HS45
INCREMENTAL OPTICAL ENCODER

Introduction

The HS45 is a large bore, heavy duty, rugged encoder designed to operate in very demanding environments. It is available in both single and dual output versions as shown. These encoders use a preloaded bearing set for mechanical stability and a long service life. The dual output version has redundant electronics internal to the encoder simplifying signal distribution to multiple controllers.

Special Models of the HS45 Incremental Encoder are available with one or more of the following certifications. Consult factory for details.

MECHANICAL SPECIFICATIONS

Shaft Bore	1.750" max
Allowable Misalignment	Axial: ±0.030 (with R2), ±0.050 (with R1), Radial: 0.005 T.I.R.
Bore Runout	0.002" T.I.R.
Running Torque at 25°C	Dual seals (SS) = 30 in-oz (max); Single seal (BS) = 18 in-oz (max)
Bearings	52100 dual preloaded bearings
Shaft Material	Stainless Steel
Bearing Housing	Die cast aluminum with protective finish
Cover	Die cast aluminum with protective finish
Bearing Life	5 X 10^{12} revs
Maximum RPM	5,000 RPM (see Frequency Response, below)
Moment of Inertia	0.063 oz-in-sec^2 max
Weight	Approximately 2.3 lbs single output, 2.6 lbs dual output

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ELECTRICAL SPECIFICATIONS

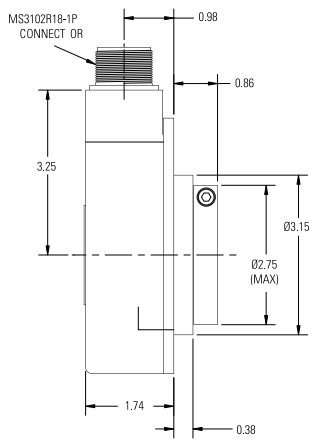
Code	Incremental
Output Format	Incremental output format, 2 channels with complements, in quadrature, 1/2 cycle index gated with negative B channel
Cycles per Shaft Turn	Up to 8192
Supply Voltage	5–28 VDC (± 5%)
Current Requirements	100 mA (typical) per side + output load, 250 mA (max)
Voltage/ Output	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}
Protection Level	Reverse, overvoltage and output short circuit
Frequency Response	150kHz
Output Terminations	(See Table 1)

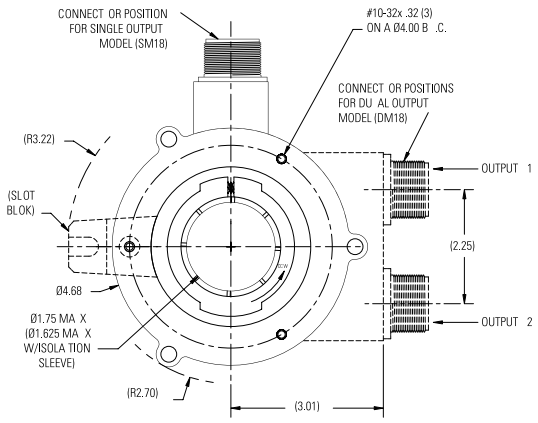
ENVIRONMENTAL SPECIFICATIONS

Enclosure Rating	IP65 (NEMA 4 & 13)
Temperature	Operating 0° to 70°C standard, -40° to 85° C optional, storage -40 to 90° C
Shock	50 g's for 11 msec
Vibration	10–2000 Hz @ 20 g's
Humidity	98% RH without condensation

DIMENSIONS

MS Connector Termination





MAXIMUM BORE PENETRATION ON BLIND SHAFT IS 2.00"

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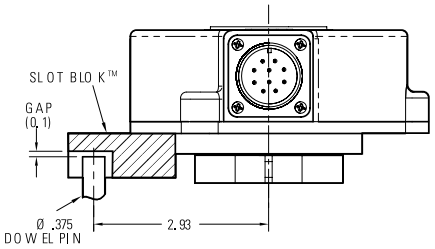
R1 Tether Block and Pin



R1 Tether matches to the 3/8-16 hole of a 56C face at 5.875 inches [149] BC

R2 Tether Arm Mounts to 0.725 [184] BC i.e. 182TC Motor Face

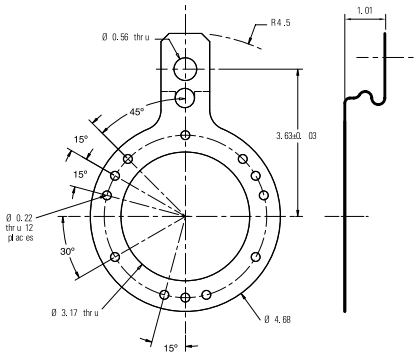


TABLE 1

Incremental Output Terminations

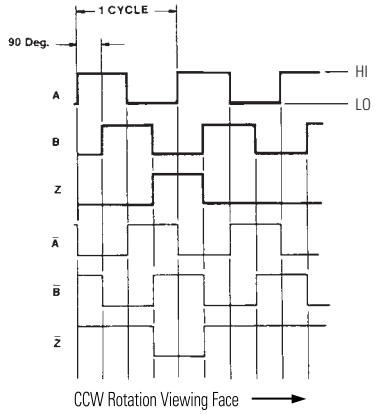
The connector style will determine pinouts. For example, an encoder with ABC channels and an M18 connector uses the table to the right.

WIRE COLOR	DA 15P CONNECTOR	CHANNELS DESIGNATED IN MODEL NO.		
		ABZ	ABC	ABZC
YEL	13	A	A	A
BLUE	14	B	B	B
ORN	15	Z	-	Z
W-Yel	10	-	$\overline{A}$	$\overline{A}$
W-Blu	11	-	$\overline{B}$	$\overline{B}$
W-Orn	12	-	-	$\overline{Z}$
RED	6	+V (SUPPLY VOLTAGE)		
BLK	1	0 V (CIRCUIT COMMON)		
GRN	9	CASE GROUND (CG) (except H20)		
WHITE		SHIELD DRAIN (Shielded Cable Only)		

M18 Connector	
PIN	Channel
A	A
B	B
C	Z
D	+V
E	-
F	0V
G	CG
H	$\overline{A}$
I	$\overline{B}$
J	$\overline{Z}$

Output Waveform

Figure 1



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ORDERING OPTIONS

Example : HS45F-175-R2-SS-8192-ABZC-28V/V-SM18

Use this diagram, working from left to right to construct your model number

HS45 - - - - - - - - - -

Type

Hallow Shaft
45 = 4.5" Encoder Diameter

Housing Configuration

F = Standard

Bore Size

30mm = 1.18"
175 = 1.750"
162 = 1.625"
125 = 1.250"
150 = 1.50"
Bores <1.750" are insulated
Consult factory for more bore sizes

Tether

Blank = None
R1 = Tether Block and Pin
R2 = Tether Arm

Shaft Seal Configuration

SS = Through Shaft Rubber Seals
BS = Blind Shaft Rubber Seal
FS = Through Shaft Felt Seals
BFS = Blind Shaft Felt Seal
See Note 2

Cycles per Turn

60, 500, 720, 1000,
1024, 2000, 2048,
2500, 4096, 8192

Channels

ABZC

Voltage/Output

28V/V = 5-28$V_{in/out}$
28V/5 = 5-28V_{in}/5V_{out}
28V/OC = 5-28V_{in}/OC_{out}

Termination

S = Single Termination
C = Dual Termination

Connector

M18 = 10 PIN connector

Hazardous Area Rating

Blank = None
EX = Intrinsically Safe
NI = Non-Incentive
Contact factory for voltage options

Special Features

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

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NOTES

1. The typical hollow shaft product is supported by, and clamped to, the driving shaft. A flexible tether is used to keep the housing from rotating.
2. 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 1/10th the Starting Torque specified under Mechanical Configurations.
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: Vout = Vin). 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 minus +5VDC) = 357 mA total allowed current. Consult factory for your specific requirements. **15V/V:** Multi-voltage Line Driver (4469*): 100 mA source/sink. Input voltage 5 to 15 VDC +/- 5% standard (Note: Vout = Vin). 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 pullups. 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.on this page.
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

AGENCY APPROVALS & CERTIFICATIONS

EN 55011
and EN 61000-6-2

U.S. Standards Class I, Group A,B,C & D;
Class II Group E,F & G

UL 12.0035X
UL 13.0071X

Canadian Standards
Class I, Zone 0, Group IIC

CENELEC
II 1 G Ex ia IIB/IIC T4 Ga
II 3 G Ex nA IIB T3 Gc

Class I, Div 2, Group A,B,C & D;
Class II, Div 2, Group F & G

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