

**FlexPak 3000
Pulse Encoder Interface Kit
Installation Instructions**

M/N 907FK0101

Instruction Manual D2-3302-2

 **Rockwell** Automation

Reliance Electric

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1.0 INTRODUCTION

The products described in this instruction manual are manufactured or distributed by Reliance Electric Industrial Company.

This instruction manual describes how to install and configure the optional Pulse Encoder Interface kit used by FlexPak 3000 Digital DC Drives. These instructions assume that either a single-channel or quadrature differential output Pulse Encoder has been properly installed on the drive's motor. (Follow all procedures from the manufacturer to properly install the Pulse Encoder on the motor.)

Each Reliance Model 907FK0101 Pulse Encoder Interface kit includes a Pulse Encoder Interface board (with captive screws), nylon washers, and an extension ribbon cable. See table 1.1.

Table 1.1 - Pulse Encoder Interface Kit Contents

Description	Qty	Reliance Part Number
M3 x 10 Screw	4	419062-001PEG
Nylon Washer	4	419064-0045
Pulse Encoder Interface Board	1	58775-0x
60-pin Ribbon Cable	1	610273-388

1.1 Related Publications

This manual describes the Pulse Encoder Interface kit and its associated FlexPak 3000 software parameters. You will also need the FlexPak 3000 DC Drive instruction manual, which describes the drive hardware and software.

1.2 Getting Assistance from Reliance Electric

If you have any questions or problems with the products described in this instruction manual, contact your local Reliance Electric sales office. For technical assistance, call 1-800-726-8112.

2.0 INSTALLING THE PULSE ENCODER INTERFACE KIT

DANGER

DO NOT INSTALL MODIFICATION KITS WITH POWER APPLIED TO THE DRIVE. 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.

Installing the Pulse Encoder Interface kit requires completing the following steps. When you have finished installing the kit, adjust the required drive parameters as described in chapter 3 before using the drive.

- Opening the drive and carrier
- Mounting the Pulse Encoder Interface board
- Wiring the Pulse Encoder Interface board
- Checking motor and drive wiring
- Closing the carrier and drive
- Verifying and adjusting drive parameters

These steps are described in detail below.

2.1 Opening the Drive and Carrier

- Step 1. Turn off, lockout, and tag power to the drive.
- Step 2. If necessary, loosen the captive screws and remove the cover from the drive.
- Step 3. Loosen the captive screw securing the Operator Interface Module (OIM) carrier, and then swing open the carrier.
- Step 4. Loosen and remove the four screws that attach the shield to the back of the OIM Carrier. See figure 2.1.

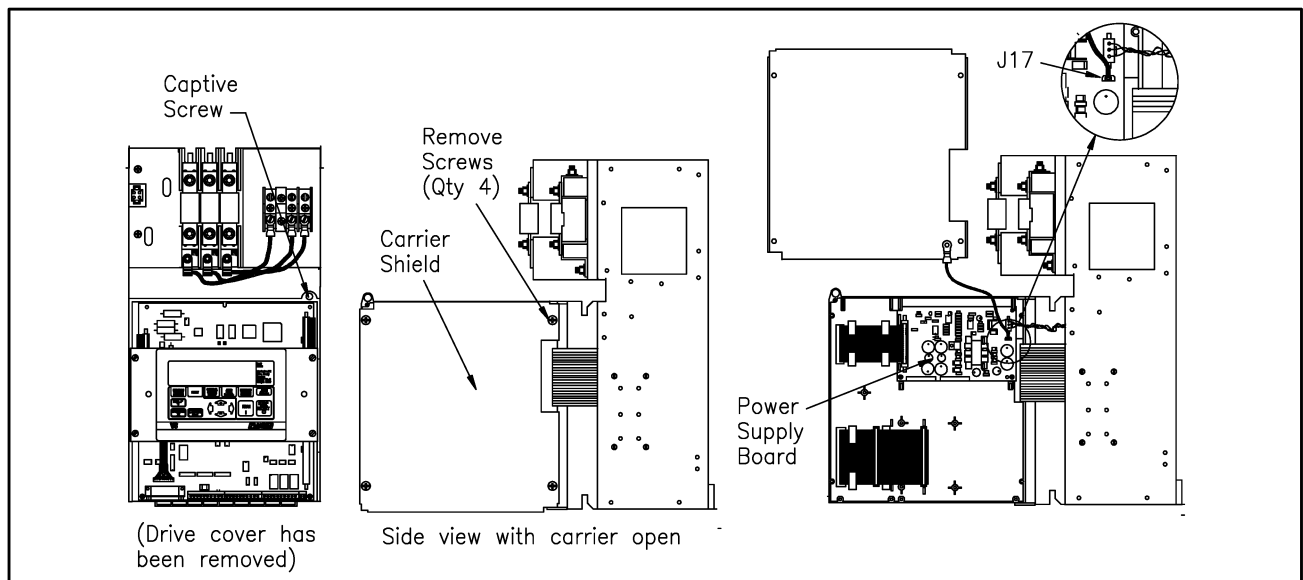


Figure 2.1 - Removing the OIM Carrier Shield

- Step 5. Remove the connector that attaches the shield's ground wire to J17 on the drive's power supply. Set the shield aside.

2.2 Mounting the Pulse Encoder Interface Board

The Pulse Encoder Interface board is mounted on the back of the OIM carrier in one of two ways: directly on the carrier or on an optional I/O (Input/Output) Expansion board.

If no I/O Expansion board is mounted on the carrier, perform the following steps (refer to figures 2.2 and 2.3). **If an I/O Expansion board is mounted on the carrier, skip to step 6.**

- Step 1. Insert a mounting screw in each of the Pulse Encoder Interface board's four mounting holes.
- Step 2. Slide a nylon washer over the end of each mounting screw. When the Pulse Encoder Interface board is mounted, the washers are between the board and the OIM carrier's standoffs (see figure 2.2).
- Step 3. Lift the option board ribbon cable out of the way, then position the Pulse Encoder Interface board over the OIM Carrier's molded standoffs.
- Step 4. Secure the Pulse Encoder Interface board to the carrier using the board's attached screws.
- Step 5. Plug the option board ribbon cable into the Pulse Encoder Interface board.

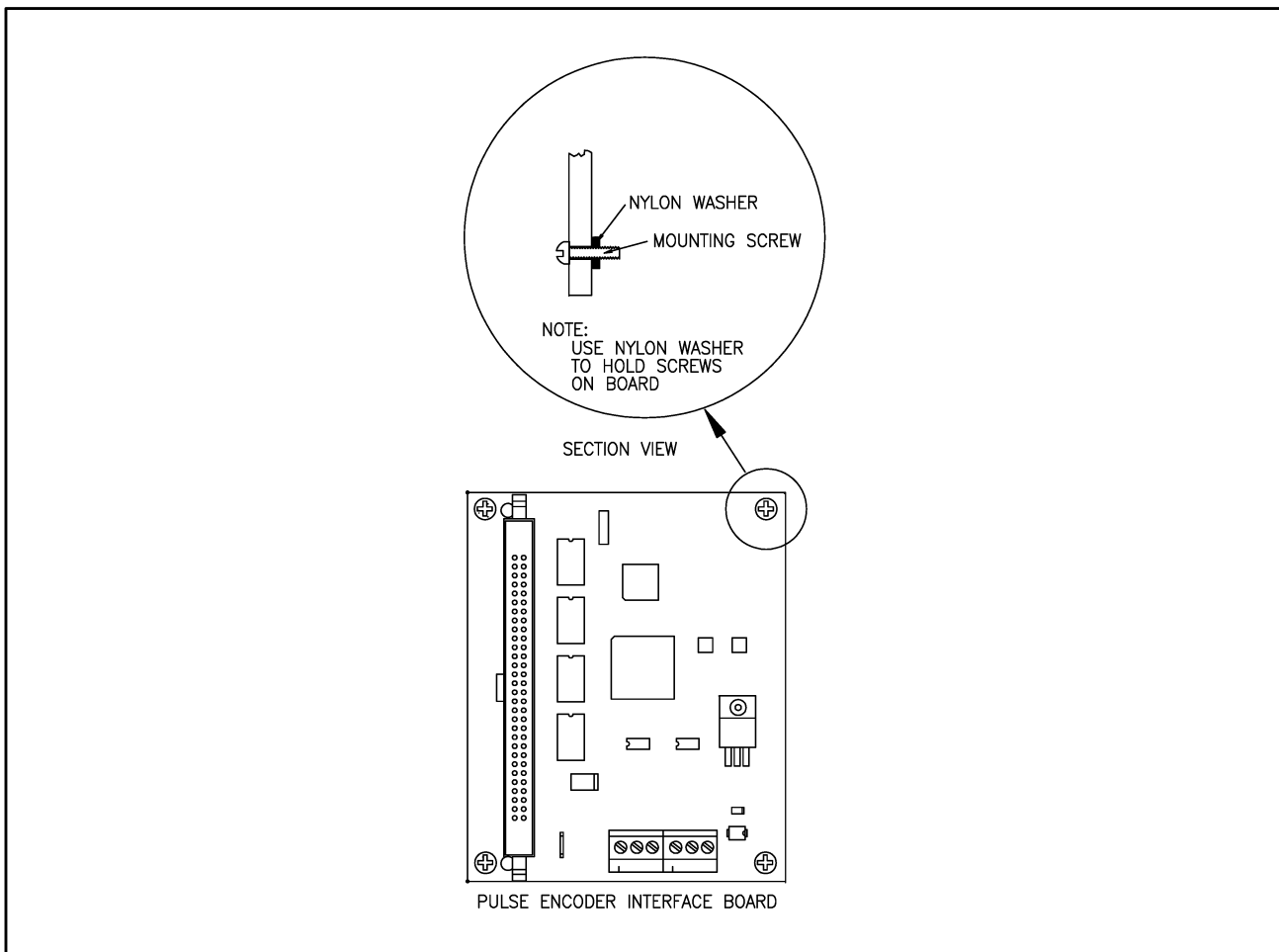


Figure 2.2 - Installing the Mounting Screws and Washers on the Pulse Encoder Interface Board

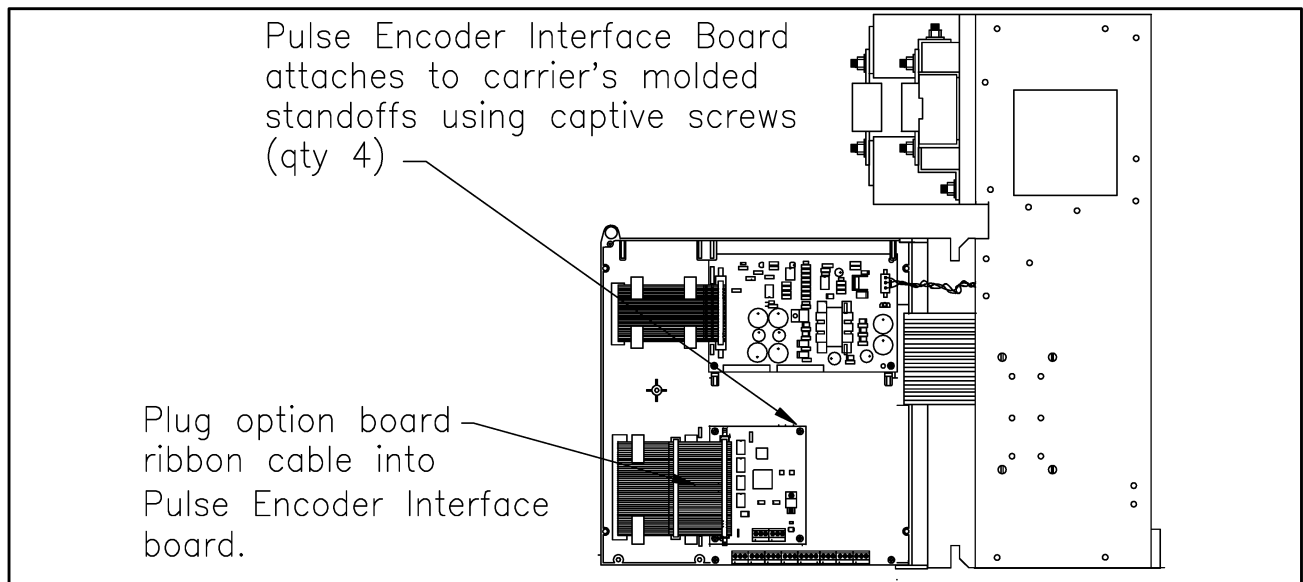


Figure 2.3 - Mounting the Pulse Encoder Interface Board on the Carrier

If an Input/Output Expansion Board is mounted on the carrier, perform the following steps (refer to figures 2.2 and 2.4).

- Step 6. Insert a mounting screw in each of the Pulse Encoder Interface board's four mounting holes.
- Step 7. Slide a nylon washer over the end of each mounting screw. When the Pulse Encoder Interface board is mounted, the washers are between the board and the I/O Expansion board's standoffs (see figure 2.2).
- Step 8. Position the Pulse Encoder Interface board over the I/O Expansion board's standoffs.
- Step 9. Secure the Pulse Encoder Interface board to the I/O Expansion board using the attached screws.
- Step 10. Connect the extension ribbon cable to the Pulse Encoder Interface board and to the I/O Expansion board as shown in figure 2.4.

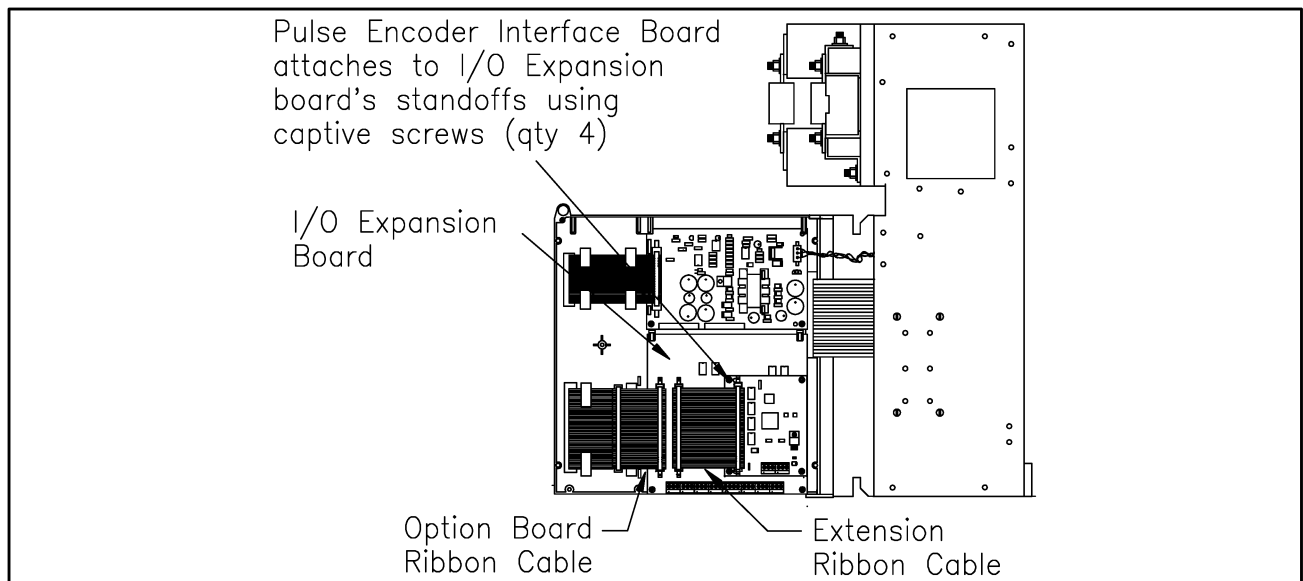


Figure 2.4 - Mounting the Pulse Encoder Interface Board on an I/O Expansion Board

2.3 Wiring the Pulse Encoder Interface Board

Read and follow the recommendations listed below before wiring the Pulse Encoder Interface board.

- Install all wiring in conformance with the NEC/CEC and all other applicable local codes.
- Refer to the manufacturer's wiring diagram (included with the encoder) for all pulse encoder connections.
- Use twisted pair wire having two or three twists per inch. (Reliance twisted pair, 12 to 18 AWG, is recommended for optimum long distance noise immunity.)
- The maximum cable length must insure the minimum specified supply voltage to the pulse encoder and the minimum specified input voltage to the Pulse Encoder Interface board.
- Route all tachometer wiring in its own separate conduit.

Refer to figure 2.5 when making wiring connections.

CAUTION: Do not route pulse encoder wiring with power (AC and DC power) or logic control wiring in the same conduit. This may cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

CAUTION: Do not ground any pulse encoder wiring connection. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

- Step 1. Run the twisted pair wire from the motor to the FlexPak drive's enclosure. Place a lead number on each wire. For example:

Table 2.1 - Twisted Pair Lead Numbering

Pair No.	Function	Wire Lead No.
1	+15 VDC	71
	15 VDC common	72
2	A	73
	A not	74
3	B	75
	B not	76

- Step 2. Swing the drive's OIM carrier open.

- Step 3. Continue routing the twisted pairs to the drive as follows:

Drives without a NEMA 1 enclosure

Route the twisted pairs to the OIM carrier's pivot point and then along the bottom of the carrier to the Pulse Encoder Interface board. Secure the twisted pairs to the OIM carrier's tie bar.

Drives mounted in a NEMA 1 enclosure

Route the twisted pairs through the bottom of the drive chassis to the OIM carrier's pivot point and then along the bottom of the carrier to the Pulse Encoder Interface board. Secure the twisted pairs to the OIM carrier's tie bar.

- Step 4. Make sure that the twisted pair wires reach the Pulse Encoder Interface board's terminal strip, then cut off any excess wire.

- Step 5. Strip about 1/4 inch (6.35 mm) of the insulation from the end of each wire.

- Step 6. Refer to figure 2.5. Connect each lead to the corresponding position on the Pulse Encoder Interface board's terminal strip. Tighten the terminal strip connectors to no more than 7 in-lbs (.79 Nm).

Step 7. Refer to your pulse encoder's installation instructions. Connect the twisted pair wires to the pulse encoder in accordance with its manufacturer's installation instructions.

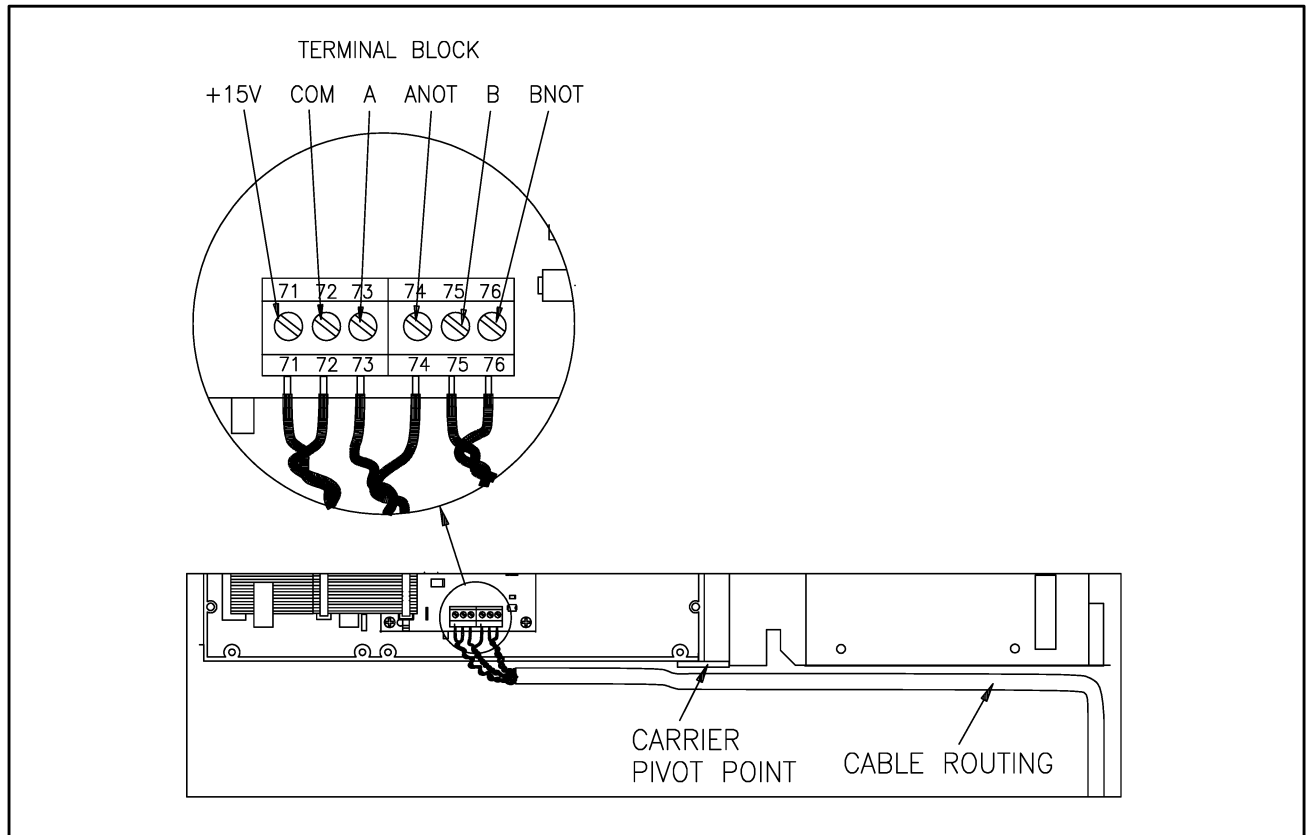


Figure 2.5 - Wiring the Pulse Encoder Interface Board

2.4 Checking Motor and Drive Wiring

Refer to your FlexPak 3000 drive's installation manual. Check all motor and drive wiring to make sure it is correct.

2.5 Closing the Carrier and Drive

Step 1. Close the carrier and secure it in place by tightening the captive screw.

Step 2. If necessary, replace the cover on the drive and secure it in place with its captive screws.

2.6 Verifying and Adjusting Drive Parameters

Perform system parameter adjustments and determine pulse encoder feedback polarity according to the instructions in the following section and your drive's installation manual.

3.0 ADJUSTING DRIVE PARAMETERS

Proper operation of the Pulse Encoder Interface kit requires verifying and adjusting the following drive parameters;

- Parameter 200 (FEEDBACK SELECT),
- Parameter 207 (PULSE TACH PPR),
- Parameter 208 (PULSE TACH QUADRATURE), and
- Parameter 798 (PULSE TACHOMETER KIT).

These parameters are accessed through the SPEED/VOLTAGE LOOP and DRIVE INFORMATION menus on the OIM.

WARNING

THE INCORRECT SETTING OF PARAMETERS 207 (PULSE TACH PPR) AND 208 (PULSE TACH QUADRATURE) CAN CAUSE AN OVERSPEED CONDITION. THESE PARAMETERS MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. SET THE VALUES OF THESE PARAMETERS PER YOUR APPLICATION REQUIREMENTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

3.1 Parameter 200 (FEEDBACK SELECT)

The value of this input parameter determines the type of feedback signal used for the FlexPak 3000 major control loop.

Step 1. Access the Speed/Voltage Loop (SPD) Feedback menu.

Step 2. Verify and/or change (if necessary) the selection to PULSE TACH.

RANGE: Refer to the following table for ranges relating to the software version of the drive.

Table 3.1 - Pulse Encoder Parameter Ranges for Different Firmware Versions

Firmware Version	Range
Earlier than Version 2	ARMATURE VOLT ANALOG TACH PULSE TACH
Version 2 & later	ARMATURE VOLT DC TACH PULSE TACH AC TACH

DEFAULT: ARMATURE VOLT

Note: If the FEEDBACK SELECT has been previously set to PULSE TACH and the Pulse Encoder Interface board either fails power-up diagnostics or is removed, the drive will automatically change FEEDBACK SELECT to ARMATURE VOLT.

3.2 Parameter 207 (PULSE TACH PPR)

This parameter's value must contain the selected pulse encoder's nameplate PPR (Pulses Per Revolution). Refer to Appendix A for how to select a pulse encoder.

Step 1. Access the SPEED/VOLTAGE LOOP menu.

Step 2. Verify and/or adjust the parameter value to match the pulse encoder's PPR nameplate value.

RANGE: 18 - 2500 PPR

DEFAULT: 120 PPR

3.3 Parameter 208 (PULSE TACH QUADRATURE)

Unlike single-channel pulse encoders, a quadrature (dual-channel) pulse encoder indicates both motor speed and rotation direction. A quadrature pulse encoder must be used in applications which change rotation directions. Regenerative drive (S6R) applications must use a quadrature pulse encoder because regenerative current from the drive could result in reverse motor rotation.

When parameter 200 (FEEDBACK SELECT) is set to PULSE TACH, parameter 208 (PULSE TACH QUADRATURE) must be enabled (ON) for all regenerative (S6R) drive applications. Parameter 208 may be disabled (OFF) when using non-regenerative drive applications.

When parameter 208 is disabled (OFF), the drive automatically:

- clamps parameter 006 (NEGATIVE CURRENT LIM) to zero (0) to prevent regenerative current
- clamps parameter 015 (REVERSE DISABLE) to ON to prevent reverse rotation

Step 1. Access the SPEED/VOLTAGE LOOP menu.

Step 2. Verify and/or adjust the parameter value to match your selected pulse encoder type.

RANGE: ON (Enabled)
OFF (Disabled)

DEFAULT: ON (Enabled)

Note: A quadrature pulse encoder can also be used in single-quadrant (non-regenerative, nonreversing) motor applications.

3.4 Parameter 798 (PULSE TACHOMETER KIT)

This output parameter's value simply indicates the status of the Pulse Encoder Interface board. See the following table for status values and descriptions:

Table 3.2 - Parameter 798 Status Descriptions

Status Value	Description
NOT INSTALLED	A Pulse Encoder Interface board is not installed in the drive. The drive's processing will also prevent parameter 200 (FEEDBACK SELECT) from being set to PULSE TACH.
INSTALLED	A Pulse Encoder Interface board is installed in the drive and it passes power-up diagnostics.
FAILEDDIAGS	A Pulse Encoder Interface board is installed in the drive and it fails power-up diagnostics. The drive's processing will also prevent parameter 200 (FEEDBACK SELECT) from being set to PULSE TACH. Using the OIM's DRIVE INFORMATION menu, verify the status of the Pulse Encoder Interface board.

Note: If parameter 200 (FEEDBACK SELECT) has been previously set to PULSE TACH and the Pulse Encoder Interface board is either removed or fails power-up diagnostics, the drive will automatically change parameter 200 to ARMATURE VOLT.

4.0 DETERMINING PULSE ENCODER FEEDBACK POLARITY

The drive may require that the feedback polarity of some pulse encoders be reversed for proper operation. After you have installed the Pulse Encoder Interface board and have adjusted the drive's parameters, verify that your pulse encoder has the correct feedback polarity.

WARNING

IF THE ROTATION OF THE MOTOR IS CHANGED FROM COUNTERCLOCKWISE TO CLOCKWISE, YOU MUST REVERSE THE PULSE ENCODER FEEDBACK POLARITY ON THE B AND B NOT LEADS IN ADDITION TO CHANGING EITHER THE MOTOR ARMATURE LEAD CONNECTIONS OR THE FIELD CONNECTIONS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

To determine pulse encoder feedback polarity, perform the following steps:

- Step 1. Turn on power to the drive.
- Step 2. Access the SPEED/VOLTAGE menu.
- Step 3. Select parameter FEEDBACK SELECT and adjust its value to ARMATURE VOLT.
- Step 4. Select the SPEED/VOLTAGE TEST POINT menu from the SPEED/VOLTAGE menu.
- Step 5. In the SPEED/VOLTAGE TEST POINT menu, select output parameter PULSE TACH FEEDBACK and verify that the PULSE TACH FEEDBACK value's polarity matches the drive's requested direction for motor rotation.

Note: Output parameter PULSE ENCODER FEEDBACK indicates the motor's speed (as a +/- RPM value) received from the pulse encoder.

A positive (+) RPM value indicates that the pulse encoder is rotating in a FORWARD direction.

A negative (–) RPM value indicates that the pulse encoder is rotating in a REVERSE direction.

- Step 6. Initiate a JOG command on the drive.
- Step 7. If the polarity (+ or – sign) of the PULSE TACH FEEDBACK parameter's RPM value does not match the drive's requested direction of motor rotation, perform steps 8 through 20. Otherwise, skip to step 19.
- Step 8. Turn off, lockout, and tag power to the drive.
- Step 9. Loosen the captive screw and swing the carrier open.
- Step 10. Loosen and remove the four screws that attach the shield to the back of the OIM Carrier. See figure 2.1.
- Step 11. Remove the connector that attaches the shield's ground wire to the drive's power supply. Set the shield aside.
- Step 12. Perform the following procedure to change polarity for the PULSE TACH FEEDBACK parameter.
 - a) Remove the B (75) and B NOT (76) pulse encoder leads from the Pulse Encoder Interface board. See figure 2.5.
 - b) Reverse the leads and reconnect them to the Pulse Encoder Interface board's terminal strip. (Connect lead 75 to terminal 76 and lead 76 to terminal 75.)
- Step 13. Connect the carrier shield's ground wire to the drive's power supply.
- Step 14. Re-attach the shield to the carrier.
- Step 15. Close the carrier and secure it in place by tightening its attached captive screw.

- Step 16. Re-install the drive's cover, if necessary.
- Step 17. Remove the lockout and tag.
- Step 18. Turn on power to the drive.
- Step 19. Using the SPEED/VOLTAGE menu, select parameter FEEDBACK SELECT and adjust its value to PULSE TACH.
- Step 20. Check for proper drive operation.

Appendix A

Technical Specifications and Application Data

Table A.1 contains pulse encoder, wire size, and Pulse Encoder Interface board specifications. The pulse encoder and wire specifications are guidelines for meeting requirements of the Pulse Encoder Interface board.

Table A.1 - Pulse Encoder, Wire Size, and Pulse Encoder Interface Board Specifications

Pulse Encoder	
Differential Outputs	Better noise immunity than pulse encoders with single-ended outputs
Wave Form	Including zero (0) speed
Duty Cycle	50% Nominal
Quadrature	Required for all regenerative/reversing drive applications
Line Drivers	May be needed to satisfy the Pulse Encoder Interface board's voltage limits (see Voltage Limit)
Wire Size	
Wire AWG	3 twisted pair 12 to 18 AWG (2 to 3 twists per inch)
Pulse Encoder Interface Board	
Power Supply	+15 VDC \pm 5% 200 mA (maximum)
Differential Inputs	
Impedance	11K Ω
Line Termination	100 Ω in series with a 3900 pF capacitor
Frequency Limit	100 kHz (absolute maximum) 73 kHz (recommended maximum) 50 Hz (minimum)
Voltage Limit	25 VDC to common (absolute maximum) 15 VDC (recommended maximum) 5 VDC (minimum) Note: <i>square wave (amplitude) after tachometer lead IR drop</i>

Selecting a Pulse Encoder

In addition to the specifications in table A.1, base your selection of an appropriate pulse encoder on the following criteria:

- A single-channel pulse encoder is used for non-regenerative and non-reversing motor applications. For FlexPak 3000 non-regenerative drives (S6), use a single-channel differential output (A and A not) pulse encoder. Refer to figure A.1 for an example waveform from a single-channel pulse encoder.

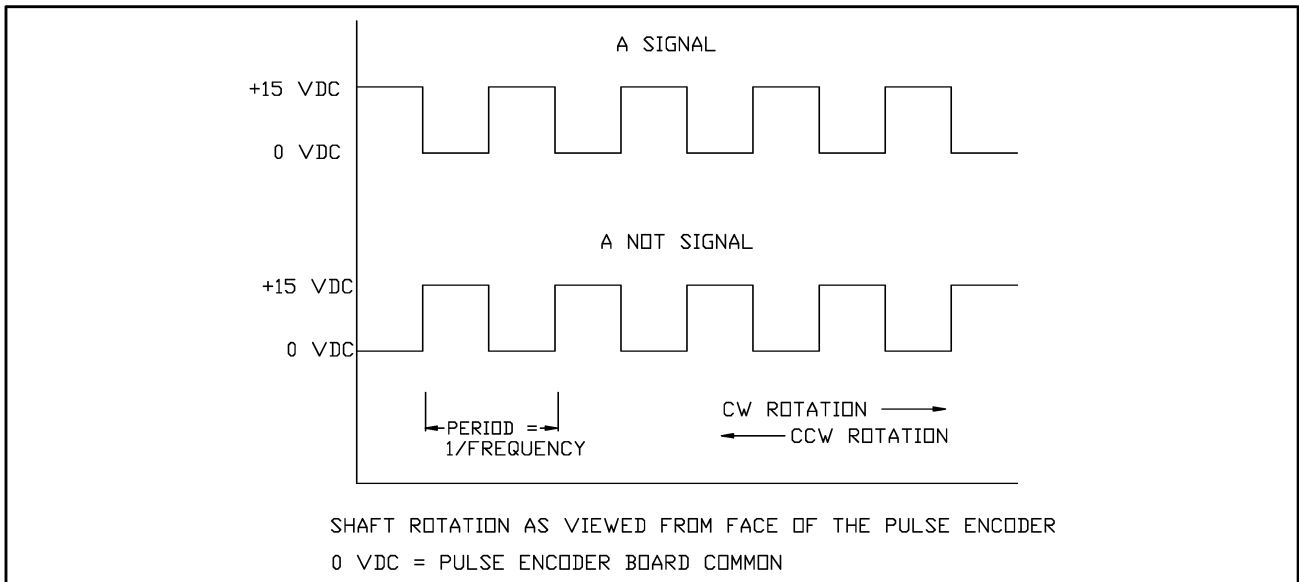


Figure A.1 - Single-Channel Pulse Encoder Waveform

- A quadrature pulse encoder is used primarily for regenerative and reversing motor applications. For FlexPak 3000 regenerative drives (S6R), use only a dual-channel (quadrature) differential output (A, A not and B, B not) pulse encoder. Refer to Figure A.2 for an example waveform from a quadrature pulse encoder.

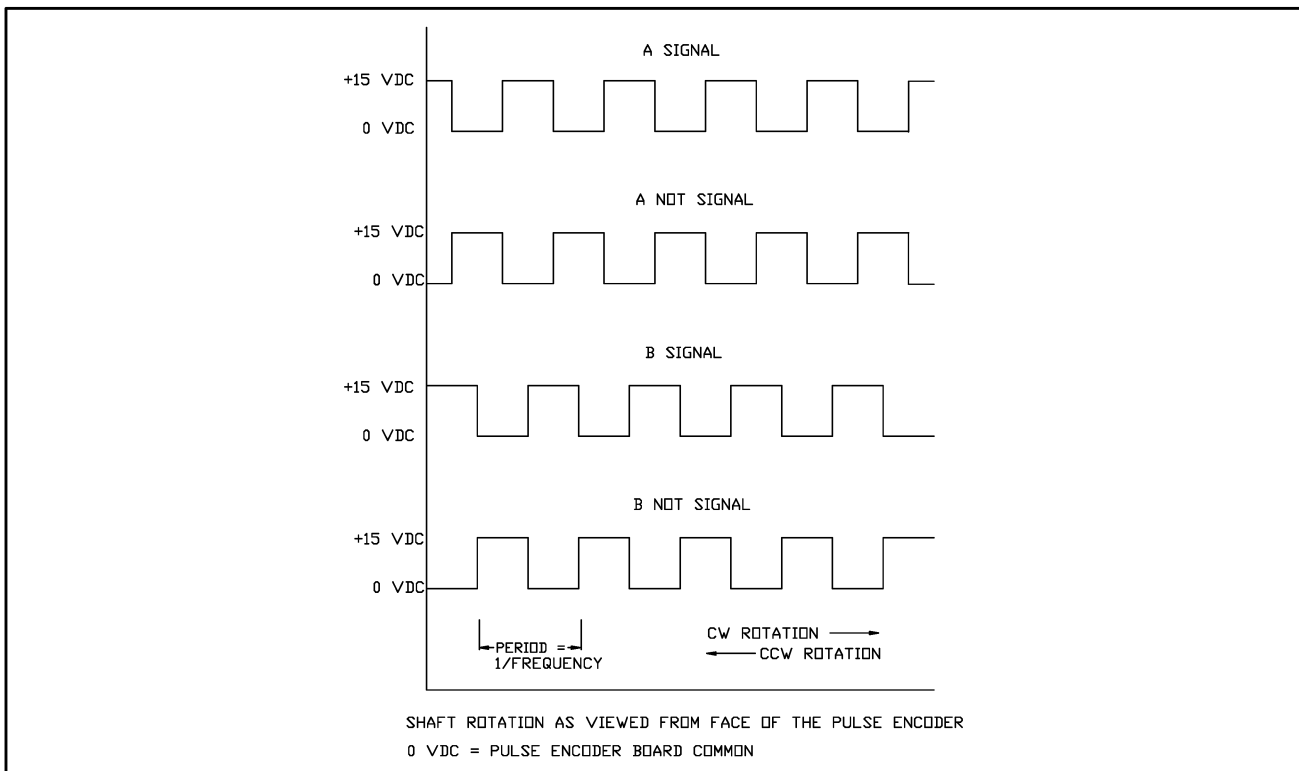


Figure A.2 - Dual-Channel Pulse Encoder Waveform

- The pulse encoder's power requirements must be within the pulse encoder Interface board's power supply specification. The voltage drop due to lead runs between the drive and the pulse encoder should be factored into the selection process. The Pulse Encoder Interface board requires at least 5 VDC pulses.

How to Set the Pulse Encoder

Use the steps that follow to set the pulse encoder. The example uses a 5,000 RPM motor with a requirement to run as low as 25 RPM. The pulse encoder has a maximum rated nameplate frequency of 120 kHz.

- Step 1. Determine the pulse encoder's minimum PPR requirement. One pulse/scan is required to guarantee the specified drive regulation performance. Since the Pulse Encoder Interface board's scan time is 0.02 seconds, the board requires a minimum of 50 pulses per second from the pulse encoder. Given a desired minimum drive speed (RPM), the minimum number of pulses per revolution for your application can be calculated by:

$$PPR_{MIN} = \frac{[1] \times 60}{N_1 \times 0.02}$$

where:

PPR_{MIN} = The pulse encoder's minimum pulses per revolution

N_1 = The required minimum motor speed in RPM

For example:

$$PPR_{MIN} = \frac{[1] \times 60}{25 \times 0.02} = 120 \text{ PPR}$$

- Step 2. Determine the maximum allowable pulse encoder PPR. To leave adequate "head room" for possible motor overspeeding at the motor's rated nameplate speed, the Pulse Encoder Interface board's headroom frequency should not exceed 73 kHz, the module's maximum frequency.

$$PPR_{MAX} = \frac{73,000 \times 60 \text{ sec/min}}{N_2}$$

where:

PPR_{MAX} = The maximum allowable pulse encoder PPR

N_2 = Motor rated nameplate speed (TOP SPEED parameter value)

For example:

$$PPR_{MAX} = \frac{73,000 \times 60}{5,000} = 876 \text{ PPR}$$

- Step 3. Pick a PPR for the application between the values calculated in steps 1 and 2.

$$PPR_{MIN} \leq PPR_{REQ} \leq PPR_{MAX}$$

where:

PPR_{REQ} = The PPR required for the application

For example:

$$PPR_{MIN} \leq 500 \leq PPR_{MAX}$$

Step 4. Using the value calculated in step 3, calculate the pulse encoder frequency at the motor's rated maximum RPM (TOP SPEED parameter value).

$$FREQ_{REQ} = \frac{N_2 \times PPR_{REQ}}{60}$$

where:

$FREQ_{REQ}$ = The pulse encoder's required frequency

N_2 = Motor rated nameplate speed (TOP SPEED parameter value)

PPR_{REQ} = The PPR required for the application

For example:

$$FREQ_{REQ} = \frac{5,000 \times 500}{60} = 41.67 \text{ kHz}$$

Step 5. To ensure that the pulse encoder has adequate head room for motor overspeeding, confirm that the pulse encoder's required frequency is less than or equal to 80% of the pulse encoder's maximum rated nameplate frequency.

$$FREQ_{REQ} = 80\% \times FREQ_{PE}$$

where:

$FREQ_{REQ}$ = The pulse encoder's required frequency

$FREQ_{PE}$ = The pulse encoder's maximum rated nameplate frequency

For example:

$$41.67 \text{ kHz} \leq [0.8 \times 120,000]$$

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