AVTRON ENCODERS

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A Nidec BRAND

Encoder Instructions

MODEL HS4

Incremental Magnetic
1/4", 3/8", 1/2", 5/8" & 6-15mm
Hollow Shaft Encoder

DESCRIPTION

The Avtron Model HS4 Incremental Encoder is a light mill duty speed and position transducer (also known as tachometer or rotary pulse generator), allowing operation down to zero RPM. The HS4 employs Hall Effect magnetic sensing technology, and when coupled to a motor or machine the encoder outputs a specific number of electrical Pulses Per Revolution (PPR) that is directly proportional to shaft position (pulse count) or speed (pulse rate).

The HS4 employs a hollow shaft and clamping collar to lock the encoder to the motor shaft. An insert permits models to fit a broad range of shaft sizes from 3/8" to 5/8" [6mm - 15mm]. An anti-rotation tether prevents rotation of the encoder while allowing for shaft end float and axial movement. The HS4 encoder offers 2Ø outputs (A, B) 90° apart for direction sensing (A Quad B), with complements (A/, B/), and with marker pulse and complement (Z ,Z/).

INSTALLATION CONSIDERATIONS

See page 3 and drawing on last page for shaft engagement rules. Shaft may include keyway, but should not be flatted. The HS4 offers optional Avtron flexible anti-rotation tethers 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.

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.

Equipment Needed for Installation		
Provided	**Optional**	**Not Provided**
HS4 Encoder with Tether (if selected)	Mating MS Cable Connector Protective Basket Kit Tether w/mounting screws	Thread Locker (Loctite 242 recommended) Anti-Seize Dial Indicator Gauge

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐☐
MODEL	**PPR**	**LINE DRIVER**	**SHAFT BORE**	**CONNECTOR***	**IP RATING**	**HOUSING SIZE**	**PROTECTION**	**TETHER**	**CHANNEL**	**MOD CODE**
HS4	**BA** - 30 **AA** - 32 **AK** - 80 **BC** - 100 **AH** - 120 **AC** - 128 **AM** - 200 **AL** - 240 **AN** - 256 **AE** - 360 **AG** - 400 **AB** - 480 **AQ** - 500 **AR** - 512 **AS** - 600 **AP** - 720 **AJ** - 960 **AW** - 1000 **AY** - 1024 **AZ** - 1200 **AV** - 1440 **AU** - 1800 **A3** - 2000 **A4** - 2048 **AT** - 3072 **A6** - 3600 **AD** - 4096 **A8** - 4800 **A9** - 5000 **CA** - 12700 **CB** - 10000	**1** - 5-30V In & Out **4** - 5-30V In / 5V Out	**D** - 1/4" **A** - 3/8" **B** - 1/2" **C** - 5/8"* **L** - 6mm **M** - 8mm **N** - 10mm **2** - 11mm **P** - 12mm **Q** - 14mm **R** - 15mm* *Native Bore / No Insert	See Connector Codes table for compatible Connector & Housing	**A -** IP65 Seals, Alum **G -** IP67 Seals, Alum	**3** - 36mm **5** - 58mm	**0 -** No Basket **1 -** Protective Basket		**A -** All Channels (A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$) **B -** A, $\overline{A}$, B, $\overline{B}$, No Marker **E -** A, B, Z, No Compliments	**000** - NONE **905** - 5' [2m] cable **915** - 15' [5m] cable **933** - 33' [10m] cable

Note: Some combinations of seals, bore size and housing size are not possible. See online Configurator for options selections.

CONNECTOR CODES	HOUSING
A, B, C, D, E, F, G, H, J, K, M, N, R	**3**
2, 3, 5, 7, T, U, W	3,5

CONNECTOR CODES	CHANNEL
A, B, C, D, R, T, U, 2, 3, 7, W	A
E, F, G, H, J, K, M, N	B, E
5	E

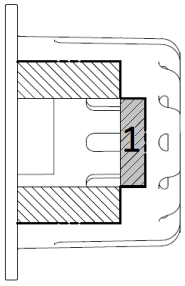
TETHER OPTIONS	
	A - Dual-Tab Tether: 1.65" [42mm] BC, 0.14" [3.5mm] slot **B** - Dual-Tab Tether: 2.48" [63mm] BC, 0.13" [3.2mm] slot **C** - Dual-Tab Tether: 1.65"-2.48" [42-63mm] BC, 0.14" [3.6mm] slot **D** - Fan Cover Tether: 1.57-2.95" [40-75mm] BC, 0.45" [11.4mm] slot **X** - No Tether

CONNECTOR				
A - 10 pin MS w/o Plug, Avtron/BEI Pinout **B** - 10 pin MS w/o Plug, Dynapar HS35 pinout (Rev Phasing) **C** - 10 pin MS with Plug, Avtron/BEI Pinout **D** - 10 pin MS with Plug, Dynapar HS35 pinout (Rev Phasing)	**E** - 6 pin MS w/o Plug, BEI/Avtron HS35 pinout **F** - 6 pin MS w/o Plug, Dynapar HS35 Pinout (Rev Phasing) **G** - 6 pin MS with Plug, BEI/Avtron HS35 pinout **H** - 6 pin MS with Plug, Dynapar HS35 Pinout (Rev Phasing)	**J** - 7 pin MS w/o Plug, Avtron/BEI HS35 Pinout **K** - 7 pin MS w/o Plug, Dynapar HS35 Pinout (Rev Phasing) **M** - 7 pin MS with Plug, Avtron/BEI HS35 Pinout **N** - 7 pin MS with Plug, Dynapar HS35 Pinout (Rev Phasing)	**R** - 10 Pin Mini Twistlock with Plug **T** - M12-8 pin w/o Plug, Global Pinout **7** - M12-8 pin w/o Plug, Global Pinout (Rev Phasing) **U** - M12-8 pin w/o Plug, USA Pinout	**2** - M23-12 Pin w/o Plug, Leine & Linde and Hubner pinout **3** - M23-12 Pin w/o Plug, Inverted Hubner Signals **5** - M12-5 Pin w/o Plug **W** - 3.2ft [1m] Cable (also use with special mod 9XX)

INSTALLATION

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

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, -0.013mm].
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".
5) Install the anti-rotation tether to the face of the encoder using screws and thread locker.
6) Loosen clamping collar and insert shaft sizing insert into encoder. DO NOT FORCE. (NOTE: To fit an HS4 on a 5/8" or 15mm shaft, use no insert.)
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 5/8" or 15mm shaft in HS4 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) Apply thread locker to screws on clamping collar. Tighten each screw 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.
10) Secure free end of anti-rotation tether to frame. Use insulating hardware. Use additional washers as needed to install the thether without a large deflection or bend.
11) Turn shaft by hand and verify the shaft turns freely and does not produce excessive runout/wobble of the encoder: <0.005" TIR (Total Indicated Runout). Additional instructions under "Adjusting the Encoder to Eliminate Excess Runout/Wobble" are provided if needed.
12) Connect cable as shown in wiring diagram.
13) Apply power (5-30VDC) to the encoder.
14) Rotate the shaft by hand, or using jog mode of the speed controller and verify proper direction.
15) Optional Protective Basket: Install protective basket using either the T-bolts (fan cover) or bolt to 4.5" C-Face (bolts provided). Remove section 1 (see illustration) on protective basket. Be certain to pivot the basket over the encoder connector when installing. Be certain that the protective basket does not touch or interfere with the anti-rotation tether.



To mount the basket on an 8.5" C-Face: DO NOT FORCE. Thread the ½"-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.

ELECTRICAL

A. Operating Power (Vin)
   1. Volts ..... See Line Driver Options
   2. Current ..... ≤140mA @ 5V DC, ≤70mA @ 10V DC, ≤40mA @ 24V DC
B. Output Format
   1. 2Ø & Comp ..... See Channel Options (A, A/, B, B/ Z ,Z/ available)
C. Signal Type ..... Incremental, Square Wave 90° ± 4.5° electrical
D. Direction Sensing ..... Phasing with respect to rotation as viewed from the back of the encoder (non-shaft side).

Connector options "A", "C", "E", "G", "J" "M", "R", "T", "U", "W" "2", "5", "7" ..... ØA leads ØB for CW rotation (Std. phasing).

Connector options "B", "D", "F", "H", "K" "N", "U", "3" ..... ØA leads ØB for CCW rotation (Reverse phasing).

E. Max Frequency Response 1MHz
F. PPR 1-16,384

MECHANICAL

A. Speed ..... 3,000-12,000 Max RPM (consult factory)
B. Max Shaft Load ..... Axial 40 N, Radial 110 N
C. Shaft Diameter ..... 1/4", 3/8", 6mm, 10mm
D. Starting Torque ..... ≤5 Ncm @ 20°C (7.1 oz-in @ 68° F)
E. Weight ..... 320g nom (varies by configuration)
F. Length ..... 55mm nom (varies by configuration)

ENVIRONMENTAL

A. Operating Temperature ..... -40 °C (-40 °F) - +85 °C (+185 °F)
B. Humidity ..... 98% RH, non-condensing
C. Shock Resistance ..... ≤ 100 g ..... (half sine 6 ms, EN 60068-2-27)
D. Permanent Shock ..... ≤ 10 g (half sine 16 ms, EN 60068-2-29)
E. Vibration Resitance ..... ≤ 10 g (10 Hz – 1000 Hz, EN 60068-2-6)

		OUTPUT OPTIONS	
		1	4
Output Type		Differential Line Driver	Differential Line Driver, 5V fixed
Line Driver		IC-HD2	IC-HD2
Voltage Input (Vin)		5-30V in & out	5-30V in / 5V out
Protection	Reverse Polarity	yes	yes
	EMC: Emitted Interference	DIN EN 61000-6-4	DIN EN 61000-6-4
	EMC: Noise Immunity	DIN EN 61000-6-2	DIN EN 61000-6-2
	Short Circuit	yes	yes
Max Cable Length		5V 500' [150m] 12V 250' [75m] 24V 100' [30]	500' [150m]

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 HS4 is mounted on for excessive shaft runout. 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).
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, it may be necessary to physically bias the attitude of the encoder on the motor shaft while the clamping collar is being tightened.

Shaft Sizes:

HS4: 0.025", 0.375", 0.500", 0.625"*, 6mm, 8mm, 10mm, 11mm 12mm, 14mm, 15mm*

NOTE: HS4 units utilize shaft insert; models from 0.025" to 0.500" [6mm to 14mm] may be resized as needed by interchanging inserts.

* HS4 at 0.625" and 15mm does not utilize shaft insulating insert: use insulating washers with anti-rotation thether to achieve electrical isolation from shaft currents.

Shaft Engagement:

HS4: Shaft insertion/engagement should be from 0.5" to 0.71" [12.5mm to 18mm] (maximum, for 36mm body models) and up to 0.79" to 1.10" [20mm to 28mm] (maximum, for 58mm body models), with a minimum of 1/8" [3mm] between encoder and mounting surface.

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 tether.

WIRING INSTRUCTIONS

CAUTION
Be sure to remove power before wiring the HS4 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 anti-rotation tether kits provide insulating washers).

The HS4 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, A/, B, B/, Z, Z/), A and A/ should be wired using one twisted, shielded pair; B and 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", & "W"). Follow instructions under corrective installation as needed to reverse the direction of output or purchase HS4 with reverse (Dynapar HS35) phasing (options "B", "D").

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 user end of the wires.
   b.) Differential 2-Phase Wiring (see wiring diagram) Exchange either A with A in the phase A pair OR B with 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 below are based on typical applications. 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, each wire pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance, outer sheath insulator. See Wire Selection Chart below for some suggested cables. *Maximum cable length (and line driver selection) is limited by several factors: line driver protection, maximum RPM, PPR, output voltage and cable capacitance.

WIRING DIAGRAMS

Line Driver (Output Option 1, 4)

DIFFERENTIAL TWO PHASE WIRING APPLICATIONS, With or Without Marker

	Pinout								
Connector	Option "W" (Cable)	Option "A", "B", "C", "D" (10-Pin MS)	Option "E", "F", "G", "H" (6-Pin MS)	Option "J", "K", "M", "N" (7-Pin MS)	Option "R" (mini Twist-lock)	Option "2", "3" (M23-12 Pin)	Option "T", "7" (M12-8 Pin)	Option "U" (M12-8 Pin)	
Channel Option & Signals	A A, A/ B, B/ Z, Z/	A A, A/ B, B/ Z, Z/	B A, A/ B, B/	B A, A/ B, B/	A A, A/ B, B/ Z, Z/	A A, A/ B, B/ Z, Z/	A A, A/ B, B/ Z, Z/	A A, A/ B, B/ Z, Z/	Ref Signal
Encoder Wiring	GREEN	A	E	A	A	5	3	1	A
	YELLOW	H	C	C	H	6	4	3	A/
	GRAY	B	D	B	B	8	5	4	B
	PINK	I	F	E	I	1	6	5	B/
	BLUE	C	-	-	C	3	7	6	Z
	RED	J	-	-	J	4	8	8	Z/
	BROWN	D	B	D	D	12	2	2	+V
	WHITE	F	A	F	F	10	1	7	COM/GND
	SHIELD								

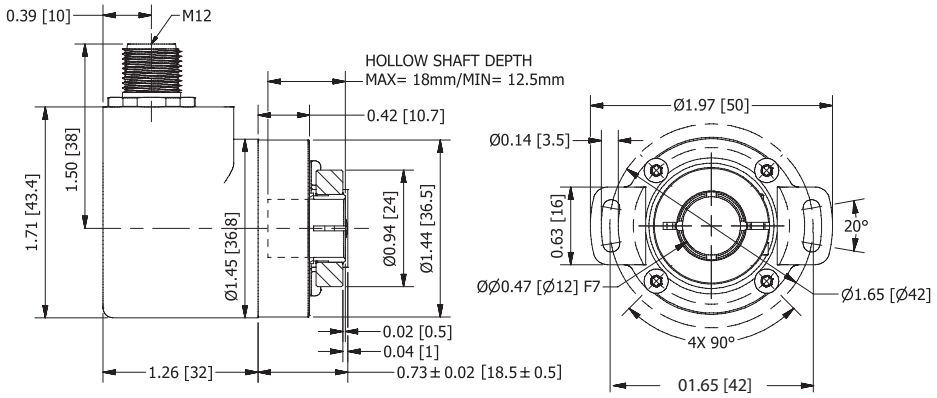
Line Driver (Output Option 1, 4)

SINGLE ENDED TWO PHASE WIRING APPLICATIONS, WITH OR WITHOUT MARKER

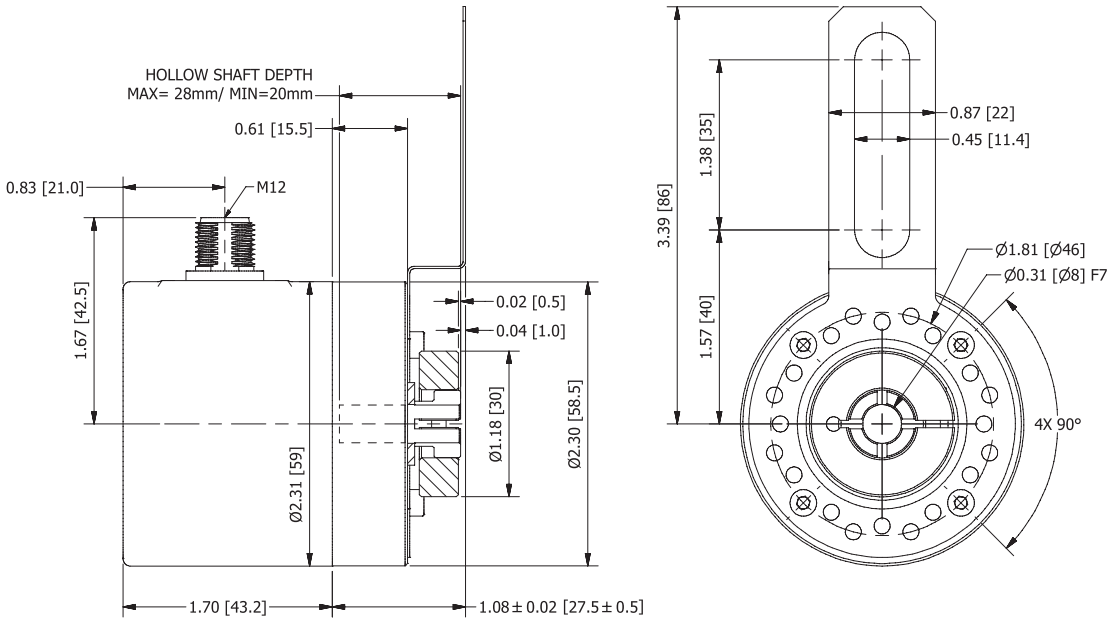
	Pinout				
Connector	Option "W" (Cable)	Option "E", "F", "G", "H" (6-Pin MS)	Option "J", "K", "M", "N" (7-Pin MS)	Option "5" (M12-5 Pin)	
Channel Option & Signals	A A, A/^ B, B/^ Z, Z/^	E A, B, Z	E A, B, Z	E A, B, Z	Ref Signal
Encoder Wiring	GREEN	A	A	4	A
	YELLOW				A/
	GRAY	B	B	2	B
	PINK				B/
	BLUE	C	C	5	Z
	RED				Z/
	BROWN	D	D	1	+V
	WHITE	F	F	3	COM/GND
	SHIELD				

^ Marker N/A

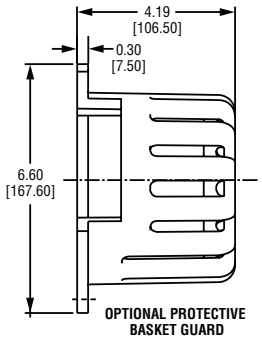
Tether Option “A” - Dual-Tab Tether: 1.65” [42mm] BC, 0.14” [3.5mm] slot



Tether Option “D” - Fan Cover Tether: 1.57-2.95” [40-75mm] BC, 0.45” [11.4mm] slot



Housing	Seals	Hollow Shaft Mounting Depth	
		(min)	(max)
“3” (36mm) “4” (42mm)	A, G, X	0.60” (15mm)	0.71” (18mm)
“3” (36mm) “4” (42mm)	J, K	0.71” (18mm)	0.87” (22mm)
“5” (58mm)	A, G, J, K	0.79” (20mm)	1.10” (28mm)



DIMENSIONS IN INCHES [MILLIMETERS]

ALL DIMENSIONS ARE APPROXIMATE

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