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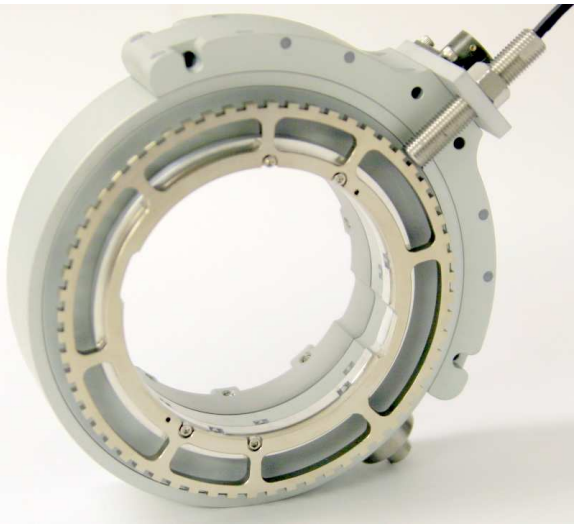
MODEL B6-3.2W/E60

WEATHERPROOF SLIP RING / ENCODER ASSEMBLY

OPERATOR'S MANUAL



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Introduction

The Model B6-3.2W/E60 Weatherproof Slip Ring Assembly is ideal for applications that require the slip ring to be sealed and mounted directly on a rotating shaft. Typically used for automotive drive shaft applications, this model employs specially designed non-contacting labyrinth seals that provide weatherproof protection from water, mud, snow, dust, and other contaminants. It is designed to fit on shafts up to 3.2 inches (81.28 mm) in diameter and make electrical connection to strain gages, thermocouples, or other sensors that have been installed on rotating equipment. The slip ring brushes and rings are made of precious metals which minimize noise and enable the assemblies to be used for low level instrumentation signals. Connections are made through color coded solder terminals located on the slip ring rotor and a connector on the slip ring stator. The compact design of these assemblies makes them ideal for applications where limited space is available.

This assembly includes an optional encoder package that produces a 60 pulse/revolution square wave voltage output. The TTL compatible signal is produced by a hall-effect sensor, which allows speed to be determined down to 0 rpm. The voltage required to drive the encoder can range from 4.5 to 26.0 DC Volts @ 20 mA max.

Features

- 6 circuit weatherproof slip ring.
- Compact design.
- Mounts on shafts up to 3.2” [81.28 mm] in diameter.
- Permanently lubricated bearings.
- Rugged construction, utilizing stainless steel and anodized aluminum on all external parts.
- Instrumentation quality rings and brushes.
- Includes 15 foot [~4.6 meter] stator cable.
- 60 pulse / revolution hall-effect encoder with square wave output.

Specifications

Slip Ring	
Circuits	6
Current Capacity per Circuit	1 Amp
Temperature Range	-40℉ to 250℉ (-40℃ to 121℃)
RPM Rating	4000 RPM continuous; 6000 RPM bursts
Maximum Peak Noise*	0.1 Ohm
Width (with encoder option)	1.833 in (46.6 mm)
Weight (with encoder option)	3.02 lbs (1.37 Kg)
Output Connector	Bendix PT02E-10-6P
Mating Connector	Bendix PT06E-10-6S(SR)
*Resistance variation across slip ring contact.	

Encoder	
Supply Voltage	4.5 to 26.0 VDC @ 20MA max.
Temperature Range	-40℉ to 257℉ (-40℃ to 125℃)
Operating Frequency	0 to 15 kHZ

*For more information on encoder see appendix

Operation

General Operation

Slip Ring Assemblies allow for electrical connections to be made between rotating and stationary portions of an application. For many applications no additional equipment would be required that is not required for a stationary application. We specialize in instrumentation type slip ring assemblies, which are designed to carry signals across rotating junctions.

The most common sensors used with slip rings are strain gages and thermocouples. These sensors have outputs in the microvolt to millivolt range. By using the correct circuits and installation techniques these small signals can be brought through the slip ring with minimal distortion.

Because of the large diameter of the rings used in tubular assemblies relative to the end of shaft assemblies, the surface speed of the ring surfaces relative to the brushes is much higher. To deal with the higher surface speeds and to maintain good signal quality, we use silver alloy rings and silver-graphite brushes in all of our tubular assemblies. The contacts are somewhat sacrificial in nature; they tend to wear out more quickly than the rest of the assembly. Under ideal conditions, the contacts tend to last ~30 million revolutions.

Many factors can affect the life of the contacts, including temperature, humidity, rotational speed, amperage, vibration, etc. It is a good idea to occasionally check the condition of the

contacts until you become familiar with the rate of wear for a particular application. This procedure is described in the “Maintenance” portion of this document.

This assembly uses permanently lubricated bearings and solid silver alloy rings (rather than plated). If the contacts are not allowed to wear completely away during use, the rest of the assembly will typically last through several sets of contacts. If the contacts are allowed to completely wear away, severe damage can result to the brush assembly and ring surfaces.

Technical Considerations

As mentioned earlier, the most common sensors used with slip rings are strain gages and thermocouples. These sensors have outputs in the microvolt to millivolt range. By using the correct circuits and installation techniques these small signals can be brought through the slip ring with minimal distortion.

Strain gages are usually configured as a Wheatstone bridge which is very sensitive to their small resistance changes. The full bridge should be located on the rotating side of the application so the small resistance variations at the slip ring are not inside the bridge. This results in the signal rings being in series with a high input resistance instrument like a recorder, readout, or oscilloscope. Small resistance variations at the signal rings will not distort the signal. The effects of using different wiring methods are discussed and recommended wiring diagrams are included in the “Technical Notes” portion of our website (www.michsci.com/tech_notes.htm).

The use of slip ring assemblies with thermocouple circuits is also discussed in the “Technical Notes” section of our web site. There is potential for error when slip ring assemblies are used with thermocouples. If possible, the slip ring assembly should be kept at a uniform temperature because it is not thermocouple material. If, for example, the rotor terminals are 5F hotter than the stator terminals, a 5F error will be introduced into the measurement.

For tubular assemblies thermocouple measurements are more difficult because the slip ring bearings and brushes generate heat, making the formation of a temperature gradient more likely. This potential increases with rotational speed. We tested a model B6-2 tubular slip ring. At 5000 rpm the error was 40F.

With an instrumentation slip ring assembly there is another minor source of error called the thermoelectric effect. Heat from the slip ring bearings and sliding brush contacts cause small temperature gradients inside the slip ring assembly. The gradients create thermoelectric voltages between rings. In small assemblies with a few rings this is insignificant and can be ignored. Assemblies with many or large diameter rings have more thermoelectric voltage. For example, a 36 connection end of shaft assembly or a tubular slip ring may have voltages of 80 to 150 microvolts at higher speeds. The sensitivity of a type J thermocouple is about 28 microvolts/F (50 microvolts/C) and for type K it is about 22 microvolts/F (39 microvolts/C). So an error of a few degrees can result. The solution is to minimize the error by using adjacent rings for a given thermocouple.

For any thermocouple application, the above considerations can be transcended by using rotating thermocouple amplifiers. Also, other temperature sensors could be considered, such as an RTD.

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Installation

This assembly has a 3.200 inch (81.3 mm) bore. If the shaft the slip ring assembly will be mounted to is a smaller diameter, an adapter bushing will need to be made to make up the difference. For best results, the assembly should be mounted as square and as concentric as possible with the axis of rotation of the shaft. For low rotational speeds this is not as critical. As rotational speeds increase, it becomes much more important. For high speed use, we recommend axial and radial run-out to be held to .001 TIR, if possible.

The slip ring assembly is secured to the shaft with eight 8-32 set screws. It is best if the adapter is made of aluminum or other soft metal, so that the set screws can provide a good grip. We strongly recommend that you dental drill, grind or machine small recesses or flats in the surface of the adapter or shaft that align with the set screws; this will help make sure the rotor is secured adequately to the shaft. This is particularly helpful in very dynamic applications and/or if the shaft or adapter is made of a harder metal.

This assembly was originally designed for use on vehicle drive shafts that run horizontally, parallel with the longitudinal axis of the vehicle. Because of this, the non-contacting labyrinth seals are designed to be most effective when installed on a horizontal shaft. The seals are not nearly as effective when installed on a vertical shaft. If the assembly is to be mounted on a vertical shaft, it is best if the assembly is installed with the terminal face facing down. Care would also need to be taken to shield the top of the assembly from direct exposure.

Because the seals are “non-contacting”, this assembly is not considered a sealed unit. The seals are very effective at keeping out weather and water spray, but will not protect the assembly if it becomes submerged. If the assembly is installed on a vehicle prop-shaft, it is best if the assembly is installed so the terminals face the rear of the vehicle.

The method for restraining the stator of the assembly from rotating should allow for some flexibility. If the rotor of the assembly is rigidly secured to the shaft and a rigid rotational restraint is applied to the stator housing, any run-out in the application would impose large loads on the slip ring assembly as the application rotates. Small cables, springs or wire ties work well as rotational restraints. It is best if the stator cable is not used as the restraint.

Electrical connections to the slip ring rotor are made using solder terminals. Two sets of redundant terminals are installed on this assembly. If one set is damaged, the other set can be used. It is best to use small stranded lead wire (24 AWG maximum). Be careful when attaching and removing lead wires so the terminals are not broken by excessive force or heat. The solder iron should be no more than about 30 watts or 500F if the temperature controlled type. Once the leads are soldered to the terminals secure them to the rotating shaft to prevent the leads from fatiguing off or damaging the terminals.

If the leads are thermocouples it is necessary to use the correct flux. Contact Michigan Scientific for flux and instructions. 28 or 30 AWG wire is recommended.

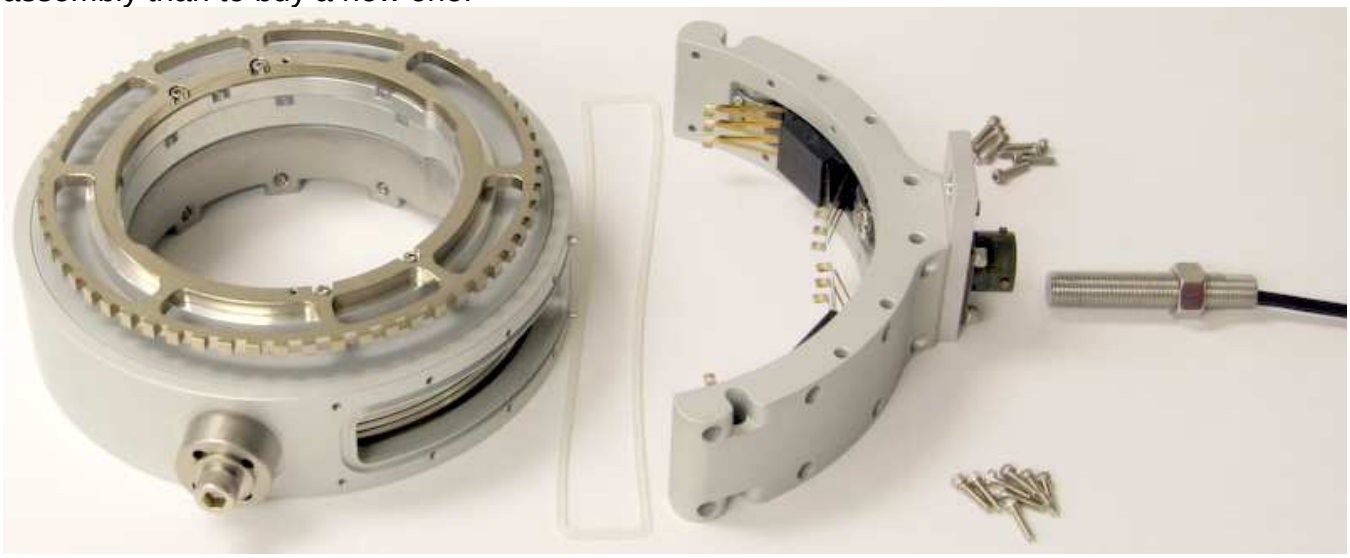
After the electrical connections are made, it is important to apply a protective coating to the exposed wires and terminals, including the spare set of terminals. Several coatings are available. We recommend using electronics grade RTV silicone sealant.

Maintenance

The Model B6-3.2W/E60 Slip Ring Assembly is designed to require very little maintenance during normal use. It is highly recommended that assemblies that appear to be malfunctioning be returned to Michigan Scientific Corporation for evaluation and repair. One part that can be inspected and maintained by the user fairly easily is the Brush Assembly.

Because of the relatively high speed of the ring surfaces in relation to the electrical contacts, sacrificial contacts are used in this assembly. These contacts wear at a much higher rate than the rest of the assembly. This rate of wear can be affected by many environmental factors (i.e. temperature, humidity, etc.) so contact life can vary from application to application. As the contacts wear the debris from the contacts builds up within the slip ring housing. Since this debris is conductive, over time it can build up to the point where it can cause shorting between rings, affecting signal quality. Experience and testing has shown that this wear debris does not typically cause any ill affects during the useable life of the contacts. As the contacts near the end of their useable life, the signal quality tends to degrade at a rapid rate. It is important to service the slip ring assembly if it is determined that the slip ring assembly is causing a degradation of signal quality. If the contacts are allowed to wear away completely the rings and brushes in the slip ring assembly can become severely damaged. As long as the contacts are serviced as needed, the rest of the assembly should last through several sets of contacts.

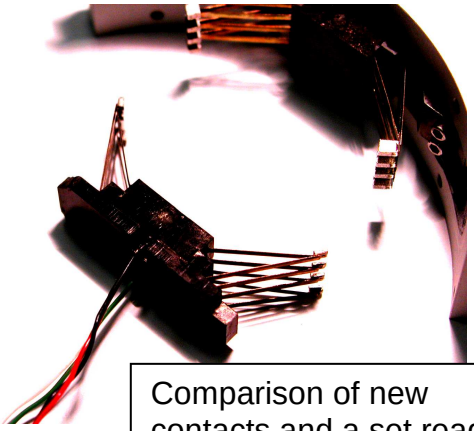
The brush assembly on the Model B6-3.2W/E60 Slip Ring Assembly is the anodized aluminum part with the connector installed on the outer diameter of the slip ring assembly. To remove the housing first remove the RTV silicone from the sixteen screw holes in the housing. Hold the housing in place with one hand and remove the sixteen 2-56 x3/8” socket head cap screws that attach it to the Slip Ring Assembly. The Brush Housing can then be carefully removed from the assembly. Do not throw this away. It is less expensive to rebuild this assembly than to buy a new one.



Handle the brush assembly carefully because the contacts and leaves are fragile and can be damaged easily. Remove wear debris that has accumulated in the brush assembly by spraying an appropriate precision cleaning solvent or contact cleaning solution on the contacts

and leaves to flush away the debris. If such solvents are not available the debris can be removed by using a soft flux brush and clean isopropyl alcohol to gently brush the debris away. Remove the solvents by spraying the assembly with clean air. The air must be very clean, either filtered air or “bottled air” used for cleaning electronics. Do not use air from shop compressors, since it often contains oil and/or water, either of which would contaminate the slip ring assembly.

Once the brush assembly is clean inspect the contacts and wipers for damage and wear. If the leaves or contacts are damaged or if the contacts are significantly worn, the assembly must be returned to Michigan Scientific Corporation for service.



Comparison of new contacts and a set ready for replacement.

Examples of appropriate cleaning products for the brush assembly.

New contacts are 0.135” (3.5 mm) in length. If any contact has less than 0.040” (1 mm) of material left on the leaf it is time to have the contacts replaced.

It is important to remove the excess wear debris from the slip ring assembly housing when the brush assembly is serviced. First remove the O-ring from around the brush assembly installation area. Also remove the two dowel pins installed on either side of the opening if they are loose. Wear debris can be removed from the interior of the slip ring assembly simply by placing the nozzle of a shop vac near the opening in the housing where the Brush Assembly was installed. Vacuum away the debris as the assembly is slowly rotated. Do not wipe the rings since this can force wear debri between the rings and could cause shorting. Do not clean the rings with solvent. It is actually good to leave a fine dusting of debris on the rings since it acts as a contact lubricant.

While cleaning the assembly you may notice the presence of grooves in the ring surfaces. These grooves are normal. They are machined into the ring surfaces to help stabilize the contacts and improve signal quality. If the grooves become damaged, return the assembly to MSC for service.

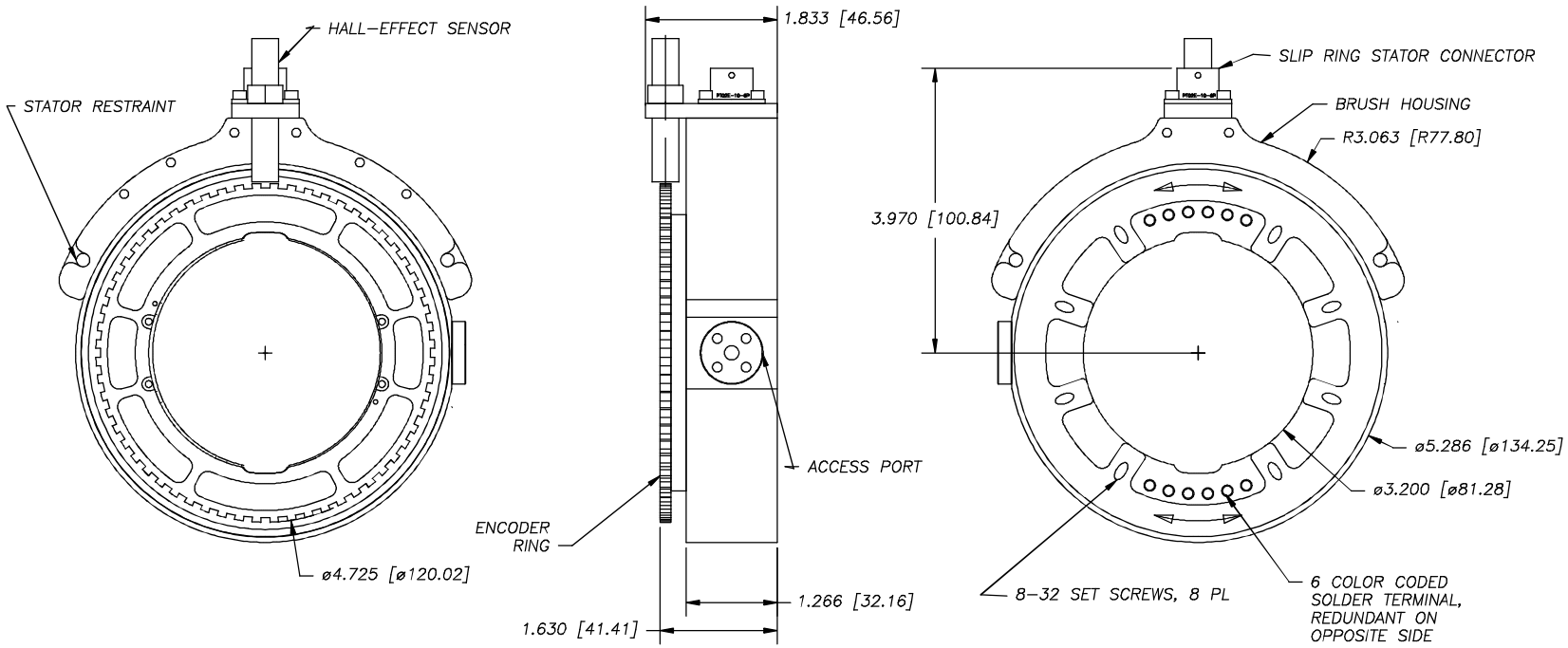
The exterior of the slip ring assembly can be cleaned by wetting a cloth with clean isopropyl alcohol or other appropriate solvent and wiping the surfaces. Do not spray solvents on the housing since solvents can penetrate the labyrinth seal and contaminate the assembly.

Occasionally the wear debris can cause signal problems before the contacts are completely worn away. If the contacts are in good condition the brush assembly can be reinstalled and the assembly returned to service. Contact life expectancy can be estimated by carefully measuring the length of the shortest contact. The contacts are approximately 0.135" long when new. The percentage of contact length left is a good indicator of the percentage of useable life left. If the contacts are worn away return the assembly to MSC for contact replacement. It is best if the entire slip ring assembly is returned, but if this is not desirable or possible just the brush assembly can be returned. Use care when packaging to protect the brush assembly during shipping. To avoid possible delays in long term testing customers occasionally purchase spare brush assemblies to install on the slip ring assembly while the original is being serviced.

The easiest way to install the Brush Housing to the Slip Ring Assembly is to lay both pieces on a smooth tabletop and carefully slide them together. The Brush Housing can be replaced on a Slip Ring Assembly that is still installed on a shaft as long as care is taken to maintain proper alignment of the two pieces as the Brush Housing is moved into position. It is possible to do this by visually aligning the pieces but you may find the use of a flat, smooth piece of material that can be placed against the side of the assembly to be very useful.

The Brush Housing must be installed so that it is oriented as shown in the above photos. First make sure the o-ring is seated in its groove then carefully move the housing into position until the alignment pins on the Slip Ring Assembly enter the holes in the Brush Housing. Note that the dowel pins are not the same size. Orient the housings so that the dowel pins fit into the correct size holes. Install screws in the holes of the Brush Housing closest to the connector and tighten until snug. Check to make sure the o-ring is not being forced from its groove. The unit can now be lifted from the table. Verify that the Brush Housing is installed correctly and that it is aligned with the Slip Ring Assembly. If it is slightly out of alignment loosen the screws and adjust it. Install the rest of the screws. The housing is held on with 2-56 x 3/8" socket head cap screws. If the assembly will be exposed to the weather it is not a bad idea to fill the screw holes with RTV silicone. Assembly is now complete.

Appendix


HALL–EFFECT SENSOR
STATOR RESTRAINT
ø4.725 [ø120.02]
1.833 [46.56]
ACCESS PORT
ENCODER RING
1.266 [32.16]
1.630 [41.41]
SLIP RING STATOR CONNECTOR
BRUSH HOUSING
R3.063 [R77.80]
3.970 [100.84]
ø5.286 [ø134.25]
ø3.200 [ø81.28]
8–32 SET SCREWS, 8 PL
6 COLOR CODED SOLDER TERMINAL, REDUNDANT ON OPPOSITE SIDE

LCZ Series

Hall Effect Zero Speed Sensors

APPLICATIONS

- Industrial process control
- Factory automation
- Meter
- Pump
- Roller
- Mixer
- Fan speed
- Transmission
- Gear reducer RPM
- Process speed
- Synchronization
- Spindle
- Generator set
- Compressor speed
- Dyno testing
- R&D testing
- RPM

FEATURES

- Low cost
- Zero speed
- Omni-directional sensor to target orientation
- Digital output
- Small size
- Low power consumption
- Environmentally sealed

The LCZ Series Hall Effect Speed Sensors address a variety of industrial control, factory automation and rotary equipment applications requiring a long-life, cost effective solution in manufacturing or where durability is a factor in harsh environments. Assembled in a stainless steel, easily adjustable package, the LCZ Series is suitable for a wide range of speed applications. Versatile and simple to install, this Hall Effect speed sensor does not require rotational orientation.

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Sensor Systems

SPEED & POSITION CONTROL PRODUCTS
electro corp

SPEED & POSITION CONTROL PRODUCTS
electro corp

LCZ Series

Hall Effect Zero Speed Sensor

SPECIFICATIONS

MECHANICAL

Housing:	Stainless Steel 3/8, 1/2, 5/8, 15/32 with one hex nut, blind (sealed) front end
Interconnect:	69" TPE 24 AWG 3-conductor shielded cable

ELECTRICAL

Supply Voltage:	4.5 to 26 VDC @ 20 mA maximum
Operating Frequency:	0 to 15 kHz
Output Signal:	Open drain MOSFET, sinking configuration short circuit protected
Voltage Low:	.4V maximum @ 30 mA maximum sink
Voltage High:	30 VDC maximum
Duty Cycle:	40% to 60%
Dielectric:	200 VDC
Air Gap Performance:	See graph

ENVIRONMENTAL

Sealing:	Hermetically sealed sensing face IP67 rated cable exit area
Low Temperature Operation:	-40° C
High Temperature Operation:	125° C
Storage Temperature:	125° C maximum
Shock:	50 Gs, 11ms
Vibration:	15Gs, 10 to 2000 Hz

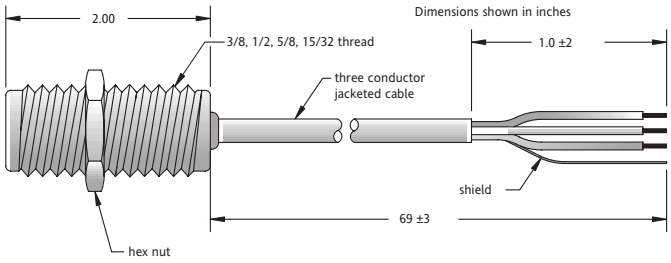
MODEL NUMBER CONFIGURATION

	THREAD	FLATS
LCZ260:	3/8-24	.312
LCZ360:	1/2-20	.438
LCZ460:	5/8-18	.562
LCZ560:	15/32-32	.438

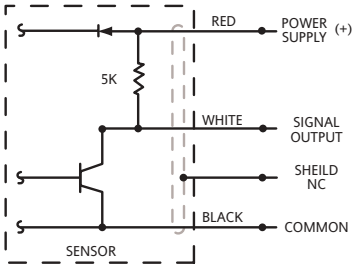
Note: For 3" thread length, add -30 to model #.

Note: Contact Factory for custom OEM applications

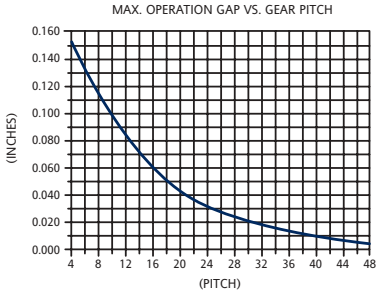
DIMENSIONS



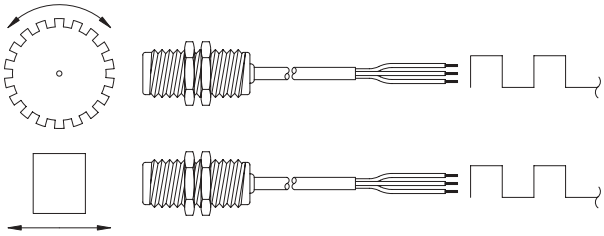
EQUIVALENT ELECTRICAL SCHEMATIC



AIR GAP PERFORMANCE



TARGET MOTION



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