



Aeronautics and Space > LEO Products >

## Power supply for LEO Applications

PSU-1431 isolated power supply board with high efficiency, compact DC/DC converters, battery management and power solar cells control is designed for robust operation in Low Earth Orbit (LEO) environments.

**Module main characteristics:** management of separation switch, solar cells & battery management, current & voltage telemetries, compact form factor 3U (100mm x 160mm), and 259 grams of mass; are some characteristics of PSU-1431 module.

### Flight Experience:

This module is working in LEO application form SEP-2020.

Qualified in vacuum chamber & vibration.

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**PSU-1431** used as stand-alone power supply or combine with other Tecnobit modules for a powerful, robust & redundancy capabilities. The main characteristics of this module are shown in the following table:

PSU-1431 Specifications	
<b>Power Supply Input</b>	
Unregulated Input Power	From 18V to 30V
Electrical isolation	Yes, Primary power line & Outputs are isolated.
<b>Power Supply Outputs</b>	
Overvoltage protection	Yes
Overvoltage Current Protection	Yes
<b>Output 1: +15V</b>	
Maximum output power	30W
Maximum ripple	150 mVp-p
Typical ripple	<20mV @ 90% load
<b>Output 2: + 5V</b>	
Maximum output power	12.6W Load @ efficiency 81%
Typical ripple	<18mV @ 3W load
<b>Output 3: +3.3V</b>	
Maximum output power	8.1W Load @ efficiency 75%
Typical ripple	<20mV @ 3.5W load
<b>Output 4: -15V</b>	
Maximum output power	9W Load
<b>Battery Management</b>	
Charger/discharger functions	Yes
Telemetry of battery charge level	Yes
<b>Radiation</b>	
TID	See section: Radiation Tolerance.
SEE	See section: Radiation Tolerance.
<b>Mechanical</b>	
Form factor	100mm x 160mm
Total Mass	259 grams
<b>Processor Drivers</b>	
Available TM/TC drivers	YES, in source code format.
<b>Qualification (*1)</b>	
Operational temperature	-40°C to +70°C
Vibration	12.3grms, 11.6grms & 13.2grms in x, y & z respect.
Shock	40Gs 11msec, half sine

Notes:

(\*1) See additional information in section 6.1

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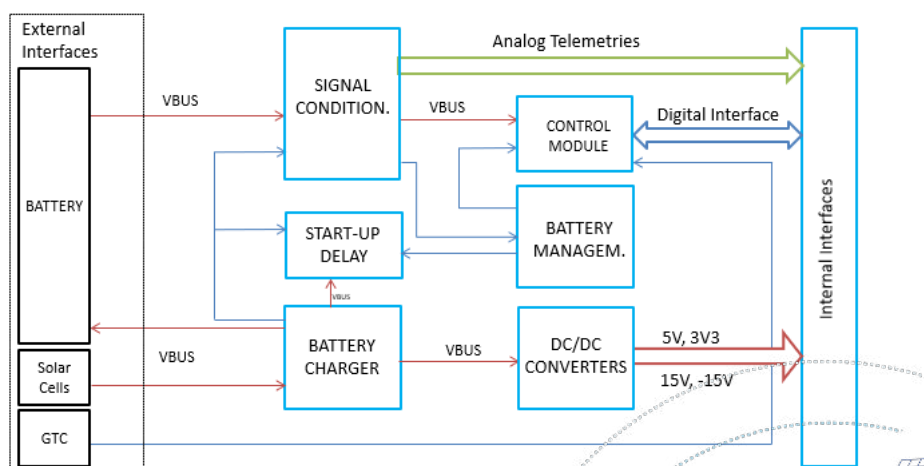
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## 2 Key Design Features

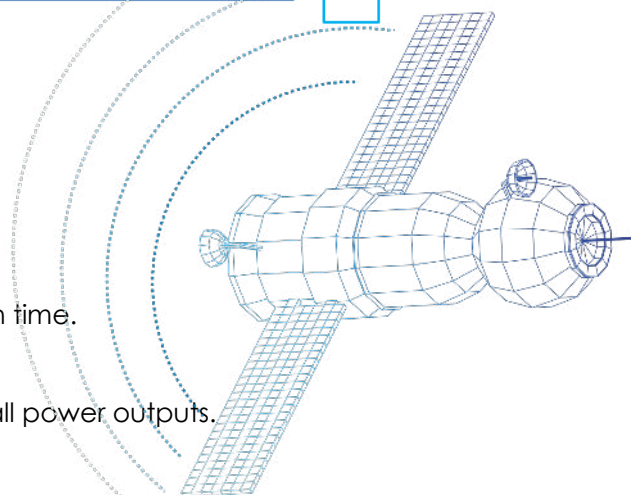
### 2.1 General

PSU-1431 is a hardware module based on the following architecture. Main blocks are DC/DC converters, Battery charger, signal conditioning & Start-up delay.



### 2.2 Hardware Features

- EMI filter in all external interfaces.
- Power Solar cells management.
- Elapsed time indicator to use as global mission time.
- Separation Switch control and GTC interface
- Overvoltage and over current protections in all power outputs.
- Telemetries of currents and voltage.
- Manage the battery charger with the energy of solar cells.
- Control module to receive the processor telecommands and to send the requested telemetries.



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## 2.2.1 Electrical ICD

PSU-1431 Module incorporates the following connectors:

### J1 & J2: Internal ICD

- Nominal communication
- Redundant communications
- Power supply output: -15V, 3V3, 5V and +15V
- Internal telemetries

### J3: SUB-D 78 pins (External ICD)

• Battery interface	• Power Solar cells IF
• GTC arm	• Separation switch IF
• VBUS	• VBUS Return

## 2.3 Key software features

PSU-1431 is an open frame hardware module to be adapted to several LEO applications. The customer can development its own software application without any restriction.

### 2.3.1 Software drivers

Source code of driver (ADA) is available to manage:

- Driver of digital interfaces for PSU-1431 board for telemetries and telecommands: For example, to read from the processor the battery charge level.

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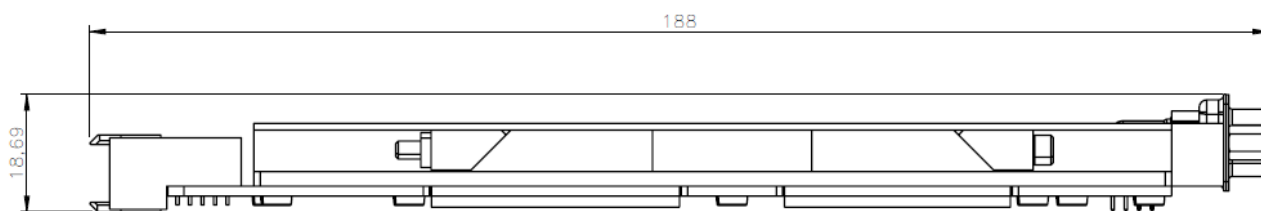
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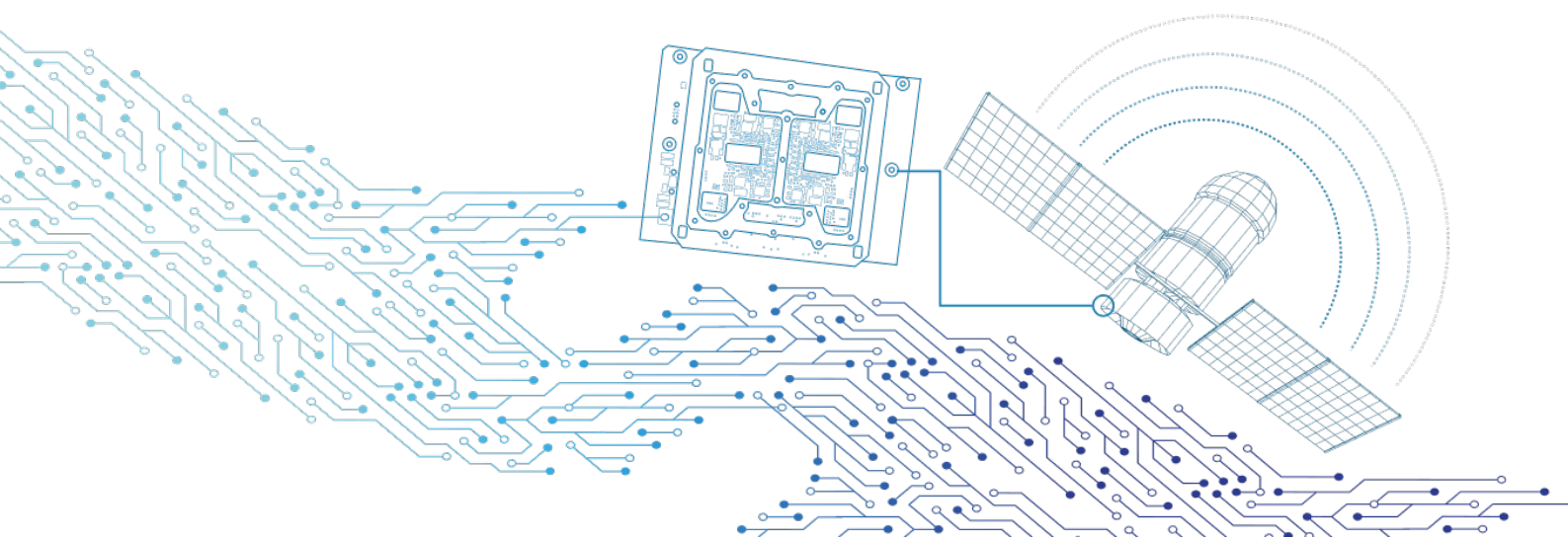
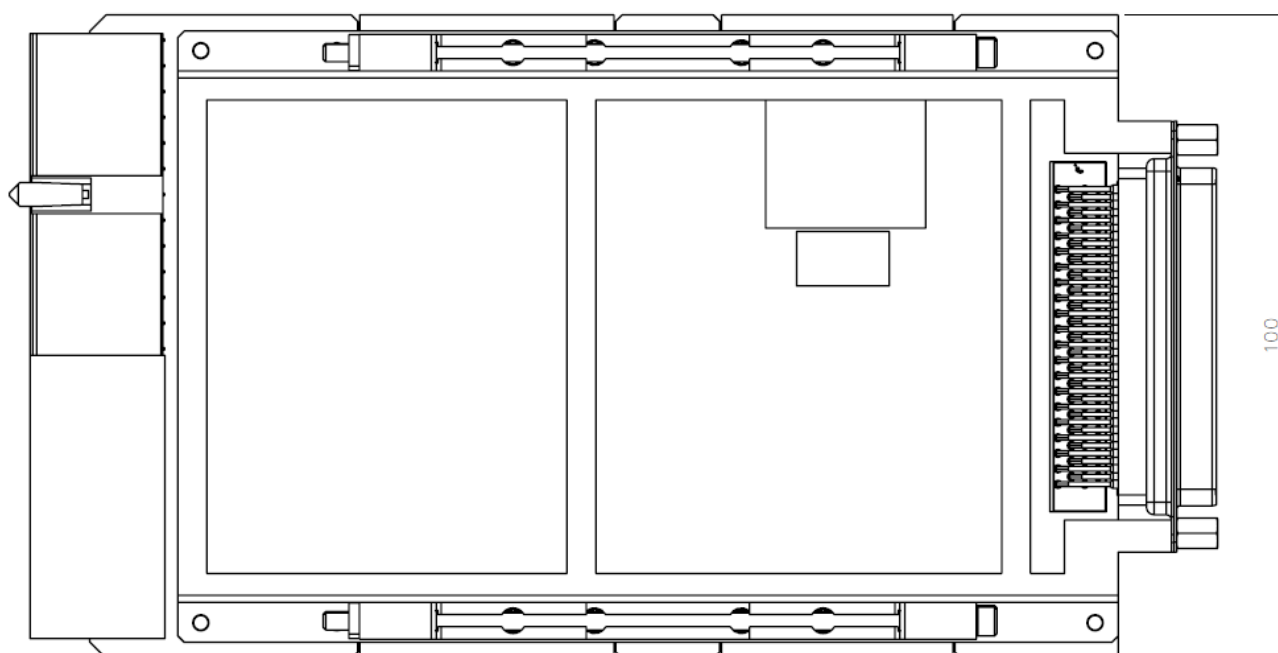
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## 2.4 Outline Drawing:

LATERAL VIEW



TOP VIEW



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### 3 Radiation Tolerance

According to the section 6.2 Ordering Information, PSU-1431 can be adapted to the quality requested by the application. The following paragraph describe the main rules to carried out this part selection:

- **Quality 1:** Parts according to Class 1 of ECSS-Q-ST-60-15C. Expected more than 15 years in LEO orbit. To guarantee this lifetime in GEO a radiation analysis is needed, due to the final housing is important in this orbit. TID better than 100krad, LET Threshold 120 MeV.cm2 /mg and Non-destructive Single Event Effects (SEE) rad hard.
- **Quality 2:** Rad tolerant parts, JANTXV for semiconductors & new space considerations. Expected more than 10 years for LEO applications. In this case the parts used has been designed by manufactured to withstand levels of TID and SEE. TID from 30krad (Si) to 300krad (Si), LET Threshold from 43 to 96 MeV.cm2 /mg and Non-destructive Single Event Effects (SEE) tolerant.
- **Quality 3:** Technology analysis & new space consideration. Expected more than 5 years in orbit. For this quality of parts, the selection is based on technologies, but the datasheets of components do not indicate any rad tolerance. This quality is only recommended for sort time missions where we can accept the risk.
- **Quality 4:** Industrial parts. Expected only 0.5 years in orbit. This quality option is the lower cost, but it is not recommended for flight.

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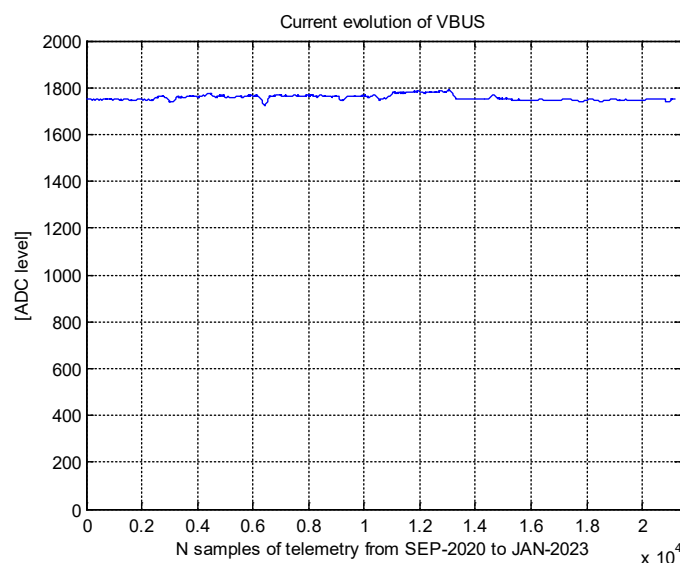
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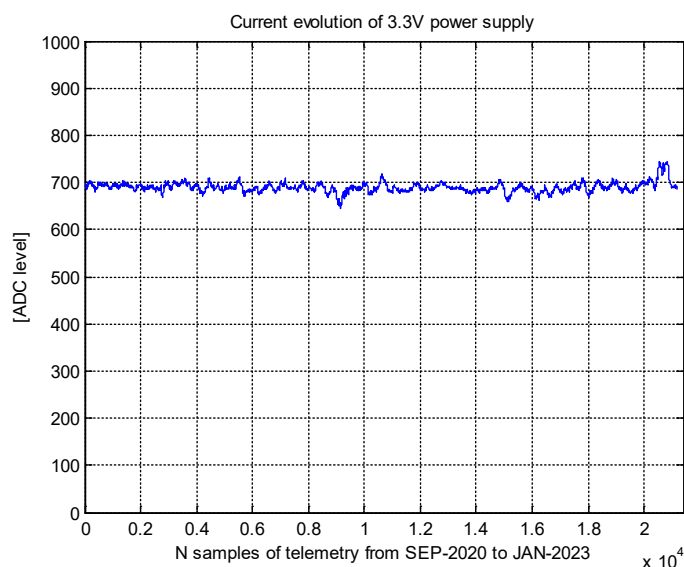
## 4 Flight Experience

PSU-1431 is working in LEO applications from SEP-2020 with components “Quality 3” (see radiation levels in section 4). In orbit telemetries of currents supports us to justify the quality of this product and the expected alive time in LEO.

The evolution of supplied current of VBUS is constant and this do not present any incrementation due to the electronic degradation.



PSU-1431 digital consumption is also very stable and this current does not present any mean increase in orbit. This behaviour presents additional evidence about the stability of PSU-1431 in LEO.



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## 5 General

### 5.1 Qualifications tests

- **Random vibration test levels:** (12,3 grms, 11,6 grms, 13,2 grms) in x, y & z axis, respectively.
- **Shock test level:** Designed for 40Gs 11msec, half sine.
- **Vacuum temperature test range:** -40 to 70°C (\*1).

#### Notes:

(\*1) Designed for this range, but only tested in vacuum chamber at satellite level from -23°C to +58°C.

### 5.2 Ordering Information

#### Standard Reference:

- Tecnobit Reference: **PSU-1431-XY** (where XY are according to the following options)
- LEO Flight experience from sep-2020 over the reference: PSU-1431-31

#### Options for X:

- **1:** Parts according to Class 1 of ECSS-Q-ST-60-15C. See quality 1 in section 4.
- **2:** Rad tolerant parts & new space considerations. See quality 2 in section 4.
- **3:** Technology analysis & new space consideration. See quality 3 in section 4.
- **4:** Industrial components. See quality 4 in section 4.

#### Options for Y:

- **1:** Original design of PSU-1431 (first version).
- Etc... (new customized solution)

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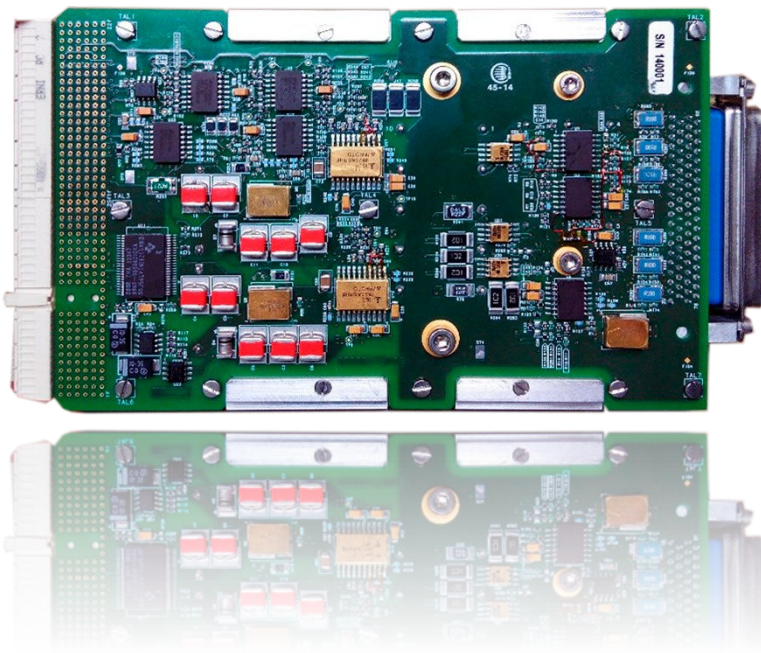
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### 5.3 Data Package

- User manual to manage all TM/TC
- Electrical ICD
- Mechanical ICD
- Outline 3D model
- Source code of digital IF driver



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-  Development,
-  QUAL & CERT,
-  Manufacturing,
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Open Frame Hardware to final user application

Optimum balance between quality and cost for LEO applications.

Flexibility adapting this module to the requested interfaces of end user.

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