



## Heidenhain Feedback Option Card for PowerFlex 700S Phase II Drives



**ATTENTION:** To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC & –DC terminals of the Power Terminal Block. The voltage must be zero.



**ATTENTION:** HOT surfaces can cause severe burns. **Do not** touch the heatsink surface during operation of the drive. After disconnecting power allow time for cooling.



**ATTENTION:** This drive contains **ESD** (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

**ATTENTION:** This Feedback Option Card is only for use with PowerFlex 700S **Phase II** Control.

### What This Kit Contains

Verify that your kit contains the items listed in the following table. If your kit does not contain the correct items, contact your Rockwell Automation sales representative.

Quantity:	Description
1	Heidenhain Feedback Option circuit board
2	34 - pin “stacker” connectors
3	Screws with captive lock washers

### Tools That You Need

- Phillips® screwdriver for M3 screws
- Pozidrive® screwdriver for M4 screws (for high power drives only)
- Nut driver or wrench for M3 hex nut
- Nut driver or wrench for M5 hex nut

Phillips® is a registered trademark of Phillips Screw Company  
Pozidrive® is a registered trademark of Phillips Screw Company

**What You Need to Do**

To remove the feedback option board from a PowerFlex 700S drive:

- Step 1: Remove power from the drive
- Step 2: Open door over power unit and main control board
- Step 3: Remove the control cassette
- Step 4: Remove the outside covers from the cassette
- Step 5: Remove the feedback option card

To install the new feedback option board on the PowerFlex 700S drive:

- Step 6: Install the feedback option card
- Step 7: Wire the feedback option card to the encoder
- Step 8: Wire the outputs of the feedback option card to a control device (if necessary)
- Step 9: Replace the covers and control cassette
- Step 10: Document revision changes

To return replaced feedback option board, use packing material from the new feedback option board.

## Step 1: Removing Power from the Drive

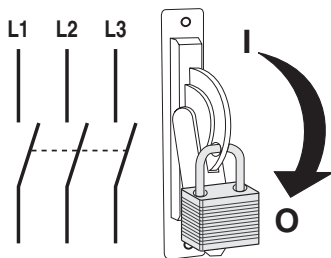


**ATTENTION:** To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC & –DC terminals of the Power Terminal Block. The voltage must be zero.

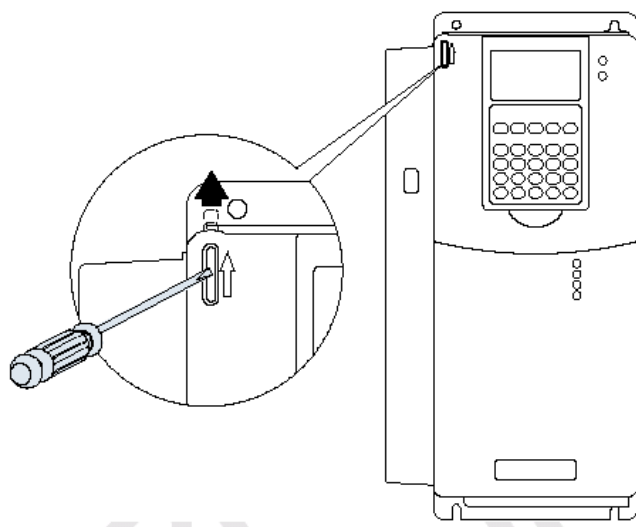
Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.



## Step 2: Opening Door Over Power Structure and Main Control Board



### Frames 1-4

Locate the slot in the upper left corner. Slide the locking tab up and swing the cover open. Special hinges allow cover to move away from drive and lay on top of adjacent drive (if present).

### Frame 5

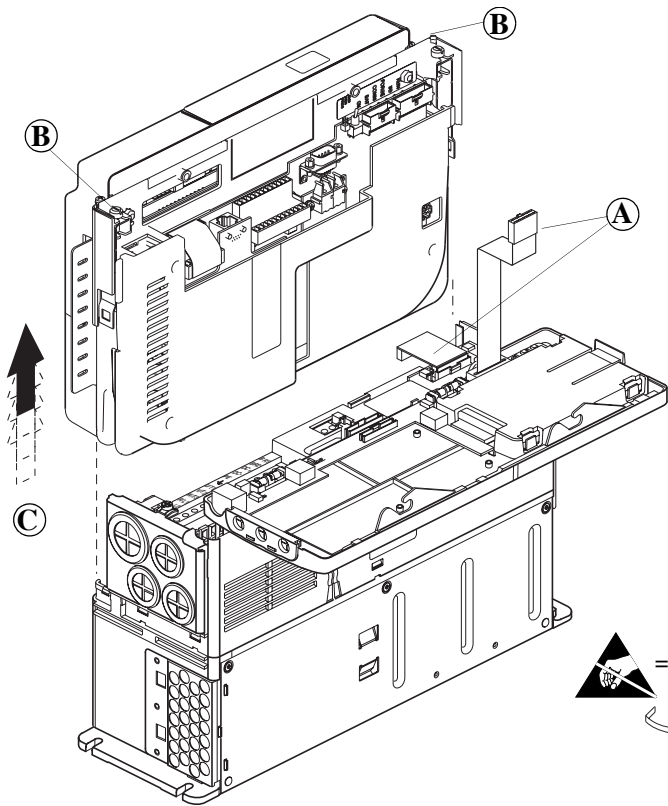
Slide the locking tab up, loosen the right-hand cover screw and remove.

### Frame 6

Loosen 2 screws at bottom of drive cover. Carefully slide bottom cover down & out. Loosen the 2 screws at top of cover and remove.

### Step 3: Removing the Control Cassette

It is necessary to remove the control cassette from the drive for installing the Heidenhain Feedback Option Card.



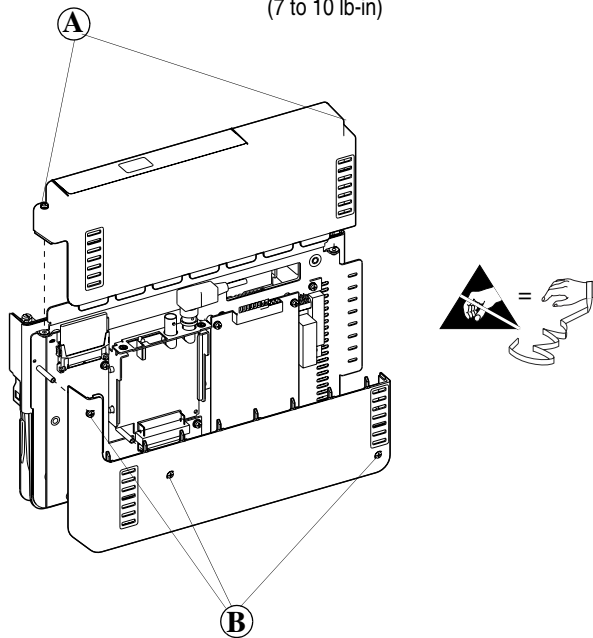
#### Removing the Cassette

Task	Description
(A)	Disconnect the cables that connect the main board
(B)	Loosen 2 screws on face of cassette
(C)	Remove the cassette

Proper tightening torque for reassembly is 1 Nm (7 to 10 lb-in)

### Step 4: Removing the Outside Covers from the Cassette

Task	Description
(A)	Loosen 2 screws on face of front cover and remove the cover
(B)	Loosen 3 screws on side of rear cover and remove the cover



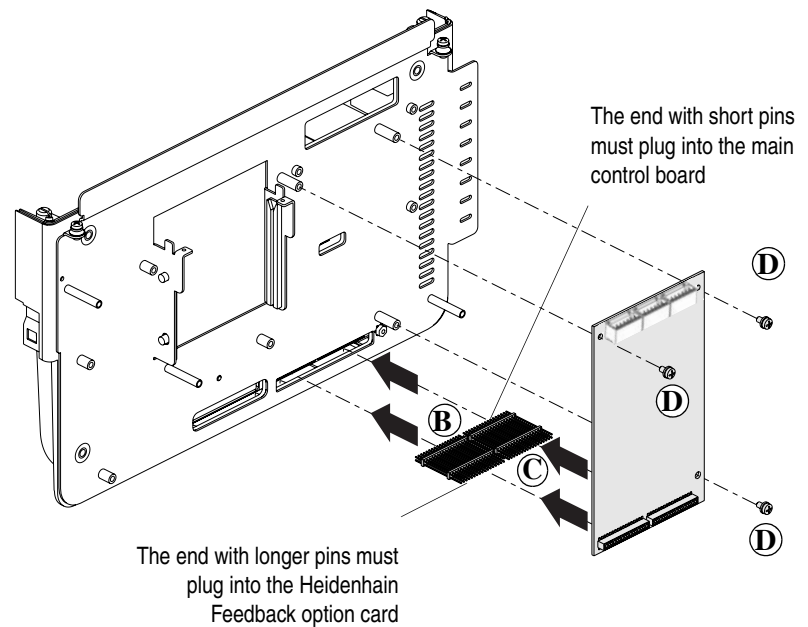
## Step 5: Removing the Feedback Option Card

If you are replacing the the Feedback Option card with a new one, the procedure is the reverse of installing the Heidenhain Feedback Option card, as shown in the next step 6.

## Step 6: Installing the Heidenhain Feedback Option Card

The following figure shows the Heidenhain Feedback Option card and the parts associated with its installation. To install the card, follow the tasks.

Task	Description
Ⓐ	Remove the terminal blocks from the sockets J1-J3 on the Heidenhain feedback option card.
Ⓑ	Insert short pins of through-board pin connectors into mating connectors on the the main control board. The end with short pins must plug into the main control board.
Ⓒ	Plug mating connectors of feedback option card onto long pins of through-board pin connectors.  The end with longer pins must plug into the Heidenhain feedback option card.
Ⓓ	Secure card to stand-offs, using screws with captive lock washers, tighten screws with phillips screwdriver (min./max 0.7 Nm / 0.9 Nm or 6 in-lb / 8 in-lb).

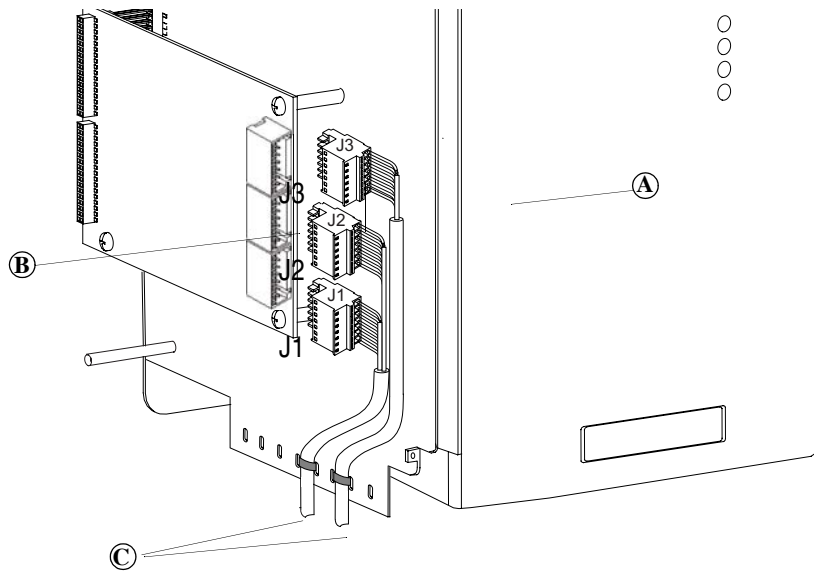


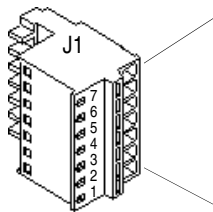
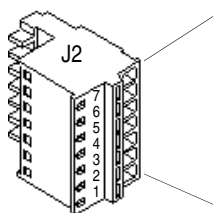
**Important:** Do not use a screwdriver to pry the terminal plugs from the circuit board. This may damage the plug.

### Step 7: Wiring the Heidenhain Feedback Option Card to an Encoder

Terminal blocks J1, J2 contain connection points for a Heidenhain encoder with EnDat interface and terminal block J3 contains connection points for a simulated incremental encoder output. These terminal blocks reside on the Encoder Feedback Option card.

Task	Description
Ⓐ	Connect the encoder and control device cable (if used) to the terminal block plugs J1-J3.
Ⓑ	Re-install the plugs, when wiring is complete.
Ⓒ	Route and secure cables. Use cable ties to anchor cables to slots on this flange for strain relief.



Encoder Connections	Terminal	Signal	Description
	J2-7	0V SENSOR	Sensor lines of the voltage at the encoder
	J2-6	Up SENSOR	
	J2-5	POWER COMMON	Power supply for the encoder interface.
	J2-4	POWER Up	
	J2-3	B-	Neg. sinusoidal incremental signal
	J2-2	B+	Pos. sinusoidal incremental signal
	J2-1	A-	Neg. cosinusoidal incremental signal
	J1-7	A+	Pos. cosinusoidal incremental signal
	J1-6	INTERNAL SHIELD	Analog signals shield
	J1-5	SHIELD	Cable shield
	J1-4	CLOCK-	Synchronization clock signal
	J1-3	CLOCK+	
	J1-2	DATA- (RS 485)	Data input /output signal lines of serial data transmission
	J1-1	DATA+ (RS 485)	

**NOTE:** The terminal blocks are keyed, but without designation label.

### Recommended Cables

Use of shielded cables with properly terminated shielding is required to control electromagnetic emissions for CE EMC compliance.

Table 1.A specifies recommended cables for connecting the Heidenhain Encoder Feedback Option module to the encoder and to a control device.

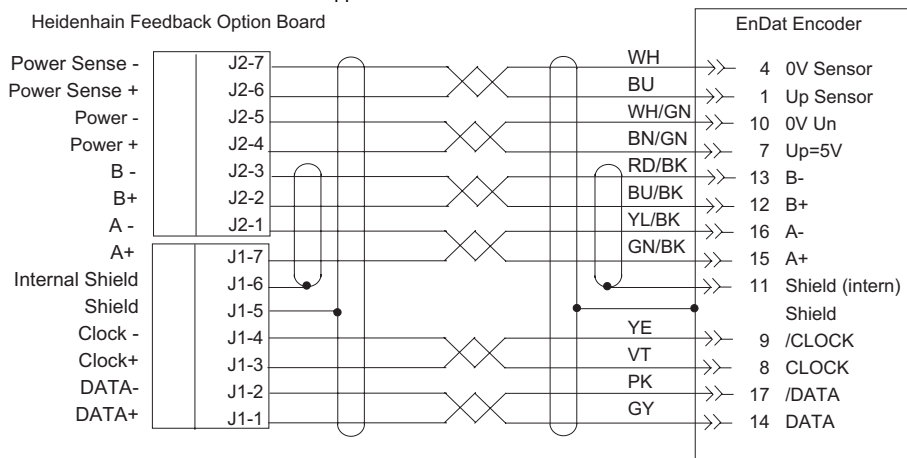
**Table 1.A Recommended Cables**

Connection	Cable Type	Specification
Non-EnDat Encoder	Heidenhain shielded cable Type PUR, 12 pins	4 (2 x 0.14mm <sup>2</sup> ) + (4 x 0.5mm <sup>2</sup> ) with distributed capacitance of 90 pF/m
EnDat Encoder	Heidenhain shielded cable Type PUR, 17 pins	(4 x 0.14mm <sup>2</sup> ) + 4 (2 x 0.14mm <sup>2</sup> ) + (4 x 0.5mm <sup>2</sup> ) with distributed capacitance of 90 pF/m
Simulated Incremental Encoder Output	Belden 9773 (or equivalent)	3 twisted and shielded pairs 0.75mm <sup>2</sup>

### EnDat Rotary Encoder Connection Example

The wire color codes are valid for the Heidenhain cable PUR (see Table above)

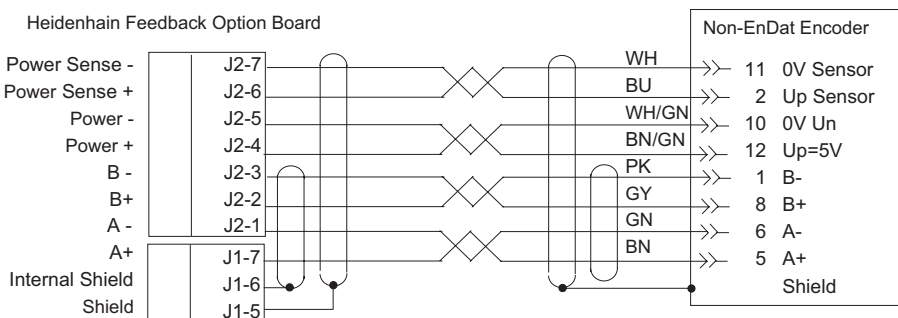
**NOTE:** Refer also to the Instruction Sheet supplied with the Heidenhain encoder



### Non-EnDat Rotary Encoder Connection Example

The wire color codes are valid for the Heidenhain cable PUR (see Table above).

**NOTE:** Refer also to the Instruction Sheet supplied with the Heidenhain encoder.



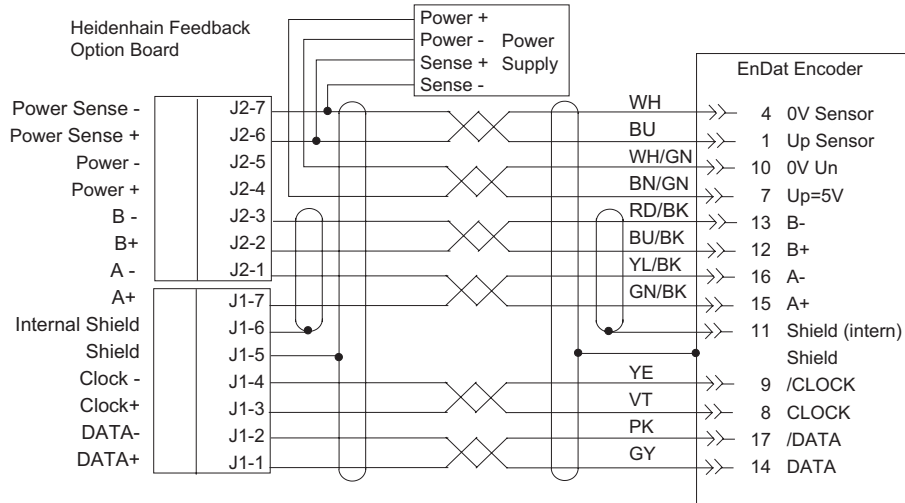
**EnDat Angle Encoder Connection Example**

The wire color codes are valid for the Heidenhain cable PUR (see Table above).

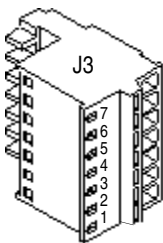
**NOTE:** Refer also to the Instruction Sheet supplied with the Heidenhain encoder.

**NOTE:** For the Heidenhain angle encoder (e.g. RCN727/827), an external power supply (5V +/-5% / max. 350mA) is needed.

So, J2-4 (Power+) and J2-5 (Power-) must not be connected to the encoder. The brown/green and white/green conductors have to be connected to the external power supply.

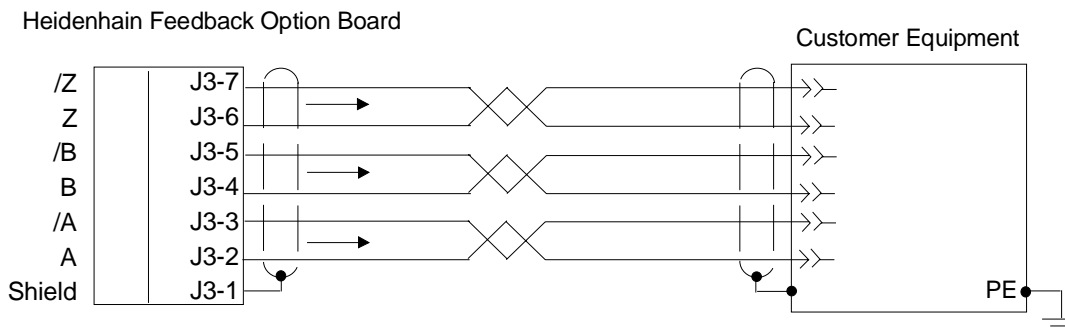


**Step 8: Wiring the Simulated Incremental Encoder Output of the Heidenhain Feedback Option Card (if necessary)**

Output Signals	Terminal	Signal	Description
	J3-7	/Z	Reference mark signal
	J3-6	Z	Incremental square -wave output signals.
	J3-5	/B	
	J3-4	B	
	J3-3	/A	
	J3-2	A	
	J3-1	Shield	Connection point for cable shield
			See also <a href="#">Specifications on page 10</a>

**Simulated Incremental Encoder Output Connections Example**

For recommended cable see Table 1.A on page 7)



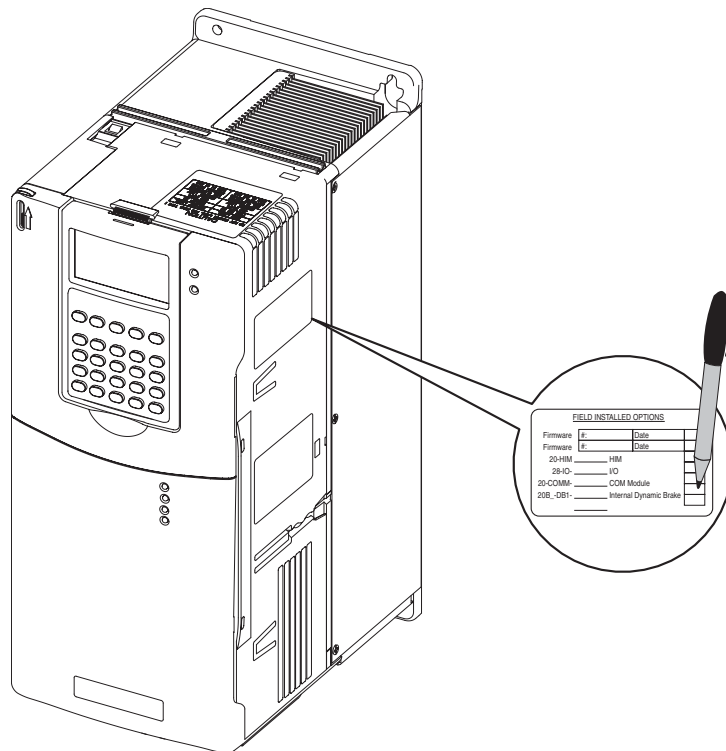


## Step 9: Replacing the Covers and Control Cassette

**Important:** The procedure for replacing the covers and control cassette is the reverse of removing these components. Refer to [Step 3: Removing the Control Cassette on page 4](#). and [Step 4: Removing the Outside Covers from the Cassette on page 4](#)

## Step 10: Documenting Revision Changes

Document drive revisions on the “Field Installed Options” tag. Use the blank line if you are installing the Heidenhain Feedback option in a drive that was manufactured without it.



Specifications

Heidenhain Feedback Option Card Specifications

Table 1.B General Data

Consideration	Description
Encoder Power Supply	5V dc ±5% @ 250 mA
Position Format - Bits per Revolution - Distinguishable Revolutions	20 bits for multi-turn and 20 or 24 bits for single-turn 4096 (12 bits) (Multiturn)
Incremental Signals - Line Count - Cut-off Frequency	Sine/Cosine 1V P-P Offset 2.5 512, 1024, 2048, 4096, 32768 < 180 kHz
Maximum Cable Length	150m (492 ft.)
Maximum Frequency (Encoder Speed)	(300 RPM for encoders with 32768 sine cycles per revolution) (1800 RPM for encoders with 4096 sine cycles per revolution) (3600 RPM for encoders with 2048 sine cycles per revolution) (7200 RPM for encoders with 1024 sine cycles per revolution) (10000 RPM for encoders with 512 sine cycles per revolution)

Table 1.C Simulated Incremental Encoder Output Data

Consideration	Description
Simulated Output  - Maximum Frequency	5V TTL / 25 mA Maximum short circuit protection current: 50 mA 200 kHz Signals Pattern

The diagram shows six digital signals: /Z, Z, /B, B, /A, and A. Each signal is labeled with '5V' on the left. A horizontal double-headed arrow labeled 'T' spans the width of the diagram, with four vertical lines dividing it into four equal segments. The signals exhibit a specific phase relationship: /Z and Z are complementary square waves; /B and B are complementary square waves; /A and A are complementary square waves. The signals /Z, Z, /B, and B are in phase with each other, while /A and A are phase-shifted relative to them.

## Supported EnDat Devices

Table 1.D specifies which EnDat rotary encoders are supported by the PowerFlex 700S Phase II Heidenhain Encoder Feedback Option module.

**Table 1.D Supported Heidenhain EnDat Devices - Rotary Encoders**

Model	Distinguishable Revolutions (Multi-turn)	Line Counts	Mechanical Mounting
ECN 113	-	2048	Rotary encoders with mounted stator coupling, blind hollow shaft or hollow through shaft
ECN 413, ECN 1313	-	512 / 2048	
ECN 1113	-	512	
EQN 425, EQN 1325	4096 (12 bits)	512 / 2048	
EQN 1125	4096 (12 bits)	512	
ROC 413	-	512 / 2048	Rotary encoder for separate shaft coupling with synchro flange
ROQ 425	4096 (12 bits)	512 / 2048	
ROC 415	-	8192	

Interface	EnDat 2.1 (serial bidirectional)
Output Incremental Signals	Sinusoidal voltage signals ~ 1 V <sub>PP</sub> 2 nearly sinusoidal signals A and B  Signal amplitude M: 0.8 to 1.2 V <sub>PP</sub> Asymmetry IP - NI/2M: Typically 1 V <sub>PP</sub> Signal ratio M <sub>A</sub> /M <sub>B</sub> : 0.065/0.05 Phase angle  φ <sub>1</sub> + φ <sub>2</sub> /2: 0.8 to 1.25/0.9 to 1.1 90° ±10° elec./±5° elec.

Table 1.E specifies which EnDat angle encoders are supported. For these angle encoders, firmware with version 3.01 or higher is required for PowerFlex 700S and firmware version 2.0 or higher with ID 16720 (indicated by Par.249 on version 2.0) is required for Heidenhain option. An external power supply (5V +-5% / max. 350mA without load) is required for the encoder. See EnDat Angle Encoder Connection Example.

**Table 1.E Supported Heidenhain EnDat Devices - Angle Encoders**

Model	Distinguishable Revolutions	Line Counts	Mechanical Mounting
RCN 727	-	32 768	Angle encoders with mounted stator coupling, hollow through shaft
RCN 827	-	32 768	
RCN 729	-	32 768	
RCN 829	-	32 768	
RCN 220	-	16 384	
RCN 226	-	16 384	

RCN729/829 is the upgrade of the angle encoder RCN727/827 with EnDat 2.2 or EnDat 2.1 communication interface. Therefore indication of the used interface with EnDat 2.1 is required when ordering.

RCN226 is the upgrade of the angle encoder RCN220.

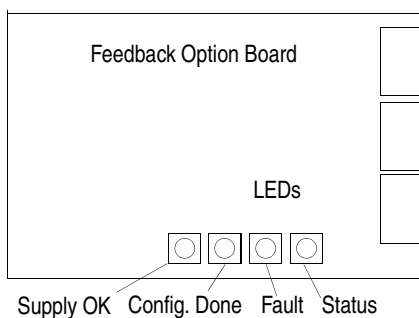


### LED Status Indicators



**ATTENTION:** The Heidenhain feedback option board LEDs are only operational when energized, and visible when the front cover of the cassette is removed. Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of the controlled equipment. Follow Safety related practices of NFPA 70E, ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES. DO NOT work alone on energized equipment!

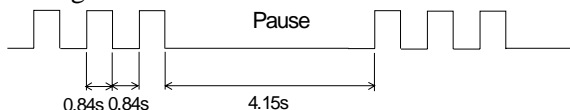
The feedback option board provides four indicators to report its operation status. The LED functional descriptions are provided below in Table 1.G.



**Table 1.G LED Status Indicators**

Name	Color	State	Description
Supply OK	Green	Solid	Power Supply OK
		OFF	The board is not correctly powered
Config. Done	Yellow	Solid	The FPGA is correctly configured
		OFF	The FPGA configuration is unsuccessful
Fault	Red	Steady OFF	No Faults
		Flashing	The option board is operational, but has an error and the transferred position value is not correct. The <b>number [n] of flashes</b> (see pattern below) indicates one of the following errors:
		[1]	EnDat communication CRC error
		[2]	Parameter access error
		[3]	The uP interrupt error
		[4]	The position quadrature error
		[5]	EnDat communication error
		[6]	Encoder power supply error
		[7]	The sine/cosine signal amplitude too small
		[8]	The sine/cosine signal amplitude too high
[9]	The data bus from uP to FPGA error		
[10]	Data format error		
Status	Green	Flashing	The 'STATUS' LED indicates that the initialization of microprocessor and EnDat communication, if with EnDat, is done.
		OFF	The microprocessor is not operational

**Flashing Pattern on the FAULT LED**



Example: uP interrupt error, n = 3 flashes





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