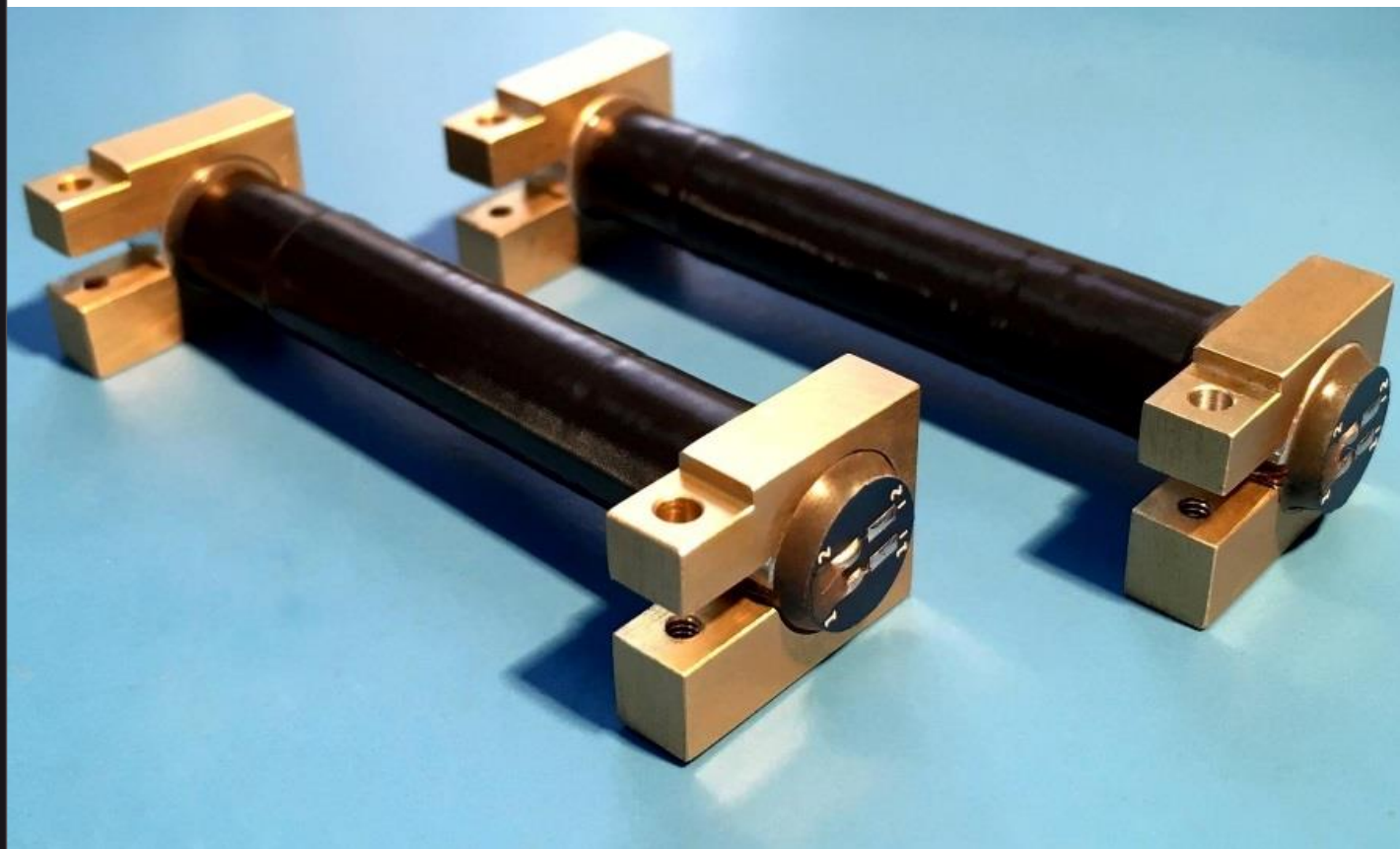




CUBETORQUER

MAGNETIC TORQUER ROD AND COIL



INTERFACE CONTROL DOCUMENT

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1. Introduction

CubeTorquers are magnetic torquer rods intended for use on small satellites. These rods are typically used as part of an Attitude Determination and Control System (ADCS) to generate an external magnetic torque on a satellite, by interacting with the Earth's geomagnetic field. CubeTorquer is available in either a ferrous rod or a flat air-core form, referred to respectively as CubeRod and CubeCoil.

CubeRod has a specially treated ferrous core with ultra-low remanence and high linearity. It comes in three different sizes: Small, Medium and Large. CubeCoil a low-profile, flat air coil and is intended to fit within a PC104 stack between PCBs. It is available in 'n single or double-wound version that are suitable for 3U and 6U CubeSats respectively.



Handling: The ferrous cores that are used in the CubeTorquer rods are heat treated to improve magnetic performance. The magnetic performance of the core is significantly degraded by high intensity shocks, and caution must be taken to avoid any bumps or drops of CubeTorquer rods.

2. Mechanical

2.1 Description and sizing

The torquer rods consist of a heat-treated ferrous core wound with copper wire. The outside layer is protected by non-outgassing heatshrink and the windings terminate on a PCB located at the end of the rod. The sizes for the S, M and L sizes rods are shown in Figure 1.

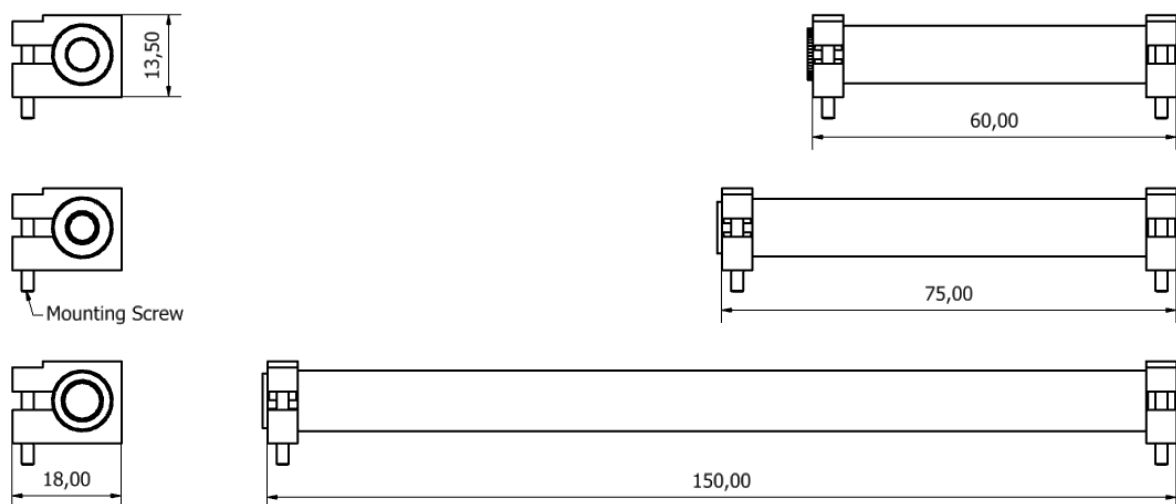


Figure 1: CubeRod sizes: Small (top), Medium (mid), Large (bottom)

The coil consists of two Alodined Aluminium plates with the copper wire wound in-between. The wire is terminated on a PCB mounted on the side of the upper plate. The coils come in two sizes, single and double wound, which are both shown in Figure 2.

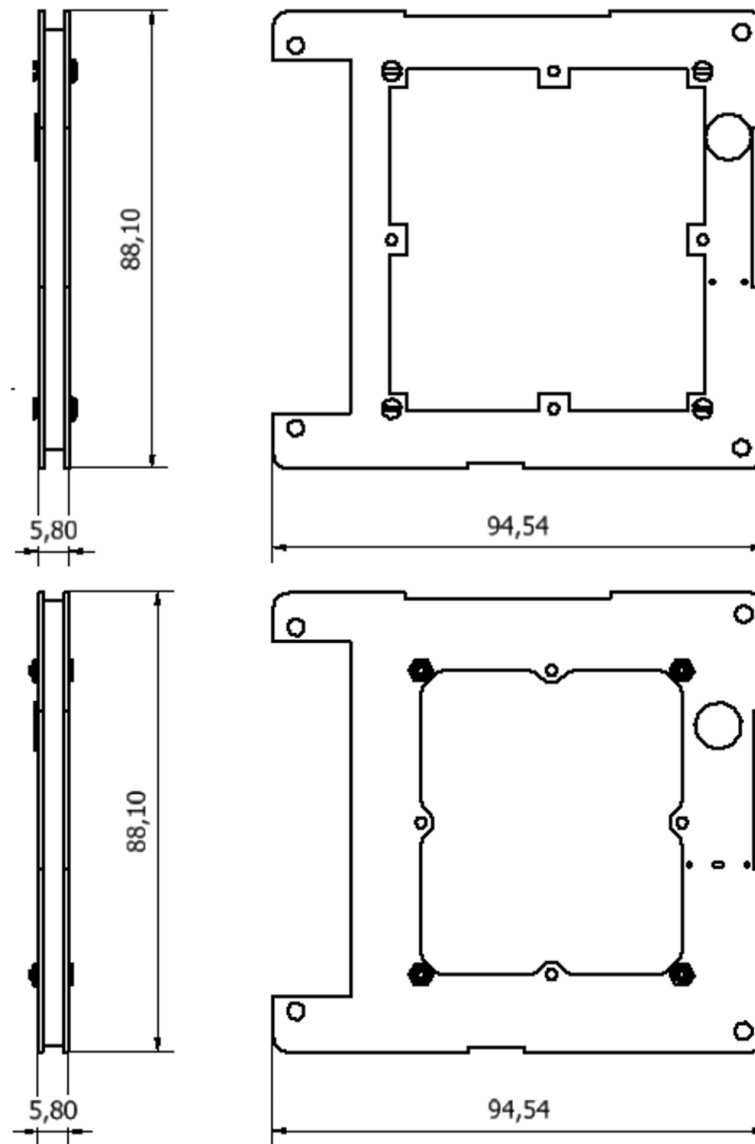


Figure 2: CubeCoil sizes: Single (top), Double (bot)

2.2 Mounting

Mounting brackets are fastened to the ends of the rods with an M2 screw from the topside of the bracket. These screws protrude past the bottom face of the bracket, and doubles as mounting mechanism to fasten the torquer to another surface/base. Typically, non-threaded clearance holes are drilled into the base on which the rod will be mounted, the rod is placed on the base from one side with the mounting screws through the holes, and the rod is fastened to the base using M2 nuts on the opposite side of the base.

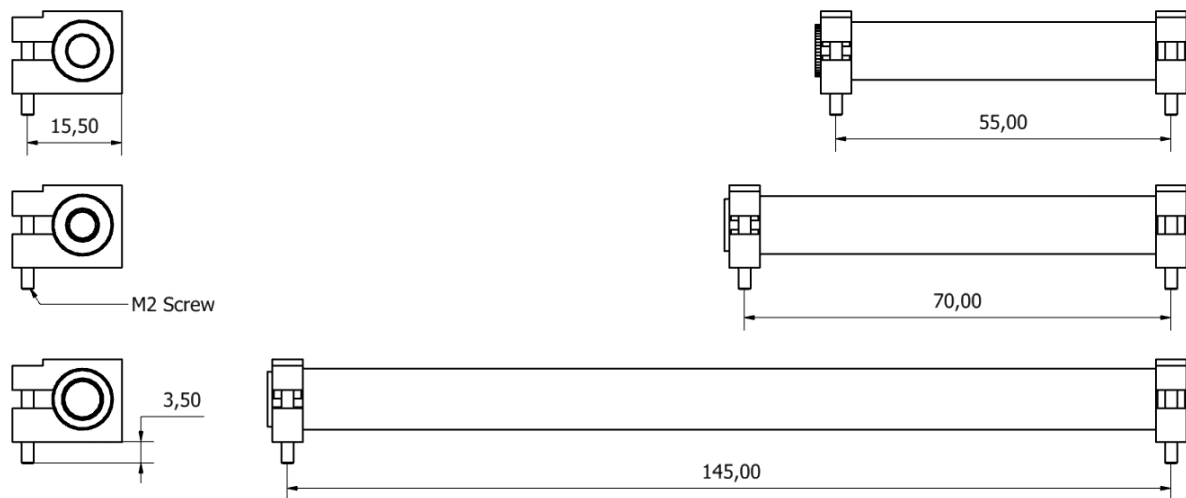


Figure 3: CubeRod mounting

The CubeCoil have four 3.2mm holes on the corners that are compatible with the CSKB standard. The locations of these mounting holes are shown in Figure 4.

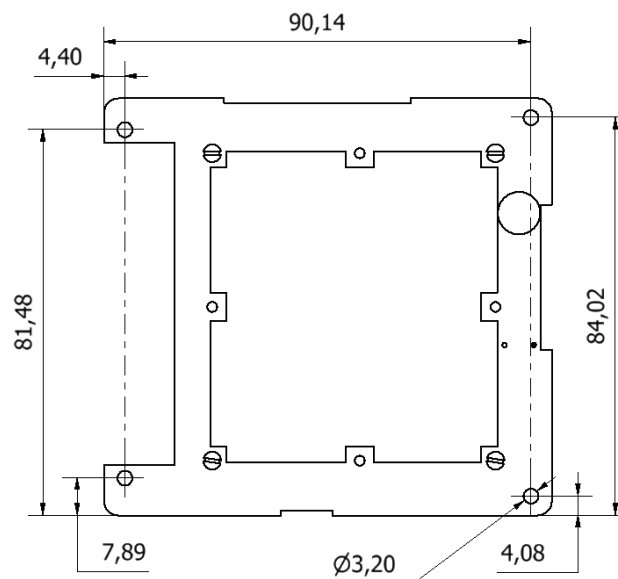


Figure 4: CubeCoil mounting

2.3 Materials

All materials used are low-outgassing. The table below lists the materials used:

Part	Material
Heat shrink	PVDF (TML = 0.36%, CVCM = 0.04%)
Epoxy	DP 2216
Copper Wire	Polyesterimide Enamel Coating
End Caps	Alodined Aluminium
PCB	High Temp FR4
Solder	60EN (60%Tin, 40% Lead)
Brackets	Alodined Aluminium
Screws	A4 Stainless Steel (316)

3. Electrical Interface

3.1 Polarity

All CubeTorquers have a PCB with pads marked 1 and 2. When applying a positive voltage to the pad marked 1 and the ground to the pad marked 2, the magnetic field is as indicated in the figure below:

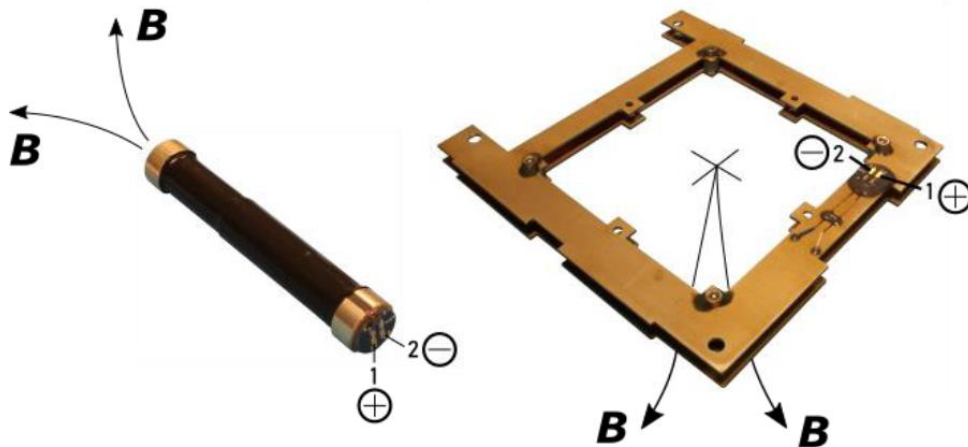


Figure 5: CubeTorquer field direction

4. Specifications

	Small Rod	Medium Rod	Large Rod	Coil	Double Coil
Physical					
Mass	28g	36g	72g	46g	74g
Dimensions (mm)	18x14x62	18x14x77	18x14x153	90x96x6	90x96x6
Electrical					
Max Allowed Continuous Current @ 25°C	150 mA	150 mA	150 mA	150 mA	150 mA
Performance					
Maximum Magnetic Moment @ 25° C	$\pm 0.24 \text{ Am}^2$ (2.5)V	$\pm 0.61 \text{ Am}^2$ (5)V	$\pm 1.88 \text{ Am}^2$ (5)V	$\pm 0.13 \text{ Am}^2$ (5)V	$\pm 0.27 \text{ Am}^2$ (5)V
Magnetic Gain	2.8 Am ² /A	8.2 Am ² /A	25 Am ² /A	2.1 Am ² /A	2.1 Am ² /A
Linearity	2.5 %	2.5 %	2.5 %		
Environmental					
Operating Temp	-20°C to 70°C				
Vibration	14g RMS				

5. Document Version History

Version	Author(s)	Pages	Date	Description of change
0.1	DS	ALL	26/09/2019	First draft
1.0	DS	ALL	27/09/2019	Initial release
1.1	LH	3, 5	6/10/2020	Updated figures 1 & 3