



Your easy way to space.

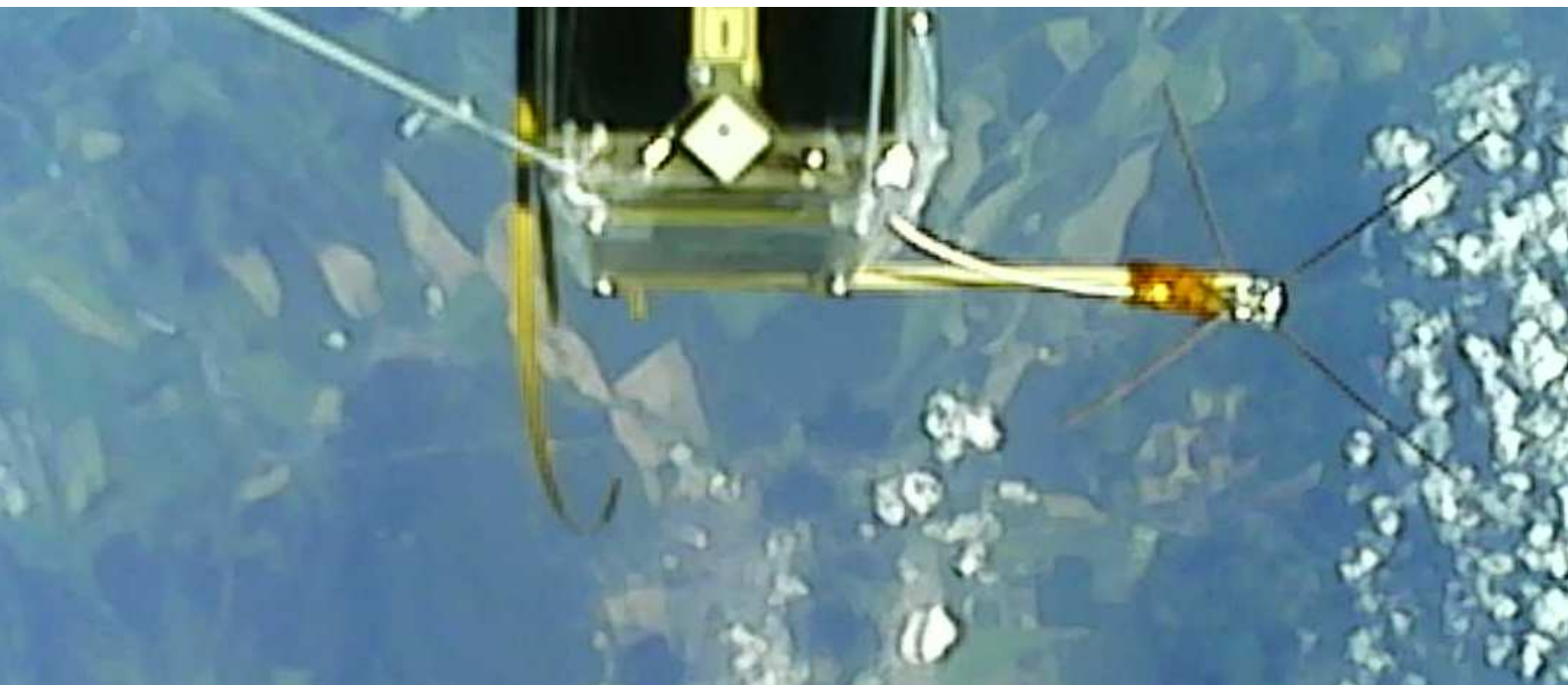


Space-Friendly™
Active GPS-L1 Patch Antenna
nanoPATCH-L1

Product Datasheet

Rev. A/2021

Intended to cover all **CubeSat Project** needs.



PRODUCT DATASHEET

nanoPATCH-L1

FEATURES – Flight Model

- Up to 50 dBc-Hz SNR on ground for close-to-zenith satellites (mounted on chassis)
- Power consumption
20 mA (typical), 3.3 V @ 25°C
- 2.7 to 5.5V power supply voltage
- Groundplane insulated from chassis
- Patch antenna element size 35×35 mm
- Mass 29 grams
- Dimensions
50×50×(12.5) mm incl. shielding (MCX-F)
+5 mm top, -6 mm bottom
- Wide temperature range
-40°C to +85°C
- Connector
MCX-F (both signal + power)
straight or right-angle on request
- FR-4 space-grade 4-layers PCB
- Chipset TRL-9
- SAW filter
- Patch epoxy-fixed (Ultra Low Outgassing)
- Double-sided Kapton® fix below the patch
- 60/40 Tin-Lead used (prevent tin whiskers)



Fig. 1 Nano GPS-L1 Patch Antenna - Flight Model.

FEATURES – Engineering Model

- Model intended for satellite development
- Up to 50 dBc-Hz SNR on ground for close-to-zenith satellites (mounted on chassis)
- Power consumption
20 mA (typical), 3.3 V @ 25°C
- 2.7 to 5.5V power supply voltage
- Groundplane insulated from structure
- Patch antenna element 35×35 mm
- Mass 29 grams
- Dimensions
50×50×(12.5) mm incl. shielding
+5 mm top, -6 mm bottom
- Wide temperature range
-40°C to +85°C
- Connector
MCX-F (both Signal + Power)
straight or right-angle on request
- FR-4 Space-grade 4-layers PCB
- SAW filter
- Patch epoxy-fixed (Ultra Low Outgassing)
- RED Remove Before Flight coating finish
- RoHS (for lab/engineering purposes only)

GENERAL DESCRIPTION

The nanoPATCH-L1 is a subminiature version of the Space-Friendly™ GPS-L1 CubeSat Active Antenna module specially designed to provide strong signal for GPS satellites reception in space. Integrated Low Noise Amplifier as well as SAW filter are matched together with 35×35 mm Patch antenna and minimized ground plane. Outer dimensions of 50×50 mm represent a great compromise of the size and minimum viable groundplane area. The module shall be embedded into the satellite body close to conductive parts such as metallic sidewalls or PCB groundplanes, to extend the existing antenna groundplane.

Easy-to-use MCX signal and power interface provides compact solution for all kind of projects where strong GPS signal reception with enough margins is required.

Product is manufactured in two grades to satisfy both Engineering and Flight requirements. Modules (/EM, /FM) are electrically identical, however their chemical and mechanical properties allows it to be used in laboratory or space, respectively.

The fully functional Engineering Model is finished by red coating with Remove Before Flight labelling.

APPLICATIONS

- Crowded CubeSat sidewall panels, SmallSats

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DIMENSIONS

The four-layer PCB with outer dimensions of 50×50 mm contains four mounting holes for M2.5 conical head screws. Metalized vias below screw heads are electrically insulated from the inner groundplane potential to prevent grounding loops. Conductive mounting holes are expected to be mounted onto the metallic part of the satellite chassis, thus interconnected together to chassis potential. Ground the mounting system to prevent arcing. In nanoPATCH-L1 product, the grounding is provided by the CubeSat structure. The nanoPATCH-L1 antenna is equipped with the MCX-Female straight or right angle RF connector.

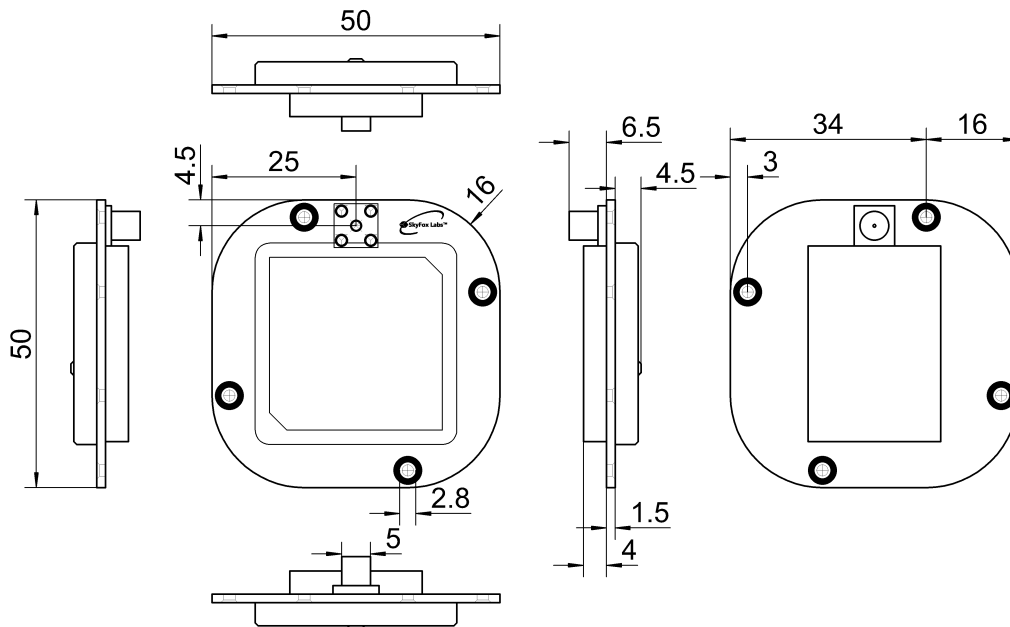


Fig. 2 nanoPATCH-L1 Dimensions drawing, standard MCX straight configuration depicted.

Tab.: 1 The nanoPATCH-L1 MCX-F Connector Description.

Pin	Name	I/O, Power or Do Not Connect	Description
Shield	GND	Power	System ground. Must be connected to receiver ground potential. This signal is internally connected to the inner ground plane and patch antenna tap.
Center	VDD	Power	Positive system power input. Positive power supply input and RF signal output.

ABSOLUTE MAXIMUM RATINGS

V_{IN} to GND-0.3 V to (≤ 7 V max) Operating Temperature Range:.....-40°C to +85°C
 DC Input Current: I_I at $V_I < 0$ V or $V_I > V_{DD}$ 30 mA Storage Temperature Range:.....-40°C to +85°C

NOTE: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under specification conditions is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability. Voltage values are with respect to system ground terminal. The manufacturer reserves all rights to decline the responsibility for any damage caused by improper using of the nanoPATCH-L1 product.



CAUTION: *The antenna tap is DC-shortened with the ground plane and the MCX connector shielding potential. Always disconnect the power before start to change the antenna electrical/mechanical setup. Short circuit of the DC bias feeding or its overloading over the Absolute maximum ratings may affect device reliability, damage the power source device and void the product warranty. Conductive mounting holes are disconnected electrically from the antenna groundplane potential. Connect all screws in conductive manner to prevent arcing in space caused by radiation. The nanoPATCH-L1 module uses the satellite conductive structure itself to connect screws and mounting pads electrically together.*

APPLICATION NOTES & RECOMMENDATIONS

EMC CONSIDERATIONS

As the size of the small satellites imply the high level of integration of different electronic devices (switch mode power supplies, high speed digital electronics, pulse-width modulated electromagnetic actuators, etc.) into a limited satellite structure volume containing potential sources of disturbing signals, the electromagnetic susceptibility and compatibility is critical for implementation of any subsystems sensitive to electromagnetic radiation.

Proper ground planes and PCB design rules minimizing the radiated and conducted emissions shall be applied within the whole small satellite structure, including custom payloads, both conventional (Communication and Data Handling, Power Supply and Power Distribution, Onboard Computer, Attitude Determination and Control) and third party electronic subsystems. The small satellite electronics should be properly designed to not disturb the GNSS receiver input with harmonic frequencies falling to the GPS-L1 frequency band. The C/N₀ parameter provided in GPS receiver output sentences can be exploited as a diagnostic tool if the EMC issues affect the signal reception capability. Observe the C/N₀ levels and switch On/Off each electronic subsystem to identify the potential source of the disturbance, if needed.

ANTENNA LOCATION

Special care should be taken to the interference with the small satellite communication subsystem, as an active electronic device radiating the high power electromagnetic waves. The manufacturer recommends installing the GPS antenna as far from the communication antennas as possible.

Be sure to test the target small satellite subsystems against affecting the performance of the GPS receiver under all satellite operation conditions. Keep in mind the receiver may be sensitive to harmonics of the downlink (transmitter) frequency (i.e. 1575 MHz /9, /8, /7, /6, /5 /4, /3, /2, etc.).

The nanoPATCH-L1 signal reception has been successfully tested onboard the 1U CubeSat with omnidirectional antenna and FM modulated transmitter with 500 mW_{EIRP} output power at the UHF band (435 MHz) with no functional degradation of the receiver functionality. However, special care have to be taken during integration campaign to check the GPS system performance prior flight. Recommended accommodation aboard the 3U CubeSat structure is depicted in Fig. 3. Panel-centered mount is preferred to maintain the antenna radiation pattern symmetrical and in-band frequency tuned. Metallic panels accommodated in the same mounting plane may improve the antenna radiation efficiency. Always test the SNR readings performance before flight.

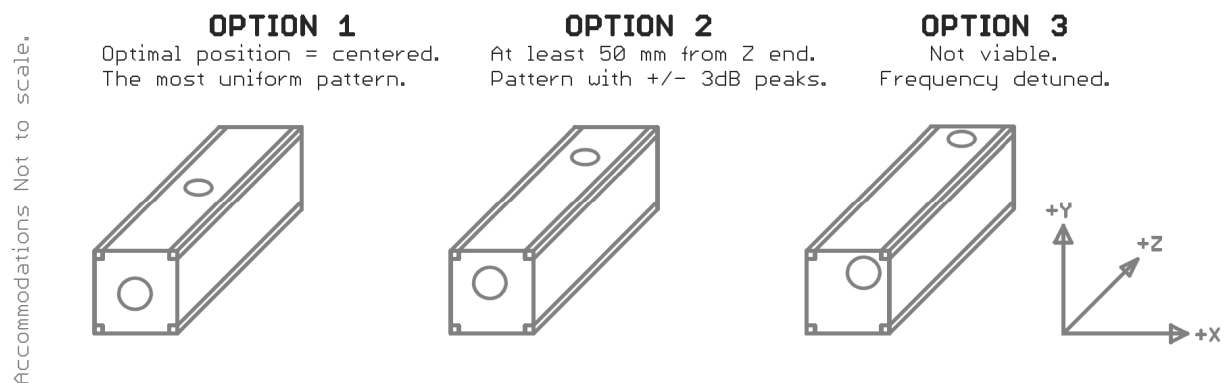


Fig. 3 Recommended Accommodation, the 3U CubeSat structure example mounts.

ENGINEERING MODEL

To test the GNSS system aboard the satellite prototype or engineering / development / qualification model, the Engineering Model grade with identical electrical and RF properties is available at reduced cost. The red finish with Remove Before Flight label reminds the user to replace the unit with the Flight Model grade unit suitable for the environment of space. Photo of the nanoPATCH-L1/EM unit is depicted in Fig. 4.

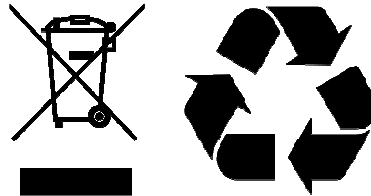


Fig. 4 Engineering Model of the nanoPATCH-L1 unit with red Remove Before Flight finish.

RECYCLING

Below mentioned logo given on the goods, its packaging or inside this datasheet or other related documentation means that used electrical or electronic devices or products should not be disposed with household waste. To ensure proper disposal of the product hand it to designated collection points, where they will be accepted free of charge.

Eco disposal of SkyFox Labs s.r.o. products is maintained by collective system RETELA in Czech Republic. Please recycle product and its packaging in proper way according to valid laws in country of disposal.



The nanoPATCH-L1 / **Engineering Model** is RoHS compliant.



The nanoPATCH-L1 / **Flight Model** is **NOT RoHS** compliant, contains leaded solder.



PRODUCT SAFETY

According to use of the product in line with this Quick Start Guide, the product is safe under normal use. The CE mark (Conformité Européenne) has been issued on this family of products. Related EC Declaration of Conformity is issued with each supply and is available online at manufacturer's website <http://www.skyfoxlabs.com>.



EXPORT CONTROL

Since the country of origin of this product (the Czech Republic) is a valid participating member of the Wassenaar Agreement (<http://www.wassenaar.org>) and agrees with the Missile Technology Control Regime (<http://www.mtcr.info>) and the **nanoPATCH-L1/FM and EM (Space-grade Flight Model, Engineering Model)** functional parameters are considered as a regulated goods, the export is controlled and needs special Export License approved by the Ministry of Industry and Trade of the Czech Republic (the local control entity). The request for the Export License has to be submitted by the manufacturer to the local control entity, based on the binding order, including all the information as: the characteristics of goods, target country (territory), detailed end-user and target application information, etc.

Manufacturer is fully prepared to support the customer with obtaining the valid Export License (if approved by the local control entity). The entity declares the typical Export License assessing period from 30 to 60 days since the Export License Application Form delivery, implicating the respective product delivery date extension.

DISCLAIMER

THIS DEVICE HAS BEEN DEVELOPED WITH IDEA TO SUPPORT THE SMALL SATELLITE COMMUNITY EFFORT IN SPACE RELATED RESEARCH, ENGINEERING AND PEACEFUL CONQUEST OF SPACE. THE MANUFACTURER RESERVES ALL RIGHTS TO DECLINE THE ORDER OF THIS PRODUCT OR PROVIDE ANY FURTHER INFORMATION TO END USERS ASSUMING TO VIOLATE ANY LOCAL OR GLOBAL NATIONAL LAWS BY THIS DEVICE OR INFORMATION MENTIONED IN THIS AND RELATED DOCUMENTS. MANUFACTURER DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF THIS PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. MANUFACTURER RESERVES THE RIGHT TO MAKE CHANGES OF THIS PRODUCT DATASHEET WITHOUT FURTHER NOTICE.



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