DATASHEET

On-Board Computer (OBC) Type I

ON-BOARD COMPUTER (OBC) TYPE I
DATASHEET

This datasheet details the functions and features of EnduroSat's On-Board Computer (OBC) Type I.

Please read carefully the manual before unpacking the OBC in order to ensure safe and proper use.

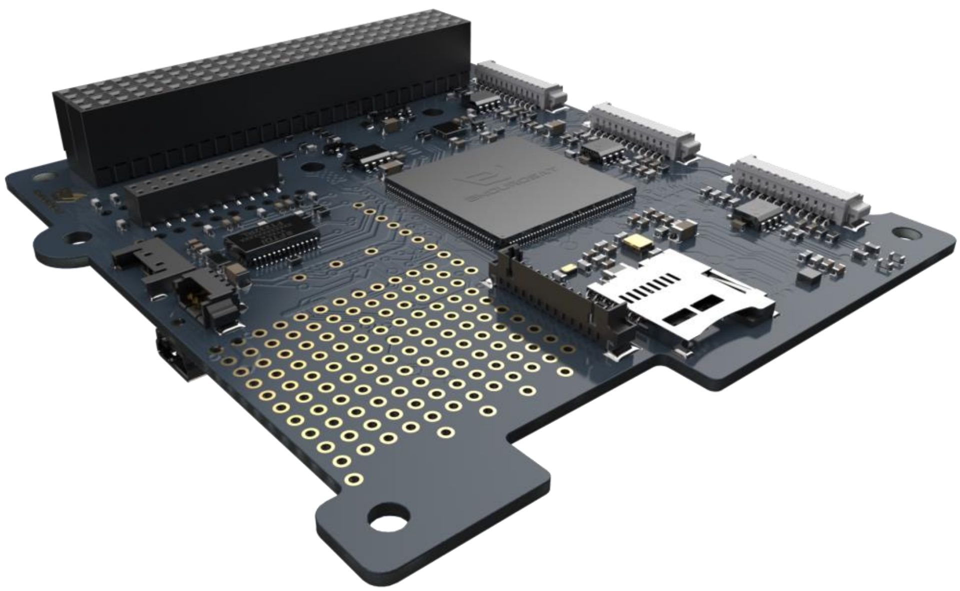

Figure 1: EnduroSat's On-Board Computer(OBC) Type I

1 CHANGE LOG

Date	Version	Note
19/07/2019	Rev 1	Initial document
18/10/2019	Rev 1.1	Minor text changes

2 ACRONYMS LIST

ADC	Analog to Digital Converter
ASIC	Application Specific Integrated Circuit
CAN	Controller Area Network
CSAC	Chip Scale Atomic Clock
ECSS	European Cooperation Space Standardization
EPS	Electrical Power System
ESA	European Space Agency
ESD	Electrostatic Discharge
GEVS	General Environmental Verification Standard.
GND	Ground
GPS	Global Positioning System
I2C	Inter-Integrated Circuit
OBC	Onboard Computer
PCB	Printed Circuit Board
PWM	Pulse Width Modulation
RAM	Random-Access Memory
RF	Radio Frequency
SD card	Secure Digital Card
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-High Frequency
USART	Universal Synchronous Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VCP	Virtual Communication (COM) Port

3 DESCRIPTION

EnduroSat's Onboard Computer Type I is a high-performance and low-power computing platform for nanosatellites. It is fully compatible with the CubeSat standard. It is based on an ARM Cortex M4 with a clock rate up to 180MHz or optionally on ARM Cortex M7 processor with a clock rate up to 216 MHz.

It comes with integrated double redundancy sensors: 3-axis accelerometers and a compass. An Attitude Determination and Control System (ADCS) can be implemented using the PWM peripheral outputs for the magnetorquers, and the peripheral inputs for the sun sensors, temperature sensors and gyroscope.

The OBC has a highly flexible third-party protoboard connector for easily connecting and integrating third-party modules which may contain additional sensors and ICs such as an atomic clock or a GPS receiver for example. This connector is also ideal for fast prototyping of external modules and test-bed modules. The pins to the protoboard connector can be configured by soldering or removing zero-ohm resistors. There are mechanical mounting holes on the OBC for convenient mechanical fixing of the third-party protoboard.

4 PRODUCT PERFORMANCE AND PROPERTIES

- ARM Cortex M4/M7 processor
- Clock rate: up to 180 MHz for M4, up to 216 MHz for M7
- ARM Cortex M4: 256kB RAM and 2MB Flash Memory
- ARM Cortex M7: 2MB RAM and 2MB Flash Memory
- MicroSD card slot
- Integrated double redundancy sensors: 3-axis accelerometer and compass
- 3x PWM drivers for magnetorquers
- OBC can be easily connected with external (provided on the EnduroSat solar panels):
  - 6x analog sun sensor
  - 6x external temperature sensors
  - 3x external gyroscopes
- Interfaces: CAN (not supported by software), 2x USART, UART, 2x I2C, 2x SPI, USB (VCP)
- Real Time Clock
- Flexible clock eco-mode
- Weight: 58 g.
- 256Mbit Serial NOR Flash Memory
- 64Mbit Static RAM (Optional)
- Connector for antenna deployment
- Protoboard area for easy connection of payload and access to main power and communication buses.

5 ELECTRICAL CHARACTERISTICS

Parameter	Unit	Condition	Min	Typ	Max
Supply voltage	V		3	3.3	3.6
Supply current	mA	STM32F427 @185Mhz		104	123
	mA	STM32F427 @120Mhz		58	72
	mA	STM32F427 @60Mhz		30	38
	mA	STM32F427 @16Mhz		13	27
	µA	3-Axis Accelerometer – Normal Mode[1]	200		400
	µA	3-Axis Accelerometer – Low Power Mode[1]	8		12
	µA	3-Axis Accelerometer – Power Down Mode[1]	0.1		2
	µA	3-Axis Digital Compass – Power Down Mode[2]		1	
	µA	3-Axis Digital Compass - Measurement Mode[2] – Low Power Mode		40	
		3-Axis Digital Compass - Measurement Mode[2] – High Resolution Mode		280	
	mA	Ext. 64M-bit Static RAM (Opt.), F = 18Mhz		45	55
	mA	Ext. 64M-bit Static RAM (Opt.), F = 1MHz		7.5	9
	µA	Ext. 64M-bit Static RAM (Opt.), Stand-By Mode		8	48
	mA	Ext. 1Gbit NOR Flash Memory Operational Mode @108Mhz (fast-read extended I/O)		4	15
	mA	Ext. 1Gbit NOR Flash Memory Operational Mode @54Mhz (fast-read extended I/O)		6	6
	mA	Ext. 1Gbit NOR Flash Memory Operational Mode @108Mhz (fast-read dual I/O)			18
	mA	Ext. 1Gbit NOR Flash Memory Operational Mode @108Mhz (Operating current (fast-read quad I/O)			20
	µA	Ext. 1Gbit NOR Flash Memory Operational Mode Stand by Mode			200
Bi-directional PWM Outputs	mA	@3.3V			3000
Operating Temperature	°C		-30		85
Storage Temperature	°C			25	

Table 1: Electrical Characteristics

[1] Current consumption is for one 3-Axis Accelerometer. The OBC has two identical sensors on the same location, but on opposite sides of the PCB.

[2] Current consumption is for one 3-Axis Digital Compass. The OBC has two identical sensors on the same location, but on opposite sides of the PCB

6 INTERFACE DIAGRAM

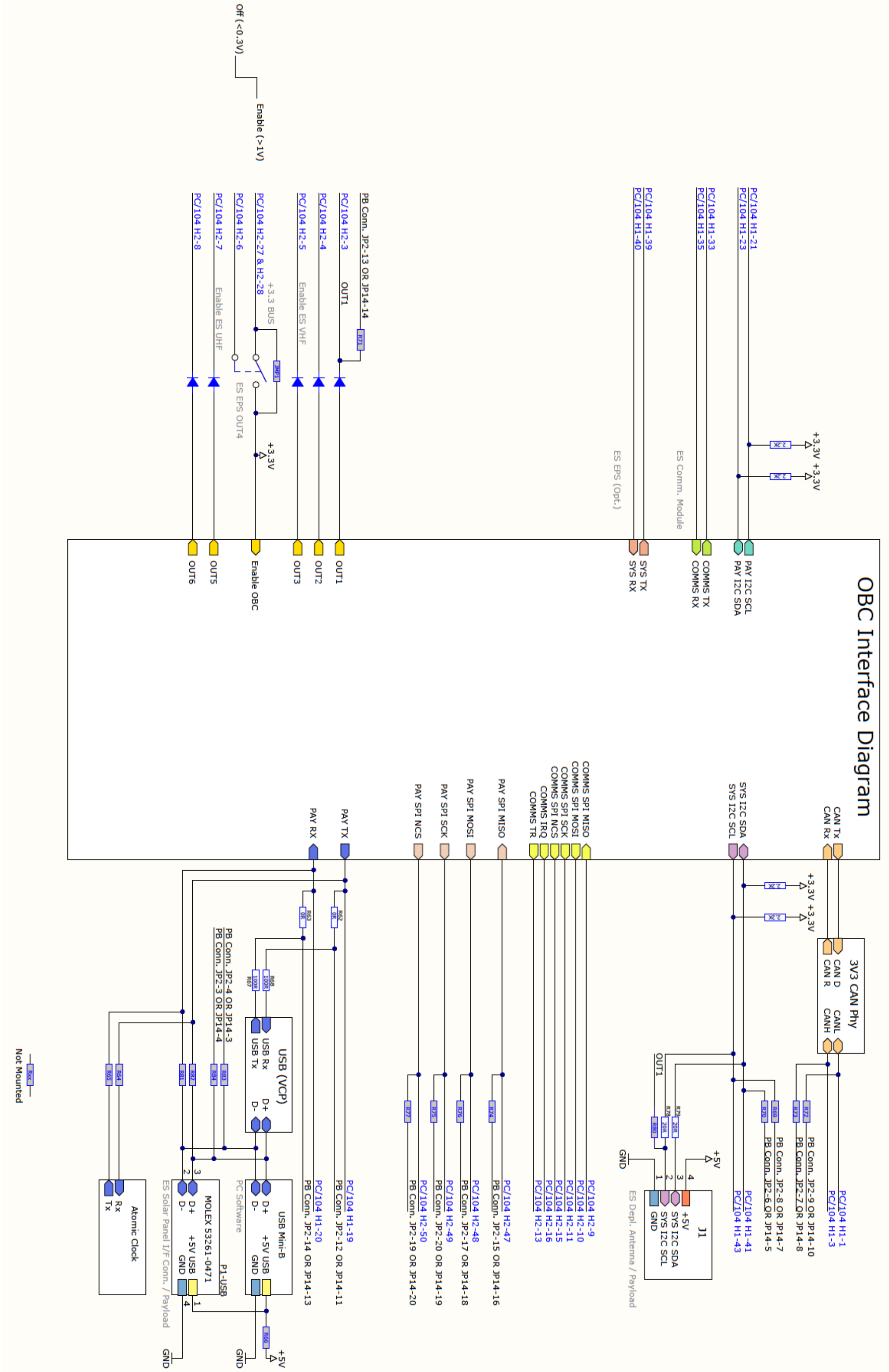

Figure 2: Interface Diagram

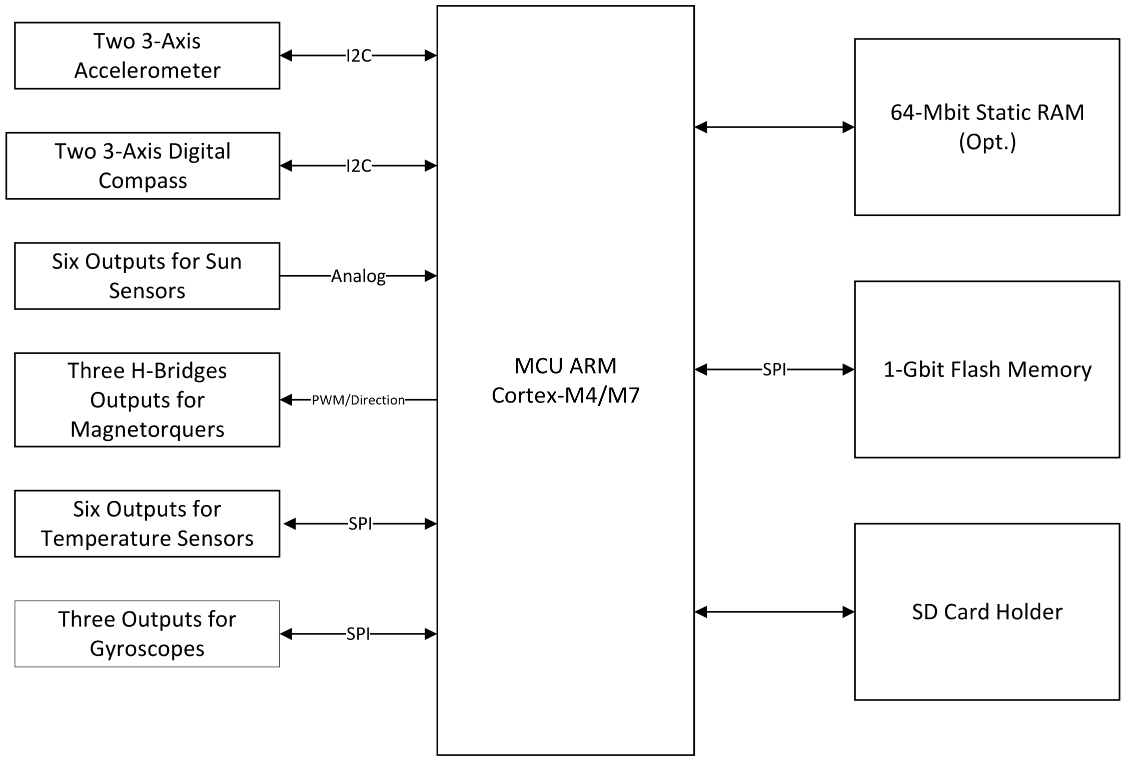

Figure 3: Peripherals of the OBC's Microcontroller

7 COMMUNICATION INTERFACES

7.1 CAN

EnduroSat's On-Board Computer(OBC) has a CAN bus interface using a 3.3V CAN transceiver.

The CAN interface of external modules should be connected to header 1, pins 1 and 3 (H1-1 and H1-3) of the PC/104 connector.

The same CAN interface can be reached from the protoboard area using the JP2 and JP14 connectors (TLE-110-01-G-DV). In this case, the zero Ohm resistors R72 and R73 should be mounted as shown in Figure .

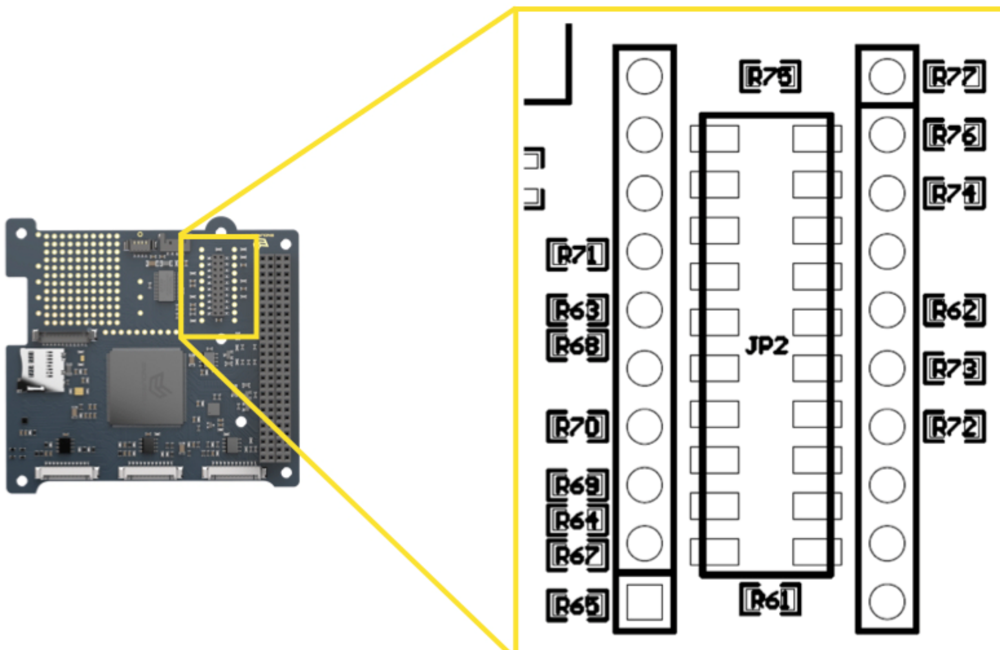

Figure 4: Protoboard Connector and Zero-Ohm Resistor Jumpers

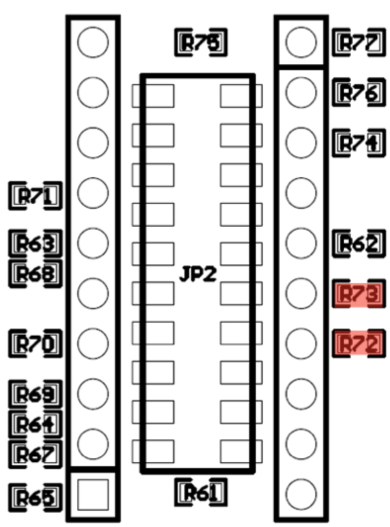

Figure 5: CAN Resistors R72 and R73

7.2 USART and UART

EnduroSat's On-Board Computer(OBC) provides two USART interfaces and one UART interface.

The first USART interface (H1-33 and H1-35) is used by EnduroSat's UHF Transceiver.

The second USART interface is left free for the payload (H1-19 and H1-20). If the USB peripheral is mounted (Figure), then this interface is used for UART to USB communication (VCP).

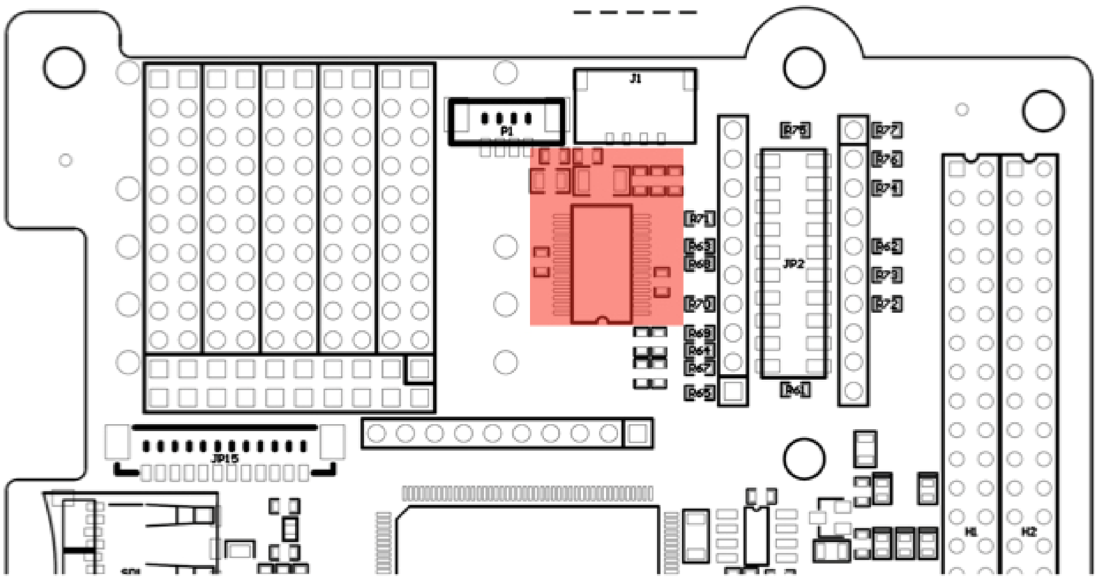

Figure 6: USB Peripheral Location

Mounting zero Ohm resistors on R62 and R63 gives access to this interface through the connectors JP2 or JP14 on the protoboard area as shown in Figure 7.

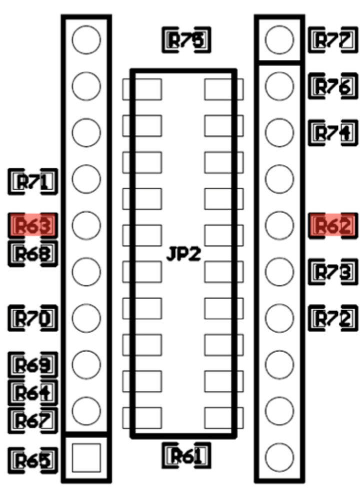

Figure 7: Necesery Zero Ohm resistors to connect Payload USART to Protoboard connector

For USB (VCP) R62, R63, R67 & R68 as shown on figure 8.

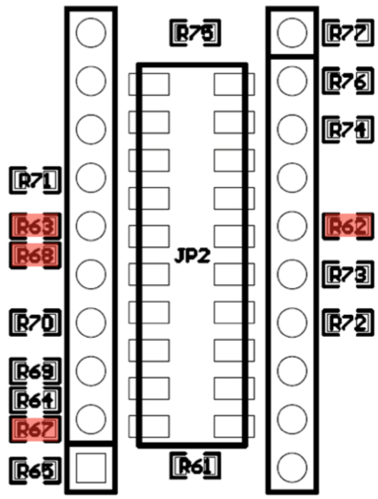

Figure 8: Necesery Zero Ohm resistors to connect Payload USART to USB (VCP) connector

For USART on “P1-USB” R82, R81 as shown on figure 9.

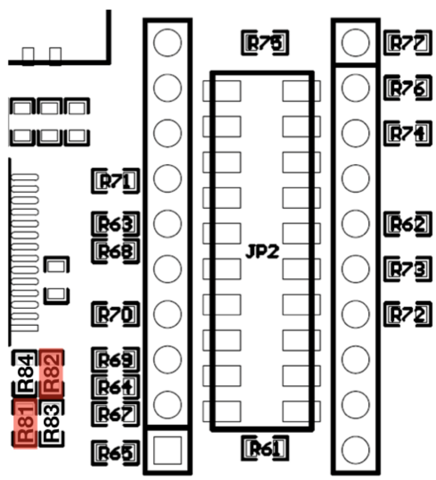

Figure 9: Necesery Zero Ohm resistors to connect Payload USART to Molex connector P1

Moreover, the same interface can be used for communication with atomic clock if it is mounted on the ProtoBoard area (Microsemi Quantum™ SA.45s CSAC). To realize the communication with the atomic clock, zero-ohm resistors – R62, R63, R64 and R65 have to be mounted as shown in Figure 10.

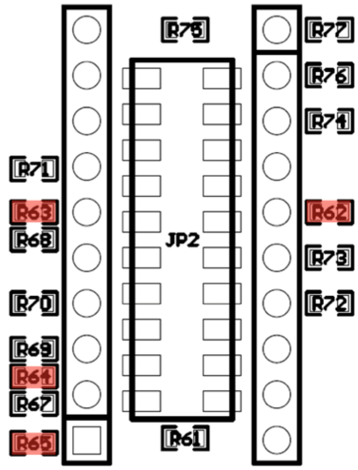

Figure 10: Necesery Zero Ohm resistors to connect Payload USART to External Atomic clock

UART – is free for payload and it can be access through H1-39 / H1-40 (EnduroSat EPS Opt.).

7.3 SPI

Two 3.3V SPI interfaces are provided.

In the EnduroSat CubeSat platform the first SPI interface (H2-9, H2-10, H2-11, H2-15 and H2-16 of the PC104 connector) is used for the EnduroSat S-Band transceiver.

The second SPI interface (H2-47, H2-48, H2-49 and H2-50 of the PC104 connector) can be used for the payload or for generic user needs.

The second SPI interface also can be accessed through JP2 or JP14 of the ProtoBoard area mounting zero Ohm resistors R74, R75, R76 and R77 as shown in Figure 11.

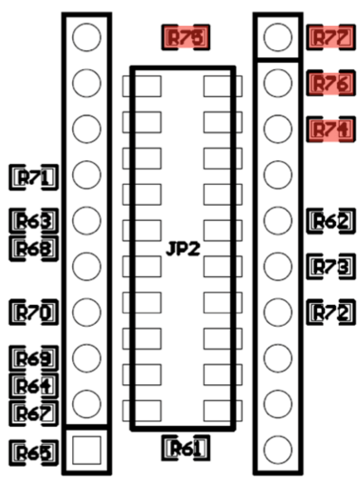

Figure 11: Necesery Zero Ohm resistors to connect Payload SPI to Protoboard connector

7.4 I²C

Two 3.3V I²C interfaces are provided.

First I²C interface (H1-41 and H1-43 of the PC104 connector) can be used as main interface among all the subsystems of the satellite.

Second I²C interface (H1-21 and H1-23 of the PC104 connector) can be used for the payload and to control the deployment of the EnduroSat UHF Antenna through the connector J1 located on the ProtoBoard area. To realize the access through JP2 or JP14, zero Ohm resistors R69 and R70 and have to be mounted (Figure 12).

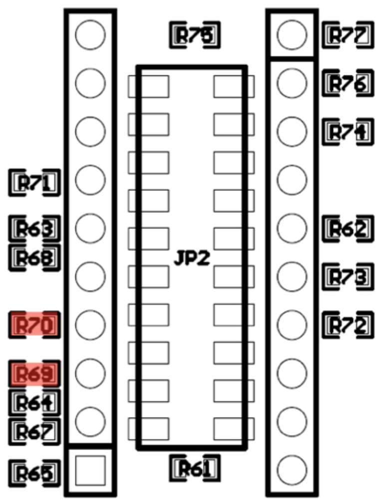

Figure 12: Necesery Zero Ohm resistors to connect System I2C to Protoboard connector

7.5 Six General Purpose Outputs

The OBC module has five general purpose outputs. Each output can be switched between 3.1V and Ground. All outputs are protected with diodes. In this way other modules can control the same outputs (there are 10k pull-down resistors on the EnduroSat EPS Type I Module). A diode OR gate can be realized.

8 SENSORS FOR ATTITUDE DETERMINATION AND CONTROL

EnduroSat's On-Board Computer(OBC) comes with an embedded array of sensors for the attitude determination and outputs for control of the magnetorquers.

8.1 Compass

Two 3-axis digital compasses designed for low-field magnetic sensing with high-resolution are included on the OBC as peripherals. Both sensors are located at the same place, but on opposite sides of the OBC. The compass is based on magneto-resistive sensors plus an ASIC containing amplification, automatic degaussing strap drivers, offset cancellation, and a 12-bit ADC that enables 1° to 2° compass heading accuracy. Compass utilizes Anisotropic Magneto-resistive (AMR) technology that provides advantages over other magnetic sensor technologies. These anisotropic, directional sensors feature precision in-axis sensitivity and linearity. These sensors have a solid-state construction with very low cross-axis sensitivity and are designed to measure both the direction and the magnitude of the Earth's magnetic field, from milli-gauss to 8 gauss.

8.2 Accelerometers

Two high-performance ultra low-power 3-axis accelerometers are added as OBC peripherals. Both are placed at the same location but on opposite sides of the PCB. The accelerometers have dynamic user-selectable full-scales of ±2g/±4g/±8g and are capable of measuring accelerations with output data rates from 0.5 Hz to 1 kHz

8.3 Sun sensors

Six analog inputs for sun sensors. The current OBC has filters and amplifiers optimized for the sun sensors on EnduroSat's Solar Panels.

8.4 Temperature sensors

Six external temperature sensors with SPI communication interface can be connected to the OBC.

8.5 Magnetorquers control

Three independent outputs for control of the magnetorquers. The control of the magnetorquers is realised using a H-Bridge with 3.3V and maximum output current of 3A.

Sensor	Parameter	Unit	Condition	Min	Typ	Max
Two 3-Axis Digital Compass						
	Measurement Range	gauss	Full scale	-16		+16
	Sensitivity	LSb/gauss	±4		6842	1370
			±8		3421	
			±12		2281	
			±16		1711	
Two 3-Axis Accelerometer						
	Measurement range				±2g/±4g/±8g	
	Output Data Rate	Hz		0.5		1000

Table 2: Parameters of the Magnetorquers

9 OBC PROTOBOARD AREA

9.1 USB interface

An additional USB interface can be provided on the ProtoBoard area. This interface gives accessibility to an external device/PC (Master device) to communicate with the OBC Microcontroller (Slave device). The OBC USB interface is based on IC FT232RL - UART to USB interface (VCP). Full driver support can be found at http://www.ftdichip.com.

EnduroSat's On-Board Computer(OBC) Type I comes with electronic components for the USB Interface already mounted on it.

The USB interface can be accessed from the PC/104 connector (Tx) H-19 and (Rx) H-20. Moreover, it can be also accessed from the 20 pin headers "JP2" on the top side of the OBC through pin 11(Rx) and pin 12(Tx) or "JP14" on the bottom side through pin 12 (Rx) and pin 11 (Tx). To realize the access through "JP2" and "JP14", zero Ohm resistors R62, R63, R67 and R68 have to be mounted as shown in Figure 8.

Two types of connectors can be used to access the USB Interface: standard USB Mini B Connector (USB1) or Molex 53398-0471 (P1). When EnduroSat's Solar Panel with a Remove Before Flight (RBF) is used in the platform, then connection to it can be realized using the OBC Molex 53398-0471 and an EnduroSat 4 pin cable. In this way, when the CubeSat is fully assembled, the OBC USB interface can be accessed with EnduroSat's external USB adapter. For more information check the datasheet of a solar panel, and find a chapter with the information about "Satellite Communication Interface Connector (SCIC)". Both USB connectors can be connected to the ProtoBoard Connectors "JP2" (DM – pin3 / DP – pin4) and "JP14" (DM – pin4 / DP – pin3) when zero Ohm resistors are mounted on R83 and R84 (Figure 13).

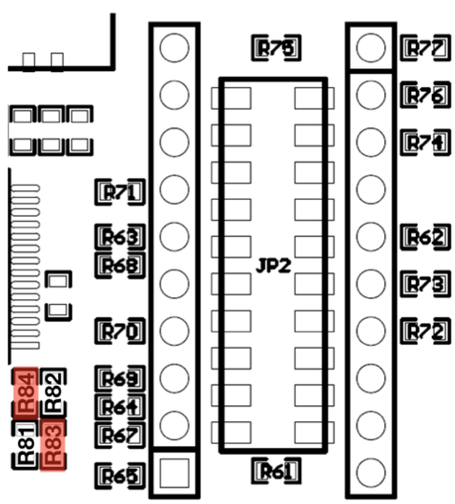

Figure 13: Necesery Zero Ohm resistors to connect USB sygnals to Protoboard connector

9.2 External PCB (Payload)

An external PCB (Payload) can be connected to the connector located on the ProtoBoard Area. Additional mounting holes are also provided. The ProtoBoard connector is the 20pin SAMTEC TLE-110-01-G-DV. One is on the top side (JP2) of the OBC and the other on the bottom (JP14 -Not Mounted). This allows minimization of the used space inside the satellite and easy access to different communication interfaces and power supplies. The interfaces on the ProtoBoard connectors should be chosen very carefully, because they are shared with the main PC/104 connector. All pins of the ProtoBoard connectors are separated from the rest of the OBC when zero Ohm resistors are not mounted. Each pin of the ProtoBoard connector has its own testing point located just next to it for research and development purposes. All test points are plated holes with pitch 0.1inch (2.54mm) and diameter of 0.060inch.

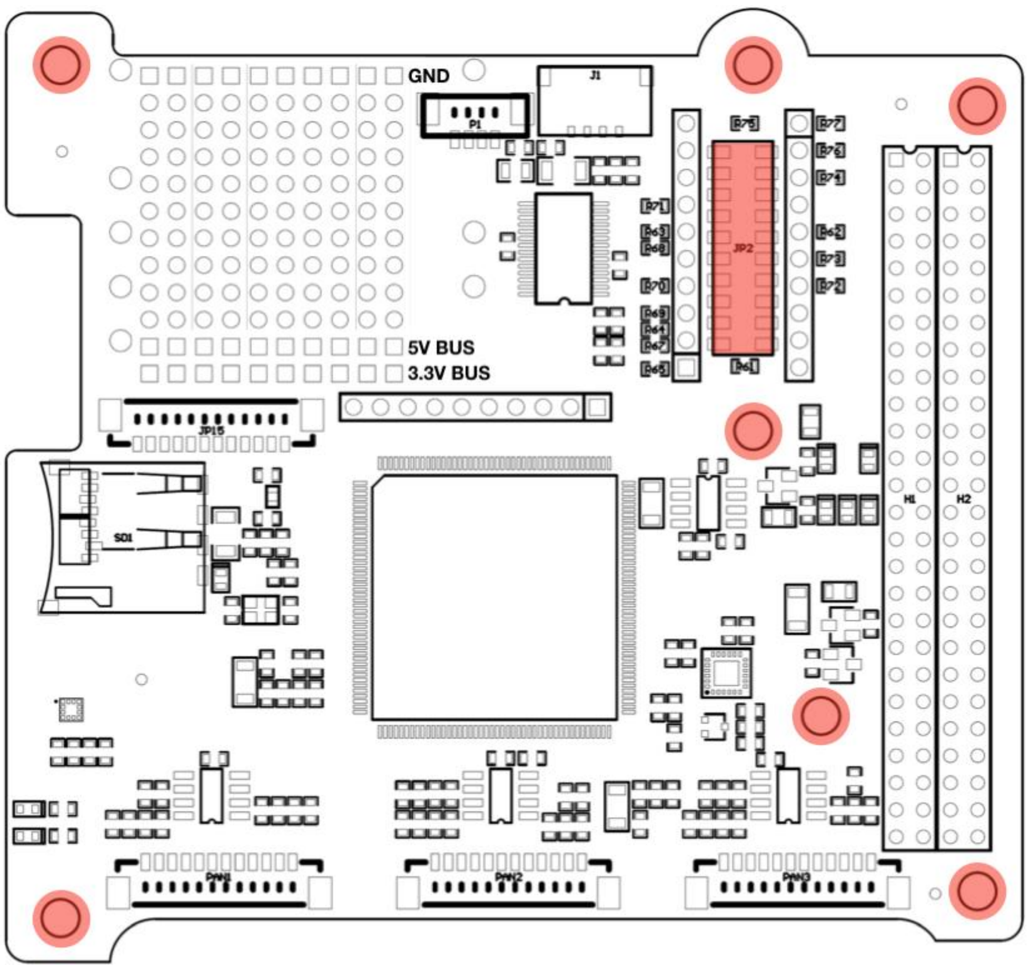

Figure 14: External PCB

9.3 Stripboard Grid

For developing and prototyping purposes an area of OBC is left as a stripboard grid with 11 holes on 16 strips. All holes are plated with grid spacing of 0.1inch(2.54mm) and diameter of 0.060inch. All holes in the first strip are connected to the 5V BUS, in the second strip to 3.3V BUS and the last one to GND. These power strips can be recognized by the square rings.

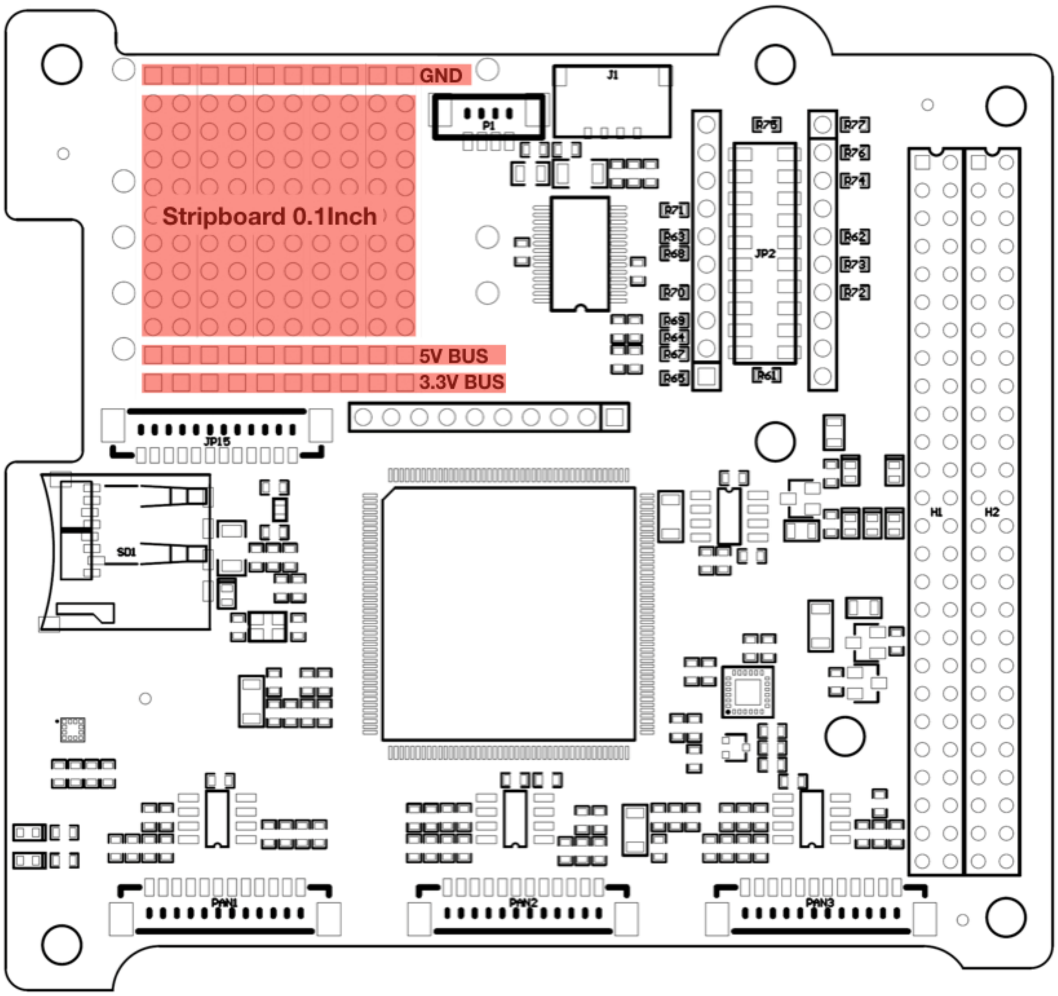

Figure 15: Stripboard Grid

9.4 Atomic Clock Ready

On the protoboard area, there are mounting holes for Quantum™ SA.45s Chip Scale Atomic Clock from Microsemi. UART interface can be connected through zero Ohm resistors. Access to other pins of the atomic clock can be realized with plated holes next to each pin.

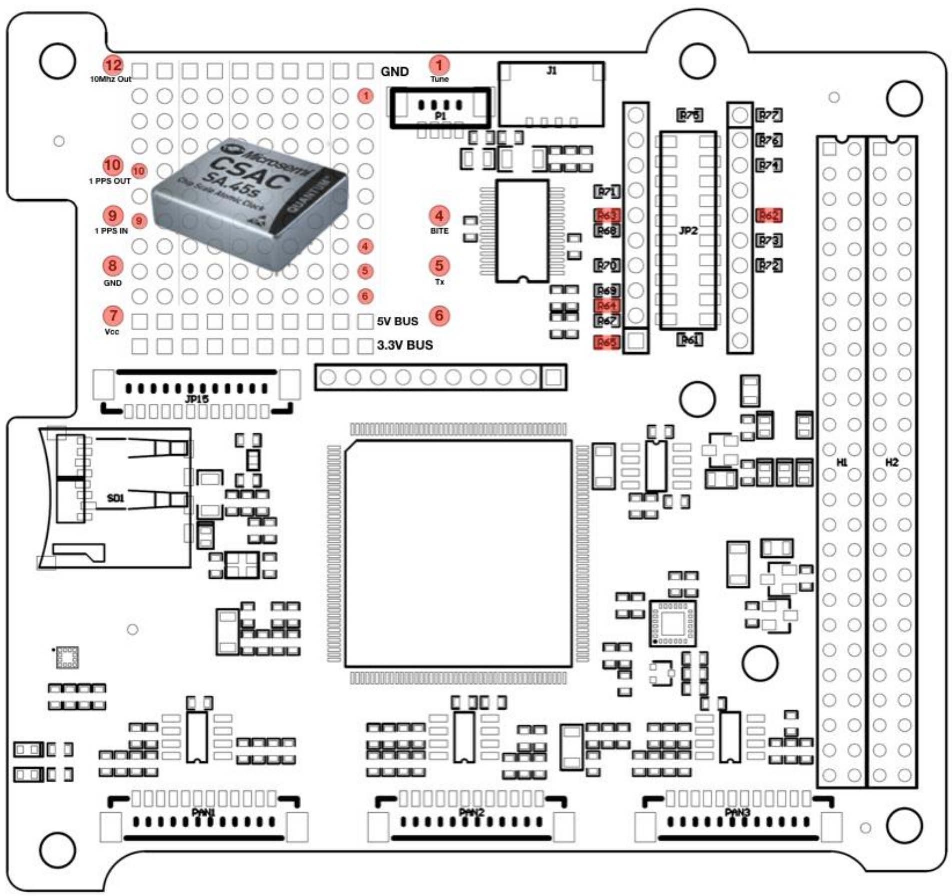

Figure 16: Atomic Clock Pins

9.5 SD Card Holder

Direct access to SD Card holder is enabled through the 12 pin connector JP15 – Molex 53398-1271. The SD card is shared with the high speed data payload and the OBC to resend data if required through the RF communication module.

10 CONNECTOR PINOUT

10.1 Connector Location

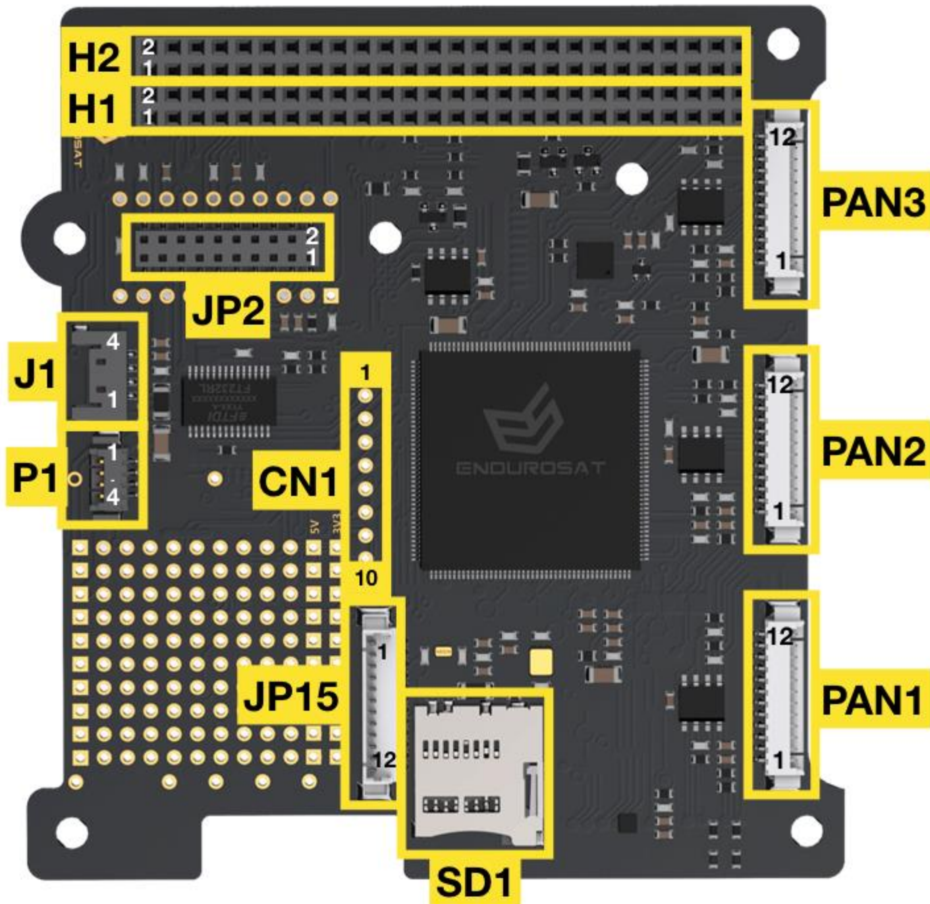

Figure 17: Connector Location on Top Side

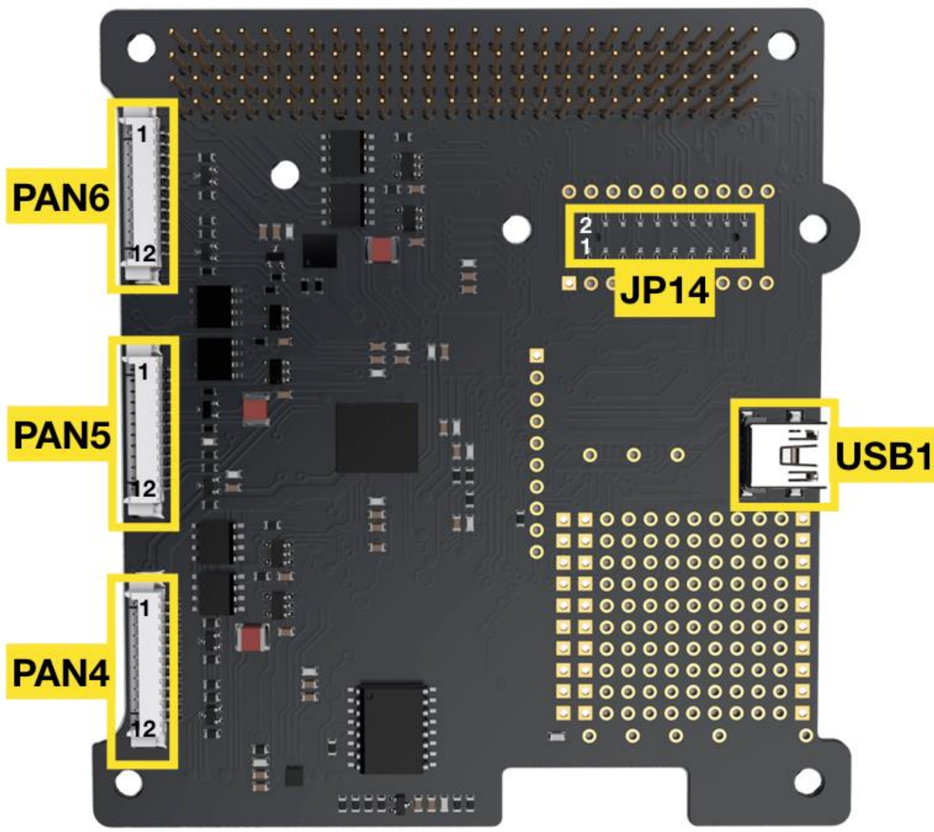

Figure 18: Connector Location on Bottom Side

10.2 H1 & H2 Stack Connector

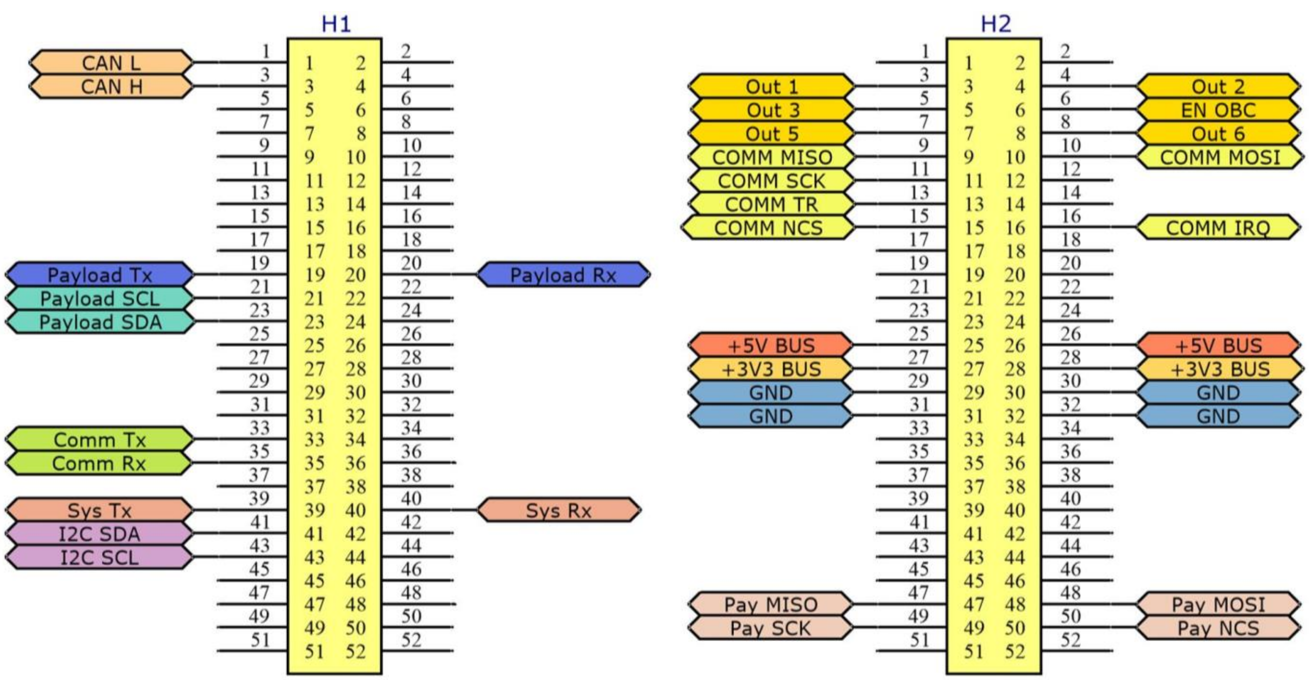

Figure 19: Header 1 & 2 Stack connectors

H1		
Pin	Mnemonic	Description
H1-1	CANL	CAN communication Low (3.3V)
H1-3	CANH	CAN communication High (3.3V)
H1-19	PAY_TX	USART payload transmit data
H1-20	PAY_RX	USART payload receive data
H1-21	PAY_SCL	I2C for payload
H1-23	PAY_SDA	I2C for payload
H1-33	UHF RX	USART UHF module transmit data (optional EnduroSat EPS)
H1-35	UHF TX	USART UHF module receive data (optional EnduroSat EPS)
H1-39	SYS_TX	UART transmit data
H1-40	SYS_RX	UART receive data
H1-41	SYS_SDA	I2C between sub-systems
H1-43	SYS_SCL	I2C between sub-systems

Table 3: Pinout Description of Stack Connector Header 1

H2		
Pin	Mnemonic	Description
H2-3	OBC_OUT1	Universal Output 1
H2-4	OBC_OUT2	Universal Output 2
H2-5	OBC_OUT3	Universal Output 3
H2-6	EN_OBC	Enable OBC (to turn on the OBC)
H2-7	OBC_OUT5	Universal Output 5
H2-8	OBC_OUT6	Universal Output 6
H2-9	SPI MISO	SPI MISO
H2-10	SPI MOSI	SPI MOSI
H2-11	SPI SCK	SPI SCK
H2-13	SPI TR	SPI TR
H2-15	SPI CS	SPI CS
H2-16	SPI IRQ	SPI IRQ
H2-25	+5V	+5V BUS
H2-26	+5V	+5V BUS
H2-27	3V3	+3.3V BUS
H2-28	3V3	+3.3V BUS
H2-29	GND	Ground
H2-30	GND	Ground
H2-31	GND	Ground
H2-32	GND	Ground
H2-47	PAY_MISO	SPI Payload
H2-48	PAY_MOSI	SPI Payload

H2-49	PAY_SCK	SPI Payload
H2-50	PAY_NCS	SPI Payload

Table 4: Pinout Description of Stack Connector Header 2

10.3 PAN1, PAN2 and PAN3

Picoblade 12 pin connectors PAN1, PAN2 and PAN3 are located on the top side of the OBC as shown in Figure 20.

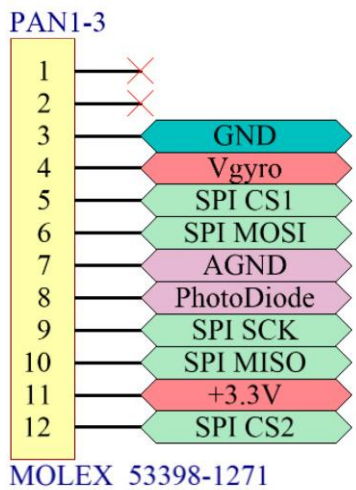

Figure 20: Picoblade 12 Pin Connectors (PAN1, PAN2, PAN3)

Pin	Mnemonic	Description
1	NC	Not connected
2	NC	Not connected
3	GND	Ground
4	Vgyro	Power for gyroscope
5	SPI CS1	SPI chip select for gyroscope
6	SPI MOSI	SPI (for gyroscope and temperature sensor)
7	AGND	Photodiode Analog Ground
8	PhotoDiode	Photodiode signal
9	SPI SCK	SPI (for gyroscope and temperature sensor)
10	SPI MISO	SPI (for gyroscope and temperature sensor)
11	+3.3V	+3.3V BUS power supply for sensors
12	SPI CS2	SPI chip select for temperature sensor

Table 5: Picoblade 12 Pin Connectors (PAN1, PAN2, PAN3)

10.4 PAN4, PAN5 and PAN6

Picoblade 12 pins connectors PAN4, PAN5 and PAN6 are located on the bottom side of the OBC as shown in Figure 21.

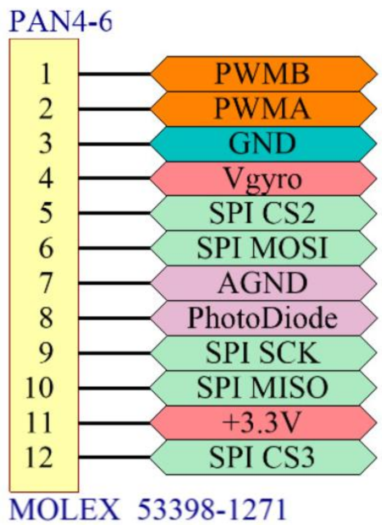

Figure 21: Picoblade 12 Pin Connectors (PAN4, PAN5, PAN6)

Pin	Mnemonic	Description
1	PWMB	PWM (in/out)
2	PWMA	PWM (out/in)
3	GND	Ground
4	Vgyro	Power for gyroscope
5	SPI CS1	SPI chip select for gyroscope
6	SPI MOSI	SPI (for gyroscope and temperature sensor)
7	AGND	Photodiode Analog Ground
8	PhotoDiode	Photodiode signal
9	SPI SCK	SPI (for gyroscope and temperature sensor)
10	SPI MISO	SPI (for gyroscope and temperature sensor)
11	+3.3V	+3.3V BUS power supply for sensors
12	SPI CS2	SPI chip select for temperature sensor

Table 6: Picoblade 12 Pin Connectors (PAN4, PAN5, PAN6)

10.5 JP2

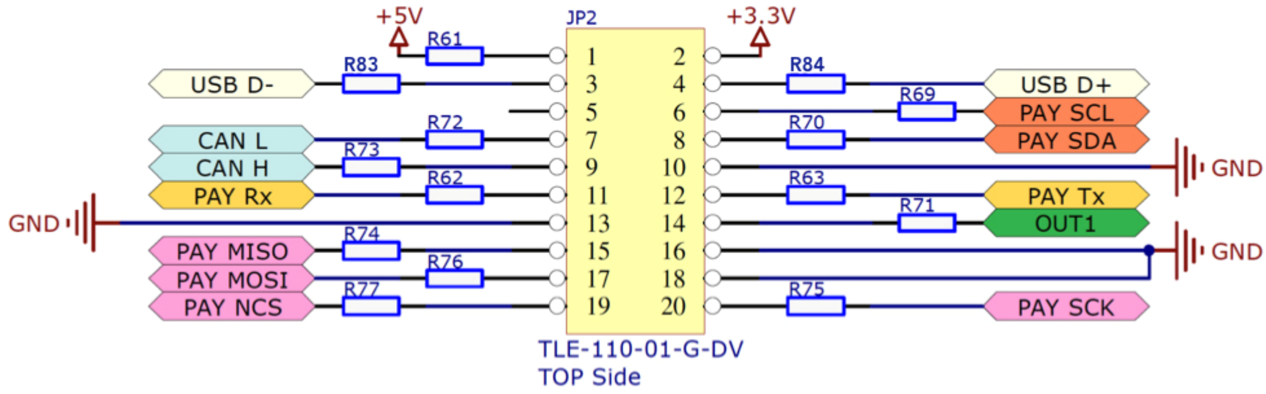

Figure 22: JP2 Interface Diagram

JP2		
Pin	Mnemonic	Description
1	+5V	+5V BUS
2	+3.3V	+3.3V BUS
3	USB D-	USB data -
4	USB D+	USB data +
5		Not connected
6	PAY SCL	I2C payload
7	CAN L	CAN Low (3.3V)
8	PAY SDA	I2C payload
9	CAN H	CAN High (3.3V)
10	GND	Ground
11	PAY Rx	USART receive data
12	PAY Tx	USART transmit data
13	GND	Ground
14	OUT1	Universal output 1
15	PAY MISO	SPI payload
16	GND	Ground
17	PAY MOSI	SPI payload
18	GND	Ground
19	PAY NCS	SPI payload
20	PAY SCK	SPI payload

Table 7: JP2 Pin Description

10.6 JP14

JP14		
Pin	Mnemonic	Description
1	+3.3V	+3.3V BUS
2	+5V	+5V BUS
3	USB D+	USB data +
4	USB D-	USB data -
5	PAY SCL	I2C payload
6		Not connected
7	PAY SDA	I2C payload
8	CAN L	CAN Low (3.3V)
9	GND	Ground
10	CAN H	CAN High (3.3V)
11	PAY Tx	USART transmit data
12	PAY Rx	USART receive data
13	OUT1	Universal output 1
14	GND	Ground
15	GND	Ground
16	PAY MISO	SPI payload
17	GND	Ground
18	PAY MOSI	SPI payload
19	PAY SCK	SPI payload
20	PAYNCS	SPI payload

Table 8: JP14 Pin Description

10.7 J1

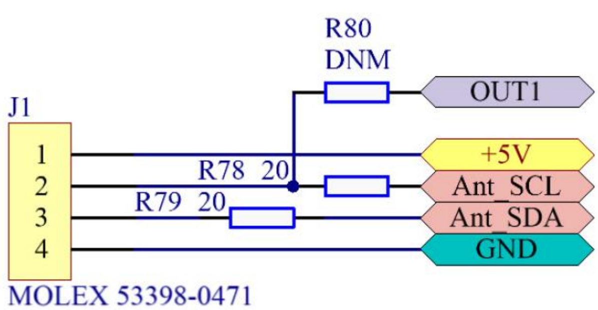

Figure 23: J1 Interface Diagram

J1		
Pin	Mnemonic	Description
1	+5V	+5V BUS
2	Ant_SCL / OUT1	I2C UHF antenna / Universal output 1
3	Ant_SDA	I2C UHF antenna
4	GND	Ground

Table 9: J1 Pin Description

10.8 JP15

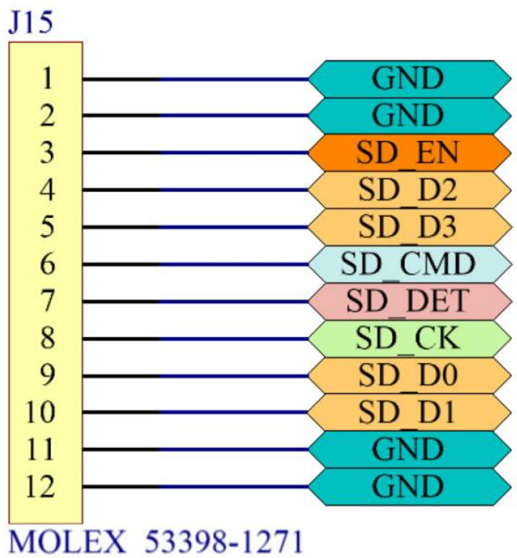

Figure 24: JP15 Connector

Pin	Mnemonic	Description
1	GND	Ground
2	GND	Ground
3	SD_EN	SD Enable
4	SD_D2	SD data 2
5	SD_D3	SD data 3
6	SD_CMD	SD command I/O
7	SD_DET	SD detect
8	SD_CK	SD clock
9	SD_D0	SD data 0
10	SD_D1	SD data 1
11	GND	Ground
12	GND	Ground

Table 10: JP15 Pin Description

10.9 CN1

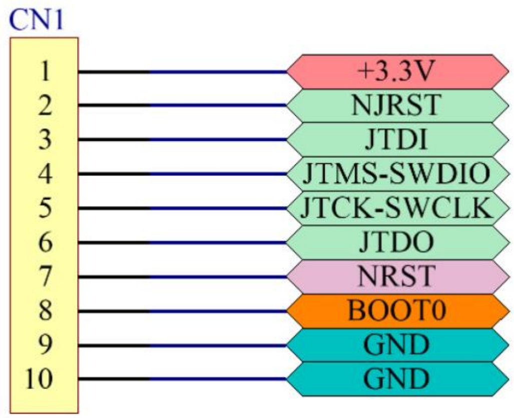

Figure 25: CN1 Connector

Pin	Mnemonic	Description
1	+3.3V	+3.3V BUS
2	NJRST	JTAG Test nReset
3	JTDI	JTAG Test Data Input
4	JTMS-SWDIO	JTAG Test Mode Selection / Serial Wire Data I/O
5	JTCK-SWCLK	JTAG Test Clock / Serial Wire Clock
6	JTDO	JTAG Test Data Output
7	NRST	External Reset
8	BOOT0	Boot Configuration
9	GND	Ground
10	GND	Ground

Table 11: CN1 Pin Description

10.10 SD1

Pin	Signal	Description
1	Data2	Data signal 1
2	Data3	Data signal 2
3	CMD I/O	input and output command
4	GND	supply voltage negative
5	VDD	supply voltage positive
6	CLK	clock signal
7	GND	supply voltage negative
8	Data0	data signal 0
9	Data1	data signal 1

Table 12: SD1 Pin Description

10.11 P1

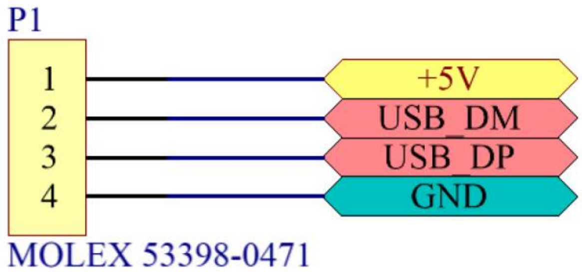

Figure 26: P1 Connector

Pin	Mnemonic	Description
1	+5V	+5V USB
2	USB_DM	USB data -
3	USB_DP	USB data +
4	GND	Ground

Table 13: P1 Pin Description

11 MECHANICAL CHARACTERISTICS

In this section, the main dimensions of the OBC are shown. All dimensions are in mm. A STEP file can be provided upon request.

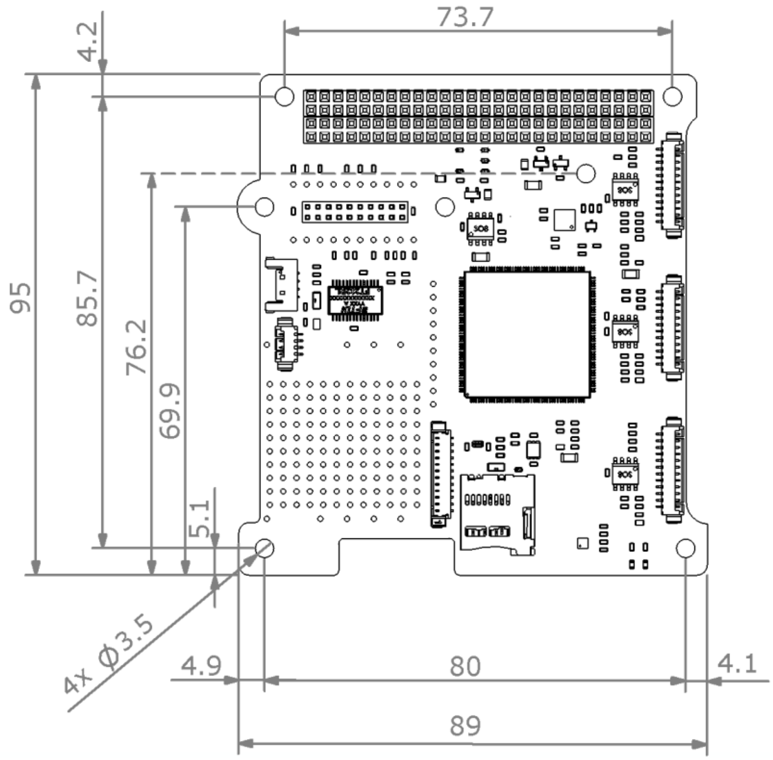

Figure 27: OBC Top View

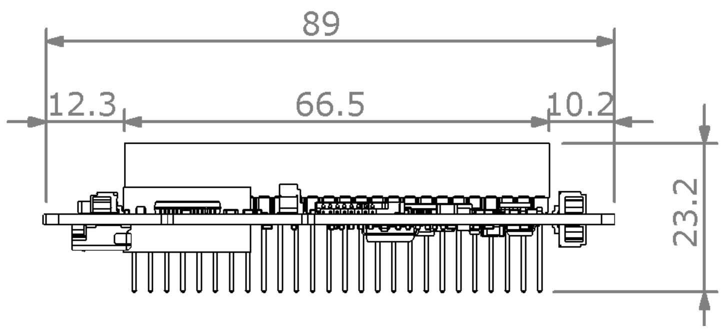

Figure 28: OBC Side View

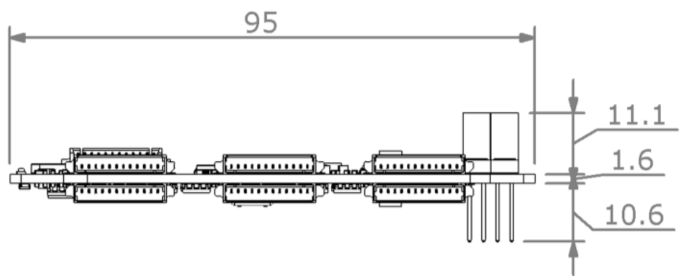

Figure 29: OBC Side View

12 ASSEMBLING

The production process follows the quality standards:

- PC-A-610E, class 3 (Acceptability of Electronic Assemblies)
- IPC-A-600 (Acceptability of Printed Boards)
- J-STD-001 (Requirements for Soldered Electrical and Electronic Assemblies)
- ISO 14644 (Cleanrooms and Associated Controlled Environments)
- IEC 61340 (Electrostatics ESD: Protection of Electronic Devices from Electrostatic Phenomena)

Conformal coating:

- Outgassing requirements: NASA SP-R-0022A
- Thickness tolerance: NASA-STD-8793.

13 ENVIRONMENTAL AND MECHANICAL TESTS

A full campaign of tests at qualification level was performed on the On-Board Computer(OBC) qualification engineering model. Qualification test levels and duration follow the ESA standard ECSS-E-ST-10-03C and GEVS: GSFC-STD-7000A. Tests performed:

- Thermal Cycling
- Thermal Vacuum
- Random Vibration
- Sine Vibration
- Shock Test

Space qualification campaign link: https://www.endurosat.com/space-qualification/

14 HANDLING AND STORAGE

Particular attention shall be paid to the avoidance of damage to the On-Board Computer(OBC) during handling, storage and preservation. The handling of the OBC should be performed in compliance with the following instructions:

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

15 WARNINGS

This product uses very fragile components. Observe precautions for handling.

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.