Description

A target for electronically marking the position of moving parts. Use in conjunction with CambridgeIC's resonant inductive sensors and Central Tracking Unit (CTU) family of single chip processors to provide high-quality position data to a host device.

The target includes an inductively coupled resonant circuit comprising a ferrite rod wound with a coil connected to a capacitor. The circuit's resonant frequency matches the operating frequency of the CTU. The high Q-factor of the resonator enables high resolution position sensing.

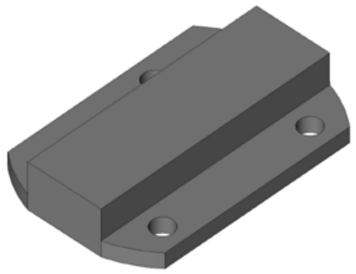


Figure 1 isometric sketch

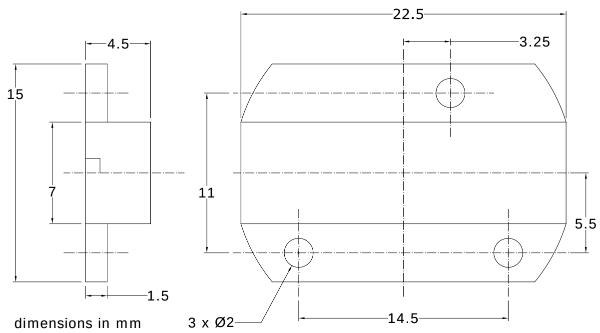


Figure 2 nominal dimensions

Features

- Non contact: wireless and wear free
- Compact
- Sealed
- For both linear and rotary position sensing
- Holes for alignment and/or mounting

Performance

- Linear magnetic axis alignment ±0.1mm
- Rotary magnetic axis alignment ±0.2°
- Typical Q-factor 115
- Operating Temperature -20°C to +85°C
- Max rotation speed 6000rpm
- Max linear acceleration 4000ms^{-2}

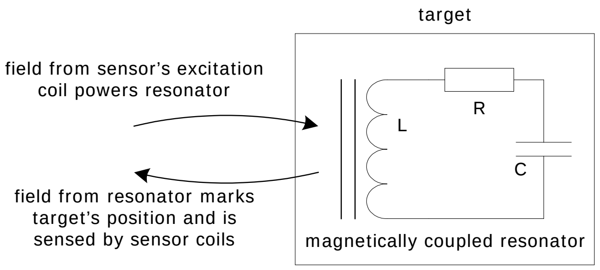


Figure 3 equivalent circuit

Applications

- Motion control
- Actuator position feedback
- Insert for precision front panel knobs and sliders
- Valve position marking
- Industrial potentiometer wiper replacement
- RVDT rotor replacement
- Optical encoder code ring replacement

Product identification

Part no.	Description
013-1005	Target, Fo=187.5kHz

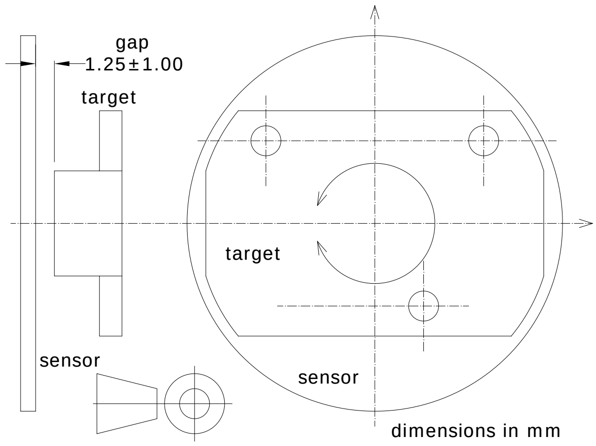


Figure 4 use with end-shaft rotary sensor

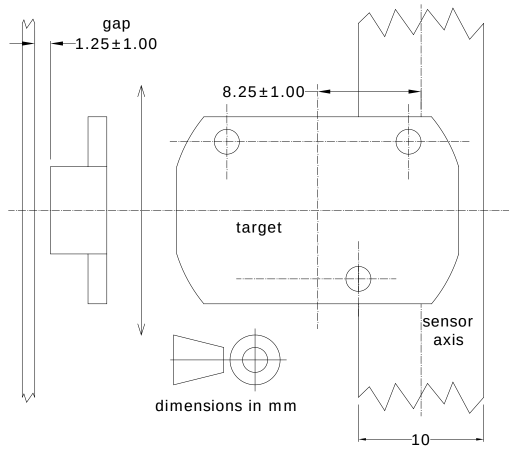


Figure 5 use with 10mm wide linear sensor

1 Mechanical Drawing

Figure 6 shows the mechanical outline of the target including tolerances. Figure 6 also defines the Target Coordinate System, comprising the Target Origin and three orthogonal axes.

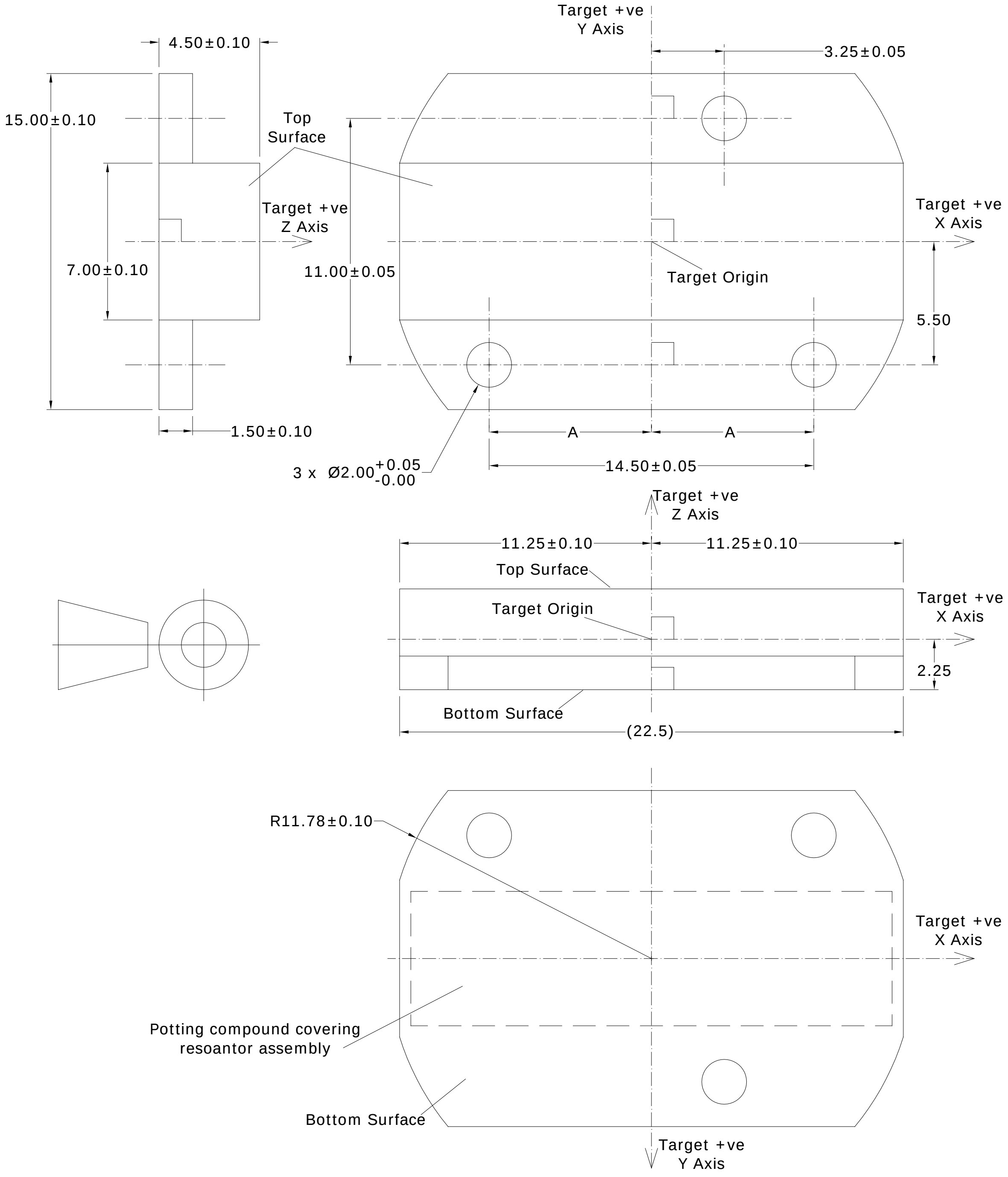


Figure 6 drawing with tolerances and showing reference axis locations and orientation

The X Axis is parallel to a line joining both Reference Holes and to the Bottom Surface. The Y Axis is perpendicular to the X-Axis and parallel to the Bottom Surface. The Z axis is perpendicular to the Bottom Surface. Axes intersect at the Target Origin, which is 2.25mm from the Bottom Surface, 5.50mm from the line joining both Reference Holes and opposite the mid point of that line.

2 Magnetic Field Specifications

2.1 Field Shape

When energised by current flowing in the excitation coil of a sensor PCB, the target emits a shaped AC magnetic field. Its shape is optimised for both rotary and linear position sensing. The field is radially symmetric about the X Axis. Figure 7 illustrates the radial field component at a distance of 4mm from the X Axis.

The field is asymmetric about the Y Axis so that the target is capable of marking position unambiguously over a full 360°. The asymmetry also concentrates field towards the +ve X end, for maximum amplitude when used with linear sensors.

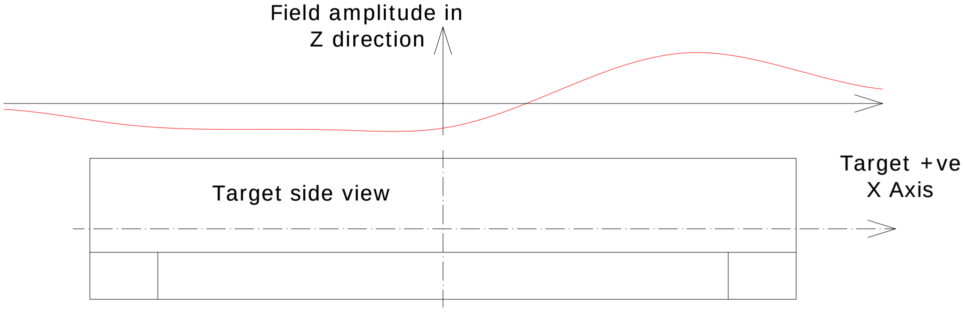


Figure 7 magnetic field

Since the target is radially symmetric, it may be used with either the Top Surface of Bottom Surface facing the sensor PCB.

2.2 Field Alignment

The target is carefully designed so that the resonator's field axis is aligned with its mechanical X Axis. This minimises errors in the measurement of absolute position. When used with a rotary position sensor as in Figure 4, it is the misalignment in angle Az_field illustrated in Figure 8 which contributes to offset error. When used with a linear sensor as in Figure 5, it is the misalignment in linear position Y_field illustrated in Figure 9 which contributes to offset error.

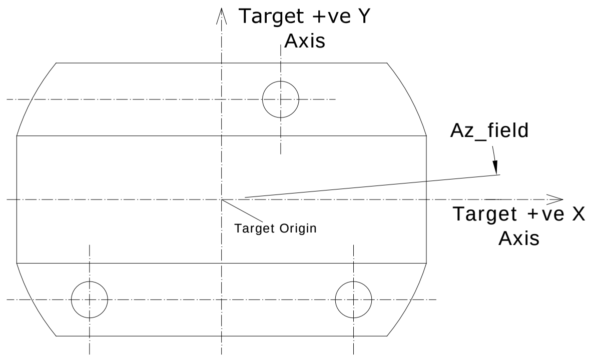


Figure 8 Az_field measurement

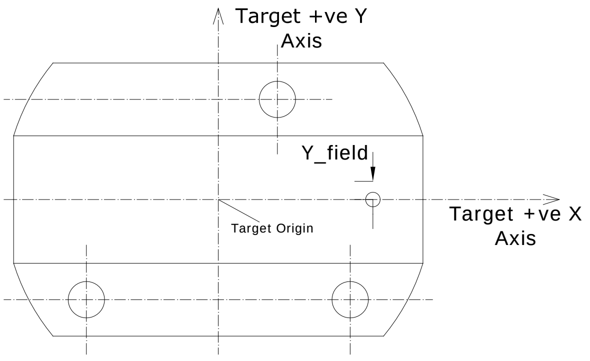


Figure 9 Y_field measurement

The maximum values of these position offsets are specified in Table 1.

Table 1

Parameter	Maximum magnitude
Az_field	0.1°
Y_field	0.1mm

3 Electrical Specifications

Table 2

Parameter	Value	Comments
Nominal resonant frequency Fo	187.5kHz	Across Operating Temperature, in free space
Q-factor	90 min	
Resonant frequency tolerance	±5% max	

4 Physical Specifications

Table 3

Parameter	Value	Comments
Minimum Operating Temperature	-20°C	
Maximum Operating Temperature	+85°C	
Minimum Storage Temperature	-40°C	
Maximum Storage Temperature	+85°C	
Maximum relative humidity	95%	
Climatic category	IEC 60068–1 40/125/56	–40 °C/ +125 / 56 days damp heat test
Vibration	IEC 60068-2-6, Fc	10…55Hz: A = +/- 0.75 mm 55…2000Hz: $100ms^{-2}$
Bump	IEC 60068-2-27, Ea	Pulse half-sine, duration 6 ms, a= $40ms^{-2}$, n= 4000
Solvent resistance	Propan-2-ol, 5 minutes	Isopropylalcohol IPA
Mass	0.32g	

5 Metal Integration

Targets may be mounted near metal given adequate gap. However precautions must be taken to ensure the system maintains adequate performance.

When a target resonates, its AC field sets up eddy currents flowing in any nearby metal. Energy is lost from the resonance, particularly when the material has a high surface resistivity (e.g. Aluminium foil). This yields a reduction in Q-factor. The eddy currents also oppose the target's field, reducing coupling factor to the sensor. Both of these effects reduce the amplitude measured by the CTU connected to the sensor. The reduced amplitude results in less good resolution.

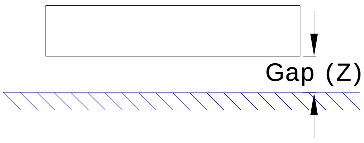
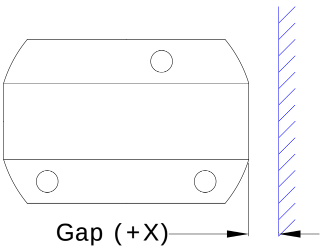
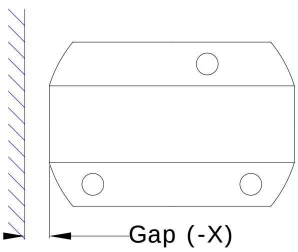
Another effect of the metal is to change the target's resonant frequency. This is due to the eddy currents once again, together with any magnetisation of the metal if it is ferromagnetic. Changes in resonant frequency have minimal effect within the CTU's tuning range, which typically extends ±7% from the nominal value for the CAM204A. Beyond this range the CTU may fail to detect the target. Given a free space frequency tolerance of ±5% (Table 2), metal should usually be placed so that target frequency is within ±2% of its free space value.

None of these effects presents difficulties given sufficient gap between the target and metal.

5.1 Effect of Metal Plates

Table 4 illustrates the gaps required for different metal locations and materials.

Table 4

Metal location relative to target	Material	Absolute Minimum Gap / mm (3)	Recommended Minimum Gap / mm (4)
	Aluminium sheet	4	4
	Austenitic stainless steel	3	7
	Copper ground plane (1)	4	8
	Aluminium foil (2)	6	10
	Carbon steel	7	10
	Aluminium sheet	2	2
	Austenitic stainless steel	2	4
	Copper ground plane (1)	2	5
	Aluminium foil (2)	4	8
	Carbon steel	5	8
	Aluminium sheet	0	0
	Austenitic stainless steel	0	1
	Copper ground plane (1)	0	2
	Aluminium foil (2)	1	6
	Carbon steel	2	6

Note (1): Solid copper ground plane of PCB, 1oz thick (35µm) = 0.5mΩ/square.
Note (2): Aluminium foil 15µm thick = 2mΩ/square.
Note (3): The Absolute Minimum Gap is based on a 70% reduction in amplitude relative to free space, or a change in resonant frequency of 2%, whichever occurs at the greatest gap. Amplitude measurements are relative to free space, with the target at Typical Gap for the sensor.
Note (4): The Recommended Minimum Gap is based on a 90% reduction in amplitude relative to free space, or a change in resonant frequency of 2%, whichever occurs at the greatest gap. Amplitude measurements are relative to free space, with the target at Typical Gap for the sensor.

5.2 Effect of Metal Mounting Screws

If the target is mounted using screws, the screw material can be plastic, brass or stainless steel. Mild steel is not recommended. Table 5 illustrates the effect of different mounting screw materials. The reason mild steel is not recommended is the large reduction in amplitude caused by damping of the resonator in the target.

Table 5

Type	Screw Material	Amplitude Change	Frequency Change	Comments
3 off M2 x 6mm Pan Head	Plastic	0%	0Hz	No effect
	Brass	-7%	+100Hz	Small effect, usually acceptable
	Stainless Steel (A2)	-10%	-100Hz	
	Mild Steel	-30%	-1000Hz	Not recommended

6 Document History

Revision	Date	Description
A	23 October 2008	Increased thickness to 4.5mm for manufacturability, new target and datasheet part number
0002	8 June 2009	Added tolerances, magnetic and electrical parameters
0003	4 November 2009	Added effect of different mounting screw materials
0004	13 January	Updated logo and style
0005	14 September 2010	Corrected toleranced mechanical drawing: 11.20mm and 11.30 dimensions each corrected to 11.25mm
0006	22 July 2014	Added RoHS details Added patent details
0007	13 May 2015	Corrected hole location in isometric view

7 RoHS Compliance

CambridgeIC certifies, to the best of its knowledge and understanding, that part number 013-1005 is in compliance with EU RoHS, China RoHS and Korea RoHS.

8 Contact Information

Cambridge Integrated Circuits Ltd
21 Sedley Taylor Road
Cambridge
CB2 8PW
UK

Tel: +44 (0) 1223 413500

info@cambridgeic.com

9 Legal

The part described in this datasheet may be subject to one or more of the following patents, depending on the design of the matching sensor that it is used with: US8570028, GB2461448, GB2488389 and GB2500522. Other patents are pending.