SkyFox Labs™
Your easy way to space.

MEGA-C READY!

Space-Friendly™

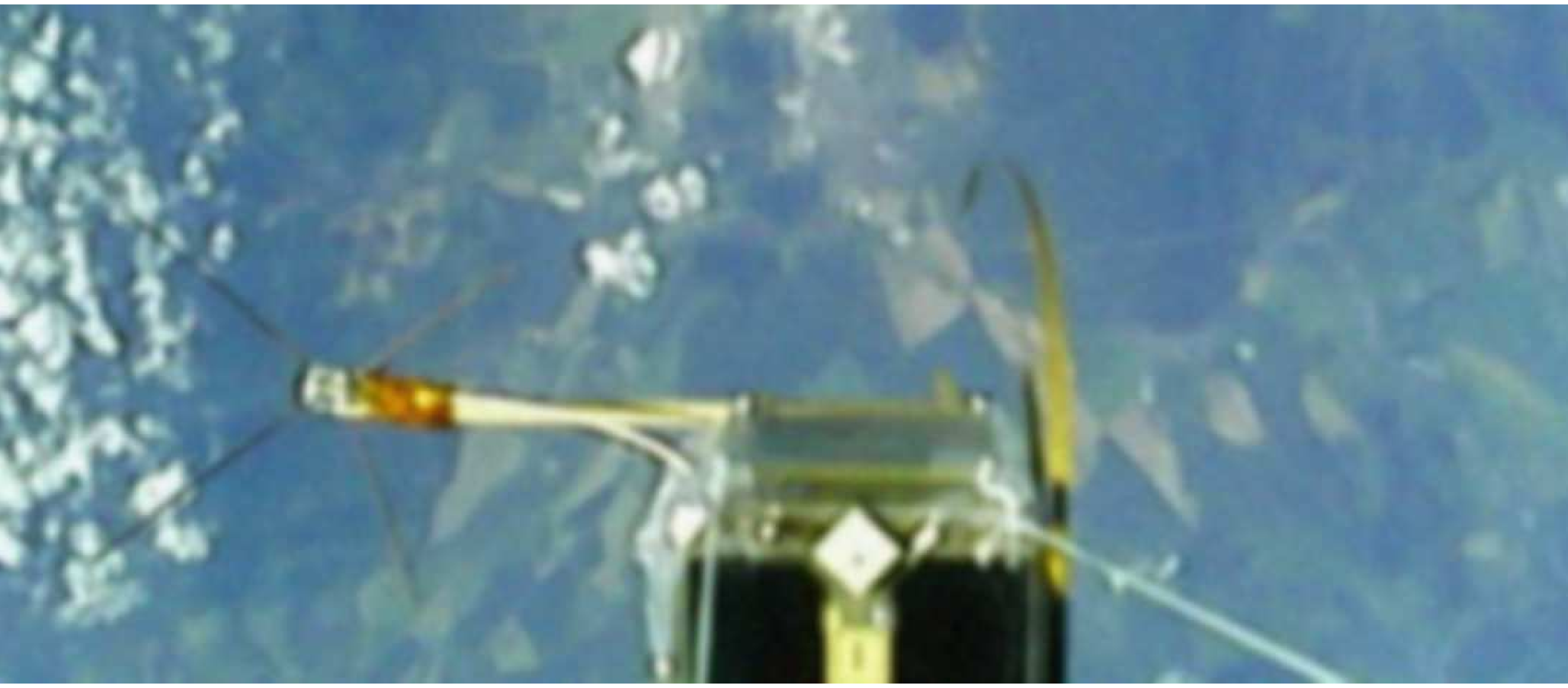
CubeSat ADS-B Next Generation

piADSB-NG

Product Datasheet

Rev. A/2024

Intended to **track Air Traffic from Space**.



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

PRODUCT DATA SHEET — piADSB-NG

FEATURES

- **Realtime Aircraft Surveillance for Space Stations**
- **CubeSat ADS-B System with No Moving Parts**
- **Fully functional Passive Radar for Aircraft tracking**
- **Automatic Dependent Surveillance – Broadcast (ADS-B) Receiver, Mode-S 1090ES**
- **1090 MHz L-band Zero-IF receiver**
- **Improved sensitivity, Squitter Counter, Telemetry**
- **56bit, 112bit Extended Squitters**
- **Civil Downlink Format 11, 17 (DF11, DF17) Output**
- **Highly Sensitive, Ultra Low Power, World's Lowest Profile**
- **Sensitivity up to -106 dBm (10^{-2} BER)**
- **Up to 2000 km slant range**
- **Embedded RHCP Patch Antenna Array**
- **Intended to LEO up to h = 600 km,**
- **Squitter Filters, 24bit CRC calculation**
- **CubeSat standard Compatible**
- **Ideal for X/Y,+/- CubeSat wall mount**
- **Mega-Constellation Ready! product**
- **Easy-to-Implement Data Interface**
  - **UART 230400-8-N-1, 3V3-CMOS levels**
- **Allow Nonstop Operation with conventional**
  - **1U CubeSat power budget**
- **2.7 to 3.6V Power supply**
- **Power consumption**
  - **250 mW (typical), 3.3 V @ 25°C**
- **Velocity**
  - **0 up to 10 km/s (Flight Model)**
- **Startup time less than 3 seconds (typical)**
- **Protocols**
  - **ASCII output (standard)**
  - **HEX or Binary (on request)**
- **Ultra Low Profile and Dimensions**
  - **98×82.6×12.5 mm**
- **Wide temperature range**
  - **-40°C to +85°C**
- **Connectors**
  - **PicoBlade™ 1.25 6P connector (Power + Data)**
- **Low mass 124 grams**
- **Engineering Model for FlatSat design Available**
- **Evaluation Kit Available**

APPLICATIONS

- **Nonstop Aircraft tracking on Small Satellites**
- **Air Trafic Control (ATC) Megaconstellations**
- **Air Trafic Control (ATC) Management**
- **CubeSats, Nano- Micro-Sats**
- **Limited Power Budget Space Projects**
- **Stratospheric, Meteorological, Scientific Balloons**

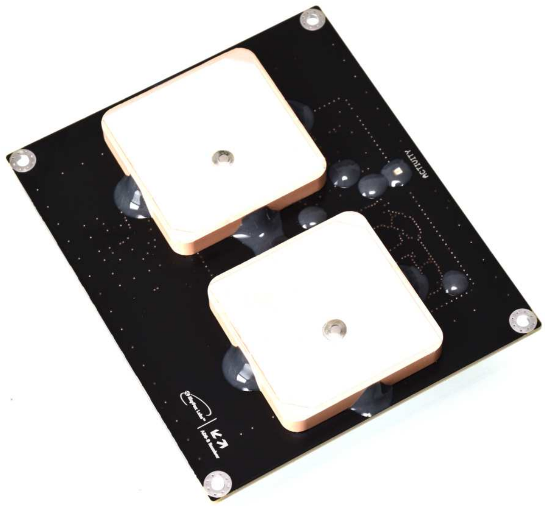


Fig. 1 CubeSat ADS-B System - Next Generation, Flight Model.

GENERAL DESCRIPTION

The piADSB-NG/Flight Model is the World's First Space-Friendly™ Automatic Dependent Surveillance–Broadcast or ADS-B Extended Squitter, Mode-S Passive Radar Receiver System with No Moving Parts, Ultra Low Profile, Low Power requirements, Squitter Counter and Telemetry engine. With integrated RHCP patch antenna array the product is intended to track Aircrafts from satellites in Low Earth Orbit (LEO), High Altitude Balloons (HAB) or Unmanned Aerial Vehicles (UAVs) with limited power and mass budgets.

It requires only 10 % of power in comparison with conventional space-grade ADS-B receivers allowing permanent data output.

Easy-to-use UART serial data interface output providing standardized ASCII sentences together with embedded ADS-B antenna array provides a smart standalone solution for all kind of Space-grade or terrestrial projects where the precise Aircraft position, type, velocity, direction or ICAO/airliner information is required.

The unit is interfaced with power supply and data output using single six pin PicoBlade™ connector with redundant pins.

Very low mass and dimensions fits perfectly with all kind of space-demanding projects.

TABLE OF CONTENTS

ABSOLUTE MAXIMUM RATINGS

V_{DD} to GND........-0.3 V to +4.2 V
DC Input Voltage: V_I .... -0.3 V to V_{DD} + 0.3 V (≤ 4.2 V max.)
DC Output Voltage: V_O ....-0.3 V to V_{DD} + 0.3 V (≤ 4.2 V max.)
DC Input Current: I_I at V_I < 0 V or V_I > V_{DD} ....±20 mA
DC Output Current: I_O at V_O < 0 V or V_O > V_{DD}........±20 mA
Other Pins to GND:........ -0.3 V to +(V_{DD} +0.3) V
Maximum RF Input Power:........ +15 dBm
Operating Temperature Range:........-40°C to +85°C
Storage Temperature Range:........-45°C to +90°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.

PARAMETRIC SPECIFICATION

T_A = −40°C to +85°C, V_{DD} = 3.3 V, Integrated RHCP patch antenna array used, unless otherwise noted.

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Operating Supply Voltage	V_{DD}	2.7	3.3	3.6	V	
Operating Supply Current	I_D		75		mA	Continuous DC current consumption during nominal operations.
Operating Power Consumption	$P_{Operation}$		250		mW	
Operating Frequency	f_{RFIN}		1090		MHz	1090ES, L-band
RF Bandwidth	BW		15		MHz	-3dB
Operating Velocity	V	0		9	km/s	
Time-to-First-Frame	t_{TTFF}			3	s	The piADSB-NG Start-up time.
RF Sensitivity	P_{IN}	-104	-105	-106	dB	BER 10^{-2}
Dynamic range	DR		20	30	dB	-76 to -86 dBm maximum input power
Slant Range	d	600	1000	2000	km	Depending on the ADS-B Out transponder output power/aircraft antenna radiation pattern.
Output Data Framerate	FR	1		~33000	fpm	Framerate given by DF11, DF17 frames filtering and provided at 230400 bps output bitrate per minute. Framerate is limited by amount of Downlink Format frames selected and output bitrate and was measured with periodical frame transmission generator, at 230400 bps output datarate. Minimum framerate is 1 fpm telemetry frame, if no aircraft transponder is received.
				~600		Limitation of the Engineering Model unit maximum framerate. 100ms delay between frames.
Output Data Bitrate	BR	9600	230400	1250000	bps	Bitrate settings are uploaded and fixed during manufacturing process. No post-manufacturing settings possible.
Output Frame Data Quality	DQ		99.999	100	%	As a standard, only CRC-checked Downlink Format 11 and 17 frames are provided. Most civil airliners uses ADS-B 1090ES frames to broadcast the most useful and detailed data in this frame type. 100% of all output data frames are valid, based on internal software-defined Cyclic redundancy check.

CONNECTORS DESCRIPTION

The piADSB-NG receiver is connected to the satellite system via standardized PicoBlade™ 6 pin interface connector (P/N 53261-06). Each pin, its function and direction or manner of use is indicated in the Tab.: 1 below. The connector location is displayed in Fig. 2.

Tab.: 1 **The piADSB-NG Pin Description**, NOTE: Minimum required interface pins are highlighted.

Pin	Name	Input, Output, Power	Description
1	VDD	Power	**Positive (+) System Power Input.** Positive power supply input, connect to +3.3 V with respect to GND system ground pins.
2			
3	TXD	Output	**ADS-B Receiver Serial Data Output.** ASCII sentences are present on this pin. Data is provided by standard UART serial transfer at a rate of 230400 bps, no parity, 8 data bits, 1 stop bit. LVCMOS compatible signaling.
4			
5	GND	Power	**System Ground.** Must be connected to ground potential. This pin may be internally connected to mounting areas. GND-Chassis zero ohm resistors/jumpers may be soldered to connect the system ground to mounting chassis. Keep GND-Chassis left floating to prevent grounding loops.
6			

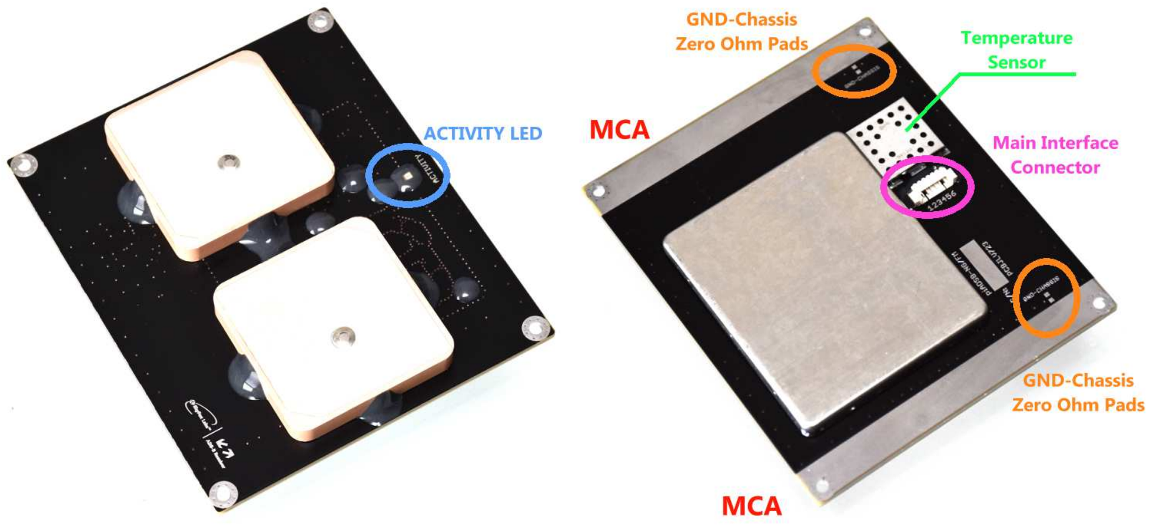


Fig. 2 **The piADSB-NG ACTIVITY LED and Interface Connector locations.** NOTE: The piADSB-NG connector location is displayed from the BOTTOM side. The SMD mount connector type is MOLEX 53261-0671 with 1.25mm pitch. Detailed dimensions drawing is available online as STEP model.

IMPORTANT NOTE: Metallic Contacting Areas (MCA) touching the satellite walls after the panel is mounted are electrically insulated from the module GND in DC domain (<100MΩ), however works as an AC short in order to extend the antenna ground plane. Total capacity per each of two metallic contacting areas is 150 + 150 pF = 300 pF with respect to GND groundplane potential. To prevent the grounding loops, GND-Chassis zero ohm solder jumpers are intrinsically not used. In case the satellite structure is realized as non-conductive, please contact factory for further recommendations. Standard cylindrical head screws (M2.5) can be utilized to fix the module onto the CubeSat structure.

FUNCTIONAL BLOCK DIAGRAM

The key functional blocks of the piADSB-NG are described in Fig. 3. The system consists of the high gain RHCP (Right Hand Circular Polarization) Patch Antenna array interconnected via RF coupler, Low Noise Amplifier (LNA), SAW Filter, Down Converter to Zero-IF and High speed baseband data processing core. The telemetry engine consist of the main input bus voltage readout, input current sensing, temperature measurement and squitter counter. The design of the front-end guarantees excellent noise figure and ensure high suppression of the out of band signals, whilst being optimized for large/orbital range with at least 20 - 30dB dynamic range.

The frame decoder, downlink format filter, CRC calculation and serialization is performed in high speed digital core. Output ASCII sentences are provided via UART interface. The piADSB-NG receiver is realized on 4-layers PCB including two power planes to maximally suppress the noise of analogue and digital circuits and protect the receiver circuits against interference from the other electronics (EMC susceptibility). Frame transmission indication using Blue "ACTIVITY" LED is used for quick check of the receiver's activity. DC discharge attenuation and ESD protection is applied on the antenna array input.

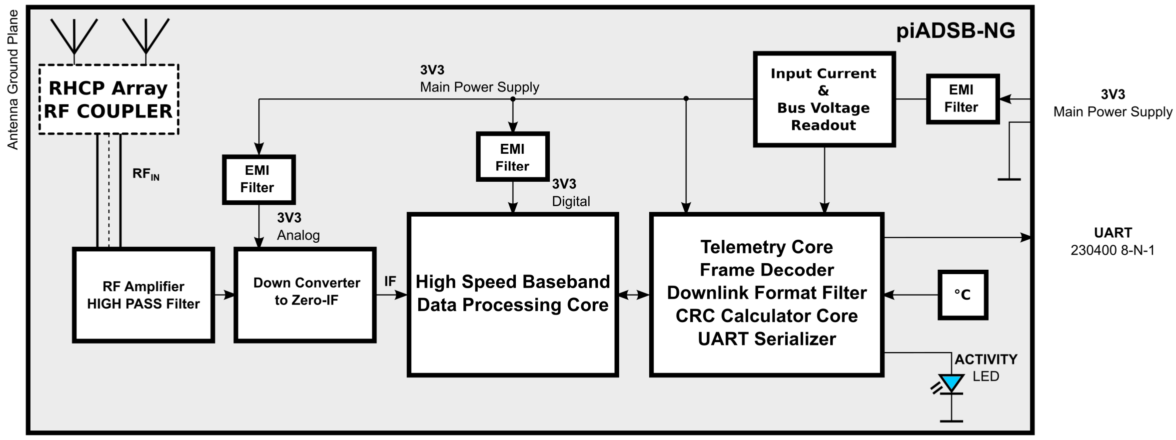


Fig. 3 The piADSB-NG Receiver Functional Block Diagram.

THEORY OF OPERATION

The piADSB-NG unit is the standalone single channel zero-IF receiver processing freely available frame transmissions of the Aircrafts' Mode-S Automatic Dependent Surveillance–Broadcast or ADS-B Extended Squitter, Mode-S Passive Radar working on 1090 MHz frequency band. Signals are broadcasted by flying or fly-ready aircraft transponders upon terrestrial Air Traffic Control (ATC) interrogations broadcasted at 1030 MHz. Concurrent in-flight transponders interrogations occurs also by line-of-sight airplanes in the air.

Data processing core and RF signal chain supports 1090ES transport protocol only. Interrogation reception on 1030 MHz or 978 MHz Universal Access Transceiver (UAT) transport protocol are not implemented.

Aircraft Flight Management System (FMS) produces data which are then stored in Binary Data Store or so-called BDS registers. This aircraft's digital memory space is updated according to actual in-flight values as a database source for Mode-S interrogation replies. Moreover a total of 56 and 112 bits long Mode-S Extended Squitter frames transmitted at a rate of 1 Mbps contains cyclic redundant check (CRC) bytes to help control the correctness of transmitted data on receiver side.

High frequency L-band RF signal from the passive antenna array is fed through the Low Noise Amplifier with ultra low Noise Figure and ESD protection blocking the DC bias and possible antenna plasma charging in space. Signal is then filtered out to clean out-of-band signals using SAW filter with as low as 2dB passband attenuation. Downconversion to zero-IF band is then performed to feed the high speed data processing core. The frame header pattern is continuously searched in digitized input signal. In case the frame initial header is correctly found in the signal, the record of following 56/112 bits long datagram is extracted using SkyFox Labs' developed demodulator and decoder. Zero-IF conversion together with software-defined decoder allows the receiver to perform the whole reception task using ultra low power requirement only.

On top of signal recordings the Downlink Format or data type filtering is performed and in case of Downlink Format 11 and 17, the CRC is calculated. If the calculated CRC matches the received CRC data, the serialized data output is provided on output TX pin. During the processed datagram transmission the associated SMD LED shines to indicate the receiver performance / activity. Ultra low power LED requirement and short duty cycle allows user to remain the LED soldered even for flight conditions.

The piADSB-NG receiver software-defined demodulator and data processing core allows to perform also other Downlink Format reception processing and output. However, in most cases Downlink Format 11 and 17 frames provided by civil aircrafts' broadcasts contains the most useful and most detailed data such as position, ICAO callsign, velocity, heading, etc. From this point of view, the DF11 and DF17 filter has been implemented as fixed providing up to 100% of output datagrams to be correct.

The same frequency band (1090 MHz) is also shared with the Traffic Collision Avoidance System (TCAS), by different frequency channel spacing also due to the Distance Measuring Equipment (DME) system interrogations. Furthermore, more aircraft transponders may share the same band at a time by nature of timing-uncoordinated media access transmissions. Several transponders in the range are also broadcasting different types of frames. Certain amount of squitter loss rate is thus always expected. Including the CRC filtering, the frame rate of DF11 and DF17 piADSB-NG output data yield is therefore in order of ~4000 sentences per minute in a crowdy airspace.

PROTOCOLS

The physical communication is realized via the standard UART data interface. The bitrate is set to 230400 bps, no parity, 8 data bits, 1 stop bit. Logical levels are equal to LVCMOS (3.3V) levels as defined in JEDEC JESD8C.01 standard.

The bitrate settings is defined during the manufacturing process and cannot be changed later on. As a standard, 230400 bps is a well tested and recommended compromise between the receiver lock-out time needed to process the data transfer and slow enough to not overload upper level system with too much interrupt requests caused by UART data transmission. By a factory settings during manufacturing, the bitrate can be changed from 9600 bps up to a maximum of 1.25 Mbps, on request.

OUTPUT DATA DESCRIPTION

Data is provided in ASCII representation of HEX characters. Thus for example one received byte from air radio traffic represented by binary set (0b00111100), which means 60d (Decadic) and 0x3C in Hexadecimal representation is provided as two bytes - ASCII letter "**3**" followed by ASCII letter "**C**". This is to make the data reception easily readable using standard serial terminal in PC. Fully binary data output would cause non-printable characters to be shown on serial terminal (like Hyperterminal, etc.) However, fully binary data output is two times shorter than ASCII representation.

NOTE: Firmware modification to provide only BINARY data is possible to perform on request during manufacturing process. To make the use of the unit as much simple as possible, no settings is needed and also is not possible (no RXD pin on the Main Interface Connector). Customer shall decide which format requires in advance.

A) ASCII Output - STANDARD:

As a standard, the piADSB-NG unit is delivered with firmware providing 56 bit and 112 bit long 1090ES sentences of Downlink Format 11 and 17, which means the datagram contains 14 and 28 bytes of ASCII data with 1 byte prefix and 3 bytes suffix. Total of 1+14+3 = **18 bytes** or 1+28+3 = **32 bytes**, respectively are provided, with fixed length.

B) BINARY Output - ON REQUEST ONLY:

*In case the Binary output is selected during the order process, the prefix and suffix characters remains the same, to keep good orientation in data stream. However, internal datagram is shorter, only 7 or 14 bytes. Total of 1+7+3 = **11 bytes** or 1 + 14 + 3 = **18 bytes**, respectively are provided, with fixed length.*

Each datagram is initiated with the character "*****" (star) prefix and ended with semicolon "**;**" and **CR + LF** (0x13h + 0x10h) suffix string.

There are four different types of datagrams provided by the piADSB-NG in the output serial data stream:

1) The Initial Sentence available after power up or automatic reset (via watchdog within the radiation environment) is still the same and distinguishing between the Engineering and Flight Model firmware as highlighted below (0x0E and 0x0F for Engineering and Flight Model, respectively):

piADSB-NG INITIAL SENTENCE (Engineering Model)

```
*0E00112233445566778899AABBCC;
```

piADSB-NG INITIAL SENTENCE (Flight Model)

```
*0F00112233445566778899AABBCC;
```

2) During nominal operations, the 56 bit squitter sentence is provided in following form,

piADSB-NG 56bit Squitter OUTPUT SENTENCE Example

```
*5DA2A3D2010CDA;
```

3) and the 112 bit squitter sentence in following form:

piADSB-NG 112bit Squitter OUTPUT SENTENCE Example

```
*8D3C54659909C8173004A132B0C5;
```

There are several freely available online resources describing how to parse the output data into dedicated BDS register's information. It is out of scope of this document to provide detailed squitter content and parsing procedures.

However, for **Search and Rescue (SAR) applications**, the most valuable content is stored on byte positions shown in underlined **bold** below. **Each** received sentence provided by the piADSB-NG represents published unique Mode - S **Aircraft ICAO Registration Code**. From the example above is thus the ICAO code as following:

*8D**3C5465**9909C8173004A132B0C5;

☞ Identified Aircraft ICAO Code is: **3C5465**

There is much more information provided about the aircraft flight parameters such as Aircraft Velocity, Altitude, Heading, GPS position, etc. in piADSB-NG data output, DF11 and DF17. Above is listed only one example showing how to easily interpret the data.

4) The Telemetry sentence containing human-readable values (Input Bus Voltage, Input Current, Temperature and Squitter Counter, respectively) is provided periodically each ~60 seconds. In order to keep the fixed amount of characters in the Telemetry sentence, the temperature zero crossing is as follows: +01°C, +00°C, -01°C and vice versa. If the squitter counter reaches 99999999 frames, the value is reset down to 00000000.

piADSB-NG Telemetry OUTPUT SENTENCE Example

```
#3.28V,075.6mA,+22°C,00004187;
```

ANTENNA

The piADSB-NG receiver system is equipped with SkyFox Labs-optimized high gain RHCP ceramic patch antenna array, with a typical hemispherical pattern elongated along the axis between two ceramic patch elements, forming +3dB more gain with respect to a single patch antenna element. The whole CubeSat panel serving as the antenna ground plane with outer dimensions of 98×82.6 mm has milled corners fitting the standard CubeSat Structure and +/- X/Y-axis footprint. Antenna radiation pattern is described in Fig.4. As a groundplane extension, the CubeSat rails are utilized, for full performance, the module needs to be mounted onto the structure as much smooth with the rails as possible.

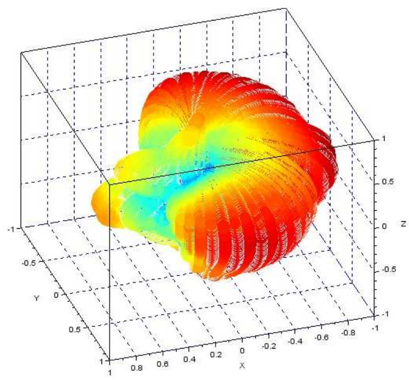


Fig. 4 Optimized piADSB-NG Antenna Array Radiation Pattern plot mounted on 1U AL-6061 CubeSat structure.

ENGINEERING MODEL

As the Space-based long distance (free space loss -148dB @ 1090MHz, 550 km range) ADS-B link budget is set to be extremely tight (~ -90 to -100dBm level only! at the 550 km slant range signal level with 750W transponder), a special care have to be taken to the EMC/EMI environment in order to maximize the receiver sensitivity yield. To test whether the satellite bus subsystems, flatsat or satellite qualification model (magnetorquers, MPPT solar controllers, DC/DC converters, transmitters, mixers, local oscillators, etc.) are not affecting the piADSB-NG system noisefloor, the Engineering Model grade with identical electrical and RF properties is available. It is highly recommended to run the test before the flight and observe whether the fully operational satellite is not limiting the maximum available range/frame rate in open space or using ADS-B 1090 MHz test signal generator. The Engineering Model is also an excellent module for satellite software development with all basic (yet framerate limited) functionalities and data outputs as Flight Model.

The red Remove Before Flight finish reminds the user to replace the unit with the Flight Model grade unit suitable for the environment of space, in case it is used on Flight Model of the satellite. The firmware of the EM model is modified to notify the upper level system that the EM model is mounted. To distinguish between FM and EM firmware, please note chapter: Output Data Description, section 1) Initial Sentence. A limit of maximum frame rate is applied. Photo of the piADSB-NG Engineering Model unit is depicted in Fig. 5.

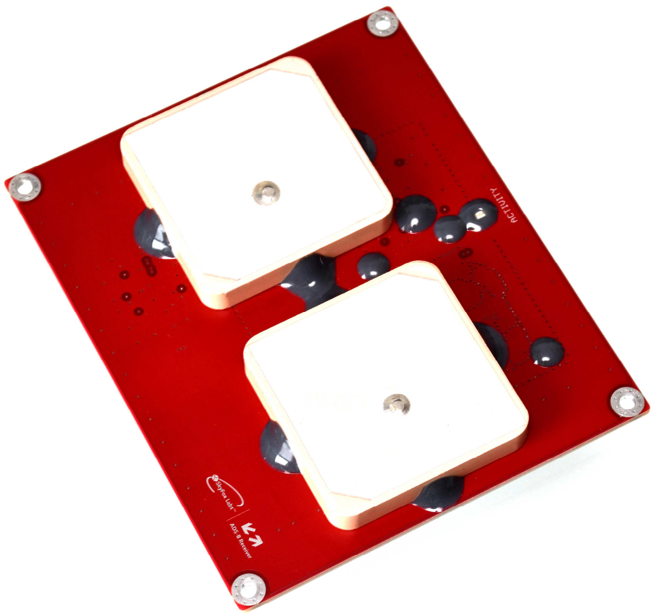


Fig. 5 Engineering Model of the piADSB-NG unit with Red Remove Before Flight finish.

EVALUATION KIT

To connect the piADSB-NG with a conventional PC during satellite development, the Evaluation Kit is provided to serve as a power supply from the USB bus via voltage regulator (3.3V), ESD protection and EMI filters. The PCB contains signal test pins for oscilloscope probe hooks, current sensing/power cycling jumper (3.3V Main Power) and a set of indicating LEDs. A **Starboard Side (Right wing) green LED** indicates the available power. It is lit up once the input power is available (regardless the ADS-B 3.3V Main Power jumper status). **Port Side (Left wing) red LED** is active during the data transmission FROM the piADSB-NG towards the PC/satellite/terminal, the idle status is normally OFF.

A front side yellow LED is indicating the transmission of data TO the piADSB-NG from the PC/satellite/terminal. Not connected on piADSB-NG, intended for future use.

The layout of the Evaluation Kit PCB is depicted in Fig. 6. The associated USB-to-Serial FTDI cable can connect and power the unit from the USB. A simple communication with PC terminal is realized via Virtual COM Port (VCP).

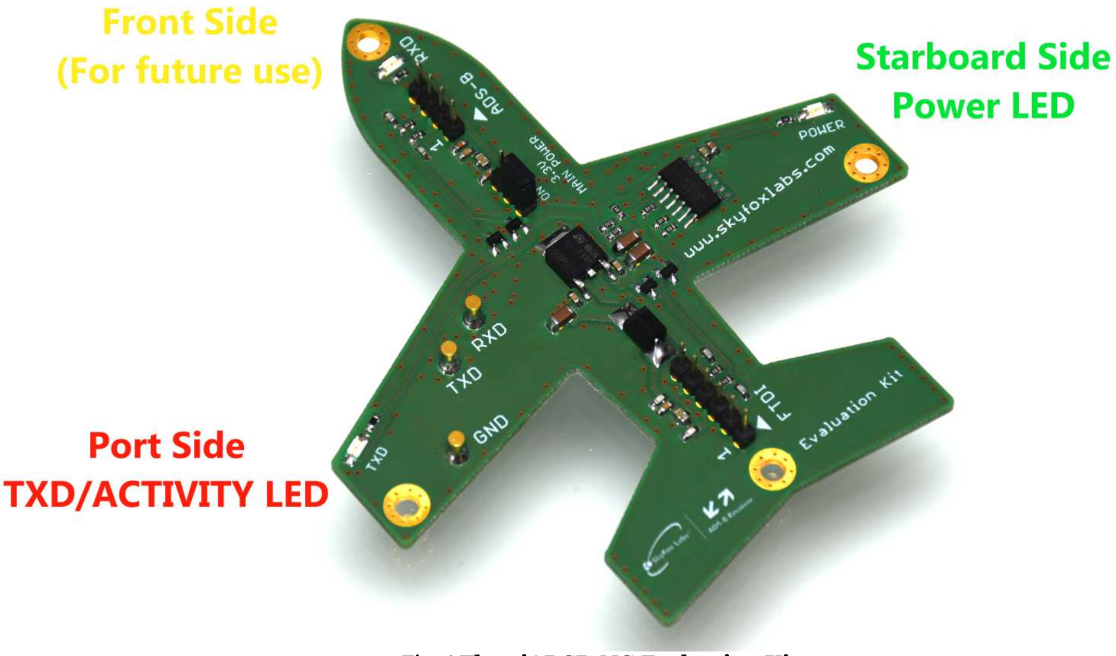


Fig. 6 **The piADSB-NG Evaluation Kit.**

EVAL KIT SCHEMATICS

When interfacing the piADSB-NG unit, the effect of power bootstrapping of a typical UART receiver needs to be considered. When UART line is idle, it holds the logical level HIGH or 1 (3.3V in case of LVCMOS levels). Such voltage and current capability is able to power up the digital core, which is naturally very low power in order of 5 - 10 mA. Thus, even if the main power input is held LOW (or 0V), the bootstrapping via communication interface may still prevent the unit from proper power cycle / restart. It is thus highly recommended to disable the receiver pull-up resistor of UART interface on RXD channel or forcing it directly to zero Volts in input mode (set UART RX pin to input, force it with log. 0).

Each successful unit boot-up is indicated by three blinks of BLUE LED and with sending Initial sentence towards the onboard computer. An example of interface including the bus receiver/driver is provided within the Evaluation Kit schematics in Fig. 7.

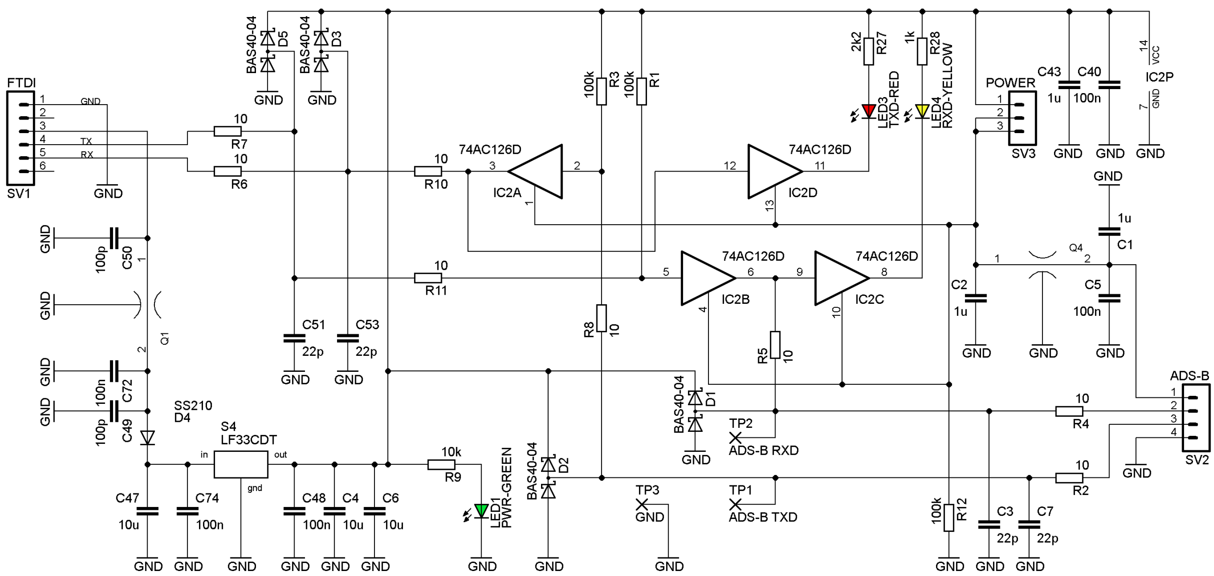


Fig. 7 **piCAM Evaluation Kit Schematics with highlighted 3.3V LED Flash Driver Example circuitry.**

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 ADS-B receiver input with harmonic frequencies falling to the 1090 MHz L-band.

Observe the maximum distance logged over 1 hour of daylight operations and compare it with switched On/Off electronic subsystem to identify the potential source of the disturbance if needed. Keep in mind, local horizon visibility of the open airspace determines the maximum range, which typically does not exceed 400 km.

QUALITY ASSURANCE

GENERAL INFORMATION

Since the piADSB-NG/FM (Flight Model) receiver has been designed for the operation in harsh space environment as a specially featured electronic device based on Commercial Off-the-Shelf (COTS) components, the special care is taken to follow the standardized space-grade product assembly procedures, materials and components where possible (i.e. no Radiation Hardened integrated circuit are used).

MATERIALS

Components are soldered on the Space-grade 4-layers FR-4 PCB, using 60/40% (Tin/Lead) compound. Special Non-toxic Flux is used for precise soldering of the integrated circuits for its excellent soft soldering quality properties, complying with the RoHS 2002/95/EC directive. The NASA approved 3M Scotch Weld Epoxy is used for critical component fixings.

Vacuum-proof electronic components from ESA and NASA-preferred space-grade vendors are used (i.e. no electrolytic capacitors) in industrial or automotive/military temperature grade, where possible.

PACKAGING & SHIPPING

Once the piADSB-NG successfully passes the screening test, it is finally cleaned, optically inspected and shipped encapsulated in ESD protective packaging.

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 **piADSB-NG (both Engineering and Space-grade Flight 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.

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 FURTER 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