
NXG COMMUNICATIONS MANUAL FOR HARMONY SERIES

Adjustable Speed AC Motor Drives
with Next Generation Control

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- Version 2.6 and later NXG Software

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Safety Precautions and Warnings

Perfect Harmony drives are designed with considerable thought to personal safety. However, as with any piece of high power equipment, there are numerous internal connections that present potentially lethal voltages. In addition, some internal components are thermally hot to the touch. Follow the warnings below when working in or near the Perfect Harmony System.



Danger - Electrical Hazards!

- **Always** follow the proper lock-out/tag-out procedures before beginning any maintenance or troubleshooting work on the drive.
- **Always** follow standard safety precautions and local codes during installation of external wiring. Protective separation must be kept between extra low voltage (ELV) wiring and any other wiring as specified in IEC61800-5-1.
- **Always** work with one hand, wear insulated or rubber safety shoes, and wear safety glasses. Also, always work with another person present.
- **Always** use extreme caution when handling or measuring components that are inside the enclosure. Be careful to prevent meter leads from shorting together or from touching other terminals.
- **Use** only instrumentation (e.g., meters, oscilloscopes, etc.) intended for high voltage measurements (that is, isolation is provided inside the instrument, not provided by isolating the chassis ground of the instrument).
- **Never** assume that switching off the input disconnect will remove all voltage from internal components. Voltage is still present on the terminals of the input disconnect. Also, there may be voltages present that are applied from other external sources.
- **Never** touch anything within the Perfect Harmony cabinets until verifying that it is neither thermally hot nor electrically alive.
- **Never** remove safety shields (marked with a **HIGH VOLTAGE** sign) or attempt to measure points beneath the shields.
- **Never** run the drive with cabinet doors open. The only exception is the control cabinet which contains extra low voltages (ELV).
- **Never** connect any grounded (i.e., non-isolated) meters or oscilloscopes to the Perfect Harmony system.
- **Never** connect or disconnect any meters, wiring, or printed circuit boards while the drive is energized.
- **Never** defeat the instrument's grounding.
- **Only** qualified individuals should install, operate, troubleshoot, and maintain this drive. A qualified individual is "one familiar with the construction and operation of the equipment and the hazards involved."
- **Hazardous voltages** may still exist within the Perfect Harmony cabinets even when the disconnect switch is open (off) and the supply power is shut off.

**Warning!**

- **Always** comply with local codes and requirements if disposal of failed components is necessary (for example, CPU battery, capacitors, etc.).
- **Always** ensure the use of an even and flat truck bed to transport the Perfect Harmony drive system. Before unloading, be sure that the concrete pad is level for storage and permanent positioning.
- **Always** confirm proper tonnage ratings of cranes, cables, and hooks when lifting the drive system. Dropping the cabinet or lowering it too quickly could damage the unit.
- **Never** disconnect control power while medium voltage is energized. This could cause severe system overheating and/or damage.
- **Never** store flammable material in, on, or near the drive enclosure. This includes equipment drawings and manuals.
- **Never** use fork trucks to lift cabinets that are not equipped with lifting tubes. Be sure that the fork truck tines fit the lifting tubes properly and are the appropriate length.

**ESD Sensitive Equipment!**

- Always be aware of electrostatic discharge (ESD) when working near or touching components inside the Perfect Harmony cabinet. The printed circuit boards contain components that are sensitive to static electricity. Handling and servicing of components that are sensitive to ESD should be done only by qualified personnel and only after reading and understanding proper ESD techniques. The following ESD guidelines should be followed. Following these rules can greatly reduce the possibility of ESD damage to PC board components.
- Always transport static sensitive equipment in antistatic bags.
- Always use a soldering iron that has a grounded tip. Also, use either a metallic vacuum-style plunger or copper braid when desoldering.
- Make certain that anyone handling the Perfect Harmony printed circuit boards is wearing a properly grounded static strap. The wrist strap should be connected to ground through a 1 megohm resistor. Grounding kits are available commercially through most electronic wholesalers.
- Static charge buildup can be removed from a conductive object by touching the object to a properly grounded piece of metal.
- When handling a PC board, always hold the card by its edges.
- Do not slide printed circuit boards across any surface (e.g., a table or work bench). If possible, perform PCB maintenance at a workstation that has a conductive covering that is grounded through a 1 megohm resistor. If a conductive tabletop cover is unavailable, a clean steel or aluminum tabletop is an excellent substitute.
- Avoid plastic, Styrofoam™, vinyl and other non-conductive materials. They are excellent static generators and do not give up their charge easily.
- When returning components to Siemens LD A, always use static-safe packing. This limits any further component damage due to ESD.

Additional safety precautions and warnings appear throughout this manual. These important messages should be followed to reduce the risk of personal injury or equipment damage.



About This Manual

Separation of Manuals

This manual is one component in a series of manuals intended for use with the Perfect Harmony series of adjustable speed AC motor drives. Each part in this series is for use by individuals having unique job functions and qualifications. The manuals in this series are listed below:

- *NXG Communications Manual* (Manual Number: A5E02924901)
- *NXG Control Manual* (Manual Number: A5E02924900)
- *NXG ToolSuite User Manual* (Manual Number: A5E03086439)

The *NXG Communications Manual* describes the Communication Board that enables network communication via a variety of protocols, and enables modem connection. The system supports up to two networks. Only the Modbus and Ethernet Modbus protocols are enabled with the Communication Board alone. All others require optional controller cards, called UCS modules or AnyBus modules, which plug into the Communication Board.

The *NXG Control Manual* describes the NXG Control interface, applications, troubleshooting, maintenance, and system programming.

The *NXG ToolSuite User Manual* describes the NXG ToolSuite, which is a PC-based application that integrates various software tools used for NXG based drives. With the ToolSuite, the operator can navigate through a drive's features using a PC and a mouse or touch screen, which makes the ToolSuite more convenient to use than a keypad. The NXG ToolSuite is a high-level GUI that runs on a PC equipped with the Microsoft Windows operating system.

All manuals in this series contain a reader's comments form. Please complete this form and return it to us. Monitoring your feedback allows us to continue to exceed your expectations and provide complete, effective, easy-to-use product documentation.

Reference Tools

Many steps have been taken to promote the use of this manual as a reference tool. Reference tools include the following:

- A thorough table of contents for locating particular sections or subsections
- Chapter number thumb nails in the outer margins for easy location of chapters
- Special text styles are applied to easily differentiate between chapters, sections, subsections, regular text, parameter names, software flags and variables, and test points
- A comprehensive index

If you have any comments or suggestions to improve the organization or increase the usability of this manual, please complete the Reader's Comments Form located at the end of this manual and return it to Siemens LD A R&D Technical Documentation Department.

Conventions Used in this Manual

The following conventions are used throughout this manual:

- The terms “Perfect Harmony,” “VFD,” “variable frequency drive,” and “drive” are used interchangeably throughout this manual.



Note: Hand icons in the left margin alert readers to important operational or application information that may have special significance. The associated text is enclosed in a border for high visibility.



Attention! Attention icons in the left margin alert readers to important safety and operational precautions. These notes warn readers of potential problems that could cause equipment damage or personal injury. The associated text is enclosed in a border for high visibility.



Caution - Electrical Hazard! Electrical hazard icons in the outer margins alert readers to important safety and operational precautions. These notes warn readers of dangerous voltages, potential safety hazards, or shock risks that could be life threatening. The associated text is enclosed in a border for high visibility.



ESD Warning! These icons in the left margin alert readers to static sensitive devices. Proper electrostatic discharge precautions should be taken before proceeding or handling the equipment.

▽ ▽ ▽

1 Communications Overview

1.1 Introduction

Each Siemens NXG Control has a Communication Board that enables network communication via a variety of protocols and enables modem connection. The system supports up to two networks. Only the Modbus™ and Ethernet Modbus™ protocols are enabled with the Communication Board; all others require optional controller cards, called UCS modules or AnyBus™ modules, which plug into the Communication Board. Figure 1-1 shows an NXG Communication Board. Note the locations of the connectors for the UCS modules, AnyBus™ modules, the Modbus™ port, the debug port, the Modbus™ jumpers, board designator jumper, and the RS232 jumpers.

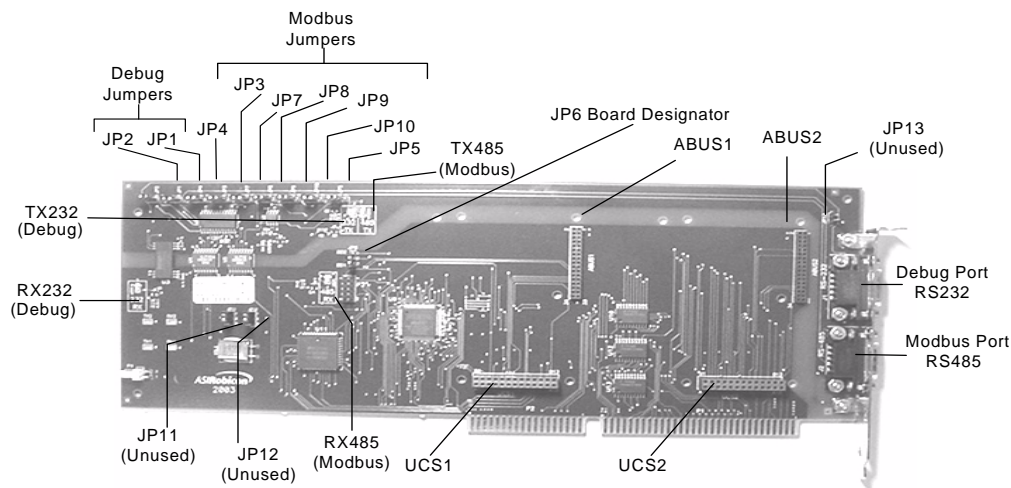


Figure 1-1: NXG Communication Board

The Modbus™ and Ethernet Modbus™ communication protocols are available without the addition of any UCS or AnyBus™ modules. The Ethernet Modbus™ connection is on the microprocessor board. UCS modules, which support the following protocols, are available from Siemens:

- DeviceNet™ Drive Profile (DP)
- Modbus™ Plus
- Profibus™
- DH+™

AnyBus™ modules support:

- Profibus™
- Ethernet Modbus (as Network 2 only)
- DeviceNet™ Profile 12
- Modbus™ Plus
- ControlNet™

1.2 RS232 Debug Port

1

The debug port shown in Figure 1-1 is useful for downloading system program data from a PC, as well as for uploading parameter dumps, event logs, and historic data logs directly to a PC or through an external modem.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive’s manual.

Figure 1-2 below shows a communications connection between a PC and a drive. Table 1-1 shows RS-232 jumper settings.

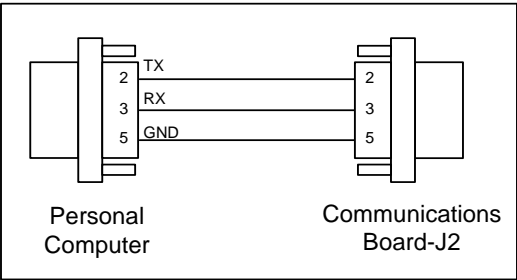


Figure 1-2: Typical RS232 Communications Connection

Table 1-1: RS232 Jumper Settings

Jumper	Setting	Jumper Diagram
JP1 = 1-2 JP2 = 1-2	RD on pin 2 TD on pin 3	
JP1 = 2-3 JP2 = 2-3	RD on pin 3 TD on pin 2	

1.3 Dual Networks

The NXG Control supports dual networks. Dual networks usually require optional hardware.

1.3.1 Dual Networks with UCSTM and AnyBusTM Modules

The protocols listed below require an additional UCSTM module:

- DeviceNetTM DP
- ModbusTM Plus
- ProfibusTM
- DH+TM

The protocols listed below require an additional AnyBusTM module:

- ProfibusTM
- Ethernet Modbus
- DeviceNetTM Profile 12
- ModbusTM Plus
- ControlNetTM

For the modules listed above, network designations follow the numbering of the board connection (e.g., UCS1 is Network 1).

1.3.2 Dual Networks with ModbusTM

Two Communication Boards or one Communication Card and one Siemens ModbusTM are required to support dual networks.

Table 1-2 shows the hardware used to support each of the two networks based on the control type:

Table 1-2: NXG and NXG II Control

	NXG Control	NXG II Control
Network 1 Hardware	Communication Board 1	Communication Board 1
Network 2 Hardware	Communication Board 2	Siemens Modbus TM Module

Refer to Section 2.5 for ModbusTM hardware configuration.

1

Table 1-3: Dual Networks with Modbus™

Board	Dual Modbus	Ethernet/Modbus	JP6 Jumper Position
Board 1 ¹	JP6 set to BD1 Debug Port Available Modbus™ 1	JP6 set to BD1 Debug Port Available No communication port ²	<div> BD2 <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 BD1 <input checked="" type="checkbox"/> 3 </div>
Board 2	JP6 set to BD2 No Debug Port Modbus™ 2	JP6 set to BD2 No Debug Port Modbus™	<div> BD2 <input checked="" type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 BD1 <input type="checkbox"/> 3 </div>

1. The user can use one board for the Ethernet Modbus™/Modbus™ dual network if they do not require a debug port. The single board must still be designated as BD2. See Figure 1-3 for the board setup.
2. The ethernet network is connected to the microprocessor board and must be designated as Network 1.

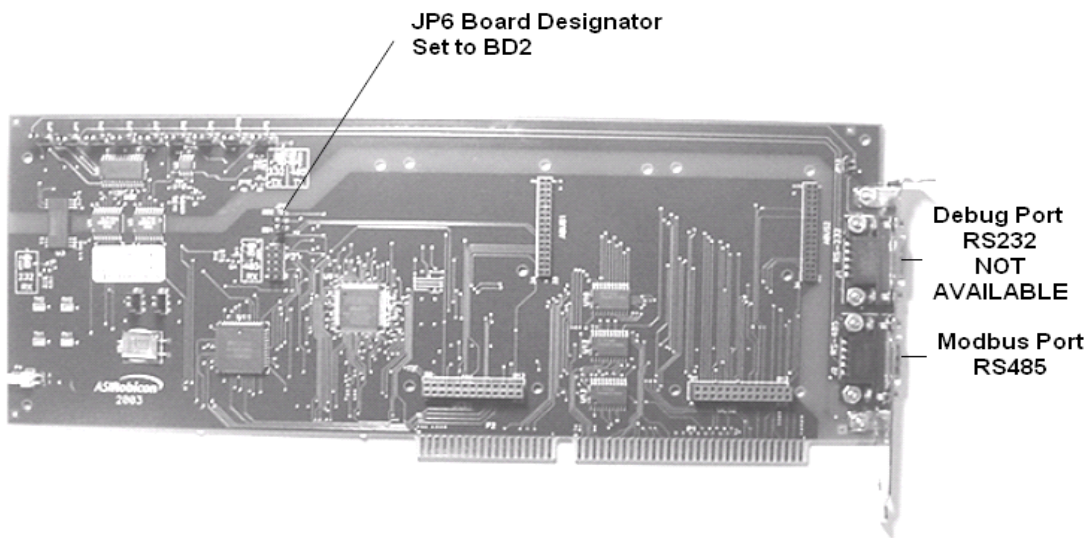


Figure 1-3: Using One Board for Ethernet Modbus™ and Modbus™ Dual Network

Figures 1-4 and 1-5 show the board settings and connections for an Ethernet Modbus/Modbus dual network with a debug port.

1. Set JP6 to BD1 on the board where the Debug port is available. BD1 will not have a communications port available.

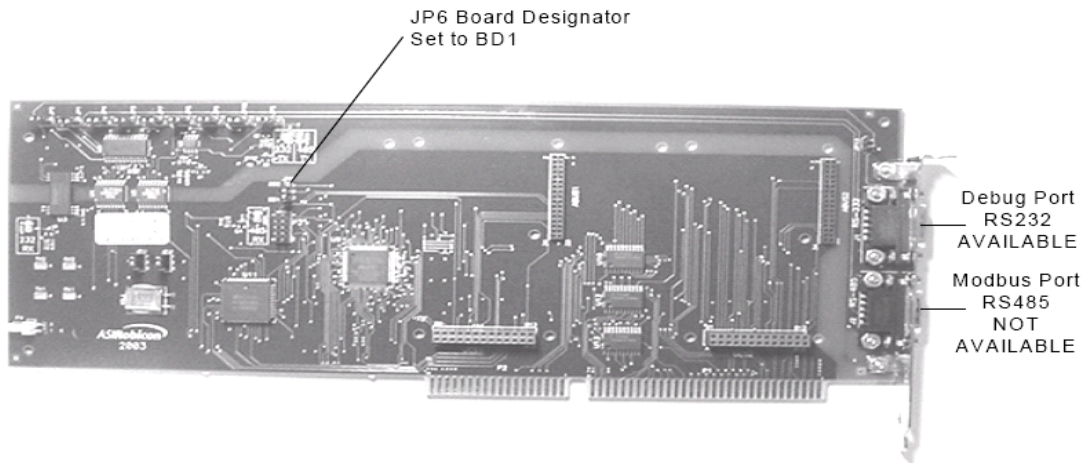


Figure 1-4: Using Ethernet Modbus—Board 1 Setup

2. Set JP6 to BD2 on the board where Modbus™ is available.

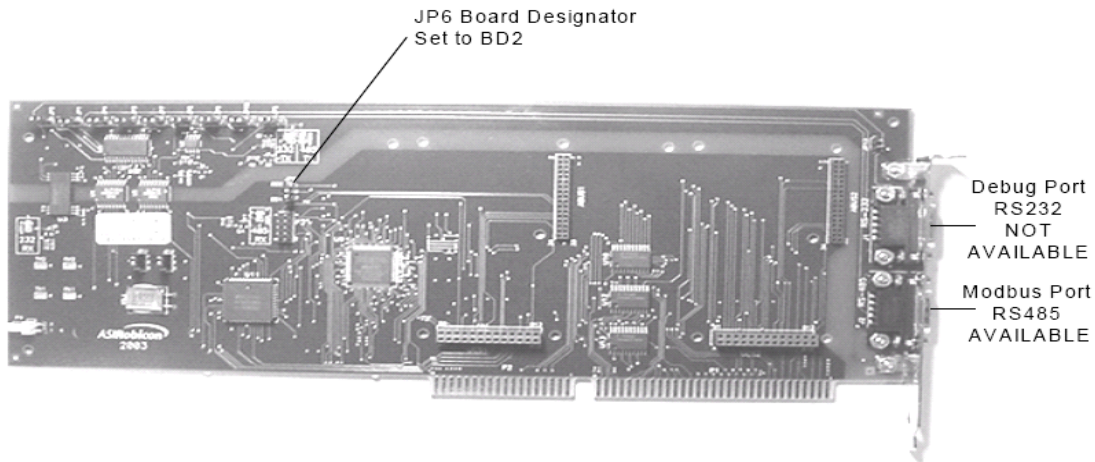


Figure 1-5: Modbus™—Board 2 Setup



Note: If the system fails to boot up, check the firmware on the Communication Board for current Version Number.

Menu function **Network Module Types (9955)** will display the types of UCS or AnyBus™ modules installed in the system.



1

CHAPTER

2 Modbus™ Communications

2

2.1 Introduction

Every NXG Control is shipped with the necessary hardware to support Modbus™ network protocol connectivity. Connectivity using other network protocols is possible with optional controller cards that plug into the Communication Board. This chapter contains instructions on how to control a Siemens VFD using a PLC over a Modbus™ network.

This chapter features a Fast Setup section that will help the user to start controlling the Siemens drive with NXG control via a Modbus™ PLC as quickly as possible. Section 2.2 is short, procedural, and covers a minimum of detail. Please refer to the other sections for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, e.g., (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [⇒] in order to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [⇒] key. A numerical value expressed as 0xnn (e.g., 0x12) is being represented in hexadecimal format.

The Modbus™ control interface specification is an open architecture design. Information on Modbus™ is available from:

Schneider Automation Inc.

One High Street
North Andover, MA 01845
Tel: (978) 794-0800
Fax: (978) 975-0910
Website: www.modicon.com

The Modbus™ communication interface is a serial interface that operates at standard baud rates up to 19.2 Kbaud. The 10-bit data frame consists of 1 start bit, 8 data bits (no parity), and 1 stop bit. These data parameters are **fixed** for the drive.

The drive always acts as a Modbus™ slave. This means that the drive does not initiate dialogue on the Modbus™ network. Rather, it listens to and then responds to the Modbus™ master (the PLC).

Currently, only register-based read and write functions of the Modbus™ protocol are supported. These functions are used to monitor and control analog and digital inputs and outputs of the drive.

Notes:

- Users must already be familiar with Modicon's Modbus™ protocol specification and terminology. If additional information is required, please contact Schneider Automation, Inc. at the address given above.
- Only the Remote Terminal Unit (RTU) format of the Modbus™ protocol is supported by the NXG Control.

2.2 Fast Setup

To begin controlling the Siemens drive using a Modbus™ PLC, as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

2

2.2.1 Set up Modbus™ for Motor Control using Default Configuration (Fixed Reg Bits)

The drive can be controlled from a PLC using the following simple setup procedure. Using the keypad on the front of the drive, set 'Network 1 Type' (9901) to Modbus™. Set the correct baud rate (9060) and address (9070). Finally, set the 'Status/Control Menu' (9944) to FIXED. This sets the bits at Modbus™ address 40065 to have the definitions shown below in Table 2-1. Next, add the following line to the SOP: Network1RunEnable_O = TRUE; (the semicolon is part of the code).

The user can now control the drive through the PLC.

Table 2-1: Default meaning of 'Fixed Reg Bits'

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved.

To run the motor, the PLC must send 0x21 in register 40065. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 in register 40065.

2.2.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:,

1. Set the desired speed units that will be sent (RPM,% or HZ) in menu (9080).
2. The PLC needs to send the desired speed setting to the drive in Modbus™ register 40066. This is a reserved register only used to hold speed settings (refer to Table 2-27).
3. Send 0x61 in Modbus™ register 40065. The motor will accept the PLC commanded speed setting.

2.2.3 To Control the Motor Using User-defined Bits Controlled by the SOP

Use the keypad on the front of the drive to set 'Network 1 Type' (9901) to Modbus™. Set the correct baud rate (9060) and address (9070). Finally, set the 'Status/Control' menu (9944) to SOP. To control the motor this way, the drive needs to know what bits will be used in the SOP program. Three steps are required to do this:

1. Find the bits required by referring to Table 2-2 below, and locate the keypad pick list variable associated with the bits. By referring to Table 2-27, the user can see that the first available data to drive register is at Modbus™ address 40067, which corresponds to keypad parameter ID (9603). Using the keypad on the drive, go to menu item 'Data To Drive 03' (9603).
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program, as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit  
;Network1Flag1_I Use bit 1 for Run Forward bit  
RunRequest_O = /Network1Flag0_I * Network1Flag1_I;Run drive using bit  
1,stop using bit 0
```

3. To enable speed settings from the network, add the following line to the SOP program file:

```
RawDemandNetwork1_O = true;
```

If the user chose 'Data to Drive 03' as the write register; by referring to Table 2-27, they can see that the PLC now needs to send 0x02 in Modbus™ address 40067 to run the drive, or 0x01 in the same register to stop the drive.

Table 2-2: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 2.9.3

2.2.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed. Set 'Network 1 Type' (9901) to Modbus™. Set the correct Baud Rate (9060) and Address (9070). Set Velocity Units (9080) to desired motor speed units. By referring to Table 2-27, the user can see the Modbus™ addresses needed to read drive status and speed feedback from the drive by sending from the PLC Modbus™ are 40001 and 40002, respectively. The definitions of the status bits, which are always found in Modbus™ register 40001, are shown below.

Table 2-3: General Status output from the drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

See Section 2.7 for details on how to read other drive data.

2.3 Remote Capabilities

The Modbus™ interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through Modbus™ telegrams sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.

Note that the discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

2.4 Menu Setup Procedures

The Modbus™ interface is built in to all Siemens drives with NXG control. It uses a dedicated serial port. To configure the Modbus™ interface, simply configure the serial port and related operating characteristics of the interface via the drive's keypad menu system.

All Modbus™ setup functions are contained in the Configure Parameters Menu (9902), which is a submenu of the Communications Menu (9). Access is security-controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the Modbus™ interface are listed in Table 2-32. For the correct setup procedure, please refer to Section 2.7.

Select menu contents by using pick lists. The Modbus™ address of each menu item is fixed. For example, for network 1, 'Data from Drive 01' (9401) can be read by sending the read register request in address 40001. The menu 'Data from Drive 02' (9402) can be read in address 40002, and so on. The complete address references can be found in Table 2-33.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user will need to search Appendix B to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 2.7.1.

2.5 Network Interface

The Network Interface Section provides information regarding settings and configuration for the Communication Board and the Siemens Modbus™ module.

2.5.1 Network 1 Interface

Modbus™ Network 1 is supported by the Communication Board. (see Section 2.5.3 for Communication Board settings and configuration).

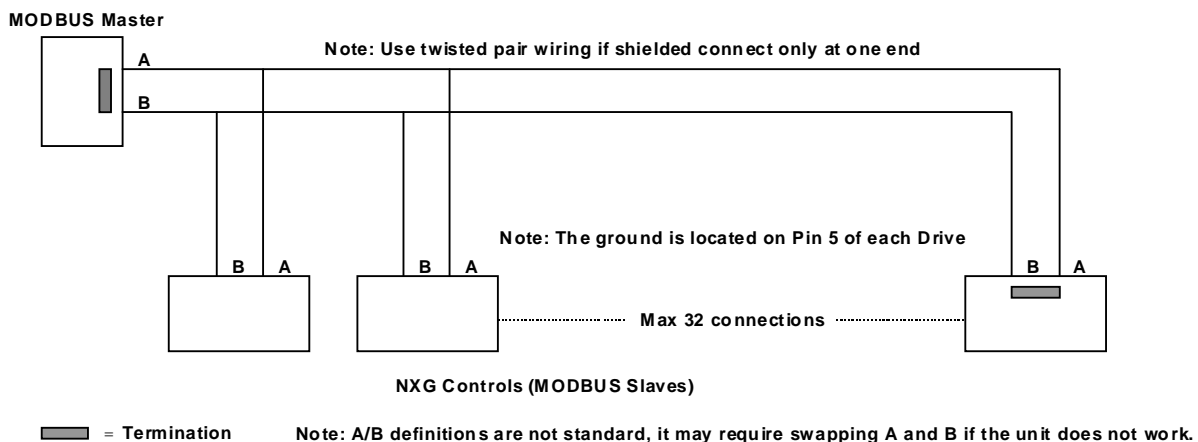


Figure 2-1: Typical Two-Wire Modbus™ Communications Connection

2.5.2 Network 2 Interface

Modbus™ Network 2 has two different hardware configurations available, based on the control method provided.



Note: The menu setup for both Network 2 configurations are the same, regardless of the control method used.

- NXG Control - Features include a 14 slot backplane with spare ISA slots. Modbus™ Network 2 is supported by adding a Communication Board into the ISA backplane (see Section 2.5.3 for Communication Board settings and configuration).
- NXGII Control - Features include an 8 slot backplane and does not contain any spare ISA slots. Modbus™ Network 2 is supported by adding a Siemens Modbus™ module onto the ABUS2 connector located on the Communication Board (see Section 2.5.4 for Siemens Modbus™ module settings and configuration).

2.5.3 Communication Board Configuration

The Modbus™ serial port for the NXG Control is located on the Communication Board (Figure 2-2 shows the pin designations used for the output connector).



Note: The Modbus™ serial port is an optically isolated two-wire (shielded, twisted pair), half-duplex, RS-485 serial interface.

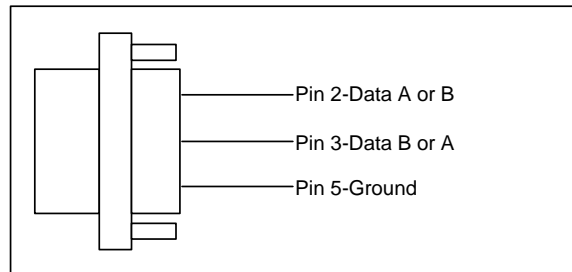


Figure 2-2: RS-485 Pin Designations

Jumper settings are available for configuring data(+) and data(-) signals. These settings swap the functions of pins 2 and 3 on the output connector. If the user is unsure of which settings are correct for the interface, try one and then the other. Jumpers are also provided to enable or disable the 120-ohm terminator resistor.



Note: When verifying settings are correct for the interface, note that nothing will be harmed with an incorrect setting.

Table 2-4: Modbus™ Related Jumpers on Communication Board

Jumper	Setting
JP5 = 1-2	Terminator resistor disabled
JP5 = 2-3	Terminator resistor enabled
JP3 = 1-2 JP4 = 1-2	Data (B) on Pin 2 Data (A) on Pin 3
JP3 = 2-3 JP4 = 2-3	Data (B) on Pin 3 Data (A) on Pin 2
JP7 - JP8	Network Biasing
JP9 - JP10	Network Biasing

If network bias is needed, refer to Table 2-5 for jumper settings.

Table 2-5: Modbus™ Related Jumpers Settings for Network Bias

Jumper	Jumper	Setting
JP7= 1-2	JP9= 1-2	Bias Disabled (Default)
JP7= 1-2	JP9= 2-3	Invalid
JP7= 2-3	JP9= 1-2	Invalid
JP7= 2-3	JP9= 2-3	Bias Enabled

If additional bias is needed, refer to Table 2-6 for jumper settings.

Table 2-6: Modbus™ Related Jumper Settings for Network Bias

Jumper	Jumper	Setting
JP8= 1-2	JP10= 1-2	Bias Disabled (Default)
JP8= 1-2	JP10= 2-3	Invalid
JP8= 2-3	JP10= 1-2	Invalid
JP8= 2-3	JP10= 2-3	Bias Enabled

2.5.4 Siemens Modbus™ Module Configuration (for Network 2)

The Siemens Modbus™ module (see Figure 2-3) was designed to support a second Modbus connection without the need for a second Communication Board.

The module plugs into the ABUS2 connector (see Figure 1-1 in Chapter 1) located on the Communication Board.

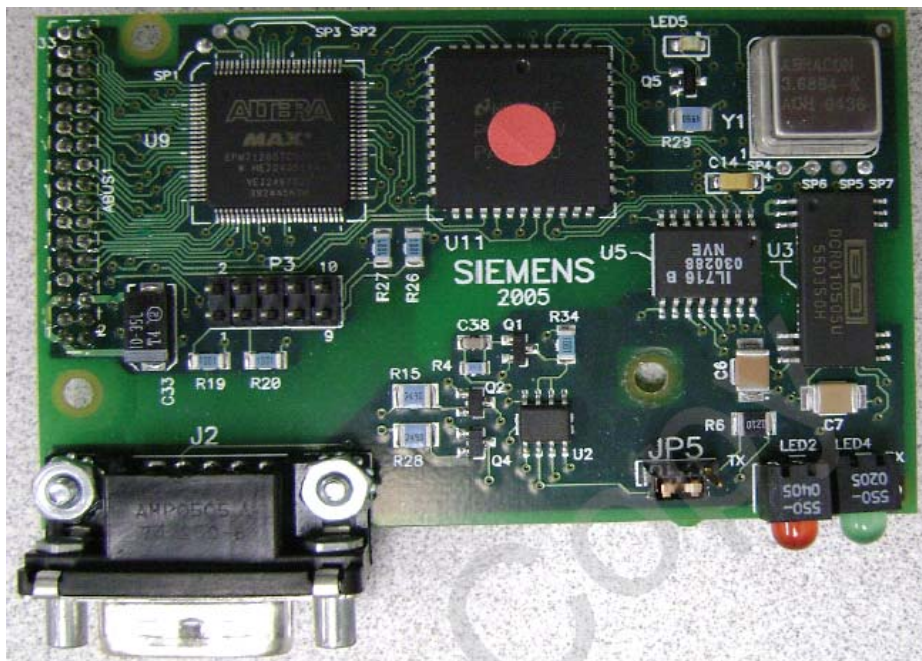


Figure 2-3: Siemens Modbus™ Module

The red LED is used to indicate that the module is sending data to the Modbus™ network.

The green LED is used to indicate that the module is receiving data from the ModbusTM network.



Note: The green LED does not indicate the network traffic is for this specific device, it only indicates network traffic is present.

The module has fixed-pin designations for Data A and Data B (see Figure 2-4 for RS-485 output pin configuration).

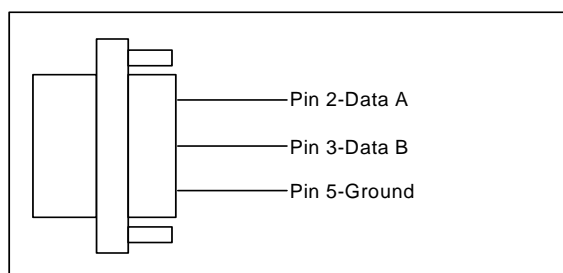


Figure 2-4: RS-485 Pin Designation

The module contains a jumper (JP5) which can be used to terminate the network line. (see Table 2-7)

Table 2-7: Modbus™ Related Jumpers on Communication Board

Jumper	Setting
JP5= 1-2	Terminator resistor disabled
JP5= 2-3	Terminator resistor enabled

2.6 Supported Command Set

The NXG Control implements the following Modbus commands:

- Read Coil Command Function code 0x01
- Read Holding Registers Function code 0x03
- Write Single Register Function code 0x06
- Loop back Diagnostic Test Function code 0x08
- Write Multiple Registers Function code 0x10

Each of these supported commands are listed and described in the sections that follow. Each of these commands is issued by the Modbus™ master (PLC) and sent over the network (to the Siemens slave[s]).

2.6.1 Read Coil Command (0x01)

This function allows the user to obtain the ON/OFF status of logic coils used to control discrete outputs from the addressed slave. In addition to the slave address and function fields, the message requires that the information field contain the initial coil address to be read (Starting Address) and the number of locations that will be interrogated to obtain status data.

The coils are numbered from zero (coil number 1 = zero, coil number 2 = one, etc.). The figure below shows a sample of Read Output Status Request to read coils 0020 to 0056 from a slave device number 3.

Figure 2-5: Sample Read Output Status Request

TX

01	01	00	13	00	25	--	--
----	----	----	----	----	----	----	----

An example response to Read Output Status is shown below. The data is packed with one bit for each coil. The response includes the slave address, function code, quantity of data characters, the data characters, and error checking. Data will be packed with one bit for each coil (1 = ON, 0 = OFF). The low order bit of the first character contains the addressed coil, and the remainder bits follow. For coil quantities that are not even multiples of eight, the last characters will be filled in with zeros at high order end.

Figure 2-6: Sample Read Output Register of Read Coil Status Message

RX

01	01	CD	6B	B2	0E	1B	--	--
----	----	----	----	----	----	----	----	----

The status of coils 20-27 is shown as CD (HEX) = 1100 1101 (Binary). Reading left to right, this shows that coils 27, 26, 23, 22, and 20 are all on. The other coil data bytes are decoded similarly. Due to the quantity of coil statuses requested, the last data field, which is shown as 1B (HEX) = 001 1011 (Binary), contains the status of only five coils (52-56) instead of eight coils. The three left-most bits are provided as zeros to fill the 8-bit format.

Table 2-8: Read Coils Transmission to Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x01	Read coils command
Start address of coils to read (HIGH)	0x00	Start address is coil number 20
Start address of coils to read (LOW)	0x13	
Number of coils to read (HIGH)	0x00	Read 37 coils starting from coil 20
Number of coils to read (LOW)	0x25	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

Table 2-9: Read Coils Response from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x01	Read coils command
Data from coils	0xCD	Decoded data as described above
Data from coils	0x6B	
Data from coils	0x02	Decoded data from coils
Data from coils	0x0E	
Data from coils	0x1B	Decoded data, high bits are filled with zeros if no data requested
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

2.6.2 Read Holding Registers Command (0x03)

The read holding registers command allows the Modbus™ master to read up to 64 consecutive memory registers from the drive. A sample read holding register command and its associated response are shown (in hexadecimal) in Figure 2-7. This sample request to read two registers (40005 and 40006) is detailed in Table 2-10. The drive’s read holding register response is detailed in Table 2-11. Parameter names and their corresponding data ID numbers are listed in Appendix B of this manual.

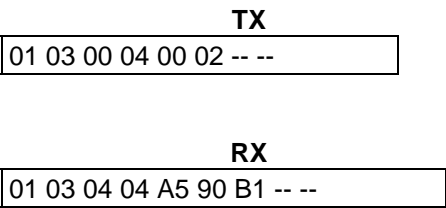


Figure 2-7: Sample Read Output Registers Command (TX) and Response (RX)

Table 2-10: Read Output Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x03	Read output registers command
Starting Address (High)	0x00	Register number 40005
Starting Address (Low)	0x04	
Number of Registers to Read (High)	0x00	Read 2 (0x0002) registers
Number of Registers to Read (Low)	0x02	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

Table 2-11: Read Output Registers Response (RX) from Drive

Field Name	Value (in Hex)	Actual Result	Scaled Value	Notes
Slave Address	0x01	N/A	N/A	0x01 = 1 decimal
Function	0x03	N/A	N/A	Read output register command code
Byte Count	0x04	N/A	N/A	4 bytes in response
Data Value 1 (MSB)	0x04	0x04A5	This register is user programmable. See Table 2-33.	high byte of item 1
Data Value 1 (LSB)	0xA5			low byte of item 1
Data Value 2 (MSB)	0x90	0x90B1	This register is user programmable. See Table 2-33.	high byte of item 2
Data Value 2 (LSB)	0xB1			low byte of item 2
CRC byte 1	—	N/A	N/A	byte 1 for this msg
CRC byte 2	—	N/A	N/A	byte 2 for this msg



Note: For responses received from the drive (such as in Table 2-11), the keypad parameter Velocity Units (9080) is set to 'Percent' by default. Interpreted values (shown in the Scaled Value column of Table 2-11) will differ if this parameter is configured differently. See Table B-1 in Appendix B for all data scaling.

2.6.3 Write Input Register Command (0x06)

The write input register command allows the Modbus™ master to write a value to a specified input register in the drive. A sample write input register command and its associated response are shown (in hexadecimal) in Figure 2-8. This sample request to write a value to register 40067 is detailed in Table 2-12. The write input register response from the drive is an echo of the transmission; therefore only one table is shown below. Parameter names are listed in Appendix B of this manual.

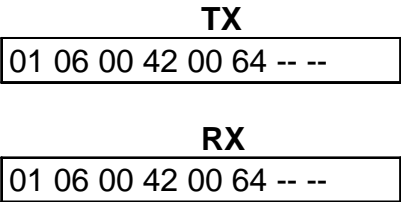


Figure 2-8: Sample Write Input Register Command (TX) and Response (RX)

Table 2-12: Write Input Register Transmission (TX) from Master (same as (RX) Echo Response from Drive)

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x06	Write input register command
Register Address (High)	0x00	register no. 40067
Register Address (Low)	0x42	
Preset Data (High)	0x00	Value = 100
Preset Data (Low)	0x64	
Error Check (CRC) byte 1	—	byte 1 of CRC for this message
Error Check (CRC) byte 2	—	byte 2 of CRC for this message

2.6.4 Loop Back Test Command (0x08)

The loop back test command allows the Modbus™ master to test the communication link to the drive. The drive’s response to a legal Modbus™ message is an echo of the transmission. A sample loop back test message is shown with the associated response (in hexadecimal) in Figure 2-9.

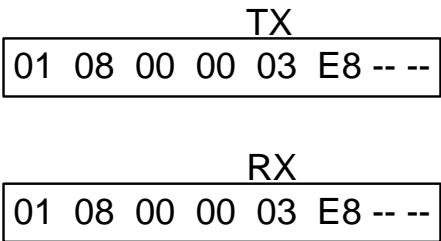


Figure 2-9: Loop back Test Command (TX) and Response (RX)

2.6.5 Write Multiple Coils Command

The message forces multiple coils in a consecutive block to a desired ON or OFF state. Any coil that exists within the controller can be forced to either state (ON or OFF). However, the controller can also alter the state of the coil. The coils are numbered from zero (coil number 1 = zero, coil number 2 = one, etc.). Figure 2-10 below shows a sample of forcing of slave number 1 to write 10 coils starting at address 20 (13 HEX).

The two data fields, CD = 1100 and 00 = 000 0000, indicate that coils 27, 26, 23, 22, and 20 are to be forced on.

TX

```
01 0F 00 13 00 0A 02 CD 00 ----
```

RX

```
01 0F 00 13 00 0A -- --
```

Figure 2-10: Write Multiple Coils Command (TX) and Response (RX)

Table 2-13: Write Coils Transmission to Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	
Function	0x0F	Write coils command
Start address of coils to write (HIGH)	0x00	Start address is coil number 20
Start address of coils to write (LOW)	0x13	
Number of coils to write (HIGH)	0x00	Write 10 coils starting from coil 20
Number of coils to write (LOW)	0x0A	
Byte count	02	
Data to write coils 20 - 27	CD	
Data to write coils 28 – 29	00	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

Table 2-14: Write Coils Response Transmission from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	
Function	0x0F	Write coils command
Start address of coils to write (HIGH)	0x00	Start address is coil number 20
Start address of coils to write (LOW)	0x13	
Number of coils to write (HIGH)	0x00	Write 10 coils starting from coil 20
Number of coils to write (LOW)	0x0A	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

2.6.6 Write Multiple Input Registers Command (0x10)

The write multiple input registers command allows the Modbus™ master to write up to 64 values (in a single command) to multiple input registers in the drive. A sample request to write to two registers is shown with the associated response (in hexadecimal) in Figure 2-11. The sample request is detailed in Table 2-15. The associated response is detailed in Table 2-16. Parameter names and descriptions are listed in Appendix B.

TX		
01 10 00 43 00 02 04 00 64 24 E3 -- --		
RX		
01 10 00 43 00 02 -- --		

Figure 2-11: Sample Write Multiple Input Registers Command (TX) and Response (RX)

Table 2-15: Write Multiple Input Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x10	Write multiple input registers command
Starting Address (High)	0x00	Register number 40068
Starting Address (Low)	0x43	
No. Registers (High)	0x00	Write to 0x0002 (2) registers
No. Registers (Low)	0x02	
Byte Count	0x04	4 bytes total
Preset Data 1 (High)	0x00	Value = 0x0064 (100 decimal)
Preset Data 1 (Low)	0x64	
Preset Data 2 (High)	0x24	Value = 0x24E3 (9443 decimal)
Preset Data 2 (Low)	0xE3	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

Table 2-16: Write Multiple Input Registers Response (RX) from Drive

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x10	Write multiple input registers command
Starting Address (High)	0x00	Register number 40068
Starting Address (Low)	0x43	
No. Registers (High)	0x00	Write to 0x0002 (2) registers
No. Registers (Low)	0x02	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	byte 2 of CRC for this message

2.7 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter Network 1 Type (parameter ID 9901), scroll to Modbus™, then press [ENTER]. The Modbus™ configuration parameters will be viewable.
2. Set the Modbus™ Baud Rate (9060) to the desired rate, which must match the PLC controller's baud rate.
3. Set the Modbus™ parity to match the PLC controller's parity.
4. Set the Modbus™ Address (9070) to the desired Modbus™ address for the drive.
5. Select the Velocity Units (9080). This sets the units for motor commanded speed and motor feedback speed scaling.
6. If needed, set the Demand Scalar (9912) to $n \times \text{command speed}$ where $-125 \leq n \leq 125$.
7. Set the Aux Demand Scalar (9913) if used.
8. Use Table 2-27 to program the drive to send data to and receive commands from available Modbus™ addresses. Each Modbus™ address from 40001 through 40128 corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular Modbus™ address. Note that (4) Registers (40001, 40003, 40065, & 40067) are already programmed, giving the drive basic send and receive functionality. The data in these addresses are not changeable.
9. The definition of the bits in the available Modbus™ addresses may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 2.9 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the Modbus™ network will they need to set any flags in the SOP program.

If the user needs to control the drive through a Modbus™ network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To control a drive through a network by sending commands to the drive, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

2.7.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her PLC. These are status, motor speed, power, and number of active faults. The customer would like to set Modbus™ PLC register 40001 to indicate drive general status. To program a register, refer to Table 2-27 to see if it is programmable. Register 40001 is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. This customer wants to set PLC register 40002 to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 2-17 shows several hypothetical settings for Modbus™ addresses.

Table 2-17: Hypothetical Desired Address Settings

PLC Modbus Register	Data	Scaling
40001(not changeable)	General Status	16 bits
40002 (not changeable)	Motor Speed	RPM
40003	Output Power	kW
40004	Number of faults	0 – 128

The customer wants to set register 40003 to indicate output power. Table 2-27 indicates that this address is programmable. Use Table 2-27 to determine the necessary parameter ID. Enter parameter ID (9403) “Data from drive 03” using the keypad on the front of the drive. Choose “output power” from the pick list.

The customer wants to set register 40004 to indicate the number of active faults. Enter parameter ID (9404) “Data from drive 04” using the keypad on the front of the drive. Scroll through the pick list to find “number of active faults”. Note that “number of active faults” is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 2-29 for a list of data from drive pick list variables. Since “number of active faults” is not a choice in the pick list, choose “ManId” from the pick list. Find “number of active faults” in Appendix A of this manual and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. “ManId-0000” will be shown on display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show “ManId-3000”. If the data ID number could not be found, the error message “Invalid Id Entered” will be displayed. Ensure that the data ID is correct. Now the number of active faults will appear at register 40004 on the PLC.

An example of how the PLC interacts with the drive to read information is given below.

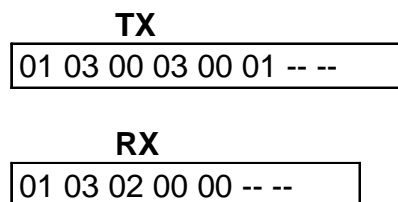


Figure 2-12: Sample Read Output Registers Command (TX) and Response (RX)

Table 2-18: Read Output Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x03	Read output registers command
Starting Address (High)	0x00	Register number 40004
Starting Address (Low)	0x03	
Number of Registers to Read (High)	0x00	Read 1 (0x0001) register
Number of Registers to Read (Low)	0x01	
Error Check (CRC) byte 1	—	Byte 1 of CRC for this message
Error Check (CRC) byte 2	—	Byte 2 of CRC for this message

Table 2-19: Read Output Registers Response (RX) from Drive

Field Name	Value (in Hex)	Actual Result	Scaled Value	Notes
Slave Address	0x01	N/A	N/A	0x01 = 1 decimal
Function	0x03	N/A	N/A	Read output register command code
Byte Count	0x02	N/A	N/A	2 bytes in response
Data Value 1 (MSB)	0x00	0x0000	Programmable by user in this register. See Table 2-33.	high byte of item 1
Data Value 1 (LSB)	0x00			low byte of item 1
CRC byte 1	—	N/A	N/A	byte 1 for this msg
CRC byte 2	—	N/A	N/A	byte 2 for this msg

2.8 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 2-27 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to 'FIXED'. This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 2-20. Note that these particular drctry.ngn bits are always located at Modbus™ address 40065, whether the default configuration is used or not. To redefine the bits at this address, refer to Section 2.8.2.

Table 2-20: If Set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved.

2.8.1 Status Output

To read drive status data, the user must read the General Status register as listed in Table 2-21. The drive's status output bits are always located at Modbus™ address 40001.

Table 2-21: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation CANNOT be reprogrammed.

2.8.2 Running the Drive Using Non-default Settings

The drive can be run in a non-default manner by reprogramming the 'Fixed Reg Bits' register. As seen in Table 2-27, the *location* is fixed at 40065. However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits in Modbus™ register 40065, use the following procedure:

By setting menu parameter 9944 (Status/Control) to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. In order to make the definition of the 'Fixed Reg Bits' in Modbus™ address 40065 programmable, use the drive's keypad to set parameter 9944 (Status/Control) to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to Network1FixedRegBit9 in Modbus™ register 40065.

2.9 User Programming via the SOP

2.9.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 2-27 to find the location of the first 'Reg to Drive' register which is programmable. Please note which network 1 keypad parameter ID corresponds to that Modbus address. The table reveals the first programmable data to drive Modbus™ address to be 40067, and that its corresponding keypad parameter ID for Network 1 is (9603). Go to the keypad on the front of the drive and enter parameter (9603). The user will see a pick list, the first item of which is 'None' (see Table 2-28 for a list of possible pick list choices for input to drive data). The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 2-24.

This example shows how to use the Modbus™ network to trip the input medium voltage. In this example, our PLC will be writing to Modbus™ register 40067, which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of 'Net Input Flag 1', bit 9 (Network1Flag9_I) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium Voltage
ExternalDigitalOutput01h_O = Network1FixedRegBit9_I;
```

2.9.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 2-27 to find the location of the first 'Reg From Drive' register which is programmable. Please note which Network 1 keypad parameter ID corresponds to that Modbus™ address. The table reveals the first programmable data from drive Modbus™ address to be 40003, and that its corresponding keypad parameter ID for Network 1 is (9403). Go to the keypad on the front of the drive and enter parameter 9403. The user will see a pick list, the first item of which is 'None' (see Table 2-29 for a list of possible pick list choices for output from drive data). The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 2-25. This example shows how to use the Modbus™ network to detect a trip on the input medium voltage. In this example, our PLC will be reading Modbus™ register 40003, which we programmed to 'Net1 Out Reg 1'. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of 'Net1 Out Reg 1', which is Network1Flag9_O, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of Net 1 Out Reg 1, bit 9 (Network1Flag9_O) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

2.9.3 Flags Available to the SOP Program

Net Control Type by Default:

The drive's interpretation of the bits in Table 2-22 is fixed by the drive's control software unless the user sets the parameter (9944) "Status/Control" to 'SOP'. To change the default interpretation of these bits, see Section 2.8.2.

**Table 2-22: Relationship of 'Fixed Reg Bits' to Keypad Menus drctrly.ngn Bits
(programmable bits available for use in the SOP)**

Pick list variable in 'Data to Drive Reg nn' menus	Related Drctrly.ngn bits	Modbus Register Address
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	40065
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	40065

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

2

Table 2-23: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>an</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 2-24: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 2-25: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 2-26: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

2.10 Modbus™ Address and Keypad Pick List Tables

Table 2-27: Correspondence Between Drive Parameter ID and Modbus Address*

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	Modbus™ Addresses ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	40001
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	40002
1	9403 - 9464	Data From Drive 03-64 ³	None	40003-40064
1	9601	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	40065
1	9602	Data To Drive 02 ⁴	Velocity Demand (not changeable)	40066
1	9603 - 9664	Data To Drive 03-64 ⁴	None	40067 - 40128
2	9501	Data From Drive 01 ³	General Status (not changeable)	40001
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	40002
2	9503 - 9564	Data From Drive 03-64 ³	None	40003 - 40064
2	9701	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	40065
2	9702	Data To Drive 02 ⁴	Velocity Demand (not changeable)	40066
2	9703 - 9764	Data To Drive 03-64 ⁴	None	40067 - 40128

- 1. Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- 2. Modbus™ Addresses**—digital locations provided by the Modbus™ Protocol, which store values for use by the master (PLC) and slave (Siemens drive) devices. To establish functional communication between the PLC and the drive, the control software in the drive needs to know for what certain addresses are used. That is the key to configuring the drive's Modbus™ connection.
- 3. Data From Drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- 4. Data To Drive**—data that the PLC will send to the drive in order to control it. Each register contains a 16-bit digital representation of the PIC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices.

Table 2-28: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	Scaling
None		None			MUX 5 ID NA	None
Fixed Reg Bits	B	None			MUX 6 ID NA	None
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID NA	None
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID NA	None
Net Input Flag 1	B	None			PTD1 NA	None
Net Input Flag 2	B	None			PTD2 NA	None
Net Input Flag 3	B	None			PTD3 NA	None
Net Input Flag 4	B	None			PTD4 NA	None
Ratio	U	% /100			Parallel Cmd 1	None
Forward Max Lim	U	/10000 or % /100			Torque Demand	/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand	/100
Forward Acc Time		/10			Flux Demand	/100
Forward Dec Time		/10			Node Count	None
Reverse Acc Time		/10			Node Index	None
Reverse Dec Time		/10			Torque Acc Time	/100
Net Input Pulse		In * 1			Torque Dec Time	/100
Forward Min Lim		/10000 or % /100			Torque Offset	/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar	/1000
Torque Limit		/10000 or % /100			Vars Command	/1000
MUX 1 ID	NA	None			No Load I Scalar	/1000
MUX 2 ID	NA	None			Avg Field Cur	/10000
MUX 3 ID	NA	None			Manual Ids Demand	/1000
MUX 4 ID	NA	None				

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 2-29: Modbus™ Communications Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 2-30: Network Control Menu (9943)

Parameter	ID	Default	Description
Net Control Type	9944	Sop	Bit definition is fixed or defined in Sop program
Start Stop Control	9945	Maintained	Start/Stop bit inputs are treated as maintained or momentary.

2.11 Menu Parameters Tables

Table 2-31: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ Profibus™ Modbus™ plus Ethernet Modbus Data Highway™ ControlNet™

Table 2-32: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Modbus™ Baud Rate	9060		19200			Modbus network baud rate. <ul style="list-style-type: none"> 1200 2400 4800 9600 19200
Modbus™ Parity	9047		None			<ul style="list-style-type: none"> none odd even
Modbus™ Stop Bits	9048			1		<ul style="list-style-type: none"> one two
Modbus™ Address	9070		1	1	247	Sets address of node on Modbus™ network.
Velocity Units	9080		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network Timeout	9934		0	0	65535	Timeout for network determined to be non-responsive.

Table 2-33: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 2-34: Register Data to Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 2-35: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • Profibus™ • Modbus™ • Ethernet Modbus • Data Highway +™ • ControlNet™

Table 2-36: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
Modbus™ Baud Rate	9917		19200			Modbus™ network baud rate. <ul style="list-style-type: none"> • 1200 • 2400 • 4800 • 9600 • 19200
Modbus™ Parity	9947		None			<ul style="list-style-type: none"> • none • odd • even
Modbus™ Stop Bits	9948		1			<ul style="list-style-type: none"> • one • two
Modbus™ Address	9920		1	1	247	Sets address of node on Modbus™ network.
Velocity Units	9924					Designates the units for velocity values from the drive. <ul style="list-style-type: none"> • % • RPM • Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network Timeout	9935		0	0	65535	Timeout for network determined to be non-responsive.

Table 2-37: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 2-38: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

Table 2-39: Network 1 to Network 2 Register (9946)

Parameter	ID	Units	Default	Min	Max	Description
Net 1 to 2 reg. Copy	9946		Function			Copies Network 1 registers to Network 2 registers.

2.12 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted, and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

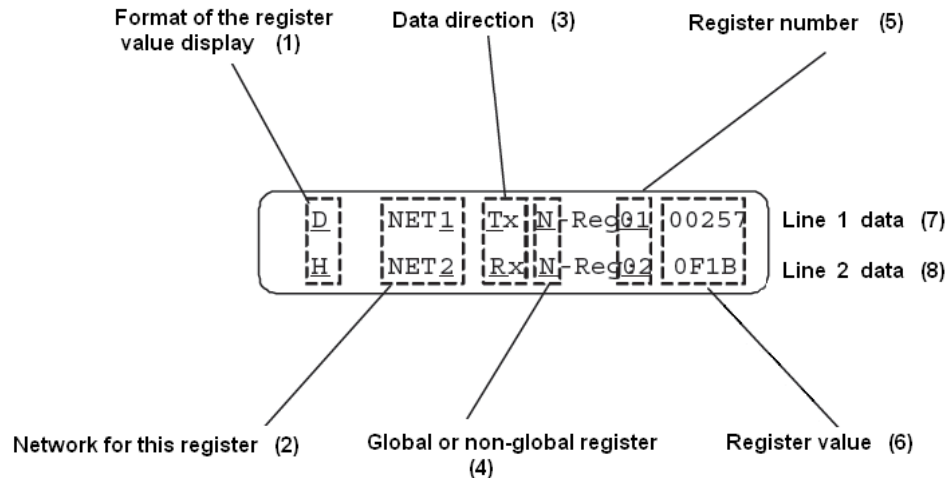


Figure 2-13: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The Modbus™ protocol does not support global registers. Therefore, when working with a Modbus™ controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (9401) through "Data from Drive 64" parameter ID (9464).
'Rx' 01-64 are "Data to Drive 01" parameter ID (9601) through "Data to Drive 64" parameter ID (9664).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 2-14 represents the display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

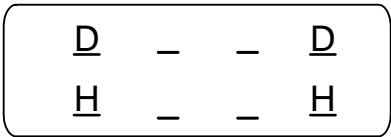


Figure 2-14: Cursor Movement Diagram



2

CHAPTER

3 DeviceNet™ DP Communications

3

3.1 Introduction

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control using a DeviceNet™ network as quickly as possible. Section 3.4 is short and procedural, and covers a minimum of detail. Please refer to the other sections of this chapter for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, e.g., (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] in order to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (e.g., 0x12) is being represented in hexadecimal format.

3.1.1 DeviceNet™ DP Network Topologies

DeviceNet™ Drive Profile (DP) uses linear bus topology. This topology is configured as a series of clusters. A cluster is a collection of nodes that are logically connected. A node may belong to one or more clusters. The linear bus topology is illustrated in Figure 3-1. Three clusters are shown using master/slave or peer-to-peer.

Notes:

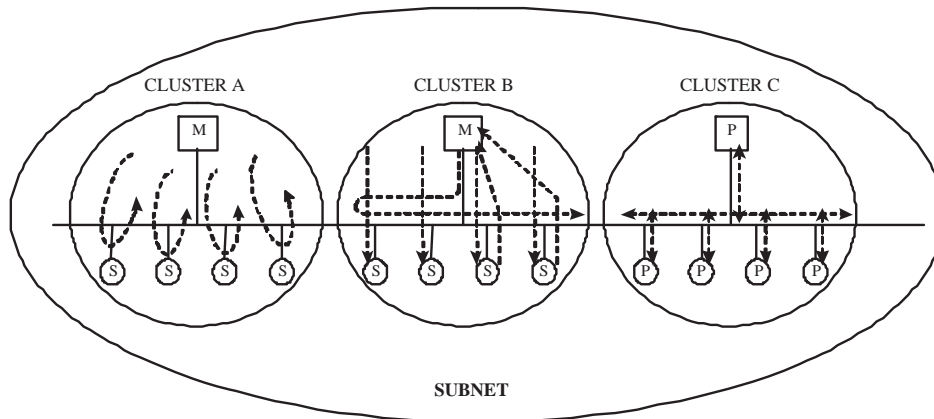
- Siemens drives use master/slave connections and do not support DeviceNet™ DP “strobe” connections.
- The Siemens DeviceNet™ DP UCS board functions only as a slave device and cannot initiate communications (it can only respond to requests).

Legend

M = Master (Active) Station

S = Slave (Passive) Station

P = Peer



Cluster A: Master/Slave Point-to-Point Communication (i.e., Poll/Cyclic/Change of State (COS))

Cluster B: Multicast Master/Slave Communication (i.e., Strobe)

Cluster C: Peer-to-Peer Communication (Point-to-Peer or Multicast)

Nodes participating in a particular relationship are a cluster.

Figure 3-1: DeviceNet™ DP Network Topologies

3.1.2 Configuring the DeviceNet™ DP UCS Module

The DeviceNet™ DP UCS module mounts to the Communication Board of the NXG Control. Figure 3-2 shows the connectors, jumpers, and status indicators on the DeviceNet™ DP UCS board.



Note: To properly configure the DeviceNet™ DP UCS module, jumpers BA1 and BA2 must be removed from the board.

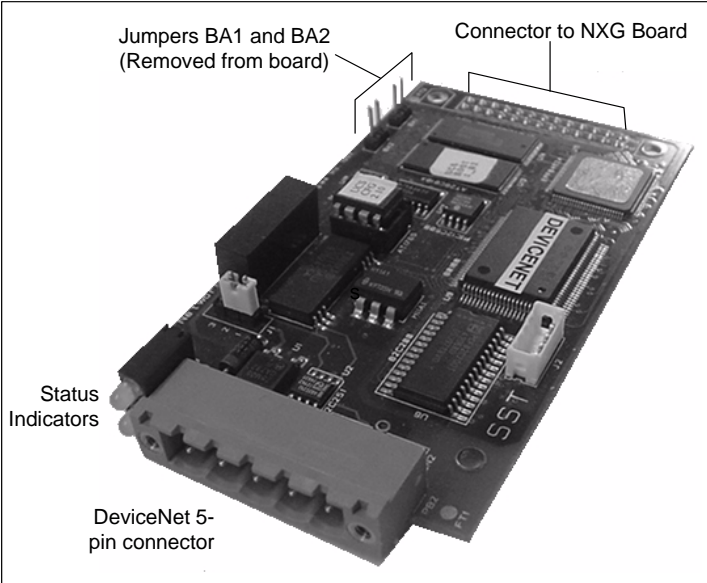


Figure 3-2: DeviceNet™ DP UCS Communication Board

3.1.3 Connector

The UCS DeviceNet™ DP interface module uses a DeviceNet™ DP compatible 5-pin connector.

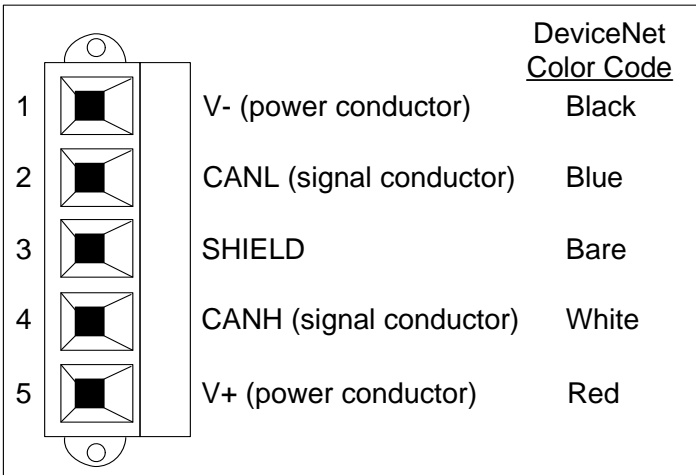


Figure 3-3: DeviceNet™ DP Network 5-Pin Connector

The maximum cable length depends on the transmission speed and cable type. The maximum cable length/ baud rates are shown in Table 3-1.

Table 3-1: Maximum Values of DeviceNet™ DP Cable Length/Baud Rates

Baud Rate	Trunk Distance (Thick Cable)
125 K	500 Meters (1640 Feet)
250 K	250 Meters (820 Feet)
500 K	100 Meters (328 Feet)

3.1.4 Status Indicators

Figure 3-4 shows the status indicators. Table 3-2 describes the LED states. At startup, the UCS™ module tests the UCS™ Status indicator by making it red for 250 msec, green for 250 msec, then off.

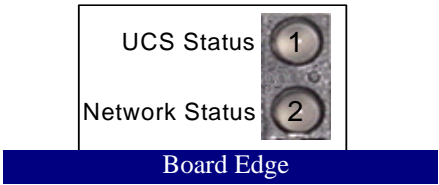


Figure 3-4: UCS™ Module Circuit Board Status Indicators (Board Orientation)

Table 3-2: UCS™ Module Circuit Board Status Indicator Descriptions

Number from Figure 3-4	Indication	State	Description
1	UCS™ Status	Off	No power or hard/soft reset asserted.
		Red, Flashing ¹	Recoverable configuration fault (invalid firmware, OEM data, or personality data).
		Red	Hardware error or fatal runtime error.
		Green, flashing ¹	No errors, data exchange interface is not open.
		Green	No errors, data exchange interface is active.
		Amber (red/green)	Configuration mode.
2	Network Status	Off	DeviceNet™ DP UCS module offline/no network power.
		Red	Unrecoverable network fault.
		Green	DeviceNet™ DP UCS online with established connections.
		Flashing red	I/O connection(s) in timed-out state or other recoverable fault.
		Flashing green	DeviceNet™ DP UCS module is online, but has no connections.
		Flashing green/red	DeviceNet™ DP UCS module is in communication faulted state and responding to an “identify communication faulted” request.

1. Nominal flash rate is 500 msec on, 500 msec off.

3.2 Network Termination

The nodes at the physical ends of the network should each have a terminating resistor installed. The termination resistor is connected across the data lines. Refer to the recommendations of the Open DeviceNet™ DP Vendor Association (ODVA) for values of network termination resistors.

3.3 DeviceNet™ DP Network Address

Users can set the drive's DeviceNet™ DP network address (Mac Id) to any value by the user, via the keypad on the front of the drive or by using ToolSuite.

3.4 Fast Setup

To begin controlling the Siemens drive using the DeviceNet™ network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

This example will permit control of the drive from a PLC using the following simple set-up procedure:

3

1. Using the keypad, set 'Network 1 Type' (**9901**) to DeviceNet™ DP.
2. Set the 'DeviceNet™ DP address' (**9908**) to a value that is not currently in use (1 to 63).
3. Set the 'DeviceNet™ DP Baud Rate' (**9505**) to the appropriate rate (125K, 250K, or 500Kbaud) for the network.
4. Verify the DeviceNet™ DP UCS module status as indicated in Table 3-2.
5. The system program will need to be modified if the user wants to run the drive from the network. The modification will have to either fix the `Network1RunEnable_O = TRUE`; or conditionally true, depending on the application requirements.



Note: Setting the `Network1RunEnable_O = TRUE`; may prevent the drive from being started and stopped locally from the keypad or panel-mounted start/stop switches.

6. Set the (NetRef) bit true (1) to request that the speed demand input to the drive originate from the DeviceNet™ DP network.
7. From the PLC, set the VFD Speed Reference to the desired speed.
8. Set the (NetCtrl) bit true (1) to request that the start/stop functionality be controlled from the DeviceNet™ DP network.
9. Set the (Run fwd) bit true (1) to request that the drive run in the forward direction. Bit 1 (Run Rev) must be low (0).
10. The VFD should run at the commanded speed.

3.5 Network Communications Setup

This section defines the procedures necessary to configure Siemens NXG control parameters for remote control and/or monitoring purposes using a communications network. Users will need to be familiar with the Siemens NXG Control and its menu system.

Upon completing the following set-up procedures, all data entered via the menu system is retained in the NXG Control's CompactFLASH module. Use the keypad on the front of the drive to complete the procedure below, which will configure the NXG Control's network parameters. Please refer to Table 3-3 or the drive's menu and submenu ID numbers.



Note: In this manual, a “register” consists of one 16-bit data word.

1. Start by selecting the pick list item “DeviceNet DP” from the pick list of the ‘Network 1 Type’ menu.
2. Set the **DeviceNet™ DP Address** to the desired node address (Mac Id) for the drive. The valid range is 1 through 63.
3. Set up the ‘Register Data From Drive’ (to select the data to be sent by the drive) or ‘Register Data To Drive’ (to select the data to be received by the drive). **Register Data From Drive** are data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices. **Register Data To Drive** are data that the PLC will send to the drive to control it. Each register contains a 16-bit digital representation of the PLC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices. Continue at step 4 for ‘Register Data From Drive’ or step 5 for “Register Data To Drive” setup.
4. The ‘Register Data From Drive’ menu provides the user the ability to define up to 32 register-based data items that can be sent from the drive via keypad parameters (9401–9432) “Data From Drive 01-32”. Each of these items can now be independently defined as desired. Upon selecting any of the send data items, the user is prompted to enter the data to be transmitted from a predefined pick list. As an alternative, an ID may reference a specific item if not found in the pick list. Most pick list items simply require scrolling through the menu to the desired item and pressing the ENTER key. For ID entry, the user is prompted for the 4-digit ID code of the data item and the desired data type. ID's are listed in Appendix B of this manual.
5. The ‘Register Data To Drive’ menus provides the user the ability to define up to 32 register-based data items that can be received from the drive via keypad parameters (9601–9632) “Data To Drive Reg 01-32”. Each of these items can now be independently defined as desired. Upon selecting any of the receive data items, the user is prompted to enter the data to be received from a predefined pick list.

Table 3-3: Menu IDs

Network	Drive Parameter ID Numbers	Description	Default Contents
1	9401	Data From Drive 01	General Status (not changeable)
1	9402	Data From Drive 02	Motor Speed (not changeable)
1	9403 – 9432	Data From Drive XX	None
1	9601	Data To Drive Reg 01	Fixed Reg Bits (not changeable)
1	9602	Data To Drive Reg 02	Velocity Demand (not changeable)
1	9603 - 9632	Data To Drive Reg XX	None
1	9901	Network 1 Type	None
1	9908	DeviceNet™ DP Address	1
1	9905	DeviceNet™ DP Baud Rate	125K
2	9501	Data From Drive 01	General Status (not changeable)
2	9502	Data From Drive 02	Motor Speed (not changeable)
2	9503-9532	Data From Drive XX	None
2	9701	Data To Drive Reg 01	Fixed Reg Bits (not changeable)
2	9702	Data To Drive Reg 02	Velocity Demand (not changeable)
2	9703 – 9732	Data To Drive Reg XX	None
2	9915	Network 2 Type	None
2	9922	DeviceNet DP Address	1
2	9919	DeviceNet™ DP Baud Rate	125K

3.6 DeviceNet™ DP EDS File

The electronic data sheet, or EDS file, is a specifically formatted ASCII file that provides the definition of a device's configurable parameters and public interfaces to those parameters. An electronic copy of this file (NXG.eds) is available from Siemens.

3.7 DeviceNet™ DP Network Overview



Note: This section requires that the reader be familiar with DeviceNet™ DP terminology and DeviceNet™ DP networks. Information about DeviceNet™ DP can be obtained by contacting the Open DeviceNet™ DP Vendor Association (ODVA). Their internet address is <http://www.odva.org>.

The DeviceNet™ DP network consists of the UCS DeviceNet™ DP module, the UCS firmware, and NXG Control software. Siemens configures the DeviceNet™ DP network as master/slave, point-to-point communication connections. The master may use explicit messages to control the drive. The UCS DeviceNet™ DP module acts as a slave on the DeviceNet™ DP network. It uses I/O assembly data as the basis for drive control. Only the UCS firmware handles DeviceNet™ DP classes 1-3 and 5. The UCS firmware and the NXG Control software work together to handle DeviceNet™ DP classes 4 and 40-42. The Siemens UCS DeviceNet™ DP module supports the DeviceNet™ DP classes listed in the Table 3-4 below:

Table 3-4: DeviceNet™ DP Classes

Class Number	Object Class	Communication Messages handled by:
1	Identity	UCS DeviceNet™ DP module
2	Message Route	UCS DeviceNet™ DP module
3	DeviceNet DP™	UCS DeviceNet™ DP module
4	Assembly	UCS DeviceNet™ DP module and NXG
5	Connection	UCS DeviceNet™ DP module
40	Motor	UCS DeviceNet™ DP module and NXG
41	Control Supervisor	UCS DeviceNet™ DP module and NXG
42	AC/DC Drive	UCS DeviceNet™ DP module and NXG

3.7.1 Data Types

DeviceNet™ DP networks use data types in two different manners. These manners are explained below.

3.7.2 DeviceNet™ DP Data Types

Each class attribute has a pre-defined data type. The Open DeviceNet™ DP Vendor Association (ODVA) defines the data types used. Table 3-5 is an abbreviated list of the DeviceNet™ DP data types.

Table 3-5: DeviceNet™ DP Data Types

Data Type Name	Data Type Description
BOOL	Logical Boolean with values TRUE and FALSE
BYTE	Bit string, 8 bits long
WORD	Bit string, 16 bits long
DWORD	Bit string, 32 bits long
SINT	Signed 8-bit integer value
INT	Signed 16-bit integer value
DINT	Signed 32-bit integer value
USINT	Unsigned 8-bit integer value
UINT	Unsigned 16-bit integer value
UDINT	Unsigned 32-bit integer value

3.8 Network Data Transfer Methods

DeviceNet™ DP uses assembly data and explicit messages for data transfer.

3.8.1 DeviceNet™ DP Assembly Data

The Siemens UCS DeviceNet™ DP Module uses assembly data to transfer data to and from the drive. DeviceNet™ DP networks have pre-defined assemblies to allow multiple similar devices from different vendors to communicate in the same manner. The pre-defined assemblies allow substitution of one manufacturer's device for another without having to change the communication software.

3.8.2 DeviceNet™ DP AC Drive Input Assembly Data (Assembly #71)

The Siemens UCS DeviceNet DP module uses the predefined Input Assembly 'Extended Speed Control Input' for AC Drives as the default I/O assembly.

The 'Extended Speed Control Input' assembly (assembly #71) uses 4 bytes of data. The assembly data is passed from the drive to the UCS DeviceNet™ DP module via the NXG Control. The DeviceNet™ DP master can obtain the Siemens drive data via a master/slave communication. The 4 bytes of assembly input data are defined below. The first byte of data is broken down into bits used to define the operating status of the drive. The second byte of data is the drive state. The third and fourth bytes of data are combined together to form a 16-bit signed number representing the drive speed in RPM. The range is 0 to 32767 RPM. Refer to Tables 3-6, 3-7, and 3-8 for more information on assembly data bits and bytes.

Table 3-6: DeviceNet™ DP Assembly Input Data Bytes

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Ref From Net	Ctrl From Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted
1	Drive State							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							

Table 3-7: DeviceNet™ DP I/O Assembly #71 Byte 0 Bit Definitions

Bit	Bit Name	Bit Function
7	AtReference	Set true (1) when the drive speed matches ($\pm 1.5\%$) the drive reference speed (not ramping up or down).
6	RefFromNet	Set true (1) when the speed demand input to the drive originates from the DeviceNet DP network.
5	CtrlFromNet	Set true (1) when the start/stop functionality is controlled from the DeviceNet DP network.
4	Ready	Set true (1) when the drive is not running and is in a non-faulted state.
3	Running2 (Rev)	Set true (1) when the drive is running in the Reverse direction.
2	Running1 (Fwd)	Set true (1) when the drive is running in the Forward direction.
1	Warning	Set true (1) when the drive has an active Alarm.
0	Faulted	Set true (1) when the drive is faulted.

Table 3-8: DeviceNet™ DP I/O Assembly #71 Byte 1 Drive States

Drive State Byte Value	Drive State
3	Ready (Not Faulted and Not Running)
4	Enabled (Running)
5	Stopping (Running, Run Request Disabled)
7	Faulted (Drive Fault(s) Exist)



Note: The term “Ready” is defined as “Not Faulted” and “Not Running.” The lack of a permissive is not considered a fault. The drive will change from the “Ready” state to the “Enabled” (running) state when all drive permissive signals are “True.”

3.8.3 DeviceNet™ DP AC Drive Output Assembly Data (Assembly #21)

The Siemens UCS DeviceNet™ DP module uses the predefined input assembly 'extended speed control output' for AC Drives as the default I/O assembly.

The 'extended speed control output' assembly (assembly #21) uses 4 bytes of data. The assembly data is consumed by the UCS DeviceNet™ DP module and passed to the drive. The master updates the data to the UCS DeviceNet™ DP module. The 4 bytes of assembly output data are defined in Table 3-9. The first byte of data is broken down into bits used to control the operating mode of the drive. The second byte of data is not used (all bits are 0). The third and fourth bytes of data are combined together to form a 16-bit signed number representing the DeviceNet™ DP network speed reference in RPM. The range is 0 to 32767 RPM. Table 3-10 lists assembly output data bit definitions.

Table 3-9: DeviceNet™ DP Assembly Output Data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Not Used	NetRef	NetCtrl	Not Used	Not Used	Fault Reset	Run Rev	Run Fwd
1	Reserved (Not Used)							
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							

Table 3-10: DeviceNet™ DP Assembly Output Data Bit Definitions

Bit	Bit Name	Bit Function
7		Not Used (0).
6	NetRef	Set true (1) to request that the speed demand input to the drive originate from the DeviceNet™ DP network.
5	NetCtrl	Set true (1) to request that the start/stop functionality be controlled from the DeviceNet™ DP network.
4		Not Used (0).
3		Not Used (0).
2	Fault Reset	Set true (1) to request a drive fault reset.
1	Run Rev	Set true (1) to request that the drive run in the reverse direction. Bit 0 (Run Fwd) must be low (0).
0	Run Fwd	Set true (1) to request that the drive run in the forward direction. Bit 1 (Run Rev) must be low (0).

3.8.4 DeviceNet™ DP Explicit Messages

Explicit messages may be used to control (set) or obtain (get) the status of the drive. This section defines the attributes for the three main DeviceNet™ DP object classes used with AC drives: motor, control supervisor, and AC/DC drive.

The UCS DeviceNet™ DP module contains only one instance of the three classes. The supported attributes and the access type for each of the classes can be found in Tables 3-11, 3-12, 3-13, and 3-14.



Note: The term “Ready” is defined as “Not Faulted” and “Not Running.” The lack of a permissive is not considered a fault. The drive will change from the “Ready” state to the “Enabled” (running) state when all drive permissive signals are “True.”

Table 3-11: DeviceNet™ DP Motor Class Supported Attributes (1 Instance)

Class (Hex)	Attribute (Decimal)	Data Access	Data Type	Description
0x28	3	Set	USINT	Motor Type (refer to DeviceNet DP ODVA Specifications)
0x28	6	Set	UINT	Motor Rated Current (in .1 Amps)
0x28	7	Set	UINT	Motor Rated Volts (in Volts)
0x28	9	Set	UINT	Motor Rated Frequency (in Hz)
0x28	12	Set	UINT	Number of Poles
0x28	15	Get	UINT	Base Speed (in RPM)

Table 3-12: DeviceNet™ DP Control Supervisor Class Supported Attributes (1 Instance)

Class (Hex)	Attribute (Decimal)	Data Access	Data Type	Description
0x29	3	Get	Bool	Run1 (Run Fwd Command)
0x29	4	Get	Bool	Run2 (Run Rev Command)
0x29	5	Get	Bool	NetCtrl (True - request the drive start/stop control to originate from DeviceNet DP network)
0x29	6	Get	USINT	State (Drive State - See Table 3-8)
0x29	7	Get	Bool	Running1 (True - drive is running in Fwd direction)
0x29	8	Get	Bool	Running2 (True - drive is running in Rev direction)
0x29	9	Get	Bool	Ready (True - drive is not running and not faulted)
0x29	10	Get	Bool	Faulted (True - drive fault(s) exist)
0x29	12	Get	Bool	FaultRst (True - Fault Reset Command is Active)
0x29	15	Get	Bool	CtrFromNet (True - start/stop is being controlled from the DeviceNet DP network)

Table 3-13: DeviceNet™ DP AC/DC Drive Class Supported Attributes (1 Instance)

Class (Hex)	Attribute (Decimal)	Data Access	Data Type	Description
0x2A	3	Get	Bool	AtReference
0x2A	4	Get	Bool	NetRef
0x2A	6	Get	USINT	DriveMode
0x2A	7	Get	INT	Speed Actual
0x2A	8	Get	INT	Speed Reference
0x2A	9	Get	INT	Current Actual
0x2A	15	Get	INT	Power Actual
0x2A	17	Get	INT	Output Voltage
0x2A	18	Get	UINT	Acceleration Time
0x2A	19	Get	UINT	Deceleration Time
0x2A	22	Get	SINT	Speed Scale
0x2A	23	Get	SINT	Current Scale
0x2A	26	Get	SINT	Power Scale
0x2A	27	Get	SINT	Voltage Scale
0x2A	28	Get	SINT	Time Scale
0x2A	29	Get	Bool	RefFromNet

**Notes:**

- Attributes 101-130 are used for Register Data from Drive.
- Attributes 131-160 are used for Register Data to Drive.

Table 3-14: DeviceNet™ DP AC/DC Drive Class Extension Supported Attributes (1 Instance)

Class (Hex)	Attribute (Decimal)	Data Access	Data Type	Description
0x2A	101-132	Get	UINT	Reg From Drive 03-34
0x2A	133-164	Set	UINT	Reg To Drive 03-34

3.8.5 Register Data to Drive

The 'Register Data To Drive' menu provides the user the ability to define up to 32 register-based data items that can be received from the drive via keypad parameters (9601–9632) "Data To Drive Reg 01-32". Each of these items can now be independently defined as desired. Upon selecting any of the receive data items, the user is prompted to enter the data to be received from a pre-defined pick list.

Table 3-15: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name		Scaling
None		None			MUX 5 ID	NA	None
Fixed Reg Bits	B	None			MUX 6 ID	NA	None
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA	None
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA	None
Net Input Flag 1	B	None			PTD1	NA	None
Net Input Flag 2	B	None			PTD2	NA	None
Net Input Flag 3	B	None			PTD3	NA	None
Net Input Flag 4	B	None			PTD4	NA	None
Ratio	U	% /100			Parallel Cmd 1		None
Forward Max Lim	U	/10000 or % /100			Torque Demand		/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand		/100
Forward Acc Time		/10			Flux Demand		/100
Forward Dec Time		/10			Node Count		None
Reverse Acc Time		/10			Node Index		None
Reverse Dec Time		/10			Torque Acc Time		/100
Net Input Pulse		In * 1			Torque Dec Time		/100
Forward Min Lim		/10000 or % /100			Torque Offset		/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar		/1000
Torque Limit		/10000 or % /100			Vars Command		/1000
MUX 1 ID	NA	None			No Load I Scalar		/1000
MUX 2 ID	NA	None			Avg Field Cur		/10000
MUX 3 ID	NA	None			Manual Ids Demand		/1000
MUX 4 ID	NA	None					

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

3.8.6 Register Data from Drive

The 'Register Data From Drive' menu provides the user the ability to define up to 32 register-based data items that can be sent from the drive via keypad parameters (9401–9432) 'Data From Drive 01-32'. Each of these items can now be independently defined as desired. Upon selecting any of the send data items, the user is prompted to enter the data to be transmitted from a predefined pick list. As an alternative, an ID may reference a specific item if not found in the pick list. Most pick list items simply require scrolling through the menu to the desired item and pressing the ENTER key. For ID entry, the user is prompted for the 4-digit ID code of the data item and the desired data type. IDs are listed in Appendix B of this manual.

Table 3-16: DeviceNet™ DP Data from Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

3.9 Networking and the System Program

3.9.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Using the keypad, go to menu ID (9603). The user will see a pick list, the first item of which is 'None'. See Table 3-15 for a list of possible pick list choices for input to drive data. The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 3-18.

3.9.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Using the keypad, go to menu ID (9403). The user will see a pick list, the first item of which is 'None'. See Table 3-17 for a list of possible pick list choices for output from drive data. The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 3-19.

3.9.3 Flags Available to the System Program

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 3-17: Network 1 Programmable Input Bits (keypad parameter ID 9603-9632)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 3-18: Network 2 Programmable Input Bits (keypad parameter ID 9703-9732)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 3-19: Network 1 Programmable Output Bits (keypad parameter ID 9403-9432)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctrtry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 3-20: Network 2 Programmable Output Bits (keypad parameter ID 9503-9532)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctrtry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

3.9.4 System Program Network Flags



Note: Use of status flags in the system program requires a thorough understanding of the system program and how it is edited, compiled, and downloaded. Use of system program flags should be limited to only qualified and experienced individuals.

Table 3-21: Network Run Enable Flags

System Program Variable	Description
Network1RunEnable_O	This flag must be set TRUE for the Drive to be run from network 1.
Network2RunEnable_O	This flag must be set TRUE for the Drive to be run from network 2.

Table 3-22: Network Status Flags

System Program Variable	Description
Network1CommOk_I	Indicates that network 1 is active = 1, or inactive/faulted = 0
Network2CommOk_I	Indicates that network 2 is active = 1, or inactive/faulted = 0

3.10 Power-up Sequence

The complete power-up sequence is defined below:

1. The NXG Control begins execution by setting up internal processor registers.
2. UCS firmware is downloaded to the DeviceNet™ DP UCS module.
3. Next, if the DeviceNet™ DP UCS card is on an active network, the green LED will come on solid green. (Refer to Table 3-2).
4. At this point, the UCS Network Status LED reflects the state of the DeviceNet™ DP UCS board on the DeviceNet™ DP network.
5. The interface between the DeviceNet™ DP UCS board and the NXG is opened. The UCS™ Status LED turns green.

3.11 Troubleshooting Network Communications Problems

Table 3-23 lists things to check if network communications seem to be malfunctioning. Checking these items will solve the majority of problems that may arise.

Table 3-23: Troubleshooting Network Communications Problems

#	Things to Check
1	Verify that the UCS module is securely seated on the Communication board.
2	Verify the DeviceNet™ DP UCS board is properly secured using the mounting hardware.
3	Verify the jumpers BA1 and BA2 have been removed from the DeviceNet™ DP UCS board.
4	Check for proper wiring connections to the card.
5	Check for shorted network wiring.
6	Check for shorted board components.
7	Check network termination resistors.
8	Check LED blink rates (refer to Figure 3-4).
9	Verify Network address is valid and unique to the network.
10	Verify network wiring and connection.

3.12 Display Network Monitor Function (Menu ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

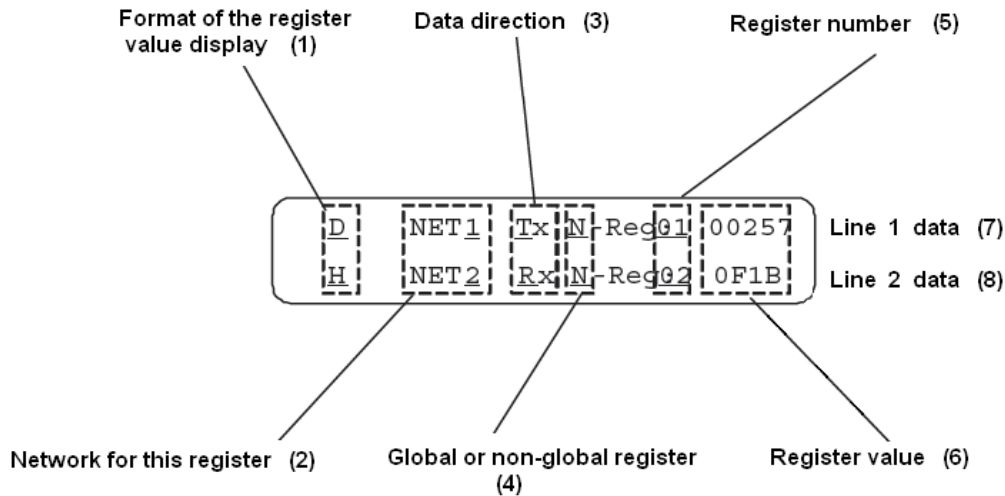


Figure 3-5: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The DeviceNet protocol does not support global registers. Therefore, when working with a DeviceNet™ controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (9401) through "Data from Drive 64" parameter ID (9464).
'Rx' 01-64 are "Data to Drive 01" parameter ID (9601) through "Data to Drive 64" parameter ID (9664).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

3

Figure 3-6 below represents a display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

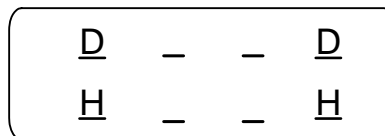


Figure 3-6: Cursor Movement Diagram

▽ ▽ ▽

CHAPTER

4 Ethernet Modbus™ Communications

4.1 Introduction

Every Siemens NXG Control is shipped with the necessary hardware to support Modbus™ and Ethernet Modbus™ network protocol connectivity. The Communication Board also supports the AnyBus Ethernet Modbus™ module. Connectivity using other network protocols is possible with optional controller cards that plug into the Communication Board. This chapter contains instructions on how to control a Siemens VFD over a Ethernet Modbus™ network.

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control via an Ethernet Modbus™ as quickly as possible. Section 4.2 is short, procedural, and covers a minimum of detail. Please refer to the other sections for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, *i.e.* (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (*i.e.*, 0x12) is being represented in hexadecimal format.

The Modbus™ control interface specification is an open architecture design. Information on Modbus™ is available from:

Schneider Automation Inc.

One High Street
North Andover, MA 01845
Tel: (978) 794-0800
Fax: (978) 975-0910
Website: www.modicon.com

The Ethernet Modbus™ communication interface is based on the TCP/IP protocol. All addressing is based on IP addresses.

The drive always acts as a Modbus™ slave. This means that the drive does not initiate dialogue on the Ethernet Modbus™ network. Rather, it listens to and then responds to the Ethernet Modbus™ master.

Currently, only register-based read and write functions of the Modbus™ protocol are supported by the NXG Control. These functions are used to monitor and control analog and digital inputs and outputs of the drive.

Notes:


- Users must already be familiar with Modicon's Modbus™ protocol specification and terminology. If additional information is required, please contact Schneider Automation Inc. at the address given above.
- Only the Remote Terminal Unit (RTU) format of the Modbus™ protocol is supported by the NXG Control. All requests are sent via register port 502.

NXG Control only supports the following function codes:

- Read Holding RegistersFunction code 0x03
- Write Single RegisterFunction code 0x06
- Write Multiple RegistersFunction code 0x10

Each of these supported commands are listed and described in the sections that follow. Each of these commands is issued by the Modbus™ master (PLC) and sent over the network (to the Siemens slave[s]).

4.1.1 AnyBus Ethernet Modbus™ Module



Notes:

- *AnyBus Ethernet Modbus™ is for Network 2 only!*
- Ethernet Modbus™ Network 1 utilizes the CPU RJ-45 port.

4 Figure 4-1 shows the connector and indicators on the AnyBus Ethernet Modbus™ module. The DIP switches are not used for the NXG application.

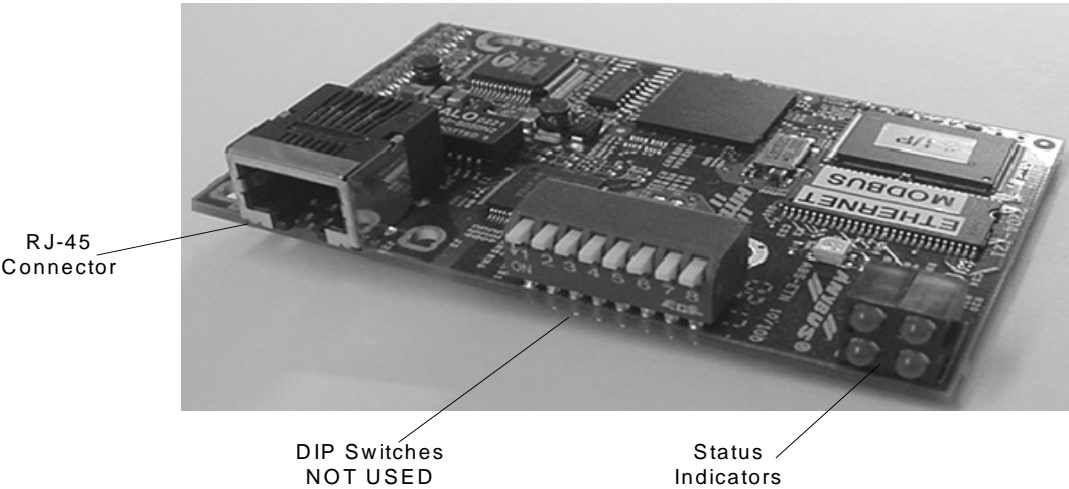


Figure 4-1: AnyBus Ethernet Modbus™ Module

4.1.2 Anybus Ethernet Modbus™ Status Indicators

Figure 4-2 shows the status indicators for run time status and errors. Table 4-1 explains the indications.

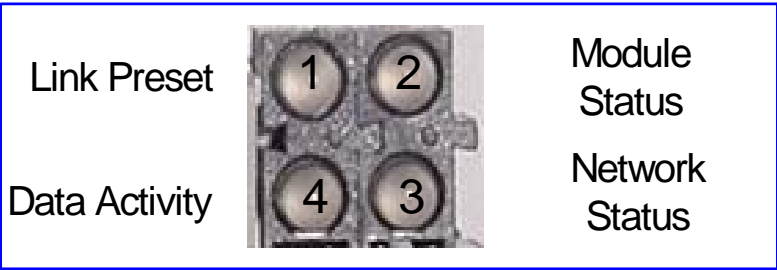


Figure 4-2: AnyBus Ethernet Modbus™ Status Indicators

Table 4-1: Status Indicator Descriptions

Number from Figure 4-2	Indication	State	Description
1	Link Present	On	The module has a link.
		Off	The module does not sense a link.
2	Module Status	Off	No power applied to the module.
		Green, steady	The module is operating correctly.
		Green, flashing	The module has not been configured.
		Red, flashing	A minor recoverable fault has been detected.
		Red, steady	A major internal error has been detected.
		Flashing green/red	The module is performing a power-on self-test.
3	Network status	Flashing	The number of established Modbus™/TCP connections to the module equals the number of flashes.
4	Data Activity	Flashing	Flash indicates a packet being received or transmitted.

4.2 Fast Setup

To begin controlling the Siemens drive using the Ethernet Modbus™ network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

4.2.1 To Set Up Ethernet Modbus™ for Control Using Default Configuration (Fixed Reg Bits)

The drive can be controlled from a master device using the following simple setup procedure. Using the keypad on the front of the drive, set 'Network 1 Type' (9901) to "Ethernet Modbus™". This setup assumes that there is an existing working TCP/IP network established. Verify the network settings for Subnet mask, and Gateway address (9320, 9330). The IP address (9310) must be unique to the drive. The default Subnet Mask and Gateway address will work for most network configurations. Finally, set the 'Net Control Type' parameter (9944) to FIXED. This sets the bits at Modbus™ address 40065 to have the definitions shown below in Table 4-2. Next, add the following line to the SOP: **Network1RunEnable_O = TRUE;** (the semicolon is part of the code). The user can now control the drive through the master device.

Table 4-2: Default Meaning of 'Fixed Reg Bits

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the master device must send 0x21 in register 40065. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the master device must send 0x08 or 0x00 in register 40065.

4.2.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units that will be sent (RPM,% or HZ) in menu (9080).
2. The user can see that the master device needs to send the desired speed setting to the drive in Modbus register 40066. This is a reserved register only used to hold speed settings (refer to Table 4-23).
3. Send 0x61 in Modbus™ register 40065. The motor will accept the master device commanded speed setting.

4.2.3 To Control the Motor Using User-defined Bits Controlled by the SOP

Use the keypad on the front of the drive to set 'Network 1 Type' (9901) to "Ethernet Modbus™". This setup assumes that there is an existing working TCP/IP network established. Verify the network settings for Subnet mask, and Gateway address (9320, 9330). The IP address (9310) must be unique for the drive. The default Subnet Mask and Gateway address will work for most network configurations. To enable speed settings from the network, add the following line to the SOP program file:

```
RawDemandNetwork1_0 = true;
```

Finally, set the 'Net Control Type' parameter (9944) to SOP. To control the motor this way, the drive needs to know what bits will be used in the SOP program. Two steps are required to do this:

1. Find the bits required by referring to Table 4-3 below, and locate the keypad pick list variable associated with the bits. By referring to Table 4-23 the user can see that the first available data to drive register is at Modbus address 40067, which corresponds to keypad parameter ID (9603). Using the keypad on the drive, go to menu item 'Data To Drive 03' (9603).
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit
;Network1Flag1_I Use bit 1 for Run Forward bit
RunRequest_0 = /Network1Flag0_I * Network1Flag1_I;Run drive using bit
1,stop using bit 0
```

If the user chose 'Data to Drive 03' as the write register; by referring to Table 4-23 they can see that the master device now needs to send 0x02 in Modbus™ address 40067 to run the drive, or 0x01 in the same register to stop the drive.

Table 4-3: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 4.9.3.

4.2.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed. Set 'Network 1 Type' (9901) to "Ethernet Modbus™". This setup assumes that there is an existing working TCP/IP network established. Verify the network settings for Subnet mask, and Gateway address (9320, 9330). The IP address (9310) must be unique to the drive. The default Subnet Mask and Gateway address will work for most network configurations. Set Velocity Units (9080) to desired motor speed units. By referring to Table 4-23, the user can see the Modbus™ addresses needed to read drive status and speed feedback from the drive by sending from the master device Modbus™ are 40001 and 40002, respectively. The definitions of the status bits, which are always found in Modbus™ register 40001, are shown below.

Table 4-4: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Reserved for future use	
12	Reserved for future use	
13	Reserved for future use	
14	Reserved for future use	
15	Reserved for future use	

See Section 4.7 for details on how to read other drive data.

4.3 Remote Capabilities

The Modbus™ interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through Modbus™ telegrams sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.



Note: The discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

4.4 Menu Setup Procedures

The Ethernet Modbus™ interface is built into all Siemens drives with NXG Control. It uses a dedicated Ethernet port located on the front of the CPU board. To configure the Modbus™ interface, verify the network settings for Subnet mask, and Gateway address (9320, 9330). The IP address (9310) must be unique for the drive. The default Subnet Mask and Gateway address will work for most network configurations.

All Modbus™ setup functions are contained in the Configure Parameters Menu (9902), which is a submenu of the Communications Menu (9). Access is security controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the Modbus™ interface are listed in Section 4.11. For the correct setup procedure, please refer to Section 4.7.

Select menu contents by using pick lists. The Modbus™ address of each menu item is fixed. For example, for network 1, 'Data from Drive 01' (9401) can be read by sending the read register request in address 40001. The menu 'Data from Drive 02' (9402) can be read in address 40002, and so on. The complete address references can be found in Table 4-25.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user needs to search Appendix B to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 4.7.1.

4.5 Network Interface

The NXG Control is equipped with a high performance 32-bit Ethernet chipset which is fully compliant with IEEE 802.3 100 MBPS CSMA/CD standards. It uses a dedicated standard RJ-45 jack located on the front of the CPU board. The AnyBus Ethernet Modbus™ module also uses a standard RJ-45 jack located on the module.

4.5.1 Setting Up Ethernet (TCP/IP) Communications

The Ethernet communications between a Modbus™ Ethernet device and the NXG Drive Control Software have two different configurations. The choice of which configuration to use depends on the site infrastructure. To use the LAN connection to control one or more drives on an existing network, assign a unique IP address to each drive. Go to each drive and set the menu items of the "Config Parameters" menu ID (9300). The menu items below will need to be updated based on the settings unique to the network.

Table 4-5: Net 1 Parameter Configuration Information

Menu item	Menu ID	Default setting	Custom setting
IP Address	9310	172.16.20.16	
Subnet mask	9320	255.255.0.0	
Gateway mask	9330	172.16.1.1	

Table 4-6: Net 2 Parameter Configuration Information

Menu item	Menu ID	Default setting	Custom setting
IP Address	9336	172.16.20.17	
Subnet mask	9337	255.255.0.0	
Gateway mask	9338	172.17.1.1	

4.5.2 Direct Connection

The Direct connection is intended for a single Ethernet Modbus™ device connected to the Drive using a special Ethernet crossover cable.

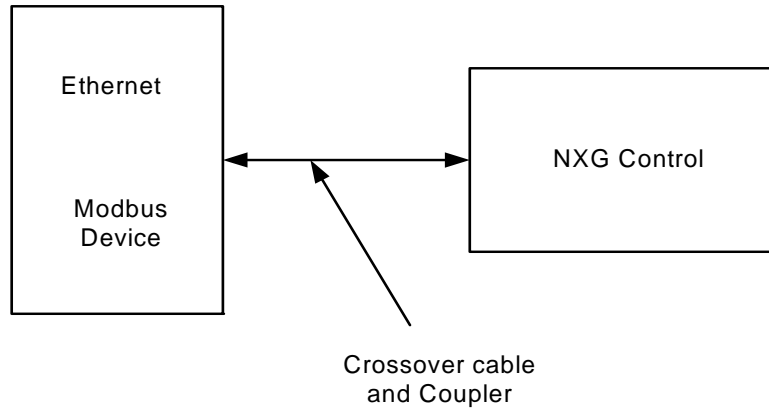


Figure 4-3: Direct Ethernet Modbus™ Communications Connection

Items for a single Ethernet direct connection support:

- Crossover patch cable - This allows the user to connect directly with the drive without a hub or server. Requires a coupler (below). Solutions4sure, <http://www.solutions4sure.com/>, 800.595.9333, supplier no. SOL4

S878311 10/100BT CAT5 XOVER PATCH 3' ORG 88468

S104652 RJ45 MODULAR COUPLER STRT R6G050

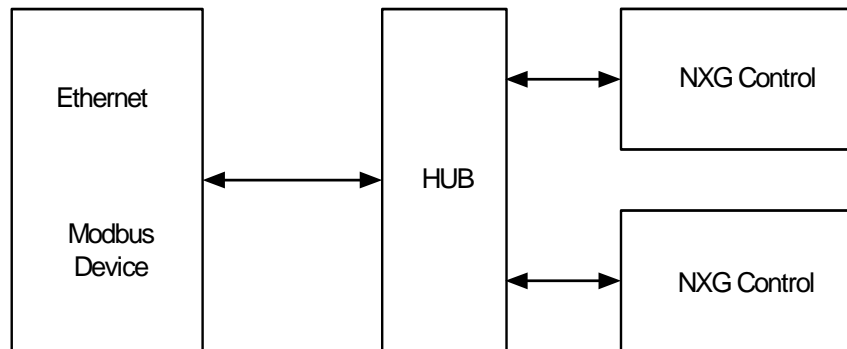


Figure 4-4: Network Ethernet Modbus™ Communications Connection

Items for a LAN multiple Drive Ethernet connection support:

- EtherFast 10/100 5 port HUB
GLOBAL COMPUTER SUPPLIES, <http://www.globalcomputer.com/eQZ25aqd/>, 888.8GL.OBAL
302517Linksys EtherFast 10/100 5pt WKGP Hub EFAH05W
- Ethernet Cat5 Cable
GLOBAL COMPUTER SUPPLIES, <http://www.globalcomputer.com/eQZ25aqd/>, 888.8GL.OBAL
ZCC31805XX 25' SNAG-PROOF Ethernet cable Cat5 RJ-45 (xx - choose color)

4.6 Supported Command Set

The NXG Control implements the following Modbus™ commands:

- Read Holding RegistersFunction code 0x03
- Write Single RegisterFunction code 0x06
- Write Multiple RegistersFunction code 0x10

Each of these supported commands are listed and described in the sections that follow. Each of these commands is issued by the Modbus™ master (master device) and sent over the network (to the Siemens slave[s]). The request and response message prefix for all codes is in Table 4-7.

Table 4-7: Request and Response Message Prefix

Six Byte prefix for messages
Transaction Identifier – copied by server – usually 0
Transaction Identifier – copied by server – usually 0
Protocol Identifier = 0
Protocol Identifier = 0
Length Field (upper byte) = 0 (all messages are less than 256 bytes)
Length Field (lower byte) = number of bytes to follow

4.6.1 Read Holding Registers Command (0x03)

The read holding registers command allows the Modbus™ master to read up to 64 consecutive memory registers from the drive. A sample read holding register command and its associated response are shown (in hexadecimal) in Figure 4-5. This sample request to read two registers (40005 and 40006) is detailed in Table 4-8. The drive’s read holding register response is detailed in Table 4-9. Parameter names and their corresponding data ID numbers are listed in Appendix B.

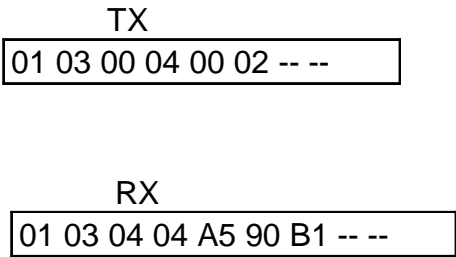


Figure 4-5: Sample Read Output Registers Command (TX) and Response (RX)

Table 4-8: Read Output Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x03	Read output registers command
Starting Address (High)	0x00	Register number 40005
Starting Address (Low)	0x04	
Number of Registers to Read (High)	0x00	Read 2 (0x0002) registers
Number of Registers to Read (Low)	0x02	

Table 4-9: Read Output Registers Response (RX) from Drive

Field Name	Value (in Hex)	Actual Result	Scaled Value	Notes
Transaction Identifier	0			
Transaction Identifier	0			
Protocol Identifier	0			
Protocol Identifier	0			
Length Field (upper byte)	0			
Length Field (lower byte)	#bytes to follow			
Slave Address	0x01	N/A	N/A	0x01 = 1 decimal
Function	0x03	N/A	N/A	Read output register command code
Byte Count	0x04	N/A	N/A	4 bytes in response
Data Value 1 (MSB)	0x04	0x04A5	This register is user programmable. See Table 4-21.	high byte of item 1
Data Value 1 (LSB)	0xA5			low byte of item 1
Data Value 2 (MSB)	0x90	0x90B1	This register is user programmable. See Table 4-21.	high byte of item 2
Data Value 2 (LSB)	0xB1			low byte of item 2



Note: For responses received from the drive (such as in Table 4-8), the keypad parameter Velocity Units (9080) is set to 'Percent' by default. Interpreted values (shown in the Scaled Value column of Table 4-9) will differ if this parameter is configured differently. See Appendix B for all data scaling.

4.6.2 Write Input Register Command (0x06)

The write input register command allows the Modbus™ master to write a value to a specified input register in the drive. A sample write input register command and its associated response are shown (in hexadecimal) in Figure 4-6. This sample request to write a value to register 40067 is detailed in Table 4-10. The write input register response from the drive is an echo of the transmission; therefore only one table is shown below.

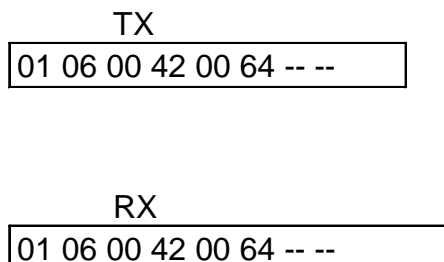


Figure 4-6: Sample Write Input Register Command (TX) and Response (RX)

Table 4-10: Write Input Register Transmission (TX) from Master (same as (RX) Echo Response from Drive)

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x06	Write input register command
Register Address (High)	0x00	register no. 40067
Register Address (Low)	0x42	
Preset Data (High)	0x00	Value = 100
Preset Data (Low)	0x64	

4.6.3 Write Multiple Input Registers Command (0x10)

The write multiple input registers command allows the Modbus master to write up to 64 values (in a single command) to multiple input registers in the drive. A sample request to write to two registers is shown with the associated response (in hexadecimal) in Figure 4-7. The sample request is detailed in Table 4-11. The associated response is detailed in Table 4-12.

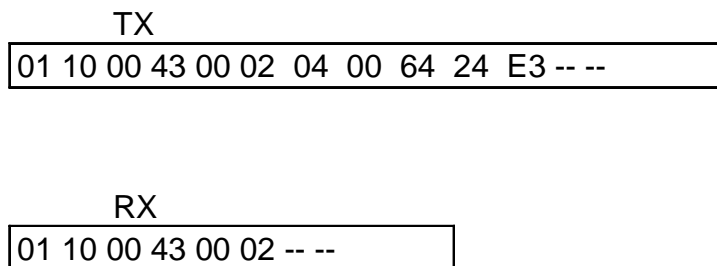


Figure 4-7: Sample Write Multiple Input Registers Command (TX) and Response (RX)

Table 4-11: Write Multiple Input Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x10	Write multiple input registers command
Starting Address (High)	0x00	Register number 40068
Starting Address (Low)	0x43	
No. Registers (High)	0x00	Write to 0x0002 (2) registers
No. Registers (Low)	0x02	
Byte Count	0x04	4 bytes total
Preset Data 1 (High)	0x00	Value = 0x0064 (100 decimal)
Preset Data 1 (Low)	0x64	
Preset Data 2 (High)	0x24	Value = 0x24E3 (9443 decimal)
Preset Data 2 (Low)	0xE3	

Table 4-12: Write Multiple Input Registers Response (RX) from Drive

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x10	Write multiple input registers command
Starting Address (High)	0x00	Register number 40068
Starting Address (Low)	0x43	
No. Registers (High)	0x00	Write to 0x0002 (2) registers
No. Registers (Low)	0x02	

4.7 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter Network 1 Type parameter ID (9901), scroll to Ethernet Modbus™, then press [ENTER]. The Modbus™ configuration parameters will be viewable.
2. Select the Velocity Units (9080). This sets the units for motor commanded speed and motor feedback speed scaling.
3. If needed, set the Demand Scalar (9912) to $n \times \text{command speed}$ where $-125 \leq n \leq 125$
4. Set the Aux Demand Scalar (9913) if used
5. Use Table 4-23 to program the drive to send data to and receive commands from available Modbus™ addresses. Each Modbus™ address from 40001 through 40128 corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from a particular Modbus™ address. Note that four such addresses are already programmed, giving the drive basic send and receive functionality. The data in these addresses are not changeable.
6. The definition of the bits in the available Modbus™ addresses may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 4.9 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the master device can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the Modbus™ network will they need to set any flags in the SOP program.

If the user needs to control the drive through a Modbus™ network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, change some of the drive's control parameters using the keypad on the front of the drive.

4.7.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her master device. These are status, motor speed, power, and number of active faults. The customer would like to set Modbus™ master device register 40001 to indicate drive general status. To program a register, refer to Table 4-23 to see if it is programmable. Register 40001 is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. This customer wants to set master device register 40002 to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 4-13 shows some hypothetical settings for Modbus™ addresses.

Table 4-13: Hypothetical Desired Address Settings

Master device Modbus Register	Data	Scaling
40001(not changeable)	General Status	16 bits
40002 (not changeable)	Motor Speed	RPM
40003	Output Power	kW
40004	Number of faults	0 – 128

4

The customer wants to set register 40003 to indicate output power. Table 4-23 indicates that this address is programmable. Use Table 4-23 to determine the necessary parameter ID. Enter parameter ID (9403) “Data from drive 03” using the keypad on the front of the drive. Choose “output power” from the pick list.

The customer wants to set register 40004 to indicate number of active faults. Enter parameter ID (9404) “Data from drive 04” using the keypad on the front of the drive. Scroll through the pick list to find “number of active faults”. Note that “number of active faults” is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 4-25 for a list of data from drive pick list variables. Since “number of active faults” is not a choice in the pick list, choose “Man Id” from the pick list. Find “number of active faults” in Appendix B, and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. “ManId-0000” will be shown on display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show “Man Id-3000”. If the data ID number could not be found, the error message “Invalid Id Entered” will be displayed. Ensure that the data ID is correct. Now the number of active faults will appear at register 40004 on the master device.

An example of how the master device interacts with the drive to read information is given below.

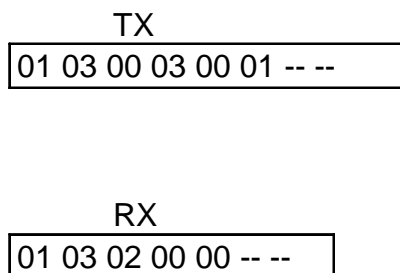


Figure 4-8: Sample Read Output Registers Command (TX) and Response (RX)

Table 4-14: Read Output Registers Transmission (TX) from Master

Field Name	Value (in Hex)	Notes
Slave Address	0x01	0x01 = 1 decimal
Function	0x03	Read output registers command
Starting Address (High)	0x00	Register number 40004
Starting Address (Low)	0x03	
Number of Registers to Read (High)	0x00	Read 1 (0x0001) register
Number of Registers to Read (Low)	0x01	

Table 4-15: Read Output Registers Response (RX) from Drive

Field Name	Value (in Hex)	Actual Result	Scaled Value	Notes
Slave Address	0x01	N/A	N/A	0x01 = 1 decimal
Function	0x03	N/A	N/A	Read output register command code
Byte Count	0x02	N/A	N/A	2 bytes in response
Data Value 1 (MSB)	0x00	0x0000	Programmable by user in this register. See Table 4-21.	high byte of item 1
Data Value 1 (LSB)	0x00			low byte of item 1

4.8 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 4-23 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to 'FIXED'. This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 4-16. Note that these particular drctry.ngn bits are always located at Modbus address 40065, whether the default configuration is used or not. To redefine the bits at this address, refer to Section 4.8.2.

Table 4-16: If 'Net Control Type' is set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for future use
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

4.8.1 Status Output

To read drive status data, the user needs to read the General Status register as found in Table 4-23. The drive's status output is shown below in Table 4-17. These status bits are always located at Modbus address 40001.

Table 4-17: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation can **NOT** be reprogrammed.

4.8.2 Running the Drive Using Non-default Settings

The drive can be run in a non-default manner by reprogramming the 'Fixed Reg Bits' register. As seen in Table 4-23, the *location* is fixed at 40065. However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits in Modbus™ register 40065, use the following procedure:

By setting menu parameter (9944) "Net Control Type" to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. In order to make the definition of the 'Fixed Reg Bits' in Modbus™ address 40065 programmable, use the drive's keypad to set parameter (9944) "Net Control Type" to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to Network1FixedRegBit9 in Modbus™ register 40065.

```
;ExternalDigitalOutput01h_0 Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_0 = Network1FixedRegBit9_I;
```

4.9 User Programming via the SOP

4.9.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 4-23 to find the location of the first 'Reg to Drive' register, which is programmable. Please note which Network 1 keypad parameter ID corresponds to that Modbus™ address. The table reveals the first programmable data to drive Modbus™ address to be 40067, and that its corresponding keypad parameter ID for Network 1 is (9603). Go to the keypad on the front of the drive and enter parameter (9603). The user will see a pick list, the first item of which is 'None' (see Table 4-24 for a list of possible pick list choices for input to drive data). The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 4-19.

This example shows how to use the Modbus™ network to trip the input medium voltage. In this example, our master device will be writing to Modbus™ register 40067, which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The master device will write the contents of 'Net Input Flag 1', bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

4.9.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 4-23 to find the location of the first 'Reg From Drive' register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that Modbus™ address. The table reveals the first programmable data from drive Modbus™ address to be 40003, and that its corresponding keypad parameter ID for Network 1 is (9403). Go to the keypad on the front of the drive and enter parameter (9403). The user will see a pick list, the first item of which is 'None' (see Table 4-25 for a list of possible pick list choices for output from drive data). The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 4-21.

This example shows how to use the Modbus™ network to detect a trip on the input medium voltage. In this example, our master device will be reading Modbus™ register 40003, which we programmed to 'Net1 Out Reg 1'. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of 'Net1 Out Reg 1', which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The master device will read the contents of Net 1 Out Reg 1, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the Modbus network
Network1Flag9_O = MediumVoltageLowFault_I;
```

4.9.3 Flags Available to the SOP Program

Net Control Type Default

The drive's interpretation of the bits in Table 4-18 is fixed by the drive's control software unless the user sets parameter (9944) "Net Control Type" to 'SOP'. To change the default interpretation of these bits, see Section 4.8.2.

Table 4-18: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits (programmable bits available for use in the SOP)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits	Modbus™ Register Address
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	40065 or 41025
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	41025

User Programmable

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 4-19: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 4-20: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 4-21: Network 1 Programmable Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

4

Table 4-22: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

4.10 Ethernet Modbus™ Address and Keypad Pick List Tables

Table 4-23: Correspondence Between Drive Parameter ID and Modbus Address*

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	Modbus™ Addresses ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	40001
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	40002
1	9403 - 9464	Data From Drive 03-64 ³	None	40003-40064
1	9601	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	40065
1	9602	Data To Drive 02 ⁴	Velocity Demand (not changeable)	40066
1	9603 - 9664	Data To Drive 03-64 ⁴	None	40067 - 40128 or 41027 - 41088
2	9501	Data From Drive 01 ³	General Status (not changeable)	40001
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	40002
2	9503 - 9564	Data From Drive 03-64 ³	None	40003 - 40064
2	9701	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	41025
2	9702	Data To Drive 02 ⁴	Velocity Demand (not changeable)	41026
2	9703 - 9764	Data To Drive 03-64 ⁴	None	41027 - 41088

- 1. Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- 2. Modbus™ Addresses**—digital locations provided by the Modbus™ Protocol, which store values for use by the master (PLC) and slave (Siemens drive) devices. To establish functional communication between the PLC and the drive, the control software in the drive needs to know for what certain addresses are used. That is the key to configuring the drive's Modbus™ connection.
- 3. Data From Drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- 4. Data To Drive**—data that the PLC will send to the drive in order to control it. Each register contains a 16-bit digital representation of the PIC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices. Network 1 Data to drive may use either listed register range. Both ranges are equivalent. Two ranges are available to be compatible with the AnyBus™ module on Network 2, and remain backward compatible with the older Ethernet Modbus™ implementation.

Table 4-24: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	NA	Scaling
None		None			MUX 5 ID	NA	None
Fixed Reg Bits	B	None			MUX 6 ID	NA	None
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA	None
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA	None
Net Input Flag 1	B	None			PTD1	NA	None
Net Input Flag 2	B	None			PTD2	NA	None
Net Input Flag 3	B	None			PTD3	NA	None
Net Input Flag 4	B	None			PTD4	NA	None
Ratio	U	% /100			Parallel Cmd 1		None
Forward Max Lim	U	/10000 or % /100			Torque Demand		/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand		/100
Forward Acc Time		/10			Flux Demand		/100
Forward Dec Time		/10			Node Count		None
Reverse Acc Time		/10			Node Index		None
Reverse Dec Time		/10			Torque Acc Time		/100
Net Input Pulse		In * 1			Torque Dec Time		/100
Forward Min Lim		/10000 or % /100			Torque Offset		/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar		/1000
Torque Limit		/10000 or % /100			Vars Command		/1000
MUX 1 ID	NA	None			No Load I Scalar		/1000
MUX 2 ID	NA	None			Avg Field Cur		/10000
MUX 3 ID	NA	None			Manual Ids Demand		/1000
MUX 4 ID	NA	None					

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 4-25: Ethernet Modbus™ Communications Data From Drive Pick List Variables

Drive Pick List Variables							
None	NA	Net1 Out Reg 4	B	Mux2 Echo	NA	Wago™ Inputs 65-80	B
Man Id	NA	Net2 Out Reg 1	B	Mux2 Data	NA	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	NA	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	NA	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	NA	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	NA	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	NA	PFD1	NA
Speed Demand	U	Motor Flux	U	Mux6 Echo	NA	PFD2	NA
Speed Reference	U	Motor Torque	U	Mux6 Data	NA	PFD3	NA
Heartbeat	U	Flux Reference	U	Mux7 Echo	NA	PFD4	NA
Drive State	U	Input Voltage	U	Mux7 Data	NA	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	NA	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	NA	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	NA	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	NA	Wago™ Inputs 49-64	B		

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

4.11 Menu Parameter Tables

Table 4-26: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ Profibus™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

Table 4-27: Network 1 Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Velocity Units	9080					Designates the units for velocity values from the drive. % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network Timeout	9934		0			Timeout for network to be determined non-responsive.
IP Address	9936		172.16.20.17			TCP/IP address on Ethernet
Subnet mask	9937		255.255.0.0			TCP/IP subnet mask
Gateway Address	9938		172.16.1.1			TCP/IP gateway address

Table 4-28: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 4-29: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 4-30: TCP/IP Setup Menu (9300)

Parameter	ID	Units	Default	Min	Max	Description
IP Address	9310		172.16.20.16			System TCP/IP Address
Subnet Mask	9320		255.255.0.0			System TCP/IP Subnet Mask
Gateway Address	9330		172.16.1.1			System TCP/IP Gateway Address

Table 4-31: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • Profibus™ • Modbus Plus™ • Ethernet Modbus™ • Data Highway +™ • ControlNet™

Table 4-32: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
Velocity Units	9924					Designates the units for velocity values from the drive. % RPM Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network Timeout	9935		0			Timeout for network to be determined non-responsive.
IP Address	9936		172.16.20.17			TCP/IP address on Ethernet
Subnet mask	9937		255.255.0.0			TCP/IP subnet mask
Gateway Address	9938		172.16.1.1			TCP/IP gateway address

Table 4-33: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 4-34: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

4.12 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen, is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

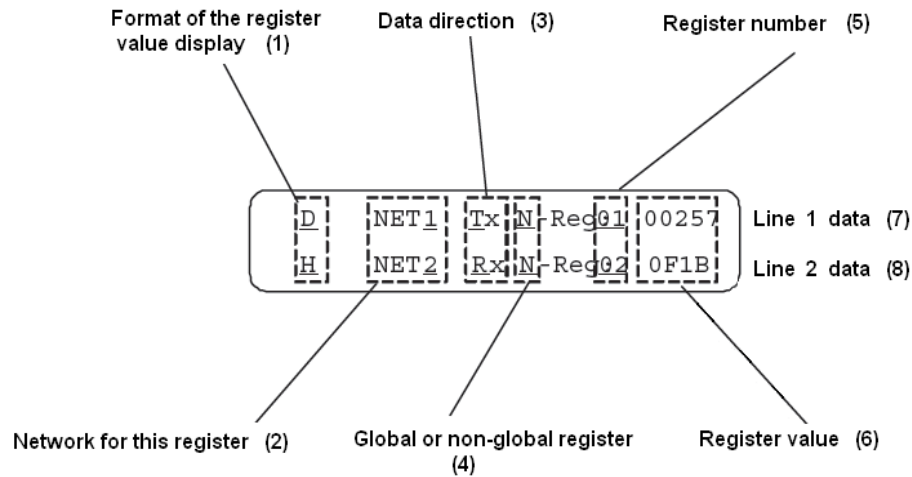


Figure 4-9: Diagram of Display Network Monitor Function

- 'D' means decimal format.
'H' means hexadecimal format.
- The drive may be connected to two separate networks.
- 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
- 'G' means a global register.
'N' means a non-global register.
The Ethernet Modbus™ protocol does not support global registers. Therefore, when working with an Ethernet Modbus™ controller, this field will contain 'N' in all of the registers.
- This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (9401) through "Data from Drive 64" parameter ID (9464).
'Rx' 01-64 are "Data to Drive 01" parameter ID (9601) through "Data to Drive 64" parameter ID (9664).
- The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
- Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
- Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

4 Figure 4-10 represents a display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

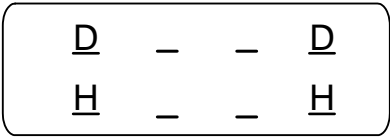


Figure 4-10: Cursor Movement Diagram



CHAPTER

5 Modbus™ Plus Communications

5.1 Introduction

Modbus™ Plus is a local area network system that provides programmable controllers, host computers, and other devices, the ability to communicate with each other. Up to 64 addressable nodes are possible, communicating at a data transfer rate of 1 million bits per second. The interface cable is a multidrop shielded twisted pair with terminating connectors at each end. Each node connects to the cable using a special 9-pin D type connector. Each section of cable can be up to 1500 feet long and can support 32 nodes. Repeaters are available to connect multiple cables to extend the LAN to a maximum distance between any two nodes to 6000 feet. A device called a Modbus™ Plus Bridge can be used to interconnect local networks. The protocol permits communications across 5 bridges. The electrical interface uses magnetic coupling to eliminate ground loops between nodes.

The LAN uses a token passing scheme to schedule data transactions. The current holder of an imaginary “token” is the current bus master, being able to perform his bus work while he retains the “token.” Once his work is complete, he will “pass the token” to the next known higher address device on the bus. An active node table is maintained by each device on the bus. Point to point transactions are acknowledged by the cooperating nodes. One complete cycle of the token to all nodes is termed “token rotation time.” Each node can place up to 32 words of global data onto the bus during its token pass. This data is “listened to” and immediately captured by each of the other nodes as global data. The update rate for global data from each node is a single token rotation time. Global data transactions are limited to the local network and are *not* passed through Modbus™ Plus Bridges. The token rotation time is a function of several factors. An equation to approximate the token rotation time is as follows:

$$TR = (2.08 + 0.016 * DMW) * DMP + (0.19 + 0.016 * GDW) * GDN + 0.53 * N$$

where:

- TR = Token Rotation time in milliseconds
- DMW = average number of Words per Data Master Path used in the network
- DMP = Number of Data Master Paths continuously used in the network
- GDW = Average number of Global Data Words per message used in the network
- GDN = Number of Nodes with Global Data transmitted in the network
- N = Number of Nodes in the network

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control via a Modbus™ Plus network as quickly as possible. Section 5.4 is short, procedural, and covers a minimum of detail. Please refer to the other sections for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, *i.e.* (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (*i.e.*, 0x12) is being represented in hexadecimal format.

Refer to the following publications for further information about the Modbus Plus network and other network related products.

840 USE 100 00 Modicon™ Quantum Automation Series Hardware Reference Guide

840 USE 101 00 Modicon™ Ladder Logic Block Library User Guide

840 USE 104 00 Modicon™ Modbus Plus Network I/O Servicing Guide

890 USE 102 00 Modicon™ IBM Host Based devices User's Guide

890 USE 103 00 Modicon Modbus™ Plus Network BM85 Bridge Multiplexer User's Guide

GM-HBDS-002 Modicon™ DEC Host Based Devices User's Guide

PI-MBUS-300 Modicon Modbus™ Protocol Reference Guide

More information on Modbus™ Plus is available from:

Schneider Automation Inc.

One High Street
North Andover, MA 01845
Tel: (978) 794-0800
Fax: (978) 975-0910
Website: www.modicon.com

The network bus consists of twisted-pair shielded cable that is run in a direct path between successive nodes. The two data lines in the cable are not sensitive to polarity. For a more detailed wiring diagram, see Modicon™ manual 890 USE 100 00.

The drive always acts as a Modbus™ Plus slave in master-slave configurations. If the user wants to have drive to drive communications, utilize the global data transfer methods as described in this document.

The Communication Board supports both UCS Modbus™ Plus modules and Anybus Modbus™ Plus modules.

5.2 UCS Modbus™ Plus Module

Figure 5-1 shows the connector and status indicators on the UCS Modbus™ Plus module.

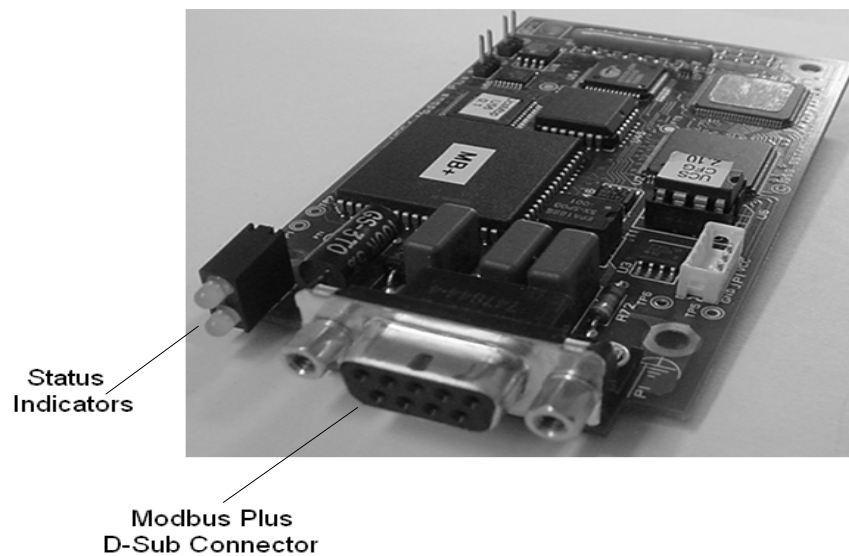


Figure 5-1: UCS Modbus™ Plus Module

5.2.1 UCS and AnyBus Modbus™ Plus Connector

The connector is a D-Sub Female connector. The pin assignments are shown in Figure 5-2.

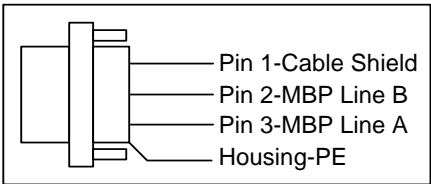


Figure 5-2: Pin Assignments for Modbus™ Plus Connector

5.2.2 UCS Modbus™ Plus Status Indicators

Figure 5-3 shows the status indicators. Table 5-1 describes the LED states.

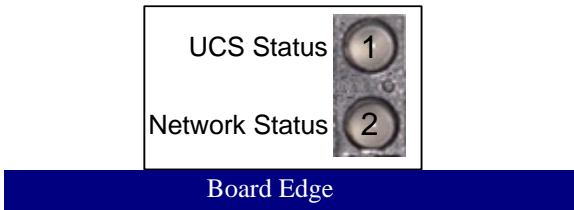


Figure 5-3: Status Indicators

Table 5-1: Status Indicator Descriptions

Number from Figure 5-3	Indication	State	Description
1	UCS™ Status	Off	No power or hard/soft reset asserted
		Red, Flashing	Recoverable configuration fault (invalid firmware, OEM data, or personality data)
		Red	Hardware error or fatal runtime error
		Green, flashing	No errors, data exchange interface is not open
		Green	No errors, data exchange interface is active
		Amber (red/green)	Configuration mode
2	Network Status		The LED is controlled by the Modicon™ firmware running on the peer processor according to Modicon™ Modbus Plus Network Developer’s Manual, ©1991 Modicon, Inc.

5.3 AnyBus Modbus™ Plus Module

The AnyBus-S™ module for Modbus™ Plus is a host device. This host device can be read and written to/from another Modbus™ Plus host device or controller. The AnyBus-S™ module for Modbus™ Plus will not initiate any point-to-point communication to other nodes, it will only respond to commands. However, it can broadcast global data to all nodes on the network.

Figure 5-4 shows the AnyBus Modbus™ Plus module.

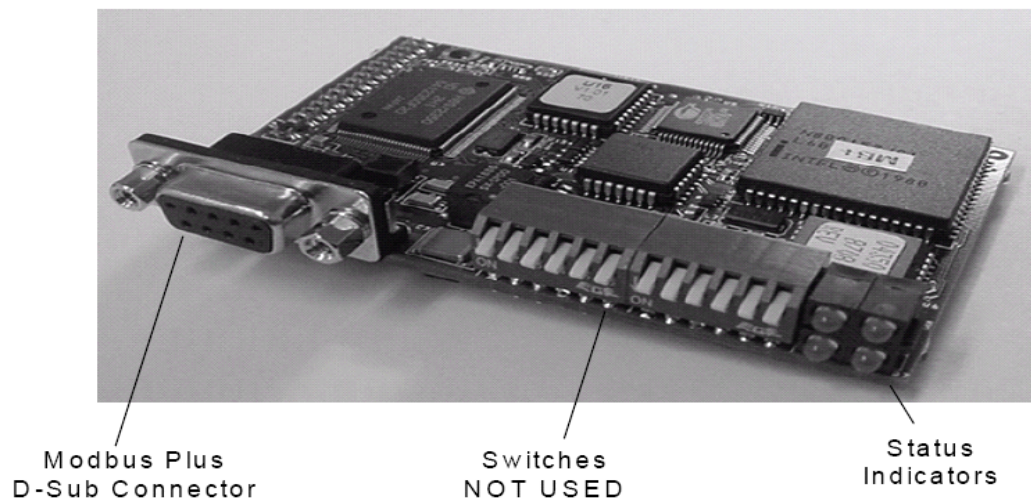


Figure 5-4: AnyBus Modbus™ Plus Module

5.3.1 AnyBus Modbus™ Plus Connector

See Figure 5-2.

5.3.2 AnyBus Modbus™ Plus Status Indicators

Figure 5-5 shows the status indicators for run time status and errors. Table 5-2 explains the indications.

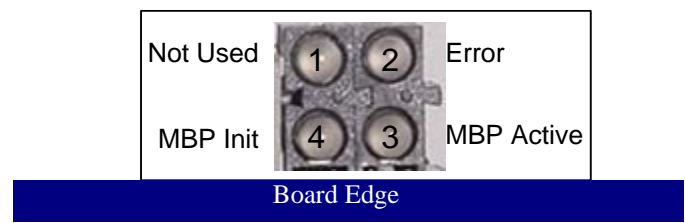


Figure 5-5: AnyBus Modbus™ Plus Indicator

Table 5-2: Status Indicator Descriptions

Number from Figure 5-5	Indication	State	Description
1	Not Used	—	—
2	Error	Red, steady	Error in communication
3	MBP Active	Flash on 80 ms, off 80 ms	Operation is normal
		Flash every 1 s	MONITOR_OFFLINE state
		2 flashes; on 160 ms, off 480 ms	MAC_IDLE never-getting-token state
		3 flashes; on 160 ms, off 240 ms, then off 1.6 s	Not sensing an other nodes
		4 flashes; on 160 ms, off 240 ms, then off 1.2 s	Detecting duplicate node addresses
4	MBP Init	Green, steady	Peer interface is initialized

5.3.3 AnyBus Modbus™ Plus Protocol and Supported Functions

The AnyBus-S Modbus™ Plus has two ways of exchanging data. The first method is Global Data that uses a fast cyclic I/O. The second method is a somewhat slower protocol for point-to-point register data transfer.

The maximum Global Data is 32 16-bit words on the bus, with the ability to set an offset within the Source node Global Data. The point-to-point data transfer is handled by using one of the following Modbus™ functions: Read holding Registers, Preset Single Register, or Preset multiple Registers (40,000 registers).

5.4 Fast Setup

5.4.1 Modbus™ Plus Network Configuration Without Global Data

Set the 'Modbus™ Plus Mode' parameter (9910) for Network 1 or parameter (9941) for Network 2 to "Reg data only".



Note: When the 'Modbus™ Plus Mode' parameter is set to "Reg data only" the menu parameters 'Modbus™ Plus Reg Control' and 'Global receive address' are not used.

5.4.2 Modbus™ Plus Network Configuration With Global Data

Set the 'Modbus™ Plus Mode' parameter (9910) for Network 1 or parameter (9941) for Network 2 to "Reg/Glob data".

The menu parameter 'Modbus™ Plus Reg Control' is used to select the source of the Motor Speed and Fixed Reg Bits which can be controlled from either global data or register data.

If the drive Fixed Reg Bits and Motor Speed are to be controlled from register data, set the 'Modbus™ Plus Reg Control' parameter (9910) for Network 1 or parameter (9942) for Network 2 to "reg data". Otherwise, set the parameter to "Global data".

Set the 'Global Receive address' parameter (9909) for Network 1 or parameter (9923) for Network 2, to the address of the network device that will be used as the source for the drives to receive global data.

5.4.3 Non-global Registers: To Set Up Modbus™ Plus for Motor Control Using Default Configuration (Fixed Reg Bits)

The drive can be controlled from a PLC using the following simple setup procedure:

1. Using the keypad on the front of the drive, set 'Network 1 Type' (9901) to Modbus™ Plus.
2. Set the correct address (9907).
3. Set the 'Net Control Type' parameter (9944) to FIXED. This sets the bits at Modbus™ Plus address 40065 to have the definitions shown in Table 5-3.
4. Add the following line to the SOP:

Network1RunEnable_O = TRUE; (the semicolon is part of the code).

The user can now control the drive through the PLC.

Table 5-3: Default Meaning of 'Fixed Reg Bits' (Input Control Registers)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset 0
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the PLC must send 0x21 in register 40065. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 in register 40065.

5.4.4 Non-global Registers: To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units to be sent to RPM, % or HZ, in menu (9080).
2. The user can see that the PLC needs to send the desired speed setting to the drive in Modbus™ Plus register 40066 for UCS modules, or 41058 for AnyBus™ modules. This is a reserved register only used to hold speed settings (refer to Table 5-14).
3. Send 0x61 in Modbus™ Plus register 40065 for UCS modules, or 41057 for AnyBus™ modules. The motor will accept the PLC commanded speed setting.

5.4.5 Non-global Registers: To Control the Motor Using User-defined Bits Controlled by the SOP

The drive can be controlled from a PLC using the following simple setup procedure.

1. Using the keypad on the front of the drive, set 'Network 1 Type' (9901) to Modbus Plus.
2. Set the correct address (9907).
3. Set the 'Net Control Type (9944) to SOP.
4. To enable speed settings from the network, add the following line to the SOP program file:

```
RawDemandNetwork1_0 = true;
```

To control the motor this way, the drive needs to know what bits will be used in the SOP program. Two steps are required to do this:

1. Find the bits required by referring to Table 5-4 below, and locate the keypad pick list variable associated with the bits. By referring to Table 5-14, the user can see that the first available data to drive register is at Modbus™ Plus address 40067 for UCS modules or 41059 for AnyBus™ modules, which corresponds to keypad parameter ID (9603). Using the keypad on the drive, go to menu item 'Data To Drive 03' (9603).
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program, as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit
;Network1Flag1_I Use bit 1 for Run Forward bit
RunRequest_0 = /Network1Flag0_I * Network1Flag1_I;Run drive using bit 1,stop
using bit 0
```

For example, if the user chose 'Data to Drive 03' as the write register, by referring to Table 5-14 the user can see that the PLC now needs to send 0x02 in Modbus™ Plus address 40067 to run the drive, or 0x01 in the same register to stop the drive.

Table 5-4: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 5.10.3.

5.4.6 Non-global Registers: To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed.

1. Set 'Network 1 Type' (**9901**) to Modbus™ Plus.
2. Set the correct Address (**9907**).
3. Set Velocity Units (**9080**) to the desired motor speed units. By referring to Table 5-14, the user can see the Modbus™ Plus addresses needed to read drive status and speed feedback from the drive by sending from the PLC Modbus Plus are 40001 and 40002, respectively. The definitions of the status bits, which are always found in Modbus Plus register 40001, are shown below.

Table 5-5: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

See Section 5.8 for details on how to read other drive data.

5.5 Remote Capabilities

The Modbus™ Plus interface to the drive allows remote control and monitoring of the drive. Control of the drive can be through Modbus™ Plus telegrams sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.



Note: The discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

5.6 Menu Setup Procedures

All Modbus™ Plus setup functions are contained in the Configure Parameters Menu (9902), which is a submenu of the Communications Menu (9). Access is security-controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the Modbus™ Plus interface are listed in Table 5-18. For the correct setup procedure, please refer to Section 5.8.

Select menu contents by using pick lists. The Modbus™ Plus address of each menu item is fixed. For example, for Network 1, 'Data from Drive 01' (**9401**) can be read by sending the read register request in address 40001. The menu 'Data from Drive 02' (**9402**) can be read in address 40002, and so on. The complete address references can be found in Table 5-16.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user will need to search Appendix B to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 5.8.1.

5.7 Supported Command Set

The NXG Control supports the following Modbus™ commands:

- Read Holding RegistersFunction code 0x03
- Write Single RegisterFunction code 0x06
- Write Multiple RegistersFunction code 0x10

Each of these supported commands are listed and described in Chapters 2 and 4 of this manual.

5.8 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter Network 1 Type (**9901**), scroll to Modbus™ Plus, then press [ENTER]. The Modbus™ Plus configuration parameters will be viewable.
2. Set the Modbus™ Plus Address (**9907**) to the desired Modbus™ Plus address for the drive.
3. Select the Velocity Units (**9080**). This sets the units for motor commanded speed, and motor feedback speed scaling.
4. If needed, set the Demand Scalar (**9912**) to $n \times \text{command speed}$ where $-125 \leq n \leq 125$.
5. Set the Aux Demand Scalar (**9913**) if used.
6. Use Table 5-15 to program the drive to send data to and receive commands from available Modbus™ Plus addresses. Each Modbus™ Plus address from 40001 through 40128 for UCS modules, or 40033 through 40096 for AnyBus™ modules, corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular Modbus™ Plus address. Note that four such addresses are already programmed, giving the drive basic send and receive functionality. The data in these addresses are not changeable.
7. The definition of the bits in the available Modbus™ Plus addresses may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 5.10 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the Modbus™ Plus network will they need to set any flags in the SOP program. If the user needs to control the drive through a Modbus™ Plus network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

5.8.1 A Practical Setup Example

A customer needs to process four drive outputs on a PLC. These are status, motor speed, power, and number of active faults. The customer would like to set Modbus™ Plus PLC register 40001 to indicate drive general status. To program a register, refer to Table 5-14 to see if it is programmable. Register 40001 is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. This customer wants to set PLC register 40002 to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 5-6 shows some hypothetical settings for Modbus™ Plus addresses.

Table 5-6: Hypothetical Desired Address Settings

PLC Modbus Plus Register (not changeable)	Data	Scaling
40001	General Status	16 bits
40002	Motor Speed	RPM
40003	Output Power	kW
40004	Number of faults	0 – 128

The customer wants to set register 40003 to indicate output power. Table 5-14 indicates that this address is programmable. Use Table 5-14 to determine the necessary parameter ID. Enter parameter ID (9403) “Data from drive 03” using the keypad on the front of the drive. Choose “output power” from the pick list.

The customer wants to set register 40004 to indicate number of active faults. Enter parameter ID (9404) “Data from drive 04” using the keypad on the front of the drive. Scroll through the pick list to find “number of active faults.” Note that “number of active faults” is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 5-16 for a list of data from drive pick list variables. Since “number of active faults” is not a choice in the pick list, choose “Man Id” from the pick list. Find “number of active faults” in Appendix B, and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. “ManId-0000” will be shown on display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show “Man Id-3000.” If the data ID number could not be found, the error message “Invalid Id Entered” will be displayed. Ensure that the data ID is correct. Now the number of active faults will appear at register 40004 on the PLC.

5.9 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 5-14 to see the location of the 'Fixed Reg Bits.' The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9928) to 'FIXED.' This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 5-7. Note that these particular drctry.ngn bits are always located at Modbus™ Plus address 40065 for UCS modules or 41057 for AnyBus™ modules, whether the default configuration is used or not. To redefine the bits at this address, refer to Section 5.9.2.

Table 5-7: If Set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset 0
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

5.9.1 Status Output

To read drive status data, the user will need to read the General Status register as found in Table 5-14. The drive's status output is shown below in Table 5-8. These status bits are always located at Modbus™ Plus address 40001.

Table 5-8: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

5.9.2 Running the Drive Using Non-default Settings

The drive can be run in a non-default manner by reprogramming the 'Fixed Reg Bits' register. As seen in Table 5-14, the *location* is fixed at 40065 (UCS) or 41057 (AnyBus™). However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits in Modbus™ Plus register 40065 (UCS) or 41057 (AnyBus™), use the following procedure:

By setting menu parameter (9944) "Net Control Type" to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. To make the definition of the 'Fixed Reg Bits' in Modbus™ Plus address 40065 programmable, use the drive's keypad to set parameter (9944) "Net Control Type" to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to Network1FixedRegBit9 in Modbus™ Plus register 40065 (UCS) or 41057 (AnyBus™).

```
;ExternalDigitalOutput01h_0 Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_0 = Network1FixedRegBit9_I;
```

5.10 User Programming via the SOP

5.10.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 5-14 to find the location of the first 'Reg to Drive' register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that Modbus™ Plus address. The table reveals the first programmable data to drive Modbus™ Plus address to be 40067 (UCS) or 41059 (AnyBus™), and that its corresponding keypad parameter ID for Network 1 is **(9603)**. Go to the keypad on the front of the drive and enter parameter **(9603)**. The user will see a pick list, the first item of which is 'None'. See Table 5-15 for a list of possible pick list choices for input to drive data. The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 5-10.

This example shows how to use the Modbus™ Plus network to trip the input medium voltage. In this example, our PLC will be writing to Modbus™ Plus register 40067 (UCS™) or 41059 (AnyBus™), which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of 'Net Input Flag 1', bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage  
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

5.10.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 5-14 to find the location of the first 'Reg From Drive' register that is programmable. Please note which network 1 keypad parameter ID corresponds to that Modbus™ Plus address. The table reveals the first programmable data from drive Modbus™ Plus address to be 40003, and that its corresponding keypad parameter ID for network 1 is **(9403)**. Go to the keypad on the front of the drive and enter parameter **(9403)**. The user will see a pick list, the first item of which is 'None'. See Table 5-16 for a list of possible pick list choices for output from drive data. The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 5-12.

This example shows how to use the Modbus™ Plus network to detect a trip on the input medium voltage. In this example, our PLC will be reading Modbus™ Plus register 40003, which we programmed to 'Net1 Out Reg 1'. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of 'Net1 Out Reg 1', which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of Net 1 Out Reg 1, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the Modbus Plus network  
Network1Flag9_O = MediumVoltageLowFault_I;
```

5.10.3 Flags Available to the SOP Program

Fixed by Drive Software by Default:

The drive's interpretation of the bits in Table 5-9 is fixed by the drive's control software unless the user sets parameter (9928) "Status/Control" to 'SOP.' To change the default interpretation of these bits, see Section 5.9.2.

Table 5-9: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits (programmable bits available for use in the SOP)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits	Modbus Plus Register Address
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	40065
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	40065

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 5-10: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 5-11: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 5-12: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 5-13: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

5.11 Modbus Plus Address and Keypad Pick List Tables

Table 5-14: Correspondence Between Drive Parameter ID and Modbus Plus Address

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	Modbus™ Plus Addresses ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	40001 (UCS™) 40033 (AnyBus™)
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	40002 (UCS™) 40034 (AnyBus™)
1	9403 - 9464	Data From Drive 03-64 ³	None	40003-40064 (UCS™) 40035 - 40096 (AnyBus™)
1	9801	(Global) Data From Drive	General Status (not changeable)	N/A
1	9802	(Global) Data From Drive	Motor Speed (not changeable)	N/A
1	9803 - 9832	(Global) Data From Drive	None	N/A
1	9601	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	40065 (UCS™) 41057 (AnyBus™)
1	9602	Data To Drive 02 ⁴	Velocity Demand (not changeable)	40066 (UCS™) 41058 (AnyBus™)
1	9603 – 9664	Data To Drive 03-64 ⁴	None	40067-40128 (UCS™) 41059-41120 (AnyBus™)
1	9201	(Global) Data To Drive	Fixed Reg Bits (not changeable)	N/A
1	9202	(Global) Data To Drive	Velocity Demand (not changeable)	N/A
1	9203 – 9232	(Global) Data To Drive	None	N/A
2	9501	Data From Drive 01 ³	General Status (not changeable)	40001(UCS™) 40033 (AnyBus™)
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	40002 (UCS™) 40034 (AnyBus™)
2	9503 – 9564	Data From Drive 03-64 ³	None	40003-40064 (UCS™) 40035 - 40096 (AnyBus™)
2	9834	(Global) Data From Drive	General Status (not changeable)	N/A
2	9835	(Global) Data From Drive	Motor Speed (not changeable)	N/A
2	9836 – 9865	(Global) Data From Drive	None	N/A
2	9701	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	40065 (UCS™) 41057 (AnyBus™)

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	Modbus™ Plus Addresses ²
2	9702	Data To Drive 02 ⁴	Velocity Demand (not changeable)	40066 (UCS™) 41058 (AnyBus™)
2	9703 – 9764	Data To Drive 03-64 ⁴	None	40067-40128 (UCS™) 41059-41120 (AnyBus™)
2	9234	(Global) Data To Drive	Fixed Reg Bits (not changeable)	N/A
2	9235	(Global) Data To Drive	Velocity Demand (not changeable)	N/A
2	9236 – 9265	(Global) Data To Drive	None	N/A

1. **Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
2. **Modbus™ Plus Address**—digital locations provided by the Modbus™ Plus Protocol, which store values for use by the master (PLC) and slave (Siemens drive) devices. To establish functional communication between the PLC and the drive, the control software in the drive needs to “know” for what certain addresses are used. That is the key to configuring the drive’s Modbus™ Plus connection.
3. **Data from drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive’s functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
4. **Data to drive**—data that the PLC will send to the drive to control it. Each register contains a 16-bit digital representation of the PLC’s command for a particular aspect of the drive’s functioning. Some registers are fixed to control certain functions; others are programmable to control any number of drive function choices.

Table 5-15: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	Scaling
None		None			MUX 5 ID	NA
Fixed Reg Bits	B	None			MUX 6 ID	NA
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA
Net Input Flag 1	B	None			PTD1	NA
Net Input Flag 2	B	None			PTD2	NA
Net Input Flag 3	B	None			PTD3	NA
Net Input Flag 4	B	None			PTD4	NA
Ratio	U	% /100			Parallel Cmd 1	None
Forward Max Lim	U	/10000 or % /100			Torque Demand	/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand	/100
Forward Acc Time		/10			Flux Demand	/100
Forward Dec Time		/10			Node Count	None
Reverse Acc Time		/10			Node Index	None
Reverse Dec Time		/10			Torque Acc Time	/100
Net Input Pulse		In * 1			Torque Dec Time	/100
Forward Min Lim		/10000 or % /100			Torque Offset	/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar	/1000
Torque Limit		/10000 or % /100			Vars Command	/1000
MUX 1 ID	NA	None			No Load I Scalar	/1000
MUX 2 ID	NA	None			Avg Field Cur	/10000
MUX 3 ID	NA	None			Manual Ids Demand	/1000
MUX 4 ID	NA	None				

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 5-16: Modbus Plus Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

5.12 Menu Parameter Tables

Table 5-17: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • Modbus™ Plus • Ethernet Modbus™ • Data Highway +™ • ControlNet™

Table 5-18: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Modbus™ Plus Address	9907		1	1	64	Sets address of node on Modbus™ Plus network.
Modbus™ Plus Reg Control	9910		Reg data			Sets use of global or non-global fixed registers to be used. <ul style="list-style-type: none"> • Reg data • Global data
Modbus™ Plus Mode	9942		Reg data only			Sets if any global registers are used <ul style="list-style-type: none"> • Reg data only • Reg/Glob data
Global Receive Address	9909		1	1	64	Address from where drive receives its global data
Velocity Units	9080		%			Designates the units for velocity values from the drive <ul style="list-style-type: none"> • % • RPM • Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network
Network Timeout	9934		0	0	65535	Timeout for network to be determined non-responsive

Table 5-19: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 5-20: Global Data From Drive Menu (9800)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9801		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9802		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9803-9832		None			Register data from drive parameters 3-32. These registers are programmable.

Table 5-21: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 5-22: Global Data To Drive Menu (9200)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9201		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9202		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-32	9203-9232		None			Register data to drive parameters 3-32. These registers are programmable.

Table 5-23: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ Profibus™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

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Table 5-24: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
Modbus™ Plus Address	9921		1	1	64	Sets address of node on Modbus™ Plus network
Modbus™ Plus Reg Control	9940		Reg data			Sets use of global or non-global fixed registers to be used <ul style="list-style-type: none"> Reg data Global data
Modbus™ Plus Mode	9941		Reg data only			Sets if any global registers are used <ul style="list-style-type: none"> Reg data only Reg/Glob data
Global Receive Address	9923		1	1	64	Address from where drive receives its global data
Velocity Units			%			Designates the units for velocity values from the drive <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network
Network Timeout	9935		0	0	65535	Timeout for network to be determined non-responsive

Table 5-25: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 5-26: Global Data From Drive Menu (9833)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9834		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9835		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03-32	9836-9865		None			Register data from drive parameters 3-32. These registers are programmable.

Table 5-27: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

Table 5-28: Global Data To Drive Menu (9233)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9234		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9235		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-32	9236-9265		None			Register data to drive parameters 3-32. These registers are programmable.

5.13 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen, is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

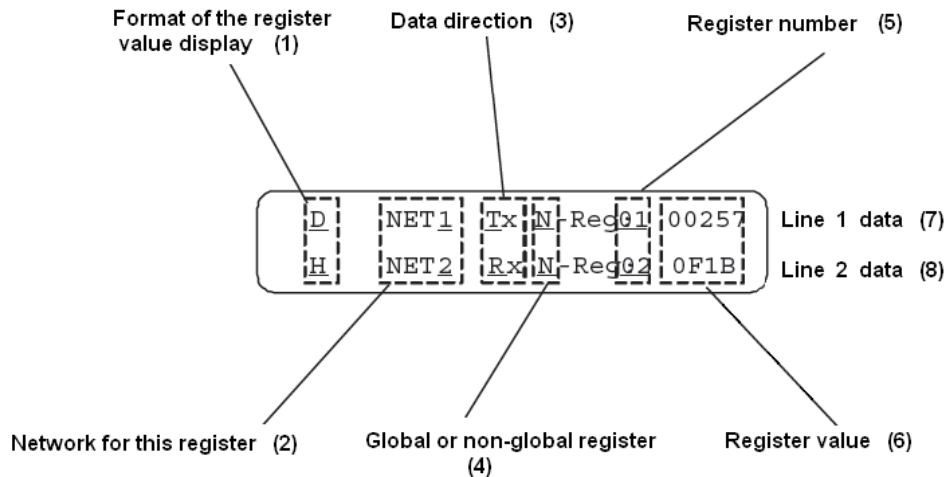


Figure 5-6: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (**9401**) through "Data from Drive 64" parameter ID (**9464**).
'Rx' 01-64 are "Data to Drive 01" parameter ID (**9601**) through "Data to Drive 64" parameter ID (**9664**).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 5-7 below represents a display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

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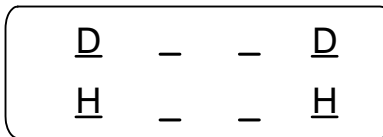


Figure 5-7: Cursor Movement Diagram

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CHAPTER

6 Profibus™ Communications

6.1 Introduction

Profibus™ is a token ring network. Master devices (or active stations) are those devices that initiate communication. When a master receives the “token,” it may then perform master-slave communications with its slaves (or passive stations).

The Siemens NXG drive acts as a slave (passive station) on the Profibus™ network. The Drive auto detects the baud rate from the network, and is capable of baud rates of up to 12 Mbit/sec.

The UCS Profibus™ and Anybus Profibus™ module supports the following baud rates: 9.6 kbit/sec, 19.2 kbit/sec, 93.75 kbit/sec, 187.5 kbit/sec, 500 kbit/sec, 750 kbit/sec, 1 Mbit/sec, 3 Mbit/sec, 6 Mbit/sec, and 12 Mbit/sec.

The UCS Profibus™ and Anybus Profibus™ module have a nine pin DB-9F connector. Pin 3 is the positive data pin (RxD/TxD-P) and pin 8 is the negative connection (RxD/TxD-N).

This chapter features a fast setup section that will help to start controlling the Siemens drive with NXG Control via a Profibus™ network as quickly as possible. Section 6-4 is short, procedural, and covers a minimum of detail. Please refer to the other sections for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, *i.e.* (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (*i.e.*, 0x12) is being represented in hexadecimal format.

Profibus™ (Process Field Bus) is registered trademark of the Profibus™ Trade Organization.

Profibus™ DP (Decentralized Periphery) is a product line of protocols and is a registered trademark of the Profibus™ Trade Organization (PTO).

6.2 UCS Profibus™ Module

Figure 6-1 shows the connector and status indicators on the UCS Profibus™ module.

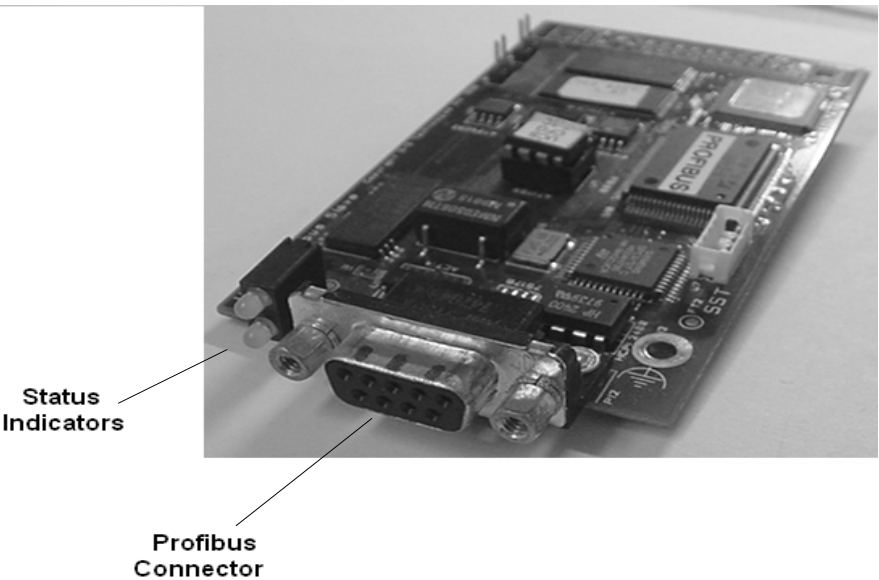


Figure 6-1: UCS Profibus™ Module

6.2.1 UCS / AnyBus Profibus™ Connector

The connector is a D-Sub Female connector. The pin assignments are shown in Figure 6-2.

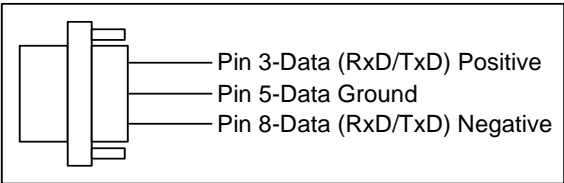


Figure 6-2: Pin Assignments for Profibus™ Connector

6.2.2 UCS Profibus™ Status Indicators

Figure 6-3 shows the status indicators. Table 6-1 describes the LED states.

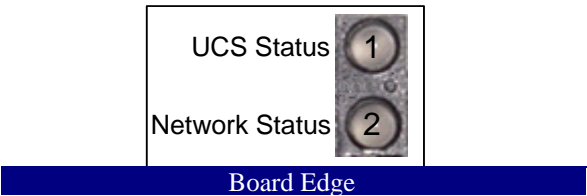


Figure 6-3: Status Indicators

Table 6-1: Status Indicator Descriptions

Number from Figure 6-3	Indication	State	Description
1	UCS™ Status	Off	No power or hard/soft reset asserted
		Red, flashing	Recoverable configuration fault (invalid firmware, OEM data, or personality data)
		Red	Hardware error or fatal runtime error
		Green, flashing	No errors, data exchange interface is not open
		Green	No errors, data exchange interface is active
		Amber (red/green)	Configuration mode
2	Network Status	Off	Network interface disabled due to closed interface or client I/O fault
		Red, flashing	Baud rate detected, not configured, or configuration error with master
		Red, solid	Network offline, no bus, no baud rate
		Green/Red flash	Online, network clear mode
		Green, solid	Online, data exchange mode

6.3 AnyBus Profibus™ Module

Figure 6-4 shows the connectors, switches, and indicators on the AnyBus™ board that are relevant to Siemens operation.

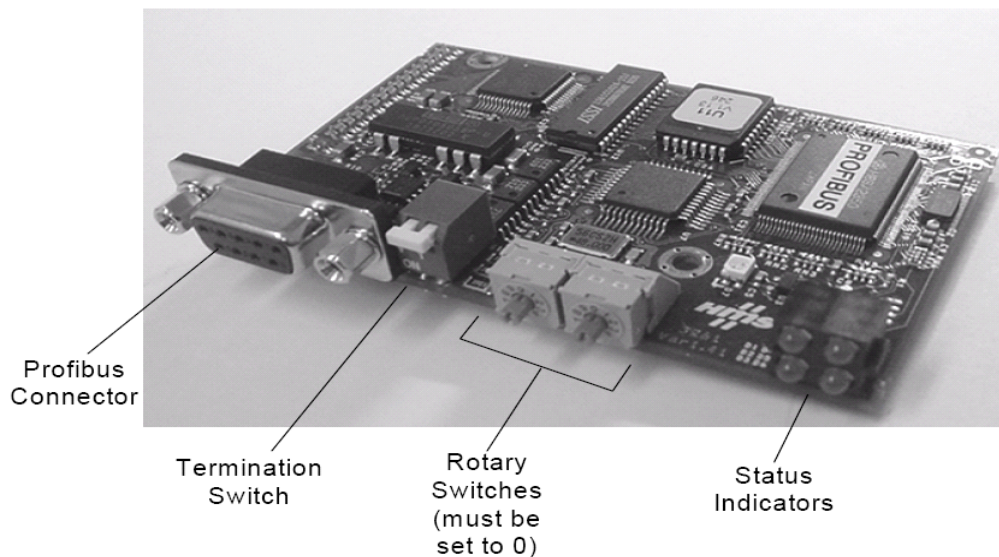


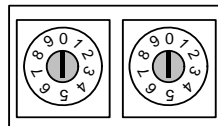
Figure 6-4: AnyBus Profibus™ Module

6.3.1 Connector

The network connector is a nine-pin DB-9F connector. See Figure 6-2 for the pin assignments.

6.3.2 Rotary Switches

The rotary switches must both be set to 0, as shown in Figure 6-5.



Note: Ensure that *both* rotary switches are set to zero!

Figure 6-5: Rotary Switch Settings

6.3.3 AnyBus Profibus™ Status Indicators

Figure 6-6 shows the status indicators. Table 6-2 describes the indications.

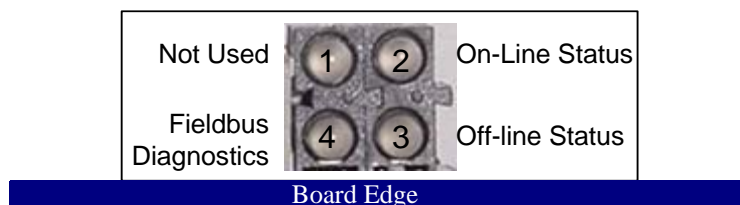


Figure 6-6: AnyBus Profibus™ Status Indicators

Table 6-2: AnyBus™ Status Descriptions

Number from Figure 6-6	Indication	State	Description
1	—	—	—
2	On-line status	Off	Module is not online
		Green	Module is online on the fieldbus
3	Off-line status	Off	Module is not offline
		Red	Module is offline from the fieldbus
4	Fieldbus diagnostics	Off	No diagnostics present
		Red, flashing at 1 Hz	Error in configuration: IN and/or OUT length set during initialization of the module is not equal to the length set during configuration of the network
		Red, flashing at 2 Hz	Error in User Parameter data: the length/contents of the User Parameter data set during initialization of the module is not equal to the length/contents set during configuration of the network
		Red, flashing at 4 Hz	Error in initialization of the Profibus™ communication ASIC

6.3.4 Termination Switch

The end nodes in a Profibus-DP™ network must be terminated to avoid reflections on the bus line. The AnyBus-S Profibus-DP™ module is equipped with a termination switch (see Figure 6-4) to easily accomplish the termination. If the module is used at either of the physical ends in a network, the termination switch has to be in the ON (down) position. In any other case, the switch must be in the OFF (up) position. See Figure 6-7 for the switch settings.

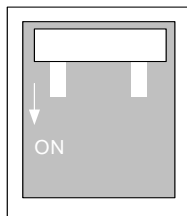


Figure 6-7: AnyBus Profibus™ Termination Switch Shown in the Off Position

6.4 Fast Setup

To begin controlling the Siemens drive using the Profibus™ network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

6.4.1 Configuring Profibus™ with Default Settings

To set up Profibus™ for motor control using the default configuration (Fixed Reg Bits), the drive can be controlled from the PLC using the following setup procedure:

1. Using the keypad on the front of the drive, set 'Network 1 Type' (9901) to Profibus™.
2. Set the Profibus™ network address (9904).
3. Set the 'Net Control Type parameter' (9944) to FIXED. This sets **Data To Drive Reg 01** to have the definitions shown in Table 6-3.
4. Add the following line to the SOP: **Network1RunEnable_O = TRUE;** (the semicolon is part of the code).

The user can now control the drive through the PLC.

Table 6-3: Default Meaning of 'Fixed Reg Bits'

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the PLC must send 0x21 to **Data To Drive Reg 01**. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 to register **Data To Drive Reg 01**.

6.4.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units that will be sent (RPM,% or HZ) in menu (9080).
2. The user can see that the PLC needs to send the desired speed setting to the drive to Data To Drive Reg 02. This is a reserved register only used to hold speed settings (refer to Table 6-14).
3. Then, send 0x61 to Data To Drive Reg 01. The motor will accept the PLC commanded speed setting.

6.4.3 To Control the Motor using User-defined Bits Controlled by the SOP

Use the keypad on the front of the drive to set 'Network 1 Type' (9901) to Profibus™. Set the Profibus™ network address (9904). Finally, set the parameter 'Net Control Type' (9944) to SOP. To control the motor this way, the drive needs to know what bits will be used in the SOP program. Three steps are required to do this:

1. Find the bits required by referring to Table 6-4 below, and locate the keypad pick list variable associated with the bits. By referring to Table 6-14, the user can see that the first available data to drive register is **Data to Drive Reg 03**, which corresponds to keypad parameter (9603). Using the keypad on the drive, go to menu item **Data To Drive Reg 03 (9603)**.
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program, as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit
;Network1Flag1_I Use bit 1 for Run Forward bit
RunRequest_O = /Network1Flag0_I * Network1Flag1_I;Run drive using bit
1,stop using bit 0
```

3. To enable speed settings from the network, add the following line to the SOP program file:

```
RawDemandNetwork1_O = true;.
```

If the user chose **Data to Drive Reg 03** as the write register, by referring to Table 6-14, they can see that the PLC now needs to send 0x02 in **Data To Drive Reg 03** to run the drive, or 0x01 in the same register to stop the drive.

Table 6-4: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 6.10.3.

6.4.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed. 'Set Network 1 Type' (**9901**) to Profibus™. Set the Profibus™ network Address (**9904**). Set Velocity Units (**9080**) to desired motor speed units. By referring to Table 6-14, the user can see the registers needed to read drive status and speed feedback from the drive are **Data From Drive 01** and **Data From Drive 02**, respectively. The definitions of the status bits, which are always found in **Data From Drive 01** register, are shown below.

Table 6-5: General Status output from the drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

Refer to Section 6.6 for details on how to read other drive data.

6.5 Remote Capabilities

The Profibus™ interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through Profibus™ registers sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.

Note that the discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

6.6 Menu Setup Procedures

All Profibus™ setup functions are contained in the Configure Parameters Menu (9902), which is a submenu of the Communications Menu (9). Access is security-controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the Profibus™ interface are listed in Table 6-18. For the correct setup procedure, please refer to Section 6.8.

Select menu contents by using pick lists. The Profibus™ data mapping is done via the Data To Drive Registers and Data From Drive Registers as described in Table 6-15.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user will need to search Appendix B of this manual to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 6.8.1.

6.7 PLC Setup using Profibus™ GSD Files

A GSD file is a device description file in a specified format. The format must conform to the Profibus™ Trade Organization's guidelines. Each device on the Profibus™ network must have a GSD file. The GSD file provides all relevant data associated with the Profibus™ device for configuration tools. A GSD file can be thought of as an electronic data sheet for a specific device on the Profibus™ network.

The GSD provides an option for 136 bytes of input and output; however, if the configuration tool cannot accommodate 136 bytes, the GSD file allows the choice of adding 8 or 16 bytes at a time, until the correct quantity of input and output bytes are selected (see "Network I/O Size" parameter in Table 6-18).



Note: The Profibus™ master *must* be configured to have the same quantity of Bytes that are set by the parameter 'Network I/O Size' (9951) to communicate with the Siemens NXG drive.

The manufacturer of the Profibus™ device normally supplies GSD files. The PTO maintains a home page on the Internet, which contains libraries of approved GSD files (<http://www.profibus.com>).

6.8 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter 'Network 1 Type' (9901), scroll to Profibus™, then press [ENTER]. The Profibus™ configuration parameters will be viewable.
2. Set the 'Profibus Address' (9904) to the desired Profibus™ network address for the drive.
3. Select the 'Velocity Units' (9080). This sets the units for motor commanded speed, and motor feedback speed scaling.
4. If needed, set the 'Demand Scalar' (9912) to $n \times \text{command speed}$ where $-125 \leq n \leq 125$.
5. Set the 'Aux Demand Scalar' (9913) if used.
6. Use Table 6-15 to program the drive to send data to and receive data from Profibus™ network. Each Profibus™ Register corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular Profibus™ Register. Note that four such registers are already programmed, giving the drive basic send and receive functionality. The data in these registers are not changeable.
7. The definition of the bits in the available Profibus™ registers may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 6.10 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the Profibus™ network will they need to set any flags in the SOP program.

If the user needs to control the drive through a Profibus™ network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

Network1RunEnable_O = TRUE;

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

Network2RunEnable_O = TRUE;

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

6.8.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her PLC. These are status, motor speed, power, and number of active faults. To program a register, refer to Table 6-14 to see if it is programmable. Data From Drive 01 is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. Data From Drive 02 is used to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 6-6 shows the data setup for a hypothetical example.

Table 6-6: Hypothetical Desired Data

PLC Profibus™ Data	Data	Scaling
Data From Drive 01	General Status	16 bits
Data From Drive 02	Motor Speed	RPM
Data From Drive 03	Output Power	kW
Data From Drive 04	Number of faults	0 – 128

Use Table 6-14 to determine the necessary parameter ID. Enter parameter ‘Data From Drive 03’ (**9403**) using the keypad on the front of the drive. Choose “output power” from the pick list. Enter parameter ‘Data From Drive 04’ (**9404**) using the keypad on the front of the drive. Scroll through the pick list to find “number of active faults”.

Note that “number of active faults” is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 6-16 for a list of ‘Data From Drive’ pick list variables. Since “number of active faults” is not a choice in the pick list, choose “Man Id” from the pick list. Find “number of active faults” in Appendix B, and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. “ManId-0000” will be shown on the display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show “Man Id-3000”. If the data ID number could not be found, the error message “Invalid Id Entered” will be displayed. Ensure that the data ID is correct. Now the number of active faults will be sent to the PLC using the Data From Drive 04 register.

6.9 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 6-14 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to "FIXED." This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 6-7. Note that these particular drctry.ngn bits are always defined by register Data To Drive Reg 01 whether the default configuration is used or not. To redefine the bits at this address, refer to Section 6.9.2.

Table 6-7: If 'Net Control Type' set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

6.9.1 Status Output

To read drive status data, the user will need to read the General Status register as found in Table 6-14. The drive's status output is shown below in Table 6-8. These status bits are always located at Data From Drive 01 (bytes 01 and 02 of the Profibus™ data to the network).

Table 6-8: General Status output from the drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation can **NOT** be reprogrammed.

6.9.2 Running the Drive using Non-default Settings

The drive can be run in a non-default manner by reprogramming the 'Fixed Reg Bits' register. As seen in Table 6-14, the *location* is fixed at 'Data To Drive Reg 01' (bytes 01 and 02 of the Profibus™ data from the network). However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits ('Data To Drive Reg 01'), use the following procedure:

By setting menu parameter 'Net Control Type' (9944) to "SOP", each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. To make the definition of the 'Fixed Reg Bits' in the 'Data To Drive Reg 01' programmable, use the drive's keypad to set parameter 'Net Control Type' (9944) to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to Network1FixedRegBit9 in Profibus™ 'Data To Drive Reg 01' (bytes 01 & 02 of the Profibus™ data from the network).

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_O = Network1FixedRegBit9_I;
```

6.10 User Programming via the SOP

6.10.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 6-14 to find the location of the first 'Data To Drive Reg' register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data To Drive Register'. The table reveals the first programmable data item for the Profibus™ network is 'Data From Drive 03', and that its corresponding keypad parameter ID for Network 1 is (9603). Go to the keypad on the front of the drive and enter parameter (9603). The user will see a pick list, the first item of which is 'None' (see Table 6-15 for a list of possible pick list choices for 'Data to Drive Registers'). The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Section 6.10.

This example shows how to use the Profibus™ network to trip the input medium voltage. In this example, our PLC will be writing data to 'Data To Drive Reg 03', which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of 'Net Input Flag 1', bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage  
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

6.10.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 6-14 to find the location of the first 'Data From Drive' register which is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data From Drive' register'. The table reveals the first programmable data item for the Profibus™ network is 'Data To Drive Reg 03', and that its corresponding keypad parameter ID for Network 1 is (9403). Go to the keypad on the front of the drive and enter parameter (9403). The user will see a pick list, the first item of which is 'None' (see Table 6-16 for a list of possible pick list choices for 'Data From Drive Registers'). The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 6-12.

This example shows how to use the Profibus™ network to detect a trip on the input medium voltage. In this example, our PLC will be reading 'Data From Drive 03', which we programmed to 'Net1 Out Reg 1'. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of 'Net1 Out Reg 1', which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of Net 1 Out Reg 1, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the Profibus network  
Network1Flag9_O = MediumVoltageLowFault_I;
```

6.10.3 Flags Available to the SOP Program

Net Control Type Default:

The drive's interpretation of the bits in Table 6-9 is fixed by the drive's control software unless the user sets parameter 'Net Control Type' (9944) to 'SOP'. To change the default interpretation of these bits, see Section 6.9.2.

**Table 6-9: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits
(programmable bits available for use in the SOP)**

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits	Profibus™ Network Data
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	Bytes 01 & 02 from network
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	Bytes 01 & 02 from network

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 6-10: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 6-11: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 6-12: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 6-13: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

6.11 Profibus™ Network Data and Keypad Pick List Tables

Table 6-14: Correspondence Between Drive Parameter ID and Modbus Address*

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	Profibus™ Network Data ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
1	9403 - 9464	Data From Drive 03-64 ³	None	Bytes 05 - 128 to network
1	9601	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 to network
1	9602	Data To Drive 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 to network
1	9603 - 9664	Data To Drive 03-64 ⁴	None	Bytes 05 - 128 to network
2	9501	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
2	9503 - 9564	Data From Drive 03-64 ³	None	Bytes 05 - 128 to network
2	9701	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 to network
2	9702	Data To Drive 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 to network
2	9703 - 9764	Data To Drive 03-64 ⁴	None	Bytes 05 - 128 to network

- 1. Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- 2. Profibus™ Network Data**—Profibus™ uses a pre-defined byte count to communicate between the master and the drive. The Siemens NXG drive uses up to 136 bytes for input and output; 128 bytes are used to form the 64 16-bit registers (2 bytes per register) and 8 bytes are 'reserved' for future use. The data received (128 bytes) is mapped to the 64 Data to Drive Registers and the data sent to the PLC is defined using the 64 Data From Drive Registers. Network data size may be limited to 16, 32, 64, 96, 128, or 136 bytes in and out using menu items (9951) and (9952). At 136 bytes, only 128 are available to the user. The master must set up to match the number of bytes in and out. Each Network Register is 16 bits (2 bytes). The order of the bytes can be swapped to match the network data format (9953, 9954).
- 3. Data From Drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- 4. Data To Drive**—data that the PLC will send to the drive in order to control it. Each register contains a 16-bit digital representation of the PLC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices.

Table 6-15: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	Scaling
None		None			MUX 5 ID	NA
Fixed Reg Bits	B	None			MUX 6 ID	NA
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA
Net Input Flag 1	B	None			PTD1	NA
Net Input Flag 2	B	None			PTD2	NA
Net Input Flag 3	B	None			PTD3	NA
Net Input Flag 4	B	None			PTD4	NA
Ratio	U	% /100			Parallel Cmd 1	None
Forward Max Lim	U	/10000 or % /100			Torque Demand	/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand	/100
Forward Acc Time		/10			Flux Demand	/100
Forward Dec Time		/10			Node Count	None
Reverse Acc Time		/10			Node Index	None
Reverse Dec Time		/10			Torque Acc Time	/100
Net Input Pulse		In * 1			Torque Dec Time	/100
Forward Min Lim		/10000 or % /100			Torque Offset	/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar	/1000
Torque Limit		/10000 or % /100			Vars Command	/1000
MUX 1 ID	NA	None			No Load I Scalar	/1000
MUX 2 ID	NA	None			Avg Field Cur	/10000
MUX 3 ID	NA	None			Manual Ids Demand	/1000
MUX 4 ID	NA	None				

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 6-16: Profibus™ Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

6.12 Menu Parameter Tables

Table 6-17: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ Profibus™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

Table 6-18: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Profibus™ Address	9904		2	2	124	Sets address of node on Profibus™ network.
Velocity Units	9080		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network I/O Size	9951		136	16	136	Number of bytes in and out.
Net1 Swap Bytes	9953		Off			Swap register byte order.

Table 6-19: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 -64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 6-20: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 6-21: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • Profibus™ • Modbus™ Plus • Ethernet Modbus™ • Data Highway +™ • ControlNet™

Table 6-22: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
Profibus™ Address	9918		2	2	124	Sets address of node on Profibus™ network
Velocity Units	9924		%			Designates the units for velocity values from the drive <ul style="list-style-type: none"> • % • RPM • Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network
Network2 I/O Size	9952		136	16	136	Number of bytes in and out
Net2 Swap Bytes	9954		Off			Swap register byte order

Table 6-23: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 -64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 6-24: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data To Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

6.13 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

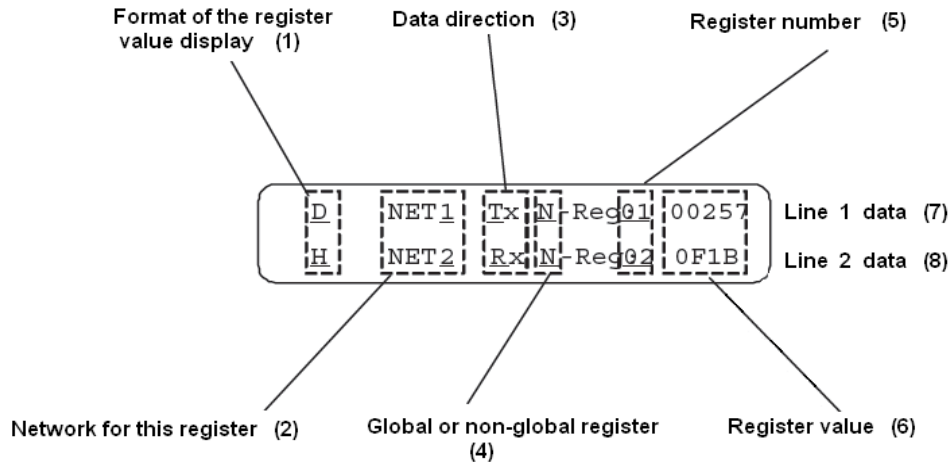


Figure 6-8: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The Profibus™ protocol does not support global registers. Therefore, when working with a Profibus™ controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are 'Data from Drive 01' (**9401**) through "Data from Drive 64" (**9464**).
'Rx' 01-64 are 'Data to Drive 01' (**9601**) through 'Data to Drive 64' (**9664**).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal) or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 6-9 represents a display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

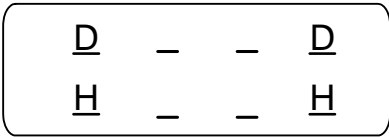


Figure 6-9: Cursor Movement Diagram

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CHAPTER

7 Data Highway Plus™ Communications

7.1 Introduction

Data Highway Plus™ uses a token ring network topology. This protocol allows any node to initiate communications or respond to inquiries from other nodes. However, in the NXG implementation, the drive functions only as a slave device and cannot initiate communications (it can only respond to requests).

The term “token passing” refers to the changing of mastership from one node to another. In the token passing configurations (that is, configurations that have more than one potential master), the node that has control (i.e., network mastership) is said to “have the token” at that time. Devices on such networks can only “hold the token” for a maximum amount of time, then they must pass the token to another node.

In a token ring configuration, bus mastership is passed to all nodes in a repeated sequence that is generally based on the node address. Generally, all devices on a token ring network monitor network activity and know “who else” is on the network. When a device “holds the token,” it owns the network and can send data at will. This process permits deterministic bus timing.

The UCS Data Highway Plus module supports the following baud rates: 57.7K, 115.2K, and 230.4K.

The Data Highway Plus™ UCS module uses a 3-pole Phoenix connector. Pin 1 is the “Line2” connection, pin 2 is the shield, and pin 3 is the “Line 1” connection.

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control via a Data Highway Plus™ network as quickly as possible. Section 7.2 is short, procedural, and covers a minimum of detail. Please refer to the other sections for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, *i.e.* (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (*i.e.*, 0x12) is being represented in hexadecimal format.

Data Highway Plus™ and DH+™ are registered trademarks of Allen-Bradley Company Inc.

7.2 Fast Setup

To begin controlling the Siemens drive using the Data Highway Plus™ network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

7.2.1 To Set Up Data Highway Plus™ for Motor Control using Default Configuration (Fixed Reg Bits)

The drive can be controlled from the PLC using the following simple setup procedure. Using the keypad on the front of the drive, set ‘Network 1 Type’ (9901) to Data Highway Plus. Set the Data Highway Plus network address (9931) and baud rate (9930). Finally, set the ‘Net Control Type’ (9944) to FIXED. This sets ‘Data To Drive Reg 01’ to have the definitions shown in Table 7-1. Next, add the following line to the SOP:

Network1RunEnable_O = TRUE; (the semicolon is part of the code)

The user can now control the drive through the PLC.

Table 7-1: Default Meaning of 'Fixed Reg Bits'

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the PLC must send 0x21 to 'Data To Drive Reg 01'. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 to register 'Data To Drive Reg 01'.

7.2.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units that the user will be sending (RPM,% or HZ) in menu (9080).
2. The user can see that the PLC needs to send the desired speed setting to the drive to 'Data To Drive Reg 02'. This is a reserved register only used to hold speed settings (refer to Table 7-13).
3. Then, send 0x61 to 'Data To Drive Reg 01'. The motor will accept the PLC commanded speed setting.

7.2.3 To Control the Motor using User-defined Bits Controlled by the SOP

Use the keypad on the front of the drive to set 'Network 1 Type' (9901) to Data Highway Plus™. Set the Data Highway Plus™ network address (9931) and baud rate (9930). Finally, set the 'Net Control Type' parameter menu (9944) to SOP. To control the motor this way, the drive needs to know what bits will be used in the SOP program. Three steps are required to do this:

1. Find the bits required by referring to Table 7-2 below, and locate the keypad pick list variable associated with the bits. By referring to Table 7-13, the user can see that the first available data to drive register is 'Data to Drive Reg 03', which corresponds to keypad parameter ID (9603). Using the keypad on the drive, go to menu item 'Data To Drive Reg 03' (9603).
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit  
;Network1Flag1_I Use bit 1 for Run Forward bit  
RunRequest_O = /Network1Flag0_I * Network1Flag1_I;Run drive using bit  
1,stop using bit 0
```

3. To enable speed settings from the network, add the following line to the SOP program file:

```
RawDemandNetwork1_O = true;
```

If the user chose 'Data to Drive Reg 03' as the write register, the user can refer to Table 7-13, which shows that the PLC now needs to send 0x02 in 'Data To Drive Reg 03' to run the drive, or 0x01 in the same register to stop the drive.

Table 7-2: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits can be found in Section 7.8.3.

7.2.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed. Set 'Network 1 Type' (9901) to Data Highway Plus™. Set the Data Highway Plus™ network Address (9931) and baud rate (9930). Set Velocity Units (9080) to desired motor speed units. By referring to Table 7-13, the user can see the registers needed to read drive status and speed feedback from the drive are 'Data From Drive 01' and 'Data From Drive 02' respectively. The definitions of the status bits, which are always found in 'Data From Drive 01' register, are shown in Table 7-3.

Table 7-3: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

See Section 7.6 for details on how to read other drive data.

7.3 Remote Capabilities

The Data Highway Plus™ interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through Data Highway Plus™ registers sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.



Note: The discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

7.4 Menu Setup Procedures

All Data Highway Plus™ setup functions are contained in the Configure Parameters Menu (9902), which is a submenu of the Communications Menu (9). Access is security-controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the Data Highway Plus™ interface are listed in Table 7-17. For the correct setup procedure, please refer to Section 7.6.

Select menu contents by using pick lists. The Data Highway Plus™ data mapping is done via the 'Data To Drive Registers' and 'Data From Drive Registers' as described in Table 7-13.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user will need to search Appendix B of this manual to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 7.6.1.

7.5 Data Highway PLUS™ Network Commands

Table 7-4: Data Highway Plus™ - Supported PLC-5 Commands

Command	Function	Description
0x0F	0x00	Word Range Write
0x0F	0x01	Word Range Read
0x0F	0x26	Word / Read / Modify / Write
0x0F	0x67	Typed Write
0x0F	0x68	Typed Read

7.6 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter 'Network 1 Type' parameter ID (**9901**), scroll to Data Highway Plus™, then press [ENTER]. The Data Highway Plus™ configuration parameters will be viewable.
2. Next, set the Data Highway Plus™ baud Rate (**9930**) to the desired baud rate, which must match the PLC controller's baud rate.
3. Set the Data Highway Plus™ Address (**9931**) to the desired Data Highway Plus™ network address for the drive.
4. Select the Velocity Units (**9080**). This sets the units for motor commanded speed and motor feedback speed scaling.
5. If needed, set the Demand Scalar (**9912**) to *uncommonly* speed where $-125n125$
6. Set the Aux Demand Scalar (**9913**) if used.
7. Use Table 7-13 to program the drive to send data to and receive data from Data Highway Plus™ network. Each Data Highway Plus™ Register corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular Data Highway Plus™ Register.



Note: Four such registers are already programmed, giving the drive basic send and receive functionality. The data in these registers are not changeable.

8. The definition of the bits in the available Data Highway Plus™ registers may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 7.8 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the Data Highway Plus™ network will they need to set any flags in the SOP program.

If the user needs to control the drive through a Data Highway Plus™ network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

7.6.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her PLC. These are status, motor speed, power, and number of active faults. To program a register, refer to Table 7-13 to see if it is programmable. 'Data From Drive 01' is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. 'Data From Drive 02' is used to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 7-5 shows the data setup for the hypothetical example.

Table 7-5: Hypothetical Desired Data

PLC Data Highway Plus Data	Data	Scaling
Data From Drive 01	General Status	16 bits
Data From Drive 02	Motor Speed	RPM
Data From Drive 03	Output Power	kwh
Data From Drive 04	Number of faults	0 – 128

Use Table 7-13 to determine the necessary parameter ID. Enter parameter ID 'Data From Drive 03' (**9403**) using the keypad on the front of the drive. Choose "output power" from the pick list. Enter parameter ID 'Data From Drive 04' (**9404**) using the keypad on the front of the drive. Scroll through the pick list to find "number of active faults."

Note that "number of active faults" is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 7-15 for a list of 'Data From Drive' pick list variables. Since "number of active faults" is not a choice in the pick list, choose "Man Id" from the pick list. Find "number of active faults" in Appendix B and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. "ManId-0000" will be shown on the display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show "Man Id-3000". If the data ID number could not be found, the error message "Invalid Id Entered" will be displayed. Ensure that the data ID is correct. Now the number of active faults will be sent to the PLC using the 'Data From Drive 04' register.

7.7 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 7-13 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to 'FIXED'. This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 7-6. Note that these particular drctry.ngn bits are always defined by register 'Data To Drive Reg 01' whether the default configuration is used or not. To redefine the bits at this address, refer to Section 7.7.2.

Table 7-6: If Net Control Type set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

7.7.1 Status Output

To read drive status data, the user will need to read the General Status register as found in Table 7-13. The drive's status output is shown below in Table 7-7. These status bits are always located at 'Data From Drive 01'.

Table 7-7: General Status Output From the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation can NOT be reprogrammed.

7.7.2 Running the Drive using Non-default Settings

The drive can be run in a non-default manner by reprogramming the 'Fixed Reg Bits' register. As seen in Table 7-13, the *location* is fixed at 'Data To Drive Reg 01'. However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits ('Data To Drive Reg 01'), use the following procedure:

By setting menu parameter 'Net Control Type' (9944) to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. In order to make the definition of the 'Fixed Reg Bits' in the 'Data To Drive Reg 01' programmable, use the drive's keypad to set Net Control Type parameter (9944) to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to Network1FixedRegBit9 in Data Highway Plus 'Data To Drive Reg 01'.

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_O = Network1FixedRegBit9_I;
```

7.8 User Programming via the SOP

7.8.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 7-13 to find the location of the first 'Data To Drive Reg' register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data To Drive Register'. The table reveals the first programmable data item for the Data Highway Plus network is 'Data From Drive 03', and that its corresponding keypad parameter ID for Network 1 is **(9603)**. Go to the keypad on the front of the drive and enter parameter **(9603)**. The user will see a pick list, the first item of which is 'None' (see Table 7-14 for a list of possible pick list choices for 'Data to Drive Registers'). The user will scroll through the pick list until they come to 'Net Input Flag 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net Input Flag 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 7-9.

This example shows how to use the Data Highway Plus network to trip the input medium voltage. In this example, our PLC will be writing data to 'Data To Drive Reg 03', which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of 'Net Input Flag 1', bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage  
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

7.8.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 7-13 to find the location of the first 'Data From Drive' register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data From Drive' register'. The table reveals the first programmable data item for the Data Highway Plus network is 'Data To Drive Reg 03', and that its corresponding keypad parameter ID for Network 1 is **(9403)**. Go to the keypad on the front of the drive and enter parameter **(9403)**. The user will see a pick list, the first item of which is 'None' (see Table 7-15 for a list of possible pick list choices for 'Data From Drive Registers'). The user will scroll through the pick list until they come to 'Net1 Out Reg 1', and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select 'Net1 Out Reg 2', and so on. The corresponding names of the bits related to the menu pick list items are found in Table 7-11.

This example shows how to use the Data Highway Plus network to detect a trip on the input medium voltage. In this example, our PLC will be reading 'Data From Drive 03', which we programmed to 'Net1 Out Reg 1'. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of 'Net1 Out Reg 1', which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of Net 1 Out Reg 1, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the Data Highway Plus network  
Network1Flag9_O = MediumVoltageLowFault_I;
```

7.8.3 Flags Available to the SOP Program

Net Control Type Default:

The drive's interpretation of the bits in Table 7-8 is fixed by the drive's control software unless the user set parameter 'Net Control Type' (9944) to 'SOP'. To change the default interpretation of these bits, see Section 7.7.2.

Table 7-8: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits (programmable bits available for use in the SOP)

Pick list variable in 'Data to Drive Reg nn' menus	Related Drctry.ngn bits	Data Highway Plus Network Data
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	Word 1 from network
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	Word1 from network

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 7-9: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg nn' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 7-10: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg nn' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 7-11: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 7-12: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

7.9 Data Highway Plus™ Network Data and Keypad Pick List Tables

Table 7-13: Correspondence between Drive Parameter ID and Data Highway Plus™ Network Data*

Network	Drive Parameter ID ¹	Description	Default Contents	Data Highway Plus™ Network Data ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	Word 1 to network
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	Word 2 to network
1	9403 - 9464	Data From Drive 03-64 ³	None	Words 3- 64 to network
1	9601	Data To Drive Reg 01 ⁴	Fixed Reg Bits (not changeable)	Word 1 from network
1	9602	Data To Drive Reg 02 ⁴	Velocity Demand (not changeable)	Word 2 from network
1	9603 – 9664	Data To Drive Reg 03-64 ⁴	None	Words 3- 64 from network
2	9501	Data From Drive 01 ³	General Status (not changeable)	Word 1 to network
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	Word 2 to network
2	9503 – 9564	Data From Drive 03- 64 ³	None	Words 3- 64 to network
2	9701	Data To Drive Reg 01 ⁴	Fixed Reg Bits (not changeable)	Word 1 from network
2	9702	Data To Drive Reg 02 ⁴	Velocity Demand (not changeable)	Word 2 from network
2	9703 – 9764	Data To Drive Reg 03-64 ⁴	None	Words 3- 64 from network

- 1. Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- 2. Data From Drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- 3. Data To Drive**—data that the PLC will send to the drive in order to control it. Each register contains a 16-bit digital representation of the PIC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices.
- 4. Data Highway Plus™ Network Data**—Data Highway Plus™ uses input and output “files”. This column defines the offset from the beginning of the file. The Siemens NXG drive uses 64 words for input (data to drive). The input data is mapped to the 64 ‘Data To Drive Registers’. The drive has 64 words for output (data from drive); this data is mapped from the ‘Data from Drive’ registers.

Table 7-14: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	Scaling
None		None			MUX 5 ID	NA
Fixed Reg Bits	B	None			MUX 6 ID	NA
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA
Net Input Flag 1	B	None			PTD1	NA
Net Input Flag 2	B	None			PTD2	NA
Net Input Flag 3	B	None			PTD3	NA
Net Input Flag 4	B	None			PTD4	NA
Ratio	U	% /100			Parallel Cmd 1	None
Forward Max Lim	U	/10000 or % /100			Torque Demand	/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand	/100
Forward Acc Time		/10			Flux Demand	/100
Forward Dec Time		/10			Node Count	None
Reverse Acc Time		/10			Node Index	None
Reverse Dec Time		/10			Torque Acc Time	/100
Net Input Pulse		In * 1			Torque Dec Time	/100
Forward Min Lim		/10000 or % /100			Torque Offset	/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar	/1000
Torque Limit		/10000 or % /100			Vars Command	/1000
MUX 1 ID	NA	None			No Load I Scalar	/1000
MUX 2 ID	NA	None			Avg Field Cur	/10000
MUX 3 ID	NA	None			Manual Ids Demand	/1000
MUX 4 ID	NA	None				

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 7-15: Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

7.10 Menu Parameter Tables

Table 7-16: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ Data Highway Plus™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

Table 7-17: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Data Highway Plus Baud Rate	9930		57.6K	57.6K	230.4K	<ul style="list-style-type: none"> 57.6K 115.2K 230.4K
Data Highway Plus Address	9933		2	2	124	Sets address of node on Data Highway Plus network.
Velocity Units	9080		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.

Table 7-18: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 –64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 7-19: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 7-20: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • Data Highway Plus™ • Modbus™ Plus • Ethernet Modbus™ • Data Highway +™ • ControlNet™

Table 7-21: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
Data Highway Plus™ Baud Rate	9932		57.6K	57.6K	230.4K	<ul style="list-style-type: none"> 57.6K 115.2K 230.4K
Data Highway Plus™ Address	9933		2	2	124	Sets address of node on Data Highway Plus™ network.
Velocity Units	9924		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network.

Table 7-22: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 –64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 7-23: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data To Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

7.11 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted, and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

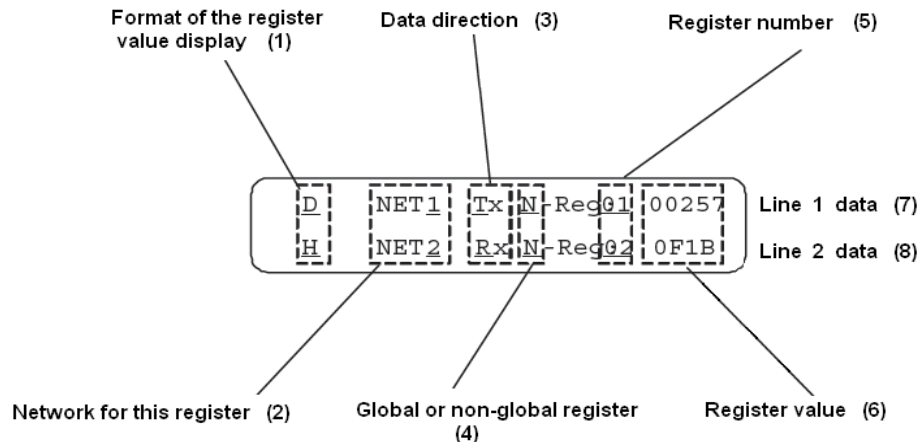


Figure 7-1: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The Data Highway Plus protocol does not support global registers. Therefore, when working with a Data Highway Plus controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (9401) through "Data from Drive 64" parameter ID (9464).
'Rx' 01-64 are "Data to Drive 01" parameter ID (9601) through "Data to Drive 64" parameter ID (9664).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in Network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in Network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 7-2 below represents a display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

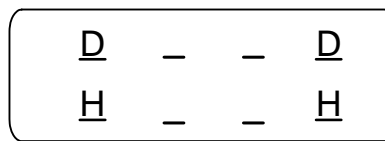


Figure 7-2: Cursor Movement Diagram

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CHAPTER

8 ControlNet™ Communications

8.1 Introduction

The AnyBus-S ControlNet™ module is classified as a ControlNet™ adapter, i.e., it cannot originate connections on its own, but a scanner node can open a connection to it. The module is implemented according to the ControlNet™ International specification for a communication adapter (profile no. 12).

The ControlNet™ Anybus module has two BNC contacts for connection to the ControlNet™ network. These two contacts are for redundant connection to the network.

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control using a ControlNet™ network as quickly as possible. Section 8.3 is short and procedural, and covers a minimum of detail. Please refer to the other sections of this chapter for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, e.g., (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnm (e.g., 0x12) is being represented in hexadecimal format.

For more information, visit the ControlNet™ International web site at www.controlnet.org.

Figure 8-1 shows the connectors, switches, and indicators on the AnyBus™ board that are relevant to Siemens operation Anybus-S ControlNet™ Communications Board.

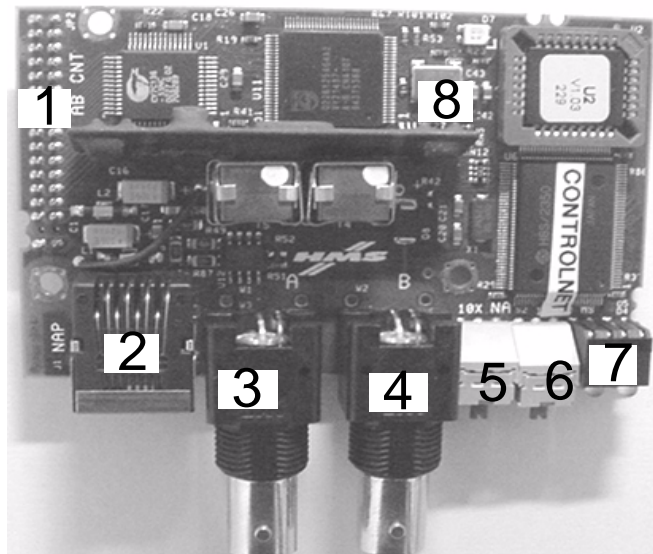


Figure 8-1: AnyBus-S ControlNet™ (see Table 8-1)

Table 8-1: AnyBus-S ControlNet™ Number Key (see Figure 8-1)

Figure 8-1 Number Key	Description
1	Connector
2	Network Access Port (NAP)
3	ControlNet Channel A
4	ControlNet Channel B
5	MacID switch (x10)
6	MacID switch (x1)
7	ControlNet status indicators
8	AnyBus-S Watchdog

8.2 Connectors

8.2.1 ControlNet Channels A & B

The module is equipped with two BNC contacts for connection to ControlNet. If redundant operation is desired, both connectors are used. Otherwise, connector A *or* B is used.

8.2.2 MacID Switches

The MacID switches must ALWAYS be set to zero to allow the control software to set the MacID from the menu.



Note: The MacID switches must **ALWAYS** be set to zero.

8.2.3 ControlNet Status Indicators

Figure 8-2 depicts the ControlNet Status Indicators. These LEDs indicate run time status and errors to the user.

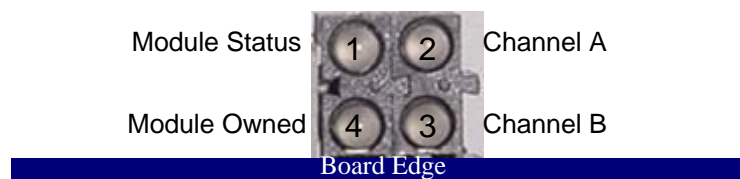


Figure 8-2: ControlNet Status Indicators

Table 8-2: Status Indicator Descriptions

Number from Figure 8-2	Indication	State	Description
1	Module Status	Green	Connection in Run State
		Green, flashing	Connecting Connection Idle
		Red	Major fault
		Red, flashing	Minor fault
2 and 3	Channel A and Channel B	Off	Module not initialized
		Red	Major fault
		Alternating red/green	Self-test
		Red, flashing	Node configuration error; duplicate MAC ID, etc.
2 or 3	Channel A or Channel B	Off	Channel disabled
		Green	Normal operation of channel
		Green, flashing	Temporary error (node will self correct) or not configured
		Red, flashing	No other nodes, or media fault
		Red & green, flashing	Network configuration error
4	Module Owned	Off	No connection has been opened
		Green	A connection has been opened towards the module

8.3 Fast Setup

To begin controlling the Siemens drive using the ControlNet™ network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

8.3.1 Configuring ControlNet™ for Motor Control with Default Settings (Fixed Reg Bits)

The drive can be controlled from the PLC using the following setup procedure.

1. Using the keypad on the front of the drive, set 'Network 1 Type' (**9901**) to ControlNet™.
2. Set the ControlNet™ network address (**9903**).
3. Set the 'Net Control Type' parameter (**9944**) to FIXED. This sets **Data To Drive Reg 01** to have the definitions shown in Table 8.3.
4. Add the following line to the SOP: **Network1RunEnable_O = TRUE;** (the semicolon is part of the code).

The user can now control the drive through the PLC.

Table 8-3: Default meaning of 'Fixed Reg Bits'

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the PLC must send 0x21 to **Data To Drive Reg 01**. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 to register **Data To Drive Reg 01**.

8.3.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units that will be sent (RPM,% or HZ) in menu **(9080)**.
2. The PLC must send the desired speed setting to the drive to **Data To Drive Reg 02**. This is a reserved register used ONLY to hold speed settings.
3. Send 0x61 to **Data To Drive Reg 01**. The motor will accept the PLC-commanded speed setting.

8.3.3 To Control the Motor using User-defined Bits Controlled by the SOP

1. Use the keypad on the front of the drive to set 'Network 1 Type' **(9901)** to ControlNet.
2. Set the ControlNet™ network address **(9903)**.
3. Set the 'Net Control Type' parameter **(9944)** to SOP.

To control the motor with the SOP, the drive needs to know what bits will be used in the SOP program. Three steps are required to do this:

1. Find the bits required by referring to Table 8-4 below, and locate the keypad pick list variable associated with the bits. By referring to Table 8-14, the user can see that the first available data to drive register is **Data to Drive Reg 03**, which corresponds to keypad parameter ID **(9603)**. Using the keypad on the drive, go to menu item 'Data To Drive Reg 03' **(9603)**.
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit
;Network1Flag1_I Use bit 1 for Run Forward bit
RunRequest_O = /Network1Flag0_I * Network1Flag1_I;Run drive using bit
1,stop using bit 0
```

3. Enable speed settings from the network by adding the following line to the SOP program file:

```
RawDemandNetwork1_O = true;
```

If the user chose **Data to Drive Reg 03** as the write register; by referring to Table 8-14 they can see that the PLC now needs to send 0x02 in **Data To Drive Reg 03** to run the drive, or 0x01 in the same register to stop the drive.

Table 8-4: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 8.9.3.

8.3.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed.

1. Set 'Network 1 Type' (9901) to ControlNet.
2. Set the 'ControlNet network Address' (9903).
3. Set 'Velocity Units' (9080) to desired motor speed units. The registers needed to read drive status and speed feedback from the drive are **Data From Drive 01** and **Data From Drive 02**, respectively. The definitions of the status bits, which are always found in **Data From Drive 01** register, are shown in Table 8-5.

Table 8-5: General Status Output From the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

See Section 8.7 for details on how to read other drive data.

8.4 Remote Capabilities

The ControlNet interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through ControlNet registers sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.



Note: The discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive)

8.5 Menu Setup Procedures

All ControlNet setup functions are contained in the **Configure Parameters Menu (9902)**, which is a submenu of the **Communications Menu (9)**. Access is security-controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the ControlNet interface are listed in Table 8-18. For the correct setup procedure, please refer to Section 8.7.

Select menu contents by using pick lists. The ControlNet™ data mapping is done via the **Data To Drive Registers** and **Data From Drive Registers** as described in Table 8-14.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user must search Appendix B to locate it. Once found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 8.7.1.

8.6 PLC Setup using ControlNet™ EDS Files

An EDS file is a device description file in a specified format. The format must conform to the ControlNet™ Trade Organization's guidelines. Each device on the ControlNet network must have an EDS file. The EDS file provides all relevant data associated with the ControlNet™ device for configuration tools. An EDS file can be thought of as an electronic data sheet for a specific device on the ControlNet™ network.



Note: The ControlNet™ master **must** be configured for 136 bytes of input and 136 bytes of output to communicate with the Siemens NXG drive.

The manufacturer of the ControlNet™ device normally supplies EDS files.

8.7 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter 'Network 1 Type' (**9901**), scroll to ControlNet, then press [ENTER]. The ControlNet™ configuration parameters will be viewable.
2. Set the 'ControlNet™ Address' (**9903**) to the desired ControlNet™ network address for the drive.
3. Some networks require a 4-byte header in the data from the drive. To use this, set **ControlNet Header (9936)** to On.
4. Select the 'Velocity Units' (**9080**). This sets the units for motor commanded speed, and motor feedback speed scaling.
5. If needed, set the 'Demand Scalar' (**9912**) to $n \times \text{command speed}$ where $-125n125$.
6. Set the 'Aux Demand Scalar' (**9913**) if used.
7. Use Table 8-14 to program the drive to send data to and receive data from ControlNet™ network. Each ControlNet™ Register corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular ControlNet™ Register. Note that four such registers are already programmed, giving the drive basic send and receive functionality. The data in these registers are *not* changeable.
8. The definition of the bits in the available ControlNet™ registers may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 8.9 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the ControlNet™ network, will they need to set any flags in the SOP program.

If the user needs to control the drive through a ControlNet™ network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

8

8.7.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her PLC. These are status, motor speed, power, and number of active faults. To program a register, refer to Table 8-14 to see if it is programmable. **Data From Drive 01** is *not* changeable; that is, a change is neither necessary nor possible. It is already permanently set to indicate general status. **Data From Drive 02** is used to indicate motor speed. This register is also *not* changeable. It is permanently set to indicate motor speed. Table 8-6 shows the data setup for the hypothetical example.

Table 8-6: Hypothetical Desired Data

PLC ControlNet Data	Data	Scaling
Data From Drive 01	General Status	16 bits
Data From Drive 02	Motor Speed	RPM
Data From Drive 03	Output Power	kW
Data From Drive 04	Number of faults	0 – 128

Use Table 8-14 to determine the necessary parameter ID. Enter parameter ID 'Data From Drive 03' (**9403**) using the keypad on the front of the drive. Choose "output power" from the pick list. Enter parameter 'Data From Drive' (**9404**) using the keypad on the front of the drive. Scroll through the pick list to find "number of active faults."

Note that "number of active faults" is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 8-16 for a list of 'Data From Drive' pick list variables. Since "number of active faults" is not a choice in the pick list, choose **Man Id** from the pick list. Find "number of active faults" in Appendix B, and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number. "ManId-0000" will be shown on the display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show "Man Id-3000". If the data ID number could not be found, the error message "Invalid Id Entered" will be displayed. Ensure that the data ID is correct. Now the number of active faults will be sent to the PLC using the 'Data From Drive 04' register.

8.8 Drive Control Defaults

To control the drive using its default configuration, the user *must* send commands to its Fixed Reg Bits location. Refer to Table 8-14 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to FIXED. This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 8-7. Note that these particular drctry.ngn bits are always defined by register **Data To Drive Reg 01** whether the default configuration is used or not. To redefine the bits at this address, refer to Section 8.8.2.

Table 8-7: If 'Net Control Type' set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

8.8.1 Status Output

To read drive status data, read the General Status register as found in Table 8-14. The drive's status output is shown below in Table 8-8. These status bits are *always* located at **Data From Drive 01**.

Table 8-8: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation can **NOT** be reprogrammed.

8.8.2 Running the Drive using Non-default Settings

The drive can be run in a non-default manner by reprogramming the **Fixed Reg Bits** register. As seen in Table 8-14, the *location* is fixed at **Data To Drive Reg 01**. However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits **Data To Drive Reg 01**, use the following procedure:

By setting menu parameter 'Net Control Type' (9944) to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. To make the definition of the 'Fixed Reg Bits' in the **Data To Drive Reg 01** programmable, use the drive's keypad to set parameter 'Net Control Type' (9944) to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to

Network1FixedRegBit9 in ControlNet™ **Data To Drive Reg 01**.

```
;ExternalDigitalOutput01h_0 Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_0 = Network1FixedRegBit9_I;
```

8.9 User Programming via the SOP

8.9.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 8-14 to find the location of the first **Data To Drive Reg** register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data To Drive Register'. The table reveals the first programmable data item for the ControlNet™ network is **Data From Drive 03**, and that its corresponding keypad parameter ID for Network 1 is (9603). Go to the keypad on the front of the drive and enter parameter (9603). The user will see a pick list, the first item of which is 'None.' (see Table 8-15 for a list of possible pick list choices for 'Data to Drive Registers'). The user will scroll through the pick list until they come to **Net Input Flag 1**, and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select **Net Input Flag 2**, and so on. The corresponding names of the bits related to the menu pick list items are found in Table 8-10.

This example shows how to use the ControlNet™ network to trip the input medium voltage. In this example, our PLC will be writing data to **Data To Drive Reg 03**, which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of **Net Input Flag 1**, bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

8.9.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 8-14 to find the location of the first **Data From Drive** register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that **Data From Drive** register. The table reveals the first programmable data item for the ControlNet network is **Data To Drive Reg 03**, and that its corresponding keypad parameter ID for Network 1 is (9403). Go to the keypad on the front of the drive and enter parameter (9403). The user will see a pick list, the first item of which is 'None.' (see Table 8-16 for a list of possible pick list choices for 'Data From Drive Registers'). The user will scroll through the pick list until they come to **Net1 Out Reg 1**, and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select **Net1 Out Reg 2**, and so on. The corresponding names of the bits related to the menu pick list items are found in Table 8-12.

This example shows how to use the ControlNet™ network to detect a trip on the input medium voltage. In this example, our PLC will be reading **Data From Drive 03**, which we programmed to **Net1 Out Reg 1**. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of **Net1 Out Reg 1**, which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of **Net 1 Out Reg 1**, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the ControlNet network
Network1Flag9_O = MediumVoltageLowFault_I;
```

8.9.3 Flags Available to the SOP Program

Net Control Type Default:

The drive's interpretation of the bits in Table 8-9 is fixed by the drive's control software unless the user sets the parameter 'Net Control Type' (**9944**) to 'SOP.' To change the default interpretation of these bits, see Section 8.8.2.

**Table 8-9: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits
(programmable bits available for use in the SOP)**

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits	ControlNet Network Data
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	Word 1 from network
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	Word 1 from network

User programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 8-10: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 8-11: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 8-12: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 8-13: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

8.10 ControlNet™ Network Data and Keypad Pick List Tables

Table 8-14: Correspondence Between Drive Parameter ID and ControlNet™ Network Data*

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	ControlNet™ Network Data ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
1	9403 - 9464	Data From Drive 03-64 ³	None	Bytes 05 – 128 to network
1	9601	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 from network
1	9602	Data To Drive 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 from network
1	9603 – 9664	Data To Drive 03-64 ⁴	None	Bytes 05 – 128 from network
2	9501	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
2	9503 – 9564	Data From Drive 03-64 ³	None	Bytes 05 – 128 to network
2	9701	Data To Drive 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 from network
2	9702	Data To Drive 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 from network
2	9703 – 9764	Data To Drive 03-64 ⁴	None	Bytes 05 – 128 from network

- Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- ControlNet™ Network Data**—ControlNet™ uses a predefined byte count to communicate between the master and the drive. The Siemens NXG drive uses 136 bytes for input and output; 128 bytes are used to form the 64 16-bit registers (2 bytes per register) and 8 bytes are ‘reserved’ for future use. The master must be set up to communicate using 136 bytes of input data and 136 bytes of output data. The data received (128 bytes) is mapped to the 64 Data To Drive Registers and the data sent to the PLC is defined using the 64 Data From Drive Registers.
- Data from drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive’s functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- Data to drive**—data that the PLC will send to the drive to control it. Each register contains a 16-bit digital representation of the PLC’s command for a particular aspect of the drive’s functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices.

Table 8-15: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name	Scaling
None		None			MUX 5 ID NA	None
Fixed Reg Bits	B	None			MUX 6 ID NA	None
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID NA	None
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID NA	None
Net Input Flag 1	B	None			PTD1 NA	None
Net Input Flag 2	B	None			PTD2 NA	None
Net Input Flag 3	B	None			PTD3 NA	None
Net Input Flag 4	B	None			PTD4 NA	None
Ratio	U	% /100			Parallel Cmd 1	None
Forward Max Lim	U	/10000 or % /100			Torque Demand	/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand	/100
Forward Acc Time		/10			Flux Demand	/100
Forward Dec Time		/10			Node Count	None
Reverse Acc Time		/10			Node Index	None
Reverse Dec Time		/10			Torque Acc Time	/100
Net Input Pulse		In * 1			Torque Dec Time	/100
Forward Min Lim		/10000 or % /100			Torque Offset	/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar	/1000
Torque Limit		/10000 or % /100			Vars Command	/1000
MUX 1 ID	NA	None			No Load I Scalar	/1000
MUX 2 ID	NA	None			Avg Field Cur	/10000
MUX 3 ID	NA	None			Manual Ids Demand	/1000
MUX 4 ID	NA	None				

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 8-16: Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

8.11 Menu Parameter Tables

Table 8-17: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ ControlNet™ Modbus Plus™ Ethernet Modbus™ Data Highway +™ ControlNet™

Table 8-18: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
ControlNet™ Address	9903		9	1	99	Sets address of node on ControlNet™ network.
ControlNet™ Header	9956		Off			Turns the ControlNet™ Header <ul style="list-style-type: none"> Off On.
Velocity Units	9080		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.

Table 8-19: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable.
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 -64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 8-20: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is <i>not</i> programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is <i>not</i> programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers <i>are</i> programmable.

Table 8-21: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ ControlNet™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

Table 8-22: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
ControlNet™ Address	9934		9	1	99	Sets address of node on ControlNet™ network
ControlNet™ Header	9957		Off			Turns the 4-byte ControlNet™ Header <ul style="list-style-type: none"> On Off
Velocity Units	9924		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network.

Table 8-23: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is <i>not</i> programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is <i>not</i> programmable.
Data From Drive 03 -64	9503-9564		None			Register data from drive parameters 3-64. These registers <i>are</i> programmable.

Table 8-24: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is <i>not</i> programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is <i>not</i> programmable.
Data To Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers <i>are</i> programmable.

8.12 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

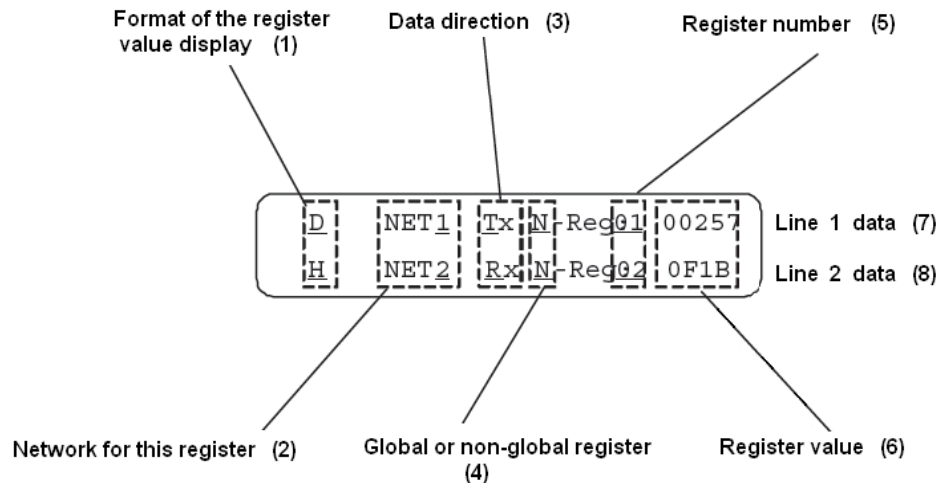


Figure 8-3: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The ControlNet™ protocol does not support global registers. Therefore, when working with a ControlNet™ controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are "Data from Drive 01" parameter ID (9401) through "Data from Drive 64" parameter ID (9464).
'Rx' 01-64 are "Data to Drive 01" (parameter ID (9601) through "Data to Drive 64" parameter ID (9664).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 8-4 represents a typical display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

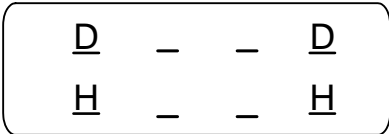


Figure 8-4: Cursor Movement Diagram

▽ ▽ ▽

8



CHAPTER

9 DeviceNet™ (Profile 12) Communications

9.1 Introduction

The AnyBus-S DeviceNet™ (Profile 12) module is implemented according to the ODVA specification for a communication adapter (Profile 12) and acts as a “group two only server” on the DeviceNet network.

The Anybus DeviceNet™ (Profile 12) module supports baud rates of 125 kbit/s, 250 kbit/s, and 500 kbit/s. The baud rate and network address is selected through the drive menu system.

This chapter features a fast setup section that will help the user to start controlling the Siemens drive with NXG Control using a DeviceNet™ (Profile 12) network as quickly as possible. Section 9-2 is short and procedural, and covers a minimum of detail. Please refer to the other sections of this chapter for detailed information.

Note that in this chapter, a four-digit number inside of parentheses, e.g., (9403), indicates a parameter ID number for the keypad on the front of the drive. Press [SHIFT] + [→] to enter this number directly. The user does not need to hold down the [SHIFT] key while pressing the [→] key. A numerical value expressed as 0xnn (e.g., 0x12) is being represented in hexadecimal format.

For more information, visit the ODVA web site at www.odva.org.

DeviceNet™ is a trademark of ODVA.

Figure 9-1 shows the connectors, switches, and indicators on the AnyBus™ board that are relevant to Siemens operation.

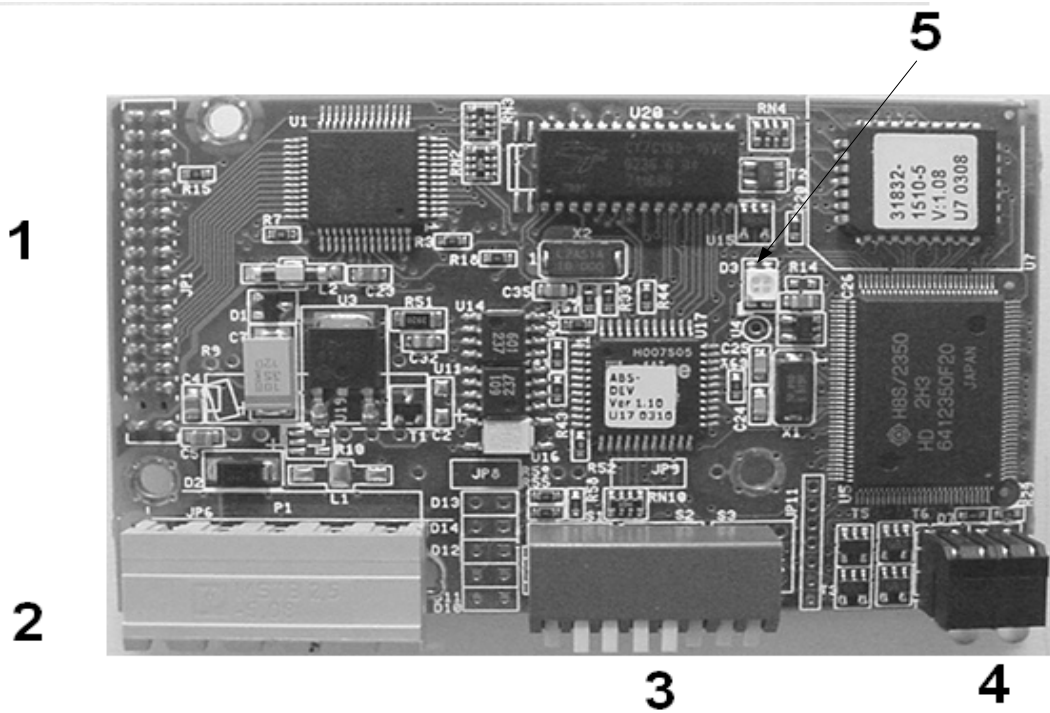


Figure 9-1: Anybus DeviceNet™ (Profile 12) Communication Board

Table 9-1: Description of DeviceNet™ (Profile 12) Communication Board

Number in Figure 9-1	Description
1	Connector to NXG Communication Board
2	DeviceNet™ Connector
3	Configuration Switches (Not Used)
4	Status Indicators
5	AnyBus™ Watchdog

9.1.1 Connectors

DeviceNet Connector

The module supports both 5.08mm and 3.84mm pluggable screw connectors as well as a 10-pin 2mm board -to-board connectors. The module supports both 5.08 mm and 3.84 mm pluggable screw connectors as well as a 10-pin, 2mm board-to-board connector. Figure 9-2 shows the pin assignments for the connector.

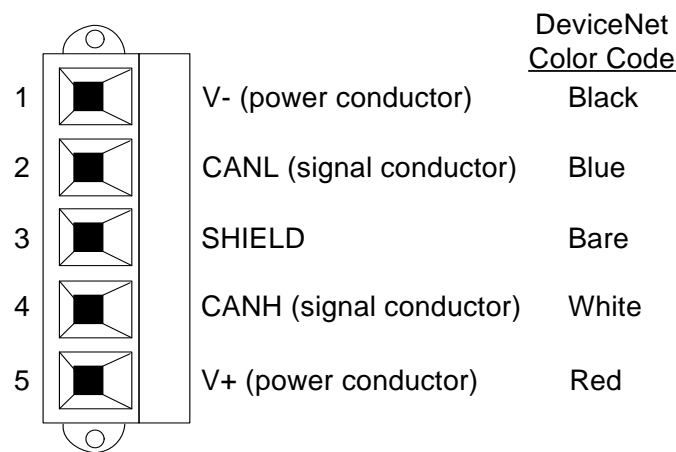


Figure 9-2: Device Network 5-Pin Connector

The maximum cable length depends on the transmission speed and cable type. The maximum cable length/ baud rates are shown in Table 9-2.

Table 9-2: Maximum Values of DeviceNet Cable Length/Baud Rates

Baud Rate	Trunk Distance (Thick Cable)
125 K	500 Meters (1640 Feet)
250 K	250 Meters (820 Feet)
500 K	100 Meters (328 Feet)

Network Termination

The nodes at the physical ends of the network should each have a terminating resistor installed. The termination resistor is connected across the data lines. Refer to the recommendations of the Open DeviceNet™ Vendor Association (ODVA) for values of network termination resistors.

Configuration Switches

The configuration switches are not used.

9.1.2 DeviceNet™ (Profile 12) Status Indicators

Figure 9-3 shows the status indicators. The LEDs indicate run time status and errors to the user. Status indicators are described in Table 9-3.

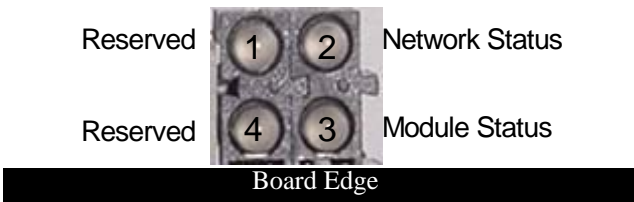


Figure 9-3: DeviceNet™ (Profile 12) Status Indicators

Table 9-3: Status Indicator Descriptions

Number from Figure 9-3	Indication	State	Description
1	Reserved	—	Reserved for future use
2	Network Status	Off	Not powered/Not online
		Green, steady	Link OK, on line, connected
		Green, flashing	On line, not connected
		Red, steady	Critical link failure
		Red, flashing	Connection timeout
3	Module Status	Off	No power to drive
		Green, steady	Device operational
		Green, flashing	Data size bigger than configured
		Red, steady	Unrecoverable fault
		Red, flashing	Minor fault
4	Reserved	—	Reserved for future use

9.2 Fast Setup

To begin controlling the Siemens drive using the DeviceNet™ (Profile 12) network as quickly as possible, use the Fast Setup as described in the following sections. Please note that the following section covers procedural information with minimum detail.

9.2.1 Configuring DeviceNet™ (Profile 12) for Motor Control with Default Settings (Fixed Reg Bits)

The drive can be controlled from the PLC, using the following setup procedure:

1. Using the keypad on the front of the drive, set 'Network 1 Type' (**9901**) to DeviceNet™ (Profile 12).
2. Set the DeviceNet™ (Profile 12) network address (**9908**).
3. Set the 'Net Control Type parameter' (**9944**) to FIXED. This sets **Data To Drive Reg 01** to have the definitions shown in Table 9-4.
4. Add the following line to the SOP: **Network1RunEnable_O = TRUE;** (the semicolon is part of the code).

The user can now control the drive through the PLC.

Table 9-4: Default meaning of 'Fixed Reg Bits'

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Reserved for Future
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

To run the motor, the PLC must send 0x21 to **Data To Drive Reg 01**. This hexadecimal value sets bit 0 (run) and bit 5 (start/stop control from network). Likewise, to command the motor to stop, the PLC must send 0x08 or 0x00 to register **Data To Drive Reg 01**.

9.2.2 To Send a Motor Speed Setting to the Drive

To send motor speed settings to the drive:

1. Set the desired speed units that will be sent (RPM,% or HZ) in menu (9080).
2. The PLC must send the desired speed setting to the drive to **Data To Drive Reg 02**. This is a reserved register only used to hold speed settings.
3. Send 0x61 to **Data To Drive Reg 01**. The motor will accept the PLC-commanded speed setting.

9.2.3 To Control the Motor using User-defined Bits Controlled by the SOP

1. Use the keypad on the front of the drive to set 'Network 1 Type' (9901) to DeviceNet (Profile 12).
2. Set the DeviceNet™ (Profile 12) network address (9908).
3. Set the 'Net Control Type parameter' (9944) to SOP.
4. Enable speed settings from the network by adding the following line to the SOP program file:

```
RawDemandNetwork1_O = true;
```

To control the motor with the SOP, the drive needs to know what bits will be used in the SOP program. Two steps are required to do this:

1. Find the bits required by referring to Table 9-5 below, and locate the keypad pick list variable associated with the bits. By referring to Table 9-15, the user can see that the first available data to drive register is **Data to Drive Reg 03**, which corresponds to keypad parameter ID (9603). Using the keypad on the drive, go to menu item **Data To Drive Reg 03 (9603)**.
2. Select the pick list variable (Net Input Flag 1, Net Input Flag 2, ...) from the pick list in the keypad or ToolSuite. Now the corresponding bits (Network1Flag0_I, Network1Flag1_I, etc.) from the drctry.ngn file can be used in the SOP program as shown below:

```
;Network1Flag0_I Use bit 0 for Stop bit
;Network1Flag1_I Use bit 1 for Run Forward bit
RunRequest_O = /Network1Flag0_I * Network1Flag1_I;Run drive using bit
1,stop using bit 0
```

If the user chose **Data to Drive Reg 03** as the write register; by referring to Table 9-15, the user can see that the PLC now needs to send 0x02 in **Data To Drive Reg 03** to run the drive, or 0x01 in the same register to stop the drive.

Table 9-5: Sample Programmable Bits*

Pick List Variable	Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

*A complete listing of SOP-programmable bits is found in Section 9.8.3.

9.2.4 To Monitor Drive Status and Speed Feedback

To read the data from the drive, no SOP flags are needed.

1. Set 'Network 1 Type' (**9901**) to DeviceNet (Profile 12).
2. Set the 'DeviceNet (Profile 12) Network Address' (**9908**).
3. Set 'Velocity Units' (**9080**) to desired motor speed units. The registers needed to read drive status and speed feedback from the drive are **Data From Drive 01** and **Data From Drive 02**, respectively. The definitions of the status bits, which are always found in **Data From Drive 01** register, are shown in Table 9-6.

Table 9-6: General Status Output From the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	

See Section 9.6 for details on how to read other drive data.

9.3 Remote Capabilities

The DeviceNet™ (Profile 12) interface to the drive allows remote control and monitoring capability of the drive. Control of the drive can be through DeviceNet™ (Profile 12) registers sent to the drive working in conjunction with a SOP program. Control capabilities include run request, stop request, fault reset, stop, reverse speed demand, and others. There are 128 remote user-programmable software flags that can be monitored and/or set through the system program.

Note that the discrete controls and the user-defined control/feedback flags are configured via the drive's built-in system program (provided with each drive).

9.4 Menu Setup Procedures

All DeviceNet™ (Profile 12) setup functions are contained in the 'Configure Parameters Menu' (9902), which is a submenu of the 'Communications Menu' (9). Access is security controlled at Level 7; therefore, the user must enter the proper security code to access these parameters. The menus required for initial setup of the DeviceNet™ (Profile 12) interface are listed in Table 9-19. For the correct setup procedure, please refer to Section 9.6.

Select menu contents by using pick lists. The DeviceNet™ (Profile 12) data mapping is done via the **Data To Drive Registers** and **Data From Drive Registers** as described in Table 9-15.

The pick lists in the menus contain the most commonly used data variables. If a variable is not found in the lists, the user needs to search Appendix B to locate it. If found, use the corresponding data ID number to enter the variable into the read registers. The procedure for doing this is described in Section 9.6.1.

9.5 PLC Setup using DeviceNet™ (Profile 12) EDS Files

An EDS file is a device description file in a specified format. The format must conform to the ODVA guidelines. Each device on the DeviceNet™ (Profile 12) network must have an EDS file. The EDS file provides all relevant data associated with the DeviceNet™ (Profile 12) device for configuration tools. An EDS file can be thought of as an electronic data sheet for a specific device on the DeviceNet™ (Profile 12) network.

The Anybus™ EDS provides for more than 136 bytes of input and output. Siemens only uses up to 136 bytes of input and output. However, if the configuration tool cannot accommodate 136 bytes, the I/O size may be modified by menu options.



Note: The DeviceNet™ (Profile 12) master must be configured to have the same quantity of bytes that are set by the parameter 'Network I/O Size' (9951).

The manufacturer of the DeviceNet™ (Profile 12) device normally supplies EDS files.

9.6 Network Setup Procedure

Use the keypad on the front of the drive to select a network protocol:

1. Using the keypad, enter 'Network 1 Type' (**9901**), scroll to DeviceNet™ (Profile 12), then press [ENTER]. The DeviceNet™ (Profile 12) configuration parameters will be viewable.
2. Set the 'DeviceNet™ (Profile 12) Address' (**9908**) to the desired DeviceNet™ (Profile 12) network address for the drive.
3. Select the 'Velocity Units' (**9080**). This sets the units for motor commanded speed, and motor feedback speed scaling.
4. If needed, set the 'Demand Scalar' (**9912**) to $n \times \text{command speed}$ where $-125 \leq n \leq 125$.
5. Set the 'Aux Demand Scalar' (**9913**) if used.
6. Use Table 9-15 to program the drive to send data to and receive data from DeviceNet™ (Profile 12) network. Each DeviceNet™ (Profile 12) Register corresponds with a keypad parameter ID, which will be used to tell the drive what data to send to, or what commands to receive from, a particular DeviceNet™ (Profile 12) Register. Note that four such registers are already programmed, giving the drive basic send and receive functionality. The data in these registers are not changeable.
7. The definition of the bits in the available DeviceNet™ (Profile 12) registers may be entered from a choice of pick list variables in the keypad menus, or custom programmed using the drive's SOP program. See Section 9.8 for details.



Note: If the user is unfamiliar with drive system programming, refer to the System Programming chapter in the drive's manual.

Please note that the PLC can receive data from the drive without any changes to the SOP program. Only if the user needs to control the drive through the DeviceNet™ (Profile 12) network will they need to set any flags in the SOP program.

If the user needs to control the drive through a DeviceNet™ (Profile 12) Plus network (or any other type of network), then they will need, at an absolute minimum, the following network control flag to appear in the source code of the SOP program:

```
Network1RunEnable_O = TRUE;
```

To be able to control a drive through a network by sending commands to it, first ensure that the drive's SOP file contains the line of code mentioned above. Note that the semicolon is part of the code. If the user would like to control the drive through a second network, then the SOP program must also contain this line:

```
Network2RunEnable_O = TRUE;
```

After ensuring that the SOP file has the necessary code to enable control of the drive over a network, the user will need to change some of the drive's control parameters using the keypad on the front of the drive.

9.6.1 A Practical Setup Example

A customer needs to process four drive outputs on his/her PLC. These are status, motor speed, power, and number of active faults. To program a register, refer to Table 9-15 to see if it is programmable. **Data From Drive 01** is not changeable; a change is neither necessary nor possible. It is already permanently set to indicate general status. **Data From Drive 02** is used to indicate motor speed. This register is also not changeable. It is permanently set to indicate motor speed. Table 9-7 shows the data setup for the hypothetical example.

Table 9-7: Hypothetical Desired Data

PLC DeviceNet (Profile 12) Data	Data	Scaling
Data From Drive 01	General Status	16 bits
Data From Drive 02	Motor Speed	RPM
Data From Drive 03	Output Power	kW
Data From Drive 04	Number of faults	0 – 128

Use Table 9-15 to determine the necessary parameter ID. Enter parameter ID ‘Data From Drive 03’ (**9403**) using the keypad on the front of the drive. Choose “output power” from the pick list. Enter parameter ‘Data From Drive’ (**9404**) using the keypad on the front of the drive. Scroll through the pick list to find “number of active faults.”

Note that “number of active faults” is not a choice in the pick list. Therefore, it needs to be specified manually. Refer to Table 9-17 for a list of ‘Data From Drive’ pick list variables. Since “number of active faults” is not a choice in the pick list, choose **Man Id** from the pick list. Find “number of active faults” in Appendix B, and look for its data ID number. Its data ID number is 3000. Note that the data ID number is not the same as a parameter ID number.

“ManId-0000” will be shown on display. Use arrows or number keys to enter 3000, and press [ENTER]. The display should show “Man Id-3000”. If the data ID number could not be found, the error message “Invalid Id Entered” will be displayed. Ensure that the data ID is correct. Now the number of active faults will be sent to the PLC using the ‘Data From Drive 04’ register.

9.7 Drive Control Defaults

To control the drive using its default configuration, the user will need to send commands to its Fixed Reg Bits location. Refer to Table 9-15 to see the location of the 'Fixed Reg Bits'. The drive's default interpretation of the Fixed Reg Bits is non-programmable and controlled by the drive's control software. To ensure that the drive is set to its default setting, use the keypad on the front of the drive to set parameter (9944) to FIXED. This is the default configuration. Using the default configuration, the Fixed Reg Bits are interpreted as shown in Table 9-8. Note that these particular drctry.ngn bits are always defined by register **Data To Drive Reg 01** whether the default configuration is used or not. To redefine the bits at this address, refer to Section 9.7.2.

Table 9-8: If 'Net Control Type' Set to FIXED (Default Command Configuration)

Bit	Default Definition
Network1FixedRegBit0_I	Run forward
Network1FixedRegBit1_I	Run reverse
Network1FixedRegBit2_I	Fault reset
Network1FixedRegBit3_I	Stop ¹
Network1FixedRegBit4_I	Reserved
Network1FixedRegBit5_I	Start stop control from network
Network1FixedRegBit6_I	Speed commanded from network
Network1FixedRegBit7_I	Not Used
Network1FixedRegBit8_I	
Network1FixedRegBit9_I	
Network1FixedRegBit10_I	
Network1FixedRegBit11_I	
Network1FixedRegBit12_I	
Network1FixedRegBit13_I	
Network1FixedRegBit14_I	
Network1FixedRegBit15_I	

1. Network1FixedRegBit3_I functions as a drive stop control bit only if "Start Stop Control" (9945) is set to "Momentary" — otherwise this bit is Reserved

9.7.1 Status Output

To read drive status data, the user will need to read the General Status register as found in Table 9-15. The drive's status output is shown below in Table 9-9. These status bits are always located at **Data From Drive 01** Word 1 of DeviceNet™ (Profile 12).

Table 9-9: General Status Output from the Drive

Bit number	Meaning in drive control software	Value
0	Fault	0 = False; 1 = True
1	Alarm	
2	RunningForward	
3	RunningReverse	
4	DriveReady	
5	StartStopControlFromNetwork	
6	SpeedFromNetwork	
7	AtSpeedReference	
8	SpeedInPercent	
9	SpeedInRPM	
10	SpeedInHz	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	



Note: The default output bit interpretation can **NOT** be reprogrammed.

9.7.2 Running the Drive using Non-default Settings

The drive can be run in a non-default manner by reprogramming the **Fixed Reg Bits** register. As seen in Table 9-15, the *location* is fixed at **Data To Drive Reg 01** (Word 1 of the DeviceNet™ (Profile 12) data from the network). However, the *definition* of the bits can be reprogrammed. To change the interpretation of the control bits (**Data To Drive Reg 01**), use the following procedure:

By setting menu parameter 'Net Control Type' (**9944**) to 'SOP', each bit from the 'Fixed Reg Bits' word can be used in any desired manner, such as shown below. To make the definition of the 'Fixed Reg Bits' in the **Data To Drive Reg 01** programmable, use the drive's keypad to set parameter 'Net Control Type' (**9944**) to 'SOP'. The source code below shows how to use the SOP program to trip the input medium voltage when '1' is sent to

Network1FixedRegBit9 in **Data To Drive Reg 01** (Word 1 of the DeviceNet™ (Profile 12) data from the network).

```
;ExternalDigitalOutput01h_0 Use digital output to trip input medium Voltage  
ExternalDigitalOutput01h_0 = Network1FixedRegBit9_I;
```

9.8 User Programming via the SOP

9.8.1 Inputs to the Drive (64 bits)

There are 64 input bits available for user programming. Use Table 9-15 to find the location of the first **Data To Drive Reg** register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that 'Data To Drive Register'. The table reveals the first programmable data item for the DeviceNet (Profile 12) network is **Data From Drive 03**, and that its corresponding keypad parameter ID for Network 1 is **(9603)**. Go to the keypad on the front of the drive and enter parameter **(9603)**. The user will see a pick list, the first item of which is 'None' (see Table 9-11 for a list of possible pick list choices for 'Data to Drive Registers'). The user will scroll through the pick list until they come to **Net Input Flag 1**, and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select **Net Input Flag 2**, and so on. The corresponding names of the bits related to the menu pick list items are found in Table 9-11.

This example shows how to use the DeviceNet™ (Profile 12) network to trip the input medium voltage. In this example, our PLC will be writing data to **Data To Drive Reg 03**, which we programmed to Net Input Flag 1. We will use the SOP program to set a flag bit that will use digital output to trip input medium voltage. The PLC will write the contents of **Net Input Flag 1**, bit 9 (**Network1Flag9_I**) to create an input medium voltage trip. The SOP source code is shown below:

```
;ExternalDigitalOutput01h_O Use digital output to trip input medium voltage  
ExternalDigitalOutput01h_O = Network1Flag9_I;
```

9.8.2 Outputs from the Drive (64 bits)

There are 64 output bits available for user programming. Use Table 9-15 to find the location of the first **Data From Drive** register that is programmable. Please note which Network 1 keypad parameter ID corresponds to that **Data From Drive** register. The table reveals the first programmable data item for the DeviceNet™ (Profile 12) network is **Data To Drive Reg 03**, and that its corresponding keypad parameter ID for Network 1 is **(9403)**. Go to the keypad on the front of the drive and enter parameter **(9403)**. The user will see a pick list, the first item of which is 'None' (see Table 9-17 for a list of possible pick list choices for **Data From Drive Registers**). The user will scroll through the pick list until they come to **Net1 Out Reg 1**, and then press [ENTER]. This setting will use the first 16 bits of the possible 64 bits. To use the second set of 16 bits, select **Net1 Out Reg 2**, and so on. The corresponding names of the bits related to the menu pick list items are found in Table 9-13.

This example shows how to use the DeviceNet™ (Profile 12) network to detect a trip on the input medium voltage. In this example, our PLC will be reading **Data From Drive 03**, which we programmed to **Net1 Out Reg 1**. We will use the SOP program to set a flag bit that corresponds to a medium voltage low fault. We will use bit 9 of **Net1 Out Reg 1**, which is **Network1Flag9_O**, to set the network flag true if the medium voltage low fault is active. The PLC will read the contents of **Net 1 Out Reg 1**, bit 9 (**Network1Flag9_O**) to determine if a medium voltage fault occurred. The SOP source code is shown below:

```
; Monitor medium voltage fault on the ControlNet network  
Network1Flag9_O = MediumVoltageLowFault_I;
```

9.8.3 Flags Available to the SOP Program

Net Control Type Default:

The drive's interpretation of the bits in Table 9-10 is fixed by the drive's control software, unless the user sets parameter 'Net Control Type' (9944) to 'SOP'. To change the default interpretation of these bits, see Section 9.7.2.

**Table 9-10: Relationship of 'Fixed Reg Bits' to Keypad Menus and drctry.ngn Bits
(programmable bits available for use in the SOP)**

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits	DeviceNet (Profile 12) Network Data
Fixed Reg Bits (network 1)	Network1FixedRegBit0_I ~ Network1FixedRegBit15_I	Word 1 from network
Fixed Reg Bits (network 2)	Network2FixedRegBit0_I ~ Network2FixedRegBit15_I	Word 1 from network

User Programmable:

The interpretation of these bits is programmable through the SOP file. These bits can be programmed to set or reset any other bits used within the SOP.

Table 9-11: Network 1 Programmable Input Bits (keypad parameter ID 9603-9664)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network1Flag0_I ~ Network1Flag15_I
Net Input Flag 2	Network1Flag16_I ~ Network1Flag31_I
Net Input Flag 3	Network1Flag32_I ~ Network1Flag47_I
Net Input Flag 4	Network1Flag48_I ~ Network1Flag63_I

Table 9-12: Network 2 Programmable Input Bits (keypad parameter ID 9703-9764)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net Input Flag 1	Network2Flag0_I ~ Network2Flag15_I
Net Input Flag 2	Network2Flag16_I ~ Network2Flag31_I
Net Input Flag 3	Network2Flag32_I ~ Network2Flag47_I
Net Input Flag 4	Network2Flag48_I ~ Network2Flag63_I

Table 9-13: Network 1 Programmable Output Bits (keypad parameter ID 9403-9464)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net1 Out Reg 1	Network1Flag0_O ~ Network1Flag15_O
Net1 Out Reg 2	Network1Flag16_O ~ Network1Flag31_O
Net1 Out Reg 3	Network1Flag32_O ~ Network1Flag47_O
Net1 Out Reg 4	Network1Flag48_O ~ Network1Flag63_O

Table 9-14: Network 2 Programmable Output Bits (keypad parameter ID 9503-9564)

Pick list variable in 'Data to Drive Reg <i>nn</i> ' menus	Related Drctry.ngn bits
Net2 Out Reg 1	Network2Flag0_O ~ Network2Flag15_O
Net2 Out Reg 2	Network2Flag16_O ~ Network2Flag31_O
Net2 Out Reg 3	Network2Flag32_O ~ Network2Flag47_O
Net2 Out Reg 4	Network2Flag48_O ~ Network2Flag63_O

9.9 DeviceNet™ (Profile 12) Network Data and Keypad Pick List Tables

Table 9-15: Correspondence between Drive Parameter ID and DeviceNet™ (Profile 12) Network Data*

Network	Drive Parameter ID Numbers ¹	Description	Default Contents	DeviceNet™ (Profile 12) Network Data ²
1	9401	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
1	9402	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
1	9403 - 9464	Data From Drive 03-64 ³	None	Bytes 05 – 128 to network
1	9601	Data To Drive Reg 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 from network
1	9602	Data To Drive Reg 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 from network
1	9603 – 9664	Data To Drive Reg 03-64 ⁴	None	Bytes 05 – 128 from network
2	9501	Data From Drive 01 ³	General Status (not changeable)	Bytes 01 & 02 to network
2	9502	Data From Drive 02 ³	Motor Speed (not changeable)	Bytes 03 & 04 to network
2	9503 – 9564	Data From Drive 03- 64 ³	None	Bytes 05 – 128 to network
2	9701	Data To Drive Reg 01 ⁴	Fixed Reg Bits (not changeable)	Bytes 01 & 02 from network
2	9702	Data To Drive Reg 02 ⁴	Velocity Demand (not changeable)	Bytes 03 & 04 from network
2	9703 – 9764	Data To Drive Reg 03-64 ⁴	None	Bytes 05 – 128 from network

- 1. Drive Parameter ID Number**—the number to enter using the keypad on the front of the drive.
- 2. DeviceNet™ (Profile 12) Network Data**—DeviceNet™ (Profile 12) uses a predefined byte count to communicate between the master and the drive. The Siemens NXG drive uses 136 bytes for input and output; 128 bytes are used to form the 64 16-bit registers (2 bytes per register) and 8 bytes are 'reserved' for future used. The master must be set up to match the number of bytes used by the network "I/O Size Parameters". Network data size may be limited to 16, 32, 64, 96, 128, or 136 bytes for input and output, using menu items (9951) and (9952). The data received (128 bytes) is mapped to the 64 Data To Drive Registers and the data sent to the PLC is defined using the 64 Data From Drive Registers.
- 3. Data From Drive**—data that the PLC will receive from the drive to determine how the drive is functioning. Each register contains a 16-bit digital representation of the status of a particular aspect of the drive's functioning. Some registers are fixed to track certain drive functions; others are programmable to track any of a number of drive status choices.
- 4. Data To Drive**—data that the PLC will send to the drive to control it. Each register contains a 16-bit digital representation of the PLC's command for a particular aspect of the drive's functioning. Some registers are fixed to control certain functions; others are programmable to control any of a number of drive function choices.

Table 9-16: Data To Drive Pick List Variables Scaling

*Name		Scaling			*Name		Scaling
None		None			MUX 5 ID	NA	None
Fixed Reg Bits	B	None			MUX 6 ID	NA	None
Velocity Demand	U	Hz /10	RPM * 1	% /10	MUX 7 ID	NA	None
Auxiliary Demand		Hz /10	RPM * 1	% /10	MUX 8 ID	NA	None
Net Input Flag 1	B	None			PTD1	NA	None
Net Input Flag 2	B	None			PTD2	NA	None
Net Input Flag 3	B	None			PTD3	NA	None
Net Input Flag 4	B	None			PTD4	NA	None
Ratio	U	% /100			Parallel Cmd 1		None
Forward Max Lim	U	/10000 or % /100			Torque Demand		/1000
Reverse Max Lim	U	/10000 or % /100			PVCL Demand		/100
Forward Acc Time		/10			Flux Demand		/100
Forward Dec Time		/10			Node Count		None
Reverse Acc Time		/10			Node Index		None
Reverse Dec Time		/10			Torque Acc Time		/100
Net Input Pulse		In * 1			Torque Dec Time		/100
Forward Min Lim		/10000 or % /100			Torque Offset		/1000
Reverse Min Lim		/10000 or % /100			Torque Scalar		/1000
Torque Limit		/10000 or % /100			Vars Command		/1000
MUX 1 ID	NA	None			No Load I Scalar		/1000
MUX 2 ID	NA	None			Avg Field Cur		/10000
MUX 3 ID	NA	None			Manual Ids Demand		/1000
MUX 4 ID	NA	None					

* Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

Table 9-17: Data From Drive Pick List Variables

Drive Pick List Variables							
None	N/A	Net1 Out Reg 4	B	Mux2 Echo	N/A	Wago™ Inputs 65-80	B
Man Id	N/A	Net2 Out Reg 1	B	Mux2 Data	N/A	Wago™ Inputs 81-96	B
General Status	B	Net2 Out Reg 2	B	Mux3 Echo	N/A	Wago™ Outputs 1-16	B
Motor Voltage	U	Net2 Out Reg 3	B	Mux3 Data	N/A	Wago™ Outputs 17-32	B
Total Current	U	Net2 Out Reg 4	B	Mux4 Echo	N/A	Wago™ Outputs 33-48	B
Output Power	U	Torque Current	U	Mux4 Data	N/A	Wago™ Outputs 49-64	B
Motor Speed	U	Magnetizing Cur	U	Mux5 Data	N/A	PFD1	N/A
Speed Demand	U	Motor Flux	U	Mux6 Echo	N/A	PFD2	N/A
Speed Reference	U	Motor Torque	U	Mux6 Data	N/A	PFD3	N/A
Heartbeat	U	Flux Reference	U	Mux7 Echo	N/A	PFD4	N/A
Drive State	U	Input Voltage	U	Mux7 Data	N/A	Drive Losses	U
Inp RMS Current	U	Inp Power Factor	U	Mux8 Echo	N/A	Excess React I	U
Input Frequency	U	Input KVars	U	Mux8 Data	N/A	Speed Droop Percent	U
Input Power Avg	U	Max Available Output Volts	U	Wago™ Inputs 1-16	B	Sync Motor Field Ref	U
Net1 Out Reg 1	B	Hottest Cell Temp	U	Wago™ Inputs 17-32	B	Avail reactive Current	U
Net1 Out Reg 2	B	Mux1 Echo	N/A	Wago™ Inputs 33-48	B	Drive Efficiency	U
Net1 Out Reg 3	B	Mux1 Data	N/A	Wago™ Inputs 49-64	B		

Name - suffix description:

- NA = Not Applicable
- B = Bit Field
- S = Signed
- U = Unsigned

9.10 Menu Parameter Tables

Table 9-18: Network 1 Configure Menu (9900)

Parameter	ID	Units	Default	Min	Max	Description
Network 1 Type	9901		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> None Modbus™ DeviceNet™ ControlNet™ Modbus™ Plus Ethernet Modbus™ Data Highway +™ ControlNet™

Table 9-19: Configure Parameters Menu (9902)

Parameter	ID	Units	Default	Min	Max	Description
Baud Rate	9905		125k			DeviceNet™ network baud rate.
DeviceNet™ (Profile 12) Address	9908		10	1	63	Sets address of node on DeviceNet™ (Profile 12) network.
Velocity Units	9080		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> % RPM Hz
Demand Scalar	9912		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9913		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network 1 I/O Size	9951		136	16	136	Select the size of input and output data.

Table 9-20: Register Data From Drive Menu (9400)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9401		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9402		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 -64	9403-9464		None			Register data from drive parameters 3-64. These registers are programmable.

Table 9-21: Register Data To Drive Menu (9600)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9601		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9602		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data to Drive Reg 03-64	9603-9664		None			Register data to drive parameters 3-64. These registers are programmable.

Table 9-22: Network 2 Configure Menu (9914)

Parameter	ID	Units	Default	Min	Max	Description
Network 2 Type	9915		None			Designates the type of external network connected to the drive. <ul style="list-style-type: none"> • None • Modbus™ • DeviceNet™ • ControlNet™ • Modbus™ Plus • Ethernet Modbus™ • Data Highway +™ • ControlNet™

Table 9-23: Network 2 Configure Parameters Menu (9916)

Parameter	ID	Units	Default	Min	Max	Description
DeviceNet™ Baud Rate	9919		125k			DeviceNet™ Network baud rate.
DeviceNet™ (Profile 12) Address	9922		9	1	99	Sets address of node on DeviceNetv (Profile 12) network.
Velocity Units	9924		%			Designates the units for velocity values from the drive. <ul style="list-style-type: none"> • % • RPM • Hz
Demand Scalar	9926		1	-125	125	Scalar for input demand reference from the network.
Aux Demand Scalar	9927		1	-125	125	Auxiliary scalar for input demand reference from the network.
Network2 I/O Size	9952		136	16	136	Select the size of input and output data.

Table 9-24: Network 2 Register Data From Drive Menu (9500)

Parameter	ID	Units	Default	Min	Max	Description
Data From Drive 01	9501		General Status			Register data from drive parameter 1. This register is not programmable
Data From Drive 02	9502		Motor Speed			Register data from drive parameter 2. This register is not programmable.
Data From Drive 03 -64	9503-9564		None			Register data from drive parameters 3-64. These registers are programmable.

Table 9-25: Network 2 Register Data To Drive Menu (9700)

Parameter	ID	Units	Default	Min	Max	Description
Data To Drive Reg 01	9701		Fixed Reg Bits			Register data to drive parameter 1. This register is not programmable.
Data To Drive Reg 02	9702		Velocity Demand			Register data to drive parameter 2. This register is not programmable.
Data To Drive Reg 03-64	9703-9764		None			Register data to drive parameters 3-64. These registers are programmable.

9.11 Display Network Monitor Function (Parameter ID 9950)

This function allows the user to view the values of network registers. It is extremely useful for troubleshooting. As data is transmitted and the values of the registers change, the display will automatically and continuously update to reflect the changes. The direction of data transmission as shown on this screen is from the drive's perspective. Therefore, 'Rx' is data received into the drive, and 'Tx' is data transmitted from the drive.

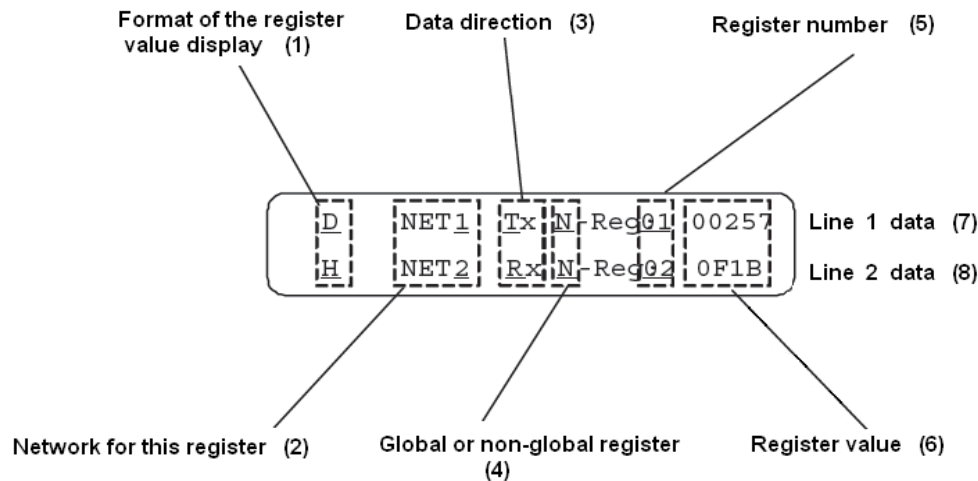


Figure 9-4: Diagram of Display Network Monitor Function

1. 'D' means decimal format.
'H' means hexadecimal format.
2. The drive may be connected to two separate networks.
3. 'Rx' means that this is a "Data to Drive" register.
'Tx' means that this is a "Data from Drive" register.
4. 'G' means a global register.
'N' means a non-global register.
The DeviceNet™ (Profile 12) protocol does not support global registers. Therefore, when working with a DeviceNet™ (Profile 12) controller, this field will contain 'N' in all of the registers.
5. This two-digit numeric field indicates the number of the register being shown.
'Tx' 01-64 are 'Data from Drive 01' parameter ID (9401) through 'Data from Drive 64' parameter ID (9464).
'Rx' 01-64 are 'Data to Drive 01' parameter ID (9601) through 'Data to Drive 64' parameter ID (9664).
6. The value of the register. Since the registers all contain 16-bit digital words, they range in value from 0-65535 (decimal), or 0-FFFF (hexadecimal).
7. Line 1 contains the following information:
The register value is shown in decimal format; the register is in network 1; the register is non-global; the data is going to the drive; "to drive" register number 1 is showing; its value is 257.
8. Line 2 contains the following information:
The register value is shown in hexadecimal format; the register is in network 2; the register is non-global; the data is coming from the drive; "from drive" register number 2 is showing; its value is 0xF1B (decimal equivalent = 3,867).



Note: The underscores in the picture of the display show possible cursor movement. To move the cursor within the display, use the left and right arrow keys. Alphabetic fields are only edited with the up and down arrow keys. Numeric fields are edited with either the up and down arrow keys or the numeric keys. The cursor will move to the beginning of the second line after it reaches the last possible position on the first line. Likewise, the cursor will move to the beginning of the first line after it reaches the last possible position on the second line.

Figure 9-5 represents a typical display. If the user starts with the cursor at position A and uses the left arrow [←] key repeatedly, the cursor will move to A, D, C, B, A, *etc.* If the user starts with the cursor at position A and uses the right arrow [→] key repeatedly, the cursor will move to A, B, C, D, A, *etc.*

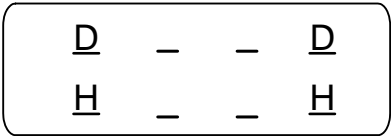


Figure 9-5: Cursor Movement Diagram

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9

APPENDIX

A

A Parameter Read / Write

A.1 Introduction

Parameter Read/Write allows to use a PLC to read and write parameter values in the drive. The Parameters To Drive (PTD) registers read and write ID commands, read and write parameter commands, read and write pick list items, and execute certain functions. The Parameters From Drive (PFD) registers echo the PTD command, hold the PTD read command results, and produce an error code if the PTD command cannot be performed.

A.2 Setting Up the PTD and PFD Registers

The PTD and PFD registers are set up in the 'Communications Menu' (9), in the submenu 'Network 1 Configure' (9900) or 'Network 2 Configure' (9914). The four PTD registers are available as pick list items in the IDs (9603 to 9664). The four PFD registers are available as pick list items in the IDs (9403 to 9464). Place each set of four registers in sequential IDs.

Each register performs a specific function.

A.3 Defining the PTD Registers

Table A-1 summarizes the possible PTD register contents.

The PTD1 register can have a value of 0 to 127:

- Values of 1 to 15 support ID commands.
- Values of 21 to 26 support parameter commands.
- Values of 31 to 40 support pick list commands.
- Values of 41 to 47 support function commands.
- Values not listed here are reserve for future use (0 = no operation).

The PTD2 register supplies the Menu ID for the required command.

The PTD3 register supplies the Write Value for Least Significant 16-Bits.

The PTD4 register supplies the Write Value for Most Significant 16-Bits.

Table A-2 lists the available ID Function commands, such as Autotune, when PTD1 is set to a Function command (value 41). The table also lists the settings or values for PTD3, PTD4, PFD3, and PFD4 for each ID function.

A.4 Defining the PFD Registers

Table A-3 summarizes the possible PFD register contents.

The PFD1 register consists of 16 bits:

- Bits 0 to 6 contains the command echo (from PTD1, bits 0 to 6).
- Bit 7 contains the error flag.
- Bits 8 to 15 are conditional. If bit 7 is not set (no error), bits 8 to 11 represent the exponent. If bit 7 is set, bits 8 to 15 contain the error code. See Table A-3.

The PFD2 register contains the Menu ID echo.

The PFD3 register contains the value returned from a Read Parameter Value command issued by PTD1. If the value is numeric, PFD3 contains the least significant 16 bits. If the value is a string, PFD3 contains the first two bytes.

The PFD4 register contains the value returned from a Read Parameter Value command, if needed. If the value is numeric, PFD4 contains the most significant 16-bits. If the value is a string, PFD4 contains the second two bytes.

Table A-1: Registers PTD 1-4 Contents

Register		Value	Description
PTD1 Bits 0-7	ID Commands	0	No Operation
		1	Read ID Type: 0 = Parameter 1 = Pick List Item 2 = Pick List with Manual ID (Manual ID Not Selected) 3 = Pick List with Manual ID (Manual ID Currently Selected) 4 = Function
		2	Read Next ID
		3	Read ID Minimum Value
		4	Read ID Maximum Value
		5	Read ID String Length
		6-11	Read ID String (4 bytes per command)
		12	Read ID Security Level (0, 5, 7)
		13	Write ID Security Level (0, 5, 7)
		14	Read ID Default Value
		15	Read ID Default Used (0 = No, 1 = Yes)
		16-20	Reserved for Future Use
	Parameter Commands	21	Read Parameter Value
		22	Write Parameter Value
		23	Read Units Text Length
		24	Read Units String (Bytes 1-40)
		25	Read IP Address
		26	Write IP Address
		27-30	Reserved for Future Use
	Pick List Commands	31	Read Pick List Item
		32	Write Pick List Item (Not Using Drive ID)
		33	Write Pick List Item (Using Drive ID)
		34	Read Pick List Text Length
		35-40	Read Pick List String (4 Bytes per Command)
	Function Commands See Table A-2 for supported IDs	41	Perform Function
		42-47	Read Function String (4 Bytes per Command)
		48-127	Reserved for Future Use
Bits 8-11	Exponent		Exponent to be used for Write Parameter Value command
PTD2	Menu ID		Menu ID for Command
PTD3	Write Value		Value to be used for Write Parameter Value command—Least Significant 16-Bits
PTD4			Most Significant 16-Bits

Table A-2: Supported ID Function Commands (PFD1-Command 41)

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ID	Function	PTD3/PTD4 Use		PFD3/PFD4 Use
1260	Autotune Stage1	Not used		Not used
1270	Autotune Stage2	Not used		Not used
2640	Reset Bypassed Cells	Not used		Not used
3510	Start Control Loop Test	Not used		Not used
3520	Stop Control Loop Test	Not used		Not used
5045	Set Current As Default	Not used		PFD3: 1 = Error PFD4: Not used
5050	Reset to Defaults	Not used		Not used
6200	Clear Event Log	Not used		Not used
6240	Alarm/Fault Log Clear	Not used		PFD3: 1 = Error PFD4: Not used
8030	Preset Hour Meter	PTD3 = Value PTD4 = Exponent		Not Used
8040	Reset Hour Meter	Not used		Not used
8060	Alarm/Fault Log Clear	PTD3 = Value PTD4 = Exponent		Not Used
8070	Reset Output KWH Meter	Not used		Not used
8074	Preset Input KWH Meter	PTD3 = Value PTD4 = Exponent		Not used
8076	Reset Input KWH Meter	Not used		Not used
8080	Set the Clock Time	PTD4	PTD3	Not used Invalid combinations of PTD3/PTD4 return a Limit Error in PFD1.
		0	Seconds (0-59)	
		1	Minutes (0-59)	
		2	Hours (0-23)	
		3	Days	
		4	Month (1-12)	
		5	Year (1999-2099)	

ID	Function	PTD3/PTD4 Use	PFD3/PFD4 Use
8090	Display Version Number (Software Release Version)	Not used	PFD4: Not used in released versions PFD3: Bits 12-15: Not used Bits 8-11: Major Rev Bits 4-7: Minor Rev Bits 0-3: Incremental release (if >0)
9140*	Display Sys Prog Name	Not used	PFD3 = String Length
9147*	Display Drctry Version	Not used	PFD3 = String Length
9195*	Show Active Config File	Not used	PFD3 = String Length
9946	Net 1 to 2 Reg. Copy	Not used	Not used

* IDs that support the use of the function string commands (commands 42-47).

Table A-3: Error Codes

Register		Bits	Description	
PFD1	Status	0-6	Echo of Command from PTD	
	Bits 0-6: Echo of Command	7	Error Flag. If Bit 7 is not set (0), Bits 8-15 represent the number of decimal digits.	
	Bit 7: Error Flag		If Bit 7 is set (1), Bits 8-15 contain the error codes shown below:	
	Bits 8-15: If Error Flag set the bits 8-15 as the Error Code. Otherwise, bits 8-11 are a 4-bit exponent for the data.	8-15	Error Code	Error Description
			0	Not used
			1	Invalid ID
			2	Limit Error
			3	Drive is running. Can't change value
			4	Parameter/pick list write Lockout (drive does allow parameter changes)
			5	ID is parameter type. Use parameter commands.
			6	ID is a pick list type. Use pick list commands.
			7	Command Error: Use write pick list Manual ID Command
			8	Command Error: Use write pick list command
			9	Invalid Manual ID
			10	Fixed Pick List (Item is Read Only)
			11	Pick List Item Already Selected
			12	Invalid Function ID
			13-255	Reserved for Future Use
PFD2	Menu ID Echo		Menu ID Echo	
PFD3	Read Value		Value returned from read parameter value command—Least Significant 16-Bits. If command is Get ID, this register contains the least significant 16 bits. If command is Read String, the 1 st two bytes are returned.	
PFD4	Read Exponent		Most Significant 16-Bits. If command is Get ID, this register contains the most significant 16 bits. If command is Read String, the 2 nd two bytes are returned.	

A.5 PLC Handshaking Procedure for Parameter Read/Write

Register Setup

1. Write register data into PTD3 and PTD4, for commands that require PLC data.
2. Write the menu ID into the PTD2 register.
3. Poll until PFD2 register value equals PTD2 register value (menu ID echo).
4. Write the command type into the PTD1 register.

Perform Handshake

5. Poll until the lower 7 bits (0-6) in the PFD1 register are equal to the value in the PTD1 register (command echo).

Error Testing

6. Test bit 7 of PFD1 (command echo flag).
7. If bit 7 is set, the upper byte of PFD1 is the error code.
8. If bit 7 is clear, the upper byte of PFD1 contains the 4-bit exponent for the data if the command was "Read Parameter Value." For all other commands, the upper byte will be zero.

Read Data

9. Read register data in PFD3 and PFD4 (commands that return PCD data).

End the Command

10. Write zero into the PTD1 register (reset the command).

A.6 Example: Change the Rated Input Voltage (ID 2010)

Change the rated input voltage parameter (2010) to 3000.

1. Write **3000** to PTD3; PT4 is not needed. This is the new voltage.
2. Write **2010** to PTD2. This is the ID of Rated Input Voltage.
3. Poll PFD2 until it's value equals **2010** (the value of PTD2).
4. Write **22** to PTD1. This is the Write Parameter Value command.
5. Poll bits 0-6 of PTD1 until the value equals **22** (the value of PTD1).
6. When PFD2 = PTD2 and the lower six bits of PFD1 = PTD1, test bit 7 of PFD1.
7. If bit 7 of PFD1 is not set, read bits 8 to 11 for the exponent.
8. If bit 7 of PFD1 is set, read bits 8 to 15 for the error code.
9. Read PFD3 and PFD4 for the new value.
10. Write **0** to PTD1.



A

APPENDIX

B Output Data IDs

B

Data ID numbers for read commands are listed in Tables B-1 through B-61.

Table B-1: General Data Register Assignments

Data ID	Units	Scalar	Point Description
2000	RPM		Speed reference command
2001			<ul style="list-style-type: none"> bit 0: Fault bit 1: Alarm bit 2: Running Forward bit 3: Running Reverse bit 4: Drive Ready bit 5: Start/Stop Control By Network bit 6: Speed Set By Network bit 7: At Speed Reference bit 8: Speed Is In Percent bit 9: Speed Is In RPM bit 10: Speed Is In Hz bit 11: not used bit 12: not used bit 13 not used bit 14 not used bit 15 not used
2010	%	÷ 100	Speed reference command
2011	%	÷ 100	Flux reference
2012	%	÷ 100	Power factor (1.0 = 100%)
2013	KVAR		Kvar
2014	Menu-Selected:		Motor speed, filtered
	Hz	÷ 10	
	RPM	-	
	%	÷ 10	
2015	%	÷ 100	Flux DS, filtered
2016	%	÷ 100	Peak voltage clamp limit, normalized
2017	%	÷ 10	Hot cell temperature (80% = Trip point)

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Data ID	Units	Scalar	Point Description
2020	RPM		Speed feedback
2030	%	÷ 100	Speed feedback (Stator frequency)
2040	RPM		Speed demand (Requested speed)
2050	%	÷ 100	Speed demand (Requested speed)
2060	%	÷ 100	Raw speed input (Speed input from selected source)
2070	%	÷ 100	Ramp output (From speed ramp)
2080	Amps		Torque demand
2090	%	÷ 100	Torque demand
2100	Volts		Motor voltage
2110	%	÷ 100	Motor voltage
2120	Volts		Line voltage
2130	Amps		Input current
2140	Hz	÷ 100	Line frequency
2150	Amps		Torque current feedback (Iqs)
2160	%	÷ 100	Torque current feedback (Iqs)
2170	Amps		Magnetizing Current Feedback (Ids)
2180	%	÷ 100	Magnetizing Current Feedback (Ids)
2190	Amps		Total Current Feedback
2200	%	÷ 100	Total Current Feedback
2210	N/A	N/A	Drive state 0 = Off 1 = Magnetizing 2 = Spinning Load 3 = Autotune 4 = Run 5 = Stop 6 = Coast 7 = Up Transfer 8 = Down Transfer
2220	N/A	N/A	Heartbeat (1ms update)
2230	KW	1	Output power
2240	% * 100	÷ 100	Output power
2250	KW	1	Input power
2260	% * 100	÷ 100	Input power
2270	% * 100	÷ 100	E _O Avg Output Neutral Voltage
2280	Volts	1	E _O Avg Output Neutral Voltage

Serial Flags: For use with Tables B-2 through B-5. There are 64 bits that can be used with any other valid input or output bits. For example, packing bits from multiple addresses into a single telegram.

Table B-2: Serial Flags 1 S1_1

Data ID	Bits	SOP Flags	Values
2380	0 – 15	* Serial Flags 0_O – 15_O (same as bit number)	0 = False (off), 1 = True (on)

Table B-3: Serial Flags 2 S1_2

Data ID	Bits	SOP Flags	Values
2390	0 – 15	* Serial Flags 16_O – 31_O (bit number + 16)	0 = False (off), 1 = True (on).

Table B-4: Serial Flags 3 S1_3

Data ID	Bits	SOP Flags	Values
2400	0 – 15	* Serial Flags 32_O – 47_O (bit number + 32)	0 = False (off), 1 = True (on).

* Serial and Network Flags are mapped using the SOP

Table B-5: Serial Flags 4 S1_4

Data ID	Bits	SOP Flag	Values
2410	0 – 15	* Serial Flag 48_O – 63_O (bit number + 48)	0 = False (off), 1 = True (on).

Table B-6: Network 1 Output Flags

Data ID	Bits	SOP Flag	Values
2002	0 – 15	* Network1Flag0_O – Network1Flag15_O	0 = False (off), 1 = True (on).
2003	0 – 15	* Network1Flag16_O – Network1Flag31_O	0 = False (off), 1 = True (on).
2004	0 – 15	* Network1Flag32_O – Network1Flag47_O	0 = False (off), 1 = True (on).
2005	0 – 15	* Network1Flag48_O – Network1Flag63_O	0 = False (off), 1 = True (on).

Table B-7: Network 2 Output Flags

Data ID	Bits	SOP Flag	Values
2006	0 – 15	* Network2Flag0_O – Network2Flag15_O	0 = False (off), 1 = True (on).
2007	0 – 15	* Network2Flag16_O – Network2Flag31_O	0 = False (off), 1 = True (on).
2008	0 – 15	* Network2Flag32_O – Network2Flag47_O	0 = False (off), 1 = True (on).
2009	0 – 15	* Network2Flag48_O – Network2Flag63_O	0 = False (off), 1 = True (on).

* Serial and Network Flags are mapped using the SOP.

Table B-8: Wago™ Inputs

Data ID	Bits	SOP Flag	Values
2650	0 – 7	ExternalDigitalInput01a_I – ExternalDigitalInput01h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput02a_I – ExternalDigitalInput02h_I	
2651	0 – 7	ExternalDigitalInput03a_I – ExternalDigitalInput03h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput04a_I – ExternalDigitalInput04h_I	
2652	0 – 7	ExternalDigitalInput05a_I – ExternalDigitalInput05h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput06a_I – ExternalDigitalInput06h_I	
2653	0 – 7	ExternalDigitalInput07a_I – ExternalDigitalInput07h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput08a_I – ExternalDigitalInput08h_I	
2654	0 – 7	ExternalDigitalInput09a_I – ExternalDigitalInput09h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput10a_I – ExternalDigitalInput10h_I	
2655	0 – 7	ExternalDigitalInput11a_I – ExternalDigitalInput11h_I	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalInput12a_I – ExternalDigitalInput12h_I	

Table B-9: Wago™ Outputs

Data ID	Bits	SOP Flag	Values
2656	0 – 7	ExternalDigitalOutput01a_O – ExternalDigitalOutput01h_O	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalOutput02a_O – ExternalDigitalOutput02h_O	
2657	0 – 7	ExternalDigitalOutput03a_O – ExternalDigitalOutput03h_O	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalOutput04a_O – ExternalDigitalOutput04h_O	
2658	0 – 7	ExternalDigitalOutput05a_O – ExternalDigitalOutput05h_O	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalOutput06a_O – ExternalDigitalOutput06h_O	
2659	0 – 7	ExternalDigitalOutput07a_O – ExternalDigitalOutput07h_O	0 = False (off), 1 = True (on).
	8 – 15	ExternalDigitalOutput08a_O – ExternalDigitalOutput08h_O	

Table B-10: Internal Digital Inputs / Outputs

Data ID	Units	Scalar	Point Description
5116	N/A	1	Internal Digital Inputs 1 - 16
5117	N/A	1	Internal Digital Inputs 17 - 20
5118	N/A	1	Internal Digital Outputs 1 - 16

Table B-11: Cell Temperature

Data ID	Units	Scalar	Point Description
4090	%	÷ 10	CellTemperature+0 (A1)
4100	%	÷ 10	CellTemperature+1 (B1)
4110	%	÷ 10	CellTemperature+2 (C1)
4120	%	÷ 10	CellTemperature+3 (A2)
4130	%	÷ 10	CellTemperature+4 (B2)
4140	%	÷ 10	CellTemperature+5 (C2)
4150	%	÷ 10	CellTemperature+6 (A3)
4160	%	÷ 10	CellTemperature+7 (B3)
4170	%	÷ 10	CellTemperature+8 (C3)
4180	%	÷ 10	CellTemperature+9 (A4)
4190	%	÷ 10	CellTemperature+10 (B4)
4200	%	÷ 10	CellTemperature+11 (C4)
4210	%	÷ 10	CellTemperature+12 (A5)
4220	%	÷ 10	CellTemperature+13 (B5)
4230	%	÷ 10	CellTemperature+14 (C5)
4240	%	÷ 10	CellTemperature+15 (A6)
4250	%	÷ 10	CellTemperature+16 (B6)
4260	%	÷ 10	CellTemperature+17 (C6)
4270	%	÷ 10	CellTemperature+18 (A7)
4280	%	÷ 10	CellTemperature+19 (B7)
4290	%	÷ 10	CellTemperature+20 (C7)
4300	%	÷ 10	CellTemperature+21 (A8)
4310	%	÷ 10	CellTemperature+22 (B8)
4320	%	÷ 10	CellTemperature+23 (C8)

Enable Faults: Faults can either be always enabled or enabled by a bit in the SOP drctry file. If they are always enabled, then when the fault occurs, the fault bit will be set. If enabled by the SOP bit, then the fault bit will only be set if the enable bit is set on the SOP drctry file.

B



Note: SOP programs are intended to be written and modified by Siemens engineers. This is just for information purposes only. For more information on these parameters, see the Troubleshooting and Maintenance chapter of the appropriate user's manual.

Differences between faults and alarms:

- **Faults:** Once a fault occurs, the drive is immediately tripped (stopped). It is not possible to run the drive again until the fault is cleared.
- **Alarms:** An alarm is only an indication of some potential trouble condition. The alarm will not trip or stop the drive. An alarm cannot be reset by any action. The only way an alarm is reset is when the condition that caused the alarm ceases to exist. An alarm can be acknowledged by attempting to reset either by the windows tool (reset button), keypad (reset key), digital input, SOP flag, menu, auto reset, or through a communication bit. Once an alarm condition does not exist, and it has not been acknowledged, it is in an "unacknowledged" state and the unacknowledged bits will remain high until they are acknowledged.
- **Active Faults:** This bit is high when the fault is active or in an active state.



Note: Bits that are NOT listed in the following tables are undefined.



Note: The values for the Faults/Alarms listed in Tables B-14 through B-24 are: 0 = False (off); 1 = True (on).

Table B-12: Number of Faults/Alarms

Data ID	Bits	Description	Values
3000	N/A	Number of active faults	0 – 255
3010	N/A	Number of unacknowledged alarms	0 – 255
3020	N/A	Number of active alarms	0 – 255



Note: In the Alarm/Fault/Programmable column of Tables B-14 through B-24, Alarm = **A**, Fault = **F**, and Programmable = **P**. In the Enable column: Fixed = **F** (always enabled and not changeable by the user), Programmable to Enable = **PE** (default state is enabled), and Programmable to Disable = **PD** (default state is disabled).

Table B-13: FW1_1

Data ID	Bits	Description	Alarm / Fault / Programmable	Enable
Fault Flags1: Fatal Outputs				
3030	1	Over speed fault	F	F
	3	Under load fault	F	F
	6	Mtr Therm Over Ld Fault	F	F
	10	IOC	F	F
	12	Cell (Any Cell Fault)	F	F
	14	In torq limit	P	PD
Unacknowledged Warning Flags1 (3150)/ Active Warning Flags1 (3270) (Note: All bits are associated with both Data IDs)				
3150/ 3270	0	Over speed alarm	A	PD
	2	Under load alarm	A	PD
	4	Mtr Therm Over Load 1	A	PD
	5	Mtr Therm Over Load 2	A	PD
	7	Output phase imbal	A	F
	9	Output Ground fault	A	F
	13	In torque limit	A	PD
	14	In torq limit rollback	P	PD
	15	Input phase loss	A	PE

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Table B-14: FW1_2

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags2				
3040	0	Phase sequence	P	PD
	2	CPU Temperature Fault	F	PD
	4	Cell over temp fault	F	F
	5	Modulator Configuration	F	F
	6	Cell count mismatch	F	F
	7	Power supply	F	F
	8	Wago™ communication fault	F	PE
	9	Wago™ configuration	F	PE
	10	Cell bypass COM fail	F	F
	11	Cell bypass acknowledge	F	F
	12	Cell bypass link	F	F
	14	System program	F	F
Unacknowledged Warning Flags2 (3160)/ Active Warning Flags2 (3280)				
3160/ 3280	0	Phase sequence	P	PD
	1	CPU Temperature Alarm	A	F
	3	Cell over temp alarm	A	F
	13	Weak battery*	A	F
	15	Medium voltage low 1	A	PD

* Only for modulator board equipped with battery

Table B-15: FW1_3

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags3				
3050	1	Medium voltage low flt	F	F
	5	Line over voltage fault	P	F
	6	Input phase imbal	P	F
	7	Input one cycle	P*	F
	9	Encoder loss	P	PD
	10	Keypad communication	P	PD
	11	Network 1 communication	P	PD
	12	Network 2 communication	P	PD
	14	Motor over volt fault	F	F
Unacknowledged Warning Flags3 (3170)/ Active Warning Flags3 (3290)				
3170/ 3290	0	Medium voltage low 2	A	F
	2	Cell alarm	A	F
	3	Line over voltage 1	A	PD
	4	Line over voltage 2	A	PD
	6	Input phase imbalance	A	F
	7	Input one cycle	P	F
	8	Input ground	A	F
	9	Encoder loss	P	PD
	10	Keypad communication	P	PD
	11	Network 1 communication	P	PD
	12	Network 2 communication	P	PD
	13	Motor over volt alarm	A	PE
	15	Cell bypass comm alarm	A	F

*Fault if GenIV or WCIII

Table B-16: FW1_4

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags⁴				
3060	1	Cell bypass fault	F	F
	2	Cell config fault	F	F
	4	Back EMF timeout	F	F
	5	Hall effect pwr supply	F	F
	6	Modulator board fault	F	F
	8	Modulator watchdog Flt	F	F
	10	Tool communication	P	PD
	11	Failed to magnetize	P	F
	12	Loss of field current	P	F
	13	Minimum speed trip	P	PE
	14	Excessive drive losses	P*	F
Unacknowledged Warning Flags⁴ (3180)/ Active Warning Flags⁴ (3300)				
3180/ 3300	0	Cell bypass link alarm	A	F
	3	Carrier Frq Set Too Low	A	F
	9	Cell DC bus low	A	F
	10	Tool communication	P	PD
	11	Failed to magnetize	P	F
	12	Loss of field current	P	F
	14	Excessive drive losses alarm	P*	F
	15	WAGO™ communication alarm	A	PD

*Fault if GenIV or WCIII

Table B-17: FW2_1

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags5				
3070	1	All blowers not avail	P	PD
	2	Clogged filters	A	PD
	5	Reactor OT Fault	P	PD
	8	Xformer OT Fault	P	PD
	10	Both pumps not available	P	PD
	12	Coolant Conductivity	P	PD
	13	Inlet water temperature high Coolant Inlet Temp	P	PD
	14	Coolant Inlet Temp Inlet water temperature low	P	PD
	15	Cell water temperature high	P	PD
Unacknowledged Warning Flags5 (3190)/ Active Warning Flags5 (3310)				
3190/ 3310	0	One blower not avail	P	PD
	1	All blowers not avail	P	PD
	2	Clogged filters	P	PD
	3	Reactor temperature 1OT Alarm alarm	A	PD
	4	Reactor temperature 2OT Trip Alarm alarm	A	PD
	5	Reactor OT Fault	P	PD
	6	Transformer Xformer OT Temperature 1 alarm	A	PD
	7	Xformer OT Trip Transformer temperature 2 alarm	A	PD
	9	One pump not AvailableFailed	A	PD
	10	Both pumps not available	P	PD
	11	Coolant conductivity high AlarmCoolant Conductivity	A	PD
	12	Coolant Conductivity	P	PD
	13	Inlet water temperature HighCoolant Inlet Temp	P	PD
	14	Coolant Inlet Temp Inlet water temperature low	P	PD
	15	Cell water temperature high	P	PD

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Table B-18: FW2_2

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags6				
3080	0	Xfrm Cool OT Trip Alarm	P	PD
	2	Coolant Tank Level	P	PD
	4	Low Coolant Flow	P	PD
	6	Loss all HEX fans	P	PD
	8	Loss of drive enable	F	PD
	12	A/D Hardware fault	F	F
	14	Config File Read Error	F	F
Unacknowledged Warning Flags6 (3200)/ Active Warning Flags6 (3320)				
3200/ 3320	0	Xfrm Cool OT Trip Alarm	P	PD
	1	Coolant Tank Level	A	PD
	3	Low Coolant Flow	A	PD
	4	Low Coolant Flow	P	PD
	5	Loss one HEX fan	A	PD
	6	Loss all HEX fans	P	PD
	7	All HEX fans on	A	PD
	9	Up transfer failed	A	PD
	10	Down transfer failed	A	PD
	11	A/D Hardware alarm	A	F
	13	Config File Write Alarm	A	F

Table B-19: FW2_3

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags7				
3090	7	Loss of signal intern	P	PD
	8 ~ 15	Loss of signal 1 through 8	P	PD
Unacknowledged Warning Flags7 (3210)/ Active Warning Flags7 (3330)				
3210/ 3330	7	Loss of signal intern	P	PD
	8 ~ 15	Loss of signal 1 through 8	P	PD

Table B-20: FW2_4

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags8				
3100	0 ~ 15	Loss of signal 9 through 24	P	PD
Unacknowledged Warning Flags8 (3220)/ Active Warning Flags8 (3340)				
3220/ 3340	0 ~ 15	Loss of signal 9 through 24	P	PD

Table B-21: FW3_1

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags9				
3110	0 ~ 15	User Fault 1 through 16	P	PD
Unacknowledged Warning Flags9 (3230)/ Active Warning Flags9 (3350)				
3230/ 3350	0 ~ 15	User Fault 1 through 16 (bit number + 1)	P	PD

Table B-22: FW3_2

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags10				
3120	0 ~ 15	User Fault 17 through 32 (bit number + 17)	P	PD
Unacknowledged Warning Flags10 (3240)/ Active Warning Flags10 (3360)				
3240/ 3360	0 ~ 15	User Fault 17 through 32 (bit number + 17)	P	PD

Table B-23: FW3_3

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags11				
3130	0 ~ 15	User Fault 33 ~ 48 (bit number + 33)	P	PD
Unacknowledged Warning Flags11 (3250)/ Active Warning Flags11 (3370)				
3250/ 3370	0 ~ 15	User Fault 33 ~ 48 (bit number + 33)	P	PD

Table B-24: FW3_4

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags12				
3140	0 ~ 15	User Fault 49 ~ 64 (bit number + 49)	P	PD
Unacknowledged Warning Flags12 (3260)/ Active Warning Flags12 (3380)				
3260/ 3380	0 ~ 15	User Fault 49 ~ 64 (bit number + 49)	P	PD

Table B-25: FW4_1

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags13				
3141	0	Loss of internal analog input #1	P	PD
	1	Loss of internal analog input #2	P	PD
	2	Loss of internal analog input #3	P	PD
	3-15	Reserved for future use	-	-
Unacknowledged Warning Flags13 (3261)/ Active Warning Flags13 (3381)				
3261/ 3381	0	Loss of internal analog input #1	P	PD
	1	Loss of internal analog input #2	P	PD
	2	Loss of internal analog input #3	P	PD
	3-15	Reserved for future use	-	-

Table B-26: FW4_2

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags14				
3142	0-15	Reserved for future use	-	-
Unacknowledged Warning Flags13 (3262)/ Active Warning Flags13 (3382)				
3262/ 3382	0-15	Reserved for future use	-	-

Table B-27: FW4_3

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags15				
3143	0-15	Reserved for future use	-	-
Unacknowledged Warning Flags13 (3263)/ Active Warning Flags13 (3383)				
3263/ 3383	0-15	Reserved for future use	-	-

Table B-28: FW4_4

Data ID	Bits	Description	Alarm/ Fault/ Programmable	Enable
Fault Flags16				
3144	0-15	Reserved for future use	-	-
Unacknowledged Warning Flags13 (3264)/ Active Warning Flags13 (3384)				
3264/ 3384	0-15	Reserved for future use	-	-

Table B-29: Fault/Alarm Flags1-1

Data ID	Bits	Description
3400	0	Over speed alarm
	1	Over speed fault
	2	Under load alarm
	3	Under load fault
	4	Mtr Therm Over Load 1
	5	Mtr Therm Over Load 2
	6	Mtr Therm Over Ld Fault
	7	Output phase imbal
	8	Output phase open
	9	Output Ground fault
	10	IOC
	11	MenuInit
	12	Cell (Any cell)
	13	In torque limit
	14	In torq limit rollback
	15	Input phase loss

Table B-30: Fault/Alarm Flags1-2

Data ID	Bits	Description
3401	0	Phase sequence
	1	CPU Temperature Alarm
	2	CPU Temperature Fault
	3	Cell over temp alarm
	4	Cell over temp fault
	5	Modulator Configuration
	6	Cell count mismatch
	7	Power supply
	8	Wago™ communication fault
	9	Wago™ configuration
	10	Cell bypass COM fail
	11	Cell bypass acknowledge
	12	Cell bypass link
	14	System program
	13	Weak battery
	15	Medium voltage low 1

Table B-31: Fault/Alarm Flags1-3

Data ID	Bits	Description
3402	0	Medium voltage low 2
	1	Medium voltage low flt
	2	Cell alarm
	3	Line over voltage 1
	4	Line over voltage 2
	5	Line over voltage fault
	6	Input phase imbal
	7	Input one cycle
	8	Input ground
	9	Encoder loss
	10	Keypad communication
	11	Network 1 communication
	12	Network 2 communication
	13	Motor over volt alarm
	14	Motor over volt fault
	15	Cell bypass comm alarm

Table B-32: Fault/Alarm Flags1-4

Data ID	Bits	Description
3403	0	Cell bypass link alarm
	1	Cell bypass fault
	2	Cell config fault
	3	Carrier Frq Set Too Low
	4	Back EMF timeout
	5	Hall effect pwr supply
	6	Modulator board fault
	7	Not Used
	8	Modulator watchdog Flt
	9	Cell DC bus low
	10	Tool communication
	11	Failed to magnetize
	12	Loss of field current
	13	Minimum speed trip
	14	Excessive drive losses
	15	WAGO™ communication alarm

Table B-33: Fault/Alarm Flags2-1

Data ID	Bits	Description
3404	0	One blower not avail
	1	All blowers not avail
	2	Clogged filters
	3	Reactor temperature 1OT Alarm
	4	Reactor temperature 2OT Trip Alarm
	5	Reactor OT Fault
	6	Transformer Xformer OT Temperature 1 alarm
	7	Xformer OT Trip Transformer temperature 2 alarm
	8	Xformer OT Fault
	9	One pump not availablefailed
	10	Both pumps not available
	11	Coolant conductivity high AlarmCoolant Conductivity
	12	Coolant Conductivity
	13	Inlet water temperature HighCoolant Inlet Temp
	14	Coolant Inlet Temp Inlet water temperature low
	15	Cell water temperature high

Table B-34: Fault/Alarm Flags2-2

Data ID	Bits	Description
3405	0	Xfrm Cool OT Trip Alarm
	1	Coolant Tank Level
	2	Coolant Tank Level
	3	Low Coolant Flow
	4	Low Coolant Flow
	5	Loss one HEX fan
	6	Loss all HEX fans
	7	All HEX fans on
	8	Loss of drive enable
	9	Up transfer failed
	10	Down transfer failed
	11	A/D Hardware alarm
	12	A/D Hardware fault
	13	Config File Write Alarm
	14	Config File Read Error
	15	Not Used

Table B-35: Fault/Alarm Flags2-3

Data ID	Bits	Description
3406	0-6	Not Used
	7	Loss of signal intern
	8 – 15	Loss of signal 1 through 8

Table B-36: Fault/Alarm Flags2-4

Data ID	Bits	Description
3407	0 – 15	Loss of signal 9 through 24

Table B-37: Fault/Alarm Flags 3-1

Data ID	Bits	Description
3408	0 – 15	User Fault 1 through 16

Table B-38: Fault/Alarm Flags3-2

Data ID	Bits	Description
3409	0 – 15	User Fault 17 through 32

Table B-39: Fault/Alarm Flags3-3

Data ID	Bits	Description
3410	0 – 15	User Fault 33 through 48

Table B-40: Fault/Alarm Flag 3-4

Data ID	Bits	Description
3411	0 – 15	User Fault 49 through 64

Table B-41: Fault/Alarm Enable Flags1 1-4

Data ID	Bits	Description
3412	0 – 15	See table Fault/Alarm Flags Flags 1-1
3413	0 – 15	See table Fault/Alarm Flags Flags 1-2
3414	0 – 15	See table Fault/Alarm Flags Flags 1-3
3415	0 – 15	See table Fault/Alarm Flags Flags 1-4

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Table B-42: Fault/Alarm Enable Flags2 1-4

Data ID	Bits	Description
3416	0 – 15	See table Fault/Alarm Flags Flags2-1
3417	0 – 15	See table Fault/Alarm Flags Flags2-2
3418	0 – 15	See table Fault/Alarm Flags Flags2-3
3419	0 – 15	See table Fault/Alarm Flags Flags2-4

Table B-43: Fault/Alarm Enable Flags3 1-4

Data ID	Bits	Description
3420	0 – 15	See table Fault/Alarm Flags Flags3-1
3421	0 – 15	See table Fault/Alarm Flags Flags3-2
3422	0 – 15	See table Fault/Alarm Flags Flags3-3
3423	0 – 15	See table Fault/Alarm Flags Flags3-4

Table B-44: Fatal Fault Flags Flags1 1-4

Data ID	Bits	Description
3424	0 – 15	See table Fault/Alarm Flags Flags1-1
3425	0 – 15	See table Fault/Alarm Flags Flags1-2
3426	0 – 15	See table Fault/Alarm Flags Flags1-3
3427	0 – 15	See table Fault/Alarm Flags Flags1-4

Table B-45: Fatal Fault Flags Flags2 1-4

Data ID	Bits	Description
3428	0 – 15	See table Fault/Alarm Flags Flags2-1
3429	0 – 15	See table Fault/Alarm Flags Flags2-2
3430	0 – 15	See table Fault/Alarm Flags Flags2-3
3431	0 – 15	See table Fault/Alarm Flags Flags2-4

Table B-46: Fatal Fault Flags Flags3 1-4

Data ID	Bits	Description
3432	0 – 15	See table Fault/Alarm Flags Flags3-1
3433	0 – 15	See table Fault/Alarm Flags Flags3-2
3434	0 – 15	See table Fault/Alarm Flags Flags3-3
3435	0 – 15	See table Fault/Alarm Flags Flags3-4

Table B-47: Fault/Alarm Flags4 1-4

Data ID	Bits	Description
3436	0	Loss of internal analog input #1
	1	Loss of internal analog input #2
	2	Loss of internal analog input #3
	3-15	Reserved for future use.

Table B-48: Fault/Alarm Flags4 2-4

Data ID	Bits	Description
3437	0-15	Reserved for future use.
3438	0-15	Reserved for future use.
3439	0-15	Reserved for future use.

Table B-49: Fault/Alarm Enable Flags4 3-4

Data ID	Bits	Description
3440	0 – 15	See table Fault/Alarm Flags Flags4-1
3441	0 – 15	See table Fault/Alarm Flags Flags4-2
3442	0 – 15	See table Fault/Alarm Flags Flags4-3
3443	0 – 15	See table Fault/Alarm Flags Flags4-4

Table B-50: Fatal Fault Flags Flags4 4-4

Data ID	Bits	Description
3444	0 – 15	See table Fault/Alarm Flags Flags4-1
3445	0 – 15	See table Fault/Alarm Flags Flags4-2
3446	0 – 15	See table Fault/Alarm Flags Flags4-3
3447	0 – 15	See table Fault/Alarm Flags Flags4-4

Table B-51: Analog Input Read Registers

Data ID	Units	Point Description	Range
3502 – 3525	N/A	Analog input #1– Analog input #24	0mA = 0 to 20mA = 32767, 0V = 0 to 10V = 32767

Table B-52: Active Cells Read Registers

Data ID	Units	Point Description	Range
4000	Cells	Active cells phase A	0 – 8
4010	Cells	Active cells phase B	0 – 8
4020	Cells	Active cells phase C	0 – 8

Table B-53: Cell Status Phase A (4030), Phase B (4040), Phase C (4050)

Data ID	Bits	Description	Values
4030/ 4040/ 4050	0	Cell 1 status	0 = Not installed, 1 = Active, 2 = Bypassed, 3 = Faulted
	1		
	2	Cell 2 status	
	3		
	4	Cell 3 status	
	5		
	6	Cell 4 status	
	7		
	8	Cell 5 status	
	9		
	10	Cell 6 status	
	11		
	12	Cell 7 status	
	13		
	14	Cell 8 status	
	15		

Table B-54: Bypass Status Phase A (4060), Phase B (4070), Phase C (4080)

Data ID	Bits	Description	Values
4060/ 4070/ 4080	0	Cell 1 bypass status	0 = Unavailable, 1 = Bypassed, 2 = Available.
	1		
	2	Cell 2 bypass status	
	3		
	4	Cell 3 bypass status	
	5		
	6	Cell 4 bypass status	
	7		
	8	Cell 5 bypass status	
	9		
	10	Cell 6 bypass status	
	11		
	12	Cell 7 bypass status	
	13		
	14	Cell 8 bypass status	
	15		



Note for Modbus™: If the user is using a control software version earlier than 2.0, these data can be accessed directly in fixed Modbus™ addresses. The first cell of the first table is Modbus™ address 46001. Increment the Modbus™ address by one for each table cell downward.

B.1 Various Data Tables

Table B-55: Performance Table

Data ID	Units	Scalar	Point Description
2161	%	÷ 100	Drive Losses
2162	%	÷ 100	Excessive Reactive Current
2163	%	÷ 100	Speed Droop
2164	%	÷ 100	Sync Motor Field Current
2168	%	÷ 100	Efficiency

Table B-56: Parameter Read / Write Table

Data ID	Name	Value
2660	Network 1 PFD1	Refer to Appendix A of this manual
2661	Network 1 PFD2	
2662	Network 1 PFD3	
2663	Network 1 PFD4	
2664	Network 2 PFD1	
2665	Network 2 PFD2	
2666	Network 2 PFD3	
2667	Network 2 PFD4	

Table B-57: Parallel Drive Table

Data ID	Units	Scalar	Point Description
2268	N/A	÷ 100	Peak Voltage clamp Limit
2269	N/A		Parallel Drive Status <ul style="list-style-type: none"> • bit 0: Slave • bit 1: In Network • bit 2: Spinning Load Enabled • bit 3: Energy Saver Enabled • bit 4: Speed Loop Test Mode Enabled • bit 5: Auto Tune Enabled • bit 6: Reset Timeout
2271	N/A	N/A	Handshake
2272	N/A	÷ 100	Available PVCL
2273	%	÷ 100	Available Torque
2274		1	Number of Nodes
2275	Amps		Mag Current Command Amps
2276	%	÷ 100	Mag Current Command %
2277		÷ 100	Field Weakening Output

Table B-58: Voltage/Current Table

Data ID (min / max / avg)	Units	Scalar	Point Description
3600 / 3601 / 3602	%	÷ 100	Real Current Feedback Filtered
3603 / 3604 / 3605	%	÷ 100	Real Current Feedback Filtered
3606 / 3607 / 3608	%	÷ 100	DC Link Voltage
3609 / 3610 / 3611	%	÷ 100	Real Voltage Feed Forward
3612 / 3613 / 3614	Hz	÷ 10	Input Frequency
3615 / 3616 / 3617	%	÷ 100	Real Voltage Command
3618 / 3619 / 3620	%	÷ 100	Reactive Voltage Command
3621 / 3622 / 3623	%	÷ 100	Highest Cell Temperature
3624 / 3625 / 3626	%	÷ 100	Differential Cell Temperature
3627 / 3628 / 3629	%*100		Input Current
3630 / 3631 / 3632	%*100		Multiplexed Data
3633			State
3634			Status
3635			EPLD Status 1
3636			EPLD Status 2
3637 / 3638 / 3639		÷ 100	Water Flow
3640 / 3641 / 3642		÷ 100	Water Glycol Flow
3643			Number of AFE Cells
3644			Number of AFE Cells With Open Sensors
3653	%	÷ 100	Available Reactive Current
3660	A	÷ 1000	Drive Torque Capability
3661	V	1	V_a RMS Output Phase Voltage
3662	V	1	V_b RMS Output Phase Voltage
3663	V	1	V_c RMS Output Phase Voltage
3664	A	1	I_a RMS Output Phase Current

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Data ID (min / max / avg)	Units	Scalar	Point Description
3665	A	1	I_b RMS Output Phase Current
3666	A	1	I_c RMS Output Phase Current
3668	MWHr	1	Input MWHr
3669	A	1	Input Ia Phase Current
3670	A	1	Input Ib Phase Current
3671	A	1	Input Ic Phase Current
3672	V	1	Input Va (line to neutral)
3673	V	1	Input Vb (line to neutral)
3674	V	1	Input Vc (line to neutral)
3675	%	÷ 100	Input Reactive Power
3676	%	÷ 100	Input Reactive Current

Table B-59: SilcoGraph Data Table

Data ID	Units	Scalar	Point Description
3645 - 3652	%	÷ 100	Float Outputs 0 - n7

Table B-60: Shared Memory Table

Data ID	Point Description
3654 - 3659	Shared Memory Handshake 0 - 5

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Table B-61: Internal Network

Manual ID	Description	Value
5000	Handshake	Refer to Appendix C of this manual
5001 - 5009	Discrete Outputs	
5100	Net Input Pulse	
5101 - 5109	Discrete Inputs	
5110 - 5115	Analog Inputs	

▽ ▽ ▽

B

APPENDIX

C Network Implementation

C.1 Overview

To support recent and future drive control features, a new communications network has been established. This network, the “Internal Network,” is designed to connect programmable devices within the drive system to the NXG Control.

C.2 Detailed Description

The Internal Net is implemented as a Modbus™ Ethernet (Modbus/TCP) socket in the NXG Control.

C.2.1 Network Parameters

Network - Modbus™ Ethernet

Connector - NXG CPU Ethernet Port

IP Address - Same as the NXG TCP/IP Address

Ethernet Port - 5002

Network Timeout - 3 seconds

C.2.2 Network Registers

The network comprises of 10 16-bit output registers (from NXG) and 16 16-bit input registers (to NXG). The first register in each direction is a handshake register to validate network communication for network timeout. The next nine registers in each direction are each mapped as 16 discrete bit values. There are also 6 16-bit analog input values in the to-drive direction. (See Table C-1).

Table C-1: Network Registers

Output Registers (From Drive)		Input Registers (To Drive)	
Register	Description	Register	Description
40001	Handshake	40101	Net Input Pulse
40002 - 40010	Discrete Outputs	40102 - 40110	Discrete Inputs
		40111 - 40116	Analog Inputs



Note: The values of the input and output register data are dependent on the external device. Please see the appropriate documentation for register data definitions.

C.2.3 Manual ID's

The values from the Internal Network are available to customer Networks 1 and 2 through network output Manual IDs (see Table C-2). The Manual IDs directly reflect the data on the Internal Network with no scaling.

Table C-2: Manual ID's

Manual ID	Description
5000	Handshake
5001-5009	Discrete Outputs
5100	Net Input Pulse
5101-5109	Discrete Inputs
5110-5115	Analog Inputs

C.2.4 SOP Flags

All of the discrete Input and Output bits are mapped to flags available in the SOP (see Tables C-3 and C-4). These provide 144 input flags and 144 output flags. Flags are numbered from low to high as LSB to MSB.

Table C-3: SOP Output Flags

Register	SOP Output Flags
40002	InternalNetOutFlag0_O - InternalNetOutFlag15_O
40003	InternalNetOutFlag16_O - InternalNetOutFlag31_O
40004	InternalNetOutFlag32_O - InternalNetOutFlag47_O
40005	InternalNetOutFlag48_O - InternalNetOutFlag63_O
40006	InternalNetOutFlag64_O - InternalNetOutFlag79_O
40007	InternalNetOutFlag80_O - InternalNetOutFlag95_O
40008	InternalNetOutFlag96_O - InternalNetOutFlag111_O
40009	InternalNetOutFlag112_O - InternalNetOutFlag127_O
40010	InternalNetOutFlag128_O - InternalNetOutFlag143_O

Table C-4: SOP Input Flags

Register	SOP Input Flags
40102	InternalNetInFlag0_I - InternalNetInFlag15_I
40103	InternalNetInFlag16_I - InternalNetInFlag31_I
40104	InternalNetInFlag32_I - InternalNetInFlag47_I
40105	InternalNetInFlag48_I - InternalNetInFlag63_I
40106	InternalNetInFlag64_I - InternalNetInFlag79_I
40107	InternalNetInFlag80_I - InternalNetInFlag95_I
40108	InternalNetInFlag96_I - InternalNetInFlag111_I
40109	InternalNetInFlag112_I - InternalNetInFlag127_I
40110	InternalNetInFlag128_I - InternalNetInFlag143_I

C.2.5 Handshaking

An additional SOP input flag, InternalNetCommOk_I, indicates the health of the Internal Network communications. This flag is set if the Net Input Pulse (40101) is unchanged for 3 seconds.

▽ ▽ ▽

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