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Aeronautics and Space > LEO Products >

Up to 64 analog Telemetries

ADC-1421 single acquisition board with integrated signal conditioning, redundancy capabilities and multiplexing features is designed for robust operation in Low Earth Orbit (LEO) environments.

Module main characteristics: 64 Operational amplifiers to adequate signals from temperature sensors, magnetometers, voltage & currents measurement, solar sensors, etc... Power supplies protected by Latch current limiters, compact form factor 3U (100mm x 160mm), and 228 grams of mass.
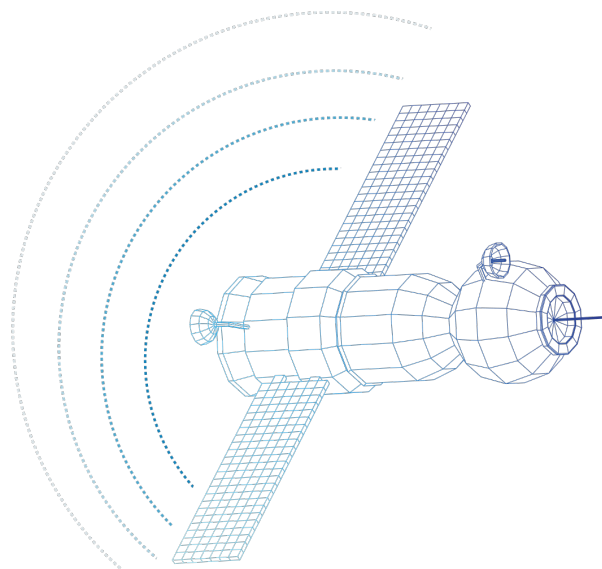
Flight Experience:

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

Qualified in vacuum chamber & vibration.

1   Index of Contents

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2

2   Product Overview

ADC-1421 used as stand-alone acquisition board or combine with other Tecnobit modules for a powerful, robust & redundancy capabilities. The main characteristics of this module are shown in the following table:

ADC-1421 Specifications	
ADC	
Resolution	12 bits
Sample rate	1M sample per second
Signal conditioning	
Differential Amplifiers	Up to 76 for signal conditioning, TM & LCLs.
Configurable Gain	Yes. The gain of each stage can be customized.
Configurable Offset	Yes. The offset of each stage can be customized.
Customizable Origin of signal	Yes. Total 64 channels from external and internal IF.
Condition	
Signal conditioning	Yes, based on Operational amplifiers
ADC	Conditioning & conversion of 64 inputs
Power supply	
Input Voltages	-15V, 3V3, 5V &15V
Overcurrent protections	Yes, all supplies are protected
Nominal Power consumption	0.7 W
Radiation	
TID	See section: Radiation Tolerance.
SEE	See section: Radiation Tolerance.
Mechanical	
Form factor	100mm x 160mm
Total Mass	228 grams
Processor Drivers	
Available ADC drivers	YES, in source code format.
Available TM/TC drivers	YES, in source code format.
Qualification (*1)	
Operational temperature	-40ºC to +70ºC
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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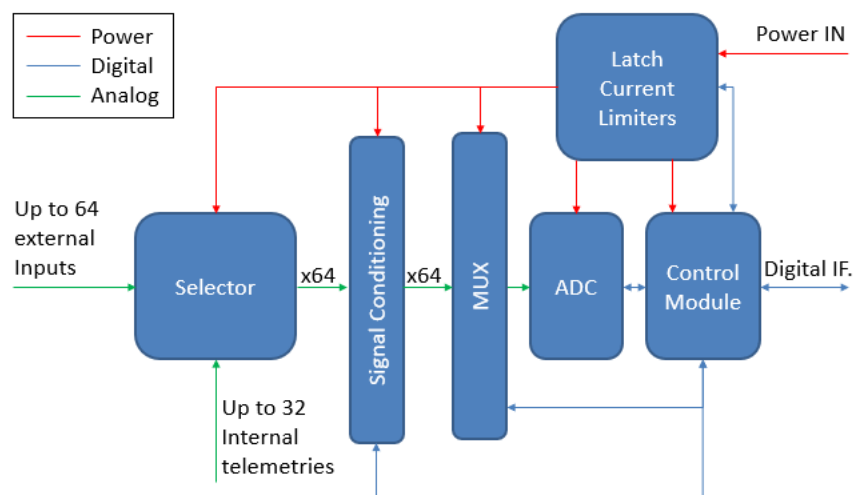Telephone: +34 916 617 161   Fax: +34 916 619 840

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3

3 Key Design Features

3.1 General

ADC-1421 is a hardware module based on the following architecture.

3.2 Hardware Features

- EMI filter in all external interfaces.
- Differential Inputs & single inputs.
- Each conditioning stage, can be customized for each application:
  o Source internal or external
  o Differential or single
  o Gain
  o Offset
  o Voltage range -15V to +15V
- Can be connected many different input types: magnetometer, temperatures, solar sensors, voltages, and currents.
- LCL protections for inner electronic of ADC-1421.
- Telecommand of power enable.
- Individual over voltage protection in the 64 channels.
- Control module to receive the processor telecommands and to send the requested telemetries. Acquisition rate up to 1M sample per second.

3.2.1 Electrical ICD

ADC-1421 Module incorporates the following connectors:

J1 & J2: Internal ICD

- Nominal communication
- Redundant communications
- 32 Internal telemetries

- Power supply of -15V, 3V3, 5V and +15V
- Telecommand of power enable

J3: SUB-D 78 socket (External ICD)

- 64 Analog Inputs

  Examples of typical Analog Inputs:

- Battery telemetries
- Voltage telemetries
- Magnetometer telemetries
- Solar sensors telemetries

- Analog Power supplies

- Solar cells telemetries
- Currents telemetries
- Temperature telemetries

3.3 Key software features

ADC-1421 is an open frame hardware module to be adapted to several LEO applications. The customer can development its own software application without any restriction.

3.3.1 Software drivers

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

- Driver of digital interfaces for ADC-1421 board for telemetries and telecommands.
- Driver to manage the analogy to digital converters.

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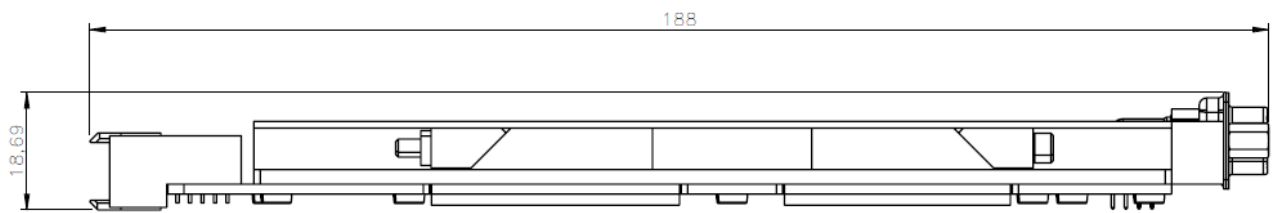Telephone: +34 916 617 161   Fax: +34 916 619 840

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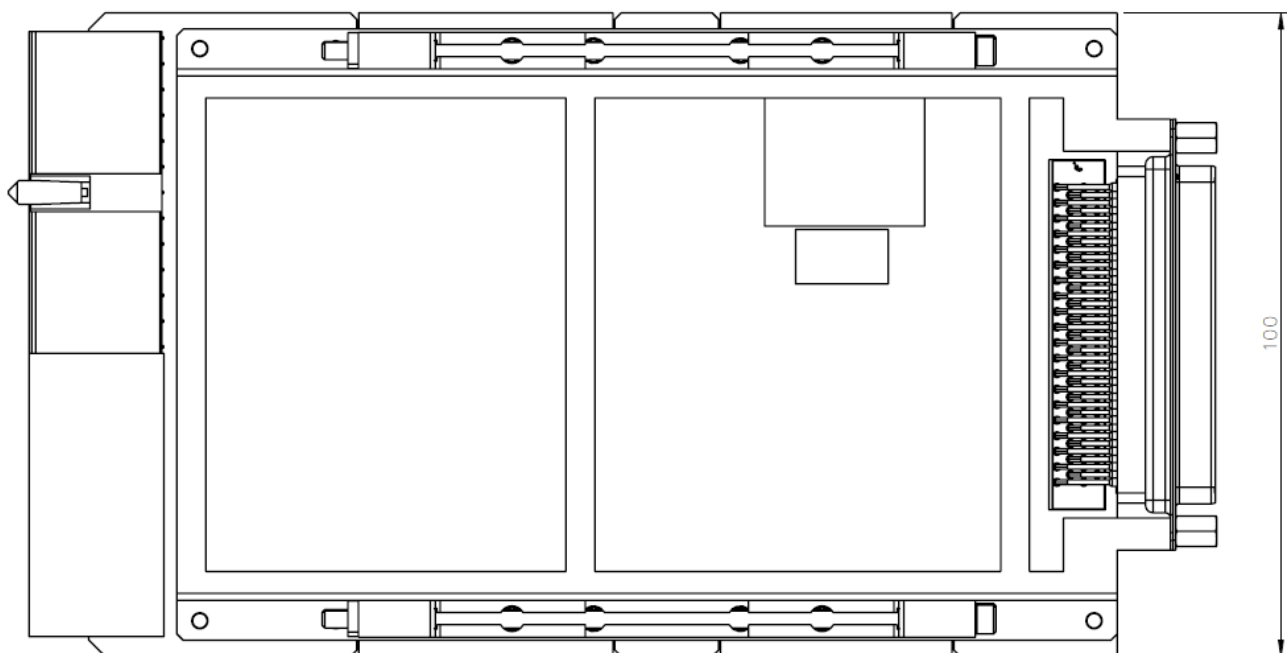13300 Valdepeñas (Ciudad Real), Spain

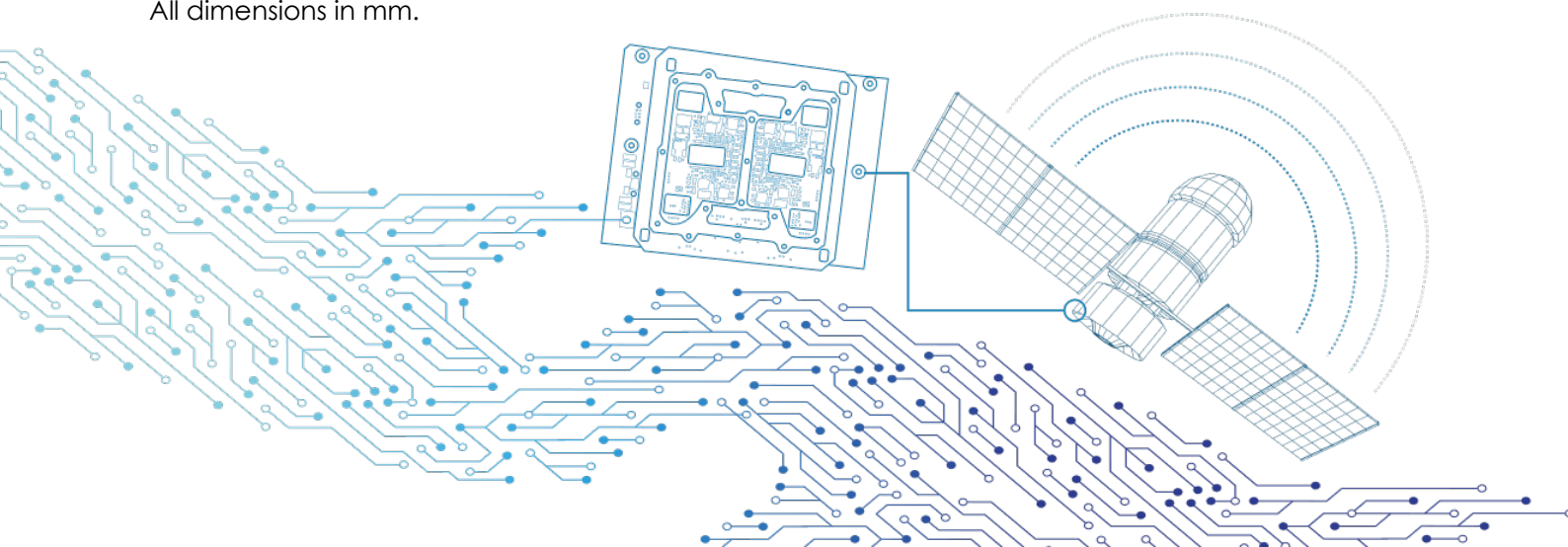Telephone: +34 926 347 830   Fax: +34 926 312 896

5

3.4   Outline Drawing:

LATERAL VIEW

TOP VIEW

All dimensions in mm.

4 Radiation Tolerance

According to the section 6.2 Ordering Information, ADC-1421 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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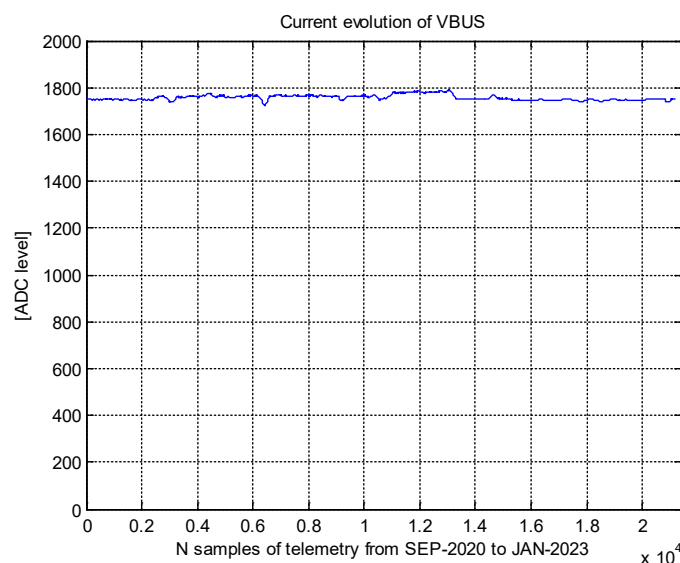
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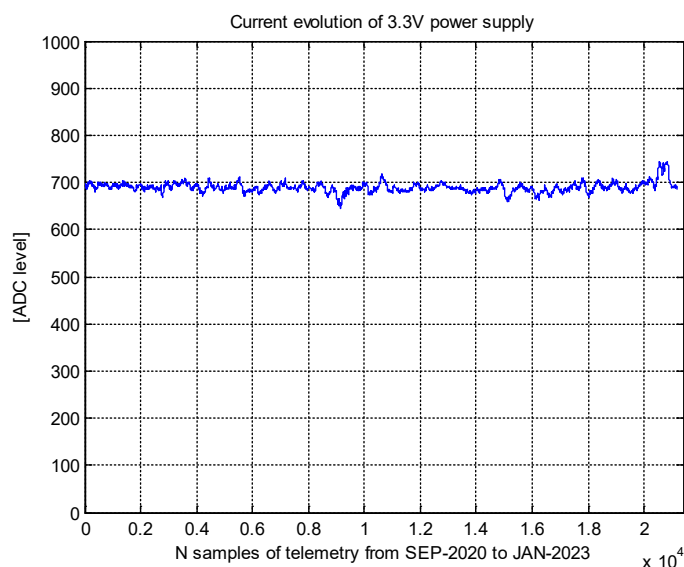Telephone: +34 926 347 830   Fax: +34 926 312 896

7

5   Flight Experience

ADC-1421 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.

ADC-1421 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 ADC-1421 in LEO.

6 General

6.1 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 70ºC (*1).

Notes:

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

6.2 Ordering Information

Standard Reference:

- Tecnobit Reference: **ADC-1421-XY** (where XY are according to the following options)
- LEO Flight experience from sep-2020 over the reference: ADC-1421-31

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:** Gain, Offset, selector & differential signals of the ADC-1421 first version.
- **2:** Gain, Offset, selector & differential signals of the ADC-1421 second version.
- Etc… (new customized solution)

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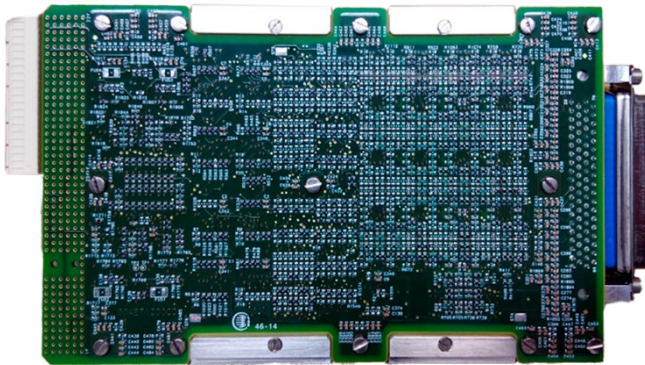
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9

6.3 Data Package

- User manual to manage all TM/TC

- Electrical ICD

- Mechanical ICD

- Outline 3D model

- Source code of MUX driver

- Source code of ADC driver

We accompany you throughout the entire product life cycle

- **Design**
- **Development,**
- **QUAL & CERT,**
- **Manufacturing,**
- **In-service support,**
- **Enhancements**

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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10

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