H40
ABSOLUTE SHOCK-PROOF ENCODER

Introduction

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.

SPECIFICATIONS

Mechanical

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, stainless steel option
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, below)
Coupling Windup	The H40 uses an internal coupling. Windup error (degrees) = a X 7.5 X 10^{-4} rad/sec^2 where a = angular acceleration in rad/sec^2
Weight	Approx 9 lbs.

Electrical

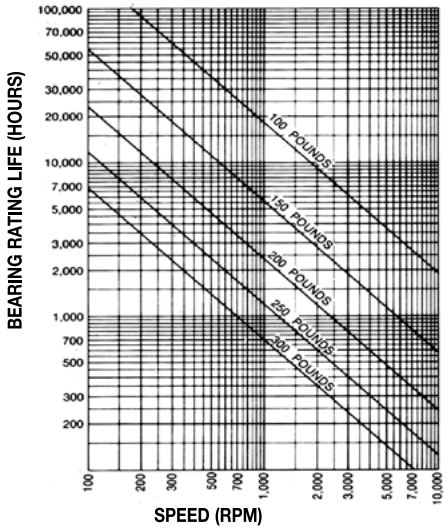
Code	12 or 13 bits NB or GC; excess gray and BCD available
Counts Per Shaft Turn	4096 or 8192
Output Format	2 channels in quadrature, 1/2 cycle index gated with negative B channel
Count Transition Accuracy	± 1/2 bit maximum
Supply Voltage	5 to 28 VDC
Current Requirements	120 mA typical
Voltage/Output	(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, OC_{out} 28V/5: Line Driver, 5 – 28 VDC in, $V_{out} = 5$ VDC SSI: 5 - 28 $VDC_{in}/5V_{out}$ (consult factory, reference Figure 2)
Protection Level	Reverse, overvoltage and output short circuit (see note 5)
Frequency Response	100 KHz (1200 RPM for 12-bits, 600 RPM for 13-bits)
Output Terminations	see Table 1 for Parallel outputs and Table 2 for SSI outputs.

Environmental

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); 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

FIGURES

Figure 1



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/0V, 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).
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

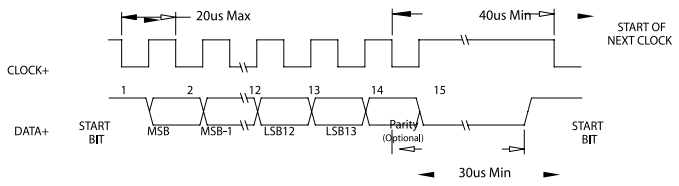
Serial Synchronous Interface (SSI)

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 MHzone

Figure 2



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 / Cable Length (ft)CW

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

ORDERING OPTIONS

Example : H40-A-12-GC-28V/V-CW-SC-UL-S

H40 – A – 12 – GC – 28V/V – CW – SC – UL – S

Type

H: Heavy Duty
40: 4.00" Square

Housing Configuration

A: Base Mounted Feet
B: No Mounting Feet

No. of Bits

12: 12-Bits, 4096 counts per turn
13: 13 Bits, 8192 counts per turn
14, 15, HMT — Consult factory
(Excess gray codes and BCD available—consult factory)

Code Type

GC: Gray Code
NB: Natural Binary
BCD: Binary Coded Decimal
X: Excess Gray Code

Voltage/Output

28V/V: 5–28V_{in}/$_{out}$
28V/5: 5–28V_{in}/5V_{out}
28V/OC: 5–28V_{in}/OC_{out}
A1: 4-20mA
A2: 0-10V
S1: RS422 Asynchronous Serial Interface
S3: Serial Synchronous Interface
(See Note 5)
(More SSI options available — consult factory)

Direction of Count

CW: Clockwise increasing count
CCW: Counter clockwise increasing count

Output Termination

SC: Side Conduit
EC: End Conduit; Conduit uses 1/2–14 NPSF (dryseal) straight pipe threads;
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)

Table 1.-Output Code and Terminations (12 & 13 Bit)

Parallel Code						Termination Type		
	Gray Code		Natural Binary		Binary Coded Decimal	Cable	M14/19 Conn	Term Board H38 & H40
	12 Bits	13 Bits	12 Bits	13 Bits				
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/VIO	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
LBS_{12}	G_0	G_1	2^0	2^1	D_2	GRY/BRN	M	12
LBS_{13}		G_0		2^0	A_3	GRY/RED	N	13
	OV (CIRCUIT COMMON)				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	-	

Table 2.- SSI Output Termination Table

	M18 Conn	M14/19 Conn	Cable Conn	Term. Board	
				H38	H40
DATA +	A	A	YEL	4	1
DATA -	H	B	WHT/YEL	7	7
CLOCK +	B	C	BLU	5	2
CLOCK -	I	D	WHT/BLU	8	8
DIR Control	C	R	ORN	6	3
Case Ground	G	S	GRN	1	6
Circuit Common	F	T	BLK	2	5
+V Supply Voltage	D	V	RED	3	4
Shield Drain	-	-	BARE	-	-