SkyFox Labs™

Your easy way to space.

Space-Friendly™

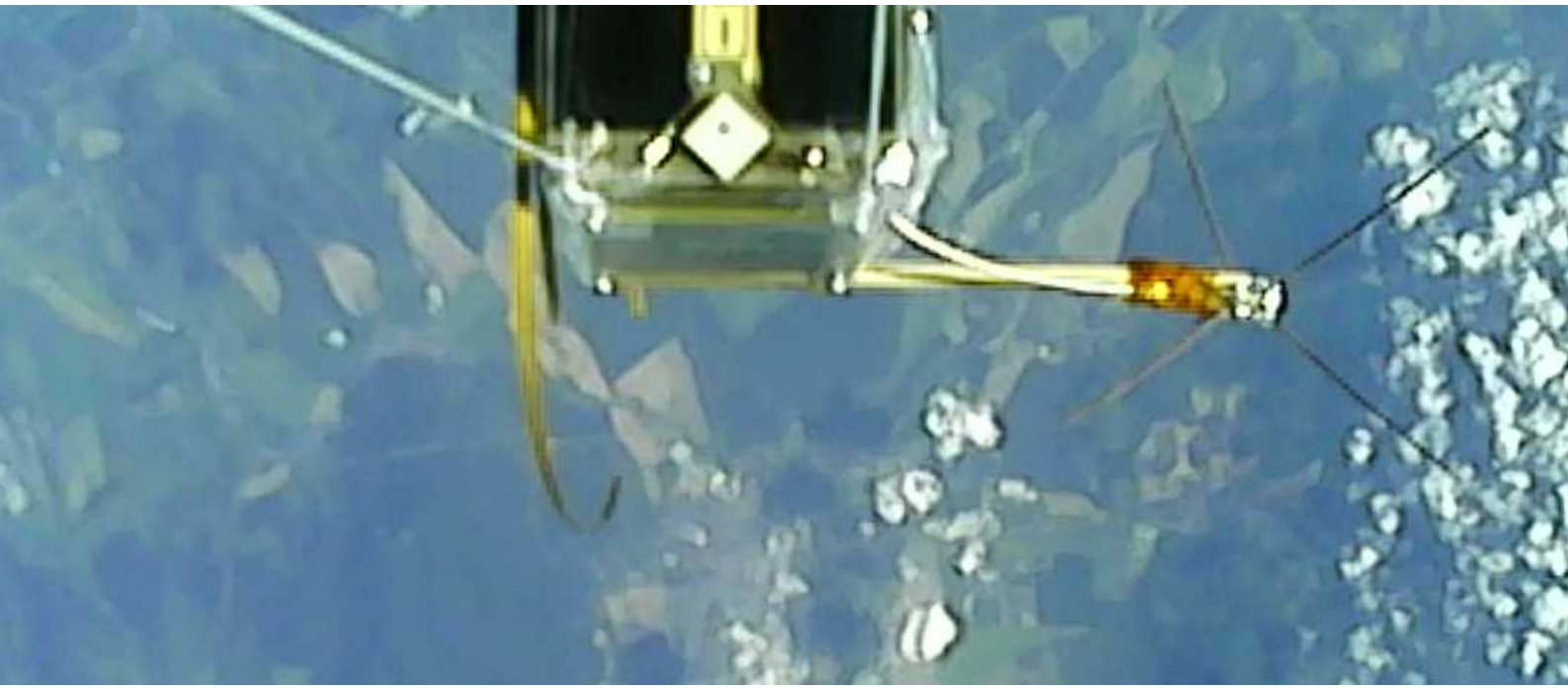
ZeroCore S-Band Patch Antennas

piPATCH-S-(DL/UL)

Product Datasheet

Rev. A/2025

Intended to cover all **High Speed Communication** needs.



Made in Czech Republic, a country with space heritage since 1978.

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PRODUCT DATA SHEET piPATCH-S-DL, piPATCH-S-UL

FEATURES – Flight Model

- ZeroCore Patch Antenna for S-Band operations
- RHCP (standard) or Linear Mode (on request)
- Circular Mode (RHCP) Gain (50 Ω):
  +4.7 dBd, 5.55 dBiC Gain (average band gain, front lobe)
- Linear Mode Gain (50 Ω):
  +7.8 dBd Gain (average band gain, front lobe)
- Gain Flatness over the whole band: ± 1 dB
- Excellent Axial Ratio (better than 1dB V-H, RHCP)
- Frequency Range:
  -DL (Downlink): 2200-2290 MHz
  -UL (Uplink): 2025-2110 MHz
- Power handling capability
  10 W CW @ 25°C, open space radiation
- Large groundplane insulated from Structure, AC-coupled to GND potential
- ESD Protection via DC shunt Plasma Discharger
- Mass:
  60 grams (± X/Y side mount)
  65 grams (± Z side mount)
- Dimensions:
  98×82.6×+6/-8 mm (± X/Y side mount)
  98×98×+6/-8 mm (± Z side mount)
- Wide temperature range
  -40˚C to +85˚C
- Connector
  MCX-F (standard), SMA-F (on request)
  Right-angle (standard), Straight (on request)
- FR-4 PCB mounting bracket, Radiator finish: gold
- 60/40 Tin-Lead used (prevent tin whiskers)

FEATURES – Engineering Model

- ZeroCore Patch Antenna for S-Band operations
- RHCP (standard) or Linear Mode (on request)
- RF and DC characteristics of the Flight Model
- Red Remove Before Flight finish
- Mechanical outline fitting the Flat Sat design and AIT/AIV activities requirements
- Not intended for spaceflight/vacuum environment
- Lead-Free Solder used
- Connector
  MCX-F (standard), SMA-F (on request)
  Right-angle (standard), Straight (on request)

APPLICATIONS

- CubeSats, Microsatellites orbital operations
- High Speed Data Communication Links
- S-Band links with high link budget requirements
- Fixed (No deployables) Communication Systems
- Groundstation Polarization Measurement Systems
- FlatSat Designs
- Anechoic Chambers Test Specimens

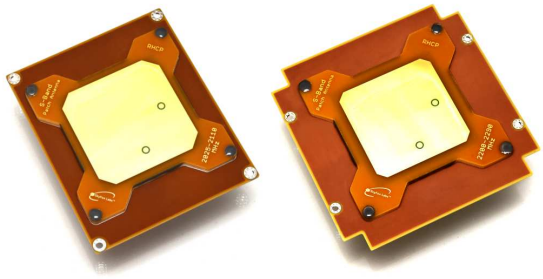

Fig. 1 piPATCH-S-DL/FM, piPATCH-S-UL/FM Patch Antennas, Flight Models, X/Y and Z mounts.

GENERAL DESCRIPTION

The piPATCH-S is the is the World's First Space-Friendly™ ZeroCore, a new generation extra low RF loss patch CubeSat antenna with radiating element optimitzed for the whole Uplink (-UL) or Downlink (-DL) S-frequency bands (~2 GHz) of operations with outstanding axial ratio and temperature stability. The antenna module is specially designed to provide improved link budgets and better signal integrity during operations for majority of communication systems performing reception and transmission to and from satellites in space. Two RF band versions in RHCP or Linear polarization are provided to cover uplink and downlink frequency needs. The antenna ground plane is DC-insulated from the mounting structure and AC-coupled to enhance the RF groundplane using the CubeSat or satellite structural rails.

Easy-to-use MCX or SMA-Female RF signal interface provides compact solution for all kind of projects where reliable signal reception or transmission with enough margins is required.

The module can be easily mounted to the satellite structure using four M3 flat head screws.

The used chemistry, patch antenna fixture, Sn/Pb tin-lead soledring compound (non-RoHS) and FR4 used for the Flight Model baseplate brings the best possible outgassing performance in vacuum environment of space.

The Engineering Model with red Remove Before Flight finish is available for satellite development, flatsat design and AIT/AIV activities.

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TABLE OF CONTENTS

ABSOLUTE MAXIMUM RATINGS

DC V_{IN} to GND ……..-0.3 V to (≤ 3 V max)
Chassis to GND Potential ……..+/- 50 V max
DC Input Current: I_I at $|V_I|$> 0 V .....60 mA
RF Power Continuous Wave (CW).....10W
Operating Temperature Range:……..-40°C to +85°C
Storage Temperature Range:……..-55°C to +100°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-S-(DL/UL) product.

CAUTION: *The antenna mounting holes are DC-insulated from the RF coaxial connector GND potential acting as a power source return wire in order to prevent the grounding loops between the antenna, receiver/transmitter, onboard power supply and satellite mounting wall (if conductive). Internal electronic circuits are capacitively AC-coupled to the antenna groundplane to improve the antenna RF performance. Keep the chassis grounding in mind when designing the satellite power system to prevent the charge build-up in case the chassis is not grounded and the satellite mounting wall is not conductive or dissipatively-wise not matched to discharge the charge build-up in the plasma environment of space. Always disconnect the power before start to change the antenna electrical/mechanical setup. Overloading over the Absolute maximum ratings may affect device reliability, damage the RF power source / transmitter power amplifier device and void the product warranty.*

DIMENSIONS

The patch antenna is mounted on top of the main PCB with outer dimensions of 98×82.6 and 98×98 mm respectively, extending the module height from surface by up to 6 mm. As a standard, each antenna is equipped with the MCX-Female Right Angle, with SMA-Female connector and/or straight versions available on request.

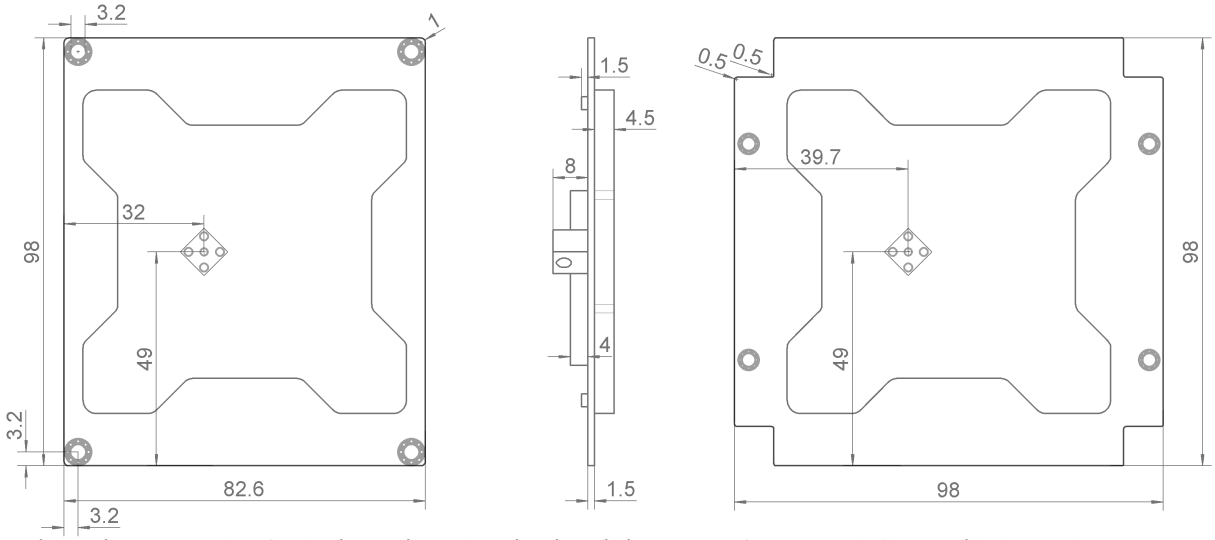

Fig. 2 piPATCH-S-(DL/UL) Dimensions drawing in millimeters. X/Y mount (left), profile (center), Z mount (right). Detailed STEP files available for download.

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Tab.: 1 **The piPATCH-S-DL, piPATCH-S-UL MCX-F/SMA-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	RFIN/OUT	Power	**RF power input/output.**

APPLICATION NOTES & RECOMMENDATIONS

RADIATION PATTERN

The standalone piPATCH-S patch antenna naturally exhibits with hemispherical cosine pattern above the ground plane (peak gain in front lobe with gain -3dB at ± 45° out of the front lobe axis. Any close proximity local obstacles, metallic parts or deployables may affect the radiation pattern.

Front to back ratio is strongly affected by the metallic structure of the CubeSat and corresponding wave diffraction. Typical standalone F/B parameter is close to 10-15 dB, but may differ according to the antenna mount, when installed on the satellite structure.

It is highly recommended to perform real satellite measurements in case the precise radiation pattern or F/B measurement is necessary.

ANTENNA LOCATION

Special care should be taken to the interference with the small satellite communication or power subsystem, as an active electronic device radiating the high power electromagnetic waves. The manufacturer recommends installing the S-band receiver (uplink) antenna as far from the (transmitting) electrical systems.

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 S-band receiver input frequency band with harmonic frequencies.

EMI/EMC CONSIDERATIONS

Special care should be taken to the interference with the small satellite communication or power subsystem, as an active electronic device radiating the high power electromagnetic waves. The manufacturer recommends installing the S-band receiver (uplink) antenna as far from the (transmitting) electrical systems as possible, whilst recommended installing the S-band transmitter (downlink) antenna as close from the communication system/power amplifier as possible. The RF coaxial cable (harness) between the antenna and the receiver may also pick up harmful interference along the path inside of the satellite body. **Be sure to test** the target small satellite subsystems against affecting the performance of the S-band receiver/transmitter under all satellite operation conditions.

It is highly recommended to perform full functional test on the flight or flight-representative satellite model to ensure the EMC compatibility, receiver sensitivity and link budget verification.

In order to maintain and/or improve the antenna radiation pattern, gain, efficiency and performance, it is **recommended to mount** the antenna **in the centre, on top of a flat and conductive surface or centered between satellite rails as much as possible.**

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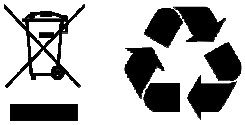
RECYCLING

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-S-UL, piPATCH-S-DL / Engineering Model** is RoHS compliant.

The **piPATCH-S-UL, piPATCH-S-DL / Flight Model** is **RoHS** compliant through exemptions, 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 .

CE

EXPORT CONTROL

Since the country of origin of this product (the Czech Republic) is a valid participating member of the Wassennaar Agreement (http://www.wassenaar.org) and agrees with the Missile Technology Control Regime (http://www.mtcr.info) and the **piPATCH-S-DL/FM, piPATCH-S-UL/FM, (Space-grade Flight Model), piPATCH-S-DL/EM, piPATCH-S-UL/EM, (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), if exported outside EU-member states territory. 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.

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DISCLAIMER

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Prague, Czech Republic

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