



Your easy way to space.

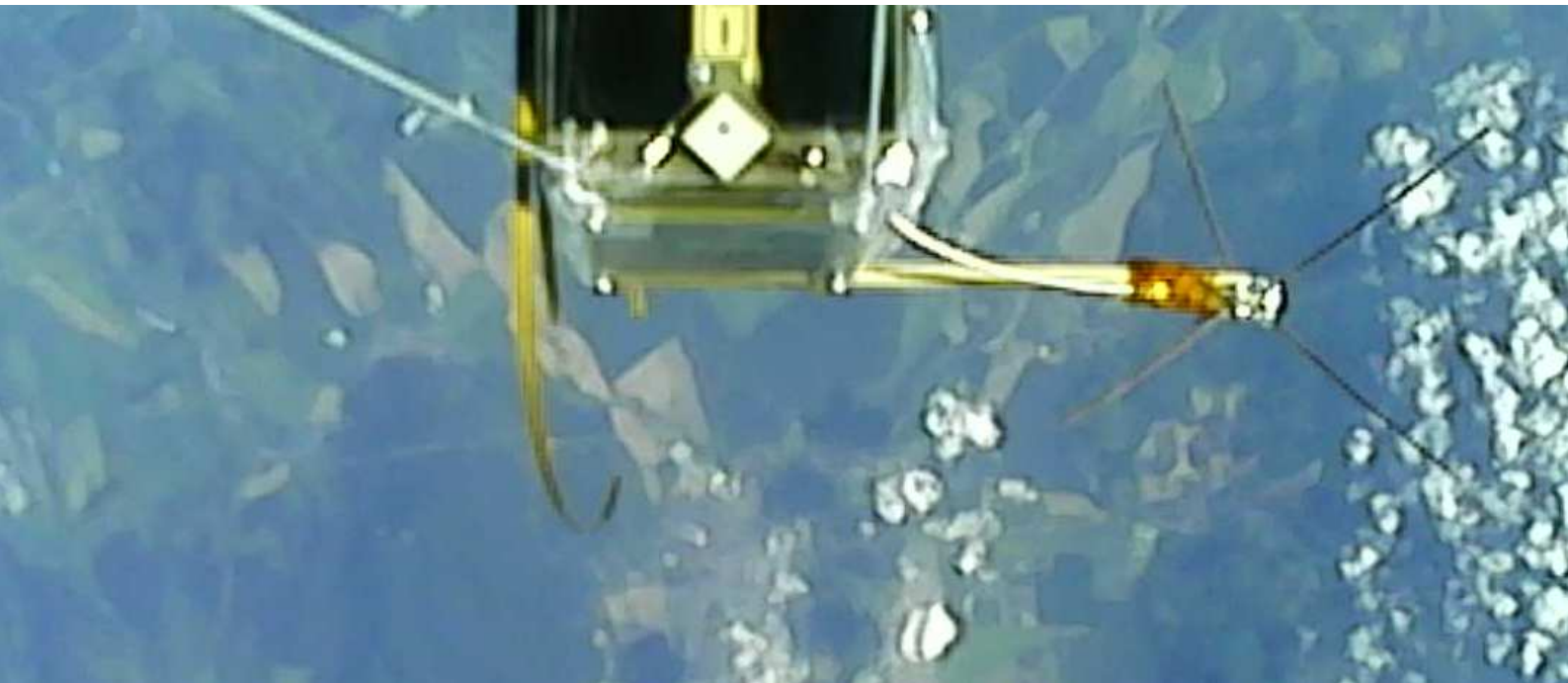


Space-Friendly™  
**Active GPS+GALILEO Patch Antenna**  
**piPATCH-L1E1**

**Product Datasheet**

Rev. B/2024

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



## PRODUCT DATASHEET

## piPATCH-L1E1

### FEATURES – Flight Model

- Stable 50+ dBc-Hz SNR on ground for close-to-zenith satellites
- Power consumption  
20 mA (typical), 3.3 V @ 25°C
- 2.7 to 5.5V power supply
- Large groundplane insulated from structure
- Mass 50 grams
- Dimensions fitting CubeSat Structure Z+/Z-  
98×98×13 mm incl. EMI shielding  
+5 mm, -6.5 mm in Z-axis
- Wide temperature range  
-40°C to +85°C
- Connector  
MCX-F (both Signal + Power)  
straight (standard), right-angle (on request)
- FR-4, 4-layers PCB
- SAW Filtering (GPS L1, GALILEO E1)
- Patch Epoxy-fixed (3M Ultra Low Outgassing)
- Double-sided Kapton® fix below Patch
- 60/40 Tin-Lead used (to prevent tin whiskers)
- Technology Readiness Level - 9, (SSO, 590 km)

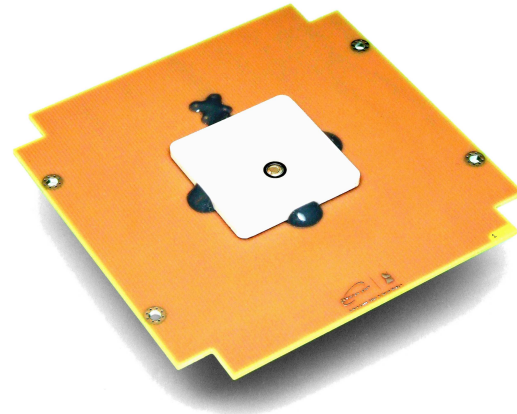


Fig. 1 GPS + GALILEO piPATCH-L1E1 Antenna Module, Flight Model.

### FEATURES – Engineering Model

- Stable 50+ dBc-Hz SNR on ground for close-to-zenith Satellites
- Power consumption  
20 mA (typical), 3.3 V @ 25°C
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- Connector  
MCX-F (both Signal + Power)  
straight (standard), right-angle (on request)
- FR-4, 4-layers PCB
- SAW Filtering (GPS L1, GALILEO E1)
- Patch Epoxy-fixed (3M Ultra Low Outgassing)
- Standard Green PCB Conformal coating used
- RoHS Tin used (for Engineering Model only)

### APPLICATIONS

- CubeSats
- Limited Power Budget Space Projects

### GENERAL DESCRIPTION

The piPATCH-L1E1 is the industry's first Space-Friendly™ GPS-L1 + GALILEO E1 CubeSat Active Antenna module specially designed to provide strong signal reception in space. Integrated Low Noise Amplifier as well as SAW filter are matched together with 35×35 mm Patch antenna on a large ground plane.

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

The module fits all known CubeSat structures with M2.5 mounting holes. Dimensional envelope fits perfectly with CubeSat Design Specifications rev. 13 (6.5 mm envelope).

Customized mounting hole placement or additional sensors/EEE parts are available on request.

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.

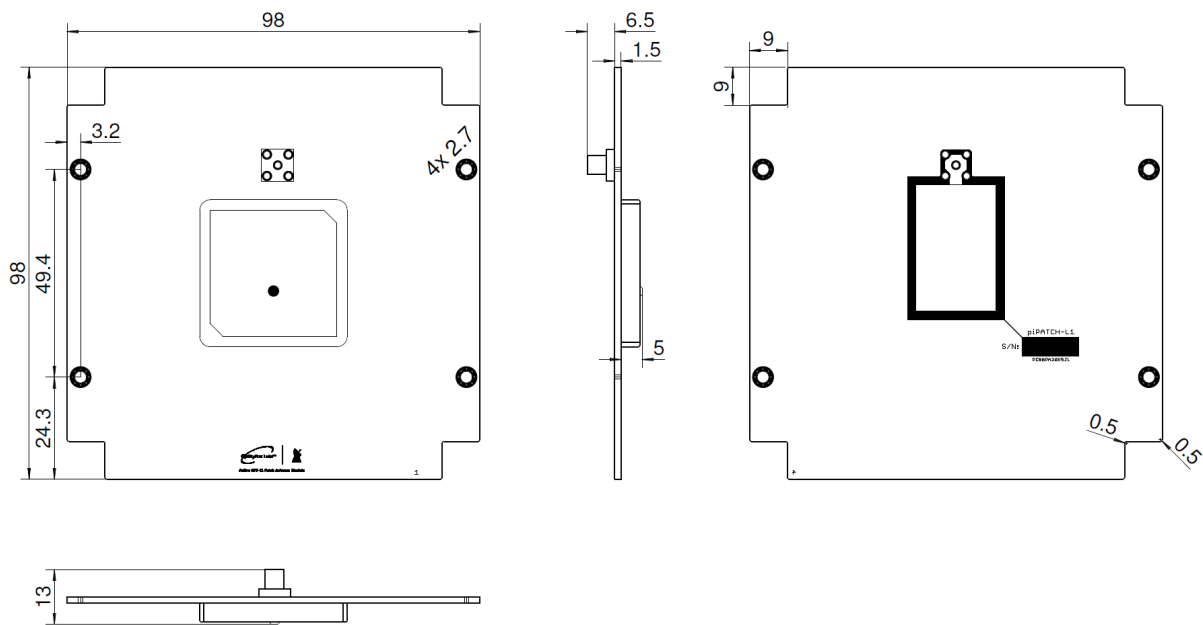
The fully functional Engineering Model is finished by red coating with Remove Before Flight labelling.

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**DIMENSIONS**

The four-layer PCB with outer dimensions of 98×98 mm contains four mounting holes for M2.5 cylindrical 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 piPATCH-L1E1 product, the grounding is provided by the CubeSat structure. The antenna is equipped with the female MCX-Female straight or right angle RF connector.



**Fig. 2 piPATCH-L1E1 Dimensions drawing, measures are in millimeters. Not to scale.**

**Tab.: 1 The piPATCH-L1E1 MCX-F Connector Description.**

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

**ABSOLUTE MAXIMUM RATINGS**

$V_{IN}$  to GND .....-0.3 V to ( $\leq 7$  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 piPATCH-L1E1 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 piPATCH-L1E1 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, 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 / GALILEO E1 frequency bands.

The  $C/N_0$  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  $C/N_0$  levels and switch On/Off each electronic subsystem to identify the potential source of the disturbance, if needed.

### ANTENNA LOCATION

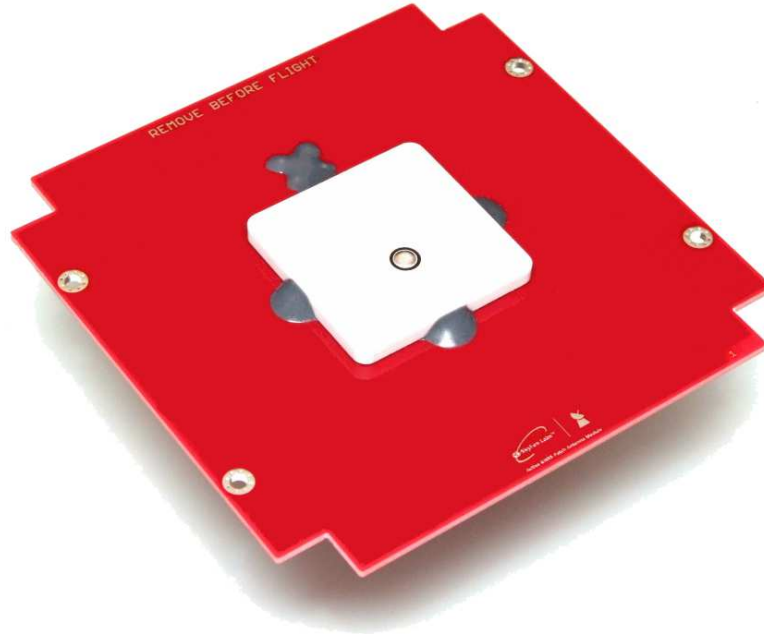
Special care shall be applied to the interference with the small satellite communication subsystem, as an active electronic device radiating the high power electromagnetic waves. The manufacturer recommends installing the GPS antenna as far from the (transmitting) communication antennas as possible.

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.). Spurious emissions of the uplink receiver (local oscillator radiating through the mixer to the receiving antenna) may also affect the antenna performance.

The piPATCH-L1E1 signal reception has been successfully tested onboard the 1U CubeSat with omnidirectional antenna and FM modulated transmitter with 500 mW<sub>EIRP</sub> output power at the UHF band (435 MHz) with no functional degradation of the receiver performance.

**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 piPATCH-L1E1/EM unit is depicted in Fig. 3.

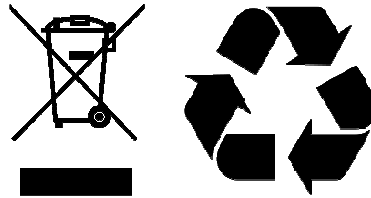


**Fig. 3 Engineering Model of the piPATCH-L1 unit with red Remove Before Flight finish.**

**RECYCLING**

Below mentioned logo given on the goods, its packaging or inside this Quick Start Guide 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 piPATCH-L1E1 / **Engineering Model** is RoHS compliant.



The piPATCH-L1E1 / **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 **piPATCH-L1E1/FM and EM (Space-grade Flight Model, Engineering Model)** functional parameters are considered as a regulated (Dual Use) 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.



**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. THE UNIT MUST NOT BE USED IN ANY SAFETY-CRITICAL APPLICATION, OR MILITARY-RELATED, OR BY ARMED FORCES, OR BY POLICE GUARDS, OR IN NUCLEAR FACILITIES, OR IN RELATION TO OIL AND GAS MINING, ON LAUNCHERS, MISSILES, TARGET DRONES, WEAPONS OF MASS DESTRUCTION, OR GOVERNMENTAL END USE OR END USER. SAFETY-CRITICAL SYSTEMS ARE THOSE SYSTEMS WHOSE FAILURE COULD RESULT IN LOSS OF LIFE, SIGNIFICANT PROPERTY DAMAGE OR DAMAGE TO THE ENVIRONMENT. THE LIST CONTAINS MOST IMPORTANT AREAS OF PROHIBITED USE AND IS NOT COMPLETE. FOR MORE DETAILS, PLEASE CONTACT FACTORY.



*Prague, Czech Republic*

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