

## ENCODER INSTRUCTIONS

## SV850

## Incremental Encoder

### GENERAL

The Avtron Model SV850 SAFETach™ III is an incremental encoder (also known as tachometer or rotary pulse generator), allowing operation down to zero RPM. It provides a specific number of electrical Pulses Per Revolution (PPR) that are proportional to a shaft's revolution. The SV850 SAFETach III is a bearingless, couplingless, modular design, providing unequalled reliability and mechanical performance in a functional safety environment.

The SV850 fits AC and DC motors with an 8.5" C (FC / 180) Face. Both end-of-shaft and through shaft mountings are accommodated. The SV850 Encoder consists of three or four parts: a rotor, a stator housing, and one or two removable sensor modules. No gapping, adjustment, or shimming is required!

An Avtron SV850 SAFETach III is equipped with one or two SV5 sensor modules. Each module has a two-phase output (A, B) 90° out of phase, with complements (A, B), (A Quad B Output), and a marker pulse with complement (Z, Z̄). For applications which require more than 2 independent outputs, SV850 encoders may be stacked via the use of shaft adapters (see Table 2 for part numbers). Two separate encoders would be purchased.

Output resolution on the SV850 is determined by the sensor only. Unlike older models, any PPR's can be mixed and matched. Selection of the rotor is based only on the shaft mounting requirements (and not PPR).

The SV5 removable sensor assembly has a diagnostic package that includes Adaptive Electronics and a Fault-Check output. With this package, the SAFETach III can maintain itself, and let you know if there is a problem before the problem causes unscheduled downtime.

### SECTION II: INSTALLATION

#### GENERAL

The motor must comply with NEMA MG1 for dimensions, face runout, and shaft runout. Axial float or endplay must be less than +/-0.100" inch.

#### INSTALLATION HARDWARE

Installation hardware required is attached to each assembly.

Equipment needed for installation

The outer edge of the rotor may be damaged by scratches, severe blows, and strong magnetic fields.

### Equipment Needed for Installation

Provided	Optional	Not Provided
<b>SV850 Encoder</b> - Washer, Spring Lock 1/2 (4) - Hex Hd. Cap Screw 1/2-13 x 3.00 (4)	- A35226 Gauge or A25355 M285/SV850 Rotor Gauge Block - Inboard Through-Shaft Seal Plate - Outboard Through-Shaft Seal Plate Kit - Silicone Lubricant or 20 Weight Machine Oil - Dead Blow Hammer - Large Frame Adapter Kit (Modification "700") - SV850 Shield Kit (A35355)	- 3/4" Wrench - Phillips Screwdriver - 7/16" Nut Driver - Dial Indicator - Vernier Caliper - 3/32" Hex Wrench (T-Handle style) (thru shaft rotors only) - 3/16" Hex Wrench (cam screw rotors only) - 9/16" Wrench (end-of-shaft rotors only)
<b>Rotor</b> - Rotor Installation Hardware Kit - Anti-Seize Compound (copper) - Thread Locker (blue)		

### ROTOR INSTALLATION

Use the dial indicator gauge to ensure motor shaft runout (TIR) does not exceed (0.004") [0.10mm]. Apply anti-seize compound to the shaft.

#### CAUTION

**Do not strike the encoder or rotor at any time. Damage will result and the warranty will be void. At installation, clean and remove paint and burrs from motor shaft and mounting face. Apply anti-seize compound (supplied) to each EXCEPT CAM SCREW ROTORS.**

#### NOTE

**If optional inboard seal plate and/or magnetic shield is used, gage the rotor location from the shield/seal plate(s). Ensure the rotor label marked "this side out" is facing away from the motor.**

**SV850 Selection Guide**

S	V	8	5	0							
<b>Model</b>	<b>Rotor Bore Size</b>	<b>Cover Plate</b>	<b>Left Output Line Driver</b>	<b>Left Output PPR</b>	<b>Right Output Line Driver</b>	<b>Right Output PPR</b>	<b>Connector Options</b>	<b>Modifications</b>			
<b>SV850</b>	<b>KB- 0.625" Thru-shaft keyway cam screw rotor</b> <b>KE- 1.000" Thru-shaft keyway cam screw rotor</b>	<b>X- No cover plate</b> <b>B- Both inboard &amp; outboard covers for thru-shaft w/ v-ring seals</b> <b>D- Domed cover</b> <b>F- Flat outboard cover</b> <b>N- Inboard seal plate w/ v-ring seal, flat outboard cover</b> <b>T- Outboard seal plate for thru-shaft w/ v-ring seal</b>	<b>6- 5-24V in/out (7272)</b> <b>9- 5-24V in, 5V out (7272)</b>	<b>X- None</b> <b>F- 60</b> <b>C- 64</b> <b>G- 100</b> <b>H- 120</b> <b>A- 128</b> <b>L- 240</b> <b>N- 256</b> <b>P- 300</b> <b>E- 360</b> <b>B- 480</b> <b>Q- 500</b> <b>R- 512</b> <b>S- 600</b> <b>U- 720</b> <b>V- 900</b> <b>J- 960</b> <b>W- 1000</b> <b>Y- 1024</b> <b>Z- 1200</b> <b>2- 1500</b> <b>6- 1800</b> <b>3- 2000</b> <b>4- 2048</b> <b>5- 2500</b> <b>D- 4096</b> <b>8- 4800</b> <b>9- 5000</b> <b>0- Special</b>	<b>6- 5-24V in/out (7272)</b> <b>9- 5-24V in, 5V out (7272)</b>	<b>X- None</b> <b>F- 60</b> <b>C- 64</b> <b>G- 100</b> <b>H- 120</b> <b>A- 128</b> <b>L- 240</b> <b>N- 256</b> <b>P- 300</b> <b>E- 360</b> <b>B- 480</b> <b>Q- 500</b> <b>R- 512</b> <b>S- 600</b> <b>U- 720</b> <b>V- 900</b> <b>J- 960</b> <b>W- 1000</b> <b>Y- 1024</b> <b>Z- 1200</b> <b>2- 1500</b> <b>6- 1800</b> <b>3- 2000</b> <b>4- 2048</b> <b>5- 2500</b> <b>D- 4096</b> <b>8- 4800</b> <b>9- 5000</b> <b>0- Special</b>	<b>G- Large EPIC (Northstar™ Pinout) with Plug</b> <b>P- Large EPIC with Plug</b> <b>T- Terminal box</b>	<b>000- None</b> <b>004- Super magnetic shielding</b> <b>007- Mechanically sealed housing &amp; super magnetic shielding</b> <b>076- Outboard sealing</b> <b>077- Mechanically sealed housing &amp; super magnetic shielding, outboard sealing</b> <b>4xx- Special PPR (see chart)</b>			

**SPECIAL PPR OPTION CODES**

4xx Code	PPR (Left)	PPR (Right)	4xx Code	PPR (Left)	PPR (Right)	4xx Code	PPR (Left)	PPR (Right)	4xx Code	PPR (Left)	PPR (Right)
401	1270	None	408	1400	None	415	3000	None	422	96	None
402	150	None	409	30	None	416	3600	None	423	10000	None
403	50	None	410	None	6000	417	1250	None			
404	None	16	411	12000	None	418	2400	2400			
405	16	None	412	200	None	419	160	160			
406	6000	None	413	30	30	420	450	None			
407	2800	None	414	1500	None	421	None	30			

**Functional Safety**

The encoder outputs may be used in the following functions:

- SAR – Safe Acceleration Range
- SBC – Safe Brake Control
- SDI – Safe Direction Indication
- SLA – Safe Limited Acceleration
- SLI – Safe Limited Increment
- SLS – Safe Limited Speed
- SOS – Safe Operating Stop
- SSM – Safe Speed Monitor
- SSR – Safe Speed Range
- SS1 – Safe Stop 1
- SS2 – Safe Stop 2
- STO – Safe Torque Off

Meets safety metrics:

IEC 61508 SIL 2

**NOTE:**

Special option 4xx selects an alternate PPR code definition. Example: PPR Code 0, special option code 401=1270 PPR (Left) / no right output.

## THROUGH SHAFT APPLICATIONS (Rotors KA-K9)

1. The through-shaft must project at least 1.5" [38.1mm] from the accessory mounting face. If it is greater than 2" [50.80mm] long, use the outboard through-shaft cover, detailed in Figure 4.
2. Slide the rotor on the shaft (option "B" or "T"), ensuring the rotor label "this side out" is away from the motor and shaft key engages keyway in rotor. The space between the mounting face and the rotor must be set to 0.584" [14.83mm], as shown in Figure 2. Use Avtron gauges (A35226 or A25355) or housing alignment grooves as shown in Figure 5 to verify position. (Note: if optional inboard seal or shield plate is used, gage the rotor location from the seal shield plates. See Figure 3.) Turn the cam screw of the rotor in the directions shown on the rotor to engage the cams. Tighten to 9-10 ft-lb (12.3- 13.5 n-m). **Total cam screw rotation will be less than one turn.**

**ROTOR MOUNTING**  
(Through Shaft Shown)

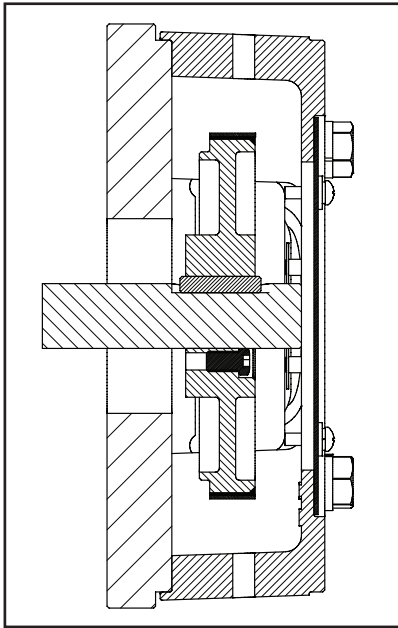


FIGURE 2

## STATOR HOUSING INSTALLATION

The stator housing is retained to the motor using four, 1/2-13 x 3" bolts and spring type lock washers (supplied). If the stator is to be sandwich mounted between an accessory such as a brake and the motor, select the bolt length accordingly. Apply anti-seize compound to the perimeter of the SV850 where it will contact the motor C-face.

Carefully move the stator housing into position, avoiding contact with the rotor. **DO NOT FORCE** the housing into place. Install the four mounting bolts (torque 30 to 35 foot pounds) [47.5-40.6 n-m].

### CAUTION

**DO NOT use silicone sealants or caulk of any kind on the motor or encoder face; these can cause misalignment or sensor scraping damage. Do apply anti-seize compound (copper) to the encoder face to assist in easy removal. The SV850 electronics are fully sealed; water may enter and leave the rotor area as needed. Remove the bottom pipe plug in the housing if frequent moisture buildup is expected.**

## (OPTIONAL) OUTBOARD SEAL PLATE KIT INSTALLATION.

For applications requiring shafts to pass completely through the SV850, Avtron offers an outboard through-shaft seal plate kit with V-ring seal. See Table 4 for part numbers and Figure 4.

1. Install the encoder rotor as shown above.
2. Remove the existing cover of the encoder. Retain the screws and washers.
3. Mount the SV850 stator housing as shown in Figure 4.
4. Install new through-shaft cover using the (4) #10-24 screws and washers from step 2.
5. Apply silicone lubricant or medium grade machine oil (20 weight) to the outboard side of the cover where the V-ring seal will contact it.
6. Slide the V-ring seal onto the shaft, and ensure that it is compressed against the cover. See installation Figure 4.

## (OPTIONAL) CHECK ROTOR POSITION

1. Remove a sensor or blank side cover plate.
2. Verify the rotor magnetic stripe is aligned with the grooves (see Figure 5).
3. Replace the sensor or side cover plate.

## WIRING INSTRUCTIONS

### CAUTION

**Remove power before wiring.**

Wiring diagrams are shown in Figure 6 and 7.

For bidirectional operation of the encoder, proper phasing of the two output channels is important. Phase A channel leads phase B channel for clockwise shaft rotation as viewed from the anti-drive or accessory end of the motor (encoder mounting end). Wiring option "G" provides a pinout compatible with Northstar™ encoders, with a cable shield connection on pin 10. Note that this option does not ground the shield; Avtron still recommends grounding the shield at the drive end of the cable for all wiring options.

## CORRECTIVE ACTION FOR PHASE REVERSAL

- 1) Remove Power.
- 2) Exchange wires on cable, either at encoder cable end or at speed controller end (but not both).
  - a. Single Ended 2 Phase Wiring (see wiring diagram) Exchange A and B at the use end of the wires.
  - b. Differential 2 Phase Wiring (see wiring diagram) Exchange either A with  $\bar{A}$  in the phase A pair OR B with  $\bar{B}$  in the phase B pair but NOT both.
- 3) Apply power.
- 4) Verify encoder feedback is correct, using hand rotation of shaft, or jog mode of the speed controller.

Interconnecting cables specified in the WIRE SELECTION CHART in Figure 6 are based on typical applications. Refer to the system drawing for specific cable requirements where applicable.

Physical properties of cable such as abrasion, temperature, tensile strength, solvents, etc., are dictated by the specific application.

General electrical requirements are: stranded copper, 22 thru 16 gauge (Industrial EPIC Connector options can use 14-20 AWG), each wire pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance, outer sheath insulator, 1,000 ft. max. See WIRE SELECTION CHART in Figure 6 for some suggested cables.

See Figure 7 for examples of alarm output wiring.

### NOTE

**When using the industrial connector ("G", "P" options), the minimum wire size is 20 gage, and 20 gage (only) wire ends must be tinned with solder before connection at the screw terminals.**

## MAINTENANCE

### GENERAL

This section describes routine maintenance for the Avtron SV850 Encoder. For support, contact field service for Avtron Encoders at 216-642-1230. For emergency after hours service contact us at 216-641-8317. The SV850 SAFETach III circuitry includes a diagnostic package that includes Adaptive Electronics and a Fault-Check output.

### ADAPTIVE ELECTRONICS

A perfect duty cycle consists of a waveform whose “high” and “low” conditions are of the same duration (50%/50%). The SV850 adaptive electronics extends the life of the SV850 by constantly monitoring and correcting duty cycle over time.

### FAULT-CHECK

After power-up and the rotor position is checked by the sensor, the Fault-Check LED will turn GREEN.

If the adaptive electronics reach their adjustment limit for any reason, the Fault-Check alarm and LED will notify the drive and operator of an impending failure. The LED will turn RED if the Adaptive Electronics reach their adjustment limit. This output occurs before an actual failure, allowing steps to be taken to replace the unit before it causes unscheduled downtime. Fault-Check annunciation is available as an “alarm” output through the connector and as an integral LED.

### TROUBLESHOOTING:

If the drive indicates a loss of encoder/tach fault and the SV850 fault-check LED is not illuminated, check the encoder power supply. If power is present, check polarity; one indicator of reversed power supply is that all outputs will be high at the same time. If the drive indicates encoder fault, but the LED shows GREEN, then check the wiring between the drive and the encoder. If the wiring appears correct and in good shape, test the wiring by replacing the SV5 sensor module. If the new module shows GREEN, and the drive still shows encoder loss/tach fault, then the wiring is faulty and should be repaired or replaced.

#### WARNING

**Only use SV5 sensors with the SV850 encoder. Do not mix rotors between AV850 and SV850 encoders. Use of other sensors or rotors will not retain the functional safety compliance of the SV850.**

#### If the alarm output and/or LED indicate a fault (RED):

1. Remove a sensor plate or one of the sensors, and use the built-in gauge to check the location of the rotor (see Figure 2.1). Ensure the label marked “This side out” is facing away from the motor.
2. Remove the SV5 sensor from the housing. Clean the housing mounting surface for the SV5 sensor and the SV850 housing. Ensure the SV5 sensor is directly mounted on the SV850 housing, with no sealant, gasketing, or other materials, and that it is firmly bolted in place.

**If the alarm output and/or LED indicate a fault (RED)** on a properly mounted SV5 sensor and the rotor is properly located, replace the SV5 sensor.

An oscilloscope can also be used to verify proper output of the SV850 encoder at the encoder connector itself and at the drive/controller cabinet. If the outputs show large variations in the signals at steady speed (jitter or “accordion effect”, see figure 9), check rotor position. If the rotor position is correct, the motor or shaft may be highly magnetized. Replace any magnetized material nearby with non-magnetic material (aluminum, stainless) (shafts, etc). For GE CD frame motors and similar styles, Avtron offers non-magnetic stub shafts (included with all “U” style rotor kits). If variations persist, consider replacing the sensors with super-shielded models, option -004.

#### If the alarm output and/or LED indicate a wiring fault (ORANGE):

Remove all output wires/connections (A,  $\bar{A}$ , B,  $\bar{B}$ , Z,  $\bar{Z}$ ). The LED should turn GREEN. If the LED does not turn GREEN, the encoder is not receiving enough voltage at +V to properly operate. Correct input voltage problem at power supply or cabling.

If the LED turns GREEN once all outputs are disconnected, reconnect each output, one at a time, monitoring for ORANGE LED. For partial/resistive short circuits, the LED may take a few minutes to turn ORANGE. To speed the troubleshooting process, if possible, spin the encoder while replacing individual output connections. This may make the ORANGE LED condition occur faster. Once the shorted output(s) are located, correct the shorting condition, and the encoder LED should remain GREEN.

If the LED is OFF, but power is being applied to the encoder, check the output voltage level at A, A,B, B. If all outputs are ON ( $\approx +V$ ), the connections to +V and COM are reversed. Swap connections between +V and COM; the LED should turn GREEN.

### STATOR HOUSING REMOVAL

To remove the stator housing remove the qty 4 1/2 13 x 3” bolts holding the housing to the motor.

#### CAUTION

**Take care that the housing does not fall from the pilot and cause the sensors to crash into the rotor. Damage to the sensor or rotor could result.**

### ROTOR REMOVAL

Remove shaft rust and burrs before removing the rotor.

### THROUGH-SHAFT AND UNIVERSAL (KA-K9):

Loosen the set or cam screws holding the rotor to the shaft. The cam screws rotate less than one turn to disengage the shaft. The stub shaft adapter from the universal (Ux) rotors can be left in place.

#### NOTE

**Do not remove the cam screws from the rotor.**

Remove the rotor by hand, taking care not to damage the outer magnetized ring.

If the rotor cannot be removed by hand, use a gear puller taking care not to damage the outer magnetized ring.

#### DO NOT APPLY HEAT TO THE ROTOR.

#### ROTOR ALIGNMENT GROOVE

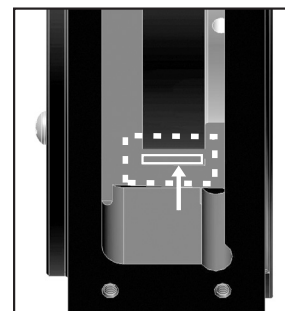


Figure 2.1

Rotor magnetic strip aligns with groove.

# SPECIFICATIONS

## ELECTRICAL\*\*

- A. Operating Power (Vin)
  - 1. Volts.....5-24 VDC
  - 2. Current .....100mA, nominal, no load
- B. Output Format
  - 1. 2Ø & Comp .....A,  $\bar{A}$ , B,  $\bar{B}$  (differential line driver)
  - 2. Marker .....1/Rev, Z,  $\bar{Z}$
- C. Signal Type .....Incremental, Square Wave, 50 ±10% Duty Cycle.
- D. Direction Sensing.....ØA leads ØB for CW rotation as viewed from the back of the tach looking at the non-drive end of the motor.
- E. Phase Sep. ....15% minimum
- F. Frequency Range.....@5V, @1m cable, 250 kHz Max  
@24V, @300m cable, #8 output, 45 kHz Max
- G. PPR .....4-50000\*\*\*
- H. Line Driver Specs.....See table
- I. Connectors.....Industrial Connector or terminal box
- J. LED Indicator.....GREEN: power on, unit ok.  
RED: alarm on  
ORANGE: wiring fault (Thermal Overload; Under-voltage)

## MECHANICAL

- A. Rotor Inertia:.....0.12-0.41 Oz. In. Sec.<sup>2</sup>
- B. Acceleration:.....5000 RPM/Sec. Max.
- C. Speed:.....6000 RPM Max.\*\*\*\*
- D. Weight:.....2-3 lbs [0.9kg to 1.36kg].
- E. Sensor to Rotor
  - Air Gap (nominal):.....0.045" [1.14mm]
  - Tolerance: .....-0.030"/+0.015" [-0.76mm/+0.38]
- F. Rotor Axial Tolerance.±0.050" [±1.27mm]

## ENVIRONMENTAL

Solid cast aluminum stator and rotor  
Fully potted electronics, protected against oil and water spray  
Use "W" cable option on IP66/67 applications

V-Ring seals provided on through shaft covers  
Operating Temperature:.....-40 to 100°C, 0-100% condensing humidity  
Vibration: 18 g's  
Shock: 1 meter drop test

## LINE DRIVER OPTIONS

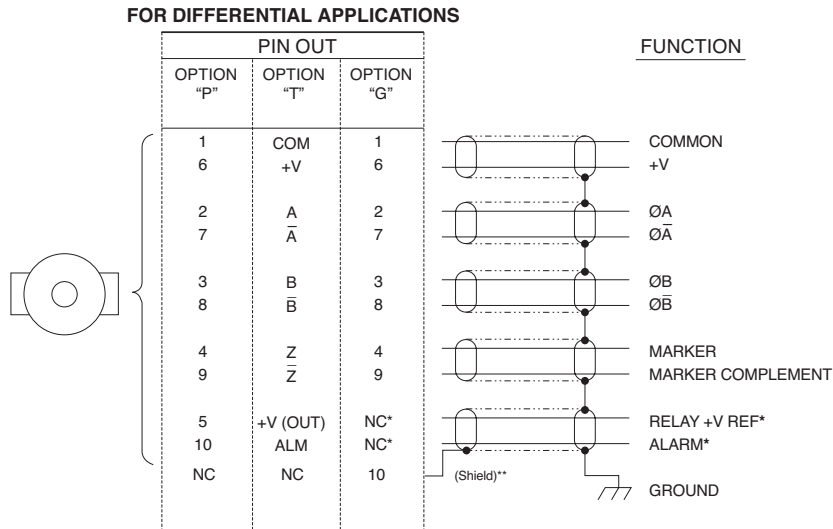
		LINE DRIVER OPTIONS		
Electrical Specifications		6	9	Units
Input Voltage		5-24	5-24	VDC
Nom Output Voltage		5-24	5	VDC
Line Driver		7272	7272	
Output Resistance Typ		13	13	ohms
Maximum Peak Current		1500	1500	mA
Maximum Average Current		120	120	mA
Voh Typ		V <sub>IN</sub> -1	V <sub>IN</sub> -1	VDC
Vol Typ		0.5	0.5	VDC
Cable Drive Capacity		1000' @ 5V 500' @ 12V 200' @ 24V	1000'	feet
Protection	Reverse Voltage	yes	yes	
	Short Circuit	yes	yes	
	Transient	yes	yes	
	Power to A, Gnd to A/	yes	yes	
Alarm	+V(out)	Output voltage equal to input voltage.		
	Alarm*	Open collector, normally off, goes low on alarm, sink 100mA max, 50VDC max		
	LED	Green=power on, Red=Alarm Orange=Wiring Error (Thermal Overload; Under-voltage)		
Marker		One per revolution. Pulse width approximately 2° (1/128 of a revolution)		

\* Alarm not available on connector option "G" (Northstar™ compatible pinout)  
 \*\* Electrical specifications for SAFETach III model (rev BA or later), consult Nidec Industrial Solutions for earlier model specifications.  
 \*\*\*(PPR) Standard maximum PPR is 5000. Consult Factory with your application for PPRs up to 50,000.  
 \*\*\*\* (Speed) Maximum RPM may be limited for PPR > 2,500. Consult Factory with your application.



## WIRING DIAGRAMS

FIGURE 6



**TYPICAL WIRE SELECTION CHART**  
for 18 AWG, multiple pair, individually shielded

	BELDEN	ALPHA
2 PAIR	9368	6062
3 PAIR	9369	6063
4 PAIR	9388	6064
6 PAIR	9389	6066

\* See Figure 7 page 6 for examples of alarm output wiring.

\*\* Avtron recommends shield grounding at drive end. Shield pin does not ground the shield.

**EU Declaration of Conformity**



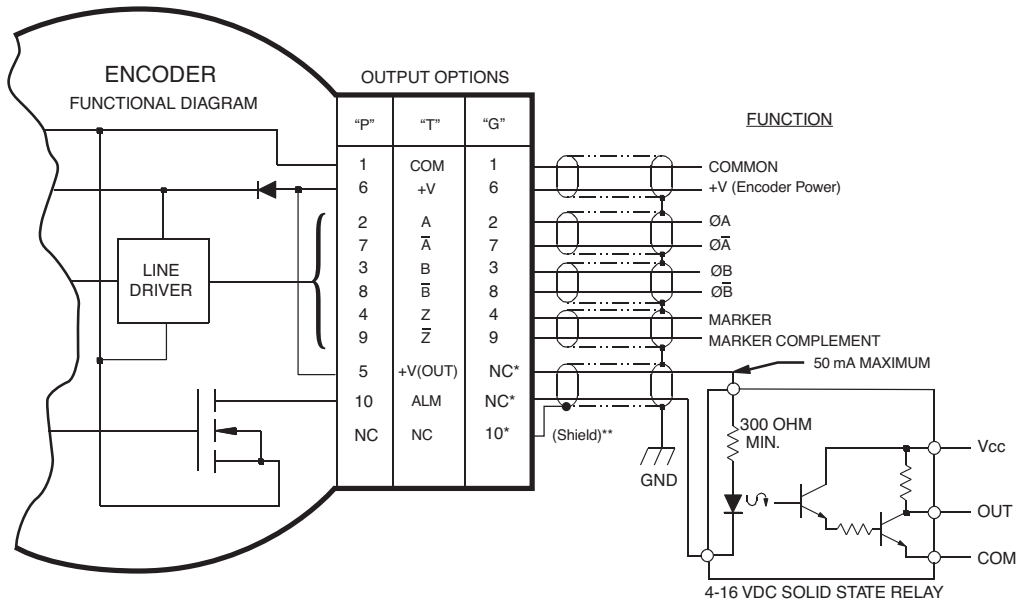
# SAFETach III™

## Application Examples

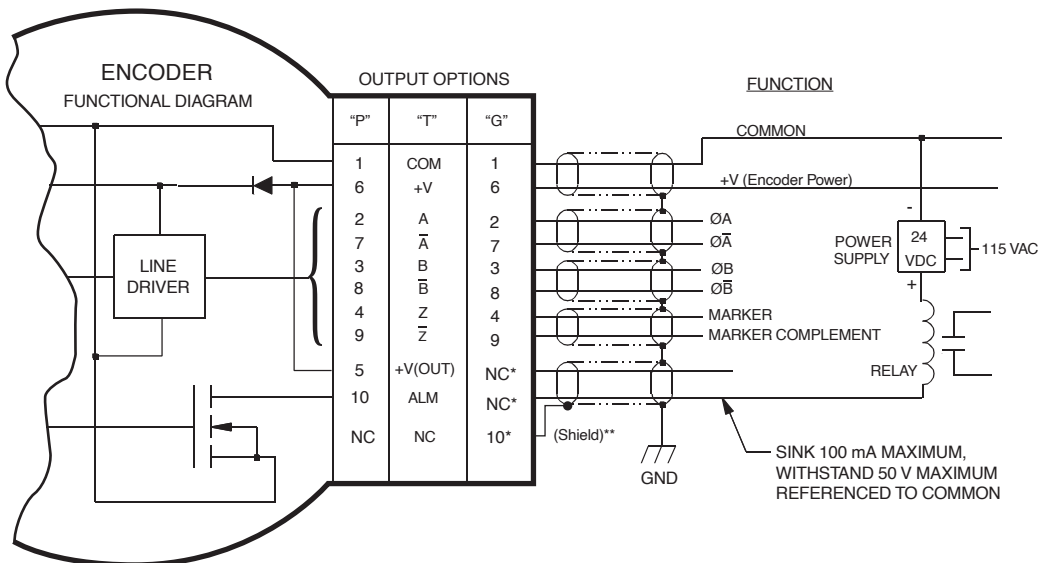
### ALARM OUTPUT CONNECTION

Avtron SAFETach III encoders provide an alarm signal if maintenance is required under specific circumstances. A green LED indicates power on and proper operation, red indicates alarm on. Following are application examples provided to help install the alarm output.

Example 1. Alarm output using +V(OUT). +V(OUT) is equal to +V, the encoder power supply.



Example 2. Alarm Output Using Separate 24 VDC Power Supply and Relay.

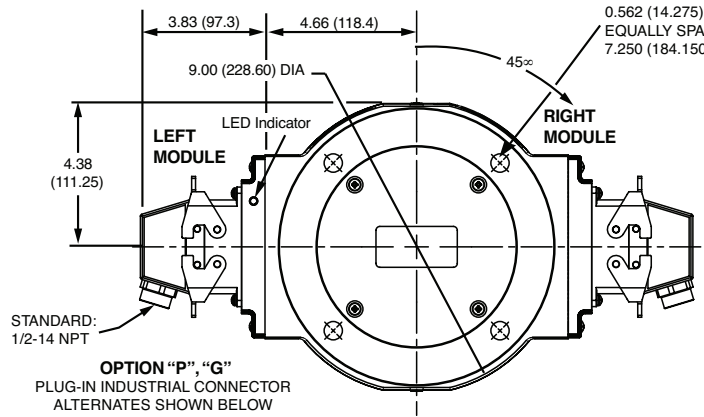


Note: Alarm output is "low true" ; i.e. it goes to 0V when activated

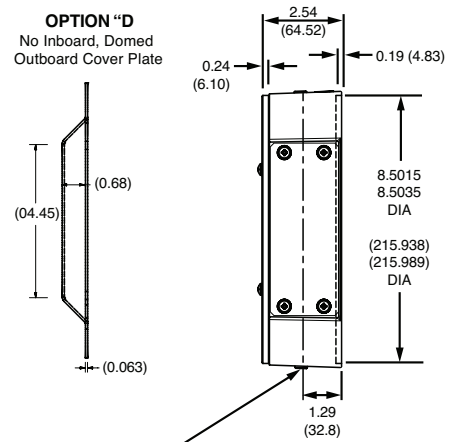
# OUTLINE DIMENSIONS AND OPTION DETAILS

For additional wiring options see Figure 8.

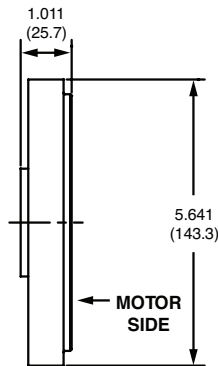
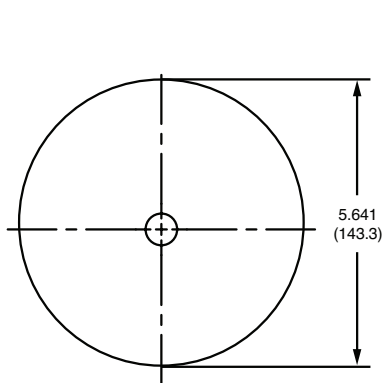
FIGURE 10



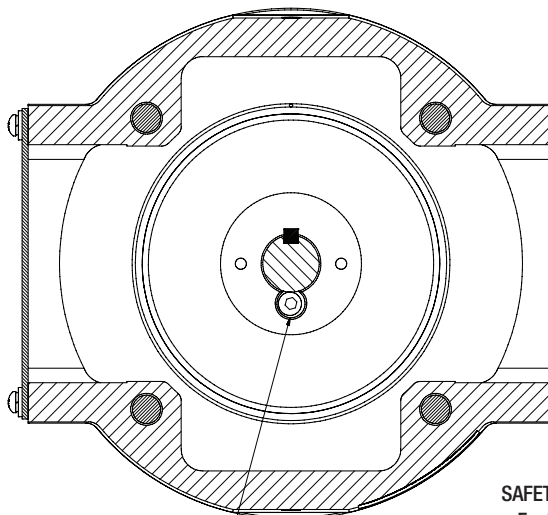
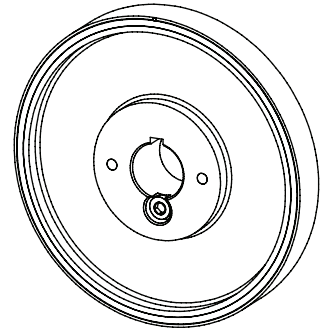
OPTION "D" No Inboard, Domed Outboard Cover Plate



NOTE: If the pulse generator will be exposed to water spray, the bottom 1/8" pipe plug should be removed.



OPTION "KA-K9" CAM SCREW STYLE ROTOR



CAM SCREW @ 180° OPPOSITE KEYWAY - TIGHTEN TO 10 FT-LBS.

SAFETach™ III is a trademark of Nidec Industrial Solutions, Inc. Features and specifications subject to change without notice. Avtron Encoder standard warranty applies. All dimensions are in inches (mm).