BiSon64-ET-B SUNSENSOR

PRODUCT SPECIFICATION DOCUMENT

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DOCUMENT CHANGE RECORD

Issue	Date	Total pages	Pages affected	Brief description of change
1	28-09-2017	15	All	New document
1a	13-10-2017	14	All	Removed typo’s like double Req. numbers to come in line with the verification control document. Added [AD] numbers where needed.
1b	05-10-2018	15	9,11-15	Cover picture added and Update: 4 Optical interfaces, 6.1 storage conditions, 6.4 temp cycling, 6.5.3 Random vibrations, 6.5.4 Shock specification, 6.6 Cosmic radiation resistance
1c	09-10-2018	15	All	Removed typo’s
1d	06-11-2018	15	8	Removed typo
2	3-5-2019	15	11, 14	Update shock specification and thermal cycling
3	28-05-2019	15	9	Update mass to come in line with VCD and ICD
3a	18-06-2019	15	10	Update transition resistance and random vibration time

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Abbreviations

AD	Applicable Document
ADC	Analogue to Digital Converter
-B	Baffle
COTS	Commercial Off The Shelf
CTE	Coefficient of Thermal Expansion
EMC	Electro Magnetic Compatibility
-ET	Extended Temperature
FOV	Field of View
ICD	Interface Control Document
LOS	Line Of Sight
MAIT	Manufacturing Assembly Integration and Test
NTC	Negative Temperature Coefficient resistor (thermistor)
PIND	Particle Induced Noise Detection
PSD	Power Spectral Density
RD	Reference Document
Req	Requirement
RMS	Root Mean Square
TBV	To be validated (tests still need to be performed)

Applicable documents

Nr	Document number	Document name	Issue
[AD-1]	150T701	BiSon64-ET-B interface control drawing	03
[AD-2]	500M085	Precision fastener	01
[AD-3]	500M086	Washer vented	01

Reference documents

Nr	Document number	Document name	Issue

1 Introduction

The BiSon64-B sunsensor, see Photo 1, is a high reliability sunsensor, with a straylight baffle, and having a nominal field of view of 64 degrees in diagonal which is specifically designed for demanding satellite applications.

The BiSon64-ET-B sunsensor, see Photo 2, is an extended temperature version of the standard BiSon64-B where a higher temperature range is one of the main discriminating factors. This higher temperature range is obtained through using different materials during the manufacturing.

This document shall be read in conjunction with the interface control drawing [AD-1].

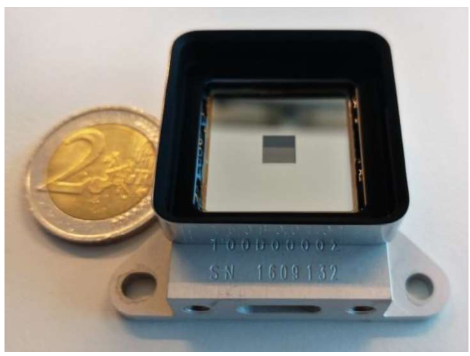

Photo 1 BiSon64-B Sunsensor

Photo 2 BiSon64-ET-B Sunsensor

2 Solar direction angles

Apart from the quadrant definition as given in [AD-1] it is necessary to define the reference frame of the sunsensors in order to avoid sign errors in the attitude control subsystem. All BiSon64-ET sunsensors use the reference definition given below.

These diagrams provide the definition of the angles α and β to be calculated by means of the formulas given in Equation 1. It can be deducted that a negative α means that the sun is to the top of the sensor and that a negative β means that the sun is to the right of the sensor (both when viewed from the top side).

The illumination given in Figure 1 is for positive α and positive β of the BiSon64-ET Sunsensor.

All BiSon64-ET sunsensors use the reference definition given in Equation 1.

$$S_a = \frac{Q_1 + Q_4 - Q_2 - Q_3}{Q_1 + Q_2 + Q_3 + Q_4} = \frac{\tan(\alpha)}{\tan(\alpha_{max})}$$

$$S_b = \frac{Q_1 + Q_2 - Q_3 - Q_4}{Q_1 + Q_2 + Q_3 + Q_4} = \frac{\tan(\beta)}{\tan(\beta_{max})}$$

Equation 1 BiSon64-ET α and β formulas

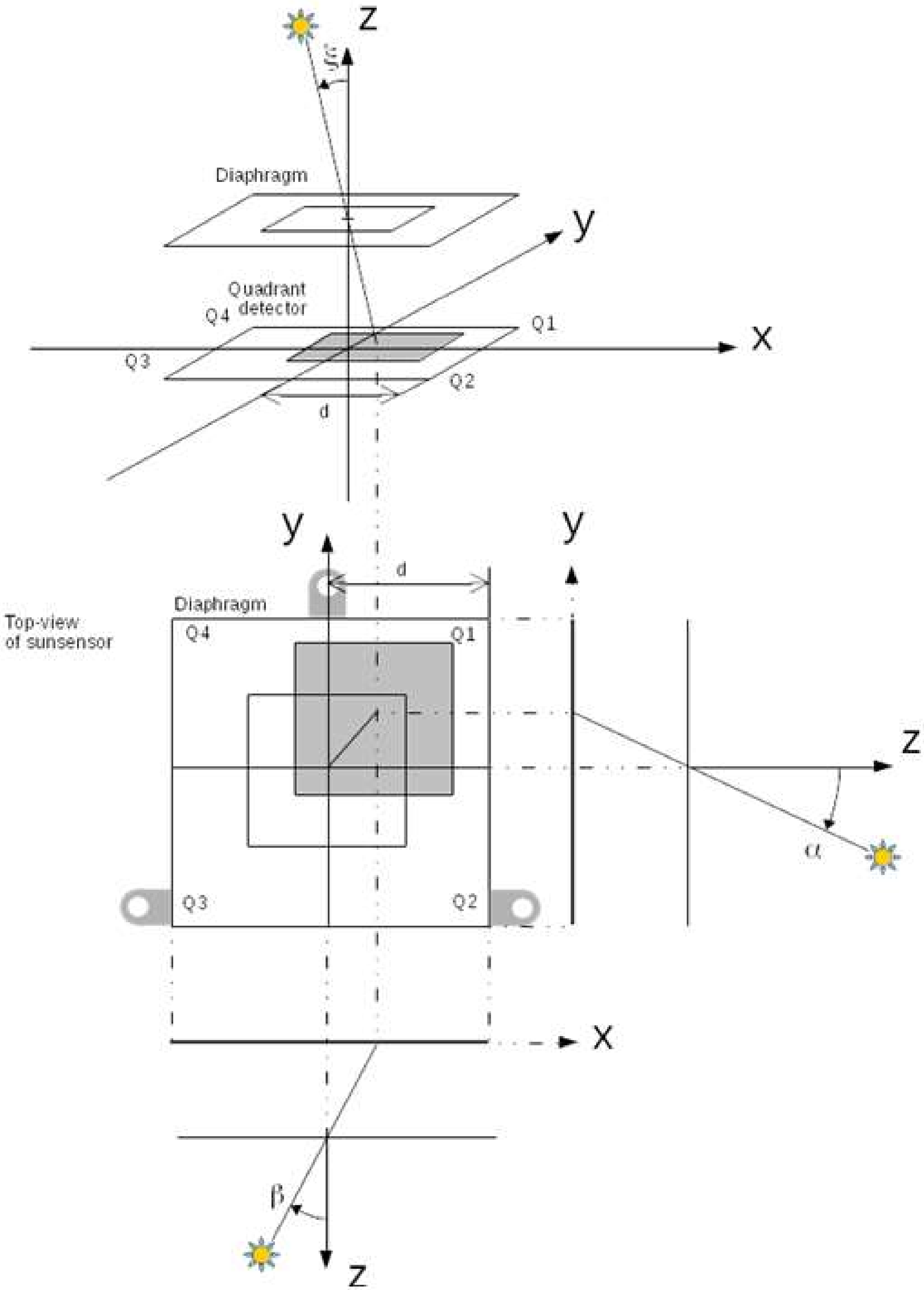

Figure 1 α and β reference frame and angle visualization

3 Mechanical interfaces

The dimensions of the mechanical interfaces are given in [AD-1] the actual reference of the sensor is formed by the line through the center of the two lower mounting holes. The actual reference hole is the right lower hole which has a H7 fit and defines the position of the sensor sensitive surface. The left lower hole is a slotted hole (see detail Z) which defines the rotation around the reference hole. The third hole is merely for ensuring the sensor is mounted flat on the surface.

3.1 Repeatability of mounting

Req. 3.1-1 The repeatability of mounting shall be better than 0.15 degrees. When using the prescribed mounting hardware see [AD-2] and [AD-3]

3.2 Fastening torque

The special fasteners defined in [AD-2] shall be fastened with a torque of 1 Nm ± 10%.

3.3 Mass

Req. 3.3-1 The mass of the unit is ≤33 grams but more accurately given on page 1 of [AD-1]

3.4 Centre of gravity

The center of gravity is given on page 1 of [AD-1]. But there are no requirements on the CoG.

4 Optical interfaces

The optical interfaces are defined on page 2 of [AD-1] in combination with the reference frame definition as given in par 2.

Req. 4-1 The field of view of the sensors shall be ±66°±2° in both diagonals

Resulting in a nominal field of view of ±58°±2° in the X and Y axis.

5 Electrical interfaces

The electrical connections are as given on page 3 of [AD-1].

The sensor will generate 4 analogue currents.

Req. 5-1 The currents generated shall be 1.45 mA ±20 % at normal incidence and 20°C ± 5°C
Req. 5-2 The generated currents shall be 1.75 mA ±20 % maximum and 20°C ± 5°C
Req. 5-3 The currents generated shall be 1.45 mA ±60 % at normal incidence over the full temperature range
Req. 5-4 The generated currents shall be 1.75 mA ±60 % maximum over the full temperature range

These values are at 1 Am(0) sun illumination and 0 bias (measured with a transimpedance amplifier) over the full temperature range.

Req. 5-5 The internal thermistor shall have a nominal value of 10kΩ ± 10% @ 25°C

5.1 Grounding and isolation

Req. 5.1-1 The resistance from the common ground to case shall be 1MΩ<R<10MΩ
Req. 5.1-2 The capacitance between the sensor and ground shall be <100pF
Req. 5.1-3 The resistance from sapphire window to housing shall be <1MΩ
Req. 5.1-4 The resistance from baffle to housing shall be <20mΩ

5.2 Conductivity of external surfaces

Req. 5.2-1 In order to avoid build-up of electrical charge, the electrical conductivity of the external surfaces (including the sapphire window) shall be better than 10kΩ square

5.3 Specified accuracy

Req. 5.3-1 The specified accuracy for the sensors is better than 3.5 degrees if no calibration table is used
Req. 5.3-2 The specified accuracy for the sensors is better than 2 degree if a sensor specific offset and gain correction is implemented
Req. 5.3-3 The specified accuracy for the sensors is better than 0.5 degree 3σ if calibration tables are used

For this accuracy to be reached the readout electronics shall have:

- An offset of < 1mV per channel at a full scale of 10V
- 12 bit accuracy
- Inter channel gain equality of better than 0.1%

6 Environmental specifications

6.1 Storage conditions

Req. 6.1-1 Sensors should be stored in a dust free, dry and temperature controlled environment with a temperature range of 0°C to +30 °C and a relative humidity of 40% to 60% storage lifetime under these conditions is longer than 5 years when kept in the original packaging

6.2 Operating temperature range

Req. 6.2-1 The sensors shall perform within specifications when operated in the range of -120°C to +120°C

6.3 Non-operating temperature range

Req. 6.3-1 The sensors shall survive a non-operating temperature range of -125°C to +125°C

6.4 Temperature cycling

The sensors shall meet the temperature cycling requirements specified in Table 1.

Req.	Conditions	Temperature range	Number of cycles
6.4-1	Burn in 1)	-55°C...+125°C	10 (performed on each sensor)
6.4-2	High range thermal vacuum cycling	-125°C...+125°C	100
6.4-3	High volume thermal cycling 1)	-55°C...+125°C	800

Table 1 Thermal cycling specification

1) As part of the acceptance test procedure a 10 cycle burn in test is performed according to MIL-STD-883 Method 1010 B before final electrical measurements and visual inspection.

6.5 Vibration specifications

Vibration specifications of the sensors are given below. It should be noted that these are qualification levels and sensors are actually tested to these levels. Any safety margins required for the mission shall therefore be subtracted from the given level to see if the sensors meet mission requirements. The sine and random qualifications have been performed using the in [AD-2] and [AD-3] defined hardware and torqued to the level specified in 3.2

6.5.1 Eigenfrequency

Req. 6.5.1-1 The first eigenfrequency shall be > 200Hz.

6.5.2 Sine vibration

Req. 6.5.2-1 The sensors shall be able to function within specifications after being subject to vibration test levels specified in Table 2 in all three axis

Sine vibrations	
Frequency (Hz)	Level
5..44.6	20mm peak to peak
44.6..100	40g
1 octave/minute 1 sweep up/1 sweep down	

Table 2 Sine vibrations

6.5.3 Random vibrations

Req. 6.5.3-1 The sensors shall be able to function within specifications after being subject to vibration test levels specified in Table 3 in all three axis and displayed in Figure 2

Random vibrations	
Frequency	PSD
Hz	
20..80	13dB/oct
80..400	2 g^2/Hz
400..2000	-9dB/oct
RMS level 41.4 g	
Duration 150 seconds	

Table 3 Random vibrations

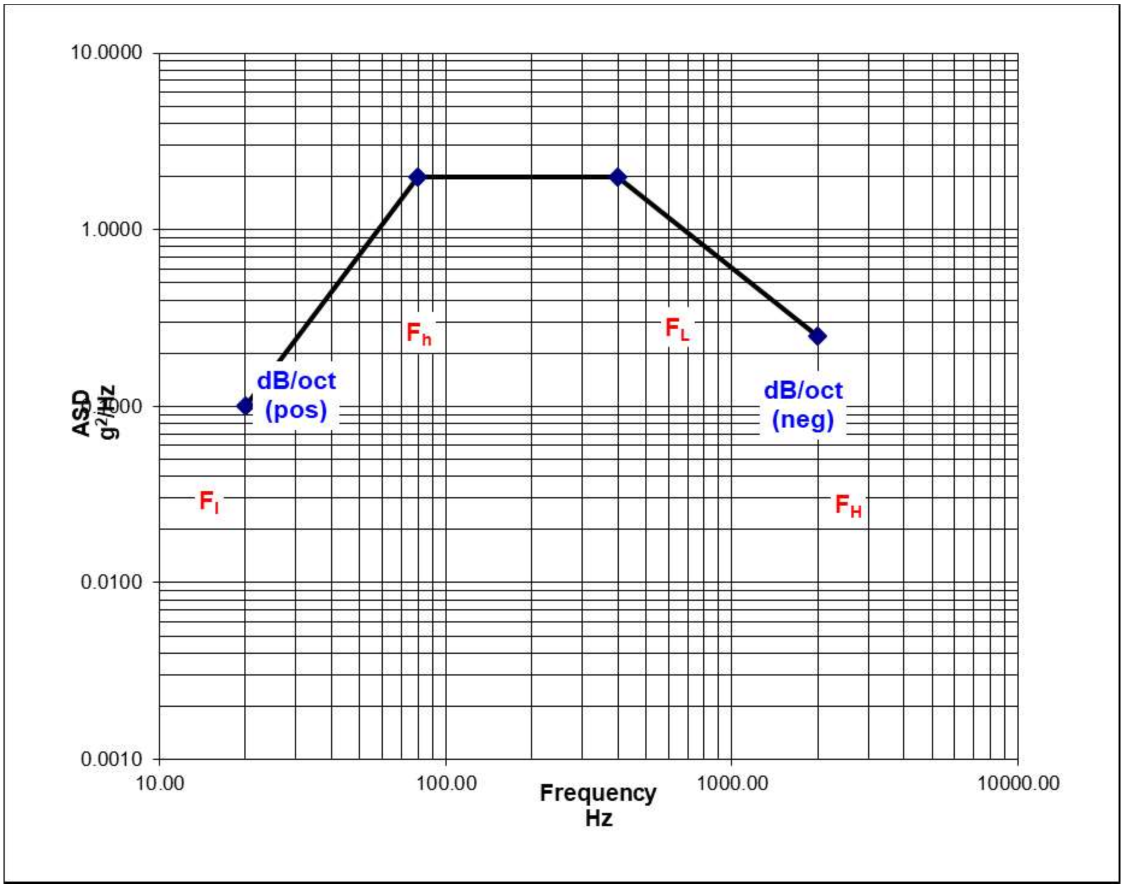

Figure 2 Random vibration profile

6.5.4 Shock specification

Req. 6.5.4-1 The sensors shall be able to function within specifications after being subject to shock test levels specified in Table 4 in all three axis and displayed in Figure 3

Pyro shock	
Frequency	Level
Hz	g
100	40
1000	2100
10000	10000
3 shocks in any direction	

Table 4 Pyro shock specifications

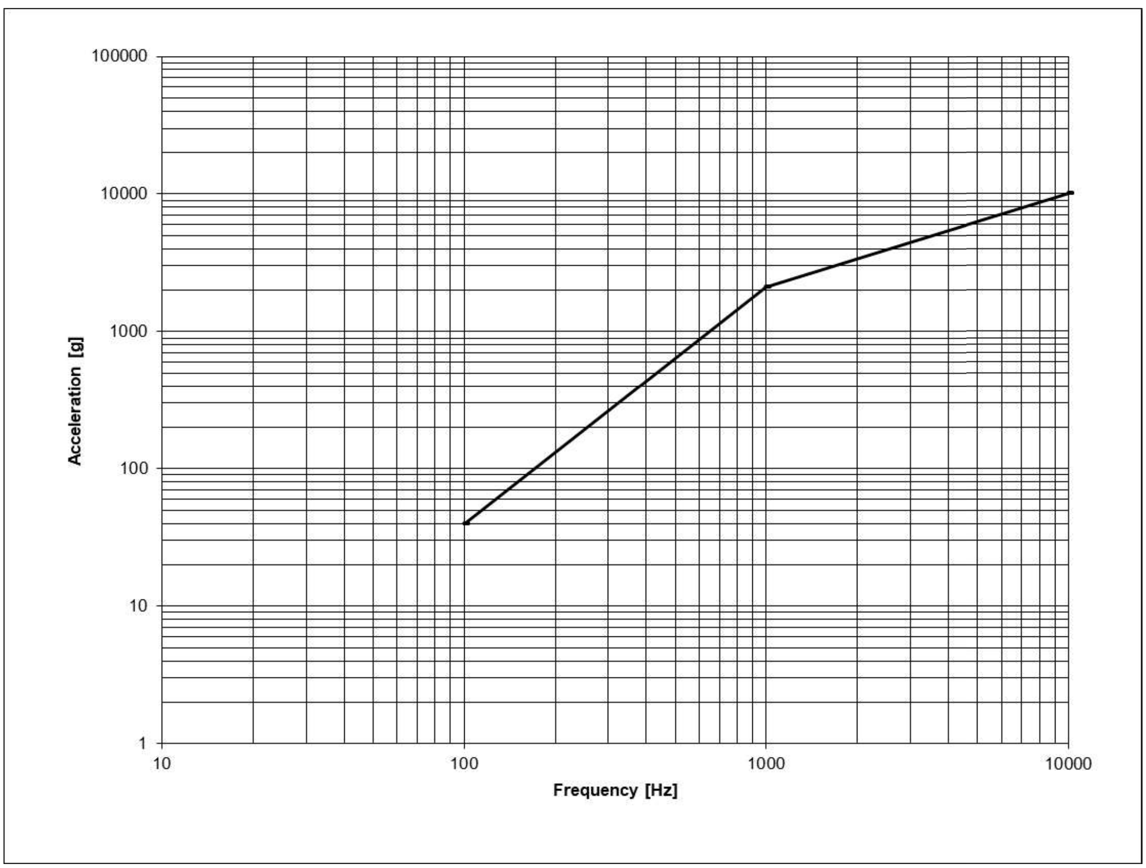

Figure 3 Pyro shock spectrum specified

6.5.5 PIND testing

Req. 6.5.5-1 The sensors shall be able to function within specification after being subject to a PIND test (Particle Induced Noise Detection) according to MIL-STD-883 Method 2020 A

NOTE: this test is performed on each sensor during production as a workmanship test.

6.6 Cosmic radiation resistance

Req. 6.6-1 The sensors shall be able to function 20 years in orbit after using electric orbit raising during one year to reach the orbit

NOTE: The bare diodes have been tested up to 10^{16} 1MeV electrons which is equivalent to:

- 240Mrad total ionizing dose
- $314 \cdot 10^9$ MeV cm^2/g Total non-ionizing dose (displacement damage)

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