

NanoUtil TestDock

Datasheet

Nano-satellite tabletop test bed

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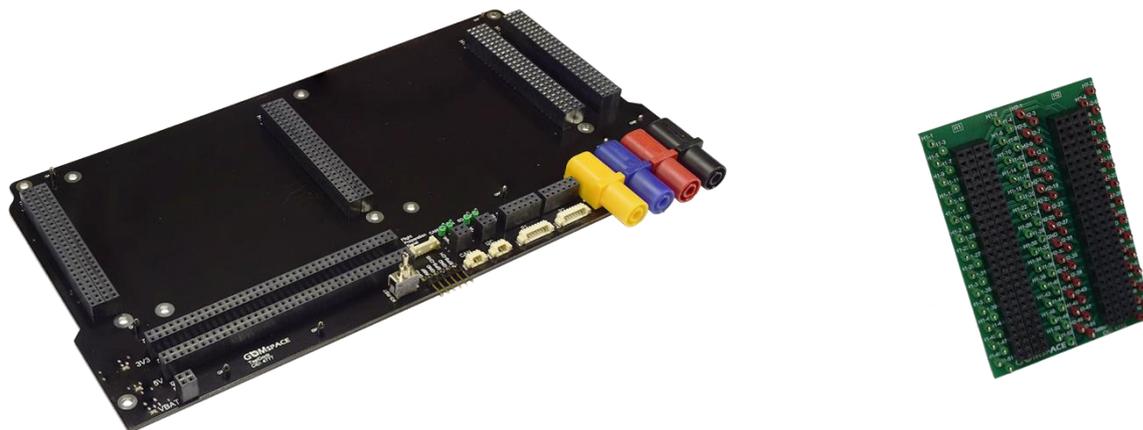
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2 Overview

The NanoUtil TestDock is a laboratory test bed for nano-satellite hardware and software.

Hardware can easily be assembled and disassembled on top of the TestDock. Pins and connectors along the edges provide easy access to all parts of the hardware. Jumpers are used for various hardware choices. The TestDock will accommodate testing with and without EPS on board.

If one TestDock is not enough, an Extension board is provided to smoothly connect to another TestDock. The Extension board also provides measurements points for all the points in the stack connector.



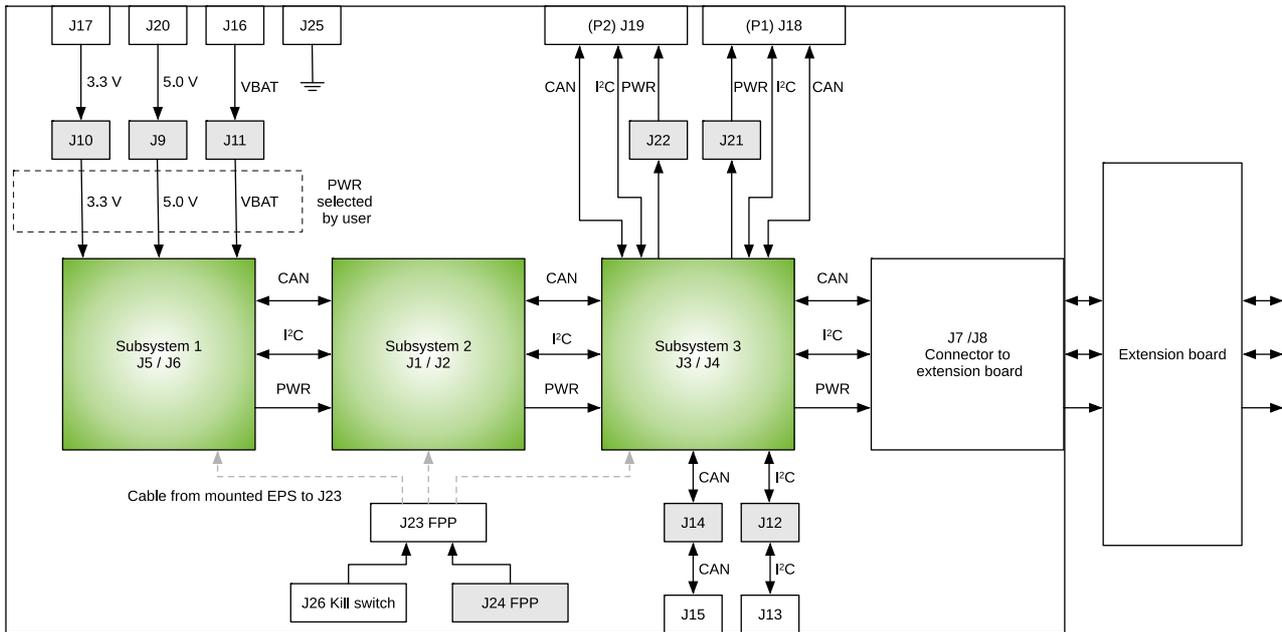
The TestDock can be used for hardware and software testing or for training purposes.

2.1 Highlighted Features

- Easy integration with other GomSpace products
- Easy assembling/disassembling of the subsystems on it due to low-insertion force of the connectors mounted on the board
- To prevent shortage between pins, female connector with male jumpers are used
- Support three subsystems per board
- Support two external payload via connector
- Support two different modes of operation.
 1. Powering up the satellite via EPS module (NanoPower P31u or NanoPower P60), using flight preparation, kill switch and battery charge/status.
 2. Powering up the satellite via external power cables, using banana plugs and jumpers.
- Possible to extend the Main board through an Extension board with as many Main boards as required
- Using Extension board for easy accessibility to all the pins on the stack connector for test purposes via test points.
- Designed for easy accessibility of bottom side of one of the boards
- Kill/Reset Switch
- CAN and I²C Interface
- Test points for GND, CAN and I²C
- PCB material: FR4
- IPC-A-610 Acceptability of Electronic Assemblies

2.2 Block Diagram

Below is shown a block diagram displaying the power and data routes.

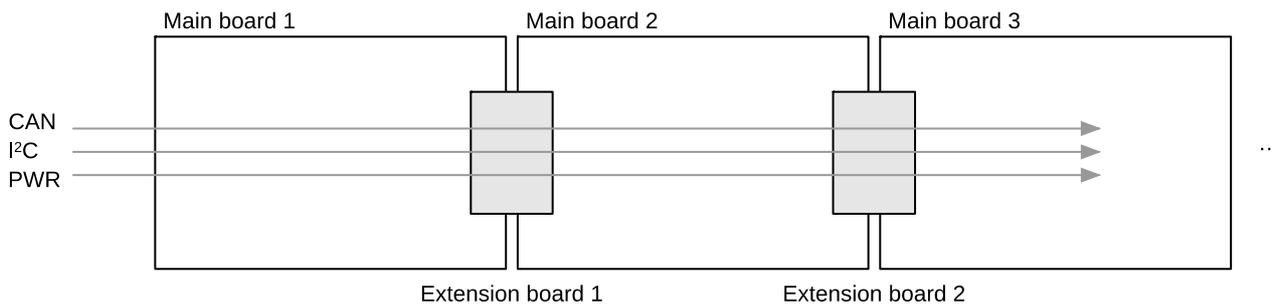


The grey boxes are jumper choices. See chapter 3.

An EPS can be mounted on any subsystem and connected by cable to the J23 FPP. Subsystem 3 is next to the J23 connector.

2.3 Extending the TestDock

With the TestDock comes an Extension board used to connect one TestDock to another TestDock. All power supply and communication lines can run into one TestDock and through to the next ones. An unlimited number of TestDocks can be connected.



On each Extension board there are test point for each stack channel.

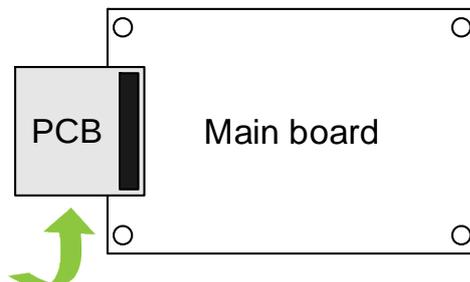
2.3.1 Voltage Drop

A limiting factor on each Main board is a voltage drop, which is measured to be 0.3 V per 1 A load from the front plugs to the last connector (J7/J8). In the block diagram in chapter 2.2 the path through the Subsystems is shown. So modules that are voltage specific depended have to be places with this in mind.

If using more than one main board, applying power independently to each board will help to avoid a large power drop.

2.4 Mounted PCB Bottom Access

By mounting a PCB on the J5/J6 location there will be easy access to that PCB bottom connectors.



2.5 Modes of Operation

There are two options to power on your satellite sitting on the TestDock, one with an EPS and one with an external power supply. Below is described the two options.

1. The first operational mode is designed to have power supply (EPS, P31u or P60) on board.

For this mode J23, J24 (FPP) and J26 (Kill switch) connectors are implemented to be able to switch on and off the power together with charging and checking the status of the batteries. To use all the functions, use the provided harnesses to connect J23 PicoBlade connector to its equivalent connector on the P31u or P60 module. This mode of operation is depicted in the image in chapter 10 with P31u on board (white cable).

The TestDock comes with two harnesses; one with PicoBlade-PicoBlade for the NanoPower P31u and a PicoBlade-PicoLock for the NanoPower P60.



Note: The banana connectors (J16, J17, J20 and J25) and jumpers for the power headers (J9, J10 and J11) should not be used/connected at the same time as an EPS on board to avoid damaging the EPS.

2. The second mode of operation is designed to be able to power on the satellite modules without having an EPS on board.

For this mode of operation, the banana connectors (J16, J17, J20 and J25) and power headers (J9, J10 and J11) are used. Connectors J23, J24 (FPP) and J26 (Kill switch) connectors cannot be used.

Most of the stack pins can supply power through placing jumpers in J9, J10 and J11. See chapter **Error! Reference source not found.** and 3.1.3. There are specific pins allocated to only 3.3 V and 5 V on GS products, where can be powered on by placing jumpers in J9, J10 on the pin called "Perm."

3.1.3 J10 – 3.3 V Power Header

SSQ-137-01-G-D

By applying a 2.54 mm male jumper a stack connector channel is supplied with 3.3 V. The following channels can be used: H1- 4-6, 10, 12, 14, 35-40, 47-52 and H2- 1-6, 9-14, 27/28, 35, 37, 39, 47, 49, 51. Channels are clearly written on the PCB. H2-27 and H2-28 are the channels used for permanent connection to 3.3V on GomSpace products and the first pin allocated to these connections by written term “perm.” On the PCB.

3.1.4 J11 – VBAT Power Header

SSQ-102-01-G-D

By applying a 2.54 mm male jumper a stack connector channel is supplied with VBAT, which can be from 8 to 34 V. Channels are clearly written on the PCB.

Pin	Description
1-2	J16 VBAT to H2-45
3-4	J16 VBAT to H2-46

Use a 2.54 mm male jumper.

3.1.5 J12 – I²C Header

SSQ-102-01-G-D

Pin	Description	Pin	Description
1	SCL pull up	2	SCL1
3	SDA pull up	4	SDA1

Use a 2.54 mm male jumper.

3.1.6 J13 – I²C Connector

PicoBlade. Right angle. Molex 53261-0371

Pin	Description
1	SDA
2	SCL
3	GND

3.1.7 J14 – CAN Header

SSQ-102-01-G-D

Pin	Description	Pin	Description
1	CANH termination channel	2	CANH1
3	CANL termination channel	4	CANL1

Use a 2.54 mm male jumper.

3.1.8 J15 – CAN Connector

PicoBlade. Right angle. Molex 53261-0371

Pin	Description
1	CANL1
2	CANH1
3	GND

3.1.9 J16 – VBAT (red)

Connect VBAT here. It can be between 8 and 34 V.

3.1.10 J17 - 3.3 V (yellow)

Connect 3.3 V here.

3.1.11 J20 – 5.0 V (blue)

Connect 5.0 V here.

3.1.12 J21 – P1 Payload Voltage Header

By applying a 2.54 mm male jumper a pin header with voltage is chosen. The following channels can be used: H1-47 to H1-52.

3.1.13 J22 – P2 Payload Voltage Header

By applying a 2.54 mm male jumper a pin header with voltage is chosen. The following channels can be used: H2-47 to H2-52.

3.1.14 J23 – Flight Preparation Panel pins to connect to an EPS

PicoBlade Straight. Molex 53398-0671.

Pin	Description
1	GND
2	RBF
3	KS1
4	KS_RST
5	EPS-CHARGE-STATE
6	EPS-CHARGE

Use 2.54 mm male jumpers.

RBF - Remove Before Flight

The RBF is connected to the EPS RBF and by shorting it to ground ensures that the satellite cannot be switch on.

KS1 - Kill Switch

There are two kill switch pins. By shorting Kill Switch 1 to ground the satellite will turn on. By shorting Kill Switch Reset it will turn off.

Battery Voltage

The battery voltage can be measured through the EPS_CHARGE_STATE pin.

Charge

The satellite can be charged through the EPS_CHARGE.

3.1.15 J24 – Flight Preparation Panel Pins

2.54 mm Header

Pin	Description
1	GND
2	RBF
3	GND
4	EPS-CHS
5	GND
6	EPS-CH

Use 2.54 mm female jumpers.

RBF - Remove Before Flight

The RBF is connected to the EPS RBF and by shorting it to ground ensures that the satellite cannot be switched on.

Battery Voltage

The battery voltage can be measured through the EPS-CHS pin.

Charge

The satellite can be charged through the EPS-CH.

3.1.16 J25 – GND (black)

Connect ground here.

3.1.17 J26 – Kill Switch

If an EPS is mounted and connected through J23, a toggle Kill Switch can be used to turn on and off the satellite.

3.1.18 P1 (J18) – External Payload Connector 1

PicoBlade. Right angle. Molex 53261-0871

Pin	Description
1	H2-46
2	H2-45
3	to J21 choice
4	SDA1
5	SCL1
6	CANL1
7	CANH1
8	GND

3.1.19 P2 (J19) – External Payload Connector 2

PicoBlade. Right angle. Molex 53261-0871

Pin	Description
1	H2-46
2	H2-45
3	to J22 choice
4	SDA1
5	SCL1
6	CANL1
7	CANH1
8	GND

3.2 Connector Location for Extension Board

3.2.1 J1, J3 – H1 Stack Connector

Same as for Mainboard stack connector H1. See chapter 3.1.1.

3.2.2 J2, J4 – H2 Stack Connector

Same as for Mainboard stack connector H2. See chapter 3.1.1.

4 Data Interface

The TestDock uses the CubeSat Space Protocol (CSP) to transfer data to and from PCB mounted CSP nodes on-board the main system bus. CSP is a routed network protocol that can be used to transmit data packets between individual subsystems on the satellite bus. For more information about CSP please read the documentation on libcsp.org and on Wikipedia: http://en.wikipedia.org/wiki/Cubesat_Space_Protocol

The CSP network layer protocol spans multiple data-link layer protocols, such as CAN-bus and I²C.

4.1 CAN-BUS / CFP Protocol

The standard method to communicate through the TestDock is the CAN-bus. The CAN interface on the TestDock uses the CSP CAN Fragmentation Protocol (CFP). CFP is a simple method to make CSP packets of up to 256 bytes, span multiple CAN messages of up to 8 bytes each. The easiest way to implement CSP/CFP over CAN is to download the CSP source code from <http://libcsp.org> and compile the CFP code directly into your own embedded system.

The CAN-bus is connected to each individual module.

4.2 I²C Communication Protocol

It is possible to communicate through the TestDock over multi-master I²C. Please note that since the CSP router sends out an I²C message automatically when data is ready for a subsystem residing on the I²C bus. The bus needs to be operated in I²C multi-master mode.

The TestDock uses the same I²C address as the CSP network address per default. This means that if a message is sent from the radio link, to a network node called 1, the TestDock will route this message to the I²C interface with the I²C destination address 1.

The I²C bus is connected to each individual module in the TestDock system.

5 Absolute Maximum Ratings

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

For mounted PCB's check the individual products datasheet.

Symbol	Description	Min.	Max.	Unit
V	Supply Voltage per pin		60	V
I	Supply Current per pin		2.0	A
T	Temperature	-40	100	°C

6 Electrical Characteristics

Recommended 1 A per power channel selection.

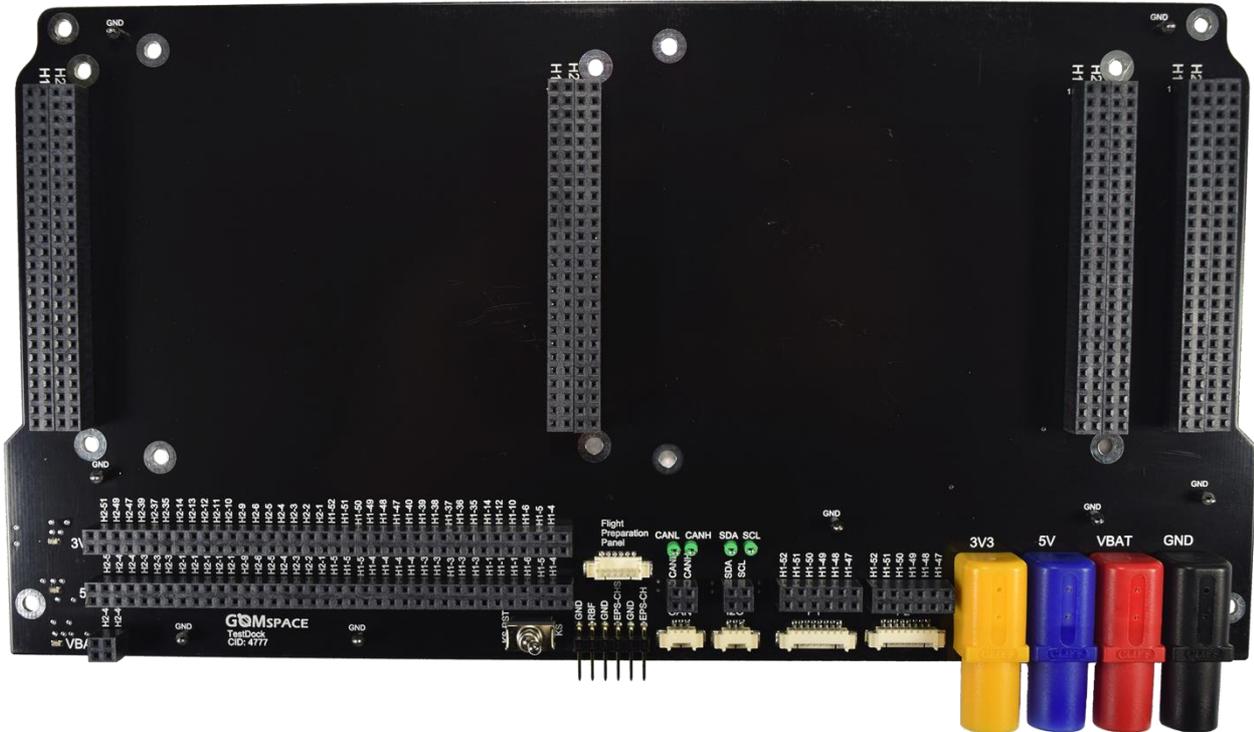
Symbol	Description	Min.	Typ.	Max.	Unit
3.3 VCC	Supply voltage, depending on jumper		3.3		V
5.0 VCC	Supply voltage, depending on jumper		5.0		V
VBAT VCC	Battery voltage	7	8	34	V
I	Supply current per power selection	0.1		2.0	A
V _{drop}	Voltage drop from voltage plug to Connector J7 at 1 A. See chap 2.3.1		0.3		V
P _{max_3.3}	Max power consumption for 3.3 V input		66		W
P _{max_5}	Max power consumption for 5.0 V input		100		W
P _{max_BAT}	Max power consumption for VBAT input		160		W

7 Physical Characteristics

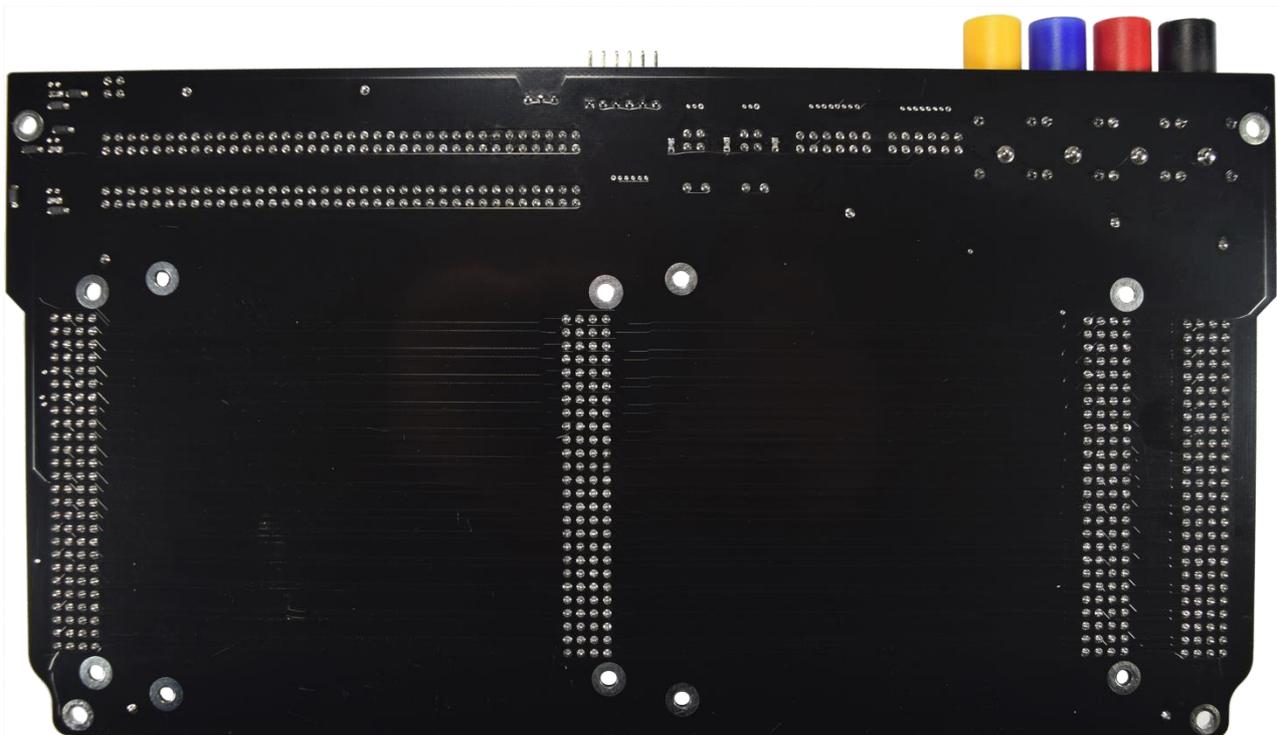
Description	Value	Unit
Mass	220	g
Size	129.1 x 247.3 x 11.2	mm

8 Physical Layout

8.1 Top



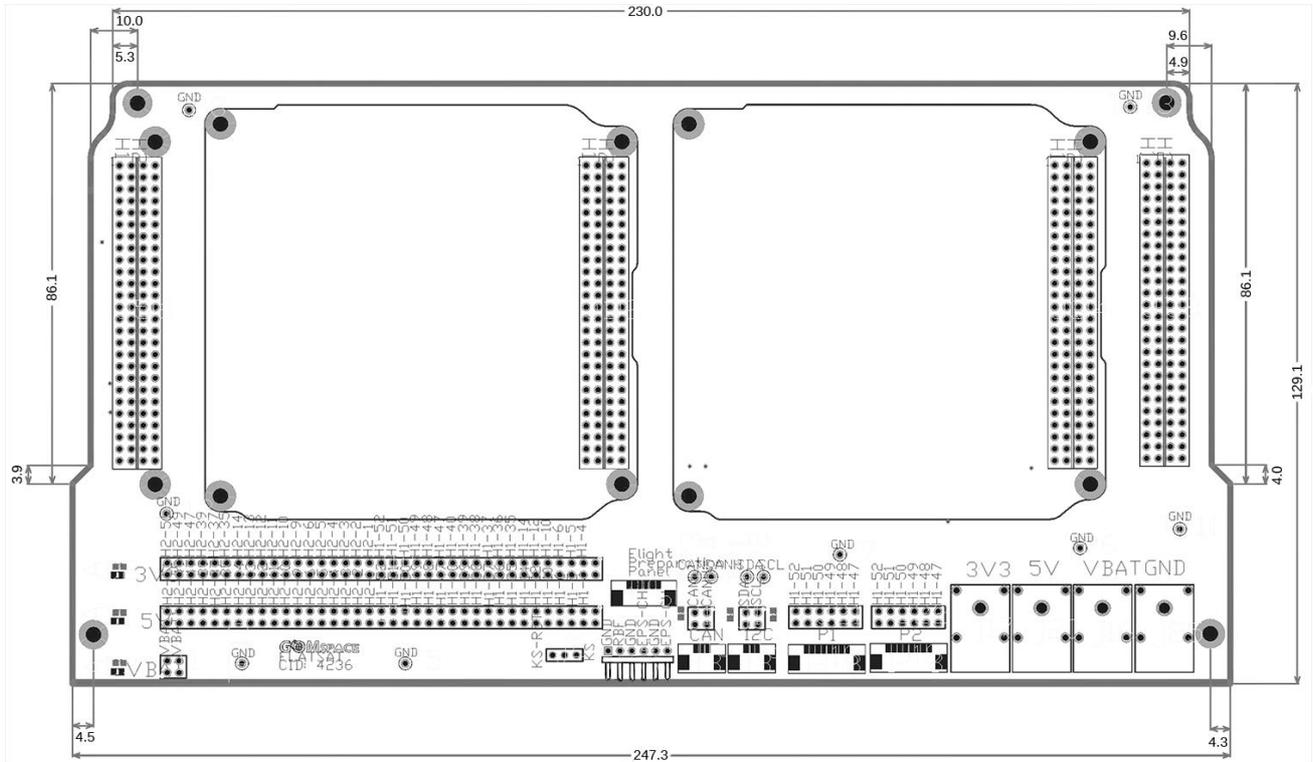
8.2 Bottom



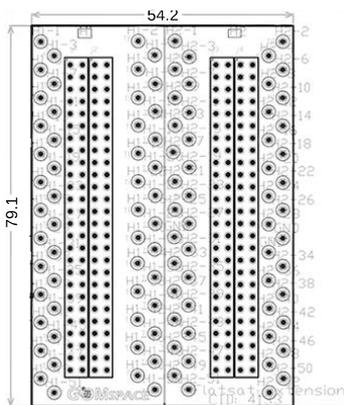
9 Mechanical Drawing

All dimension in mm.

9.1 Main Board

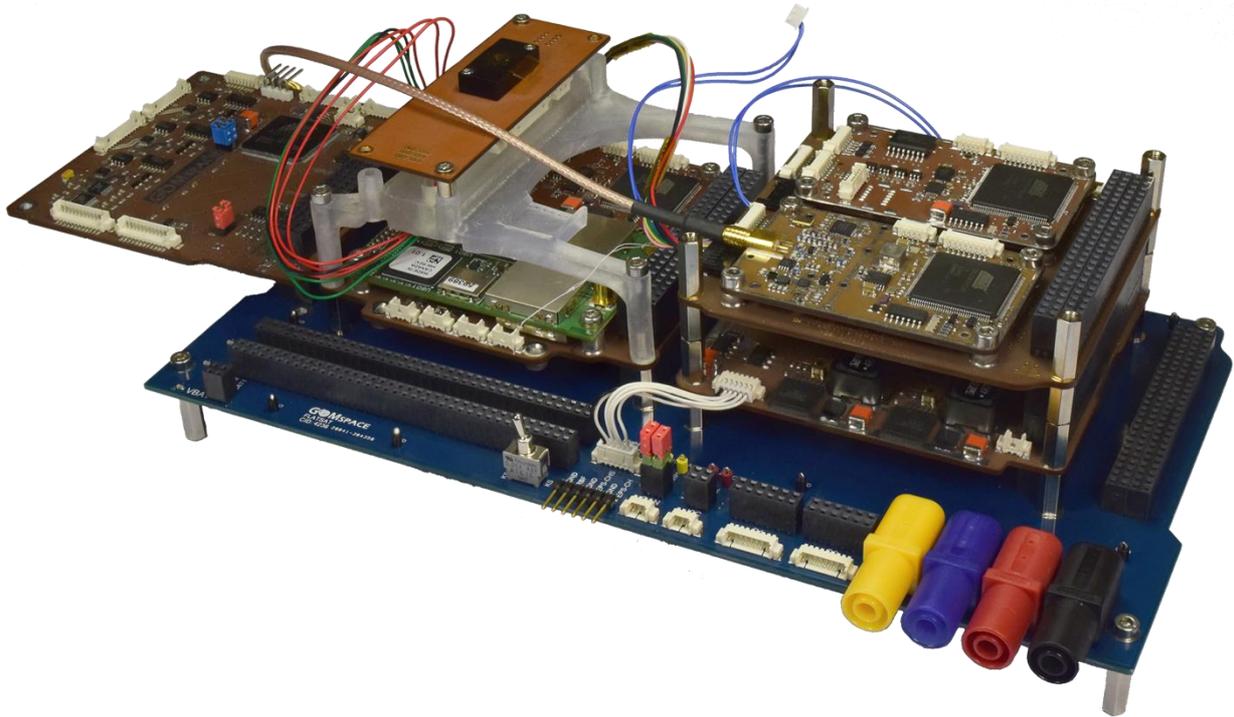


9.2 Extension Board



10 Example

Below is an example of a setup used in GomSpace laboratory.



On the TestDock is mounted (from left to right):

- NanoMind A712D
- NanoDock ADCS with NanoMind A3200 and a GPS
- Interstage GSSB with a NanoSense Fine Sun Sensor on top a 3D printed mount
- NanoPower P31u with a white harness connected to the TestDock
- NanoDock DMC3 with NanoMind A3200 and a NanoCom AX100 (without shield)