

RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

| | | | | |
|-----------------------------|-----------------------|--|--------------|-----------------|
| Spacecraft / Project | FLEX | Originator's Name | Marco Lai | |
| System / Experiment / Model | FLORIS | Signature / Date | | |
| Sub-System | FLEX Calibration Unit | Request Type (Highlight applicable request) | Waiver (RFW) | Deviation (RFD) |
| Assembly | ALM-DES-225-0001 | Organisation | Almatech | |
| Sub-Assembly | Position detection | Ref. Doc. / Drwg No. | ALM-PRO-4152 | |
| Item | - | References | - | |
| Serial No. | EQM, PFM | | | |

RFD/RFW Title

Knowledge of position of Observation and Black Target Position

| End Items(s) Affected (Hardware, Software) | | | | |
|--|---------------------|-------|------------|----------------|
| Name | CI-Number | | Model(s) | |
| Calibration Unit | | | EQM/PFM | |
| Requirement / Interface Documents Affected | | | | |
| Specification/Drawing Title | Number | Issue | Date | App. Paragraph |
| FLORIS Calibration Unit URD | FLX-RS-FNM-INS-0006 | 5 | 09.05.2018 | 5.3.4.3 |

Description of Deviation / Discrepancy / Non-Conformance

25.01.2019: Analysis of the hall sensor activation range

Requirement FLO-CU-URD-REQ-0240 says :

FLO-CU-URD-REQ-0240 Verification: A,T

The CU shall guarantee the knowledge of angular position of the sun diffuser, black target and Rotor Observation baffle, each time one of these elements is in its operating mode (see # FLO-CU-URD-REQ-0040):

- with an overall accuracy of +/- 0.04 deg. wrt. REF_{CU_PH} , REF_{CU_ALN} for sun diffuser (in Sun calibration mode)
- with an overall accuracy of less/equal +/- 0.1 deg. wrt. REF_{CU_PH} , REF_{CU_ALN} for black target (Black calibration position) and for Rotor Observation baffle (i.e. nadir baffle in Earth Observation position).

Position sensors shall be provided for the scope.

Knowledge shall include, position sensor error, GTO, BOL/EOL and rotor stabilities (including rotor axis alignment accuracy) as well as any other effects such as diffuser to diffuser mount setting and thermo-elastic effects.

RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

Notes:

- 1) *the position knowledge can be limited to the single element under operation (i.e. diffuser if CU is in sun calibration mode, Nadir Baffle if CU is in Earth observation mode and black target if CU is in dark calibration mode);*
- 2) *this requirement is driven by needs specific to the Sun diffuser position knowledge when in Sun Calibration mode ;*
- 3) *A REF_{CU_ROT} frame shall be proposed and agreed with Customer for AIV/AIT activities.*
- 4) *A budget shall be provided by Customer to identify and detail all possible contributions to the overall position errors including initial knowledge, GTO, thermoelastic effects (EOL); contributions can be summed by RMS. Required overall accuracy levels shall comply with a 3 sigma equivalent confidence value.*

Parents: FLO-TRD-REQ-0690 *

Therefore the knowledge of position for the Observation and Black calibration position is requested to be +/-0.1°.
The sensor hall OMH090S presents the magnetic characteristics w.r.t activation and release reported in Table 1(see also datasheet in annex)

Table 1: OMH090S thresholds values

| Part Number | Hi-Reliability Hallogig® Sensor | Operate Point Gauss Min / Typ / Max | Release Point Gauss Min / Typ / Max | Hysteresis Gauss Min / Typ / Max |
|-------------|---------------------------------|--|--|-------------------------------------|
| OMH090B | | 50/90/180 | 30 / 65 / 160 | 10 / 30 / 60 |
| OMH090S | | | | |

The activation thresholds display a wide activation range:

Operative threshold: 50 to 180 Gauss

Release threshold: 30 to 160 Gauss.

The location of the sensitive part w.r.t packaging is also given with wide uncertainty with respect to the packaging top surface:

Best location: 0.65mm

Nominal Location: 0.864mm

Worst location: 1.0765mm

RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

The sensing configuration is reported here after:

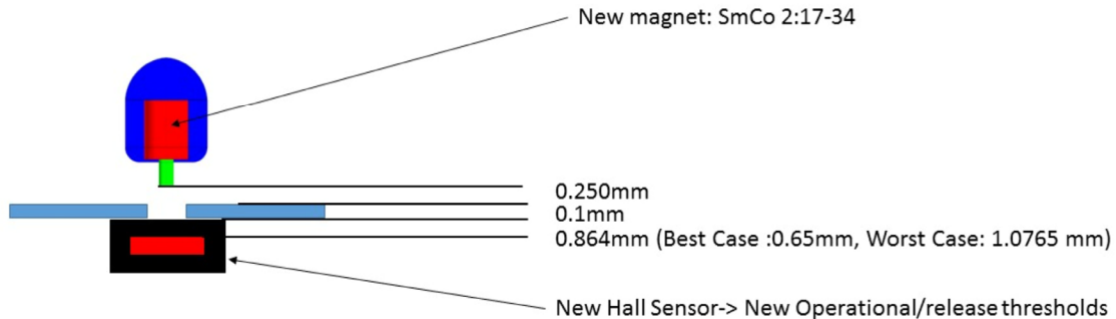


Figure 1: Sensing configuration

In the Figure 1 value of 0.250mm is driven by the shock analysis results resulting from shock level requested in FLO-CU-URD-REQ-1340 and reported here after for convenience.

| Frequency [Hz] | SRS [g] Q=10 all axes | Test Tolerance [dB] |
|----------------|-----------------------|---------------------|
| 100 | 10 | -0/+6 |
| 725 | 636 | -0/+6 -> -3/+6 |
| 10000 | 636 | -3/+6dB |

A series of magnetic simulation is performed under the following hypothesis:

- Sensor activation threshold 90 Gauss (nominal values in Table 1)
- Sensor release threshold 65 Gauss (nominal values in Table 1)
- Threshold activation variation from BOL to EOL as reported in FLX-RP-ALM-CU-0007 Issue 1.0 (Radiation Analysis Report) and FLX-RP-ALM-CU-0002 Rev 2.0 (CU Functional Analysis Report)

The influence of the sensitive part distance from the top packaging surface on the detection range is analysed in the following sections:

RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

Nominal distance equal to 0.864mm

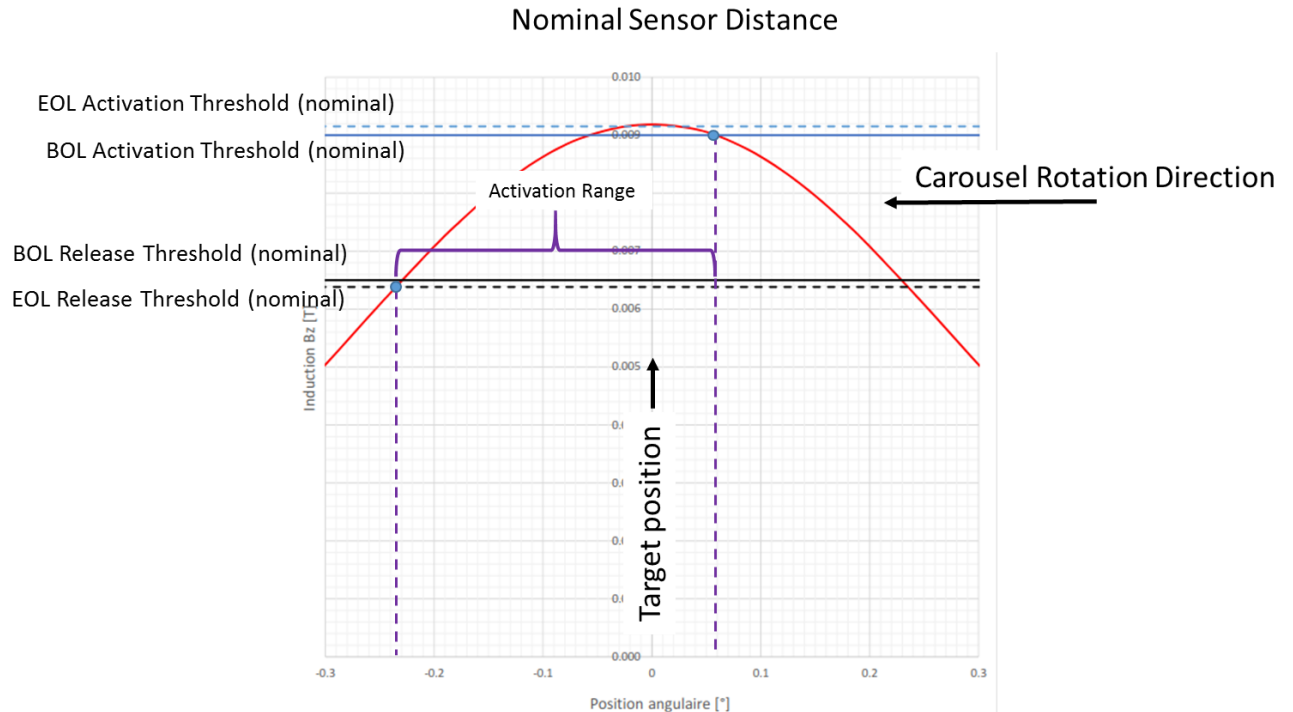


Figure 2: Nominal sensor distance activation range

The activation range is therefore comprised between $+0.06^\circ$ and -0.235° , i.e. a total range of 0.295° which reported to a symmetric interval results to a $\pm 0.1475^\circ$ range which is out of specifications w.r.t. FLO-CU-URD-REQ-0240.

In the same way, in the other cases activation range is reported hereafter

RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

Best distance equal to 0.65mm

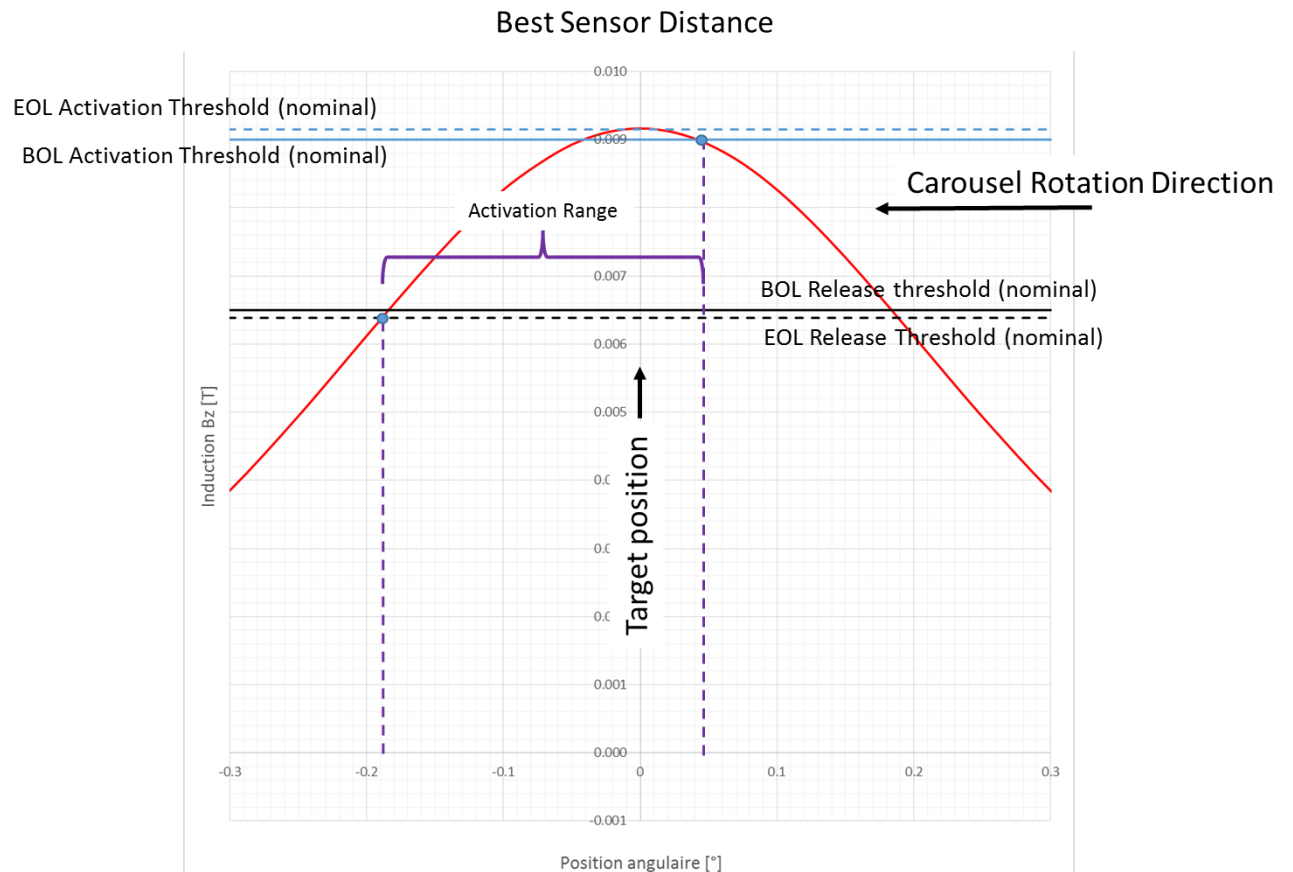


Figure 3: Best sensor distance activation range

In this case The activation range is comprised between $+0.045^\circ$ and -0.085° , i.e. a total range of 0.13° which reported to a symmetric interval results to a $\pm 0.065^\circ$ range which is compliant to specifications w.r.t. FLO-CU-URD-REQ-0240.

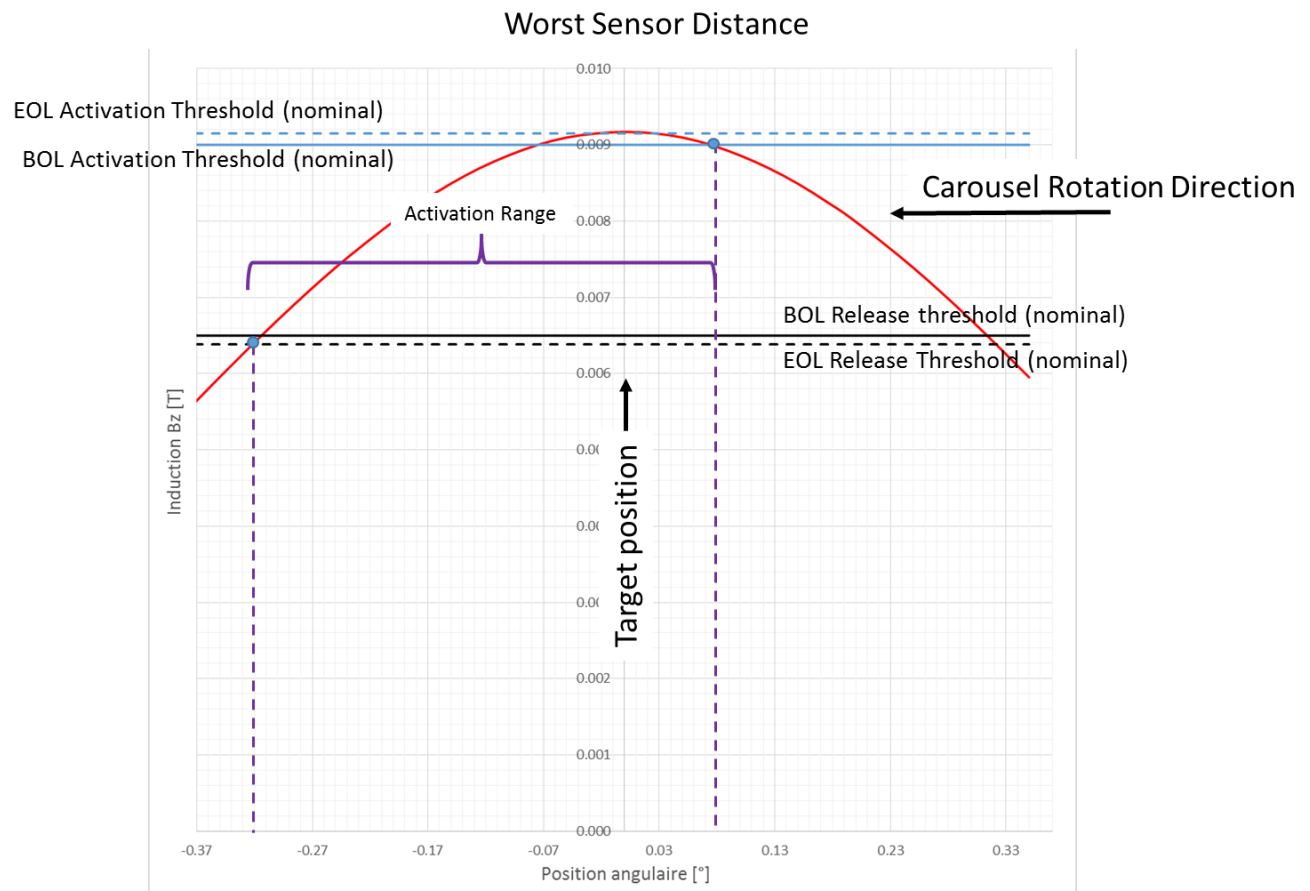
RFD/RFW Number:

FLX-RFD-ALM-CU-0003

Issue

1.0

Worst distance equal to 1.0765mm



In this case the activation range is comprised between $+0.08^\circ$ and -0.32° , i.e. a total range of 0.4° which reported to a symmetric interval results to a $\pm 0.2^\circ$ range which is out of specifications w.r.t. FLO-CU-URD-REQ-0240.

On the base of what precedes the following points are highlighted:

- The activation and release threshold will have a variation within a batch of 100 components. If component with lower thresholds and hysteresis are possible to be selected the above reported range could be improved. On the contrary, if hall sensors are delivered with threshold and hysteresis higher than the nominal values the activation ranges reported above will be worst-
- For given activation and release thresholds the distance of embedment of the sensitive part of the Hall sensor from the package upper surface is determinant in the performances. In particular:
 - A) If nominal distance is considered the activation range appears to be slightly above the required one (if nominal thresholds are considered).
 - B) If worst distance is considered the activation range appears to be largely above the required one (if nominal thresholds are considered).
 - C) If best distance is considered the activation range appears to be compliant with the required one (if nominal thresholds are considered).

Other Items or Requirements (Potentially) Affected

None

RFD/RFW Number:
FLX-RFD-ALM-CU-0003
Issue
1.0
Need for RFW/RFD and Rationale for Acceptance

Possible deviation of the activation range and therefore of the required knowledge of position is highlighted by the analysis. Based on the requirements and the data given above, Almatech cannot assure a better knowledge of position.

| RFW/RFD CLOSED | Name | Sign & Date | |
|--|-----------------------|------------------------|-----------------|
| | | Approved | Rejected |
| Project Manager / Engineering: (Sub System) | Gianluigi Capo | | |
| Engineering: (Almatech) | Marco Lai | | |
| Product Assurance: (Almatech) | Thomas Gandy | | |
| Project Manager: (Leonardo) | | | |
| Engineering: (Leonardo) | | | |
| Product Assurance: (Leonardo) | | | |
| Engineering (ESA) | | | |
| Contract Manager (ESA) | | | |
| | | | |

Continuation sheet: