ALLEN-BRADLEY

High Resolution Magnetic Feedback for 8510 AC Spindle Drive System

(Cat. No. 8510SA-PGxxx)

Instructions

Objective

This publication provides the information you need to properly install and use the High Resolution Magnetic Feedback option for the 8510 AC Spindle Drive System.

Description

The High Resolution Magnetic Feedback option is designed to provide highly accurate position feedback information from a machine tool spindle to the 8510 AC Spindle Drive for spindle orient or precision spindle indexing.

The High Resolution Magnetic Feedback option consists of two parts:

1. Position Detecting Gear
2. Sensing Head.

The Position Detecting Gear has a pair of high precision ring gears that are bolted together and designed to be mounted directly to the spindle shaft. The primary gear has a very fine pitch and precision teeth that provide the primary position information. Gears are available with 225 through 500 teeth. The tooth pitch is constant for all gears, so the diameter varies directly with the number of teeth on the gear. The secondary gear has one tooth and provides the reference marker information.

ATTENTION: The Position Detecting Gear is a precision assembly that can be damaged by improper handling. It has been manufactured to very precise specifications. To guard against damage and possible replacement, **do not drop** this gear.

Additionally, the Position Detecting Gear assembly is supplied with two gears that are factory aligned to give correctly phased A and B plus marker channel outputs. To guard against misalignment and/or damage, **do not remove** the screws that hold the primary and secondary gears together. Special instruments are required for proper alignment.

The Analog Sensing Head is mounted to the spindle head stock with a small gap between the teeth of the detecting gear and the face of the sensor. As each gear tooth passes the sensor face, a sine-cosine waveform is produced by the sensor. The 8510 drive can decode this information to resolve each gear tooth into 1000 parts.

Due to a mechanical design that requires no bearings or couplings, and the high frequency capacity of the control electronics, this system can operate properly at spindle speeds as high as 30,000 rpm.

Features

- The sensing device has no bearings and does not contact the detecting gear, eliminating mechanical wear and extending the life of the sensor.
- Resolutions from 225,000 to 500,000 parts/revolution can be achieved for precision orienting capability.
- The feedback device is directly mounted to the spindle shaft without the use of belts, gears, etc., thus, backlash does not effect positioning accuracy.

Specifications

Refer to the Figure 1 for detailed dimensions of the Detecting Gear and Figure 2 for Sensing Head dimensions.

Detecting Gear Catalog Number	Number of Teeth [1]	Gear Class	Resolution Parts/Rev	Absolute Accuracy [2]
8510SA-PG225	225	Standard	225,000	0.067 degrees
8510SA-PG256	256	Standard	256,000	0.058 degrees
8510SA-PG300	300	Standard	300,000	0.048 degrees
8510SA-PG400	400	Standard	400,000	0.036 degrees
8510SA-PG500	500	Standard	500,000	0.030 degrees
8510SA-PG500P	500	Precision	500,000	0.015 degrees

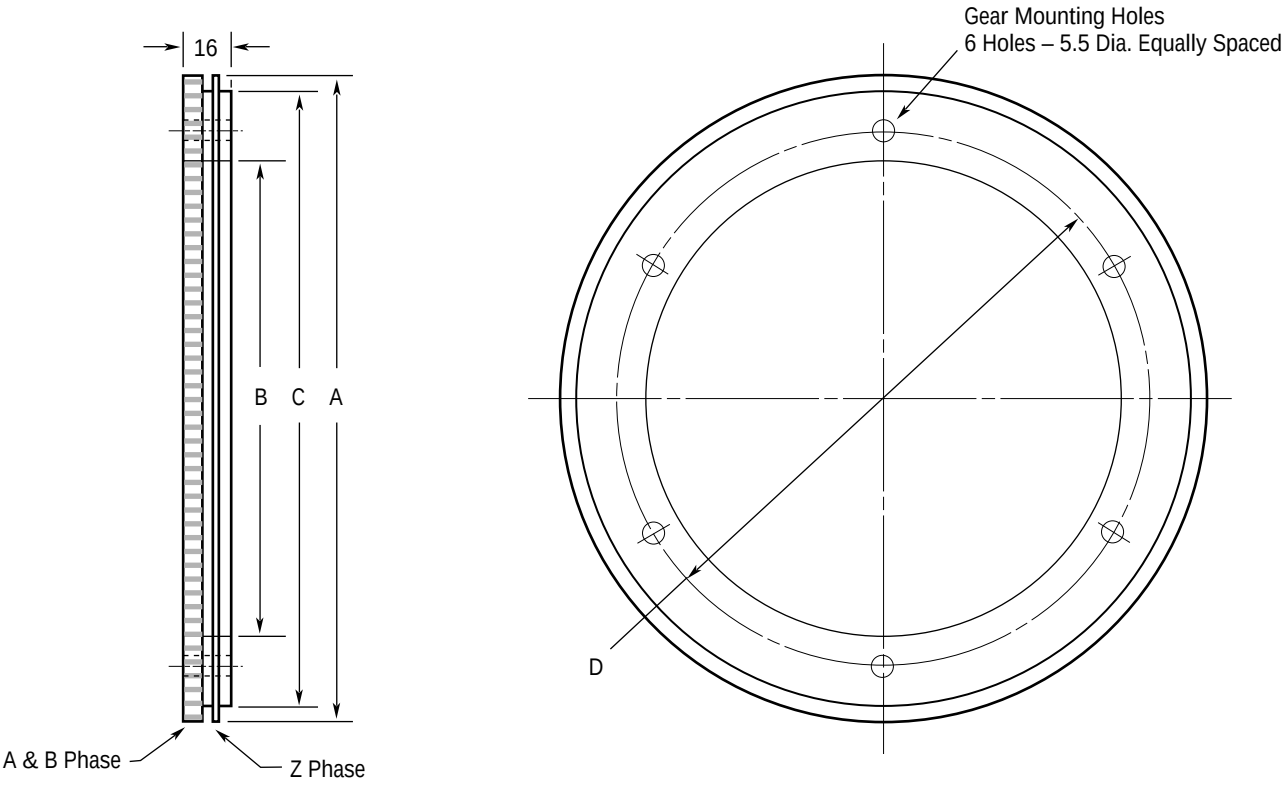
[1] By special order, gears are also available with 360, 650, and 800 teeth and all gears can be special ordered in the precision class.

[2] Gear and sensor mounting accuracy must meet the specifications defined in this publication in order to achieve the absolute accuracy specified above.

Environmental Specification

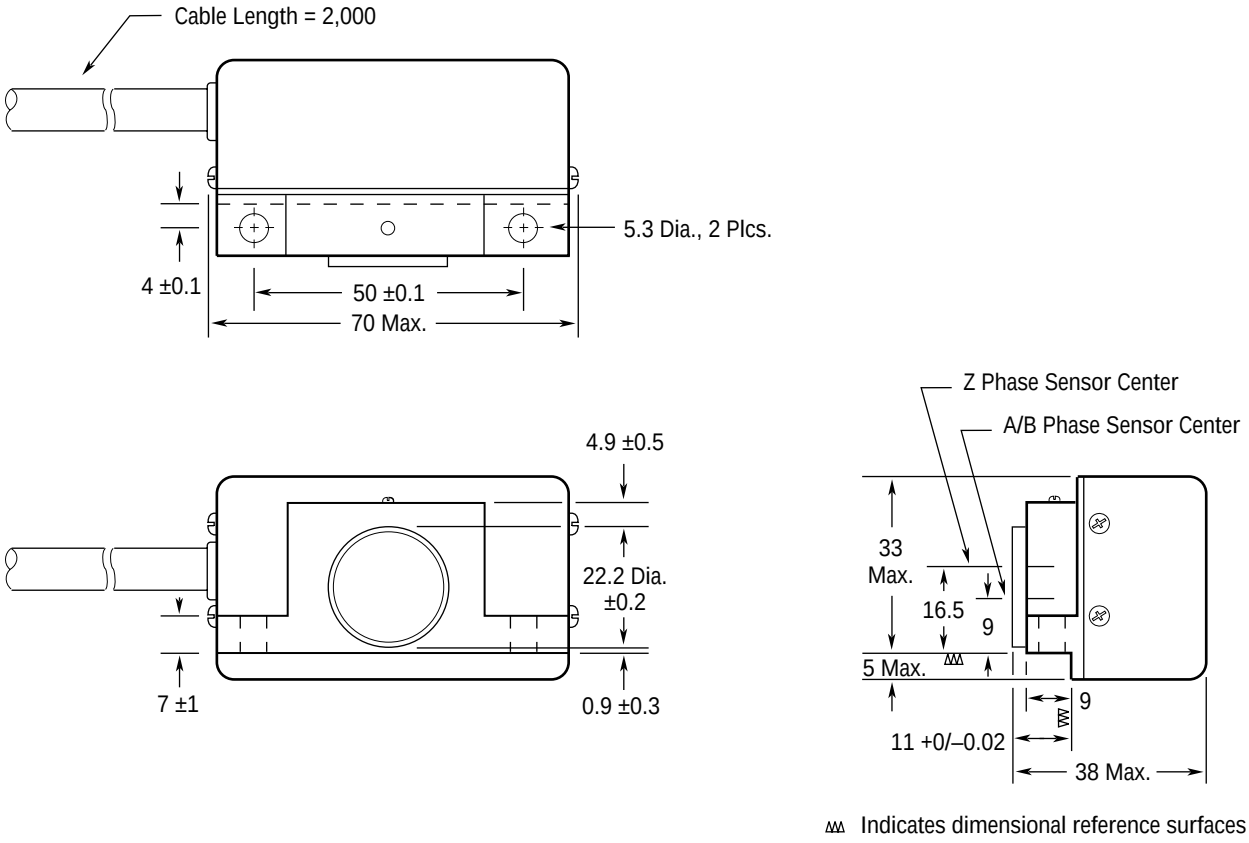
Storage temperature range:	–30°C to +70°C (–22° F to +159° F)
Operating temperature range:	–10°C to +60°C (+14° F to +140° F)
Allowable vibration range:	To maximum of 8G
Allowable shock range:	To maximum of 100G
Allowable dead load on the sensor face:	10 kg/cm^2 (140 lb./in^2)
Allowable impact load on the sensor face:	3 kg/cm^2 (40 lb./in.^{2})
Sensor Enclosure sealing rating:	IP66

Figure 1
Detecting Gear Dimensions *(in millimeters)*



Detecting Gear Catalog Number	Number of Teeth	A Outer Gear Diameter	B Center Bore Through Gear	C Gear Shoulder Diameter	D Bolt Circle Diameter
8510SA-PG225	225	90.8 h6 (0.0/–0.022)	52 H6 (+0.019/0.0)	82	67 (+0.1/–0.1)
8510SA-PG256	256	103.2 h6 (0.0/–0.022)	65 H6 (+0.019/0.0)	92	80 (+0.1/–0.1)
8510SA-PG300	300	120.8 h6 (0.0/–0.025)	85 H6 (+0.022/0.0)	112	100 (+0.1/–0.1)
8510SA-PG400	400	160.8 h6 (0.0/–0.025)	120 H6 (+0.022/0.0)	152	135 (+0.1/–0.1)
8510SA-PG500	500	200.8 h6 (0.0/–0.029)	150 H6 (+0.025/0.0)	192	165 (+0.1/–0.1)
8510SA-PG500P	500	200.8 h6 (0.0/–0.029)	150 H6 (+0.025/0.0)	192	165 (+0.1/–0.1)

Figure 2
Sensing Head Dimensions *(in millimeters)*



Mounting Considerations

The following items must be considered when mounting the High Resolution Magnetic Feedback option.

- Shield the sensor from direct exposure to oil and water. Over a period of time the sensor may be damaged by some coolant mixtures. The gear assembly is steel and may rust if exposed to sprayed water.
- Protect the gear and sensor from metal chips. The clearance between the sensor face and the gear is very small, so any metal chips caught on the gear will damage the sensor face.
- Protect the sensor from iron dust or chips. The sensor contains a permanent magnet – iron dust and chips will easily adhere to it and interfere with proper system operation.
- To assure ease of alignment, mount the gear and sensor in an easily accessible location.

Detecting Gear Mounting Requirements

The accuracy of the feedback system is directly affected by the accuracy with which the feedback gear is mounted to the spindle shaft. Using very tight tolerances, the gear must be mounted to a surface that is perpendicular to the spindle axis of rotation and must be mounted concentric with the axis of rotation. Any wobble or eccentricity induces errors in the output signal and reduces the absolute accuracy of the feedback system.

With the standard gear accuracy class, it is usually possible to meet the gear installation accuracy requirements by simply mounting the gear to carefully machined, low tolerance mounting surfaces on the spindle shaft.

With the precision gear accuracy class, it will be necessary to adjust the gear during the mounting and alignment process to achieve the required installation accuracy requirements. With this class of gear, the spindle shaft should be turned slightly undersize to allow for concentricity adjustments.

Table A defines the general tolerances for the gear mounting surfaces for the two classes of gears.

Table A
Mounting Tolerance *(in millimeters)*

Mounting Accuracy Characteristic	**Standard Accuracy**	**Precision Accuracy**
Squareness of mounting face relative to spindle shaft center of rotation	Less than 0.02	Less than 0.005
Flatness of the gear mounting face	Less than 0.02	Less than 0.005
Dimensional tolerance of centering shaft	h5 (see Table B)	–0.05 / –0.10
Concentricity of centering shaft relative to spindle shaft center of rotation	Less than 0.02 T.I.R.	Less than 0.02 T.I.R.

The Detecting Gear can be bolted directly to the mounting flange on the spindle shaft or a clamping ring can be used to clamp it to the mounting flange. The mounting flange and clamping ring diameters must be small enough so they do not extend into the area of the gear teeth. This would interfere with proper gear tooth signal pickup by the Sensor Head. Table B and Figure 3 show the dimensions required for the mounting surfaces and the gear mounting layout.

Figure 3 also shows the various ways the gear can be mounted to the spindle shaft. Tolerances are shown for both the standard class and the precision class gears.

After the gear has been mounted, the mounting concentricity relative to the center of rotation must be verified. Use a dial indicator to determine the runout and adjust the gear mounting until the T.I.R. is less than the amounts specified below.

Standard Class Gear: Less than 0.02 mm T.I.R.
Precision Class Gear: Less than 0.005 mm T.I.R.

Figure 3
Detecting Gear Mounting Methods *(in millimeters)*

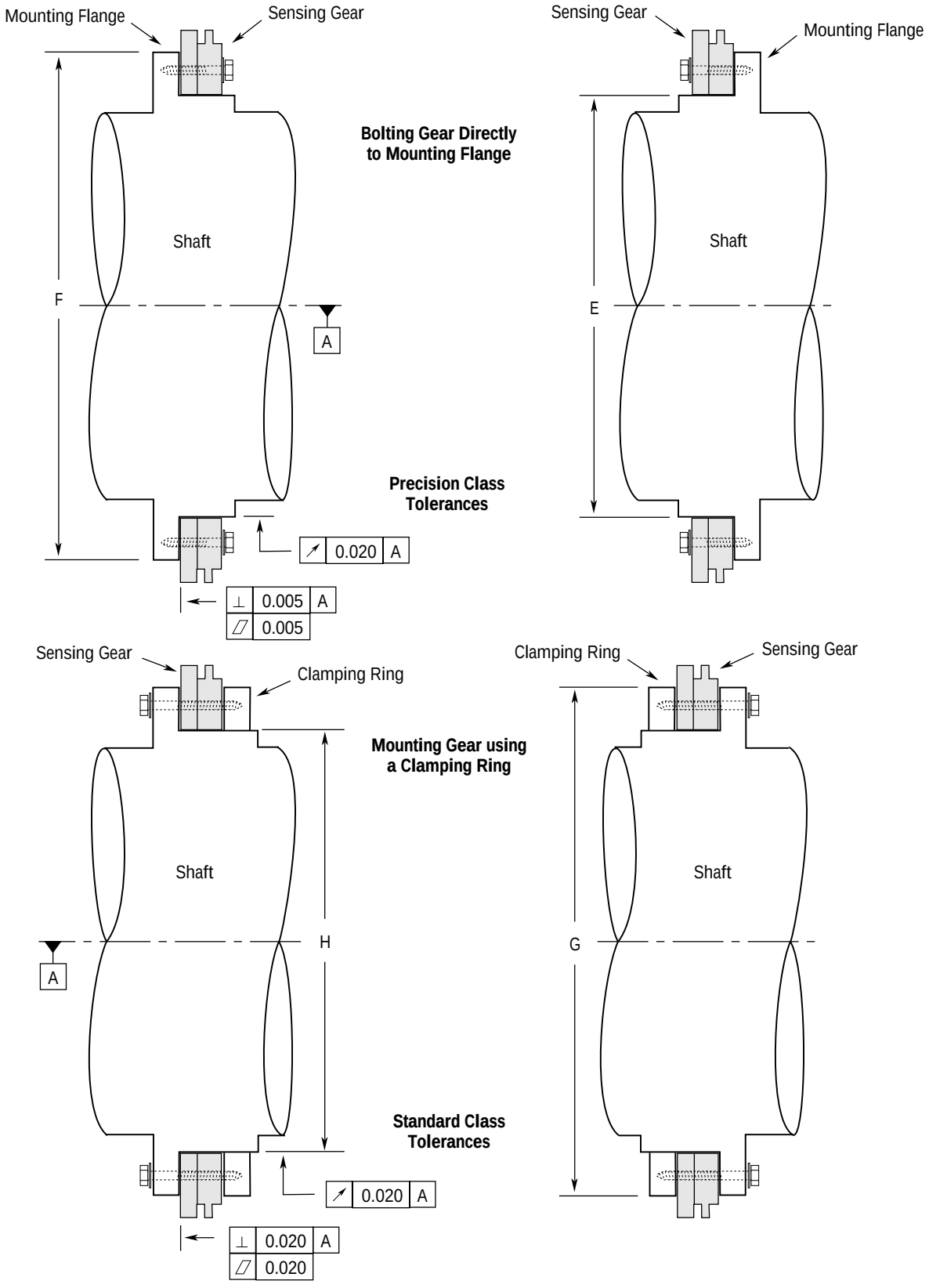


Table B
Mounting Dimensions *(in millimeters)*

Detecting Gear Catalog Number	Number of Teeth	E Centering Shaft O.D. Standard		E Centering Shaft O.D. Precision		F Mounting Flange *Max. O.D.*	G Clamping Ring *Max. O.D.*	H Clamping Ring *I.D.*	
8510SA-PG225	225	52h5	0.0 / –0.013	52	–0.05 / –0.10	82	82	52	+0.05 / 0.0
8510SA-PG226	256	65h5	0.0 / –0.013	65	–0.05 / –0.10	92	92	65	+0.05 / 0.0
8510SA-PG300	300	85h5	0.0 / –0.015	85	–0.05 / –0.10	112	112	85	+0.05 / 0.0
8510SA-PG400	400	120h5	0.0 / –0.015	120	–0.05 / –0.10	152	152	120	+0.05 / 0.0
8510SA-PG500	500	150h5	0.0 / –0.018	150	–0.05 / –0.10	192	192	150	+0.05 / 0.0
8510SA-PG500P	500	150h5	0.0 / –0.018	150	–0.05 / –0.10	192	192	150	+0.05 / 0.0

Sensing Head Mounting Requirements

The Sensing Head must be mounted relative to the Detecting Gear as shown in Figure 4. For proper operation, it is critical that the center line of the gears be positioned as shown relative to the mounting surface of the sensor. The air gap between the Detecting Gear surface and the surface of the circular sensing plate on the Sensing Head must be 0.15 ±0.05 mm. A properly designed mounting support will permit sufficient adjustment to assure proper alignment and will be rigid enough to prevent sensor movement relative to the gear.

Sensing Head Wiring To 8510 AC Spindle Drive

Refer to Chapter 8 in the *8510 AC Spindle Drive System User Manual* (publication 8510-5.1) for wiring details.

Figure 4
Sensing Head Mounting and Alignment *(in millimeters)*