MT01 Compact Magnetorquer
Revision B, 2020

ICD/USER GUIDE

1. **OVERVIEW:**
With only 10.5 grams and 3.2 millimeters thickness, the MT01 Compact Magnetorquer is a vacuum core magnetic coil designed for ADCS control in cubesat mission from 1U to 3U that boast an impressive performance compared to its small footprint over the mass, power and area budget of the spacecraft. Even with that small dimensions the MT01 is capable of greater magnetic moments, turn speeds and angular accelerations than comparable products on the market, yet the power usage is kept to a minimum: It can turn a 1U mass 90 degrees in 60 seconds using only 0.2 Watts at a LEO orbit of 500kms.

MT01 can be integrated in to our BA0x family of high capacity compact batteries and our DSA Deployable Solar Array family too, the biggest advantage of the MT01 is that it can be easily affixed anywhere on your spacecraft using a minimal area.

Every coil is tested and qualified in our own facilities and shipped with full reports and packed with additional match connectors interfaces. The MT01 has flight heritage since 2013.

2. **Configuration:**
MT01 Revision A: Non polarity
MT01 Revision B: Polarity

3. **Features**:
Low cost, proven standard
Very thin and lightweight: only 3.2 mm thick at 10.5 grams
Compact, power efficient, yet powerful magnetic dipole strength: Up to 0.39 Am2
Fast 5.90 degrees per second turn speed (at max power, 1U mass) optimizes power usage
Perfectly coupled with our DSA Deployable Solar Arrays or BA0x batteries
Manufactured with space grade materials according to space standards and custom mission design
Functional, performance, thermal bake out and vibration tests provided with documentation.
Extensive documentation as 3D pdf, STEP files and blue prints
Compatible with almost any structure and compliant to CubeSat Standard
Custom Interface available

Functional, performance, thermal bake out and vibration tests provided with documentation.
Compatible with ISIS and Pumpkin Structures and compliant to Calpoly's CubeSat Standard.
Charging cables provided by default and custom Interface available

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4. **Performance:**

-Working Voltage: From 1.25V to 12.0V
-Working Current: From 100mAh to 2000 mAh
-Nominal Magnetic moment: >0.19 Am^2
-Saturation Magnetic moment: >0.85 Am^2
-Linearity: +/- 4% across operating design range
-Residual moment: <0.0045 Am^2
-Torque: 5.36 µNm @ 7.2^{-3} Tesla (1U mass)
-Angular acceleration: 3.2^{-3} Rad/sec^{-2} (1U mass)
-B-center = 8.9 Gauss at 5V@0.25A
-B-corners = 14.5 Gauss at 5V@0.25A
-Supply Power: From 250mW to 1750mW
-Typical resistance: 4.1 to 4.7 ohms @ 25°C
-Random Vibration: 25g rms
-Lifetime: >10 years

5. **Product Properties and ratings:**

-Dimensions:
External: 50x50 mm
Internal: 42x42 mm
Width: 4.3 mm
Height: 3.2 mm
-Mass: 10.5 +- 0.5 grams
-Operating Temperature: -55 °C to +85 °C
-Radiation Tolerance: 2 years minimum in LEO, 4 years minimum when the S/C has NEMEA shielding

6. **Materials**:

-Pre-evacuated enamel copper wire
-Cohesion: Space grade epoxy 3M
-Interfaces:
Custom choice, normally Molex PicoBlade/PicoSpox inline 2 pin connector with gold plated contacts
PTFE (Teflon) space grade cables, single strand, silver plated copper (AWG26 to AWG30)

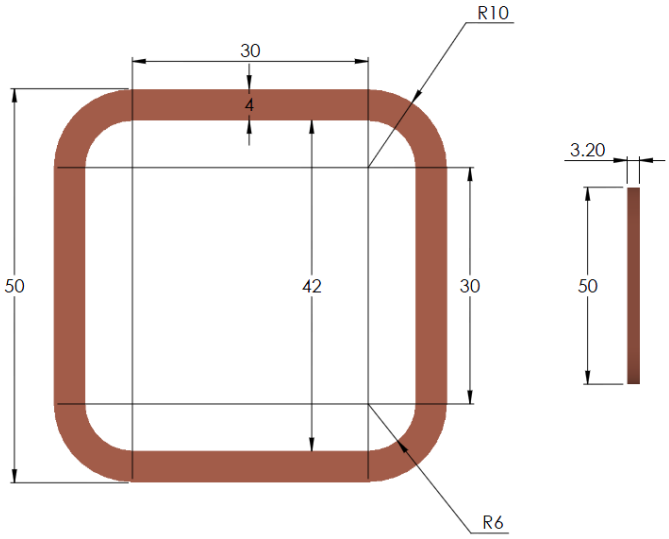
7. **Shipping:**

Qualification and Acceptance Testing: All batteries are shipped with tests reports regarding the following tests:

Test	QT	AT
Functional	✓	✓
Vibration	-	✓
Thermal Vacuum	-	✓
Cable/Connector integrity	✓	✓
Polarity	✓	✓
Performance	✓	✓

Thermal Bake out (10E-5 mbar @ 50C for 24 hours)
Full vibration test for Falcon 9 and Electron 20 vibration profiles, other LV profiles available upon request
QT and AT is performed on the unit to be shipped at no charge.

8. MECHANICAL LAYOUT AND DIMENSIONS:



9. FUNCTIONAL:

10. CONNECTORS AND POLARITY:

CONNECTOR MOLEX 51021-02

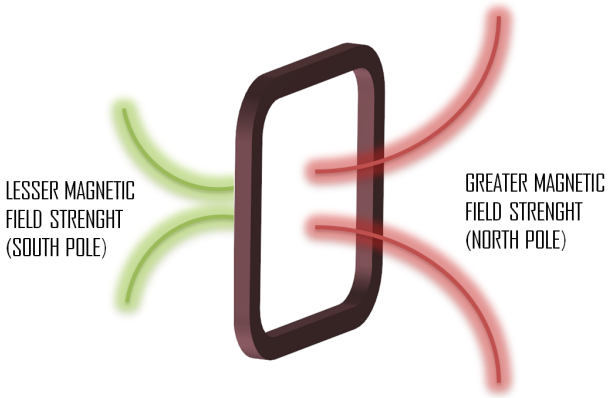
MATCHING CONNECTOR MOLEX 53261-02

11. POWER CONNECTOR:

This connector Molex 51021-02 is used to power the MT01, on Revision A you will notice 2 silver cables, on Revision B, you will see 1 blue cable and 1 silver cable, the blue cable is POSITIVE (+) terminal and the silver cable is NEGATIVE (-) terminal.

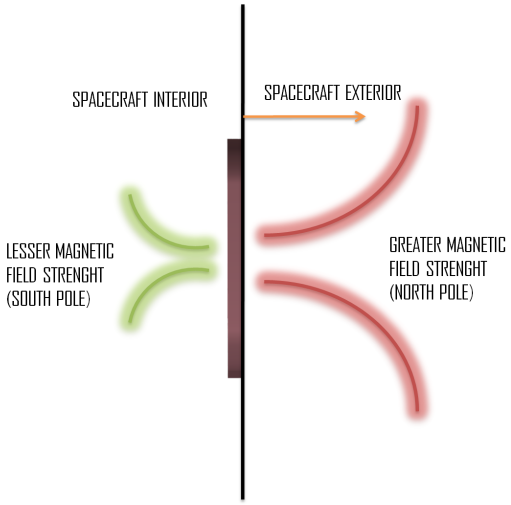
12. MAGNETIC FIELD PROJECTION POLARITY:

The MT01 Revision B has a polarity in the way it projects the magnetic field, it is designed to project the most magnetic field strength outwards the spacecraft, so you need to measure the field strength on both sides and determine which one is the side that has the most magnetic power and that side is the one you will install against the inner surface of the spacecraft.



13. MAGNETIC FIELD DENSITY:

The MT01 Magnetic field density is concentrated in the inner area of the magnetorquer, while a much weaker field density remains on the corners of the outer area.



14. **OPERATION:**

The MT01 can be operated on continuous wave mode or pulsing mode, this last one either on Pulse Width Modulation (PWM) or Variable Pulse Operation.

Your ADCS software will define the length and strength of the pulses or continuous operation depending on the voltage and current applied to the magnetorquer, while being careful to not reach saturation, which is normally reached when the current being applied ramps up without any noticeable increase in the magnetic field strength, this much depends on the capabilities of your chips drivers and/or your ADCS module or card.