NanoCom
ADS-B

Datasheet

An ADS-B reciever for space applications

GomSpace A/S | Langagervej 6 | DK-9220 Aalborg East | Denmark
gomspace.com | sales@gomspace.com | T: +45 71 741 741

Product name: NanoCom ADS-B

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Author: KLK

Approved by: MJN

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Confidentiality Notice

1 Table of Contents

2 Introduction

The Automatic Dependent Surveillance – Broadcast (ADS-B) is a cooperative surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked. Usually it is ground stations and other airplanes receive the information, but when flying over large bodies of water, no receiver might be in the vicinity.

3 Overview

The NanoCom ADS-B with an antenna is fully nano-satellite system to pick up and broadcast airplanes positions no matter where on the globe they are.

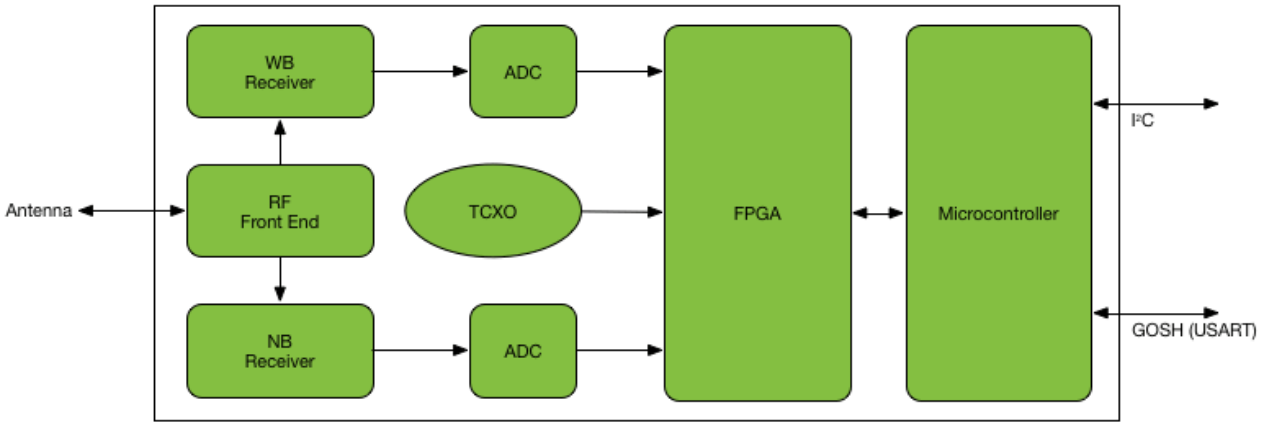
The system has been flight tested on GOMX-1, and performed as planned.

Figure 1 GOMX-1 data

3.1 Highlighted Features

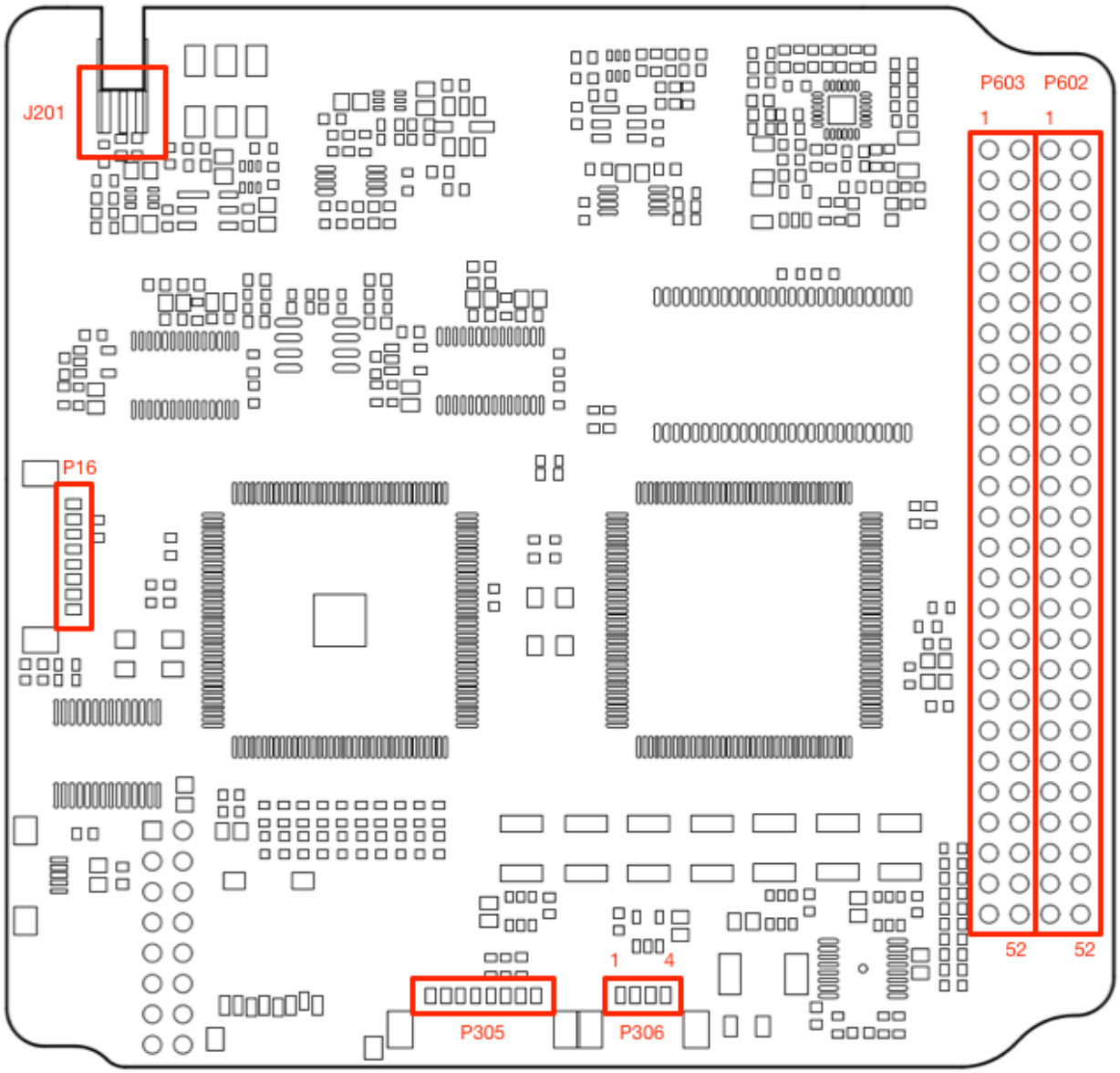
- Sensitivity down to –103 dBm (NB) and -99 dBm (WB)
- CSP data interfaces over I^2C-bus
- Low power consumption: ~500 mW
- Operational temperature: -40 °C to +60 °C
- Dimensions: 92.0 x 88.9 x 6.2 mm (without stack connector)
- UART console interface for easy use in lab setup
- SSMCX antenna connector
- Integrated EMI shield
- Fits standard PC104
- PCB material: Glass/Polyimide 4+4 twin stack ESA ECSS-Q-ST-70-11-C
- IPC-A-610 Class 3 assembly

3.2 Block diagram



4 Hardware Layout, Connector pin out

4.1 Connector Location



4.2 52-pin Stack Connector (H2, P602)

PIN	Description
1 to 24	Not Connected
25	3.3 V Input *
26	3.3 V Input *
27	3.3 V Input *
28	3.3 V Input *
29	GND
30	GND
31	Analog GND
32	GND
33 to 52	Not Connected

* Select pin in purchase option sheet

4.3 52-pin Stack Connector (H1, P603)

PIN	Description
1 to 40, 42, 44, 45 and 46	Not Connected
41	I^2C Data
43	I^2C Clock
47	3.3 V Input *
48	3.3 V Input *
49	3.3 V Input *
50	3.3 V Input *
51	3.3 V Input *
52	3.3 V Input *

* Select pin in purchase option sheet

4.4 FPGA JTAG (P16)

The JTAG connector is a Molex 8pin PicoBlade and interface is used for factory tests only.

4.5 uP JTAG (P305)

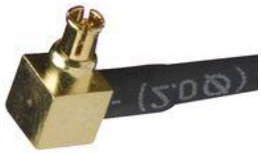
The JTAG connector is a Molex 8pin PicoBlade and the interface is used for factory software upload only. The ADS-B module will ship with firmware pre-installed. Uploading new firmware will void the factory checkout.

4.6 SSMCX RF connector (J201)

The SSMCX connector is a 50 Ω edge mounted type from Molex.

It works well with a right angle connector on a RG316 or RG178 cable e.g. Molex.

Note: The cables should be made without the typical black heat-shrink tubing to avoid outgassing in vacuum.



4.7 USART (P306)

The connector is a 4 pin PicoBlade from Molex. The USART is designed for easy-access to the ADS-B configuration and makes it possible to do factory checkout of standalone modules. Note: please only supply the ADS-B from a single power-supply. So if you have the debug USART connected to a PC and power is coming from the stack connector, you must disconnect pin 2 in the USART connector. Also take special care about grounding when connecting a laptop with an external switch-mode power supply. These tend to produce a high common-mode noise, which can damage the PCB's if not grounded correctly. Serial port settings are 500000 baud and 8n1.

PIN	Description
1	GND
2	VCC 3.3 V
3	USART2 RX (Data to ADS-B)
4	USART2 TX (Data from ADS-B)

5 Absolute Maximum Ratings

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the ADS-B.

Exposure to absolute maximum rating conditions for extended periods may affect the reliability.

Symbol	Description	Min.	Max.	Unit
VCC	Supply voltage	3.3	3.4	V
P_i	Absolute maximum input power at receiver input		-10	dBm
T_{amb}	Operating Temperature	-60	85	°C
T_{stg}	Storage Temperature	-65	120	°C
T_j	Junction Temperature		150	°C
V_{io}	Voltage on I^2C/USART/JTAG pins	-0.3	3.6	V

6 Electrical Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
VCC	Supply voltage		3.3		V
I_{rx}	Supply current RX		170	400	mA

7 Nominal Operation Conditions

Symbol	Description	Min.	Typ.	Max.	Unit
T_{amb}	Nominal operating temperature	-40	20	60	°C

8 Debug Interface

The USART interface uses the GomSpace Shell (GOSH) to present a console-like interface to the user. GOSH is a general feature present on all GomSpace products.

The console can be used during checkout of the ADS-B to send commands and set parameters of the ADS-B. During integration into the satellite, the debug interface can be used to evaluate and see incoming traffic through the ADS-B radio. Telemetry and housekeeping parameters can also be monitored. Here is a short list of features of the debug interface:

- Inspect CSP traffic (incoming and outgoing)
- Inspect I^2C driver (use full during early driver development)
- Inspect runtime performance
- Modify, save and restore default parameters
- Run test, etc.

9 Data Interface

The ADS-B uses the Cubesat Space Protocol (CSP) to transfer data to and from 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 and between the satellite and ground station. For more information about CSP please read the documentation on libcsp.org and on Wikipedia: http://en.wikipedia.org/wiki/Cubesat_Space_Protocol

10 In Orbit Verification

The ADS-B receiver has been tested in orbit on the GomSpace GOMX-1 mission and the performance of the receiver was as expected. During the mission, a lot of raw ADS-B data messages were received and analyzed. Below is shown an example of a received data package.

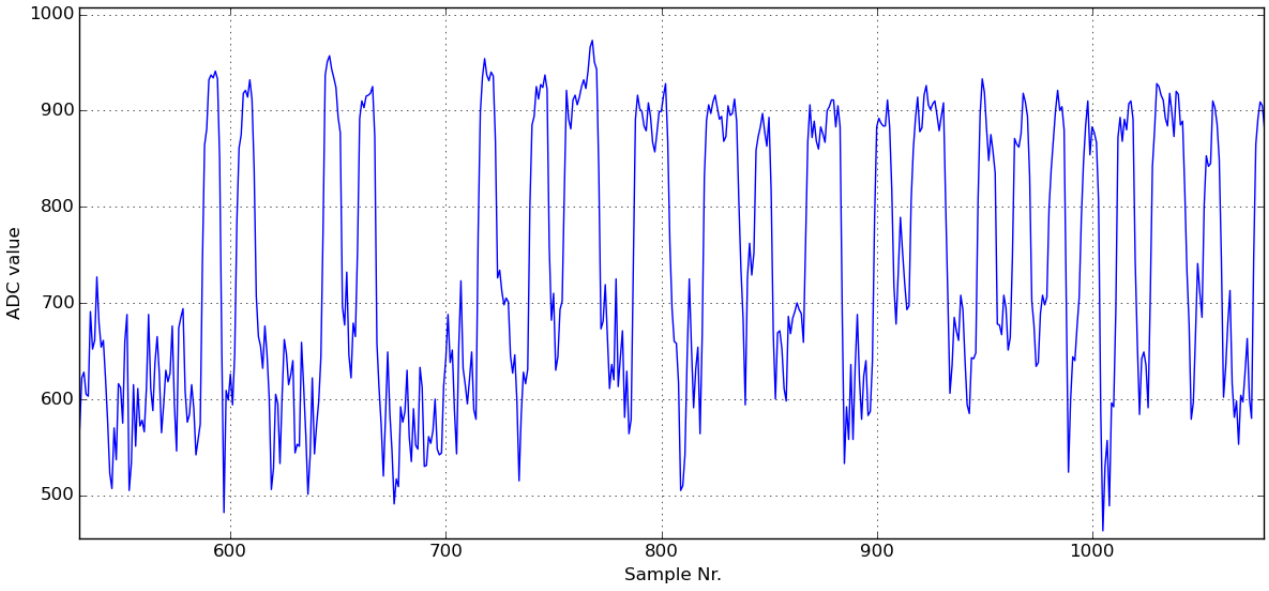
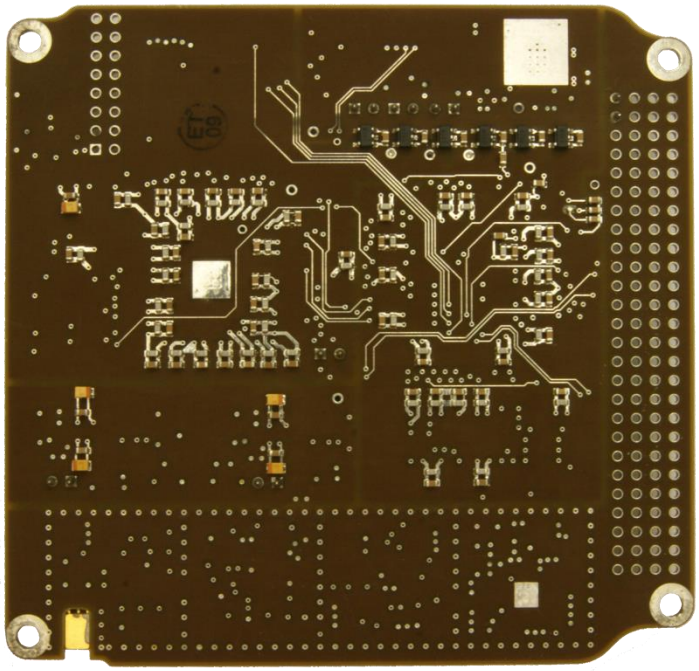


Figure 2 Raw samples of ADS-B messages

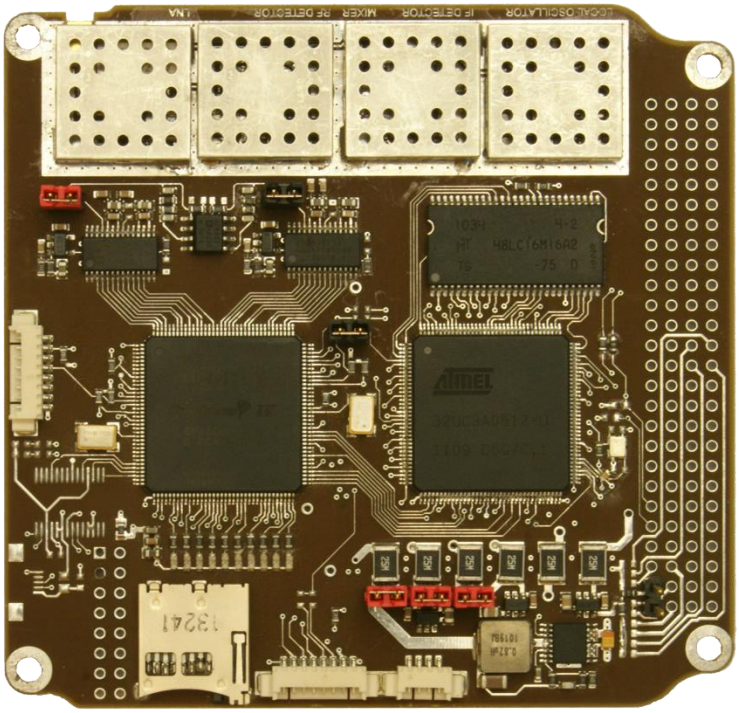
11 Physical Layout and measurements

11.1 PCB Description: Bottom



11.2 PCB Description: Top

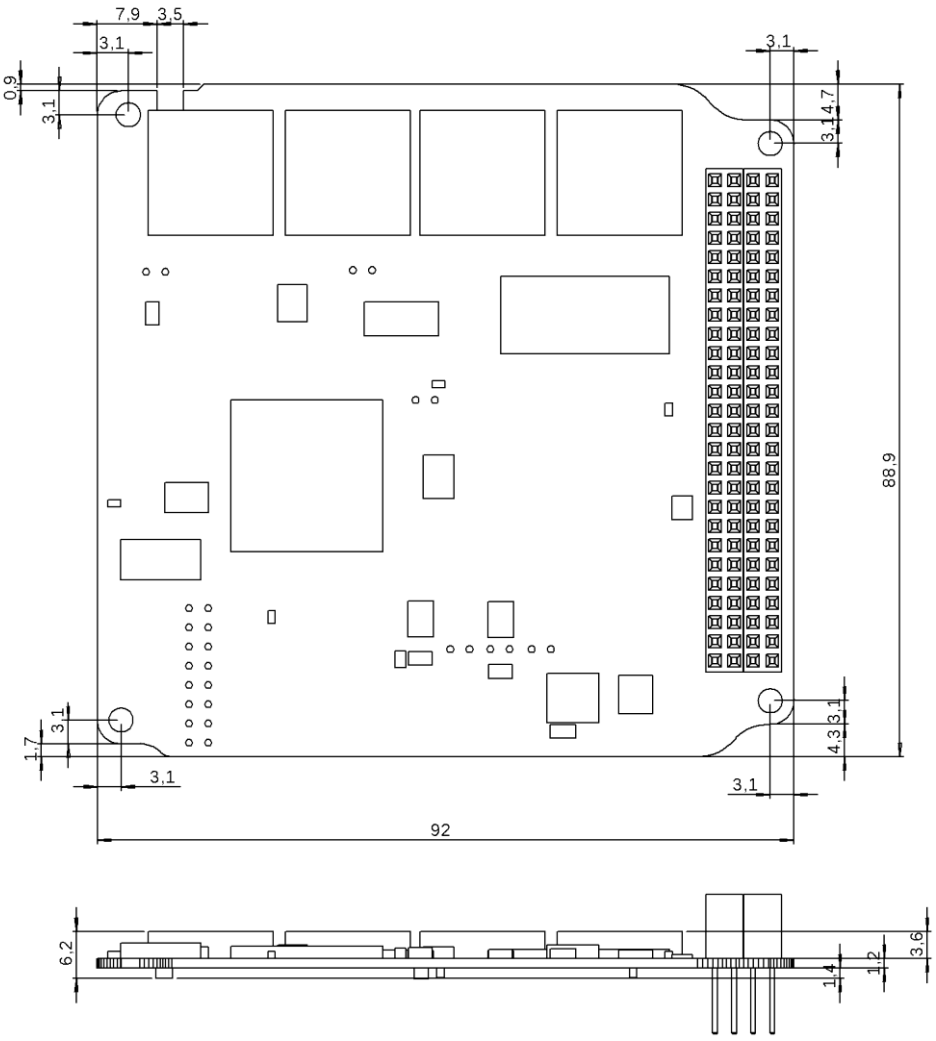
The top of the PCB contains all the connectors. At the top of the picture is the RF front-end with shielding. On the left middle is 2x ADC connected with the FPGA. On the right RAM and MCU.



12 Mechanical Drawing

All dimensions in mm.

The height of the stack connector depends on the choice in the option sheet.



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