DATASHEET

S-Band Receiver

S-BAND RECEIVER

DATASHEET

This datasheet details the applications, features and technical characteristics of EnduroSat's S-band Receiver module.

Please contact EnduroSat if further information is needed.

Figure 1: S-Band Receiver module

1 CHANGE LOG

Date	Version	Note
08/May/2018	Rev 0	Initial document
01/Aug/2019	Rev 1	Interfaces update

2 ACRONYMS LIST

CAN	Controller Area Network
CCSDS	Consultative Committee for Space Data Systems
DVB-S	Digital Video Broadcasting – Satellite
ESD	Electrostatic Discharge
ETSI	European Telecommunications Standards Institute
FEC	Forward Error Correction
GEVS	General Environmental Verification Standard.
GND	Ground
HW	Hardware
I2C	Inter-Integrated Circuit
ITU	International Telecommunication Union
LEO	Low Earth Orbit
OBC	On-Board Computer
RF	Radio Frequency
SMA	Sub-Miniature version A
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

3 SYSTEM OVERVIEW

EnduroSat's S-band Receiver module is designed for telecommand and telemetry purposes of a LEO uplink communication channel. The module works in the licensed 2025 – 2110 MHz frequency band. This band is allocated by the ITU for Earth Exploration Satellite services (Earth-to-Space and Space-to-Space). The module conforms to the DVB-S ETSI 300 421 standard, but also custom modulation and FEC schemes are available on request. It features configurable symbol rates and FEC schemes, which can be set from a ground terminal while the satellite is in orbit.

The form factor of the S-band Receiver is built around the PC-104 connector standard which is the most common for CubeSat systems.

The module has two operation modes: *Idle* and *Receive*. When a receiving session is initiated, i.e. the module is in *Receive* mode, there are two possible approaches how the received data to be handled:

- data is recorded on to the internal memory
- data is directly transferred to the OBC or another module

The internal memory of the module is up to 32 GB. The power consumption in *Receive* mode at 5Msym/s is 2 W. When the module is in *Idle* mode it automatically switches off all unnecessary electronics and thus reducing the power consumption to less than 0.35 W. While the S-band Receiver is in *Idle* mode the OBC can access and process all the data recorded in the internal memory of the module.

The operation mode, frequency, output power, symbol rate and all other communication parameters are set by the RS-485, I2C, CAN or UART interfaces. The system has an easily available USB interface for configuring and performing tests on the ground. The RF connector from the antenna is a 50 Ohm female SMA jack.

The small overall dimensions of the metallic box combined with the robust HW architecture of the S-band Receiver makes it a perfect choice for CubeSat / nanosat LEO missions.

4 HIGHLIGHTED FEATURES

The main features are as follows:

- Frequency range: 2025 – 2110 MHz
- Protocol: DVB-S – ETSI EN 300 421-1 v1.1.2
- Sensitivity: -95dBm
- Power supply: 10 to 24.5 V
- Power consumption during *Receive* mode: 2W
- Frequency stability: +/- 1 ppm
- Maximum symbol rate: 10Msym/s
- Interfaces: RS-485 / UART / I2C / CAN / LVDS
- Input interface connector: PC-104
- RF connector: SMA jack (female)
- Weight: 220g

5 RF CHARACTERISTICS

Parameter	Condition	Unit	Min	Typ	Max
Freq. Range		MHz	2025		2110
Freq. Tuning		kHz	1		
Sensitivity	5Msym/s	dBm		-95[1]	
System Noise Figure	25°C	dB			2
Symbol Rate		Msym/s	2		10

[1] *BER = 1*10^{-5}*

6 ELECTRICAL CHARACTERISTICS

Parameter	Condition	Min	Typ	Max
Supply Voltage [V]		10	12	24.5
Enable [V]	Logic High disables the module	1.8	3.3	5
Current Consumption [A]	Idle mode			0.029
	Receive mode at 5Msym/s		0.16	
Operating Temperature [°C]		-30		70

7 CONNECTOR PINOUT

7.1 Location of Connectors

Figure 2: Location of Main Stack Connector

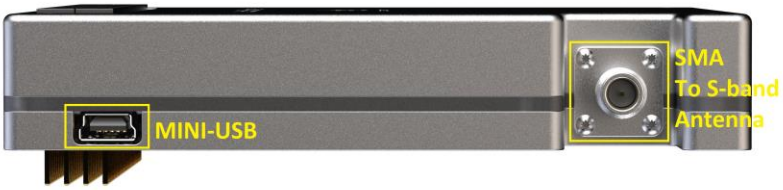


Figure 3: Location of SMA and mini-USB Connectors

7.2 Pinout: H1 - Stack Connector

Pin	Mnemonic	Description
H1-1	CAN L	CAN communication Low (3.3V)
H1-3	CAN H	CAN communication High (3.3V)
H1-5	LVDS_1_RxD_N	LVDS 1 Data Negative
H1-6	LVDS_1_RxD_P	LVDS 1 Data Positive
H1-7	LVDS_1_RxC_N	LVDS 1 Clock Negative
H1-8	LVDS_1_RxC_P	LVDS 1 Clock Positive
H1-9	LVDS_2_RxD_N	LVDS 2 Data Negative
H1-10	LVDS_2_RxD_P	LVDS 2 Data Positive
H1-11	LVDS_2_RxC_N	LVDS 2 Clock Negative
H1-12	LVDS_2_RxC_P	LVDS 2 Clock Positive
H1-21	I2C SCL Payload	I2C clock for Payload usage
H1-23	I2C SDA Payload	I2C data for Payload usage
H1-22	RS-485_2_N	Secondary RS-485
H1-24	RS-485_2_P	Secondary RS-485
H1-37	RS-485_1_N	Primary RS-485
H1-38	RS-485_1_P	Primary RS-485
H1-39	TxD System	UART transmit data for System usage
H1-40	RxD System	UART receive data for System usage

7.3 Pinout: H2 - Stack Connector

Pin	Mnemonic	Description
H2-3	Out1	S-band Receiver power enable
H2-23	+12V	+12V BUS Power supply
H2-24	+12V	+12V BUS Power supply
H2-29	GND	Ground
H2-30	GND	Ground
H2-31	GND	Ground
H2-32	GND	Ground
H2-45	VBatt	Raw Battery BUS Power supply
H2-46	VBatt	Raw Battery BUS Power supply

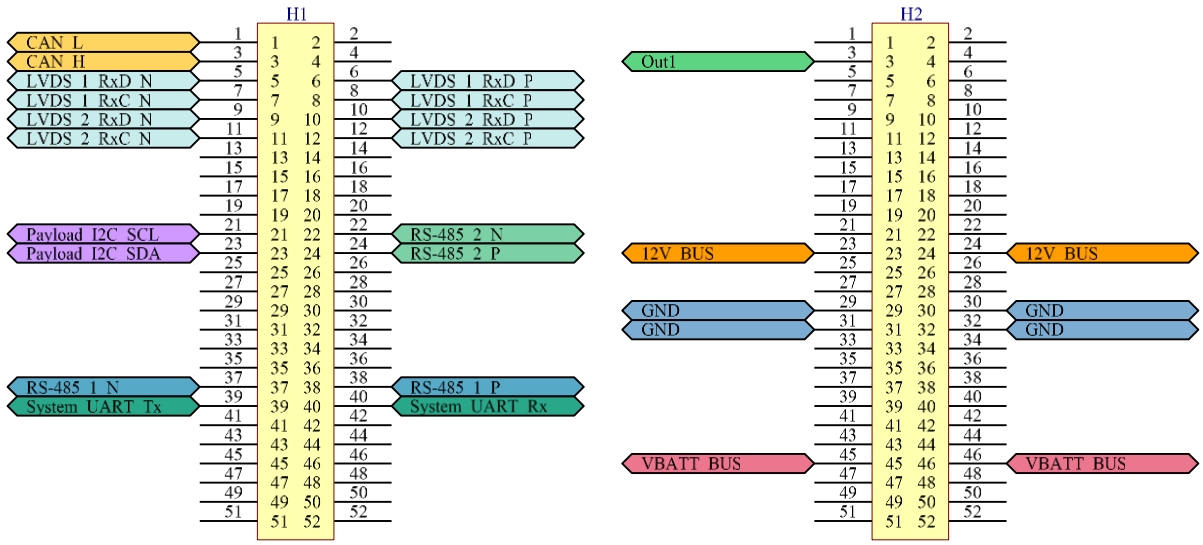


Figure 4: Pinout of the Stack Connectors

7.4 Mini USB

The mini-B USB shown in Figure 3 allows the user to configure and test the module under laboratory conditions.

7.5 SMA Connector

The SMA connector shown in Figure 3 is for the RF input signal and is a 50 Ohm female jack. It is recessed into the case to save space and its position allows easy routing of the coaxial cable within the satellite. As an option it can be purchased in a straight or right-angled configuration.

8 MECHANICAL DRAWING

The following pictures show the external dimensions of the S-band Receiver module.

STEP files can be provided upon request. All dimensions are in mm.

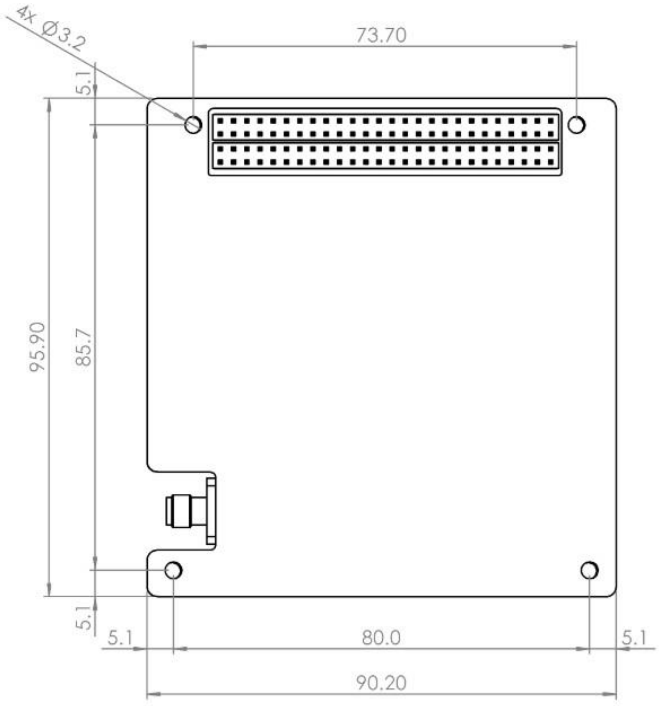


Figure 5: S-band Receiver - Top View

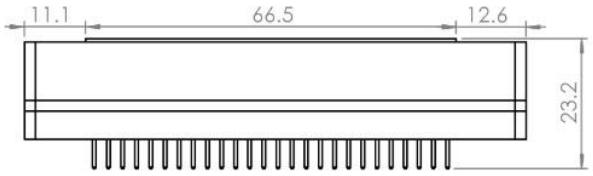


Figure 6: S-band Receiver - Side View

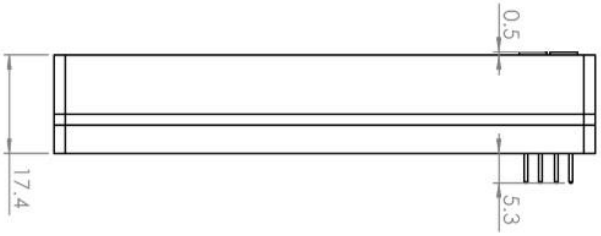


Figure 7: S-band Receiver - Side View

9 ENVIRONMENTAL AND MECHANICAL TESTING

A full campaign of qualification tests was performed on the qualification engineering model. Qualification tests, limits and duration followed the GEVS standard: GSFC-STD-7000A. The performed tests were:

- Random Vibration
- Sinusoidal Vibration
- Pyroshock Test
- Thermal Cycling
- Thermal Vacuum
- Total Ionizing Dose

10 MATERIALS AND PROCESSES

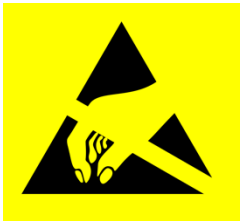
- Surface mount technology component placement
- Standard: IPC-A-610E Class 3
- Aluminum 6061 T651 box
- Visually inspected
- X-ray checked
- Functionally verified

11 HANDLING AND STORAGE

Particular attention shall be paid to the avoidance of damage to the module during handling, storage and preservation. The handling of the module should be performed in compliance with the following instructions:

- Handle using PVC, latex, cotton (lint free) or nylon gloves.
- The environment where the module will be handled shall meet the requirements of Class 100,000, and be free of contaminants such as dust, oil, grease, fumes and smoke from any source.
- Store in such a manner as to preclude stress and prevent damage
- To prevent deterioration, then the module shall be stored in a controlled environment, i.e. the temperature and humidity levels shall be maintained in the proper range:
    - Ideal storage temperature range: 15ºC to 27ºC
    - Ideal storage humidity range: 30% to 60% relative humidity (RH)

12 WARNINGS



This product uses semiconductors that can be damaged by electrostatic discharge (ESD). Observe precautions for handling

Sensitive electronic device. Do not ship or store near strong electrostatic, electromagnetic, magnetic or radioactive fields.

Communication module. Do not transmit without antenna or attenuator. Be mindful of RF interference.