



# H40 SHOCK PROOF OPTICAL ENCODER

Extra Heavy Duty Encoder

## Product Description

The H40 is an ultra heavy duty encoder whose internal structure is totally isolated from severe shock and shaft loading conditions. The optics and electronics are supported in shock absorbing material within the heavy cast outer housing. The encoder shaft is flexibly coupled to the high load capacity bearings and shaft assembly, which is carried in the outer housing. The entire bearing assembly is field-removable to permit proper shaft support while pressing pulleys, gears, etc. onto the shaft. An Underwriters Laboratories listed version of this model is available.



## SPECIFICATIONS

### Electrical Specifications

<b>Output Format</b>	2 channels in quadrature, 1/2 cycle index gated with negative B channel
<b>Cycles per Shaft Turn</b>	1 to 72,000 (see Table 3). For resolutions above 3,600 consult factory
<b>Supply Voltage</b>	5 to 28 VDC available
<b>Current Requirements</b>	100 mA typical + output load, 250 mA (max)
<b>Voltage/Output</b>	(see note 5) 15V/V: Line Driver, 5–15 VDC in, $V_{out} = V_{in}$ 28V/V: Line Driver, 5–28 VDC in, $V_{out} = V_{in}$ 28V/5: Line Driver, 5–28 VDC in, $V_{out} = 5$ VDC 28V/OC: Open Collector, 5 – 28 VDC in, $OC_{out}$
<b>Protection Level</b>	Reverse, overvoltage and output short circuit (see note 5)
<b>Frequency Response</b>	100 KHz, up to 1 MHz with interpolation option (see note 5)
<b>Output Terminations</b>	see Table 2, following pages
<b>Termination Type</b>	Compression type, UL recognized. Accepts AWG 14 to 22, stranded wire, strip 1/4"

**Note:** Contact factory for other electrical options

## Mechanical Specifications

<b>Shaft Diameter</b>	5/8" Nominal
<b>Flats On Shaft</b>	Two flats, 0.75" long X 0.30" deep at 90°
<b>Shaft Loading/ Bearing Life</b>	Refer to figure 1
<b>Shaft Runout</b>	0.001" T.I.R. at mid-point of shaft
<b>Starting Torque at 25°C</b>	10.0 in-oz (max)
<b>Bearings</b>	Class 52100 SAE high carbon steel, stainless steel option
<b>Shaft Material</b>	1070 carbon steel, 303 and 316 stainless steel optional
<b>Enclosure</b>	Die cast aluminum, hard anodized with dichromate sealed finish (optional). Shaft seals and sealed bearings are standard to achieve environmental ratings.
<b>Maximum RPM</b>	10,000 RPM (see frequency response, below)
<b>Coupling Windup</b>	The H40 uses an internal coupling. Windup error (degrees) = $a \times 7.5 \times 10^{-4} \text{ rad/sec}^2$ where $a$ = angular acceleration in $\text{rad/sec}^2$
<b>Weight</b>	Approx 9 lbs.

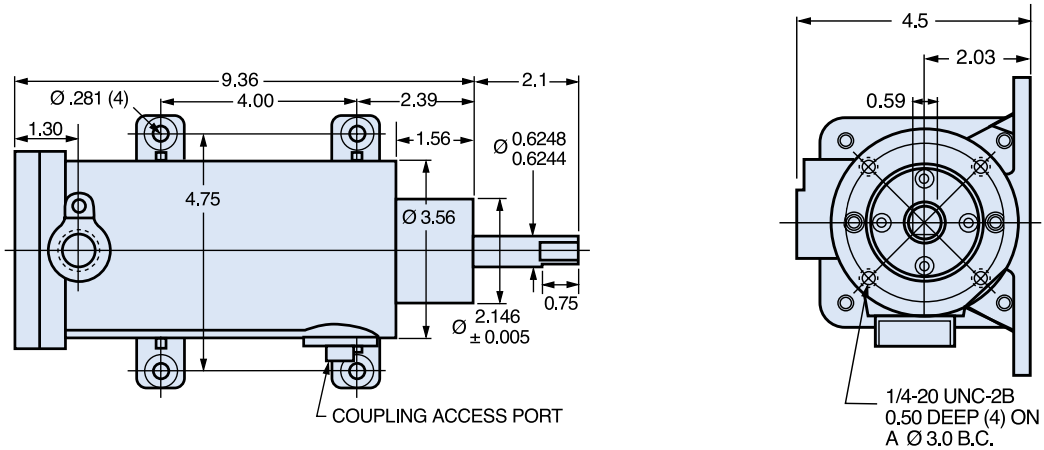
## Environmental Specifications

<b>Enclosure Rating</b>	NEMA 4 X & 6 (IP66), outdoor Non-Hazardous locations, NEMA 4 X & 13 (IP66), indoor Non-Hazardous locations
<b>Hazardous Area Rating</b>	The optional Underwriters Laboratories listed version is for use in hazardous locations; NEMA Enclosure 7. Class 1, Group D, Division 1, NEC Class 2 circuits only
<b>Temperature</b>	Operating, 0° to 70° C; extended temperature testing available (see note 6); 80° C max for UL and CEN approved units; storage; -25° to 90° C
<b>Shock</b>	200 g's at 11msec
<b>Vibration</b>	5 to 2000 Hz @ 20 g's
<b>Humidity</b>	100% RH

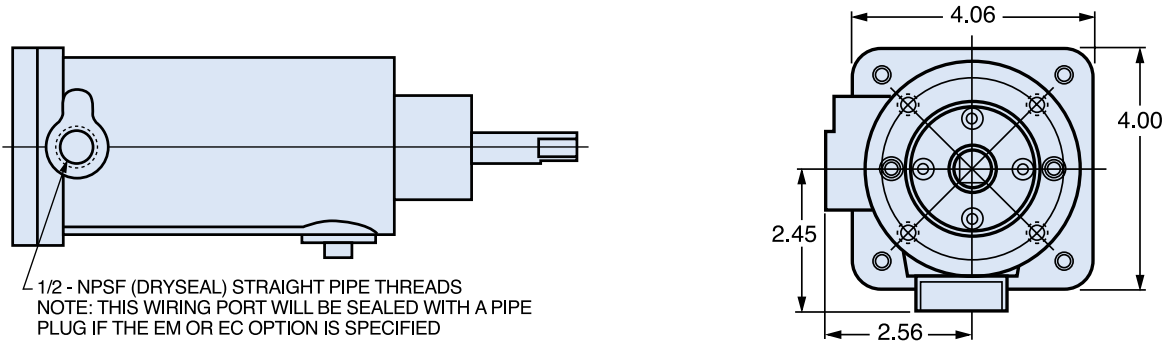
**Note:** Contact factory for other electrical options

**Notes and Tables:** All notes and tables referred to in the text can be found on the pages that follow.

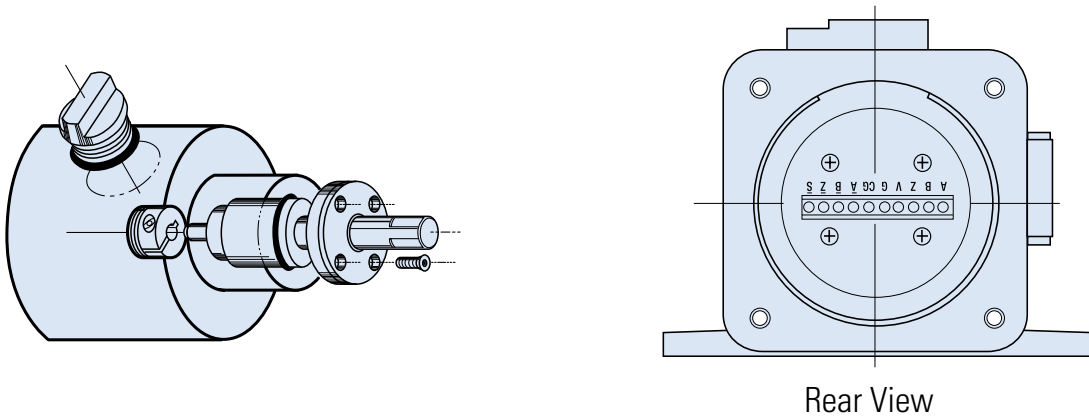
H40A



H40B



Field Replaceable Coupling & Bearing Assembly



**Table 1 —**  
 Output Functions

Incremental	
Terminal	Function
A	Channel A
B	B
Z	Z
V	+VDC
G	Ground (0V)
CG	Case Ground
$\bar{A}$	$\bar{A}$
$\bar{B}$	$\bar{B}$
$\bar{Z}$	$\bar{Z}$
S	Spare*

\* or Select on Dual Count encoders

8-Bit Absolute*		
Gray Code	Natural Binary	Function
G0	2 <sup>0</sup>	1
G1	2 <sup>1</sup>	2
G2	2 <sup>2</sup>	3
G3	2 <sup>3</sup>	4
G4	2 <sup>4</sup>	5
G5	2 <sup>5</sup>	6
G6	2 <sup>6</sup>	7
G7	2 <sup>7</sup>	8
Spare		9
Spare		10
Latch		11
Interrogate		12
Spare		13
+VDC		14
0V (Common)		15
Case Ground		16

\* Latch and Interrogate are optional

**Table 2 —**  
 Incremental Output Terminations

M16 Connector	Channels Designated in Model Number	
	ABZ	ABC
PIN		
A	A	A
B	B	B
C	Z	$\bar{A}$
D	+V (Supply Voltage)	
E	—	$\bar{B}$
F	0V (Circuit Common)	
G	Case Ground (CG)	

M18 Connector	
PIN	Channel
A	Channel A
B	B
C	Z
D	+VDC
F	Ground (0V)
G	Case Ground
H	$\bar{A}$
I	$\bar{B}$
J	$\bar{Z}$

**Table 3 —**  
 Disc Resolutions for Incremental Encoder Model H40

1, 2, 3, 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, 628, 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, 3000, 3125, 3600, 4000, 4096, 5000

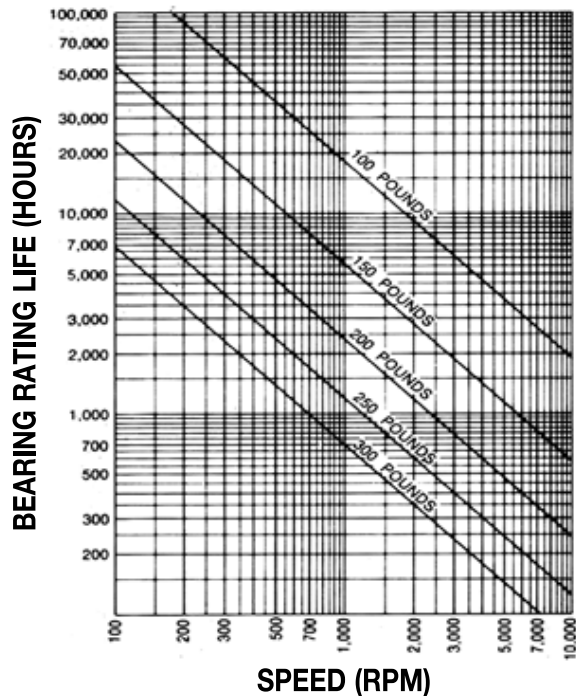
\* AB or ABC output only.

**Note:** Resolutions up to 72,000 are available.



FIGURE 1

### Bearing Life vs. Speed at Various Radial Loads



### NOTES

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:  $V_{out} = V_{in}$ ). 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:  $V_{out} = V_{in}$ ). 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. Max current source is 10 mA. Supply current is 100 mA typical, 120 mA with internal pull-ups. The 5V/OCR, 15V/OCR and 24V/OCR are often replaced by the 28V/V in system upgrades.

**3904, 3904R, 4469, 5V/V, 5V/OC, 5V/OCR, 9V/OC:** Intrinsically safe line driver and 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 of the 2008 BEI Specifying Guide.

**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.** Extended temperature ratings are available in the following ranges: -40 to 70°C, -40 to 85°C, -20 to 105°C and -40 to 105°C depending on the particular model. Some models can operate down to -55°C. Extended temperature ranges can affect other performance factors. Consult with factory for more specific information.

**9.** 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

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



## ORDERING OPTIONS

**H40** - **X** - **X** - **X** - **X** - **X** - **X** - **X** - **X** - **X**

**Type**  
**H:** Heavy Duty  
**40:** 4.00" Square

**Housing Configuration**  
**A:** Base Mounted Feet  
**B:** No Mounting Feet

**Cycles per Turn**  
 Enter Cycles (See Disc Resolutions for Incremental Encoder Model H40)

**No. of Channels**  
**A:** Single Channel  
**AB:** Dual Quad. Ch.  
**ABZ:** Dual with Index  
**AZ:** Single with Index  
 (See Table 1)

**Compliments**  
**C:** Complimentary Outputs  
**Blank:** None  
 (See Table 2)

**Voltage/Outputs**  
**15V/V:** 5–15 Vin/out  
**28V/V:** 5–28Vin/out  
**28V/5:** 5–28Vin/5Vout  
**28V/OC:** 5–28Vin/OCout  
 (See note 5)

**Output Termination**  
**SC:** Side Conduit  
**EC:** End Conduit; Conduit uses 1/2–14 NPSF (dryseal) straight pipe threads;  
**EM16:** MS3102R16S-1P  
**EM18:** MS3102R18-1P,

**Certification**  
**UL:** UL Explosion Proof rating, only available with SC termination

**Special Features**  
**S:** Special features specified on purchase order (consult factory)  
 (See note 6)



## AGENCY APPROVALS & CERTIFICATIONS



Agency	File Number
CE	EN 55011 and EN 61000-6-2
UL	U.S. Standards Class I, Group D, Division 1
cUL	Canadian Standards Class I, Group D, Division 1

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## CONTACT US

### Americas

+1 (800) 350 2727 – Option 1  
[sales.beisensors@sensata.com](mailto:sales.beisensors@sensata.com)  
**Europe, Middle East & Africa**  
+33 (3) 88 20 8080  
[position-info.eu@sensata.com](mailto:position-info.eu@sensata.com)

### Asia Pacific

[sales.isasia@list.sensata.com](mailto:sales.isasia@list.sensata.com)  
China +86 (21) 2306 1500  
Japan +81 (45) 277 7117  
Korea +82 (31) 601 2004  
India +91 (80) 67920890  
Rest of Asia +886 (2) 27602006  
ext 2808

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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)