



NanoTorque GSW-600

Datasheet

High performance reaction wheel for 6U, 8U and 12U nano-satellites

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2 Overview

The GomSpace NanoTorque GSW-600 is a compact and high-performance reaction wheel designed and qualified for an equivalent of 3 years in-orbit operations.



The wheel can be purchased as either a single wheel without a mounting bracket or in a 4-wheel pyramid setup within a mounting bracket. The envelope of the reaction wheel is designed for allowing 4 wheels to be placed in a redundant setup within the envelope of a standard CubeSat.

The GSW-600 wheel is available with SPI and I²C interface¹.

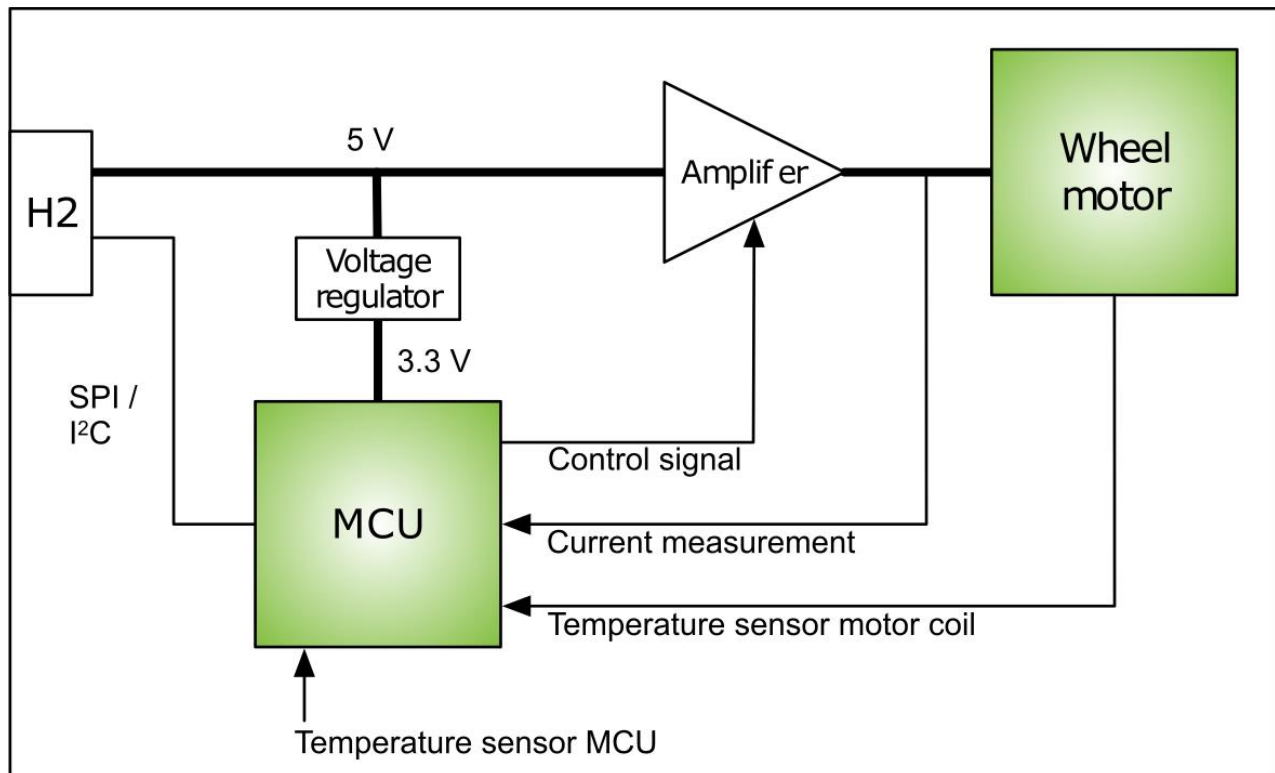
2.1 Highlighted Features

- 3-year design lifetime
- 2 mNm torque
- 19 mNms storage
- Long life hybrid bearings
- Precisely balanced flywheel
- Integrated electronics
- SPI and I²C interface
- Mounting from 5 sides
- IPC-A-610 Class 3 assembly

¹ External pullups are needed for I²C communication.

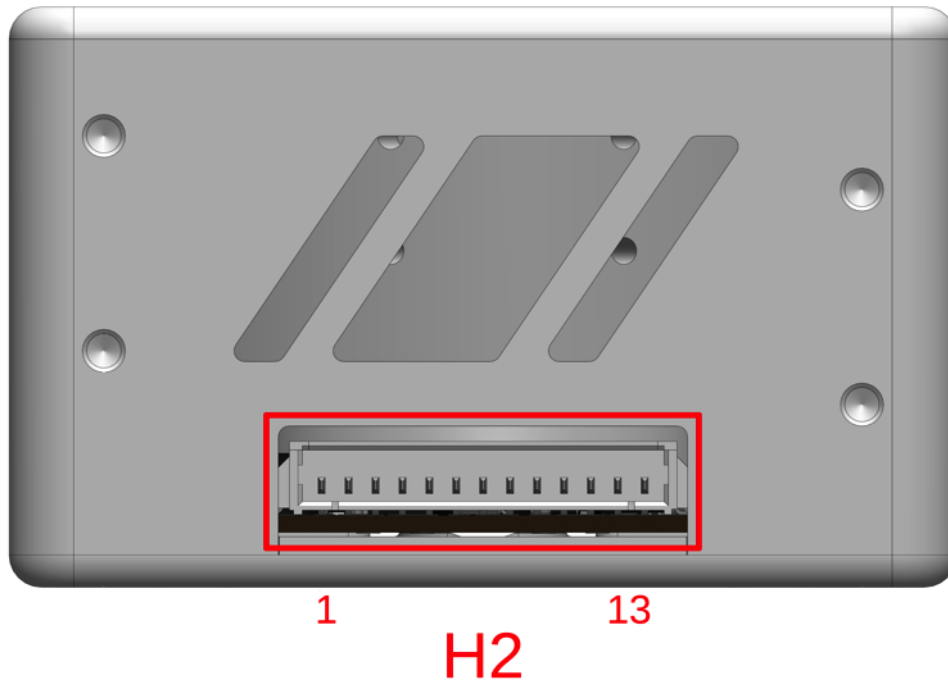
2.2 Block Diagram

Below is shown the data and power pathways.



3 Connector Pinout

3.1 Connector Location



3.2 H1 – GomSpace Debug

The 5-pin connector on the opposite side is for internal use.

3.3 H2 – Main Connector

The main connector provides power and communication to the GSW-600. Two communication interfaces are available: SPI and I2C. **Please note** that the I2C interface is not recommended for in-flight operation unless SPI is not an option.

Pin	Description
1	Vcc
2	Vcc
3	GND
4	GND
5	NC
6	NC
7	SPI MISO
8	SPI MOSI
9	SPI CS
10	SPI SCK
11	I ² C SDA (<i>do not use</i>)
12	I ² C SCL (<i>do not use</i>)
13	GND

Connector type: Molex PicoBlade right angle, 053261-1371

Absolute Maximum Ratings

Stresses above those listed under Absolute Maximum Rating may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect the reliability.

Parameter	Description	Min	Typ.	Max	Unit
V _{cc}	Maximum supply range	-0.3		6.0	V
T _{op}	Operational temperature range	-40		80	°C
T _{st}	Storage temperature range	-40		85	°C

Note: There is no latch up protection in the wheel itself.

4 Electrical and Torque Characteristics per Wheel

4.1 Performance

Parameter	Condition	Min	Typ.	Max	Unit
Torque	Continuous	-1.5		1.5	mNm
Minimum torque ²	Torque control	-0.015		0.015	mNm
Speed	Maximum	-6000		6000	rpm
Speed	At max torque	-3500		3500	rpm
Momentum	At max speed		19		mNms
Supply voltage		4.9	5	5.1	V
Supply current	At maximum torque			500	mA
Supply current	At 4500 rpm (zero torque)		60		mA
Control accuracy	Speed control		0.5		rpm

4.2 Interface

Parameter	Condition	Min	Typ.	Max	Unit
SPI speed				250,000	bps
I ² C speed				400,000	bps
I/O voltage	SPI / I2C		3.3	3.4	V

² Lowest possible torque to command from standstill.

5 Physical Characteristics

5.1 One Wheel

Description	Value	Unit
Mass	180	g
Size	44.0 x 44.0 x 27.0	mm
Flywheel inertia	300	gm ²

5.2 Pyramid

Mounting bracket and 4 wheels.

Description	Value	Unit
Mass	940	g
Size	95.0 x 95.0 x 61.6	mm

6 Mounting

6.1 One Wheel

On five sides of the casing of one wheel, there are 4 holes that are designed to be used for mounting. Use a M2.0 screw. No screw holes in the lid of the unit. Please refer to **Section 8.1**.

6.2 Pyramid Bracket Mounting

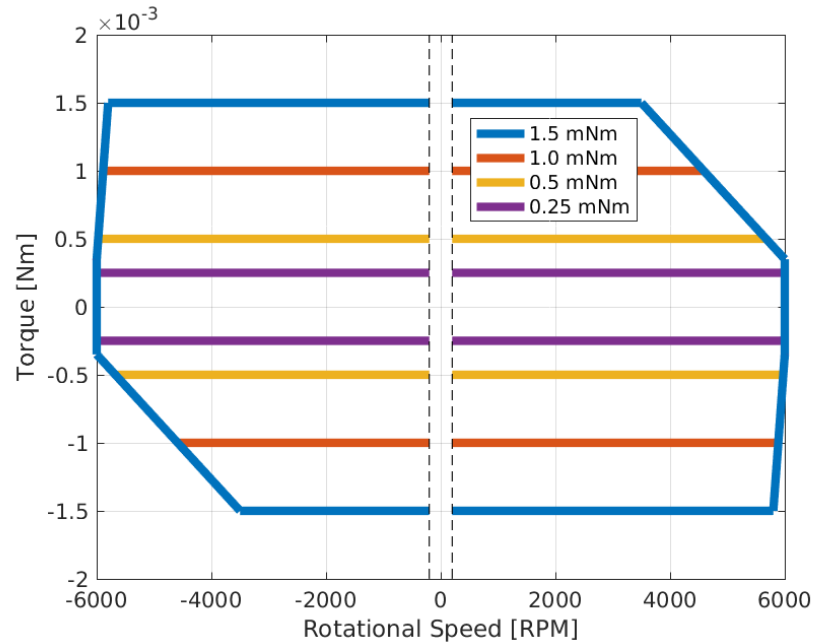
This bracket is designed for the GomSpace 6U structure but can be used with other structures.

The bracket can be mounted as part of a PC104 stack (3 mm rods) or directly on the GomSpace 6U structure (2.5 mm screws). Further holes on bottom can be used for mounting smaller units (2.5 mm screws), like a gyroscope. Please refer to **Section 8.2**.

7 Wheel Performance

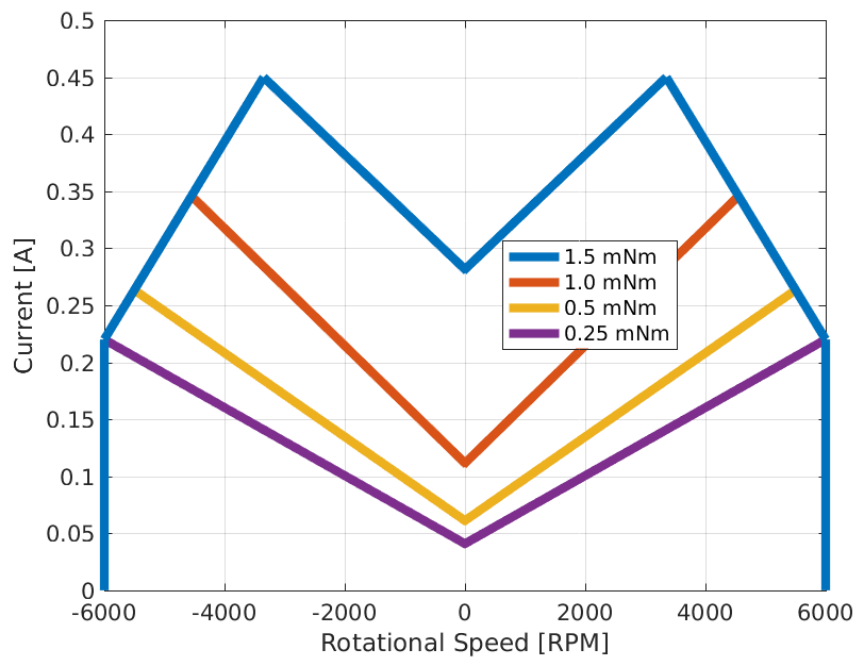
7.1 Torque Box

The plot shows the wheel performances for different torque levels. The dashed line indicates the dead zone which is shown on its own plot.



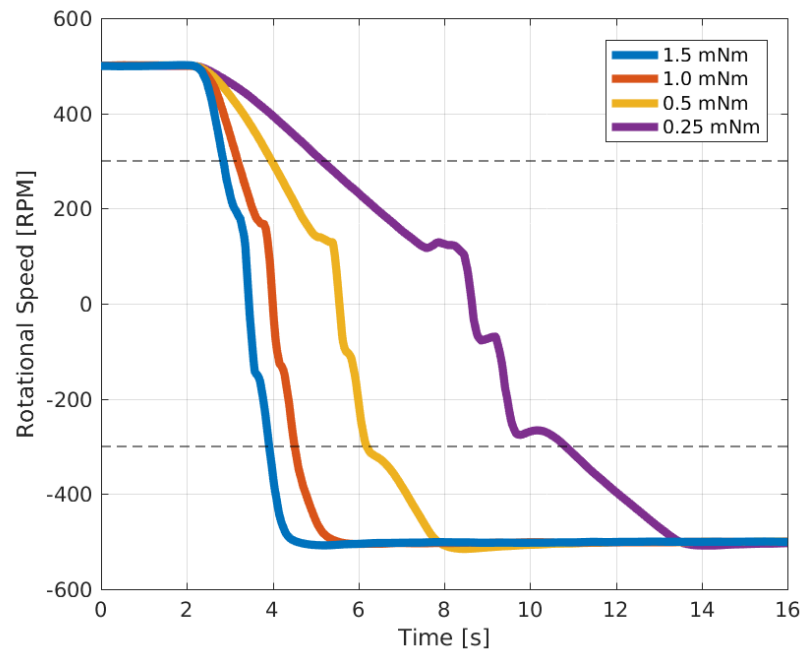
7.2 Current vs Speed

The plot shows the current consumption at different torque levels.



7.3 Dead Zone

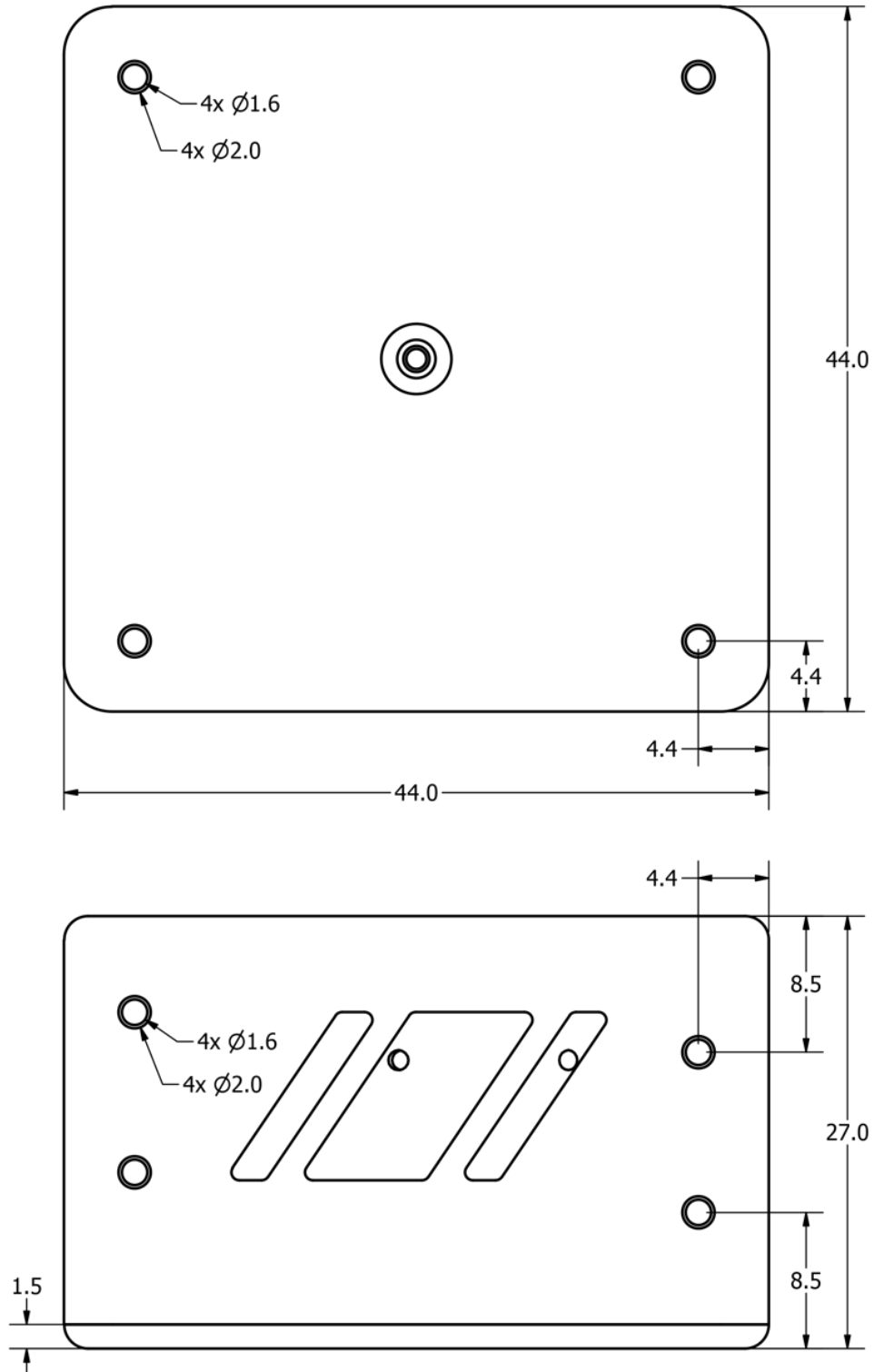
The plot below shows the behaviour of the reaction wheel through the dead zone at different torque levels. The dead zone is caused by static friction and is framed by the dashed lines. To ensure proper control it must be avoided to operate the wheel within this zone.

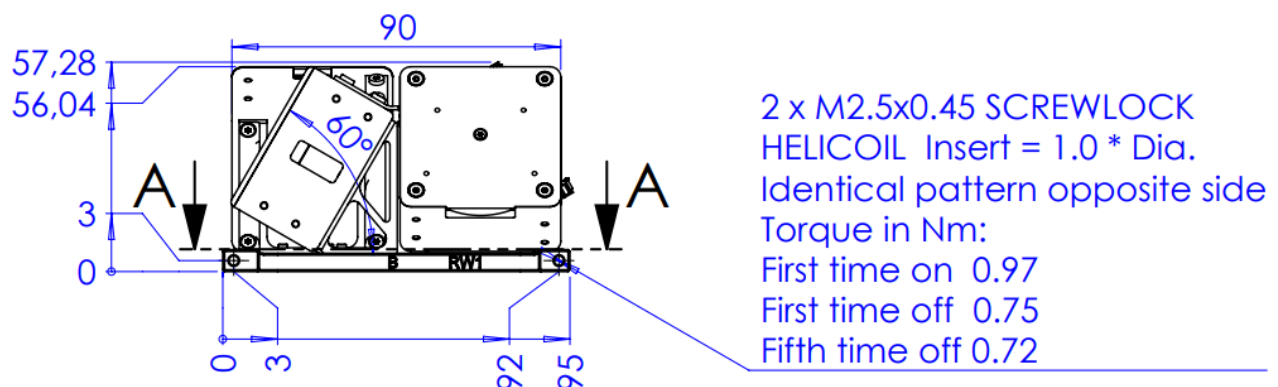


8 Mechanical Drawing

All dimensions in mm.

8.1 One Wheel





9 The GSW-600 with GomSpace AACS Products

The GSW-600 is part of a GomSpace ADCS solution. The center unit is the NanoDock ADCS-6 or ADCS-8 PCB mounted with a NanoMind A3200 and a GPS. All peripheral units are connected to the NanoDock.

Below is shown an example with GomSpace products. View the individual datasheets for further info.



NanoDock ADCS-6 with NanoMind A3200 and GPS

NanoTorque GST-600 magnetorquer

NanoTorque GSW-600 reaction wheel

NanoStructure 6U with a Fine Sun Sensor

NanoSense M315 magnetometer

10 Safety and Passivation

The GSW-600 reaction wheel is designed to be inherently safe, and no command or failure can cause a mechanical breakup of it. To passivate the GSW-600 switch off the reaction wheel by removing power from it.

11 Disclaimer

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