



Built to the same rugged standards as the H40 Incremental Heavy Duty encoder, this unit features an absolute encoder output up to 13 bits of resolution. Designed to take the rigors of physically demanding environments, the H40 has a heavy-duty housing, a 100+ pound bearing, and internal shock absorbers. When you need absolute position in a really tough environment—the H40 absolute is what you need.

Electrical Specifications

Code: 12 or 13 bits NB or GC; excess gray and BCD available
Counts Per Shaft Turn: 4096 or 8192
Count Transition Accuracy: ± 1/2 bit maximum
Supply Voltage: 5–28 VDC
Current Requirements: 120 mA typical
Output Formats: Parallel: Gray Code, Natural Binary and Binary Coded Decimal; Serial: Serial Synchronous Interface (SSI) compatible; Analog: 4-20 mA, 0-10V
Voltage/Output: (see note 5)
 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 OCout
 SSI: 5–28 VDC in/5Vout (consult factory)
Protection Level: Reverse, overvoltage and output short circuit protection
Frequency Response: 100kHz (1200 RPM for 12-bits, 600 RPM for 13-bits)
Output Termination Pinouts: see Table

Mechanical Specifications

Shaft Diameter: 5/8" nominal
Flats On Shaft: Two flats, 0.75" long X 0.30" deep at 90°
Shaft Loading/Bearing Life: Refer to Figure 1
Shaft Runout: 0.001" T.I.R. at mid-point of shaft
Starting Torque at 25° C: 10.0 in-oz (max)
Bearings: Class 52100 SAE high carbon steel
Shaft Material: 1070 carbon steel, 303 stainless steel optional
Enclosure: Die cast aluminum, hard anodized with optional sealed finish. Shaft seals and sealed bearings are standard to achieve environmental ratings.
Maximum RPM: 10,000 RPM (see Frequency Response)
Coupling Windup: The H40 uses an internal coupling. Windup error (degrees) = $a \times 7.5 \times 10^{-4}$ rad/sec² where a = angular acceleration in rad/sec²
Weight: Approx 9 lbs

Environmental Specifications

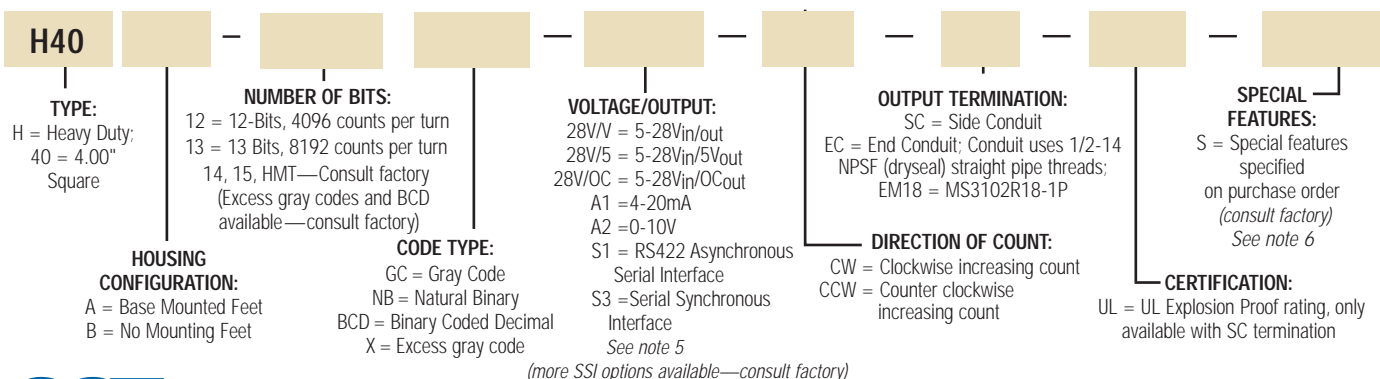
Enclosure Rating: NEMA 4 X & 6 (IP66), outdoor Non-Hazardous locations, NEMA 4 X & 13 (IP66), indoor Non-Hazardous locations
Hazardous Area Rating: The optional Underwriters Laboratories listed version is for use in hazardous locations; NEMA Enclosure 7, Class 1, Group D, Division 1, NEC Class 2 circuits only
Temperature: Operating, 0° to 70° C; extended temperature testing available (see note 8, pg 64); 80° C max for UL and CEN approved units; storage; -25° to 90° C
Shock: 200 g's at 11msec
Vibration: 5 to 2000 Hz @ 20 g's
Humidity: 100% RH
NOTES & TABLES: All notes and tables referred to in the text can be found on the back of this page.

H40 Absolute Encoder Ordering Options

FOR ASSISTANCE CALL 800-350-2727

Use this diagram, working from left to right to construct your model number (example: H40A-12GC-28V/V-CW-SC-UL).

All notes and tables referred to can be found on the back of this page.



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). **Note:** Limit encoder load to 2.5W max at ambient. Example at 12 VDC: $2.5W / (+12VDC \text{ minus } +5VDC) = 357 \text{ mA}$ total allowed current. Consult factory for your specific requirements.
- 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.

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

Options

Serial Synchronous Interface (SSI) SSI output provides effective synchronization in a closed-loop control system. A clock pulse train from a controller is used to clock out sensor data: one bit of position data is transmitted to the controller per one clock pulse received by the sensor. The use of a differential driver permits reliable transmission of data over long distances in environments that may be electrically noisy. The encoder utilizes a clock signal, provided by the user interface, to time the data transmission. Receiving electronics must include an appropriate receiver as well as line terminating resistors.

- Features :**
- Synchronous transmission
 - Transmission lengths to 1000 feet
 - Accepts clock rates from 100 KHz to 1.8 MHz

Data Transmission Sequence

1. Output driver of the encoder is a MAX 491 transceiver in transmit mode. The recommended receiver is a MAX 491 transceiver in receive mode.
2. Controller provides a series of pulses (or differential pulse pairs) on the CLOCK input lines.
3. On the first HIGH-to-LOW CLOCK transition, the encoder latches its data at the current position and prepares to transmit.
4. Controller reads data on the falling edge of the next 15 clock cycles.
5. The first bit is a START bit and is always HIGH.
6. Next comes 13 data bits beginning with the most significant bit (MSB) and ending with the parity bit. On 12 bit encoders, bit 13 is LOW. When parity is not ordered, parity is LOW.
7. After the last CLOCK HIGH-to-LOW transition, a minimum of 40 microseconds must pass before the beginning of the next CLOCK series.

Interfacing Long Data Lines

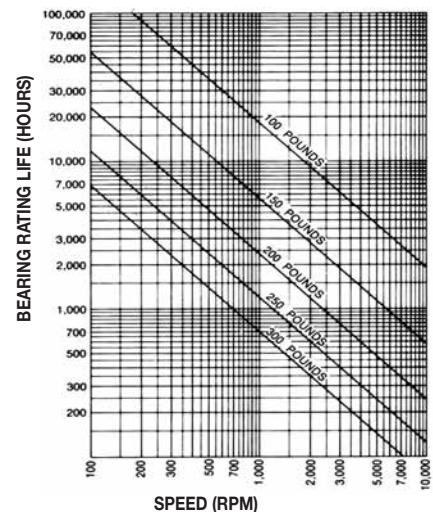
Cable impedance can create a transmission delay, in effect, shifting the phase relationship between the clock pulse and the data. If this phase shift exceeds 180°, then the wrong bit position will be sampled by the receiver. As a result, the maximum allowable clock frequency is a function of the cable length. For 24 AWG, stranded, 3 pair cable (BEI part number 37048-003 or equivalent) the group delay is 1.36ns/ft. The table below shows the maximum transmission rate allowable as a function of cable length to ensure a phase shift of less than 90°.

CLOCK, Maximum (kHz) = $92,000 / \text{Cable Length (ft)} \times \text{CW}$

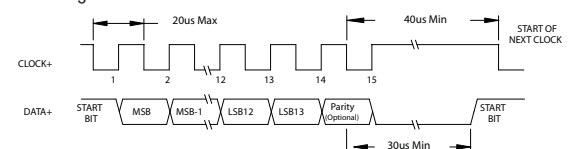
Cable Length (ft)	50	100	200	300	500	1000
Max Freq (kHz)	1800	900	500	300	200	100

Figure 1

Bearing Life vs. Speed at Various Radial Loads



SSI Timing



Tables

Output Code and Terminations (12 & 13 Bit)								
PARALLEL CODE					TERMINATION TYPE			
	Gray Code		Natural Binary		Binary Coded Decimal	Cable	M14/19 Conn	Term Board
	12 Bit	13 Bit	12 Bit	13 Bit				
MSB	G ₁₁	G ₁₂	2 ¹¹	2 ¹²	A ₀	WHT/BLK	A	1
	G ₁₀	G ₁₁	2 ¹⁰	2 ¹¹	B ₀	WHT/BRN	B	2
	G ₉	G ₁₀	2 ⁹	2 ¹⁰	C ₀	WHT/RED	C	3
	G ₈	G ₉	2 ⁸	2 ⁹	D ₀	WHT/ORN	D	4
	G ₇	G ₈	2 ⁷	2 ⁸	A ₁	WHT/YEL	E	5
	G ₆	G ₇	2 ⁶	2 ⁷	B ₁	WHT/GRN	F	6
	G ₅	G ₆	2 ⁵	2 ⁶	C ₁	WHT/BLU	G	7
	G ₄	G ₅	2 ⁴	2 ⁵	D ₁	WHT/IO	H	8
	G ₃	G ₄	2 ³	2 ⁴	A ₂	WHT/GRY	J	9
	G ₂	G ₃	2 ²	2 ³	B ₂	WHT	K	10
	G ₁	G ₂	2 ¹	2 ²	C ₂	GRY/BLK	L	11
LSB ₁₂	G ₀	G ₁	2 ⁰	2 ¹	D ₂	GRY/BRN	M	12
LSB ₁₃		G ₀		2 ⁰	A ₃	GRY/RED	N	13
	OV (CIRCUIT COMMON) ¹				B ₃	GRY/ORN	P	
	DIRECTION OF COUNT					ORN	R	18
	CASE GROUND					GRN	S	16
	0 V (CIRCUIT COMMON)					BLK	T	15
	LATCH CONTROL					YEL	U	17
	+V (SUPPLY VOLTAGE)					RED	V	14
	SHIELD DRAIN					BARE	—	

¹Pin P is available for a tri-state option

SSI Output Termination Table				
	M18 CONN	M14/19 CONN	CABLE CONN	TERM. BOARD
DATA +	A	A	YEL	1
DATA-	H	B	WHT/YEL	7
CLOCK+	B	C	BLU	2
CLOCK-	I	D	WHT/BLU	8
DIR CONTROL	C	R	ORN	3
CASE GROUND	G	S	GRN	6
CIRCUIT COMMON	F	T	BLK	5
+V SUPPLY VOLTAGE	D	V	RED	4
SHIELD DRAIN	—	—	BARE	—

Parallel Code (14 & 15 Bit) ²					
	Gray Code		Natural Binary		M14/19 Connector
	14 BIT	15 Bit	14 BIT	15 Bit	
MSB	G ₁₃	G ₁₄	2 ¹³	2 ¹⁴	A
	G ₁₂	G ₁₃	2 ¹²	2 ¹³	B
	G ₁₁	G ₁₂	2 ¹¹	2 ¹²	C
	G ₁₀	G ₁₁	2 ¹⁰	2 ¹¹	D
	G ₉	G ₁₀	2 ⁹	2 ¹⁰	E
	G ₈	G ₉	2 ⁸	2 ⁹	F
	G ₇	G ₈	2 ⁷	2 ⁸	G
	G ₆	G ₇	2 ⁶	2 ⁷	H
	G ₅	G ₆	2 ⁵	2 ⁶	J
	G ₄	G ₅	2 ⁴	2 ⁵	K
	G ₃	G ₄	2 ³	2 ⁴	L
	G ₂	G ₃	2 ²	2 ³	M
	G ₁	G ₂	2 ¹	2 ²	N
LSB ₁₄	G ₀	G ₁	2 ⁰	2 ¹	P
LSB ₁₅	DIR CONTROL	G ₀	DIR CONTROL	2 ⁰	R
	CASE GROUND				S
	OV (CIRCUIT COMMON)				T
	LATCH	DIR/LATCH	LATCH	DIR/LATCH	U
	+V (SUPPLY VOLTAGE)	+V (SUPPLY VOLTAGE)	+V (SUPPLY VOLTAGE)	+V (SUPPLY VOLTAGE)	V

²Units Manufactured before April 2007 are LSB Justified.

Direction of Count: Standard is CW increasing when viewed from the shaft end. Pin R is normally HI (or N/C) and is pulled up internally to +V. To reverse the count direction, Pin R must be pulled LO (COMMON).

Latch control: Encoder outputs are active and provide continuous parallel position information when Pin U is HI (or N/C). Pin U is pulled up internally to +V. When Pin U is LO (COMMON) the encoder outputs are latched at the logic state that is present when the latch is applied and will stay latched until Pin U is no longer grounded.

Dir/Latch on 15-Bit Encoders: Due to a limited number of connector pins, either direction of count or latch is available on pin U.

M18 Connector is a MS3102R18-1P, 10-pin connector on the encoder body and mates to an MS3106F18-1S connector or can be used with a standard cable/connector assembly, BEI P/N 924-31186-18XX (Where XX = 10, 20 30 or 50 for a 10, 20, 30, or 50 foot length). This is the preferred connector for SSI output.

M14/19 Connector is a MS3112E14-19P, 19-pin connector on the encoder body and mates to an MS3116J14-19S or equivalent.