



**BALDOR®**

**Device Net  
Expansion Board  
(Baldor Binary Protocol)**

Catalog No. EXB013A01

**Installation and Operating Manual**

8/03

MN1320

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# Section 1

## General Information

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### Introduction

The Baldor controls represent the latest technology in microprocessor based motor controls. In addition to the user programmable parameters available in every control, many different expansion boards are available from Baldor to further customize the control to most any application.

Expansion boards are categorized by compatibility into two groups: Group 1 and Group 2, see Table 1-1. A board from either group may be used alone in a control. If two boards are to be used, one board must be from Group 1 and the other from Group 2.

Note: Using two Group 1 or two Group 2 boards in the same control is not allowed.

**Table 1-1 Group 1 and Group 2 Board Categories**

<b>Group 1 Board Name</b>	<b>Catalog No.</b>	<b>Manual No.</b>
Isolated Input	EXB003A0X	MN1314
Master Pulse Reference/ Isolated Pulse Follower	EXB005A0X	MN1312
DC Tachometer Interface	EXB006A0X	MN1311
Isolated Encoder	EXB008A0X	MN1317
Resolver to Digital Interface	EXB009A0X	MN1313
<b>Group 2 Board Name</b>		
RS-232 Serial	EXB001A0X	MN1310
RS-422/RS-485 Serial	EXB002A0X	MN1310
RS-232/485 Serial	EXB012A0X	MN1310
Four Output Relays/3-15 PSI Pneumatic	EXB004A0X	MN1315
High Resolution Analog I/O	EXB007A0X	MN1316
2 Isolated Analog Output/ 3 Relay Output	EXB010A0X	MN1319
Device Net	EXB013A0X	MN1320
Profibus	EXB014A0X	MN1323
Modbus Plus	EXB015A0X	MN1322

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## **Limited Warranty**

For a period of two (2) years from the date of original purchase, BALDOR will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.

Goods may be returned only with written notification including a BALDOR Return Authorization Number and any return shipments must be prepaid.

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## **Safety Notice**

This equipment contains voltages that may be as great as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

## PRECAUTIONS

**⚠ WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.**

**⚠ WARNING: Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.**

- 
- ⚠ WARNING:** Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.
- ⚠ WARNING:** Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.
- ⚠ WARNING:** Improper operation of control may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.
- ⚠ WARNING:** Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.
- ⚠ Caution:** To prevent equipment damage, be certain that the electrical service is not capable of delivering more than the maximum line short circuit current amperes listed in the appropriate control manual, 230 VAC, 460 VAC or 575 VAC maximum per control rating.

## **Section 2**

# **Expansion Board Description**

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### **Introduction**

The Device Net expansion board is a Device Net Group 2 Only Slave device using the predefined master/slave connection set, as defined by the ODVA. It is capable of explicit messaging, as well as polled and/or COS/Cyclic I/O. The interface is based on the Baldor Binary Protocol (BBP) command set.

Group 2 board

Device Net Communications Expansion Board

Catalog No. EXB013A01





## Section 3

# Installation

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### Board Installation

This section describes the Expansion Board installation procedure.

**⚠ Caution:** Before you proceed, be sure to read and become familiar with the safety precautions at the beginning of this manual. Do not proceed if you are unsure of the safety precautions described. If you have any questions, contact BALDOR before you proceed.

1. Remove the expansion board from the shipping container.
2. Remove all packing material from the board.

**⚠ Caution:** Be sure all packing materials are removed from the board. Conductive foam may be present on the connectors to prevent static build up during shipping. This can prevent proper circuit operation.

If you are installing only one board, refer to the “Single Expansion Board Installation” procedure. If you are installing two expansion boards (or a second board) refer to the “Dual Expansion Board Installation” procedure.

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## AC Controls

(For all 15H Inverter, 21H Line Regen Inverter, 18H Vector, 22H Line Regen Vector and 23H Servo).

### **Single Expansion Board Installation**

Procedure:

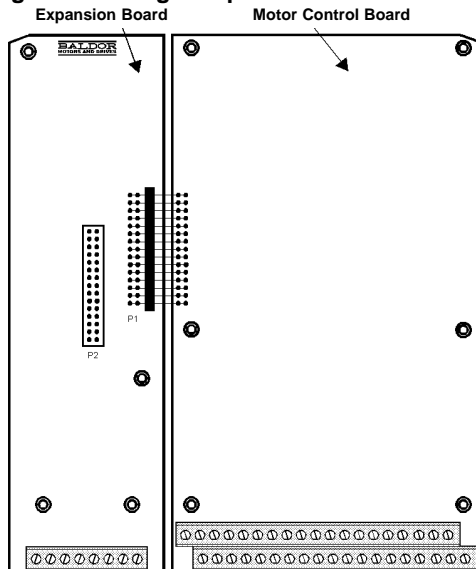
1. Be sure drive operation is terminated and secured.
2. Remove all power sources from the control.
3. Wait at least 5 minutes for internal capacitors to discharge.
4. Remove the four (4) Phillips head screws ( $1/4$  turn) that secure the control cover. (For A & B size, remove four screws that secure the cover. On floor mounted G size enclosures, open the enclosure door).
5. Remove the control cover.
6. Slide the expansion board male connector into the female connector of the control board. See Figure 3-1.
7. Securely mount the expansion board to the sheet metal mounting plate using the #6 screws provided in the installation hardware. See Figure 3-2.
8. The mechanical installation of the expansion board is now complete. Refer to Section 4 of this manual and configure the jumpers as desired. Also complete the wiring before you proceed to step 9.
9. When complete, install the control cover using the four (4) Phillips head screws ( $1/4$  turn). (For A & B size, install four screws that secure the cover. On floor mounted G size enclosures, close the enclosure door).
10. Restore all power sources to the control.
11. Restore drive operation.

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## AC Controls

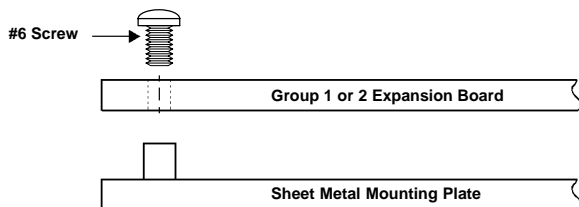
### Single Expansion Board Installation (Continued)

**Figure 3-1 Single Expansion Board Installation**



Terminal tightening torque is 7 lb-in (0.8 Nm) maximum.

**Figure 3-2 Single Expansion Board Installation**



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## **AC Controls (Continued)**

### ***Dual Expansion Board Installation***

Procedure:

1. Be sure drive operation is terminated and secured.
2. Remove all power sources from the control.
3. Wait at least 5 minutes for internal capacitors to discharge.
4. Remove the four (4) Phillips head screws ( $1/4$  turn) that secure the control cover. (For A & B size, remove four screws that secure the cover. On floor mounted G size enclosures, open the enclosure door).
5. Remove the control cover.
6. Slide the Group 1 expansion board male connector into the female connector of the control board. See Figure 3-1.
7. Securely mount the Group 1 expansion board to the sheet metal mounting plate using the short standoffs provided in the installation hardware. See Figure 3-3.
8. The mechanical installation of the expansion board is now complete. Refer to the manual for the Group 1 board and configure the jumpers as desired. Also complete the wiring before you proceed to step 9.
9. Install the Group 2 board on top of the previously installed Group 1 board by plugging the female connector onto the male connector of the Group 1 board as shown in Figure 3-3.
10. Secure this Group 2 board to the Group 1 board using the #6 screws provided. See Figure 3-3.
11. The mechanical installation of the expansion board is now complete. Refer to the manual for the Group 2 board and configure any jumpers and switches as desired. Also complete the wiring for this board before you install or close the cover.

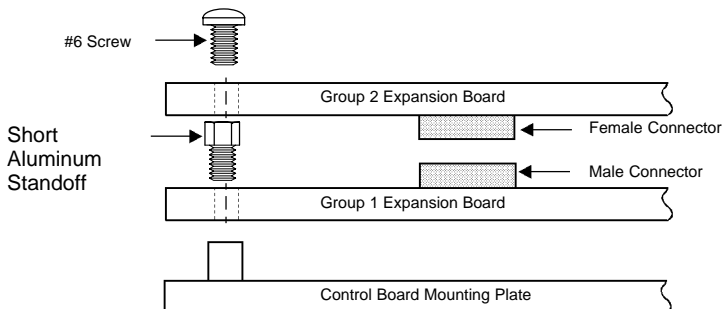
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## AC Controls

### *Dual Expansion Board Installation (Continued)*

- When complete, install the control cover using the four (4) Phillips head screws ( $\frac{1}{4}$  turn). (For A & B size, install four screws that secure the cover. On floor mounted G size enclosures, close the enclosure door).
- Restore all power sources to the control.
- Restore drive operation.

**Figure 3-3 Dual Expansion Board Installation**





## Section 4

### Hardware Setup

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#### **DIP Switch Settings**

This procedure will configure the Device Net Expansion Board for communication with a computer or terminal. Reference Figure 4-1 and Table 4-1 for the following procedure.

1. Set DIP switches 1 and 2 for the desired baud rate.
2. Set switches 3 through 8 for the ID number desired.
3. Install the Device Net expansion board in the Series H control as instructed in Section 3 of this manual.

Note: The switch settings can be changed after the board is powered up. However, switch changes will not take effect until the board is reset (by pushing PB1 or by turning power off then on).

#### **Cable Connection**

1. Connect the Device Net wires to the 5 pin connector provided with the expansion board as shown in Figure 4-1.

Note: The Device Net bus must provide 24VDC power to the expansion board.

2. If a terminator is required, connect a 120 ohm terminating resistor across pins 2 and 4 of the modular connector (CAN- and CAN+).

#### **Powerup**

When the Device Net expansion board is powered up it will perform the following:

1. Perform a self test.
2. Check the switch settings for configuration information.
3. Verify communications with the Series H control board.
4. Check for power on the Device Net bus.
5. Perform a Duplicate MAC ID check to determine if any other devices on the network have the same MAC ID number.
6. Go online.

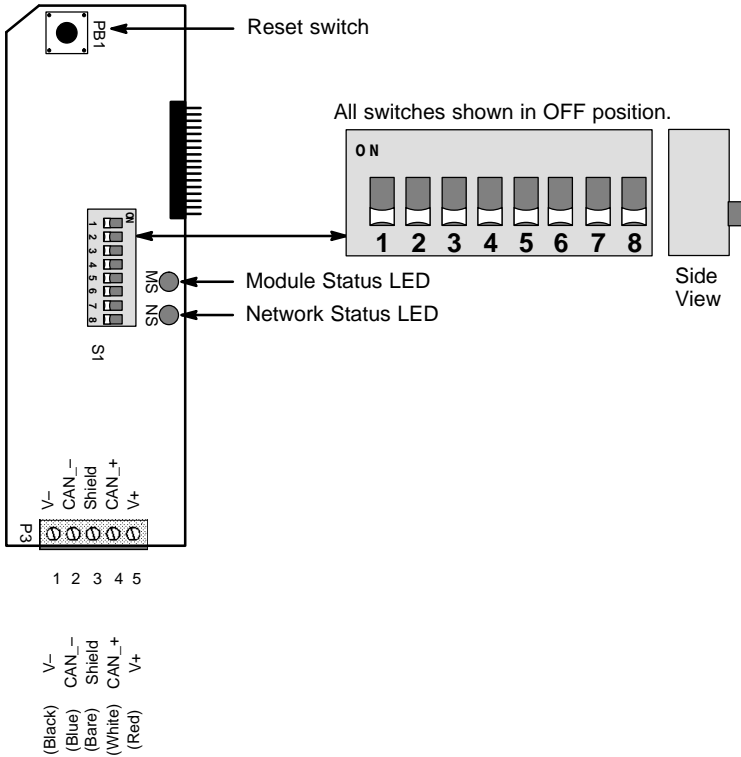
After powerup, both LED's should be GREEN.

Refer to the LED Indicators description in this section of the manual.



## Figure 4-1 Board Configuration

Device Net Expansion Board Catalog No. EXB013A01



**Table 4-1 Switch Settings**

Description	Switch Number							
	1	2	3	4	5	6	7	8
125kBPS	OFF	OFF						
250kBPS	OFF	ON						
500kBPS	ON	OFF						
MAC ID 0			OFF	OFF	OFF	OFF	OFF	OFF
MAC ID 1			OFF	OFF	OFF	OFF	OFF	ON
MAC ID 2			OFF	OFF	OFF	OFF	ON	OFF
MAC ID 3			OFF	OFF	OFF	OFF	ON	ON
MAC ID 4			OFF	OFF	OFF	ON	OFF	OFF
MAC ID 5			OFF	OFF	OFF	ON	OFF	ON
MAC ID 6			OFF	OFF	OFF	ON	ON	OFF
MAC ID 7			OFF	OFF	OFF	ON	ON	ON
MAC ID 8			OFF	OFF	ON	OFF	OFF	OFF
MAC ID 9			OFF	OFF	ON	OFF	OFF	ON
MAC ID 10			OFF	OFF	ON	OFF	ON	OFF
MAC ID 11			OFF	OFF	ON	OFF	ON	ON
MAC ID 12			OFF	OFF	ON	ON	OFF	OFF
MAC ID 13			OFF	OFF	ON	ON	OFF	ON
MAC ID 14			OFF	OFF	ON	ON	ON	OFF
MAC ID 15			OFF	OFF	ON	ON	ON	ON
MAC ID 16			OFF	ON	OFF	OFF	OFF	OFF
MAC ID 17			OFF	ON	OFF	OFF	OFF	ON
MAC ID 18			OFF	ON	OFF	OFF	ON	OFF
MAC ID 19			OFF	ON	OFF	OFF	ON	ON
MAC ID 20			OFF	ON	OFF	ON	OFF	OFF
MAC ID 21			OFF	ON	OFF	ON	OFF	ON
MAC ID 22			OFF	ON	OFF	ON	ON	OFF
MAC ID 23			OFF	ON	OFF	ON	ON	ON
MAC ID 24			OFF	ON	ON	OFF	OFF	OFF
MAC ID 25			OFF	ON	ON	OFF	OFF	ON
MAC ID 26			OFF	ON	ON	OFF	ON	OFF
MAC ID 27			OFF	ON	ON	OFF	ON	ON
MAC ID 28			OFF	ON	ON	ON	OFF	OFF
MAC ID 29			OFF	ON	ON	ON	OFF	ON
MAC ID 30			OFF	ON	ON	ON	ON	OFF
MAC ID 31			OFF	ON	ON	ON	ON	ON
MAC ID 32			ON	OFF	OFF	OFF	OFF	OFF
...	...	...	...	...	...	...	...	...
MAC ID 63			ON	ON	ON	ON	ON	ON

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## LED Indicators

Two LED's are located on the Device net expansion board.

### MS - Module Status LED

Displays the operational status of the Device Net Interface expansion board (EXB). Status is summarized in Table 4-2.

**Table 4-2**

LED State	Status Description
OFF	No power is applied to the EXB.
Green	The EXB is operating in a normal condition.
Flashing Green	The EXB is in standby mode. The EXB may be attempting to communicate with the Series H control. Be sure the Series H control is in RS485BBP mode.
Red	The EXB has an unrecoverable fault and may need to be replaced.
Flashing Red	The EXB has had a recoverable fault. This may be an invalid DIP switch setting or the lost Bus Power (Device Net cable disconnected).
Flashing Red-Green	The EXB is in a self test mode.

### NS - Network Status LED

Displays the status of the connection to the Device Net network. Status is summarized in Table 4-3.

**Table 4-3**

LED State	Status Description
OFF	The EXB is not Online or has lost power.
Green	The EXB is Online and operating. Link OK, Online, Connected.
Flashing Green	EXB is Online but no connection is established. EXB passed the DUP_MAC_ID test, Online, but has no connections to other nodes.
Red	Failed communications tests. EXB detected errors that prevent it from communicating on the network. Duplicate MAC ID, Bus-Off.
Flashing Red	One or more I/O connections have timed out. Connection timed out.
Flashing Red-Green	The EXB is in a self test mode.

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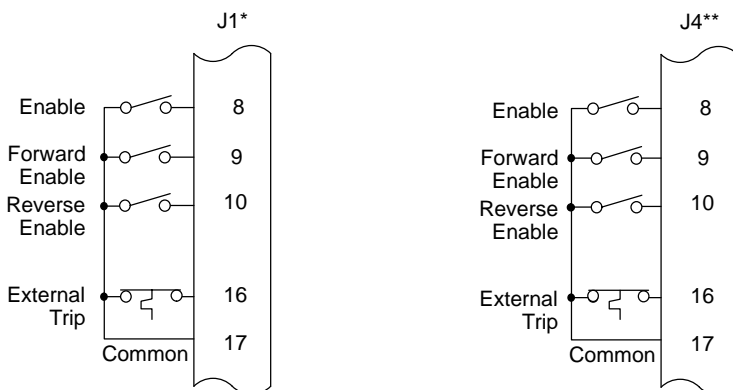
## Control Terminal Strip Connections

For Serial Mode operation, the Input/Output terminal strip of the control (J1 of the Vector and DC controls and J4 of the Inverters) is wired as shown in Figure 4-2. Connect the Enable, Forward Enable Switch, Reverse Enable Switch, External Trip and Opto Common connections as shown.

Note: All opto-isolated outputs and analog outputs remain active while operating in the Serial Mode.

When these connections are complete, refer to Section 5 of this manual and set the software for Serial Mode.

**Figure 4-2 Serial Opto Input Connections**



\* Series 18H, 22H and 23H controls.

\*\* Series 15H and 21H controls.



## Section 5

### Software Setup

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#### **Configure Control Software for Device Net Mode**

The Series H control operating mode must be set to Serial to use the Device Net expansion board. There is no selection for Device Net on the Level 1 Input block Operating mode parameter list. However, selecting Serial with the Device Net expansion board installed will allow operation of the Device Net board.

Many commands in the Command Language can be used regardless of the setting of the control's Operating Mode parameter (such as changing and viewing parameters). However, commands intended to control the motor shaft require the control be in the Serial (Device Net) Mode.

**Note:** The firmware version of the Series H control must support the Baldor Binary Protocol (BBP). To confirm that BBP is supported, perform the following:

Scroll to the Level 2 Communications block, and view the selections. If RS485BBP is available, the software version is compatible with the Device Net expansion board. Otherwise, contact Baldor to obtain a software update.

During power up, the control checks if the communication board is installed. If an RS485 board is installed, the RS485BBP protocol is automatically selected during power up.

Action	Description	Display	Comments
Apply Power	Display illuminates	BALDOR MOTORS & DRIVES	Logo is displayed for 5 seconds.
	If no fault is found and control is programmed for local mode,OR,	STP MOTOR SPEED LOCAL 0RPM	Display mode.
	If no fault is found and control is programmed for remote mode	STP MOTOR SPEED REMOTE 0RPM	Display mode.
Press PROG key	Access programming mode.	PRESS ENTER FOR PRESET SPEEDS	First screen in programming mode
Press ▲ or ▼ key	Scroll to Level 1 Input block	PRESS ENTER FOR INPUT	Input Block.
Press Enter key	First selection choice	OPERATING MODE P: KEYPAD	Now in keypad mode.
Press Enter key	Flashing cursor indicates mode can be changed	OPERATING MODE ⊕ □ KEYPAD	
Press ▲ or ▼ key	Scroll to Serial mode	OPERATING MODE ⊕ □ SERIAL	Change to Serial mode.
Press Enter key	Saves mode change value	OPERATING MODE P: SERIAL	
Press ▲ key	Scroll to Command Select parameter	COMMAND SELECT P: +/-10VOLTS	Now in ±10 Volt input mode.
Press Enter key	Flashing cursor indicates mode can be changed	COMMAND SELECT ⊕ □ +/-10VOLTS	
Press ▲ or ▼ key	Scroll to Serial mode	COMMAND SELECT ⊕ □ SERIAL	Change to Serial mode.
Press Enter key	Saves change to serial command select	COMMAND SELECT P: SERIAL	Control is now in Serial mode.

Note: The 15H control does not have a Command Select "Serial", this is not needed for this control.

Action	Description	Display	Comments
Press ▲ or ▼ key	Scroll to Level 2 blocks	PRESS ENTER FOR LEVEL 2 BLOCKS	
Press ENTER key	Select Level 2 blocks.	PRESS ENTER FOR OUTPUT LIMITS	First screen in Level 2 block
Press ▲ or ▼ key	Scroll to Communications block	PRESS ENTER FOR COMMUNICATIONS	
Press ENTER key	Select Level 2 Communications block.	PROTOCOL p: RS232 ASCII	
Press Enter key	Flashing cursor indicates mode can be changed	PROTOCOL ◊ □ RS232ASCII	
Press ▲ or ▼ key	Scroll to RS 485 BBP (Baldor Binary Protocol)	PROTOCOL ◊ □ RS485BBP	
Press ENTER key	Select RS 485 BBP mode.	PROTOCOL p: RS485BBP	
Press ▲ or ▼ key	Scroll to Exit Menu	PRESS ENTER FOR MENU EXIT	
Press DISP key	Returns to Display mode.	STP MOTOR SPEED LOCAL 0RPM	Display mode.
Press LOCAL key	Changes to Serial Operation.	STP MOTOR SPEED SERIAL 0RPM	Ready for device net operation.

The control is now configured for Device Net mode and the Host software can now be setup.



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## **Device Net Configuration**

The Device Net expansion board is a Device Net Group 2 Only Slave device using the predefined master/slave connection set, as defined by the ODVA. It is capable of explicit messaging, as well as polled and/or COS/Cyclic I/O. The interface is based on the Baldor Binary Protocol (BBP) command set.

This EDS file (Electronic Data Sheets) is used by Device Net equipment to communicate with the BBP of the Baldor Device Net expansion board. The Baldor EDS file is provided on a diskette that is shipped with the expansion board. A Device Net configuration tool, such as Allen-Bradley "Device Net Manager" software should be used to configure the Device Net expansion board. The EDS file is also available on the Baldor World Wide WEB page ([www.baldor.com](http://www.baldor.com)).

### ***EXB I/O Instances***

The input and output assembly instances are predefined I/O data formats that can be selected based on your application. If an I/O connection is being used, the selected I/O assembly instance determines the size and format of the data. Only one input instance and one output instance can be selected. The Input and Output instances should be set using a Device Net configuration tool prior to connection to a host device.

**Note:** Instances 105 and 155 are factory preset. These instances must be properly set for your application.

Elements of an I/O instance can be 1 to 32 bits in length and can reference any of the Baldor Binary Protocol (BBP) transactions supported by the Device Net expansion board (see Section 6 of this manual). Each assembly instance can contain no more than 8 bytes.

Tables 5-1 and 5-2 defines the format of the Input and Output Assembly Instances.

**Table 5-1 Format of Input Assembly Instances**

#	Byte	Instance Byte Format							
		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
151	0	ControlState T#4			Warning T#27	Output1	Output2	Output3	Output4
	1	CommandMode T#5			network CtrlSource T#3		remote	rev	fwd RunCMD T#1
	2	SpeedActual T#18 (Low Byte)							
	3	SpeedActual T#18 (High Byte)							
	4	CurrentActual T#17 (Low Byte)							
	5	CurrentActual T#17 (High Byte)							
152	0	SpeedActual T#18 (Low Byte)							
	1	SpeedActual T#18 (High Byte)							
	2	CurrentActual T#17 (Low Byte)							
	3	CurrentActual T#17 (High Byte)							
	4	ZeroSpd T#25	AtSpeed T#26	Input 4	Input 5	Input 6	Input 7	Input 8	Input 9
	5	FaultStatus T#45							
	6	MotorDir T#24	ControlState T#4			Output1	Output2	Output3	Output4
	7	CommandMode T#5			network CtrlSource T#3		remote	rev	fwd RunCMD T#1

**Table 5-1 Format of Input Assembly Instances** Continued

#	Byte	Instance Byte Format							
		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
153	0	ControlState T#4			Warning T#27	Output1	Output2	Output3	Output4
	1	CommandMode T#5				network CtrlSourceT#3	remote	rev	fwd RunCMDT#1
	2	FreqActual T#19 (Low Byte)							
	3								
	4	CurrentActual T#17 (Low Byte)							
	5	CurrentActual T#17 (High Byte)							
154	0	Input6	Input7	Input8	Input9	Output1	Output2	Output3	Output4
	1	CommandMode T#5				network CtrlSourceT#3	remote	rev	fwd RunCMDT#1
	2	SpeedActual T#18 (Low Byte)							
	3	SpeedActual T#18 (High Byte)							
	4	Position T#15 (Low Word/Low Byte)							
	5	Position T#15 (Low Word/High Byte)							
	6	Position T#15 (High Word/Low Byte)							
	7	Position T#15 (High Word/High Byte)							

Note: For Table 5-2, use instance 103 for 15H and 21H controls (speed is sent in Hertz). Use other instances for 18H, 22H and 23H (speed is sent in RPM).

**Table 5-2 Format of Output Assembly Instances**

#	Byte	Instance Byte Format							
		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
101	0	FaultRst T#46	RunInhibit T#2	TableSelect [3] T#39		Output1	Output2	Output3	Output4
	1	CommandMode T#5				network CtrlSourceT#3	remote	rev RunCMDT#1	fwd
	2	(RPM) SpeedRef T#7 (Low Byte)							
	3	(RPM) SpeedRef T#7 (High Byte)							
	4	TorqueRef T#9 (Low Byte)							
	5	TorqueRef T#9 (High Byte)							
102	0	SpeedRef T#7 or PositionSpeed T#13 Low Byte [1]							
	1	SpeedRef T#7 or PositionSpeed T#13 High Byte [1]							
	2	TorqueRef T#9 or TorqueRef T#12 Low Word, Low Byte [2]							
	3	TorqueRef T#9 or TorqueRef T#12 Low Word, High Byte [2]							
	4	TorqueRef T#9 or TorqueRef T#12 High Word, Low Byte [2]							
	5	TorqueRef T#9 or TorqueRef T#12 High Word, High Byte [2]							
	6	FaultRst T#46	ZeroPos T#12	AccDecGroup T#40		Output1	Output2	Output3	Output4
7	CommandMode T#5				network CtrlSourceT#3	remote	rev RunCMDT#1	fwd	
103	0	FaultRst T#46	RunInhibit T#2	TableSelect [3] T#39		Output1	Output2	Output3	Output4
	1	CommandMode T#5				network CtrlSourceT#3	remote	rev RunCMDT#1	fwd
	2	(0.1Hz) HzSpeedRef T#6 (Low Byte)							
	3	(0.1Hz) HzSpeedRef T#6 (High Byte)							
	4	TorqueRef T#9 (Low Byte)							
	5	TorqueRef T#9 (High Byte)							
104	0	FaultRst T#46	ZeroPos T#12	TableSelect [3] T#39		Output1	Output2	Output3	Output4
	1	CommandMode T#5				network CtrlSourceT#3	remote	rev RunCMDT#1	fwd
	2	PositionSpeed T#13 (Low Byte)							
	3	PositionSpeed T#13 (High Byte)							
	4	PositionRef T#12 (Low Word/Low Byte) [4]							
	5	PositionRef T#12 (Low Word/High Byte) [4]							
	6	PositionRef T#12 (High Word/Low Byte) [4]							
	7	PositionRef T#12 (High Word/High Byte) [4]							

See notes on next page.

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**Notes:**

- ① Used with CommandMode (T#5). These bytes represent the variables SpeedRef (T#7), or Position SpeedRef (T#13).
- ② Used with CommandMode (T#5). These bytes represent the variables TorqueRef or PositionRef. PositionRef requires 4 bytes. TorqueRef requires 2 bytes (Low Word).
- ③ TableSelect is not implemented at this time.
- ④ When a PLC updates memory in the middle of a double integer write of PositionRef, a problem may occur. If the first integer is written and the PLC updates the memory of a networked device, the position information is wrong (second integer is missing). To avoid this problem, be sure the CommandMode (T#5) is not set to PositionCmd until after both integers are written.
- ⑤ Torque and Position commands are not implemented for the Series 15H Control.

## Section 6

### Command Language

---

#### **Transaction Specification**

This section contains a detailed list of the transactions currently supported by the protocol. The list includes the transaction number, name, type description, and a detailed specification of the required and returned data.

Note: Some transactions are not supported by all control types. Also some controls require variations in commanded data. Where these exceptions exist, they will be identified in the text.

#### **How To Read The Transaction Specification**

The transaction table provides quick access to relevant information about each transaction. When necessary a transaction will be explained in more detail in the sections that follow.

#### **Transaction Number (T#)**

The transaction number is the identification of the command. As mentioned in Section 3, the maximum number of transactions is 256 (250 – 255 are reserved for future use.)

---

## Name

The 'Name' field refers to a 'C' style variable for function names associated with the transaction. Use of these names is not necessary to interface with the transaction. These names may be used in present and future software drivers and libraries provided by Baldor. When used in conjunction with Baldor software tools, the transaction name is case sensitive.

## Type

There are three basic transaction types: Set, Get, and those which do both: Set/Get.

- 'Set' transactions are used to change internal values, or execute one-time (nonmodal) commands. As a general rule most 'set' transactions pass data to the control, but do not return any. Most execution 'set' commands do not pass or return data.
- 'Get' transactions are used to retrieve internal values or control conditions. Most 'get' transactions return data but do not pass data.
- 'Set/Get' transactions do both functions. Usually these transaction always return data, but only accept or pass data when a 'set' or change function is occurring. When no data is passed, the 'Set/Get' functions as a 'Get' or read-only transaction.

When a transaction does not fit these general rules, both passed and returned data fields will be clearly specified.

---

## Data Field

The Data Field defines the data transfer requirements of the application layer message. This field describes the data using the 'data type' defined in Section 2.1. Commas separate individual elements of data.

As previously discussed in Section 3, there are two types of application layer packets— Command and Response. Command packets ALWAYS contain a transaction number (USINT). Response packets ALWAYS contain a transaction number (USINT) and a status (USINT). The transaction specification is only concerned with the data field portion of these messages. The transaction number and status are assumed to be present, and are not shown in the specification.

In transactions that fit the basic Set, Get, and Set/Get definitions, only a single data field is described in the specification. In these cases it is assumed that a 'Set' transaction has only Command packet data. A 'Get' has only Response packet data. And a 'Set/Get' has the same data in the Command and Response packet, unless it is being used to 'Get' only, in which case there is no Command data.

Transactions are not required to conform to these basic rules. When such exceptions exist, both their Command and Response data fields will be described in detail. The command data field is preceded by a C:, the response data field is preceded by a R: for identification purposes only.

In some cases variable names are given in the data field specification. These names are used to describe multiple elements of a common data type. These names are not required for use, but may be included in present and future software drivers and libraries provided by Baldor. (When used with tools provided by Baldor, variable names are case sensitive.)



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## **Class**

The class field indicates the product classes that support the transaction. The product codes are as follows:

E = Encoderless Vector

I = Inverter

S = Servo

V = Vector

V\* = Vector with custom software for positioning

## **Description**

The description field gives information regarding the use of the transaction. When possible the data range, scale, units, etc. are also given. When it is not possible to fully describe the transaction in the table, or when other information such as a state diagram or event matrix must be given, further information will be included in sections following the transaction table. An asterisk is used to indicate default power up values where applicable.

---

## Transaction Specification Table

Table 6-1 Transaction Specification Table

T#	Name	Type	Data Field	Class	Description
0	Null	Set	None	All	No action. This can be used to reset the watchdog timer, or as a placeholder in conjunction with a global Execute Buffer transaction.
1	RunCmd	Set/ Get	USINT	All	Network run / stop command. Get 0 = Stop (refer to stop mode parameter) 1 = Fwd 2 = Rev 3 = Bipolar Run * Actual motor direction is returned in Motor Direction. In fwd or rev, only the absolute value of the command references (speed, torque) are used. In bipolar run, the signed reference values control the direction. These commands are only valid when CtrlSource = 2 (control from network)
2	RunInhibit	Set/ Get	BOOL	All	Commands a stop regardless of the command source (Local Keypad, Remote terminal strip, control from network.) 1 = Stop, 0 = No action*

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
3	CtrlSource	Set	USINT	All	0 = Keypad (local) 1 = Terminal strip (remote) 2 = Control from network
4	ControlState	Get	USINT	E,V,S	0 = Not Ready (no main power) 1 = Ready (disabled) 2 = Enabled 3 = Stopping 4 = Fault exists
5	CommandMode	Set/ Get	USINT	All	Command Mode 0 = None (Disabled) * 1 = Torque CMD selected source 2 = Torque CMD network 3 = Speed CMD selected source 4 = Speed CMD network 5 = Orient 6 = Position CMD ABS  7 = Position CMD INC 9 = Position CMD external 10 = Home 11 = Process Torque 12 = Process Speed 13 = Auto Tune Refer to the command mode section for complete operational description.

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
6	HzSpeedRef	Set/ Get	INT INT	I, All	Hertz Speed Reference. Set Units: 0.1 Hz (one decimal place)
7	SpeedRef	Set/ Get	INT INT	E,V,S, All	Speed reference Units: RPM (Standard Get Resolution)
8	SpeedRefHigh	Set/ Get	DINT	E,S,V	Speed reference (High Resolution) Units: 1/256 RPM . The middle 16 bits mirror SpeedRef. Not supported by all product classes.
9	TorqueRef	Set/ Get	INT	S,V	Torque reference (Current) Scaling: $\pm 15$ bit (32767) = programmed current limit.
12	PositionRef	Set/ Get	DINT	S, V*	Position Reference Scaling = quadrature counts (4 x feedback counts per rev.)
13	PositionSpeed	Set/ Get	INT	S, V*	Positioning Speed Reference Max speed used for positioning commands. Also referred to as feed rate or target velocity. Units: RPM
15	Position	Set/ Get	DINT	S, V*	Position counter Scaling = quadrature

V\* = Vector with custom software for positioning

**Table 6-1 Transaction Specification Table** Continued

<b>T#</b>	<b>Name</b>	<b>Type</b>	<b>Data Field</b>	<b>Class</b>	<b>Description</b>
17	CurrentActual	Get	INT	E,I,S, V	Actual motor phase current Units: 100mA RMS Note: calculated on inverter.
18	SpeedActual	Get	INT	All	Actual motor speed (absolute value.) (Approximated in some products.) Units: RPM
19	FrequencyActual	Get	INT	E,I,S, V	Actual motor frequency Units: 0.1 Hz (one decimal place)
20	PowerActual	Get	INT	E,V,S	Actual output power Units: Watts
21	InputVoltage	Get	INT	E,V,S	Input line voltage Units: Volts RMS
22	OutputVoltage	Get	INT	E,V,S	Motor phase voltage (commanded) Units: Volts RMS
24	MotorDirection	Get	BOOL	E,V,S	0 = Fwd 1 = Rev Actual in position feedback products, commanded in others.
25	ZeroSpeed	Get	BOOL	E,S,V	1 = At zero 0 = Not at zero
26	AtSpeed	Get	BOOL	E,V,S	1 = At commanded speed 0 = Not at speed
27	Warning	Get	BOOL	E,V,S	1 = Warning 0 = No warnings present

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
28	AtPosition	Get	BOOL	S,V	1 = At position 0 = Not at position
29	AtSetpoint	Get	BOOL	E,V,S	1 = At setpoint 0 = Not at setpoint
30	AtSetSpeed	Get	BOOL	E,V,S	1 = At set speed 0 = Not at set speed
31	TerminalStrip	Get	WORD	All	Digital I/O status word. Refer to Table 6-3 for description.
32	SoftwareVersion	Get	STRING	E,V,S	Control software version (16 characters maximum.)
33	SoftwareRevision	Get	UINT	All	Control software revision number. For example S15-4.03 is returned as 403. Note: for custom software revisions, only the core (standard) revision is returned.
34	ProductSeries	Get	UINT	All	Product series for example a Series 15H returns: 15.
35	ProductClass	Get	USINT	All	0 = D 1 = DP 2 = E 3 = I 4 = S 5 = V
36	OptionId1	Get	USINT	E,V,S	Option ID1 (see table 6-4) 0 = Not installed
37	OptionId2	Get	USINT	E,V,S	Option ID2 (see table 6-4) 0 = Not installed

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
38	RunTime	Get	UDINT	E,V,S	Total time power has been applied. Units: seconds.
39	TableSelect	Get/ Set	USINT	E,S,V	Parameter table select Range 0 – 3 Note: DDC only supports 2 tables. Can only be changed when under network control
40	AccDecGroup	Get/ Set	USINT	E,V,S	Accel / decel group select Range 1 – 2 Can only be changed when under network control.
41	WatchdogTime	Get/ Set	UINT	All	Network watchdog timer Get Units: 10mS 0 = disable 2= 20mS minimum 6000= 60S maximum Note: resolution varies among product classes.
45	FaultStatus	Get	USINT	All	Request current fault condition 0 = No fault 1–xx = Current fault code (See H Series – Fault Message Description table at the end of this section for description.)

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
46	FaultRst	Set	BOOL	All	1 = Execute fault reset 0 = No action Clears any active fault condition. Operation resumes at previous command.
47	FaultLog	Get	<b>C:</b> <u>USINT</u> <u>FaultLogIndex</u> <b>R:</b> UINT FaultCode, UDINT TimeStamp	All	Requests the FaultCode and TimeStamp for the given index. The fault log holds the last 31 fault conditions (1 being most recent) The log will return a 0 for the code and time stamp if the specified index is empty. Time stamp is in seconds.
48	FaultCodeText	Get	<b>C:</b> <u>USINT</u> <u>FaultCode</u> <b>R:</b> STRING FaultText	All	Returns the text string associated with the FaultCode. 16 characters maximum.
49	ForceFault	Set	BOOL	All	0->1 =Force Network Fault 0 = No action
50	SecurityStatus	Get	USINT	All	Requests network security status. 0 = Security disabled  1 = Security unlocked 2 = Security locked

\* Indicates initial powerup value.



**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
51	SecurityLock	Set	INT or NONE	All	Unlocks or locks network parameter security. Passing the valid SecurityCode unlocks parameter access. Any other value (including NONE) locks parameter access.
52	CalcPresets	Set	BOOL	E,S,V	This transaction is used during setup to calculate initial values for tuning and performance parameters based on motor nameplate values. Note: this command is not valid for all product classes. 1 = Execute preset calculation 0 = No action
56	BlockStructure	Get	USINT Level1Max, Level2Max, Level3Max,	All	Returns the number of blocks on each programming level. Assumes a max of three programming levels.
57	BlockDetail	Get	<u>C: USINT</u> <u>Level, Block</u> <u>R: USINT</u> MaxParams, STRING BlockName	All	Returns the number of parameters in the block and the BlockName (16 characters max.)

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
58	BlockParamDetail	Get	<b>C:</b> <u>USINT</u> <u>Level, Block,</u> <u>Index</u> <b>R:</b> INT Pnum, Pvalue, Pmin, Pmax, Pdflt, Pprec, Ptype, STRING Pname, Punits	All	Returns full parameter detail information for the parameter specified at the given Level, Block and index.
59	ParameterDetail	Get	<b>C:</b> <u>INT</u> <u>Pnum,</u> <b>R:</b> INT Pnum, Pvalue, Pmin, Pmax, Pdflt, Pprec, Ptype, STRING Pname, Punits	All	Returns full parameter detail information for the given Pnum.
60	ParameterList	Get	<b>C:</b> <u>INT</u> <u>Pnum,</u> <u>ListIndex</u> <b>R:</b> STRING ListText	All	Returns the enumerated list string for the given parameter number and list index. 16 characters max. If ListIndex exceeds the number of elements an 'end of block' status will be returned. (Note: Use Pmax to determine the end of the list.)

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
61	ParameterValue	Set/ Get	<b>C:</b> INT Pnum, Pvalue <b>R:</b> INT Pvalue (excluding Pvalue from CMD indicates request only).	All	Change / request value of specified user parameter. Returned value will give actual, after any bounds checking. Refer to the control manual for description.
62	BatchSend	Get	<b>C:</b> INT GroupNumber <b>R:</b> INT Pnum <sub>N</sub> , Pvalue <sub>N</sub> , ... N=16	All	Batch transfer that returns raw (data only) from control to host. Up to 16 parameters are sent at a time. Last group will be truncated if necessary. Group numbers start at 0. If the GroupNumber exceeds the number of blocks an 'end of block' status is returned. The control must be disabled.
63	BatchRcv	Set	INT Pnum <sub>N</sub> , Pvalue <sub>N</sub> , ... N=16	All	Block transfer that accepts raw parameter (data only) from host to control. Up to 16 parameters may be sent at a time. Parameters may be sent in any order. The control must be disabled.
64	FactorySettings	Set	BOOL	All	1 = Reset all parameters to factory settings. 0 = No action

\* Indicates initial powerup value.

**Table 6-1 Transaction Specification Table** Continued

T#	Name	Type	Data Field	Class	Description
69	ClearAll	Set	USINT	All	Reserved for factory use.
70	LogClear	Set	USINT	All	Reserved for factory use.
71	AnalogInput1	Get	UINT	All	Reads the raw value of the A/D converters on the control. Update rate and resolution vary per control. Unused MSBs will be padded with zero.
72	AnalogInput2	Get	UINT	All	
73	SetAnalogOut1	Set	INT	All	Commands the DACs on the control, and/or option card. Analog output parameter must be set to Serial to be valid. (Note 8 bit DACs will only use the upper byte.)
74	SetAnalogOut2	Set	INT	All	
75	SetDigitalOut	Set	BYTE	All	Commands the digital outputs on the control, and/or option card. Only lowest four bits are used. The LSB corresponds to opto out #4. The opto output parameter must be set to serial to be valid.
76	GetDebugVal	Get	C: INT MemLoc R: INT Value	All	Reserved for factory use.

\* Indicates initial powerup value.

---

**Table 6-1 Transaction Specification Table** Continued

<b>T#</b>	<b>Name</b>	<b>Type</b>	<b>Data Field</b>	<b>Class</b>	<b>Description</b>
250					Reserved for future use.
251					Reserved for future use.
252					Reserved for future use.
253					Reserved for future use.
254					Reserved for future use.
255					Reserved for future use.

---

## 5 - Command Mode

### Command

5	USINT CommandMode
---	-------------------

### Response

5	ST	USINT CommandMode
---	----	-------------------

### Type: Set/Get

This transaction changes the command mode of the Series H control. The command mode is an 8-bit value. Loading the appropriate value into the command mode register activates the appropriate operating mode. Only one mode can be selected at a time. Table 6-2 provides a description of the possible command modes.

### Initial Condition:

At powerup, the command mode is set to 00H (disabled).

**Table 6-2 Command Mode Table**

<b>Value</b>	<b>Mode</b>	<b>Class</b>	<b>Description</b>
0	None	ALL	No mode selected. Output stage of control remains off or disabled (voltage and current removed from the motor), regardless of RunCmd condition.
1	Torque CMD selected source	S,V	Closes the current loop with command input from the source selected in the COMMAND SELECT parameter.
2	Torque CMD Network	S,V	Closes the current loop with command input from the TorqueRef register.
3	Speed CMD selected source	All	Closes the velocity loop with command input from the source selected in the COMMAND SELECT parameter.
4	Speed CMD Network	All	Closes the velocity loop with command input from the SpeedRef register.
5	Orient	S,V	C or Index channel orient. The motor will be commanded in the Fwd direction at the predefined homing speed until the index pulse is detected. The motor will then be commanded to hold position at the predefined home offset.
6	Position CMD ABS	S,V	Closes the position loop with an absolute position command from the PositionRef register.
7	Position CMD INC	S,V	Closes the position loop with an incremental position command from the PositionRef register.
9	Position CMD External	S,V	Closes the position loop with command input from external option source (such as pulse follower EXB card.)
11	Process Torque	All	Closes the torque process control loop. Commands come from the appropriate command input parameters.
12	Process Velocity	All	Closes the velocity process control loop. Commands come from the appropriate command input parameters.

---

## 31- TerminalStrip

### Command

31
----

### Response

31	ST	WORD TerminalStrip
----	----	--------------------

### Type: Get

This transaction returns a bit-wise word representing the status of the control digital inputs and outputs.

Table 6-3 provides a description of the codes.

Note: A bit value of 1=closed or ON, 0=open or OFF.

**Table 6-3 TerminalStrip Table**

Bit	Name	Typical Single-Axis Location	Typical Multi-Axis Location
0	Output4	J1 (J4) - 22	J1B - 13
1	Output3	J1 (J4) - 21	J1B - 12
2	Output2	J1 (J4) - 20	J1B - 11
3	Output1	J1 (J4) - 19	J1B - 10
4	Input9	J1 (J4) - 16	J1B - 9
5	Input8	J1 (J4) - 15	J1B - 8
6	Input7	J1 (J4) - 14	J1B - 7
7	Input6	J1 (J4) - 13	J1B - 6
8	Input5	J1 (J4) - 12	J1B - 5
9	Input4	J1 (J4) - 11	J1B - 4
10	Input3	J1 (J4) - 10	J1B - 3
11	Input2	J1 (J4) - 9	J1B - 2
12	Input1	J1 (J4) - 8	J1B - 1
13	Not Used		
14	Not Used		
15	Not Used		

Note: J1 = for Vector Controls, J4 = for Inverter Controls.



---

## 36 or 37 - OptionId#

### Command

36
----

### Response

36	ST	USINT OptionId
----	----	----------------

### Type: Get

This transaction returns the id number for the option installed in the specified location.

Table 6-4 provides a description of the possible values.

**Table 6-4 OptionId# Table**

ID	EXB No.	EXB Name	Group
1	EXB001A01	RS232 Serial Communications	2
2	EXB002A01	RS422/485 Serial Communications	2
3	EXB003A01	Isolated Input	1
4	EXB004A01	4 Output Relays / 3-15 PSI Pneumatic	2
5	EXB005A01	Master Pulse Reference/Isolated Pulse Follower	1
6	EXB006A01	DC Tachometer	1
7	EXB007A01	High Resolution Analog I/O	2
8	EXB008A01	Isolated Encoder	1
9	EXB009A01	Resolver to Digital	1
10	EXB010A01	2 Isolated Analog Output / 3 Relay	2
11	EXB012A00	RS232/485 Serial Communications	2

---

## 41 - WatchdogTime

### Command

41	U	INT WatchdogTime
----	---	------------------

### Response

41	ST	U	INT WatchdogTime
----	----	---	------------------

### Type: Set/Get

This transaction is used to change the value of the network watchdog timer. The value is entered in milliseconds (mS). The watchdog timer is used to detect a communications loss. When the time between network commands exceeds the value stored in this register, a fault is generated and the control is disabled. Each time a network command is received, the internal timer is reset to zero. The host must continuously send commands to keep the timer reset. If desired a NULL transaction can be used to reset the timer. Setting the timer to zero disables this function. The minimum time value (other than zero) is 20mS (2). The maximum value is 60S (6000). Resolution varies among product classes.

### Scale/ Units: 10mS

### ParameterDetails

Table 6-5 describes the data that is returned during a parameter detail response.

---

**Table 6-5 ParameterDetails Table**

<b>Field Name</b>	<b>Description</b>
INT Pmin	Parameter minimum allowed value.
INT Pmax	Parameter maximum allowed value. (Number of list items in an enumerated type parameter.)
INT Pdfit	Parameter default value (factory) value.
USINT Pprec	Indicates the number of decimal places to use for the parameter value.
BYTE Ptype	Returns bit-wise parameter type. Bit 0 = Numeric parameter Bit 1 = Enumerated list parameter Bit 2 = Can be changed while enabled Bit 3 = Default from calculation Bit 4 = Not set during 'restore to factory' Bit 5 = Signed parameter
STRING Pname	Returns string representing parameter name. For example "Preset Speed #1". Max number of characters is 16.
STRING Punits	Returns the parameter engineering units string. Max number of characters is 4.

## H Series – Fault Message Description

Fault Message	Fault Code		Fault Description
	15H	18H	
Line Regen	1	1	Fault in Line REGEN converter unit - Series 21H Line REGEN Inverter control.
Feedback Fault		2	Loss of encoder feedback.
Invalid Base ID	3	3	Failed to read configuration from the Power Base ID value in software.
Low INIT Bus V	4	4	Low bus voltage detected on start-up.
Regen Res Power	5	5	Excessive power dissipation required by Dynamic Brake Hardware.
Current SENS FLT	6	6	Failure to sense phase current.
HW Desaturation	7	7	High output current condition detected (greater than 400% of rated output current).
HW Ground Fault	8	8	Ground Fault detected (output current leakage to ground).
Resolver Fault		9	Loss of resolver feedback.
HW Power Supply	10	10	Control Board power supply failure detected.
Overcurrent	11	11	Continuous current limit exceeded.
Bus Overvoltage	12	12	High DC Bus voltage.
Following ERR		13	Motor speed/position does not follow command.
Torque Prove		14	Unbalanced current between all 3 phases.
Bus Undervoltage	15	15	Low DC Bus voltage condition detected.
3 Sec Overload	16	16	Peak output current exceeded the 3 second rating value.
Over Speed		17	Motor RPM exceeded 110% of MAX Speed.
Motor Temp		18	Motor over temperature
Heatsink Temp	19	19	Control heatsink exceeded temperature limit.
External Trip	18	20	Connection at J1/J4 pin 16 and 17 is open.
Param Checksum	51	21	Parameter checksum error.

## H Series – Fault Message Description Continued

Fault Message	Fault Code		Fault Description
	15H	18H	
µp Reset	22	22	A software watchdog timer has reset the processor because a process has timed out.
ROM Fault		23	ROM checksum error.
1 Min Overload	24	24	Peak output current exceeded the 1 minute rating value.
No I Feedback		25	Loss of current feedback
New Base ID	26	26	Control board detected a change in the Power Base ID value in software.
EXB Selection	27	27	Expansion board not installed to support the Level 1 Input Block, Command Select parameter.
Power module		28	Power module failure.
Co-processor		29	Co-processor error (i.e. DSP board).
Software Version		30	Wrong control software version detected.
Feedback Module		31	Feedback HW module failure.
Serial watchdog		32	Serial port transmit/receive error
FLT Network	33	33	Lost network communications.
Hardware Protect	54		A general hardware fault was detected but cannot be isolated.
Unknown FLT Code	55	34	Microprocessor detected a fault that is not identified in the fault code table.
Bus Current SENS	56		Failure to sense bus current.

Note These faults may be different for custom software.

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