



MAUS Sunsensor

Interface Control Document

| | Name | Signature |
|--------------|-------------------------------|-----------|
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DOCUMENT CHANGE RECORD

| Issue | Date | Total pages | Pages affected | Brief description of change |
|-------|------------|-------------|----------------|--|
| 1 | 14-08-2020 | 9 | All | New document |
| 2 | 05-11-2020 | 9 | 7 | Electrical scheme updated with proper info |
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Abbreviations

| | |
|--------|--|
| AD | Applicable Document |
| BOM | Bill Of Material |
| COTS | Commercial Of The Shelf |
| CSS | Coarse Sunsensor |
| ECSS | European Cooperation for Space Standardization |
| ESA | European Space Agency |
| FOV | Field Of View |
| FSS | Fine Sunsensor |
| IC-Doc | Interface Control Document |
| IC-Drw | Interface Control Drawing |
| LOS | Line Of Sight |
| NTC | Negative Temperature Coefficient resistor (thermistor) |
| RD | Reference Document |
| TRR | Test Readiness Review |



Applicable Documents

| AD | Document title | Document number | Issue |
|-------|--------------------------------|-----------------|-------|
| AD-01 | MAUS product specification | 19-LRD-SP-0012 | 1 |
| AD-02 | MAUS Interface Control Drawing | 114T701 | 02 |
| AD-03 | Precision fastener | 500M085 | 01 |
| AD-04 | Washer vented | 500M086 | 01 |
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Reference Documents

| RD | Document title | Document number | Issue |
|-------|--|-----------------|-------|
| RD-01 | Space engineering Interface management | ECSS-E-ST-10-24 | C |
| RD-02 | Delivery-Packing-Storage-Handling and Transportation procedure | 19-LRD-PR-0052 | 1 |
| RD-03 | Detail specification, connectors, electrical, rectangular, nanominiature, polarized shell, general specification | MIL-DTL-32139 | A |
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1 Introduction

The MAUS Sunsensor, see Photo 1, is a high reliability Sunsensor which is specifically designed for cubesat applications. The low profile of this sensor is achieved by using a standard nano-D connector.



Photo 1 MAUS

This document specifies the interfaces for the MAUS Sunsensor and shall be read in conjunction with the interface control drawing [AD-02]. And is written in line with the ESA Space engineering Interface management ECSS-E-ST-10-24 C [RD-01].

2 MAUS Interface data

2.1 Electrical

2.1.1 Grounding and insulation

- The resistance from the common ground is identified by "R2" as mentioned on [AD-02] sheet 3.
- Resistance "R2" to case shall be $1M\Omega < R < 10M\Omega$ as mentioned on [AD-02] sheet 3.
- The capacitance between the sensor and ground shall be $< 100\text{pF}$.

2.1.2 Signal interface data

2.1.2.1 Diode signal

- The sensor is identified by "D1" as mentioned on [AD-02] sheet 3.
- Sensor "D1" will generate 4 currents.
- Signal type of "D1" is analogue.
- Signal function of "D1" is measurement.
- Circuit diagram is mentioned on [AD-02] sheet 3.
- When illuminated with a $1\text{AM}(0)$ light source the generated currents on the diode outputs with respect to the diode return will be $-1.45\text{mA} \pm 60\%$ at normal incidence over the full temperature range.

2.1.2.2 Thermistor signal

- The internal thermistor is bipolar and identified by "R1" as mentioned on [AD-02] sheet 3.
- Thermistor "R1" has a nominal value of $10\text{k}\Omega \pm 10\%$ @ 25°C .
- The material constant B of the thermistor will be $3930\text{K} \pm 1\%$.
- $T1=25^\circ\text{C}$ and $T2=50^\circ\text{C}$.

$$B_{(T1/T2)} = \frac{T2 \times T1}{T2 - T1} \times \ln\left(\frac{R1}{R2}\right)$$

- Where:
 - o B value (material constant).
 - o T1 is the first temperature point in Kelvin.
 - o T2 is the second temperature point in Kelvin.
 - o R1 is the thermistor resistance at temperature T1 in Ohms.
 - o R2 is the thermistor resistance at temperature T2 in Ohms.

2.1.3 Harness interfaces

For the below paragraphs (as per [RD-01]) polarity indicators are defined as:

- B=bipolar
- R=return
- P=positive
- N=negative

2.1.3.1 Connector interface data – per pin

The connector, identified as “J1” on [AD-02] sheet 3, is a single row 9 pin Nano-D female surface mount connector complying to requirements according to MIL-DTL-32139 [RD-03] (for instance Glenair 890-013-09S), for which the pins are identified as follows:

| PIN number | Component | Output | | Function | Polarity |
|------------|-----------|--------------|----------|-------------|-------------|
| | | signal | type | | |
| J1-1 | N/A | | | Case | |
| J1-2 | Q1 | Diode | Analogue | Measurement | N -negative |
| J1-3 | Q4 | Diode | Analogue | Measurement | N -negative |
| J1-4 | Q3 | Diode | Analogue | Measurement | N -negative |
| J1-5 | RTN | Diode return | Analogue | Measurement | N/A |
| J1-6 | Q2 | Diode | Analogue | Measurement | N -negative |
| J1-7 | R1-2 | Thermistor | Analogue | Measurement | B -bipolar |
| J1-8 | R1-1 | Thermistor | Analogue | Measurement | B -bipolar |
| J1-9 | N/A | | | Case | |

2.2 Optical

The optical interfaces are defined by means of a right-hand orthogonal coordinate system defined by the X axis running through the center of the reference hole (right side bottom hole “z” on sheet 1 of [AD-02]) and the slotted hole. Consequently, the Z axis is defined orthogonal to the mounting plane of the sensor.

Sheet 2 of [AD-02] defines the fields of view of the sensor with respect to the mounting plane in cross sections A-A, B-B and C-C. For each of these cross sections there are two fields of view given for which the smaller one is the measurement field of view and the larger one is the Sun exclusion field of view.

Within the specified measurement field of view the defined accuracies will be obtained after the appropriate calibration compensation.

Outside of the specified Sun exclusion field of view, the sensor will not be sensitive to Sun light.

More applicable information:

- The Field of View is mentioned on [AD-02] sheet 2.
- Outside optical coating is an ITO coating.
- The first inside optical coating is a reflection coating.
- Outside mechanical surface finisher is not applied as mentioned on [AD-02] sheet 4.

2.3 Thermal control

- Baseplate thermal contact area are mentioned as “grounding studs” on [AD-02] sheet 4.
- Temperature range is mentioned in [AD-01].
- Contact area flatness is mentioned on [AD-02] sheet 1.
- Overall roughness Ra is 1.6 μ m according to DIN ISO 1302 as mentioned on [AD-02] sheet 1.
- Thermal design of the mounting interface shall be such that the temperature is kept within the specified temperature ranges at the sensor side of the TRP as indicated on [AD-02] page 4 through conduction.
- The housing is made of bare ASTM grade V Titanium as mentioned on [AD-02] sheet 4.
- The window has a measured α of 0.56
- The window has a measured ϵ of 0.76
- Thermal mass of the sensor is 6.67 J/°C \pm 5%.

2.4 Structural

In order to achieve the specified accuracy and environmental withstanding capability.

- Precision fastener 500M08501 [AD-03] shall be used.
- Specified precision fasteners shall be fastened with the recommended specified torque of 1Nm \pm 10%.

In order to avoid entrapment of air slowing evacuation.

- Washer vented 500M08601 [AD-04] can be used.
- The approximate position of the 1mm venting is indicated on [AD-04].

More applicable information:

- The reference hole is identified by “Temperature Reference Point” as mentioned on [AD-02] sheet 1.
- The reference hole is \varnothing 4H7.
- Envelope dimensions are mentioned on [AD-02] sheet 1.
- Mass in mentioned on [AD-02] sheet 1.
- Centre of gravity is identified by “COG” as mentioned on [AD-02] sheet 1.

- Calculated Moment of inertia are mentioned on [AD-02] sheet 4.
- Mounting holes size and location are mentioned on [AD-02] sheet 1.
- Mounting pads thickness are mentioned on [AD-02] sheet 1.
- Geometrical tolerance is mentioned on [AD-02] sheet 1.
- Connector location is mentioned on [AD-02] sheet 1, position: (I – 3/4).
- Grounding studs are mentioned on [AD-02] sheet 4.
- The mutually flatness studs are mentioned on [AD-02] sheet 1.
- Overall roughness Ra is 1,6 μ m according to DIN ISO 1302 as mentioned on [AD-02] sheet 1 up to 5.
- Sensor mounting method can be found in [RD-02].

2.5 Mechanisms

- Protection cover outside dimensions are mentioned on [AD-02] sheet 5.
- Protection cover material is POM as mentioned on [AD-02] sheet 5.
- Protection cover mounting holes size and location are mentioned on [AD-02] sheet 5.
- Mounting hardware delivered with the protection cover:
 - o Screw specification is according to DIN912 A2-70 M4*16.
 - o Washer specification is according to DIN433 A2-140 HV M4.
- Mass of protection cover including mounting material is <47gr.

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