GIADA FS MODEL

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REVISIONS LOG

REV	DOCUMENT CHANGE ORDER	DATE	CHANGES DESCRIPTION	PREPARED
0	-	15-02-2005	First issue	M. Cosi & PI Team
1		21-03-2005	Updated by PI	M. Cosi & PI Team

1. SCOPE AND APPLICABILITY

1.1 SCOPE

The II part of the in flight commissioning is composed by two-test scenario: the interference (parts 1A and 1B) and the pointing scenarios. The Interference scenario is started the 20 of September and is finished the 22 of September. Following the Interference scenario, the Pointing is run in two days: the 23 and 30 September.

This document reports the activities performed on GIADA experiment on the 23 and 30 September '04 (Pointing scenario).

1.2 APPLICABILITY

This report is applicable to GIADA FS model on board the Rosetta S/C now flying @ about $74.2x10^6$ km from the Earth (about 4 minutes of delay between the S/C and Earth in the radio link communication). The data have been retrieved from DDS by means of the PI Workstation located @ INAF - Osservatorio Astronomico di Capodimonte in Naples.

GIADA IWS software configuration is GES 4.2.1 plus RSOConverter v1.1.1, GIADA in flight software configuration is 2.3 plus four additional patches (one to update the context file).

2. REFERENCES

2.1 APPLICABLE DOCUMENT

AD1	RO-EST-RS-3001/EID A	ROSETTA Experiment Interface Document - Part A
AD2	RO-EST-RS-3009/EIDB	ROSETTA GIADA Experiment Interface Document – Part B
AD3	RO-ESC-PL-5000 Issue 4.7 09/08/2004	Flight Control Procedure
AD4	GIA-GAL-MA-007 Issue 2	GIADA Flight Spare User Manual
AD5	RO-EST-DP-028 dated 04/08/2004	ITL Procedure for Interference scenario
AD6	GIA-GAL-RP-518 Rev 1	GIADA FS MODEL REPORT OF IN-FLIGHT INTERFERENCE SCENARIO PART 1A (20 - 21 SEPT ‘04)
AD7	GIA-GAL-RP-519 Rev 1	GIADA FS MODEL REPORT OF IN-FLIGHT INTERFERENCE SCENARIO PART 1B (21 - 22 SEPT ‘04)

2.2 REFERENCE DOCUMENT

None.

3. DEFINITIONS AND ABBREVIATIONS

3.1 ABBREVIATIONS

ACK	Acknowledge
ADC	Analogue To Digital converter
ADP	Acceptance Data Package
AFT	Abbreviated Functional Tests
AIV	Assembly, Integration and Verification
ALS	Alenia Spazio
BT	Bench Test
CCS	Central Checkout Equipment
DDS	Data Disposition System
EGSE	Electrical Ground Support Equipment
EMC	Electromagnetic Compatibility
ESA	European Space Agency
ESOC	European Spacecraft Operation Centre
FB	GIADA Frangibolt
FCP	Flight Control Procedure
FFT	Full Functional Tests
FS	Flight Spare
GA	Galileo Avionica
GDS	Grain Detection System
GIADA	Grain Impact Analyser and Dust Accumulator
GSE	Ground Support Equipment
H/W	Hardware
HK	House Keeping
I/F	InterFace
IAA	Istituto de Astrofisica de Andalucia – Granada (E)
INAF-OAC	INAF - Osservatorio Astronomico di Capodimonte – Napoli (I)
IS	Impact Sensor
IST	Integrated System Test
IWS	Instrument Workstation
KAL	Keep Alive Line
LCL	Latch Current Limiter
LFT	Limited Functional Tests
MBS	Micro Balance Sensor
MTL	Mission TimeLine
NA	Not Applicable
OBCP	On-Board Control Procedure
PI	Principal Investigator
PM	Progress Meeting
PS	GIADA Power Supply
PZT	(IS) Piezo Sensor
QM	Qualification Model
RMOC	Rosetta Mission Operation Centre
RSOC	Rosetta Science Operation Centre
RW	Reed Switch

S/C	Rosetta Spacecraft
S/S	GIADA Sub-system (e.g. IS or GDS or MBS)
S/W	Software
SIS	Spacecraft Interface Simulator
SPT	Specific Performance test
SSMM	Solid State Mass Memory on-board of Rosetta Spacecraft
STD	Standard
TBC	To Be Confirmed
TBD	To Be Defined
TC	Telecommand
TM	Telemetry
UPA	Università Parthenope – Napoli (I)
UTC	Universal Time Code

4. DESCRIPTION OF ACTIVITIES

The Pointing scenario test was performed on 23 and 30 September 2004, according to the Interference-Pointing scenario plan provided by ESA/ESOC (ROS-RSSD-PO-002 dated 06/08/2004).

In the first day, the Rosetta S/C was manoeuvred to get sun light from GIADA –X axis (refer to Figure 6 for axes direction) and to change the angle of the sunlight with respect to the S/C Z axis (which is along GIADA bore-sight) from 80 to 45 deg with steps of 5 deg. In the second day (the 30th September) the sunlight angle was changed from 20 to 45 deg with steps 5 deg.

The objective of the test was to evaluate the behaviour of GIADA (and the other on board payloads) induced by the different angles of the sunlight.

This document reports the GIADA behaviour during the Pointing Scenario. The GIADA PI team and GA personnel (only applicable for 30 September) were located at INAF – Osservatorio di Capodimonte in Naples, with support by the RMOC team at ESOC. Activities have started @ 20:30 local time of 23 September and @ 20:30 local time of 30 September. TM was expected to start to arrive (at **New-Norcia** Ground Station) at 18.30 UTC (20:30 local time) of 23 September and to finish at 02.45 UTC (04:45 local time) of the 24 September.

Commands were previously loaded in the Rosetta S/C and sent to GIADA via MTL. The plan foresees to use the nominal FCPs (Section 4.1), which have been already validated in the previous GIADA Commissioning (only the modification to change the GDS threshold has been introduced).

4.1 FCP LIST

Table 1 lists all the used FCP's during the GIADA commissioning.

Procedure Number	Notes
	POINTING 80 to 45 deg (23-September-2004) and **POINTING 20 to 45 deg** (30-September-2004)
AGDF001A, B and C	Switch GIADA on main, patch CF with default, patch SW (one patch at a time) and dump
AGDS035A	Go to COVER
AGDS090A	Cover opening OBCP [arm cover, open cover with heaters 5+6+4 on]
AGDS065A	Go to SAFE
AGDS036A	Set IS
AGDS110A	Go to NORMAL and enable Science TM
AGDS120A	Calibrate GDS, IS and MBS - Several times, every 6 minutes
AGDS065A	Go to SAFE
AGDS035A	Go to COVER
AGDS070A	Cover closing OBCP [arm cover, close cover with heaters 5+6+4 off]
AGDF060A	Go to SAFE, dump memory CF, switch off OBCP [close cover OBCP with heaters 6+4 on, go to SAFE, Report context, Reset VD .... switch off]

Table 1 GIADA Flight Control Procedure

5. POINTING SCENARIO TEST REPORT

5.1 POINTING SCENARIO (23-24/09/04 - MAIN)

5.1.1 Activities log

The following activities have been performed in sequence by preloaded command timeline sequence.

UTC	Description
23 Sept 2004 – 06:21	Beginning of activity – GIADA power on
23 Sept 2004 – 06:44	Cover open operation
23 Sept 2004 – 06:58	Go to Normal mode (science enabled)
23 Sept 2004 – 16:45	Go to Safe – Science disabled
23 Sept 2004 – 16:53	1st close cover operation
23 Sept 2004 – 17:00	GIADA Switch-off (with automatic Cover close operation incorporated in the Power-off OBCP)
23 Sept 2004 – 20:18	Cover recovery procedure start: GIADA power on
23 Sept 2004 – 20:56	Cover Recovery procedure stop: GIADA Switch-off (with automatic Cover close operation incorporated in the Power-off OBCP)

The GIADA switch-on procedure was applied selecting the Main I/F and with the Context File stored in SSMM. The Instrument Main I/F was successfully powered-on by means of the GIADA POWER-ON OBCP on 23rd of September 2004 @ 06:21 (UTC time), which corresponds to a SCET Time of about 54541258sec.

The first expected packet (Connection Report, service 17,2) was not received.

The second expected packet (i.e., 'GIADA in Safe mode' Event Report) has been received as first TM report in the test. GIADA was correctly time synchronised. After the GIADA in Safe Mode event, the first HK report was correctly received @ default HK rate of 40s.

Afterwards, the first patch (regarding the Context File) was sent, as well as the other required software patches that were, as expected, divided in six memory load commands. All commands were nominally received, as well as the expected 25 memory dumps. As result of the Context File patch, GIADA HK rate was changed to 10s rate. GIADA remained in Safe mode until 06:44 (UTC time).

The next step was to open the cover. The operation was successfully completed @ 06:51 (UTC Time) when the Cover Report was received. The IS setting commanding was sent by FCP before to enter in Normal mode and thus refused by GIADA; the IS setting change was not performed as expected. Then GIADA was sent to Normal @ 06:58 (UTC Time). The Lasers were switched-on by the Laser_power_on OBCP, upon the reception of the 'Start Switch Lasers ON OBCP' event. Science was enabled @ 06:59 (UTC Time). Due to the production of a flood of GDS 'Ghost events', the SSMM was saturated until the GDS receivers saturated due to the sun light. The internal calibration of GDS, IS and MBS sub-systems was periodically performed every 6 minutes to check the instrument behaviour.

The objective of the test was to check the behaviour of GIADA (and the other on board payloads) induced by the different angles of the sun light. The S/C was manoeuvred in such a way that the direction of the sun light moved from 80 deg, with respect to the S/C Z axis (Figure 6), to 45 deg with steps of 5 deg (Figure 1).

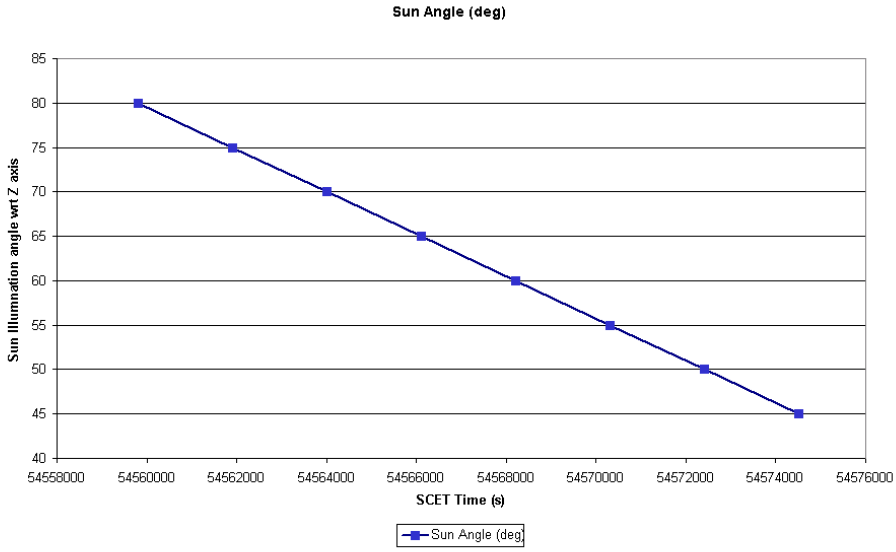

Figure 1 Sun light direction wrt SCET Time

Except for the mentioned loss of science TM due to SSMM saturation (about 8500 packets), no other packets were lost, neither HK nor Acknowledge reports.

As expected, GIADA was commanded to Safe mode @ 16:45:04 (UTC Time) of 23rd September. By means of the command sequence in the FCP, the cover was successfully closed and finally a cover report was received @ 16:53:11 (UTC Time) of 23rd September. Then the experiment power-off (GIADA power-off OBCP) was started (@ about 17:00 – UTC Time) and the cover was again closed (with heaters Cover and Motor Heaters Off) and the cover report received @ 17:04:15 (UTC Time) of 23rd September. The Instrument was switched-off @ about 17:05 of 23rd Sept. (UTC Time).

During the successive data post-processing, which was performed in real time by PI team, a not expected cover final position was found: cover remained in the open position after the second close operation. Therefore a recovery procedure was suddenly initiated by asking to ESOC RMOC to run in-real time the following:

- Switch-on GIADA by the nominal Power-on FCP
- Wait few minutes and check the HK telemetry to control the status of the two Reed-switches indicating the open/close cover position
- Switch-off GIADA by means of the embedded Power-off OBCP: the cover was automatically closed.
- Verify the Cover close by means of the received cover report and HK telemetry report. In case of correct status, the procedure is stop here otherwise it should be run again.

Having ESOC RMOC agreed on the proposed procedure, GIADA was switched-on again @ 20:18:58 UTC Time of the 23 Sept. (SCET = 54591522s). The power-on was successfully completed at 20:30:18 UTC time. After about 40 minutes, the GIADA power-off procedure was initiated and successfully completed @ 20:57:58 UTC Time (SCET = 54593861s) after having received the Cover Report Event. **At this time the cover resulted successfully closed.**

5.1.2 Housekeeping data analysis

The following figures have been taken from the HK database.

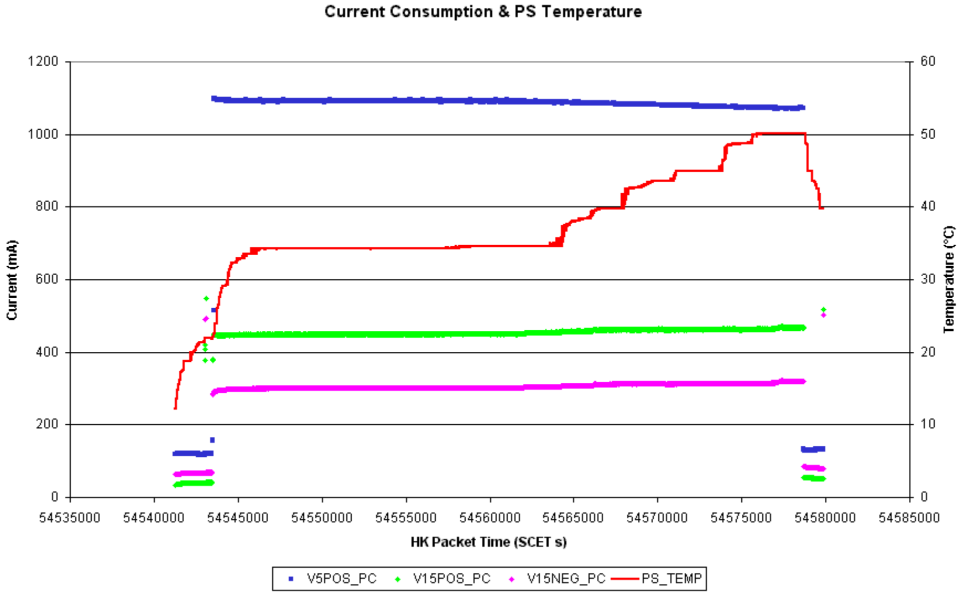

Figure 2 +5V and ±15V Currents and PS Temperature

The current consumptions and the Power Supply temperature (Figure 2) are in the expected ranges. The PS temperature increases while the sun orientation goes towards S/C Z axis and illuminates the GIADA instrument, but in any case is still below 50°C. The +5V current consumption measured in Normal mode decreases of about 20mA and the +15V and –15V currents increase of 20mA while the temperature of GIADA increases from 30 to 50 °C. The measured +5V, +15V and –15V currents are 1070mA, 469mA and 320mA, respectively.

The instrument cover was successfully opened and closed by command sequences at the expected time. **Unfortunately the second cover close attempt, which was run during the Power Off OBCP, failed and at the end of the procedure the cover resulted unexpectedly open.** In Figure 3, it is shown the status of the two reed-switches that indicate the open position of the cover. The status of the 'open' reed switch remained active also at the end of power off: **this shows that the cover remained open** (details are reported in Section 5.1.2.1, in which the status of the two reed switches as decoded from the Cover Reports are reported).

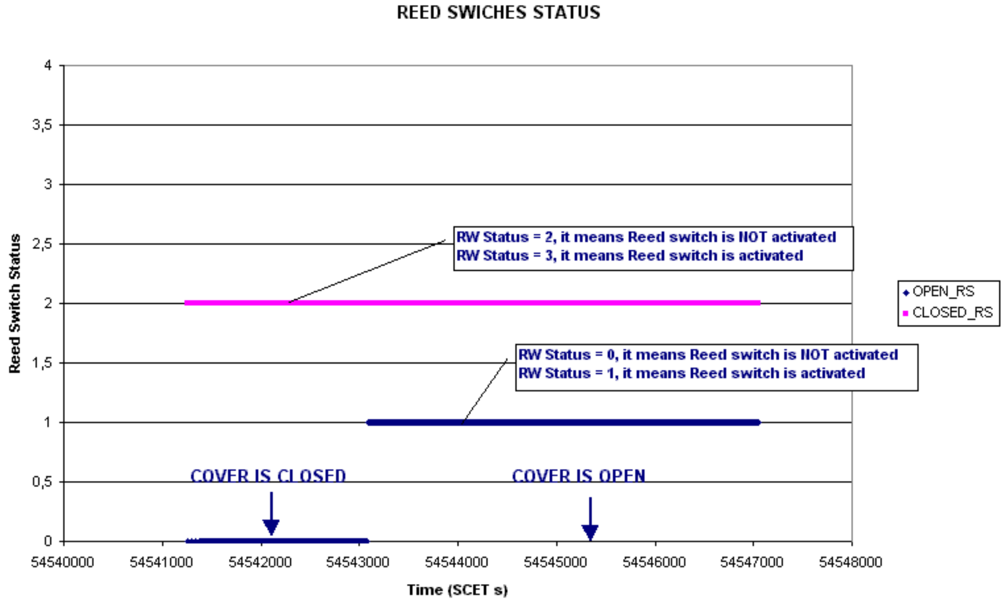

Figure 3 Cover Reed Switch Status (Cover open & close operations)

The status of the 'closed' reed switch remained always not-activated: this is nominal, because when the cover reaches its closed position, the reed switch is still not active (the switch is active only for few steps before the close position is reached) and the transit in front of the 'closed' reed switch is performed in a time shorter than the sampling rate of HK telemetry, i.e. 10s (thus the described transition cannot be seen in the HK TM report!).

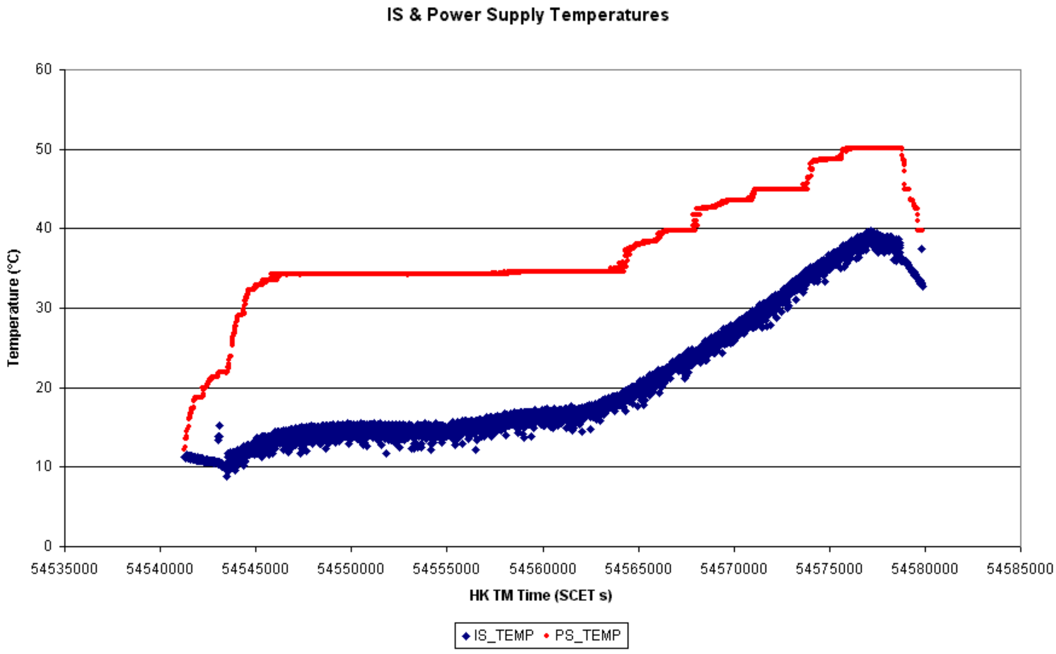

Figure 4 IS & PS Temperatures

In Figure 4, the Power Supply temperature increases from 10°C (@ power-on) up to 50°C, when GIADA is in Normal mode (in which the maximum power is drawn) and when the sun orientation is below 80 deg wrt. the S/C Z axis. The IS temperature increases from 10°C (cover is closed) to about 40°C when GIADA cover is open and the sun orientation is 45 deg wrt. the S/C Z axis. As already detected in the previous tests, when the lasers are switched on, the IS temperature becomes noisy (data are spread within 3°C) wrt. the case when GIADA is in safe mode.

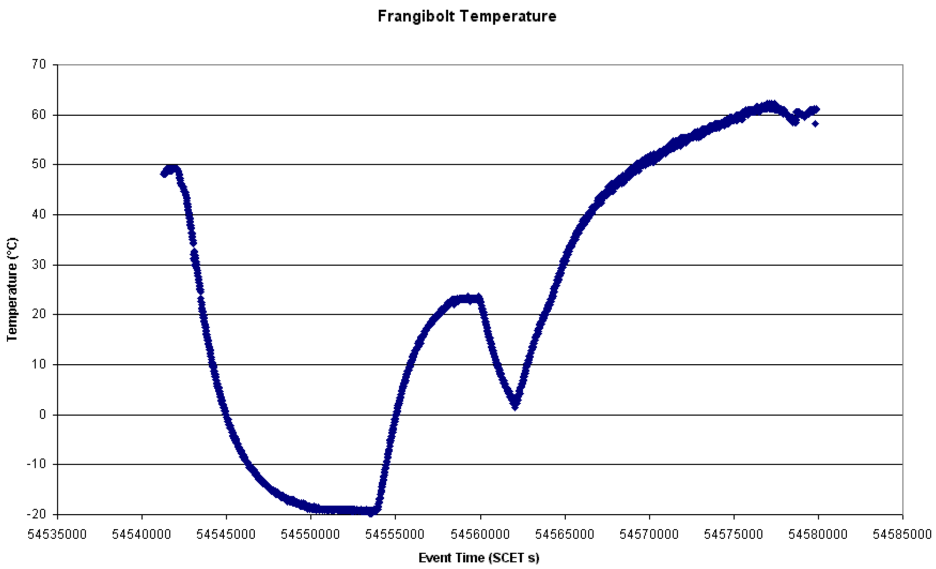

Figure 5 Frangibolt Temperature

The Frangibolt temperature, shown in Figure 5, monitors (indirectly) the direction of the sun illumination along the test.

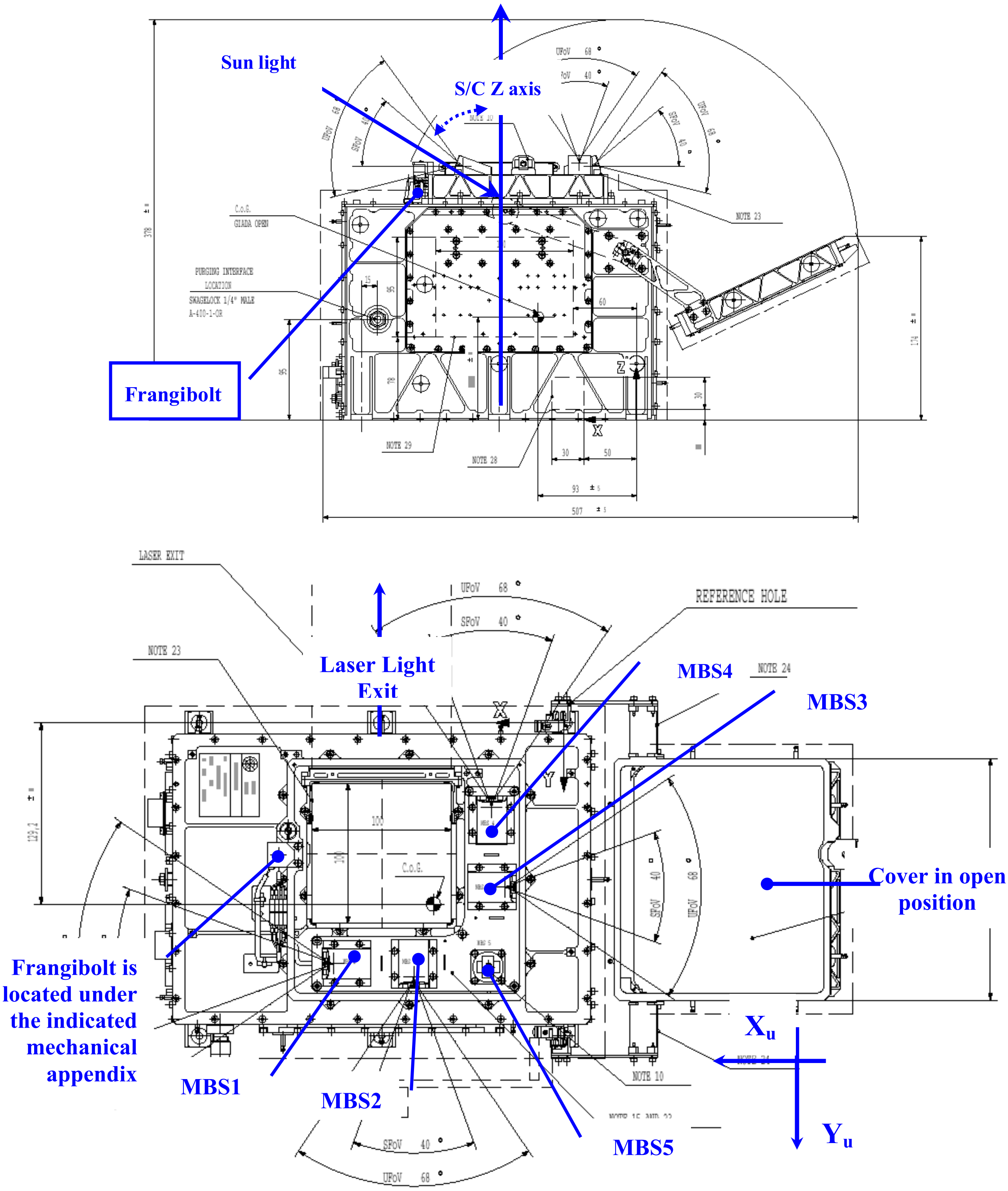

Figure 6 MBS location-pointing & sun illumination angle wrt GIADA unit axes

The laser light temperatures (Figure 7) increase from 8°C to about 40°C. As expected, the light of each lasers decreases when the temperature rises up.

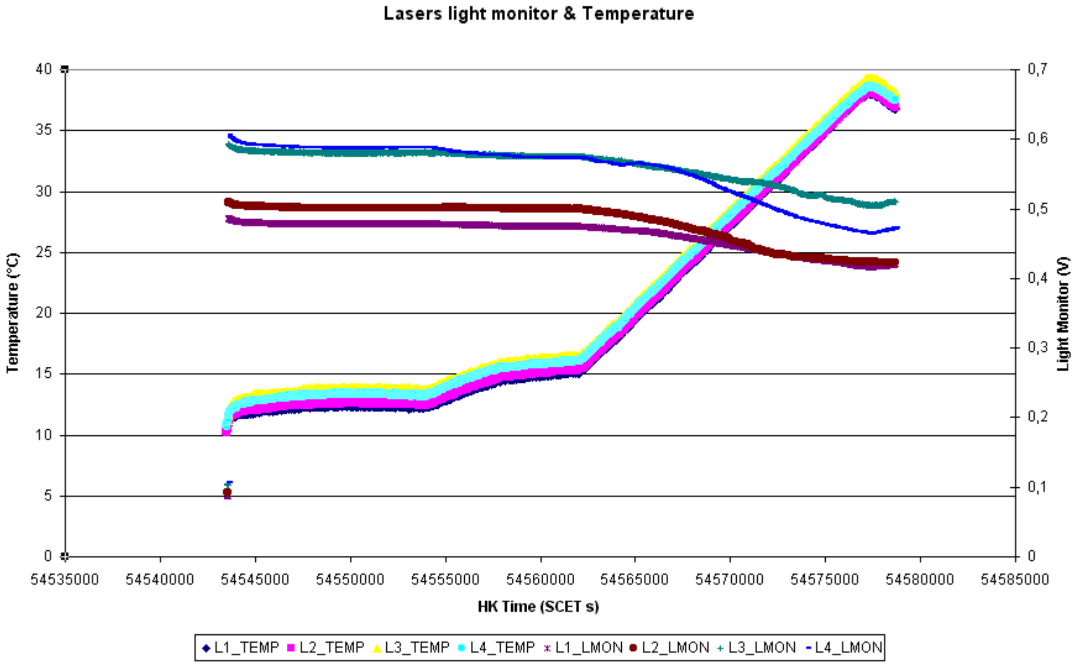

Figure 7 Laser light monitor and temperatures

The five MBS show a temperature in the range 15 ÷ 25°C (see Figure 8). The temperatures increase due to the sun illumination up to 60°C (sun light @ 45 deg wrt. the S/C Z axis).

The Dust Flux indication is > 0 (Figure 9) four times: the first 1 minute after the sensor switch-on (in which - as understood on ground - few IS ghost events can be observed) and the other 3 sporadic during the test. The reason is that channels A and C have detected few 'Ghost events', due to internal noise level when Gain is High.

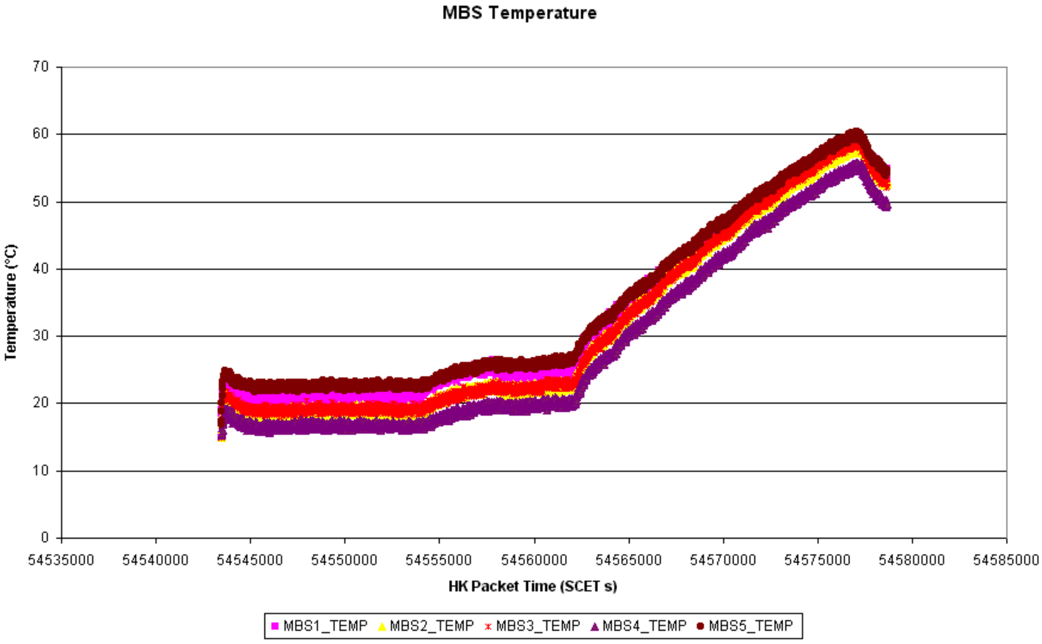

Figure 8 MBS Temperature

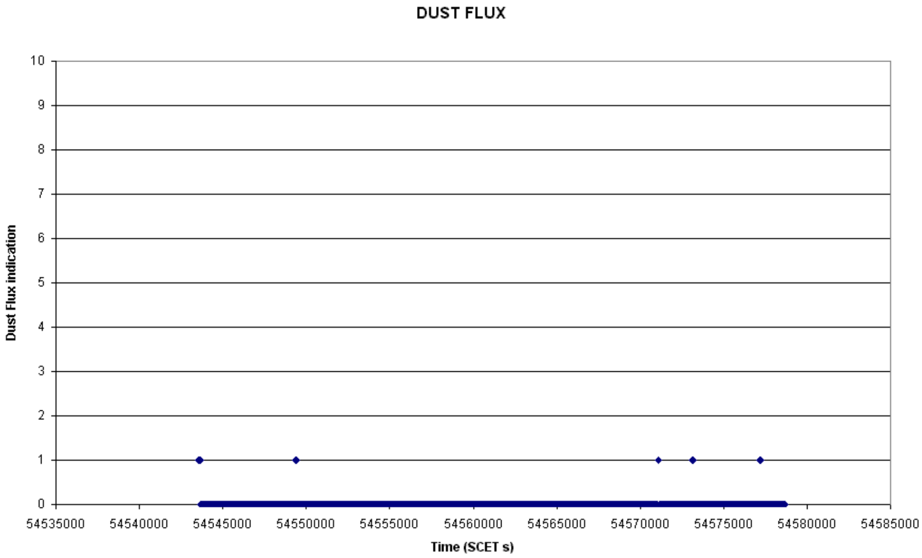

Figure 9 Dust-Flux Monitor (valid only when the IS sub-system is ON)

Figure 10 and Figure 11 show the Source Sequence Count of HK Telemetry and the science TM overflow flag versus time, respectively. **No missing HK packets have been found in the TM, while the science TM has been overflow due to a flood of the GDS ghost detections**, in the period when the GDS receiver was not saturated due to the stray-light induced by sun illumination. This, consequently, has provided an SSMM memory overflow and, thus, a loss of the science packets.

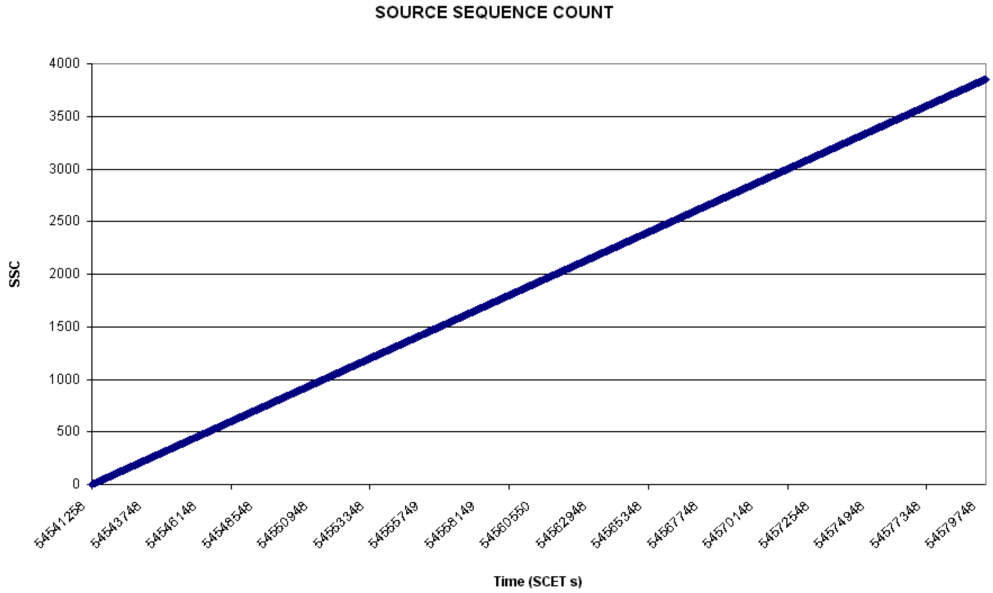

Figure 10 SSC of HK TM

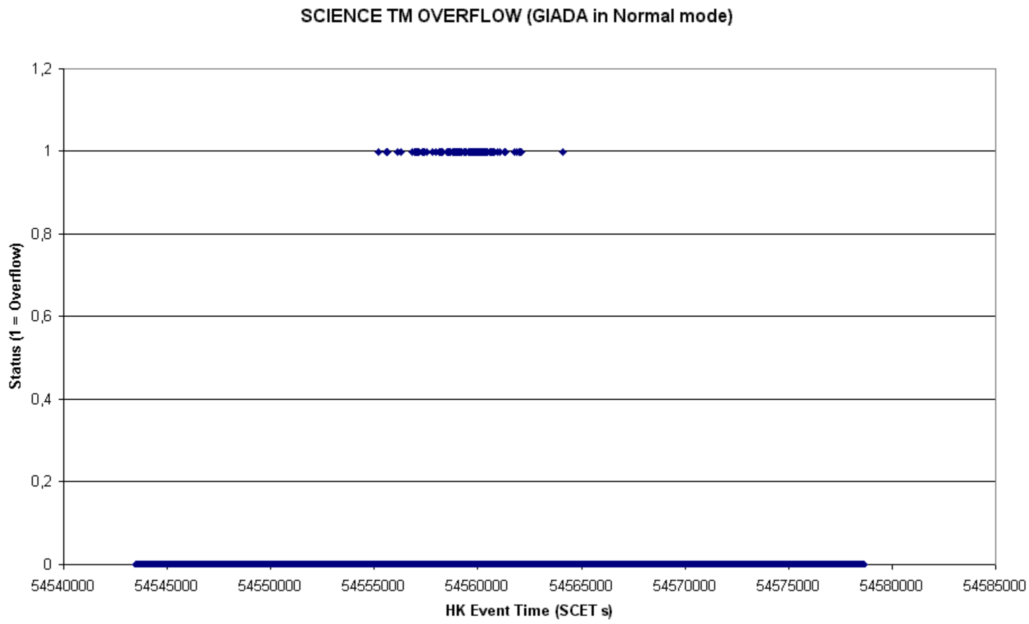

Figure 11 TM overflow monitor

5.1.2.1 Cover open & close operations

After the cover open operation, the cover resulted completely open, as shown in Figure 12, in which the status of the two reed-switches is reported. The figure is extracted from the cover report, which is received on-ground at the completion of the operation (@SCET time 54543084s, corresponding to about 06:51:40 UTC Time of 23 Sept 2004). The correct behaviour of the operation is when the sequence of the following conditions appears:

- The reed switch that indicates the Cover-Close position (named RW_CLOSE) starts not activated, and then it is temporarily activated after the start of opening operation for a short number of steps (expected value: 29-30 steps).
- The reed switch that indicates the Cover-Open position (named RW_OPEN) is activated after 124-125 steps and remains permanently in this status.

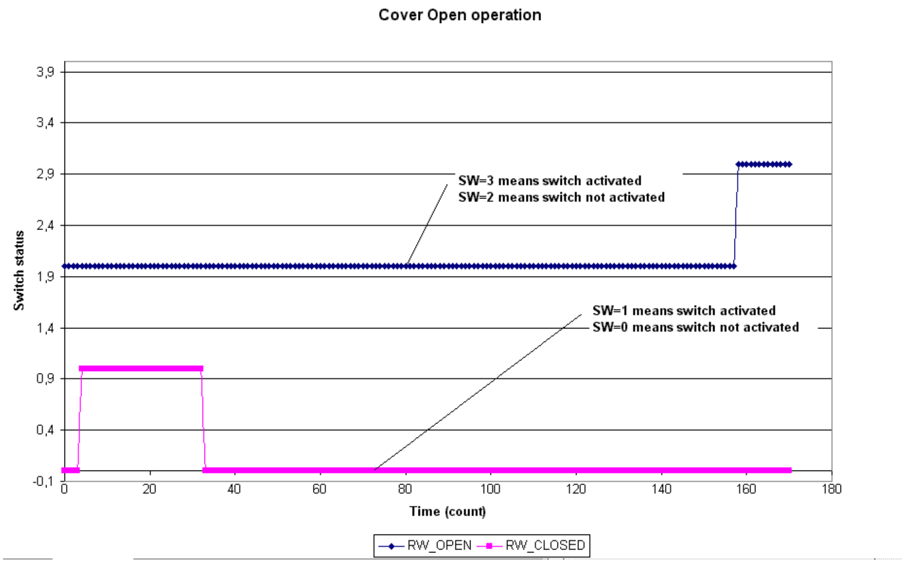

Figure 12 Reed switches Status during the Cover Open operation

Before the GIADA power-off, the GIADA cover was automatically closed by a sequence of the proper TC (Close Cover). The cover was successfully closed by command @ SCET time of 54579168s, corresponding to 16:53:11 UTC time of the 23 Sept. 2004. Figure 13 reports the correct sequence of the two reed-switches. As expected:

- The reed switch that indicates the Cover-Open position (named RW_OPEN) is activated for a small number of steps (about 15 steps) and then remains not active for the remaining movement.
- The reed switch that indicates the Cover-Close position (named RW_CLOSE) is activated after 126 steps for 29 steps and finally reaches the not-activated status that means the cover is close to the closed position.

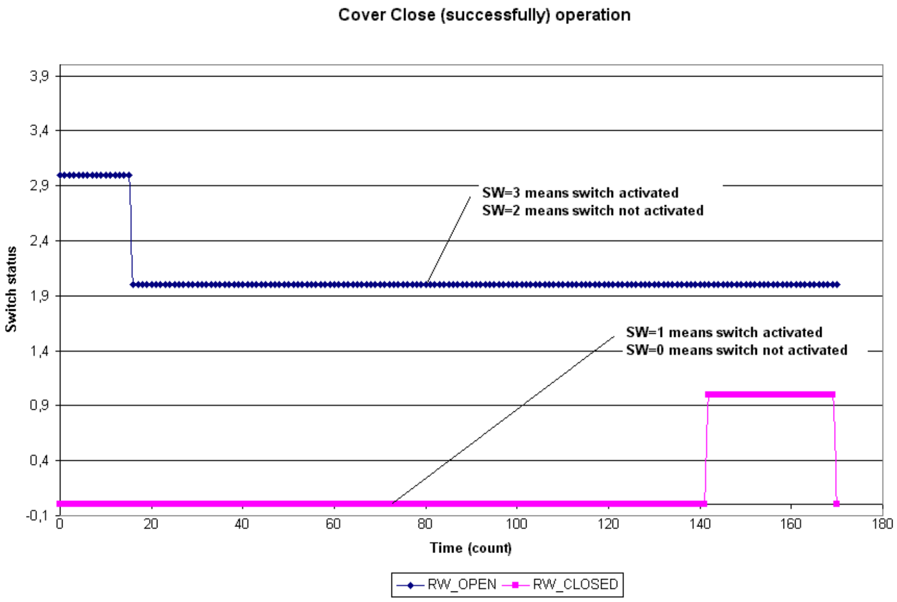

Figure 13 Reed switches Status during Cover Close operation

During the power-off, the GIADA cover is automatically closed by the OBCP (Close Cover) despite its actual position (operation happened @ 17:04:15 UTC time of the 23 Sept. 2004). Since the cover was already closed (by the previous Close Cover operation), the new close cover operation resulted unexpected: at the beginning the cover bunched over the cover support, then it reversed its movement and it came to the open position. This is in line with the status of the two reed-switches in Figure 14, in which the reed switch indicating the Cover-Open position is active at the end of the movement (in nominal operation it should be not active at all) and the other is activated only few times (while in nominal operation it should be activated several times).

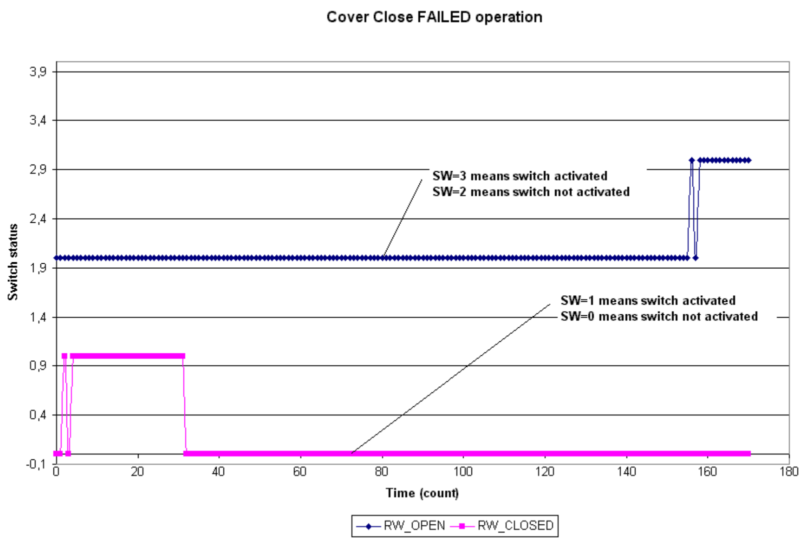

Figure 14 Reed switches Status during Cover Close FAILED operation

This unexpected behaviour was also confirmed by the reed switch status in the HK report (see Section 5.1.1). A recovery action was organised immediately by the PI team in collaboration with RMOC, as described in Section 5.1.1.

In Figure 15, the two reed switches confirm that the cover was in open position (red coloured text) at the first power-off and then was successfully closed after the new power-off. These conditions are also confirmed by the Cover Report (refer to Figure 16) which was received @ 20:57:07 UTC Time of the 23 Sept. 2004.

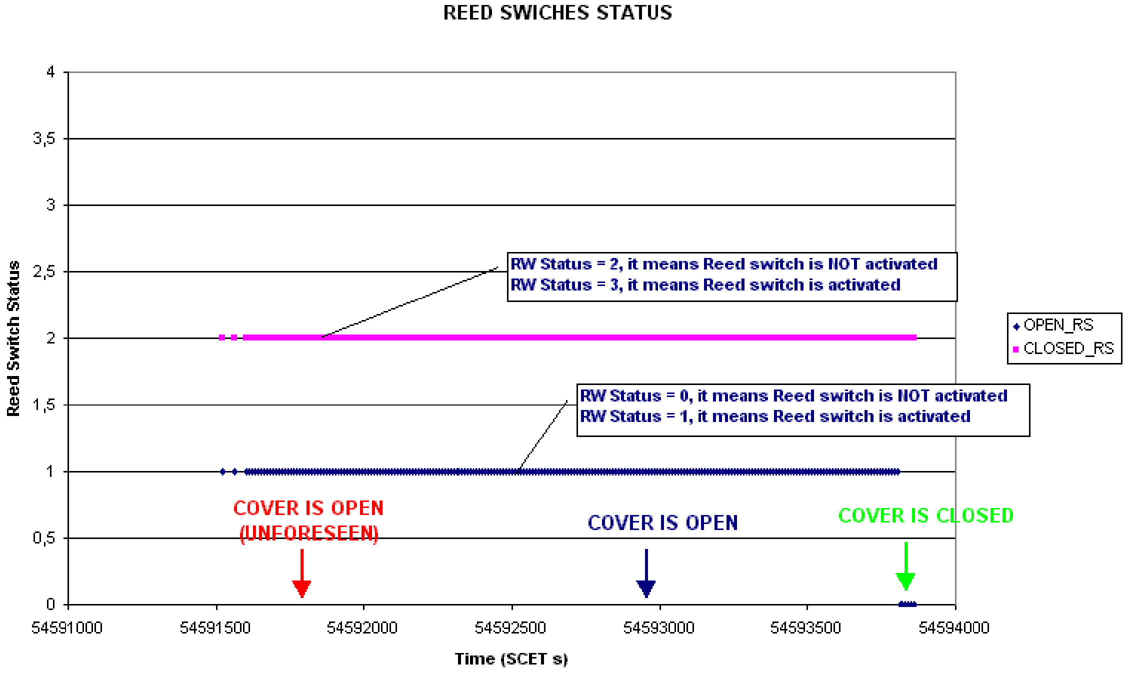

Figure 15 HK Reed switches status (during the recovery procedure)

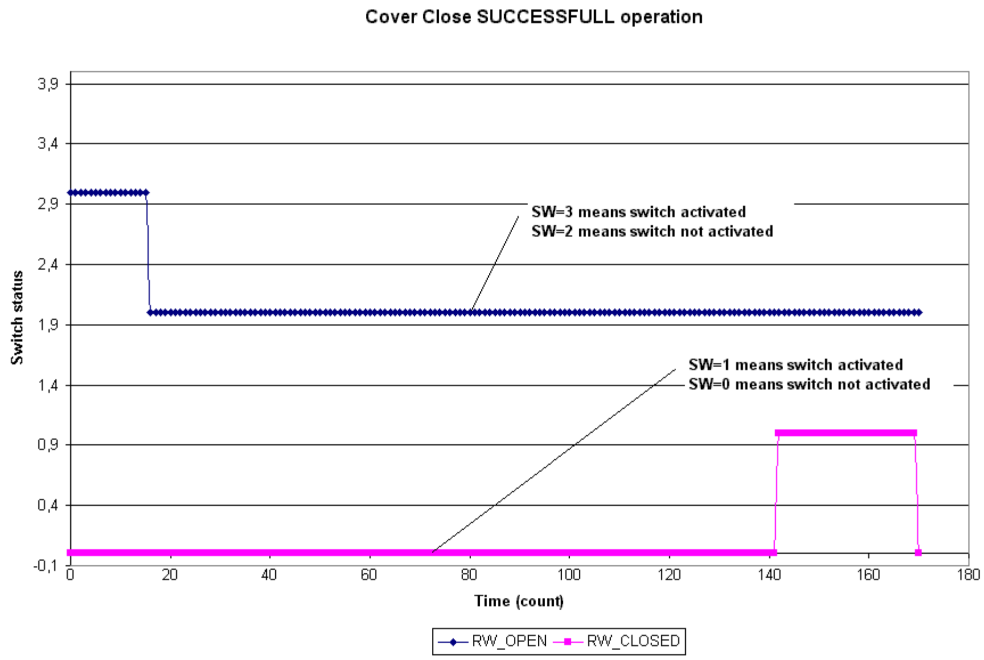

Figure 16 Reed switches Status during Cover Close SUCCESSFUL operation

Figure 17, Figure 18 and Figure 19 show the drawn currents and the HK temperature of Power Supply, Frangibolt and IS sensors during the run of the recovery procedure.

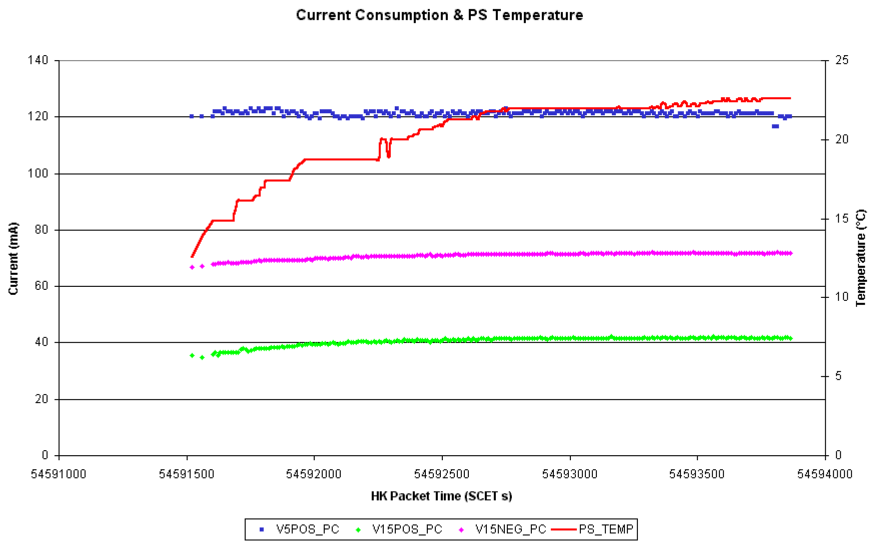

Figure 17 +5V and ±15V Currents (during the recovery procedure)

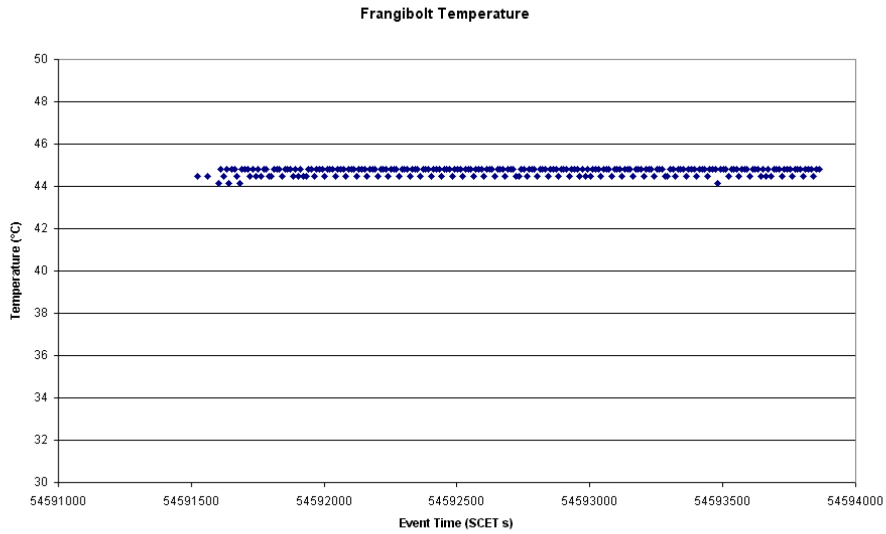

Figure 18 Frangibolt Temperature (during the recovery procedure)

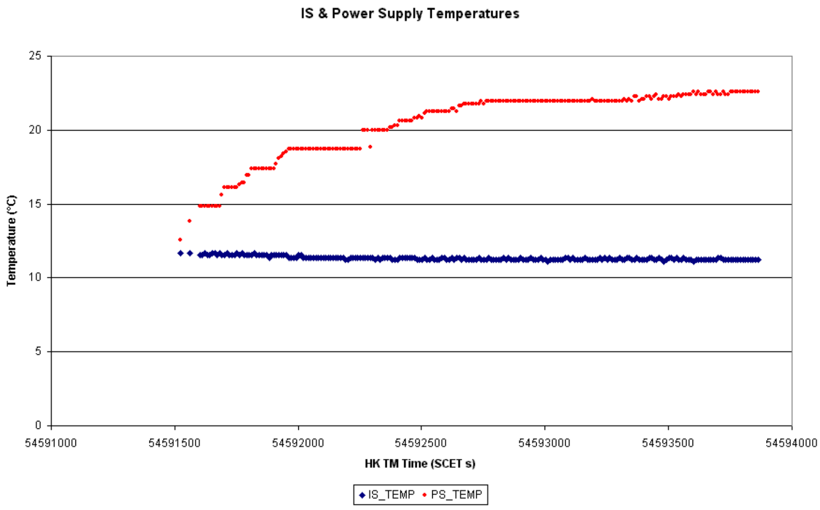

Figure 19 IS and Power Supply Temperature (during the recovery procedure)

5.1.3 Engineering evaluation on sensor data

Many science TM packets were lost due to the **saturation of the SSMM memory allocated to GIADA (1 Mbytes).** Figure 20 shows the Source Sequence Count of science TM packets when GIADA is in Normal mode and the science TM is enabled. The first 8437 science packets were completely lost. The flood of TM packets was observed after the lasers were switched on and until the sun illumination saturated the GDS receiver output (sun stray-light). In fact, due to the level of the internal stray-light (background noise) in combination with the electronic noise (as already seen in the previous Interference tests performed on 20-22 September), the GDS Left receiver provided several GDS 'ghost detections' (GDS production rate is discussed in Section 5.1.3.2). As the sunlight entered inside the GIADA aperture (sun angle < 70 deg), the GDS left and right receivers became saturated and no more GDS ghost events were produced. Consequently the SSMM started to empty by the downlink data rate and no more science packets were lost (Figure 21).

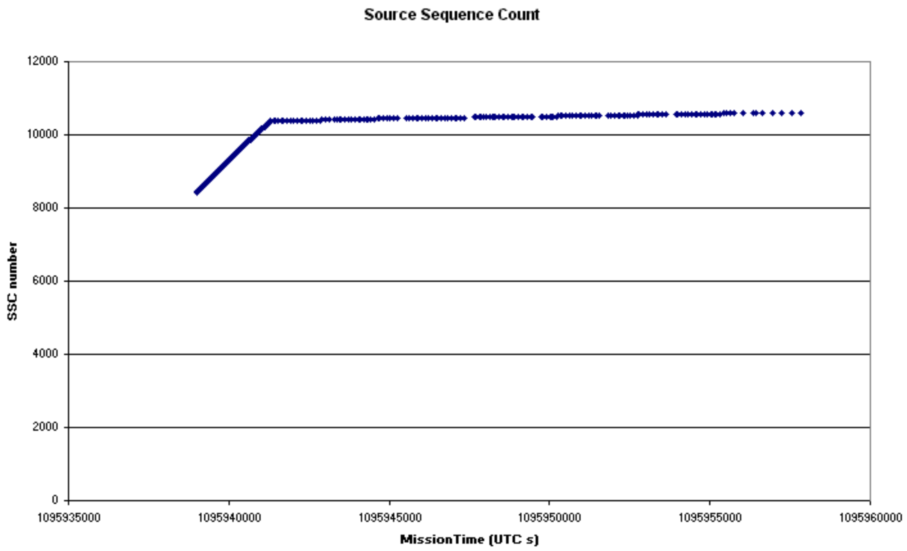

Figure 20 Science TM packet Source Sequence Count versus time

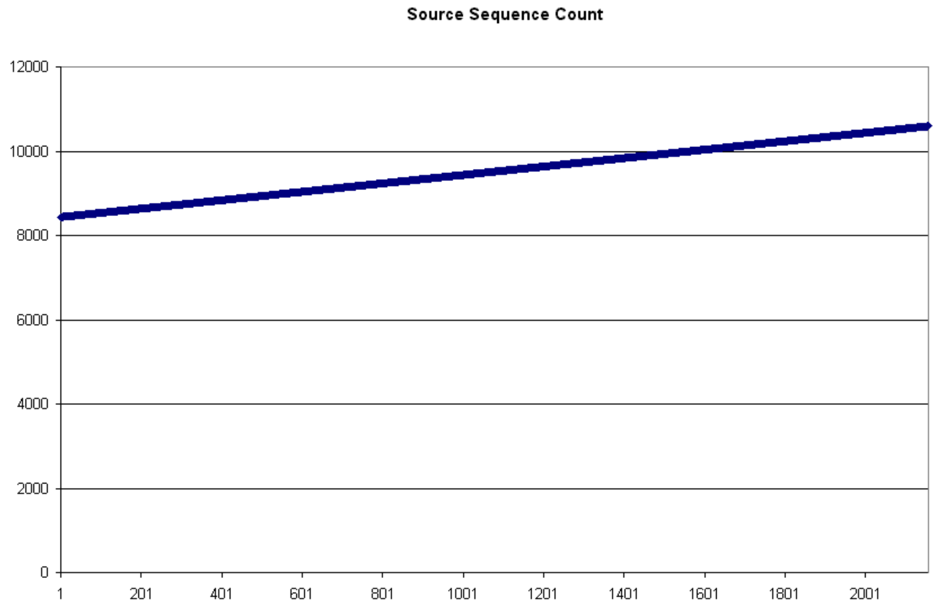

Figure 21 Science TM packet Source Sequence Count when the SSMM becomes not saturated

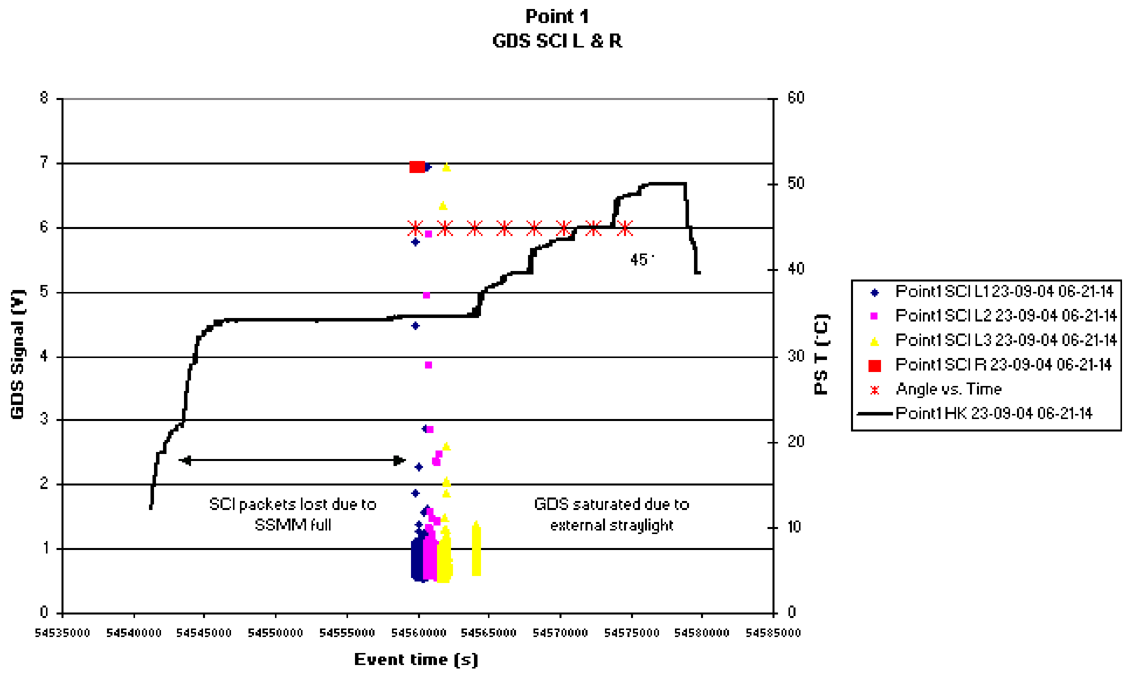

Figure 22 GDS production (Ghost Events) wrt. SSMM saturation and sun illumination angles

5.1.3.1 IS Sub-system

After the sub-system power on, the detection thresholds of each channel were set to 50 mV (Context file updated via memory load command). The Range/Gain configuration is that reported in Table 2.

RANGE	**GAIN**				
	PZTA	**PZTB**	**PZTC**	**PZTD**	**PZTE**
Low	High	High	High	High	Low

Table 2 IS Range/Gain configuration

After entering in Normal mode, the IS calibration run until the end of the test every 6 minutes. Due to the SSMM saturation, only few IS science 'Ghost' detections were received on-ground: 1 on Channel A and 2 on Channel C (Figure 23).

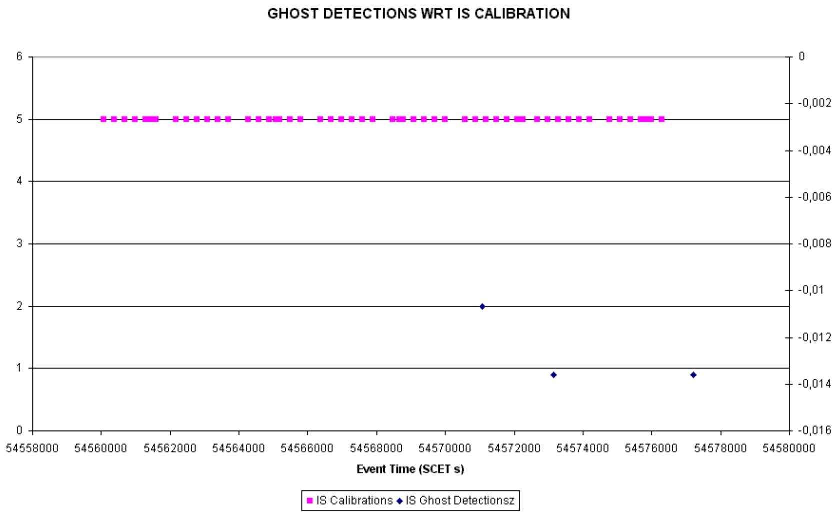

Figure 23 IS Ghost detections wrt. IS Calibration

Table 3 shows the minimum, maximum of mean and the standard deviation for each channel output before the start of the IS calibration.

Type	**PZTA**		**PZTB**		**PZTC**		**PZTD**		**PZTE**	
	MEAN	**STD**	**MEAN**	**STD**	**MEAN**	**STD**	**MEAN**	**STD**	**MEAN**	**STD**
Maximum	-0.0049	0.0638	-0.0078	0.0638	-0.002	0.067	-0.008	0.064	-0.014	0,064
Minimum	-0.0107	0	-0.0107	0	-0.0049	0	-0.014	0	-0.014	0
Average	-0.009	-	-0.009	-	-0.0023	-	-0.011	-	-0.014	-

Table 3 IS Calibration – Max, Min & Average of the mean and STD Dev of channel outputs

As we can see, all channel have a low mean value (negative value means channel output close to 0 V) and a noise level (@ 3σ) close or little above to the detection thresholds.

The noise levels are compatible with those measured during on-ground test campaign and in the previous Commissioning tests.

Figure 24 to Figure 35 show the results of the IS internal calibrations. According to Section 5.2.2.1 of **AD4**, only the 2nd and 4th stimuli are meaningful.

- Channel-A response is quite consistent (i.e. the same amplitude) along the test; the values result in the range 8.31 to 8.46V. The measured amplitudes depend on the temperature (Figure 31): variation is about 100mV in 30°C of temperature change.
- Channel-B response is quite consistent (i.e. the same amplitude) along the test; the amplitude slightly decrease with the temperature (Figure 32): variation is about 50mV when temperature increases of about 30°C.
- Channel-C response is confirmed not stable along the different calibrations (refer to the voltage/delay time measurements of 2nd and 4th stimuli) and with respect to the temperature change (Figure 33). It is suggested to increase the channel C detection threshold (e.g. 100-150mV) and to compare the obtained results.
- Channel-D response results quite consistent (i.e. the same amplitude) along the test, except for eight calibrations in which the channel response was about 3.5V (1 calibration) and 1V (7 calibrations) more then the others. The measured amplitude seems slightly increasing with temperature change (variation is less then 60 mV within 30°C of temperature increase) (Figure 34 and Figure 35).
- No detections on Channel-E (as expected) were observed.

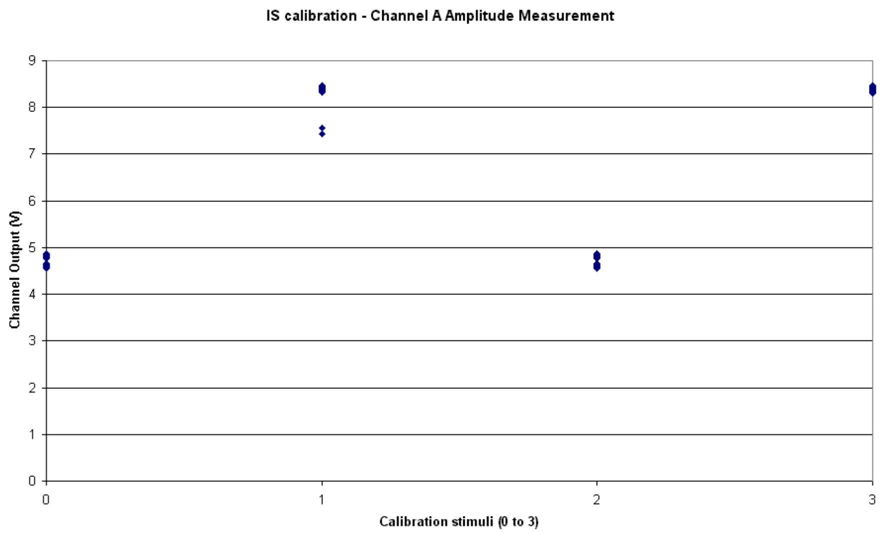

Figure 24 IS Calibration - Channel A Amplitude

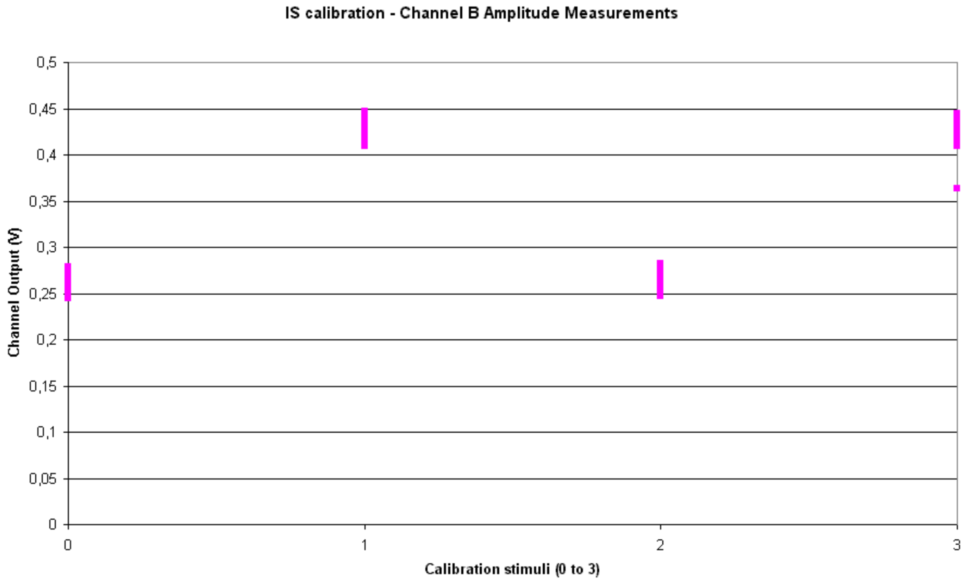

Figure 25 IS Calibration - Channel B Amplitude

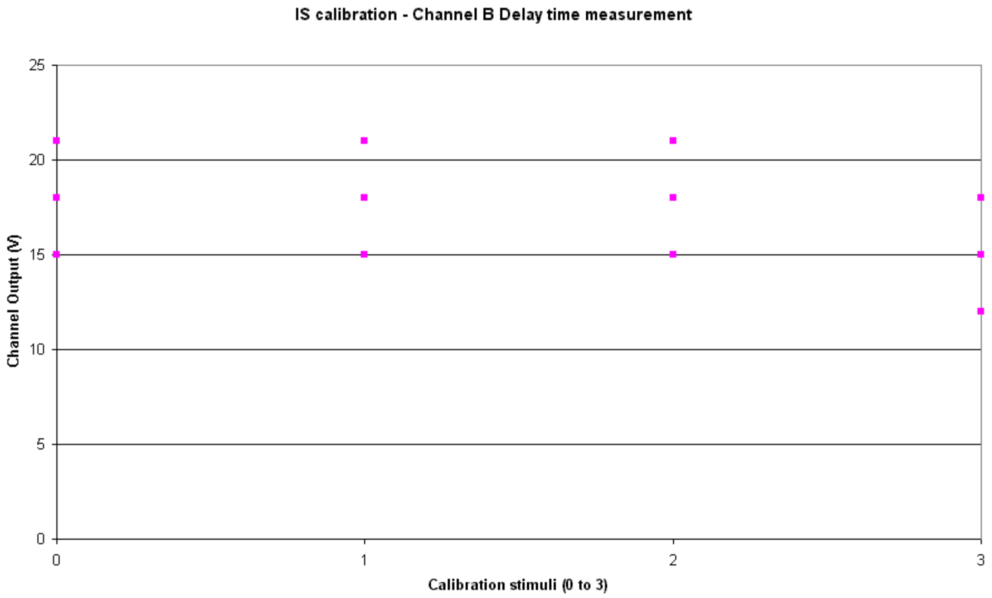

Figure 26 IS Calibration - Channel B Delay Time

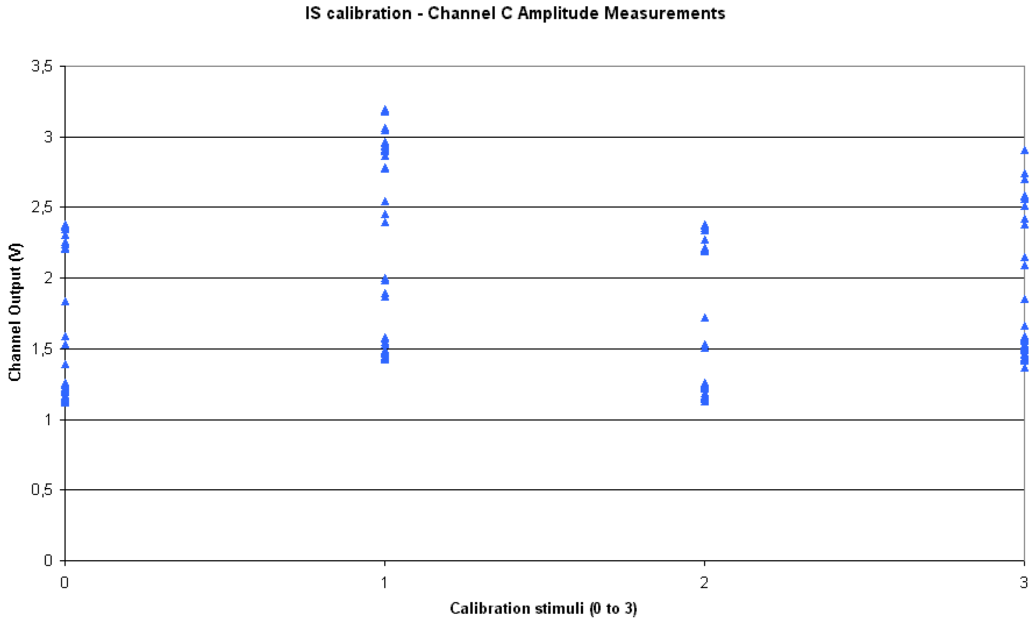

Figure 27 IS Calibration - Channel C Amplitude

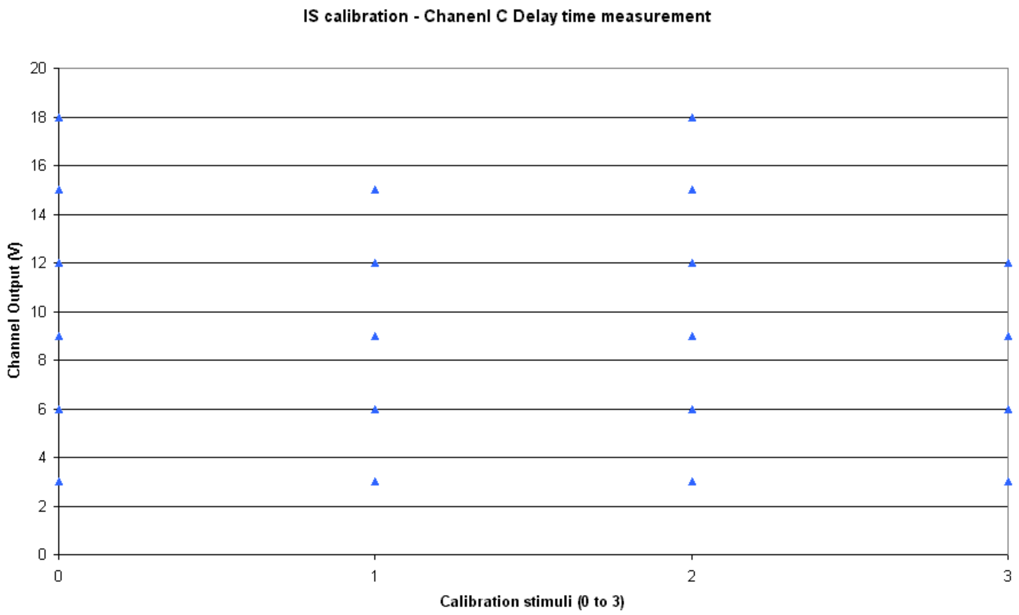

Figure 28 IS Calibration - Channel C Delay Time

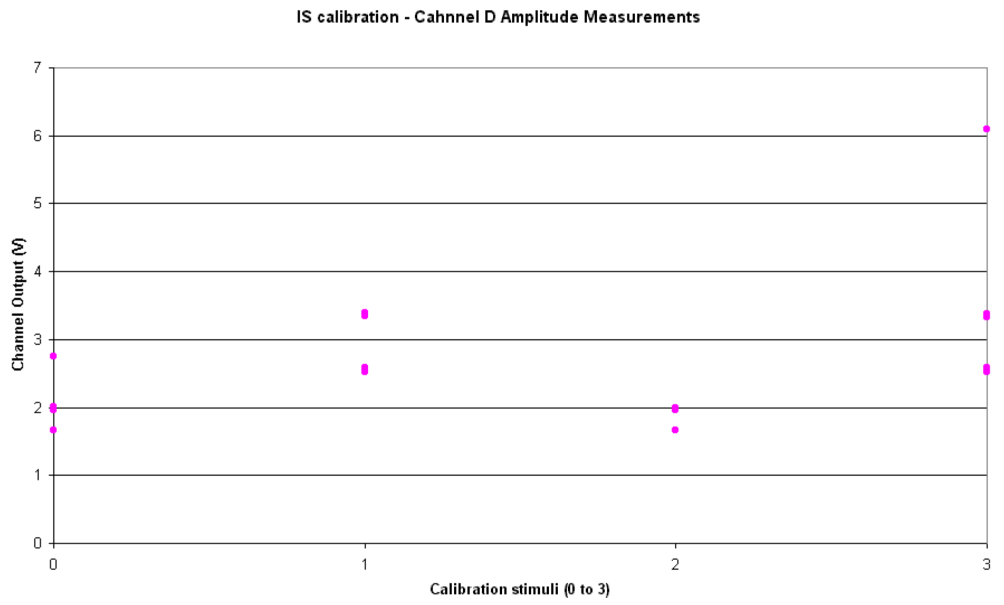

Figure 29 IS Calibration - Channel D Amplitude

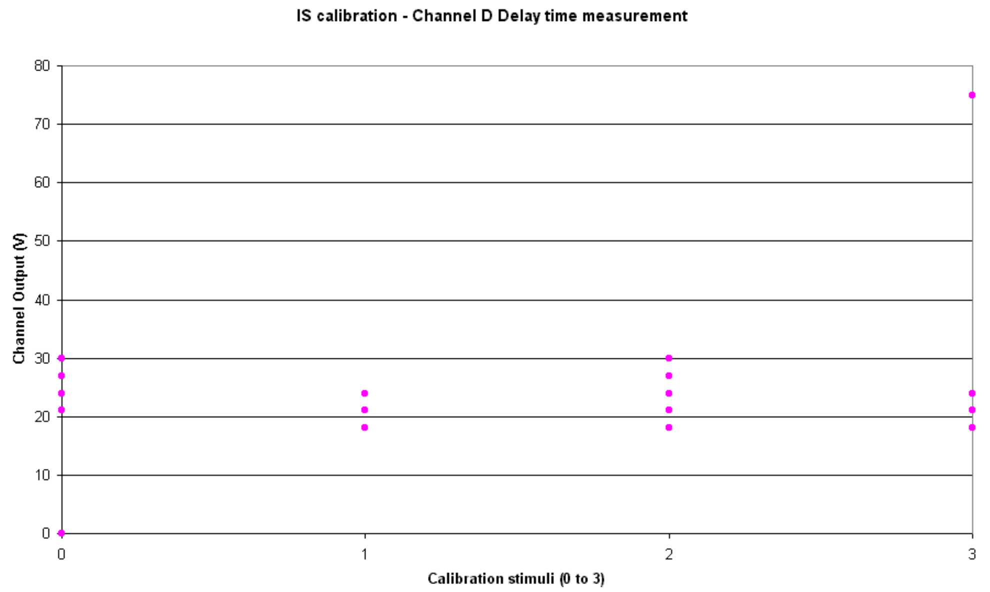

Figure 30 IS Calibration - Channel D Delay Time

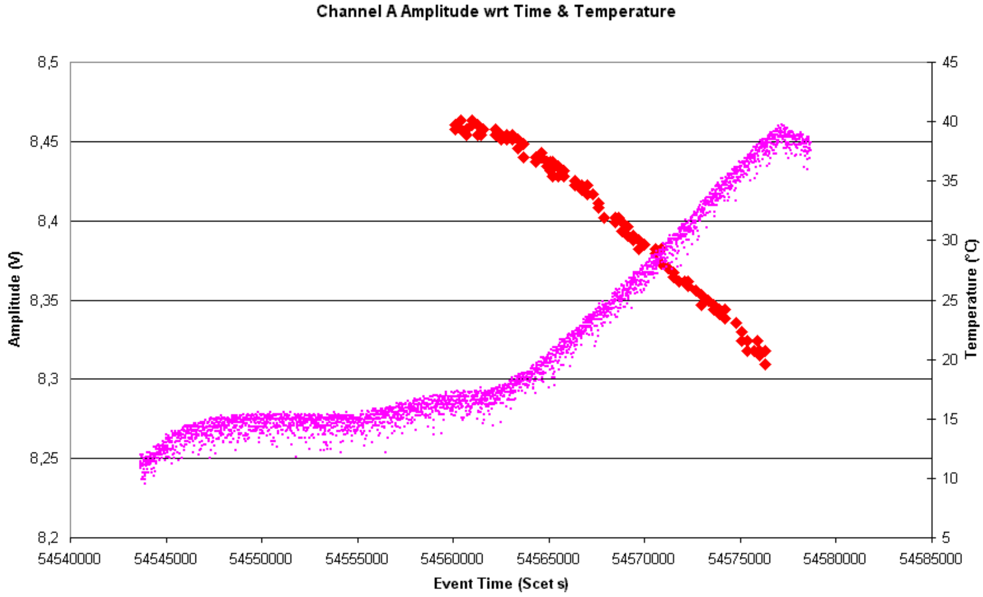

Figure 31 Channel A response wrt IS temperature

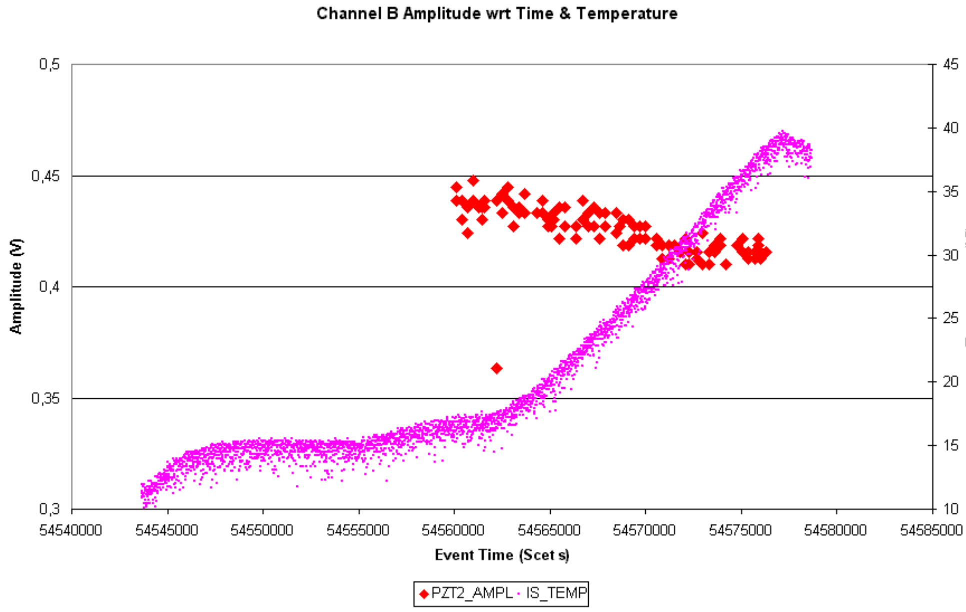

Figure 32 Channel B response wrt IS temperature

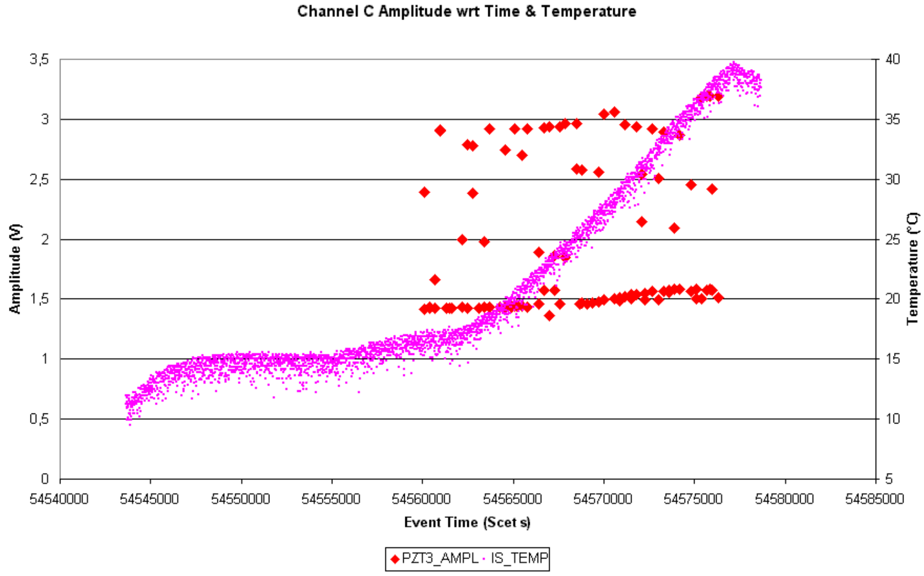

Figure 33 Channel C response wrt IS temperature

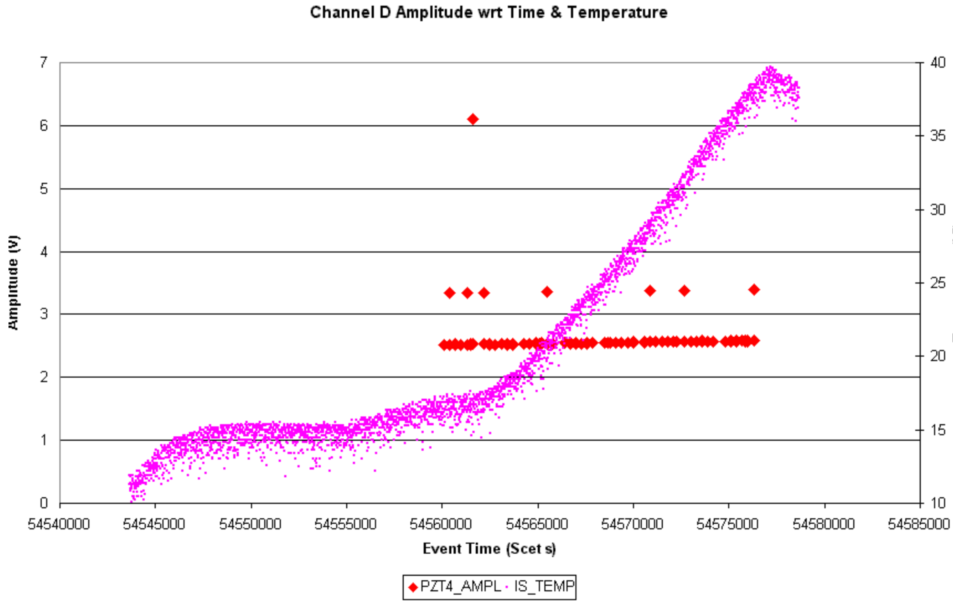

Figure 34 Channel D response wrt IS temperature

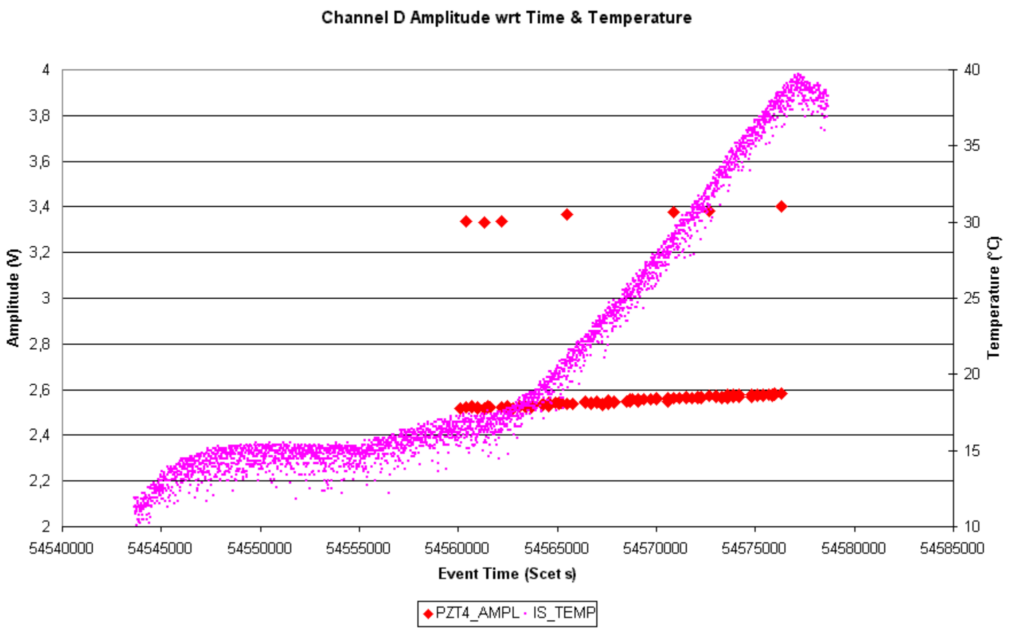

Figure 35 Channel D response versus IS temperature – scale amplification

5.1.3.2 GDS Sub-system

The detection thresholds of Left and Right channels were both set to 0.8 V (via Context file). The nominal operation was to perform periodic GDS calibrations every 6 minutes.

Figure 36 and Figure 37 show the GDS Calibration Right and Left mean value and STD deviation.

The output level of the Left and Right channels reports a direct measure of the internal stray-light in combination with the electronics noise that may be conducted on the power lines from other instruments or induced by temperature increase. The outputs show also the behaviour of the GIADA GDS receivers in the presence of the sunlight inside the aperture (stray-light induced by sun). In this case, the first stage of the electronics amplifier may be saturate and, as expected, no more 'ghost detections' are observed (the receiver output is almost constant and the detection electronics in the GIADA Main Electronics will not work at all).

As we can see, the mean value of the Right receiver is always below the detection threshold (only few ghost detections were observed on the Right channel). In particular three phases can be distinguished depending on the sun angle with respect to the S/C Z axis:

- From the beginning of the test (i.e. from the on-ground availability of the data) until the Sun angle has reached about 70 deg from S/C Z axis (Figure 6), in which the mean value is almost constant and it is about 0.22V. The standard deviation is below 50 mV.
- When the sun angle has reached about 70 deg (@ about 12:12:00 UTC), the mean value decreases from 0.22V to 0.11V and the GDS receiver becomes to be saturated. The standard deviation is below 30 mV.
- After this time up to the end of the test (Sun angle reached 45 deg), in which the mean value slowly decreases from 0.1V to 0.06V (possibly due to increasing of the lasers temperature). The GDS right receiver is saturated. The standard deviation is below 50 mV.

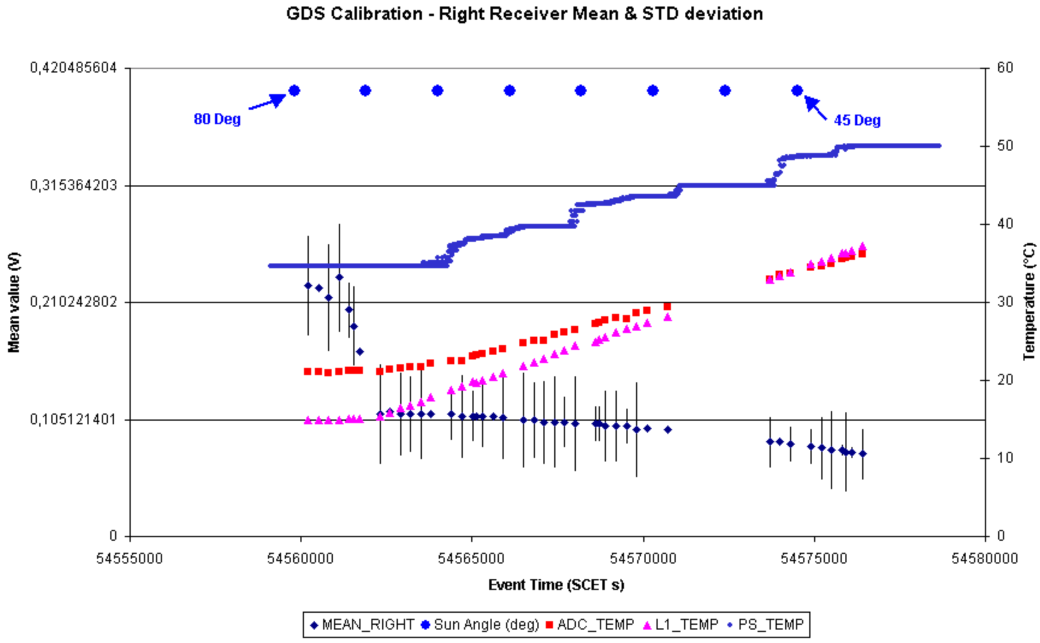

Figure 36 GDS Right Receiver Calibration (mean value and STD deviation)

The mean and standard deviation of the Left receiver calibrations are similar to those described for the Right receiver, except for a higher mean value and standard deviation, when the receiver is not saturated due to the internal stray-light level. When the receiver becomes saturated, due to sun light, the calibration output becomes almost constant.

When GDS is not in saturation, the average is about 0.87 V (minimum and maximum are within 0.86V and 0.94V), while its standard deviation is always below 70mV. The saturation occurs almost at the same time (i.e. with the same sun angle) of Right receiver. The mean level at saturation is 0.2-0.18V, which is slightly higher then for the Right receiver. The mean value slightly decreases when the temperature increases.

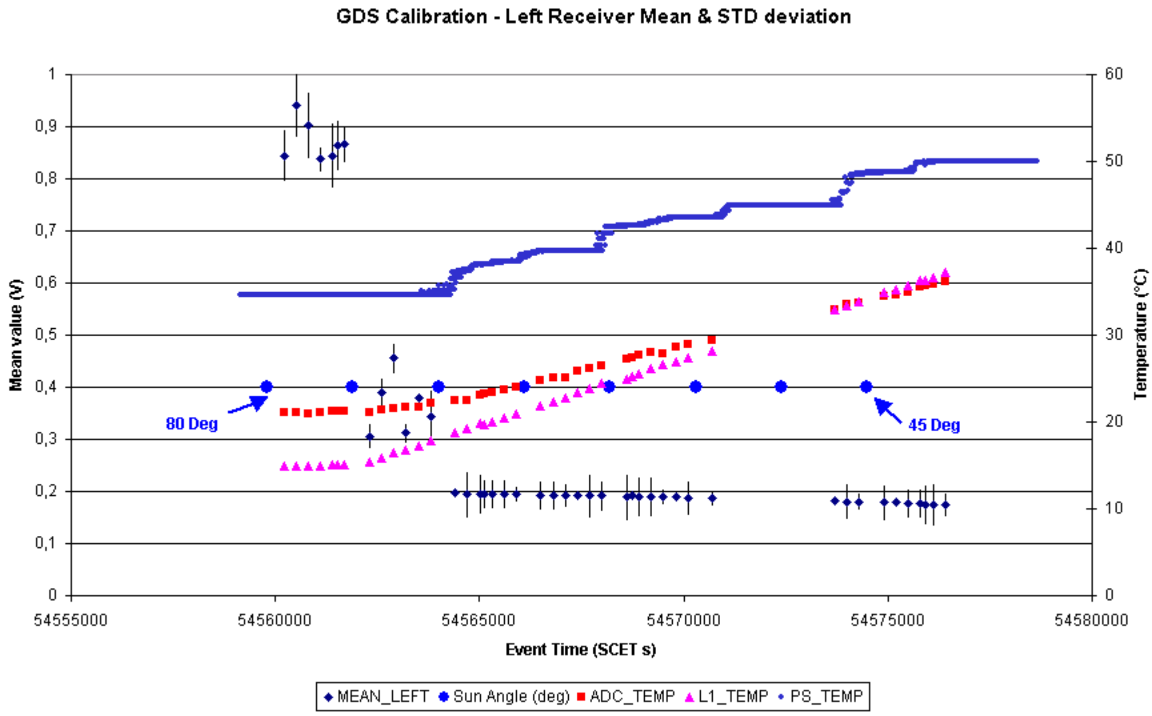

Figure 37 GDS Left Receiver Calibration (mean value and STD deviation)

Figure 38 and Figure 39 show the light monitors and temperatures of the four lasers at the time of the GDS calibrations. The laser light decreases when temperature increases, as expected.

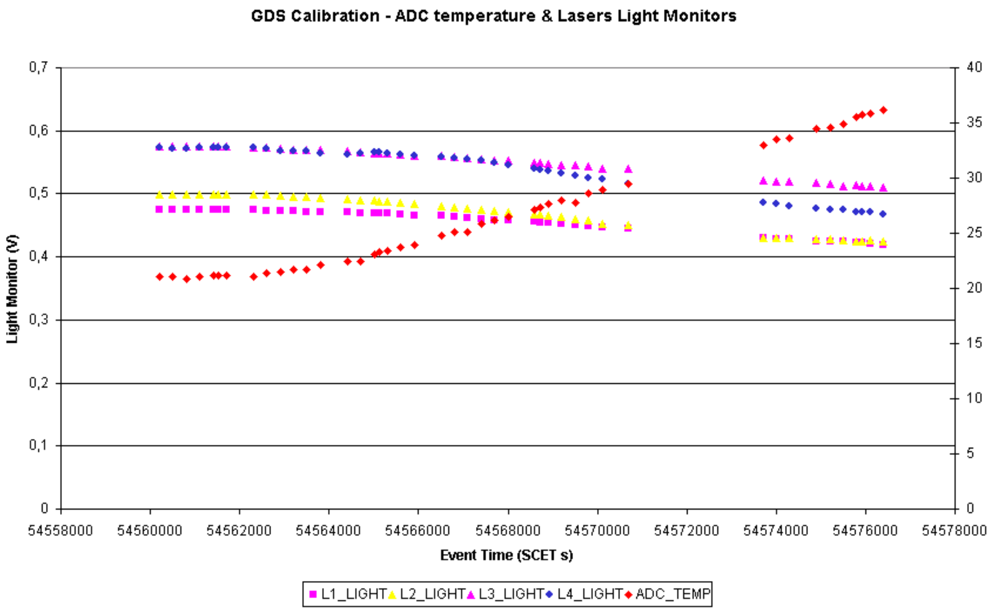

Figure 38 GDS Calibration - ADC temperature & Lasers Light Monitors

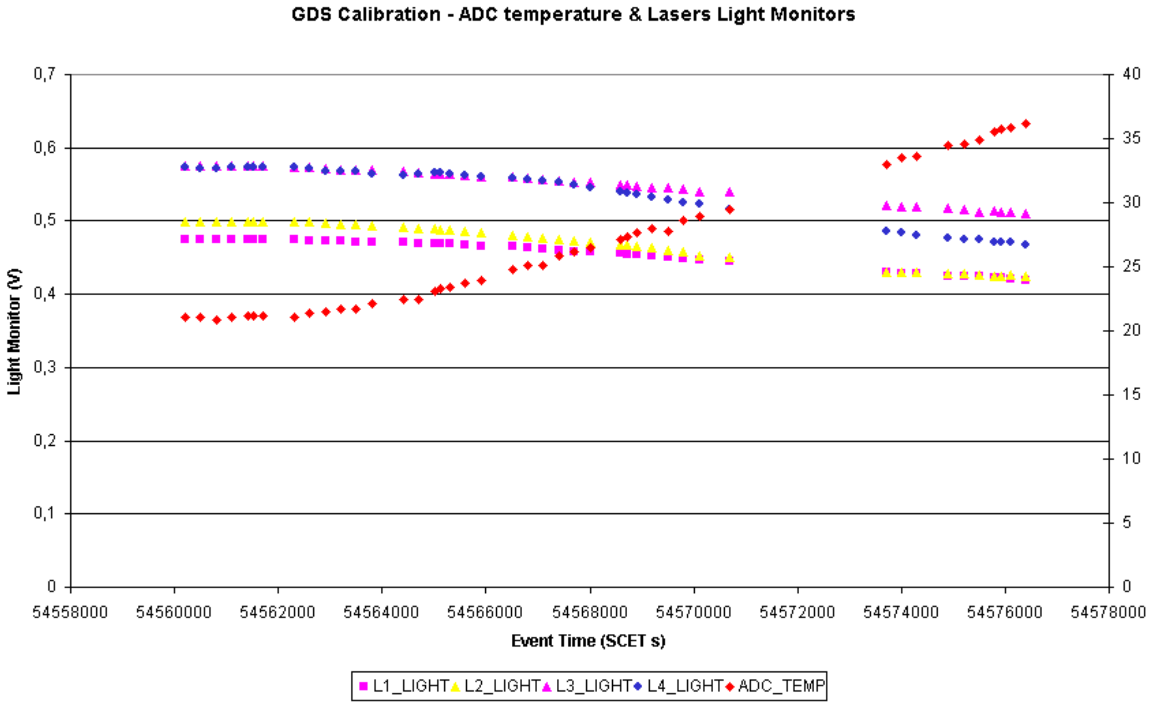

Figure 39 GDS Calibration – ADC & Lasers Temperatures

Figure 41 shows the amplitude of the scattered light of the Left and Right Receiver 'Ghost detections', while Figure 40 reports 'Ghost detections' wrt. the Laser temperature and the calibrations. <u>The 'Ghost detections' happened only when the receivers were not saturated</u> (as expected). The 'Ghost detections' on the Right receiver are very few (2 events).

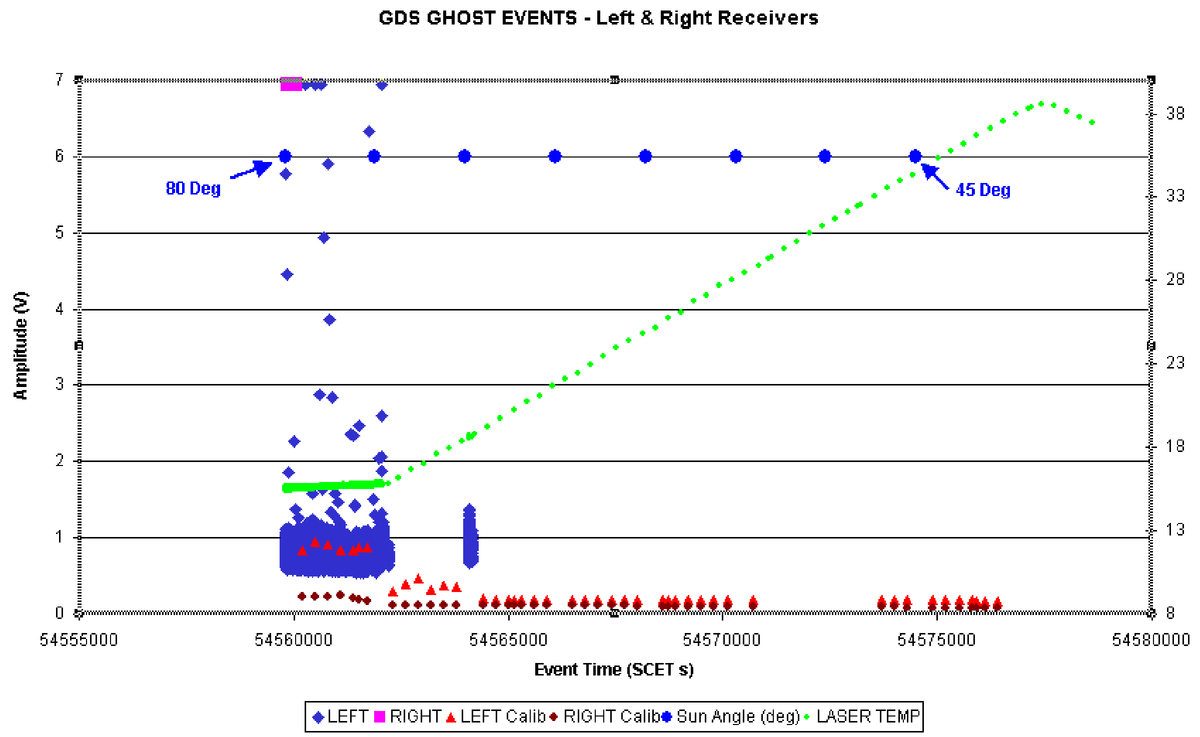

Figure 40 'Ghost detections' & sun angle & GDS Calibrations on Right and Left receivers

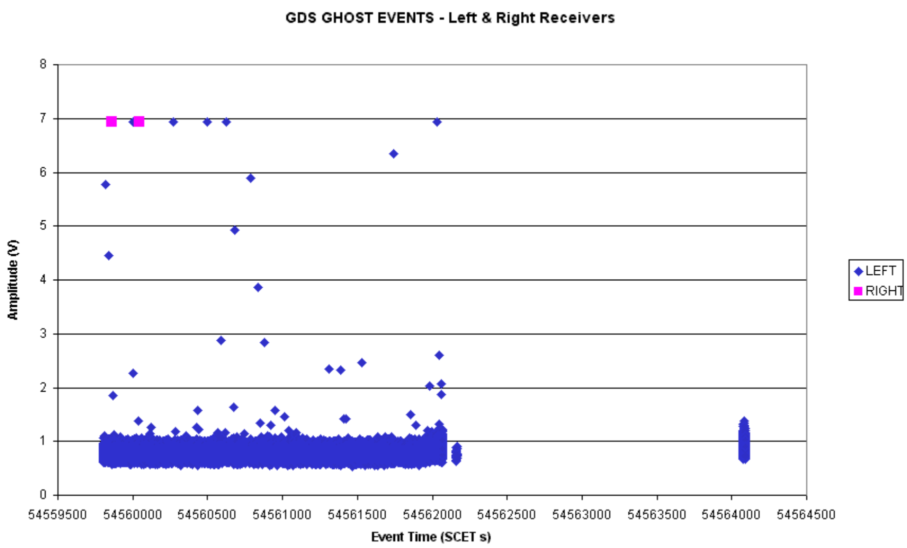

Figure 41 Amplitude of 'ghost detections' on Left and Right receivers

Concerning the ghost detections on the Left receiver (as in the previous Interference Part 1A & Part1B) two 'detection' types can be distinguished:

- detections with amplitude of the order or little below the threshold (0.8 V). The detection rate is on the same order than in previous tests. This type of events provides the TM flood that is responsible of the SSMM saturation.

- detections with amplitude well above the threshold or in saturation (6.9375 V). As in the Interference Part 1A-B test, they seem not correlated to any specific GIADA internal events (calibration, temperature or relay on-off switching).

The Table 4, Figure 42 and Figure 43 show the ADC Reference Voltages along the test (i.e. when the calibration data where received) for the sequence of the IS, GDS and MBS Calibrations. The voltages are quite stable in the temperature range 20 - 36 °C.

ADC REF. V0		ADC REF. V1		ADC REF. V2		ADC REF. V3	
Mean [V]	STD [V]	Mean [V]	STD [V]	Mean [V]	STD [V]	Mean [V]	STD [V]
9.7796	0.001	4.3449	0.0014	1.0793	0.001	-0.011	0.001

Table 4. ADC Reference Voltages

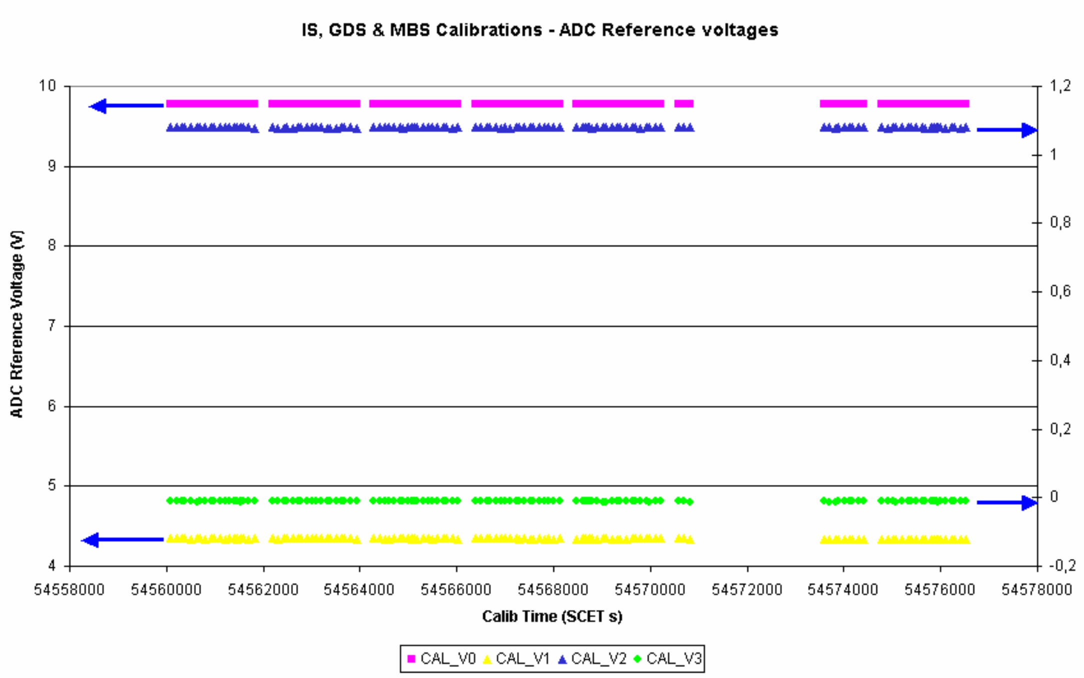

Figure 42 ADC Voltage Reference during Calibration

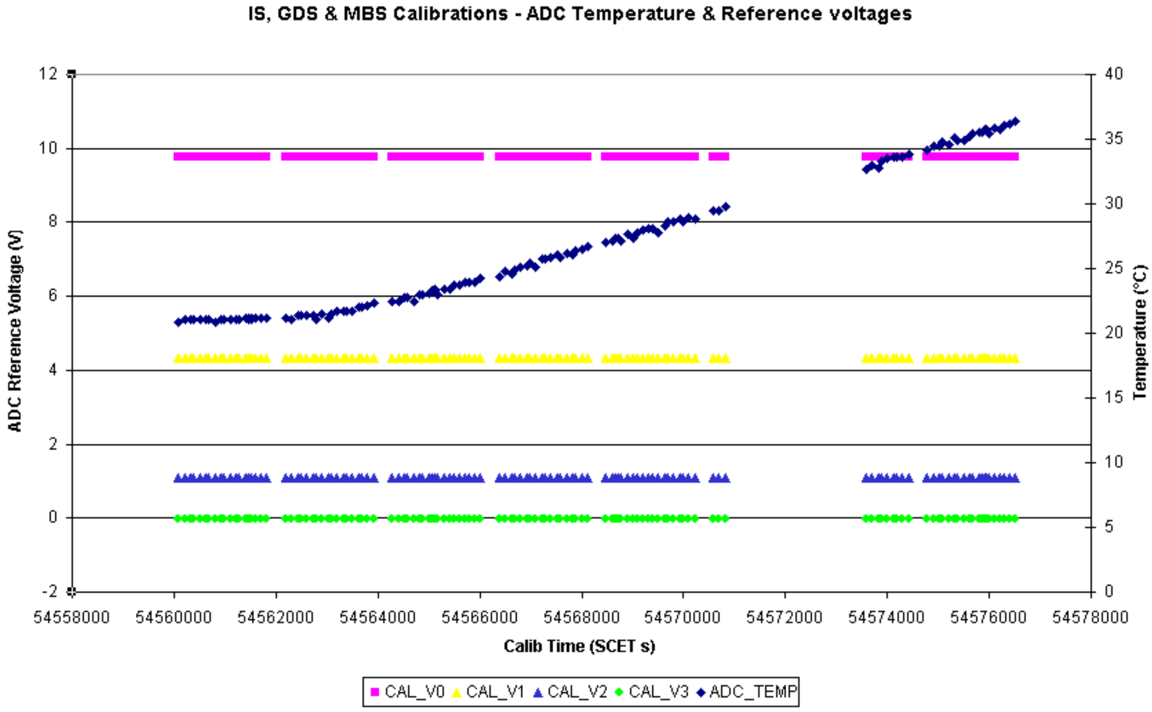

Figure 43 ADC Voltage Reference wrt ADC temperature during Calibration

5.1.3.3 MBS sub-system normal acquisition

The MBS frequency for three of the MBS (1, 3 & 5) is confirmed to be significantly higher then in the 1st Commissioning. However, no significant deviations have been observed from the measurements taken during the Interference test, even if the MBS were heated up to 60°C due to the sun illumination.

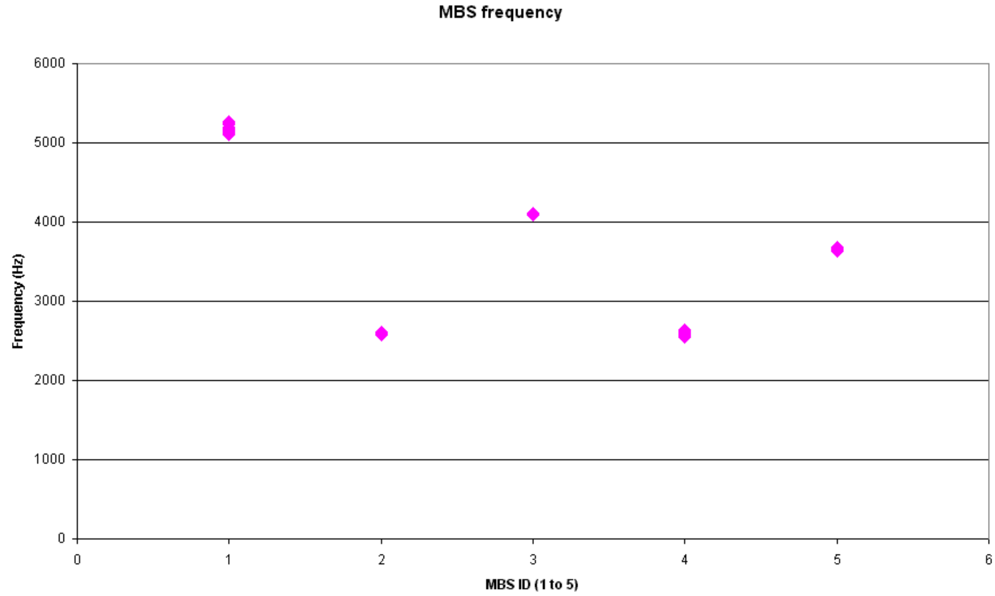

Figure 44 MBS Frequency

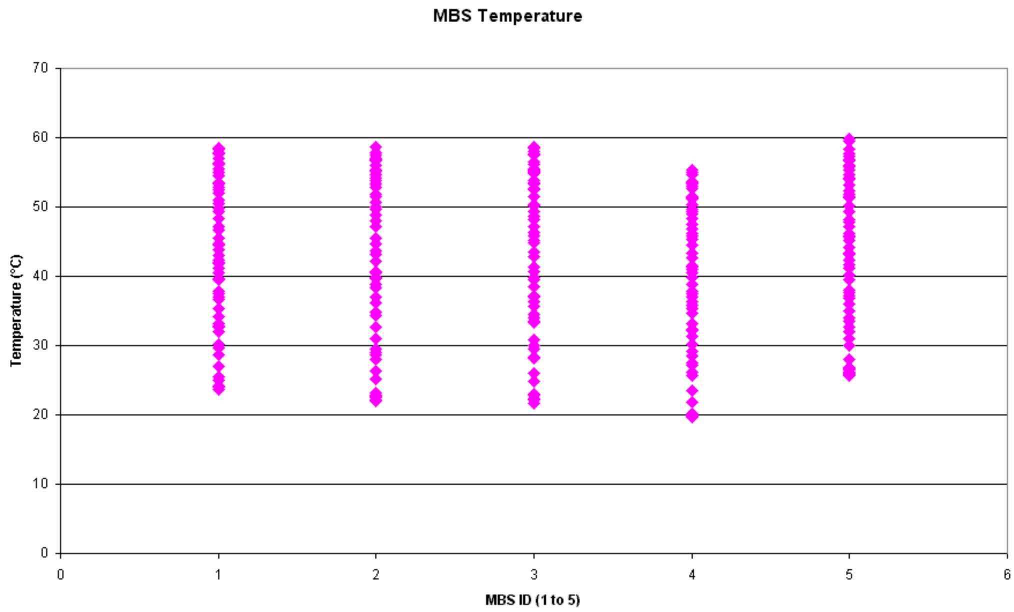

Figure 45 MBS Temperature

- The MBS1 frequency (MBS1 points to the +Xu direction, as it is shown in Figure 6) is about doubled, from 2700 Hz (data taken during the GIADA 1st Commissioning) to about 5230Hz @ 24°C (Interference part 1B) and now to about 5265 Hz @ 24°C.
- The MBS2 frequency (which points to the +Yu direction) is slightly increased of about 100Hz, from 2625Hz (data taken during the GIADA 1st Commissioning), to about 2625Hz @ 20°C (Interference part 1B) and now to about 2619 Hz @ 22°C.
- The MBS3 frequency (which points to the -Xu direction) is increased of about 1700Hz, from 2365Hz (data taken during the GIADA Commissioning), to about 4081 Hz @ 20°C (Interference part 1B) and now to about 4090 Hz @ 23°C.
- The MBS4 frequency (which points to the -Yu direction) is increased of about 100Hz, from 2548Hz (data taken during the GIADA Commissioning) to about 2546 Hz @ 18°C (Interference part 1B) and now to about 2549 Hz @ 20°C.
- The MBS5 frequency (which points to the +Zu direction) is increased of about 1000Hz, from 2430Hz (data taken during the GIADA Commissioning) to about 2687Hz @ 24.5°C (Interference part 1B) and now to about 3684 Hz @ 26.5°C.

It is confirmed that some MBS in-flight contamination occurred due to out-gassing of volatile material. From the operational point of view, it is confirmed that all MBS work as expected and the frequency dependence vs. temperature (frequency shift due to temperature change) is consistent with the commissioning data. <u>It is also requested an MBS heating to try to volatise the contamination material at the next GIADA-on opportunity.</u>

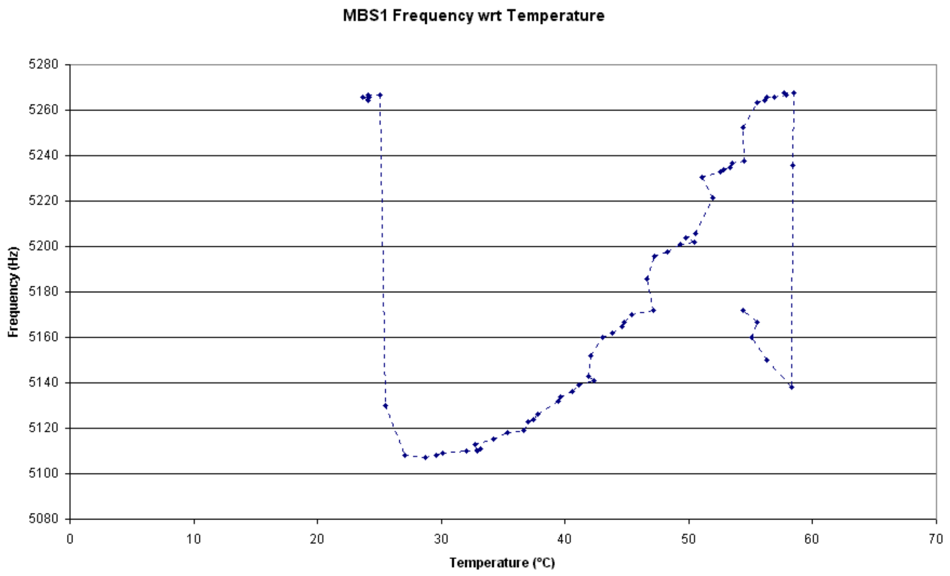

Figure 46 MBS1 Frequency wrt Temperature

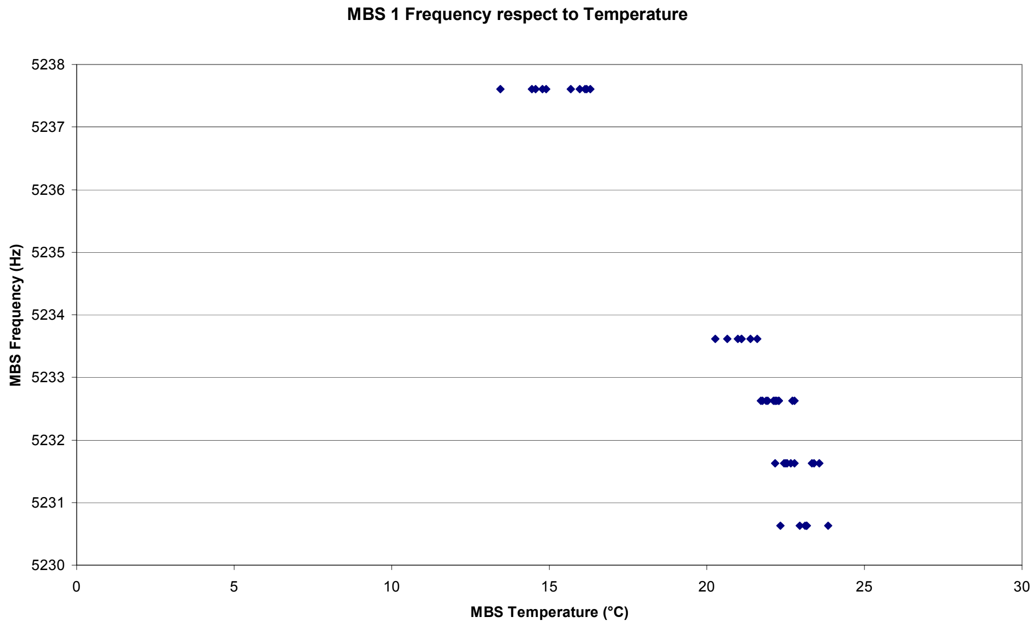

Figure 47 MBS1 Frequency wrt Temperature (Interference part 1B)

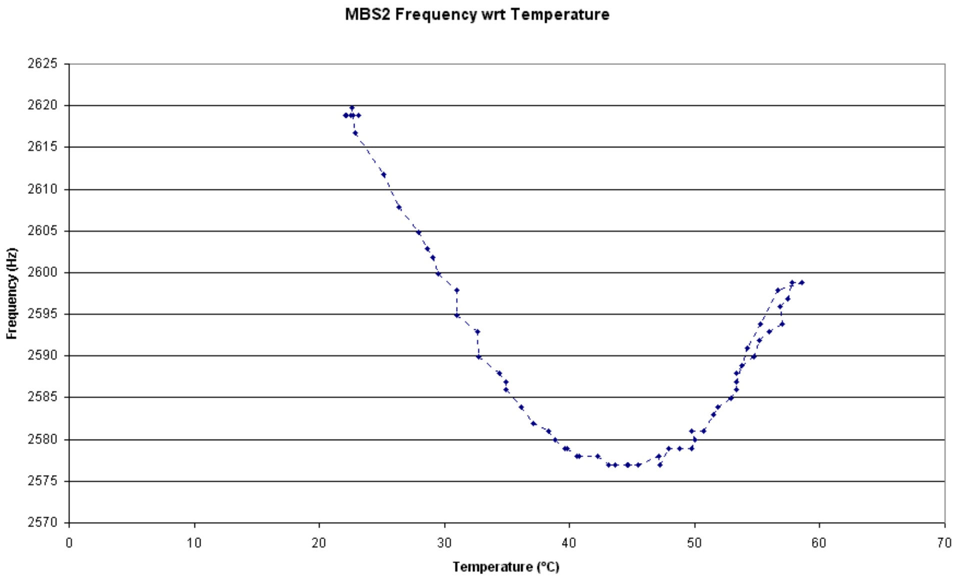

Figure 48 MBS2 Frequency wrt Temperature

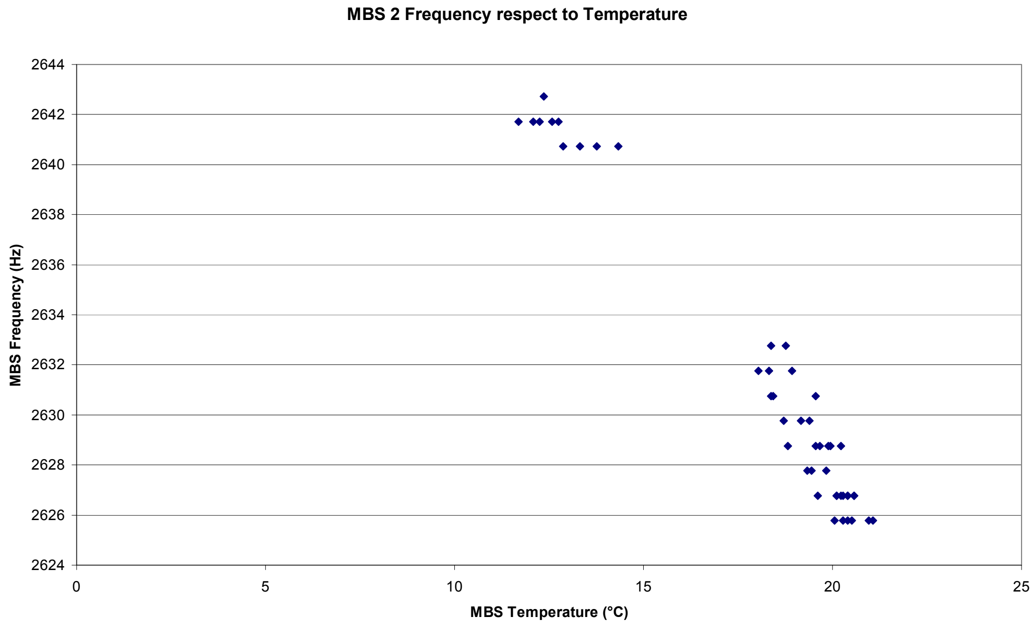

Figure 49 MBS2 Frequency wrt Temperature (Interference part 1B)

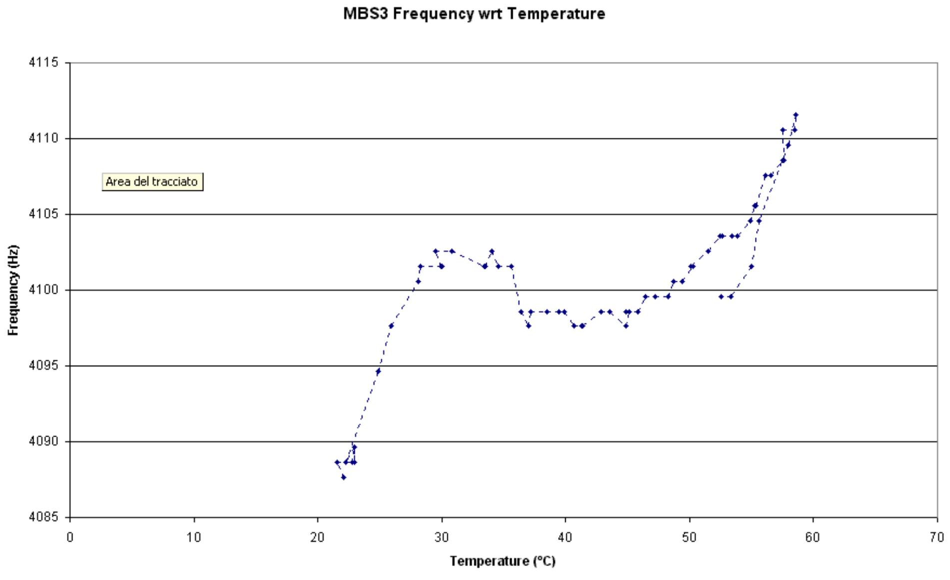

Figure 50 MBS3 Frequency wrt Temperature

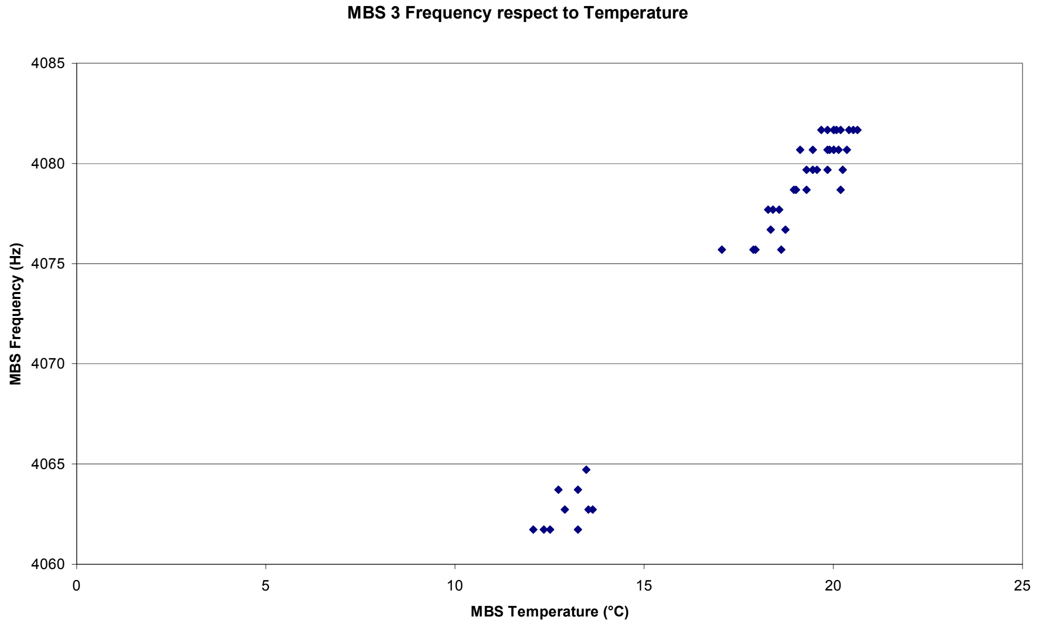

Figure 51 MBS3 Frequency wrt Temperature (Interference part 1B)

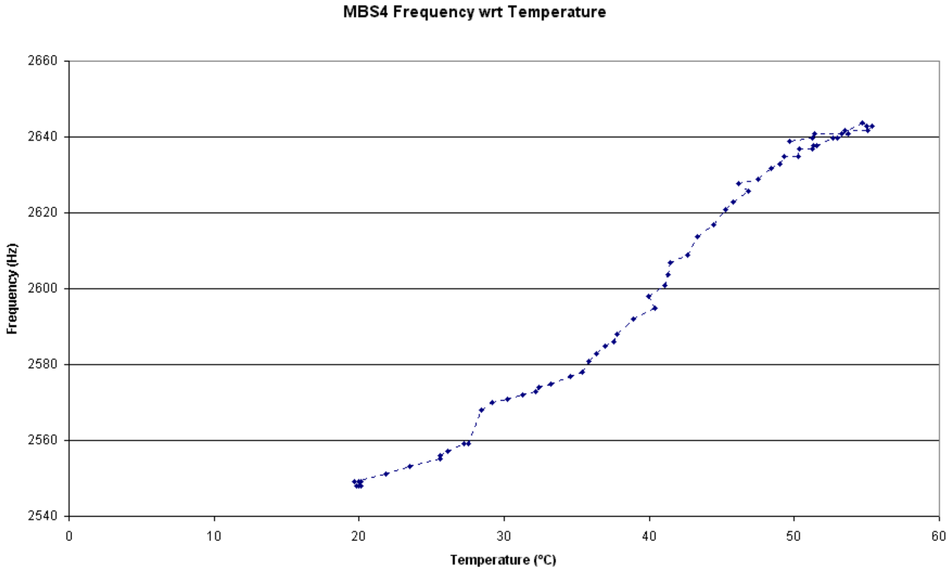

Figure 52 MBS4 Frequency wrt Temperature

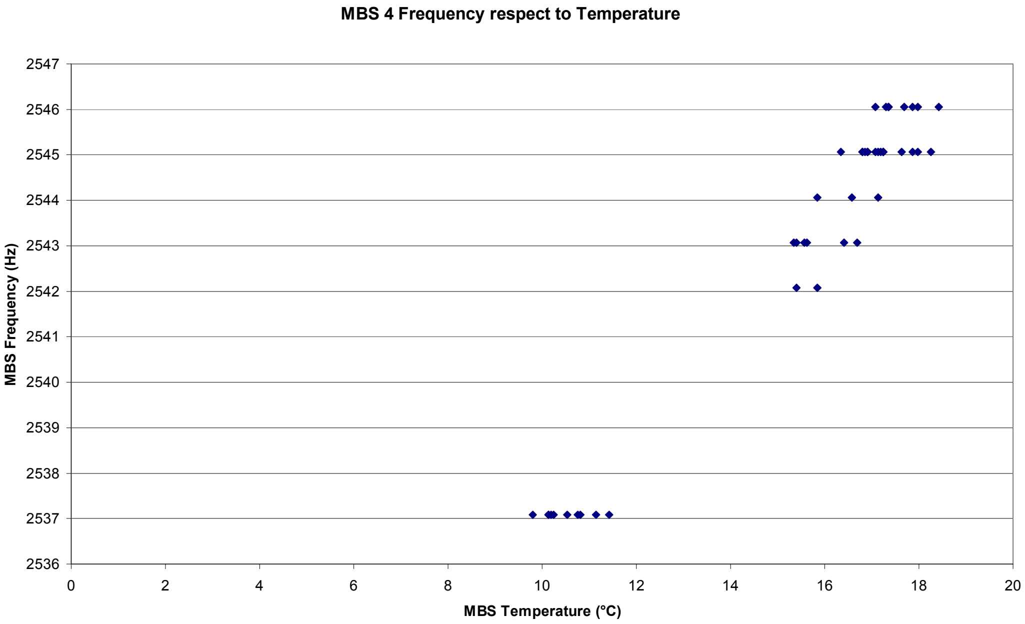

Figure 53 MBS4 Frequency wrt Temperature (Interference Part 1B)

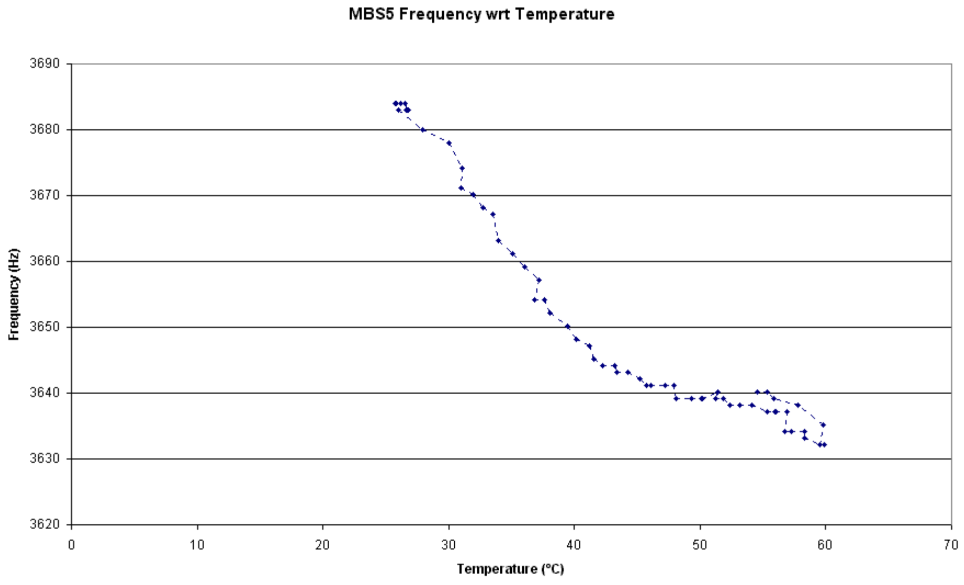

Figure 54 MBS5 Frequency wrt Temperature

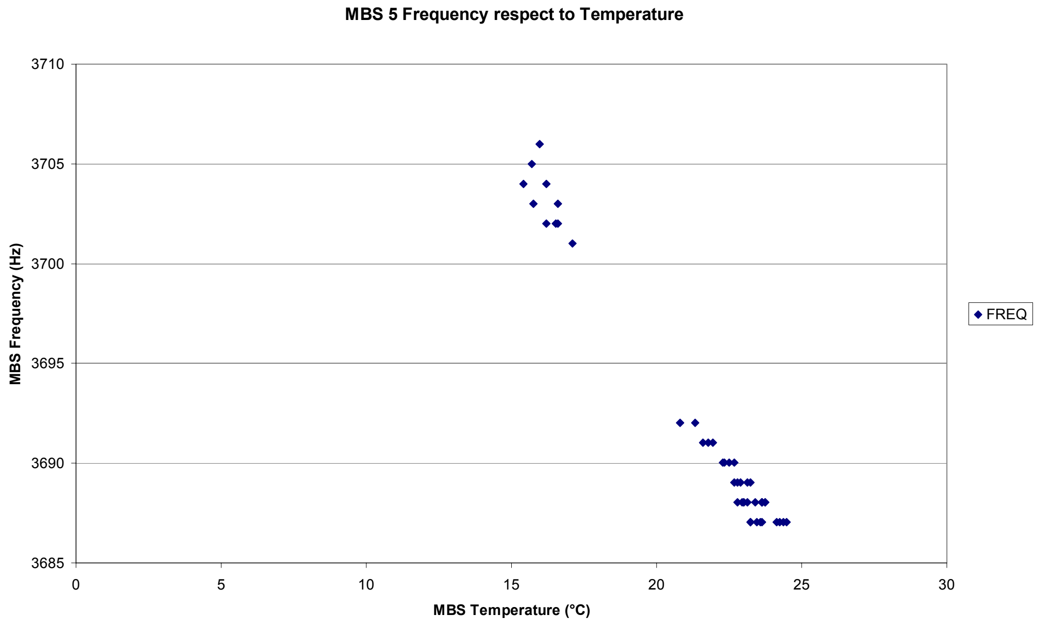

Figure 55 MBS5 Frequency wrt Temperature (Interference Part 1B)

5.1.3.4 Housekeeping signals in science packets

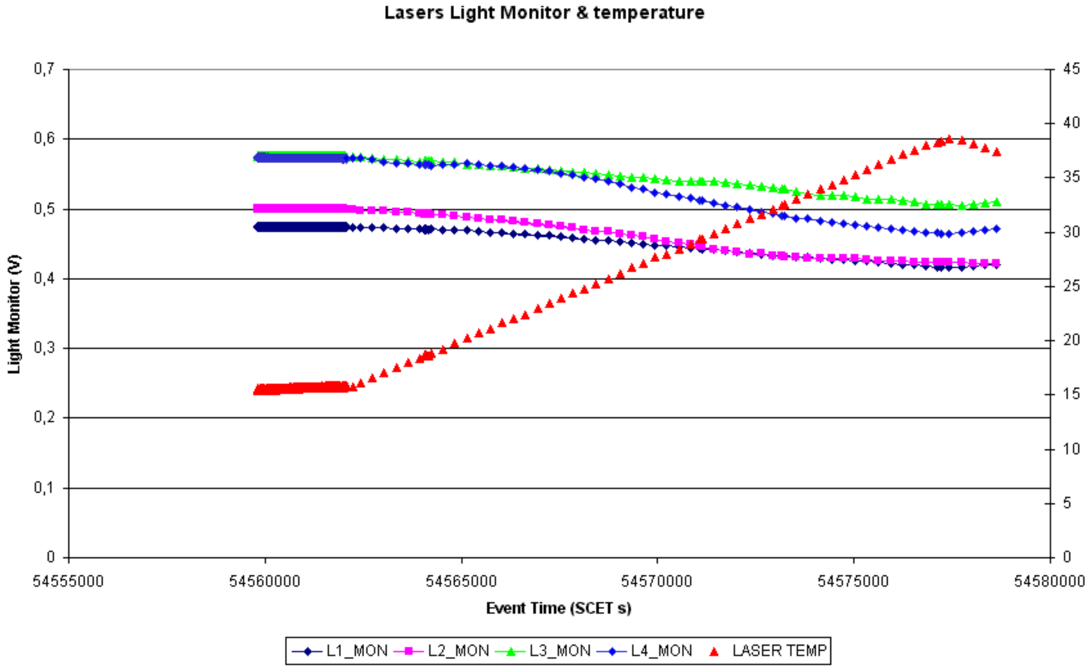

Figure 56 Laser lights monitor (Normal science packet)

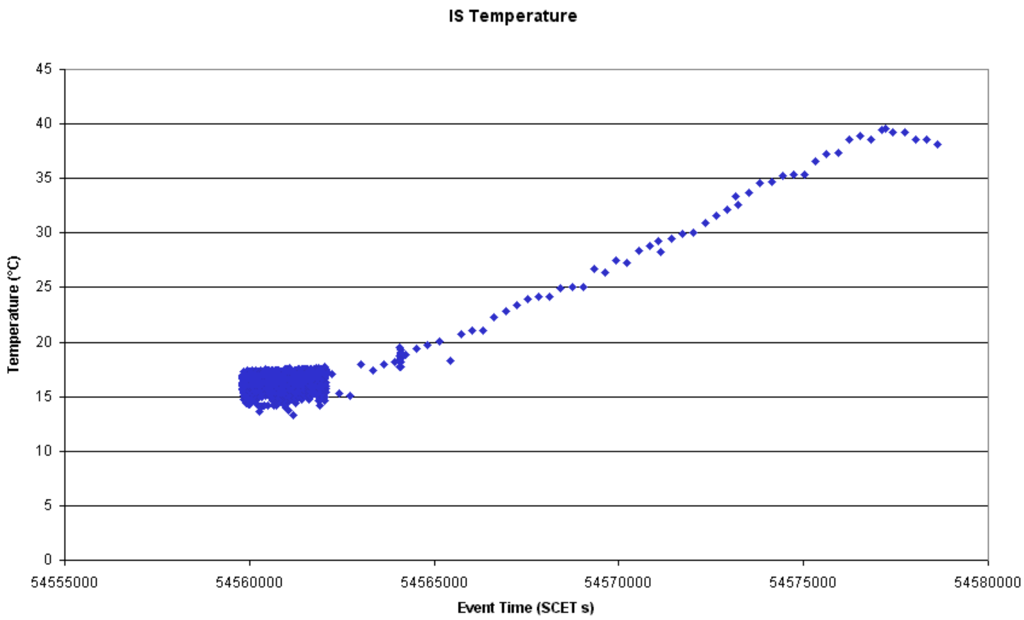

Figure 57 IS temperature (Normal science packet)

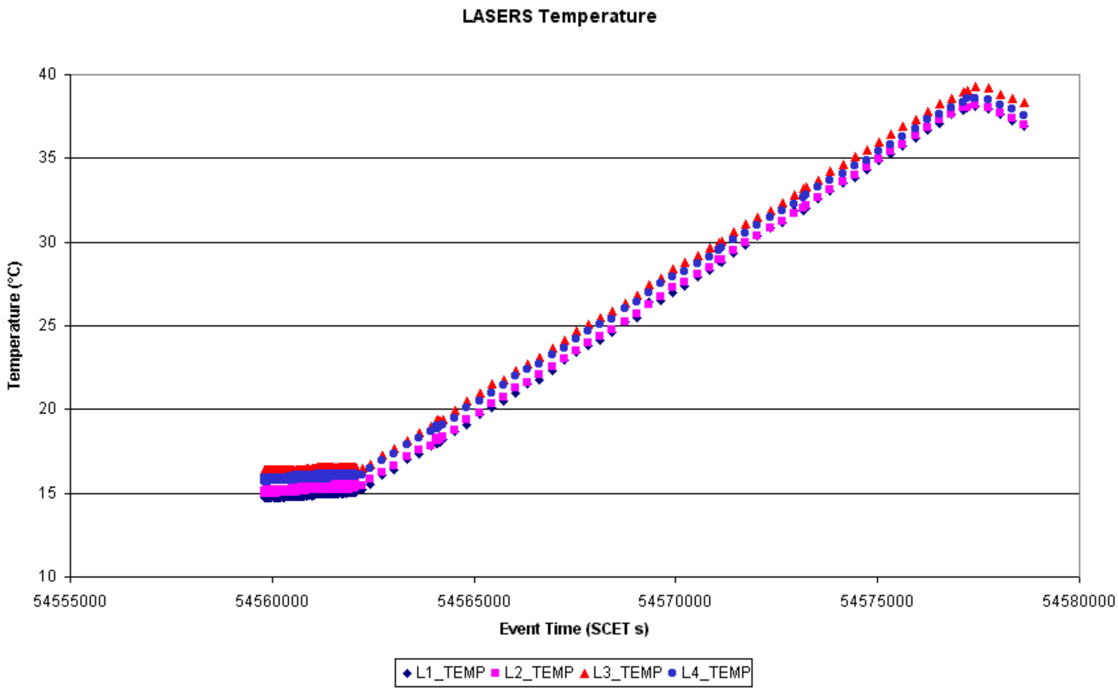

Figure 58 Lasers temperatures (Normal science packet)

5.2 POINTING SCENARIO IIA (30/09/04 - MAIN)

5.2.1 Activities log

The following activities have been performed in sequence by preloaded command timeline sequence.

UTC	Description
30 Sept 2004 – 04:21	Beginning of activity – GIADA power on
30 Sept 2004 – 04:51	Cover open operation
30 Sept 2004 – 04:58	Go to Normal mode (science enabled)
30 Sept 2004 – 08:35	Go to Safe – Science disabled
30 Sept 2004 – 08:47	GIADA Switch-off (with automatic Cover close operation incorporated in the Power-off OBCP)

The GIADA switch-on procedure was applied selecting the Main I/F and with the Context File stored in SSMM. The instrument Main I/F was successfully powered-on by means of the GIADA POWER-ON OBCP on 30th September 2004 @ 04:21 (UTC time), which corresponds to a SCET Time of about 55138858s.

The first expected packet (Connection Report, service 17,2) was not received.

The second expected packet (i.e. 'GIADA in Safe mode' Event Report) was received as first TM report in the test. GIADA was correctly time synchronised. After the GIADA in Safe Mode event, the first HK report was correctly received @ default HK rate of 40s.

Afterwards, the first patch (regarding the Context File) was sent, as well as the other required software patches that were, as expected, divided in six memory load commands. All commands were nominally received, as well as the expected 25 memory dumps. As result of the Context File patch, GIADA HK rate was changed to 10s rate. GIADA remained in Safe mode until 04:44 (UTC time).

The next step was to open the cover. The operation was successfully completed @ 04:51 (UTC Time) when the Cover Report was received.

Then GIADA was sent to Normal @ 04:58 (UTC Time). The Lasers were switched-on by the Laser_power_on OBCP, upon the reception of the 'Start Switch Lasers ON OBCP' event. Science was enabled @ 04:59 (UTC Time). The GDS Left receiver threshold was set to 1.24V, by TC inserted in the sequence. The SSMM was not saturated since the rate of 'Ghost events' on the Left receiver was reduced.

The internal calibration of GDS, IS and MBS sub-systems was periodically performed every 6 minutes to check the instrument behaviour.

The objective of the test was to check the behaviour of GIADA induced by the different sun light angles. The S/C was manoeuvred in such away that the sun angle moved from 20 deg wrt. the S/C Z axis (Figure 6) to 45 deg with steps of 5 deg (Figure 59).

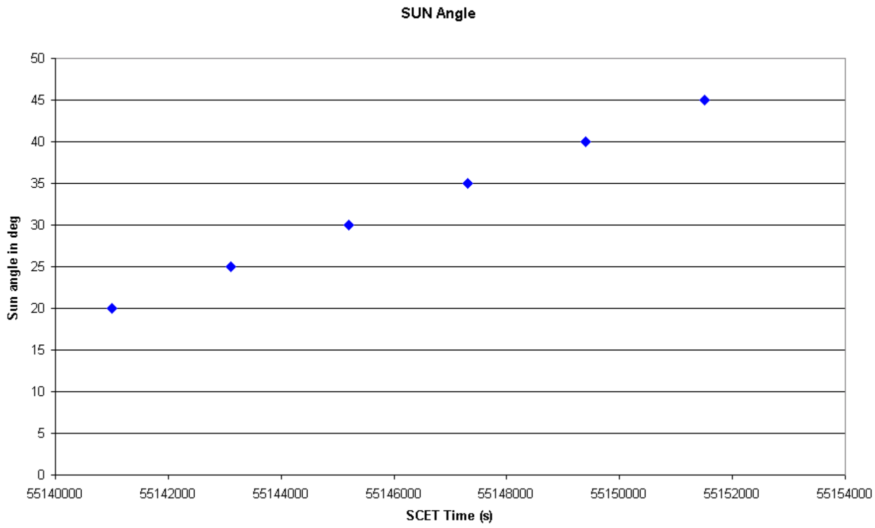

Figure 59 Sun light direction wrt SCET Time

Except for the mentioned loss of event report, no packets were lost, neither HK and Acknowledge reports nor science packets.

As expected, GIADA was commanded in Safe mode @ 08:35 (UTC) of 23rd September. Then the experiment power-off (GIADA power-off OBCP) was started (@ about 08:47 – UTC), the cover was successfully closed (with heaters Cover and Motor Heaters Off) and the cover report received @ 08:54:15 (UTC) of 23rd September. The instrument was switched-off @ about 08:55 of 23rd Sept. 2004 (UTC).

5.2.2 Housekeeping data analysis

The current consumption and the Power Supply temperatures (Figure 60) are both in the expected range. The PS temperature increases from 12°C to 55°C, as expected, after the cover was open, due to the thermal stabilization from the power-on to Normal mode (power consumption from minimum to maximum), due to the sun orientation (when cover is open, the sun moves from 20 to 45 deg inside the GIADA aperture) and due to the radiative coupling with the deep sky. It becomes constant after thermal stabilization and seems not strongly dependent on the sun orientation.

The +5V current consumption measured in Normal mode decreases of about 30mA and the +15V and –15V currents increase of 20-25mA while the temperature of GIADA increases from 20 to 55 °C.

The Instrument cover has been successfully opened by command and closed by **Power Off OBCP (the on-board FCP was changed after the previous experience of 23rd of September removing the command to close the cover before the Power-off OBCP).** In Figure 61, it is shown the status of the two reed-switches that indicate the close and open position of the cover. The details are reported in Section 5.2.2.1, in which the status of the two reed switches as decoded from the Cover Reports is reported.

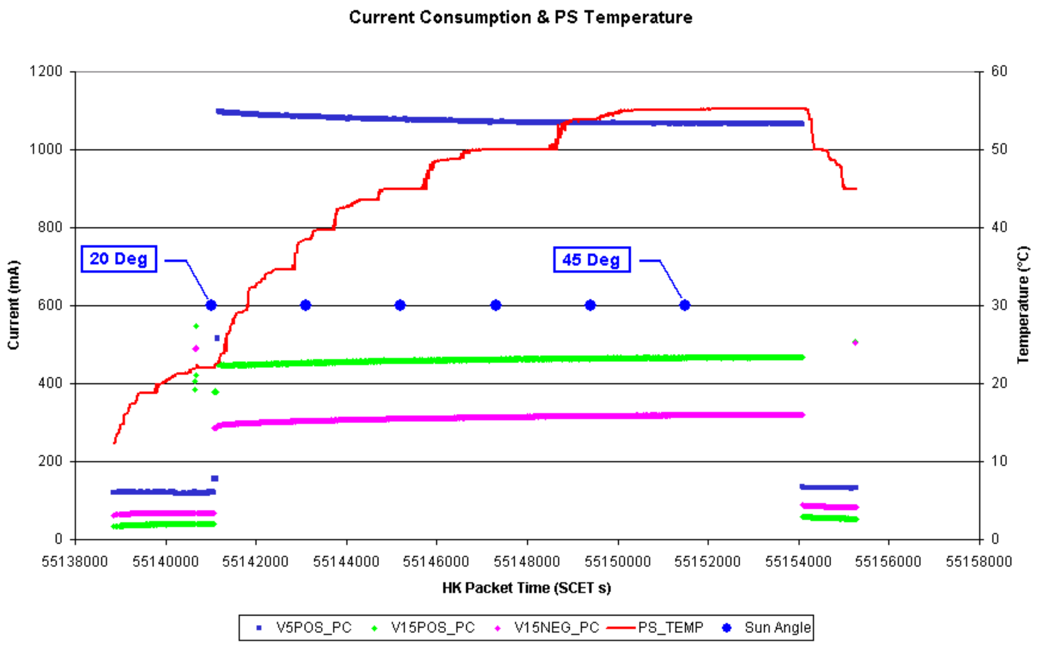

Figure 60 +5V and ±15V Currents and PS Temperature

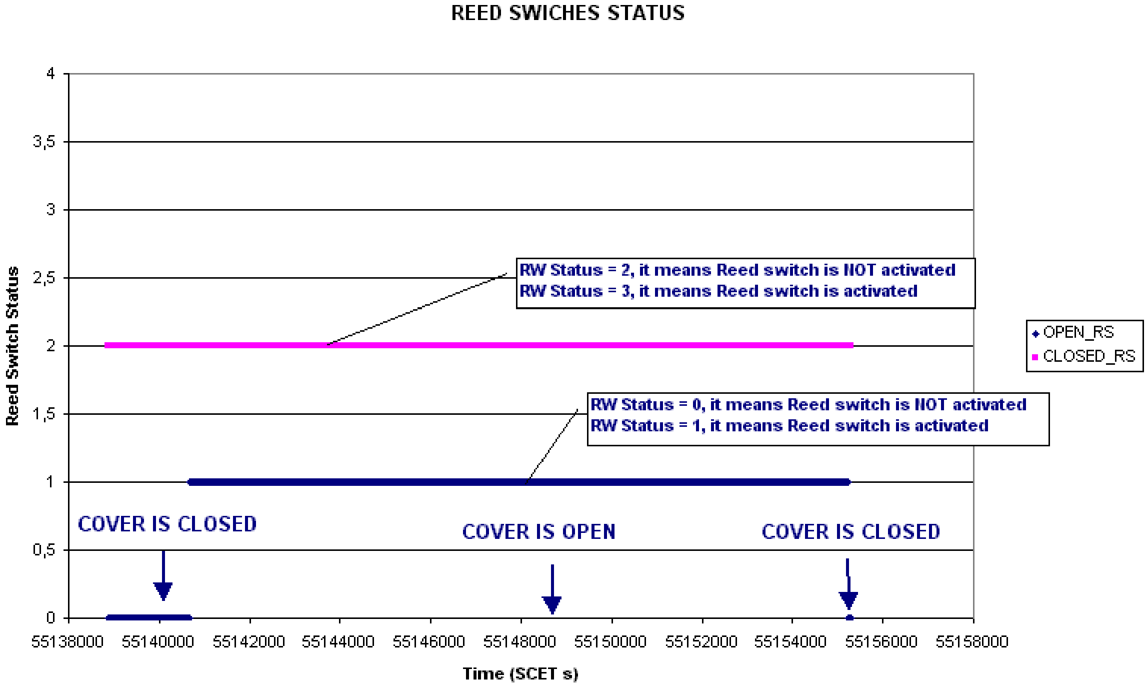

Figure 61 Cover Reed Switch Status (Cover open & close operations)

The status of the 'closed position' reed switch remains always not-active: this is nominal, because when the cover reaches its closed position, the reed switch is still not active (the switch is active only for few steps before the closed position is reached) and the cover closure is performed in a time shorter than the sampling rate of HK telemetry, i.e. 10s (thus the described transition cannot be seen in the HK TM report!).

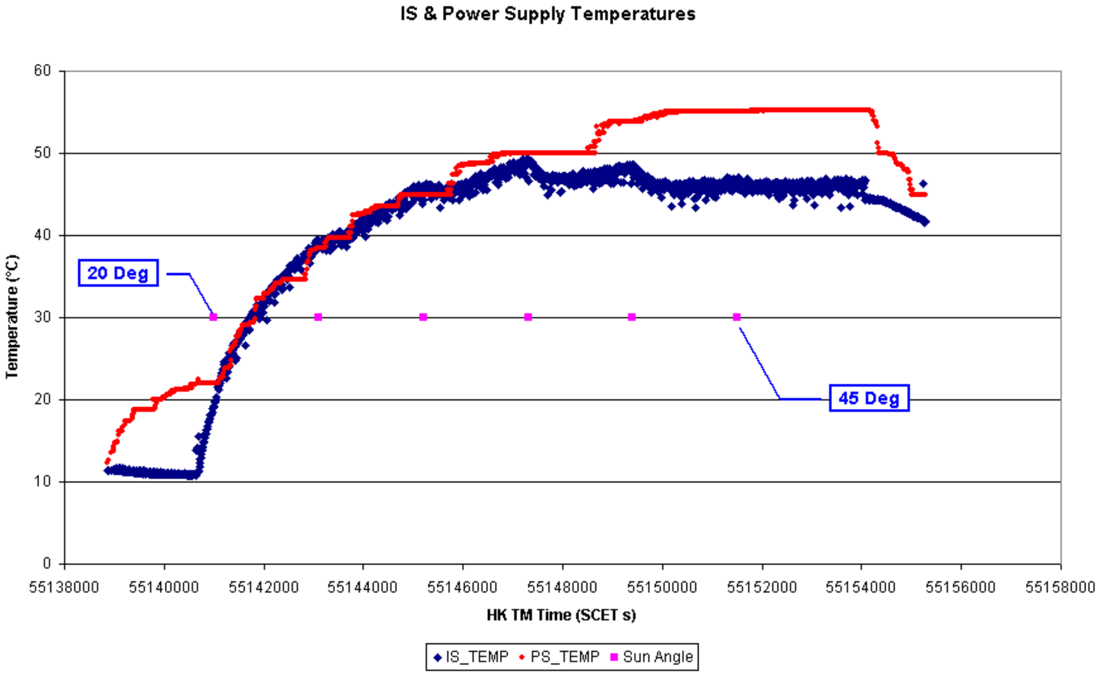

Figure 62 IS & PS Temperatures & Sun illumination angle

In Figure 62, the Power Supply temperature increases from 10°C (@ power-on) up to 55°C when GIADA was in Normal mode (in which the maximum power is drawn) and when the sun orientation was 45 deg with respect to the S/C Z axis. The IS temperature increases from 10°C (cover is closed) to about 50°C after GIADA cover is open and the sun orientation has reached 45 deg wrt. the S/C Z axis. In this state, the IS temperature seems reaching the thermal equilibrium. As already detected in the previous tests, when the lasers are switched on, the IS temperature becomes noisy (data are spread within 3°C) wrt. the case when GIADA is in safe mode.

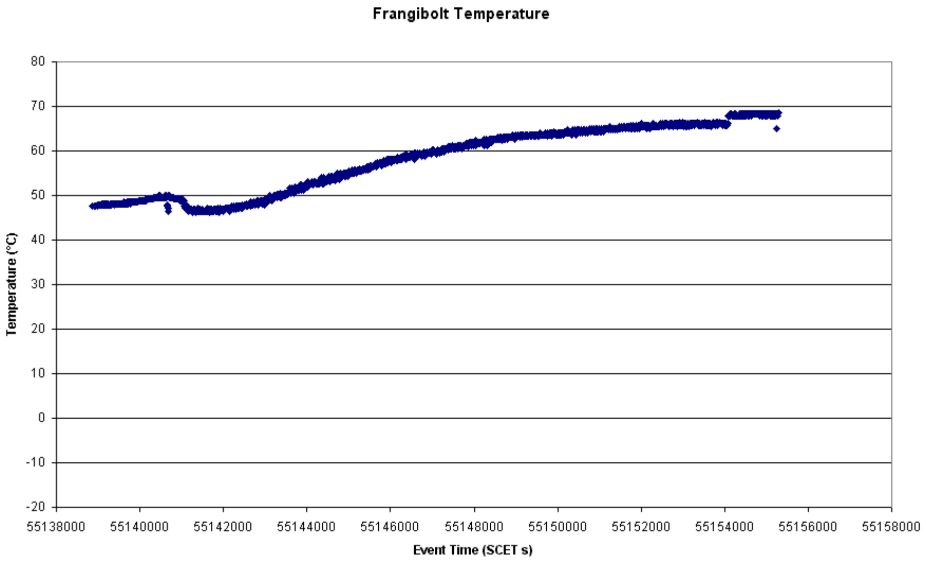

Figure 63 Frangibolt Temperature

The Frangibolt temperature, shown in Figure 63, monitors (indirectly) the sun illumination along the test. The temperature increases when the sun illuminates the Frangibolt (with sun at 20 deg, the light does not illuminate the Frangibolt due to the particular position under the appendix which is shown in Figure 6).

The Lasers are properly switched-on and their temperatures (Figure 64) increase from 15°C to about 45°C, when the GIADA internal temperatures seem reaching the thermal equilibrium. As expected, the light of each laser decreases when the temperature rises.

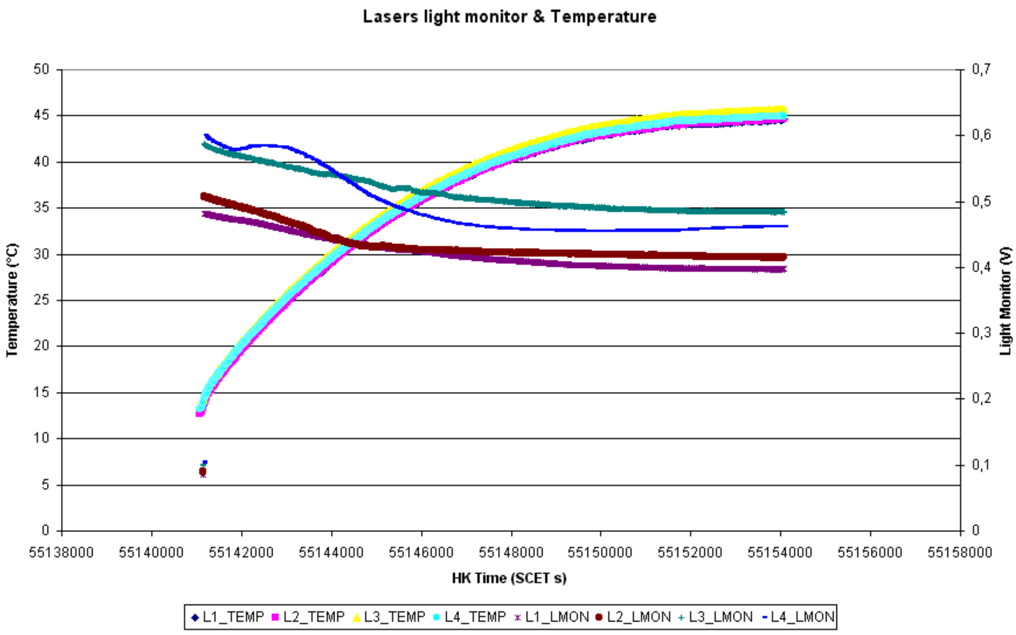

Figure 64 Laser Light monitor and temperatures

The five MBS, after switch-on, show a temperature between 23÷25°C (Figure 65). Then the temperatures increase due to the internal dissipation, the radiative link with the deep sky and the sun illumination angle. It reaches the thermal equilibrium at the temperature of 65°C (sun light @ 45 deg wrt. the S/C Z axis).

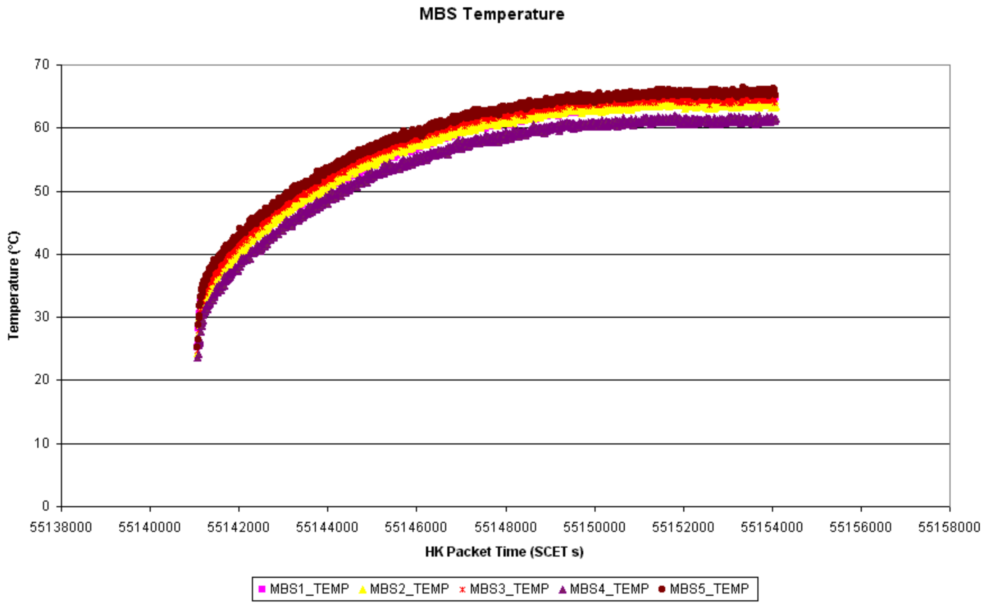

Figure 65 MBS Temperature

The Dust Flux indication is observed greater than 0 (Figure 66) four times: the first after 1 minute the sensor switch-on (in which - as understood on ground - few IS ghost events can be observed) and the other 3 are sporadic during the test. The reason is that channels A and C have detected few ‘Ghost events’.

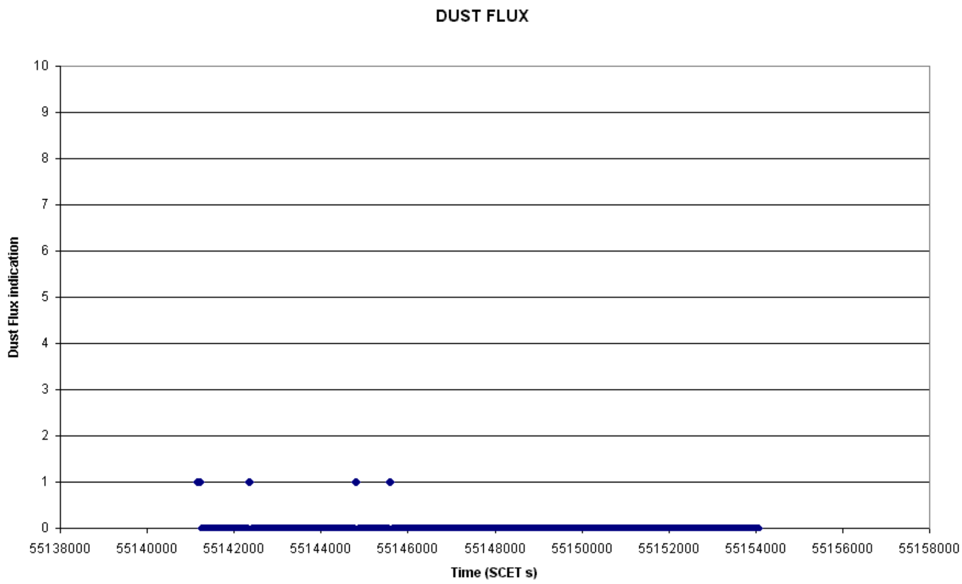

Figure 66 Dust-Flux Monitor (valid only when the IS sub-system is ON)

Figure 67 and Figure 68 indicate respectively the Source Sequence Count of HK Telemetry and the science TM overflow flag versus time. **No missing HK packets have been found in the TM, while the science TM has been overflow due to a flood of the GDS ghost detections only at power-on. Then after this** period the GDS receiver was saturated due to the stray-light induced by sun illumination. This, consequently, has not provided an SSMM memory overflow and thus no missing science packets were observed.

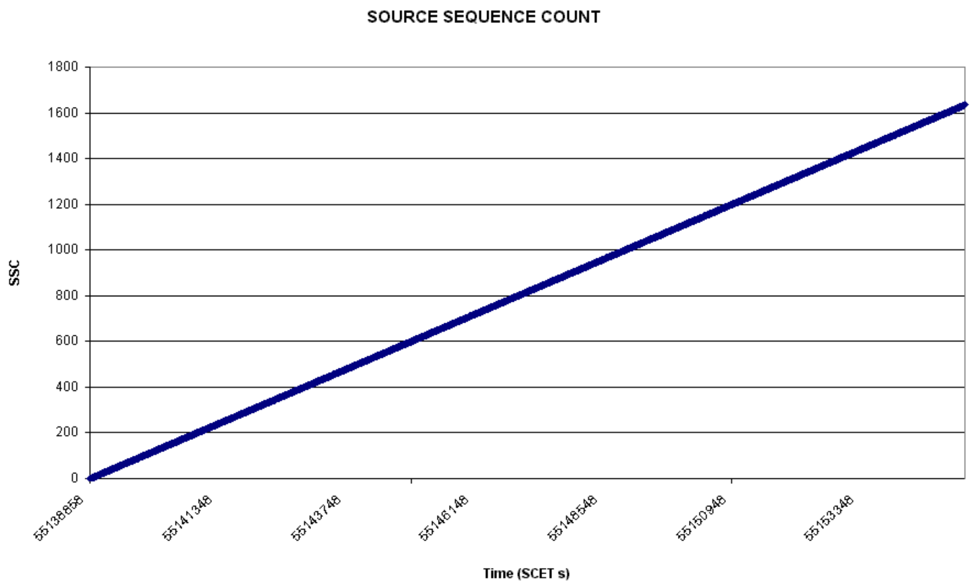

Figure 67 SSC of HK TM

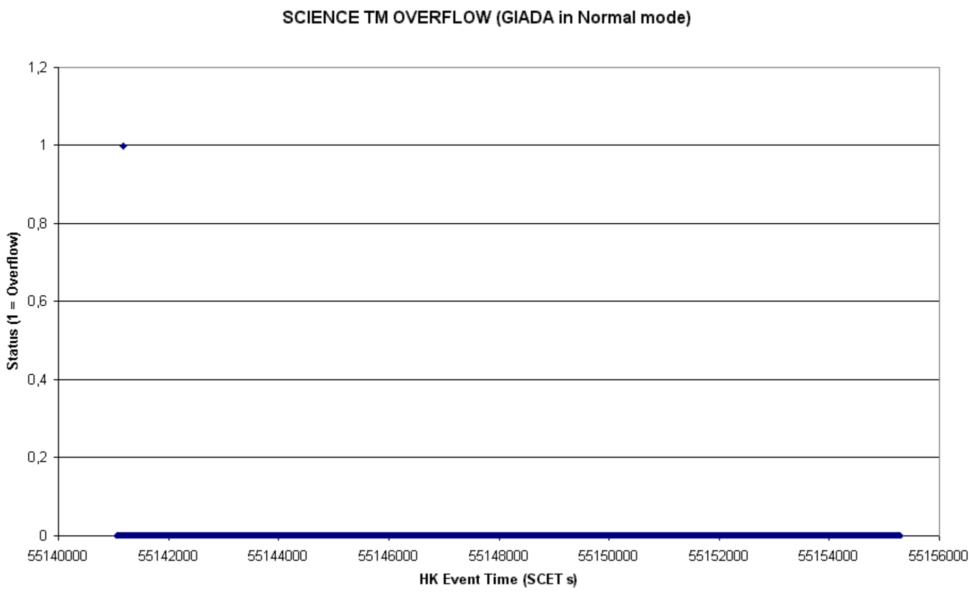

Figure 68 TM overflow monitor

5.2.2.1 Cover open & close operations

After the cover open operation, the cover resulted completely open, as shown Figure 69, in which the status of the two reed-switches is reported. The figure is extracted from the cover report, which is received on-ground at the completion of the operation (@SCET time 55140684s, corresponding to about 04:51:39 UTC of 30 Sept. 2004). The behaviour is correct.

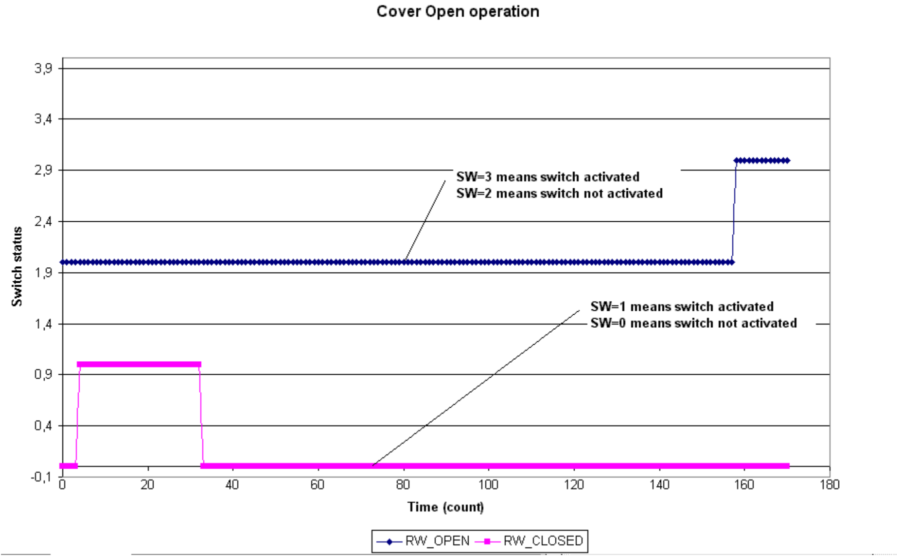

Figure 69 Reed switches Status during the Cover Open operation

Before the GIADA power-off, the GIADA cover was automatically closed by means of the Power-off OBCP procedure (as already stated, the FCP was modified to avoid the cover close command before to enter in the Power-Off OBCP procedure). The cover was successfully closed as shown in the cover report received at the completion of the operation (@ SCET time of 55155240s, corresponding to 08:54:15 UTC of 30 Sept. 2004). Figure 70 reports the correct sequence of the two reed-switches.

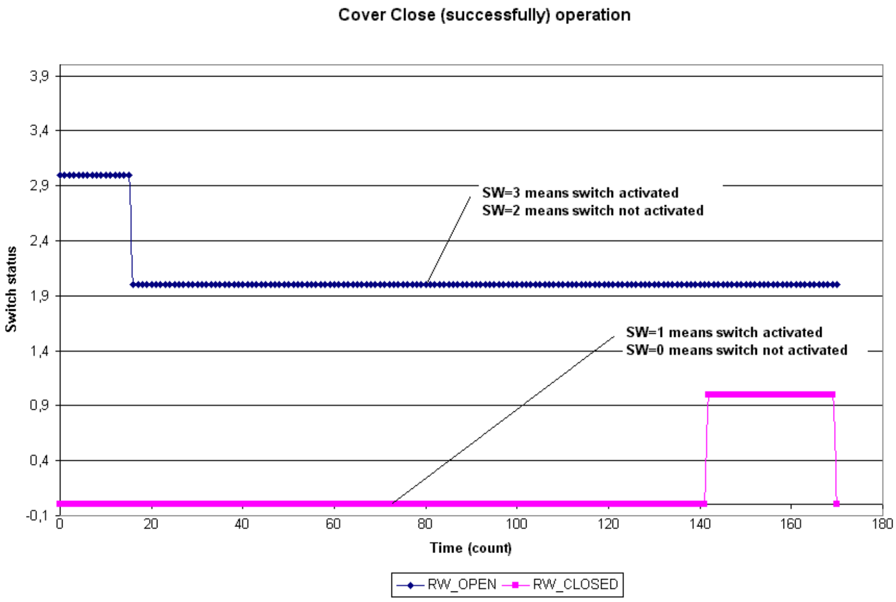

Figure 70 Reed switches Status during Cover Close operation

5.2.3 Engineering evaluation on sensor data

<u>**No science TM packets were lost**</u> because **the SSMM memory allocated to GIADA (1 Mbytes) did not saturate.** Figure 71 shows the Source Sequence Count of science TM packets when GIADA is in Normal mode and the science TM is enabled. After the GIADA is entered in Normal mode and the lasers have been switched-on, a flood of TM packets was observed until the GDS Left Threshold has been increased and the number of 'Ghost events' has significantly reduced. Moreover, when the sun angle reached 30 deg, the GDS receivers saturated and no more Ghost events were produced (Figure 73; GDS production rate is discussed in Section 5.2.3.2). Consequently the SSMM did not saturate and no science packets were lost (Figure 72).

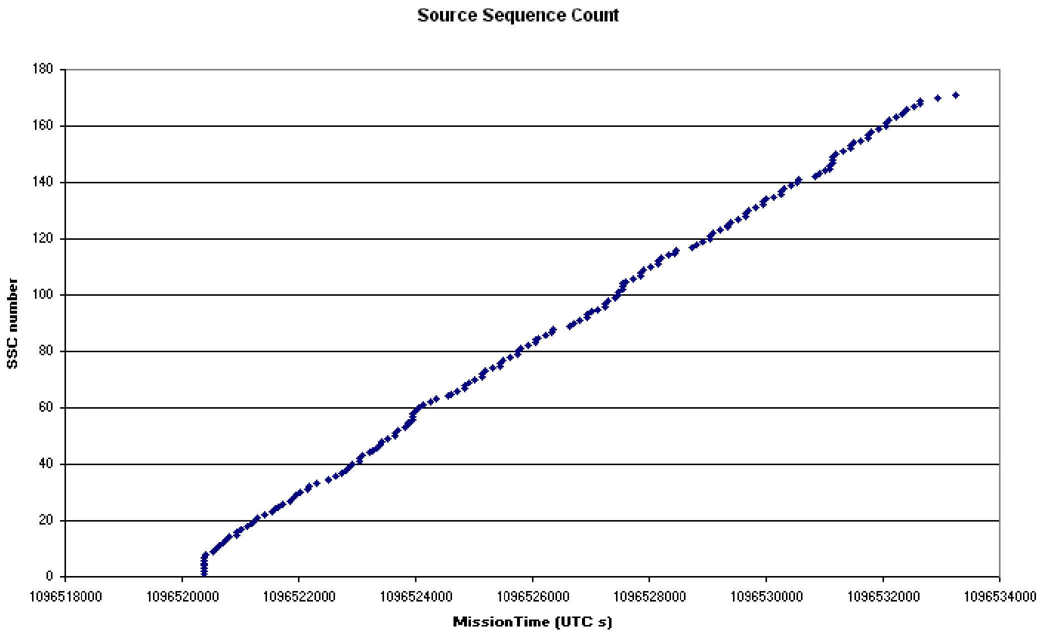

Figure 71 Science TM packet Source Sequence Count versus time

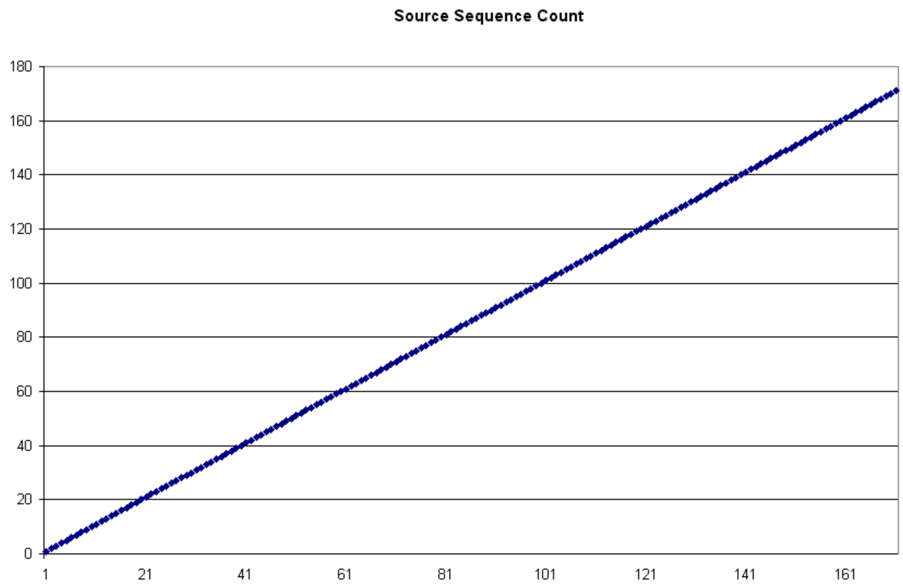

Figure 72 Science TM packet Source Sequence Count

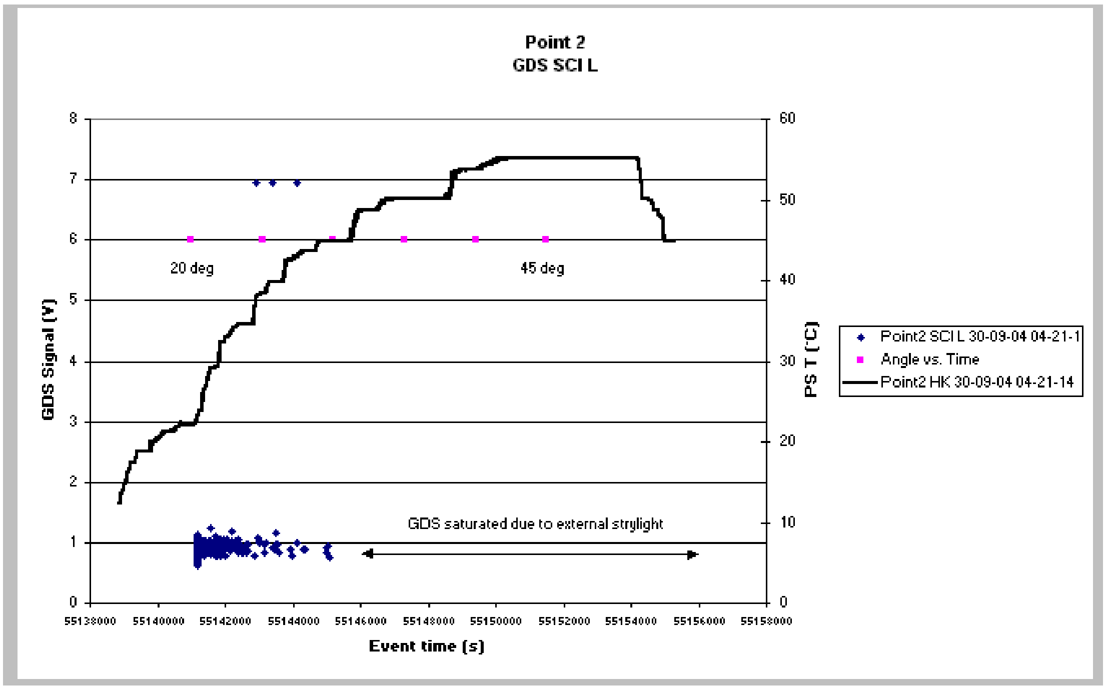

Figure 73 GDS production (Ghost Events) and sun illumination angles

5.2.3.1 IS Sub-system

After the sub-system power on, the detection thresholds of each channel were set to 50 mV (Context file updated via memory load command). The Range/Gain configuration is the same as in previous tests (Table 2).

After entering in Normal mode, the IS calibration run until the end of the test every 6 minutes. Only few IS science 'Ghost' detections were received: 1 on Channel A and 2 on Channel C (Figure 74).

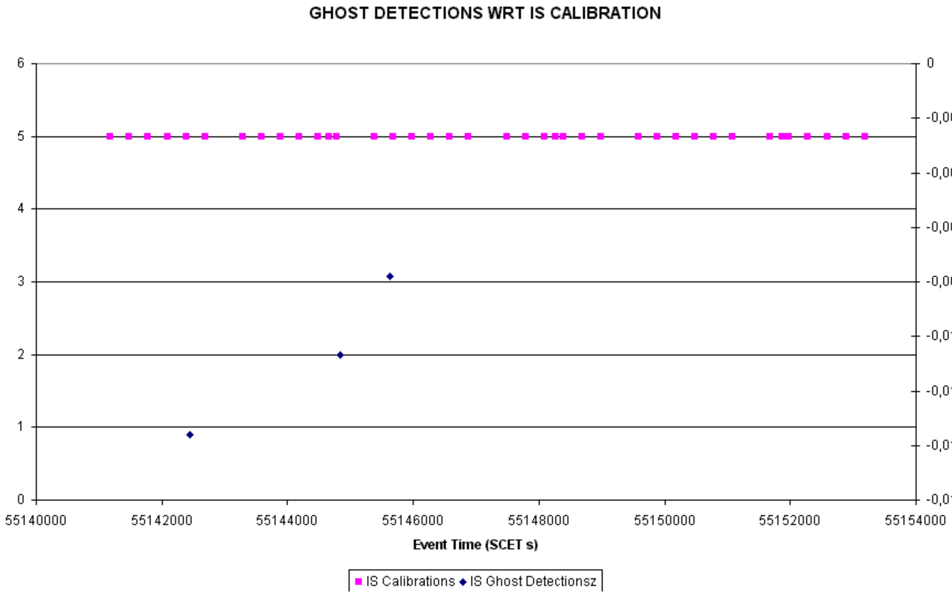

Figure 74 IS Ghost detections wrt IS Calibration

Table 5 shows the minimum, maximum of mean and the standard deviation for each channel output before the start of the IS calibration.

Type	PZTA		PZTB		PZTC		PZTD		PZTE	
	MEAN	STD	MEAN	STD	MEAN	STD	MEAN	STD	MEAN	STD
Maximum	-0.0049	0.0638	-0.0049	0.0638	-0.002	0.067	-0.008	0.064	-0.014	0,064
Minimum	-0.0107	0	-0.0107	0	-0.0049	0	-0.014	0	-0.014	0
Average	-0.008	-	-0.009	-	-0.0033	-	-0.011	-	-0.014	-

Table 5 IS Calibration – Max, Min & Average of the mean and STD Dev of channel outputs

All channels have a low mean value (negative value means channel output close to 0 V) and a noise level (@ 3σ) close or little above the detection thresholds. The noise levels are compatible with those measured during on-ground test campaigns and in the previous Commissioning tests.

Figure 75 to Figure 88 show the results of the IS internal calibrations. According to the section 5.2.2.1 of **AD4**, only the 2^{nd} and 4^{th} stimuli are meaningful.

- Channel-A response is consistent along the 3.5 hours of the test; except for six calibrations in which the amplitudes were 1V lower then the others. The values are in the range 8.533 to 8.257V (Figure 83) and decrease when the temperature increases (variation is about 300mV in 22°C of temperature change). When the IS sensor has reached the thermal equilibrium (temperature 46±1°C), the amplitude becomes quite constant (variations are within 10 mV).
- Channel-B response is quite consistent (i.e. the same amplitude) along the 3.5 hours of the test. The measured amplitude slightly decreases with temperature (Figure 32) with a variation < 40mV when temperature increases of about 22°C (from 24 to 46°C). The same behaviour is observed for the measured delay time, for which the variations are within 6 μsec.
- Channel-C response is confirmed not stable along the test (refer to the voltage/delay time measurements of 2nd and 4th stimuli) and wrt. the temperature change (Figure 85 and Figure 86). The same behaviour is observed for the delay time, for which the variations are within 20-60 μsec. It is suggested to increase channel C detection threshold to 100-150mV for the next in-flight tests and compare the obtained results.
- Channel-D response results consistent (i.e. the same amplitude) along the 3.5 hours of the test, except for six calibrations in which the channel responses were about 5.4V (for one calibration) and 3.5V (for the three remaining calibrations) above the others. The measured amplitudes (Figure 87 and Figure 88) slightly increase when temperature increases (variation is < 40 mV within 22°C of temperature change) and are quite constant when IS has reached the thermal equilibrium (variation is < 12 mV when the temperature is within 46±1°C). The same behaviour is observed for the measured delay time, for which the variations are within 20 μsec.
- No detection on Channel-E (as expected).

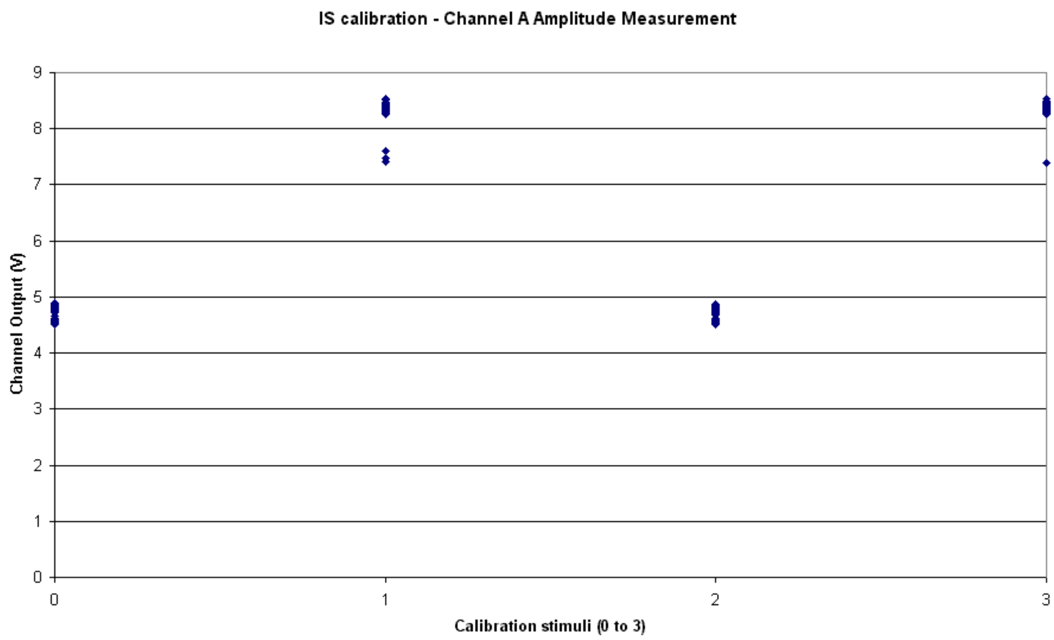

Figure 75 IS Calibration - Channel A Amplitude

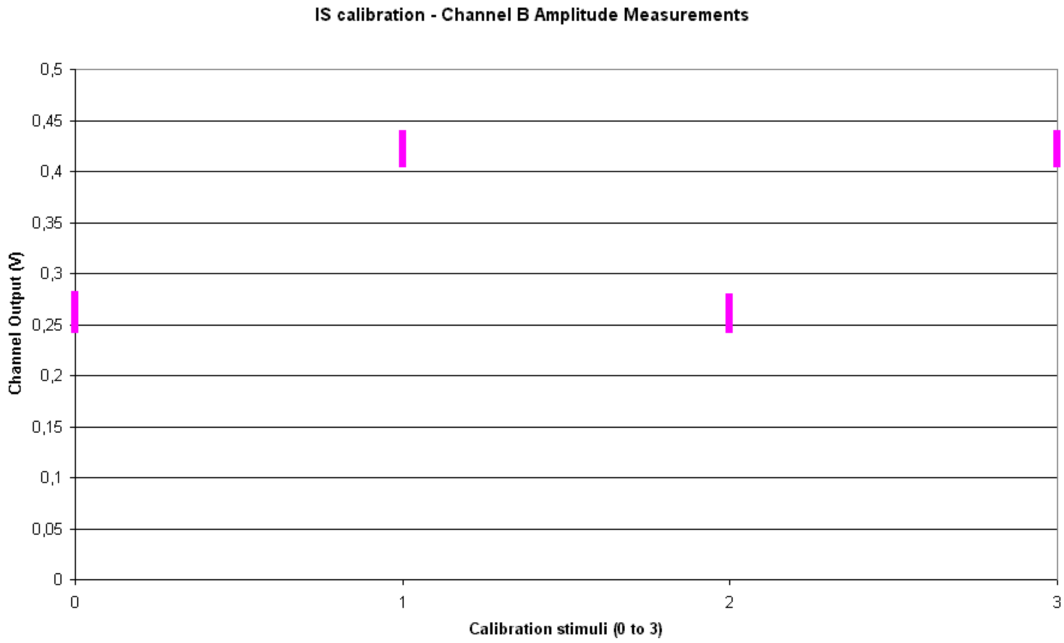

Figure 76 IS Calibration - Channel B Amplitude

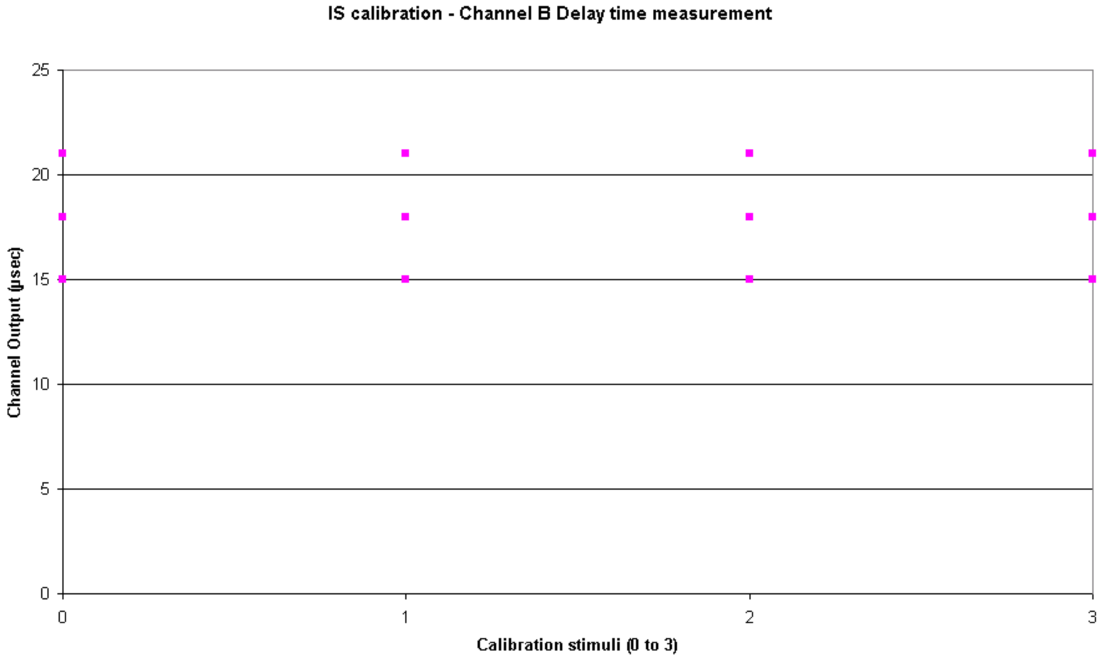

Figure 77 IS Calibration - Channel B Delay Time

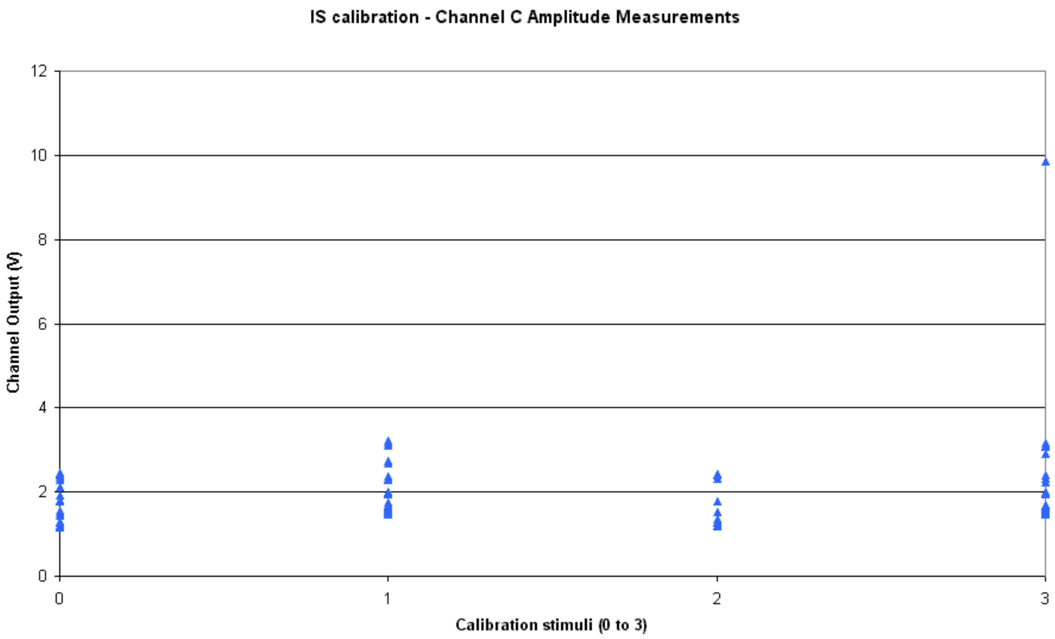

Figure 78 IS Calibration - Channel C Amplitude

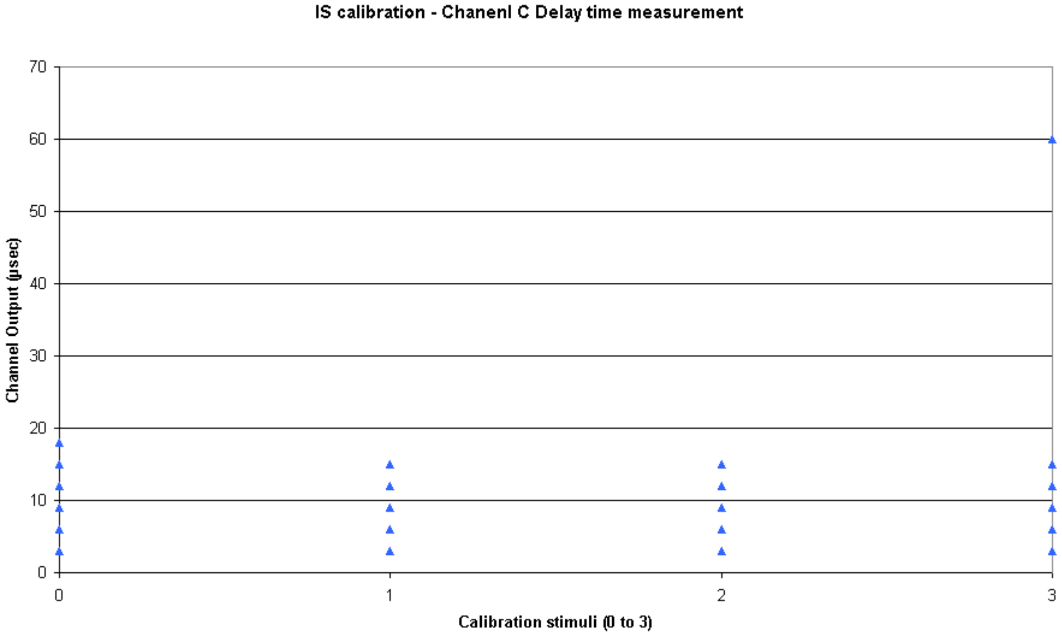

Figure 79 IS Calibration - Channel C Delay Time

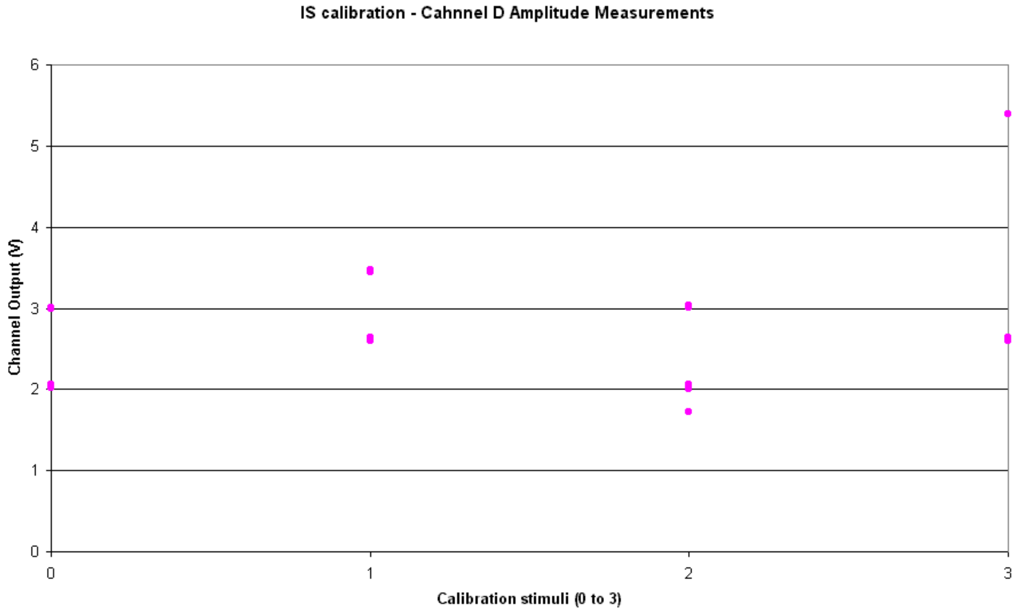

Figure 80 IS Calibration - Channel D Amplitude

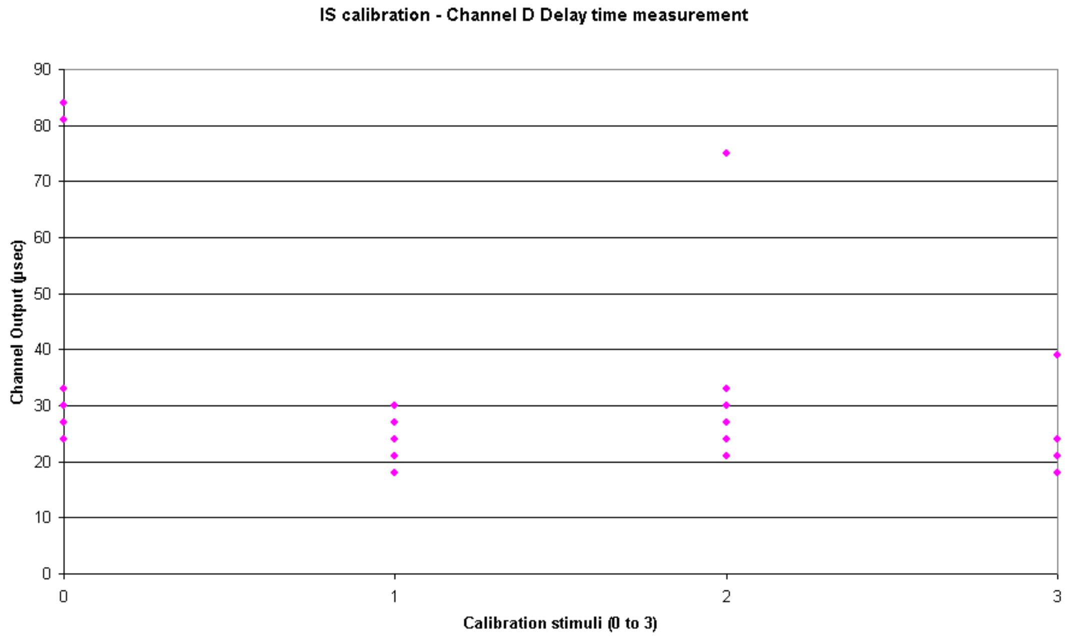

Figure 81 IS Calibration - Channel D Delay Time

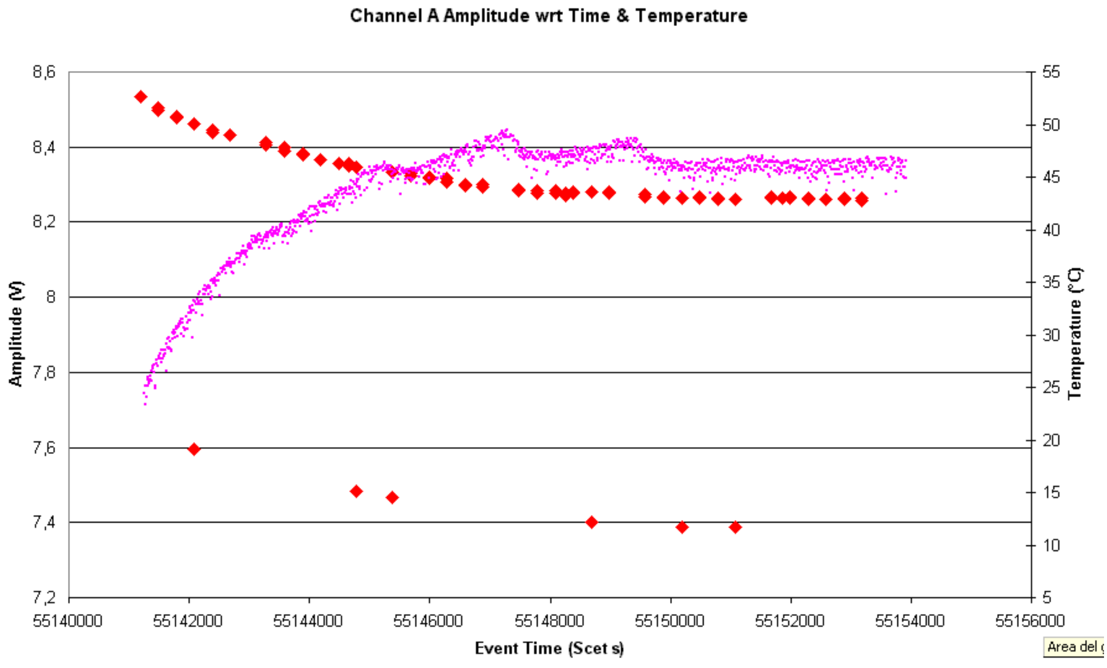

Figure 82 Channel A response wrt IS temperature

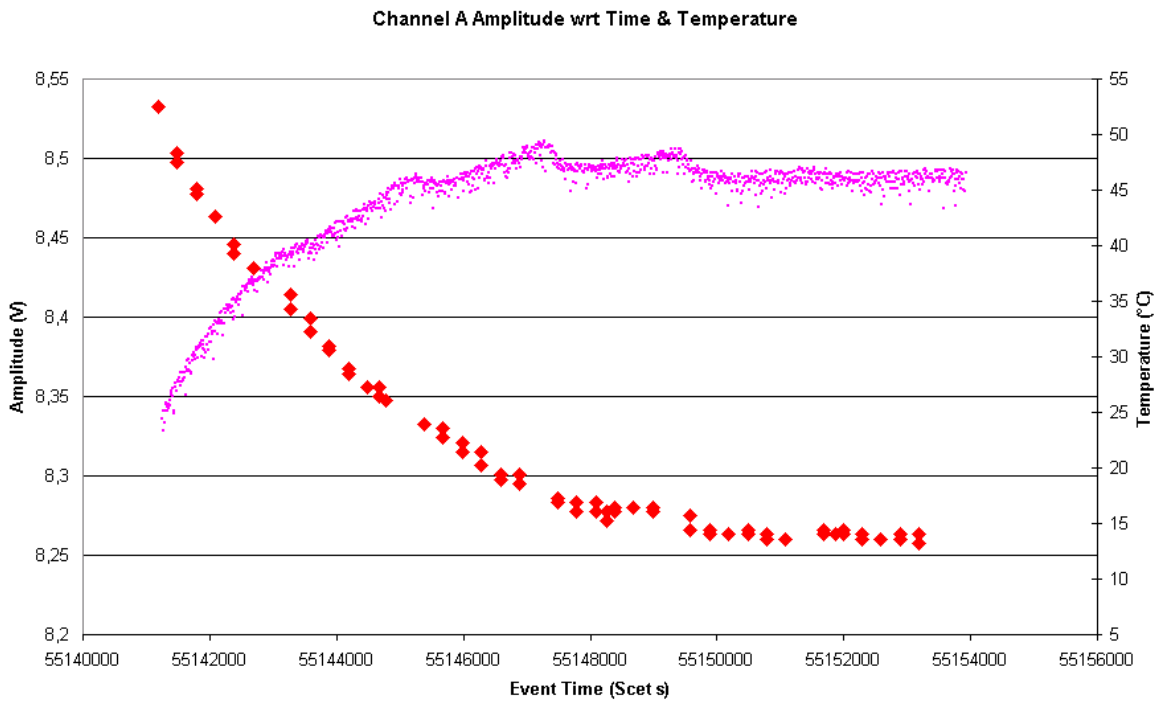

Figure 83 Channel A response wrt IS temperature - scale magnification

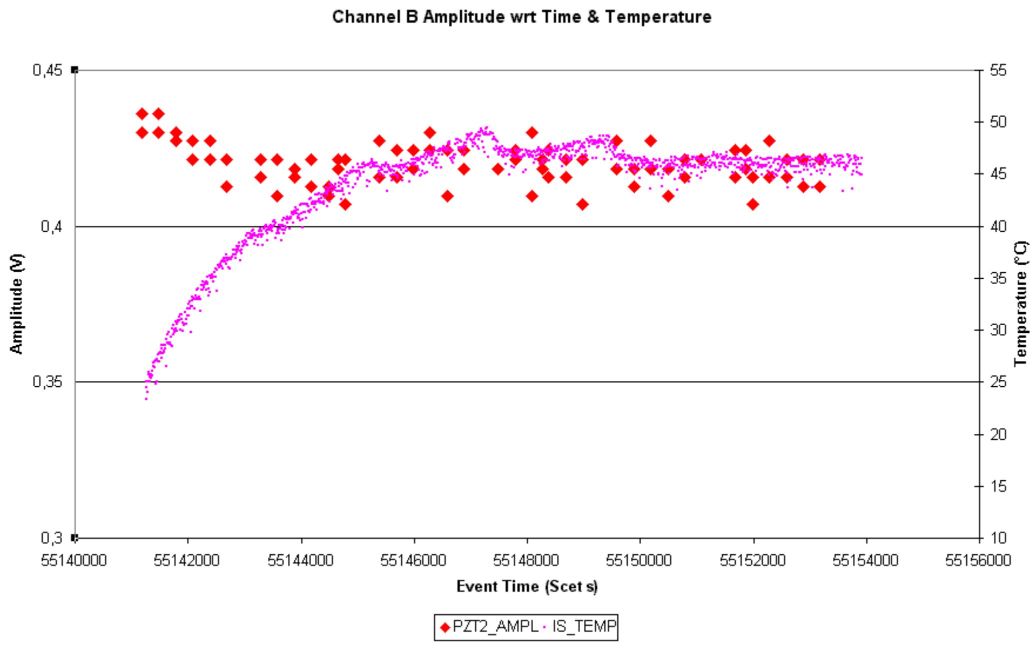

Figure 84 Channel B response wrt IS temperature

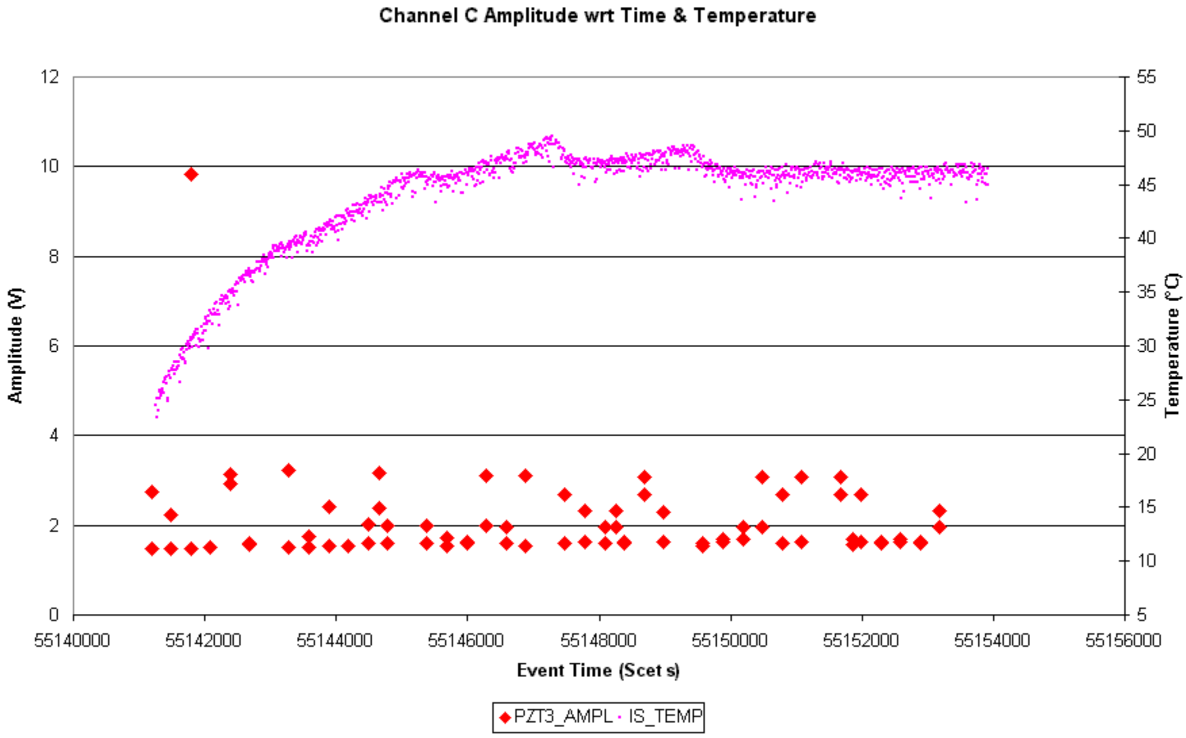

Figure 85 Channel C response wrt IS temperature

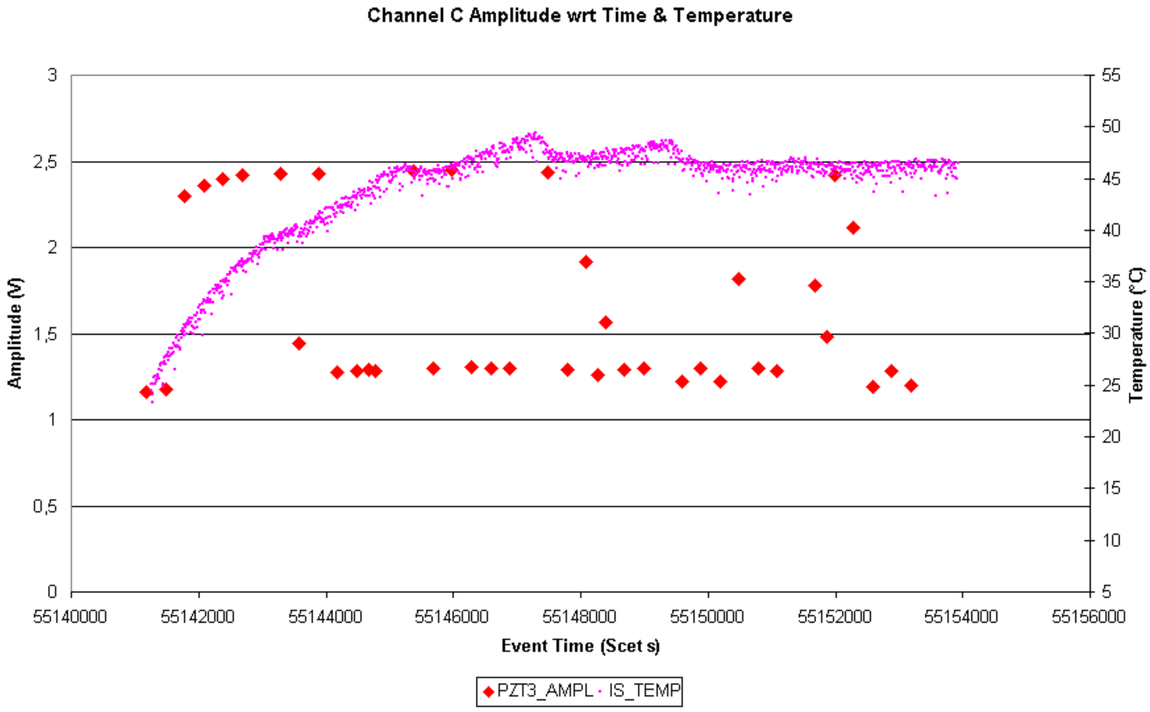

Figure 86 Channel C response wrt IS temperature - scale magnification

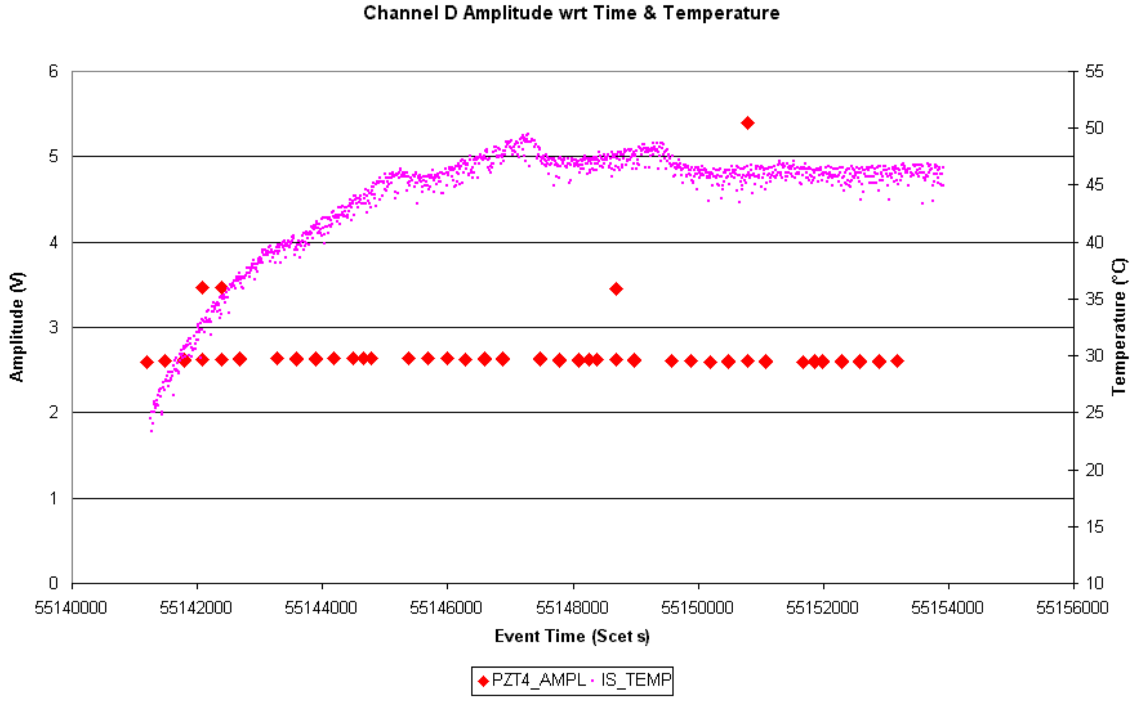

Figure 87 Channel D response wrt IS temperature

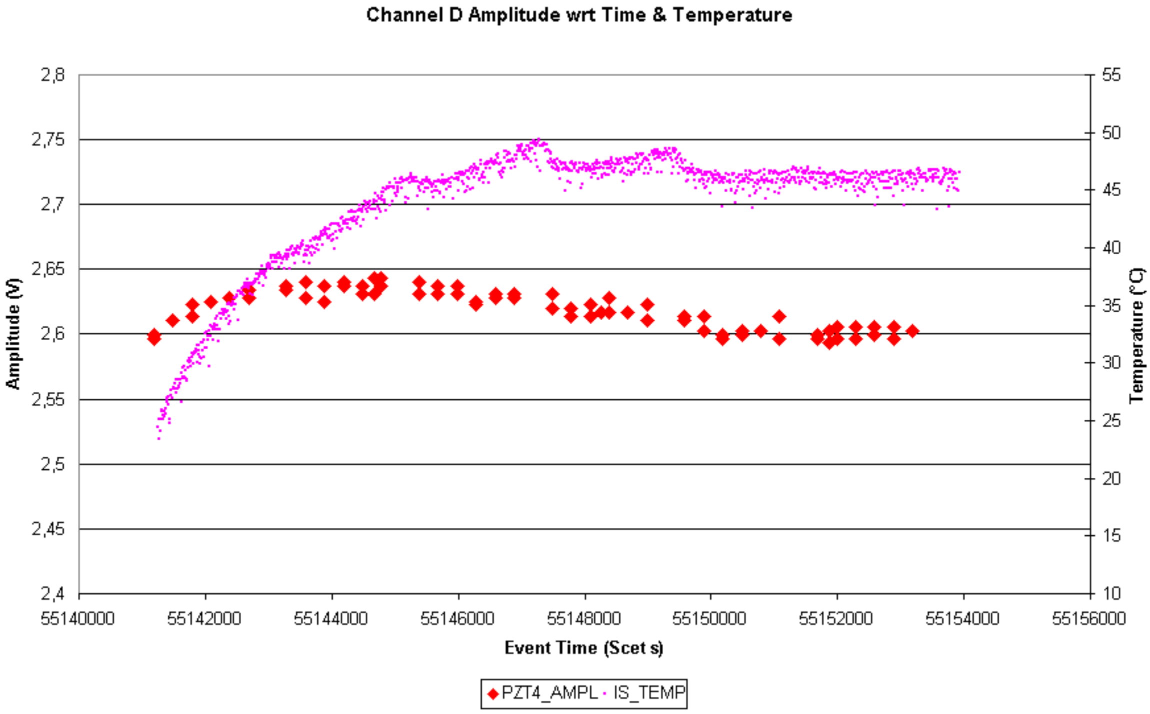

Figure 88 Channel D response versus IS temperature – scale amplification

5.2.3.2 GDS Sub-system

The detection thresholds of Left and Right channels were set to about 1.24 V and 0.8 V respectively (via Context file updated via memory load command at GIADA power-on and by command after GIADA is entered in Normal mode).

The nominal operation was to perform periodic GDS calibrations every 6 minutes.

Figure 89 and Figure 90 show the GDS Calibration Right and Left mean value and STD.

The output level of the Left and Right channels reports a direct measure of the internal stray-light in combination with the electronics noise that may be conducted on the power lines from other instruments or induced by temperature increasing. The outputs depend also on the behaviour of the GIADA GDS receivers in the presence of the sunlight (stray-light induced by sun). In this case, the first stage of the electronics amplifier may be saturate and no more 'ghost detections' can be observed (the receiver output is almost constant).

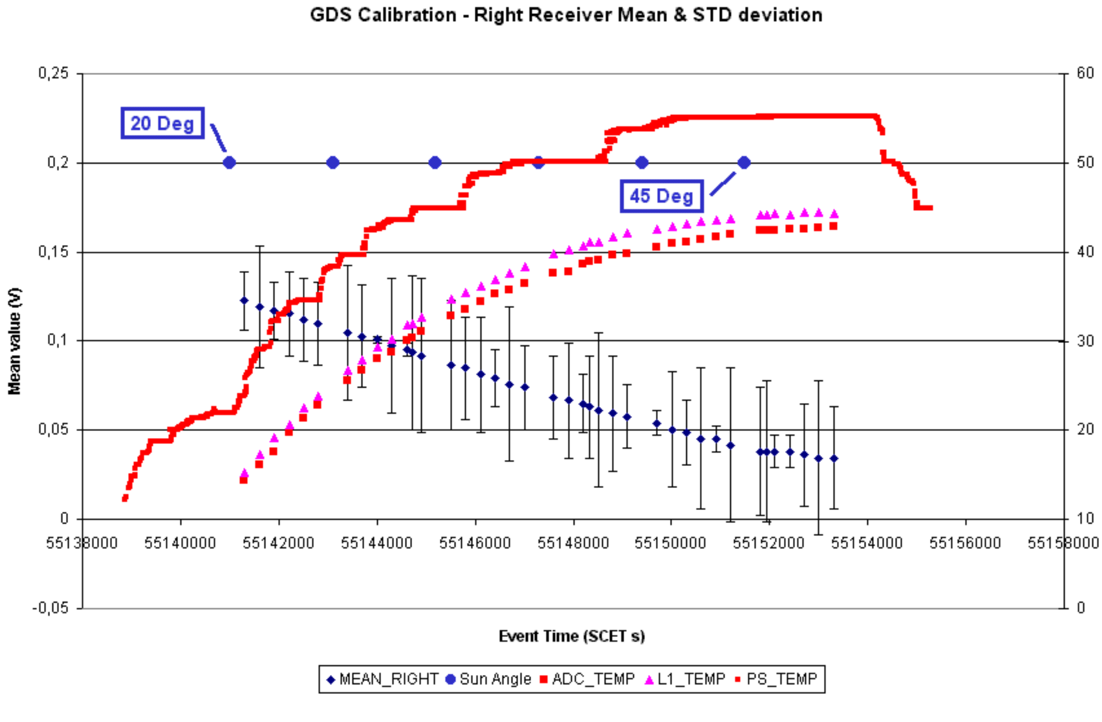

Figure 89 GDS Right Receiver Calibration (mean value and STD deviation)

In Figure 89, the mean value of the Right receiver is always saturated and below the detection threshold (no ghost detections observed on the Right channel). From the beginning of the test (sun angle 20 deg wrt. S/C Z axis) up to the end of the test (sun angle 45 deg wrt. S/C Z axis - Figure 6), the mean value is slowly decreasing from 0.12V to 0.03V, probably due to the increase of the GIADA internal temperature (the laser temperature is in the range 14 - 44°C). When the internal thermal equilibrium is reached, the calibration output becomes constant (variation is less than 5mV). The GDS Right receiver is always saturated. The standard deviation is below 50 mV.

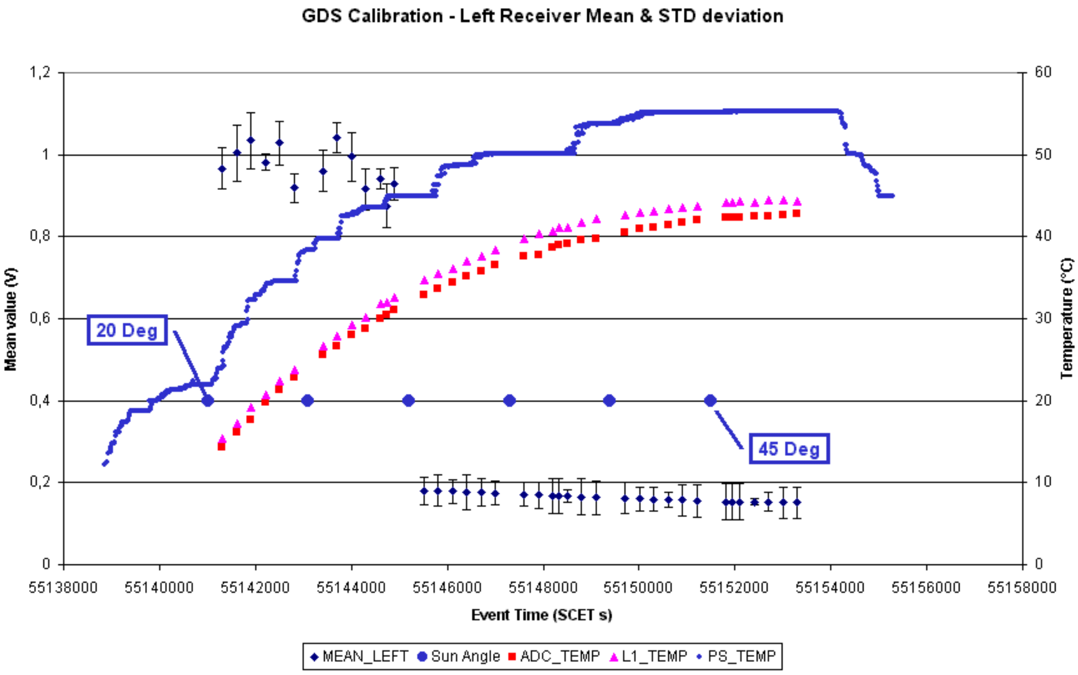

Figure 90 GDS Left Receiver Calibration (mean value and STD deviation)

The mean and standard deviations of the Left receiver calibrations (Figure 90) are quite similar to those obtained in the first part of the Pointing scenario: at the beginning the channel is not saturated (and thus due to internal stray-light it produces 'Ghost events'); after the sun angle reaches 30 deg the Left receiver output becomes saturated until the end of the test. In particular three phases can be distinguished:

- From the beginning of the test until the sun angle has reached about 30 deg from S/C Z axis (Figure 6), the mean value is almost constant about 1V (it is of the same order of the new detection threshold). The standard deviation is below 70 mV.
- When the sun angle reaches about 30 deg, the mean value decreases from 1V to 0.18V and the GDS receiver becomes saturated. The standard deviation is below 30 mV.
- After this time until the end of the test (the sun light has reached 45 deg), the mean value slowly decreases from 0.18V to 0.15V, probably due to the increase of the internal temperatures. The GDS Right receiver is saturated. The standard deviation is below 70 mV.

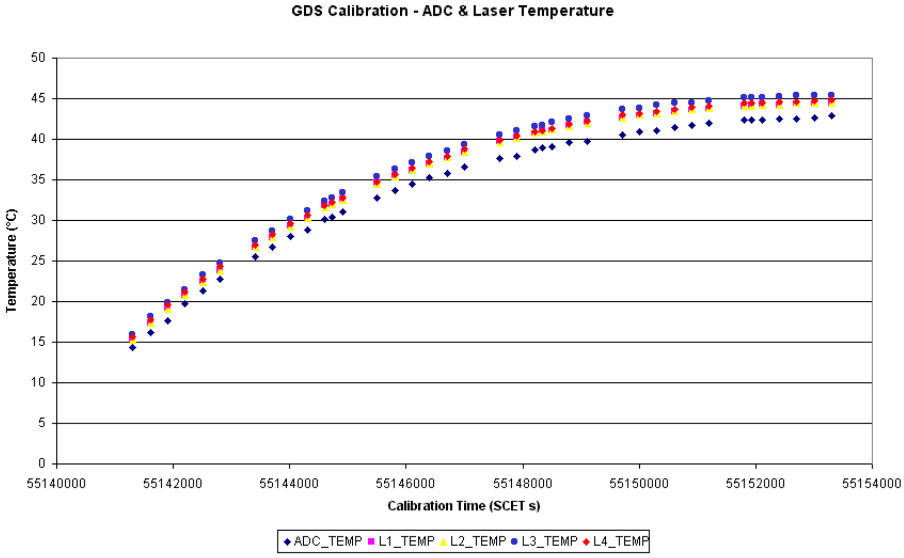

Figure 91 GDS Calibration - ADC temperature & Lasers Light Monitor

Figure 91 and Figure 92 show the light monitors and the temperatures of the four lasers at the time of the GDS calibration. The behaviour is as expected (i.e., the laser light decreases when temperature increases).

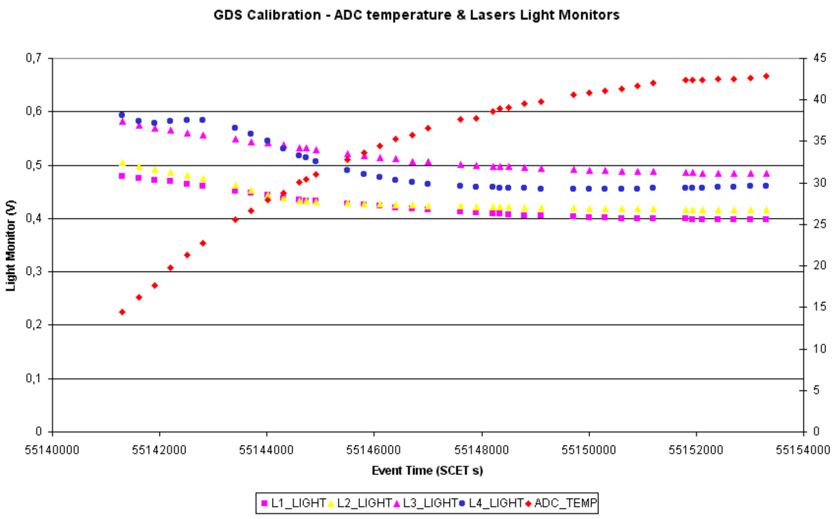

Figure 92 GDS Calibration – ADC & Lasers Temperatures

Figure 94 show the amplitude of the scattered light of the Left and Right Receiver 'Ghost detections', while Figure 93 reports 'Ghost detections' wrt. the Laser temperature and the calibrations. As expected, the 'Ghost detections' happened only when the receivers were not saturated.

As we can see there were no 'Ghost detections' on Right receiver, because it resulted saturated from the beginning until the end of the test.

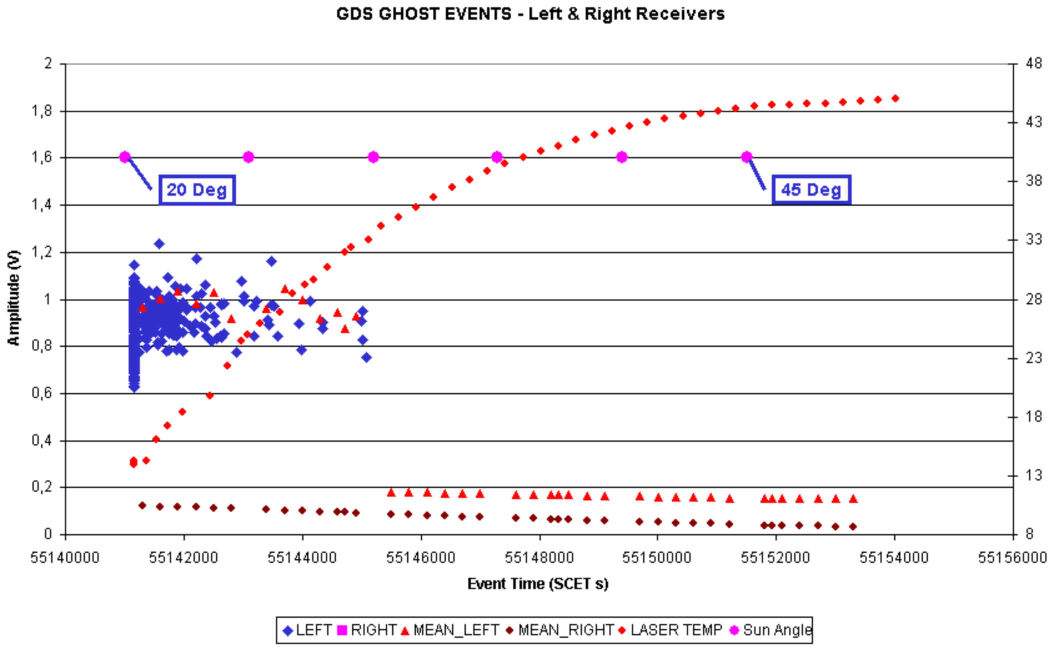

Figure 93 'Ghost detections', Sun direction & GDS Calibrations on Right and Left receivers

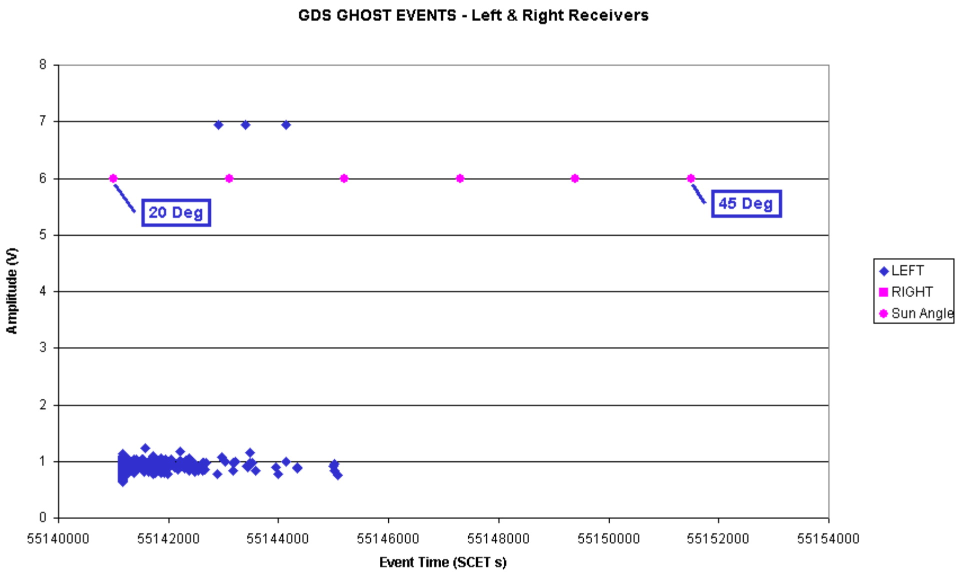

Figure 94 Amplitude of 'ghost detections' on Left and Right receivers

Concerning the Ghost detections on the Left receiver (when it was not saturated) two 'detection' types can be distinguished (as in the previous tests):

- The first type in which the detections amplitude is of the order of detection threshold (1.0 V).

- The second type, in which the detection amplitude on the Left receiver is well above the detection threshold or in saturation (6.9375 V). These detections have occurred as in the previous tests and seem not correlated to any specific GIADA internal events (calibration, temperature or relay on-off switching as shown in the).

Table 6, Figure 95 and Figure 96 show the ADC Reference Voltages along the 3,5 hours of test for the sequence of IS, GDS and MBS Calibrations. The voltages are quite stable in the temperature range 13 to 43°C.

ADC REF. V0		ADC REF. V1		ADC REF. V2		ADC REF. V3	
Mean [V]	STD [V]	Mean [V]	STD [V]	Mean [V]	STD [V]	Mean [V]	STD [V]
9.7792	0.001	4.3426	0.0015	1.079	0.0013	-0.011	0.0012

Table 6. ADC Reference Voltages

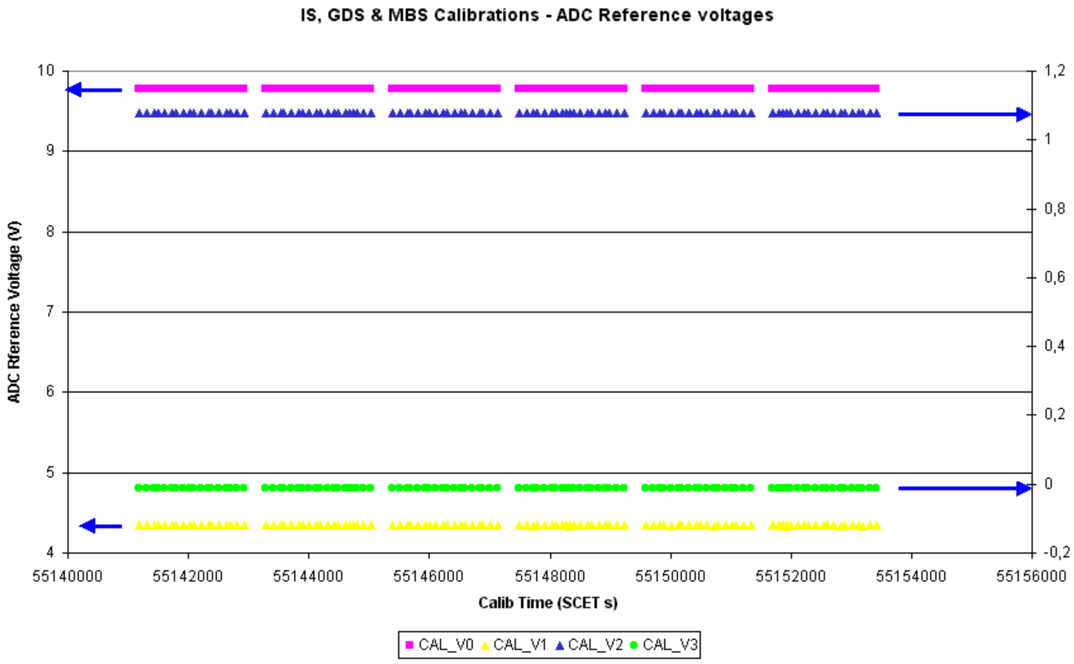

Figure 95 ADC Voltage Reference during Calibration

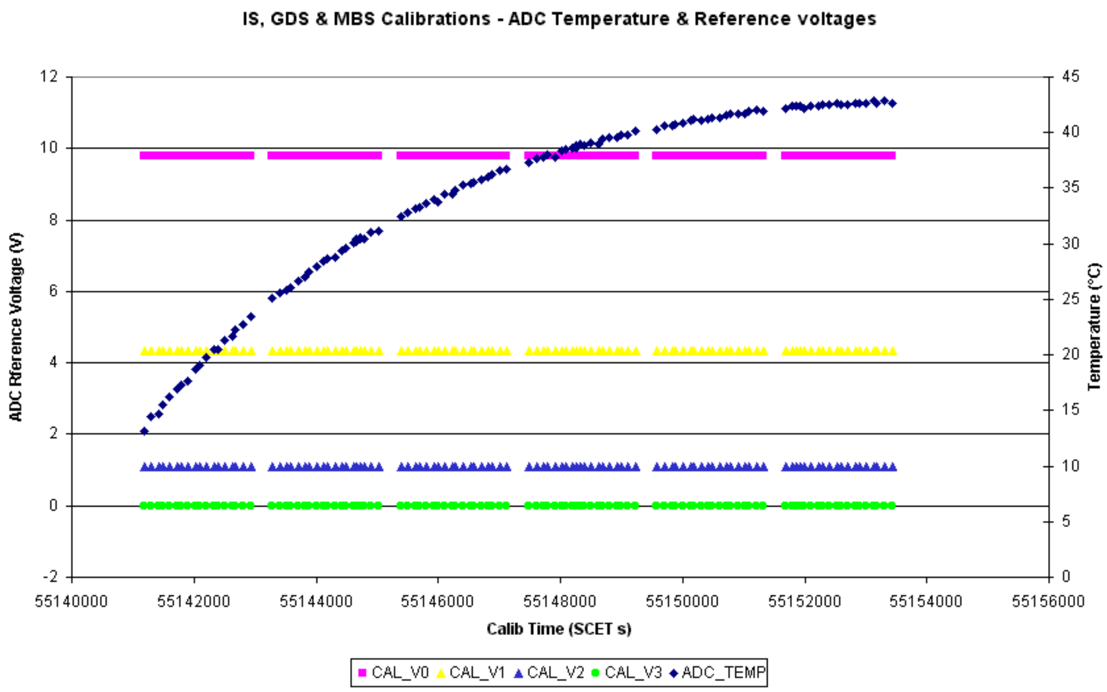

Figure 96 ADC Voltage Reference wrt ADC temperature during Calibration

5.2.3.3 MBS Sub-system normal acquisition

The MBS frequency for three of the MBS (1, 3 & 5) is confirmed to be significantly higher then in the 1st Commissioning. However, no significant deviations was observed wrt. to Pointing - I part (23 Sept. 2004), even if the MBS were heated up to 65°C due to the sun illumination.

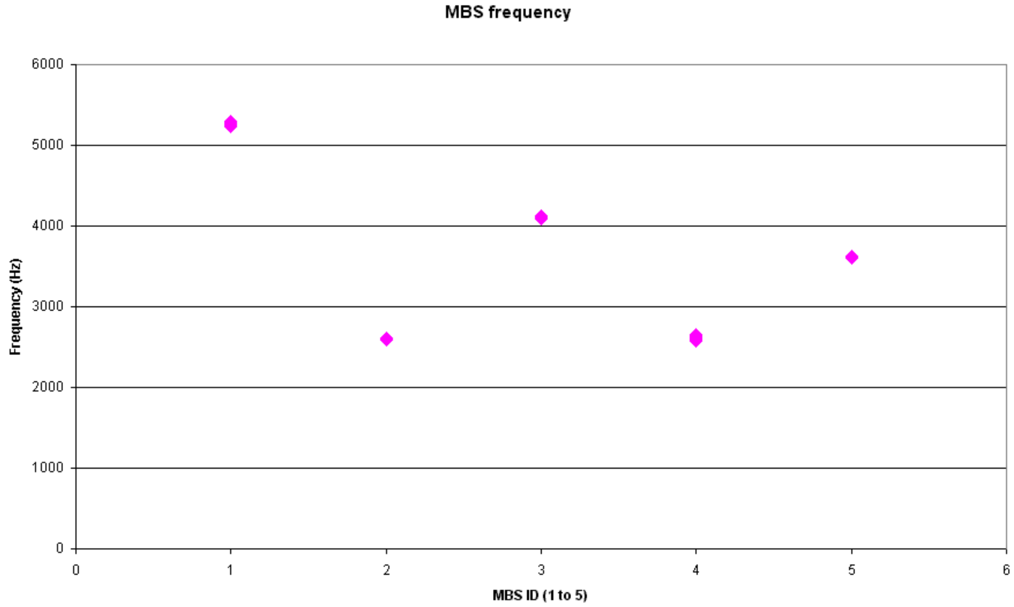

Figure 97 MBS Frequency

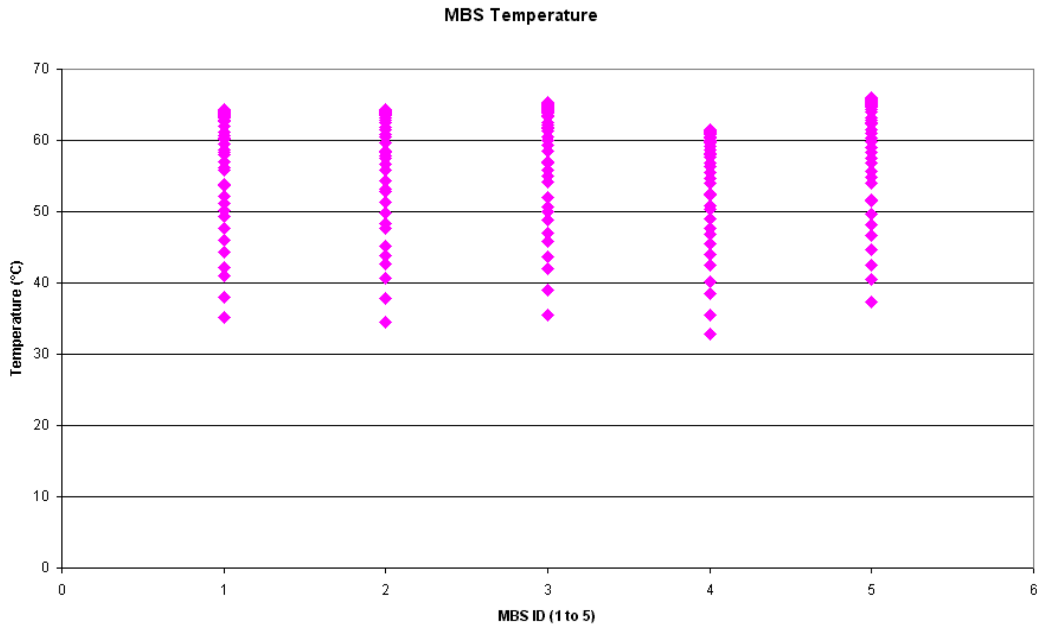

Figure 98 MBS Temperature

- The MBS1 frequency (MBS1 points to the +Xu direction, Figure 6) is about doubled, from 2700 Hz (1st Commissioning) to about 5230Hz @ 24°C (Interference part 1B) and to about 5265 Hz @ 24°C (Pointing 1st part - Section 5.1.3.3) and now to about 5226 Hz @ 35°C.
- The MBS2 frequency (MBS2 points to the +Yu direction) is slightly increased of about 100Hz, from 2625Hz (1st Commissioning), to about 2625Hz @ 20°C (Interference part 1B), to about 2619 Hz @ 22°C (Pointing 1st part - Section 5.1.3.3) and now to 2582Hz @ 37°C
- The MBS3 frequency (MBS3 points to the -Xu direction) is increased of about 1700Hz, from 2365Hz (1st Commissioning), to about 4081 Hz @ 20°C (Interference part 1B), to about 4090 Hz @ 23°C (Pointing 1st part - Section 5.1.3.3) and now to about 4085 Hz @ 35.5°C.
- The MBS4 frequency (MBS4 points to the -Yu direction) is increased of about 100Hz, from 2548Hz (1st Commissioning) to about 2546 Hz @ 18°C (Interference part 1B), to about 2549 Hz @ 20°C (Pointing 1st part - Section 5.1.3.3) and now to about 2576 Hz @ 33°C
- The MBS5 frequency (MBS5 points to the +Zu direction) is increased of about 1000Hz, from 2430Hz (1st Commissioning) to about 2687Hz @ 24.5°C (Interference part 1B), to about 3684 Hz @ 26.5°C (Pointing 1st part - Section 5.1.3.3) and now to about 3612 Hz @ 37°C.

It is confirmed that this seems possible because of MBS in-flight contamination due to out-gassing of volatile material. From the operational point of view, all MBS's work as expected and the frequency dependence vs. temperature (frequency shift due to temperature change) is consistent with the commissioning data.

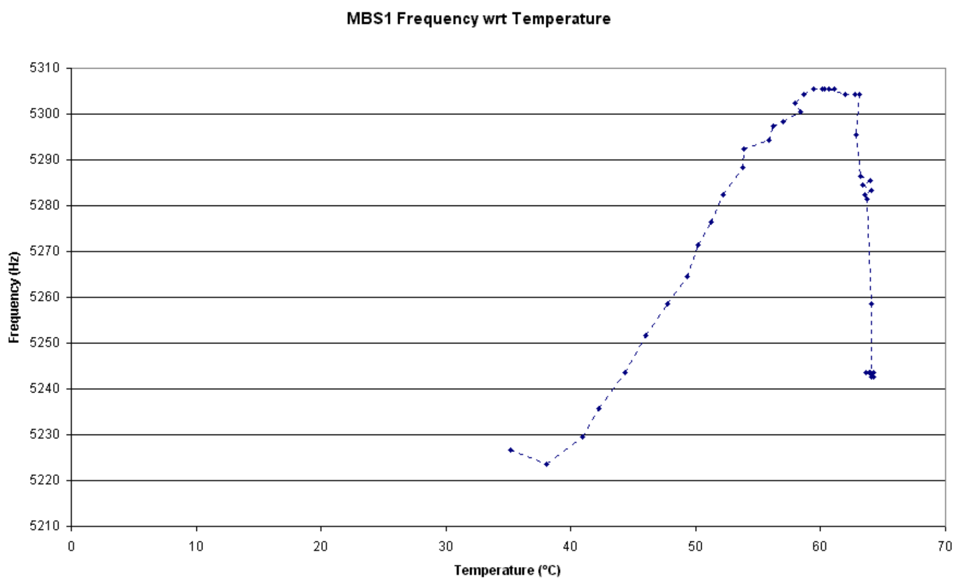

Figure 99 MBS1 Frequency wrt Temperature

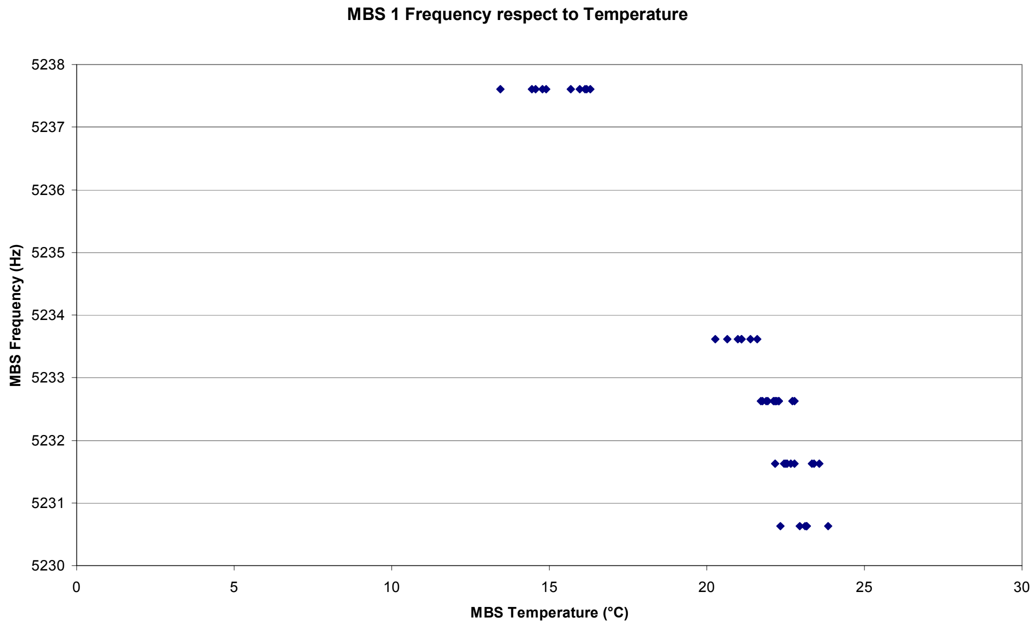

Figure 100 MBS1 Frequency wrt Temperature (Interference part 1B)

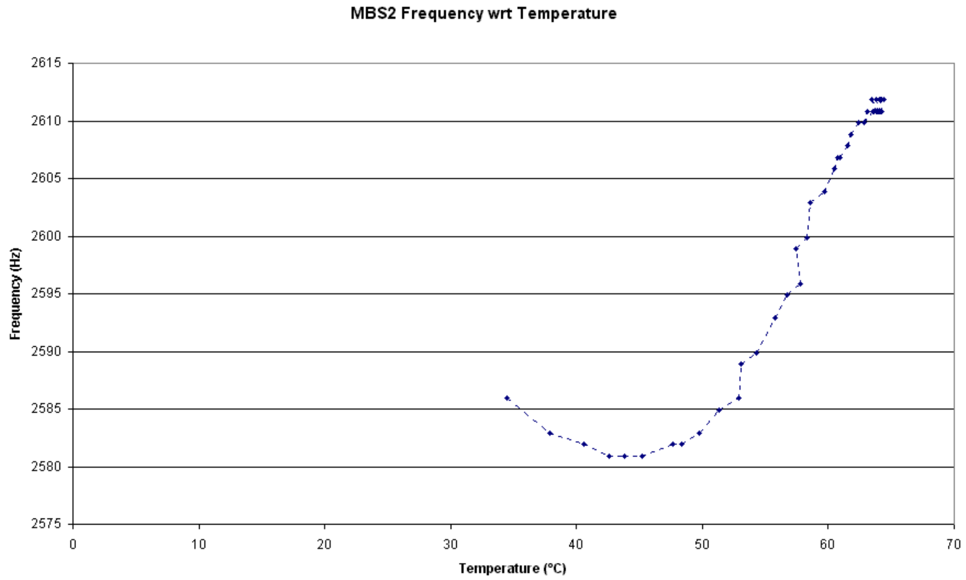

Figure 101 MBS2 Frequency wrt Temperature

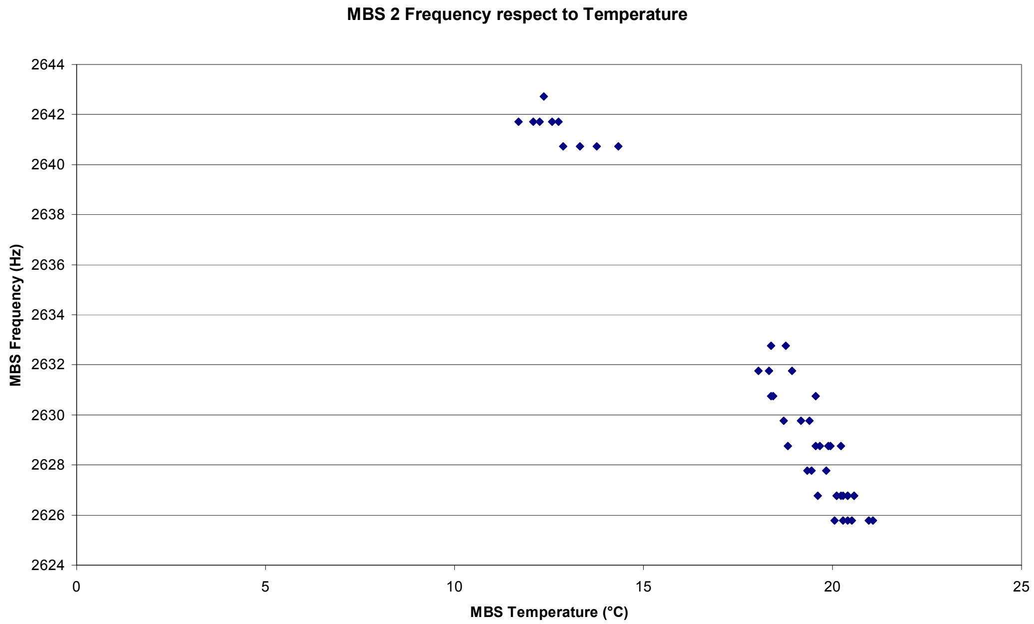

Figure 102 MBS2 Frequency wrt Temperature (Interference part 1B)

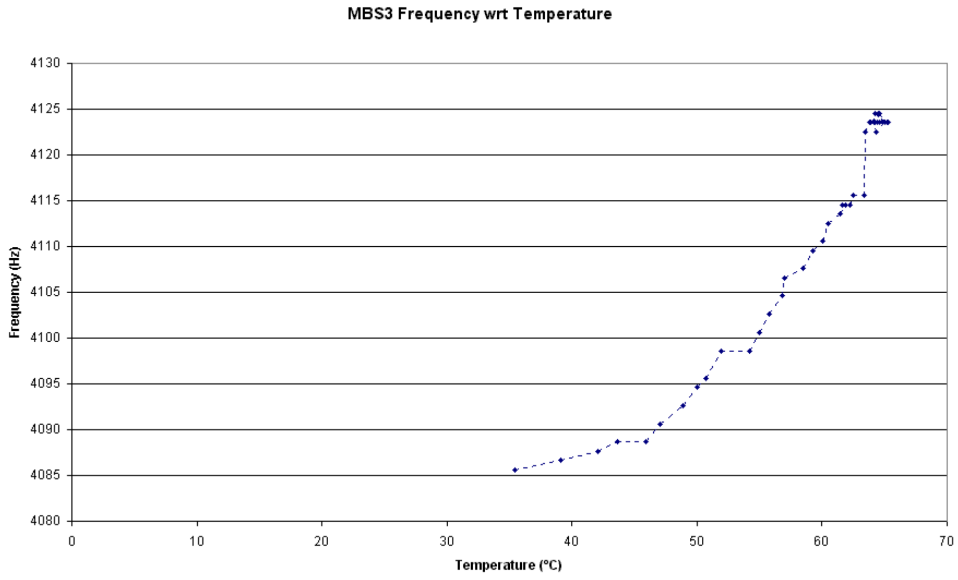

Figure 103 MBS3 Frequency wrt Temperature

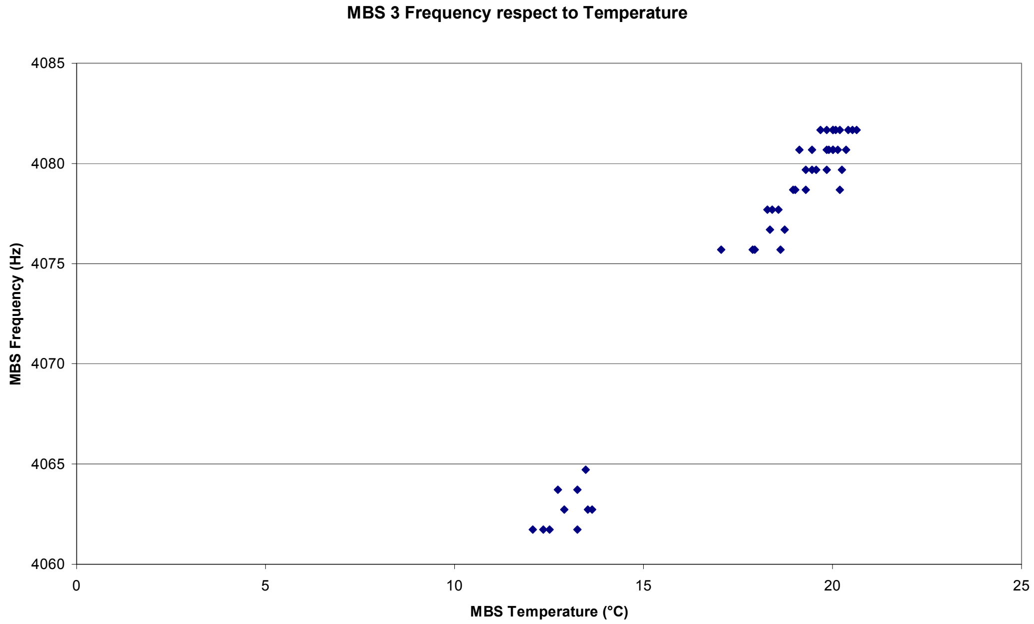

Figure 104 MBS3 Frequency wrt Temperature (Interference part 1B)

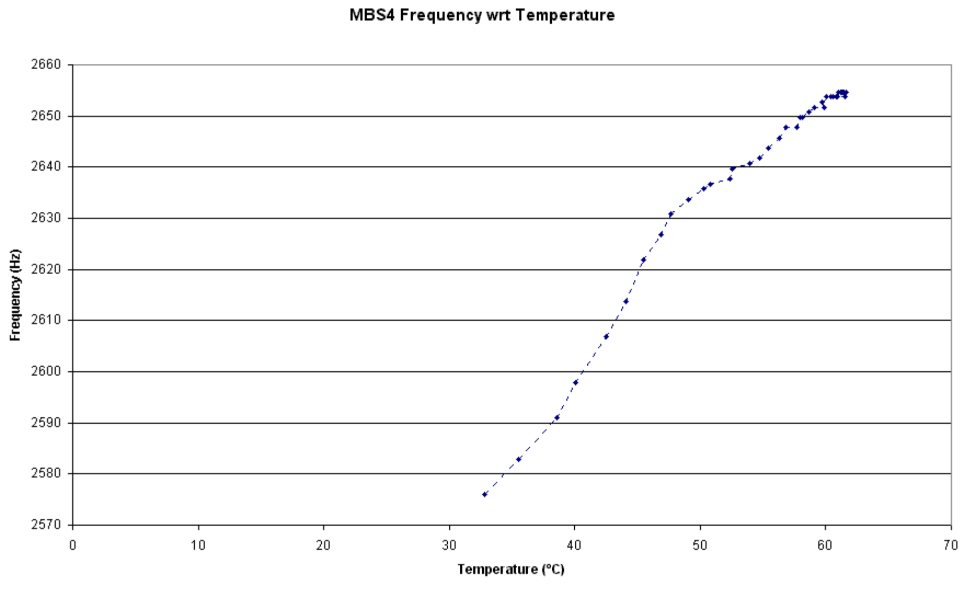

Figure 105 MBS4 Frequency wrt Temperature

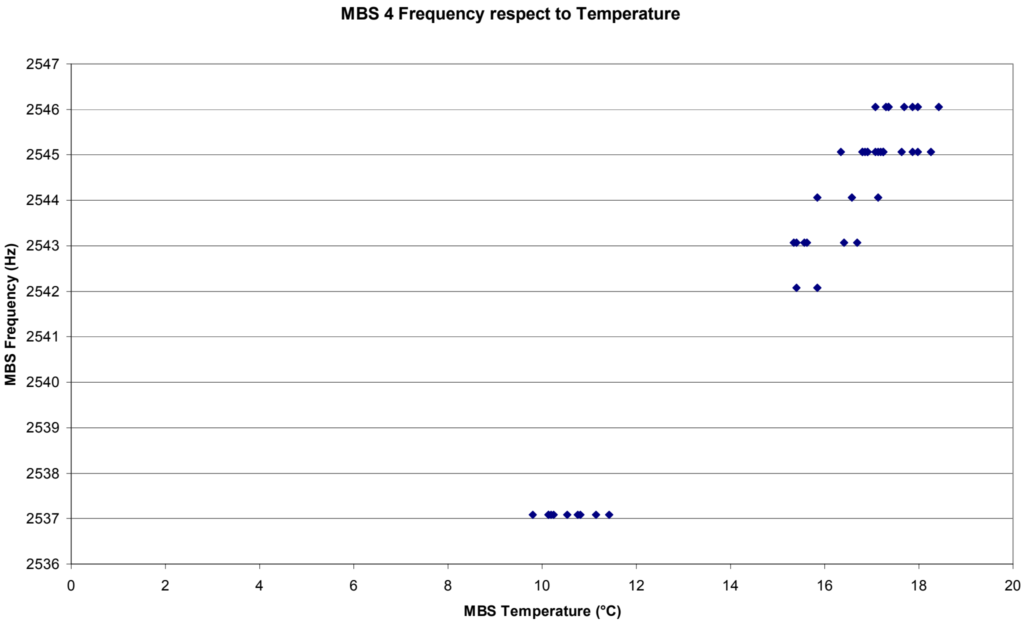

Figure 106 MBS4 Frequency wrt Temperature (Interference Part 1B)

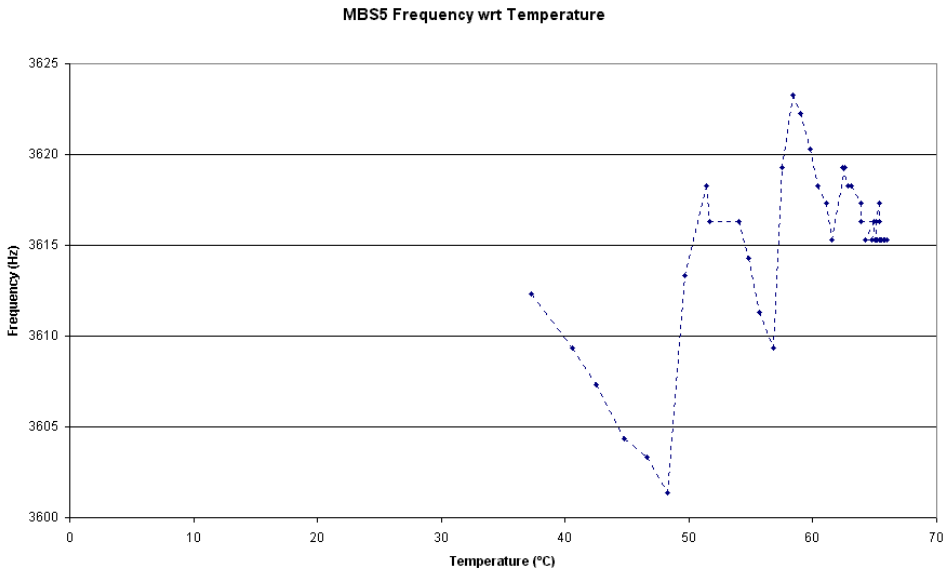

Figure 107 MBS5 Frequency wrt Temperature

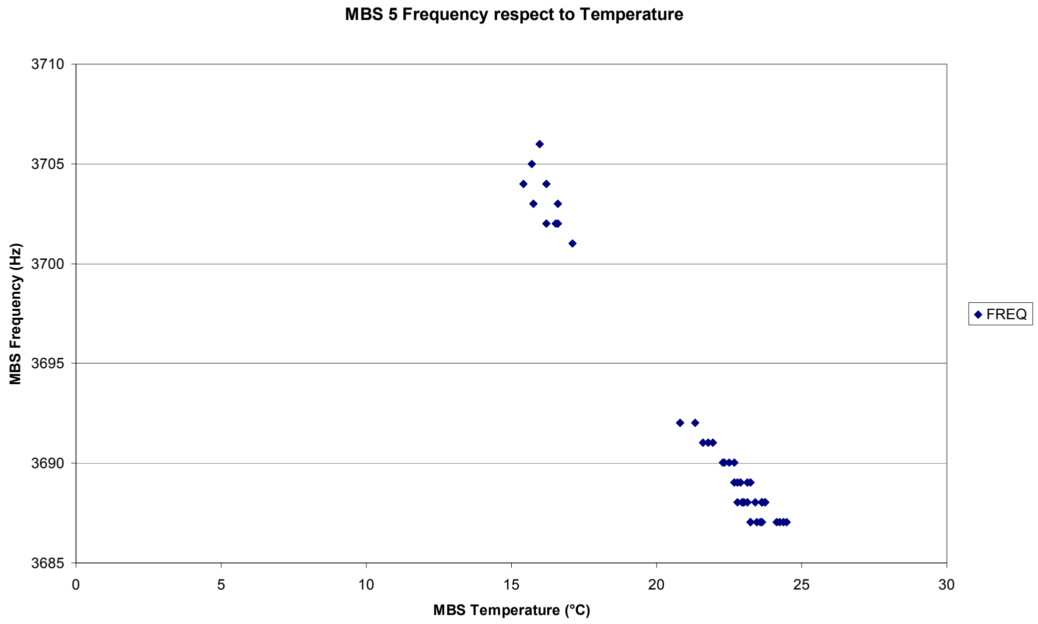

Figure 108 MBS5 Frequency wrt Temperature (Interference Part 1B)

5.2.3.4 Housekeeping signals in science packets

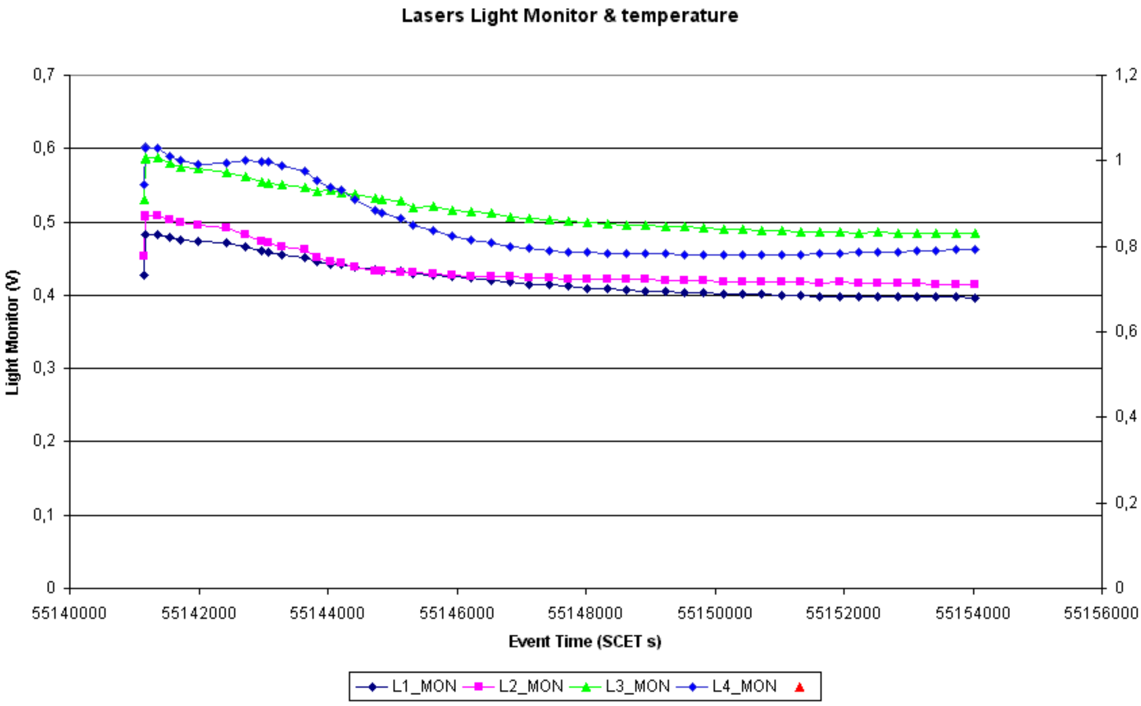

Figure 109 Laser lights monitor (Normal science packet)

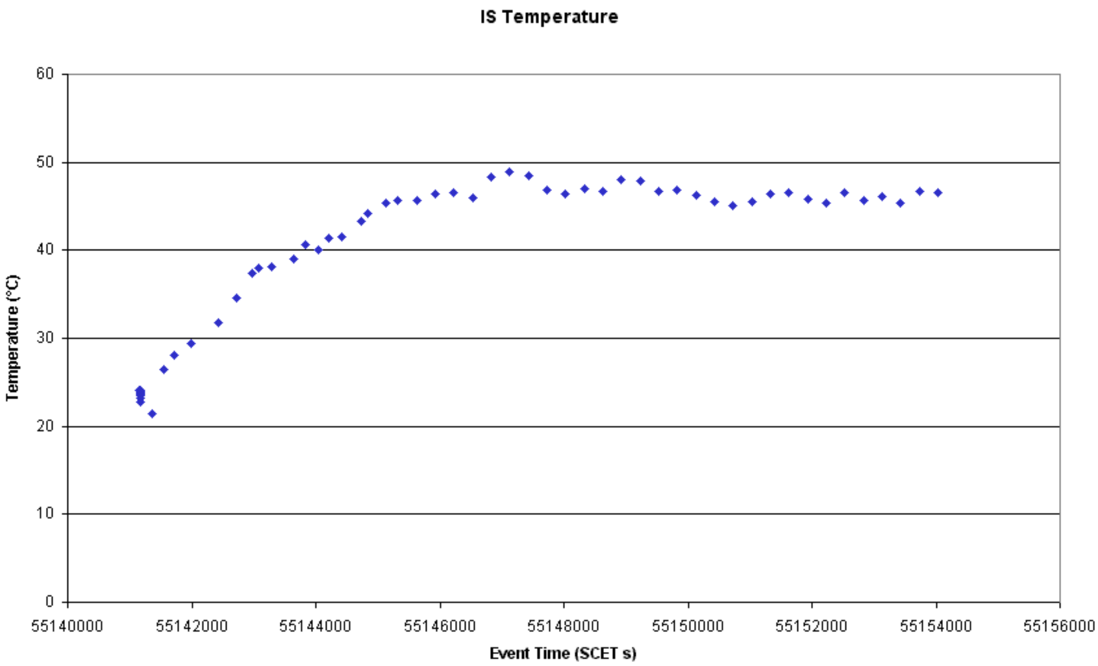

Figure 110 IS temperature (Normal science packet)

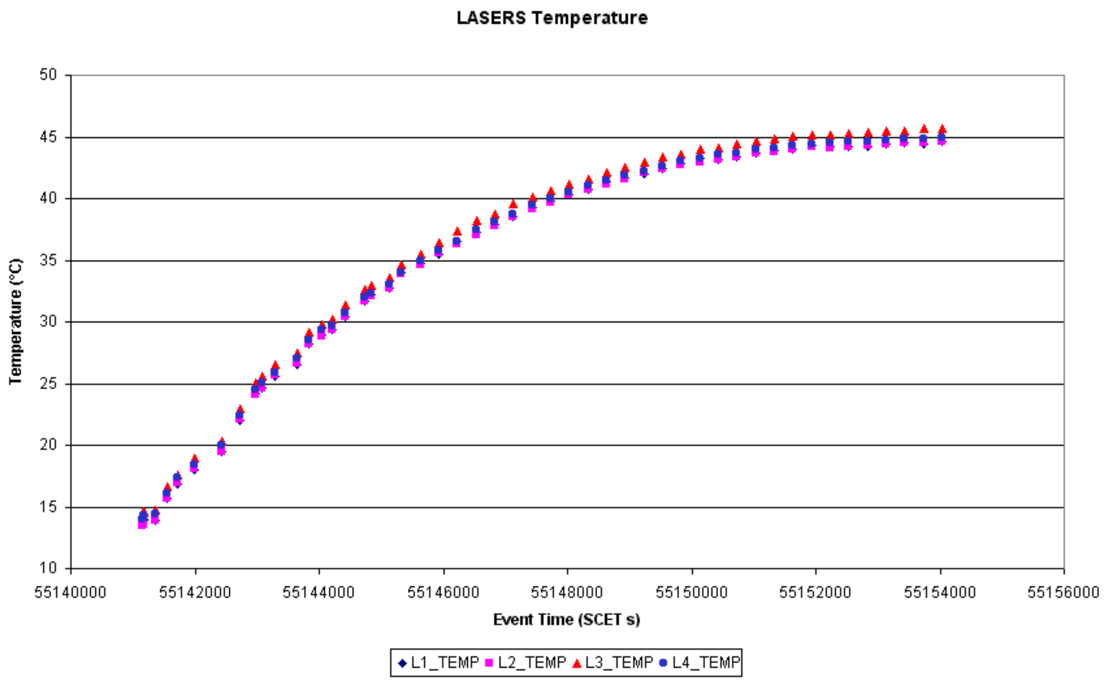

Figure 111 Lasers temperatures (Normal science packet)

6. CONCLUSION

The following conclusions can be drawn about the Pointing test - Part 1:

- The 1st GIADA switch-on was successful, except the 2nd Cover close operation; in particular it has been observed that:
  - The TM were correctly received and few missing HK, Event and Acknowledge packets were observed (one (17,2) service report at switch-on), but for the first 8400 **science packets that were lost because the SSMM allocated for GIADA** (1 Mbytes) **was saturated**.
  - The internal (Impact Sensor, Laser and Power Supply) and external (Frangibolt and MBS) temperatures were in the nominal range, as well as the current consumption during all the phases of the test. They increased when the sun angle raised up to 45 deg wrt. the S/C Z axis.
  - The GIADA cover was correctly open and closed at the 1st attempt. The 2nd cover close operation (inside the power-off OBCP) was unsuccessful: the cover at the end resulted open, despite the close cover command. Some investigations have been done (refer to GIA-GAL-TN-525); presently the conclusion is that the electronics driver and software has worked correctly. As consequence of this un-expected behaviour, two actions were proposed (by PI and RMOC) and initiated:
    - Modify the FCP to avoid two consecutive close cover operations (the close cover command before the power-off OBCP has been removed). The modifications have been implemented since the 30th September pointing test.
    - Implement in the ESOC ground system an on-line display/control of the Cover Report and perform a real-time alarm on the status of the two reed-switches after each opening and closing operations (refer to GIA-GAL-TN-524 rev1, provided by PI-GA to RSOC).
  - One not-acceptance report was received before GIADA power-off, since the ‘go to Safe’ TC was sent twice (as expected in the ITL sequence); the second TC was correctly refused by GIADA.
  - The Impact sensor (IS) has produced few ‘ghost events’. The calibration responses are in line with the previous in-flight tests. It is confirmed a dependence of the output levels wrt. the IS temperature. No major effects (except the heating of the IS sensors) have been induced by the sun illumination.

- The Right receiver of the GDS has produced few 'Ghost events' even if it was not in saturation. The GDS Left receiver still produces 'ghost events', due to internal stray-light in combination with internal electronics noise. When the sun angle reached 70 deg wrt. the S/C Z axis, both Left and Right receivers saturated and no more 'ghost events' were produced. The mean value of the GDS outputs during the calibration is confirmed to depend on the temperature.
- For the MBS, **comparing the frequency acquisition during this test with those at the first commissioning, a significant increase of frequency of the MBS1, MBS3 and MBS5 is observed**, as already detected **during Interference test.**

o The 2nd GIADA Main I/F switch-on was correctly performed, however it has been observed that:

- The TM was correctly received along four hours of the test and no packets were lost (one (17,2) service report at switch-on). SSMM was not saturated, since the GDS Left threshold was increased from 0.8 to 1.2V. The GIADA cover was correctly open and closed (modification in the FCP to avoid close operation before the Power-off OBCP was correctly implemented and it worked).
- One not-acceptance report was received before GIADA power-off, since the 'go to Safe' TC was sent twice (as expected in the ITL sequence); the 2nd TC was correctly refused by GIADA.
- The internal (Impact Sensor, Laser and Power Supply) and external (Frangibolt and MBS) temperatures were in the nominal range, as well as the current consumption during all the test. They increased until sun angle was 45 when they reached almost thermal equilibrium (all internal temperatures are < 45°C, except for the PS temperature that reached 55°C).
- As expected, it is observed that the Laser light is decreasing when the temperature is increasing and is quite constant when the temperature reached the equilibrium.
- Three Dust Flux indications (i.e., greater than 0) were observed, the first one for 1 minute period after the sensor switch-on, performed by means of the internal relay (in which - as understood on ground - few IS ghost events can be observed), the last 2 (in correspondence of two 'Ghost events') are sporadic within 3,5 hours of test. The IS sensor calibration is nominal and is confirmed, as experienced during the 1st Commissioning, that the **Channel C voltage and delay time measurements are not stable** during the internal calibrations. The channel outputs during IS calibration depends on the temperature changes.

- The GDS Right receiver has produced no 'ghost events' since it was in saturation due to the sun illumination (sun angle from 20 to 45 deg wrt. the S/C Z axis). The Left receiver, due to the internal stray-light in combination with the electronics noise, produced a flood of 'GDS Ghost detection' (science events) from the start of the test (sun light was @ 20 deg wrt. the S/C Z axis). Then, the rate decreased until the sun angle became 25-30 deg. At this time (i.e. sun angle @ 30 deg wrt. the S/C Z axis) the Left receiver saturated and no more events were produced. The mean value of the GDS outputs during the calibration is confirmed to depend on the temperature.
- **The value of frequency for three of the MBS's (1, 3 & 5) is confirmed to be significantly higher then in the 1st Commissioning (April '04)**. This seems due to MBS in-flight contamination due to out-gassing of volatile material.

More in general, the following points should be considered as part of the next in-flight data analysis and recommendations for next tests:

- The GIADA internal stray-light (with or without electronics noise) is definitely higher than the detection threshold of the Left receiver. Depending on the downlink data rate, it can be possible to saturate the SSMM memory file allocated to GIADA, thus loosing important science data, if the left detection threshold is not increased to 1.1-1.2V.
- The behaviour of the MBS has changed since the 1st commissioning. It is suggested to monitor the variation of the reading frequencies with respect the temperature during the next tests and to perform **an MBS heating at the next GIADA-on opportunity.**
- Due to the stray-light induced by the sun light, GIADA operations during comet observation must take into consideration the found behaviour hereafter summarised:

	Sun Angle (deg)	
Left Receiver saturation	From 30 to 70	
Right Receiver saturation	From 20 to 70	

With sun angle from –Xu axis (Figure 6) and wrt. the S/C Z axis