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# Encoder Instructions

## HS35A

1/2" to 1" [12mm-20mm]  
 HOLLOW SHAFT

### DESCRIPTION

The Avtron Model HS35A Hollow Shaft Rotary Incremental Encoder is a speed and position incremental transducer (also known as tachometer or rotary pulse generator). When mounted to a motor or machine, its output is directly proportional to shaft position (pulse count) or speed (pulse rate). The HS35A operates down to zero speed and can be used for both control and instrumentation applications.

The HS35A employs a hollow shaft and clamping collar to lock the encoder to the shaft. A high-performance resin hollow shaft insert provides electrical isolation from motor shaft currents and permits models to fit a broad range of shaft sizes from 1/2" to 1" [12mm - 20mm]. An anti-rotation bracket prevents rotation of the encoder while allowing for shaft end float and axial movement. An optional protective basket kit offers additional protection from impact and motor lifting damage.

The HS35A encoder offers 2Ø outputs (A,B) 90° apart for direction sensing (A Quad B), with complements (Ā,B̄) and with marker pulse and complement (Z,Z̄).

### INSTALLATION CONSIDERATIONS

See page 3 and drawing on last page for shaft engagement rules. Shaft may include keyway, but should not be flatted.

The HS35A offers optional Avtron flexible anti-rotation tethers/brackets which will permit the encoder to tolerate ±0.1" of shaft end float/axial movement. Select the proper tether for the application from the table below.

#### CAUTION

**Be careful not to damage clamping fingers of hollow shaft during handling. Do not tighten clamping collar before installation onto motor shaft.**

Equipment Needed for Installation		
Provided	Optional	Not Provided
HS35A Encoder Clamping Collar Thread Locker (blue)	Anti-Rotation Tether Kit Shaft Sizing Insert Mating MS Cable Connector Protective Basket Kit	#2 Phillips Screwdriver 5/32" Hex Wrench (US) 3mm Hex Wrench (Metric) (T-Handle Style) Caliper Gauge Dial Indicator Gauge 7/16", 9/16", 5/8", 3/4", 10mm Wrenches (tether options) Avtron TACHTester (optional)

#### WARNING

**Installation should be performed only by qualified personnel. Safety precautions must be taken to ensure machinery cannot rotate and all sources of power are removed during installation.**

#### WARNING

**Be certain to identify thread locker and anti-seize compound correctly. Using anti-seize in place of thread locker can cause mechanical failure leading to equipment failure, damage, and harm to operators.**

### INSTALLATION

Refer to the back page of these instructions for outline and mounting dimensions. Also available: EU (European Union) Installation Sheet and Basket Mount Installation Sheet.

- 1) Disconnect power from equipment and encoder cable.

### HS35A PART NUMBERS AND AVAILABLE OPTIONS

Model	PPR	Line Driver	Bore Options	Connector Options	Mounting Style	Protection	Anti-Rotation Tether Options	Channels	Special Features
HS35A		1- 5-28V (7272) 2- 5-28V, open collector (7273) 4- 5-28V in, 5V out (7272)	0- Non-std. P- 12mm B- 1/2" R- 15mm C- 5/8" S- 16mm D- 3/4" W- 20mm E- 7/8" F- 1" U- Universal 1/2" to 7/8" (all U.S. inserts) Z- Universal 12mm to 20mm (all metric inserts)	W- 18" flex. cable	U- Universal End-of-Shaft & Thru Shaft	0- None 1- Basket	X- None A- Fan cover, 1/4-20 B- Fan cover, 5/16-18 C- Fan cover, 3/8-16 D- Fan cover, all E- 4.5" or 6.75" C-Face F- 8.5" C-Face M- 4.5" C-Face or Fan Cover G- Torque Arm U- Universal (all tether options)	A- A,Ā,B,B̄, Z,Z̄ B- A,Ā,B,B̄« D- A,Ā« E- A,B,Z« F- A,B«	000- None 9xx- Specify cable length xx=feet (use w/ option "W")

\*Only available with MS 6 and 7 pin connectors

All dimensions are in inches [millimeters].  
 Specifications and features are subject to change without notice.

Connector Options			
10 Pin MS	6 Pin MS	7 Pin MS	8 Pin M12
A- w/o plug (std. phasing) B- w/o plug (Dynapar HS35 phasing) C- "A" w/ plug D- "B" w/ plug	E- w/o plug (std. phasing) F- w/o plug (Dynapar HS35 phasing) G- "E" w/ plug H- "F" w/ plug	J- w/o plug (std. phasing) K- w/o plug (Dynapar HS35 phasing) M- "J" w/ plug N- "K" w/ plug	T- w/o plug (Turck Pinout) U- w/o plug (US Pinout)

- 2) Use caliper gauge to verify motor shaft is proper diameter and within allowable tolerances: +0.000", -0.0005" [+0.00, -0.13mm].
- 3) Clean machine shaft of any dirt and remove any burrs.
- 4) Use dial indicator gauge to verify the motor shaft Total Indicated Runout (TIR) < 0.002" [0.05mm].
- 5) Install the anti-rotation bracket to the face of the encoder using 8-32 screws and lock washers.
- 6) Loosen clamping collar and insert shaft sizing insert into encoder. **DO NOT FORCE.** The insert has a retaining flange and is larger at one end than the other. (NOTE: 1.0" HS35A has insert factory-installed; this insert cannot be removed, nor can an additional insert be used to resize the unit.)
- 7) Test Fitting: carefully slide the encoder onto the shaft to verify fit. Ensure a minimum of 1/8" between encoder and mounting surface. **DO NOT FORCE.** Encoder should slide on easily. If the encoder does not fit easily, remove it, verify shaft size and check for burrs and shaft damage.
- 8) Apply thread locker to screw on clamping collar. Tighten screw on clamping collar evenly until snug, then tighten each screw to 35-40 in-lb [4.0-4.5 Nm]. **DO NOT USE A STANDARD RIGHT ANGLE WRENCH.** Use only a T-handle hex wrench or torque wrench with hex bit. Note: Units shipped with a metric bore size require a 3mm T-handle hex wrench, units with US size bores, a 5/32" T-handle hex wrench.
- 9) Secure free end of anti-rotation bracket to frame. Use insulating hardware as shown (supplied with Avtron anti-rotation kit). Use additional washers as needed to install the bracket without a large deflection or bend. For 8.5" C-Face, install 1/2"-13 to 3/8"-16 reducer with 3/8"-16 threaded stud (supplied) to secure anti-rotation bracket using insulating hardware as shown.
- 10) Turn shaft by hand and verify the shaft turns freely and does not produce excessive runout/wobble of the encoder: <0.005" [0.13mm] TIR (Total Indicator Reading). Additional

instructions under "Adjusting the Encoder to Eliminate Excess Runout/Wobble" are provided if needed.

- 11) *Optional:* Attach Avtron Encoder/Tachometer Tester unit (B27609) using factory-provided cable. Follow tester instructions to check direction of rotation, proper output, PPR, and signal quality.
- 12) Connect cable as shown in wiring diagram.
- 13) Apply power (5-28VDC) to the encoder.
- 14) Rotate the shaft by hand, or using jog mode of the speed controller and verify proper direction.
- 15) *Optional:* Install Protective Basket using either T-bolts (Fan Cover) or bolt to 4.5" C-Face (bolts provided). For 8.5" C-Face use adapter clips supplied. Be certain that the Protective Basket does not touch or interfere with the anti-rotation arm.

To mount the basket on an 8.5" C-face, thread the 1/2"-13 bolts into the motor face, through each clip (provided with options "F" and "U") but do not tighten fully. Pivot the basket over the encoder, and pivot each clip over each respective basket bolt hole. **DO NOT FORCE.** Tighten each bolt to secure the basket and clip.

#### Adjusting the Encoder to Eliminate Excess Runout/Wobble:

In a typical installation, a housing movement of 0.005" TIR or less (as measured at the outside diameter of the main encoder body) will not have an adverse effect. If excessive housing movement is detected in the installation:

- 1) Check the shaft the HS35A is mounted on for excessive shaft runout using a dial gauge. NEMA MG1 calls for 0.002" TIR or less.
- 2) Verify that the mounting shaft meets minimum and maximum diameter tolerances.
- 3) Maximize the shaft insertion into the encoder (retaining the minimum of 1/8" between mounting face and encoder)

## SPECIFICATIONS

### ELECTRICAL

- A. Operating Power (Vin)
  - 1. Volts..... 5-28V
  - 2. Current ..... 50mA, no load
- B. Output Format ..... A Quad B with marker (A,  $\bar{A}$ , B,  $\bar{B}$ , Z,  $\bar{Z}$ )
- C. Signal Type ..... Incremental, Square Wave, 50%  $\pm$ 10% Duty Cycle
- D. Direction Sensing ..... Phasing with respect to rotation as viewed from the back of the encoder (non-clamping collar side).
  - Connector options "A", "C", "E", "G", "J", "M", "U", & "W":  $\emptyset$ A leads  $\emptyset$ B for CW rotation (Std. phasing).
  - Connector options "B", "D", "F", "H", "K", "N", & "T":  $\emptyset$ A leads  $\emptyset$ B for CCW rotation (Dynapar HS35 phasing).
- E. Transition Separation..... 15% minimum
- F. Frequency Range..... 0 to 125kHz.
- G. PPR ..... 100 - 5000 standard
- H. Output..... See Line Driver Options

### MECHANICAL

- A. Acceleration..... 6,000 RPM/Sec.
- B. Speed ..... 6,000 RPM max. (for higher RPM needs, Consult Factory).
- C. Shaft Diameter ..... 0.500" to 1.000" [12mm to 20mm]
- D. Shaft Engagement..... 1.250" to 2.250" [32mm-57mm] End-of-Shaft\*  
\*1.750" to 2.250" with sizing inserts  
Unlimited Thru Shaft
- E. Weight ..... 1.6 lbs. (730g)
- F. Starting Torque @ 25C... 5oz in [0.035N-m] Max

### ENVIRONMENTAL

- A. Enclosure Rating..... NEMA 4, 13, IP65 (dust and water tight, not for immersion).
- B. Operating Temp. .... -20° to +100°C
- C. Humidity ..... 98% Non-condensing
- D. Shock..... 50G, 11 ms Duration
- E. Vibration ..... 5-2000Hz @ 20G

### LINE DRIVER OPTIONS

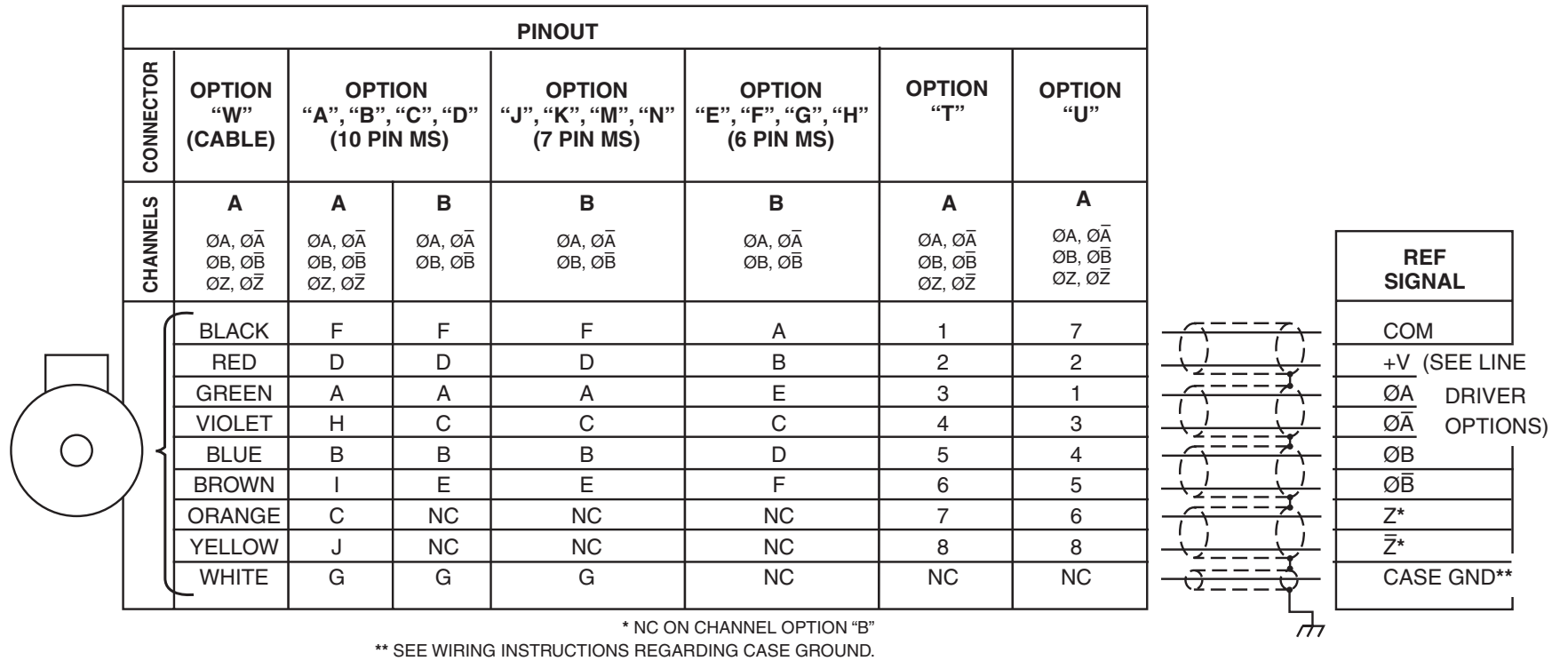
		Output Options		
		1	2	4
Output Type		Differential Line Driver	Open Collector	Differential Line Driver, 5V fixed
Line Driver		7272	7273	7272
Voltage Input (Vin)		5-28VDC	5-28VDC	5-28VDC
Protection	Reverse Voltage	Yes	Yes	Yes
	Transient	Yes	Yes	Yes
	Short Circuit	Yes	Yes	Yes



## HS35A WIRING DIAGRAMS

### LINE DRIVER (Options 1 & 4)

### DIFFERENTIAL TWO PHASE WIRING APPLICATIONS



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

	BELDEN	ALPHA
<b>2 PAIR</b>	<b>9368</b>	<b>6062C</b>
<b>3 PAIR</b>	<b>9369</b>	<b>6063C</b>
<b>4 PAIR</b>	<b>9388</b>	<b>6064C</b>
<b>6 PAIR</b>	<b>9389</b>	<b>6066C</b>

For Connector Option "W", unused connections must be insulated to prevent accidental contact.

\* **NOTE:** Connecting Case Ground is optional.

## HS35A WIRING DIAGRAMS

### LINE DRIVER (Options 1,2,^ & 4) SINGLE ENDED TWO PHASE WIRING APPLICATIONS, WITH OR WITHOUT MARKER

^Open Collector Line Driver Output Option 2 requires pull up resistors from each active output to a +V reference.

PINOUT						
CONNECTORS	OPTION "W" (CABLE)	OPTION "A", "B", "C", "D" (10 PIN MS)	OPTION "J", "K", "M", "N" (7 PIN MS)	OPTION "E", "F", "G", "H" (6 PIN MS)	OPTION "T"	OPTION "U"
CHANNELS	A $\emptyset A, \emptyset \bar{A}$ $\emptyset B, \emptyset \bar{B}$ $\emptyset Z, \emptyset \bar{Z}$	E, F $\emptyset A, \emptyset B, \emptyset Z$	E, F $\emptyset A, \emptyset B, \emptyset Z$	E, F $\emptyset A, \emptyset B, \emptyset Z$	A $\emptyset A, \emptyset \bar{A}$ ^ $\emptyset B, \emptyset \bar{B}$ ^ $\emptyset Z, \emptyset \bar{Z}$ ^	A $\emptyset A, \emptyset \bar{A}$ $\emptyset B, \emptyset \bar{B}$ $\emptyset Z, \emptyset \bar{Z}$
	RED	D	D	B	2	2
	BLUE	B	B	D	5	4
	GREEN	A	A	E	3	1
	BLACK	F	F	A	1	7
	ORANGE*	C*	C*	C*	7	6
	WHITE	G	G	NC	NC	NC

REF SIGNAL
+V (SEE LINE DRIVER OPTIONS)
COM
$\emptyset Z^*$
CASE GND**

\* NC ON CHANNEL OPTION "F"

\*\* SEE WIRING INSTRUCTIONS REGARDING CASE GROUND.

^ COMPLEMENTS INCLUDED BUT NOT USED

### LINE DRIVER (Options 1,2,^ & 4) SINGLE ENDED SINGLE PHASE WIRING APPLICATIONS

PINOUT						
CONNECTORS	OPTION "W" (CABLE)	OPTION "A", "B", "C", "D" (10 PIN MS)	OPTION "J", "K", "M", "N" (7 PIN MS)	OPTION "E", "F", "G", "H" (6 PIN MS)	OPTION "T"	OPTION "U"
CHANNELS	A $(\emptyset \bar{A}, \emptyset B, \emptyset \bar{B}, \emptyset Z, \emptyset \bar{Z})$ INCLUDED BUT NOT USED)	D $\emptyset A$ $(\emptyset \bar{A}$ INCLUDED BUT NOT USED)	D $\emptyset A$ $(\emptyset \bar{A}$ INCLUDED BUT NOT USED)	D $\emptyset A$ $(\emptyset \bar{A}$ INCLUDED BUT NOT USED)	A $(\emptyset \bar{A}, \emptyset B, \emptyset \bar{B}, \emptyset Z, \emptyset \bar{Z})$ INCLUDED BUT NOT USED)	A $(\emptyset \bar{A}, \emptyset B, \emptyset \bar{B}, \emptyset Z, \emptyset \bar{Z})$ INCLUDED BUT NOT USED)
	BLACK	F	F	A	1	7
	RED	D	D	B	2	2
	GREEN	A	A	E	3	1
	WHITE	G	G	NC	NC	NC

REF SIGNAL
COM
+V (SEE LINE DRIVER OPTIONS)
$\emptyset A$
CASE GND**

\*\* SEE WIRING INSTRUCTIONS REGARDING CASE GROUND.

- 4) Loosen the clamping collar and rotate the motor shaft 180° within the encoder hollow shaft sleeve. Retighten the clamping collar.
- 5) Loosen the clamping collar; move the split in the clamping collar over a solid portion of the encoder shaft, retighten the clamping collar.

If excessive housing movement still exists after the above steps, the shaft or the encoder may be damaged and should be checked by the manufacturer.

### Shaft Sizes:

**HS35A:** 0.500", 0.625", 0.750", 0.875", 1.000"\*, 12mm, 15mm, 16mm, 20mm

NOTE: HS35A units utilize shaft insulating resin insert; models may be resized as needed by interchanging or removing inserts.

Consult factory for other shaft sizes not shown.

### Shaft Engagement:

**HS35A:** Shaft insertion/engagement should be 1.25" to 2.25" [32mm to 57mm] with a minimum of 0.125" [3mm] between encoder and mounting surface. Minimum insertion/engagement is 1.75" [44mm] for models using a sizing insert. If greater shaft insertion is required, remove outboard shaft cover and mount the encoder as a through-shaft unit.

For shaft lengths greater than the maximum engagement allowed, end of shaft mounting may still be employed by using a spacer between the mounting surface and anti-rotation bracket.

### CAUTION

**When inserting shafts to a depth over 2.25" [57mm], be sure to remove the shaft cover to prevent cover contact with the rotating shaft.**

### WIRING INSTRUCTIONS

#### CAUTION

**Be sure to remove power before wiring the HS35A Encoder.**

**Be sure to ground the cable shield(s): It can be connected to case ground at the encoder, or grounded at the receiving device, but should not be grounded on both ends.**

If necessary, case ground can also be provided through a separate wire. Be certain not to ground the case ground wire if the encoder is already grounded by mechanical mounting. (The standard antirotation arm kits provide insulating washers)

The HS35A encoder can be wired for single phase or two-phase operation, either with or without complements, with or without markers. See connector options and wiring diagrams.

### CAUTION

**When wiring for differential applications (A,  $\bar{A}$ , B,  $\bar{B}$ , Z,  $\bar{Z}$ ), A and  $\bar{A}$  should be wired using one twisted, shielded pair; B and  $\bar{B}$  should be in a second pair, etc. Failure to use complementary pairs (say, using A and B in a twisted pair) will reduce noise immunity significantly.**

For encoder output that correctly reflects the direction of rotation, proper phasing of the two output channels is important. Phase A channel leads phase B channel for clockwise shaft rotation as viewed from the back (non-mounting side) of the encoder for standard phasing options ("A", "C", "E", "G", "J", "M", "U", & "W"). Follow instructions under corrective installation as needed to reverse the direction of output or purchase HS35A with reverse (Dynapar HS35) phasing (options "B", "D", "F", "H", "K", & "N").

### CORRECTIVE ACTION FOR PHASE REVERSAL

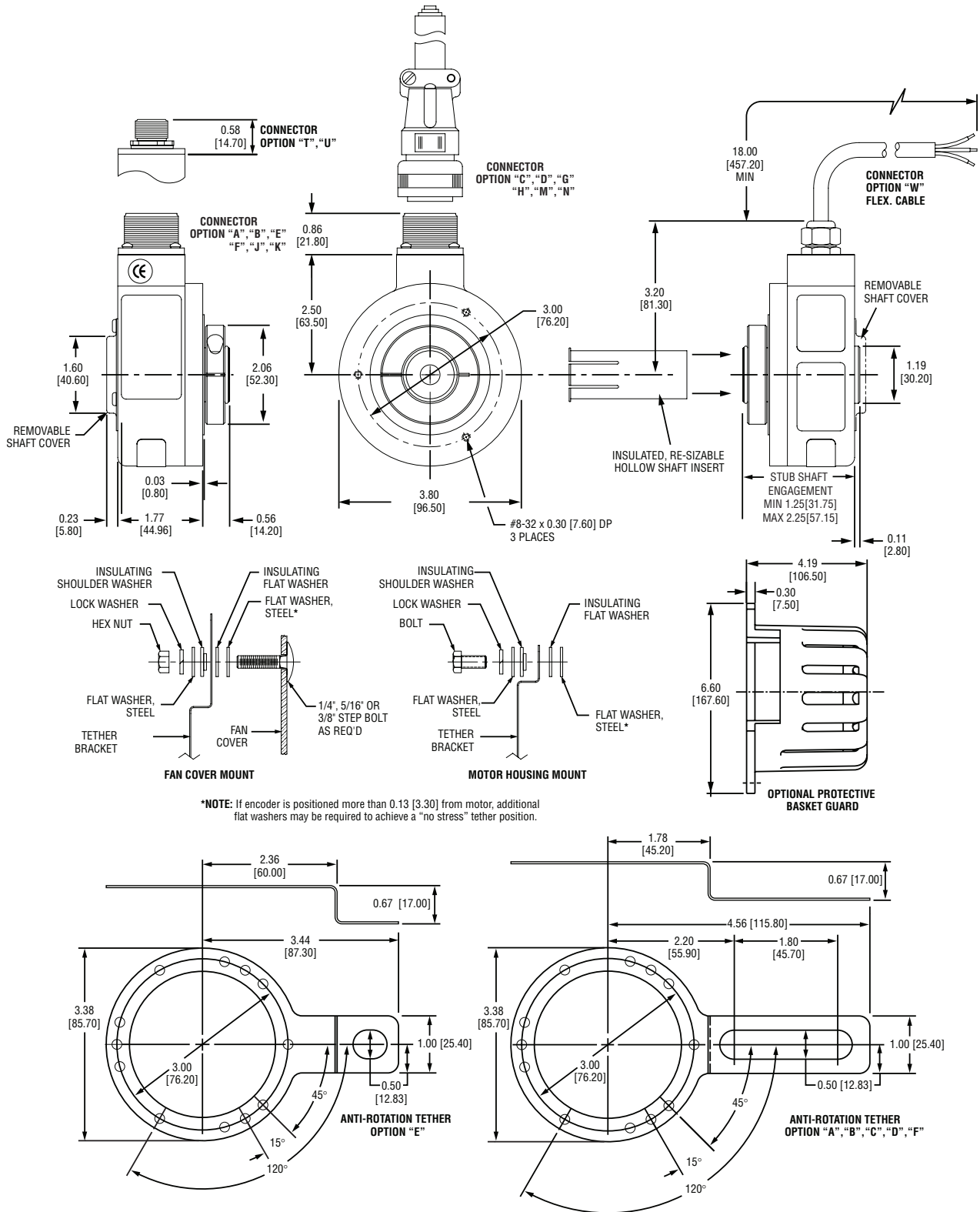
#### If Encoder Direction is Reversed:

- 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 below)  
Exchange A and B at the user end of the wires.
  - b.) **Differential 2 Phase Wiring** (see wiring diagram below)  
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 are based on typical applications. Refer to the "Wiring Diagrams" below for suggested cable types. General electrical requirements are: stranded copper, 22 thru 16 gauge, each wire pair individually shielded with braid or foil with drain wire

\* Maximum cable length (and line driver selection) is limited by several factors: line driver protection, maximum RPM, PPR, output voltage and cable capacitance. The open collector driver (option 2) is much more heavily limited by output frequency on long cable runs, and is not recommended for new applications. These factors may dictate maximum potential cable length.

# OUTLINE DRAWINGS



\*NOTE: If encoder is positioned more than 0.13 [3.30] from motor, additional flat washers may be required to achieve a "no stress" tether position.

Motor shaft tolerance to be +0.0000/-0.0005 [+0.0000/-0.0127] per NEMA Std. MG1.  
All dimensions are in inches [millimeters]. All dimensions are approx.

Avtron standard warranty applies. Copies available upon request.  
Specifications subject to change without notice.