TIMKEN
Where You Turn

Evaluation Kit: MPS 160 ASIC

Magneto Encoder ASIC

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Reference Documents: MPS160 ASIC Series data sheet

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1.0 Overview

This kit is designed to help you evaluate and understand the Timken MPS160 Magnetic Encoder IC. The MPS160 CMOS IC combines a direct sensing Hall-Effect quadrature encoder with an integrated index pulse. The **t-board** in **figure 1** has additional circuitry for open-collector or differential line driver outputs. If a reference pulse magnet is used then the optional index pulse is also available.

2.0 Mounting Instructions

To achieve proper sensor output, it is important that the MPS160 sensor is properly mounted with respect to the magnetic target. Described below are the important parameters to be considered when mounting the sensor demo board and magnet.

2.1 Sensor Orientation

Proper sensor orientation can be seen in fig. 1. The center line of the sensor IC's length should be mounted tangentially, approximately 90° to the magnet and the center line of the IC's width should be aligned along the radius of the target disk. Failure to keep these angles will lead to inaccuracy of the output signal.

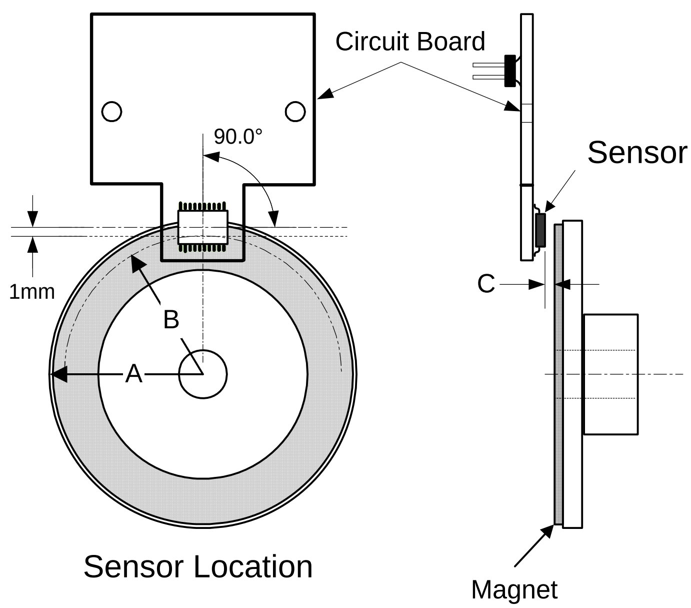


Figure 1
A – Target Diameter
B – Pitch Radius
C – Air Gap

2.2 Pitch Radius

Pitch Radius is the radial distance on the magnetic target where the sensor elements of the MPS160 chip should be oriented, fig. 1, dimensions **B**. The MPS160 ASIC's Hall-Effect sensors are located **1mm** from the IC's center line toward pins 15-16. Pitch Radius is calculated from the pole spacing or magnetic pole length, and the number of poles on the magnetic target. The MPS160 sensor is designed to work with a pre-programmed pole spacing. The Magnetic Target chart in fig. 2 shows the Pitch Radius of each magnet provided for evaluation. The pitch radius can be calculated using the formula:

$$Pitch\ Radius = \frac{\#\,Pole\ Pairs \times Magnet\ \ Pole\ Length}{\pi}$$

2.3 Air Gap

Air Gap is the distance between the sensor and the magnetic target, dimension **C** in fig. 1. The range of air gap depends on which kit magnet is provided. The nominal air gap for each target is found on the magnetic Target chart in fig. 2. The sensor will still operate outside these air gap tolerances however accuracy of the output signal will decrease. It is also important that the sensor be mounted so that the air gap is consistent over the axial run out of the target magnet.

3. 0 Magnetic Target

The kit contains one of the 8 different magnetic target hubs. The available output resolution is determined by the number of pole pairs, size of the magnet and the pole length, or 'pole spacing'. Dimensions for the available target hubs are shown in the chart below in Figure 1.

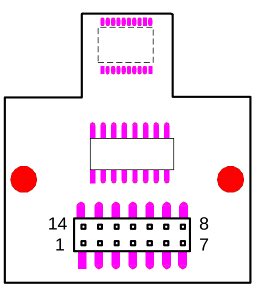
The chart also provides the sensor mounting dimensions shown in figure 1, and described above. The pitch radius is **B** and the nominal air-gap is dimension **C**. The total signal edges in column 3 are the total rising and falling edges of channel A and channel B combined. Note: Magnet rings up to and including 2" fit 1/4" shafts, larger magnet fit 3/8" shafts.

Target ID	Target OD **A** in	Signal Edges Total	# Pole Pairs	Pole Spacing mm	Pitch Radius **B** mm	Mag. OD mm	Mag. ID mm	Air Gap **C** in	in
A	**1.00**	2048	16	1.8	9.167	21.33	9.33	0.018	0.008+/-
B	**1.00**	2048	16	2.25	11.459	26.42	14.42	0.026	0.010+/-
C	**1.60**	4096	32	1.8	18.335	39.67	27.67	0.018	0.008+/-
D	**2.00**	4096	32	2.25	22.918	49.34	37.34	0.026	0.010+/-
E	**2.30**	6144	48	1.8	27.502	58.00	46.00	0.018	0.008+/-
F	**3.00**	6144	48	2.25	34.377	72.25	60.25	0.026	0.010+/-
G	**3.00**	8192	64	1.8	36.669	76.34	64.34	0.018	0.008+/-
H	**3.75**	8192	64	2.25	45.837	95.17	83.17	0.026	0.010+/-

Fig. 2

4.0 Output

The connections of the t-Board are shown in fig. 3. The quadrature sensor signals can be accessed as <u>either</u> open-collector outputs or as line-driver differential outputs. Pull-up resisters of 2.4k are supplied on the circuit board for the Open-collector outputs.



Pin	Function		
1	A-	CH 1 OUT	Differential Line-Driver
2	A+		
3	B-	CH 2 OUT	
4	B+		
5	Z-	Ref./Index Pulse *	
6	Z+		
7	NC		
8	A	CH 1 OUT	Open-Collector
9	B	CH 2 OUT	
10	Z	Ref/Index Pulse OUT *	
11	Vcc	4.7-10V	
12	T Out	Linear Temperature	
13	NC		
14	GND		

* *(Optional)*

Fig. 3

The t-board also is equipped with an on-board voltage regulator, which allows for a supply voltage in the range of 5 to 10 volts to be used.

4.1 Index/Reference Pulse (Optional)

In addition, the MPS160 sensor is equipped with an internal index pulse hall-effect. This sensor element is mounted opposite the high resolution hall-effects in the IC, approximately 1mm from center-line towards pins 5 and 6. To use the index pulse feature, you must use a special magnetic target that has a second magnetic track on the target hub.

5.0 Using low power mode for low speed battery applications

The MPS160 is programmable for operation at lower speeds with a reduced power requirement. This operation reduces long term power consumption such as in battery applications. There is a typical variation of ± 1 edge on the A and B channel output. This may happen even if the target is held still during power up/down cycles - the chip can wake up in either a high or low state for a given angle. In this case the digital hysteresis can be enabled to prevent the output from toggling and can be programmed for the application when necessary.

6.0 Absolute position over a motor phase using the SPI/SSI

The MPS 160 is capable of interfacing with external halls and providing absolute position over a motor phase through the SPI/SSI interface. This feature does not have to be preprogrammed into the ASIC and is available at all times.

Up to 4 external Hall signals can be routed through the MPS160 to the SPI/SSI line to provide positional data. The number of external Halls needed is dependent on the number of high resolution pole pairs and motor phases. Timken application engineers work with the applications parameters to design target magnets and determine the number of external Hall's needed. The absolute position data output is via Synchronous Serial Interface/Synchronous Peripheral Interface (SSI/SPI).