H38 Absolute Explosion Proof Encoder

This is the same Explosion Proof rated encoder as the H38 Incremental, in an absolute encoder version with output up to 13 bits of resolution. When your application needs the ability to recover position information quickly after a power loss and you are operating in a hazardous area – the H38 may be the answer to your needs.

Electrical Specifications

Reference the H25 Absolute Encoder, page 34

Mechanical & Environmental Specs

Reference the H38 Incremental Encoder, pages 26-27

H38 Absolute Encoder Ordering Options

FOR ASSISTANCE CALL 800-350-2727

Use this diagram, working from left to right to construct your model number (example: H38D-12GC-7272-CW-SC-UL).
All notes and tables referred to can be found on pages 50-51.

H38 [ ] – [ ] [ ] — [ ] — [ ] — [ ] — [ ] — [ ] — [ ]

TYPE:
H = Heavy Duty;
38 = 3.75" Square

HOUSING CONFIGURATION:
D = Standard

NUMBER OF BITS:
12 = 12-Bits, 4096 counts per turn
13 = 13 Bits, 8192 counts per turn
(Excess gray codes and BCD available–consult factory

CODE TYPE:
GC = Gray Code
NB = Natural Binary
BCD = Binary Coded Decimal
X = Excess gray code

OUTPUT IC TYPE:
A1 = 4-20mA
A2 = 0-10V
7272 = Line Driver
7273 = Open Collector
S3 = Serial Synchronous Interface *(See note 5 and page 40 for SSI*

DIRECTION CONTROL:
CW = Clockwise increasing count
CCW = Counter

OUTPUT TERMINATION:
SC = Side Conduit, 1/2–14 NPSF (dryseal) straight pipe threads

UL:
UL = Class I Environments
UL2 = Class I & II Environments

SPECIAL FEATURES:
S= Special features specified on purchase order (consult factory)
See note 6

H25 Absolute Optical Encoder

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

Output Device: (see note 5)
7272: Line Driver, 5 – 28 VDC, $V_{out} = V_{in}$
7272: Line Driver, 5 – 28 VDC, V_{out} = 5 volts (special feature)
7273: Open Collector, accepts 5 – 28 VDC
SSI: See page 40

Protection Level: Reverse, overvoltage and output short circuit protection (7272 only)

Frequency Response: 100kHz (1200 RPM for 12-bits, 600 RPM for 13-bits)

Output Termination Pinouts: See table page 41

Mechanical & Environmental Specs

Reference the H25 Incremental Encoder, pages 16-17

Connector

MS3112E14-19P, 19–pin connector on encoder body, mates to MS3116F14-19S (or equivalent)

NOTES & TABLES: All notes and tables referred to in the text can be found on pages 50 and 51.

Figure 1 Gray Code

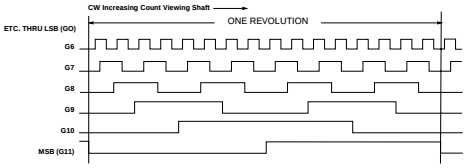
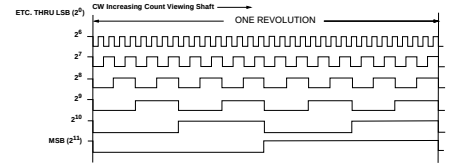


Figure 2 Natural Binary



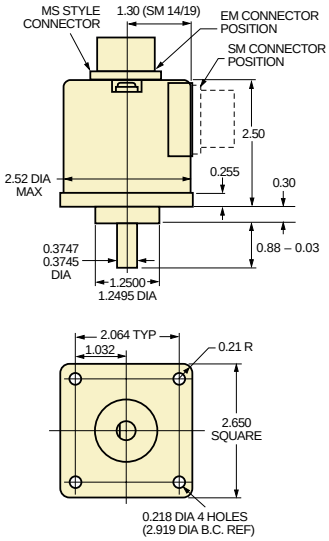
Long considered the industry standard for shafted incremental encoders, the Model H25 is now available in an absolute version up to 13 Bits of resolution. It incorporates many of the great standard features of the incremental version, including: EMI shielding, 40-lb ABEC 7 bearings, matched thermal coefficients on critical components, and custom optics. This encoder features a 12 or 13 Bit absolute parallel gray code output, a selection line for count direction, and an output latch as standard. Output is standard gray code with options for natural binary or SSI compatible signals. Signals can be provided in either a single-ended multi-voltage line driver (TTL compatible when provided with 5 volts) or as an open-collector style of output. Typical applications include dam gate control, cranes, telescopes, tool changers, and robotics.

Certifications

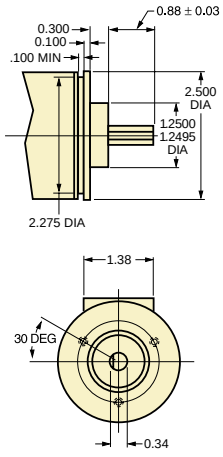
CE EN 55011 and EN 61000-6-2

See Regulatory Information on pages 47–49 for further certification details.

H25D - Square Flange

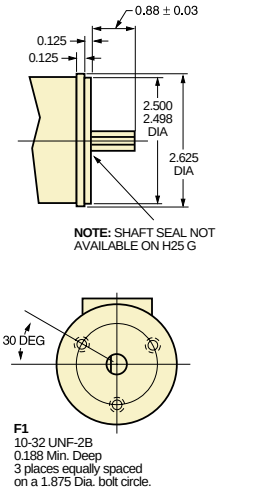


H25E - 2.50 Servo Mount



F4
6-32 UNC-2B
0.250 Min. Deep
3 places equally spaced
on a 2.00 Dia. bolt circle.

H25G - 2.62 Dia Servo Mount



NOTE: SHAFT SEAL NOT AVAILABLE ON H25 G

F1
10-32 UNF-2B
0.188 Min. Deep
3 places equally spaced
on a 1.875 Dia. bolt circle.

TOLERANCES: .XX = ± 0.01, .XXX = ± 0.005

H25 Absolute Encoder Ordering Options

FOR ASSISTANCE CALL 800-350-2727

Use this diagram, working from left to right to construct your model number (example: H25E-F4-SS-12GC-7272-CW-SM14/19).
All notes and tables referred to can be found on pages 50-51.

H25 – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ]

TYPE:
Heavy Duty
2.5 inch Dia.

HOUSING :
D = Square Flange
E = 2.5 inch dia. servo mount
G = 2.62 inch dia. servo mount
See dimensions

FACE MOUNTS:
F1
F4
See note 1

SHAFT SEAL CONFIGURATION:
SS = Shaft Seal
See note 2

NUMBER OF BITS:
12 = 12-Bits, 4096 counts per turn
13 = 13 Bits, 8192 counts per turn
(Excess gray codes and BCD available–consult factory

CODE TYPE:
GC = Gray Code
NB = Natural Binary
BCD = Binary Coded Decimal
X = Excess gray code

OUTPUT IC TYPE:
A1 = 4-20mA; A2 = 0-10V
7272 = Line Driver
7273 = Open Collector
S3 = Serial Synchronous Interface
See note 5 and page 40 for SSI

DIRECTION CONTROL:
CW = Clockwise increasing count
CCW = Counter clockwise increasing count

OUTPUT TERMINATION LOCATION:
E = End
S = Side

TERMINATION TYPE:
M14/19 = 19 pin connector
CS= Cable with gland seal
Cable length specified in inches
(i.e. C18 = Pigtail 18" long)
See page 41

SPECIAL FEATURES:
S = Special features specified on purchase order (consult factory)
See note 6

EXPRESS ENCODERS® Items highlighted with are standard Express Encoders and ship in one to three days.

H38 Explosion Proof Optical Encoder

Table 1- Output Functions		
TERMINAL PIN NO.	**INCREMENTAL OUTPUT**	**8 BIT GRAY CODE OUTPUT***
1	CASE GRND.	CASE GRND.
2	GROUND	GROUND
3	+V	+V
4	A	G0
5	B	G1
6	Z	G2
7	$\overline{A}$	G3
8	$\overline{B}$	G4
9	$\overline{Z}$	G5
10	SPARE	G6
11	SPARE	G7

*For higher resolutions, see Absolute Encoder Options on pages 40-41.

The H38 is an explosion proof version of the field-proven H25 encoder series. The H38 is UL certified for NEMA Class 4X and 6 (outdoor non-hazardous locations) and Class 4X and 13 (indoor non-hazardous locations). It also carries a Class 1, Group D, Division 1; and Class 2, Division 1 Group E, F, and G rating for use in hazardous locations. It features a standard shaft seal, double bearing seals, and a cast aluminum housing with hard anodized and dichromate sealed finish. The H38 is suitable for use in petroleum service industries, solvent refining operations, spray painting applications, and explosive dust environments.

H38 Explosion Proof Ordering Options

FOR ASSISTANCE CALL 800-350-2727

Use this diagram, working from left to right to construct your model number (example:H38D-2000-ABZC-4469-SC-UL2).
All notes and tables referred to can be found on pages 50-51.

H38 [ ] – [ ] – [ ] [ ] – [ ] – [ ] – [ ] – [ ]

TYPE:
H = Heavy Duty
38 = 3.75" Square

HOUSING CONFIGURATION:
D = Standard, (see dimensions, next page)

CYCLES PER TURN:
Enter Cycles, *See Table 2*

NO. OF CHANNELS:
A = Single Channel
AB = Dual Quad. Ch.
ABZ = Dual with Index
AZ = Single with Index
See note 3

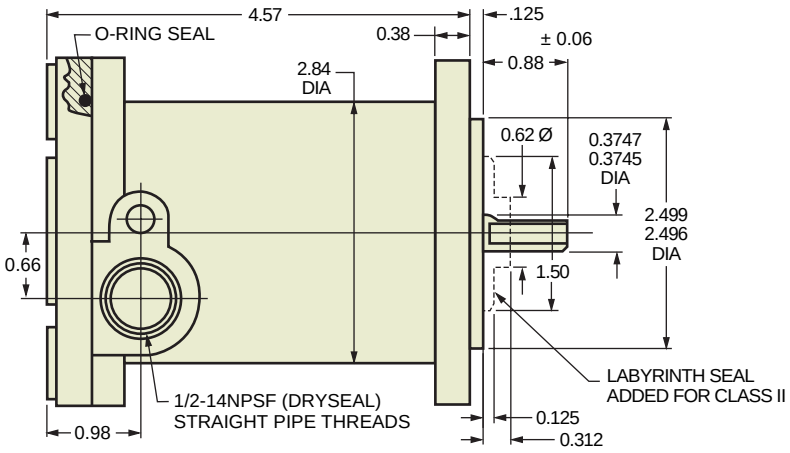
COMPLEMENTS:
C = Complementary Outputs,
Blank = None
See note 4

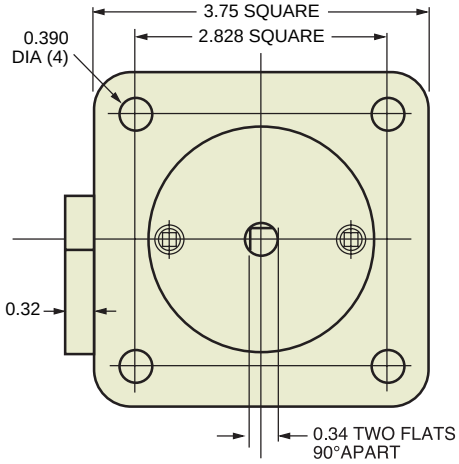
OUTPUT IC:
4469, 7272, or 7273
See note 5

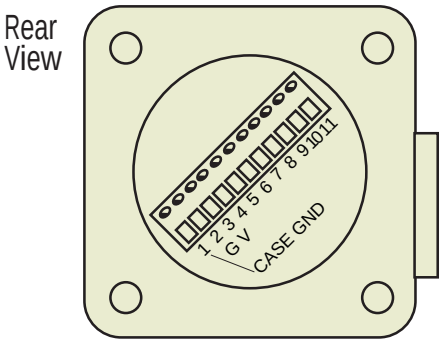
OUTPUT TERMINATION:
SC = Side Conduit, 1/2–14 NPSF (dryseal) straight pipe threads

UL:
UL = Class I Environments
UL2 = Class I & II Environments

SPECIAL FEATURES:
S= Special features specified on purchase order (consult factory)
See note 6







TOLERANCES:
.XX = ± 0.01,
.XXX = ± 0.005

Mechanical Specifications

Shaft Diameter: 3/8" nominal

Flats On Shaft: Two flats, 0.80" long X 0.30" deep at 90º

Shaft Loading: Up to 40 pounds axial and 20 pounds radial applied 1/4" from housing

Shaft Runout: 0.0005 T.I.R.

Starting Torque at 25° C: 4.0 in-oz (max)

Bearings: Class ABEC 7 standard

Shaft Material: 303 stainless steel

Enclosure: Die cast aluminum, hard anodized with dichromate sealed finish. Shaft seals and sealed bearings are standard to achieve environmental ratings.

Bearing Life: 2 X 10^8 revs (1300 hrs at 2500 RPM) at rated load; 1 X 10^{10} revs (67,000 hrs at 2500 RPM) at 10% of rated load

Maximum RPM: 10,000 RPM (see Frequency Response, below)

Moment of Inertia: 4.1 X 10^{-4} oz-in-sec^2

Weight: 64 oz typical (approx 4 lbs)

Electrical Specifications

Code: Incremental or Absolute (see Absolute version, pg 37)

Output Format: 2 channels in quadrature, 1/2 cycle index gated with negative B channel, or Absolute to 13 bits

Cycles per Shaft Turn: 1 to 72,000 (see table 2).
For resolutions above 3,600 see interpolation options on pages 32 and 32); Absolute to 8192 counts per turn

Supply Voltage: 5 to 24 VDC available

Current Requirements: 100 mA typical +output load, 250 mA (max)

Output Device: (see note 5)
4469: Line Driver, 5 – 15 VDC, $V_{out} = V_{in}$
7272: Line Driver, 5 – 28 VDC, $V_{out} = V_{in}$
7272: Line Driver, 5 – 28 VDC, V_{out} = 5 VDC (special feature)
7273: Open Collector, accepts 5 – 28 VDC

Protection Level: Reverse, overvoltage and output short circuit (See note 5)

Frequency Response: 100 KHz (see note 7)

Output Terminations: See Table A, this page

Termination Type: Compression type, UL recognized. Accepts AWG 14 to 22, stranded wire, strip 1/4"

Note: Consult factory for other electrical options

Environmental Specifications

Enclosure Rating: NEMA 4 X & 6 (IP66), outdoor Non-Hazardous locations, NEMA 4 X & 13 (IP66), indoor Non-Hazardous locations

Temperature: Operating, 0º to 70º C; extended temperature testing available (see note 8, pg 50); storage; -25º to 90º C unless extended temperature option called out.

Shock: 50 g's at 11 msec

Vibration: 5 to 2000 Hz @ 20 g's

Humidity: 100% RH

Hazardous Area Rating: Underwriters Laboratories listed for use in hazardous locations; NEMA Enclosure 7. Class 1, Group D, Division 1, NEC Class 2 circuits only, or Class 2, Groups E, F, and G

NOTES & TABLES: All notes and tables referred to in the text can be found on pages 50 and 51.

Certifications

The H38 Explosion Proof Encoder is available with the following certifications:

- EN 55011 and EN 61000-6-2
- CENELEC EEX ia IIB T5*
- U.S. Standards Class I, Group D, Division 1; Class II, Group E,F & G–requires labyrinth seal
- Canadian Standards Class I, Division 1, Group D; Class II, Class II, Group E, F & G–requires labyrinth seal
- CSA Class I, Div 1 Group C&D

*Available after Q3, 2004. See Regulatory Information on pages 47–49 for further certification details.

Parallel Absolute Output

The two most common types of absolute outputs are the Gray Code and the Natural Binary. Resolution for absolute encoders is expressed in "bits" where each successive bit increases the resolution by a factor of two. For example, 10 bits = 2^{10} = 1024 counts per revolution.

Natural binary code (Figure 1) is constructed so that the code counts up using the natural sequence of binary counting, i.e. 000, 001, 010, 011, 100 . . etc. The drawback to using this code sequence is that at several count positions the code will have transitions on multiple bits simultaneously. Due to the normal variations caused by gate delays, line impedances, etc. the actual transitions will not occur simultaneously. Reading data during one of these times could result in an erroneous reading. This can be overcome by taking multiple readings.

Gray code (Figure 2), by contrast, is designed to avoid the multiple transition problem entirely. It is specifically constructed so that only one bit will transition at a time. This ensures that state changes are much less ambiguous to the controller and is generally considered to be a more robust type of absolute code.

Regardless of the code type, one of the characteristics of absolute encoders is that they can readily be used for any resolution up to and including their maximum resolution. For example, a 12 bit encoder can be used at only 8 bits by ignoring (or disconnecting) the four lowest significant bits (LSB). This enables an installation that uses multiple absolute encoders to use the same encoder throughout with each controller using only the bits that it needs.

Figure 1 Natural Binary

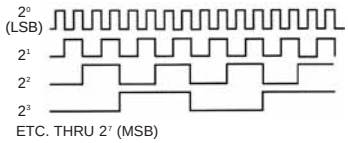
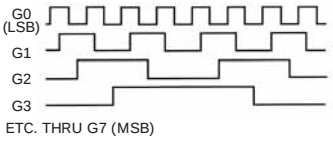


Figure 2 Gray Code



Ordering 8-Bit Absolutes

For years, we produced encoders with a maximum resolution of 8 bits. Lots of those old 8 bit encoders are still around. We update them to newer 12 bit designs on a case-by-case basis. If you have an 8 bit encoder, here is how that model number was constructed: **Direction of Rotation**, **Count, Code** and **Latch** designators were inserted between **Shaft Seal Configuration** and **Output IC** as shown below. To specify an equivalent encoder based on the 12 bit design, please call our Applications Specialists at **800-ENCODER** (800-362-6337) or check our web site at **www.beiied.com.**

Direction of Rotation: CCW or CW
Count: 8
Code: GC = Gray Code or NB = Natural Binary
Latch: L= Latch or Blank=None
Output Terminations: EM20=MS3102R20-29P or ED25=DB25P; SM18 = MS3102R18-1P; C18 = Cable, with length specified in inches. Specify ED25 for Line Driver Outputs.

Example: H25E-F1-SS-CCW-8GC-7406R-EM20
(one possible encoder configuration with the 8-Bit Absolute Option.)

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 16 clock cycles.
5. The first bit is a START bit and is always HIGH.
6. Next come 12 data bits beginning with the most significant bit (MSB) and ending with the least significant bit (LSB). This is followed by three LOW pulses.
7. After the DATA bits, the DATA line goes LOW and remains LOW for a minimum of 30 microseconds between the end of the DATA bits and the beginning of the next CLOCK series.

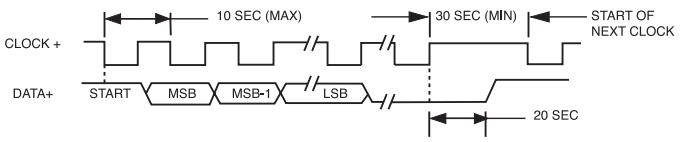
Interfacing Long Data Lines

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

SSI Timing



Ordering SSI

HOW TO SPECIFY SSI OUTPUT IN THE ENCODER MODEL NUMBER:

Use the designation, S3 between the **Code Format** designation and the **Connector** designation.

Example: H25D-SS-12GC-S3-CW-SM18

Single Turn Absolute Encoder Options

The tables below are reference for pinouts, connections and operation of BEI's single turn absolute encoders. These absolute options are available in a wide range of package styles with a variety of outputs. The applicability table below shows which combinations are currently available. As always, you can call us at **800-360-ASAP** (2727) for immediate applications assistance should you have any questions.

Output Code and Terminations (12 & 13 Bit)

	PARALLEL CODE					TERMINATION TYPE		
	Gray Code		Natural Binary		Binary Coded Decimal	Cable	Conn	Term Board H38 & H40
	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/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
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
	*0V (CIRCUIT COMMON)				B_3	GRY/RED	P	
	DIRECTION CONTROL					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	—	

*Pin P is available for a tri-state option

Output Applicability Table

	12 BITS	13 BITS	14/15 BITS	12x12 BITS	SSI	4–20 mA	0–10 V
H25	•	•			•	•	•
H25X			•				
HS35	•				•		
H38	•	•		•	•	•	•
H40	•	•		•	•	•	•
HMT25				•	•		

Direction Control: 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 control or latch is available on pin U.

Parallel Code (14 & 15 Bit)

	Gray Code		Natural Binary		M14/19 Connector
	14 BIT	15 Bit	14 BIT	15 Bit	
LSB	G_0	G_0	2^0	2^0	A
	G_1	G_1	2^1	2^1	B
	G_2	G_2	2^2	2^2	C
	G_3	G_3	2^3	2^3	D
	G_4	G_4	2^4	2^4	E
	G_5	G_5	2^5	2^5	F
	G_6	G_6	2^6	2^6	G
	G_7	G_7	2^7	2^7	H
	G_8	G_8	2^8	2^8	J
	G_9	G_9	2^9	2^9	K
	G_{10}	G_{10}	2^{10}	2^{10}	L
	G_{11}	G_{11}	2^{11}	2^{11}	M
	G_{12}	G_{12}	2^{12}	2^{12}	N
MSB14	G_{13}	G_{13}	2^{13}	2^{13}	P
MSB15	DIR CONTROL	G_{14}	DIR CONTROL	2^{14}	R
	CASE GROUND	CASE GROUND	CASE GROUND	CASE GROUND	S
	CIRCUIT COMMON	CIRCUIT COMMON	CIRCUIT COMMON	CIRCUIT COMMON	T
	LATCH	DIR/LATCH	LATCH	DIR/LATCH	U
	+V SUPPLY VOLTAGE	+V SUPPLY VOLTAGE	+V SUPPLY VOLTAGE	+V SUPPLY VOLTAGE	V

SSI Output Termination Table

	M18 CONN	M14/19 CONN	CABLE CONN	TERM. BOARD	
				H38	H48
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	BARE/SHIELD	1	6
CIRCUIT COMMON	F	T	BLK	2	5
+V SUPPLY VOLTAGE	D	V	RED	3	4
SHIELD DRAIN	—	—	BARE	—	—

M18 Connector is a MS3102E18-1P, 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 X = 10, 20 or 30 for a 10, 20, or 30 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 MS3116F14-19S or equivalent.