200	Register Slots 2-9/Right of Slot 1
RRK-300	Register Slots 2-18/Upper Section Right of Slot 1; Lower Section - Any Slot Including Non-addressable Slots

Figure 2.1 CRM-580 Rack and Slot Installation

All communication with external devices, including communication between the TNIMs, is routed via the CRM-580's SY/MAX or SY/NET ports.

Edge connectors, in the register slots of the SY/MAX racks, have two factory installed "keying pins" between the contact fingers at positions 4 and 6, and 96 and 98 (see Figure 2.2). The keying pins prevent non-register-type modules from being installed in the register slots of the racks listed in Figure 2.1.

To prevent any non-CRM-5xx type modules from being installed in a register slot, a third keying pin is available as a field installable option (Class 8030 Type CBP-104 Keying Pin Kit). Insert the third keying pin (using the insertion tool provided with the kit) between the contact fingers at positions 14 and 16, as illustrated in Figure 2.2.

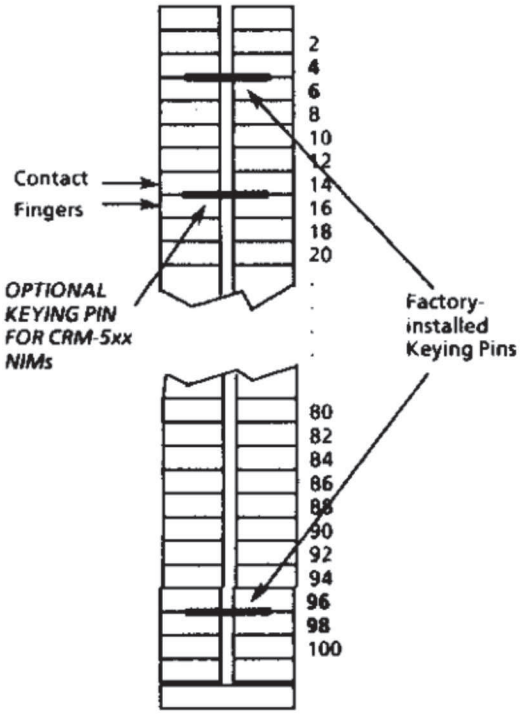


Figure 2.2 Register Slot Edge Connector Keying Pin Locations

CAUTION

Use care when inserting or removing the keying pin to avoid damaging the edge connector's contact fingers. Avoid touching the fingers.

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2.2 CRM-580 Network and COMM Port Cabling

2.2.1 NETWORK CABLING AND ASSEMBLY

To interface the CRM-580 to the SY/NET LAN, the following connectors and cable(s) are required and ordered separately from Square D:

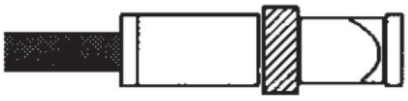
CLASS 8030, TYPE:	DESCRIPTION
CCK-211	Cable End
CCK-212	Tee Connector
CCK-213	Terminator (set of two)
CCK-214	Cable Extension
CC-201*	Pre-assembled Cable (2 feet long)*
CC-202*	Pre-assembled Cable (10 feet long)*

Figure 2.3 CRM-5xx SY/NET Connectors and Cables

* The CC-201 and CC-202 cables are available in 2 and 10 foot lengths. If longer cables are required, refer to Appendix B for cable assembly instructions. The recommended LAN cable is Belden® 9272 or equivalent.

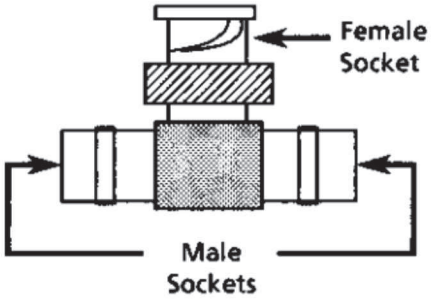
The following illustrations identify the connectors listed in Figure 2.3 that require attachment to the network cables and any CRM-5xx NIM. Refer to Figure 2.4 for a complete network cable assembly.

CABLE END (CCK-211)



The cable end is a female socket and provides a locking connector for each network cable. Two cable ends are required for each length of network cable used (see Figure 2.4).

TEE CONNECTOR (CCK-212)



The TEE connector attaches the SY/NET network cables to the CRM-5xx NIM. The TEE connector is made up of one female and two male sockets. The female socket mates with the socket on the base of the CRM-580 or attached drop cable (see Figure 2.4) and the male sockets mate with the network cable ends (CCK-211).

TERMINATOR (CCK-213)



The terminator is a female socket with an internal 78 ohm resistor. The terminator is used to terminate the end of a network cable that is not attached to another NIM. Two terminators are required for each network; one at either end of the main SY/NET network cable (see Figure 2.4).

CABLE EXTENSION (CCK-214)



The cable extension is made up of two male sockets. The cable extension may be used to 1) connect two networks together, 2) replace a TEE connector when the NIM is removed from the network, 3) provide a splice for future modules, or 4) extend the drop distance between a NIM and a TEE connector (see Figure 2.4).

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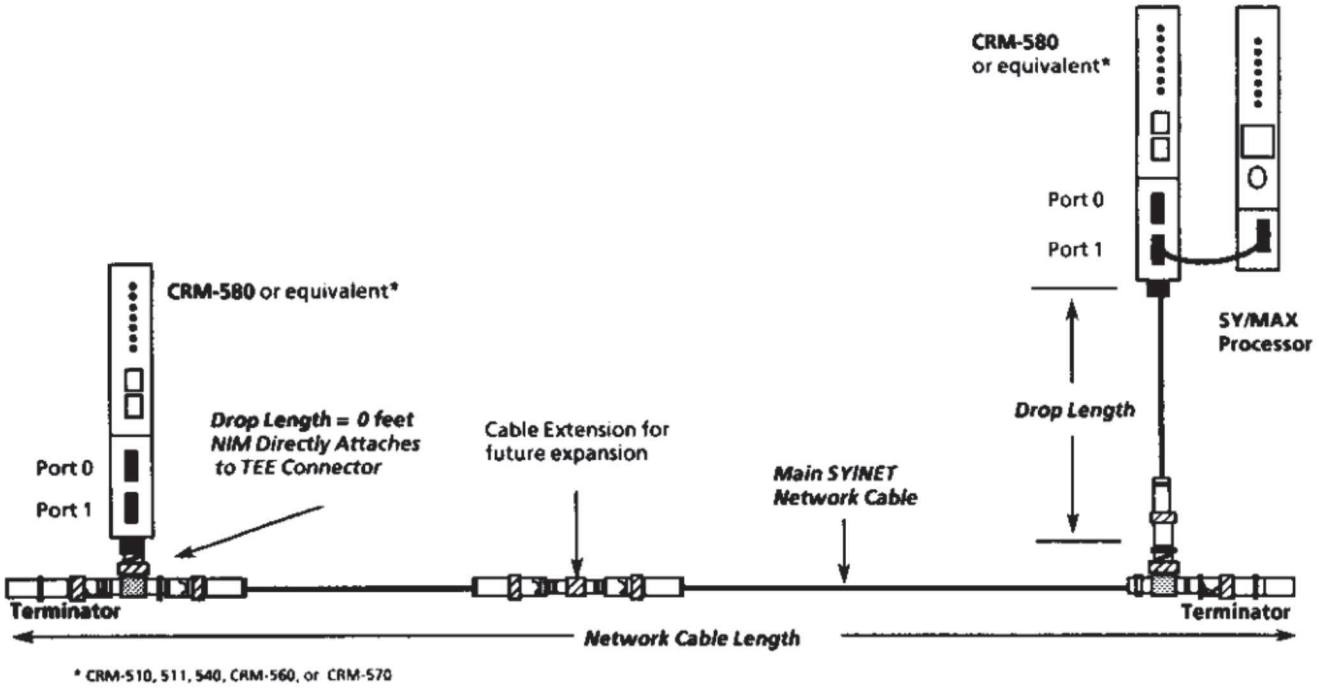


Figure 2.4 Basic Hardware Configuration

2.2.2 NETWORK CABLE LENGTH AND BAUD RATE

The SY/NET network transfers data to and from the attached NIMs at very high speeds. The rate of data transfer is measured in bits per second or commonly referred to as baud rate.

An inverse relationship exists between how long a network can be and what baud rate can be used. To maintain the accuracy of the data during a network data transfer, the **baud rate** of the network ports on CRM-5xxs may need to be adjusted by considering the following four items listed below (and illustrated in Figure 2.4, 2.5, and 2.6):

1. the **main SY/NET network cable length** (the length of the network cable from Terminator to Terminator)

- **ADDED TO**

2. each **drop length** (the distance from the female end of the TEE connector to the network connector on the CRM-5xx NIM)

- **WITH CONSIDERATION TO THE**

3. **total number of drops** (CRM-5xx NIMs attached to the network) *and*

4. **environmental conditions** (i.e., network cable placement, chassis grounding, and data line protection) Refer to the section NETWORK ENVIRONMENTAL CONSIDERATIONS.

The length relationship governs how many drops, and what length drops can exist on a network of a given length operating at a given baud rate.

NOTE: *If the TEE connector is directly attached to the NIM, the drop length is equal to 0 (zero) feet and is not added to the overall network cable length when calculating the maximum network cable length.*

The following identifies certain restrictions when assembling a network:

- Maximum network cable length: 15,000 feet (4572 meters)
- Maximum number of drops (NIMs) : 100
- Maximum drop cable length: 100 feet (30.5 m.)

If all of the drop lengths in a network are 0 (zero) feet and the number of drops (attached NIMs) totals 100, then use Figure 2.5 to determine the correct baud rate of the network.

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NETWORK BAUD RATE	MAXIMUM NETWORK CABLE LENGTH (FEET)
62.5 K	15,000
125 K	9,250
250 K	4,250
500 K	2,400

Figure 2.5 Baud Rate vs Network Length (Drop Lengths = 0)

If the network contains drops with cable lengths greater than 0 (zero), then the relationship to the number of drops and drop lengths governs the baud rate and the maximum network cable length. Figure 2.6 below, gives an example of how the drop length and number of drops affect the maximum network cable length, and baud rate within a network. Once the drop length increases, the maximum network length for any given baud rate decreases. Note that for a baud rate of 62.5 K baud, the maximum network length decreases when additional 100 foot drops are placed on the network. See Section 3.2.1, *SY/NET Network Baud Rate*, for baud rate switch settings.

NOTE: *Since a TNIM pair uses three network address, fewer than 100 drops are available on a SY/NET network which uses TNIMs.*

BAUD RATE	NUMBER of DROPs	LENGTH of DROPs	MAX. NETWORK CABLE LENGTH
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'

Figure 2.6 Baud Rate vs Drops vs Network Length

NETWORK ENVIRONMENTAL CONSIDERATIONS

A complete list of "Installation Considerations" is provided in the SY/MAX *Planning And Installation Guide* (Instruction Bulletin 30598-175-XX); several considerations that stand out are:

1. PROVIDING ADEQUATE SEPARATION *BETWEEN NETWORK CABLE AND AC POWER WIRING.* A minimum of six inches for 120 volt wiring and 12 inches for 240 volt wiring.

2. *GROUNDING.* This is extremely critical for the elimination of noise.

3. *DATA LINE PROTECTION.* Surge suppressors (such as Square D's Class 8030 Type CBP-300) offer protection from voltage spikes. Refer to Instruction Bulletin 30598-517-XX, Network Data Line Protector Class 8030 Type CBP-300.

NOTE: *If the network is incurring communications errors, a good rule of thumb is to double check for proper environmental considerations as described above. If the failures are not resolved, then decrease the network baud rate one setting. The throughput of the network is only reduced by 7% when the baud rate is reduced by one setting.*

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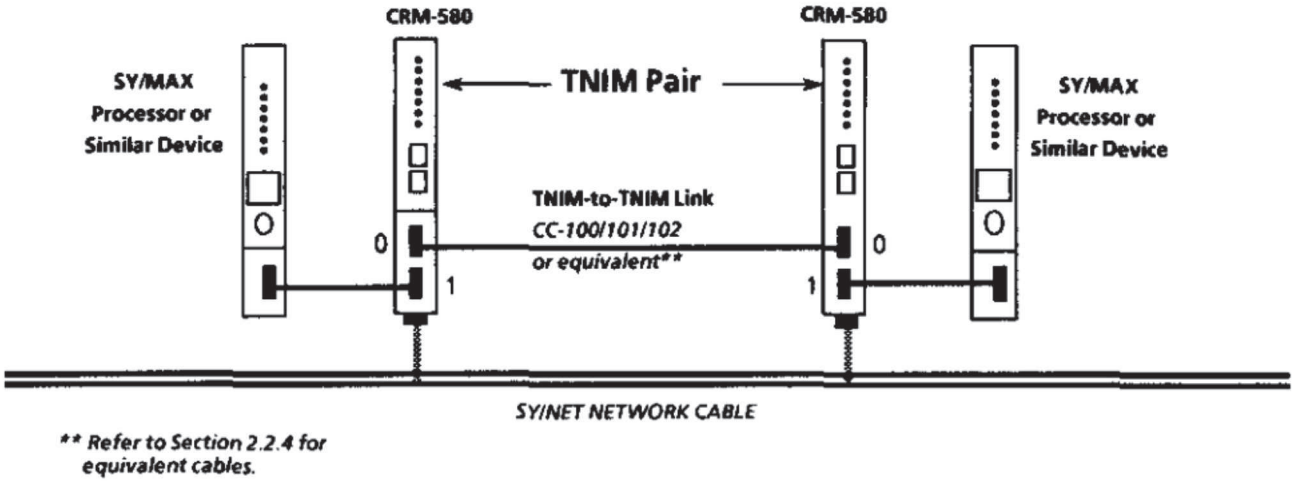


Figure 2.7 TNIM Pair

2.2.3 CRM-580 COMM PORT CABLING

The two CRM-580s COMM ports provide serial RS-422 communications. COMM port 0 is reserved exclusively for the TNIM-to-TNIM link, while COMM port 1 is used for connecting the PRIMARY and BACKUP control systems (refer to Figure 2.7).

Figure 2.8 shows the RS-422 pinout of both COMM ports (0 and 1) on the CRM-580. The COMM ports support the Request to Send and Clear to Send hardware handshaking signals. For the devices described in this manual, only pins 1-4 and 9 are used, however other cables are used to attach devices requiring Clear to Send and Request to Send signals. These devices and cabling requirements are covered in the appropriate Instruction Bulletin.

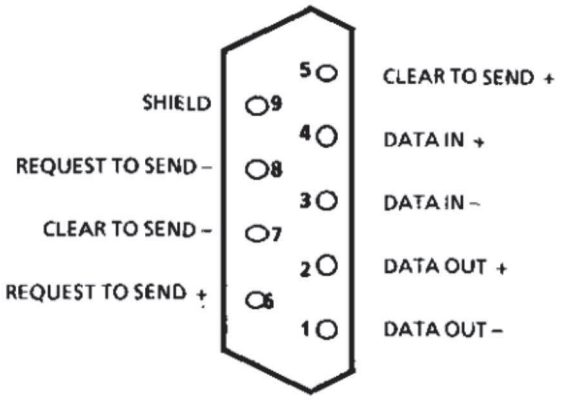


Figure 2.8 CRM-580 COMM Port Pinout

Ready to use cables for the CRM-580 COMM ports are available in three lengths and ordered separately from Square D as indicated in the following table.

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

2.2.4 CUSTOM COMM PORT CABLES

If different lengths of COMM port cables are required, a custom cable can be assembled by ordering the connector kit Class 8010 Type CCK-102 and up to 10,000 feet (3048 meters) of the following Belden cable types listed in Figure 2.9.

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CLASS 8010, TYPE:	QTY.	DESCRIPTION
CCK-102 Connector Kit	2	DB9P, 9-pin connector
	2	DB9P connector cover
	18	connector/wire pins
COMM Port Cables	1 to 10,000 feet	Belden® type 9502 (UL/CSA approved)
	1 to 10,000 feet	Belden type 8723

Figure 2.9 Custom COMM Port Cable Parts

Assemble the custom COMM port cable in accordance with the wiring diagram in Figure 2.10 (the connectors are both male and are interchangeable). Figure 2.10 also shows the internal wiring of the ready to use CC-1xx type COMM port cables described in Section 2.2.3.

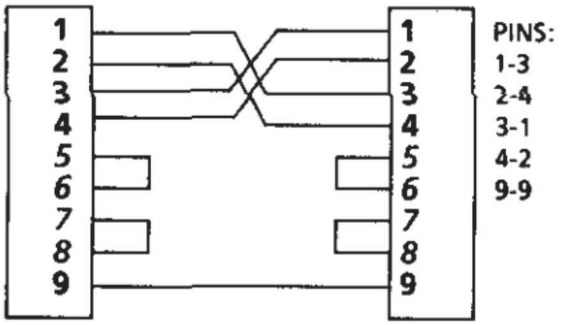


Figure 2.10 COMM Cable Wire To Pin Assignment

NOTE: *Handshaking is not employed when a CC-100, CC-101, or CC-102 cable is used.*

2.3 Specifications

The following sections list operating and environmental specifications for the CRM-580 NIM, the SY/NET network.

2.3.1 CLASS 8030 TYPE CRM-580 TNIM SPECIFICATIONS

Voltage Requirement ..... 5VDC, from SY/MAX rack.

Current Draw on SY/MAX Power Supply ..... 950 mA (100% duty cycle).

Operating Temperature ..... 32 to 140°F (0 to 60°C)

Storage Temperature ..... -40 to +176°F (-40 to +80°C)

Humidity ..... 5-95% RH, non-condensing.

COMM Port ..... Two independent 9-pin RS-422 ports. COMM "0" must be used for the TNIM-to-TNIM link at 9600 baud. COMM "1" is standard SY/MAX protocol, and can be set to 300, 1200, 2400, and 9600 baud.

Network Port ..... One dual concentric twist-lock connector for the LAN.

Operating Mode ..... TRANSFER

Thumbwheel ..... Sets Network Device Number, valid range is "00" to "99".

Physical Dimensions ..... Single-Width Module.
W: 1.5 in. (3.8cm)
H: 12.8 in. (32.5cm)
D: 6.6 in. (16.8cm)
Wt: 2.7lbs. (1.22kg)

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2.3.2 SY/NET NETWORK SPECIFICATIONS

A description of network operation is given in Appendix A, "An Introduction To Networks".

Cable	Baseband twinaxial type, Belden 9272 or equivalent.
Clock Frequency	1.0 MHz maximum
Cable Length	See Section 2.2.2.
Transmission Format	Manchester encoded HDLC.
Message Format	Packet type, similar to ANSI 3.28.
Collision Avoidance	Token-passing based on time windows.
Transmission Priority	Determined by module's Network Interface Number - the lower the number, the higher that module's priority.
Error Checking	Cyclic Redundancy Code (CRC) on each transmission.
Number of Devices	Maximum of 200
Expansion Capability	In NET-TO-NET mode, multiple networks can be tied together (not applicable to CRM-580).
Protection	TransZorbs™ on all ports.

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3 SWITCH SETUP

This section describes setting the CRM-580's thumbwheel and DIP switches to adjust the following Network Interface parameters:

- Network Device Numbers (EVEN/ODD pair)
- Network Baud Rate
- COMM Port Baud Rate
- Enable "Broadcast" Receive Capability
- Enable "Self-Test" Capability
- Network Size Selection

3.1 Network Device Number Thumbwheels

The two thumbwheel switches, on the CRM-580 front panel, assign a Network Interface Number to each CRM-580 and also a unique Network Device Number (NDN) to the device connected to the TNIM COMM port 1.

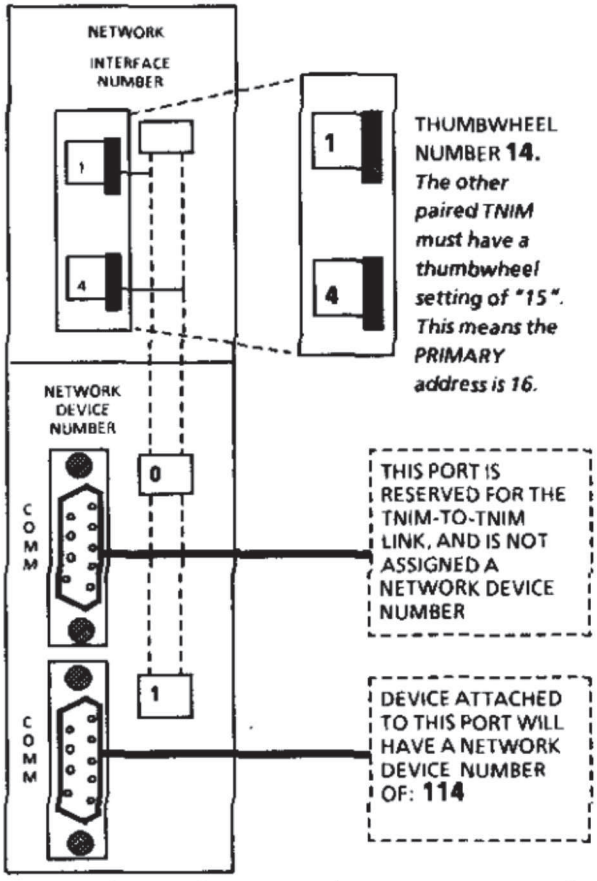


Figure 3.1 Thumbwheel Number vs Network Device Number

Using a small screwdriver, set the thumbwheels through the access holes on the side of the module. The number on the thumbwheel can be any number *from "00 to 99"*.

Transfer NIMs (TNIMs) are paired on the network based on their thumbwheel numbers. The paired modules consist of an even numbered module and the next consecutive addressed (odd number) module. The PRIMARY address, which actually uses a time slot on the network, is the even address *which is one greater than the odd address. For* example:

TNIM PAIR

CASE	TNIM #1	TNIM #2	Primary Address	EXPLANATION
CASE 1	0	1	2	Thumbwheel addresses are 0 and 1, PRIMARY address is 2.
CASE 2	18	19	20	Thumbwheel addresses are 18 and 19, PRIMARY address is 20.
CASE 3	2	3	4	Thumbwheel addresses are 2 and 3, PRIMARY addresses is 4.
CASE 4	98	99	0	Thumbwheel addresses are 98 & 99, PRIMARY address is 0. The address wraps around at 0.

NOTE: *Cases 1 and 3 or 1 and 4 cannot exist on the same network simultaneously because they share an address. Case 1 and 3 share address 2. Case 1 and 4 share address 0.*

CAUTION

Within one network, a Network Device **Number can be used ONLY ONCE. If more than one NIM has the same device number the network will not operate properly.**

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To determine the NDN of a device connected to COMM port 1 of a TNIM, simply place a 1 in front of the TNIM's thumbwheel number. Recall TNIM Port 0 is reserved for the TNIM-to-TNIM link and does not have a NDN. If a TNIM is currently the PRIMARY controller, the NDN will be one greater than the NDN of the odd module. For example:

NDN of TNIM NUMBER 1*	NDN of TNIM NUMBER 2*	NDN of PRIMARY*
100	101	102
118	119	120
112	133	114

* COMM Port 1

NOTE: *The primary address (NDM) will always be greater than 100.*

3.2 DIP Switches

On the back of the CRM-580 are three circuit board-mounted DIP "switchbanks". One switchbank (S3) contains four switches, the other two switchbanks (S4 and S5) each contain seven switches. All are accessible through the rear of the module as shown in Figure 3.2.

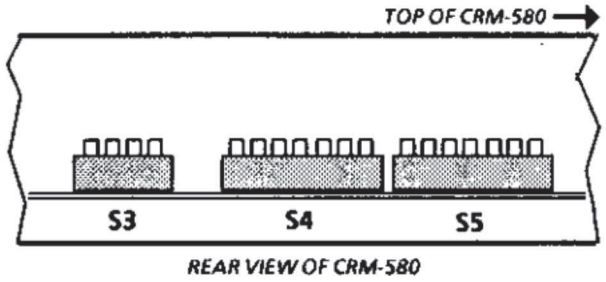


Figure 3.2 DIP Switches

Each DIP switchbank controls one or more setup parameters as shown below:

SWITCH-BANK	FUNCTION	SEE SECTION
S3	Network Baud Rate	3.2.1
S4	Baud Rate for COMM port 1 (bottom port)	3.2.2
	Self-Test Enable	3.2.3
S5	Baud Rate for COMM port 0 (top port)	3.2.2
	Network Size Select	3.2.4

When setting a switch, use Figure 3.3 to identify the switch or switches needed for each setting and the orientation of the switch.

Each switch within a switchbank is a small lever. When the switch lever is UP, it is OPEN/OFF. When the lever is DOWN flat against the body of the switchbank, it is CLOSED/ON.

In the sample setup of Figure 3.3, switchbank S3 is setup for illustrative use. Switch 1 in switchbank S3 is CLOSED (ON), while switches 2, 3, and 4 are OPEN (OFF).

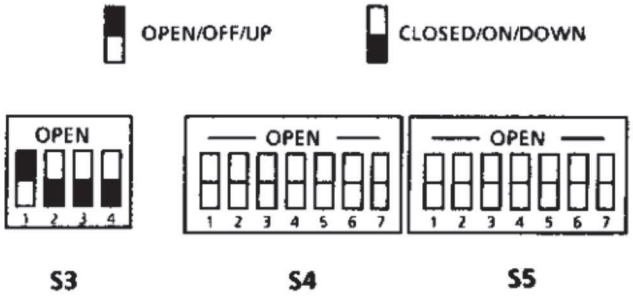


Figure 3.3 Sample Switch Orientation

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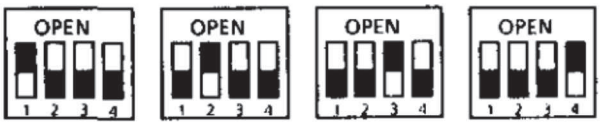
The following sub-sections give switch positions needed to set up the parameters listed in the beginning of this section.

CAUTION

Remove power to the rack before removing or installing the CRM-580 to change the DIP switches.

3.2.1 SY/NET NETWORK BAUD RATE

Four baud rates are available for SY/NET network communication - 500K, 250K, 125K, and 62.5K. Switchbank S3 sets this parameter as shown in Figure 3.4. *Switchbank S4 and S5 do not affect the SY/NET network baud rate in any way.*



500K 250K 125K 62.5K

Switchbank S3

NOTE; Set only one switch UP (OFF) on S3.

Figure 3.4 Network Baud Rate Selection

CAUTION

The longer the network cable, the greater possibility for noise to affect the signal within the cable. (The cable acts as an antenna.) To reduce noise and line losses related to operational frequency, the baud rate is limited by cable length as shown in Section 2.2.1.

Reducing baud rate by 50% (for example, dropping it from 500K to 250K) results in only a 7% reduction in throughput - not a 50% reduction. Therefore, if noise is a problem, the baud rate of a network can be considerably reduced without a significant loss in network performance.

3.2.2 COMM PORT OPERATING MODE

The CRM-580 TNIM communication ports are always set for the TRANSFER mode of operation. Port 0 is dedicated for the TNIM-to-TNIM Transfer Link. Port 1 is used for operation with SY/MAX devices such as Class 8020 processors, D-LOG Data Controllers or similar devices with SY/MAX protocol.

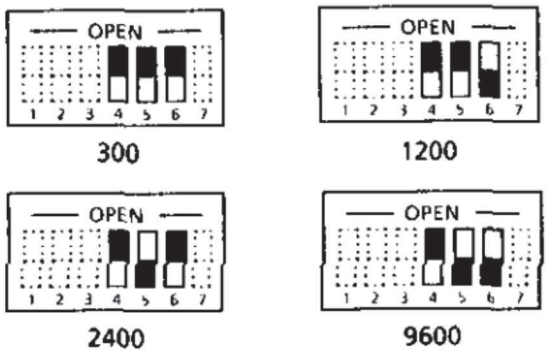
NOTE: *In all other network interface modules, the mode of operation of port 1 is referred to as the SY/MAX mode.*

3.2.3 COMM PORT BAUD RATE

Four baud rates are available for COMM port "1" - 300, 1200, 2400, and 9600 baud. COMM "0" port is used for the TNIM-to-TNIM communication link and must be set to 9,600 baud to ensure rapid communication transfer.

NOTE: *The factory default setting is 9600 baud.*

Figure 3.5 shows valid switch settings for the four baud rates.



Switchbank **S4** (port "1")

Figure 3.5 COMM Port Baud Rate Selection

Switches 4, 5, and 6 on switchbank S4 set the baud rate for COMM port "1". Switches 4, 5, and 6 on switch bank S5 set the baud rate for comm port "0". Any other switch combination is invalid. Switches 1-3, and switch 7, do not affect the baud rate.

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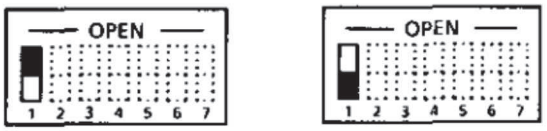
3.2.4 RECEIVE BROADCAST

COMM port 1 of the CRM-580 has the ability to receive messages that are "broadcast" by a different Network Interface Module. A broadcast message is a single message sent to several network devices simultaneously.

CAUTION

Broadcast messages are NOT acknowledged by any Square D CRM-type module. The device sending the broadcast does not receive a reply, and therefore does not guarantee that it was received by any CRM-type module.

Switch 1 of switchbank S4 determines whether port 1 of the CRM-580 will receive broadcast messages. Set the switch as shown in Figure 3.6.



WILL NOT RECEIVE *WILL* RECEIVE

Switchbank **S4**

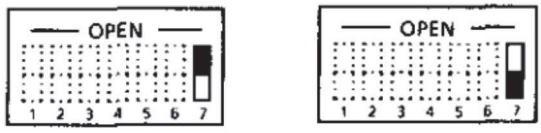
Figure 3.6 Broadcast Receive Options

See Section 5.2.6 for more information on the broadcast function.

3.2.5 TNIM SELF-TEST

To aid in troubleshooting, the CRM-580 can run a self-test routine which checks internal ROM and RAM along with the two COMM ports and network port. To use this self-test, two test plugs (Class 8010 Type CTP-11) are required for the COMM ports. The complete self-test procedure is described in *Section 7, Troubleshooting.*

Switch 7 on switchbank S4 activates the self-test sequence as shown in Figure 3.7.



SELF-TEST *OFF* (*Normal Operation*) SELF-TEST *ON*

Switchbank **S4**

Figure 3.7 Self-Test Activation

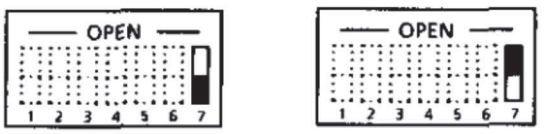
NOTE: *Both COMM ports must have the test plugs installed in order for the test to run. Remove any network cable attached to the network port.*

3.2.6 NETWORK SIZE

A network can be configured for a maximum of either 31 NIMs or 100 NIMs. When set for a maximum of 31 NIMs (network device numbers 00 to 30), network performance is improved 300% over the 100-NIM (00 to 99) setting. This is because internal timers within the NIMs do not time to 100, but instead reset upon reaching network number 30.

For a detailed description of the principles of network size, refer to Section 8.0, *Theory Of Operation*, and/or Appendix A, *An Introduction To Networks.*

Switch 7 on switchbank S5 sets the network size as shown in Figure 3.8. *If less than 32 NIMs are being used on a network, make sure this switch is set to the "30" position.*



31 NIMs MAXIMUM *100* NIMs MAXIMUM

Switchbank **S5**

Figure 3.8 Network Size Selection

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NOTE: *The side-panel label on the CRM-580 shows network size selection as "30/100". The "30" is the largest thumbwheel setting that can be used. When dealing with actual module count, interpret this as "31/100" since "00" is a valid network number.*

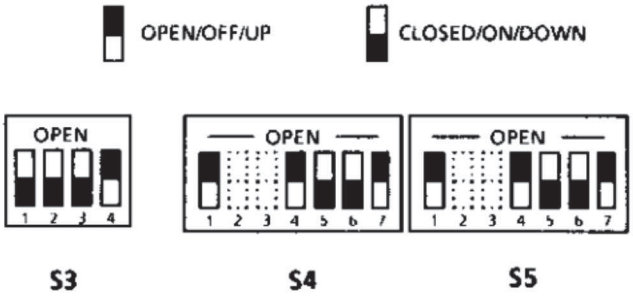


Figure 3.9 Factory DIP Switch Settings

CAUTION

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

3.3 Factory DIP Switch Settings

The CRM-580 is shipped from Square D Company with the DIP switch configuration shown in Figure 3.9. As discussed earlier, switches 2 and 3 in both S4 and S5 are inactive, and can be in any position.

The settings in Figure 3.9 configure the CRM-580 to the following parameters:

Network Baud Rate	62.5K baud
COMM Port "1" Baud Rate	9,600 baud
COMM Port "0" Baud Rate	9,600 baud
Receive Broadcast	Disabled
Self-Test	Disabled
Network Size	100

3.4 Side Panel Label

Figure 3.10 shows the side panel label for the TNIM dipswitch settings.

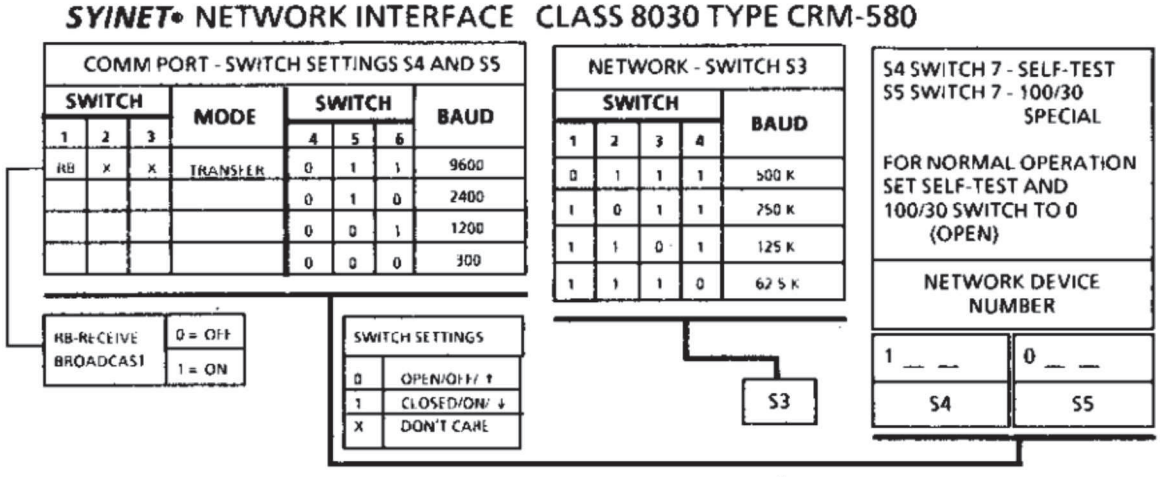


Figure 3.10 Side Panel Label

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4 DEFINING A NETWORK

4.1 Point-To-Point Routing

This section explains how to locate the TNIM, and the device attached to the TNIM, on the SY/NET Local Area Network (LAN). Two types of ROUTING, point-to-point and advanced, identify places on the LAN.

4.1.1 ROUTING WITHIN ONE NETWORK

To direct a message to a SY/MAX device attached to the CRM-580 (or any other NIM on a network), both the receiving and sending device's network device number (communication route) must be programmed into a communication rung (a READ, WRITE, or ALARM rung).

To send a message from a SY/MAX device such as a processor requires the rung shown in Figure 4.2. For communication within a single network (SY/MAX mode) only two ROUTEs are needed: ROUTE 116 is the destination of the WRITE, while 112 is the source device in which the rung is programmed. Referring to the TNIM pair in Figure 4.1, if it was necessary to Route to the current PRIMARY processor, the destination Route would be 118. The NIM used with the source device can be any SY/NET NIM.

NOTE: *Routes to TNIM COMM port 0 are not accepted. This port is dedicated for the TNIM-to-TNIM link.*

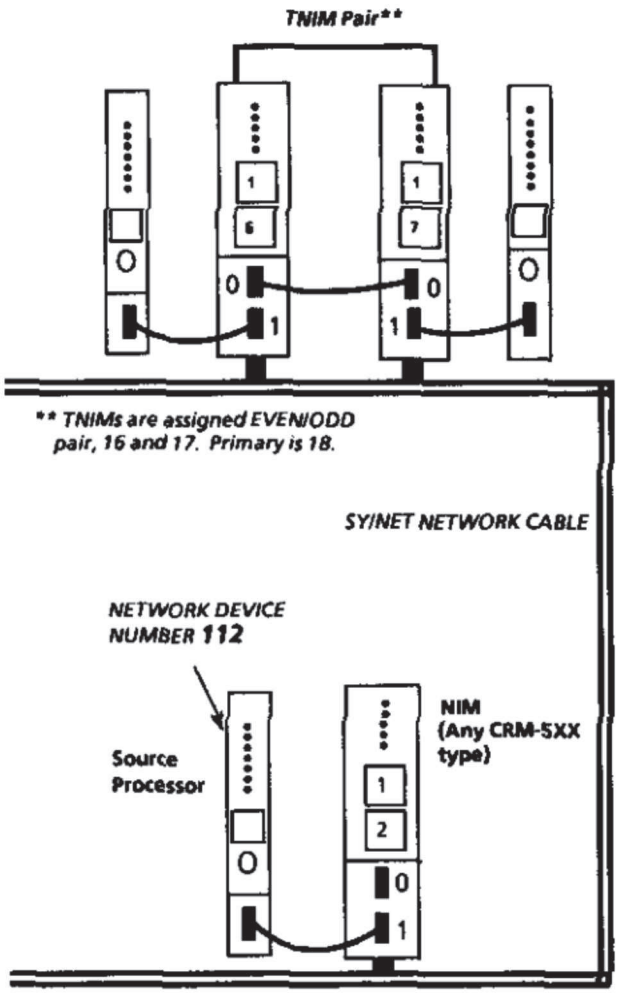


Figure 4.1 Single-Network ROUTE Configuration

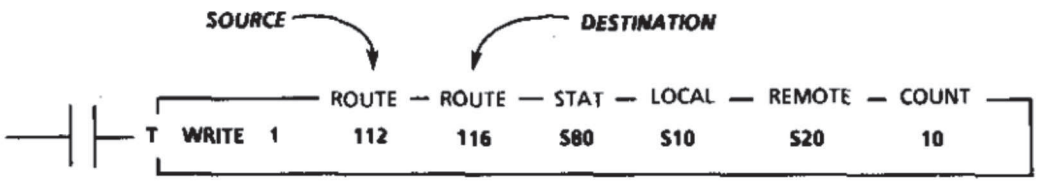


Figure 4.2 Point-to-Point WRITE Rung for Sending Data to a SY/MAX Device

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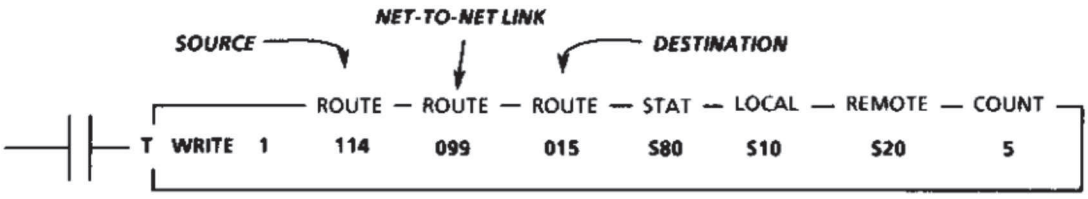


Figure 4.3 WRITE Rung for Net-to-Net Communication

4.1.2 NET-TO-NET ROUTING

Network-to-Network (NET-TO-NET) routing allows multiple networks to be tied together. Figure 4.3 shows a sample WRITE rung for the hardware configuration example that appears in Figure 4.4. This configuration allows a processor on SY/NET NETWORK #2 to communicate with a processor on SY/NET NETWORK #1 (the *source* network).

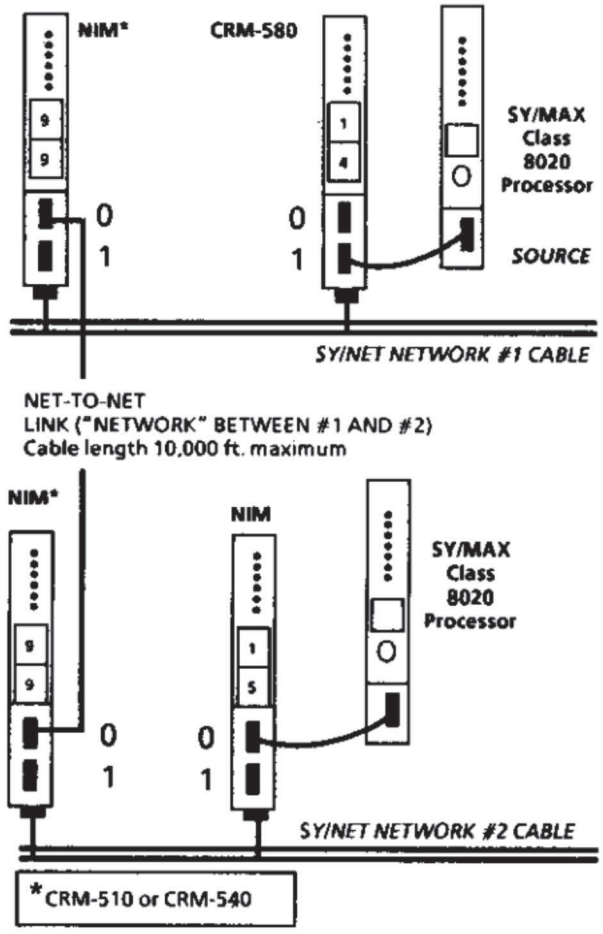


Figure 4.4 Net-to-Net ROUTE Configuration

An additional ROUTE entry is needed in the communication rung for net-to-net communication. The *second* ROUTE entry for NET-TO-NET is always the *net-to-net* ROUTE. The *first* ROUTE is always the *source* of the communication, while the *third* (and beyond) ROUTE defines the *destination*.

The two NIMs involved in the NET-TO-NET link must have the NET-to-NET mode (i.e., CRM-510, CRM-540) and the same NETWORK DEVICE NUMBERS (NDNs) selected on the thumbwheels. The COMM port on each of these NIMs must be set to the NET-TO-NET mode and to the same baud rate.

Additional net-to-net links can be set up. As each new network is added, an additional ROUTE is also added to the communication rung. The new ROUTE entries are inserted in the rung in the order they are accessed.

For example, if a third network was added to Figure 4.4 with the net-to-net NIMs set to "55", the new ROUTE portion of the rung would look like this:

114, 099, 055, (Final NDN)

The 114 entry is the *source* network, **055** is the link between Network #2 and Network #3 (the linking network), while **099** is the link between Network #1 and Network #2. The "final NDN" depends on the thumbwheel setting of the final destination device.

NOTE: *Up to five ROUTE values can be programmed into a processor's communication rung. Within a programming device, the limit is eight ROUTEs.*

A typical application for NET-TO-NET routing is a multi-level factory in which each floor is controlled by a network. These networks are then linked to another network set for NET-TO-NET operation, providing control of multiple networks from one central location.

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4.2 Advanced Routing

In addition to routing point-to-point with Network Device Numbers 000 through 199, the CRM-580 supports *Special Function* ROUTEs numbered 200 through 255. These Special Functions are listed in Figure 4.5, and are described in the following sections.

ROUTE	SPECIAL FUNCTION
200	READ CRM-580 status and WRITE CRM-580 status
201	Source's network number unknown
202	Port-to-port within the same NIM (not applicable to CRM-580)
203	Source and target NIM numbers unknown
204	DON'T CARE, go to next ROUTE
205-232	NOT USED
233-254	Broadcast functions (SY/MAX mode only.)

Figure 4.5 Special Function Routes

CAUTION

Use care when programming the special routes since more than one NIM on the network may be affected by them.

4.2.1 READ TNIM STATUS (ROUTE 200)

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

ROUTE AAA, 200, XXX

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

A communication rung sent to a TNIM by a processor or programming device obtains the following data from the target TNIM:

REGISTER NUMBER	FUNCTION
1	Type number (580).
2	Software revision.
3	Module number (thumbwheel setting)
4	COMM port "1" configuration (DIP switchbank S4).
5	Serial port number. If the message originates from one of the two COMM ports, this indicates which port (0 or 1). If the message originated from the network port, returned data is ignored.
6	COMM port 0 partition broadcast route. For details refer to Figure 4.7. Note: It is always 0 for this port.
7	COMM port 1 partition broadcast ROUTE.
8	Number of Network Transmit and Receive errors logged.
• • •	• • •
20	Transfer/Status (PRIMARY, BACKUP, or TRANSITION). (Refer to Section 6.2.)
21	Supplemental Error Code. (Refer to Section 7.1.)

4.2.2 WRITE TNIM STATUS

The operational mode (PRIMARY, BACKUP, TRANSITION) of a TNIM can be changed by a priority WRITE or ALARM with a ROUTE of 200 to TNIM register 20. The TNIM mode can only be altered by a device connected to COMM port 1 of the TNIM. The Write TNIM status is identical in format to a Read TNIM status with the exception that AAA and XXX routes are identical (source device). For more information, refer to Section 6, *TNIM Operation.*

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4.2.3 SOURCE NETWORK NUMBER UNKNOWN

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

ROUTE 201, 022

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

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

ROUTE 201, 200, 201

4.2.4 PORT-TO-PORT WITHIN THE SAME NIM (NOT APPLICABLE TO CRM-580 TNIM)

The CRM-580 DOES NOT support the use of ROUTE 202, which allows port-to-port communications between two devices attached to the same TNIM. This configuration is only supported when NIMs such as the CRM-540 and CRM-510, etc. are used. Refer to the appropriate NIM Instruction Bulletin for application details of port-to-port communications with the same NIM.

4.2.5 MODULE "PAIR" - SOURCE *AND* DESTINATION NIM NUMBERS UNKNOWN

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

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

ROUTE 201, 203 (From 6 to 7. Even-numbered network number, plus one, creates module pair 6/7.)

ROUTE 201, 203 (From 7 to 6. Odd-numbered network number, minus one, creates module pair 7/6.)

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

4.2.6 DON'T CARE, SKIP THIS ROUTE NUMBER

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

4.2.7 BROADCAST FUNCTIONS

(**NOTE:** Not applicable to NIMs set to Model 50 or Net-to-Net Mode.)

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

CAUTION

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

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Sending a Broadcast

To have *all* devices on a network receive a broadcast, **ROUTE 253** or **254** is used. ROUTE 253 sends the message to all COMM port "0"s (*except* the COMM "0" port of the TNIM), while 254 sends to all COMM port "1"s. To have only certain devices on a network receive the broadcast, a ROUTE number from **233** to **252** is used. Figure 4.7 shows which ROUTE assigns which device.

EXAMPLE: A broadcast message is to be sent to COMM port "1" of network devices 30 through 39. From Figure 4.7, the proper route to use is 240.

A broadcast message consists of a WRITE or ALARM rung in a processor/programmable controller, or a PUTN statement in a D-LOG program. A sample broadcast WRITE command appears in Figure 4.6.

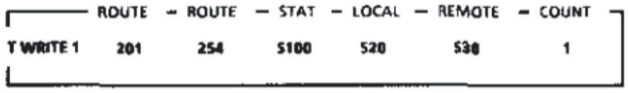


Figure 4.6 Broadcast WRITE Command

The communication command in Figure 4.6, WRITEs register 20 to register 30 in all devices connected to NIM COMM port 1 from a device of unknown network number (ROUTE 201).

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

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

Figure 4.7 Partitioned Broadcast ROUTEs

Receiving a Broadcast

Every device on the network has the option of being disabled from receiving a broadcast message. On the CRM-580, place switch 1 of switchblock S4 (UP) to disable broadcast to COMM port 1. See Section 3.2.4 for more information. Once this switch is OFF, the TNIM will ignore all broadcast messages. Unless switch #1 is set to OFF, port 1 of the TNIM *will* receive any broadcast message directed to it.

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CAUTION

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

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

Use care when programming ANY broadcast message.

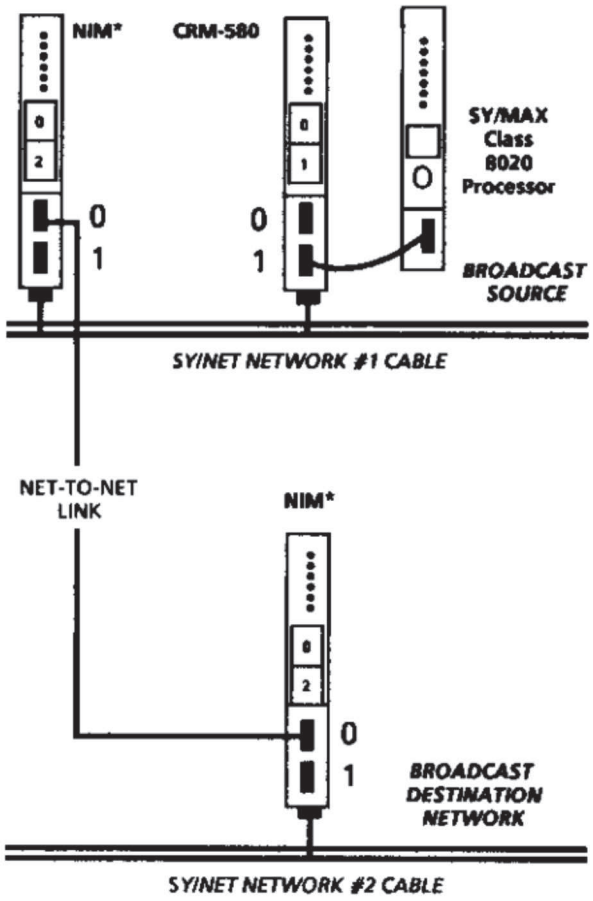
Net-to-Net Broadcasts

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

As an example, the following ROUTE entry sends a non-broadcast message from Network #1 to Network #2. Refer to Figure 4.8. Upon entering Network #2, the message becomes a broadcast message:

101, 002, 234

Figure 4.9 summarizes the ROUTE numbers which can be used in the CRM-580.



*CRM-510 or CRM-540

Figure 4.8 Net-to-Net ROUTE Configuration

ROUTE	PURPOSE
000-099	Point-to-point through COMM port 0 (NOT applicable to CRM-580 TNIM).
100-199	Point-to-point through COMM port 1.
200	Check status of this TNIM and change TNIM status.
201	Local device Network Number is unknown.
202	Transfer COMM port to COMM port within the same module (NOT applicable to CRM-580).
203	Local and remote device Network Numbers are unknown.
204	Dummy ROUTE, execute third ROUTE as if it were the second.
205-232	NOT USED.
233-254	Broadcast functions (SY/MAX mode only, not applicable to NIMs set for Model 50 or Net-to-Net modes).

Figure 4.9 ROUTE Summary

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5 PROGRAMMING EXAMPLES

5.1 Communication Rungs

To communicate with a SY/MAX device on the SY/NET network, the user's Class 8020 processor program *must* contain communication rungs. This section gives some example rungs within sample programs. For details on rung programming, refer to the appropriate SY/MAX programming Instruction Bulletin.

NOTE: *The Model 50 processor can RESPOND to network communication requests, but cannot INITIATE such communication. For more information, refer to Instruction Bulletin 30598-523-xx.*

CAUTION

The D-LOG Data Controller, Screenware2 Color Graphic Software, and SFW-234 etc. have special commands that are covered in their respective Instruction Bulletins.

5.1.1 DESCRIPTION

Three basic types of processor communication rungs include the:

1. READ rung
2. WRITE rung
3. ALARM rung

All three types of rungs transfer information from one SY/MAX device to another.

In the READ rung, register data is obtained from a remote device for use by the device originating the READ (the LOCAL device is the device containing the communication rung).

In a WRITE rung, the data flow is from the local device to the remote device.

In its simplest form, a communication rung looks like the rung in Figure 5.1 :

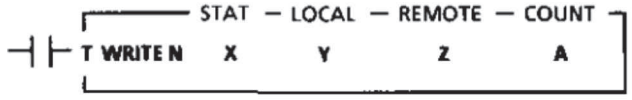


Figure 5.1 Basic Communication Rung

An ALARM operation, although similar to a WRITE, transfers a *constant* value from the local processor to a storage register in a remote processor or D-LOG module. A portion of a sample ALARM rung is shown below in Figure 5.2:

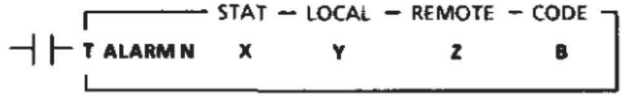


Figure 5.2 Partial ALARM Rung

Each part of a WRITE communication rung is described in the following.

T WRITE N This rung is a *transitional* (T) rung, which will WRITE data out of COMM port "N" (where N = processor port #1, 2, 3, etc.).

STAT (X) This *status* register keeps track of the communication rung and provides information on:

- *Rung continuity* - whether signal flow is occurring to the rung (*bit 22 of register "X"*).
- *Message progress* - has a message been sent? (Bit 17 of register "X").
- *Error detection* - Bits 1-14 of register "X".
- *Message complete* - Bit 16 of register "X".
- *HALT/RUN status of remote device* - Bit 15. *(This is only valid if bit 16* of register "X" *is set.)*

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The status register of the local device receives the information previously listed from the remote device in response to a communication rung. The status information is available up to the time the rung is opened. After being opened, the rung clears the status register information. For more information on the communication rung status register, refer to the appropriate SY/MAX processor or programming Instruction Bulletin.

LOCAL (Y) The *local* register is the first register in the local (originating) device that is affected by the communication rung. In a WRITE, register "Y" is the first register sent *to* a remote device. In a READ, the local register is the first register written to *by* the remote device.

REMOTE (Z) The *remote* register is the first register within the remote device affected by the communication rung. In a WRITE, register "Z" is the first register written *to* in a remote device by the local device. In a READ, register "Z" is the first register transferred *from* the remote device to the local device.

COUNT (A) This entry specifies how many registers are involved with a data transfer. The count begins with the register specified by REMOTE or LOCAL, and goes through the number of registers specified by COUNT. For example, if a COUNT of 15 is specified beginning with LOCAL register 150, local device registers 150 through 164 will be involved in the transfer.

CODE (B) In a alarm rung, the constant data value sent to the remote device register.

By adding the desired communication routing (as explained in Section 4.0, Defining a Network) to a Read, Write, or Alarm rung I/O and Register data can be easily transferred between SY/MAX devices via SY/NET.

Depending on which type of SY/MAX processor is involved, there is a limit to the number of registers that can be transferred:

PROCESSOR	MAXIMUM "COUNT"
Model 50	128
Model 300	16
Model 400	128
Model 500 *(Series M or later)*	128
Model 600	128
Model 700	64
D-LOG Data Controller	128

WARNING

WRITE and ALARM rungs change the contents of registers in remote devices. This may cause unanticipated output actuation resulting in personal injury or property damage. Make sure all effects of any register change are understood prior to using the WRITE or ALARM commands.

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5.2 Rung Examples

Described in this section are five programming examples, illustrating the following:

1. Multiple register READ.
2. Enabling several communication rungs simultaneously.
3. Increasing communication efficiency (report-by-exception principle.

5.2.1 OPERATION

The contact preceding the communication rung is called the *initiating* contact. It can consist of one or more normally-open or normally-closed contacts.

When the initiating contact produces continuity to the rung, the rung is enabled and bit 22 of the status register turns ON.

Any time the initiating contact *breaks* continuity to the rung, the rung is disabled and the status register is cleared.

WARNING

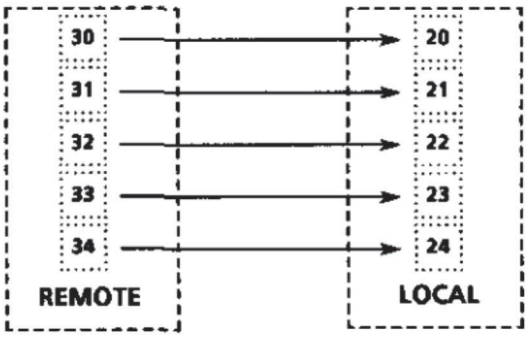
Keep the initiating contact CLOSED (rung ENABLED) until the rung has finished communicating, as indicated by bit 16 of the status register being set to 1. If the initiating contact will be CLOSED for only one scan, insert a "seal" circuit in the program to maintain continuity until the rung has finished communicating. Failure to do this may cause unanticipated output actuation resulting in personal injury or property damage.

For more details, refer to the appropriate SY/MAX programming manual.

5.2.2 MULTIPLE REGISTER READ RUNG

The multiple-READ rung is almost identical to a single register READ rung, except for the COUNT entry. The READ rung, shown in Figure 5.3, when enabled will READ the contents of the remote device registers 30 through 34 and transfer the data to local registers 20 through 24. Communication takes *place through COMM port 2 of the local device.*

The transfer in the multiple-register READ rung (Figure 5.3) is one-to-one as shown below:



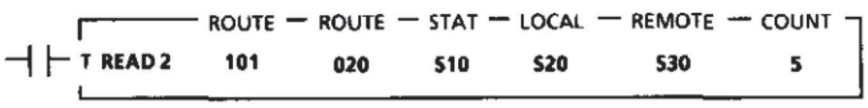


Figure 5.3 Multiple Register READ Rung

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5.2.3 MULTIPLE RUNG COMMUNICATION

Enabling multiple communication rungs allows sending more than one message using only a single initiating condition.

The Multiple Communication program in Figure 5.4 allows contact "Z" to initiate three different communication rungs. Each rung WRITEs one register from the local device to the remote device.

NOTE: *Although all three rungs are initiated from a single contact, each rung must have its own unique status register.*

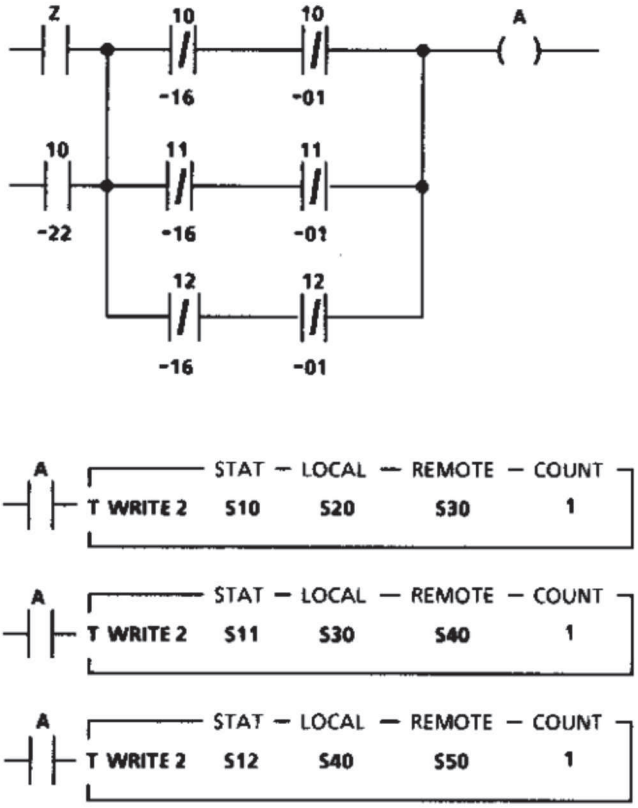


Figure 5.4 Multiple Communication

WARNING

Figure 5.4 and 5.5 provide programming examples that will change register contents in remote devices. This may cause unanticipated output actuation resulting in personal injury or property damage. If these examples are used in an operating system, make sure all effects of any register change are fully understood before running the examples.

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5.2.4 MAKING COMMUNICATION MORE EFFICIENT

Many times it is not necessary to constantly send communication rungs to a device, but rather send or receive information only when certain data changes. This might be only once a minute, once an hour, or once a day. By sending communication only when needed, network activity is reduced and other devices have more opportunity to access the network.

Figure 5.5 is an example of how this "only-when-needed" philosophy is applied to a user program to *cut down on network time. Basically, rungs are* added to the program in Figure 5.4 to:

- Detect a communication fault.
- Automatically re-transmit a message if a fault is detected, or if a message is not completed in a specified amount of time.
- Periodically update the remote device, even if the data has not changed, to determine if the local processor is active or not.

REGISTER AND I/O USE FOR FIGURE 5.5
(On Following Page)

Registers

S29 ..... Status register for WRITE rung.

S30 ..... Master timer.

S31 ..... Register change memory, contains old I/O or register data.

I/Os

9-01 ..... Enables the periodic update.

9-02 ..... Communication fault has occurred.

9-03 ..... WRITE rung is enabled
9-04 ..... Enables update for one scan.

9-05 ..... Sets fault latch and resets the communication rung.

29-16 ..... Resets "send update" rung.

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