



## HS35 ABSOLUTE ENCODER



### Introduction

Built on the same rugged design as the incremental model, the HS35 Absolute Encoder is available with various output options including Gray Code and Natural Binary. Designed with a cast aluminum housing, a sealed connector and shaft seals, it carries an IP65 environmental rating. With the optional insulating inserts, it can be mounted on smaller diameter shafts. It is designed for either a through shaft mounting or blind shaft mounting with a closed cover to maintain its environmental rating.



### SPECIFICATIONS

#### Electrical Specifications

<b>Options</b>	<b>Parallel:</b> NB or GC 12-14 Bits (See Table 1) <b>Serial (S3):</b> 12-16 Bits (See Table 3) <b>Analog:</b> (A1-A5) 12-15 Bits (See Table 2)
<b>Count Transition Accuracy</b>	±1/2 Bit Maximum (Consult factory over 13 Bits)
<b>Counts per Shaft Turn</b>	4096 - 65536, Depending on Options
<b>Supply Voltage</b>	5 to 28 VDC, 13 to 28 VDC for analog
<b>Output Formats</b>	<b>Parallel:</b> Gray Code, Natural Binary, Serial and Analog
<b>Voltage/Output</b>	(see note 2) 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, $OC_{out}$ SSI: 5–28 VDC in/5V $_{out}$ (consult factory for more information) Analog: A1-A5
<b>Protection Level</b>	Reverse, overvoltage and output short circuit protection
<b>Frequency Response</b>	500kHz or 6000 RPM (Parallel)
<b>Output Termination Pinouts</b>	See Tables For S3 options, reference Spec Addendum 02087-005 For A1-A5 options, reference Spec Addendum 02088-002

## Mechanical Specifications

<b>Shaft Bore</b>	Many diameters from .375 to 1.000 inch are available, including metric. (Consult factory for details)
<b>Allowable Misalignments</b>	0.005" T.I.R. on mating shaft 0.75" from shaft end
<b>Bore Runout</b>	0.001 T.I.R. maximum
<b>Starting Torque at 25°C</b>	Through shaft version (SS) = 7 in-oz (max); Blind shaft version (BS) = 4 in-oz max
<b>Bearings</b>	52100 SAE High carbon steel
<b>Shaft Material</b>	416 stainless steel
<b>Bearing Housing</b>	Die cast aluminum with iridite finish; stainless steel (special feature)
<b>Cover</b>	Die cast aluminum with protective finish (For MS or CS terminations), otherwise drawl aluminum with protective finish; stainless-steel (special feature)
<b>Bearing Life</b>	7.5 X 10 <sup>9</sup> revs (50,000 hrs at 2500 RPM)
<b>Maximum RPM</b>	6,000 RPM (see frequency response above)
<b>Moment of Inertia</b>	0.019 oz-in-sec <sup>2</sup>
<b>Weight</b>	18 oz. typical

## Environmental Specifications

<b>Temperature</b>	Operating, 0° to 70°C; Extended temperature ratings are available in the following ranges: -40 to 70°C, -40
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**Notes and Tables:** All notes and tables referred to in the text can be found on the following pages.



# DIMENSIONS

Dimensions in mm

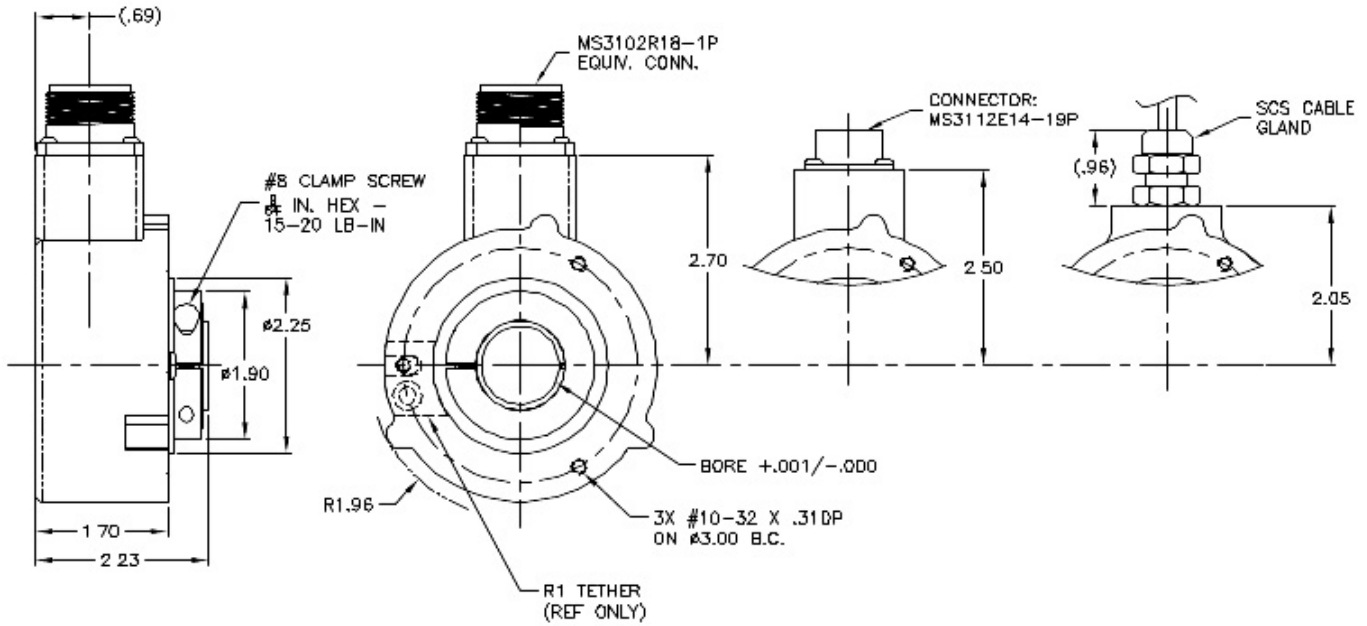
MS Connector Termination

Termination Options

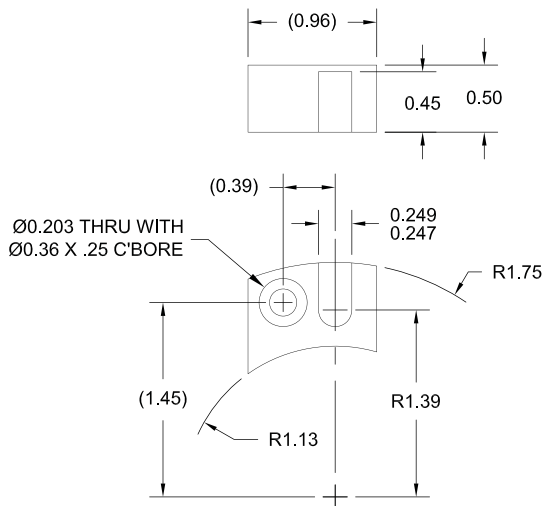
SM18 Conn.

SM14/19 Conn.

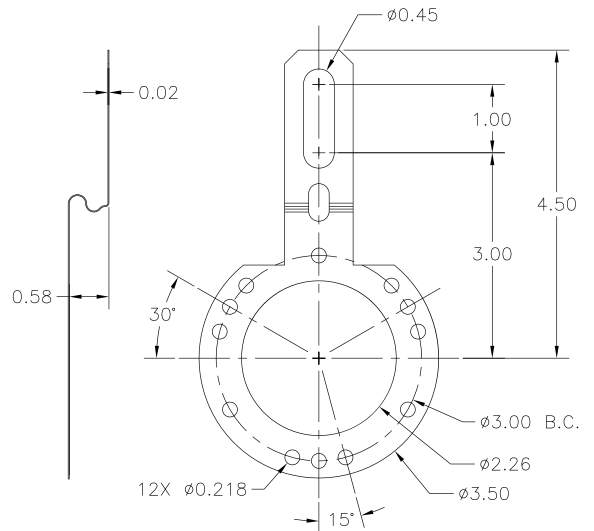
SCS CABLE



R1 Tether Block and Pin



R2 Tether Arm



**Table 1 —**  
Parallel Output Code and Terminations

Parallel Gray or Natural Code			Termination	
			M14/19 CONN	Cable Color
14 Bit	13 Bit	12 Bit Std.		
B13 (MSB)	<b>B12 (MSB)</b>	B11 (MSB)	A	W/BLK
B12	<b>B11</b>	B10	B	W/BRN
B11	<b>B10</b>	B9	C	W/RED
B10	<b>B9</b>	B8	D	W/ORN
B9	<b>B8</b>	B7	E	W/YEL
B8	<b>B7</b>	B6	F	W/GRN
B7	<b>B6</b>	B5	G	W/BLU
B6	<b>B5</b>	B4	H	W/VIO
B5	<b>B4</b>	B3	J	W/GRY
B4	<b>B3</b>	B2	K	WHT
B3	<b>B2</b>	B1	L	GRY/BLK
B2	<b>B1</b>	B0 (LSB)	M	GRY/BRN std
B1	<b>B0 (LSB) or NC</b>		<b>N</b>	<b>GRY/RED *</b>
OV std. (BO_LSB 14 BIT or Enable, Dir C, latch)			P	GRY/ORN *
Dir Control std. (Optional: Latch or Enable)			R	ORN *
Case GND			S	GRN
OV Return			T	BLK
LATCH std. (Optional: DC or Enable)			U	YEL *
+V SUPPLY			V	RED
SHIELD DRAIN			—	BARE

**\* Optional**

Items highlighted in blue are standard Express Encoders and ship in one to three days.

**Ordering SSI:**

HOW TO SPECIFY SSI OUTPUT IN THE ENCODER MODEL NUMBER: Example:  
HS35-100-R2-SS-12-NB-S3-CW-SM18

**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 LO (COMMON).

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.

**Table 2 —**  
Analog Termination and Options

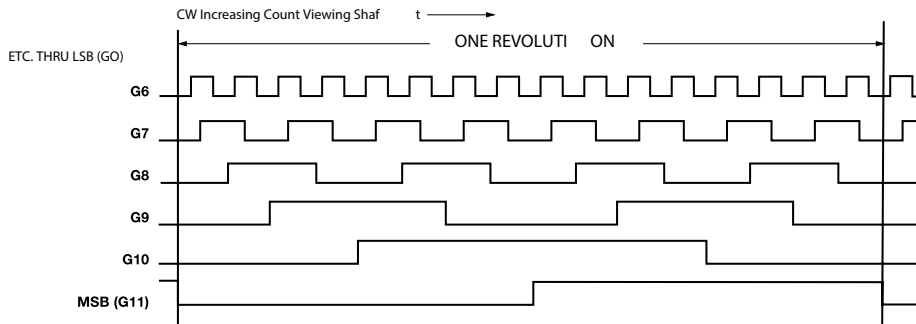
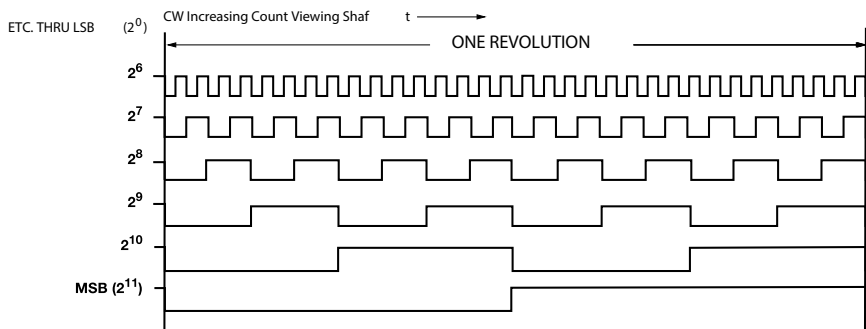
Analog	M18	M14/19	Cable Color
A1, 2, 3, 4, & A5			
A+ OUT	A	A	YEL
A Return	H	B	W/YEL
Dir Control	C	U	ORN
Reset *	B	C	BLU
OV Return	F	T	BLK
+V Supply	D	V	RED
CASE GND	G	S	GRN

**\* Optional**

**Table 3 —**  
SSI Termination

SSI	Termination		
	M18	M14/19	Cable Color
DATA +	A	A	YEL
DATA -	H	B	W/YEL
CLK +	B	C	BLU
CLK -	I	D	W/BLU
Dir Control	C	R	ORN
ENABLE *	J	P	W/ORN
OV RETURN	F	T	BLK
+V SUPPLY	D	V	RED
CASE GND	G	S	GRN
SHIELD DRAIN	—	—	BARE

**\* Optional**

**Figure 1 —**  
 Gray Code

**Figure 2 —**  
 Natural Binary


**NOTES**

- The rubber 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. For these exceptions, a felt shaft seal is recommended. Felt seals require very low starting torque and can virtually eliminate frictional heat. Encoders ordered with felt shaft seals will have an enclosure rating of IP50 and will have less than 1/10<sup>th</sup> the Starting Torque specified under Mechanical Configurations.
  - 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  $\pm 5\%$  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
  - 13-28VDC:** For Analog
  - 28V/5:** Multi-voltage Line Driver (7272\*): 100 mA source/sink. Input voltage 5 to 28 VDC  $\pm 5\%$  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  $\pm 5\%$  standard. Supply current is 120 mA typical. This replaces prior IC's with designations of 3904, 7406, 3302, 681 and 689.
- 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.

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



# ORDERING OPTIONS

**EXPRESS ENCODERS:** Items highlighted with this are standard Express Encoders and ship in few days.

**Encoder** X HS35 F - 100 - R1 - SS - 12 GC - 28V/V - CW - SM14/19 - S

**X:** Express Encoder

**Type**

**HS:** Hollow Shaft  
**35:** 3.5" Encoder Diameter

**Housing Configuration**

**F:** Standard

**Shaft Bore**

**100:** 1.00"      **62:** 0.625"  
**87:** 0.875"      **50:** 0.50" etc.  
**75:** 0.75"

**Tether**

**R1:** Tether Block and Pin  
**R2:** Tether Arm

**Shaft Seal Configuration**

**SS:** Through Shaft, Rubber Seals      **BFS:** Blind Shaft Felt  
**BS:** Blind Shaft, Rubber Seal      (See Note 1)  
**FS:** Through Shaft, Felt Seals

**Number of Bits**

**12:** 12 Bits, 4096 Counts      **15:** 15 Bits, 32768 Counts  
**13:** 13 Bits, 8192 Counts      **16:** 16 Bits, 65536 Counts  
**14:** 14 Bits, 16384 Counts

**Code Type**

**GC:** Gray Code      (\* Leave Blank for A1-A5)  
**NB:** Natural Binary

**Voltage / Output**

**28V/V:** 5-28V<sub>in</sub>/out      **A2:** 0-10V  
**28V/5:** 5-28V<sub>in</sub>/5V<sub>out</sub>      **A3:** 0-20mA  
**28V/OC:** 5-28V<sub>in</sub>/OC<sub>out</sub>      **A4:** 0-5V  
**S3:** SSI      **A5:** 0-24mA  
**A1:** 4-20mA      (See Note 2)

**Direction of Count**

**CW:** Clockwise Increasing Count  
**CCW:** Counter Clockwise Increasing Count

**Output Termination**

**SM14/19:** 19 Pin Connector  
**SCS:** Shielded/Jacketed Cable with Cable Seal.  
Length of Cable is specified in inches.  
(i.e. SCS18 = 18 inches) SM18 = MS3102R18-1P (A1-A5 and S3 outputs only)  
(Consult Factory for More Information)

**Special Features**

**S:** Special Features specified on Purchase Order.  
(See Note 3)  
(Consult Factory for More Information)



## AGENCY APPROVALS & CERTIFICATIONS



Agency	File Number
CE	EN 55011 and EN 61000-6-2

Consult factory for more details.

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