# H25 | INCREMENTAL OPTICAL ENCODER



#### Introduction

The H25 is the flagship of the BEI Sensors product line. It was designed from the ground up for the industrial marketplace. The H25 offers features such as EMI shielding, 40 lb. ABEC 7 bearings, matched thermal coefficients on critical components, and custom high efficiency optics. The encoder meets NEMA 4 and 13 requirements when ordered with the shaft seal. Typical applications include machine control, process control, the wood processing industry, oil well logging, industrial weighing, agricultural machinery, textile equipment, web process control, robotics, and food processing.

Sensata

**Technologies** 



#### Mechanical

Shaft Diameter	3/8" nominal (1/2" as special feature)
Flat On Shaft	3/8" Shaft: 0.80 long X 0.03" deep; 1/2" Shaft: 0.80 long X 0.04" deep (1/2" shaft w/flat must be ordered as special feature)
Shaft Loading	3/8" shaft: Up to 40 pounds axial and 35 pounds radial; 1/2" shaft: Up to 90 pounds axial and 80 pounds radial
Shaft Runout	0.0005 T.I.R. at midpoint regardless of shaft diameter
Starting Torque at 25°C	Without shaft seal 1.0 in-oz (max); With shaft seal 2.5 in-oz (max); 1/2" shaft with shaft seal: 3.5 in-oz (max)
Bearings	Class ABEC 7 standard, ABEC 5 for 1/2" shaft
Shaft Material	416 stainless steel
Bearing Housing	Die cast aluminum with protective finish; stainless steel (special feature)
Cover	Die cast aluminum; stainless steel (special feature)
Bearing Life	2 X 10 <sup>8</sup> revs (1300 hrs at 2500 RPM) at rated load 1 X 10 <sup>10</sup> revs (67,000 hrs at 2500 RPM) at 10% of rated load
Maximum RPM	12,000 RPM nominal, 8000 RPM with 1/2" shaft (see Frequency Response, below) 30,000 RPM available on units with 3/8" shaft—consult with factory
Moment of Inertia	4.1 X 10 <sup>-4</sup> oz-in-sec <sup>2</sup> ; 5.2 X 10 <sup>-4</sup> oz-in-sec <sup>2</sup> with 1/2" shaft
Weight	13 oz typical, 14.5 oz typical with 1/2" shaft





# Electrical

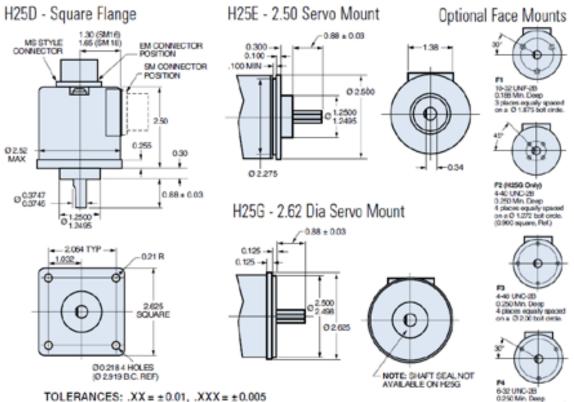
Code	Incremental
Output Format	2 channels in quadrature, 1/2 cycle index gated with negative B channel
Cycles per Shaft Turn	1 to 72,000 (see table 2) For resolutions above 3,600 see BEI for interpolation options
Supply Voltage	5 to 28 VDC available
Current Requirements	100 mA typical +output load, 250 mA (max)
Voltage/Output	(see note 5) <b>15V/V:</b> Line Driver, 5–15 VDC in, Vout = Vin <b>28V/V:</b> Line Driver, 5–28 VDC in, Vout = Vin <b>28V/5:</b> Line Driver, 5–28 VDC in, Vout = 5 VDC <b>28V/OC:</b> Open Collector, 5–28 VDC in, OCout
Protection Level	Reverse, overvoltage and output short circuit (see note 5)
Frequency Response	100 kHz, up to 1MHz with interpolation option (see note 7)
Output Terminations	See Table 1
Note	Consult factory for other electrical options

# Environmental

Enclosure Rating	NEMA 4 & 13 (IP 66) when ordered with shaft seal (on units with an MS connector) or a cable gland (on units with cable termination).
Temperature	Operating, 0° to 70° C; extended temperature testing up to 105°C available; Storage, -25° to 90° C unless extended temperature option called out.
Shock	50 g's for 11 msec duration
Vibration	5 to 2000 Hz @ 20 g's
Humidity	98% RH without condensation







6-32 UNC-25 0.250 Min. Deep 3 pisces equally spaced on a (0.2.00 bot circle.





## Table 1: Incremental Output Terminations

The connector style will determine pinouts. For example, an encoder with ABC channels and an M18 connector uses the table to the right.

M14 Connector	M16 Connector	Channels Designated in Model Number		
Pin	Pin	ABZ	ABC	
E	А	А	А	
D	В	В	В	
С	С	Z	Ā	
В	D	+V (Supply Voltage)		
F	E		B	
А	F	OV (Circuit Common)		
	G	Case Ground (CG) (except H2O)		

M14 Connector		
Pin	Channel	
А	А	
В	В	
С	Z	
D	+V	
E		
F	0V	
G	CG	
Н	Ā	
I	B	
J	Z	

Wire Color	DA 15P Connector		Designated in Model Number		
(22AWG)	DA 15P Connector	ABZ	ABC	ABZC	
YEL	13	А	А	А	
BLUE	14	В	В	В	
ORN	15	Z		Z	
W-Yel	10		Ā	Ā	
W-Blu	11		B	B	
W-Orn	12			Z	
RED	6	+V (Supply Voltage)			
BLK	1	OV (Circuit Common)			
GRN	9	Case Ground (CG0) (except H2O)			
WHITE		Shield Drain (Shielded Cable Only)			

M12 Connector		
Pin	Channel	
А	А	
В	В	
С	Z	
D	+V	
E	—	
F	0V	
G	CG	
Н	Ā	
J	B	
К	Z	

### Table 2: Disc Resolutions for Incremental Encoder Models H25, H38, H40, L25, E25

Resolutions highlighted with are available H25 EXPRESS ENCODERS® that ship in one to three days.

1, 2, 5, 6, 7, 8, 10, 13, 16, 20, 24, 25, 26, 30, 32, 33, 34, 36, 37, 40, 45, 48, 50, 51, 56\*, 60, 64, 66, 72, 75, 80, 86, 88, 90, 100, 102, 120, 122, 125, 127, 128, 132, 144, 148, 150, 158, 160, 175, 176, 180, 187, 192, 200, 202, 204\*, 217, 220, 240, 250, 254, 255, 256, 264\*, 274, 280, 283, 288, 292, 300, 312, 320, 321, 325, 360, 366, 372, 375, 377, 380, 381, 384, 385, 393, 400, 430, 432, 450, 462, 480, 490, 500, 502, 508, 512, 522, 530, 550, 560\*, 576, 598, 600, 604, 625, 635, 638, 640, 660, 672, 676, 680, 687, 690, 700, 720, 725, 735, 740, 744, 748, 750, 762, 768, 780, 785, 800, 812, 825, 850, 864, 878, 888, 900, 912, 914, 938, 942, 955, 960, 1000, 1016, 1024, 1030, 1035, 1036, 1040, 1054, 1056, 1074, 1076, 1080, 1088, 1100, 1101, 1125, 1136, 1200, 1237, 1250, 1257, 1270, 1280, 1300, 1314, 1332, 1333, 1390, 1400, 1414, 1427, 1440, 1484, 1500, 1562, 1570, 1596, 1600, 1650, 1666, 1718, 1745, 1774, 1800, 1840\*, 1850, 1855, 1875, 1894, 1920, 1952, 1968, 1979, 1995, 2000, 2048, 2080, 2094, 2100, 2160, 2164, 2199, 2200, 2250, 2356, 2400, 2485, 2500, 2514, 2519, 2540, 2821, 2827, 2833, 3000, 3125, 3600, 4000, 4096, 5000

\*AB or ABC output only. NOTE: Resolutions up to 72,000 are available.





Express Encoder  Expres	H25 D SS - 2000 - ABZ C - 28V/V	/— s M <sup>,</sup>	18 — —	
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De Segue Pange 2 - 200 Ennets Seno Maurt 2 - 200 Ennet Maurt 2 - 200 Ennets Seno Maurt 2 - 200 Ennet Maurt 2 - 2	<b>25</b> = 2.500" Diameter			
E 2 AD Diameter Seron Mount See drivensions Deptiminal Face Mounts See drivensions Deptiminal Face Mounts See drivensions See drivension	Housing Configuration			
If (E. Nousing only), P2, P3, or F4         Beach = Yaono         See note 7         Shaft Seal Configuration         See note 7         Shaft Seal (Not available on M250)         Blank = Noine (Not available on M250)         See note 2         Vumber of Channels         A = Single Channel         AB = Daul Unaut, Channel         AB = Daul Unaut, Channel         AB = Oal Unaut, Channel         AB = Daul Unaut, Channel         See note 3         Complements         See note 3         Doutput Termination Location         See note 3         Dutput Termination         M2 = M31 UE12: 10P         M1 = M33 UE12: 10P         M1 = M33 UE12: 10P         M1 = M33 UE12: 10P	D = Square Flange E = 2.50 Diameter Servo Mount G = 2.62 Diameter Servo Mount See dimensions			
Bink - None       Shaft Seal (Configuration       Image: Sea (Sea (Sea (Sea (Sea (Sea (Sea (Sea	Optional Face Mounts			
SS = Shafe Sear (Nat maintained Bearing Sear note 2 Cycles Per Turn	F (E housing only), F2, F3, or F4 Blank = None See note 1			
Bink = Shielded Bearing See note 2 Cycles Per Turn  Cycles Per Turn  Cycl	Shaft Seal Configuration			
The Cycles) See Table 2 Wumber of Channels A = Single Channel A = Single With Index A = Single with Index See note 3 Complements Complementary Outputs Blanks = None See note 4 Voltage/Output Voltage/Output See note 4 Voltage/Output See note 5 Dutput Termination Location E = End S = Side Dutput Termination Location See note 5 Dutput Itermination Category Contex See See Side See See See Side See See See Side See See See Side See See Side See See See Side See See See Side See See See Side See See See See See See See See See Se	SS = Shaft Seal (Not available on H25G) Blank = Shielded Bearing See note 2			
See Table 2           Yumber of Channels         A         Single Channel           As Single Channel         AB = Doal Quad, Channel         ABZ = Doal With Index           AZ = Single With Index         AZ = Single With Index         ABZ = Doal With Index           AZ = Single With Index         AZ = Single With Index         AB = Doal Quad, Channel           ABZ = Doal With Index         AZ = Single With Index         AB = Doal Quad, Channel           ABZ = Single With Index         AB = Doal Quad, Channel         AB = Doal Quad, Channel           Complements         Complements         AB = Doal Quad, Channel           See note 3         Complements         AB = Doal Quad, Channel           Voltage/Output         See note 4         AD = DOAL QUAD, Channel           Voltage/Output         See note 5         AD = DOAL QUAD, Channel           Valtage/Output         See note 5         AD = DOAL QUAD, Channel           Valtage/Output         See note 5         AD = DOAL QUAD, Channel           Valtage/Output         See note 5         AD = DOAL QUAD, Channel           See note 5         See note 5         AD = DOAL QUAD, Channel           See note 5         See note 5         AD = DOAL QUAD, Channel           See note 5         See note 5         See note 5           See note 5         See note 6 <td>Cycles Per Turn</td> <td></td> <td></td> <td></td>	Cycles Per Turn			
A = Single Channel AB = Dual Quad. Channel AB = Z = Single with Index AZ = Single with Index AZ = Single with Index See note 3 Complements	(Enter Cycles) See Table 2			
AB = Dual Quad. Channel ABZ = Dual With Index ABZ = Single With Index See note 3 Complements Complemen	Number of Channels			
Complements C = Complementary Outputs Blanks = None See note 3 Voltage/Output TSVV = 5-15 Vin/out 28VV = 5-28Vin/OCout 28VV = 5-28Vin/O	A = Single Channel       AB = Dual Quad. Channel         ABZ = Dual with Index       AZ = Single with Index			
C = Complementary Outputs Blanks = None See note 4 Voltage/Output TSVV = 5-15 Vin/out 280V/0 = 5-28Vin/OCout 280V/	See note 3			
Blanks = None See note 4 Outpue/Output 15V/v = 5-15 Vin/out 28V/v = 5-28Vin/Out 28V/v = 5-28Vin/OUt 28V/v = 5-28Vin/OCout 28V/v = 5-28Vin/OCout 28V/v = 5-28Vin/OCout 28V/v = 5-28Vin/OCout 28 = note 5 Output Termination Location E = End 5 = Side Output Termination M12 = MS3102R18-1P C = Pigai Cable See table 1 & note 9 Hazardous Area Ratings Blank = None E = Intrinsically Safe NI = Non-Incendive Contact factory for voltage options See table 1	Complements			
15V/v = 5-15 Vin/out         28V/v = 5-28Vin/out         28V/0 = 5-28Vin/OSvout         See note 5         Dutput Termination Location         = End         \$ = Side         Dutput Termination         M12 = MS3112E12-10P         M16 = MS3102B16S-1P         C = Pigtal Cable         C = Pigtal Cable         C = Pigtal Cable         C = Pigtal Cable         C = Pigtal R* Iong)         See table 1 % note 9         Hazardous Area Ratings         Blank = None         EX = Intrinsically Safe         N = Non-Incendive         Contact factor for voltage options         Special Features         S = Special	C = Complementary Outputs Blanks = None See note 4			
28VV = 5-28V <sub>in</sub> /Sv <sub>out</sub> 28V/S = 5-28V <sub>in</sub> /Sv <sub>out</sub> 28V/S = 5-28V <sub>in</sub> /Sv <sub>out</sub> See note 5         Dutput Termination Location         E = End         S = Side         Dutput Termination         M12 = MS3112E12-10P         M16 = MS3102R165-1P         C = Pigtail Cable         C S = Cable with seal         Cable length specified in inches         (i.e. C18 + Pigtail 18" long)         See table 1 & note 9         Hazardous Area Ratings         Blank = None         EX = Intinsically Safe         M1 = None         EX = Intinsically Safe         M1 = None         S = Special         Sec alle         S = Special	Voltage/Output			
Dutput Termination Location  E = End S = Side  Dutput Termination  M12 = MS3112E12-10P M16 = MS3102R185-1P M18 = MS3102R185-1P M18 = MS3102R18-1P C = Pigtail Cable CS = Cable with seal Cable length specified in inches (i.e. C18 = Pigtail 18" long) See table 1 & note 9  Hazardous Area Ratings Blank = None EX = Intrinsically Safe N1 = Non-Intendive Contact factory for voltage options Special Features S = Special	<b>15V/V</b> = 5–15 Vin/out <b>28V/V</b> = 5–28Vin/out <b>28V/S</b> = 5–28Vin/SV <sub>out</sub> <b>28V/C</b> = 5–28Vin/OC <sub>out</sub> <i>See note 5</i>			
E = End S = Side Dutput Termination M12 = MS3112E12-10P M16 = MS3102R16S-1P M17 = MS3102R18-1P C = Pigtail Cable CS = Cable with seal Cable length specified in inches ( <i>i.e.</i> C18 = Pigtail 18" long) See table 1 & note 9 Hazardous Area Ratings Blank = None EX = Intrinsically Safe NI = Non-Incendive Contact factory for voltage options Special Features S = Special				
M1 = MS3112E12-10P M16 = MS3102R16S-1P M18 = MS3102R18-1P C = Pigtail Cable CS = Cable with seal Cable length specified in inches (i.e. C18 = Pigtail 18" long) See table 1 & note 9 Hazardous Area Ratings Blank = None EX = Intrinsically Safe NI = Non-Incendive Contact factory for voltage options Special Features S = Special	E = End S = Side			
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Hazardous Area Ratings Blank = None EX = Intrinsically Safe NI = Non-Incendive Contact factory for voltage options Special Features S = Special	M12 = MS3112E12-10P M16 = MS3102R16S-1P M18 = MS3102R18-1P C = Pigtail Cable CS = Cable with seal Cable length specified in inches (i.e. C18 = Pigtail 18" long) Sea table 1.8 eatt 9			
Blank = None EX = Intrinsically Safe NI = Non-Incendive Contact factory for voltage options Special Features S = Special				
Special Features Special	Blank = None EX = Intrinsically Safe NI = Non-Incendive			
S = Special				
	S = Special			

S = Special Features specified on purchase order (consult factory) See note 6

**EXPRESS ENCODERS:** Items highlighted with **EXPRESS ENCODERS:** Items highlighted with **EXPRESS ENCODERS:** Items highlighted with **EXPRESS ENCODERS:** T2 and T5 options are available as standard H25 Express Encoder model options.



- **1.** Mounting is usually done either using the D-style square flange mount, E- or G-style servo mounts, or one of the standard face mounts, F1 for example. Consult factory for additional face mount options.
- **2.**The shaft seal is recommended in virtually all installations. The most common exceptions are applications requiring a very low starting torque or those requiring operation at both high temperature and high speed.
- **3.** Non-standard index widths and multiple indices are available by special order. Consult factory.
- **4.** Complementary outputs are recommended for use with line driver type (source/sink) outputs. When used with differential receivers, this combination provides a high degree of noise immunity.
- 5. Output IC's: Output IC's are available as either Line Driver (LD) or NPN Open Collector (OC) types. Open Collectors require pull-up resistors, resulting in higher output source impedance (sink impedance is similar to that of line drivers). In general, use of a Line Driver style output is recommended. Line Drivers source or sink current and their lower impedance mean better noise immunity and faster switching times. Warning: Do not connect any line driver outputs directly to circuit common/OV, which may damage the driver. Unused outputs should be isolated and left floating. Our applications specialists would be pleased to discuss your system requirements and the compatibility of your receiving electronics with Line Driver type outputs.
- 28V/V: Multi-voltage Line Driver (7272\*): 100 mA source/sink. Input voltage 5 to 28 VDC +/- 5% standard (Note: Vout = Vin). This driver is TTL compatible when used with 5 volt supply. Supply lines are protected against overvoltage to 60 volts and reverse voltage. Outputs are short circuit protected for one minute. Supply current is 120 mA typical (plus load current). This is the recommended replacement for 3904R and 7406R open collector outputs with internal pullup resistors. It is also a direct replacement for any 4469, 88C30, 8830 or 26LS31 line driver
- **28V/5:** Multi-voltage Line Driver (7272\*): 100 mA source/sink. Input voltage 5 to 28 VDC +/- 5% standard, internally regulated with 5V (TTL compatible) logic out. Supply lines are protected against overvoltage to 60 volts and reverse voltage. Outputs are short circuit protected for one minute. Supply current is 90 mA typical (plus load current).
- **15V/V:** Multi-voltage Line Driver (4469\*): 100 mA source/sink. Input voltage 5 to 15 VDC +/- 5% standard (Note: Vout = Vin). TTL compatible when used with 5 volt supply. Supply lines are protected against overvoltage to 60 volts and reverse voltage. Outputs are short circuit protected for one minute. Supply current is 90 mA typical (plus load current). This is a direct replacement for the 4469 Line Driver.
- **28V/OC:** NPN Open Collector (3904\*, 7273\*). Current sink of 80 mA max. Current sourced by external pull- up resistor. Output can be pulled up to voltage other than supply voltage (30 V max). Input voltage 5 to 28 VDC +/- 5% standard. Supply current is 120 mA typical. This replaces prior IC's with designations of 3904, 7406, 3302, 681 and 689.
- **5V/OCR, 15V/OCR, 24V/OCR:** Open Collector (3904R\*, 7406R\*, 7273R\*): Current sink of 70 mA max. Includes internal pull-ups sized at approximately 100 ohms/volt. 5V/V. 5V/OC, 5V/OCR and 9V/OC can be intrinsically safe line driver and open collector outputs available on certain model variations. They are intrinsically safe only when installed per the controldrawing noted on the certification label affixed to the encoder body.
- **3904, 3904R, 4469, 5V/V, 5V/OC, 5V/OCR, 9V/OC:** Intrinsically safe line driverand open collector outputs. These drivers are specific to intrinsically safe encoders, and are installed per the appropriate control drawings listed in Table 2.1 on page 48.
- **6.** Special –S at the end of the model number is used to define a variety of non-standard features such as special shaft lengths, voltage options, or special testing. Please consult the factory to discuss your special requirements.
- 7. Higher frequency response may be available. Please consult with the factory.
- **8.** Mating straight plug receptacles may be ordered from the factory:

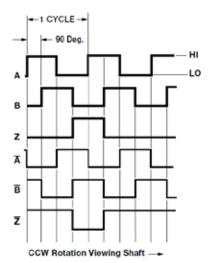
For M12 use MS3116F12-10S, For M14 use MS3106F14S-6S

For M14/19 use MS3116J14-19S, For M16 use MS3106F16S-1S

For M18 use MS3106F18-1S, For M20 use MS3106F20-29S

\* Products manufactured prior to April 2007 used the line driver IC number instead of voltage output in model number.

### Figure 1: Output Waveform



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