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Encoder Instructions

HS35M

1/2" to 1 1/8" [12mm-30mm]
 HOLLOW SHAFT

DESCRIPTION

The Avtron Model HS35M Magnetic Hollow Shaft Incremental Encoder is a speed and position incremental transducer (also known as a tachometer or pulse generator). When mounted to a motor or machine, its output is directly proportional to shaft position (pulse count) or speed (pulse rate). The HS35M operates down to zero speed and can be used for both control and instrumentation applications.

The HS35M employs a hollow shaft and clamping collar to lock the encoder to the shaft. A high-performance resin housing provides electrical isolation from motor shaft currents. An optional hollow shaft insert permits 1" models to fit a broad range of shaft sizes from 1/2" to 1" [12mm - 20mm]; 1 1/8", 25mm, and 30mm dedicated models are available. An anti-rotation bracket prevents rotation of the encoder while allowing for shaft end float and axial movement.

The HS35M encoder offers 2Ø outputs (A,B) 90° apart for direction sensing, 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 HS35M offers optional Avtron flexible anti-rotation tethers/brackets which will permit the encoder to tolerate ±0.1" of shaft end float/axial movement. For larger movement, select tether option "G" from the table below.

Equipment Needed for Installation		
Provided	Optional	Not Provided
HS35M Encoder	Anti-Rotation Tether Kit	#2 Phillips Screwdriver
Clamping Collar	Shaft Sizing Insert	3/16" Hex Wrench (US) 4mm
	Mating MS or EPIC Industrial Cable	Hex Wrench (Metric) (T-Handle Style)
	Connector/Plug	Caliper Gauge
	Protective Basket Kit	Dial Indicator Gauge
	Anti-Seize (copper)	7/16", 9/16", 5/8", 3/4" Wrenches (tether options)

CAUTION

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

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

DO NOT USE ANAEROBIC THREAD LOCKER COMPOUNDS ON THE HS35M. Use of Loctite 222, 242 or other anaerobic thread locking compounds on the housing can cause failure of the HS35M housing.

INSTALLATION

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

HS35M PART NUMBERS AND AVAILABLE OPTIONS																	
Model	Left & Right Output PPR*		Line Driver	Bore Size		Connector Options	Mounting Style	Protection	Anti-Rotation Tether Options	Channels	Special Features						
HS35M	A- 1 F- 60 G- 100 H- 120 K- 200 L- 240 M- 250 N- 256 P- 300 E- 360 Q- 500 R- 512 S- 600 U- 720 V- 900	W- 1000 Y- 1024 Z- 1200 1- 1250 2- 1440 B- 1500 3- 2000 4- 2048 5- 2500 X- None 0- Special*	6- 5-24V (7272) 8- 5-15V (4125) 9- 5-24V in, 5V out (7272)	0- Non-Std. B- 1/2" P- 12mm C- 5/8" R- 15mm D- 3/4" S- 16mm E- 7/8" W- 20mm F- 1" ^ Y- 25mm ^ G- 1 1/8" ^ 3- 30mm ^ U- U.S. Universal (all inserts, 1/2"-1") Z- Metric (all inserts, 12mm-20mm)	W- 18" flex. cable * up to 2500 PPR available. ** Not applicable on dual output. ^ No insert used for Options "F", "G", "Y", "3". ^^ Only available with OW special feature.	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 G- Torque Arm M- 4.5" C-Face or Fan Cover U- Universal (all tether options, excluding "G")	A- A,Ā,B,B̄,Z,Z̄ B- A,Ā,B,B̄ D- A,Ā E- A,B,Z F- A,B 9- All. Enter specific cable length xx=feet under Special Features (Use w/ Connector Option "W").	00- None 0W- Connector on 18" cable: Use w/ options "E", "N", "S", "U", "Z")							
Connector Options																	
Mounted on Encoder						Mounted on 18" cable (0W)											
10 Pin MS		10 Pin EPIC		10 Pin mini MS		10 Pin MS [◀]		6 Pin MS [◀]		7 Pin MS [◀]		8 Pin M12 [◀]		10 Pin EPIC [◀]		10 Pin mini MS [◀]	
A- w/o plug (std. phasing) B- w/o plug (Dynapar HS35 phasing) C- "A" w/ plug D- "B" w/ plug		P- w/ plug V- w/o plug		R- w/ plug		Y- w/o 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)		Z- w/ plug		S- w/ plug	

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

Installation Sheet, Torque Arm Installation Sheet, and Basket Mount Installation Sheet. NOTE: For metric bore sizes, the encoder is provided with metric size hardware. For US bore sizes, the encoder is provided with US size hardware.

- 1) Disconnect power from equipment and encoder cable.
- 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 screws.

NOTE

These screws have factory applied thread locker, no further thread locker application is required.

- 6) *Optional:* for resizing HS35M 1" bore to fit smaller diameter shafts: Insert shaft sizing insert into encoder. **DO NOT FORCE.**
- 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) *Special Note for shaft in HS35M without a shaft insert ONLY:* Remove encoder, apply anti-seize compound to shaft and

reinstall encoder, leaving a minimum of 1/8" between motor face and encoder (see "Shaft Engagement").

- 9) Tighten screws on clamping collar evenly until snug, then tighten each screw to 35-50 in-lb [4-6 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 4mm T-handle hex wrench; units with US size bores, a 3/16" T-handle hex wrench.
- 10) For all motor mount options other than 8.5" C-face: Snap the plastic washer pair together in the mounting slot of the anti-rotation arm. (See assembly diagram on page 4 for full details)
- 11) Secure free end of the anti-rotation bracket to frame using bolt or T-bolt provided. Use additional washers as needed to install the bracket without a large deflection or bend.
- 12) Turn shaft by hand and verify the shaft turns freely and does not produce excessive runout/wobble of the encoder (<0.005" TIR [0.13mm], Total Indicator Reading).
- 13) *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.
- 14) Connect cable as shown in wiring diagram.
- 15) Apply power to the encoder.
- 16) Rotate the shaft by hand, or using jog mode of the speed controller and verify proper direction.
- 17) *Optional:* Install Protective Basket using either T-bolts (Fan Cover) or bolt to 4.5" C-Face (bolts provided). Be certain to

SPECIFICATIONS

ELECTRICAL

- A. Operating Power (Vin)
 - 1. Volts..... See Line Driver Options
 - 2. Current 80mA, 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.
 - Connector options
 - "A", "C", "E", "G", "J", "M", "P", "R", "S", "U", "V", & "W"..... \emptyset A leads \emptyset B for CW rotation.
 - Connector options
 - "B", "D", "F", "H", "K", "N", "T" \emptyset A leads \emptyset B for CCW rotation.
- E. Transition Separation..... 15% minimum
- F. Frequency Range..... 0 to 165 kHz.
- G. PPR..... 1 - 2500 standard (for other PPR needs, Consult Factory)
- H. Output..... See Line Driver Options

MECHANICAL

- A. Acceleration..... 4,700 RPM/Sec.
- B. Speed 4,700 RPM max. (for higher RPM needs, Consult Factory)
- C. Shaft Diameter 0.500" to 1.125" [12mm to 30mm]
- D. Shaft Engagement..... 1.250" to 2.250" [32mm-57mm] End-of-Shaft*

*1.750" to 2.250" with sizing inserts Unlimited Thru Shaft

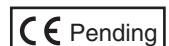
- E. Weight Single: 1.4 lbs. [635 g] approx. Dual: 2.0 lbs. [905 g] approx.

ENVIRONMENTAL

- A. Enclosure Rating NEMA 4, 13, IP65 (dust and water tight, not for immersion)
- B. Operating Temp..... -20° to +85°C
- C. Humidity..... 98% Non-condensing
- D. Shock..... 50G, 11 ms Duration
- E. Vibration..... 5-2000Hz @ 20G

LINE DRIVER OPTIONS

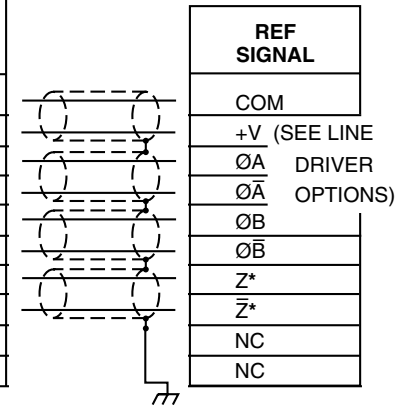
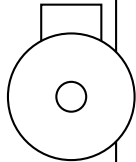
		Output Options		
		6	8	9
Output Type		Differential Line Driver	High Current Line Driver	Differential Line Driver 5V output
Line Driver		7272	4125	7272
Voltage Input (Vin)		5-24VDC	5-15VDC	5-24VDC
Protection	Reverse Voltage	Yes	Yes	Yes
	Transient	Yes	Yes	Yes
	Short Circuit	Yes	Yes	Yes



HS35M WIRING DIAGRAMS

DIFFERENTIAL TWO PHASE WIRING APPLICATIONS

PINOUT									
CONNECTOR	OPTION "W" (CABLE)	OPTIONS "A", "B", "C", "D" (10 PIN MS)		OPTIONS<< "J", "K", "M", "N" (7 PIN MS)	OPTIONS<< "E", "F", "G", "H" (6 PIN MS)	OPTIONS<< "T" (8 PIN M12)	OPTIONS<< "U" (8 PIN M12)	OPTIONS "P", "V", "Z"<< (10 PIN INDUSTRIAL)	OPTIONS "R", "S"<< (10 PIN TWIST-LOCK)
CHANNELS	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	B ØA, ØĀ ØB, ØB̄	B ØA, ØĀ ØB, ØB̄	B ØA, ØĀ ØB, ØB̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄
	BLACK	F	F	F	A	1	7	1	F
	RED	D	D	D	B	2	2	6	D
	GREEN	A	A	A	E	3	1	2	A
	YELLOW	H	C	C	C	4	3	7	H
	BLUE	B	B	B	D	5	4	3	B
	GRAY	I	E	E	F	6	5	8	J
	ORANGE	C	NC	NC	NC	7	6	4	C
	WHITE	J	NC	NC	NC	8	8	9	K
	BROWN	NC	NC	NC	NC	NC	NC	NC	NC
	VIOLET	NC	NC	NC	NC	NC	NC	NC	NC



* NC ON CHANNEL OPTION "B"
 << CONNECTED ON 18" CABLE

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

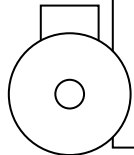
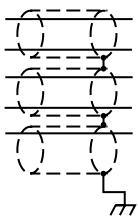
	BELDEN	ALPHA
2 PAIR	9368	6062C
3 PAIR	9369	6063C
4 PAIR	9388	6064C
6 PAIR	9389	6066C

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

HS35M WIRING DIAGRAMS

SINGLE ENDED TWO PHASE WIRING APPLICATIONS, WITH OR WITHOUT MARKER

PINOUT								
CONNECTORS	OPTION "W" (CABLE)	OPTIONS "A", "B", "C", "D" (10 PIN MS)	OPTIONS<< "J", "K", "M", "N" (7 PIN MS)	OPTIONS<< "E", "F", "G", "H" (6 PIN MS)	OPTIONS<< "T" (8 PIN M12)	OPTIONS<< "U" (8 PIN M12)	OPTIONS "P", "V", "Z"<< (10 PIN INDUSTRIAL)	OPTIONS "R", "S"<< (10 PIN TWIST-LOCK)
CHANNELS	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄	E, F ØA, ØB, ØZ	E, F ØA, ØB, ØZ	E, F ØA, ØB, ØZ	A ØA, ØĀ ^ ØB, ØĔ ^ ØZ, ØZ̄ ^	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄ INCLUDED BUT NOT USED	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄ INCLUDED BUT NOT USED
	RED	D	D	B	2	2	6	D
	BLUE	B	B	D	5	4	3	B
	GREEN	A	A	E	3	1	2	A
	BLACK	F	F	A	1	7	1	F
	ORANGE*	C*	C*	C*	7	6	4	C

REF SIGNAL

+V (SEE LINE DRIVER)

ØB DRIVER

ØA OPTIONS

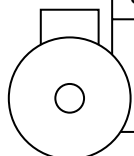
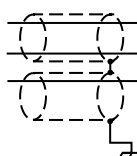
COM

ØZ*

* NC ON CHANNEL OPTION "F"
 ^ COMPLEMENTS INCLUDED BUT NOT USED
 <<CONNECTED ON 18" CABLE

SINGLE ENDED SINGLE PHASE WIRING APPLICATIONS

PINOUT								
CONNECTORS	OPTION "W" (CABLE)	OPTIONS "A", "B", "C", "D" (10 PIN MS)	OPTIONS<< "J", "K", "M", "N" (7 PIN MS)	OPTIONS<< "E", "F", "G", "H" (6 PIN MS)	OPTIONS<< "T" (8 PIN M12)	OPTIONS<< "U" (8 PIN M12)	OPTIONS "P", "V", "Z"<< (10 PIN INDUSTRIAL)	OPTIONS "R", "S"<< (10 PIN TWIST-LOCK)
CHANNELS	A (ØĀ, ØB, ØB, ØZ, ØZ̄ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	A (ØĀ, ØB, ØĔ, ØZ, ØZ̄ INCLUDED BUT NOT USED)	A (ØĀ, ØB, ØĔ, ØZ, ØZ̄ INCLUDED BUT NOT USED)	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄ INCLUDED BUT NOT USED	A ØA, ØĀ ØB, ØĔ ØZ, ØZ̄ INCLUDED BUT NOT USED
	BLACK	F	F	A	A	A	1	F
	RED	D	D	B	B	B	6	D
	GREEN	A	A	E	E	E	2	A

REF SIGNAL

COM

+V (SEE LINE DRIVER)

ØA OPTIONS

pivot the basket over the encoder connector when installing.
DO NOT FORCE.

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) Disconnect power from equipment and encoder cable.
- 2) Check the shaft the HS35M is mounted on for excessive shaft runout using a dial gauge. NEMA MG1 calls for 0.002" TIR or less.
- 3) Verify that the mounting shaft meets minimum and maximum diameter tolerances.
- 4) Maximize the shaft insertion into the encoder (retaining the minimum of 1/8" between mounting face and encoder)
- 5) Loosen the clamping collar and rotate the motor shaft 180° within the encoder hollow shaft sleeve. Retighten the clamping collar.
- 6) 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:

HS35M: 1/2", 5/8", 3/4", 7/8", 1", 1 1/8", 12mm*, 15mm*, 16mm*, 20mm*, 25mm, 30mm

NOTE: *HS35M units may utilize shaft insulating resin insert; these models from 0.500" to 1.00" [12mm to 20mm] may be resized as needed by interchanging or removing inserts.

* HS35M at 1 1/8", 25mm, and 30mm cannot be resized.

Consult factory for other shaft sizes not shown.

Shaft Engagement:

HS35M: For end of shaft applications, shaft insertion/engagement should be 1.25" to 2.06" [32mm to 52mm] with a minimum of 1/8" [3mm] between encoder and mounting surface. Minimum insertion/engagement is 1.75" [44mm] for models using a sizing insert. The HS35M may also be used for thru shaft applications by removing the end of shaft cover.

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 2.06" [52mm], be sure to remove the cover to prevent cover contact with the rotating shaft.

WIRING INSTRUCTIONS

CAUTION

Be sure to remove power before wiring the encoder.

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

The HS35M 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", "P", "R", "S", "U", "V", & "W"). Follow instructions under corrective installation as needed to reverse the direction of output or purchase HS35M with reverse (Dynapar HS35) phasing (options "B", "D", "F", "H", "K", & "N").

CORRECTIVE ACTION FOR PHASE REVERSAL

If Encoder Direction is Reversed:

(Note: Avtron offers reverse phasing options for former Dynapar HS35 customers – select wiring option "B" or "D").

- 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.

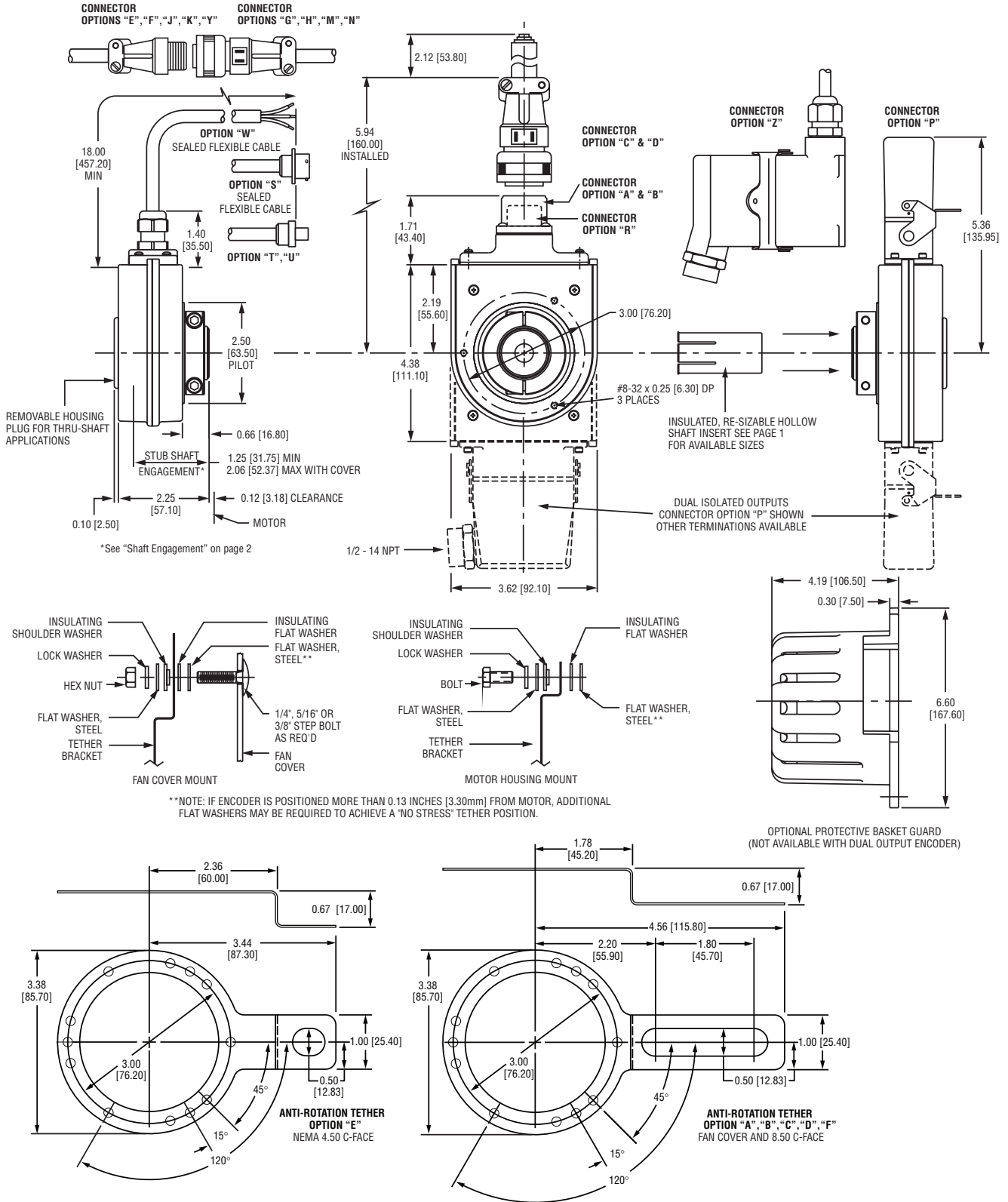
Interconnecting cables specified in the wire selection chart are based on typical applications. Refer to the "Wiring Diagrams" below for suggested cable types. General electrical requirements are: stranded copper, 22 thru 16 gauge (Connector Option "P" can use 14 AWG), each wire pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance with outer sheath insulator.

NOTE

When using the industrial connector ("P", "V", or "Z" 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.

*Maximum cable length (and line driver selection) is limited by several factors: line driver protection, maximum RPM, PPR, output voltage and cable capacitance. Line driver option 8 permits the longest cable lengths (up to 2000 feet typically at 5-15V). All HS35M line drivers have full protection against external faults. These factors may dictate maximum potential cable length.

OUTLINE DRAWINGS



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

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

