SIEMENS

SIMATIC TIWAY I

Series 500 NIM

User Manual

Order Number: PPX:TIWAY–8110
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Fifth Edition

⚠ DANGER

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

DANGER is limited to the most extreme situations.

⚠ WARNING

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and/or property damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury, and/or damage to property.

CAUTION is also used for property-damage-only accidents.

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Preface

Manual Overview

This manual contains the information necessary to install and operate the Series 500™ Network Interface Module (NIM). The following information is provided.

- NIM specifications
- Installation and testing procedures
- Operating instructions and descriptions
- SIMATIC® TIWAY™ I primitive descriptions and examples

Manual Organization

This manual is organized as follows:

- CHAPTER 1 — TIWAY I OVERVIEW contains an overview of the TIWAY I network and an explanation of how the Series 500 NIM operates within this network. NIM specifications are also defined.
- CHAPTER 2 — NETWORK DESIGN CONSIDERATIONS describes possible network design configurations, and the use of modems with TIWAY I. Local Line cabling, biasing, and termination are also discussed.
- CHAPTER 3 — INSTALLATION describes NIM installation and diagnostic procedures.
- CHAPTER 4 — NIM PRIMITIVES describes NIM operation and the primitive subset supported by the NIM.
- APPENDIX A — PM550 CIM REQUIREMENTS contains procedures for Local Line biasing and termination for networks that contain a mixture of Series 500 NIMs and SIMATIC® PM550™ Computer Interface Modules (CIM).
- APPENDIX B — FLOATING POINT NUMBERS defines floating point representation used in the TIWAY network.
- APPENDIX C — NETWORK CONFIGURATION DATA SHEET contains a form that will help you plan your network.
- APPENDIX D — NETWORK EVALUATION FORM contains a TIWAY network evaluation form. You can submit the completed form to Siemens for a free network evaluation.

- APPENDIX E — SPECIFICATIONS provides general specifications for the Series 500 NIM.
- APPENDIX F — PRIMITIVE EXAMPLES provides a simple primitive example in normal and extended addressing modes.

Related Publications

The following publications contain additional information on TIWAY I and TIWAY I compatible products. To order these publications, contact your distributor or sales office. If you need assistance in contacting your distributor or sales office in the United States, call 1–800–964–4114.

Manual Title	**Manual Number**
SIMATIC TIWAY I Systems Manual	TIWAY–8101
SIMATIC TIWAY I Host Adapter User Manual	TIWAY–8102
SIMATIC TIWAY I Host Software Programming Manual	TIWAY–8105
SIMATIC PM550 NIM User Manual	550–8110
SIMATIC 5TI NIM User Manual	5TI–8105
Unilink Host Adapter User Manual	TIWAY–8121

Chapter 1

TIWAY I Overview

1.1 TIWAY I System Overview

TIWAY I is an industrial Local Area Network designed to satisfy today's factory and plant requirements for data acquisition and control of manufacturing processes. It is a significant enhancement of the Siemens "Local Line," which has supported the PM550 Programmable Controllers and DS 990 computer products since 1980.

The TIWAY I network provides a reliable and flexible communication architecture. Two communication media options are available:

- RS-232-C/423 — provides modem interface for large geographic coverage.
- Local Line — provides high noise immunity for networks up to 25,000 feet (7620 meters).

Redundancy is supported for either choice of media. TIWAY I uses High-level Data Link Control (HDLC) protocol with CRC-16 error-checking and message-length error-checking, providing reliable network communication.

Throughout this manual, the following networking terms are used.

- Primary — the HDLC network manager
- Secondary — the device operating as an HDLC secondary slave (NIMs, UNILINK™ Secondary Adapters)
- Attached device — controller, robot, etc. (Siemens controller connected to the NIM, robot connected to a UNILINK Secondary Adapter)

TIWAY I Options

TIWAY I network products provide a number of user-selectable options.

- Baud rates are selectable from 110 baud to 115.2 K baud.
- TIWAY I devices can operate with modems in either full or half duplex mode, synchronously or asynchronously.
- Both NRZ and NRZI data encoding are available.

System Block Diagram

Figure 1-1 illustrates the basic system block diagram of a TIWAY I Network. System components include:

- Host System Interfaces (including Host Adapters, Gateways, and Network Control Modules)
- Siemens Programmable Controller Network Interface Modules (NIMs)
- UNILINK™ Secondary Adapters for interfacing non-Siemens products to the TIWAY I Network

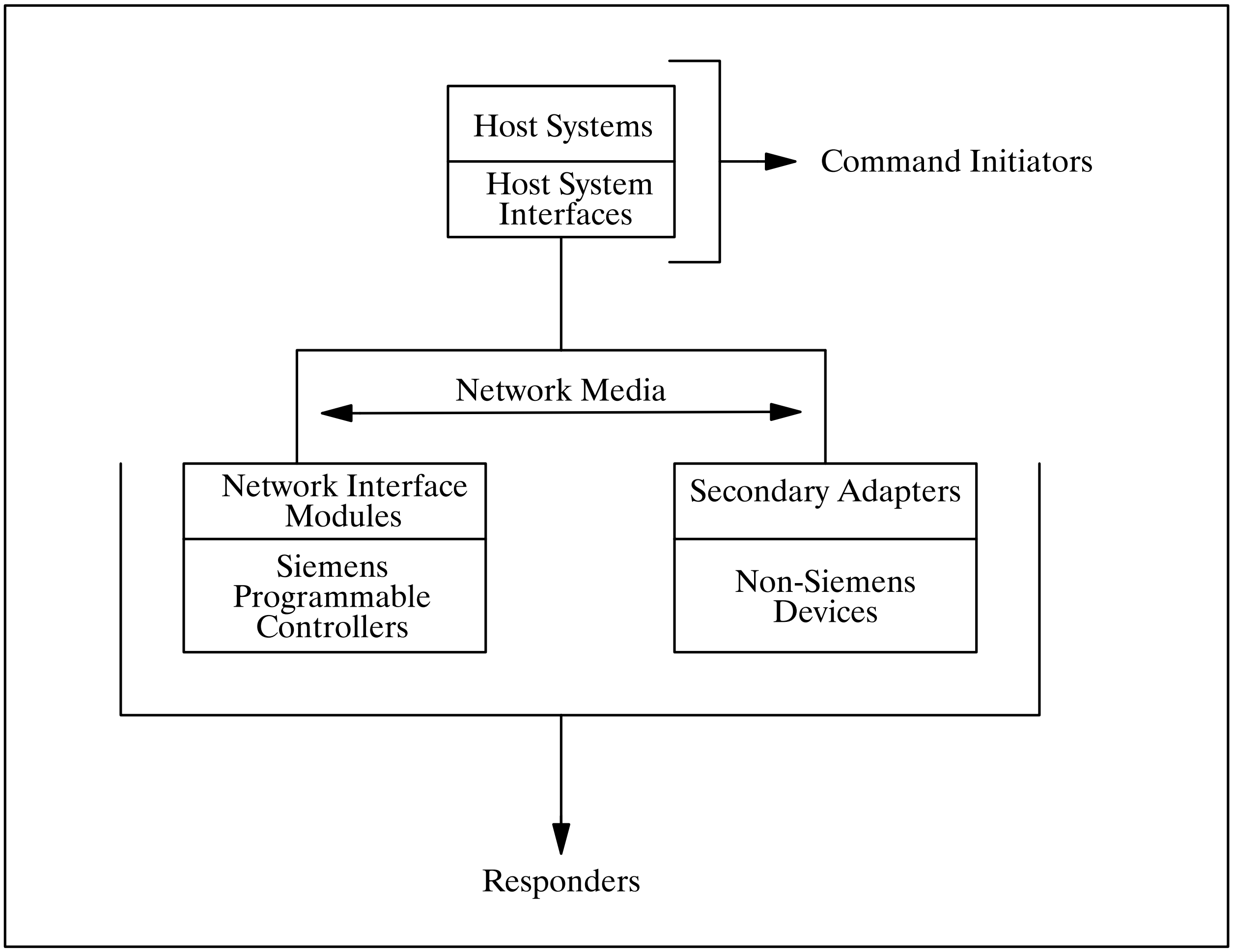

Figure 1-1 TIWAY I System Block Diagram

TIWAY I Universal Command Language, UCL

TIWAY I provides a Universal Command Language for all communication on the network. The UCL consists of a set of high-level request/response transactions known as Primitives. Primitives are used for:

- Reading and writing data
- Acquiring status of devices attached to the network
- Performing control operations on attached devices

Host Systems (computers or other intelligent devices) issue requests (Primitives) to Network Interface Modules and Secondary Adapters. The secondary interfaces then perform the requested operation on their attached device and return the appropriate response to the Host Devices to complete the transaction. (See Figure 1-1.)

The Series 500 NIM

The Series 500 NIM is the TIWAY I Network Interface Module for the Siemens Series 500 Programmable Controllers. See Chapter 3 for a specific listing of controllers supported by the Series 500 NIM.

The Series 500 NIM, which occupies two slots of a Series 500 I/O base, provides redundant TIWAY I communication ports. Each of the following models supports a specific type of network communication media.

Part Number	Port A	Port B
PPX:500–5039	Local Line	Local Line
PPX:500–5040	RS-232-C/423	RS-232-C/423

The RS-232-C/423 media interface is configured as Data Terminal Equipment (DTE) and is used to connect the NIM to Data Communication Equipment (DCE) for operation with modems. This interface uses RS-423 drivers and receivers and operates at RS-423-A signal levels (+5 or –5 volts; these levels are also RS-232-C compatible). The pin assignments for the RS-232-C port are given in Table 2–1.

The Local Line interface is a differential line port for use with shielded twisted pair cable. The Local Line interface provides line isolation and high noise immunity for installations up to 10,000 feet (25,000 feet depending on system loading and baud rate selection).

Series 500 NIM Features

The Series 500 NIM provides several features which ensure maximum network signal integrity.

- Each communication port is provided with a “jabberstop” circuit to disable the port’s transmitter in the event of a communication port failure. Such failures can cause continuous network transmission which would dominate the communication channel.
- Built–in self tests guard against failure of the NIM itself. Chapter 3 provides a complete description of these built-in tests.

Series 500 NIM Software Releases

To date there have been four releases of Series 500 NIM software. Releases 2.1, 2.2, and 3.0 provide enhancements to release 1.1.

Release 1.1 — initial release that provides basic primitive and data type support for 520 and 530 controllers. In this release, the data element range configuration is fixed.

Release 2.1 — contains all capability of release 1.1 and adds the following:

- Extended addressing
- Automatic data element range configuration
- Support for the 560/65 controllers
- I/O force data types

Release 2.2 — contains all capability of release 2.1 and adds the following:

- Support for CR force operations

Release 3.0 — contains all capability of release 2.2 and adds the following:

- Program upload/download support
- Allows data type 35 (loop mode) to be read or written
- Minor software error corrections

If the product release level does not appear on the product I.D. label, call the Siemens Technical Services Group at (423) 461–2501 for assistance. They will need the unit serial number to determine the release level.

Table 1-1 provides a complete listing of the primitives and data types supported in each release.

Table 1-1 Primitive Support in NIM Software Releases

Release 1.1		Releases 2.1 and 2.2		Release 3.0	
Primitive	**TT Types**	**Primitive**	**TT Types**	**Primitive**	**TT Types**
0	0	0	0 A	0	0 A
1	1	1	1 B	1	1 B
2	3	2	2 C	2	2 C
3	4	3	3 D	3	3 D
4	5	4	4 E	4	4 E
10	6	5	5 F	5	5 F
20	7	10	6 10	6	6 10
30	8	20	7 11	7	7 11
50	9	21	8 12	10	8 12
51	A	30	9 17	20	9 17
52	E	31	20 4A	21	20 4A
	F	50	60 6C	30	60 6C
	10	51	70 74	31	70 74
	11	52	76 7A	50	76 7A
	12	55	7C 84	51	7C 84
		56	87 8A	52	87 8A
		57		55	
				56	
				57	
				58	
				59	

NOTE: The Primitives listed in Table 1-1 are supported by the NIM. Your controller may not support all of the Primitives listed.

Chapter 2
Network Design Considerations

2.1 TIWAY I Network Configuration

TIWAY I is a multi-drop communication network which consists of a main trunk cable (the "spine") and dropline cables. The network can connect up to 254 secondaries (e.g., Series 500 controllers) to a host computer. The Series 500 NIM provides the interface to the network host, enabling the host and the controller to communicate with each other.

Communication Media

The following signal-transmission media are supported by TIWAY I:

- RS-232-C/423 dedicated lease-line modem interface in which no dial-up is necessary, providing extended (cross-continental) geographic coverage.
- RF or short-haul modem link-ups (cross-plant or cross-town coverage).
- Siemens Local Line (up to 25,000 feet).

NOTE: Media redundancy is supported for RS-232-C and Local Line NIMs. TIWAY I does not, however, directly support dial-up modems which require Modem Control Commands for communication switchover. This can be done, but specific equipment is required to dial the remote number from the host device.

In order to achieve true redundancy, you must have a *completely* redundant network (network trunk lines and drop lines).

The selection of the network communication media depends primarily upon the geographic distance to be spanned. The main TIWAY I trunk, called the Local Line, can be up to 10,000 feet long (25,000 feet depending on system loading and baud rate selection), and can have up to 254 droplines. Each dropline can be up to 100 feet long. For distances exceeding 25,000 feet, RS-232-C/423 media interfaces and modems should be used.

NOTE: The proper installation of a communication network requires careful planning and design. If you need assistance, a free site survey is available from Siemens. Simply fill out and return the enclosed "TIWAY I Network Evaluation Form" (Appendix D).

Also included with this manual is a "TIWAY I Network Configuration Data Sheet" (Appendix C). This will assist you in maintaining a complete, up-to-date record of the configuration of your network, which is particulary important if you are using several different types of secondaries.

NIM Block Diagram

Figure 2-1 is a simplified block diagram of the Series 500 NIM. The media interface blocks are intentionally left unlabeled because the type of media interface depends on which NIM model you are using. The blocks are described as follows.

- Special Function Interface Controller (SFIC) — delivers and receives controller commands.
- NIM controller — translates the controller commands and responses.
- Communications controller — supervises data transactions between the NIM and the network host.

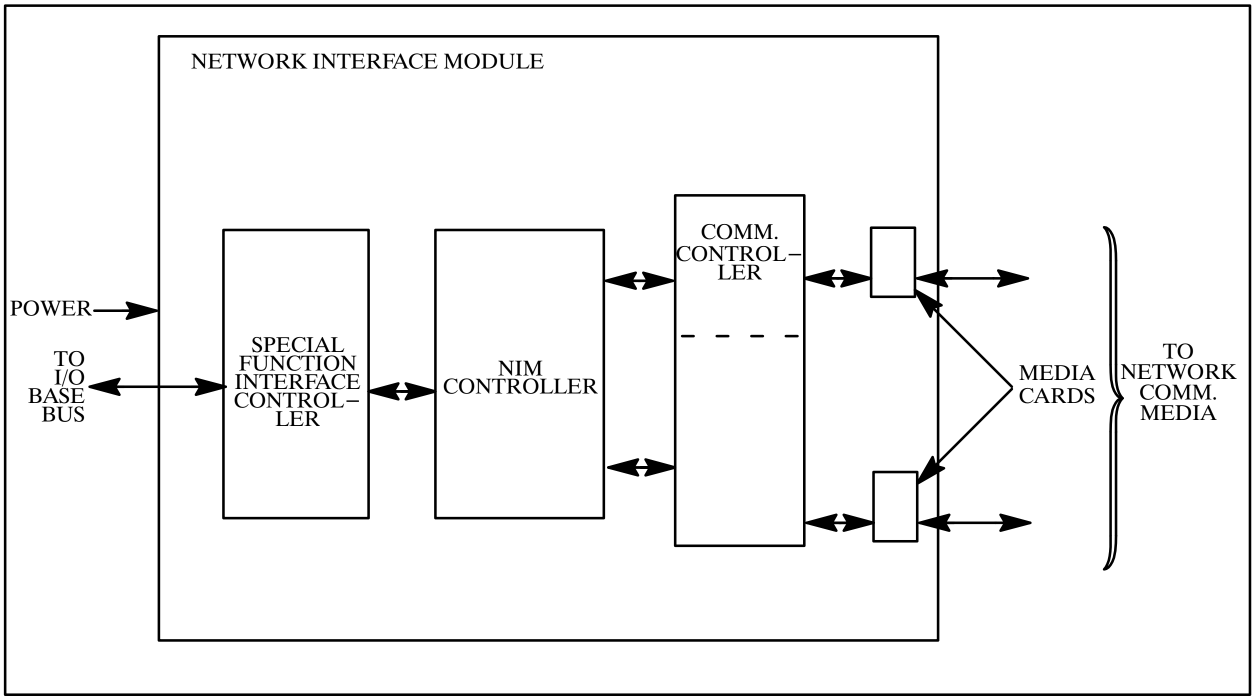

Figure 2-1 NIM Simplified Block Diagram

The basic difference in the NIM models is the configuration of the media interface cards. Examples of the possible application of the different models are as follows:

- If you want media redundancy for a dedicated line (lease-line) modem, or an RF (short-haul) modem, use PPX:500–5040 which supports RS-232-C/423 on both Port A and Port B.
- If you want media redundancy for a Local Line installation, use PPX:500–5039 which supports Local Line on both ports.

Timimg Considerations

If you use the Series 500 NIM with a dedicated short-haul RF modem, the NIM has a one-second time-out between the transmission of its RS-232-C Request to Send (RTS) and the RS-232-C Clear to Send (CTS) response.

This time-out value is set at one second to enable the RF device to switch from receive to transmit without losing access to the transmission media.

NOTE: This extended time-out feature is an important consideration when selecting a TIWAY I-compatible RF Modem. Transmitter/Receiver turnaround time must be less than the one-second network time-out.

An additional half-second delay from Clear to Send (CTS) to start of transmission can be added by setting the Keydelay Switch to the OPEN (left) position. This may be required to allow the transmitter to reach full power before start of transmission. There is also a one-second wait period for DCD to turn off in a half-duplex modem.

2.2 RS-232-C Cable Installation

The physical layer in TIWAY I provides a modem interface for synchronous or asynchronous modems at data transmission rates up to 115.2K bits per second. The modem interface provides standard signals, as defined in Table 2-1, for control of two-way alternate data transmission using both half and full duplex modems. The modem interface is a standard “Type E” DTE configuration as defined in Section 5 of EIA RS-232-C. This interface uses a male (plug) 25-pin D-type connector on the communication cable. The circuits and pin assignments for the RS-232-C connector are shown in Table 2-1.

Table 2-1 RS-232-C Connections

Pin	ISO #	RS–232-C Name – Function
1	101	AA – Protective Ground (chassis)
2	103	BA – Transmitted Data
3	104	BB – Received Data
4	105	CA – Request to Send (RTS)
5	106	CB – Clear to Send (CTS)
6	107	CC – Data Set Ready (DSR)
7	102	AB – Signal Ground
8	109	CF – Received Line Signal Detector/ Data Carrier Detect (RLSD/DCD)
15	114	DB – Transmitter Signal Element Timing
17	115	DD – Receiver Signal Element Timing
20	108/2	CD – Data Terminal Ready (DTR)

2.3 Local Line Cable Installation

The following paragraphs describe Local Line characteristics and installation guidelines.

Local Line Characteristics

The TIWAY I Local Line is a physical signaling technique (baseband, differential current drive) which operates over shielded, twisted-pair cabling. The Local Line cable may be up to 25,000 feet long, depending on loading and baud rate selection. It uses tap housings to simplify the addition of connections to TIWAY I. The Local Line is designed to operate with shielded, twisted-pair cable which has a characteristic impedance of 124 ohms.

The interface is a male, 9-pin D-type receptacle with pin assignments as shown in Table 2-2.

Table 2-2 Pin Assignments of Local Line Connectors

Pin	Name	Description
1		No connection
2		No connection
3	Shield	Cable shield and signal common
4		No connection
5		No connection
6	LLM+	Positive biased signal line
7		No connection
8		No connection
9	LLM–	Negative based signal line

NOTE: If you need Local Line cable redundancy, you will need one PPX:500–5039 NIM, two separate twisted pair cables, and a T-Tap and dropline for each port on the NIM. All taps and connectors are supplied with the Local Line, but extras may be necessary for cable splicing. Suggested routing procedures for redundant Local Line cabling are listed later in this section.

Network Cable

The TIWAY I local line network cable consists of a main cable or spine with droplines or taps for each Secondary. Interrelated network variables having direct influence upon network performance are:

- Maximum trunk cable length
- Cable type
- Tap length
- Tap spacing
- Number of Secondaries
- Maximum baud rates

Figure 2-2 illustrates the relationship of cable distance to the number of Secondaries for different baud rates for two types of twisted pair cable. Note that the cable distance (in thousands of feet) is shown vertically; the maximum number of units that may be attached is shown horizontally.

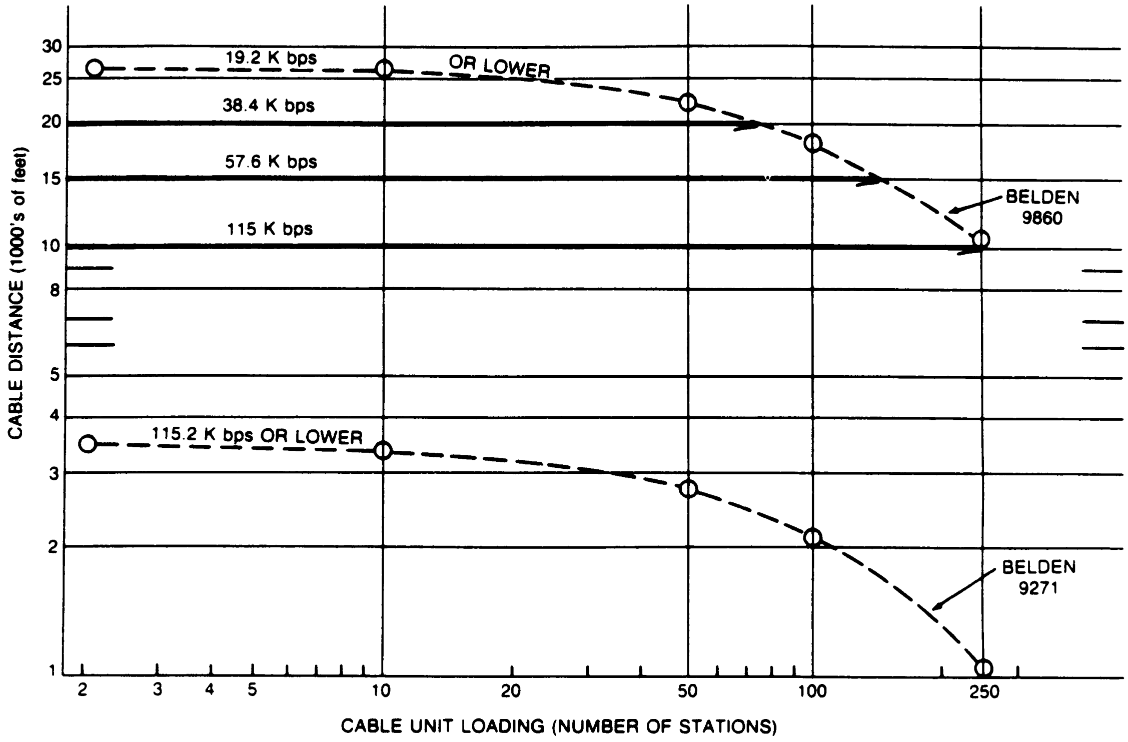

Figure 2-2 Number of Local Line Secondaries Versus Cable Length

Local Line Cable Installation (continued)

As shown in Figure 2-2, when you use Belden® 9860 cable (or its equivalent), up to 75 stations can be attached to a network operating at 38K bps and having a spine length of 20,000 feet. At 115.2K bps, the maximum length of a Local Line network having 254 stations is 10,000 feet.

Local Line Tap Housings

The Local Line primarily consists of two items:

- Twisted-pair cabling
- Tap housings

Siemens recommends Belden 9860 twisted pair cabling, or its equivalent, for use as the Local Line network spine. Belden 9271, or its equivalent, should be used for the dropline. Brands other than those listed here will be specified by Siemens upon request.

The tap housing, shown in Figure 2-3, is made by Siemens specifically for its Local Line network. The tap housing can be mounted rigidly to a NEMA panel or other enclosure. It could also be used to splice cables in a cable tray without being rigidly mounted. The tap housing not only allows an orderly connection to the TIWAY I network, but also contains terminating resistors, resists moisture, relieves strain, and provides noise isolation for attached cabling.

Tap housings are included for each Local Line port; however, extras may be ordered from your distributor. Order part number PPX:500–5606.

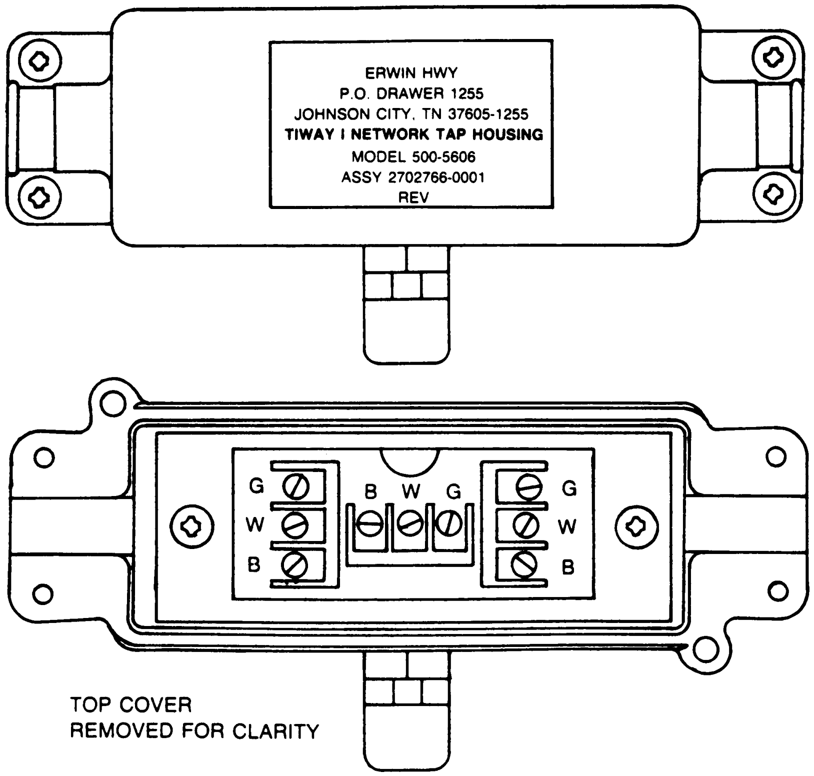

Figure 2-3 TIWAY I Tap Housing

Tap Housing Cable Connections

With the cover removed from the PPX:500–5606 Tap Housing, note that there are three sets of terminals, and that each set is labelled G, W, and B. (See Figure 2-3.) One set of these terminals is for the incoming Local Line twisted pair; the center set is for the drop line; and the remaining set is used to connect the Local Line to the following node, or to terminate the Local Line if the Tap Housing is the last one on the network trunk.

For consistency in installation, always connect the LLM+ (Pin 6 of the Local Line Connector) to the white strand of the twisted pair and to the terminal marked “W” in the Tap Housing. Connect the blue strand to the LLM– (Pin 9 of the Local Line Connector) and to the terminal marked “B” in the Tap Housing. The Cable Shield and Signal Common should be connected to Pin 3 of the Local Line connector and to terminal “G” inside the Tap Housing.

Planning Considerations

Some major points to consider during the planning phase of a Local Line network are as follows:

- From the start, allow for system growth. This means making provisions for the attachment of additional computing devices by routing cables through all probable areas of future plant expansion.
- Always make the network flexible enough to allow for rearrangement of plant equipment.
- Since network system noise is usually picked up by its interconnecting wiring, steps should be taken at the outset to bypass or eliminate noise sources such as large motor starters, high current switches, and transformers.
- If cable redundancy is desired, the two cables should never be routed along the same path, since the environmental and other factors which disable one cable will very likely disable the second.
- A detailed record of design and routing should be created and maintained. This record should be complete enough to enable a user to trace and physically locate all cable paths and hardware components.

Local Line Tap Spacing

To calculate the the minimum distance between tap nodes, use the length of the dropline at the last tap node. A tap node consists of either a single tap on the TIWAY I trunk cable or a pair of taps separated by less than the minimum tap node separation distance. The minimum distance between a given tap node and the next tap node on the network is equal to one-half the length of the longer drop line at the given node.

No limit is placed upon the number of NIMs that can be daisy-chained to form a drop line off the main trunk as long as the resulting drop length is no greater than 100 feet. Figure 2-4 illustrates three typical examples of tap spacing.

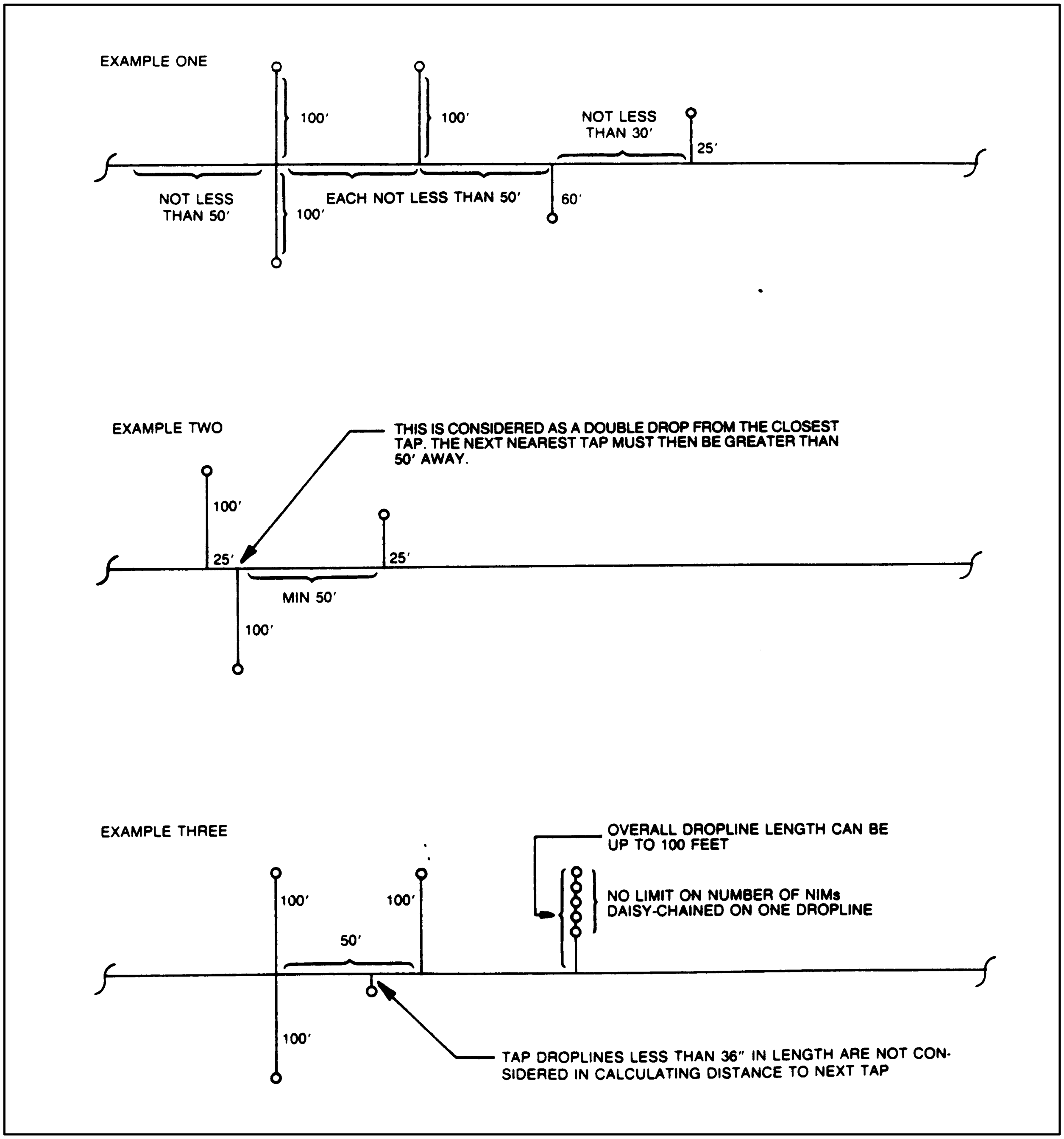

Figure 2-4 Tap Spacing Examples

Cable Routing

Cable routing should be planned as if the path between all stations on the network were free of obstructions. Next, modify the first routing to account for obstructions, then calculate the amount of cable needed.

> **⚠ CAUTION**
>
> **All local and national electrical and fire codes should be observed when installing wiring.**
>
> **Failure to observe coding requirements could result in electrical or fire hazards.**

In general, there are three types of network cabling routes:

- Under-floor
- In-ceiling
- Surface ducting

Any choice of these three routes may be used on a single network. The choice is often determined by whether the building (or buildings) in which the network is being installed is new construction, or is an existing building. The following paragraphs describe some of the advantages and disadvantages of each type of cable routing.

Under-floor Routing. For under-floor routing, the cable can be enclosed within ducts or, with raised flooring, in the "open air." Under-floor systems enclosed in ducts are usually expensive, and while they are better-protected against unauthorized taps than are "open air" systems, they often make future expansion of the network more difficult and expensive.

"Open air" under-floor cabling systems usually provide good access and allow maximum network expansion and flexibility.

In-ceiling Routing. For in-ceiling routing, network cables are usually supported in troughs or with hooks and clamps every 10 or 15 feet. In-ceiling installations provide flexibility, usually cost less, and provide easy access.

In-ceiling cable networks are not always practical. In-ceiling installations can be difficult and sometimes dangerous in areas without drop ceilings (or that have unusually high ceilings). Also, closed ceiling systems usually trap dust and other debris, which makes cable maintenance difficult.

Surface Duct Routing. Surface ducting for network cabling is usually installed along the baseboards or is attached to walls at desktop height. While surface ducting protects cables from both physical and EMI effects, it may also require that network computing devices be positioned near a wall.

Obstructions

Aside from physical obstructions such as posts, walls, and partitions, electrical interference should also be avoided.

In general, network cabling should never come into direct contact with any electrical conductor, and if cabling is installed inside a conduit, the conduit should be grounded in accordance with applicable electrical codes. Keep at least three feet between all network cabling and the following:

- Power lines carrying 440 volts or greater
- Generators
- Electric motors
- Transformers
- Electric welders
- Induction furnaces and heaters
- Rectifiers
- All sources of microwave radiation
- Fluorescent lighting
- Teletypes

2.4 Local Line Biasing

The TIWAY I Local Line is designed to operate with shielded, twisted-pair cable which has a characteristic impedance of 124 ohms. In certain network configurations, the Local Line must be biased to raise its noise immunity and to prevent oscillations of receivers connected to the line.

In all configurations, the Local Line must be properly terminated at both ends of the trunk to prevent an impedance mismatch which could result in signal reflections on the line.

The need to apply a bias voltage to the Local Line depends upon the interface configuration of your network.

Biasing Configurations

Three different Local Line media interface combinations exist, based upon the number and type of interface devices. Possible combinations are:

- Installations consisting solely of self-biased devices.
- Installations consisting of both switch-biased and self-biased devices.
- Installations with PM550 CIMs.

NOTE: This section covers self-biased and switch-biased configurations only. Appendix A discusses biasing and terminating a Local Line having all three types of devices.

Networks with only Self-biased Devices

This configuration exists when all TIWAY I Devices on the network are self-biasing (i.e., they do not have a bias switch). In this case, the position on the line of the interface devices does not matter.

Networks with a Single Switch-biased Device

This configuration exists when only one TIWAY I Device on the Local Line has the bias switch, and all other devices are self-biasing. The position of the switch-biased device on the line does not matter, but its bias switch must be ON (downward position).

Networks with Two or More Switch-biased Devices

This configuration exists when multiple switch-biased TIWAY I Devices are attached to the network, and they should be positioned as described in the following paragraphs.

If two or more devices having the bias switch are attached, place one at each end of the Local Line, and turn on each bias switch.

All other devices having a bias switch can then be placed anywhere on the network, with the bias switches turned OFF. See Figure 2-5.

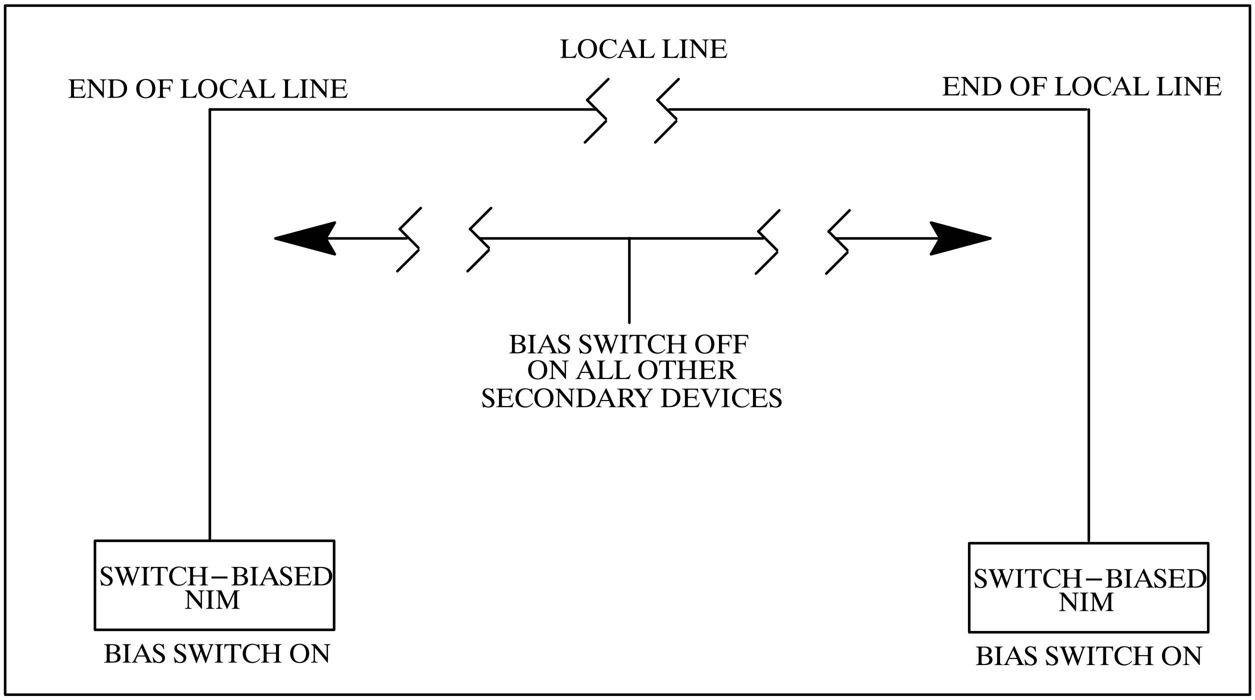

Figure 2-5 Local Line with Two or More Switch-biased NIMs

⚠ CAUTION

Excessive noise can enter the NIM if a switch-biased local line interface port is unused, for instance in a case where no redundant local line is installed.

Turn on the bias switch on the unused port to prevent the entry of noise into the NIM.

Terminating the Local Line

The Siemens Local Line must be properly terminated at both ends of the trunk to prevent a possible impedance mismatch which could result in signal reflections back along the line. Termination is required regardless of the number or type of devices attached to the network.

NOTE: In the special case of a PM550 using a CIM as its interface to the network, see Appendix A for detailed line biasing and termination instructions, which vary from those listed here.

Termination of the Local Line must be at the tap housings at the extreme ends of the network spine, and is accomplished as follows:

1. The factory-installed termination resistors in the tap housing (see Figure 2-6) are left in place in the tap housing which is to be used to terminate the Local Line.
2. If the termination resistors are used and the attached NIM has a Bias Switch, the bias switch should be moved downward to the ON position.

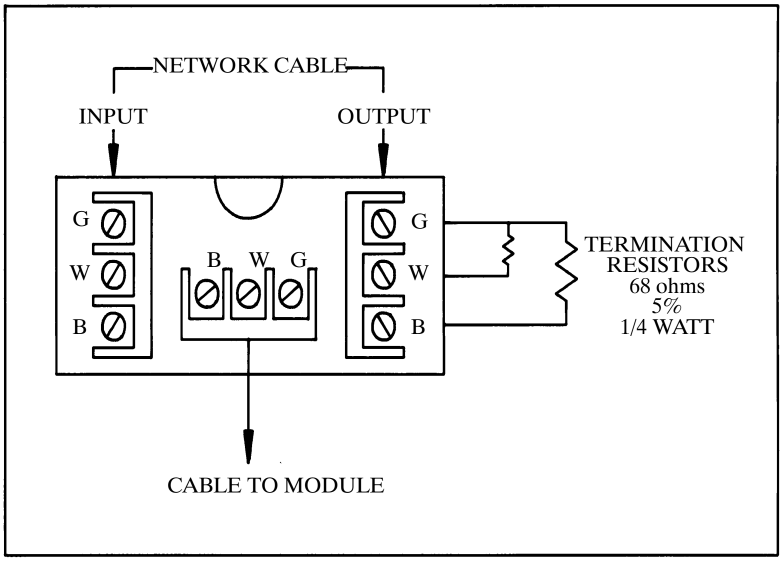

Figure 2-6 Terminating the Local Line

NOTE: All Siemens tap housings contain factory-installed terminating resistors. If the Tap Housing is not used to terminate the Local Line, the terminating resistors must be removed when the output cable is attached.

Chapter 3

Installation

3.1 General Requirements

The following requirements must be met in order to install and use a Series 500 NIM:

1. The appropriate NIM configuration should be selected.
    - 500–5039 (LOCAL LINE/LOCAL LINE)
    - 500–5040 (RS-232-C/RS-232-C)
2. The programmable controller in which the Series 500 NIM is to be installed must be a model 520, 520C, 530, 530C, 560 or 565 with an I/O base. For full NIM capabilities, the controller software release level should be greater than (or equal to) the releases in the following list.

SIMATIC 520	Release 2.1
SIMATIC 530	Release 2.0
SIMATIC 520/530C	Release 2.6
SIMATIC 560/65	Release 1.1 (For the 565, you must have a NIM with software Release 2.1 or greater. Release 3.0 NIM software is required for program transfer operations with the 560 and 565.)

    If you cannot determine whether your controller release is compatible with the Series 500 NIM, contact Siemens technical services at (423) 461–2501 for assistance.
3. The communication configurations of all devices attached to the network must match; i.e., they should each have the same data rate, encoding, etc.

NOTE: After you reconfigure the memory size of a 560/565 controller, the Series 500 NIM must be reset.

3.2 Installing the NIM

This section describes how to mount the NIM in the Series 500 I/O base, connect the communication cables to the NIM, and initialize the system for operation. The programmable controller (P/C) and the programming device should be in place before you install a NIM.

Before inserting the NIM into the I/O base, first determine which two adjacent slots that the NIM will occupy. If necessary, it is possible to place the NIM in the left end slot, although it will extend beyond the edge of the I/O base.

⚠ WARNING

Do not insert or remove the NIM while power is applied to the base, since doing this may cause personal injury, alter controller memory, cause a controller fatal error, or damage the module.

Until you disconnect power to the I/O base, hazardous voltages are present. Inserting or removing the NIM before disconnecting power to the base could cause death or serious injury to personnel, and/or damage to equipment; it could also alter CPU memory, cause a CPU fatal error, or damage the NIM.

Do not insert or remove the NIM while power is applied to the base.

Complete the following steps to install the NIM.

1. Disconnect power to the I/O base.
2. Insert the module into the two adjacent I/O base slots you have chosen.
3. Set the configuration dipswitches.
4. Power up the I/O base.
5. Check the NIM indicator lights to be sure the module is operating correctly.
6. Use a programming device to verify that the NIM is logged into the controller.
7. Connect the network cables to the NIM.

The following paragraphs provide detailed information for each step.

3.3 Inserting the Module into the Base

Before using the module, you should decide whether you want to protect it by “keying” the module’s position in the I/O base. As shown in Figure 3-1, keying is accomplished by placing the three keys provided in the right-hand slot of the two slots occupied by the module so that they fit into the notches on the module edge card. This prevents another I/O module from being mistakenly inserted into the slots reserved for a communication module.

⚠ WARNING

Do not insert or remove the NIM (or keys) while power is applied to the base, since doing this may cause personal injury, alter controller memory, cause a controller fatal error, or damage the module.

Until you disconnect power to the I/O base, hazardous voltages are present. Inserting or removing the NIM before disconnecting power to the base could cause death or serious injury to personnel, and/or damage to equipment; it could also alter CPU memory, cause a CPU fatal error, or damage the NIM.

Do not insert or remove the NIM while power is applied to the base.

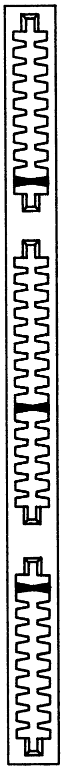

Figure 3-1 Keying the Series 500 NIM

Once the keys are in place, orient the module so that the indicators are on the top half of the module. Then, carefully push the module into the I/O base as shown in Figure 3-2. When the module is fully seated in the I/O base, tabs will hold the module in place. To remove the module, pull the tabs away from the module and take it out of the I/O base, being careful not to damage the edgecard.

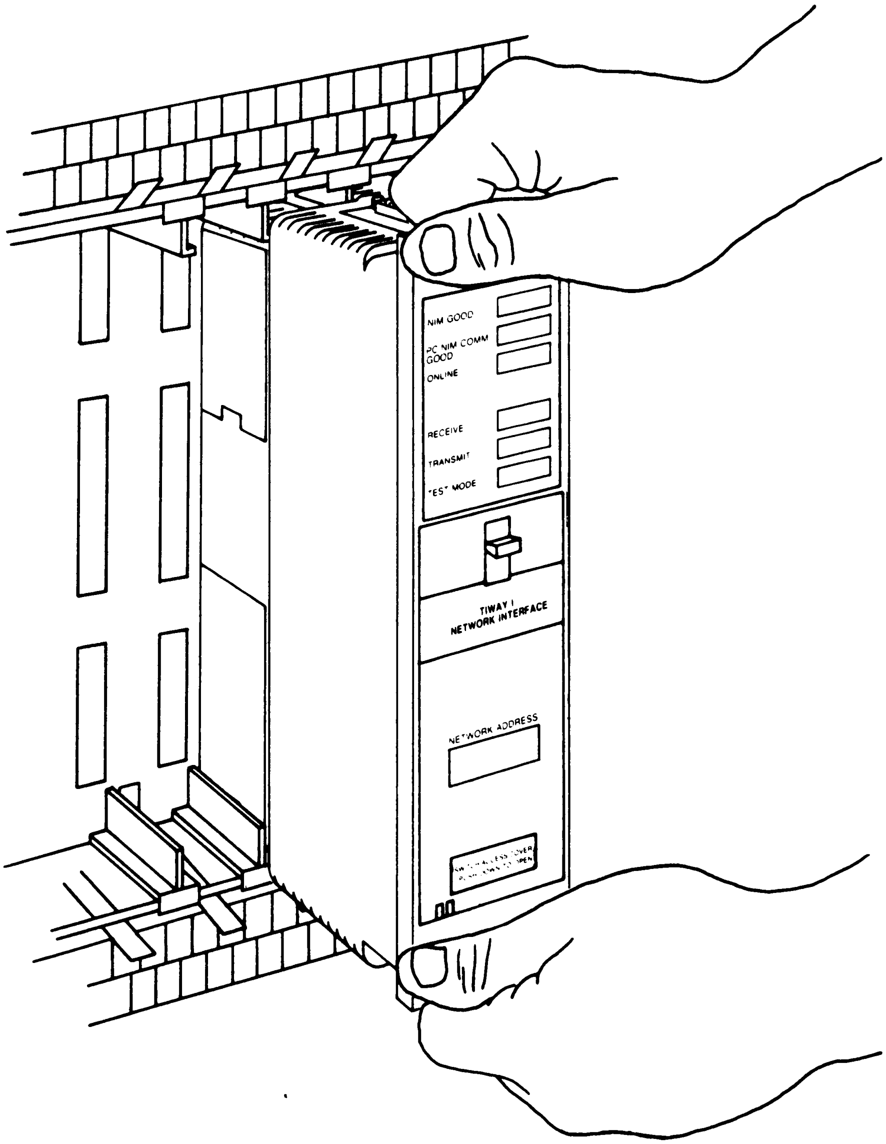

Figure 3-2 Installing the NIM in the I/O Base

3.4 Setting the Dipswitches

As Figure 3-3 illustrates, there are two blocks of dipswitches on the Series 500 NIM. The lower block of eight switches is used to select the NIM's address on the network. The upper block of ten switches is used to configure the network communication parameters. Note that the switches are numbered from bottom to top. When setting up your NIM, use the configuration data sheet in Appendix C of this manual to record important configuration information.

NOTE: The configuration and address switch settings are read only once following a power-up or reset. Be sure to reset the NIM following any change in dipswitch settings or controller memory reconfiguration.

Selecting the Network Address

Each NIM on a TIWAY I Network must have a unique address. The range of valid addresses is 1 to 254 (0000 0001 to 1111 1110 on switches 1–8 of the lower switch block). Selecting addresses 0 or 255 (0000 0000 or 1111 1111) on the address select switches will cause the NIM to initialize in a test mode, and the NIM will fail to operate properly. See Table 3-1 for address values (bit weight) of each switch and Table 3-2 for addressing examples.

Table 3-1 Network Address Selection

		Open	Closed
LSB	SW8	1	0
	SW7	2	0
	SW6	4	0
	SW5	8	0
	SW4	16	0
	SW3	32	0
	SW2	64	0
MSB	SW1	128	0

Table 3-2 Address Examples

	1	25	203
SW8	Open	Open	Open
SW7	Closed	Closed	Open
SW6	Closed	Closed	Closed
SW5	Closed	Open	Open
SW4	Closed	Open	Closed
SW3	Closed	Closed	Closed
SW2	Closed	Closed	Open
SW1	Closed	Closed	Open

Selecting Network Configuration Parameters

The upper block of ten dipswitches is used in selecting the parameters that define the network communication environment. There are two physical media types over which TIWAY I communication can occur: Siemens Local Line and RS-232-C. Several dipswitches on the configuration switch block are ignored when operating on the Local Line media. These switches are noted in the following descriptions.

Setting the Dipswitches (continued)

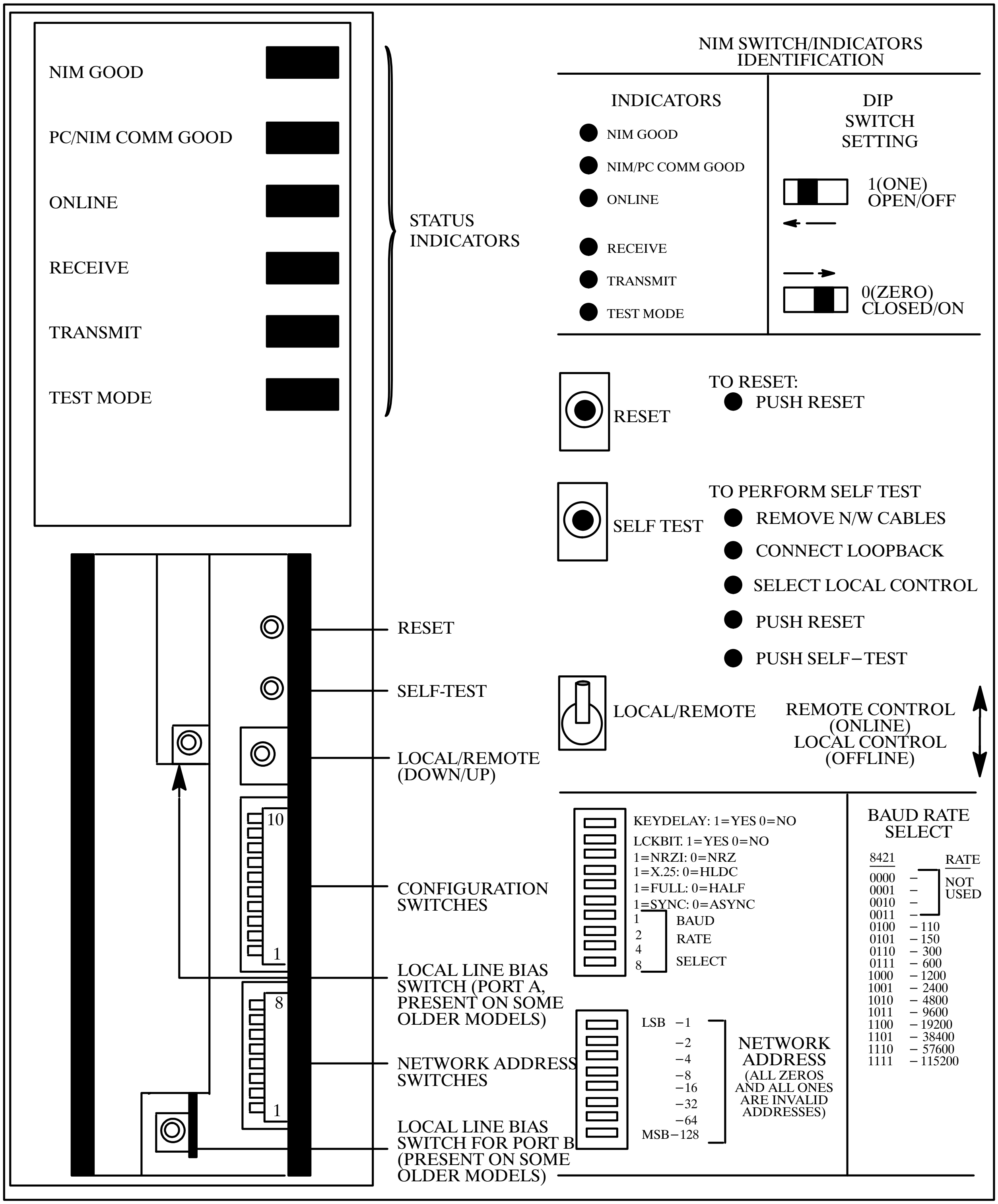

Figure 3-3 NIM Switches and LEDs

Configuration switches 1 through 4 (on the configuration switch bank) select the data transmission rate. All devices on the network must be configured to communicate at the same data rate. The data rates corresponding to the switch settings are shown in Table 3-3.

For synchronous operation in RS-232-C communication, the rate of data transmission is established by the modem. When setting switches one through four, select a data rate which matches that of the modem exactly. If this is not possible, select the next lower data rate below that of the modems. Time-out values are determined by dipswitch settings, and improper settings may cause erratic operation.

Synchronous operation is not valid for local line operation.

Table 3-3 Network Data Rate Switch Settings

Switch Settings				**Data Rate (BPS)**
SW1	**SW2**	**SW3**	**SW4**	
0	0	0	0	110
0	0	0	1	110
0	0	1	0	110
0	0	1	1	110
0	1	0	0	110
0	1	0	1	150
0	1	1	0	300
0	1	1	1	600
1	0	0	0	1200
1	0	0	1	2400
1	0	1	0	4800
1	0	1	1	9600
1	1	0	0	19,200
1	1	0	1	38,400
1	1	1	0	57,600
1	1	1	1	115,200
0 – closed = on 1 – open = off				

Synchronous/Asynchronous Selection. Configuration switch 5 selects synchronous or asynchronous operation for modems. For synchronous modem communication, the NIM receives the transmit and receive timing signals from the modem via transmit signal timing element (DB), and receive signal timing element (DD). If the modem data rate does not match a TIWAY data rate exactly, the data rate select switches should be set to a rate that is the next lower data rate from the modem For example, if a 56,000 bps synchronous modem is used, a data rate of 38,400 bps should be selected on the NIM.

For asynchronous operation, the transmit and receive timing elements are generated within the NIM. When using the local line medium, this switch must be in the asynchronous position (to the right, closed, indicates asynchronous, to the left, open, is synchronous.)

Full/Half Duplex. Configuration switch 6 selects full or half duplex operation when communicating over an RS-232-C data link. When half duplex is selected (switch 6 = 0, closed, or to the right) the NIM waits for the data carrier detect (DCD) control signal from the modem to go inactive before activating the request to send (RTS) control signal. If full duplex operation is selected, the timing relationship between DCD and RTS will be ignored. When the local line communication media is used, this switch is ignored since no externally supplied communication control signals are supplied.

X.25/HDLC. Configuration switch 7 selects the communication protocol. The HDLC protocol is activated when the switch is set to 0. The X.25 protocol is only activated when this switch is set to 1. The X.25 protocol is not used with the TIWAY I or UNILINK Host Adapter, although it is an option when communicating with any host supporting this protocol. For a more detailed description of these protocols, see the *SIMATIC TIWAY I Systems Manual* (TIWAY–8101).

NRZ/NRZI. Configuration switch 8 selects the method of data encoding used on the physical communication medium. The NRZI method of data encoding provides a mechanism for the proper decoding of received data in an asynchronous communication environment. In fact, NRZ encoding will not work satisfactorily except in the case of synchronous RS-232-C communication. When using Local Line, or asynchronous RS-232-C , NRZI encoding must be used. Either type of encoding may be used with synchronous RS-232-C communication.

Lockout/Enable. Configuration switch 9 enables the P/C to “lockout” the NIM during time-critical operations. This function is not needed normally. During lockout, the NIM will not communicate with the P/C. The actual mechanism is as follows:

1. The P/C “sees” the NIM as an 8 channel discrete output module on the I/O portion of the scan.
2. If the P/C is to “lockout” the NIM during a time critical scan, it can set the image register address that corresponds to the 8th output of the module. If switch 9 of the NIM is set to one (to the left with module installed) the NIM will not communicate with the P/C as long as the 8th output is turned on. To compute the address (A) of the lockout bit within the P/C’s I/O range, use the following equation:

   A ={64 * (B – 1) + [(S – 1) *8]+ 8}

   where: B — base number – 8 module base (1 based, no base #0)
   S — I/O module slot number in base (1 based, no slot #0)

NOTE: This is not necessarily true for 520C and 530C controllers with high density I/O configurations. Consult 520C/530C Hardware Reference Guide (530–8108) for additional information on high density I/O configurations.

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3. In your Relay Ladder Logic (RLL) program, re-enable NIM to controller communication by turning the output off after the controller is able to resume communication with the NIM.

Transmit Delay or Key Delay. Configuration switch 10 provides a delay of 500 msec following the receipt of Clear to Send (CTS) from a modem. This delay may be required in radio modem installations to permit the transmitter to reach full power before transmitting data. This delay is activated when the key delay switch is set to 1 (positioned to the left).

Other Switches

There are three switches which are located above the Dipswitch banks and are labeled “Reset” “Self Test” and “Local/Remote”. (Also, some older NIMs have Local Line bias select switches.) Their functions are described in the following paragraphs.

Reset. This switch is a momentary contact switch which initializes the NIM and initiates the power-up self-test. This switch causes all indicators to be on for approximately 1 second. Then all indicators, with the exception of the TEST indicator, are extinguished for approximately 5 seconds. During this time, the NIM runs a series of diagnostic tests to verify the hardware components of the NIM.

Setting the Dipswitches (continued)

A successful completion of these tests will leave only the NIM GOOD and PC/NIM COMM GOOD indicators on. If the TEST LED remains on, run the User Initiated Self-Test to determine the source of the error.

The reset switch should always be pressed after you change the configuration or address selection dipswitches. If a 560/565 is connected to the NIM, you should reset the NIM whenever you reconfigure the controller. This can be done by pressing the NIM reset switch, or by sending a Secondary Disconnect command from the host (which causes a reset to occur), followed by a Secondary Connect command.

Test. This switch will cause a series of user initiated diagnostic tests to be executed IF the local/remote switch is in the local position. It is important to remember to disconnect all communication cables and to install loopback connectors on any RS-232-C communication ports before running these diagnostics.

Local/Remote. When set to remote, this two-position switch enables the NIM to perform write operations to controller memory. In the local position, the NIM cannot write to the controller. In either position, the NIM can monitor P/C memory and mode of operation. The Local Mode will be indicated (after the NIM is brought into the online state) by a flashing Online LED indicator. The Remote Mode will be indicated by a continuously illuminated online indicator.

Local Line Bias. For earlier NIMs supplied with Local Line media interfaces, a toggle switch is provided which allows selection of bias or no bias for the Local Line. This switch places a 100 millivolt potential between each of the two active conductors in the cable. The Local Line must be biased to prevent undesired oscillations at the receivers connected to the line. Bias should be applied only by two units (one at each end of the cable) in the network.

3.5 Series 500 NIM Self Tests

The three levels of Series 500 NIM self tests available in the NIM are described in the following paragraphs. They are:

- Power-Up Self-Test
- Run-Time Self-Test
- User-Initiated Self-Test

Power-up Self-Test

The Series 500 executes a Power Up Self-Test in the following cases:

- Immediately following the application of +5VDC from the I/O base (power-up) as part of its initialization
- Any time the Reset switch is pressed (See Figure 3-3)
- Following a Disconnect Secondary command from the host

The Power-Up Self-Test exercises the processor, performs a test of on-board RAM and ROM, and performs an internal loopback test of the communication ports. At the start of execution, all NIM indicators (LEDs) are turned on for approximately 1 second, then all except the Test Mode indicator are turned off for approximately 5 seconds.

If the Power-Up Self-Test is successful, the NIM GOOD LED will be on, and an attempt to establish communication with a Series 500 controller will be made. If this is successful, the PC/NIM COMM GOOD LED will illuminate and the NIM is ready for normal network operation.

Failure of the Power-Up Self-Test will cause the Test Mode LED to remain on, and the NIM will not respond to any commmunications attempts.

If the Series 500 controller does not respond, the PC/NIM COMM GOOD LED will remain extinguished, and the NIM will issue an Exception Response with Error Code 1A (communication not established with attached device) to any host computer initiating a controller interactive command to this NIM.

Run-Time Self-Test

The Series 500 NIM monitors itself continuously during normal operation, as follows:

- The Operating System continuously performs a ROM integrity test as a background operation.
- The NIM periodically verifies that it is capable of communicating with the Series 500 Sequencer.
- A Watchdog Timer circuit in the NIM helps to guard against software lockup.

Failures detected in the ROM integrity test will cause the NIM GOOD LED to extinguish, and force the NIM into a failed state. In this condition the NIM goes to the Logically Disconnected State (LDS) and will always issue a Disconnect Mode (DM) response to any commands received.

Once the NIM has reached the Normal Operating Mode and fails to communicate with the controller, it reports this to the host computer with an Exception Response. Error Code 0A (attached device failed to respond) will be sent, and the PC/NIM COMM GOOD LED will be extinguished. If communication is re-established, the NIM will return to Normal Mode and the PC/NIM COMM GOOD LED will illuminate.

The Watchdog Timer circuit provides an extra measure of protection against network lockup due to a failed NIM. This circuit will force a Reset if a failure occurs that prevents the operating software from executing normally. All indicators on the NIM will be extinguished, and the NIM will not respond to any network commands.

The communication boards include a “jabberstop circuit” which will disable the transmitter after 4096 state transitions on the line. This prevents a network lockup should the NIM fail.

User-Initiated Self-Test

The User-Initiated Self-Test performs a complete test of the NIM hardware, including the communication ports. Test execution is detailed in the following paragraphs.

⚠ CAUTION

Since this test includes the communication ports, be sure to disconnect the NIM from the TIWAY I network.

Failure to disconnect the NIM from the TIWAY I network could cause unpredictable process operation during the user-initiated self-test.

1. Disconnect network cables from both network ports of the NIM.
2. Install loopback connectors on the RS-232-C port(s) of the NIM.
3. Make certain the Local/Remote switch is in the “Local” position.
4. Press the reset switch.
5. Press the self-test switch.

Start of execution of the User-Initiated Self-Test will be signaled by the illumination of the Test Mode LED, with all other LED indicators being extinguished. Then, after approximately ten seconds, all LED indicators will flash on and off for approximately two seconds. On completion of the test, the Test LED will flash at a 2 HZ rate.

A PASS condition will be indicated by the following LED indicators illuminating:

1. NIM GOOD
2. PC/NIM COMM GOOD
3. RECEIVE
4. TRANSMIT
5. TEST (flashing)

FAILURE conditions will be indicated by the following:

1. If the NIM GOOD LED indicator is extinguished, then a failure was detected which is internal to the NIM.
2. If the PC/NIM COMM GOOD LED indicator is extinguished, then a problem was found in attempting to communicate with a Series 500 controller.
3. If the RECEIVE LED indicator is extinguished, a failure was detected on the top network port (Port A). This could be due to:
    - A bad media interface
    - A missing loopback connector (RS-232-C ports only)
4. If the TRANSMIT LED indicator is extinguished, a failure was detected on the bottom port (Port B). This could also be due to:
    - A bad media interface
    - A missing loopback connector (RS-232-C ports only)

Following successful execution of the Self-Test, the network cable(s) should be connected to the NIM, the NIM Reset button should be pressed and the local/remote switch should be returned to the correct setting (for your situation). This will reinitialize the NIM, and it will return to normal operation.

3.6 Module Login Verification

After the NIM has been installed and configured, you should verify that the NIM is logged into the controller I/O map. This is the first thing you should do if the PC/NIM Comm Good LED is not on.

Connect a programming device to the controller to verify controller-module communication.

To do this in a 520/530 P/C system with a VPU200–3102, enter AUX 43, which checks all I/O points on a particular base. If you have a 520/530 system with a VPU200–3104, press F3 and use the CONFIO function.

If you have a 520/530C or 560/65 controller system with a VPU200–3104, press F3 for the CONFIO function, then F2 for SHOW, and then F5 for READ BASE. This sequence allows you to check all I/O points on the base that the NIM is installed in.

Once you have entered the appropriate command, the controller will respond with a chart listing all slots on the base and the inputs or outputs associated with each slot. If a row on the chart is blank, then the corresponding base slot does not contain a module.

To verify the installation, look in the chart for the slot number corresponding to the right-most slot of the two slots occupied by the module. If an “S” or “SF” (special function) and word memory locations appear on this line, the module is registered in the controller memory and you can proceed with the usual operations. If the line is blank or erroneous, you should check the NIM to be sure it is firmly seated in the slots and enter the appropriate command again. If you still cannot verify the installation, you should contact your local distributor or the Siemens Technical Services Group at 423–461–2501 for further assistance.

3.7 Connecting the Network Cables

Network cabling should already be in place before NIM installation is begun. If you need information concerning network cabling, see the *SIMATIC TIWAY I Systems Manual* (TIWAY–8101).

There are two communication ports on the Series 500 NIM, one on the top of the module (Port A) and one on the bottom (Port B). Depending on the model you have, these ports accept either an RS-232-C or Local Line connection. Plug the network interface cables into one of these two ports. For media redundancy, both ports are used.

Chapter 4

NIM Primitives

4.1 TIWAY I Primitives

Primitives are high-level commands that allow a user to access like data types in all different Secondaries in the same manner. For example, a Primary can access image register memory in a NIM-equipped 520, 530, 5TI, and PM550 controller with the same command. The purpose of the Primitives is to remove as many differences as possible between the controllers, so that applications programs at the Primary level may treat all TIWAY I Secondaries in the same manner.

Primitives provide the following benefits.

- Primitives reduce the amount of host computer software needed to acquire data from the Secondaries.
- Primitives provide a standard communication protocol that allow you to communicate with different types of secondaries and attached devices without custom software routines.
- Primitives allow more efficient use of the available network bandwidth by increasing the amount of data that is available in a single message. For example, with a single programming peripheral Task Code, you might be able to access no more than 15 words of data. With some Primitives, up to 134 words can be accessed.
- Primitives reduce total system loading. This is possible because the NIMs can memorize data locations that are repeatedly accessed. Block and Record Gather Primitives make it possible to access a block of data previously defined and stored in the NIM.

4.2 Primitive Functions

Primitives serve as the command structure that a TIWAY I Primary uses to access (read or write) information in a TIWAY I Secondary. The Primitives defined in the following paragraphs serve these basic functional needs:

- To access and retrieve data
- To ascertain the status and configuration of attached devices
- To perform control operations on the attached device

4.3 Primitive Structure and Operation

A Primitive consists of multiple fields that specify the Primitive's length and function, type and location of data to be accessed, and data to be transferred. In TIWAY I, a Primitive forms the information field of an HDLC Information frame (I) or Unnumbered Information frame (UI) if HDLC operation is selected. If X.25 operation is selected, the Primitive is contained in the User Data field of an X.25 Data Packet.

⚠ WARNING

When you write to memory, you may be directly affecting the process which is under control by the programmable controller.

Unexpected alterations to process operation could cause death or serious injury to personnel and/or damage to equipment.

Before you make changes in memory, be certain that the changes which result in the controlled process will not endanger any personnel or equipment.

Figure 4-1 illustrates the basic Primitive structure when HDLC operation is selected. There is a Request Format and a Response Format, as shown. The binary weight of the fields is detailed in Figure 4-2. All field lengths are multiples of 8 bits, which allows for octet testing of data link frames at the data link/media access control layer.

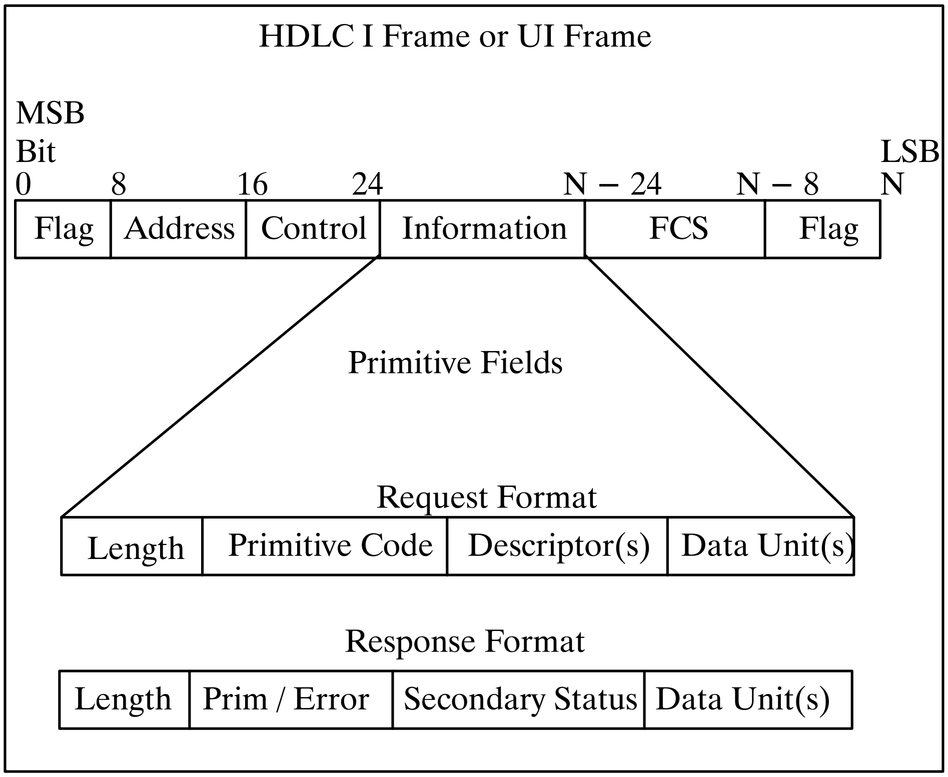


Figure 4-1 Basic Primitive Structure

The maximum length of the Information field is 273 bytes for the Series 500 NIM. In the Request format, the 273 bytes include the Length, Primitive code, Descriptor, and Data Unit fields. In the Response format, the 273 bytes include the Length, Primitive Code/Error, Secondary Status, and Data Unit fields. In both formats, the 273 bytes exclude the protocol control fields. Other devices connected to TIWAY I may support Information Field lengths in excess of 273 bytes. The actual length support is dependent on device type and must be ascertained with the Format Configuration Primitive 04.

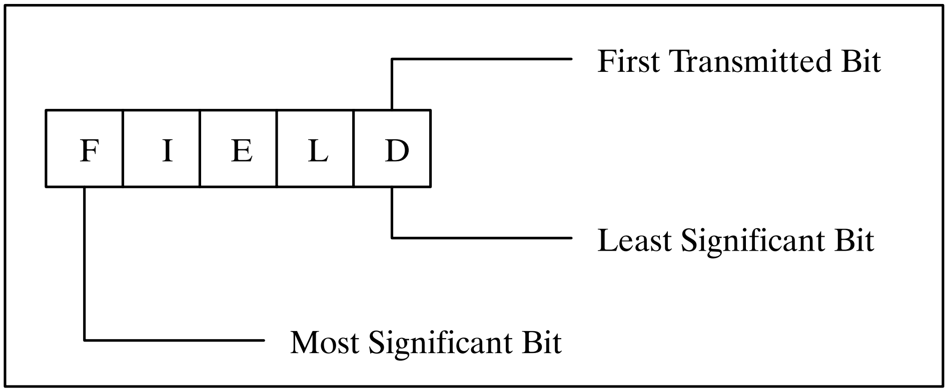


Figure 4-2 Binary Weight of the Fields

Primitive Operation and Exceptions

Normal Primitive operation consists of a request and response sequence without exceptions. Exceptions are errors found in the interpretation or execution of a Primitive.

Normal Operation Procedures

The normal operation of a Primitive is for the initiating (Host) station to form a request Primitive and address it to a Secondary on the network. If the request Primitive contains allowable data element types and data element location ranges, a legal Primitive Code for the specific device–type addressed, and the correct Length Field value, then the device addressed will return a response Primitive of the proper format.

Exception Procedures

An exception procedure is used when the addressed device finds fault with:

- The value of the Length field
- A Primitive format
- A data element type
- The execution of a Primitive

If a fault is found with the Length field, Primitive format, data element type or in the execution of the Primitive, the exception reason is returned with the Exception Primitive, which is Primitive Code 00. The procedure taken depends on the Primitive used. There are two classes of procedures used for handling exceptions:

1. Procedures which are associated with reading data elements
2. Procedures which are associated with writing data elements

Exception when Reading. The device performing the Primitive operation aborts execution of a Primitive when an exception condition is encountered, and returns the reason for the exception. The device requesting the Primitive should evaluate returned message, take appropriate corrective measures, and attempt retransmission of the Primitive.

Exceptions when Writing. Exceptions concerning Primitive format, contents, or device state when writing will abort the entire Primitive. Some exceptions indicate an error during execution of the Primitive. In this case, the data elements specified in the Primitive may or may not have been modified. Therefore, when the exception condition is returned to the sender, all data element locations specified by the failed Primitive should be re-written. The station sending the Primitive should examine the exception reason, take appropriate corrective measures, and try to send the Primitive again.

Program Transfer Procedures

The data needed to archive or restore the operating environment of a device will vary from one device to the next. Relevant data may be Relay Ladder Logic (RLL) programs and associated configuration parameters, controller process control loop information, or a machine configuration list from a UNILINK Secondary Adapter. To release the network host from having to record the various and diverse data types associated with this information, the program upload/download concept was developed. The program upload/download Primitives allow the network host to archive or restore operating environments from different types of network secondaries in a standard (or generic) fashion.

To keep the transfer as device independent as possible, several unique procedures have been defined to allow easier resource management:

- Initialize Upload/Initialize Download — places the attached device (controller, robot, CNC machine, etc.) in a safe, non-operational state, and defines the types of data to be uploaded or downloaded.
- Transfer Upload/Download data — transfers all operating environment data. These transport utilities are managed in a sequential manner to ensure proper sequencing of data frames.
- Terminate Upload/Download — terminates all program upload/download activity and returns the attached device to its original operating condition (if possible).

Four Primitives have been developed to complete the above tasks. Primitive 07 allows you to query the attached device for the type of program segments it contains. Primitives 58 and 59 provide data upload and download capability. Primitive 06 allows you to terminate the program transfer and return the attached device to its previous state.

Primitive Structure and Operation (continued)

The upload and download formats will always be identical, i.e., data that is received from an upload request will be sent unmodified (in the same order and format) to the attached device during download.

You cannot write data or change the attached device operating mode during an upload or download request; however, you can continue to read data. If an attempt is made to write data or change the operating mode, an exception code will be returned. Also, you cannot initiate another upload or download request until the previous request is complete. The native and packed native Primitives are not allowed in upload or download mode if they contain a write command.

Program transfer procedures are slightly different from normal operations in that the NIM and the controller must change operating states to participate in the data transfer. Program upload and download are mutually exclusive and cannot occur simultaneously. Only one generic load operation may be executed at any given time.

4.4 Primitive Logical Groups

All Siemens TIWAY Primitives fall into logical groups according to their function, as shown in Table 4-1. Each Primitive has a request and a response format. The device initiating the transaction formats a request Primitive, and the device answering the request formats a response Primitive. The TIWAY I Primitive subset is taken from the categories listed in Table 4-1.

Table 4-1 Logical Primitive Assignment

Function	**Primitive Code (HEX)**	
	16-Bit Addressing	**Extended Addressing**
Exception and Status	00 — 0F	80 — 8F
Control	10 — 1F	90 — 9F
Read	20 — 2F	A0 — AF
Write	30 — 3F	B0 — BF
Program Modification Aids	40 — 4F	C0 — CF
Data Acquisition Primitives	50 — 6F	D0 —EF
Undefined	70 — 7E	F0 — FE
Expansion	7F	FF

Series 500 NIM Primitive Subset

The subset of TIWAY I Primitives supported by the Series 500 NIM is given in Table 4-2. Future additions to this subset will be announced as they are implemented. Note that each of the following Primitives fits into the general categories listed in Table 4-1.

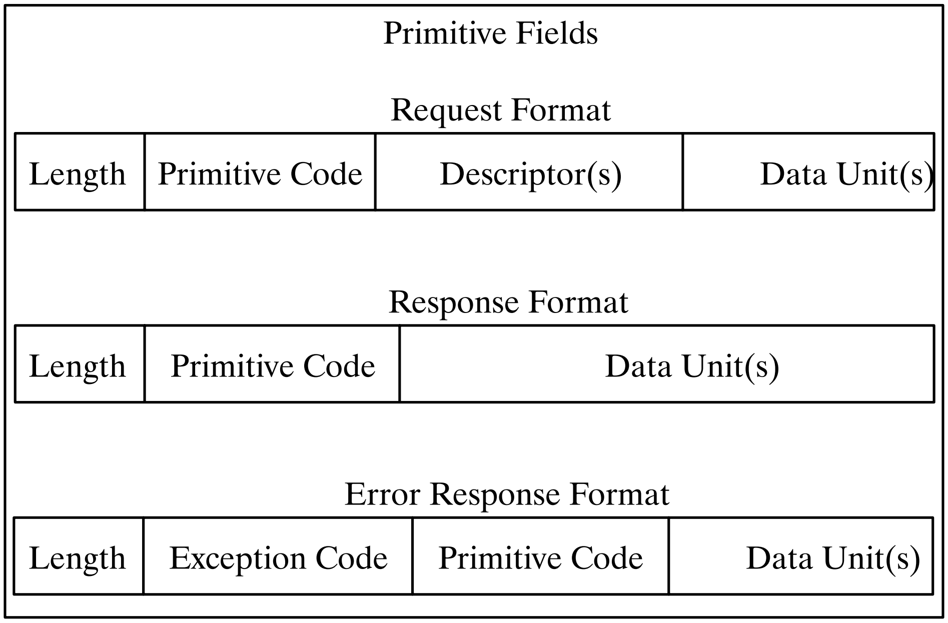
Table 4-2 Series 500 NIM Primitive Subset

Primitive Code (HEX)		Type
Non-extended Address	Extended Address	
00	80	Exception reporting
01	81	Native
02	82	Attached device status
03	83	Attached device type/confirmation
04	84	Primitive format configuration
05	85	Packed native
06	86	Reset secondary device mode
07	87	Segment definition
10	90	Change state
20	A0	Read block (single contiguous block)
21	A1	Read random block
30	B0	Write block (single contiguous block)
31	B1	Write random block
50	D0	Define blocks (up to 32 separate blocks)
51	D1	Gather defined blocks
52	D2	Write and gather defined blocks
55	D5	Define records (up to 32 records)
56	D6	Gather defined records
57	D7	Write and gather defined records
58	D8	Program upload
59	D9	Program download

You can use extended addresses by adding 80hex to the non-extended address primitive. With extended addresses, the AAAA field is expanded from sixteen bits to 32 bits (AAAAAAAA). This allows you to access data element locations beyond the non–extended limit of 65,535. With extended addresses, you can access up to 4,294,967,296 locations.

4.5 Primitive Field Definitions

The basic Primitive Request and Response field formats are shown in Figure 4-3. Each of the basic field types shown is described in the following paragraphs. For a detailed explanation of TIWAY Primitives refer to the *SIMATIC TIWAY I Systems Manual* (PPX:TIWAY–8101).



Primitive Fields

Request Format

Length	Primitive Code	Descriptor(s)	Data Unit(s)

Response Format

Length	Primitive Code	Data Unit(s)

Error Response Format

Length	Exception Code	Primitive Code	Data Unit(s)

Figure 4-3 Primitive Request and Response Field Format

Primitive Field Definitions (continued)

Primitive Field Symbols

The symbols used in the remainder of this section to denote the different types of Primitive fields are summarized in Table 4-3.

Table 4-3 Summary of Primitive Field Symbols

Symbol	Description
LLLL	Length field
PP	Primitive code
HH	Attached device status
TT	Data element types
NNNN	Number of data elements
AAAA or AAAA AAAA	Data element location
DDDD	Data unit(s)
XX	Number of user-derfined structures requested
CC	User-defined structure number
EEEE EEEE	User-defined structure mask
YYYY	Application sequence count
RRRR	Host reference number
MMMM	Attached device data segment definition
OOOO	Attached device time-out value

Length Field – LLLL

The Length Field (refer to Figure 4-3) is a 16-bit field that represents the length (in bytes) of the Primitive, Descriptor(s), and Data Unit field(s). The Length Field is initialized by the Primary in transmissions to the NIM. It is also initialized by the NIM in transmissions to the Primary. (Example: the Length Field for a Primitive 02 request would have a value of 1.)

Primitive Code Field – PP

The Primitive Code Field (see Figure 4-3) is eight bits long, which allows for 256 unique Primitives. The most significant bit of the primitive field code is used to designate that the extended addressing mode is in effect. In this mode, the data element location descriptor is a 32-bit field rather than the 16-bit field associated with non-extended addressing.

The Series 500 NIM currently supports a subset of the Primitives: 00, 01, 02, 03, 04, 05, 06, 07, 10, 20, 21, 30, 31, 50, 51, 52, 55, 56, 57, 58, and 59. The corresponding extended addressing codes are: 80, 81, 82, 83, 84, 85, 86, 87, 90, A0, A1, B0, B1, D0, D1, D2, D5, D6, D7, D8, and D9 (all values in hexadecimal). These Primitive Codes are described in detail later in this chapter.

Attached Device Status – HH

The attached device status is updated by the NIM every four seconds. The most recent attached device status is returned in most primitives.

Descriptor Field

Within the Descriptor Field (see Figure 4-3) are different fields to define the following: data element types, location or address of a data element, number of data elements to access, and the status of the attached device. The Descriptor Field may contain a single descriptor or multiple descriptors as required by the various Primitives.

Data Element Types — The length of the data element type descriptor field is eight bits. This field, labelled "TT", is a code that corresponds to the different types of data found in the attached device. See Table 4-4 for a list of data element types.

Current Status of Attached Device — Current status is designated by "HH".

Number of Data Elements to access — This 16-bit field is designated by "NNNN". A value of one is interpreted as one location to be accessed. The length of a location is determined by the data element type. The number of locations requested should not exceed the maximum allowed for that device type (see Table 4-4 and Table 4-5).

Data Element Location — Data element types are accessed by a location number, designated by "AAAA" or "AAAA AAAA". In the Series 500 NIM, the location descriptor is a 16-bit value (32 bits if extended addressing is used in the primitive code field). The allowable values for the location number are shown in Table 4-5.

The format of the AAAA field changes for these TT types are:

(1) TT Type 12 (Drum Count Preset) The format is:

AAAA = DD SS, AAAA AAAA = DDDD SSSS (extended addressing)

where DD = Drum Number
SS = Step Number (1 – 10_{16})

(2) TT types (36–3B, 76–7A) (Ramp Soak) The format is:

AAAA = LL SS or AAAA AAAA = LLLL LL SS (extended addressing)

where LL = Loop Number (1 – 40_{16})
SS = Step Number (0 – FF_{16})

Basic Data Unit – DDDD

The definition of the Basic Data Unit Field is dependent upon the data element type specified in both the Descriptor Field and the Primitive format definition. The Basic Data Unit is designated "DDDD" or "DD" in this manual.

4.6 Data Element Types and Formats

The data element types (TTs) and their length (in bytes) are defined in Table 4-4. Figure 4-4 through Figure 4-15 show the format of the data elements.

Table 4-4 Data Element Types and Formats

TT	Data Element Type	Length (in bytes)
0	Instruction Memory (L)	2
1	Variable Memory (V)	2
2	Constant Memory (K)	2
3	Discrete Input (X)	1
4	Discrete Output (Y)	1
5	Control Register (CR)	1
6	Discrete Input Packed (X)	1
7	Discrete Output Packed (Y)	1
8	Control Register Packed (CR)	1
9	Word Input (WX)	2
A	Word Output (WY)	2
B	XY Force	1
C	CR Force	1
D	Word Force	3
E	Timer-Counter Preset (TCP)	2
F	Timer-Counter Current (TCC)	2
10	Drum Step Preset (DSP)	1
11	Drum Step Current (DSC)	1
12	Drum Count Preset (DCP)	2
17	Secondary System Status*	4
** 20 or 60	Loop Gain	4
** 21 or 61	Loop Reset	4
** 22 or 62	Loop Rate	4
** 23 or 63	Loop High Alarm	4
** 24 or 64	Loop Low Alarm	4
** 25 or 65	Loop Process Variable	4

* These TT types are read-only data elements.
\# This TT type is a write-only data element.
** Format
2x, 3x, and 4x = IBM format
6x, 7x, and 8x = IEEE format

Table 4-4 Basic Data Unit Format (continued)

TT	Data Element Type	Length (in bytes)
** 26 or 66	Loop Process Variable High Limit	4
** 27 or 77	Loop Process Variable Low Limit	4
** 28 or 78	Loop Orange Deviation Alarm	4
** 29 or 79	Loop Yellow Deviation Alarm	4
** 2A or 6A	Loop Sample Rate	4
** 2B or 6B	Loop Remote Setpoint	4
** 2C or 6C	Loop Output	4
2D	Loop Status*	2
2E	Loop Control Flags	4
2F	Ramp/Soak Status*	2
**30 or 70	Loop Error*	4
**31 or 71	Loop Bias	4
** 32 or 72	Loop Process Variable High High Alarm	4
** 33 or 73	Loop Process Variable Low Low Alarm	4
** 34 or 74	Loop Rate of Change Alarm	4
# 35	Loop Mode	2
** 36 or 76	Ramp/Soak Step	13
** 37 or 77	Ramp Destination Setpoint	4
**38 or 78	Ramp Rate	4
** 39 or 79	Soak Time	4
**3A or 7A	Soak Deadband	4
3B	Ramp/Soak Event Status Bit	3
**3C or 7C	Analog Alarm P.V. High Alarm	4
** 3D or 7D	Analog Alarm P.V. Low Alarm	4
** 3E or 7E	Analog Alarm Process Variable	4
** 3F or 7F	Analog Alarm P.V. High Limit	4
** 40 or 80	Analog Alarm P.V. Low Limit	4
** 41 or 81	Analog Alarm Orange Deviation Alarm	4
** 42 or 82	Analog Alarm Yellow Deviation Alarm	4

* These TT types are read-only data elements.
\# This TT type is a write-only data element.
** Format
  2x, 3x, and 4x = IBM format
  6x, 7x, and 8x = IEEE format

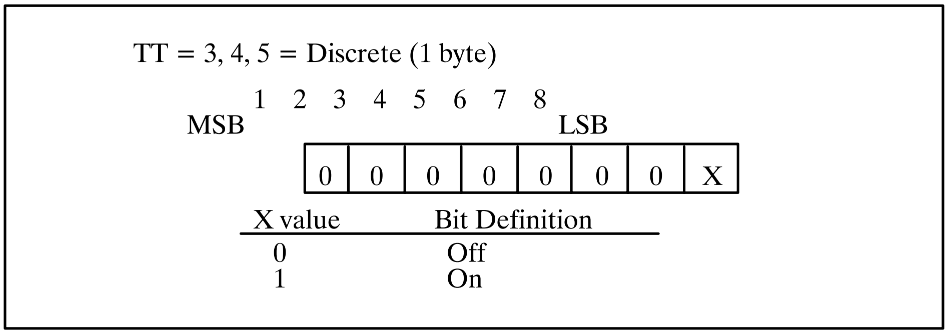
Data Element Types and Formats (continued)

Table 4-4 Basic Data Unit Format (continued)

TT	Data Element Type	Length (in bytes)
** 43 or 83	Analog Alarm Sample Rate	4
** 44 or 84	Analog Alarm Setpoint	4
45	Analog Alarm Variable Flag*	2
46	Analog Alarm Control Flag	4
** 47 or 87	Analog Alarm Error*	4
** 48 or 88	Analog Alarm P.V. High High Alarm	4
** 49 or 89	Analog Alarm P.V. Low Low Alarm	4
** 4A or 8A	Analog Alarm Rate of Change Alarm	4

* These TT types are read-only data elements.
\# This TT type is a write-only data element.
** Format
2x, 3x, and 4x = IBM format
6x, 7x, and 8x = IEEE format

NOTE: See Appendix B for a definition of TT 2x, 3x, 4x, 6x, 7x, and 8x floating point representation.

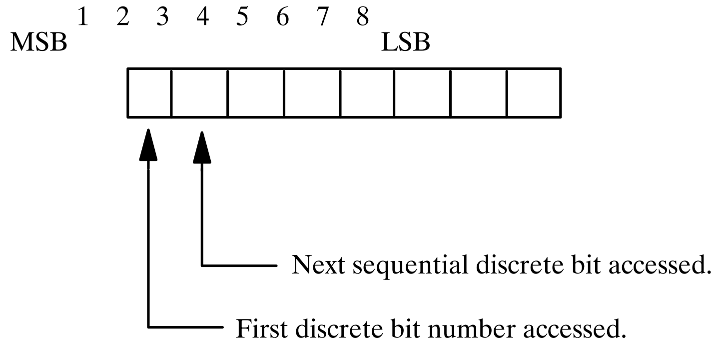


TT = 3, 4, 5 = Discrete (1 byte)

X value	Bit Definition
0	Off
1	On

Figure 4-4 Discrete Data Element Format

TT = 6, 7, 8 = Packed discrete (1 byte)



Value	Bit Definition
0	Off
1	On

If the number of packed discrete bits requested is not an even multiple of eight, the unused positions are set to zero.

Figure 4-5 Packed Discrete Data Element Format

TT = B = Word force (3 bytes)

MM <DDDD>

MM value	Force state
00	Unforced
01	Forced

Note: An MM value of FF_{16} during a write operation will unforce a point. Also, this MM value will not have a DDDD field.

Figure 4-6 Forced Word Data Element Format

TT = B, C = B: Discrete force, 1 byte C: CR force, 1 byte

MSB	1	2	3	4	5	6	7	8	LSB
	Y	0	0	0	0	0	0	X	

X value	Bit definition
0	Off
1	On

Y value	Force state
0	Unforced
1	Forced

Figure 4-7 Forced Discrete and CR Data Element Format

TT = 17 = Secondary System Status (2 words)*

	MSB			LSB
Word #1:	ABCD	EFGH	IJKL	MNOP

Each bit set to 1 indicates that the corresponding bit in word 2 is a reported status.

Word #2:	ABCD	EFGH	IJKL	MNOP

Status bits

A = 0 NIM in REMOTE mode
= 1 NIM in LOCAL mode

B = 0 P/C System in REMOTE mode
= 1 P/C System in LOCAL mode

C – P undefined (default to 0)

*This is a read-only data type

Figure 4-8 Secondary System Status Data Element Format

Format: TT = 2D = Loop Status (one word)

MSB LSB

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P

A – Loop Mode: If set to one, the loop is in auto mode. If set to zero, the loop is in manual.

B – Loop Cascade: If set to one, the loop is in closed cascade. If set to zero, the loop is in open cascade.

C – Error Deviation: If set to one, the loop is in positive error deviation. If set to zero, the loop is in negative error deviation.

D – PV High High Alarm: If set to one, the process variable is in high high alarm. If set to zero, the process variable is not in high high alarm.

E – PV High Alarm: If set to one, the process variable is in high alarm. If set to zero, the process variable is not in high alarm.

F – PV Low Alarm: If set to one, the process variable is in low alarm. If set to zero, the process variable is not in low alarm.

G – PV Low Low Alarm: If set to one, the process variable is in low low alarm. If set to zero, the process variable is not in low low alarm.

H –Yellow Band: If set to one, the loop deviation is in the yellow band. If set to zero, the loop deviation is not in the yellow band.

I –Orange Band: If set to one, the loop deviation is in the orange band. If set to zero, the loop deviation is not in the orange band.

J –PV Rate of Change Alarm: If set to one, the loop PV is in rate of change alarm. If set to zero, the loop PV rate of change is not in alarm (for 560/565 controllers).

K –PV Broken Transmitter Alarm: If set to one, the loop PV has a broken transmitter. If set to zero, the loop PV does not have a broken transmitter (for 560/565 controllers).

L –Loop Overrun: If set to one, the loop is overrunning its time allocation. If set to zero, the loop is not overrunning its time allocation (for 560/565 controllers).

M to P – Spare: Set to zero.

Figure 4-9 Loop Status Data Element Format

Data Element Types and Formats (continued)

TT = 2E = Loop Control Flags (two words)

MSB LSB

ABCDEFGH	IJKLMNOP	QRSTUVWX	YZabcdef

A – PV scale 20% offset
B – Take square root of PV
C – Monitor HIGH/LOW alarm
D – Monitor HIGH/HIGH/LOW−LOW alarm
E – Monitor deviation alarms
F – Monitor rate−of−change alarm
G – Monitor broken transmitter alarm
H – Use PID position algorithm
I – Use PID velocity algorithm
J – Direct acting
K – Reverse acting
L – Error squared control
M – Error deadband control
N – Lock auto/manual mode
O – Lock cascade mode
P – Lock setpoint
R – Execute Special Function program on the P.V.
S – Execute Special Function program on the setpoint
T – Freeze error sum on output out−of−range
U – Ramp/soak on the setpoint
V – Output is bipolar
W – Process variable is bipolar
X – Enable derivative gain limiting
Y − f – Number of the SF program that will be executed

If the bit is set to 1, the option is enabled. If the bit is set to 0, the option is disabled.

Figure 4-10 Loop Control Flag Data Element Format

TT = 2F = Ramp/Soak Status (one word)*

MSB	LSB
ABCDEFGH	IJKLMNOP

A – All programmed steps finished (1 = yes)

B – Soak timer in wait state with P.V. out of range (1 = yes)

C – H – Unused and set to zero

I – P – Ramp/soak step number currently executing (0 – 255)

*This is a read-only data type.

Figure 4-11 Ramp/Soak Status Data Element Format

TT = 35 = Loop Mode (one word)*

ABCD	EFGH	IJKL	MNOP

A = 1 – Go to MANUAL mode
0 – No action

B = 1 – Go to AUTOMATIC mode
0 – No action

C = 1 – Go to CLOSED CASCADE mode
0 – No action

D = 1 – Restart Loop
0 – No action

E = 1 – Loop in Hold
0 – No action

F = 1 – Jog to next ramp/soak step
0 – No action

G – P = Undefined (Default to 0)

In the case of multiple bits being set, the order of precedence is MANUAL, AUTOMATIC, CASCADE.

* This is a write-only data type.

Figure 4-12 Loop Mode Data Element Format

TT = 36 = Ramp/Soak Step (13 bytes, IEEE format; TT 76 is IBM format)

000K	TT	EEEE	SSSSSSSS	RRRRRRRR

K – Step type (0 = ramp step, 1 = soak step)

TT – Event status bit data element type (04 = Y, discrete output
05 = CR, control relay)

EEEE – Event status bit address

SSSS SSSS – Ramp step: contains the ramp destination setpoint
Soak step: contains the soak time

RRRR RRRR– Ramp step: contains the ramp rate-of-change
Soak step: contains the soak deadband

Figure 4-13 Ramp/Soak Step Data Element Format

TT = 45 = Analog Alarm Variable Flag (1 word)*

MSB	LSB
ABCDEFGH	IJKLMNOP

A – Enable alarm**

B – Disable alarm**

C – Analog variable in high high alarm

D – Analog variable in high alarm

E – Analog variable in low alarm

F – Analog variable in low low alarm

G – Analog variable in yellow deviation alarm

H – Analog variable in orange deviation alarm

I – Analog variable in rate-of-change alarm

J – Analog variable in broken transmitter alarm

K – Analog alarm is overrunning

L – P – Unused and set to zero

* Read only data type

** These bits can accept write updates

If the bit is set to one, the action is enabled.
If the bit is set to zero, the action is disabled.

Figure 4-14 Analog Alarm Variable Flag Data Element Format

TT = 46 = Analog Alarm Control Flag (2 words)

MSB LSB

ABCDEFGH	IJKLMNOP	RSTUVWXY	Zabcdefg

A – PV scale 20% offset
B – Take square root of PV
C – Monitor HIGH/LOW alarm
D – Monitor HIGH–HIGH / LOW–LOW alarm
E – Monitor deviation alarms
F – Monitor rate–of–change alarm
G – Monitor broken transmitter alarm
H – Local setpoint = 0
Remote setpoint = 1
I – X – Unused and set to zero
Y – g – Special function program number

If a bit is set to 1, the corresponding action is enabled.
If a bit is set to 0, the corresponding action is disabled.

Figure 4-15 Analog Alarm Control Flag Data Element Format

4.7 Data Element Address Ranges

The maximum data element locations (AAAA field) for each data element type / controller combination are provided in Table 4-5. All values in the table are 1-based (first legal value is 1; not zero). Values of zero are not supported.

Table 4-5 Data Element Address Ranges

P/C Type **Data Type**	**520–1101**	**530–1102**	**530–1104**	**530–1108**	**520C–1101**	**520C–1102**	**530C–1104**	**530C–1108**	**530C–1112**	**560–1101**	**565–1101**	**NOTE**
L Instruction TT = 00	1024	2048	4095	8191	* 1024	2048	4096	8192	12000	8192	8192	B
V Variable TT = 01	512	1024	1024	2048	512	1024	2048	4096	5120	2048	2048	B
K Constant TT = 02	0	0	0	0	0	0	0	0	0	0	0	A,B
Discrete I/O X,Y,X&Y Packed TT = 3,4,6,7	128	1023	1023	1023	1023	1023	1023	1023	1023	2048	2048	B
Control Register CR, CR Packed TT = 5,8	256	511	511	511	255	511	511	511	1023	2048	2048	B
Word I/O WX, WY TT = 9,A	128	1023	1023	1023	1023	1023	1023	1023	1023	2048	2048	B
Discrete Force TT = 0B	128	1023	1023	1023	1023	1023	1023	1023	1023	2048	2048	B
CR Force TT = 0C	256	511	511	511	255	511	511	511	1023	2048	2048	B
Word Force TT = 0D	128	1023	1023	1023	1023	1023	1023	1023	1023	2048	2048	B
Timer/Counter TCC/TCP TT = E,F	128	255	255	255	60	256	256	256	400	1024	1024	B
Drum Step DSP, DSC, DCP TT = 10,11,12	10	30	30	30	15	30	30	30	30	128	128	B,D
System Status TT = 17	1	1	1	1	1	1	1	1	1	1	1	B
Loop Data TT = 20–35 and 60–75	0	0	0	0	0	0	0	0	0	0	64	A,B
Ramp/Soak Data TT = 36–3B	0	0	0	0	0	0	0	0	0	0	255	B,C
Analog Alarm TT = 3C–4A and 7C–8A	0	0	0	0	0	0	0	0	0	0	128	A,B

Notes:

A) Entry of zero is a non-supported or non-configured Data Type for the P/C.

B) 560 and 565 data sizes are default values for a minimal system configuration. All of these values (except loops, analog alarms and system status) can be reconfigured.

C) There are 255 ramp/soak steps for each loop in a 565.

D) There are 16 steps for each event drum in a P/C.

* Read only (L-memory in EPROM only).

4.8 Data Field Length Restrictions

Table 4-6 and Table 4-7 delineate the maximum length of the data field, in bytes, for Read and Write Primitives.

Table 4-6 Maximum Read Primitive Byte Length

Read Primitive.	20	21	51	52	56	57
Maximum number of bytes read per Primitive request.	269	268	265	265	268	268
(When using extended address)	269	268	265	265	268	268

Primitives requesting more than one data element type (TT) in a Primitive request (possible with Primitives 05, 21, 51, 52, 56, and 57) must be verified to contain a cumulative byte count of less than or equal to the byte counts in this table. Consult Table 4–4 for the number of bytes per data element, and Table 4–5 for data element locations.

Table 4-7 Maximum Write Primitive Byte Length

Write Primitive	30	31	52	57
Maximum number of bytes that may be written per Primitive request.	267	265*	263	265**
(When using extended address)	265	263*	261	263**

Consult Table 4-4 for the number of bytes in each data element, and Table 4-5 for the maximum available data element address.

* This number assumes that only one data element is requested. Use the one of the following formulas for the general case of one or more data types:

Normal addressing: $N = 270 - (5 * T)$
Extended addressing: $N = 270 - (7 * T)$

where:

N = maximum number of bytes which may be written in this Primitive request.

T = total number of writes specified in the Primitive request.

** This number assumes that only one record is requested. Use the formula below for the general case of one or more records requested:

$N = 266 - C$, where: C = total number of records in this Primitive.
or
Extended addressing: $N = 264 - C$

4.9 Series 500 NIM Primitive Descriptions

The following paragraphs describe the NIM Primitives used in the Series 500 NIM. Refer to Table 4-2 for a complete list of the Primitives supported.

Exception Primitive – Code 00

Availability: Releases 1.1, 2.1, 2.2, and 3.0

Primitive 00 allows you to obtain an error status from a Secondary. For example, if a Primary tries to read variable memory at location 0000 in a Series 500 NIM, a Primitive 00 response would indicate that the memory address was out of range with an exception field of 0002.

Request: There is no request defined for this Primitive.

Response: LLLL 00 PP DDDD (TT is optional)

Symbol	Value	Definition
PP		Request primitive code that contains the exception
DDDD	0	Primative code is not implemented.
	1	Data type (specified by TT) is not defined on the attached device.
	2	Data element location (specified by TT) is out of range.
	3	Primitive has excess data unit bytes.
	4	Primitive has insufficient data unit bytes.
	5	The number of information bytes received does not match the number of bytes specified in the field length.
	6	Device is in wrong mode for primitive execution.
	7	User program in the attached device has disabled communication to the Series 500 NIM via the lock-out bit.
	A	Attached device fails to respond
	E	Primitive not valid for the specified data type (TT).
	10	The number of locations requested exceeds the maximum allowed.
	11	The number assigned to a data acquisition block or record is not within the supported block or record range.
	12	The block or record number requested has not been defined.
	13	The number of data bytes in the requested blocks or records exceeds the maximum number of bytes allowed by the primitive.
	15	Primitive not allowed while device is in local mode.

Symbol	Value	Definition
DDDD	16	TT not programmed in attached device.
	17	The attached device did not respond properly.
	19	The resulting data element location formed by the starting address, plus the number of data elements to access is out of range specified by TT.
	1A	Communication has not been established with the atttached device.
	1B	The store and forward buffer is full and the store and forward message was discarded.
	1C	Data element field (specified by TT) is improperly formatted.
	1D	The number of locations to access is zero (NNNN = 0).
	23	The number of data blocks defined in a data acquisition record exceeds the maximum supported.
	24	An illegal IEEE floating point value (an IEEE NaN, Not-a-Number) exists in a primitive write request.
	25	The address value exceeds the structure format in the request. Use extended structure format.
	29	Store and forward mechanism is not allowed in this primitive.
	2B	The write request was refused, the device is in the program upload or download mode.
	2C	The upload or download command field, “CC” is not supported.
	2D	The upload or download primitive request was refused. The attached device is currently in progress with an upload or download.
	2E	The upload request segments or programs are not supported or the segments were not defined.
	80DD	Exception generated in the attached device is not identified.
TT		Optional element data type.

Native Primitive – Code 01

Availability: Releases 1.1, 2.1, 2.2 and 3.0

The native Primitive 01 allows access to an attached device by using a Task Code which is unique to the specific device addressed. By using 01, a programmer can embed a controller-unique Task Code and can access anything in controller memory, for example, that a VPU can access.

Request: LLLL 01 DDDD, where DDDD is defined by the task codes of the device being accessed.

Response: LLLL 01 HH DDDD, where DDDD is defined by the task codes of the device type accessed.

Symbol	Value	Definition
HH		Operational status
DDDD		Defined by the type of device being accessed.

Status Primitive – Code 02

Availability: Releases 1.1, 2.1, 2.2, and 3.0

Primitive 02 is the machine status Primitive. It reports the current operational state of the attached device and NIM in a common format for all types of attached devices. The NIM gets a status update from the attached device every 4 seconds (and immediately when an 02 Primitive is issued).

Request: LLLL 02

Response: LLLL 02 HH EE FF, where:

Symbol	Value	Definition
HH		Attached device operational status (mode)
	00	Operational and performing instruction data type and loop execution. (RUN)
	01	Operational and performing instruction data type and loop execution with a non-fatal error detected. (RUN with non-fatal error)
	02	Operational and not performing instruction data type execution with loop execution. (PROGRAM)
	03	Operational and not performing instruction data type or loop execution. (PROGRAM)
	04	Operational and not performing instruction data type execution with loop execution and a non-fatal error is detected. (PROGRAM with non-fatal error)
	05	Operational and not performing instruction and data type or loop execution and a non-fatal error is detected. (PROGRAM with non-fatal error)
	80	Not operational due to a fatal error condition.
EE		Attached device auxiliary power source status
	00	Auxiliary power source good
	01	Auxiliary power source status not available
	80	Auxiliary power source not good
FF		NIM operational status
	00	Operational
	01	Channel A is not functional
	02	Channel B is not functional

Configuration Primitive – Code 03

Availability: Releases 1.1, 2.1, 2.2, and 3.0

Primitive 03 allows the Primary to identify the types of devices that exist on the network. For example, an 03 response from a 520 P/C would be different from a response from a 5TI P/C.

Request: LLLL 03

Response: LLLL 03 HH DDDD EEEE FFFF GGGG IIII JJJJ KKKK KKKK

Symbol	Value	Definition
HH		Attached device operational status
DDDD		Device type
	0000	5TI
	0020	520
	002C	520C
	0030	530
	003C	530C
	0040	540
	0050	550
	0060	560
	0065	565
	007E	UNILINK Host Adapter
	0080	PM550
	0081	PM551
	0100	UNILINK Secondary Adapter
	0200	IT–111/121 Intelligent Tank Transmitter
	0204	IT–150 Hydrostatic Tank Transmitter
	0208	IT–160 Micro Remote Control Unit
EEEE	hex	Instruction data type memory size
FFFF	hex	Variable data type memory size
GGGG	hex	Constant data type memory size
IIII	hex	Local input/output memory size
JJJJ	hex	Global input/output memory size
KKKK	hex	Total memory size (excluding input and output)

Primitive Format Configuration – Code 04

Availability: Releases 1.1, and 2.1, 2.2, and 3.0

Primitive 04 is the format Primitive that allows you to ascertain the maximum length of the Primitive acceptable to the Network Interface Module. The buffer length is returned in number of bytes.

Request: LLLL 04

Response: LLLL 04 NNNN MM EE FF GG BB ... BB

(repeated)

Symbol	Value	Definition
NNNN		Primitive descriptor(s) and data unit(s) field length supported, in bytes (270 bytes is returned)
MM		Number of Data Acquisition Blocks supported by the NIM (Primitives 50, 51, 52) (32 is already returned)
EE		Number of Data Acquisition Records supported by the NIM (Primitives 55, 56, 57). Used with releases 2.1, 2.2, and 3.0 (32 is returned)
FF		Number of Data Type Definitions supported in each defined record in the NIM (Primitives 55, 56, 57). Used with releases 2.1, 2.2, and 3.0 (32 is returned)
GG		Floating Point Formats supported in the NIM. Used with releases 2.0 and 3.0
	00	No floating point support
	01	IBM Excess 64 format support
	02	IEEE Standard 754 format support
	03	Both IBM and IEEE format support
BB		Primitive support bit mask for the NIM. The first bit represents Primitive 0. Primitive values increment by 1 for each bit position. A one in a bit position indicates that the corresponding Primitive is supported. For example, if bit 3 is set to 1, then Primitive 03 is supported. For example, if bit 3 is set to 1, then Primitive 03 is supported.

Packed Native Primitive – Code 05

Availability: Releases 2.1, 2.2, and 3.0

Primitive 05 allows one or more device task codes to be executed. Execution is aborted and an exception response returned if an exception occurs during processing. If an exception occurs during execution of any native task code, the error results are returned in the packed native response in the same position as in a normal response. Execution continues in this situation. Native task codes concerning “store” and “forward” are not supported.

Request: LLLL 05 CC DD ... DD
(repeated)

Response: LLLL 05 HH CC DD ... DD
(repeated)

Symbol	Value	Definition
HH		Attached device operational status
CC		Number of bytes in the task code field DD
DD		Task codes of the device type being accessed

Reset Secondary Device Mode – Code 06

Availability: Release 3.0

Primitive 06 returns the Secondary to its initial “ready” stated for program upload/download operations (Primitives 58 and 59). Resetting the secondary may affect the status of the attached device in some cases (depending on the type of attached device and the relationship between the attached device and Secondary).

Request: LLLL 06

Response: LLLL 06 HH

Symbol	Value	Definition
HH		Attached device operational status

Segment Definition – Code 07

Availability: Release 3.0

Primitive 07, used with the Program Upload and Download Primitives (58 and 59), obtains the attached device segment definition as an ASCII string. The definitions contain the segment number they represent and relate one-to-one with the MMMM descriptor (starting at bit P) defined in Primitive 58. Primarily, this request determines a starting point from which to obtain the definitions. This allows you to obtain ASCII strings that would otherwise exceed the maximum returnable length.

Request: LLLL 07 VV SS

Symbol	**Value**	**Definition**
VV		Segment type
	00	Generic segment definition
	01	Secondary device segment definition
	02	Program names definition
SS		Starting segment number (or program name) to be returned

Response: LLLL 07 HH VV KK SS CC DD ... DD

(repeated)

Symbol	**Value**	**Definition**
HH		Attached device operational status
VV		Segment type
	00	Generic segment definition
	01	Secondary device segment definition
	02	Program name definition
KK		Total number of segment or program definitions
SS		Segment number definition being returned
CC		Number of bytes in the ASCII DD field
DD		ASCII segment definition defined by the attahced device. The first two DD descriptors contain the MMMM (Bit Map) field for the program.

Change State Primitive – Code 10

Availability: Releases 1.1, 2.1, 2.2, and 3.0

This Primitive allows you to change the operational state of TIWAY I Secondaries. For example, you may enter the Run or Program modes with this Primitive.

Request: LLLL 10 DD, where

Symbol	Value	Definition
DD		Operational Status
	00	Enter execution of instruction data type and execution of loops state (RUN mode)
	01	Enter non-execution of istruction data type and execution of loop states (PROGRAM mode)
	02	Enter non-execution of instruction data type and loop state (PROGRAM mode)

Response: LLLL 10 HH

Symbol	Value	Definition
HH		Attached device operational status

NOTE: Issuing this command to enter the non-execution of instruction data type will cause specific devices to turn off or freeze their output systems, depending on the device. For an explanation of the modes of operation for a specific controller, refer to the manual for that particular programmable controller. The same execution response is obtained for DD values of 01 and 02 for all controllers except Series 500 controllers with process loop capabilities.

Read Block Primitive – Code 20

Availability: Releases 1.1, 2.1, 2.2, and 3.0

Primitive 20 is a command to read a single contiguous block of data in the Secondary device. Read Block will access contiguous data element locations from a given data element location.

Request: LLLL 20 TT NNNN AAAA

Symbol	Value	Definition
TT		Data element type
NNNN		Number of locations
AAAA		Data element location

Response: LLLL 20 HH DD ... DD
(repeated)

Symbol	Value	Definition
HH		Attached device operational status
DD		Data

Series 500 NIM Primitive Descriptions (continued)

Read Random Block Primitive – Code 21

Availability: Releases 2.1, 2.2, and 3.0

Primitive 21 is a command to read several random blocks of contiguous memory.

Request: LLLL 21 TT NNNN AAAA
(repeated)

Symbol	Value	Definition
TT		Data element type
NNNN		Number of locations
AAAA		Data element location

Response: LLLL 21 HH XX BB DD ... DD
(repeated)
(repeated XX times)

Symbol	Value	Definition
HH		Attached device operational status
XX		Number of blocks not processed due to error
BB		Block numbers not processed due to error
DD		Data requested

The BB field contains a value only when the P/C is reporting a P/C error.

NOTE: No data will be returned for the blocks that were in error.

Write Block Primitive – Code 30

Availability: Releases 1.1, 2.1, 2.2, and 3.0

Primitive 30 is the Write Block Primitive, which will replace contiguous data element locations from a given data element location with the data specified in the Request.

Request: LLLL 30 TT AAAA DD ... DD
├────────┤ (repeated)

Symbol	Value	Definition
TT		Data element type
AAAA		Data element location
DD		Data

Response: LLLL 30 HH

Symbol	Value	Definition
HH		Attached device operational status

Write Random Block Primitive – Code 31

Availability: Releases 2.1, 2.2, and 3.0

Primitive 31 replaces the specified blocks of data element locations with the data included in the request.

Request: LLLL 31 TT NNNN AAAA DD ... DD
├──────────────────────┤ (repeated)

Symbol	Value	Definition
TT		Data element type
NNNN		Number of locations
AAAA		Data element location
DD		Data

Response: LLLL 31 HH XX BB ... BB
├───────┤ (BB is repeated XX times)

Symbol	Value	Definition
HH		Attached device operational status
XX		Number of block writes not completed due to error
BB		Block numbers not processed due to error

⚠ CAUTION

Blocks not processed due to error (specified by BB) may have been partially written before a failure occurred. Valid blocks will complete without returning a Primitive error.

Block Data Acquisition Primitive Codes 50, 51, and 52

Availability: Releases 1.1, 2.1, 2.2, and 3.0

The block data acquisition Primitives allow predefined blocks of different data types to be accessed with a single Primitive without re-defining the blocks in each transaction. The Define Block Primitive (50) allows the random blocks to be specified. The Gather Block Primitive (51) collects the data from specific blocks. The Write and Gather Block Primitive (52) combines the functions of the Write Block Primitive (30) and the Gather Block Primitive (51).

NOTE: The block definitions within the NIM are destroyed in the event of a power loss or a hardware reset. This includes an HDLC DISC (disconnect from Primary) command. Any initialization or reinitialization procedures must use the Define Block Primitive to re-define the data acquisition blocks.

Define Block Primitive – Code 50. The define block Primitive specifies up to 32 random blocks of data elements. Refer to Table 4-5 for the allowable data element location (address) ranges. The blocks are referenced by number, ranging from 1 to 20 (hex). A block, once defined, can be re-defined to a different data element type and location by simply specifying that block number, and then providing the required information for a new block. A block can be restored to the initial state of “undefined” by setting the NNNN field to zero.

```
Request:  LLLL 50 CC TT NNNN AAAA
              |--------------------|  (repeated)
```

Symbol	Value	Definition
CC		Block number (1–20 hex)
TT		Data element type
NNNN		Number of locations
AAAA		Data element location

Response: LLLL 50 HH

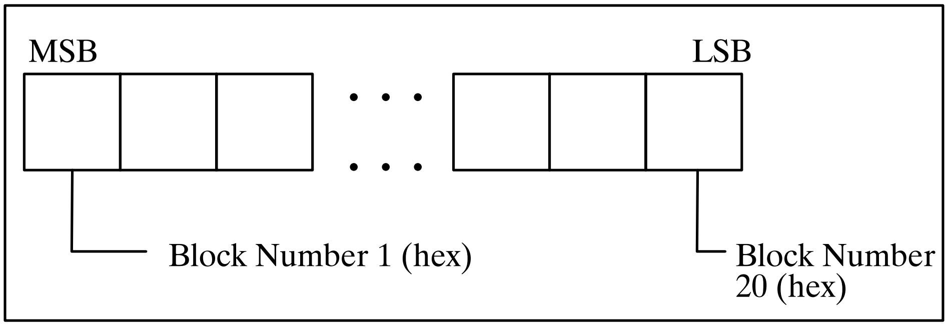
Symbol	Value	Definition
HH		Attached device operational status

Gather Block Primitive – Code 51. The Gather Block Primitive specifies which blocks (as defined by the Define Block Primitive 50) will be read. The blocks are specified through a 32-bit mask (EEEEEEEE).

Each bit position in the bit mask corresponds to a block that was defined with Primitive 50, Define Block. A bit set to 1 indicates that the block is to be returned. A bit set to 0 means that the block will not be returned. You should not request more data than can be returned in a maximum length Primitive frame. The response will return the data associated with the requested blocks, beginning with the lowest block number and increasing to the highest block number. A data block separator is not provided in the response.

Request: LLLL 51 EEEEEEEE

where EEEEEEEE is 32 bits, defined as:



Response: LLLL 51 HH EEEEEEEE DD ... DD

(repeated)

Symbol	Value	Definition
HH		Attached device operational status
EEEEEEEE		EEEEEEEE is a mask as defined by the Request Primtive and DDDD is defined by the data type being accessed. The order of return of the blocks is from the lowest numbered block to the highest. For example, if blocks 2, 4, and A were requested, the first data block in the response specifies data which is associated with block 2, the next data block specifies data which is associated with block 4, etc.
DD		Data

Write and Gather Block Primitive – Code 52. The Write and Gather Block Primitive specifies which blocks (as defined with Define Block Primitive 50) will be read. It also allows a user to replace any contiguous data element locations. The blocks are specified through a 32-bit mask (EEEEEEEE).

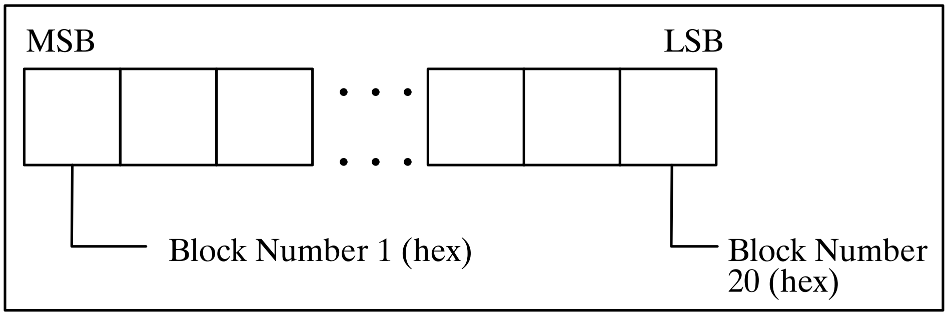
In the bit mask position which corresponds to a block specified in Define Primitive 50, a bit value of 1 indicates that the block is to be returned. A bit value of 0 means that the block will not be returned.

You should not request more data than can be returned in a maximum length Primitive frame. Following the mask are the descriptors associated with the write function, which is performed before the gather operation. The response will return the data associated with the requested blocks, beginning with the lowest block number and increasing to the highest block number. A data block separator is not provided in the response.

Request: LLLL 52 EEEEEEEE TT AAAA DD ... DD

(repeated)

where EEEEEEEE is 32 bits defined as:



Symbol	Value	Definition
TT		Data element type
AAAA		Data element location
DD		Data

Response: LLLL 52 HH EEEEEEEE DD ... DD
(repeated)

Symbol	Value	Definition
HH		Attached device operational status
EEEEEEEE		EEEEEEEE is a mask as defined by the Request Primitive and DDDD is defined by the data type being accessed. The order of return of the blocks is from the lowest numbered block to the highest. For example, if blocks 2, 4, and A were requested, the first data block in the response specifies data which is associated with block 2, the next data block specifies data which is associated with block 4, etc. This field can be set to zero if you want to perform a write function without reading a block.
DD		Data

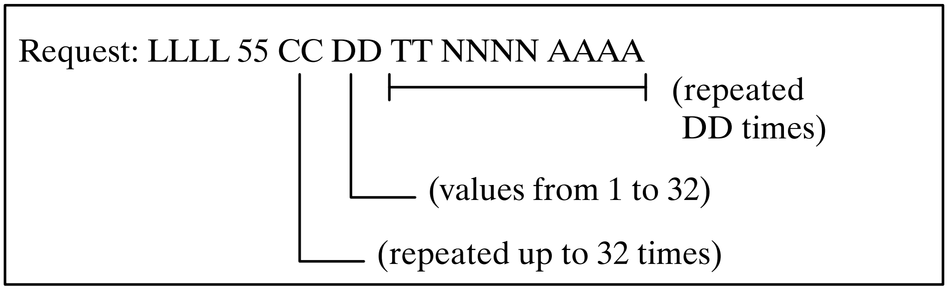
Record Data Acquisition Primitive Codes 55, 56, and 57

Availability: Releases 2.1, 2.2, and 3.0

The Record Data Acquisition Primitives allow repetitive collection of multiple predefined blocks of data. The Define Record Primitive (55) allows multiple blocks of data to be defined as a single record. The Gather Record Primitive (56) collects the data blocks for the requested records. The Write and Gather Record Primitive (57) combines the functions of the Write Block Primitive (30) and the Gather Record Primitive (56).

NOTE: The record definitions within the NIM are destroyed in the event of a power loss or a hardware reset (HDLC DISC). Any initialization or re-initialization procedures must use the Define Record Primitive (55) to re-define the data acquisition records.

Define Record Primitive – Code 55. The Define Record Primitive specifies up to 32 records with 32 blocks per record. The records are referenced by number, ranging from 1 (hex) to 20 (hex). A record, once defined, can be re–defined to different data element types and for a new record. A record may be restored to the initial state of “undefined” by specifying the number of Data type Definitions (DD – blocks) in the record as zero.



Request: LLLL 55 CC DD TT NNNN AAAA

Symbol	Value	Definition
CC		Number assigned to the record. The allowable range is 1 to 20 hex.
DD		Number of data type definitions (blocks) for the record.
TT		Data element type
AAAA		Data element location

The total byte count of data elements defined by the record(s) must not cause the Gather Record Response to exceed the maximum Primitive frame length. See Table 4-5 and Table 4-6 for the number of bytes in each data type.

Response: LLLL 55 HH

Symbol	Value	Definition
HH		Attached device operational status

Gather Record Primitive – Code 56. The Gather Record Primitive specifies which records (as defined by define Record Primitive 55) will be read. The records are specified by record numbers from 1 (hex) to 20 (hex). The total number of bytes returned by the record(s) must not cause the response to exceed the maximum frame length. The Response Primitive will return the data associated with the requested records, beginning with the lowest number record and increasing to the highest number record. A data record or data type separator is not provided in the Response Primitive.

```
Request: LLLL 56 XX CC
                 ├──┤ (repeated)
```

Symbol	Value	Definition
XX		Number of records requested
CC		Record numbers requested

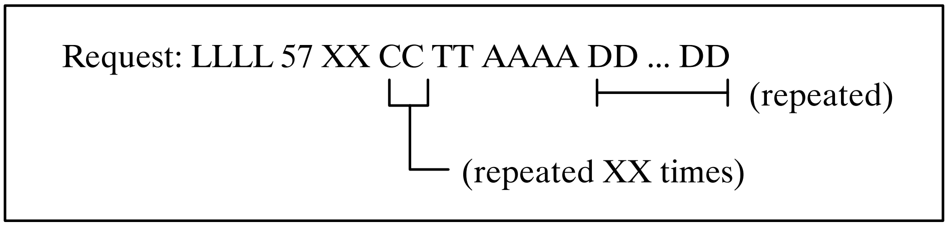
```
Response: LLLL 56 HH XX CC ... DD ... DD
                     └┬─┘    ├──────────┤ (repeated)
                      └──  (repeated XX times)
```

Symbol	Value	Definition
HH		Attached device operational status
XX		Number of records in error
CC		Record numbers in error
DD		Data records returned without errors

NOTE: No data will be returned for records in error. Invalid records will cause a Primitive error.

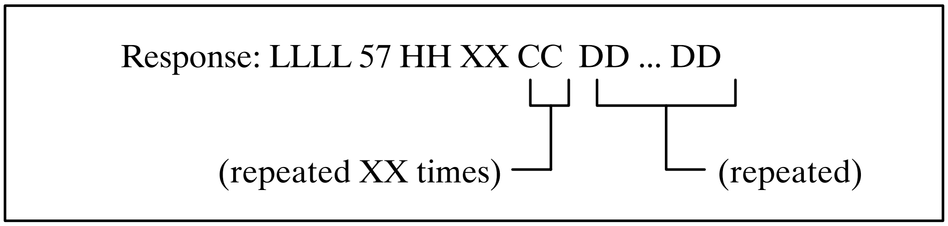
Write and Gather Record Primitive – Code 57. The Write and Gather Record Primitive specifies which records (as defined with Define Record Primitive 55) will be read. It also allows you to replace any contiguous data element locations. The Records are specified by record numbers from 1 to 20 (hex). The total number of bytes returned by the record(s) must not cause the response to exceed the maximum frame length.

Following the record numbers are the descriptors associated with the write function. The write function is performed before the gather operation. The response returns the data associated with the requested records by starting with the lowest number record and increasing to the highest record. A data record or data type separator is not provided in the response.



Symbol	Value	Definition
XX		Number of records requested
CC		Record numbers requested
TT		Data element type
AAAA		Data element location
DD		Data

Maximum DD ranges may vary depending on the number of records specified for the read function.



Symbol	Value	Definition
XX		Number of records in error
CC		Record numbers in error
DD		Data records returned without errors

NOTE: An exception will be returned if the write portion of this Primitive fails. No data will be returned for records in error or invalid read defintions.

Program Upload & Download Primitive Codes 58 and 59

Availability: Release 3.0

Primitives 58 and 59 transfer various types of program or configuration data to and from a secondary.

All data is transferred by data blocks. The blocks are numbered sequentially, starting from 0. The sequence number is contained within the primitive, and incremented each time a data block is returned.

A reference field, used by the host to identify and control attached device programs, is also defined in the Upload and Download Primitives. The reference field is returned to the host within the the primitive response, but is not modified by the attached device.

The attached device program definition is divided into segments. The Series 500 NIM supports program segments (which contain executable structures) and variable segments (which contain program variables). The segments can be requested by using a bit mask with Primitive 58.

The attached device also has a programmable time-out value. This value is used to determine whether the device should be removed from an upload or download if it does not receive the next upload or download request within the time-out period.

Attached Device States during Upload and Download. An attached device can be in one of three states in relation to an upload or download operation.

- Not uploading or downloading (neutral)
- In upload
- In download

Table 4-8 provides a state diagram for the various command/state combinations.

Program Load Exception Guidelines. If you receive a data block that is not the block you expect (the sequence number is returned in the primitive response), it is recommended that you try to access the block again. If a sequence error is detected, the host can try to request the data as far back as the previous two transactions. On occasions where the upload or download is unsuccessful, send primitive 06 (Reset Secondary Device Mode) and restart the upload or download. Notice that Primitive 06 aborts any upload or download operation in progress.

The attached device will enter a "time-out" period between an upload/download response and the next primitive request. This time period is set by default to two minutes, but can be set to different values in your host software program. If the delay period elapses without another request, the secondary will return to the state before the "time-out" or assume a "neutral" state in which upload or download activity is not permitted.

Program Upload – Code 58. Availability: Release 3.0

Primitive 58 allows you to upload program and configuration data from an attached device through the TIWAY I network secondaries. The initial request sets the attached device into an upload mode, and the first response (from the attached device) contains the segment mask for the segments that are going to be transferred. From this point, each subsequent request will automatically increment the upload request sequence number, and each response will send the requested block of data. When the upload is complete, the final device response will contain an "upload complete" indicator, but no data. At this point, you should send an upload request that contains the "end upload" command to terminate the upload.

When you send the first request, you can specify which attached device program segments should be included in the upload. You can request program information, data values, or "all" which returns all attached device segments. The first response contains the MMMM field, which details the exact segments that will be returned.

The first request also contains the “between response to request” time-out value. This value corresponds to the number of seconds that the attached device will wait for the next upload request. If the time expires, the attached device will exit upload mode. The first response also returns the actual time-out value that will be used, since some attached devices may support a maximum time-out value less than the value requested.

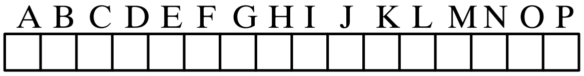
Upload Request Parameter Descriptions. The basic format of the request is as follows:

LLLL 58 XX

LLLL 58 00 RRRR MMMM OOOO
LLLL 58 01 RRRR YYYY DD ... DD
LLLL 58 02 RRRR
LLLL 58 03 RRRR

where:

Symbol	Value	Definition
CC	00	Initial upload request
	01	Next block upload request
	02	End upload request acknowledge
	03	Abort upload operation
YYYY	(number)	Requested block sequence number starting with 0 (present when CC = 1)
RRRR	(number)	Host defined reference field returned with response
MMMM	(binary)	Upload configuration bit map present only when CC = 0. A1 in a bit position indicates that the corresponding segment will be included in the upload. The chart below illustrates this concept.
OOOO	(number)	Time-out value in one second increments (present only when CC = 0)



A and B are reserved and must be set to 0.
O specifies the data segment.
P specifies the program segment.
Setting bits C – P will request all available data.

Upload Response Parameter Descriptions. The basic format of the response is as follows:

LLLL 58 HH 00 RRRR MMMM OOOO
LLLL 58 HH 01 RRRR YYYY WW ZZ DD ... DD
LLLL 58 HH XX RRRR (YYYY may be present on some codes)

where:

Symbol	Value	Definition
HH		Attached device status
XX	00	Block upload accepted. MMMM is contained in the data field
	01	Block upload
	02	Upload complete
	03	End upload
	04	Upload aborted, exited mode
	05	Upload command (CC) not supported, remain in upload mode
	06	Sequence number does not match the next expected number in the YYYY field. Either the maximum sequence roll-back is exceeded or a data block is missing; remain in upload mode.
	07	Reserved
	08	Received an end upload request before the upload was complete, exited upload model
	09	Upload completed except for an area containing a non-fatal error; exited mode
	0A	Initial upload request rejected, but still in upload mode
YYYY	(number)	Requested block sequence number starting with block 0.
DD		Data records returned without errors
RRRR	(number)	Host defined reference field
WW	00	Binary data
	01	ASCII data
ZZ	(number)	Segment number corresponding to the segment contained in the data field
DD	(number)	Data type
MMMM	bit map	Upload segment configuration that is present only when CC = 0. A value of 1 means that the segment is included in the upload.
OOOO	(number)	Time-out value (in seconds) used when CC = 0.

There are four primary forms of the upload primitive.

- Initiate upload — places the attached device into upload mode.
- Upload device — sequentially collects all information that defines the operating environment for the attached device.
- Terminate upload — removes the attached device from the upload mode as soon as the attached device notifies the host that the requested operation is complete.
- Abort upload — immediately terminates an upload operation when a higher priority operation is requested.

Initiate Upload Request and Response

Request: LLLL 58 00 RRRR MMMM OOOO

Response: LLLL 58 HH 00 RRRR MMMM OOOO

where:

Symbol	Value	Definition
RRRR		Host reference field used to identify the host
MMMM		Bit mask that defines which segments are going to be uploaded. There are four hexadecimal values allowed in the field (01, 02, 03, and 3FFF). If you use 3FFF, the attached device will report which setments are supported in the response. For example, if you send an initiate upload command to a Series 500 NIM that is communicating with a 560/565 controller, the NIM response will contain a bit mask value of 3, which shows support for the program and data segments.
OOOO		Time-out field that specifies the amount of time (in seconds) the attached device will wait between subsequent upload requests before it terminates the upload requests and exits the upload mode. If a value of 0 is specified in the time-out field, the attached device will return the default value (2 minutes). The maximum value is dependent on the controller. If a value larger that the maximum controller value is requested, the time-out will be set to the controller value available.

Upload Data Request and Response

Request: LLLL 58 01 RRRR YYYY

Response: LLLL 58 HH 01 RRRR YYYY WW ZZ DD ... DD
or LLLL 58 HH 02 RRRR (all data has been transferred)

where:

Symbol	Value	Definition
YYYY		Upload sequence count which is initially set to 0 and incremented by 1 on each subsequent upload request. The response will contain the same value as was sent to the attached device during the request. The YYYY field can also be used to retrieve the previous two responses, i.e., the response just returned, and the one immediately preceeding it. This process is known as rollback.
WW		Specifies the form of the data being uploaded: 0 – binary data, 1 – text data
ZZ		Identifies the segment that is currently being uploaded. Segment 0 is defined as program memory and segment one is defined as data memory.
DD		Data that defines the attached device's operating environment.

Terminate Upload Request and Response

Request: LLLL 58 02 RRRR

Response: LLLL 58 HH 03 RRRR or LLLL 58 HH 08 RRRR

The terminate upload command is used to remove the attached device from upload mode. The attached device will return the response LLLL 58 02 RRRR (in response to a LLLL 58 01 RRRR YYYY command) when all data has been uploaded. This response notifies the host that the upload operation is complete and that all data has been returned. The attached device will remain in the upload mode until it receives a terminate upload command.

If a terminate upload command is sent to the attached device before it notifies the host that the upload is complete, the secondary will respond with LLLL 58 HH 08 RRRR which indicates the upload was terminated prematurely.

If the terminate upload command is issued and the attached device is not in the upload mode, an error response of LLLL 00 58 002C will be returned. This notifies the host that the terminate (02) command code is not valid in the current mode.

Abort Upload Request and Response

Request: LLLL 58 03 RRRR

Response: LLLL 58 HH 04 RRRR

The abort upload command immediately stops the upload request. The command will also return the attached device to the state prior to the request. The attached device is no longer in upload mode and will not accept any additional upload Primitives unless another initialize upload command is issued.

The attached device will return an error response (LLLL 00 58 002C) if an abort upload command is received when the upload process has not been initialized.

Upload Examples

The following pages contain examples of upload requests for various conditions.

Program Download – Code 59. Availability: Release 3.0

The program download primitive allows you to send program and configuration information to a secondary or attached device.

The initial download request sets the secondary into the download mode, but does not contain any data. The first request also contains the response-to-request time-out value for the attached device. This value represents the number of seconds that the attached device will wait between download requests. If the time period expires, the attached device will exit download mode.

The download responses contain the block sequence number from the request. Each subsequent download request will increment the block sequence number. The first response also includes the actual time-out value that the attached device supports, since the device may not support the time-out value requested in the initial download request. After all data blocks have been sent to the attached device, a terminate download request must be sent to remove the attached device from the download mode and return it to the prior state. If a download is aborted, the attached device will clear memory and assume a non-executable state.

Download Request Parameter Descriptions

The basic format of the download request is as follows:

LLLL 59 XX ...

LLLL 59 00 RRRR MMMM OOOO (may have ASCII format)
LLLL 59 01 RRRR YYYY WW ZZ DD ... DD
LLLL 59 02 RRRR
LLLL 59 03 RRRR

where:

Symbol	Value	Definition
XX	00	Initial download request
	01	Download next block
	02	Exit download
	03	Abort download operation
YYYY	(number)	Requested block sequence number starting with block 0.
RRRR	(number)	Host defined reference field returned with the response.
WW	00	Binary data
	01	ASCII data
ZZ	(number)	Segment number corresponding to the segment contained in the data field.
DD	(number)	Data byte
MMMM	bit map	Upload segment configuration that is present only when XX = 0. A value of 1 means that the segment is included in the upload.
OOOO	(number)	Time-out value in seconds (all zeros denote the default value of two minutes)

Download Response Parameter Descriptions

The basic format of the response is as follows:

LLLL 59 HH 00 RRRR OOOO
LLLL 59 HH XX RRRR (YYYY may be present on some XX codes)

where:

Symbol	Value	Definition
HH		Attached device status
XX	00	Entered download mode
	01	Download data was received and valid
	02	Download complete
	03	Reserved
	04	Download aborted, exited mode
	05	Download command (XX) not supported, reamin in download mode.
	06	Sequence number does not match the next expected number in the YYYY field; remain in download mode.
	07	Segment in download data is not defined by the initial segment mask; remain in download mode.
	08	Reserved
	09	Download was partially completed except for an area containing a non-fatal error; exited mode.
	0A	Initialize download request rejected, because a download operation is already in progress
YYYY	(number)	Requested block sequence number starting with block 0.
RRRR	(number)	Host defined reference field
OOOO	(number)	Time-out value used when XX = 0.

Like the program upload primitive, there are four forms of the download request.

- Initialize download — places the attached device into download mode and clears any device memory areas that can accept download data
- Download device — sequentially transfers the archived (uploaded) program to the attached device
- Terminate download — stops the download process and removes the attached device from the download state
- Abort download — immediately terminates the download mode

Initiate Download Request and Response

Request: LLLL 59 00 RRRR MMMM OOOO

Response: LLLL 59 HH 00 RRRR MMMM OOOO

where:

Symbol	Value	Definition
RRRR		Host reference field
MMMM		Bit mask that defines which segments are going to be downloaded. There are four hexadecimal values allowed in the field (01, 02, 03, and 3FFF). If you use 3FFF, the attached device will report which segments are supported in the response. For example, if you send an initiate download request to a Series 500 NIM that is communicating with a 560/565 controller, the NIM response will contain a bit mask value of 3, which shows support for the program and data segments.
OOOO		Time-out field that specifies the amount of time (in seconds) the attached device will wait between subsequent download requests before it terminates the upload requests and exits the upload mode. If a value of 0 is specified in the time-out field, the attached device will return the default value (2 minutes).

The initiate download request places the attached device in the download mode and clears the device's memory areas. The initiate download request can only be accepted (by the NIM) if the attached device is in a neutral state, i.e. not uploading or downloading. If the NIM is not in a neutral state, send primitive 06 to reset the attached device.

Download Device Request and Response

Request: LLLL 59 01 RRRR YYYY WW ZZ DD ... DD

Response: LLLL 59 HH 01 RRRR YYYY

where:

Symbol	Value	Definition
RRRR		Host reference field
YYYY		Download sequence count which is initially set to 0. This field is incremented by one on each subsequent download request. The response will contain the same value as was sent in the request.
WW		Specifies the form of the data being downloaded: 0 – binary, 1 – text data
ZZ		Identifies the segment that is currently being downloaded. Segment 0 is defined as program memory and segment one is defined as data memory.
DD		Data that restores the attached device's operating environment.

Terminate Download Request and Response

Request: LLLL 59 02 RRRR

Response: LLLL 59 HH 02 RRRR

The terminate download command removes the attached device from download mode. The attached device will return an error code of LLLL 00 59 002C if it is not in download mode when the terminate download command is issued.

Abort Download Request and Response

Request: LLLL 59 03 RRRR

Response: LLLL 59 HH 03 RRRR

The abort download request stops the download process when an abnormal situation occurs. When the command is received, the attached device clears its memory and leaves the download mode.

The attached device will return an error code of LLLL 00 59 002C if it is not in download mode when the abort download command is issued.

Download Examples

The following pages contain examples of download requests for various conditions.

Summary of Primitives

Table 4-8 summarizes the Series 500 NIM Primitives.

Table 4-8 Summary of Primitives

Primitive	Format	
Exception	Request	(None)
	Response	LLLL 00 PP DDDD (TT) (Optional)
Native	Request	LLLL 01 DD ... DD
	Response	LLLL 01 HH DD ... DD
Status	Request	LLLL 02
	Response	LLLL 02 HH EE FF
Configuration	Request	LLLL 03
	Response	LLLL 03 HH DDDD EEEE FFFF GGGG IIII JJJJ KKKK KKKK
Primitive Format Configuration	Request	LLLL 04
	Response	LLLL 04 NNNN MM EE FF GG BB ... BB 16 bytes
Packed Native	Request	LLLL 05 CC DD ... DD (repeated) (repeated)
	Response	LLLL 05 HH CC DD ... DD (repeated) (repeated)
Reset Secondary Device	Request	LLLL 06
	Response	LLLL 06 HH
Segment Definition	Request	LLLL 07 VV SS
	Response	LLLL 07 HH VV KK SS CC DD ... DD (repeated)
Change State	Request	LLLL 10 DD
	Response	LLLL 10 HH
Read Block	Request	LLLL 20 TT NNNN AAAA
	Response	LLLL 20 HH DD ... DD (repeated)
Read Random Block	Request	LLLL 21 TT NNNN AAAA (repeated)
	Response	LLLL 21 HH XX BB DD ... DD (repeated) (repeated XX times)
Write Block	Request	LLLL 30 TT AAAA DD ... DD (repeated)
	Response	LLLL 30 HH

Series 500 NIM Primitive Descriptions (continued)

Table 4-8 Summary of Primitives (continued)

Primitive		Format
Write Random Block	Request	LLLL 31 TT NNNN AAAA DD ... DD (repeated)
	Response	LLLL 31 HH XX BB ... BB (repeated XX times)
Define Block	Request	LLLL 50 CC TT NNNN AAAA (repeated)
	Response	LLLL 50 HH
Gather Block	Request	LLLL 51 EEEEEEEE
	Response	LLLL 51 HH EEEEEEEE DD ... DD (repeated)
Write and Gather Blocks	Request	LLLL 52 EEEEEEEE TT AAAA DD ... DD (repeated)
	Response	LLLL 52 HH EEEEEEEE DD ... DD (repeated)
Define Record	Request	LLLL 55 CC DD TT NNNN AAAA (repeated DD times) (repeated up to 32 times)
	Response	LLLL 55 HH
Gather Record	Request	LLLL 56 XX CC ... CC (repeated XX times)
	Response	LLLL 56 HH XX CC...CC DD ... DD (repeated) (repeated XX times)
Write and Gather Record	Request	LLLL 57 XX CC...CC TT AAAA DD ... DD (repeated) (repeated XX times)
	Response	LLLL 57 HH XX CC...CC DD ... DD (repeated) (repeated XX times)

Table 4-8 Summary of Primitives (continued)

Primitive	Format	
Program Upload	Request	LLLL 58 00 RRRR MMMM OOOO LLLL 58 01 RRRR YYYY DD ... DD LLLL 58 02 RRRR LLLL 58 03 RRRR
	Response	LLLL 58 HH 00 RRRR MMMM OOOO LLLL 58 HH 01 RRRR YYYY WW ZZ DD ... DD (repeated) LLLL 58 HH XX RRRR (YYYY may be present on some codes)
Program Download	Request	LLLL 59 00 RRRR MMMM OOOO LLLL 59 01 RRRR YYYY VV WWZZ DD ... DD (repeated) LLLL 59 02 RRRR LLLL 59 03 RRRR
	Response	LLLL 59 HH 00 RRRR OOOO LLLL 59 HH 01 RRRR YYYY LLLL 59 HH XX RRRR (YYYY may be present on some exception codes)

Table 4-9 summarizes the same Primitives listed in Table 4-8, but with extended addressing.

Table 4-9 Summary of Primitives (Extended Addressing)

Primitive		Format
Exception	Request Response	(None) LLLL 00 PP DDDD (TT) (Optional)
Native	Request Response	LLLL 81 DD ... DD LLLL 81 HH DD ... DD
Status	Request Response	LLLL 82 LLLL 82 HH EE FF
Configuration	Request Response	LLLL 83 LLLL 83 HH DDDD DDDD EEEE EEEE IIII JJJJ KKKK KKKK
Primitive Format Configuration	Request Response	LLLL 84 LLLL 84 NNNN MM EE FF GG BB ... BB 16 bytes
Packed Native	Request	LLLL 85 CC DD ... DD (repeated) (repeated)
	Response	LLLL 85 HH CC DD ... DD (repeated) (repeated)
Reset Secondary Device	Request Response	LLLL 86 LLLL 86 HH
Segment Definition	Request Response	LLLL 87 VV SS LLLL 87 HH VV KK SS CC DD ... DD (repeated)
Change State	Request Response	LLLL 90 DD LLLL 90 HH
Read Block	Request Response	LLLL A0 TT NNNN AAAA AAAA LLLL A0 HH DD ... DD (repeated)
Read Random Block	Request	LLLL A1 TT NNNN AAAA AAAA (repeated)
	Response	LLLL A1 HH XX BB DD ... DD (repeated) (repeated XX times)
Write Block	Request	LLLL B0 TT AAAA AAAA DD ... DD (repeated)
	Response	LLLL B0 HH

Table 4-9 Summary of Primitives (Extended Addressing) (continued)

Primitive		Format
Write Random Block	Request	LLLL B1 TT NNNN AAAA AAAA DD ... DD (repeated)
	Response	LLLL B1 HH XX BB ... BB (repeated XX times)
Define Block	Request	LLLL D0 CC TT NNNN AAAA AAAA (repeated)
	Response	LLLL D0 HH
Gather Block	Request	LLLL D1 EEEEEEEE
	Response	LLLL D1 HH EEEEEEEE DD ... DD (repeated)
Write and Gather Blocks	Request	LLLL D2 EEEEEEEE TT AAAA AAAA DD ... DD (repeated)
	Response	LLLL D2 HH EEEEEEEE DD ... DD (repeated)
Define Record	Request	LLLL D5 CC DD TT NNNN AAAA AAAA (repeated DD times) (repeated up to 32 times)
	Response	LLLL D5 HH
Gather Record	Request	LLLL D6 XX CC (repeated XX times)
	Response	LLLL D6 HH XX CC DD ... DD (repeated) (repeated XX times)
Write and Gather Record	Request	LLLL D7 XX CC TT AAAA AAAA DD ... DD (repeated) (repeated XX times)
	Response	LLLL D7 HH XX CC DD ... DD (repeated) (repeated XX times)

Series 500 NIM Primitive Descriptions (continued)

Table 4-9 Summary of Primitives (Extended Addressing) (continued)

Primitive	**Format**	
Program Upload	Request	LLLL D8 00 RRRR MMMM OOOO LLLL D8 01 RRRR YYYY DD ... DD LLLL D8 02 RRRR LLLL D8 03 RRRR
	Response	LLLL D8 HH 00 RRRR MMMM OOOO LLLL D8 HH 01 RRRR YYYY WW ZZ DD ... DD (repeated) LLLL D8 HH XX RRRR (YYYY may be present on some codes)
Program Download	Request	LLLL D9 00 RRRR MMMM OOOO LLLL D9 01 RRRR YYYY VV WW ZZ DD ... DD (repeated) LLLL D9 02 RRRR LLLL D9 03 RRRR
	Response	LLLL D9 HH 00 RRRR OOOO LLLL D9 HH XX RRRR (YYYY may be present on some exception codes)

Appendix A

PM550 CIM Requirements

A.1 Introduction

This appendix discusses biasing and terminating the TIWAY I Local Line for network installations containing CIMs in addition to self-biased and switch-biased devices.

A.2 Local Line Length

The PM550 CIM supports operation over the Local Line at distances up to 10,000 feet and 9600 baud.

Advances in technology have provided line drivers and receivers that support Local Line operation up to 25,000 feet. These new drivers have been incorporated in TIWAY I Conformant devices to support the extended operation. However, in networks containing the PM550 CIM, which is not a TIWAY I conformant device, the Local Line length is restricted to 10,000 feet and 9600 baud.

A.3 Local Line Bias and Termination

For TIWAY I networks using the Local Line, some devices are provided with a toggle switch to allow selection of bias or no bias for the Local Line. Other devices have self-biasing built in and therefore have no Bias Switch. The CIM is provided with a jumper which allows selection of bias or no bias.

The Siemens Local Line must be properly terminated at both ends of the trunk to prevent a possible impedance mismatch that could result in signal reflections back along the line.

Termination is required regardless of the numbers or types of devices attached to the network.

NOTE: All Siemens tap housings contain factory-installed termination resistors. If the Tap Housing is not used to terminate the Local Line, the terminating resistors must be removed when the output cable is attached.

Networks with Switch-biased Devices and CIMs

On networks using devices with the Bias Switch, CIMs, and self-biased devices, a bias must be applied to the line using the switch-biased device as described in the previous section. All CIMs on the network should be positioned somewhere between the two outermost switch-biased devices.

Terminate the network according to the instructions in Chapter 2.

Networks with Only Self-biasing Devices and CIMs

On networks using devices without the Bias Switch, bias must be applied to the Local Line by the CIM. To accomplish this, proceed as follows:

1. On networks having only one CIM, place this CIM at one end of the Local Line trunk, and install the jumpers provided with the CIM in accordance with the instructions in the PM550 CIM User's Manual, Manual Number PM550–1101154–4. This will apply the correct bias to the Local Line to prevent oscillations of the CIM receivers.

   To terminate the Local Line, replace the existing terminating resistors inside the CIM T-Tap housing. Connect 150-ohm resistors between the LLM+ and the cable shield, and also between LLM– and the cable shield. This resistance value is 150 ohms in each instance, and the connection is made in accordance with instructions inside the tap housing. The combination of termination resistors in the CIM, together with these 150-ohm resistors, provide the correct Local Line termination. Then, terminate the other end of the local line as described in Chapter 2.

2. If more than one CIM is attached to a Local Line, place CIMs at the extreme ends of the Local Line trunk. Install the jumpers provided with the outermost CIMs in accordance with the instructions in the PM550 CIM User's Manual, Manual Number PM550–1101154–4. This will apply the correct bias to the Local Line to prevent oscillations of the CIM receivers.

   To terminate the Local Line, replace the existing terminating resistors inside the outermost CIM tap housings with 150-ohm resistors between the LLM+ and the cable shield, and also between LLM– and the cable shield. This resistance value is 150 ohms in each instance, and the connection is in accordance with instructions inside the tap housing. The combination of termination resistors in the CIM together with these 150-ohm resistors, provides the correct Local Line termination.

Figure A-1 illustrates the proper placement of the CIMs and the termination resistors for networks having CIMs and NIMs *without* the Bias Switch.

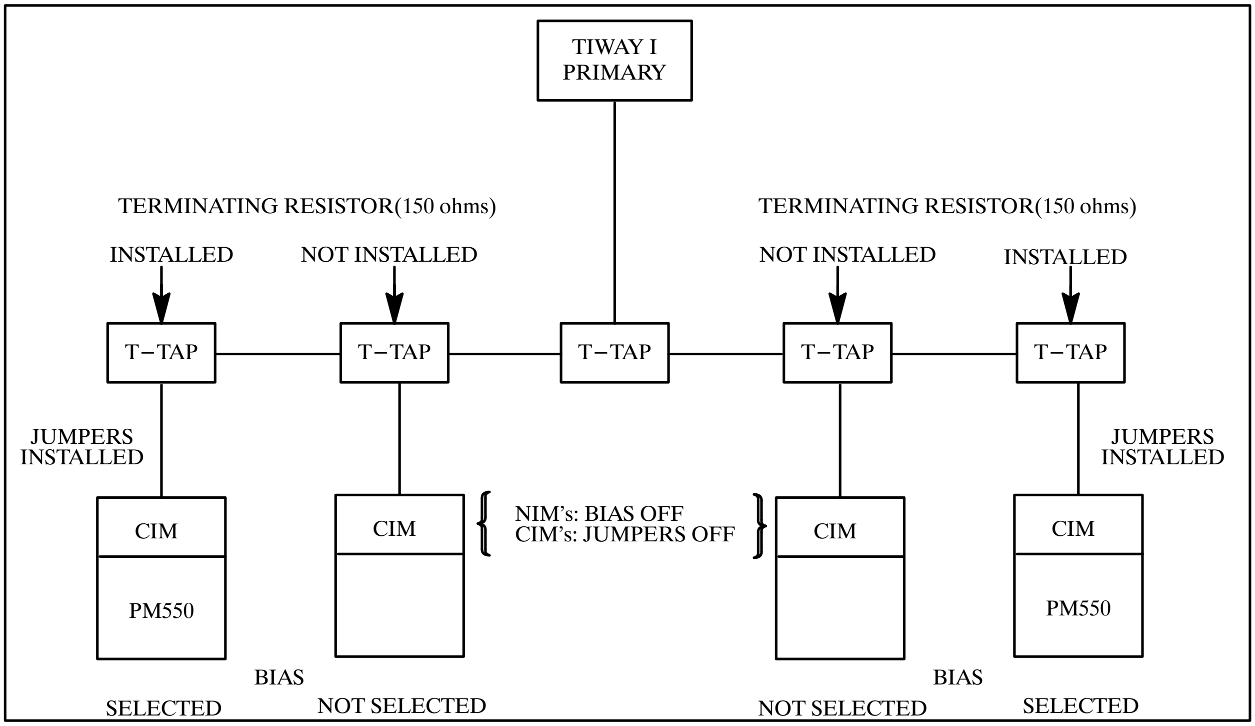


Figure A-1 Local Line Bias and Termination

Appendix B
Floating Point Numbers

B.1 Introduction

The Series 500 NIM allows IBM® excess 64 and IEEE representation of floating point data types (noted in Chapter 4).

Floating point formats consist of three parts: the sign bit, the exponent, and the mantissa, or fraction. For both the IBM and the IEEE formats, the sign bit indicates the positive or negative value of the mantissa. If the sign bit is set to one, the floating point number is a negative value. If the bit is set to zero, the number is positive.

The exponent and fraction of these formats will be described independently in the following paragraphs.

B.2 IBM Format

Floating point numbers are stored in memory in two 16-bit words as illustrated in Figure B-1. Before being stored in memory, however, the number is converted to a normalized hexadecimal fraction, a corresponding hexadecimal exponent, and a sign bit.

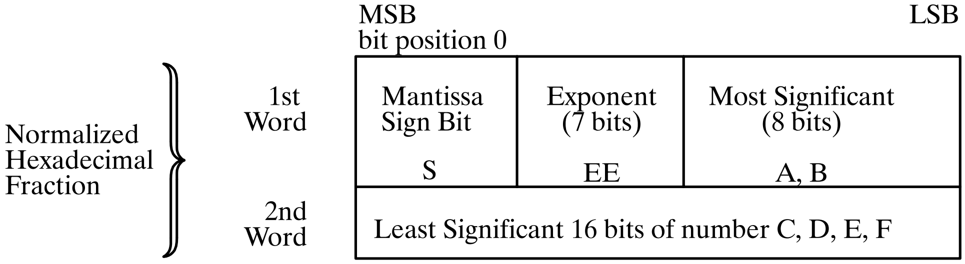
The fraction portion of the IBM number is normalized; that is, it is shifted to the left to eliminate leading zeros between the radix point and the first signficant bit. Each bit position shift in the normalization process produces a corresponding change in the exponent portion of the number which maintains the correct magnitude of the number. When the number is completely normalized, the IBM hexadecimal fraction is stored in bits 8 through 15 of the first memory word, and in all 16 bits of the second memory word. The radix point for the fraction is assumed to be positioned between bits 7 and 8 of the first memory word (at the start of the hexadecimal fraction).

The exponent portion of the number is biased by 40_{16} (excess 64 notation), so that the exponent for 16^0 is represented in memory by 40_{16}. Positive exponents are represented by numbers greater than 40_{16}, and negative exponents are represented by numbers less than 40_{16}. For example, 16^1 is represented in the exponent field by the value 41_{16}. The exponents may be any value from 00_{16} to $7F_{16}$; including the 40_{16} bias value, these numbers represent exponent values from -40_{16} to $+3F_{16}$ (16^{64} to 16^{23}). The seven exponent bits are stored in bits 1 through 7 of the first memory word.

Bit 0 of the first memory word is used for a sign bit. When this bit is zero, the number is positive. When this bit is one, the number is negative.

EXAMPLES:

Base 10 Number	Hexadecimal Contents of Memory Word	
	Word 1	Word 2
1.0	4110	0000
0.5	4080	0000
−1.0	C110	0000
0.03125	3F80	0000
100.0	4264	0000



A summary equation for IBM to decimal floating point conversion is:

$$\text{Base 10 Number} = (-1)^{S} * 16^{(EE_{16} - 40_{16})} * (A * 16^{-1} + \ldots + F * 16^{-6})$$

** All numbers in the above equation are hexadecimal.

Figure B-1 IBM Floating Point Representation

B.3 IEEE Format

The exponent portion of the IEEE format is similar to the IBM format except that it is 8 bits in length and is biased by $7F_{16}$. It is also different in that it represents a power of 2 instead of 16. The exponent for 2^0 is represented in memory by $7F_{16}$. Negative exponents are represented by numbers less than $7F_{16}$. For example, a 2^{-1} is represented in the exponent field by by a value of $7E_{16}$. The exponents may be any value from $-7E_{16}$ to $+7F_{16}$ (2^{-126} to 2^{127}). The eight exponent bits are stored in bits 1 – 8 of the first memory word. See Figure B-2.

The fraction portion of the IEEE format is similar to the IBM format. It is a hexadecimal fraction which is interpreted in one of many ways, depending on the value of the exponent. Table B-1 describes the different types of conversions for the IEEE format.

Table B-1 IEEE Conversions

Case	Exponent	Fraction	v (IEEE) = decimal value
A	FF_{16}	non−zero	NaN (regardless of sign bit)
B	FF_{16}	0	$+/- \infty$
C	$00_{16} < e < FF_{16}$	any value	$(-1)^s * 2^{(e-127)} *(1.f)$
D	00_{16}	non−zero	$(-1)^s * 2^{-126} *(0.f)$
E	00_{16}	0	+/−0 (depending on sign bit)
Note: s = sign bit; f = fraction; e = exponent			

Case A is an illegal value. A Not-a-Number (NaN) will never be returned from the Series 500 NIM. If this example is written to the NIM, an exception will be returned.

Case B, +/– infinity, is used to represent numbers too large in magnitude to be represented with the IEEE format.

Case C represents a normalized IEEE floating point value. (There is a one, not included in f, to the left of the radix point.)

Case D represents a denormalized IEEE floating point (contains a zero to the left of the radix point).

Case E represents a value of zero. Numbers too small to be represented in the IEEE format will be reported as a positive or a negative 0.

EXAMPLES:

Base 10 Number	Hexadecimal Contents of Memory Word
1.0	3F80 0000
0.5	3F00 0000
−0.5	BF00 0000
0.03125	3D00 0000
100.0	42C8 0000

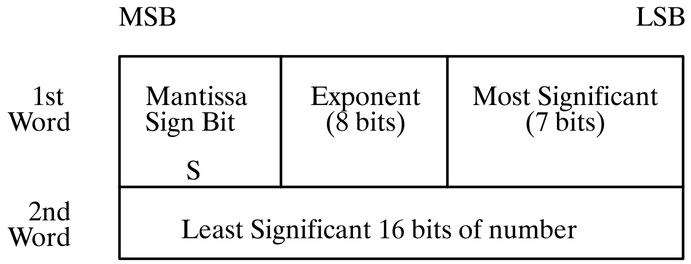


Figure B-2 IEEE Floating Point Representation

Appendix C
Network Configuration Data Sheet

Network Name ____________________ Location ____________________

Cable Diagram Reference ____

GENERAL SPECIFICATIONS

Media type ____________________ Network Baud Rate ______________

Sync/Asynch ____________________ Full/Half Duplex ______________

Encoding ____________________ Modem type ______________

NETWORK NODE SPECIFICATIONS

Node Name ____________________ Network Address ______________

Controller Type __________ Serial Number __________ Software Release __________

Interface Type __________ Serial Number __________ Software Release __________

DATA DEFINITION TABLE

Date Name or Identifier	Data Type	Starting Address	Number of Elements	Record Number	Block Number	Length (Bytes)

Appendix D

Network Evaluation Form

If you would like Siemens to evaluate your network requirements, complete and submit the Network Evaluation Form. Siemens Technical Services Group will analyze your requirements and provide you with a network design plan and quote.

TIWAY I NETWORK EVALUATION FORM

*DATE OF REQUEST: ___/___/___

*CUSTOMER COMPANY:

CONTACT NAME:

ADDRESS:

TELEPHONE: (____) ________ – ___________________

*AED CONTACT NAME: ____ PHONE:

*ORIGINATOR OF REQUEST:

*APPLICATION:

*PROPOSED HOST COMPUTER:

*PROGRAMMING LANGUAGE:

*PLC MODELS	INITIAL PLC QUALITY	NUMBER OF WORDS XFRED
* PM550–		
* 520		
* 530		
* 5TI–		
* 560		
* 565		
*		

*MAXIMUM DISTANCE FROM HOST TO FARTHEST PLC: (FEET)

*LIST ALL OPERATOR INTERFACE REQUIREMENTS FOR THE PLCs:

*CAN THE NETWORK SIZE BE REDUCED TO INCREASE PERFORMANCE?

*DESCRIBE MAXIMUM RESPONSE TIMES FOR COMMUNICATION:

*CONNECTIVITY REQUIREMENTS INTO OTHER NETWORKS OR DEVICES:

*WHO WILL BE WRITING THE APPLICATION SOFTWARE?

*SPECIAL SAFETY REQUIREMENTS:

*LIST ELECTRICAL NOISE PROBLEMS:

*OTHER REQUIREMENTS OR NOTES:

*WHEN DOES THE NETWORK HAVE TO BE OPERATIONAL?

*WHEN DOES THE COMPLETE SYSTEM HAVE TO BE OPERATIONAL?

*WHO DEFINES THE PLC CONTROL ENVIRONMENT?

*NAME: ____ PHONE: (_____) _________ –

*WHO DEFINES THE NETWORK AND SYSTEM REQUIREMENTS?

NAME: ____ PHONE: (_____) ________ –

*SEND NPS QUOTE TO:

NAME: ____ PHONE: (_____) ________ –

COMPLETE AND RETURN TO THE NETWORK PLANNING SERVICE FOR SITE SURVEY SUPPORT AND A QUOTE FOR A NETWORK DESIGN.

SEND TO: TECHNICAL SERVICES GROUP P.O. BOX 1255 JOHNSON CITY, TENN. 37605–1255

Appendix E
Specifications

Environmental Specifications

Operating temperature range	0° to 60° C (32° to 140° F)
Storage temperature range	–40° to 85° C (–40° to 185° F)
Operating humidity range	0 to 95% relative humidity
Vibration	NAVMAT P9492

Power Requirements

Model 5039: 1.25 watts, –5 VDC;
8 watts, +5 VDC

Model 5040: 0.06 watts, –5 VDC;
8 watts, +5 VDC

Communications

Data Rates	110; 150; 300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400; 57,600; 115,200 bits per second.
RS-232-C/423 Ports	Configured as Data Terminal Equipment (DTE), synchronous or asynchronous operation, full or half duplex operation, NRZ or NRZI encoding.
Local Line Ports	Local Line Ports default to asynchronous, half duplex, with NRZI encoding.
Data Link Protocol	High Level Data Link (HDLC, ISO 4335) Unbalanced Normal Response Mode, ADCCP (UN,4) class of procedure per Chapter 11 of ANSI Standard X3.66–1979. The Series 500 NIM operates as an HDLC Secondary station on the network.
Network Control Protocol	TIWAY I normally operates with null network layer services; however, the user may optionally select CCITT X.25 protocol in the Permanent Virtual Circuit Mode of operation.
Network Media	Shielded twisted pair cable for Local Line, or appropriate RS-232-C cable for RS-232-C models
Undetected Bit Error Rate	6 x 10^{-13} (calculated) with cable meeting TIWAY I recommended standards

Certifications and Approvals

UL Listed

Technical Assistance

Technical Services Group (423) 461–2501.

Appendix F
Primitive Examples

The following TIWAY I Primitive example (which does not include any program transfer capabilities) reads four words of variable memory from a Series 500 controller, starting at memory location 100 (hex = 64). The format for the request would be as follows:

Request: LLLL 20 TT NNNN AAAA = 0006 20 01 0004 0064, where:

LLLL (Length) = 0006
Primitive Code = 20
TT (Data Type) = 01 (V, variable memory)
NNNN (Number of locations) = 0004
AAAA (Address, data element location) = 0064

Response: LLLL 20 HH DDDD DDDD = 000A 20 00 8464 8665 A001 01F4
LLLL (Length) = 000A
Primitive Code = 20
HH (Status) = 00 (unit operational and executing logic)
DDDD ... (values read from V-memory)

V0100 = 8464_{16}

V0101 = 8665_{16}

V0102 = $A001_{16}$

V0103 = $01F4_{16}$

In this example, the same task is performed as in the above example, but with extended addressing.

Command: LLLL A0 TT NNNN AAAA AAAA = 0008 A0 01 0004 0000 0064, where:

LLLL (Length) = 0008
Primitive Code = A0 (extended address format for Primitive 20)
TT (Data Type) = 01 (V, variable memory)
NNNN (Number of locations) = 0004
AAAA AAAA (Address) = 0000 0064

Response: LLLL A0 HH DDDD DDDD = 000A A0 00 8464 8665 A001 01F4

LLLL (Length) = 000A
Primitive Code = A0 (extended address format for Primitive 20)
HH (Status) = 00 (unit operational and executing logic)
DDDD ... (values read from V-memory)

V100 = 8464_{16}

V101 = 8665_{16}

V102 = $A001_{16}$

V103 = $01F4_{16}$

Customer Response

We would like to know what you think about our user manuals so that we can serve you better. How would you rate the quality of our manuals?

	Excellent	Good	Fair	Poor
Accuracy	_______	_______	_______	_______
Organization	_______	_______	_______	_______
Clarity	_______	_______	_______	_______
Completeness	_______	_______	_______	_______
Graphics	_______	_______	_______	_______
Examples	_______	_______	_______	_______
Overall design	_______	_______	_______	_______
Size	_______	_______	_______	_______
Index	_______	_______	_______	_______

Would you be interested in giving us more detailed comments about our manuals?

☐ **Yes!** Please send me a questionnaire.

☐ **No.** Thanks anyway.

Your Name: ____

Title: ____

Telephone Number: (_____)____

Company Name: ____

Company Address: ____

____

____

Manual Name: SIMATIC TIWAY I Series 500 NIM User Manual **Edition:** Fifth
Manual Assembly Number: 2587871–0054 **Date:** 11/95
Order Number: PPX:TIWAY–8110

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3000 BILL GARLAND RD
P O BOX 1255
JOHNSON CITY TN 37605–1255

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