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User's Manual for the
HEC-FP3-DN

DeviceNet™ Network

for use with Reliance Electric FlexPak 3000 DC Drive

Fourth Edition
February 25, 1998

MAN0086-04

PREFACE

This manual explains how to use the Horner Electric's DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive.

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LIMITED WARRANTY AND LIMITATION OF LIABILITY

Horner Electric, Inc. ("HE") warrants to the original purchaser that the DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive manufactured by HE is free from defects in material and workmanship under normal use and service. The obligation of HE under this warranty shall be limited to the repair or exchange of any part or parts which may prove defective under normal use and service within two (2) years from the date of manufacture or eighteen (18) months from the date of installation by the original purchaser whichever occurs first, such defect to be disclosed to the satisfaction of HE after examination by HE of the allegedly defective part or parts. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES AND HE NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR HE, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive. THIS WARRANTY SHALL NOT APPLY TO THIS DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. HE MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY HE. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive IS ORIGINALLY INSTALLED. THIS WARRANTY SHALL APPLY ONLY WITHIN THE BOUNDARIES OF THE CONTINENTAL UNITED STATES.

In no event, whether as a result of breach of contract, warranty, tort (including negligence) or otherwise, shall HE or its suppliers be liable of any special, consequential, incidental or penal damages including, but not limited to, loss of profit or revenues, loss of use of the products or any associated equipment, damage to associated equipment, cost of capital, cost of substitute products, facilities, services or replacement power, down time costs, or claims of original purchaser's customers for such damages.

To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner Electric cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing the DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive to appropriately design the end system, to appropriately integrate the DeviceNet™ Network Communication Option Board for use with the Reliance Electric FlexPak 3000 DC Drive and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

SAFETY NOTICES

DANGER
Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install it. Read and understand this manual in its entirety before proceeding. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

DANGER
The user is responsible for conforming to the nec/cec and all other applicable local codes. Wiring practices, grounding, disconnects, and overcurrent protection are of particular importance. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

DANGER
Do not install modification boards with power applied to the controller. Disconnect and lock out incoming power before attempting such installation. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

WARNING
Only qualified individuals who are thoroughly familiar with the particular application may install, operate and maintain this equipment. Before any work is performed, read and understand this instruction manual as well as the appropriate drive instruction manual(s). ***Failure to observe this precaution could result in severe bodily injury.***

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CHAPTER 1: INTRODUCTION

1.1 General

1.1.1 The Homer Electric's DeviceNet™ Network Communication Option Board is designed to allow a Reliance FlexPak 3000® (version 3.1 or higher) to be operated and monitored via the DeviceNet network. The option board makes use of the parallel-bus connection port on the FlexPak 3000 controller. The option board mounts behind the regulator board inside the FlexPak 3000 carrier assembly and connects to the regulator board via a flexible ribbon cable. Power for the option board comes from the FlexPak 3000 controller power supply.

1.1.2 In normal operation, the drive can be completely controlled via the network option board. In many applications, there may be only a network interface connection, a hard-wired emergency stop (functionless input), and three-phase input and output power wiring. Start, stop, fault codes and complete control can be accomplished over the DeviceNet network.

1.2 Description

1.2.1 The section describes the mechanical and electrical characteristics of the DeviceNet Network Communication Option Board.

a. Mechanical Description

The DeviceNet Network Communication Option Board is a printed circuit assembly that mounts inside a FlexPak 3000 Controller. It connects to the regulator board within the controller via a ribbon cable. It has a standard DeviceNet 5-pin "pluggable" screw-terminal connector which is used to connect a DeviceNet cable (dual twisted pairs with shield).

b. Electrical Description

The DeviceNet Network Communication Option Board contains its own microprocessor. The microprocessor connects to one port of the board's dual port memory while the other port interfaces to the FlexPak 3000 regulator. The board contains a watchdog timer which is enabled when power is turned on the controller. The microprocessor must reset the watchdog timer within a specified period or the microprocessor will shut down resulting in a fault.

At power-up, the microprocessor will run diagnostics on the CPU, EPROM, RAM, memory management unit, and dual port memory. If there is an error during diagnostics, a fault will be generated, and the output parameter NETWORK KIT (P.796) (available in the OIM's Drive Information menu) will indicate "FAILED DIAGS". If the power up self tests pass, the NETWORK KIT parameter will indicate "INSTALLED".

Each option card requires a maximum of 95mA @ 11VDC of DeviceNet network power for the transceiver circuit to operate.

1.3 Additional Information

1.1.3 The user must be familiar with all of the instruction manuals that describe the system configuration. This may include, but is not limited to, the following:

D2-3335 **FlexPak 3000 Digital DC Drives**
(1½-75HP @ 230VAC, 3-300HP @ 460 VAC)

1.4 Related Hardware and Software

1.4.1 The option board package consists of one DeviceNet network communication option board, which provides a single connection to a DeviceNet network. This board can be mounted inside a FlexPak 3000 controller, which can then be used with the following hardware and software (purchased separately from Allen-Bradley):

a.	1747-SDN	SLC500 DeviceNet Scanner Module
b.	1746 P2	SLC500 Power Supply
c.	1747-L532	SLC503 Central Processing Unit
d.	1746-A4	SLC500 Rack
e.	1787-MGR	DeviceNet Manager Software
f.	1747-PA2E	SLC500 Advanced Programming Software

Note: The list includes the devices that would be required to construct an SLC500-based DeviceNet controller. This is only one example of the many different DeviceNet controller combinations that can be used.

CHAPTER 2: INSTALLATION

2.1 General

2.1.1 The section describes how to install the DeviceNet Network Communication Option Board into the FlexPak 3000 controller and how to connect the controller to a DeviceNet network.

2.2 Installing the Network Communication Option Board

2.2.1 Safety Notices

a. **Danger**
Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install it. Read and understand this manual in its entirety before proceeding. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

b. **Danger**
The user is responsible for conforming to the reviewed and all other applicable local codes. Wiring practices, grounding, disconnects, and overcurrent protection are of particular importance. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

c. **Danger**
Do <u>not</u> install modification boards with power applied to the controller. Disconnect and lock out incoming power before attempting such installation. ***Failure to observe this precaution could result in severe bodily injury or loss of life.***

d. **Warning**
Only qualified individuals who are thoroughly familiar with the particular application may install, operate and maintain this equipment. Before any work is performed, read and understand this instruction manual as well as the appropriate drive instruction manual(s). ***Failure to observe this precaution could result in severe bodily injury.***

2.2.2 Procedure to Install the Network Communication Option Board

2.2.2.1 Use the following procedure to install the Network Communication Option Board. Refer to Figures 2.1, 2.2, and 2.3 for mounting locations.

1. Turn off, lock out, and tag all incoming power to the FlexPak 3000 drive.
2. Loosen and remove the two (2) mounting screws on the FlexPak 3000 drive cover and remove the cover.
3. Loosen the captive screw on the carrier and swing open the carrier.
4. Loosen and remove the four screws attaching the carrier shield to the carrier.
5. Remove the connector attaching the shield's ground wire to the drive's power supply. Set the shield aside.
6. Position the Option board over the molded standoffs.

7. Secure the Option board using three (3) captive screws on the board.

8. Plug the Option board ribbon cable into the Option board.

9. Re-attach the carrier shield's ground wire to the drive's power supply.

10. Re-attach the carrier shield to the carrier.

11. Close the carrier and fasten it with the captive screw.

12. Route the DeviceNet network cable through the leftmost opening at the bottom of the controller. With the contacts numbered 1-5 from left to right, connect as described below:

Pin 1:	V-	(black)
Pin 2:	CAN_L	(blue)
Pin 3:	SHIELD	(bare)
Pin 4:	CAN_H	(white)
Pin 5:	V+	(red)

13. Re-install the FlexPak 3000 drive cover.

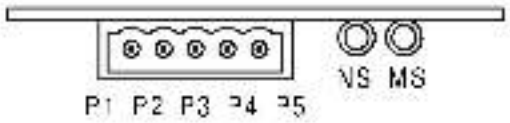

Figure 2.1 - DeviceNet Option Board End View

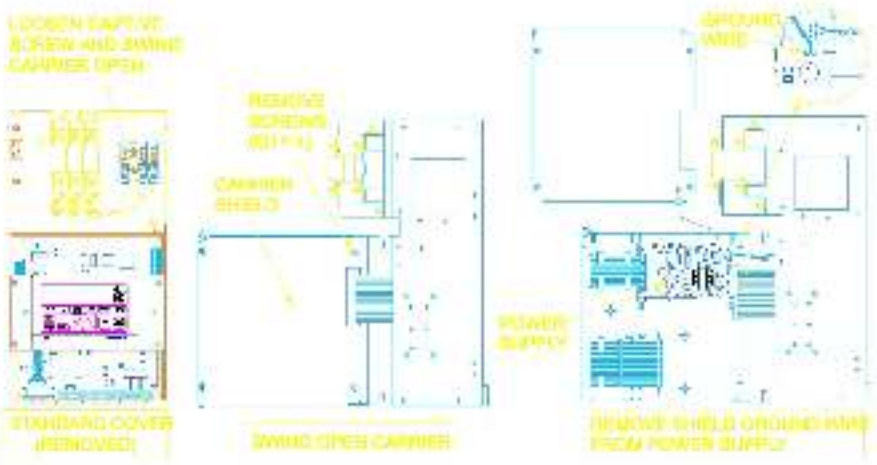

Figure 2.2 - Carrier Shield Removal

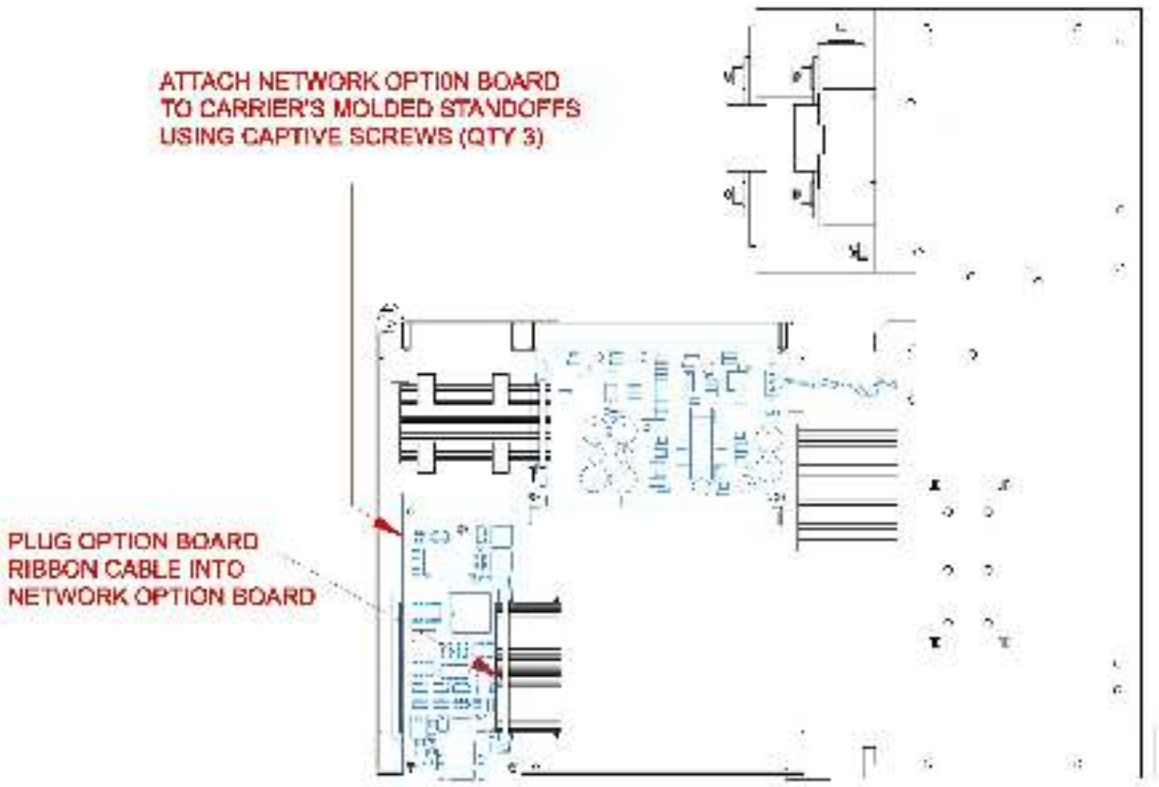

Figure 2.3 - Installing the Network Communications Option Board

2.3 Connecting the FlexPak 3000 Controller to a DeviceNet Network

2.3.1 When connecting to the DeviceNet network, the FlexPak 3000 controller should be wired with the same cabling and termination as any other DeviceNet device. For additional information, refer to Volume 1 of the DeviceNet Specification, Chapter 9.

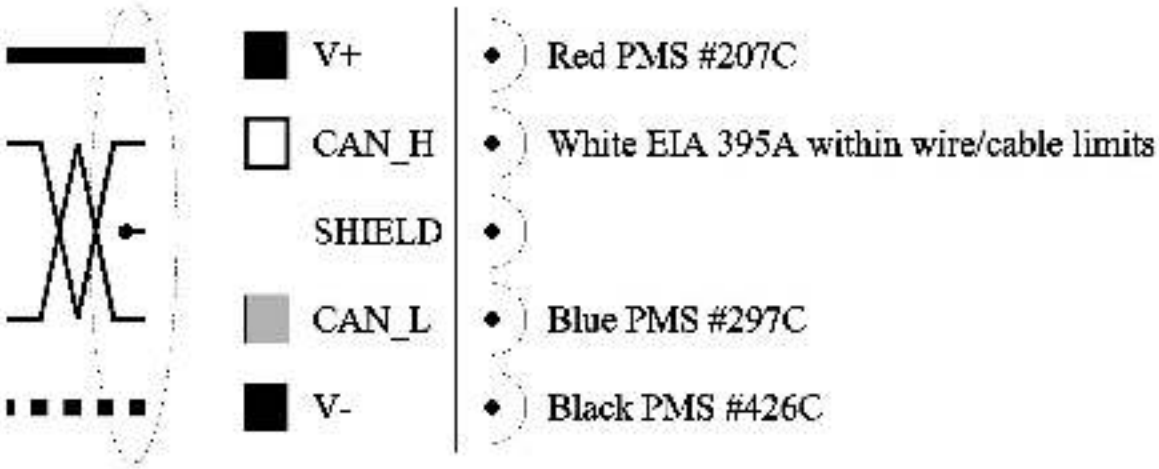

Figure 2.4

CHAPTER 3: NETWORK OVERVIEW

1.2 General

3.1.1 The DeviceNet Network Communication Option Board provides the Reliance FlexPak 3000 DC Drive with connectivity to a popular industrial network, DeviceNet. Through this option board, the FlexPak 3000 can reside on an industrial control network with a host of industrial control products. The FlexPak 3000 can, then, be easily monitored and/or controlled by a PLC through a DeviceNet Scanner module residing in a PLC. This allows a great deal of flexibility in the way that the FlexPak 3000 is controlled, and also, the amount and type of data that can be passed to and from the drive. This capability adds flexibility to the way FlexPak 3000 DC Drives can be integrated in an industrial control application.

3.2 Network Layout

3.2.1 The DeviceNet standard supports up to 64 nodes on a single network. Because DeviceNet is a master-slave network, it requires that a DeviceNet Master or Scanner be present on the network. The Scanner establishes all connections and initiates all communications with network devices.

3.2.2 In a typical industrial application, a DeviceNet network consists of a scanner and one or more DeviceNet devices which operate by manipulating PLC memory.

3.3 Network Setup

3.3.1 DeviceNet is a network consisting of four wires plus shield. Five connections are typically made to each device on the network including two for power, two for communications signals, and one for shield.

3.3.2 Each device on the network must be configured using:

a. Data rate and node address, and
b. Device-specific information.

3.3.3 There are three methods to configure the devices:

a. Mechanical switches only,
b. Parameter values stored in the device's memory, and
c. Electronic data sheet files.

The option card is configured using parameter values stored in its memory. These parameter values are set from the FlexPak 3000 keypad. See Chapter 4 for details.

3.4 Network Connections

3.4.1 Types of Network Connections

3.4.1.1 When a FlexPak 3000 DC Drive (using the DeviceNet Network Communications Option Board) is configured and resides on an active DeviceNet network, a significant amount of FlexPak 3000 data is accessible over the network. The data may be read and/or written from the drive by the DeviceNet master or scanner.

3.4.1.2 The DeviceNet data may be accessed by the master through three distinct "connections". these are:

a. Polled connection.
b. Explicit connection
c. Bit-strobed connection.

3.4.2 The Polled DeviceNet Connection

3.4.2.1 The Polled DeviceNet connection provides the primary means of drive control and monitoring. The DeviceNet master establishes the polled connection and transfers OUTPUT data in poll command messages. The drive returns INPUT data in poll reply messages. Note that all of the data accessible through the poll connection is also accessible through the explicit connection.

3.4.2.2 Some applications make use of a large number of drives with limited functionality connected to a single network. Only certain parameters and diagnostic information commonly used are required for network control. Complete configuration over the network is <u>not</u> a requirement for low-cost, high performance network applications. This type of poll connection is referred to as the **control only** poll connection. The network master issues a poll command that contains 4 words of data for output to the drive, and the drive returns a series of poll reply messages that contain 8 words of input data from the drive.

3.4.2.3 Other applications accept a slower network in exchange for greater drive parameter access over the network. This type of poll connection is referred to as the **control + config** poll connection. When the drive is configured in this manner, the network master issues a series of poll commands that contains 26 words of data, and the drive returns a series of poll reply messages that contains 13 words of data. Since a greater amount of network data is transferred, the network scan rate performance is adversely affected

3.4.2.4 The amount of data transferred through the polled connection is dependent on the drive configuration performed in Section 4.2. Poll command/reply data format is defined in Section 5.12.

3.4.3 The Explicit DeviceNet Connection

3.4.3.1 The Explicit DeviceNet connection is required of all DeviceNet modules. Through this connection, the DeviceNet master can:

a. Establish communication through all 3 connections.
b. Access DeviceNet object information
c. Access **ALL** FlexPak 3000 network parameters. (See Section 5.10 for a list of drive parameters and the method used to access them through the explicit connection).

3.4.3.1 The explicit connection is primarily used by the DeviceNet controller to initially establish communications. Once the poll and/or strobe connections are established, the controller will normally access the drive data through them.

3.4.4 The Bit-Strobed DeviceNet Connection

3.4.4.1 The bit-strobed connection allows a DeviceNet master to send one bit of information simultaneously to all devices on the network. This bit of information is used for different purposes by different devices residing on the network.

3.4.4.2 The FlexPak 3000 (with communications option board) uses the bit received in a bit-strobe connection as a start command. It allows the multiple drives to be started "simultaneously", although it may take up to 100mS for all drives to start.

CHAPTER 4: DRIVE CONFIGURATION

1.2 General

This section describes how to configure the FlexPak 3000 controller containing the DeviceNet Network Communication Option Board for use on the DeviceNet network. Refer to the FlexPak 3000 Installation and Operation Instruction manual for more information on the drive parameters described below.

4.2 Network Communication

4.2.1 The drive becomes active on the DeviceNet network after the user performs the following steps. Note that these steps should be followed in the order listed to prevent drive fault(s). (The HEC-FP3-DN Card cannot be used in conjunction with Automax card).

1. Connect the Network Option board to the network via the standard "pluggable" DeviceNet connector (See Section 2.2 for wiring information).

2. Apply power to the drive.

3. Using the keypad, access the drop number assignment parameter (NETW DROP NUMBER (P.900)) and assign a valid DeviceNet network drop number to the drive.

4. Using the keypad, access the network connection type parameter (NETW CONNECT TYPE (P.910)) and select either **Basic Drive Connection** or **Full Drive Connection**.

5. Using the keypad, access the DeviceNet Baud Rate (NETW BUAD RATE) (P.912) parameter and select **125.0 KBAUD**, **250.0 KBAUD**, **500.0KBAUD**, or **OTHER**.

6. Using the keypad, access the DeviceNet poll message type (DEVNET POLL MSG TYPE) (P.913) and select **CONTROL ONLY** or **CONTROL+CONFIG**.

7. Apply power to the DeviceNet network.

4.3 Network Connection Types

4.3.1 Two Types of Network Connections

4.3.1.1 The drive's network connection type defines the scope of data and control that the master has with the connected drive. Two types of connections are provided: BASIC drive connection and FULL drive connection. The drive's network connection type is selected with a drive parameter (NETW CONNECT TYPE (P.910)).

4.3.2 BASIC Drive Connection

4.3.2.1 Select **BASIC** drive connection if the application does not require a complete configuration of the drive over the network. Only certain parameters and diagnostic information commonly used will be controlled over the network. Selecting this option for NETW CONNECT TYPE (P.910) results in data size of 64 words.

4.3.3 FULL Drive Connection

4.3.3.1 Select **FULL** drive connection if your application requires the ability to configure the drive over the network and to have access to almost all parameters, operating variables, and diagnostic information.. Selecting this option for NETW CONNECT TYPE (P.910) results in a data size of 256 words.

4.4 Drive Response to Loss of Network Communication

4.4.1 Overview

4.4.1.1 The Network Option board will attempt to remain active on the network at all times. Whenever communication is interrupted, the board will immediately notify the drive regulator of this occurrence and then attempt to re-establish communication with the network master. To eliminate extraneous fault conditions at power-up, the drive will delay for approximately 10 seconds after power-up before indicating a fault/alarm condition. A fault/alarm condition will be indicated if network communication is not established before the 10 second power-up timer expires, or if network communications was established and then lost.

4.4.2 Fault/Alarm Conditions

a. If **CONTROL SOURCE SELECT** ((P.000) on the DCM) is not set to NETWORK (3), the loss of network communication will **not** cause a fault or alarm to occur. If CONTROL SOURCE SELECT is set to NETWORK, the drive will react to the network communication loss based on how the communication loss selection parameter (NETW COMM LOSS SELECT (P.901)) has been configured.

b. If **NETW COMM LOSS SELECT (P.901) is set to FAULT (0)**, the drive will consider a loss of network communication a drive fault resulting in a coast/DB stop. In this case, the response to network communication loss is as follows:

1. The drive will latch a fault condition and perform a coast/DB stop.
2. A fault will be logged in the drive's fault log and will be displayed on the front-panel display ("NETWORK COMMUNICATION LOSS").
3. The text that appears over the front panel CONTROL SOURCE SELECT key ("NETWORK") will blink indicating that the network is inactive.
4. Once network communications has been re-established, a drive fault reset will be required before the drive can be re-started. **(Note: A fault reset does not clear the fault log).**

c. If **NETW COMM LOSS SELECT is set to HOLD LAST REF** (1), the drive will continue to operate using the last reference received from the network master. In this case, the response to network communication loss is as follows:

1. An alarm will be logged in the alarm log.
2. An entry will be made into the drive's error log for each active-to-inactive transition of network communication status.
3. The front-panel display will indicate that a "NETWORK COMMUNICATION LOSS" alarm has occurred.
4. The text that appears over the front panel CONTROL SOURCE SELECT key ("NETWORK") will blink indicating that the network is inactive.
5. The drive can be stopped using the hardwired stop input (coast/DB stop, CTB-8) or by pressing the front panel stop key (STOP MODE SELECT). Once stopped, the drive cannot be re-started until network communication is re-established or CONTROL SOURCE SELECT is changed.
6. If the drive is still running when network communications has been re-established, the drive will once again follow the reference and sequencing control inputs supplied by the network master.

WARNING

The controller is not equipped with a coast-stop push-button. The user must install a hardwired operator-accessible push-button that provides a positive interrupt and shuts down the drive. **Failure to observe this precaution could result in bodily injury.**

NOTE: *When NETW COMM LOSS SELECT is set to HOLD LAST REF, it may not always be possible to stop the drive over the network after a comm loss has occurred. A hardwired stop must be used to stop the drive.*

d. If **NETW COMM LOSS SELECT (P.901) is set to USE TRMBLK REF (2)**, the drive will continue to operate using the selected auto reference value obtained from the terminal block inputs. In this case, the response to network communication loss is as follows:

1. An alarm will be logged in the alarm log.
2. The front panel display will indicate that a "NETWORK COMMUNICATION LOSS" alarm has occurred.
3. The text that appears over the front panel CONTROL SOURCE SELECT key ("NETWORK") will blink indicating that the network is inactive.
4. The drive can be stopped using the hardwired stop input (coast/DB stop, CTB-8), by pressing the front panel stop key (STOP MODE SELECT), or by using the terminal block stop input (STOP MODE SELECT, CTB-3). Once stopped, the drive cannot be re-started until network communication is re-established or CONTROL SOURCE SELECT is changed.
5. If the drive is still running when network communication has been re-established, the drive will once again follow the reference and sequencing control inputs supplied by the network master. The terminal block stop input (CTB-3) will no longer be active.

WARNING

The controller is not equipped with a coast-stop push-button. The user must install a hardwired operator-accessible push-button that provides a positive interrupt and shuts down the drive. **Failure to observe this precaution could result in bodily injury.**

NOTE: *When NETW COMM LOSS SELECT is set to USE TRMBLK REF, it may not always be possible to stop the drive over the network after a comm loss has occurred. A hardwired stop must be used to stop the drive.*

CHAPTER 5: PROGRAMMING

5.1 Data Types and Transfer Rates

5.1.1 General

5.1.1.1 In order to minimize regulator board CPU loading, the transfer of register data between the HFC-FP3-DN and the drive regulator board will not occur at all times and will not occur at the same rate.

5.1.1.2 The sections that follow describe the data types for input and output register data, along with typical drive information in each category. The specific register list for the FlexPak 3000 controller appears in Section 5.3.

5.2 Data Types and Transfer Rates

5.2.1 Input Data

5.2.1.1 The drive input data is categorized as one of three types: Control/reference, tunable, or configurable.

a. **Control/reference** inputs include data which require fast update rates. This includes data such as sequencing inputs (start, stop, run/jog, fwd/rev, etc.) and speed/torque reference. Control/reference inputs are transferred from the network option board to the regulator board every speed loop scan period (for the FlexPak 3000, every 20 milliseconds), or as often as it is required by the drive. For example, if the drive is configured to obtain its torque reference from the option port, it will read this data from the option port every current minor loop scan.

b. **Tunable** inputs include parameters which typically require modification or adjustment while the drive is running. Tunable data includes parameters such as accel/decel rates, min/max limits, gains or offsets, etc.

Tunable inputs are transferred from the network option board to the regulator board whenever the regulator performs the processing of new tunable parameters. This occurs approximately every 100 milliseconds while the drive is running or stopped.

c. **Configurable** inputs include parameters which alter the way that the drive operates in such a way that they **cannot** be modified while the drive is running. Configuration data includes parameters such as reference source selection, I/O configuration, motor/tach nameplate data, etc.

Configurable inputs are transferred from the network option board to the regulator board whenever the regulator performs processing of new configuration parameters. This occurs approximately every 100 milliseconds while the drive is stopped. Values sent from the network master while the drive is running will not be read in and used by the drive regulator until the drive is stopped.

5.2.2 Output Data

5.2.2.1 The drive output data is categorized as one of two types: Runtime signal data, or tunable, configuration and status data.

a. **Runtime signal data** includes items such as selected speed reference value, sequencing status (ready, running, etc.), drive fault flags, terminal block digital inputs state, and front panel display mode values (RPM, Volts, Amps). The information is transferred from the regulator board to the network option board every speed loop scan period (for the FlexPak 3000, every 20 milliseconds).

b. **Tunable, configuration and status data** includes all other information provided by the drive which is not defined as runtime signal data. This would typically include all drive parameter values. When accessed via the DeviceNet explicit connection, this data provides a complete image of how the drive is configured and operating. Tunable, configuration and status data are transferred from the regulator board to the network option board whenever the regulator performs the processing of new tunable and configurable input parameters. This occurs every 100 milliseconds.

5.3 Transfer of Data from the Network Option Board to the Regulator

5.3.1 The network option must be actively communicating with the master and it must be selected as the drive control source (P.000 = Network (3) on DCM or Control Source Select Screen Set to "Network" on OIM) in order for <u>any</u> inputs to be transferred from the network option board to the drive regulator.

5.3.2 Note that the keypad can still be used to change parameter values when the drive control source is the network option. However, any changes made via the keypad will be overwritten when the next network update occurs (if the network option is configured to update the specified keypad parameter). This should be kept in mind if parameter changes need to be made while the network option is the control source for the drive.

5.3.3 In addition, a network-master-controlled tune/config input enable bit (word 32, bit 14) is provided to enable the transfer of tunable and configurable inputs from the network option board to the drive regulator. **Until this bit is set ON (1), only control/reference data are read in by the drive.** This gives the master's application program direct control over when tunable and configurable parameter values are read in by the drive, if at all.

5.3.4 <u>For example</u>, the master application program would typically initialize the tunable and configurable parameter data in the master's network card dual-port memory <u>before</u> turning on the tune/config input enable bit.

5.3.5 <u>Another example</u> would be an application which only wants to send control/reference data to the drive. In this case, the master would always leave the tune/config input enable bit OFF. The drive would then be configured locally, but start, stop, reset and reference would be sent from the network master.

5.3.6 Note that when the drive's poll connection is configured for **control only** operation, the tune/config input enable bit is forced to 0, regardless of its state in the poll command data.

5.4 Transfer of Data from the Regulator to the Network Option Board

5.4.1 All output data provided is transferred to the network option board at all times. The network does not have to be active and the network option does not have to be selected as the drive control source (P.000). No output enable control bit is necessary.

5.5 Tune/Config Update Synchronization Flag

5.5.1 To allow the network master's application program to determine when tunable and configurable inputs have been updated in the drive, a master write bit (Register 32, bit 15) is provided which is copied to a master write bit (Register 0, bit 7) by the drive. The drive will copy the master write bit to the master read bit after the drive has read in and processed all tunable and/or configurable input registers. The tune/config input enable bit must be set (1) in order for this to happen. Note that configurable type inputs are only read in by the drive while it is not running. This will not affect the copying of the network synchronization bit since tunable inputs will still be transferred.

5.5.2 By toggling the network synchronization bit in the master and by monitoring the copied value from the drive, the master's application program can determine when the drive has read in that data. This feature is provided for those applications which may require this type of synchronization. It is not necessary for the master's application program to use it, as it has no affect on drive operation. To determine when changes to tunable and configurable data on the drive have been completed, the master would perform the following sequence:

Step 1. Modify the tunable and/or configurable register data in the appropriate network register(s).
Step 2. Set the tune/config input enable flag (if not already set).
Step 3. Toggle the network synchronization flag.
Step 4. Monitor the loopbacked copy (read register) of the network synchronization flag until it equals the value written in step 3.

5.6 I/O Update Enable Logic Summary

5.6.1 The following logic strings summarize the output and input enable logic described above.

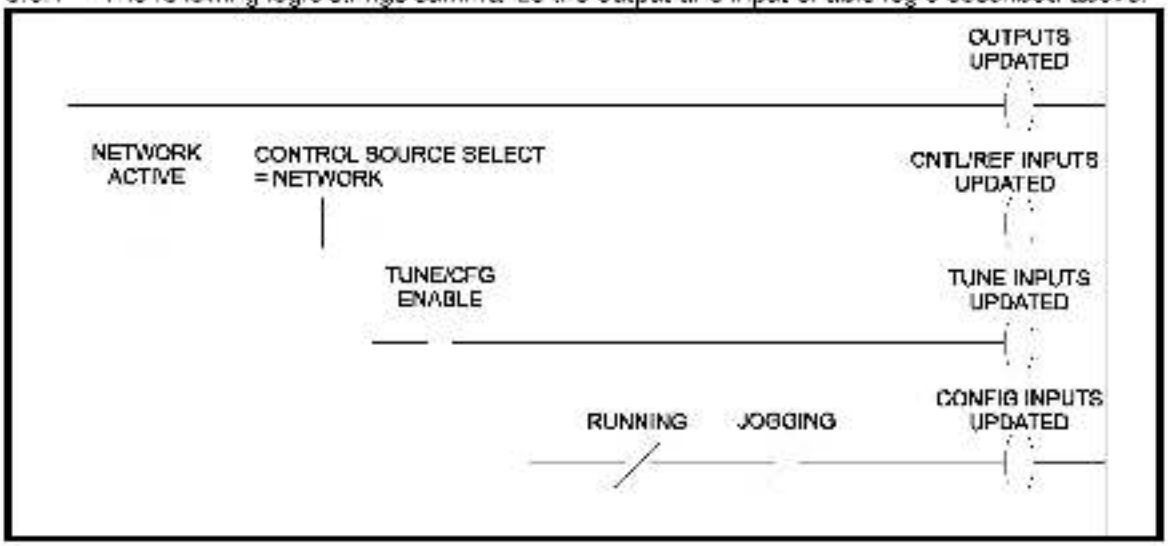

Figure 5.1 Logic Strings

5.6.2 OUTPUTS UPDATED indicates when all output data is transferred from the drive regulator to the network option board memory and consequently to the master.

5.6.3 CNTL/REF INPUTS UPDATED, TUNE INPUTS UPDATED, and CONFIG INPUTS UPDATED indicate when control/ref. tunable, and configurable inputs, respectively, are transferred from the network option board memory to the drive regulator.

5.7 Parameter Processing Error Flag

5.7.1 A parameter processing error status flag (Register 0, bit 12) is provided to allow the network master to determine whether any parameter values are unacceptable to the drive. If this flag is set (1), then one or more parameters sent to the drive were rejected. If this flag is not set (0), then all parameters sent to the drive were accepted.

5.7.2 Note that the tune/config inputs enable bit must be set (1) before the drive can read in, and consequently process, any tune/config parameters. The parameter processing error flag is updated approximately every 100 milliseconds.

5.8 Data Retention Timing Requirements

5.8.1 All tunable and configuration drive input register values must be maintained by the network master's application program for at least 500 msec. to assure that they are seen by the drive. The 500 msec. is in addition to the time required by the network master to transmit this data to all the FlexPak 3000 drops (dependent on the number of devices on the network). This is particularly relevant for data which is detected by the drive only on transition.

5.8.2 Control/Reference data types do not have this 500 msec. requirement. They are scanned (read in) by the drive every 20 msec. The Run and Jog inputs and the Fault and Alarm Log Clear command input are exceptions, and are described below.

5.8.3 The Run and Jog inputs requires a 0-to-1 transition in order to start the drive. Processing the Run and Jog inputs from the network may be delayed by the drive for up to 100 msec. This is done to synchronize a drive start to the processing of new configuration data. In order for the network master to assure this 0-to-1 transition is detected by the drive, the network master must maintain both the 0 and 1 states for at least 100 msec. Values which are maintained for less time may not be detected by the drive.

5.9 Drive Ready Status Bit

5.9.1 The Drive Ready status bit (Drop 1, reg. 0 bit 0) is used to indicate that a 0 to 1 transition on the Run or Jog input will start the drive. The Drive Ready bit will be ON (1) when all of the following conditions are met, and OFF (0) when one or more are not met:

a. No drive faults are active (Drop 1, reg. 0 bit 2 = 0)
b. Stop input is ON (Drop 1 reg. 32 bit 1 = 1)
c. Front-panel STOP/RESET button is not pressed
d. Coast/DB Stop terminal block input is closed (Drop 1, reg. 0 bit 10 = 1)
e. Customer Interlock terminal block input is closed (Drop 1, reg. 0, bit 11 = 1)

5.10 Network Register Organization

5.10.1 When the drive network connection type parameter (NETW CONNECT TYPE (P.810)) is configured for BASIC drive connection, the FlexPak 3000 drive will communicate its first 64

registers to the network communications card. Through an 'Explicit' DeviceNet connection, all of this data is available to the DeviceNet master.

5.10.2 When the drive Network Connection Type is configured for FULL drive connection, the FlexPak 3000 drive will communicate all 256 of its registers to the network communications card. Through an All of this data is available to the DeviceNet master through an 'Explicit' DeviceNet connection.

Register #s	**Automax References**
0-63	0-63, Drop 1 (Table A.1)
64-127	0-63, Drop 2 (Table A.2)
128-191	0-63, Drop 3 (Table A.3)
192-256	0-63, Drop 4 (Table A.4)

The complete list of FlexPak 3000 parameters are located in Tables A.1 - A.4 in Appendix A.

5.11 FlexPak 3000 Parameters Not Accessible Over the Network

5.11.1 The following FlexPak 3000 parameters are not accessible over the network at any time.

Table 5.1 – FlexPak 300 Parameters			
FlexPak 3000 Parameter Name	Parameter #	FlexPak 3000 Parameter Name	Parameter #
CT TURNS RATIO	P.310	CML ERROR	P.388
MANUAL REF SELECT	P.106	ARMATURE DELTA	P.509
MOP ACCEL TIME	P.115	METER OUT 1 GAIN ADJ	P.400
MOP RESET ENABLE	P.116	METER OUT 2 GAIN ADJ	P.401
PRESET SPEED 1	P.117	METER OUT 1 ZERO ADJ	P.402
PRESET SPEED 2	P.118	METER OUT 2 ZERO ADJ	P.403
PRESET SPEED 3	P.119	METER OUT 1 SELECT	P.404
MOP DECEL TIME	P.120	METER OUT 2 SELECT	P.405
TORQUE REFERENCE	P.180	FLD CURRENT REGULATOR	P.586
MOP OUTPUT	P.191	FIELD DELTA HIGH LIM	P.587
ANALOG MAN REFERENCE	P.192	FIELD DELTA	P.588
DRAW PERCENTAGE OUT	P.196	J20 FIELD LOSS DETECT	P.597
SPEED RAMP INPUT TP	P.198	J21 FLD SUPPLY JUMPER	P.598
SPEED RAMP OUTPUT	P.199	J11 ANLG TACH VLT SCL	P.792
SELF TUNE FIELD RANGE	P.218	J7 ANLG TACH VLT RNG	P.793
SELF TUNE STABILITY	P.219	POWER UNIT TYPE	P.795
SELF TUNE BRIDGE	P.220	NETWORK KIT	P.796
IR COMPENSATION TP	P.290	IO EXPANSION KIT	P.797
CURRENT COMPOUND TP	P.293	PULSE TACHOMETER KIT	P.798
JOG RAMP OUTPUT	P.294	J15 REGULATOR TYPE	P.799
SPD LOOP LAG OUTPUT	P.256	CCL REFERENCE	P.845
PHASE REF 1-5 DELTA	P.320	CCL FEEDBACK	P.847
PHASE REF 1ST BRIDGE	P.370	CCL ENABLE	P.849
A C LINE PERIOD	P.393	NETW DROP NUMBER	P.900
J18 ARMATURE RESISTOR	P.396		
CML FEEDBACK	P.397		

5.12 Poll Connection Data Transfer Format

5.12.1 General

As described in Section 4.3.3, the DeviceNet polled connection is used in most cases to accomplish drive control. The following information illustrates the data format that is expected and returned by the drive when using the polled connection:

5.12.2 Poll Connection Command Data Format

Word#	Description
0	Drive Control
1	Speed Control
2	Network Input Reg #1
3	Field Reference Reg

(Poll connection consumption size – 8 bytes)

The following data should only be sent in the poll command message if the drive is configured to accept control + config data in the poll command message. (See Section 4.2.)

4	Acce Time Out
5	Dece Time Out
6	Min Speed Out
7	Max Speed Out
8	Pos Current Limit %
9	Neg Current Limit %
10	S Curve Rounding
11	Trim Range
12	Spd Loop PI Prop Gain
13	Spd Loop PI Lead Frq
14	CML PI Prop Gain
15	CML PI Lead Freq
16	CML Ref Rate Limit
17	Jog Speed
18	Stop Type Select
19	IR Compensation
20	Current Compounding
21	Ntwk Loss Action
22	Ntwk Out Reg #1 Sel
23	Ntwk Out Reg #2 Sel
24	Ntwk Out Reg #3 Sel
25	Feedback Select

(Poll connection consumption size – 52 bytes)

5.12.3 Poll Connection Reply Data Format

Word #	Description
0	Status word
1	Speed reference
2	Speed reference sum
3	Speed Feedback
4	CMI feedback
5	Network Out Reg #1
6	Network Out Reg #2
7	Network Out Reg #3

(Poll connection production size = 16 bytes)

The following data will only be returned in the poll reply message if the drive is configured to return control config data in the poll reply message message (See Section 4.2.)

8	Fault Bits 1
9	First Fault
10	Alarm Bits 1
11	Last Alarm
12	Control Source

(Poll connection production size = 26 bytes)

CHAPTER 6: ELECTRONIC DATA SHEET (EDS) FILE

6.1 General

6.1.1 Provided with the option card is a diskette containing an Electronic Data Sheet. The Electronic Data Sheet is for use with the DeviceNet Manager Software. The software (which is used to configure a DeviceNet system including the DeviceNet Scanner) is typically used in PLC applications. The EDS file included with the option card provides important information to the software regarding the DeviceNet interface to the drive.

6.2 Installation

1. Before installing the EDS, the DeviceNet Manager Software must already be installed. Run the DeviceNet Manager software. From the Utilities Menu, select "Install EDS Files...".

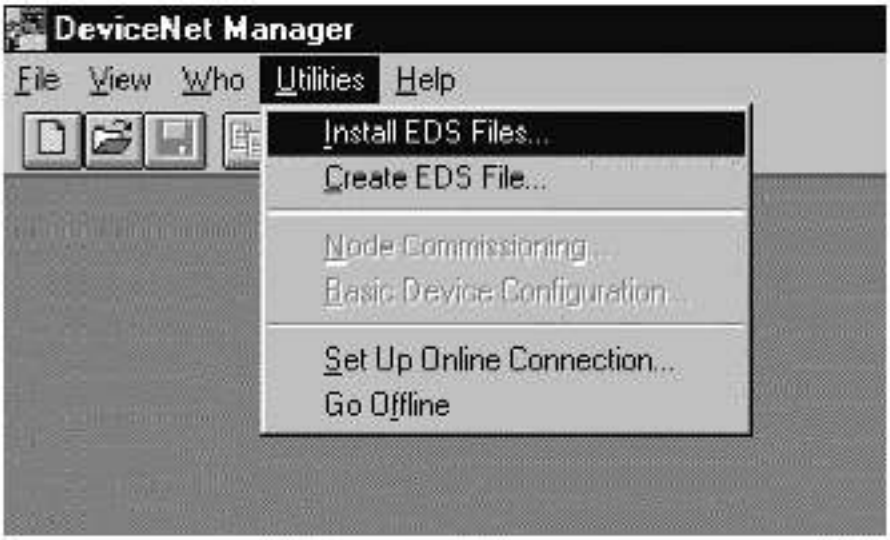

Figure 6.1

2. The following menu will appear:

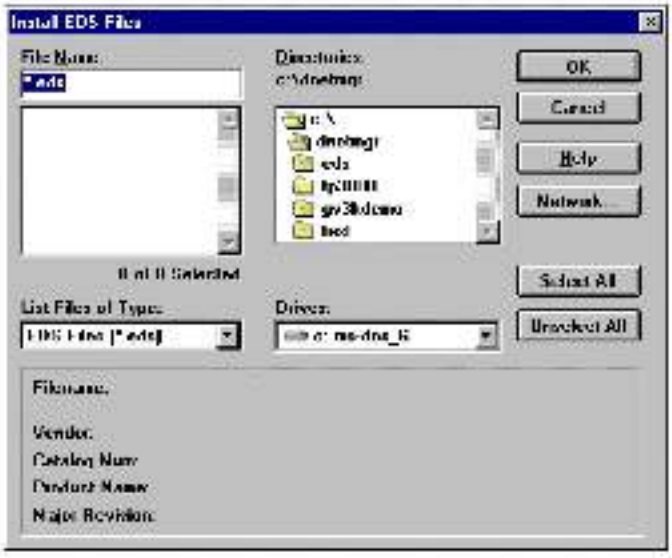

Figure 6.2

3. Select your diskette drive (A or B), and the following file will be listed:

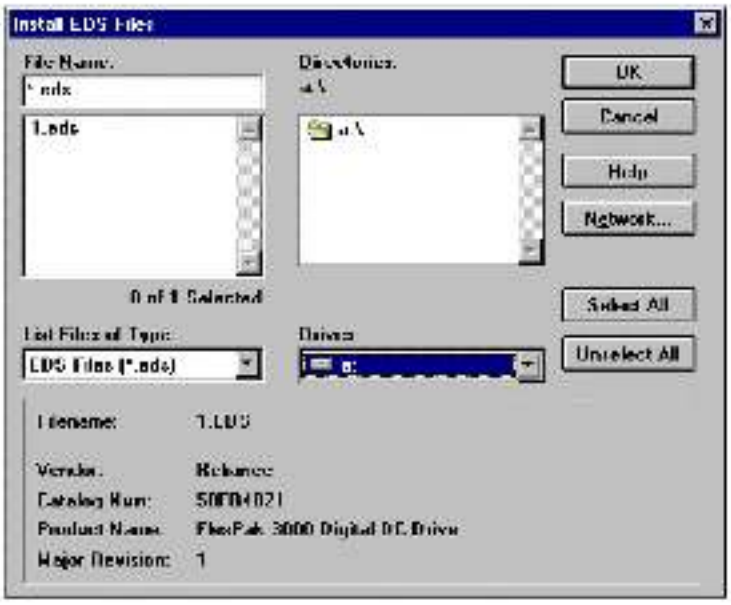

Figure 6.3

4. Information regarding the file is shown in the lower portion of the screen. Select the file named "1.eds" and press "OK". The DeviceNet Manager software will now install the EDS file to the appropriate directory on your hard disk drive.

6.3 Using the EDS File

1. Now that the EDS file is installed, the Reliance FlexPak 3000 DC Drive is added to the list of available DeviceNet products. In the example below, a project named "Press Rm" and Network named "Blanker" is open, and the only device currently added to the network is a SLC 500 DeviceNet Scanner module.

Figure 6.4

2. To add a Reliance FlexPak 3000 Variable Frequency Drive to the network, press the "Add Device" button, and a list of DeviceNet devices is recalled.

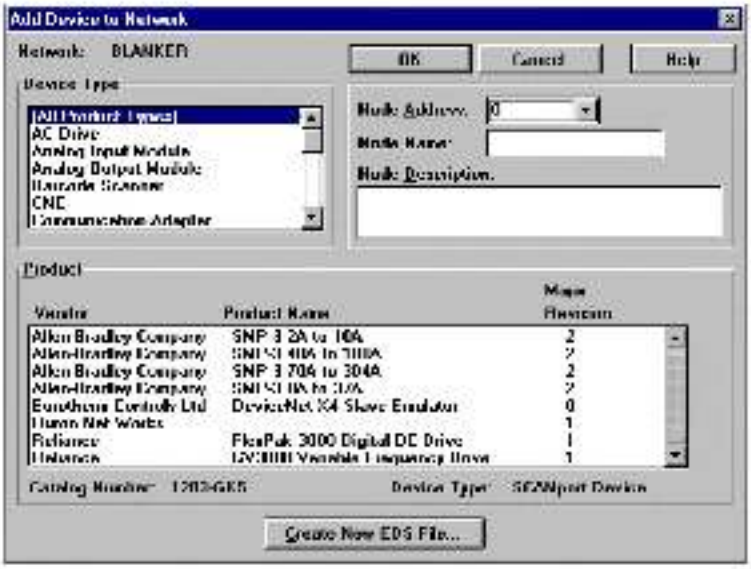

Figure 6.5

3. The list is in alphabetical order by Vendor. Page down to the "R's" and the "Reliance FlexPak 3000 Variable Frequency Drive" item is available for selection. To add a FlexPak 3000 as Node 1, select the FlexPak 3000 item, change the Node Address to 1, and press "OK". Press "Cancel" when finished. The FlexPak 3000 will now be added to the list of devices on the BLANKER network, as shown in Figure 6.6.

Figure 6.6

7. Double-clicking on the FlexPak 3000 item brings up the "Enhanced Mode" screen, showing a detailed data listing of the FlexPak 3000 parameters. There are three groups of parameters which may be listed, *Tune/config*, *Control/ref/IO*, and *All Parameters*. The listings are just for convenience. Selecting a list with the software has no effect on how much data is sent to and from the drive. That can only be set through the FlexPak 3000 keypad, Parameter P.061.

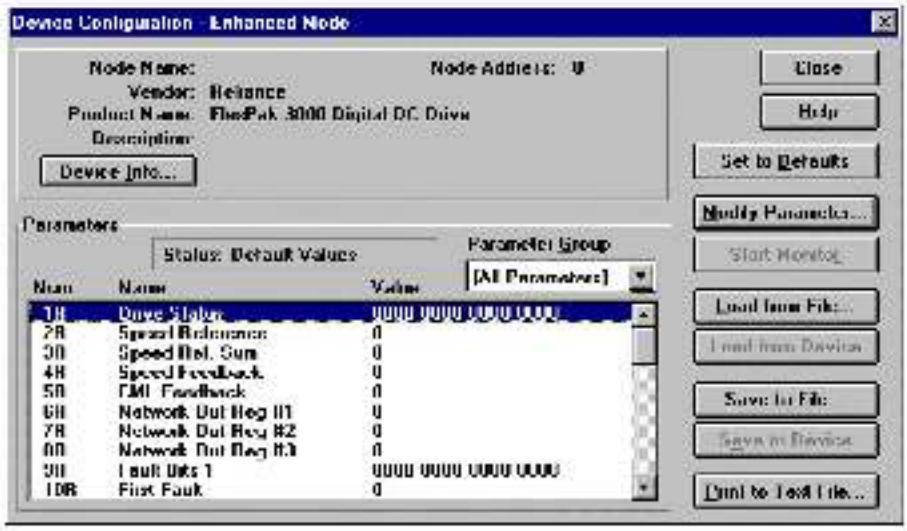

Figure 6.7

8. Double-clicking on a Parameter brings up further information. Double-clicking on Drive Status brings up the following information in Figure 6.8:

Figure 6.8

9. This is useful in interpreting all the parameters that are accessible over DeviceNet. In the case of "Drive Status" it details the meaning of each of the 16 status bits. It also shows that "Drive Status" is a Read-only parameter.

6.4 Data Mapping

6.4.1 Mapping FlexPak 3000 DeviceNet data to the DeviceNet Scanner is accomplished through the configuration of the scanner. See the documentation for your DeviceNet Scanner for details on that process.

APPENDIX A — FLEXPAK 3000 PARAMETERS

Appendix A contains Tables A.1 – A.4 covering register assignments for DROP_1 Area through DROP_4 Area.

Table A.1 - FlexPak 3000 Parameters (0 – 63)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Real-time Signal Data					
0	0			Drive Status Word Bit packed word containing information on the present status of the drive.	
		0		Drive ready	
		1		Drive running	
		2		Fault active	
		3		Drive jogging	
		4		Forward/Reverse command (0=forward, 1=reverse)	
		5		Drive stopping	
		6		Tune/Config input enable loopback (0=enabled, 1=enabled)	
		7		Tune/Config update synchronization flag loopback	
		8		Alarm active	
		9		In current limit	
		10		Cross-DB interlock (0=open, 1=closed)	
		11		Customer interlock (0=open, 1=closed)	
		12		Parameter processing error (0=no errors, 1=one or more errors)	
		13		Terminal block forward/reverse input state (CTB-5)	
		14		Terminal block coast/enable input state (CTB-6)	
		15		Terminal Block fault/clear reset input state (CTB-10)	
1	1		SPD SOURCE SELECTED	Selected speed/voltage loop reference value prior to any limiting and signal conditioning (4095 at TOP SPEED)	P.293
2	2		SPD LOOP REFERENCE	Speed/Voltage loop reference value after all limiting and signal conditioning (4095 at TOP SPEED)	P.295
3	3		SPD LOOP FEEDBACK	Raw speed/voltage loop feedback value after all scaling (4095 at TOP SPEED)	P.296
4	4		SPD LOOP OUTPUT	Speed/Voltage loop output value (4095 at MAXIMUM CURRENT)	P.299
5	5		ARMATURE VOLTAGE	Armature voltage feedback value after all scaling, and prior to IR compensation (4095 at MOTOR RATED ARM VOLTS)	P.289
6	6			Current in armature feedback averaged over a CMU sensus (4095 at MAXIMUM CURRENT)	
7	7			Network Output Register 1. Value of the parameter selected by NETWORK OUT REG 1 SELECT	

Table A.1 - Register Assignments for DROP_1 Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Runtime Signal Data (continued)					
8	8			Network Output Register 2 Value of the parameter selected by NETW OUT REG 2 SELECT	
9	9			Network Output Register 3 Value of the parameter selected by NETW OUT REG 3 SELECT (enable,	
Configuration and Status Data					
10	10			Fault Latch Bits Word 41 Bit-packed word indicating latched faults	
		0		AC line synchronization loss	
		1		Motor shunt field current loss	
		2		Stator I²t overload	
		3		Self-testing fault	
		4		Motor thermostat trip	
		5		Controller thermostat trip	
		6		Blower motor aux open	
		7		Open armature circuit	
		8		Instantaneous armature overcurrent	
		9		Overspeed/overvoltage	
		10		Open SCR	
		11		(RESERVED)	
		12		Tachometer loss	
		13		ODM communication loss	
		14		Network communication loss	
		15		(RESERVED)	
11	11			Fault Latch Bits Word 43 Bit-packed word indicating latched faults (all bits reserved)	
12	12			Fault code of the first fault that occurred after the last fault reset	
13	13			Alarm Latch Bits Word Bit-packed word containing latched alarms	
		0		Motor I²t overflow	
		1		AC line voltage < 90% of NOMINAL AC LINE VOLTS	
		2		AC line voltage > 115% of NOMINAL AC LINE VOLTS	
		3-15		(RESERVED)	
14	14			Alarm code of the most recent alarm	
15	15		CONTROL SOURCE SELECT	Selected control source (0=terminal block, 1=keypad, 2=serial port, 3=network)	P.003
16	16		ACCELERATION RATE	Minimum time to accelerate from zero speed to TOP SPEED (seconds * 10)	P.010
17	17		DECELERATION RATE	Minimum time to decelerate from TOP SPEED to zero speed (seconds * 10)	P.002
18	18		MINIMUM SPEED	Lowest operating speed (RPM)	P.015
19	19		MAXIMUM SPEED	Highest operating speed (RPM)	P.001

Table A.1 - Register Assignments for DROP 1 Area (continued)

DeviceNet Attribute #	Master Read Register Reg #	Master Read Register Bit #	Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
Tunable Configuration and Status Data (continued)					
20	20		POSITIVE CURRENT LIM	Highest level of motoring current (% of MOTOR RATED ARM AMPS)	P.005
21	21		NEGATIVE CURRENT LIM	Highest level of regenerative current (% of MOTOR RATED ARM AMPS)	P.006
22	22		TRIM RANGE	Determines how much the trim reference will affect the speed/voltage loop reference (%)	P.139
23	23		SPD LOOP PI PROP GAIN	Speed loop PI proportional gain (gain * 100)	P.211
24	24		SPD LOOP PI LEAD FREQ	Speed loop PI lead break frequency (radians/second * 100)	P.212
25	25		CML PI PROP GAIN	CML PI proportional gain (gain * 1000)	P.301
26	26		CML PI LEAD FREQ	CML PI lead break frequency (radians/second)	P.302
27	27		CML REF RATE LIMIT	Minimum time to change from zero to full load armature amps (milliseconds)	P.303
28	28		AMX NETW CONNECT TYPE	AutoMax network connection type (0=BASIC, 1=FULL)	P.910
29	29		NETW COMM LOSS SELECT	Network communication loss selection (0=fault, 1=hold last ref, 2=use terminal block ref)	P.901
30	30		AMX NETW REF SELECT	AutoMax network reference selection (0=disabled, "n"=broadcast reg. start "n" where n=1-8)	P.911
31	31		REGULATOR SW VERSION	Regulator board software version number	P.799
Master Write Registers Control/Reference Data					
32	32			Sequencing control word	
		0		Run (0 to 1 transition to run)	
		1		Stop (0=stop, 1=not stop)	
		2		Fault reset (0 to 1 transition to reset)	
		3		Jog (0 to 1 transition to jog, 0=stop jogging)	
		4		Fwd/Rev select (0=forward, 1=reverse)	
		5-6		(RESERVED)	
		7		Outer control loop enable (0=hold OCL in reset; 1=OCL enabled)	
		8		Fault register & reset (0 to 1 transition to clear)	

Table A.1 - Register Assignments for DROP 1 Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Control/Reference Data (continued)					
(32)	(22)	9		Alarm log clear & reset (0 to 1 transition to clear)	
		10		Alarm reset (0 to 1 transition to reset)	
		11		Memory save (0 to 1 transition to save)	
		13-13		(RESERVED)	
		14		Tune/Config Input Enable (0 = read Control/Reference inputs only from network. 1 = read all Cntl/Ref, Tune & Config inputs from network)	
		15		Tune/Config Update Synchronization Flag	
33	22			Network Reference: Speed/voltage loop or CML reference value used when CONTROL SOURCE SELECT (Drop 1, pg. 15) =NETWORK and ARM NETW REF SELECT (Drop 1, pg. 30) = 0 (ANLG) or TOP SPEED/MOTOR RATED ARM VOLTS or MAXIMUM CURRENT)	
34	23		NETWORK INPUT REGISTER 1	Value used when switch selection NETW IN REG 1 is chosen	
35	24		NETWORK INPUT REGISTER 2	Value used when switch selection NETW IN REG 2 is chosen	
36	25		NETWORK INPUT REFERENCE 3	Value used when switch selection NETW IN REF 3 is chosen	
37	27		FIELD REF REGISTER	Field Current Loop reference value (4095 at MOTOR RATED FLD AMPS)	P.513
38 - 39	28-39			(RESERVED)	
Tunable Data					
40	40		ACCELERATION RATE	Minimum time to accelerate from zero speed to TOP SPEED (seconds * 10)	P.010
41	41		DECELERATION RATE	Minimum time to decelerate from TOP SPEED to zero speed (seconds * 10)	P.002
42	42		MINIMUM SPEED	Lowest operating speed (RPM)	P.014
43	43		MAXIMUM SPEED	Highest operating speed (RPM)	P.007
44	44		POSITIVE CURRENT LIM	Highest level of motoring current (% motor full load armature amps)	P.015
45	45		NEGATIVE CURRENT LIM	Highest level of regenerative current (% motor full load armature amps)	P.016
46	46		SETRVF ROUNDING	Adjusts the amount of smoothing of the speed/voltage loop reference (%)	P.014
47	47		TRIM RANGE	Determines how much the trim reference will affect the speed/voltage loop reference (%)	P.139

Table A-1 - Register Assignments for DROP 1 Axes (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Control/Reference Data (continued)					
48	48		SPD LOOP PI PROP GAIN	Speed loop PI proportional gain (gain * 100)	P.211
49	49		SPD LOOP PI LEAD FREQ	Speed loop PI lead break frequency (radians/second * 100)	P.212
50	50		CML PI PROP GAIN	CML PI proportional gain (gain * 1000)	P.301
51	51		CML PI LEAD FREQ	CML PI lead break frequency (radians/second)	P.302
52	52		CML REF RATE LIMIT	Maximum time to change from zero to full load armature amps (milliseconds)	P.305
53	53		JOG SPEED	Reference value used during jogging (RPM)	P.012
54	54		STOP MODE SELECT	0=ramp 1=coast 2=dynamic brake 3=ramp to limit	P.117
55	55		IR COMPENSATION	Armature voltage loss compensation (% full load amps)	P.236
56	56		CURRENT COMPOUNDING	Sets the level of current compounding (%)	P.239
57	57		NETW COMM LOSS SELECT	Network communication loss selection (0=fault 1=hold last ref 2=ramp to zero 3=run at preset ref)	P.901
58	58		NETW OUT REG 1 SELECT	Number of the parameter whose value will be readable in Drop_1, register 7 (0=motor speed in RPM)	P.902
59	59		NETW OUT REG 2 SELECT	Number of the parameter whose value will be readable in Drop_1, register 8 (0=armature voltage in volts)	P.903
60	60		NETW OUT REG 3 SELECT	Number of the parameter whose value will be readable in Drop_1, register 9 (0=armature current in amps*100 in amps)	P.904

Table A.1 - Register Assignments for DROP_1 Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Configuration Data					
61	61		FEEDBACK SELECT	Speed/Voltage loop feedback selection (0=armature voltage, 1=DC analog tach, 2=pulse enc, 3=AC analog tach)	P.200
62	62		AMX NETW CONNECT TYPE	AcuMax network connection type (0=BASIC, 1=FULL)	P.910
63	63		AMX NETW REF SELECT	AcuMax network reference selection (0=directed, "n"=broadcast register "n" where n=1-8)	P.911

Table A.1 - Register Assignments for DROP 1 Axis

Table A.2 – FlexPak Parameters (64 – 127)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Remote Signal Data					
64	0		ANALOG AUTO REFERENCE	Analog auto reference input value after all scaling (4095 at TOP SPEED)	P.155
65	1			(RESERVED)	
66	2		ANALOG MAN TRIM REF	Analog manual trim reference input value after all scaling (4095 at TOP SPEED)	P.154
67-74	3-10			(RESERVED)	
Inverter Configuration and Status Data					
75	11		OCL RAMP OUTPUT	Outer Control Loop reference value after all ramping (4095	P.845
76	12		OCL OUTPUT	Outer Control Loop output value (RPM)	P.878
77	13		TOP SPEED	Highest operating speed (RPM)	P.011
78	14		JOG SPEED	Reference value used while jogging (RPM)	P.012
79	15		JOG ACCEL/ DECEL RATE	Minimum accel and decel time used while jogging (seconds * 10)	P.013
80	16		S-CURVE ROUNDING	Adjusts the amount of smoothing of the speed/voltage loop reference (%)	P.014
81	17		REVERSE ENABLE	Prevents speed/voltage loop reference from going negative value	P.015
		0		0=disabled, 1=positive ref.	
82	18		ANLG AUTO SIGNAL TYPE	Selects the type of analog auto reference signal for proper scaling (0=+/-10 V, 1=4-20 mA, 2=0-20 mA, 3=10-50 mA)	P.103
83	19		ANLG AUTO GAIN ADJ	Analog auto reference gain adjust.	P.101
84	20		ANLG AUTO ZERO ADJ	Analog manual reference (and analog manual trim reference) gain adjust	P.102
85	21		AUTO REFERENCE SELECT	Selects the type of auto ref. (0= analog, 1= frequency)	P.100
86	22		ANLG MAN REF GAIN ADJ	Analog manual reference (and analog manual trim reference) gain adjust	P.104
87	23		ANLG MAN REF ZERO ADJ	Analog manual reference (and analog manual trim reference) zero adjust	P.105
88	24		TRIM REF RESOLUTION	Trim reference value (% TOP SPEED * 10)	P.107

Table A.2 - Register Assignments for DROP 2 Axis (continued)

DeviceNet Attribute #	Master Read Register Reg #	Bit #	Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
Tunable Configuration and Status Data (continued)					
89	25		TRIM REFERENCE SELECT	Trim reference select (0=digital; 1=analog #1; 2=analog in 1; 3=serial in 1; 4=analog in 2; 5=serial in 2; 6=serial in 3)	P.108
90	26		TRIM MODE SELECT	Trim mode select (0=off; 1=increment; 2=proportional)	P.113
91	27		AUTO MODE MIN BYPASS	Minimum speed limit bypass while in auto mode	P.111
		0		0=min speed applied, 1=min speed bypassed	
92	28		AUTO MODE RAMP BYPASS	Rate limit (slew) bypass while in auto mode	P.112
		0		0=rate limit applied, 1=rate limit bypassed	
93	29		STOP SPEED THRESHOLD	Speed at which the main contactor will drop out during a normal stop (RPM)	P.113
94	30		STOP MODE SELECT	Stop mode select (0=ramp, 1=coast/dynamic braking, 2=current limit)	P.117
95	31		TRIM OUTPUT	Actual signal used to trim the selected speed/accel/decel loop reference (16K at TOP SPEED)	P.197
Master Write Registers					
Control/Reference Data				(NONE)	
Tunable Data					
96	32			(RESERVED)	
97	33		NORMALIZED INERTIA	Combined inertia of motor and load (seconds*10)	P.222
98	34		OCL REF REGISTER	Outer Control Loop reference used when OCL REFERENCE SELECT = REGISTER (4095)	P.801
99	35		OCL RET RAMP TIME	Minimum amount of time for OCL reference to change from 0 to 1000 and 1000 to 0 (seconds* 0)	P.802
100	36		OCL REF ROUNDING	Adjusts the amount of smoothing of the Outer Control Loop reference (%)	P.805
101	37		OCL LEAD/LAG SELECT	Outer Control Loop leading block select (0=lead/lag, 1=bypass, 2=lag/lead)	P.806

Table A-2 - Register Assignments for DROP 2 Assemblies

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Tunable Data (continued)					
102	38		OCL LEADLAG LOW FREQ	Outer Control Loop Leading block corner break frequency (radians/second * 100)	P.836
103	39		OCL LEADLAG RATIO	Specifies the ratio of lag to lead or lead to lag break frequencies	P.837
104	40		JOG ACCEL/ DECEL TIME	Minimum time (and deceleration) used while jogging (seconds * 10)	P.015
105	41		ANLG AUTO GAIN ADJ	Analog auto reference gain adjust	P.101
106	42		ANLG AUTO ZERO ADJ	Analog auto reference zero adjust	P.102
107	43		AUTO REFERENCE SELECT	Selects the type of auto reference (0=analog, 1=frequency)	P.103
108	44		ANLG MAN REF GAIN ADJ	Analog manual reference (and analog manual trim reference) gain adjust	P.104
109	45		ANLG MAN REF ZERO ADJ	Analog manual reference (and analog manual trim reference) zero adjust	P.105
110	46		TRIM REFERENCE SELECT	Trim reference select (0=analog manual, 1=analog trim, 2=serial register, 3=network trim from Drop Long 34)	P.108
111	47		TRIM MODE SELECT	Trim mode select (0=absolute, 1=incremental, 2=proportional)	P.113
112	48		AUTO MODE MIN BYPASS	Minimum speed limit bypass while in auto mode.	P.111
		0		0=min speed applied, 1=min speed bypassed	
113	49		AUTO MODE RAMP BYPASS	Rate limit block bypass while in auto mode.	P.112
		0		0=rate limit applied, 1=rate limit bypassed	
114	50		STOP SPEED THRESHOLD	Speed at which the motor is considered stopped during a controlled stop (RPM)	P.115
115	51		OCL PI PROP GAIN	Outer Control Loop PI block proportional gain (gain*100)	P.836
116	52		OCL PI LEAD FREQ	Outer Control Loop PI block lead break frequency (radians/second*100)	P.839

Table A.2 - Register Assignments for DROP_2 Area (continued)

DeviceNet Attribute #	Master Read Register Reg #	Bit #	Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
Transfer Data (continued)					
117	52		OCL PI POSITIVE LIMIT	Outer Control Loop PI block positive limit (%)	P.S13
118	54		OCL PI NEGATIVE LIMIT	Outer Control Loop PI block negative Limit (%)	P.S11
119	55		OCL TRIM RANGE	Percentage (+/-) OCL output will be trim Speed/Voltage Loop reference (%*10) Configuration Data	P.S12
120	56		INERTIA COMP SELECT	Inertia compensation select 0=none; 1=[illegible] 1,2,3=analog in 1,2; 4,5,6=selw in reg [illegible]	P.221
121	57		POS CURRENT LIM SEL	Selects positive current limit source 0=registers; 1,2=analog in 1,2; 3,4,5=selw in reg [illegible]	P.223
122	58		NEG CURRENT LIM SEL	Selects negative current Limit source 0=registers; 1,2=scaler in 1,2; 3,4,5=selw in reg [illegible]	P.225
123	59		OCL REFERENCE SELECT	Selects OCL reference source 0=registers; 1,2=scaler in 1,2; 3=frequency in; 4,5,6=selw in reg [illegible]	P.S03
124	60		OCL FEEDBACK SELECT	Selects OCL feedback source 0=CML feedback; 1,2,3=analog in [illegible]	P.S04
125	61		TOP SPEED	Highest operating speed (RPM)	P.011
126	62	0	REVERSE DISABLE	Prevents Speed/Voltage loop reference from generating a negative value 0=disabled; 1=positive ref	P.015
127	63		ANLG AUTO SIGNAL TYPE	Selects the type of analog auto reference signal for proper scaling 0=0-10 V; 1=0-5 V; 2=4-20 mA	P.103

Table A.2 - Register Assignments for DROP 2 Axis

Table A.3 – FlexPak 3000 Parameters (128 – 191)					
DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Runtime Signal Data					
128	0		ANALOG TACH FEEDBACK	Analog tachometer feedback signal after all scaling (4095 = TOP SPEED)	P.291
129	1		PULSE TACH FEEDBACK	Pulse tachometer feedback signal (4095 = TOP SPEED)	P.292
130	2		SPD LOOP ERROR	Speed/Voltage loop error value	P.297
131	3		CML REFERENCE	Current (torque) loop reference value after all limiting (4095 = MAXIMUM CURRENT)	P.496
132	4		FIELD REFERENCE	Field Current Loop reference value (4095 = MOTOR RATED FLD AMPS)	P.503
133	5		FIELD FEEDBACK	Field current feedback value (4095 = MOTOR RATED FLD AMPS)	P.589
134-139	6-11			(RESERVED)	
Immediate Configuration and Status Data					
140	12		MAXIMUM CURRENT	Highest amount of current, either positive or negative (% MOTOR RATED ARMATURE AMPS)	P.007
141	13		MOTOR RATED ARM AMPS	Rated armature amps from motor nameplate (amps * 10)	P.008
142	14		MOTOR RATED ARM VOLTS	Rated armature voltage from motor nameplate (volts DC)	P.009
143	15		FEEDBACK SELECT	Speed/Voltage loop feedback selection (0=armature voltage, 1=DC analog tach, 2=pulse tach, 3=AC analog tach)	P.203
144	16		ANALOG TACH GAIN ADJ	Analog tachometer feedback gain adjust	P.201
145	17		ANALOG TACH ZERO ADJ	Analog tachometer feedback zero adjust	P.202
146	18		ANLG TACH VOLTS/1000	Rated volts per 1000 RPM from the analog tachometer nameplate (volts * 10)	P.215
147	19		ARM VOLTAGE GAIN ADJ	Armature voltage feedback gain adjust	P.207
148	20		ARM VOLTAGE ZERO ADJ	Armature voltage feedback zero adjust	P.205
149	21		IR COMPENSATION	Armature voltage loss compensation (% full load amps)	P.206

Table A.3 - Register Assignments for DROP 3 Assemblies[1]

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Tuning Configuration and Status Data (continued)					
150	22		PULSE TACH PPR	Pulses per revolution from the pulse tachometer if employed	P.237
151	23		PULSE TACH QUADRATURE	Pulse tachometer quadrature decode enable	P.238
		0		0=non-quad. decode, 1=quad. decode	
152	24		CURRENT COMPOUNDING	Sets the level of armature compounding (%)	P.239
153	25		SPD LEADLAG RATIO	Specifies the ratio of lag to lead or lead to lag zeros Frequencies	P.213
154	26		SPD LEADLAG LOW FREQ	Speed/Voltage loop lag/lead/lag block low break frequency (radians/second * 100)	P.214
155	27		SPD LDLP LAG FREQ	Speed/Voltage loop lag block break frequency (radians/second * 100)	P.215
156	28		SPD LEADLAG SELECT	Speed/Voltage loop lead/lag block select (0=none/lag, 1=bypassed, 2=lag/lead)	P.216
157	29		SPD LDLP LAG BYPASS	Speed/Voltage loop lag block bypass	P.217
		0		0=not bypassed, 1=bypassed	
158	30		CML FEEDBACK GAIN ADJ	CML feedback gain adjust	P.503
159	31		ARMATURE BRIDGE POS	Active armature bridge	P.547
		0		0=forward, 1=reverse	
Master Write Registers					
Control/Reference Data				(NONE)	
Tuning Data					
160	32			(RESERVED)	
161	33		FIELD ECONOMY REF	Field economy current level (% of MOTOR RATED FLD AMPS)	P.511
162	34		FIELD PI PROP GAIN	Field Current Loop PI block proportional gain (gain*100)	P.512
163	35		FIELD PI LEAD FREQ	Field Current Loop PI block lead frequency (radians/second*100)	P.513
164	36		FLD FEEDBACK GAIN ADJ	Field current feedback gain adjust (gain*1000)	P.514

Table A.3 - Register Assignments for DROP_3 Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Tuning (continued)					
165	33		FLD WEAKEN THRESHOLD	Armature voltage or CEMF at which field current begins to automatically weaken (volts DC)	P.518
166	38		FLD WEAKEN PROP GAIN	Field weaken PI block proportional gain (gain*100)	P.519
167	39		FLD WEAKEN LEAD FREQ	Field weaken PI block lead break frequency (radians/second*100)	P.520
168	40		ANALOG TACH GAIN ADJ	Analog tachometer feedback gain adjust	P.201
169	41		ANALOG TACH ZERO ADJ	Analog tachometer feedback zero adjust	P.202
170	42		ARM VOLTAGE GAIN ADJ	Armature voltage feedback gain adjust	P.204
171	12		ARM VOLTAGE ZERO ADJ	Armature voltage feedback zero adjust	P.205
172	44		SPD LEAD LAG RATIO	Speed/voltage loop lead/lag block ratio between lead/lag break frequencies	P.213
173	45		SPD LEAD LAG LOW FREQ	Speed/Voltage loop lead/lag block low break frequency (radians/second*100)	P.214
174	46		SPD LOOP LAG FREQ	Speed/Voltage loop lag block break frequency (radians/second*100)	P.215
175	47		SPD LEAD LAG SELECT	Speed/Voltage loop lead/lag block select (0=Zero/lag, 1=bypass, 2=lead/lag)	P.216
176	18	0	SPD LOOP LAG BYPASS	Speed/Voltage loop lag block bypass (0=not bypassed, 1=bypassed)	P.217
177	19		CML FEEDBACK GAIN ADJ	CML feedback gain adjust.	P.300
178 - 183	50-55			(RESERVED)	

Table A.1 - Register Assignments for DROP 1 Axis (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Configuration data					
183	55		MOTOR RATED FLD AMPS	Rated motor field current from motor nameplate (amps*100)	P.513
184	56		FIELD LOSS THRESHOLD	Field current level at which a field loss fault is generated (% of MOTOR RATED FLD AMPS)	P.512
185	57		FIELD AUTO WEAKEN	Enables/disables the field current weakening circuit	P.517
		0		(0=disable; 1=enable)	
186	58		MAXIMUM CURRENT	Highest armature current value (positive or negative) (% MOTOR RATED ARM AMPS)	P.017
187	59		MOTOR RATED ARM AMPS	Rated armature current from motor nameplate (amps*100)	P.008
188	60		MOTOR RATED ARM VOLTS	Rated armature voltage from motor nameplate (volts DC)	P.009
189	61		ANLG TACH VOLTS/1000	Rated volts per 1000 RPM from the analog tachometer's nameplate (volts*100)	P.216
190	62		PULSE TACH PPR	Pulses per revolution from the pulse tachometer nameplate	P.207
191	63		PULSE TACH QUADRATURE	Pulse tachometer quadrature decoding mode	P.208
		0		Encoder input decode: 1=quad decode	

Table A.3 - Register Assignments for DROP_3 Area

Table A.4 – FlexPak Parameters (192 – 255)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Real-time Signal Data					
192	0			I/O Expansion Digital Ins Bit packed word indicating state of I/O Exp Kit digital inputs (bits 0-4; state of digital input 1-5)	
193	1		ANLG IN 1	I/O Exp Kit analog input #1 value after all scaling (4095 full scale)	P.491
194	2		ANLG IN 2	I/O Exp Kit analog input #2 value after all scaling (4095 full scale)	P.493
195	3		FREQ IN	I/O Exp Kit frequency input value after all scaling (4095 full scale)	P.491
196 - 212	4-20			(RESERVED)	
Tunable, Configuration and Status Data					
213	21			Level Detector Bit packed word indicating state of 4 digital Level Detector outputs	
		0		Level Detector 1 output	
		1		Level Detector 2 output	
214	22			Stop Status Word Bit packed word indicating the reason why the drive stopped	
		0		Stop/disable of the Run signal	
		1		Jog de asserted for > 1 second	
		2		External stop request	
		3		Current limit stop	
		4		Ramp stop	
		5		Coast/DB stop	
		6		Fault stop for Self-Tuning completed	
		7		Customer Interface opened	
		8		Over/DB time lock opened	
		9		Motor overload opened	
		10-15		(RESERVED)	
215	23		NOMINAL AC LINE FREQ	Nominal A-C line frequency (Hz)	P.506
216	24		NOMINAL AC LINE VOLTS	Nominal A-C line voltage (volts RMS)	P.507
217	25		PLL MAXIMUM ERROR	Maximum change in line synchronization PLL counter per AC Line cycle (msec)	P.508
218	26		AC LINE VOLTAGE	Measured A-C Line voltage (volts RMS)	P.592
219	27		ENHANCED FLD VOLT ADJ	Enhanced field supply voltage adjustment	P.503

Table A.4 - Register Assignments for DRIVE A Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Tunable Configuration and Status Data (continued)					
220	28		FIELD ECONOMY DELAY	Amount of time between stopping and reducing field current to economy level (minutes)	P.501
221	29	0	FIELD ECONOMY ACTIVE	Flag indicating whether or not drive is in field economy state 0=full field current, 1=field economy active	P.599
222	30		OPEN SCR SENSITIVITY	Open SCR detection sensitivity adjustment	P.600
223	31		OPEN SCR TRIP THRESH	Open SCR detection trip threshold	P.601
Master Write Registers					
Control/Reference Data				(NONE)	
Tunable Data					
224	32		ANLG IN 1 ZERO ADJ	I/O Exp Kit analog input #1 zero adjust	P.614
225	33		ANLG IN 1 GAIN ADJ	I/O Exp Kit analog input #1 gain adjust (gain*1000)	P.615
226	34		ANLG IN 2 ZERO ADJ	I/O Exp Kit analog input #2 zero adjust	P.616
227	35		ANLG IN 2 GAIN ADJ	I/O Exp Kit analog input #2 gain adjust (gain*1000)	P.617
228	36		LEVEL DETECT 1 THRESH	Level Detector circuit #1 threshold (%*10)	P.603
229	37		LEVEL DETECT 1 DELAY	Level Detector circuit #1 delay time (seconds*10)	P.604
230	38		LEVEL DETECT 2 THRESH	Level Detector circuit #2 threshold (%*10)	P.606
231	39		LEVEL DETECT 2 DELAY	Level Detector circuit #2 delay time (seconds*10)	P.607
232	40		PLL MAXIMUM ERROR	Maximum change in line synchronization PLL output per AC line cycle (msec)	P.508
233	41		ENHANCED FLD VOLT ADJ	Enhanced field supply voltage adjustment	P.503
234	42		FIELD ECONOMY DELAY	Time between stopping and reducing/reducing field supply output to economy level (0=1 sec)	P.501

Table A-1 - Register Assignments for DROP = Auto (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Tunable Data (continued)					
235	43		OPEN SCR SENSITIVITY	Open SCR detection sensitivity adjustment	P.630
236	44		OPEN SCR TRIP THRESH	Open SCR detection trip threshold	P.631
237	45		ANLG OUT 1 GAIN ADJ	DO Exp Kit analog output #1 gain adjust (gain*1000)	P.623
238	46		ANLG OUT 2 GAIN ADJ	DO Exp Kit analog output #2 gain (gain*1000)	P.722
239	47			(RESERVED)	
Configuration Data					
240	48		DIG OUT 1 SELECT	DO Exp Kit digital output #1 source 0=LEVEL DETECT 1 OUTPUT; 1=LEVEL DETECT 2 OUTPUT; 2=at current Limit; 3=drive ready; 4=NETW COMM STATUS; 5=bit n-1 of Network Input Register 1, where n=digital output number (1 or 3); 6=bit n-1 of Network Input Register 2, where n=digital output number (1 or 2); 7=bit n-1 of Network Input Register 3, where n=digital output number (1 or 3)	P.630
241	49		DIG OUT 2 SELECT	DO Exp Kit digital output #2 source 0=LEVEL DETECT 1 OUTPUT; 1=LEVEL DETECT 2 OUTPUT; 2=at current Limit; 3=drive ready; 4=NETW COMM STATUS; 5=bit n-1 of Network Input Register 1, where n=digital output number (1 or 2); 6=bit n-1 of Network Input Register 2, where n=digital output number (1 or 3); 7=bit n-1 of Network Input Register 3, where n=digital output number (1 or 2)	P.631
242	50	0	DIG OUT 1 CONTACT TYP	DO Exp Kit digital output #1 contact type (0=normally open, 1=normally closed)	P.632
		1	DIG OUT 2 CONTACT TYP	DO Exp Kit digital output #2 contact type (0=normally open, 1=normally closed)	P.712
243	51		ANLG IN 1 SIG TYP	DO Exp Kit analog input #1 signal type (0=0-10V, 1=+/-10V, 2=4-20mA)	P.713

Table A.2 - Register Assignments for DROP 4 Area (continued)

DeviceNet Attribute #	Master Read Register Reg #	Master Read Register Bit #	Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
Configuration Data (read only)					
244	22		ANLG OUT 1 SELECT	I/O Exp Kit analog output #1 source select 0=CML FEEDBACK; 1=CML REFERENCE; 2=CML ERROR; 3=SPD LOOP FEEDBACK; 4=SPD LOOP REFERENCE; 5=SPD LOOP ERROR; 6=SPD LOOP OUTPUT; 7=SPEED RAMP OUTPUT; 8=SPEED RAMP INPUT TP; 9=SPD SOURCE SELECT OUT; 10=TRIM OUTPUT; 11=ARMATURE VOLTAGE; 12=ANALOG TACH FEEDBACK; 13=PULSE TACH FEEDBACK; 14=ZERO; 15=FULL SCALE; 16=POWER OUTPUT; 17=OCL REFERENCE; 18=OCL RAMP OUTPUT; 19=OCL FEEDBACK; 20=OCL OUTPUT; 21=FIELD REFERENCE; 22=FIELD FEEDBACK; 23=NETW IN REG 1; 24=NETW IN REG 2; 25=NETW IN REG 3;	P-18
245	23		ANLG OUT 1 SIG TYPE	I/O Exp Kit analog output #1 signal type (0=+/-10V; 1=4-10V; 2=+/-20 mA)	P-19
246	24		ANLG OUT 2 SELECT	I/O Exp Kit analog output #2 source select 0=CML FEEDBACK; 1=CML REFERENCE; 2=CML ERROR; 3=SPD LOOP FEEDBACK; 4=SPD LOOP REFERENCE; 5=SPD LOOP ERROR; 6=SPD LOOP OUTPUT; 7=SPEED RAMP OUTPUT; 8=SPEED RAMP INPUT TP; 9=SPD SOURCE SELECT OUT; 10=TRIM OUTPUT; 11=ARMATURE VOLTAGE; 12=ANALOG TACH FEEDBACK; 13=PULSE TACH FEEDBACK; 14=ZERO; 15=FULL SCALE;	P-21

Table A.1 - Register Assignments for DRIVE_1 Area (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Configuration Data (continued)					
				16=POWER OUTPUT; 17=OCL REFERENCE 18=OCL RAMP OUTPUT; 19=OCL FEEDBACK 20=OCL OUTPUT; 21=FIELD REFERENCE; 22=FIELD FEEDBACK 23=NETW IN REG 1; 24=NETW IN REG 2; 25=NETW IN REG 3)	
247	55		FREQ IN ZERO	I/O Exp Kit frequency that corresponds to digital zero (0Hz*100)	P 423
248	56		FREQ IN FULL SCALE	I/O Exp Kit frequency input frequency that corresponds to digital 4095 (Hz*100)	P 424
249	57		FREQ OUT SELECT	I/O Exp Kit analog output source select 0=CML FEEDBACK; 1=CML REFERENCE; 2=CML ERROR; 3=SPD LOOP FEEDBACK; 4=SPD LOOP REFERENCE; 5=SPD LOOP ERROR; 6=SPD LOOP OUTPUT; 7=SPEED RAMP OUTPUT; 8=SPEED RAMP INPUT TP; 9=SPD SOURCE SELECT OUT; 10=TRIM OUTPUT; 11=ARMATURE VOLTAGE 12=ANALOG TACH FEEDBACK; 13=PULSE TACH FEEDBACK; 14=ZERO; 15=FULL SCALE 16=POWER OUTPUT; 17=OCL REFERENCE 18=OCL RAMP OUTPUT; 19=OCL FEEDBACK; 20=OCL OUTPUT; 21=FIELD REFERENCE; 22=FIELD FEEDBACK 23=NETW IN REG 1; 24=NETW IN REG 2; 25=NETW IN REG 3)	P 425
250	58		FREQ OUT ZERO	I/O Exp Kit frequency output frequency that corresponds to digital zero (Hz*100)	P 426

Table A-1 - Register Assignments for DROP = Auto (continued)

DeviceNet Attribute #	Master Read Register		Parameter Name	FlexPak 3000 Description	FlexPak 3000 Parameter #
	Reg #	Bit #			
Configuration Data (continued)					
251	59		FREQ OUT FULL SCALE	HD freq for frequency output that corresponds to digital 4095 (EHz^100)	P.527
252	60		LEVEL DETECT 1 SELECT	Level Detector #1 source 0=CMD, 1=spd fdbk, 2=spd cmd, 3=spd err, 4=trq cmd, 5=trq fdbk, 6=trq err, 7=selected out	P.502
253	61		LEVEL DETECT 2 SELECT	Level Detector #2 source 0=CMD, 1=spd fdbk, 2=spd cmd, 3=spd err, 4=trq cmd, 5=trq fdbk, 6=trq err, 7=selected out	P.505
254	62		NOMINAL AC LINE FREQ	Nominal A-C line frequency (Hz)	P.506
255	63		NOMINAL AC LINE VOLTS	Nominal A-C line voltage (volts RMS)	P.507

Table A-4 - Register Assignments for DROP = Axx

APPENDIX B: POLL CONNECTION DATA FORMAT

Table B.1 contains the format for Poll Connection Command Data.

Table B.1 – Poll Connection Command Data Format

✔ - Parameter available
✖ - Parameter not available.

Output Word	Bit Number	Description	Control	Control – Config
0	0-15	Sequence Control Word	✔	✔
	0	Run (0-to-1 transition to run)		
	1	Stop (0=stop)		
	2	Fault Reset (0-to-1 transition to reset)		
	3	Jog (0 to 1 transition to jog, 0 = stop jog)		
	4	Forward/Reverse (0 = Forward)		
	5	Reserved		
	6	Reserved		
	7	Outer Control Loop Enable (1=enabled)		
	8	Fault Log Clear and Reset (0-to-1 transition to clear)		
	9	Alarm Log Clear and Reset (0-to-1 transition to clear)		
	10	Alarm Reset (0-to-1 transition to reset)		
	11	Memory Save (0-to-1 transition to save)		
	12	Reserved		
	13	Reserved		
	14	Time/Cfg Input Enable (0 = read Control/Reference from network; 1 = Read Control/Reference, Time, and Cfg from network)		
	15	Time/Cfg Update Sync Initialization Flag		
1	0-15	Speed Control	✔	✔
2	0-15	Network Input Reg #1	✔	✔
3	0-15	Field Reference Reg	✔	✔
5	0-15	Acceleration Time	✖	✔
6	0-15	Deceleration Time	✖	✔
7	0-15	Min Speed Clm	✖	✔
8	0-15	Max Speed Clm	✖	✔
9	0-15	Positive Current Limit %	✖	✔
10	0-15	Negative Current Limit %	✖	✔
11	0-15	S-Curve Rate Cfg	✖	✔
12	0-15	Trim Range	✖	✔
13	0-15	Speed Loop PI Prop Gain	✖	✔
14	0-15	Speed Loop PI Lead Frequency	✖	✔
15	0-15	CML PI Prop Gain	✖	✔
16	0-15	CML PI Lead Frequency	✖	✔
17	0-15	CML Reference Rate Limit	✖	✔
18	0-15	Jog Speed	✖	✔
19	0-15	Stop Type Select	✖	✔
20	0-15	IR Compensation	✖	✔
21	0-15	Current Compensation	✖	✔
22	0-15	Network Loss Action	✖	✔
23	0-15	Network Out Register #1 Select	✖	✔
24	0-15	Network Out Register #2 Select	✖	✔
25	0-15	Network Out Register #3 Select	✖	✔
		Feedback Select	✖	✔

Table B.2 contains the format for Poll Connection Reply Data.

Table B.2 Poll Connection Reply Data Format			✔ - Parameter available ✖ - Parameter not available	
Input Word	Bit Number	Description	Control	Control + Config
0	0-15	Status Word	✔	✔
	0	Drive Ready		
	1	Drive Running		
	2	Fault Active		
	3	Drive Jogging		
	4	Forward/Reverse (0=Forward)		
	5	Drive Stopping		
	6	TorqProv, Enable Feedback (1=enable)		
	7	TorqProv Synchronization Feedback		
	8	Alarm Active		
	9	Current Limit		
	10	Coast/DB Interlock (1=closed)		
	11	Customer Interlock (1=closed)		
	12	Parameter processing error(s)		
	13	Terminal Block Forward/Reverse (CTB-5)		
	14	Terminal Block Auto/Manual (CTB-6)		
	15	Terminal Block Fault/Alarm (CTB-10)		
1	0-15	Speed reference	✔	✔
2	0-15	Speed Reference Sum	✔	✔
3	0-15	Speed Feedback	✔	✔
4	0-15	OMI Feedback	✔	✔
5	0-15	Network Out Reg #1	✔	✔
6	0-15	Network Out Reg #2	✔	✔
7	0-15	Network Out Reg #3	✔	✔
8	0-15	Fault Bits Latch Word #1	✖	✔
	0	AC Line Synchronization Loss		
	1	Motor Shunt Field Current Loss		
	2	Sustained Overload		
	3	Self-test Fault		
	4	Motor Thermostat Tripped		
	5	Controller Thermostat Tripped		
	6	Blower Motor Starter Open		
	7	Open Armature Circuit		
	8	Excessive Armature Overcurrent		
	9	Over Speed / Over Voltage		
	10	Open SCR		
	11	reserved		
	12	Tachometer Loss		
	13	OIM Communication Loss		
	14	Network Communication Loss		
	15	Reserved		
9	0-15	Data Fault	✖	✔
10	0-15	Alarm Bits Latch Word #1	✖	✔
	0	Motor Brush Wear Low		
	1	AC Line Voltage < 90% of nominal		
	2	AC Line Voltage > 110% of nominal		
	3-15	Reserved		
11	0-15	User Alarm	✖	✔
12	0-15	Control Source	✖	✔

APPENDIX C: EXPLICIT MESSAGING FOR THE HEC-FP3-DN

1.1 General

1.1.1 The HEC-FP3-DN supports the DeviceNet "Explicit Messaging" features to reach those parameters not available through the Polled Connection. Those parameters that are available in the Polled Connection are also available with the Explicit Messaging features.

1.1.2 Note that Explicit Messaging is inherently slow, as only one Explicit Message is allowed per pass through the Scan List. Explicit Messaging is not intended for continuous, high-speed update of parameters, and should be used only for infrequent or periodic updating of certain less-than-critical parameters.

1.2 Explicit Message Format

1.2.1 Each Explicit Message takes the following format:

Table C.1 – Explicit Message Format

Byte Number	Description	Example (Value in HEX)
0	MACID	As Needed
1	Service Code	10 or E0
2	Class ID	BA
3	Instance #	01
4	Attribute #	As Needed
-	Optional Data	xx
-		xx
n		xx

1.2.2 In many cases this byte wise (8 bit) data will need to be formatted into word wise (16 bit) format. Conversion of this information will be dependent on the PLC used.

1.2.3 Below is a typical word-wise (16 bit) message format used by GE Fanuc:

Table C.2 – 16-Bit Message (Example)

Word Offset	Value (Examples in HEX)
%R1	0F01
%R2	01BA
%R3	xx04
-	
-	
n	

1.2.4 The methods for sending and receiving Explicit Messages from any specific DeviceNet Master or (Scanner) will be peculiar to that device. Please refer to the Owners' Manual supplied with the DeviceNet Master (Scanner) device used to generate the messages.

1.3 Explicit Message Response Format

1.3.1 The normal, expected response from an Explicit Message is the Acknowledge Message:

Table C.3 – Acknowledged Message (Example)			
Byte Number	**Description**	**Example** (values in HEX)	
0	Number of bytes received	06	
1		00	
2	MACID	01	
3	Service Code	90	Previously sent Service Code (0x10) + 0x80
4	Optional Data	xx	
5	Optional Data	xx	
		xx	
n		xx	

1.3.2 Note that the Most Significant Bit of the Service Code byte is used as a Response Bit, thus indicating that the command was properly received. [Service Code 0x10 + Response Bit 0x80 = 0x90] If any extra data needs to be returned, that data will be placed into subsequent bytes.

1.4 Explicit Message Error Format

1.4.1 In the case that an Explicit Message requests a function that can not be performed by the addressed unit, an Explicit Message Error will be returned in the Receive Buffer.

NOTE: This should not be confused with an Explicit Message that fails during transmission. These will be returned as Network Errors.

1.4.2 An Explicit Error Message takes the following form:

Table C.4 – Explicit Error Message					
Byte Number	**Description**	**Example** (Values in HEX)		**Word Offset**	**Value** (From example)
0	Number of bytes received	08		%R1	0008
1		00		%R2	9401
2	MACID	01		%R3	xxxx
3	Service Code (Error)	94			
4	General Error Code	xx			
5	Additional Error Code	xx			

1.4.3 Like a "normal" response, the Service Code byte has the Most Significant Bit set as the Response Bit. Therefore, the actual Error Code is 0x14; with the Response Bit set the received code is 0x94. Code 0x14 indicates a Parameter Error has occurred – the requested action could not be performed by the addressed device.

1.4.4 The General Error Code is one of a number of codes supported by DeviceNet. See Table C.5 for a list of General Error Codes.

1.4.5 The Additional Error Code is generated by the answering device. This code, if available, will depend on the answering device.

1.4.1.1 Components of an Explicit Error Message (See Table C.4)

a. **MACID**

This is the Network ID of the unit to be controlled.

b. **SERVICE CODE**

Each Explict Message requires a SERVICE CODE. There are two possible Service Codes for the HEC-FP3-DN:

Service Code 0x0E -- Get Parameter
Each Get Parameter request will require 0 (zero) bytes of additional data. The returned messages will require one *word* (two *bytes*) of additional data.

Service Code 0x10 -- Set Parameter
Each Set Parameter request will require one *word* (two *bytes*) of additional data to be sent. The returned message will require 0 (zero) bytes of additional data.

c. **CLASS ID**

Each Explicit Message requires a CLASS ID. The Class ID for the HEC-FP3-DN is 0xBA (decimal 186).

d. **INSTANCE ID**

Each Explicit Message requires an INSTANCE ID, which identifies one of a group of identical controls in any attached unit. In the HEC-FP3-DN, there is only one "instance" in the controller, so the Instance Number is always "01".

e. **ATTRIBUTE NUMBER**

This is the identifying number of the parameter inside the drive to be read or written.

The HEC-FP3-DN has 256 possible parameters. These are arranged in four (4) "drops" (1-4) of sixty-four (64) parameters (0-63) each. [See Tables A.1 through A.4, above]. Therefore, to figure the INSTANCE ID for a particular parameter the following formula is used:

INSTANCE ID = ((DROP - 1) * 64) + PARAM#

1.5 Error Codes

The following General Error Codes are supported by DeviceNet devices. Any additional error code is supplied by the device generating the error.

Table C.5 – Error Codes

Error Code (hex)	Description
00 – 01	Reserved
02	Resource Unavailable
03 – 07	Reserved
08	Service Not Supported
09	Invalid Attribute Data Detected
0A	Reserved
0B	Already in requested Mode/State
0C	Object State Conflict
0D	Reserved
0E	Attribute Not Settable
0F	Privledge Violation
10	Device State Conflict
11	Reply Data Too Large
12	Reserved
13	Not Enough Data
14	Attribute Not Supported
15	Too Much Data
16	Object does not exist
17	Reserved
18	No stored attribute data
19	Store operation failure
1A – 1E	Reserved
1F	Vendor specific error
20	Invalid Parameter
21 – CF	Reserved for Future Extensions
D0 – FF	Reserved for Object Class and Service errors

1.6 Using Explicit Messages and Polling with the Same Device

1.6.1 The potential for confusion and problems with device operation exists when both Polled Messaging (by default) and Explicit Messaging (under program control) are used together. ***It is best to <u>not</u> use Explicit Messaging for any registers controlled through the Polled Message system.***

1.6.2 Regarding Read Registers (Status, Speed Reference, etc), the information is available from the Polled Message. The information is updated continuously and automatically. Accessing any of the registers through an Explicit Message is possible, but the information is already available from the Polled Message.

1.6.3 Regarding Write Registers (Sequence Control, Speed Control, etc), the problem is potentially more serious. The registers inside the HEC-FP3-DN are updated constantly by the Polled Messages. ***Any data written to the registers by an Explicit Message will be over-written almost immediately by the next Polled Message.***

1.6.4 If data is being overwritten, the problem manifests itself as either bits and controls that appear "intermittent" or completely inoperative. The problem occurs when the Explicit Message data is being over-written by the Polled Message data which violates the Data Retention Times specified in Section 5.8.

HORNER APG

07 May 1999

Revision pages for Horner Electric's DeviceNet™ Network Communication Option Board for use with Reliance Electric FlexPak 3000 DC Drive User Manual

HEC-FP3-DN, Fourth Edition

Attached to this cover page is a revision for the **Horner Electric DeviceNet™ Network Communication Option Board for use with Reliance Electric FlexPak 3000 DC Drive** User Manual dated 25 February 1998 **(MAN0086-04).**

THESE REVISED REQUIREMENTS ARE NOW IN EFFECT.

New and revised pages may be issued periodically. For user manual updates, please contact Horner Electric Advanced Products Group, Technical Support Division, at (317) 916-4274 or visit our website at www.heapg.com.

Revision Key

Changes to text, tables or graphics contained in the attached revision are indicated as follows:

1. **Added text is underlined.**
2. **Deleted text is lined through.**
3. **New, revised, or deleted items are specified as such in ( ).**

List of Effective Pages

The most current user manual consists of the following list of effective pages including the attached revision pages: ^ Denotes new or revised pages

Page	Date
Front Cover	Contained in MAN0086-04 dated 25 Feb 1998
2 – 16	Contained in MAN0086-04 dated 25 Feb 1998
^17	**Revision Pages dated 07 May 1999**
18-25	Contained in MAN0086-04 dated 25 Feb 1998
^26	**Revision Pages dated 07 May 1999**
27 -59	Contained in MAN0086-04 dated 25 Feb 1998

CHAPTER 4: DRIVE CONFIGURATION

(NEW)

WARNING: Risk of severe bodily injury or equipment damage exists. The drive restarts if the START and STOP bits in the control word are maintained **high**, and the PLC is switched from **Program** to **Run** mode. Precautions need to be taken to ensure that these mode switches do NOT create a hazard of bodily injury or equipment damage.

(Warning added 07 May 1999)

(REVISED)

~~4.2~~ 4.1 General

(Heading revised 07 May 1999)

This section describes how to configure the FlexPak 3000 controller containing the DeviceNet Network Communication Option Board for use on the DeviceNet network. Refer to the FlexPak 3000 Installation and Operation instruction manual for more information on the drive parameters described below.

4.2 Network Communication

4.2.1 The drive becomes active on the DeviceNet network after the user performs the following steps. Note that these steps should be followed in the order listed to prevent drive fault(s). (The HFC-FP3-DN Card cannot be used in conjunction with Automax card).

1. Connect the Network Option board to the network via the standard "pluggable" DeviceNet connector (See Section 2.2 for wiring information).

2. Apply power to the drive.

3. Using the keypad, access the drop number assignment parameter (NETW DROP NUMBER (P.900)) and assign a valid DeviceNet network drop number to the drive.

4. Using the keypad, access the network connection type parameter (NETW CONNECT TYPE (P.910)) and select either **Basic Drive Connection** or **Full Drive Connection**.

5. Using the keypad, access the DeviceNet Baud Rate (NETW BUAD RATE) (P.912) parameter and select **125.0 KBAUD**, **250.0 KBAUD**, **500.0KBAUD**, or **OTHER**.

6. Using the keypad, access the DeviceNet poll message type (DEVNET POLL MSG TYPE) (P.913) and select **CONTROL ONLY** or **CONTROL+CONFIG**.

7. Apply power to the DeviceNet network.

4.3 Network Connection Types

4.3.1 Two Types of Network Connections

4.3.1.1 The drive's network connection type defines the scope of data and control that the master has with the connected drive. Two types of connections are provided: BASIC drive connection and FULL drive connection. The drive's network connection type is selected with a drive parameter (NETW CONNECT TYPE (P.910)).

4.3.2 BASIC Drive Connection

4.3.2.1 Select **BASIC** drive connection if the application does not require a complete configuration of the drive over the network. Only certain parameters and diagnostic information commonly used will be controlled over the network. Selecting this option for NETW CONNECT TYPE (P.910) results in data size of 64 words.

5.12 Poll Connection Data Transfer Format

(NEW)
WARNING: Risk of severe bodily injury or equipment damage exists. The drive restarts if the START and STOP bits in the control word are maintained **high**, and the PLC is switched from **Program** to **Run** mode. Precautions need to be taken to ensure that these mode switches do NOT create a hazard of bodily injury or equipment damage.
(Warning added 07 May 1999)

5.12.1 General

As described in Section 4.3.3, the DeviceNet polled connection is used in most cases to accomplish drive control. The following information illustrates the data format that is expected and returned by the drive when using the polled connection:

5.12.2 Poll Connection Command Data Format

Word#	Description
0	Drive Control
1	Speed Control
2	Network Input Reg #1
3	Field Reference Reg

(Poll connection consumption size = 8 bytes)

The following data should only be sent in the poll command message if the drive is configured to accept control config data in the poll command message. (See Section 4.2.)

4	Acce Time Out
5	Decc Time Out
6	Min Speed Out
7	Max Speed Out
8	Pos Current Limit %
9	Neg Current Limit %
10	S-Curve Rounding
11	Trim Range
12	Spd Loop PI Prop Gain
13	Spd Loop PI Lead Frq
14	CML PI Prop Gain
15	CML PI Lead Freq
16	CML Ref Rate Limit
17	Jog Speed
18	Stop Type Select
19	IR Compensation
20	Current Compounding
21	Ntwk Loss Action
22	Ntwk Out Reg #1 Sel
23	Ntwk Out Reg #2 Sel
24	Ntwk Out Reg #3 Sel
25	Feedback Select

(Poll connection consumption size = 52 bytes)