DR1000 Digital Speed Switch

Precision Rotation Monitor

Principles of operation

The DR1000 monitors shaft speeds, and detects shaft slowdown within 1% of the set point. A DPDT control relay rated at 5 amps @ 30 Vdc and 120 Vac resistive, serving as the output. While the monitored shaft is rotating, the shaft mounted pulser disc or wrap generates a control signal that is detected by the sensor. The signal is transmitted to the control unit via a 3-conductor shielded cable. At the control unit, the signal energizes a control relay. When the shaft drops below the trip point or stops rotating, the control signal de-energizes the relay. The switch is fail safe; any loss of power or loss of signal during the operation will de-energize the control circuit.

The system features a UL listed, heavy-duty explosionproof aluminum housing, containing the control relay, related circuitry, and a terminal block. It also includes a digital sensor with a 10-foot, 3-conductor shielded cable and a magnetic pulser disc.

Installing sensors

Pulser disc

The shaft end that will be monitored must be center drilled to a depth of ½-inch, with a No. 21 drill bit and tapped for 10-32UNF. Then apply Loctite® or a similar adhesive on the threads to keep the pulser disc tight. The pulser disc should be attached *(label side out)* with the supplied 10-32UNF machine screw and lock washer.

Pulser wrap (optional)

Pulser Wraps are custom manufactured to fit the shaft they will be mounted on. When the wrap is shipped, 4-Allen head cap screws hold the two halves of the wrap together. These screws must be removed so that the wrap is in two halves. Place the halves around the shaft, reinsert the screws, and torque them to 5 foot-pounds.

Installing sensors

The standard sensor is supplied with a mounting bracket and two jam nuts. The optional explosionproof sensor is supplied with a slotted mount bracket. Sensors should be installed so the centerline of the magnets pass in front of the center of the sensor as the disc or wrap rotates. When using the pulser disc, the center of the magnetized area of the disc, dimension B Figures 1 and 3, is 1-3/4 inches from the center hole of the disc.

The gap distance between the sensor and the disc or wrap, dimension A in all figures, is 1/4 inch ± 1/8 inch. To achieve the proper gap distance with the standard sensor, adjust the jam nuts holding the standard sensor in its mounting bracket. To adjust the position of the explosionproof sensor, use the slots on its mounting bracket.

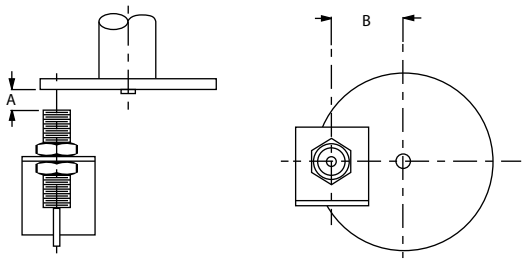

Figure 1: Standard 906 Sensor with 255 Pulser Disc

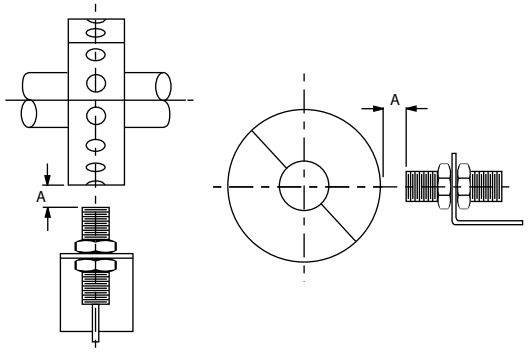

Figure 2: Standard 906 Sensor with optional Pulser Wrap

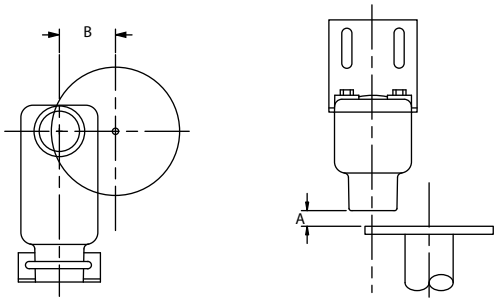

Figure 3: Explosionproof 907 Sensor with 255 Pulser Disc

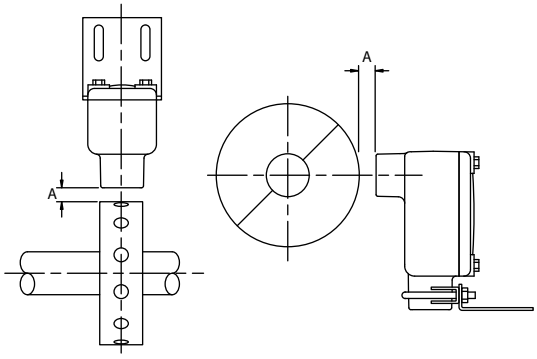

Figure 4: Explosionproof 907 Sensor with Pulser Wrap

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Sensor Dimensions

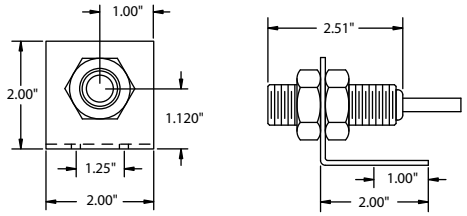


Figure 5: Standard 906 sensor dimensions

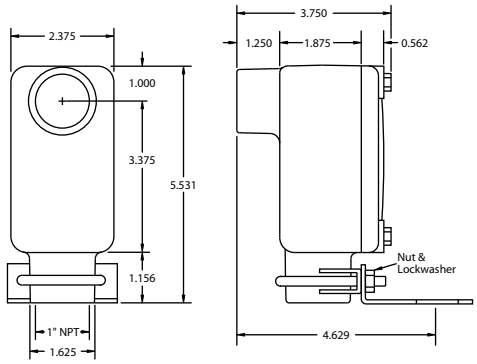


Figure 6: Explosionproof 907 Sensor dimensions

255 Pulser Disc and DR1000 Explosionproof enclosure dimensions

Figure 7 shows the dimensions of the 255 pulser disc.

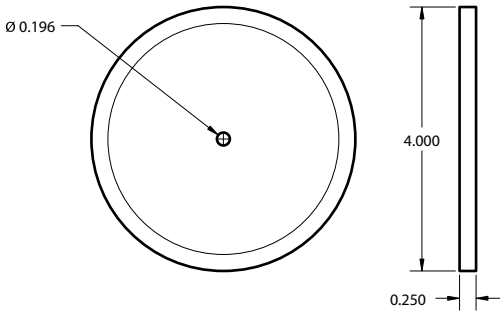


Figure 7: Disc Dimensions in Inches

Figure 8 shows the dimensions of the explosionproof enclosure.

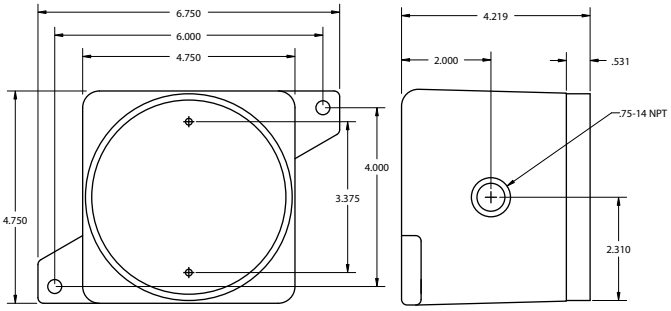


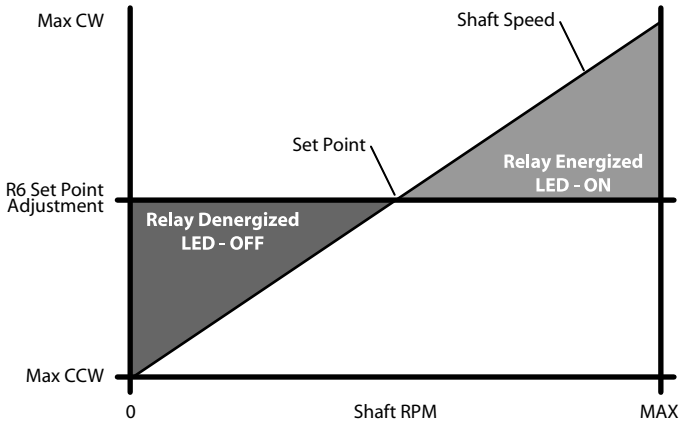
Figure 8: DR1000 Enclosure Dimensions in Inches

Mounting the enclosure

The enclosure can be mounted either horizontally or vertically using two 1/4-inch bolts. The distance between the enclosure and the sensor can be up to 1500 feet. **DO NOT** mount the housing where water might enter it. Make sure that there is access to the terminal strip and switch adjustments.

Setup

Underspeed mode shaft running graph



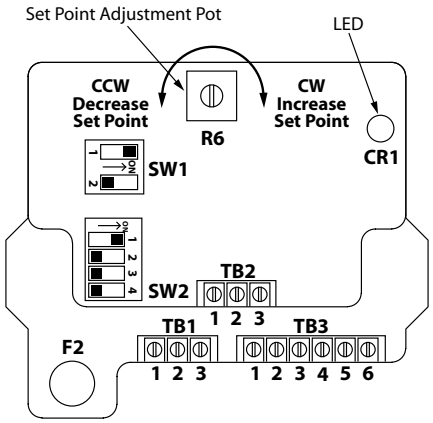
Calibrating the DR1000

1. With AC power OFF, turn the set point potentiometer, R6 on the DR1000 circuit board fully counterclockwise.
2. Determine the gross set point range of the shaft to be monitored.
3. Set the SW1 RPM position switches on the circuit board to the appropriate RPM setting for shaft rotation speed. See Table 1.
4. Apply AC power.
5. While the shaft is rotating at some known RPM, turn pot R6 on the circuit board slowly clockwise (CW) until the LED (CR1) turns OFF.
6. Turn pot R6 slowly counterclockwise (CCW) until the LED (CR1) turns ON.

The unit is now set to detect approximately a 4% to 5% reduction from the known RPM. For a set point trip at a speed reduction of more than 4% to 5% of a known RPM, continue to turn pot R6 CCW.

Note: For units wired for shutdown purposes, the relay contacts on the DR1000 can be bypassed during this procedure. If a bypass is used, it must be removed for proper operation once calibration is completed.

The DR1000 circuit board



DR	Description
CR1	LED when relay is energized
R6	Set point pot, CW increase, CCW decrease (270º Single turn)
SW1	RPM range switch
SW2	Sensor type configuration
F2	Input Power Fuse, See specifications on back page

Figure 9: DR1000 Circuit Board

DR1000 wiring schemes for TB1, TB2, and TB3

TB1 is used to connect input power to the DR circuit board.

TB1			
Power	**1**	**2**	**3**
115 Vac	Line	Neutral	Ground
230 Vac	Line	Line	Ground
12 Vdc	Positive	Negative	Ground
24 Vdc	Positive	Negative	Ground

TB2 is used to connect ESI sensors to the DR circuit board.

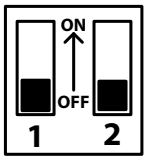
Terminal	ESI 906	ESI Prox ESI 907	ESI 916A/ 917A	All Other ESI Sensors	ESI 907 Old
1 Supply	Red	Brown	N/C	Red	Red
2 Signal	Black	Black	White	White	Black
3 Common	White & Shield	Blue & Shield	Black & Shield	Black & Shield	White & Shield

TB3 is used to connect the relay outputs to the DR circuit board

TB3					
1	**2**	**3**	**4**	**5**	**6**
NC1	COM1	NO1	NC2	COM2	NO2

DR SW1 RPM range switch setting table

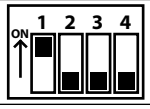
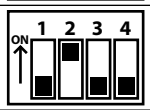
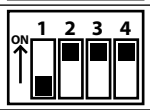
SW1 Positions		
1	**2**	**RPM Range**
ON	ON	0.5 - 5*
OFF	ON	5 - 50
ON	OFF	50 - 500
OFF	OFF	500 - 5000



*Note: The RPM range in the table above is approximate and for 8 PPR **ONLY**. You must rescale for other pulses per rev.*

** Not available with two wire sensor input due to inadequate signal.*

DR SW2 Sensor type

SW2 Positions	
For use with **NPN output 3-wire sensors** (ESI standard): Switch 1 is on and switches 2, 3, and 4 are off.	
For use with **PNP output** or **Logic-Level sensors:** Switch 1, 3 and 4 are off, and 2 is on.	
For use with **magnetic pickup 2-wire sensors** (ESI standard): Switch 1 is off and switches 2, 3, and 4 are on.	

Sample motor shutdown circuit

Figure 10 shows a typical wiring diagram for a Motor Shutdown Control circuit with an alarm for a digital speed switch such as the DR1000.

Disclaimer

The circuit shown in Figure 10 is provided for REFERENCE ONLY. Electro-Sensors accepts no responsibility for the use of this circuit or any circuit used for the purpose of Motor Shutdown.

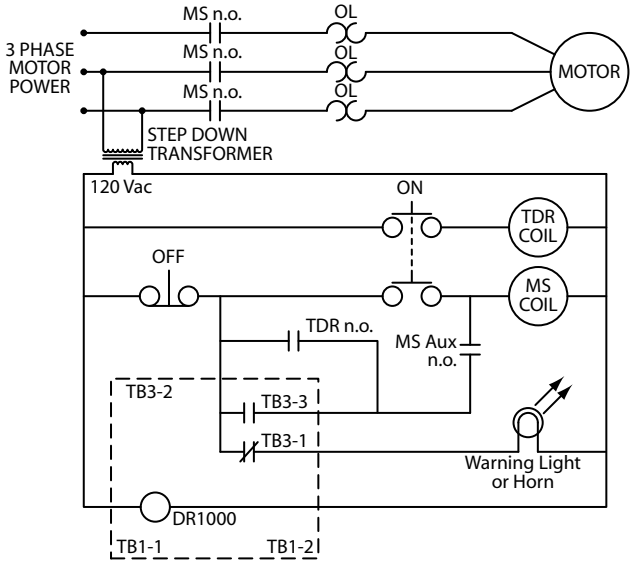


Figure 10: Sample Reference Motor Shutdown Circuit

Wiring diagram keys:

MS	Motor starter *(not supplied)*
OL	Overload contacts
n.o.	Normally open *(relay is in a de-energized state)*
TDR	Time delay OFF relay is not supplied. If the shaft being monitored comes up to speed slowly, a TDR can be used so the operator will not have to hold the START button in.

WARNING!

During a stopped condition, any slight movement of the shaft or magnetic disc could energize the control relay and start the motor—if the Motor Auxiliary Normally Open Contact (MS Aux n.o.) is not wired in series as shown Figure 10, the reference circuit. Failure to observe this warning could result in damage to the equipment or injury to persons. Always use proper Lock-Out-Tag-Out procedures.

Troubleshooting

Problem: Relay will not energize, the LED does not light up	
Possible Cause	**Possible Solution**
AC power is not applied to the DR1000 terminals correctly	Check input power @ TB1
Sensing head is not aligned or gapped properly	See figures 1 through 4, page 1
The set point is not in the proper range	See switch settings, page 3
The set point pot (R6) is not turned fully counterclockwise	See calibrating the DR1000, page 2
Shaft is not turning faster than the set point	Check actual rpm
Sensing head is not wired correctly to the DR speed switch	Check wiring @ TB2, page 3
There is no 12 Vdc sensor supply voltage	Check TB2-1 and TB2-3, page 3
The DR is not receiving a 12 volt square wave signal	Check TB2-2 and TB2-3, page 3

DR1000 speed switch specifications

Input Power	Input Current	Fuse Type (F2)
115 Vac, 50/60Hz (std)	**1/16 Amp**	**Sloblo .063A 5X20**
230 Vac, 50/60Hz (opt)	**1/32 Amp**	**Sloblo .032A 5X20**
12 Vdc (opt)	**1/8 Amp**	**Sloblo .125A 5X20**
24 Vdc (opt)	**1/8 Amp**	**Sloblo .125A 5X20**

Input Signal	Parameters
Type	NPN open collector, 2 wire, mag pickup, PNP, Logic.
Amplitude	12 V nom., 8 V min., 40 V max.
Pull-Up	2.2 K ohms
Repeatability	0.5%
Max Frequency	666 Hz (5000 RPM @ 8 PPR)
Min. Pulse Width	750 µsec

Relay Output Data	Parameters
Number Available	1 DPDT Form C
Actuation	Energized when shaft speed is above set point
Relay Contact Rating	5 Amp @ 30 Vdc, or 240 Vac resistive

Physical/Environment	Parameters
c UL us LISTED	Class I, Div 1, Group C, D Class II, Div 1, Group E, F, G UL File: E249019 CE
Enclosure Dimensions	See Figure 8
Enclosure Material	Cast Aluminum, NEMA 4X
Operating Temperature	-40ºC to +65ºC*
Storage Temperature	-40ºC to +65ºC*
Shipping Weight	7 lbs

255 Pulser Disc (std.)	Parameters **
Material	Nylon 12 Std, (opt; PVC, Alum, Stainless-Steel)
Dimensions	4-inch diameter x 1/4-inch thick
Operating Temperature	-40ºC to +60ºC* (Nylon, PVC)
Operating Temperature	-40ºC to +150ºC* (Alum, SS)

Pulser Wrap (optional)	Parameters **
Material	PVC Std. (opt; Aluminum or Stainless-Steel)
Operating Temperature	-40ºC to +60ºC* (PVC)
Operating Temperature	-40ºC to +150ºC* (Aluminum, SS)

906 Sensor (Standard)	Parameters **
Material Sensor Body	Aluminum 3/4 - 16UNF thread
Material Mount Bracket	Plate steel
Output Types	NPN open collector current sinking 20 mA max
Signal Cable	3-conductor shielded, 10 feet length std. (50 ft. or 100 ft. optional)
Operating Temperature	-40ºC to + 60ºC*
Air Gap	1/4 inch +/- 1/8 inch

907 Explosionproof Sensor (optional)	Parameters **
c UL us LISTED	Class I, Div 1, Group D Class II, Div 1, Groups E, F, G UL File: E249019 CE
Mounting Bracket Material	Plate Steel U-Bolt Assembly
Other Specifications	Similar to 906 standard sensor

Specifications are subject to change without notice.

****For higher or lower temperature ranges, consult factory.***

***** For details on Discs, Wraps and Sensors, consult factory or visit our website.***

907 Digital Speed Sensor

Description

The 907 Digital Speed Sensor produces a digital pulse signal for use with speed switches, tachometers, counters, signal conditioners, or as direct pulse input into programmable controllers. As a pulser disc or shaft wrap mounted on the monitored shaft rotates, the target magnets pass in front of the sensor. The 907 Digital Speed Sensor output switches high and low as it is exposed to the alternating polarity of the magnets on the disc or wrap, which produces one pulse for every two magnets.

Model	Targets	Duty Cycle
907	2 Magnets = 1 Pulse	50/50

The 907 Sensor allows a gap distance up to 3/8 inch between the surface of the sensor and the target magnets. The gap flexibility makes the sensors tolerant of vibration, slight shaft run-out, and minor misalignment. The 907 Sensor is used in applications requiring hazardous location ratings, or in applications where the sensor may be subject to abuse.

The 907 Sensor is powered by 5-24 VDC and provides a NPN Open Collector digital output. The 907 Sensor has a XLB-3 enclosure with a 1 inch NPT conduit opening and is provided with a steel mounting bracket. The 907 Sensor is UL Listed for use in Class I Div 1, Group D and Class II, Div 1, Groups E, F, G locations.

Pulser Disc

The end of the shaft to be monitored must be center drilled to a depth of 1/2 inch with a No. 21 drill and tapped for 10-32 UNF. After applying Loctite® or a similar adhesive on the threads to keep the pulser disc tight, the pulser disc should be attached decal side out with the supplied 10-32 UNF machine screw and lock washer.

Pulser Wrap

Pulser Wraps are custom manufactured to fit the shaft they will be mounted on. When the wrap is shipped, four Allen-head cap screws hold the two halves of the wrap together. These screws must be removed so that the wrap is in two halves. Place the halves around the shaft, reinsert the screws and torque them to 5 foot-pounds.

Sensor Installation

The 907 Sensor is supplied with a slotted mounting bracket. The sensor should be installed so the center line of the magnets pass in front of the center of the sensor as the disc or wrap rotates. When using the pulser disc, the center of the magnetized area of the disc, shown as Dimension B in figure 1, is 1-3/4 inches from the center hole of the disc.

The recommended gap distance between the sensor and the disc or wrap, Dimension A in figure 1 and 2, is 1/4 inch +/- 1/8 inch using 1/2" magnets. To achieve the proper gap distance adjust the position of the sensor using the slots on its mounting bracket.

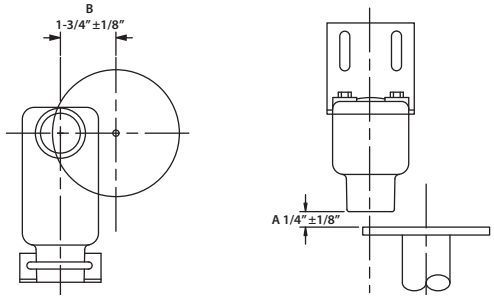


Figure 1: 907 and Pulser Disc

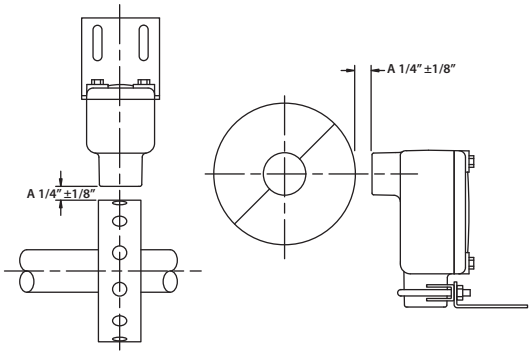


Figure 2: 907 and Pulser Wrap

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990-001601 Revision B

Electrical Connections

The 907 Sensor is designed for use with devices that have an internal pull-up resistor. If the device receiving the signal from the sensor does not have a pull-up resistor, a resistor must be placed between the sensor supply voltage and the sensor signal output.

Supply Voltage	Resistor Value 1/4 Watt	Resistor Max. Value
5V - 11V	1K	10K
12V - 15V	2.2K	10K
16V - 24V	4.7K	10K

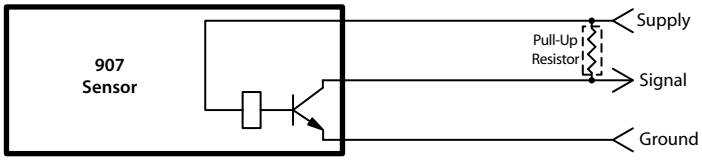


Figure 3: 907 Output Circuit

Note: *Exercise caution when wiring the sensor. Damage will occur if the* ***SIGNAL*** *and* ***SUPPLY*** *wires are shorted.*

Wiring Chart

New Color	Old Color	Connect To	Description
Brown	Red	Supply	Sensor Supply
Black	Black	Signal	Sensor Signal
Blue	White/Clear	Circuit Ground	Sensor Ground
Shield	Shield	Circuit Ground	Sensor Ground

907 Specifications

Supply	5-24 Vdc @ 10 mA
Output Type	NPN Open Collector
Current sink	25 mA Max
Max Frequency	20 kHz
Temp Range	-40º C to +60º C standard -40º C to +125º C optional
Gap Distance	1/4 inch +/- 1/8 inch w 1/2" Magnets
Max Cable Length	1500 feet
Body Material	Aluminum
Cable	3-Conductor, Shielded, PVC jacket 10' standard, other lengths optional
Mounting Bracket	Zinc Plated Steel, Included

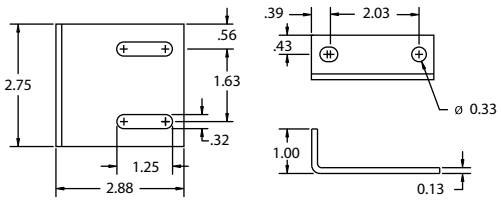
c UL us LISTED

Class I, Div 1, Group D
Class II, Div 1, Groups E, F, G
UL File: E249019

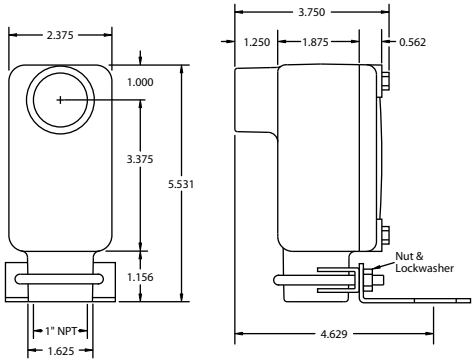
CE

Part Dimensions

907 Mounting Bracket



907 Sensor



Spare Parts List	Stock No.
907 XP HE Sensor w/10' PVC Cable	775-000600
907 XP HE Sensor w/50' PVC Cable	775-000620
907 XP HE Sensor w/100' PVC Cable	775-000621
907 XP HE HT Sensor w/10 Teflon Cable	775-000602

- No machinery tear-down required for mounting
- Five types of wraps fit most applications
- Custom number of pulses per revolution
- PVC, aluminum, or stainless steel
- High temperature wraps available

Description

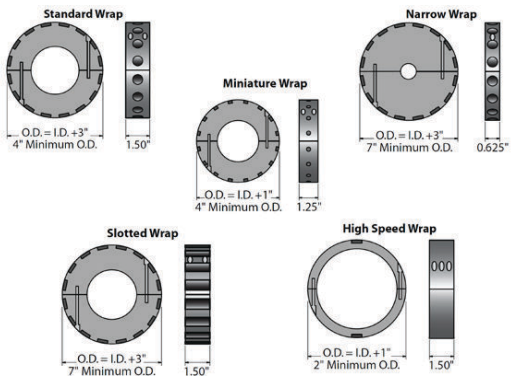
Pulser Wraps are PVC, aluminum, or stainless steel split collars with magnets mounted on the outside circumference. The magnets serve as targets for Hall-Effect and Magnetoresistive sensors that switch when exposed to magnetic fields. All wraps are custom machined to the diameter of the monitored shaft and are split into halves. This splitting process allows the wrap to clamp tightly onto the shaft without tearing down any equipment to install them. The halves are secured around the shaft with recessed Allen-head socket screws supplied. Pulser Wraps provide magnetic targets that are strong enough to allow large gap distances (up to 1/2-inch) between the wrap and the sensor. The wrap and sensor system forgives slight misalignment of the sensor, machinery vibration, dirty, wet, or greasy environments, and shaft end-play.

Special Wraps

Wraps purchased for use with standard Electro-Sensors systems are typically provided with 16 magnets of alternating polarity. Using a standard Hall-Effect sensing system, this provides 8 pulses per revolution from the sensor. Special wraps can be provided to suit particular application requirements. This often includes adding magnets to the wraps to increase the number of pulses per revolution generated by the sensing system. Adding magnets will usually require an increase in the outside diameter of the wrap. Standard and miniature wraps are typically selected when more magnets are required because the magnets may be added without large increases in the ouside diameter, particularly if the 1/4" diameter magnets are used. Wraps can be manufactured from PVC, aluminum, or stainless steel, and have the option of a keyway where required. Steel inserts can be substituted for magnets when using proximity or mag sensors. An Electro-Sensors Application Specialist can assist in the design of wraps to meet specific or special needs.

Installation

Pulser Wraps are custom manufactured to fit the shaft they will be mounted on. When the wrap is shipped, four Allen-head cap screws hold the two halves of the wrap together. These screws must be removed so that the wrap is in two halves. Place the halves around the shaft, reinsert the screws and torque them evenly to 5 foot pounds. After installation, a small gap between the two halves is normal. of wrap you require, please answer the following questions and forward the information to the sales department at Electro Sensors. Please review the specifications and differences between the various wraps before submitting this information.



Specifications ▪ Split Collar Pulser Wraps

All Wraps - Temperature Ranges	
PVC Material	-40 °C to +60 °C (-40 °F to +150 °F)
Aluminum Material	-40 °C to +150 °C (-40 °F to +302 °F)
Stainless Steel Material	-40 °C to +150 °C (-40 °F to +302 °F)

Consult factory for higher temperature ranges

Wrap Types

Standard - Under 3,000 RPM	
Width	1-1/2”
Inside Diameter	Custom to shaft size
Outside Diameter	I.D. + 3”
Min. Outside Diameter	4”
Material	PVC Std., Aluminum, Stainless Steel
Standard Magnet Size	1/2” Diameter
Standard no, of magnets	16 (8 or 16 pulses/revolution)

Wrap Types

Miniature - Under 3,000 RPM	
Width	1-1/4”
Inside Diameter	Custom to shaft size
Outside Diameter	I.D. + 1”
Min. Outside Diameter	4”
Material	PVC Std., Aluminum, Stainless Steel
Standard Magnet Size	1/4” Diameter
Standard no, of magnets	16 (8 or 16 pulses/revolution)

Specifications subject to change without notice.

Before Ordering, please check all wrap dimensions carefully.

Wraps are custom made and are non-returnable items.

Please have the following information ready when calling for a wrap order.

1. Exact Shaft diameter (in inches)
2. Type of wrap (Standard, Miniature, Narrow, Slotted, High Speed)
3. Max shaft RPM
4. Wrap Material desired (PVC, Aluminum, Stainless Steel)
5. Ambient Temperature
6. Are there corrosive or caustic elements present?
7. Additional Application Information

Wrap Types

Narrow - Under 3,000 RPM	
Width	5/8”
Inside Diameter	Custom to shaft size
Outside Diameter	I.D. + 3”
Min. Outside Diameter	7”
Material	PVC Std., Aluminum, Stainless Steel
Standard Magnet Size	1/2” Diameter
Standard no, of magnets	16 (8 or 16 pulses/revolution)

Wrap Types

Slotted - Under 3,000 RPM	
Width	1/1/2”
Inside Diameter	Custom to shaft size
Outside Diameter	I.D. + 3”
Min. Outside Diameter	7”
Material	PVC Std., Aluminum, Stainless Steel
Standard Magnet Size	1/2” X 1-1/2” bar magnet
Standard no, of magnets	16 (8 or 16 pulses/revolution)

Wrap Types

High Speed - Over 3,000 RPM	
Width	1/1/2”
Inside Diameter	Custom to shaft size
Outside Diameter	I.D. + 1”
Min. Outside Diameter	2”
Material	Aluminum, Stainless Steel
Standard Magnet Size	1/2” Diameter
Standard no, of magnets	2 (1 or 2 pulses/revolution)

Customization

If one of our standard products does not meet your specifications, please call one of our applications specialists. Many of our products can be customized to fit specific needs.

Additional Information

Please call Electro-Sensors for more information.