



USER MANUAL

Onboard Computer (OBC)

| | | |
|-------|---|----|
| 1 | Change Log | 4 |
| 2 | Acronyms List | 5 |
| 3 | Description | 6 |
| 4 | Product Performance And Properties..... | 6 |
| 5 | Electrical Characteristic..... | 7 |
| 6 | Block Diagram | 8 |
| 7 | Communication Interfaces | 10 |
| 7.1 | CAN..... | 10 |
| 7.2 | USART And UART | 11 |
| 7.3 | SPI..... | 12 |
| 7.4 | I ² C..... | 13 |
| 7.5 | Six General Purpose Outputs | 13 |
| 8 | Attitude Determination And Control System | 13 |
| 8.1 | Compass | 13 |
| 8.2 | Accelerometers | 14 |
| 8.3 | Sun Sensors | 14 |
| 8.4 | Temperature Sensors..... | 14 |
| 8.5 | Magnetorquers Control | 14 |
| 9 | OBC Protoboard Area..... | 15 |
| 9.1 | USB Interface..... | 15 |
| 9.2 | External PCB (Payload) | 16 |
| 9.3 | Stripboard Grid | 17 |
| 9.4 | Atomic Clock Ready..... | 18 |
| 9.5 | SD Card Holder..... | 18 |
| 10 | Connector Pinout..... | 19 |
| 10.1 | Connectors Location..... | 19 |
| 10.2 | H1 & H2 Stack Connector..... | 21 |
| 10.3 | PAN1, PAN2 And PAN3..... | 23 |
| 10.4 | PAN4, PAN5 And PAN6..... | 24 |
| 10.5 | JP2 | 25 |
| 10.6 | JP14 | 26 |
| 10.7 | J1 | 27 |
| 10.8 | JP15 | 28 |
| 10.9 | CN1 | 29 |
| 10.10 | SD1 | 29 |
| 10.11 | P1 | 30 |

11 Mechanical Characteristics 31

12 Assembling 32

13 Environmental And Mechanical Tests 32

14 Included In The Shipment 32

15 Handling And Storage 33

16 Warnings 34

ONBOARD COMPUTER (OBC)

USER MANUAL

This user manual is specially designed to detail the EnduroSat onboard computer (OBC), functions and features.

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

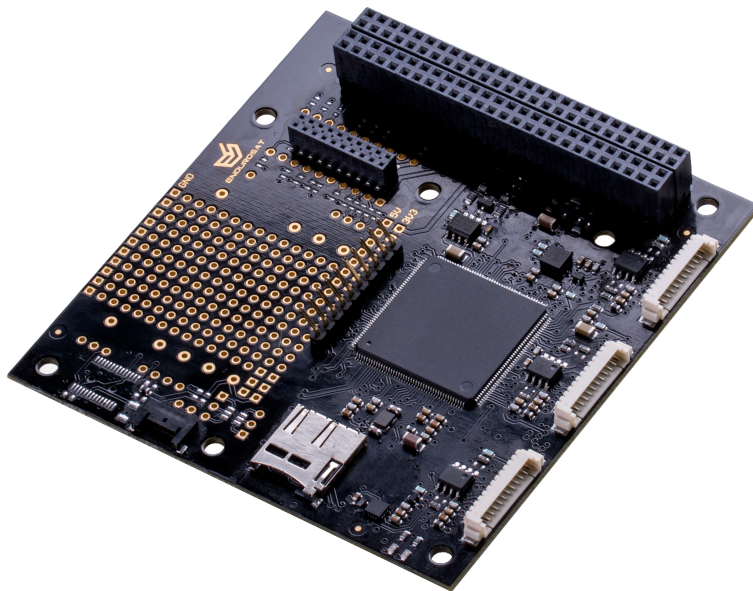


Figure 1 – Onboard computer (OBC)

1 CHANGE LOG

| Date | Version | Note |
|------------|---------|------|
| 17/11/2016 | Rev 1 | |

2 ACRONYMS LIST

| | |
|----------|---|
| ASIC | Application Specific Integrated Circuit |
| CAN | Controller Area Network |
| COM-port | Communication Port |
| CSAC | Chip Scale Atomic Clock |
| ECSS | European Cooperation Space Standardization |
| 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 |

3 DESCRIPTION

The EnduroSat onboard computer is a low power consumption and high performance computing platform for nanosatellites, fully compatible with the CubeSat standard. It is based on ARM Cortex M4 with frequency rate up to 180MHz or optionally on ARM Cortex M7 processor with frequency rate up to 216 MHz. It comes with integrated double redundancy sensors: 3-Axis accelerometers and compass. PWM drivers for magnetorquers and inputs for sun sensors, temperature sensors and gyroscope allow the implementation of the attitude determination and control systems.

Customized interfaces and connectors allow high flexibility of the unit.

A Protoboard area on the PCB allows high customization ideal for test bed and fast prototyping. It is possible to connect additional PCB through connectors and mounting holes and to integrate easily additional sensors and chips such as atomic clocks, GPS receiver and so on.

4 PRODUCT PERFORMANCE AND PROPERTIES

- ARM Cortex M4/M7 processor;
- Frequency rate: up to 180 MHz for M4, up to 216 MHz for M7;
- 2MB Program Memory Size; 256kB RAM for M4, 2MB RAM for M7; 2048kB flash memory;
- MicroSD card slot;
- Integrated double redundancy sensors: 3-axis accelerometer and compass;
- 3x PWM drivers for magnetorquers;
- 6x analog inputs for sun sensor;
- 6x external temperature sensors can be connected;
- Three external gyroscope can be connected
- Interfaces: CAN, 2x USART, UART, 2x I2C, 2x SPI, USB Opt.;
- Real Time Clock
- Flexible frequency eco-mode;
- Weight: 58 g.
- 1Gbit 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 busses.

5 ELECTRICAL CHARACTERISTIC

| 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 - Idle Mode ² | | 2 | |
| | μA | 3-Axis Digital Compass - Measurement Mode ² | | 100 | |
| | 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 | |

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.

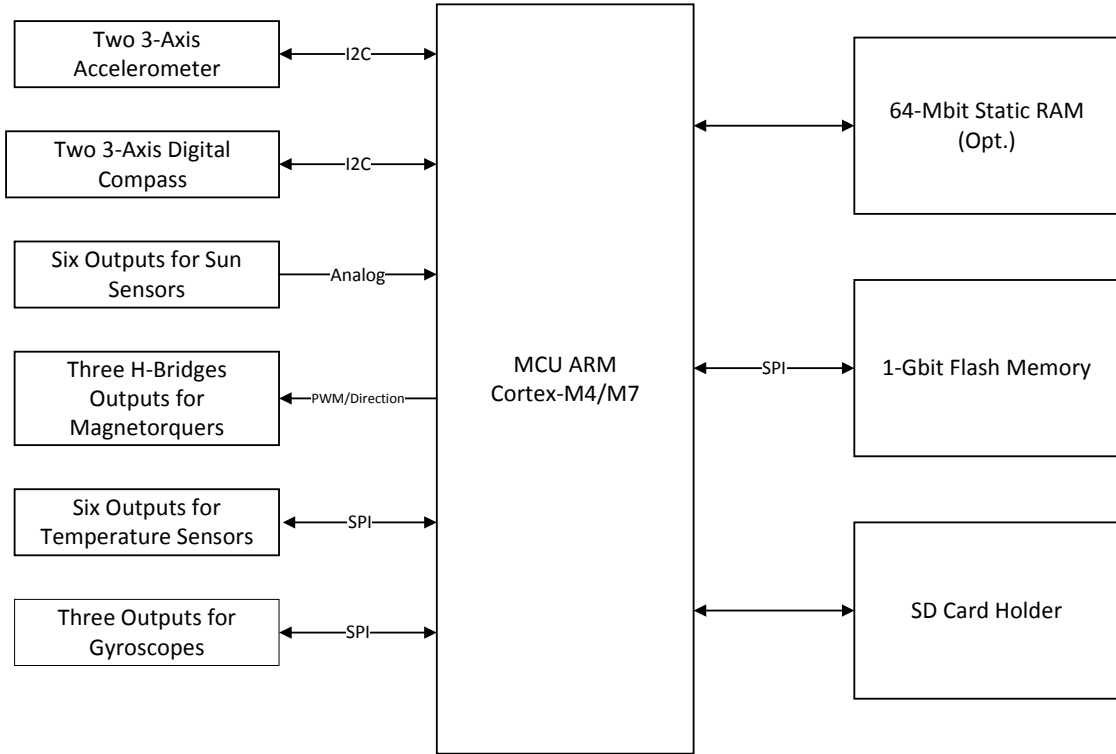


Figure 2 – OBC microcontroller periphery

7 COMMUNICATION INTERFACES

7.1 CAN

The EnduroSat On-board computer has a CAN bus interface using a 3.3-V CAN transceiver.

External modules can be connected throughout H1-1 and H1-3 of the PC/104 connector. Same interface can be reached from the ProtoBoard area through JP2 and JP14 connectors (TLE-110-01-G-DV), for this purpose zero Ohm resistors R72 and R73 should be mounted as shown in Figure 4.

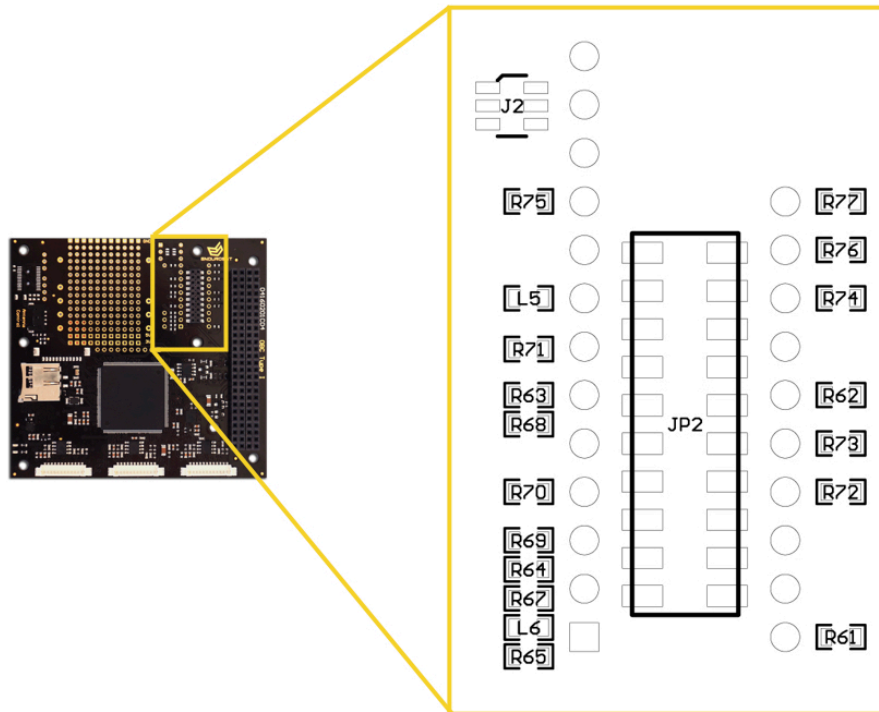


Figure 3 – ProtoBoard area customization

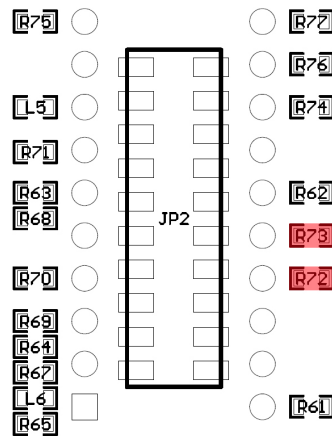


Figure 4

7.2 USART and UART

The EnduroSat onboard computer provides two USART and one UART interfaces.

The first USART interface (H1-33 and H1-35) is used by the UHF transceiver of the EnduroSat platform (EnduroSat EPS Opt.).

Second USART interface is left free for the payload (H1-19 and H1-20). If the USB peripheral is mounted (Figure 5), this interface is used for UART to USB communication (Virtual COM Port).

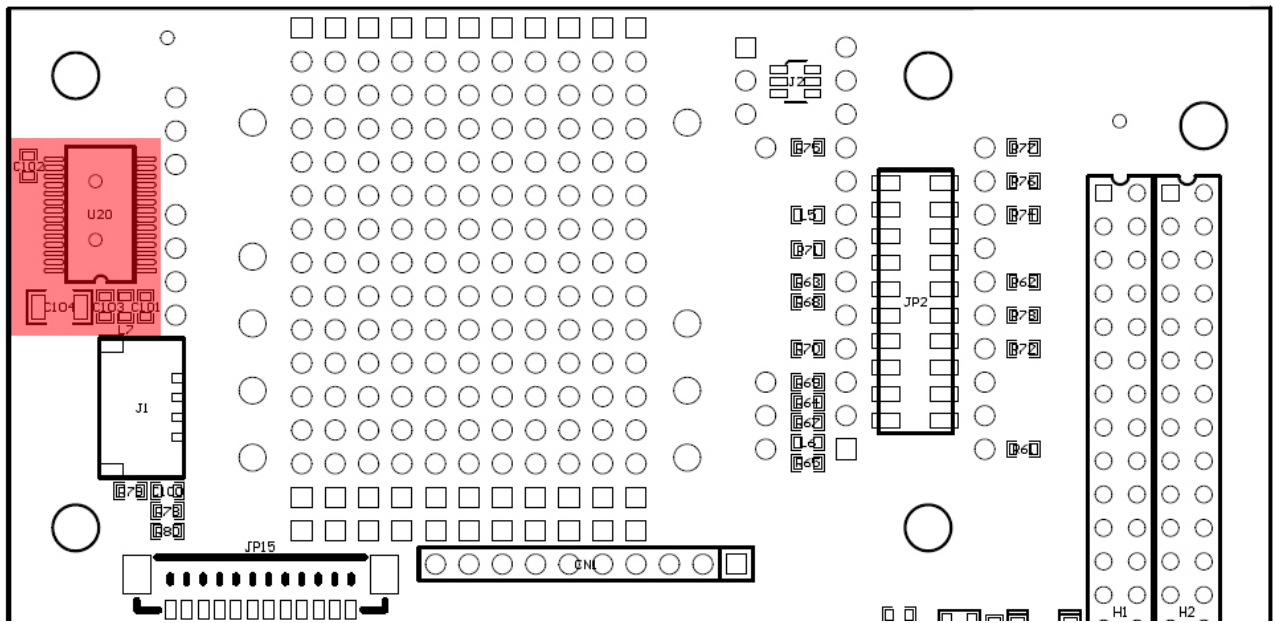


Figure 5 – USB peripheral location

Mounting zero Ohm resistors on R62 and R63 gives access to this interface through the connectors JP2 or JP14 on the ProtoBoard as shown in Figure 6.

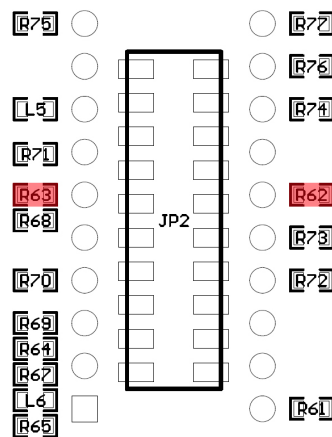


Figure 6

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 - R64 and R65 have to be mounted as shown in Figure 7.

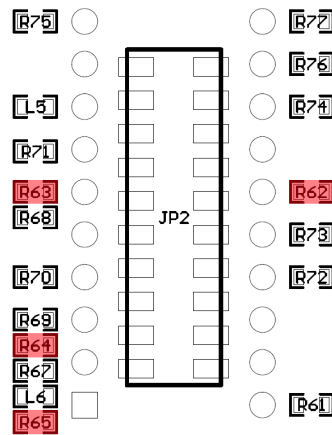


Figure 7

UART – is free for payload and it can be access through H1-39 / H1-40.

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 8.

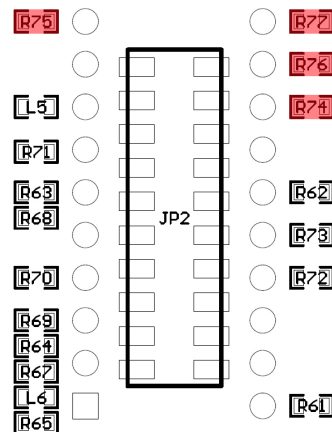


Figure 8

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 R72 and R73 have to be mounted (Figure 9).

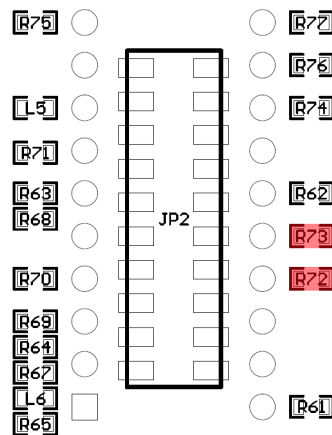


Figure 9

7.5 Six General Purpose Outputs

The OBC Module has six 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). Diode OR gate can be realized.

8 ATTITUDE DETERMINATION AND CONTROL SYSTEM

The EnduroSat Onboard computer comes with an embedded array of sensors for the attitude determination and outputs for magnetorquers control.

8.1 Compass

Two 3-axis digital compass designed for low-field magnetic sensing with high-resolution are added to the OBC periphery. 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' solid-state construction with very low cross-axis sensitivity is designed to measure both the direction and the magnitude of Earth's magnetic fields, from milli-gauss to 8 gauss.

8.2 Accelerometers

Two high-performance ultra low-power 3-axis accelerometers are added to OBC periphery. Both of them are placed at the same location but on opposite site of the PCB. Accelerometers has dynamic user-selectable full-scales of $\pm 2g/\pm 4g/\pm 8g$ and is 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. At the current OBC design filters and amplification is optimized to EnduroSat Solar Panels Sun Sensors.

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 the magnetorquers. The control of magnetorquers is realised with H-Bridge with 3.3V and maximum output current of 3A.

| Sensor | Parameter | Unit | Condition | Min | Typ | Max |
|-----------------------------------|--------------------------------|-------------|---------------------|-----|------------------------|------|
| Two 3-Axis Digital Compass | | | | | | |
| | Field Range | gauss | Full scale | -8 | | +8 |
| | Sensitivity | LSb/gauss | Gain 0÷7, 12Bit ADC | 230 | | 1370 |
| | Field Resolution (Noise Floor) | Milli-gauss | | | 2 | |
| Two 3-Axis Accelerometer | | | | | | |
| | Measurement range | | | | $\pm 2g/\pm 4g/\pm 8g$ | |
| | Output Data Rate | Hz | | 0.5 | | 1000 |

9 OBC PROTOBOARD AREA

9.1 USB interface

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). OBC USB interface is based on IC FT232RL - UART to USB interface (Virtual COM Port). Full driver support can be found at <http://www.ftdichip.com>.

Upon request, the EnduroSat On-Board Computer can be ordered with electronic components for USB Interface already mounted on it. When the components for USB interface are not mounted, the set aside USART interface can be used for other purposes (e.g. payload).

The USB interface can be accessed from PC/104 connector (Tx) H-19 and (Rx) H-20. Moreover, it can be also accessed from 20pin headers “JP2” of the top side of the OBC through 11pin Rx/12pin Tx or “JP14” from bottom side through 12pin Rx / 11pin Tx. To realize the access through “JP2” and “JP14”, zero Ohm resistors “R62” and “R63” have to be mounted as shown in Figure 6.

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 Solar Panel with RBF and interface connector are used in the platform, connection through it and the OBC Molex 53398-0471 can be realized with EnduroSat 4 pin cable. In this way the OBC USB interface can be accessed with the external EnduroSat USB adapter also when the CubeSat is fully assembled. 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 “L5” and “L6” (Figure 10).

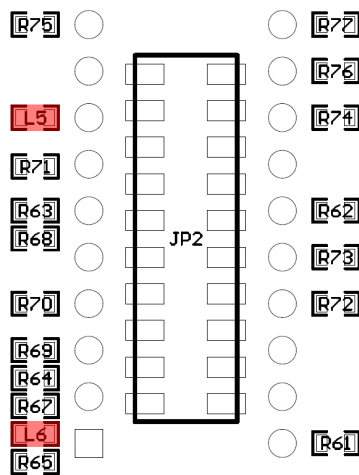


Figure 10

9.2 External PCB (Payload)

External PCB (Payload) can be connected to one of both connectors located in the ProtoBoard Area. Additional mounting holes are also provided. Both ProtoBoard connectors are 20pin SAMTEC TLE-110-01-G-DV. One is on the top side (JP2) of the OBC and the other on the bottom (JP14). This allows to minimize the used space inside the satellite and easily access to different communication interfaces and power supply. The interfaces on the ProtoBoard connectors should be chosen very carefully, because they are shared between with main PC/104 connector. All pins of 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 developing purposes. All test points are plated holes with pitch 0.1inch (2.54mm) and diameter of 0.060inch.

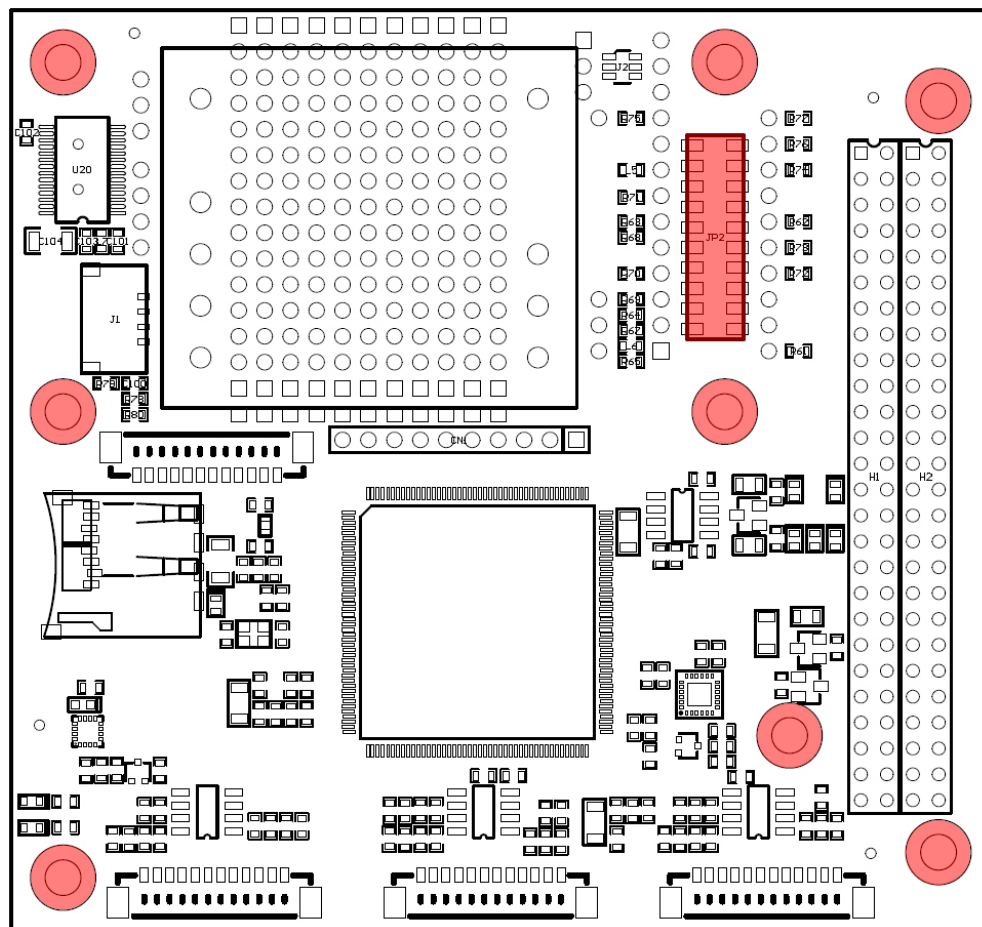


Figure 11 – External PCB

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. In addition, next to the stripboard grid there is a footprint for SOT-23-6 component (Figure 12).

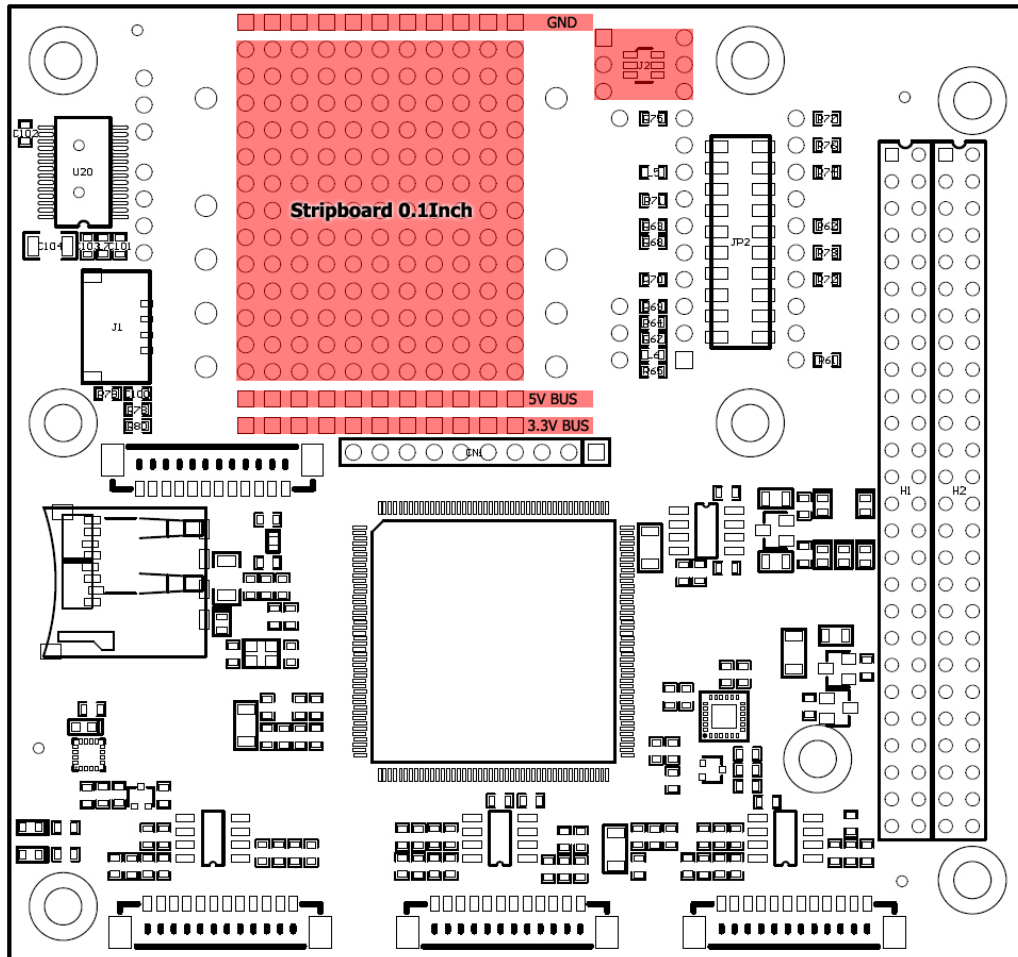


Figure 12

9.4 Atomic Clock Ready

On the protoboard area, there are mounting holes for Quantum™ SA.45s Chip Scale Atomic Clock (CSAC) 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.

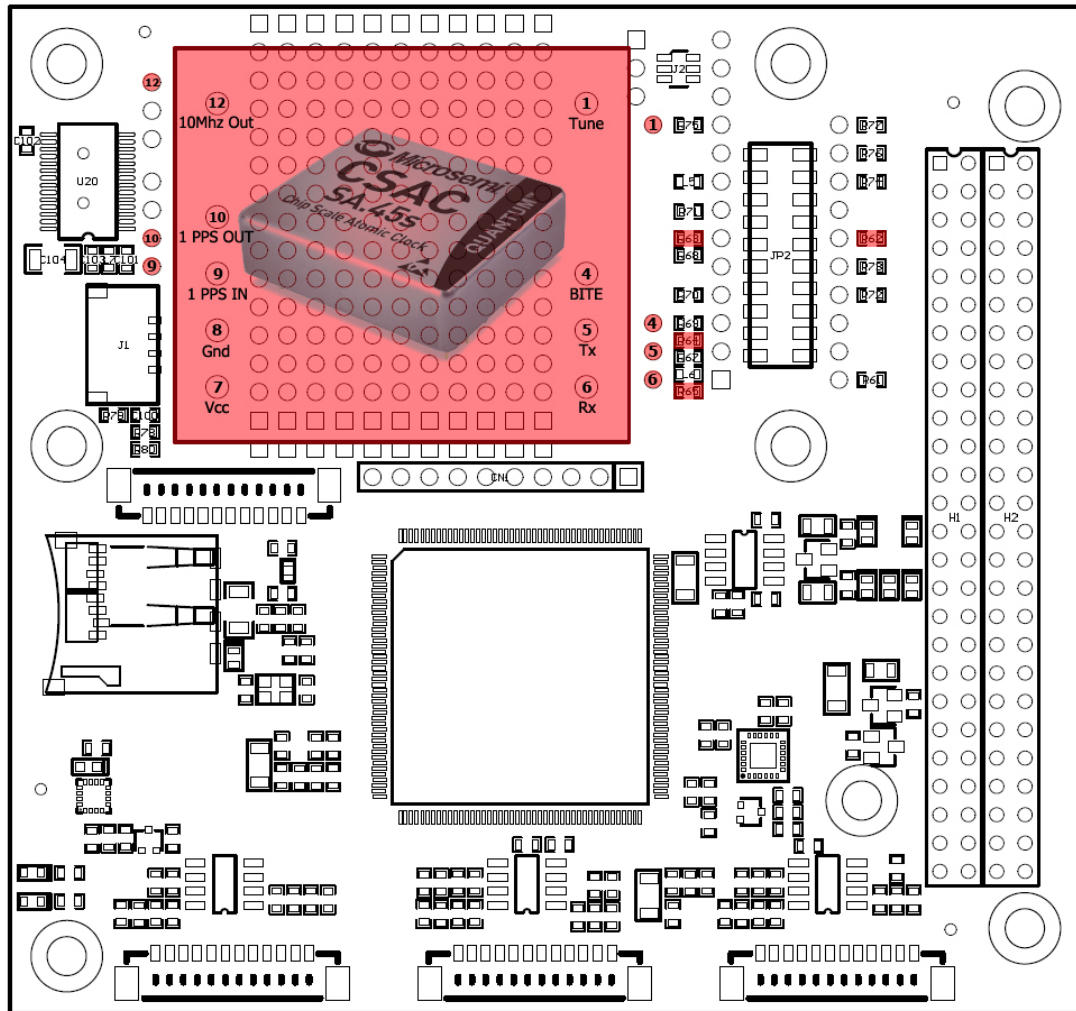


Figure 13

9.5 SD Card Holder

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

10 CONNECTOR PINOUT

10.1 Connectors location

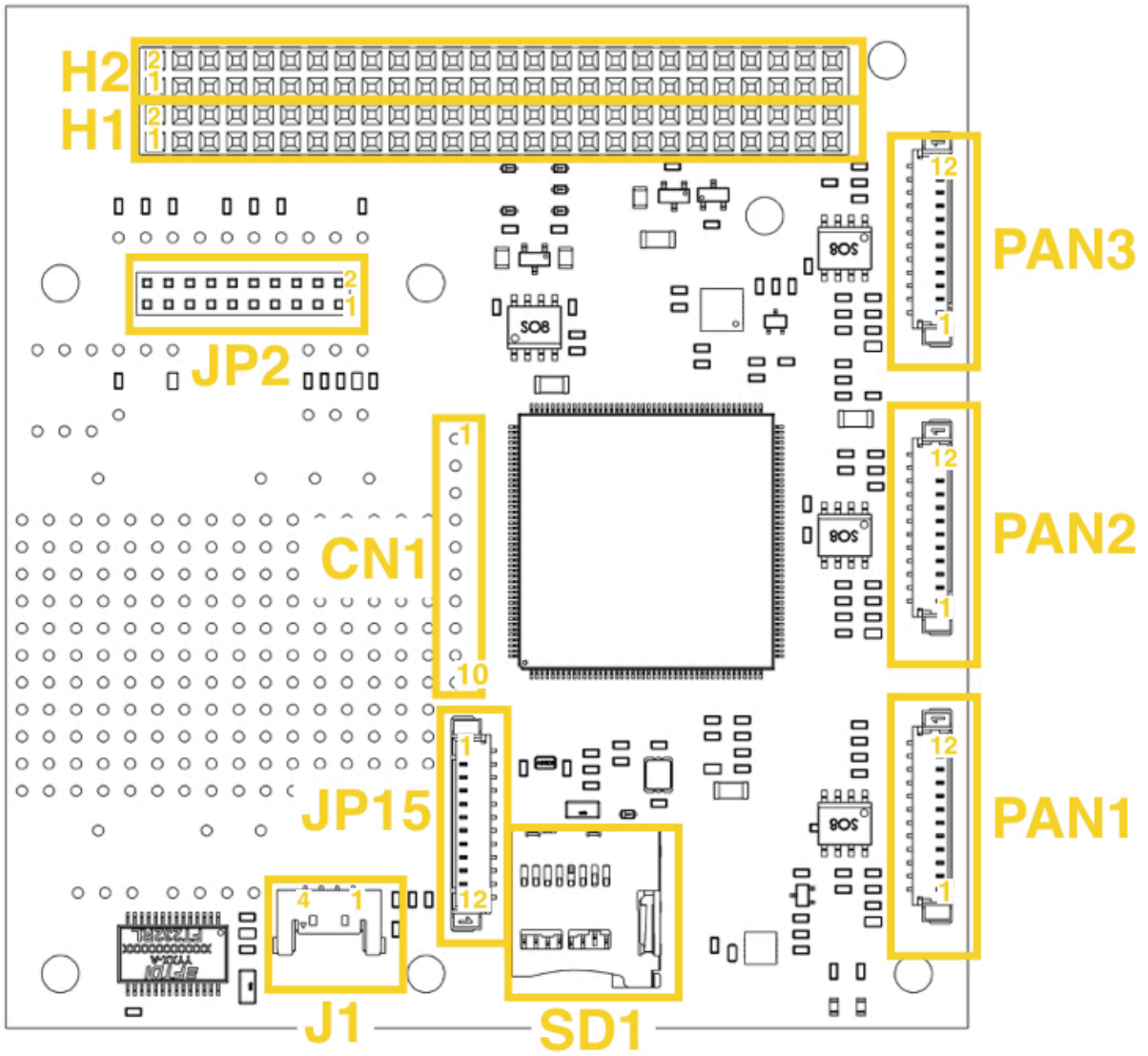


Figure 14 - OBC - top side - Connectors location

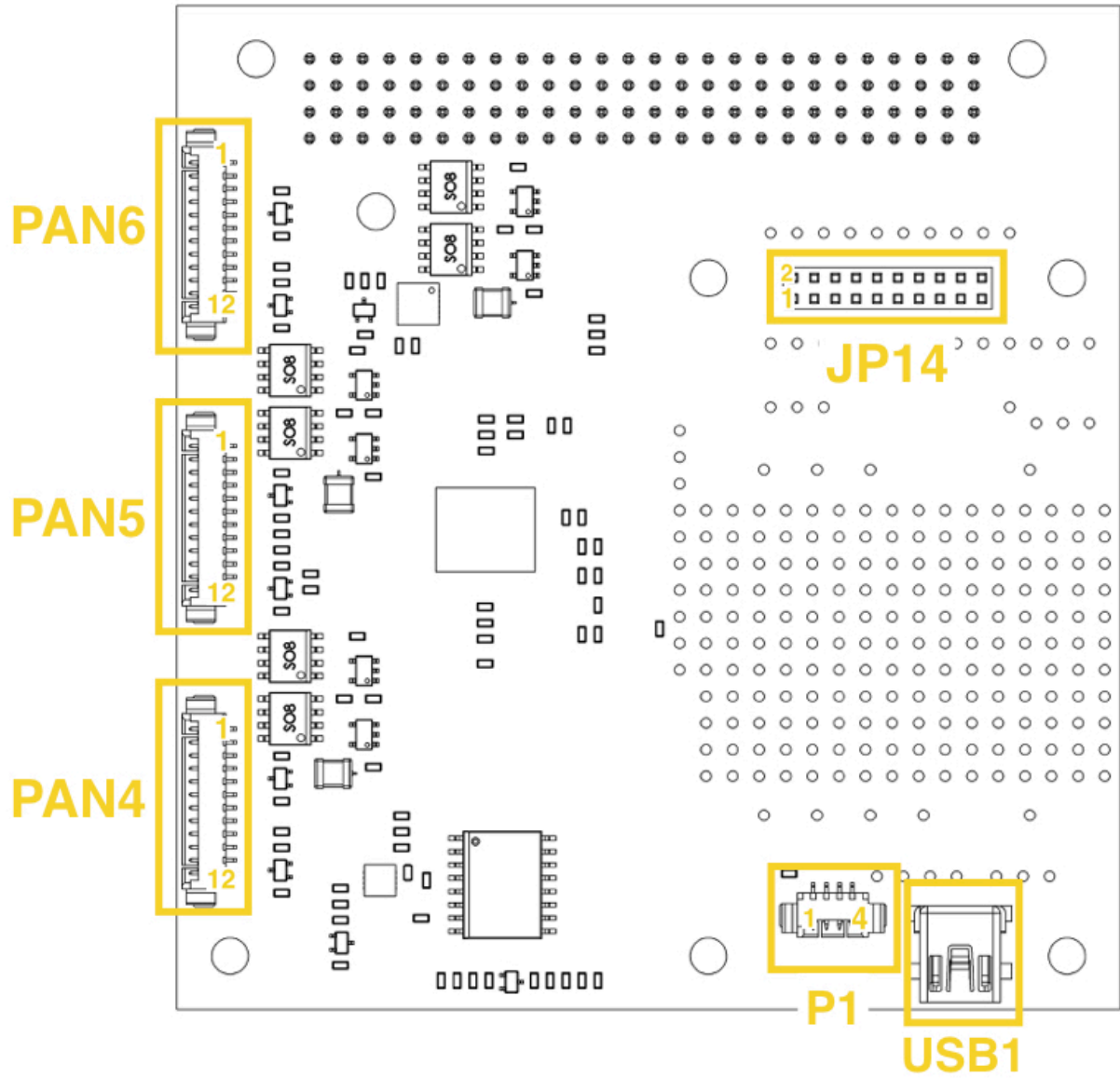
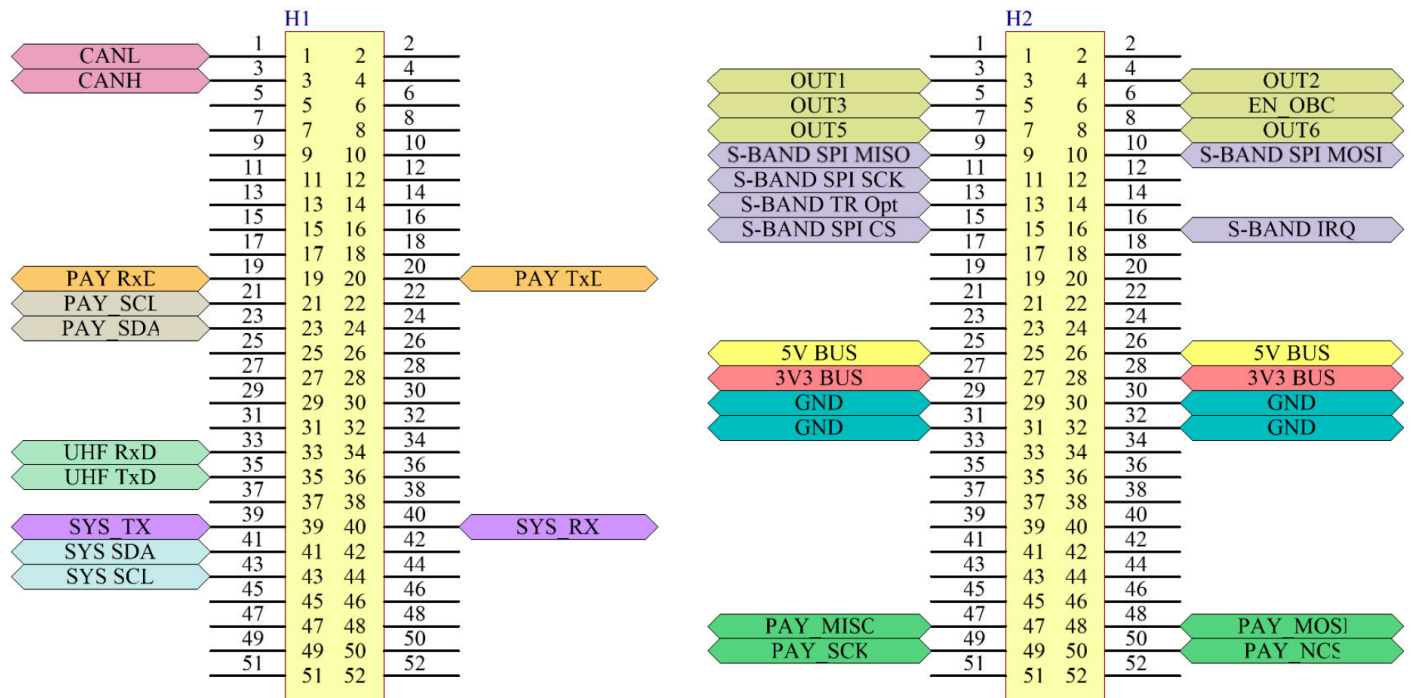


Figure 15 - OBC – bottom side side - Connectors location

10.2 H1 & H2 Stack Connector

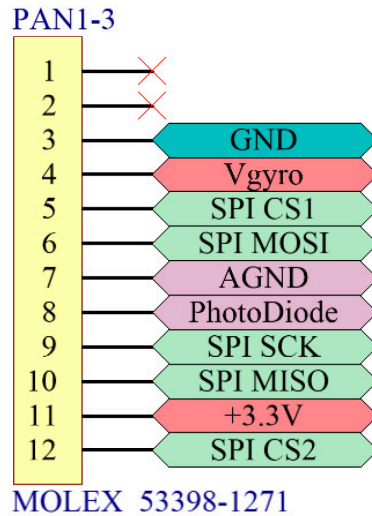


| H1 | | |
|-------|----------|---|
| Pin | Mnemonic | Description |
| H1-1 | CANL | CAN communication Low (3.3V) |
| H1-3 | CANH | CAN communication High (3.3V) |
| H1-19 | PAY_TX | USART payload transmit data (optional EnduroSat S-Band) |
| H1-20 | PAY_RX | USART payload receive data (optional EnduroSat S-Band) |
| 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 |

| 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 | S-BAND SPI MISO | SPI S-band module |
| H2-10 | S-BAND SPI MOSI | SPI S-band module |
| H2-11 | S-BAND SPI SCK | SPI S-band module |
| H2-13 | S-BAND SPI TR | SPI S-band module (optional) |
| H2-15 | S-BAND SPI CS | SPI S-band module |
| H2-16 | S-BAND SPI IRQ | SPI S-band module |
| 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 |

10.3 PAN1, PAN2 and PAN3

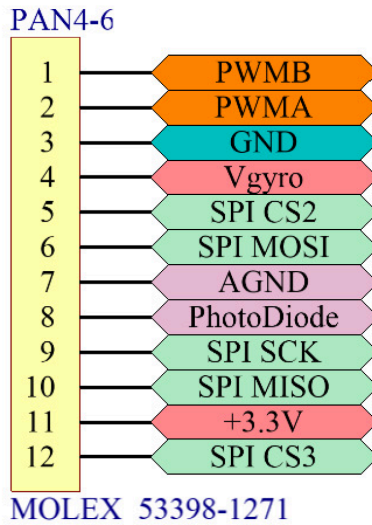
Picoblade 12 pins connectors PAN1, PAN2 and PAN3 are located on the top side of the OBC as shown in Figure 14.



| 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 |

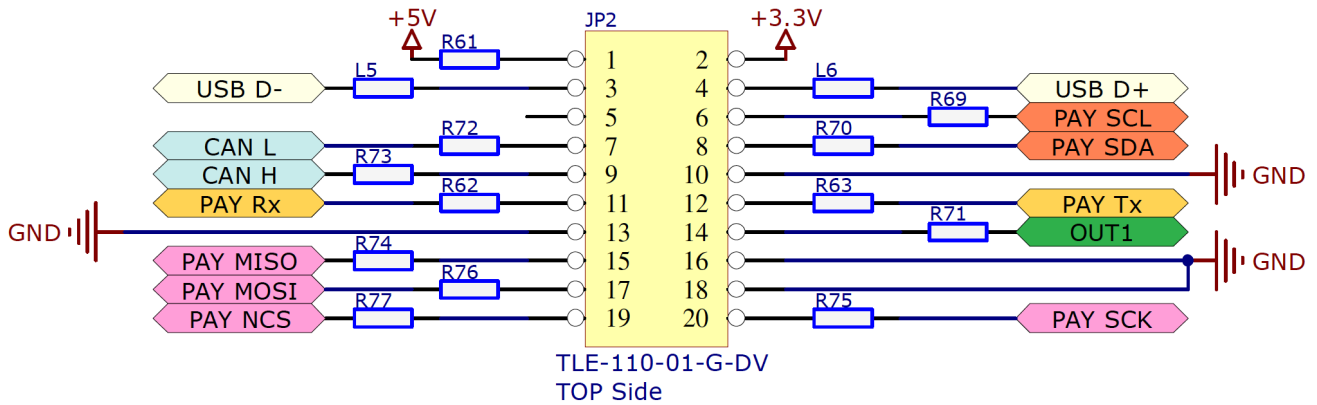
10.4 PAN4, PAN5 and PAN6

Picoblade 12 pins connectors PAN4, PAN5 and PAN6 are located on the bottom side of the OBC as shown in Figure 15.



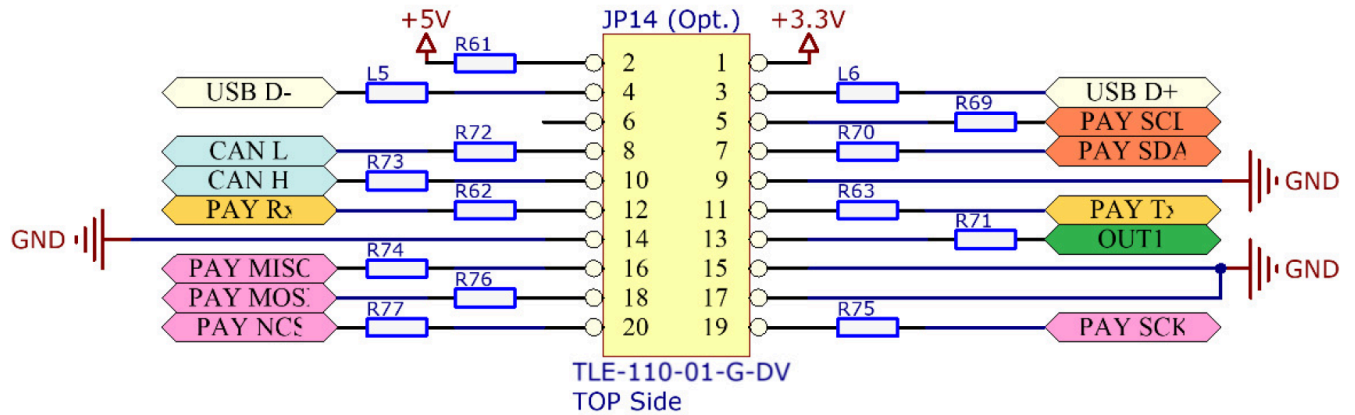
| Pin | Mnemonic | Description |
|-----|------------|--|
| 1 | PWMB | PWM (in/out) |
| 2 | PWMA | PWM (out/in) |
| 3 | GND | Ground |
| 4 | Vgyro | Power for gyroscope |
| 5 | SPI CS1 | SPI chip select for gyroscope |
| 6 | SPI MOSI | SPI (for gyroscope and temperature sensor) |
| 7 | AGND | Photodiode 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 |

10.5 JP2



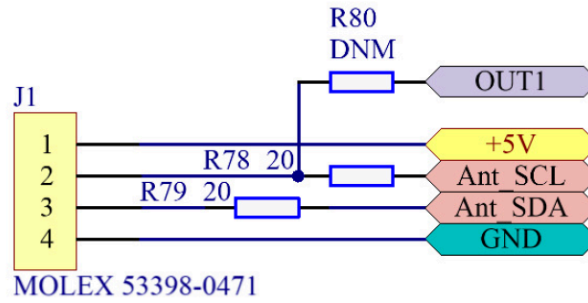
| JP2 | | |
|------------|-----------------|---------------------|
| Pin | Mnemonic | Description |
| 1 | +5V | +5V BUS |
| 2 | +3.3V | +3.3V BUS |
| 3 | USB D- | USB data - |
| 4 | USB D+ | USB data + |
| 5 | | Not connected |
| 6 | PAY SCL | I2C payload |
| 7 | CAN L | CAN Low (3.3V) |
| 8 | PAY SDA | 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 |

10.6 JP14



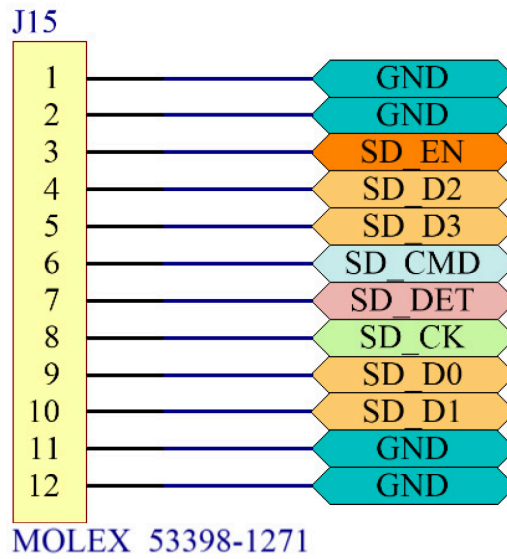
| JP14 | | |
|------|----------|---------------------|
| Pin | Mnemonic | Description |
| 1 | +3.3V | +3.3V BUS |
| 2 | +5V | +5V BUS |
| 3 | USB D+ | USB data + |
| 4 | USB D- | USB data - |
| 5 | PAY SCL | I2C payload |
| 6 | | Not connected |
| 7 | PAY SDA | I2C payload |
| 8 | CAN L | CAN Low (3.3V) |
| 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 |

10.7 J1



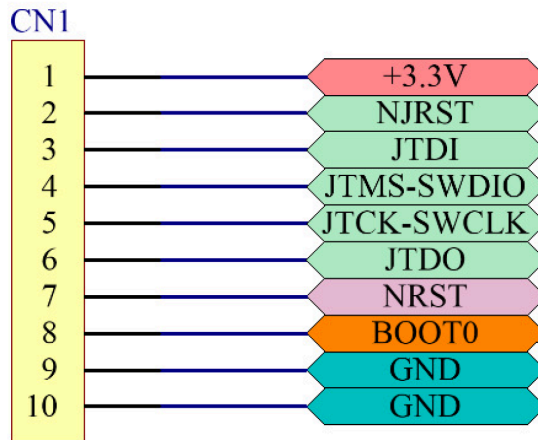
| J1 | | |
|-----|----------------|--------------------------------------|
| Pin | Mnemonic | Description |
| 1 | +5V | +5V BUS |
| 2 | Ant_SCL / OUT1 | I2C UHF antenna / Universal output 1 |
| 3 | Ant_SDA | I2C UHF antenna |
| 4 | GND | Ground |

10.8 JP15



| 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 |

10.9 CN1

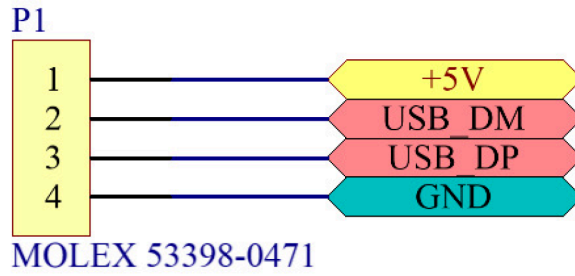


| Pin | Mnemonic | Description |
|-----|------------|---|
| 1 | +3.3V | +3.3V BUS |
| 2 | NJRST | JTAG Test nReset |
| 3 | JTDI | JTAG Test Data Input |
| 4 | JTMS-SWDIO | JTAG Test Mode Selection / Serial Wire Data I/O |
| 5 | JTCK-SWCLK | JTAG Test Clock / Serial Wire Clock |
| 6 | JTDO | JTAG Test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

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 |

10.11 P1



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

11 MECHANICAL CHARACTERISTICS

In the following paragraphs main dimensions of the Onboard Computer are shown. All dimensions are in mm.

STEP file can be provided upon request.

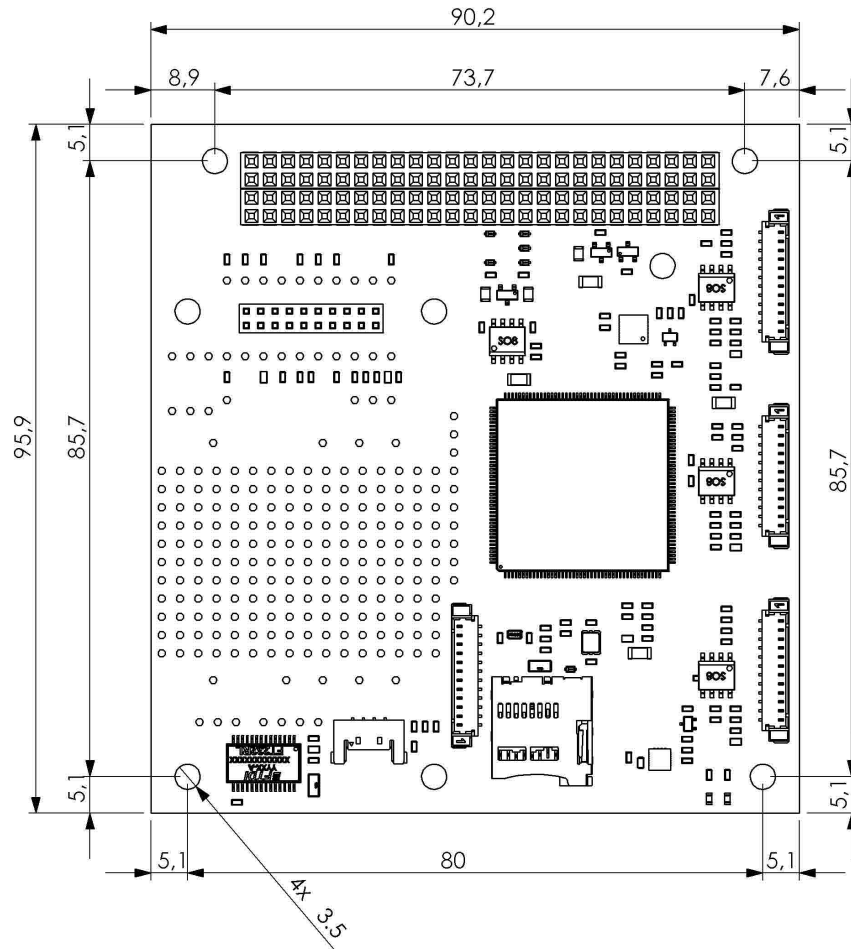


Figure 16 - OBC top view

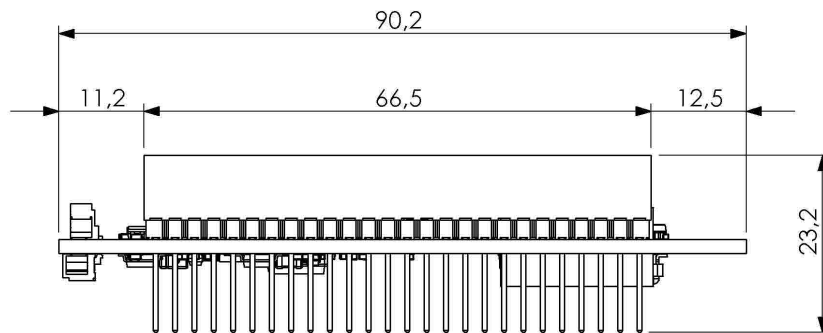


Figure 17 - OBC side view

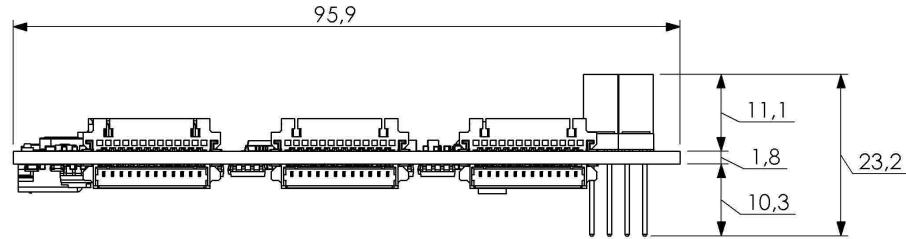


Figure 18 - OBC - side view

12 ASSEMBLING

Production process follows quality standard:

- 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 onboard computer qualification engineering model. Qualification tests level and duration follow the ESA standard ECSS-E-ST-10-03C and GEVS: GSFC-STD-7000A. Test performed:

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

Test report can be provided upon request.

14 INCLUDED IN THE SHIPMENT

EnduroSat provides along with the Onboard computer:

- USB drive with user manual
- JTAG programming cable

15 HANDLING AND STORAGE

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

- Handle using PVC, latex, cotton (lint free) or nylon gloves.
- The environment where on board computer 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: 15°C to 27°C
 - Ideal storage humidity range: 30% to 60% relative humidity (RH)

16 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.