GIADA FS MODEL

IN-FLIGHT COMMISSIONING

REPORT

	NAME	FUNCTION	SIGNATURE	DATE
Prepared by:	M. Cosi	GIADA Team		
Approved by:	M. GIUSTINI	GIADA PAPM		
Authorised by:	M. COSI	PM		

DOCUMENT CHANGE RECORD

ISSUE	DATE	AFFECTED PAGES	CHANGE DESCRIPTION
1	29/04/04	All	First Issue
2	10/05/04	Only pages with lateral bar	Included PI Comments

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1. SCOPE

This document reports the in-flight commissioning activities performed on GIADA experiment in the night between 3 and 4 April 2004 @ ESOC.

2. APPLICABILITY

This report is applicable to GIADA FS model on board the Rosetta S/C now flying @ about 11000Km from earth. The Rosetta S/C has been launched from Kourou on 2 March 2004. The data have been retrieved from DDS by means of the PI Workstation located @ PISA in ESOC.

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).

3. DOCUMENTS

The relevant issues shall be those in effect on the emission of this document.

3.1. APPLICABLE DOCUMENTS

The following documents form part of, or must be read in conjunction with, this specification.

AD1	ROSETTA Experiment Interface document - Part A	RO-EST-RS-3001/EID A
AD2	ROSETTA GIADA Experiment Interface document – Part B	RO-EST-RS-3009/EIDB
AD3	Flight Control Procedure	RO-ESC-PL-5000
AD4	GIADA Flight Spare User Manual	GIA-GAL-MA-007 Issue 2

3.2. REFERENCE DOCUMENTS

None

4. ABBREVIATIONS AND ACRONYMS

ADP	Acceptance Data Package
AFT	Abbreviated Functional Tests
AIV	Assembly, Integration and Verification
ALS	Alenia Spazio
BT	Bench Test
CCS	Central Checkout Equipment
EGSE	Electrical Ground Support Equipment
EMC	Electromagnetic Compatibility
ESA	European Space Agency
FFT	Full Functional Tests
GA	Galileo Avionica
GDS	Grain Detection System
GIADA	Grain Impact Analyser and Dust Accumulator
GSE	Ground Support Equipment
H/W	Hardware
HK	House Keeping
IAA	Instituto de Astrofisica de Andalucia – Granada (E)
INAF-OAC	INAF - Osservatorio Astronomico di Capodimonte – Napoli (I)
IPA	Isoprophilic Alcohol
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
NA	Not Applicable
OBCP	On Board Control Procedure
OG	Officine Galileo
PI	Principal Investigator
PM	Progress Meeting

PSU	Power Supply Unit
QM	Qualification Model
S/C	Spacecraft
S/S	GIADA Sub-system (i.e. IS or GDS or MBS)
S/W	Software
SIS	Spacecraft Interface Simulator
SPT	Specific Performance test
TBC	To Be Confirmed
TBD	To Be Defined
TC	Telecommand
TM	Telemetry
UPa	Università Parthenope – Napoli (I)

5. DESCRIPTION OF ACTIVITIES

The activity was performed in ESOC during the night between 3 and 4 April 2004, according to the commissioning plan provided by ESA/ESOC.

The GIADA team (PI, INAF-OAC, UPa, IAA, GA and ISL) located in the PISA room with the support of the ESOC people located in the RMOC room at ESOC, have started the activities @ 22:00 o'clock local.

The S/C was oriented before the beginning of the pass to the requested configuration with +X oriented towards the sun.

TM is expected to start at 20.34 UTC (so 22:34 local time), while TC is expected to start at 21.21 UTC. GIADA commissioning start is expected at 22.00 UTC, while the end of commanding is expected for 7.54 UTC of 4 April. It is foreseen that around 6.55 UTC GIADA activities shall end. A debriefing is expected to take place just after activities end.

The TM set-up foresees that Service 1, 6 and 20 will come on VC1 (Service 1 has high priority wrt. other data to down-link), while TM-HK will come in real time on VC0. Delay on data coming from VC1 (not GIADA) is expected for the first 2 hours of activity.

Commands have been sent one-by-one by hand. The plan foresees to perform all the nominal FCPs. At the end of the test, the GIADA switch ON with 6 (shorter) patches (instead of 3) shall be repeated. One-minute delay is expected (2 ways) on data transmission.

5.1. FCP LIST

The following table lists all the used FCP during the GAIDA commissioning as well as the expected duration and time start.

Procedure Number	Notes	TC time from FOP	Time from start
GIADA_FCP_001	Switch GIADA on main, patch CF with default, patch SW (one patch at a time) and dump	10’20”	0-11’
GIADA_FCP_020	Functional test: go to NORMAL, S/S off, enable TM, S/S on	30’01”	11’-41’
GIADA_FCP_060	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]	6’	41’-47’
GIADA_FCP_002	Switch GIADA on redundant, patch CF with default, patch SW (one patch at a time)	10’20”	47’-58’
GIADA_FCP_030	Dump memory CF, time to check values, Go to COVER	20’	58’-1h18’
GIADA_FCP_040	Activate FB OBCP [arm FB, activate FB] + time to check what happened	40’	1h18’-1h58’
GIADA_FCP_090	Cover opening OBCP [arm cover, open cover with heaters 5+6+4 on]	5’	1h58’-2h03’
Go to SAFE mode	Go to SAFE	-	2h03’
GIADA_FCP_020	Functional test: go to NORMAL, S/S off, enable TM, S/S on	30’01”	2h03’-2h33’
GIADA_FCP_100	Self interference test: Cal. GDSx2, Cal. ISx2, Cal MBSx2, GDS Off, Cal ISx2, Cal MBSx2, IS Off, Cal MBSx2, IS On, GDS On	1h06’40”	2h33’-3h40’
GIADA_FCP_055	MBS heating: GDS Off, IS Off, Enable Sci TM, Set MBS read=25 s, Heat MBSx5, Set MBS read=300 s	55’03”	3h40’-4h35’
Go to SAFE Mode	Go to SAFE	-	4h36’
GIADA_FCP_030	Go to COVER	30”	4h37’
GIADA_FCP_070	Close cover OBCP [arm cover, close cover with heaters on]	5’	4h42’
GIADA_FCP_060	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]	6’01”	4h48’
END of nominal commissioning plan			
TBD name	Switch on with different sequences of SW patches	?	
GIADA_FCP_060	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]	6’	
PASS END			

Table 1 GIADA Flight Control Procedure (Commissioning)

6. COMMISSIONG TEST REPORT

6.1. COMMISSIONING FIRST PART - MAIN I/F

6.1.1. ACTIVITIES LOG

The following activities have been performed in sequence

UTC	Description
3 Apr 2004 - 21:00	Beginning of activity
3 Apr 2004 - 21:48	TRP of GIADA: 17 deg
3 Apr 2004 - 22:02	Loading of 1st sequence
3 Apr 2004 - 22:03	AGDF001A: first sequence with parameter NO to previous context file - **GIADA Main line**
3 Apr 2004 - 22:04	Start GIADA ON OBCP
3 Apr 2004 - 22:05	GIADA ON
3 Apr 2004 - 22:06	1st HK received
3 Apr 2004 - 22:08	GIADA HK data checked: all OK - Go ahead with patches of CF
3 Apr 2004 - 22:10	1st memory dump received
3 Apr 2004 - 22:11	Go ahead with the other nominal patching of SW
3 Apr 2004 - 22:13	Events arrive twice on VC0 and VC1
3 Apr 2004 - 22:14	PS (Main Electronics) Temperature is 21.93 deg C
3 Apr 2004 - 22:16	Note: number of patches is F HEX, i.e. n. 4 Dumps of patches arrive as expected
3 Apr 2004 - 22:17	All dumps received - GIADA nominal
3 Apr 2004 - 22:21	Go on with GIADA Go to Normal Mode
3 Apr 2004 - 22:23	GIADA in Normal
3 Apr 2004 - 22:24	Laser ON
3 Apr 2004 - 22:24	Laser ON Medium power
3 Apr 2004 - 22:27	**IS Status 40713**
3 Apr 2004 - 22:29	No SCI data are received as SCI TM is disabled: nominal
3 Apr 2004 - 22:30	Next step: GIADA GDS switch OFF
3 Apr 2004 - 22:31	Next step: put IS off - GDS OFF received
3 Apr 2004 - 22:32	Next step: put MBS OFF + Enable SCI TM - IS OFF received

UTC	Description
3 Apr 2004 - 22:34	MBS OFF
3 Apr 2004 - 22:34	SCI TM Enabled
3 Apr 2004 - 22:34	Set MBS ON
3 Apr 2004 - 22:36	MBS ON - SCI packet received
3 Apr 2004 - 22:36	MBS cal at switch ON - the packet is received - Send IS ON
3 Apr 2004 - 22:39	IS ON - SCI TM received (IRQ not Rec. is nominal) - Go ahead with GDS ON commanding
3 Apr 2004 - 22:41	GDS ON
3 Apr 2004 - 22:42	Laser ON - SCI TM packets receiving
3 Apr 2004 - 22:42	Of course SCI TM arrives when lasers are ON
3 Apr 2004 - 22:43	Go to Safe mode
3 Apr 2004 - 22:45	GIADA in Safe
3 Apr 2004 - 22:45	Next TC is for Dump of CF
3 Apr 2004 - 22:47	Memory dump OK - GIADA switch OFF
3 Apr 2004 - 22:50	Note: the GIADA switch OFF includes also the cover close (nominal)
3 Apr 2004 - 22:52	22:51:22 GIADA is OFF - we wait for a few minutes before starting the next sequence AGDF002A

At the Start-up, the GIADA TRP resulted about 17°C. To better follow the commissioning, it has been decided to send manually each command composing the Flight Control Procedures and to wait its TM results, instead of to load and thus execute automatically each FCP. This policy has been applied to each payload.

The GIADA switch-on procedure was applied selecting the Main I/F and without the Context File stored in SSMM (being the first switch-on, no data were previously stored into SSMM). The Instrument Main I/F was successfully powered-on by means of the GIADA POWER-ON OBCP the 3rd of April 2004 @ 22:05:30.537094 (UTC time), which corresponds to a SCET Time of about 39650713 sec.

The first received TM packet was the nominal event 'EDAC Error during S/W Start and Dump', which was received with unsynchronised SCET. Then the connection test report (17,2) and the 'GIADA in Safe mode' were successfully received. This last Event was received with synchronised SCET Time. Afterwards, the first HK report was received (default HK rate is 40s).

After completion of the power-on, as expected, the first patch (regarding the Context File) was sent, as well as the other three required software patches. All have been nominally received and successfully dumped to ground via service 6,6. As result of the Context File patch, GIADA HK rate was changed to 10s rate.

The next FCP (GIADA_FCP_020) was started and GIADA entered in NORMAL mode. All the sub-systems were switched on and as expected, the Event ‘Start Switch Lasers ON OBCP’ was received. Automatically the lasers were switched-on by the OBCP. No science TM was received, being it disabled by default. After that, each sub-system was switched-off and science TM was enabled. Then one S/S at time was switched-on again in order to receive the expected Calibration packet. The first was the MBS, then IS and finally GDS and lasers. Calibration data were as expected (refer to section 6.1.3). A flood of Science TM packets was received due to the internal stray-light, being the cover is closed.

After having checked the GIADA housekeeping signals, it was decided to power-off GIADA by means of the GIADA_FCP_060 in which GIADA goes first to SAFE mode, it dumps to ground the Context File and it is switched-off by means of the relevant OBCP. The On-board procedure runs the CLOSE_COVER_OBCP (with heaters Cover and Motor Heaters Off) and then, at the end, puts again GIADA in SAFE mode, stores the Context File in the SSMM (by means of the Report Context File Service), resets the Virtual Disk and finally it switches-off the instrument. GIADA was successfully switched OFF @ 22:49:46.689370 (SCET Time).

6.1.2. HOUSEKEEPING DATA ANALYSIS

The Housekeeping data show a correct behaviour of GIADA along the first switch-on of Main I/F. The following pictures have been taken from the HK database.

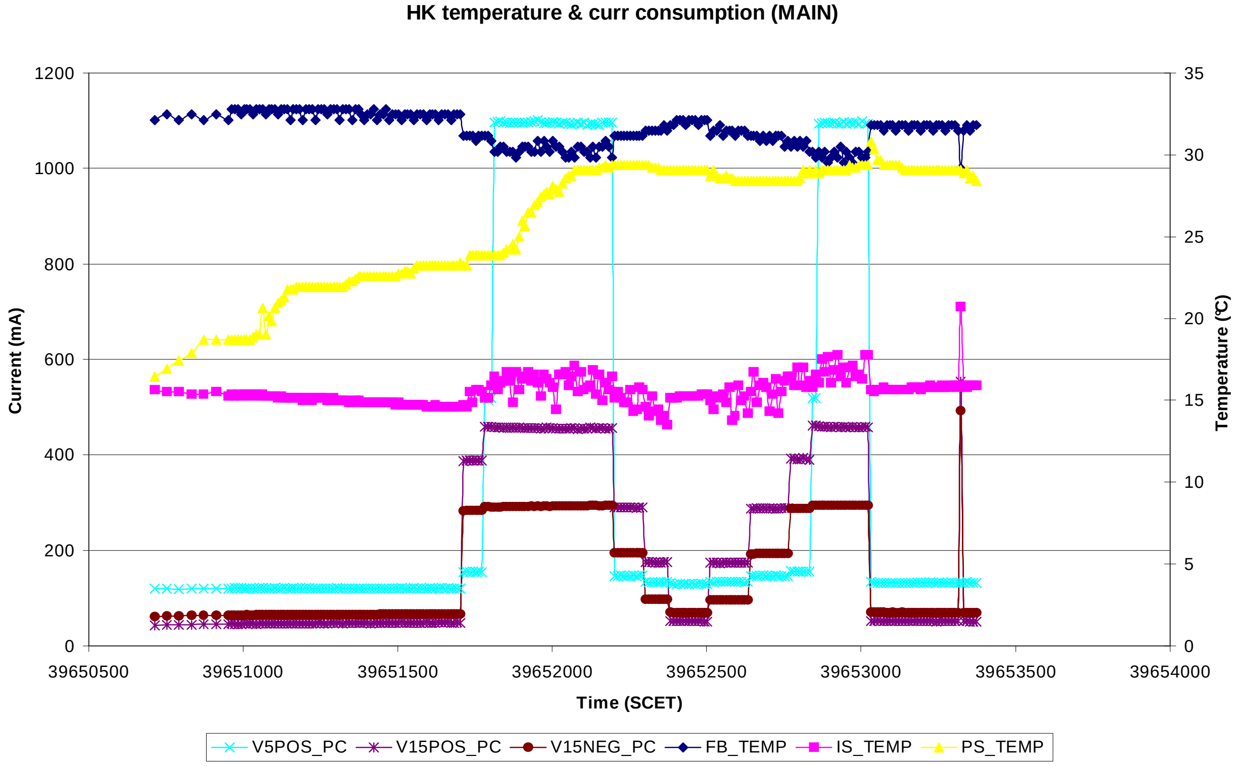

Figure 1 Frangibolt, IS and Power Supply temperatures and +5V, ±15V Currents (MAIN)

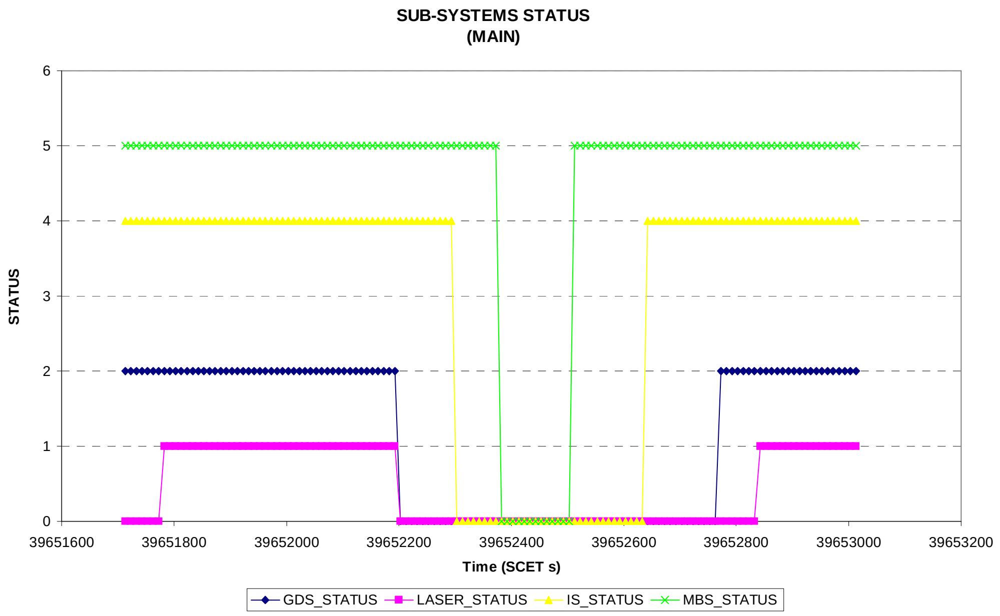

Figure 2 GIADA in Normal Mode – S/S power-on and off sequence (MAIN)

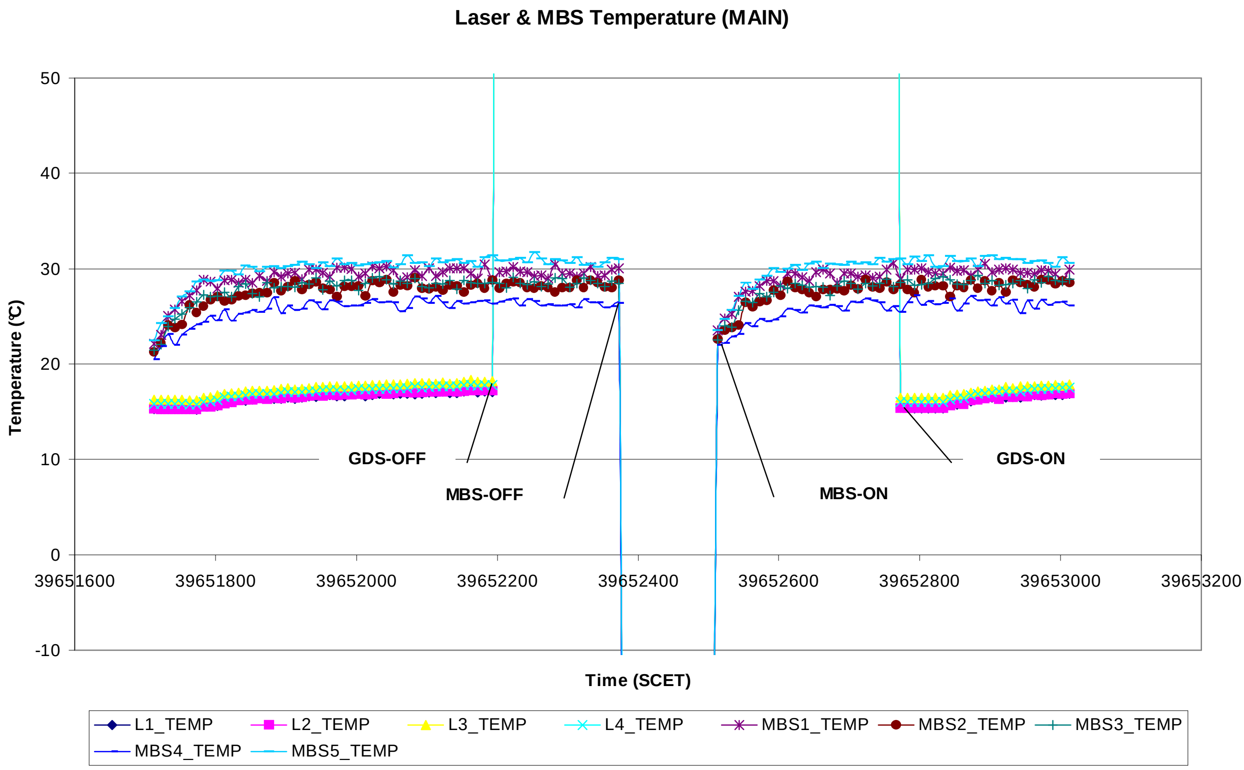

Figure 3 Laser and MBS temperatures (MAIN)

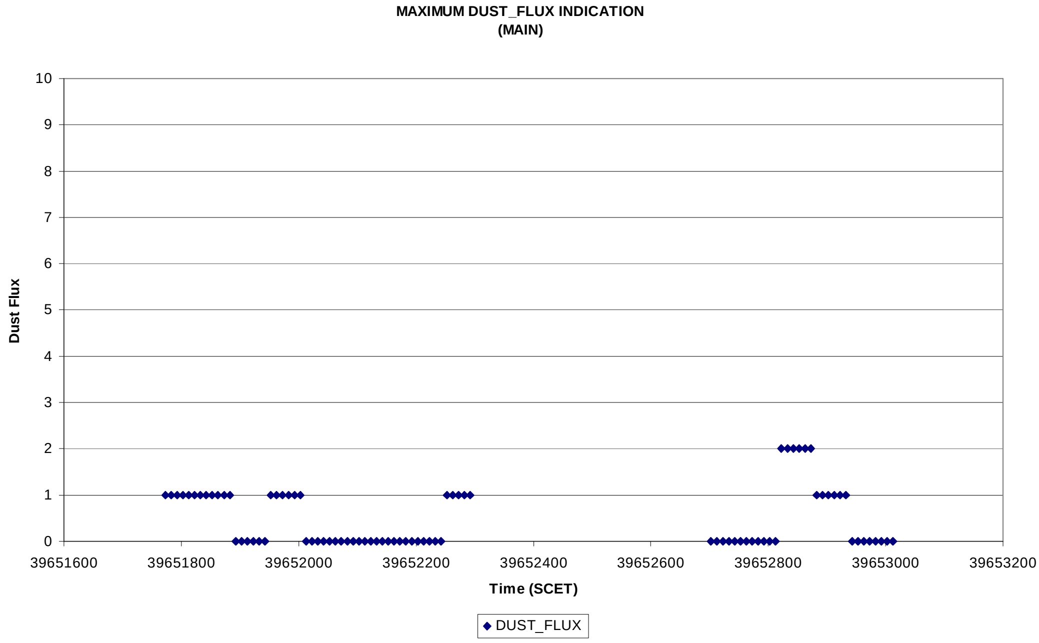

Figure 4 Dust-Flux Monitor (valid only when the IS sub-system is ON) - MAIN

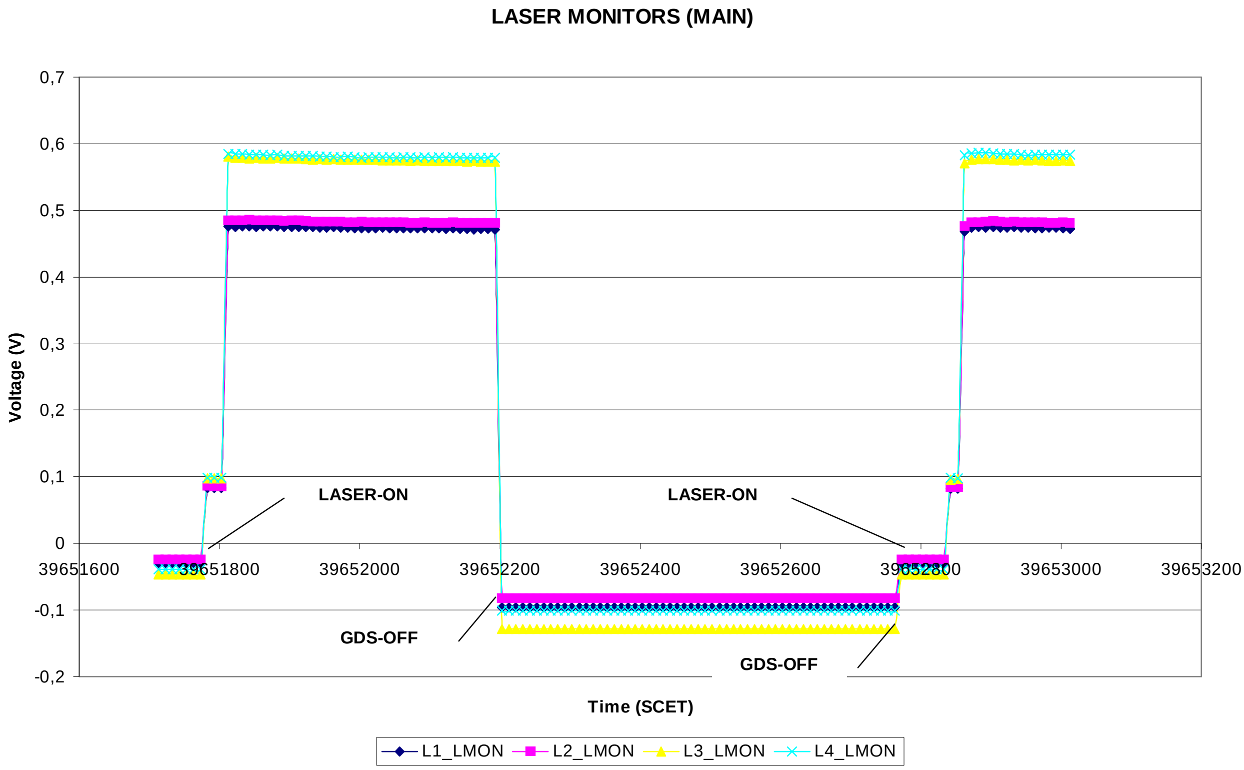

Figure 5 Laser Light Monitors (MAIN)

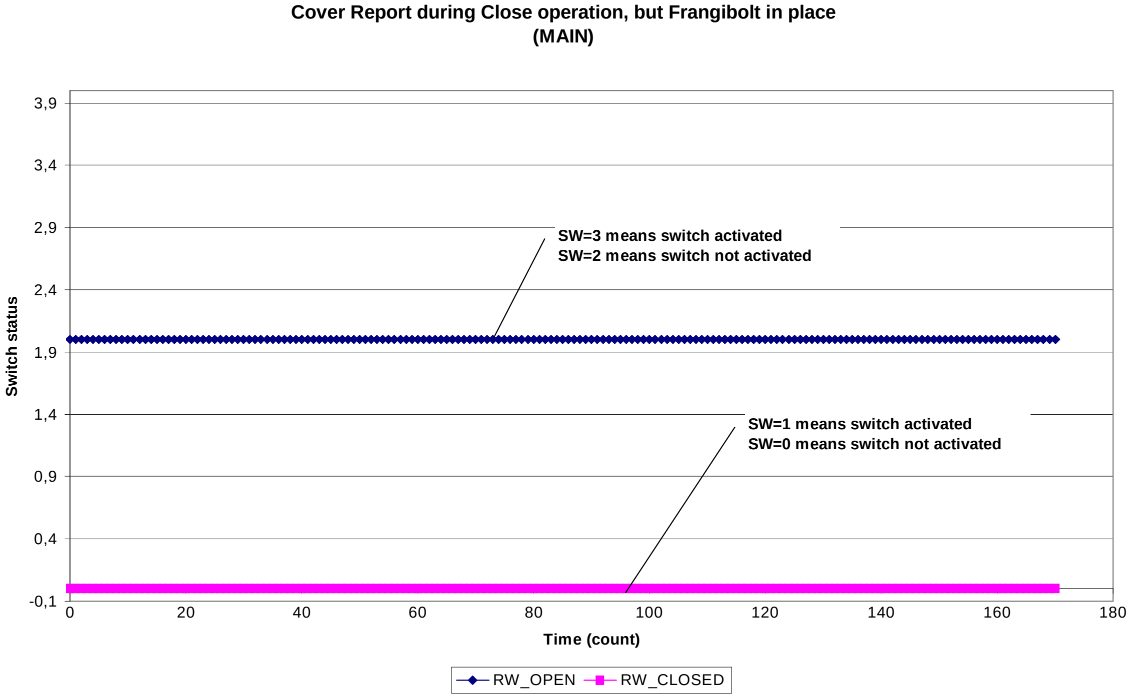

Figure 6 Cover Report (Cover close operation, but Frangibolt installed) - MAIN

As we can see in the pictures above, the GIADA experiment behaved correctly along the test, the Cover remained locked after the Rosetta launch. The current consumption and the Power Supply temperature are in the expected range. The Power Supply temperature increases from 15°C (TRP @ power-on) up to 30°C at the end of the test. The IS temperature is still around the TRP, because the cover is closed and the IS power dissipation does not produce so much heating contribution (sensor remained on for short time). The Lasers were properly switched-on and their temperatures increased from the TRP of about 10 °C (at about 30°C). The five MBS, after switch-on, show a temperature close to the TRP (about 20°C). No missing packets have been found in the TM (Figure 7).

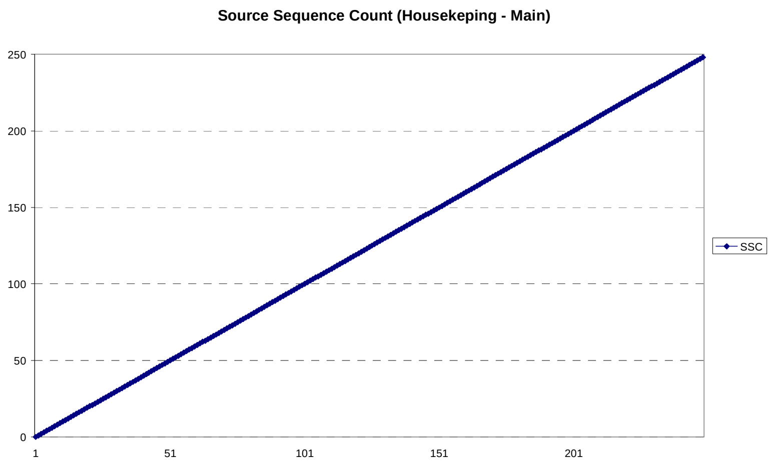

Figure 7 Housekeeping Packet reception (MAIN)

6.1.3. ENGINEERING EVALUATION ON SENSOR DATA

6.1.3.1. IS SUB-SYSTEM

The detection thresholds of each channel are set to 50mV (Context file updated via memory load command). After the 2nd IS power-on (when the Science TM is enabled), the Calibration data have been successfully received. As we can see in the following pictures, the behaviour of five channels is fully satisfactory (Channel E did not detect since the Gain is set to Low) after four Stimuli of 10V. The channel outputs measured before start each stimulus is nominally close to 0V (the five channels are below –14mV, while the standard deviation is below 60mV). Only three unexpected detections are observed during the test. They happen when the Laser relays have been switch-on (it was expected, as it has been already observed on ground). Only the 2nd and 4th stimuli are meaningful, as expected and already known after on ground calibration of the IS sensor. No major discrepancies are found in the calibration data (channel voltage and detection time).

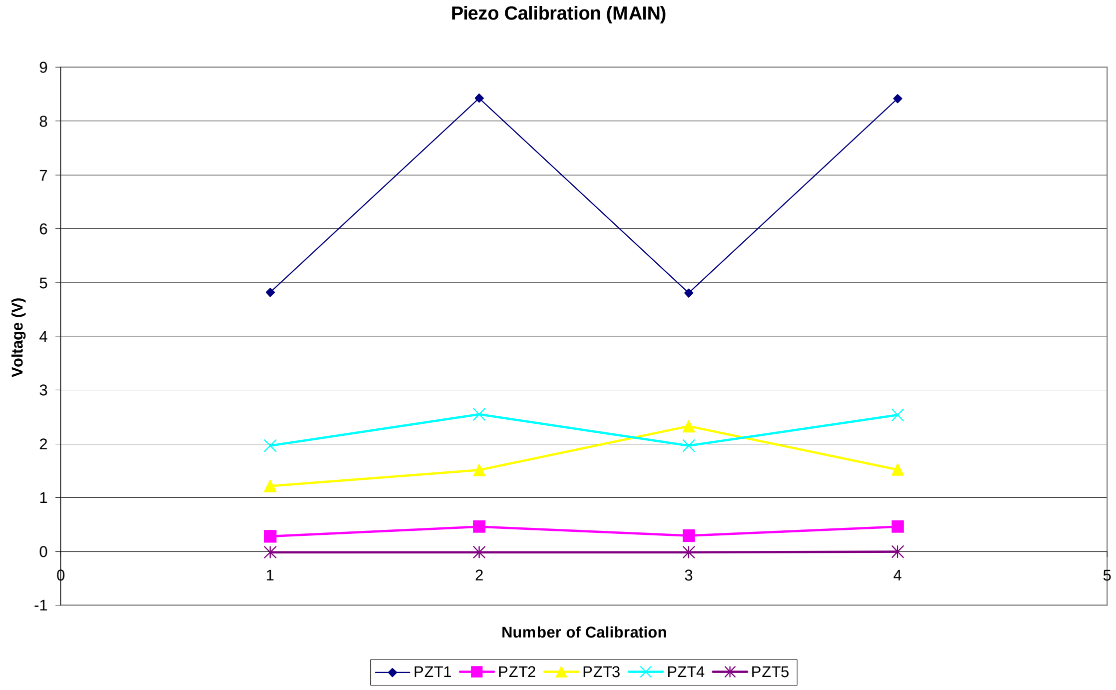

Figure 8 IS Calibration – Channel Voltage (MAIN)

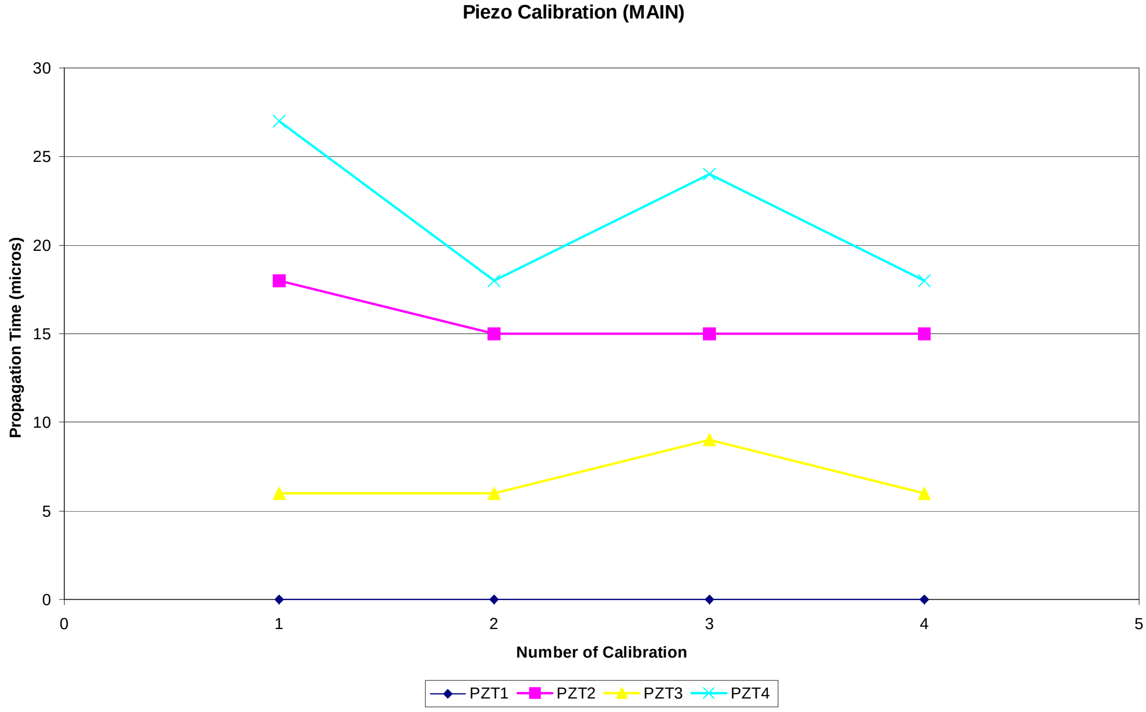

Figure 9 IS Calibration – Channel Detection Time (MAIN)

6.1.3.2. GDS SUB-SYSTEM

The detection thresholds of each channel are set to about 0.8V (Context file updated via memory load command). After the 2nd GDS power-on (when the Science TM was enabled), the Calibration data have been successfully received. The left and right channels show an average noise of 0.1÷0.2V and a standard deviation below 50mV. As soon as the Lasers have reached medium power, a flood of GDS events (especially on Left channel) have been received due to internal stray-light, as the cover is closed. As we can see in the following picture, the left channel receives a higher internal stray-light.

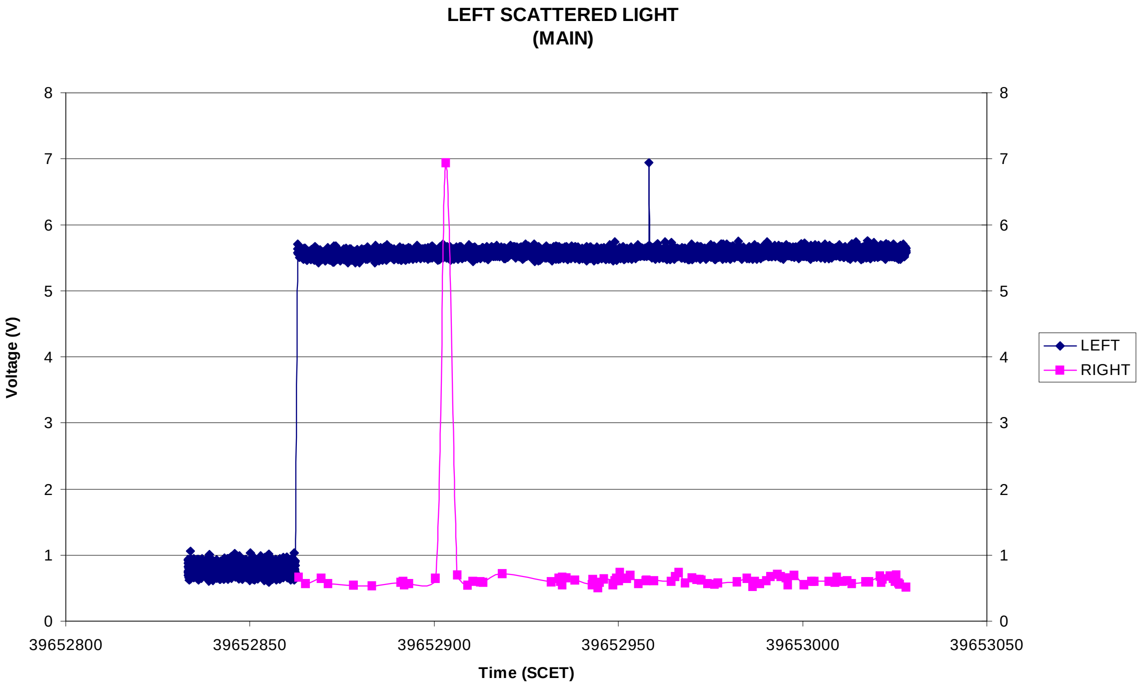

Figure 10 GDS Detection (Left and Right Receivers) - MAIN

6.1.3.3. MBS SUB-SYSTEM

After the 2nd MBS power-on (when the Science TM was enabled), the five MBS sensor data are correctly received (reading repetition time is 300s). No major differences are found in frequency reading.

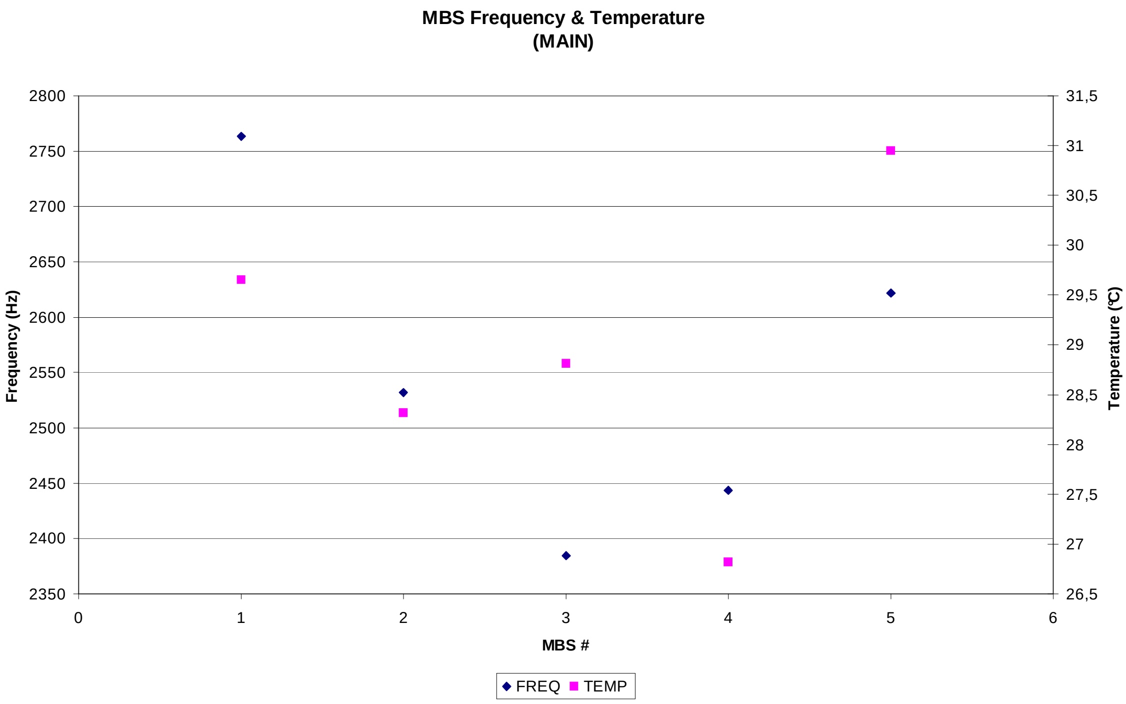

Figure 11 MBS Frequencies and Temperature (MAIN)

6.1.3.4. HOUSEKEEPING SIGNALS ON SCIENCE PACKETS

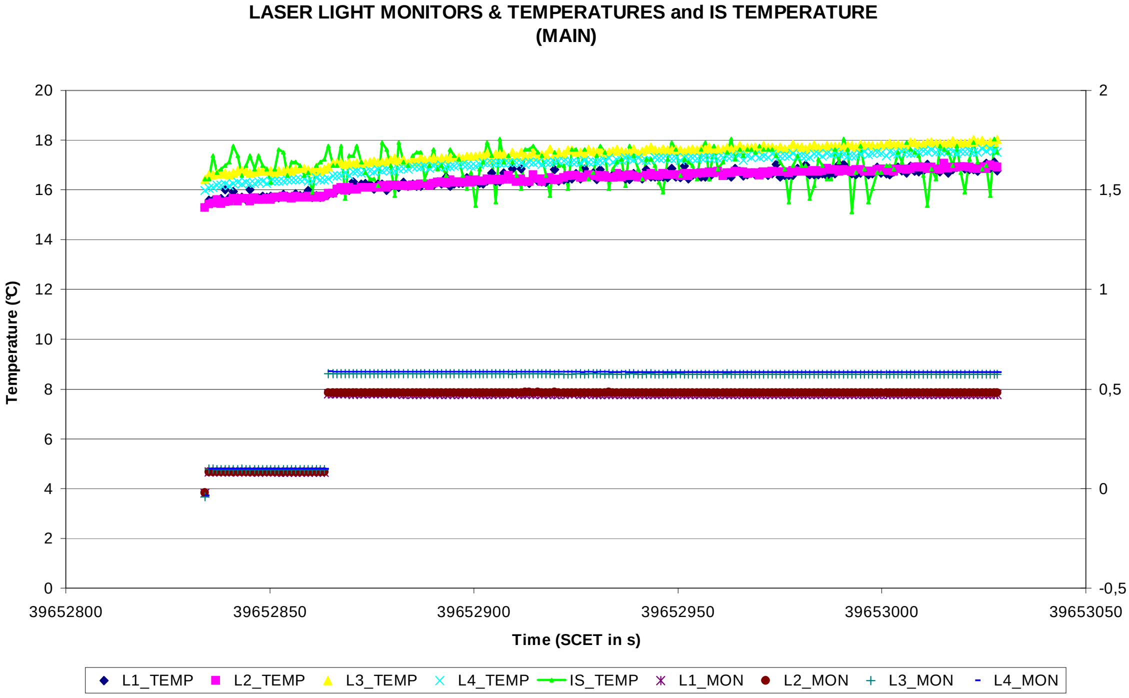

Figure 12 Laser Light Monitors and Laser & IS temperatures (MAIN)

6.2. SECOND PART - REDUNDANT

6.2.1. ACTIVITIES LOG

The following activities have been performed in sequence

UTC	Description
3 Apr 2004 - 22:57	22:57:50 we go on with sequence AGDF002A
3 Apr 2004 - 22:58	The parameter for the CF is now YES
3 Apr 2004 - 22:58	We go on the **Redundant line**
3 Apr 2004 - 22:58	TRP of GIADA is 14.5 deg C
3 Apr 2004 - 23:01	GIADA in ON on the Redundant line
3 Apr 2004 - 23:02	Start with Patching of CF
3 Apr 2004 - 23:06	Warning on Missing Patches is normal due to change of line from Main to Red
3 Apr 2004 - 23:12	All patched uploaded and dumps received
3 Apr 2004 - 23:13	Next TC is for DUMP of memory
3 Apr 2004 - 23:18	Check of dumped data: all ok
3 Apr 2004 - 23:23	Go ahead: GIADA to Cover Mode
3 Apr 2004 - 23:27	Start with GIADA activate Frangibolt TRP Temp @ 14 deg C (20 min ago)
3 Apr 2004 - 23:31	The FB temperature rises up to 111°C - current rises and back: nominal
3 Apr 2004 - 23:35	Next sequence is Cover Open
3 Apr 2004 - 23:38	Cover Open executed Now checking for Cover report
3 Apr 2004 - 23:51	**Note: the Cover Report shows that the Cover Closed passes from 1 to 0 to 1 again (nominal) while the Cover Open remains at 1 (while it should go to 0 towards the end of the open process) - We decide to repeat the Cover Open OBCP**
3 Apr 2004 - 23:54	Now the **OPEN Reed Switch goes to Closed**: this is nominal - the cover is OPEN
4 Apr 2004 - 0:05	The Reed Switch has reached the OPEN position after **100 motor steps** (+ the 170 of the first trial).
4 Apr 2004 - 0:05	Go to SAFE
4 Apr 2004 - 0:07	GIADA in Safe

UTC	Description
4 Apr 2004 - 0:12	GIADA in Normal with Laser ON
4 Apr 2004 - 0:15	Set GDS OFF
4 Apr 2004 - 0:17	GDS OFF – TC to put IS OFF
4 Apr 2004 - 0:20	MBS set OFF - SCI TM enabled - TC to put MBS ON
4 Apr 2004 - 0:21	--
4 Apr 2004 - 0:22	MBS ON at 00:22:10 - TC to put IS ON
4 Apr 2004 - 0:27	IS and GDS ON
4 Apr 2004 - 0:28	GDS is now ON at Medium power 00:28:00
4 Apr 2004 - 0:39	We start now the FCP_100
4 Apr 2004 - 0:41	The TC's are sent one-by-one
4 Apr 2004 - 1:16	All steps performed nominally
4 Apr 2004 - 1:22	Now we start the new procedure (FCP-055) to heat the MBS's
4 Apr 2004 - 1:26	We decide to send the SCI TM enable even if it is already enabled: the rejection is expected
4 Apr 2004 - 1:28	Rejected as expected
4 Apr 2004 - 1:31	Heating of the 1st MBS
4 Apr 2004 - 1:40	MBS1 heating off
4 Apr 2004 - 1:42	Heating of MBS2
4 Apr 2004 - 1:50	MBS2 Heating OFF
4 Apr 2004 - 1:53	Heating of MBS3
4 Apr 2004 - 2:06	Heating of MBS4
4 Apr 2004 - 2:14	Heating of MBS5
4 Apr 2004 - 2:25	MBS5 OFF
4 Apr 2004 - 2:30	Procedure completed
4 Apr 2004 - 2:31	Start of FCP_030: Go to Cover Mode
4 Apr 2004 - 2:33	We are in Cover Mode
4 Apr 2004 - 2:34	Next step is to close the cover
4 Apr 2004 - 2:37	Cover closed
4 Apr 2004 - 2:43	Cover Report checked: nominal
4 Apr 2004 - 2:50	Reading of IS T is stable around 7.7 °C - GIADA switch OFF started
4 Apr 2004 - 2:52	GIADA in SAFE
4 Apr 2004 - 2:57	GIADA switch OFF

UTC	Description
4 Apr 2004 - 2:59	GIADA is OFF
4 Apr 2004 - 3:01	The nominal Commissioning of GIADA is completed successfully

The GIADA switch-on procedure was applied selecting the Redundant I/F and with the option Context File already stored in SSMM (being this a 2nd switch-on and CF was stored into SSMM at the power-off of the previous test). The Instrument was successfully powered-on by means of the GIADA POWER-ON OBCP procedure the 3rd of April 2004 @ about 23:00:30.994256 (UTC time) which corresponds to a (received) SCET Time of about 39654017s. **Note that it seems the SCET is about 14s in delay with respect to the UTC time.**

The first TM packet was the ‘GIADA in Safe mode’ event, which was received with a synchronised SCET time. The two expected events (‘EDAC Error during S/W Start and Dump’ and the ‘Connection test report’) have been received unsynchronised and thus are inserted in the log file in accordance to the (ground station) reconstructed UTC time, which is less precise having the packets unsynchronised time tag. Afterwards, the first HK report was received (default HK rate is 40s). **The GIADA power-on was successfully completed**.

After completion of the power-on, as expected, the first patch (regarding the Context File) was sent as well as the other three required software patches. All them have been nominally received and successfully dumped to ground via service 6,6. As result of the Context File patch loading, GIADA HK rate changes to 10s rate.

Then GIADA entered in Cover mode, waiting for the Frangibolt activation. The internal (Power Supply and IS) and the external (Frangibolt) temperatures were checked and the go ahead for the Frangibolt activation was provided by running the relevant OBCP procedure. The ‘Cover and Frangibolt Heaters’ were first powered-on for 30s and then the Frangibolt temperature reached the limit (about 108°C) to stop the Frangibolt heating. **The Frangibolt was successfully activated.**

Now the open cover was attempted with the heaters on. The ‘Cover and Frangibolt Heaters’ were first powered-on for 30s and then the cover was open. Unlikely, the opening operation was not sufficient to reach the ‘open’ cover position **(‘Open reed switch’ shall be activated, but the HK TM does not indicate it**). Therefore, it was decided to review the Cover report (received after completion of cover operation) to check in details, which was the reed switches status during the movement. In the report, it was seen that the cover passed from the ‘Close’ position and stopped its movement before reaching the final ‘Open’ position. GIADA team decided to repeat a 2nd time the cover open operation and check again the result. After this 2nd attempt, the cover successfully reached the ‘open’ position, as it was indicated in the housekeeping telemetry.

GIADA entered in Safe mode @ about 00:04:57 (UTC) of the 4th April. The next FCP (FCP-020) was started and GIADA entered in NORMAL mode. All the sub-systems were switched on and as expected. The event ‘Start Switch Lasers ON OBCP’ was received and, automatically, the lasers were switched-on by the OBCP procedure. No science TM was received, being it disabled by default.

Then each S/S were switched-off and science TM was enabled. Finally, each S/S was switched-on separately (first the MBS then the IS and finally the GDS with Lasers) and (as expected) the relevant Calibration packet were received. At the IS power-on, the event ‘Hardware error in IS event detection circuitry. No IRQ received’ was received. This is a known problem that happens all the times @ IS power-on, when the science TM is enabled. The same event has been already seen during on-ground testing.

In order to verify the self interference of each sub-system with respect to each other, the FCP-100 it was executed, where the sub-systems calibration is repeated in different sub-system on/off conditions:

- After sub-systems switch-on, the GDS, the IS and the MBS calibrations were repeated twice.
- After GDS sub-system switch-off, the IS and the MBS calibrations were repeated again twice.
- After IS switch-off, only MBS calibration was repeated twice.

At the end, the IS and GDS sub-systems were switched-on again and calibration reports received.

As last step in the commissioning, the MBS heating (FCP-055 procedure) was executed, having before switched-off both IS and GDS sub-systems.

Detailed reporting on sensors data during the above test is done in the following sections.

After MBS heating completion, GIADA is entered in Safe mode waiting for cover closing. GIADA was commanded in Cover mode and then the cover started to close (GIADA_FCP_070). The Cover close operation started with ‘Cover and Motor Heaters’ switched-off. **The close cover operation run successfully.**

Few minutes after, it was decided to power-off GIADA by means of the nominal GIADA_FCP_060 procedure, in which GIADA goes first to SAFE mode, it dumps to ground the Context File and it is switched-off by means of the relevant OBCP.

The On-board procedure runs first the CLOSE_COVER_OBCP (with Cover and Motor Heaters Off) and then, at the end, puts again GIADA in SAFE mode, commands the storing the Context File in the SSMM (by means of the Report Context File Service), resets the Virtual Disk and finally it switches-off the instrument. The last received HK packet was time-tag with 02:58:20.510371 (UTC Time) corresponding to 39668286.511719 s (SCET Time).

6.2.2. HOUSEKEEPING DATA ANALYSIS

6.2.2.1. GENERAL

As we can see in the following pictures, the GIADA experiment behaved correctly along the test. The current consumption and the Power Supply temperature are in the expected range. In Figure 13, the first three peaks (on ±15V) appear when the internal heaters are activated during the Frangibolt and the two following cover open operations. The last three peaks (on +5V) are when the MBS heaters are switched-on during the MBS heating. The Power supply temperature increases of about 20°C from the power-on and reaches its maximum (below 38°C) when GIADA is in Normal mode with all sub-systems and Lasers switched on. The IS temperature has two different behaviours: when the IS sub-system is switched-off, the temperature decreases even below 10°C (the sensors is looking to deep space); after the IS sensor is switched-on, the temperature increases above 15°C (the sensor power dissipation heats-up the sensor it-self). The Lasers have been properly switched-on (from minimum to nominal power) and their temperatures increase up to 15°C (less than the maximum temperature that is reached during the previous test on Main Interface with the cover closed). The laser monitor signals, which are proportional to the laser light output, are little above the last measurements, which have been taken @ Kourou before launch (end of November). This is due to the temperatures, which are below the temperatures reported in the test done on-ground. They are similar with those acquired in the TV test during on ground test campaign in 2002 (refer to Figure 17). Figure 18 shows the temperatures of the five MBS. After the sub-system switch-on, the temperatures are little above the TRP (in the range 19 to 30°C). During the heating, the temperatures increase to a maximum temperature of 60°C. However, each MBS unit has different behaviour:

- The MBS1 temperature increases from 25 to 60°C (ΔT of 35°C)
- The MBS2 temperature increases from 23 to 58.5°C (ΔT of 35°C)
- The MBS3 temperature increases from 19 to 57.5°C (ΔT of 38°C)
- The MBS4 temperature increases from 25 to 54°C (ΔT of 29°C)
- The MBS5 temperature increases from 31 to 51°C (ΔT of 20°C)

During the test, no missing packets have been found in the reception of HK TM (refer to Figure 19, in which the source sequence count of HK packet is monotonically increasing from 0 to 1412). Figure 20 reports the Dust Flux number when GIADA is in Normal mode and the IS sub-system is switched-on. The dust flux is different from 0 (which is the expected value when dust is not present, as now foreseen) only for few minutes after the switch-on or off of the MBS, or GDS or Laser power relays. This behaviour is quite similar to the one found during on-ground testing (refer to the User Manual): at the time of the sub-system power relay on or off, the IS performs a 'ghost detection' and thus Dust Flux becomes different from the expected value (i.e. 0). Figure 21 shows the status of the two reed-switches from the GIADA power on until the power-off, as extracted from the HK TM packet, which are sampled with repetition time of 10s. As we can see, when GIADA was in Normal mode, the cover remained open leaving the GIADA sub-systems looking at the deep space. Taking into account the Spacecraft orientation, practically the sun did not illuminate the internal GIADA sub-systems such as GDS and IS. The five MBS baffles are illuminated from one direction (-X Axis of GIADA reference) since they are located above the GIADA balcony while the cover is open. No direct sun illumination is foreseen on the MBS field of view.

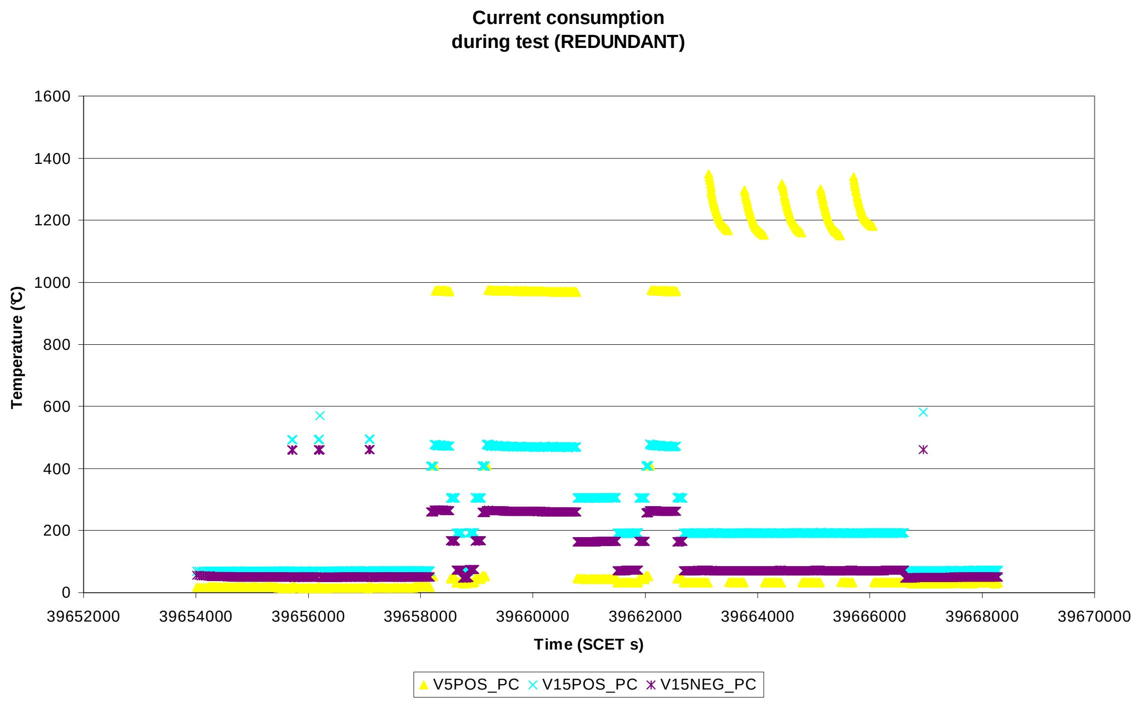

Figure 13 Current consumption on +5V, ±15V power supplies (REDUNDANT)

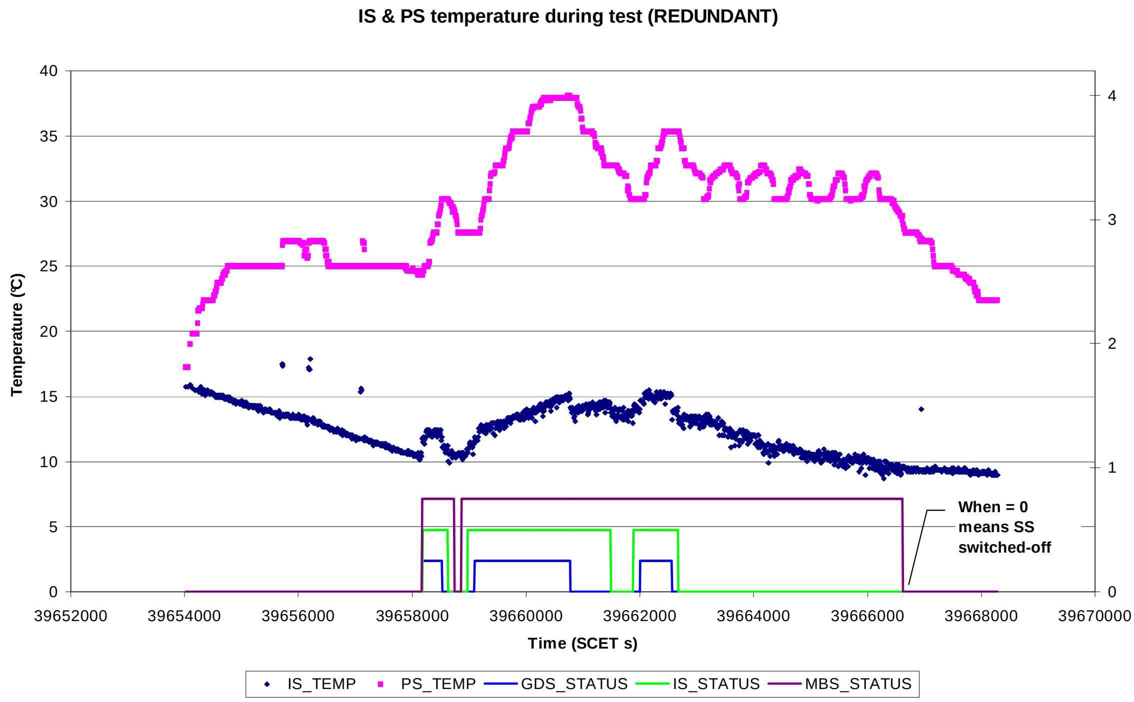

Figure 14 IS and Power Supply temperatures along the test (REDUNDANT)

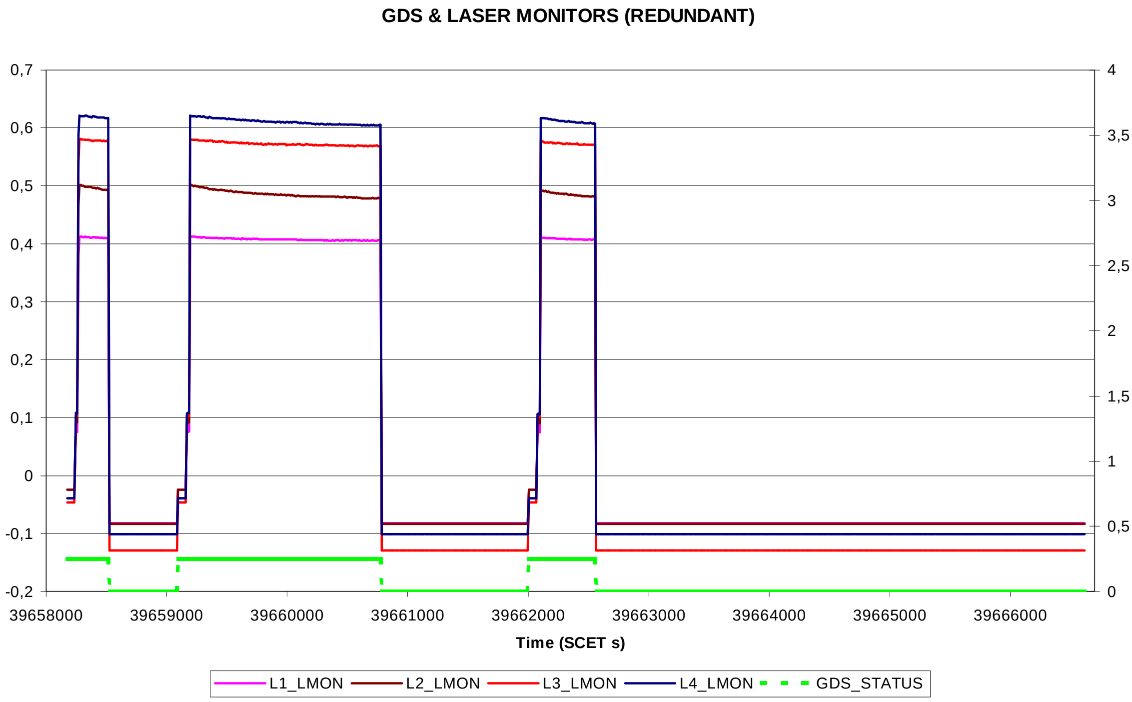

Figure 15 Laser Light Monitors (REDUNDANT)

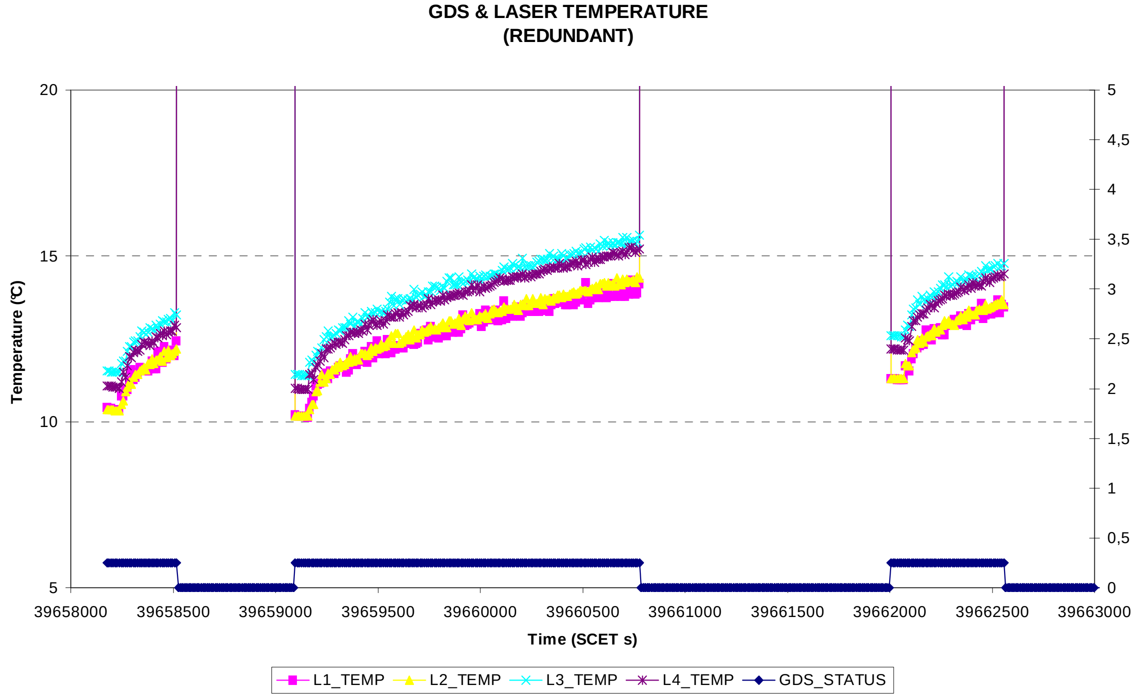

Figure 16 Lasers Temperatures (REDUNDANT)

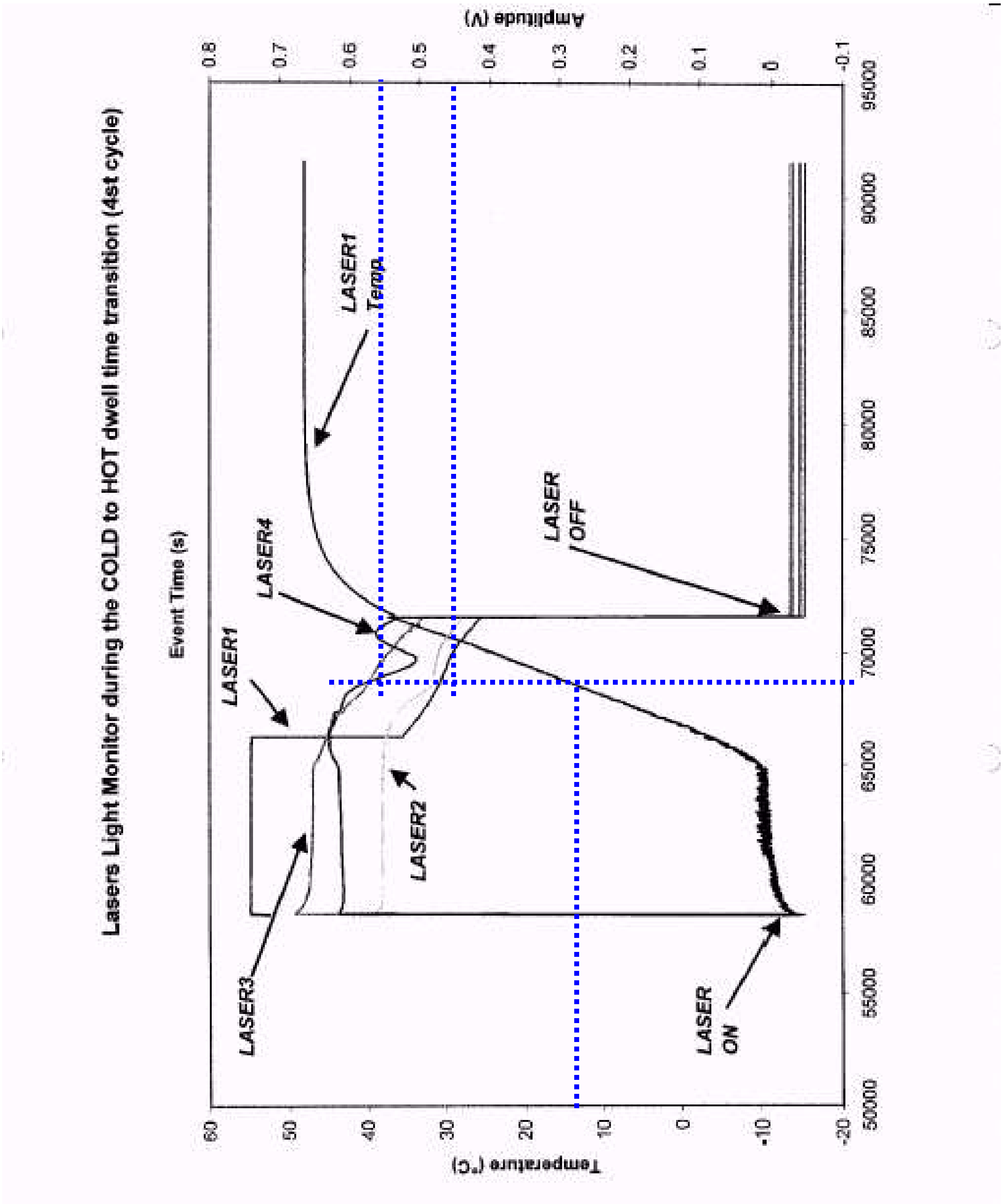

Figure 17 Laser light monitors during TV cycle (COLD to HOT transition on Main)

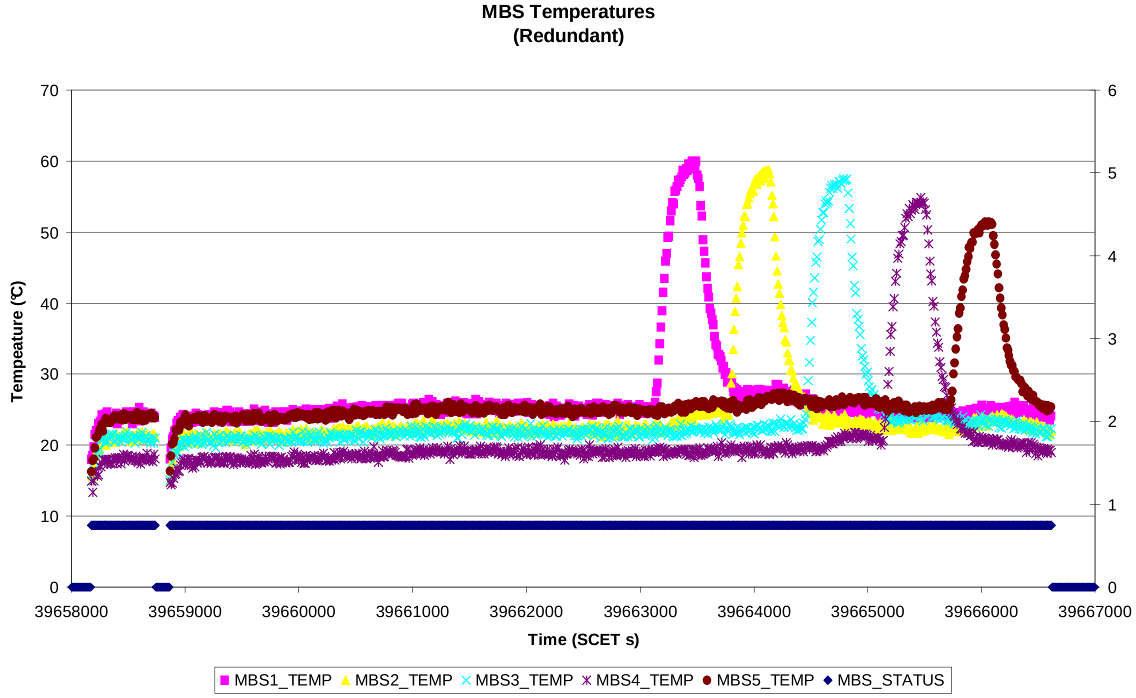

Figure 18 MBS temperatures along the test (REDUNDANT)

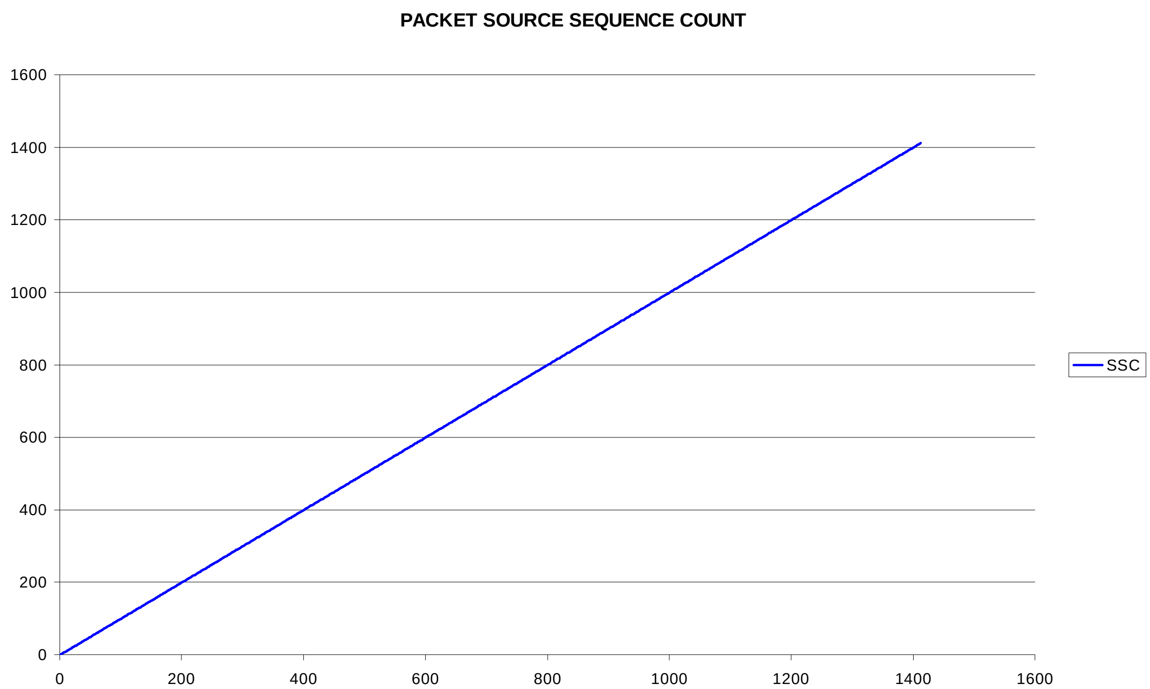

Figure 19 Source Sequence Count for HK TM packets (REDUNDANT)

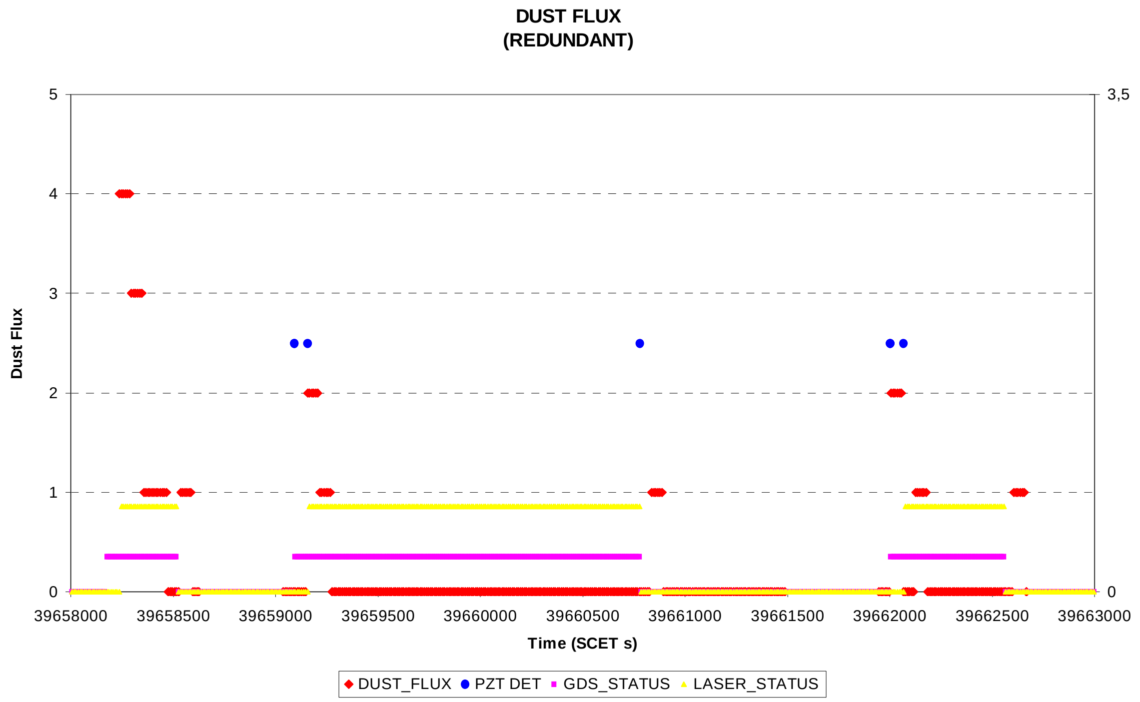

Figure 20 Dust Flux along the test (REDUNDANT)

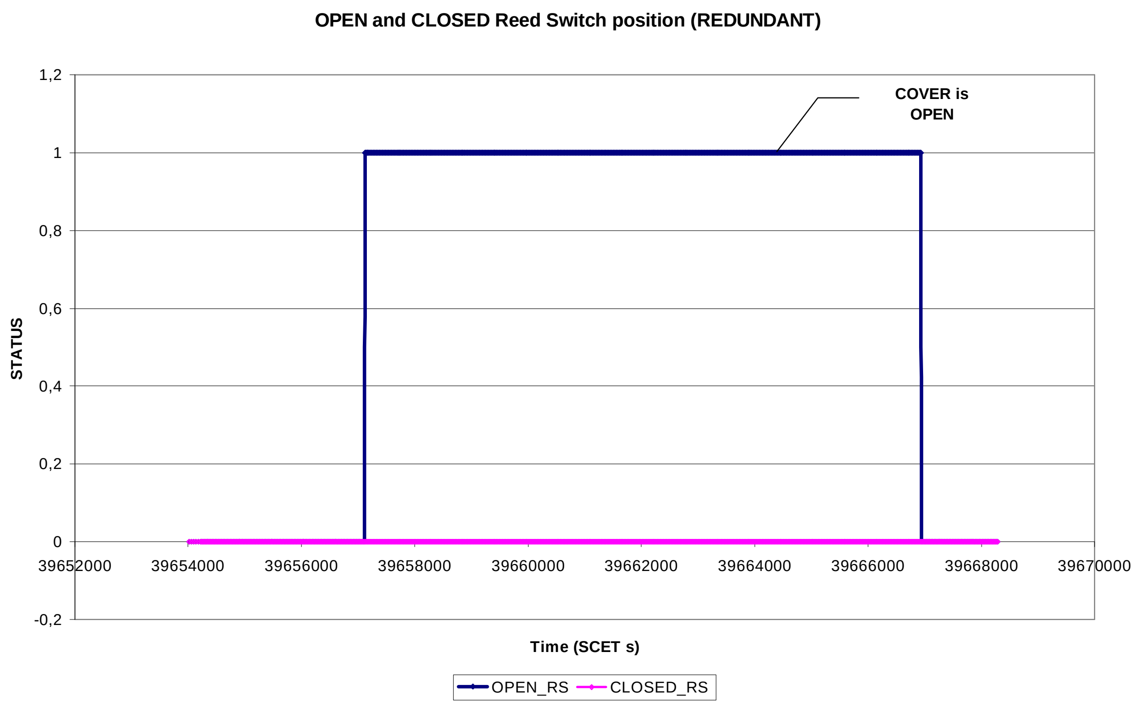

Figure 21 Status of Reed switches as extracted from Housekeeping TM (REDUNDANT)

6.2.2.2. FRANGIBOLT ACTIVATION

During the Frangibolt heating the temperature increases above 100°C, which is the temperature limit at which the Frangibolt can be activated. After that, the Frangibolt power is automatically switched-off by the on-board software and the temperature slowly decreases.

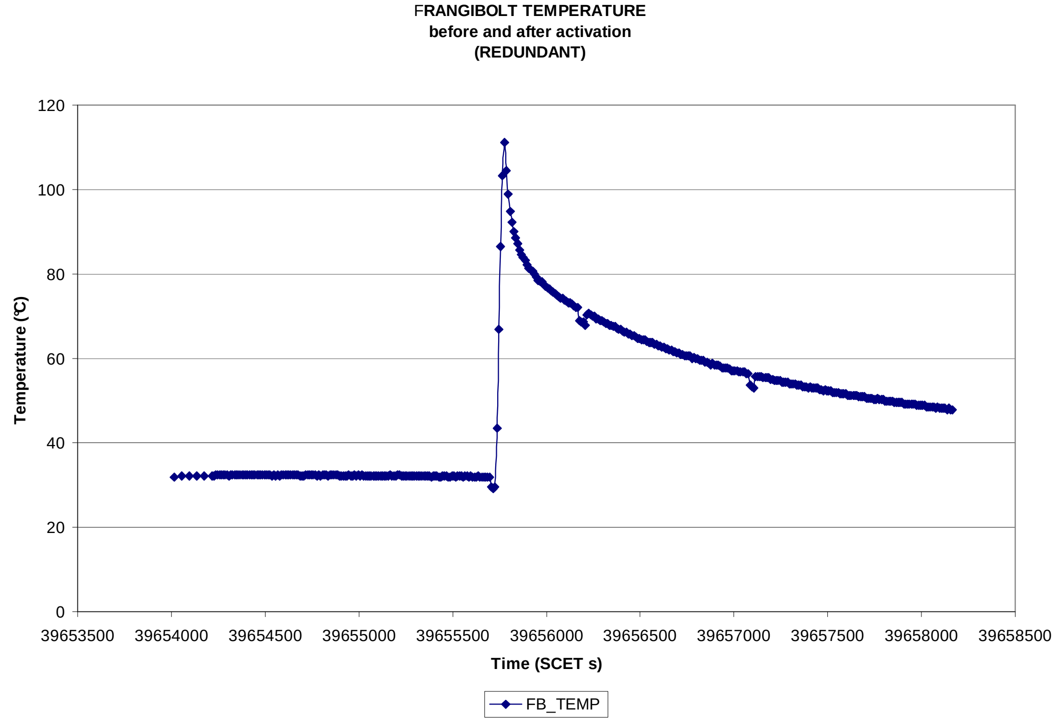

Figure 22 Frangibolt temperature during Activation (REDUNDANT)

The IS temperature is shown in Figure 23, before and after the cover was opened. The temperature decreases, being the IS sensor now radiatively coupled with the deep space.

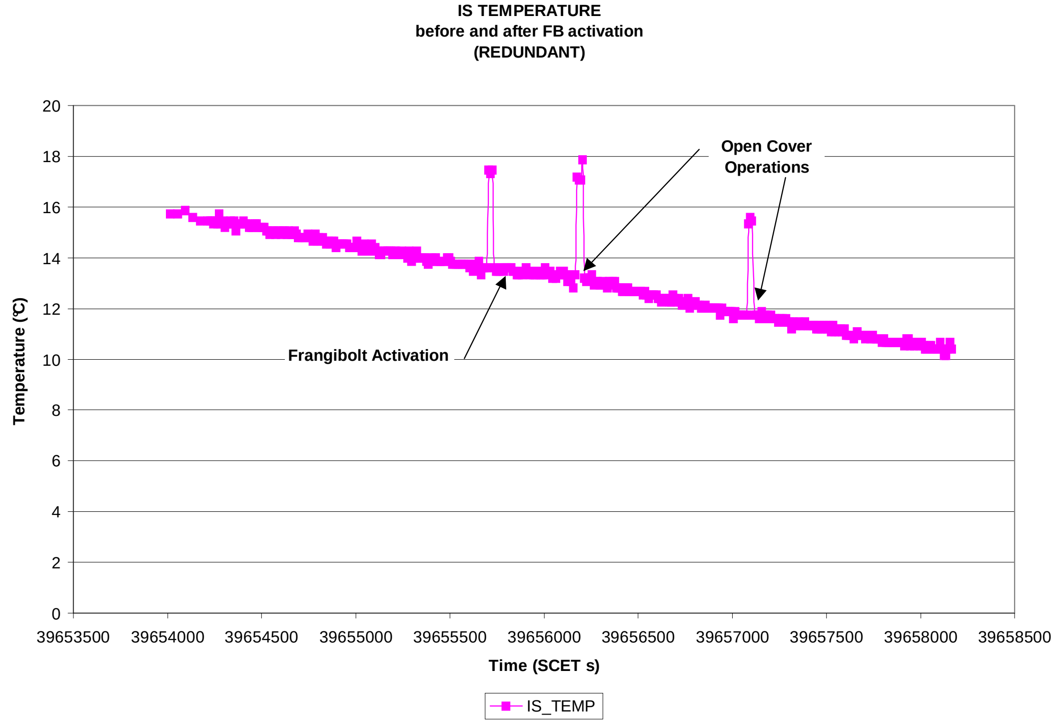

Figure 23 IS temperature before and after FB activation, but IS Off (REDUNDANT)

In the two above figures, there are three points in which the temperature suddenly jumps to a value lower or higher than expected. This is due to a known behaviour of electronics reading circuitry of the Frangibolt and IS temperature sensors when the GIADA heaters are switched-on.

6.2.2.3. COVER OPEN OPERATIONS

After the first cover open attempt, the cover resulted not completely open, as shown in the Figure 25, 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. The correct behaviour is when in the same figure it shall appear the sequence of the following conditions:

- The reed switch (named RW_CLOSE) that indicates the Cover-Close position is activated after the start of opening operation and for a short number of steps (expected value 29 steps).
- The reed switch (named RW_OPEN), which indicates the Cover-Open position, is activated after the first reed switch steps (expected number of steps is about 125) and remains permanently in this status.

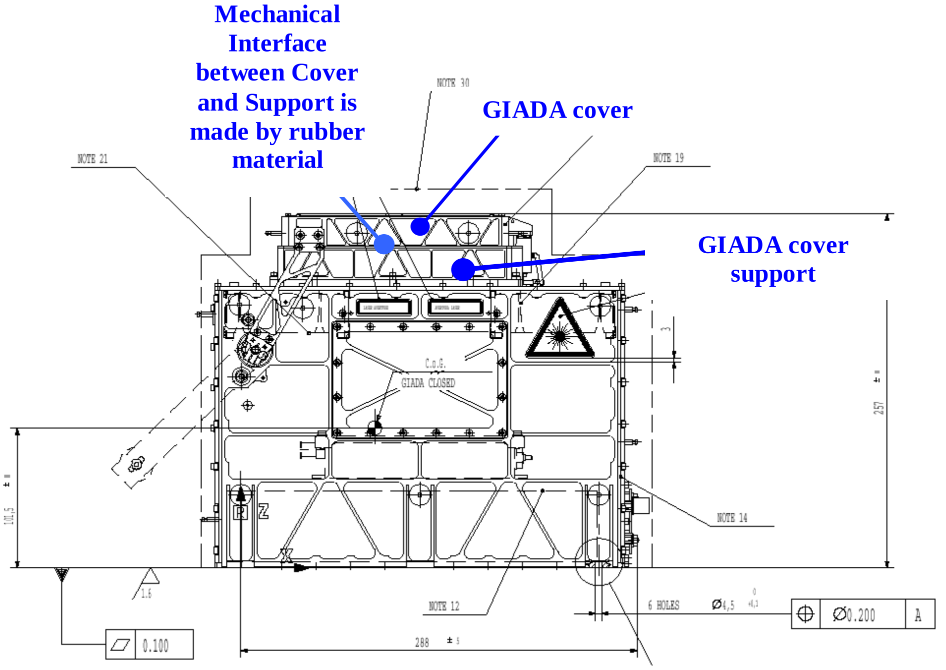

Figure 24 GIADA with Cover is closed Configuration

In the Figure 25, only the first condition is reached, while the second does not appear. This means that the cover was not completely open: it moved from its closed position but it did not reach its final open position. In the first part of the movement, it seems that the cover needs more steps to reach the activation of the RW_CLOSE: 40 steps with respect to the < 10 expected. This could be due to the possibility that the cover was unlikely 'stuck' to the GIADA support (refer to GIADA close configuration in Figure 24). Then the cover moved and the 'close reed switch' activated, as expected, for 29 steps. Unfortunately the cover seems not reaching the final open position, even after 100 steps.

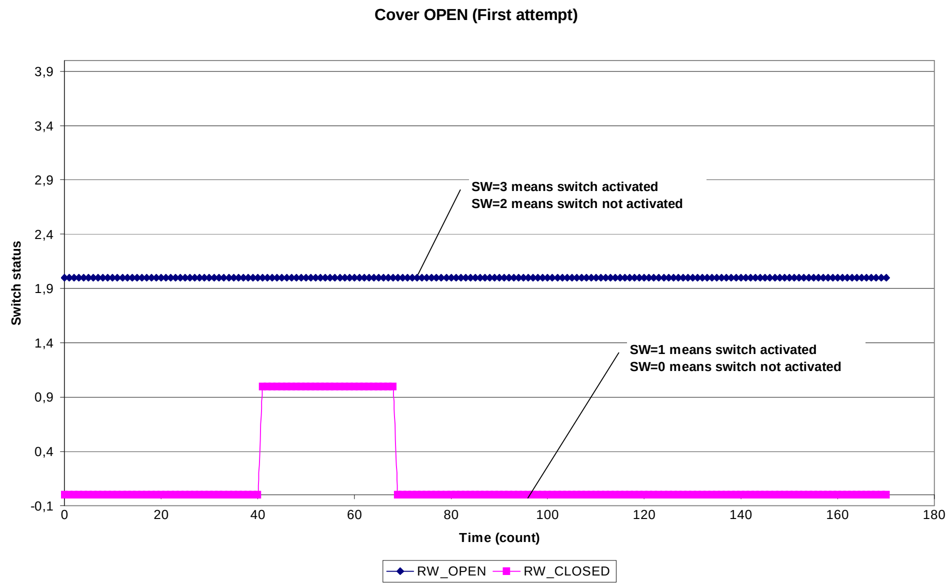

Figure 25 Reed switches Status during the 1st Cover Open operation (REDUNDANT)

At the end of discussion, a new cover open operation was decided to attempt. The second cover report, which was received after the completion of the operation, is show in the Figure 26. After 93 steps, the reed switch that indicates the 'open' position was finally activated and cover reached the open position. Therefore, a total of 193 steps were necessary to reach the final position, that is about 70 steps more than the nominal expected value, which was experienced during the on-ground tests. This, again, could be due to the possibility that the cover was unlikely 'stuck' to the GIADA support and, being the motor torque small, the stepper motor loose several steps before winnning the situation and reaching the final position.

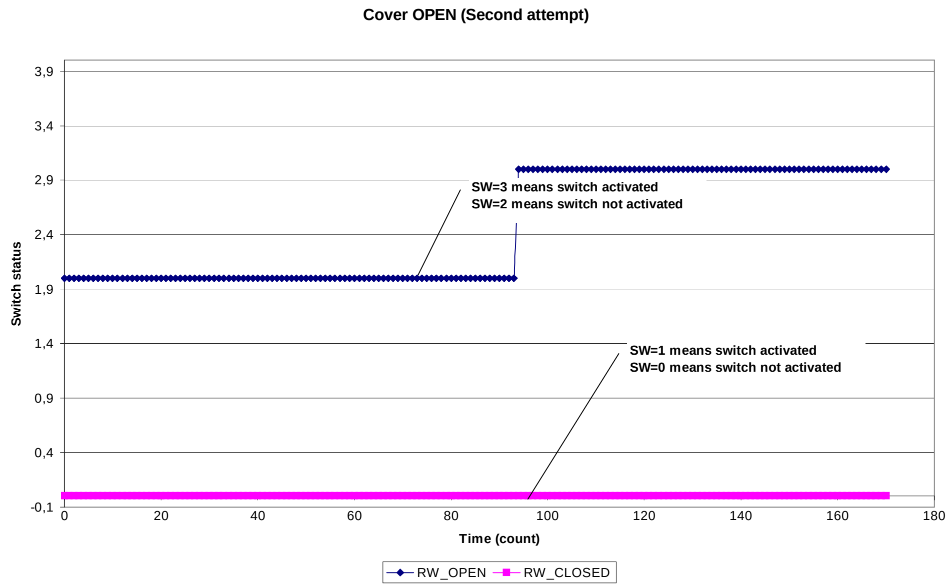

Figure 26 Reed switches Status during the 2nd Cover Open operation (REDUNDANT)

6.2.2.4. COVER CLOSE OPERATIONS

After the completion of the tests on the REDUNDANT interface, the cover was successfully closed by ground command. Figure 27 reports the correct sequence of the two reed-switches. As expected:

- The reed switch (named RW_OPEN), which indicates the Cover-Open position, is activated for a small number of steps (about 14 steps) and then remains not active for all remaining movement.
- The reed switch (named RW_CLOSE), which indicates the Cover-Close position, is activated after 127 steps for 27 steps and finally reaches the not-activated status that means the cover is close to the closed position.

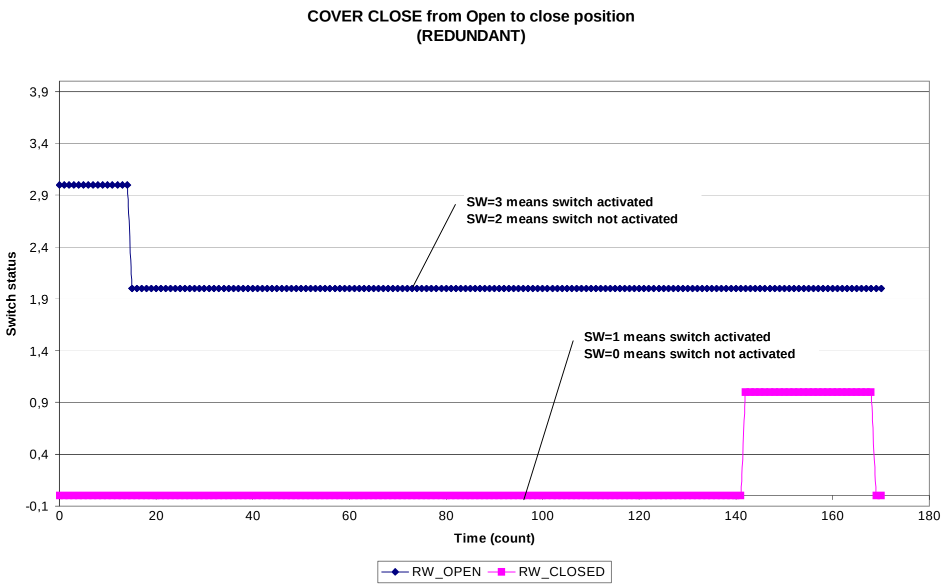

Figure 27 Reed switches Status during Cover Close operation (REDUNDANT)

During the power-off, GIADA cover is automatically closed by the OBCP (Close Cover) despite its real position. Since the cover was already closed, the new close cover operation resulted (as expected) in a continuous cover bunching over the cover support. This is the reason of the shown status of the two reed-switches in Figure 28, in which the reed switch indicating the Cover-Open position remains always not active and the other is active several time. In fact, after a bunch on the cover support, the cover returns back and the reed switch indicating the Cover-Close position is newly activated. Considering its last status and the movement direction, the cover results closed when the reed switch passes from activated to not-activated condition.

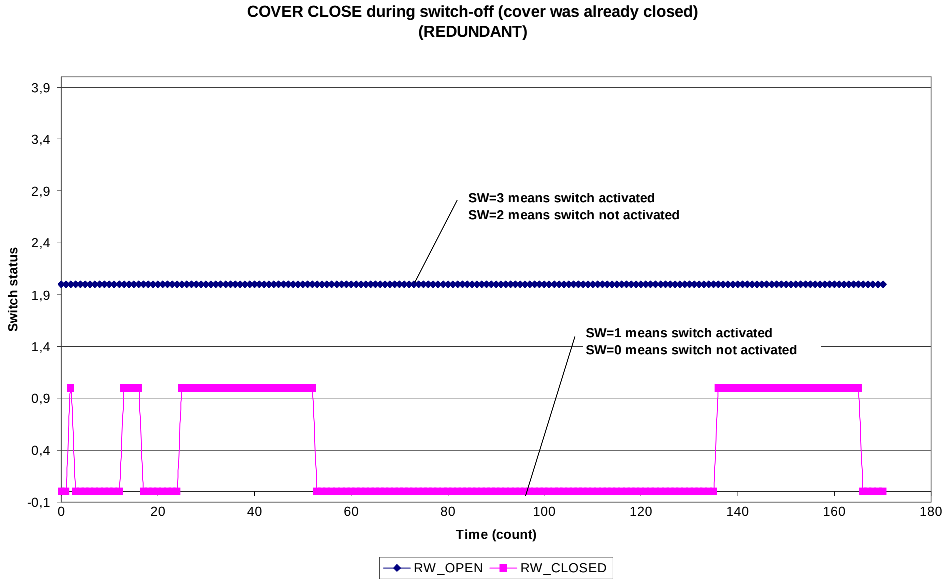

Figure 28 Reed switches Status during Cover Close operation @ power-off (REDUNDANT)

6.2.3. ENGINEERING EVALUATION ON SENSOR DATA

The science TM has been correctly received and no missing packets have been observed. Figure 29 shows the SSC of TM packets when GIADA is in Normal mode and science TM is enabled. The maximum flood of TM packets (typically 1 packet every 30s) was after the lasers were switched on. In this condition, several GDS 'ghost detections' on Left receiver were found with a rate of 1 detection every second. This is due to the level of the internal stray-light (background noise), which is caused by a contamination problem on the internal optics parts. The problem was found during the storage and pre-launch test campaign in Kourou. In this condition, the internal stray-light results in the order of the Left receiver detection threshold. Remark: the internal stray-light level remained the same even after a cleaning procedure was applied on the optics parts.

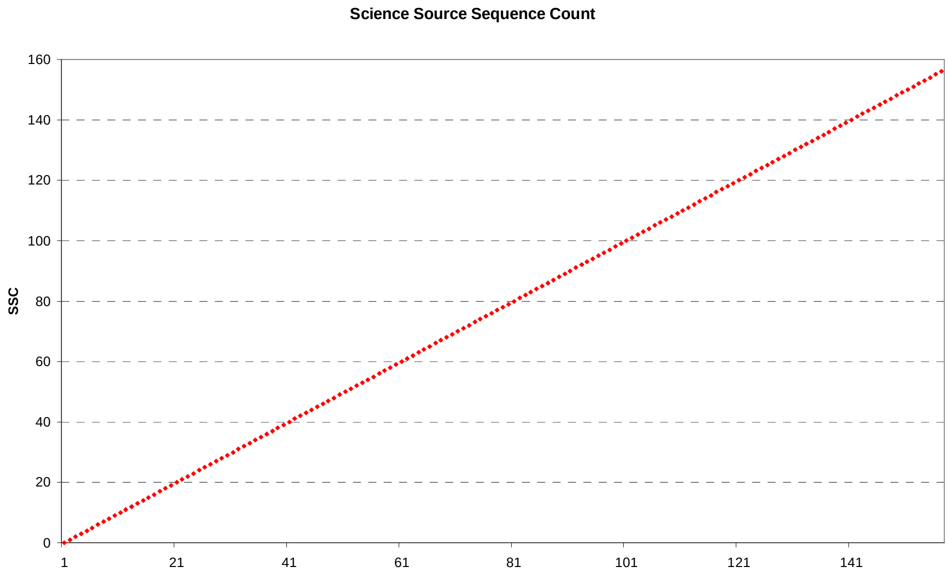

Figure 29 Science TM packet Source Sequence Count (REDUNDANT)

To avoid future flood of events, the detection threshold on Context File should be changed.

6.2.3.1. IS SUB-SYSTEM

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

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

Table 2 Range/Gain configuration (REDUNDANT)

After the 2nd IS power-on, the Science TM was enabled and the Internal Calibration data were successfully received. Along the test, the Internal Calibration command was repeated several times and in different conditions (e.g., GDS or/and MBS switched-on or off) in order to verify the sub-system interference with the others.

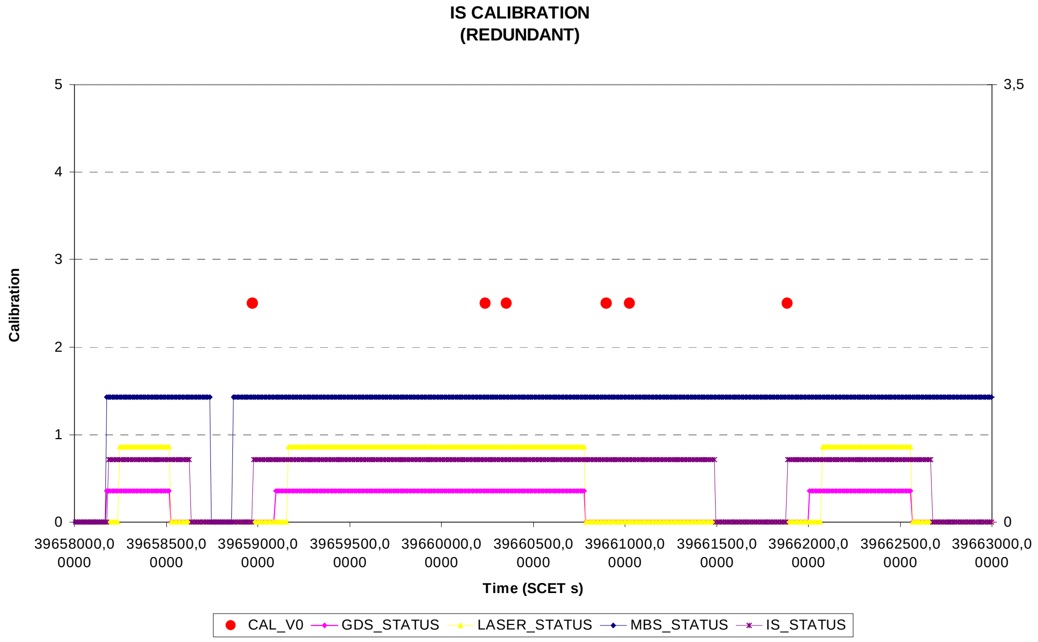

Figure 30 IS Calibration wrt Sub-system switch-on/off (REDUNDANT)

Figure 30 shows the sequence of the IS calibration: the 1st is done at IS power-on, the 2nd and the 3rd are done when the lasers are on, the following two are repeated when lasers (and GDS) are switched-off (only MBS are remained on) and the last one at the last IS power-on. The first calibration is performed with four stimuli and 10V stimuli level, while the others are done with eight stimuli and 9.6V stimuli level. Before the start of each internal calibration, GIADA measures the electronics noise of each channel. The following Table 3 reports the mean and the standard deviation:

CALIB	PZTA		PZTB		PZTC		PZTD		PZTE	
	MEAN	STD	MEAN	STD	MEAN	STD	MEAN	STD	MEAN	STD
1st	-0,0135	0,0638	-0,0106	0	0,001	0	-0,0106	0,0348	-0,0135	0
2nd	-0,0077	0	-0,0077	0,0348	-0,0019	0,0435	-0,0106	0,0638	-0,0164	0,0638
3rd	-0,0106	0,0609	-0,0077	0	-0,0019	0,0551	-0,0106	0,0435	-0,0135	0,0348
4th	-0,0106	0,0348	-0,0106	0,0435	-0,0019	0,0667	-0,0106	0,0493	-0,0135	0
5th	-0,0135	0,0551	-0,0106	0,0493	0,001	0	-0,0106	0,0435	-0,0135	0
6th	-0,0106	0,0435	-0,0106	0,0609	0,001	0	-0,0106	0,0435	-0,0135	0

Table 3 IS channel outputs prior Internal Calibration (REDUNDANT)

As we can see, the channel outputs have a low mean value (below of 10mV, negative value means channel output close to = 0V) and a noise level (@ 3σ) close to the detection thresholds. The noise levels are compatible with those measured with the Main interface and also those observed during on-ground test campaign.

Figure 31 to Figure 37 show the results of the IS internal calibrations. No detections are seen on Channel-E; this is completely expected since the channel gain is set to Low Gain. According to the section 5.2.2.1 of **AD4**, only the 2nd, 4th, 6th and 8th stimuli (that are marked in the figure with 1, 3, 5 and 7 respectively) are meaningful, except for Channel-C response, for which the voltage/delay time measurements are not stable along the six different internal calibrations, the other channels (A, B and D) show a reproducible calibration data set.

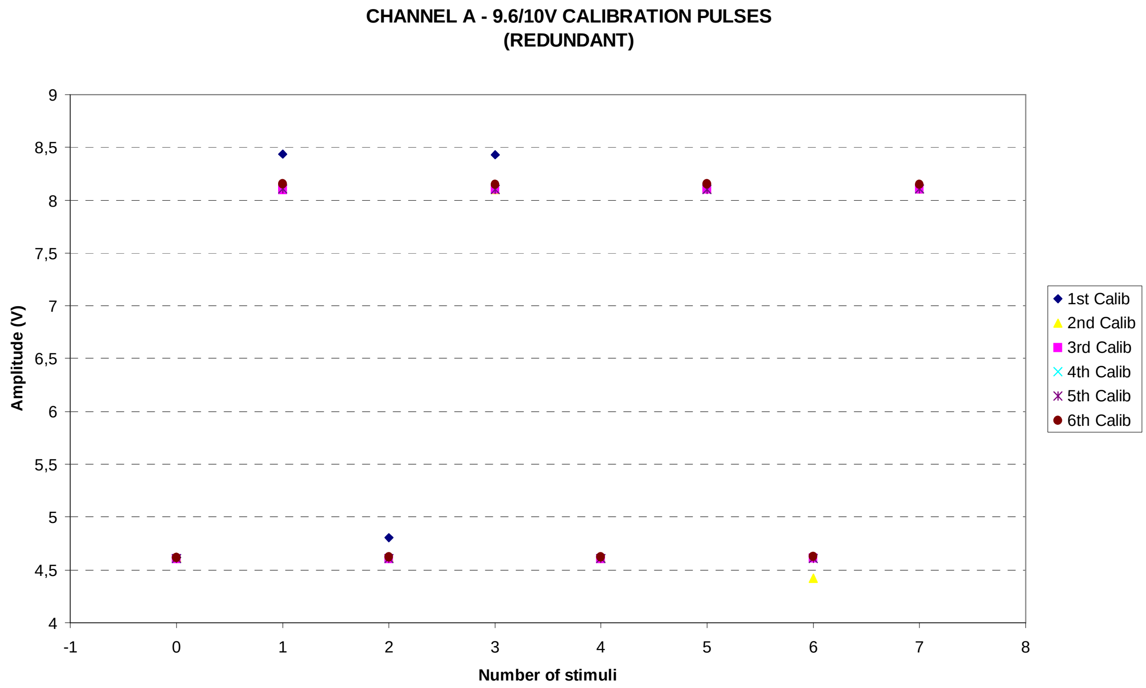

Figure 31 IS Calibration - Channel A Amplitude (REDUNDANT)

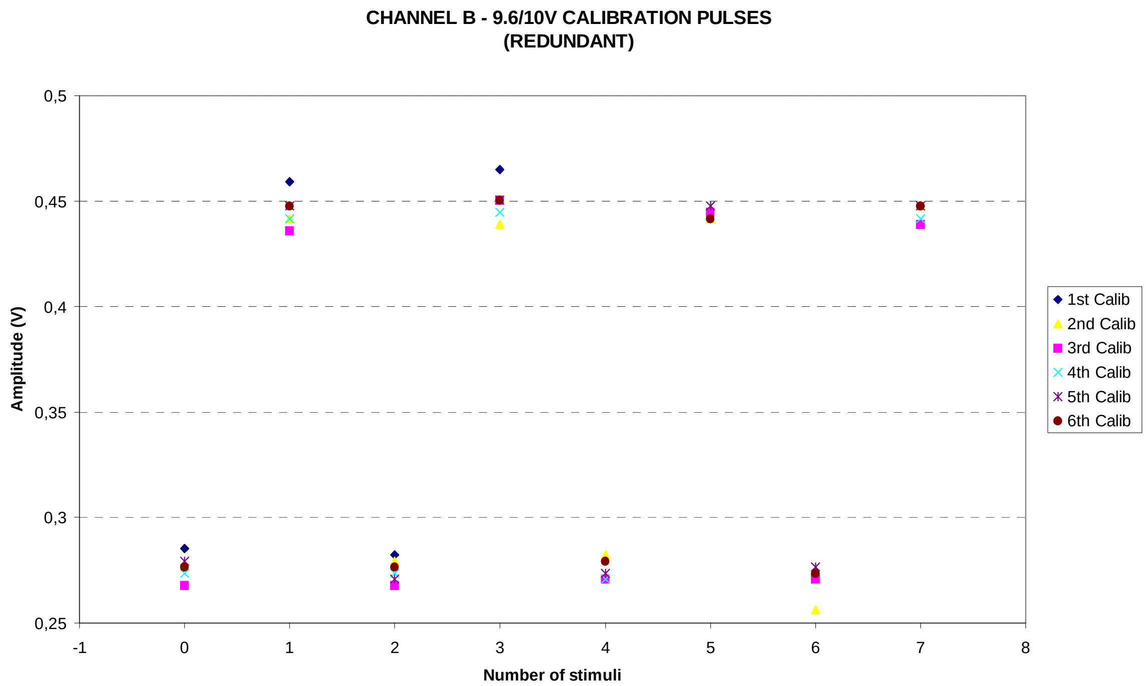

Figure 32 IS Calibration - Channel B Amplitude (REDUNDANT)

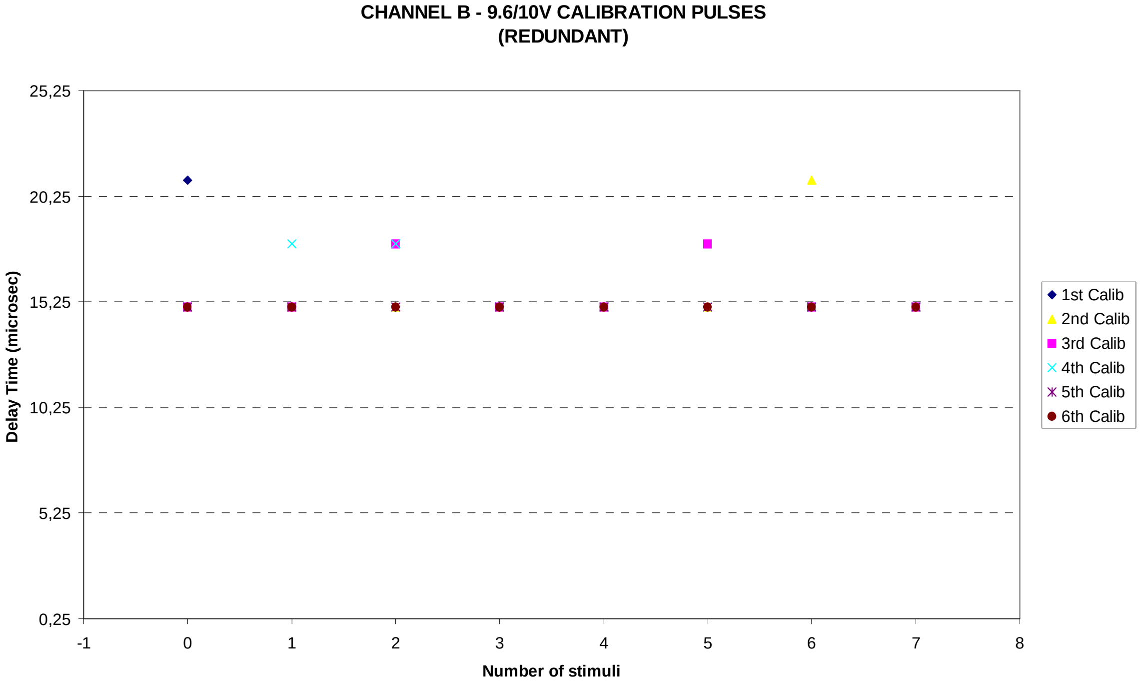

Figure 33 IS Calibration - Channel B Delay Time (REDUNDANT)

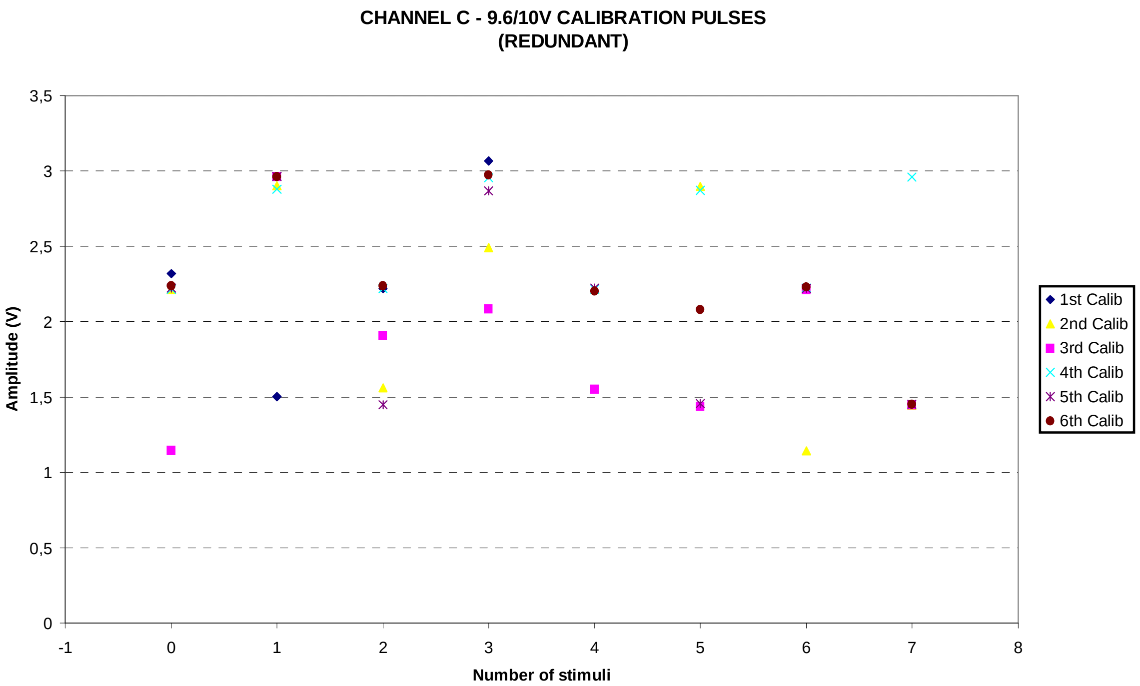

Figure 34 IS Calibration - Channel C Amplitude (REDUNDANT)

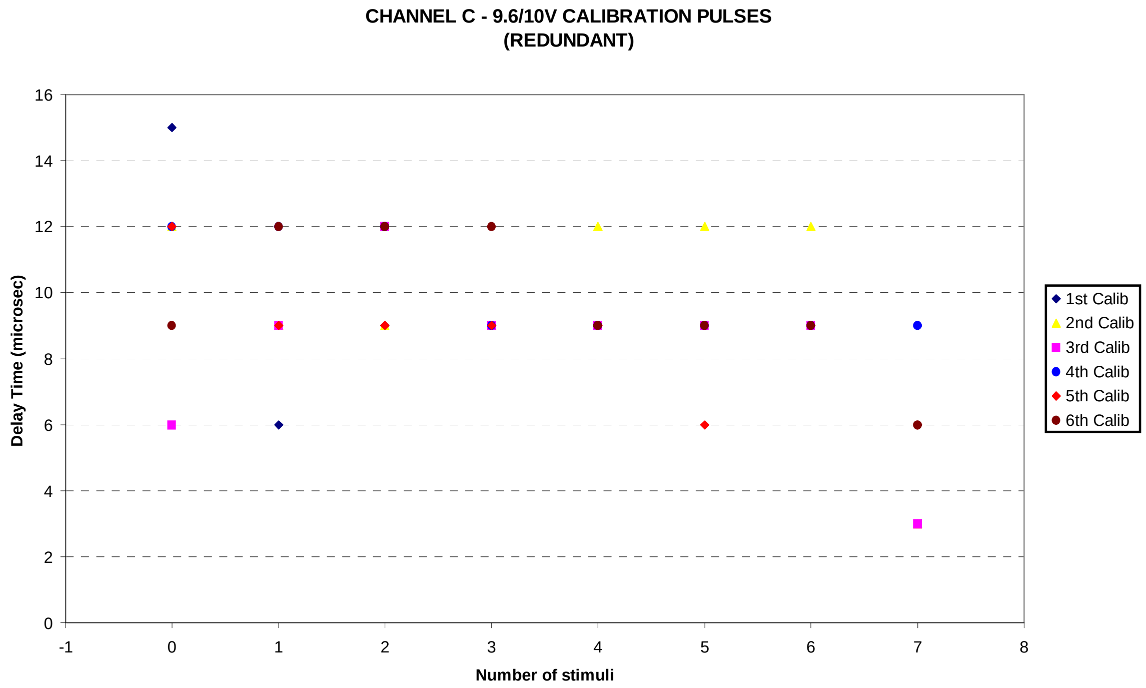

Figure 35 IS Calibration - Channel C Delay Time (REDUNDANT)

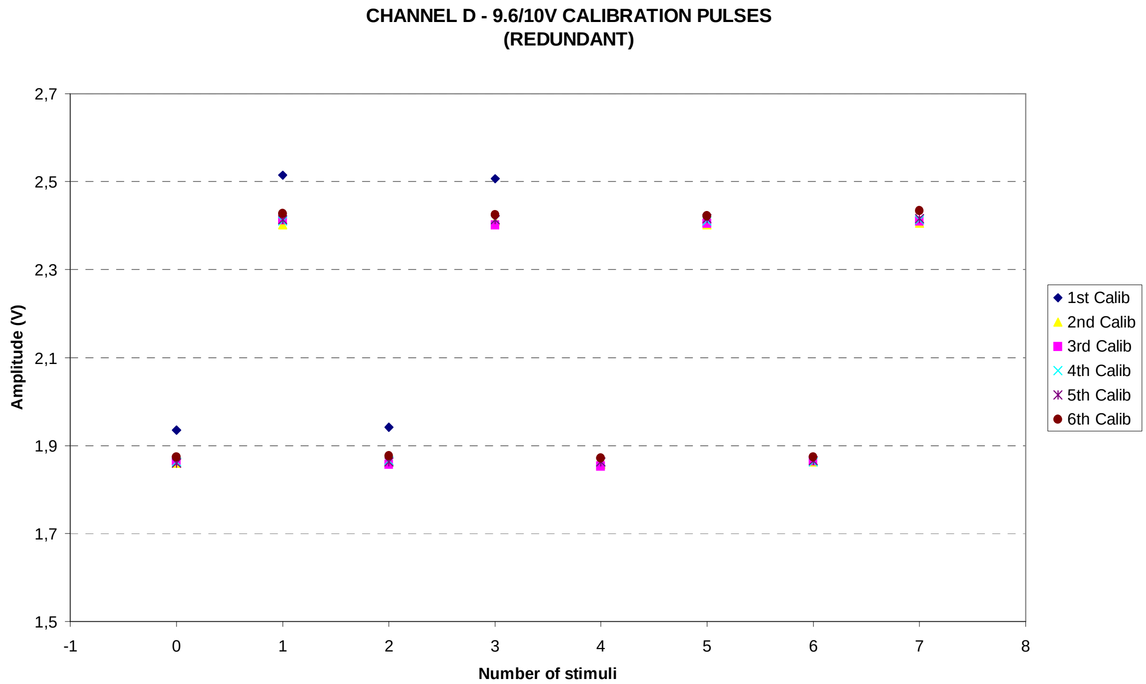

Figure 36 IS Calibration - Channel D Amplitude (REDUNDANT)

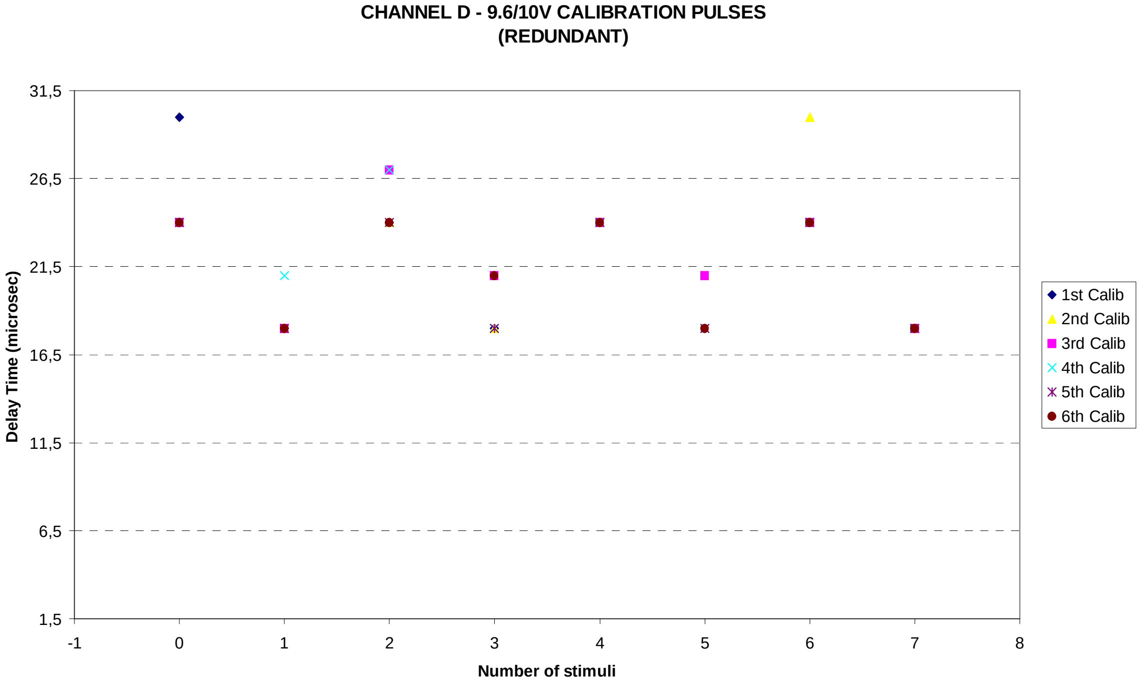

Figure 37 IS Calibration - Channel D Delay Amplitude (REDUNDANT)

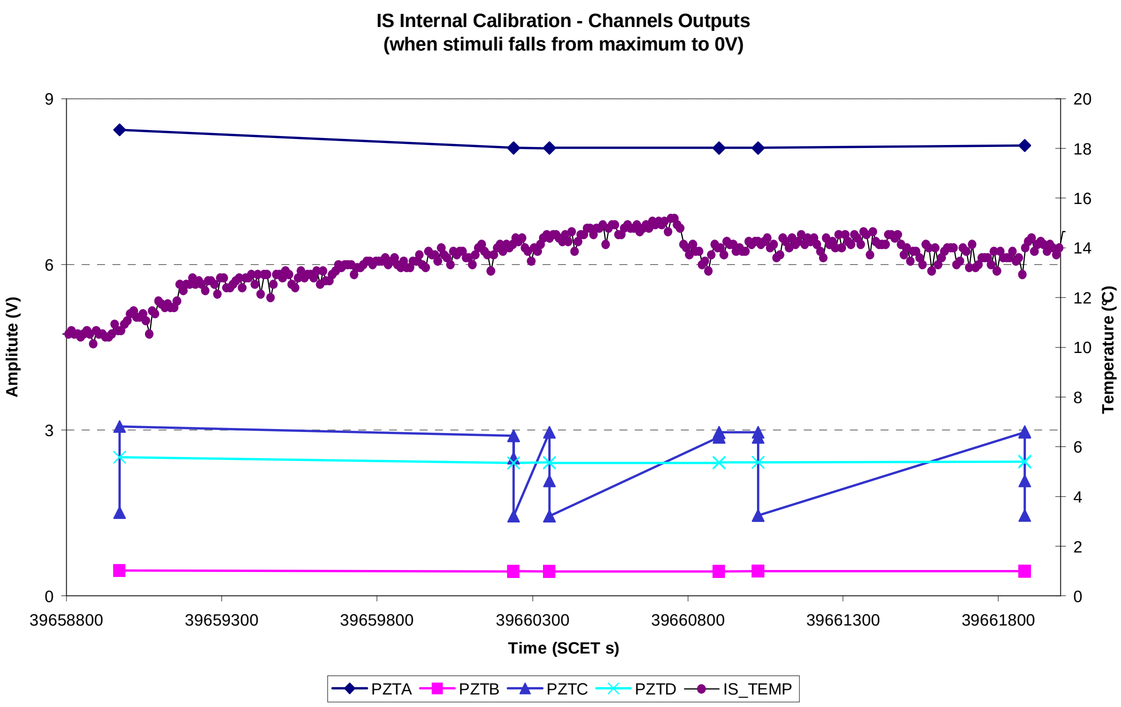

Figure 38 IS Calibration – A, B, C and D Amplitude when stimuli fall to 0V (REDUNDANT)

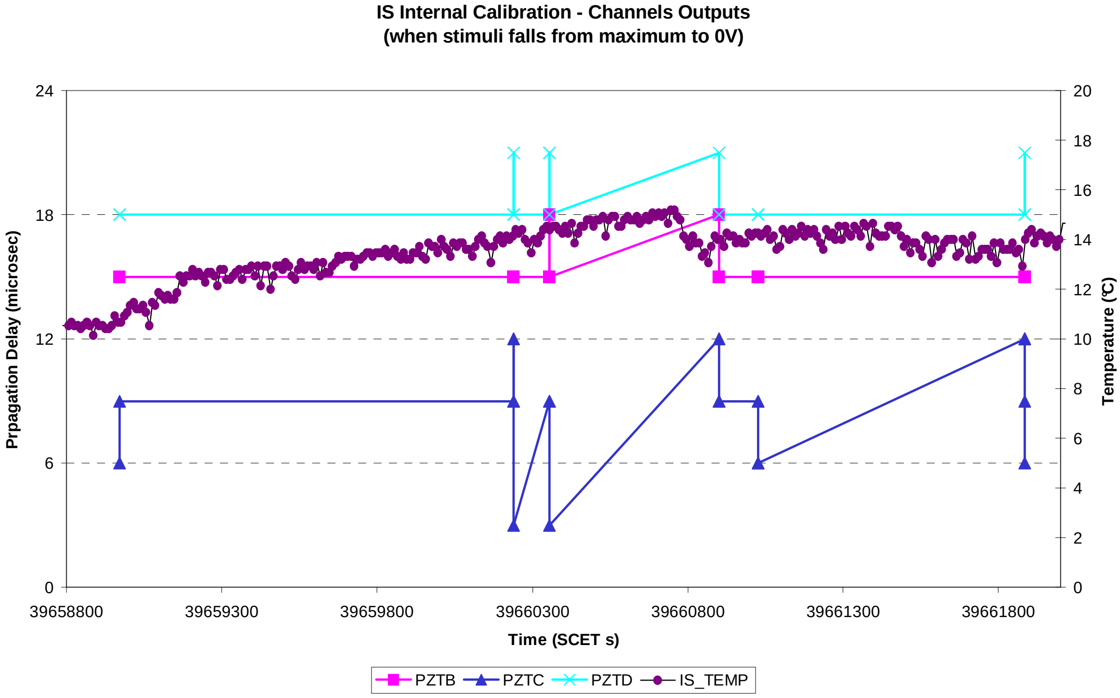

Figure 39 IS Calibration – A, B, C & D delay time when stimuli falls to 0V (REDUNDANT)

Figure 38 compares the measured amplitude of the IS channels (except the E channel) during the six internal calibrations. Only the channels output when the stimuli falls to 0V are reported in this figure. As we can see, Channel-C is confirmed not stable during the six calibrations (the amplitude varies from 1.5V to 3V), while the other channels are quite stable even if the amplitudes depend slightly on the IS temperature (e.g., Channel A decreases of 0.33V when temperature increases of about 3.5°C). This most probably is due to a combination of several causes: the stimuli amplitude, the channel peak detector error, the mechanical behaviour of the IS plate, etc.

Figure 39 shows the measured delay time of the IS channels (except channel A, for which the delay time is always 0). This variation (except for Channel-C) is in the order of the time resolution (1 bit = 3 μs). The Channel-C should be observed during the next GIADA operations and in case its behaviour is confirmed, it is suggested to increase its detection threshold to improve the reproducibility and stability of its detection.

Only eight unexpected detections (ghost events) are observed during the test. Seven are normal IS detection, while the last one is a combined IS+GDS detection. They are observed when the GDS and Laser power relays have been switch-on or off (refer to Figure 40). This behaviour was expected, since already observed during on ground testing (refer to UM). The Table 4 shows the output voltage and delay time of the five channels. As we can see the voltage measured after the detections is below the detection thresholds (50mV); this means that the noise levels (induced by power relays on or off) are very low and in any case below those observed during the on-ground testing.

EVENT TIME (SCET)	PZTA	AMPL (V)	TIME (µs)	PZTB	AMPL (V)	TIME (µs)	PZTC	AMPL (V)	TIME (µs)	PZTD & PZTE
39659092,15	Detected	0,030	0	Non-detected	-	-	Non-detected	-	-	Non-detected
39659092,16	Detected	0,044	0	Non-detected	-	-	Non-detected	-	-	Non-detected
39659158,14	Detected	0,036	0	Non-detected	-	-	Non-detected	-	-	Non-detected
39660781,16	Detected	0,047	0	Detected	0,042	45	Non-detected	-	-	Non-detected
39662002,14	Detected	0,039	0	Non-detected	-	-	Detected	0,027	15	Non-detected
39662002,15	Detected	0,044	0	Non-detected	-	-	Non-detected	-	-	Non-detected
39662068,15	Detected	0,044	36	Detected	0,05	0	Non-detected	-	-	Non-detected

Table 4 IS 'ghost detections' (REDUNDANT)

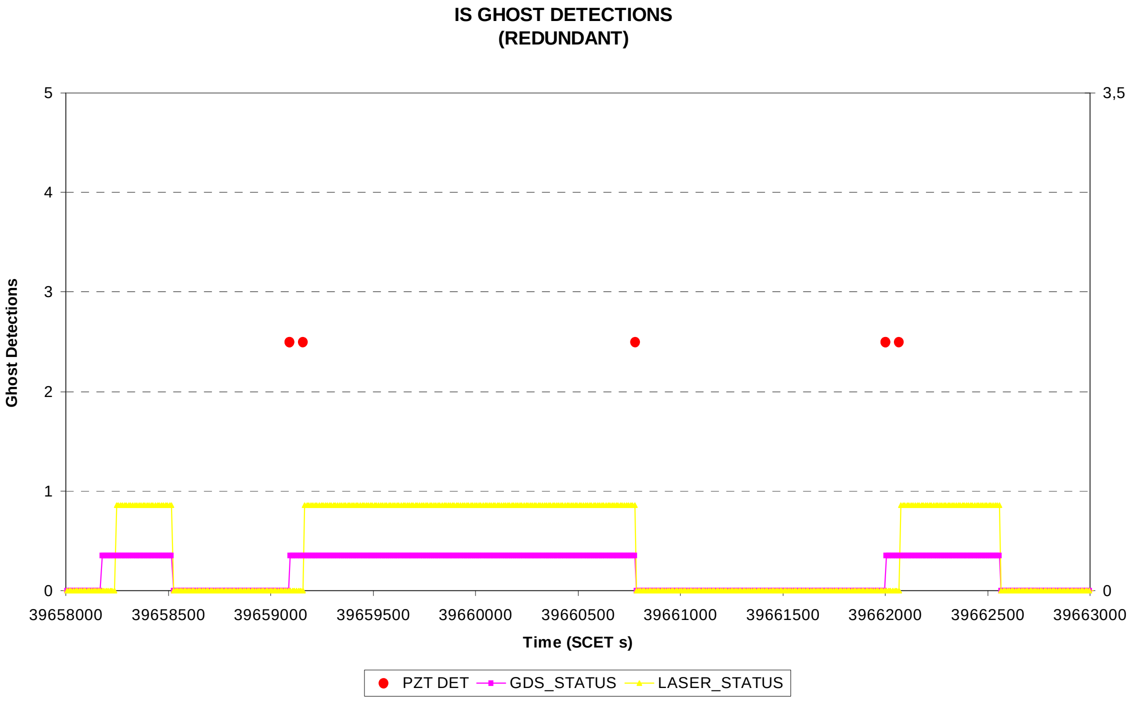

Figure 40 IS Ghost detection wrt GDS/Laser switch-on/off (REDUNDANT)

In conclusion the IS sensor behaviour does not depend on the other sub-systems (in particular GDS and Laser), except at their power-on/off (i.e., when the power relays are turned on or off). In this condition some 'ghost detections' can be observed. As expected, the performance of the sensor depends slightly on the temperature, which is measured just after the detection so that output can be corrected.

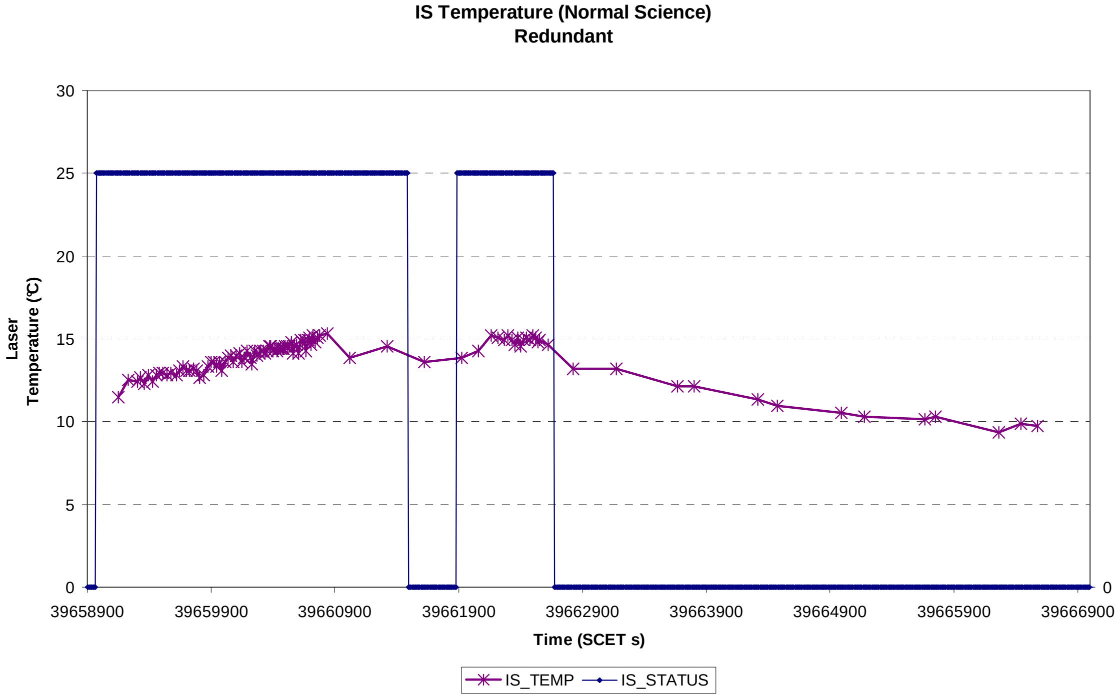

Figure 41 IS temperature (REDUNDANT)

6.2.3.2. GDS SUB-SYSTEM

The detection thresholds of Left and Right channels were set to about 0.8V (Context file updated via memory load command at GIADA power-on).

After the 2nd GDS power-on, the Science TM was enabled and the Internal Calibration TM packet was successfully received.

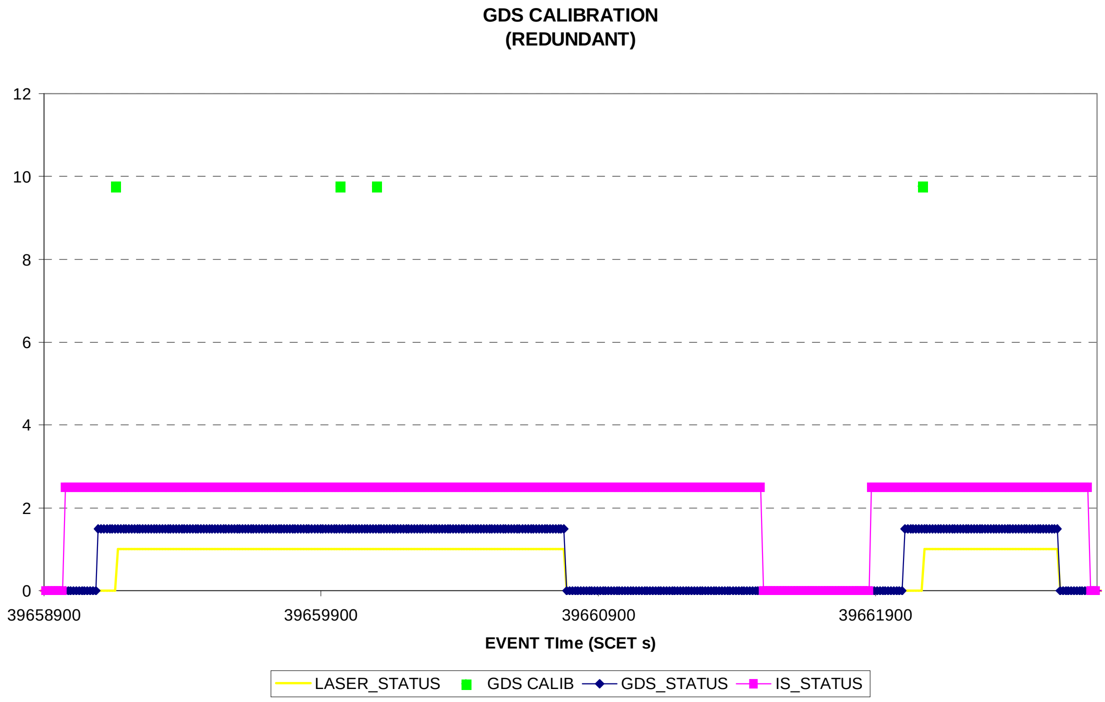

Figure 42 GDS Calibration Time & sub-system power status (REDUNDANT)

The Figure 42 shows the sequence of the GDS calibrations: the 1st was done at GDS power-on (Lasers are off), the 2nd and the 3rd calibrations were performed when the lasers were switched-on and the last one was done at the last GDS power-on (Lasers are off).

When the lasers are switched-off (i.e. the 1st and 4th set of data in Figure 43), the noise level of the Left and Right channels show an average of 0.15÷0.26V and a standard deviation (3σ) below 40mV. These values represent the electronics noise level at the output of the two channels. They are in the same order of those measured during on-ground test campaign. When the lasers are switched-on (i.e. the 2nd and 3rd set of data in Figure 43), the output level of the Left and Right channels reports a direct measure of the internal stray-light in combination with the electronics noise. In this case the Left channel has a higher average than the Right (Left=0.67V and Right=0.24V) while the standard deviations (3σ) are almost the same (<50mV). This condition was already found during the storage and pre-launch test campaign in Kourou. The internal stray-light (in combination with the electronics noise) is of the same order of magnitude of the Left receiver detection threshold. Finally, the Figure 44 shows the laser light monitor and the laser temperature at the time of the GDS calibration.

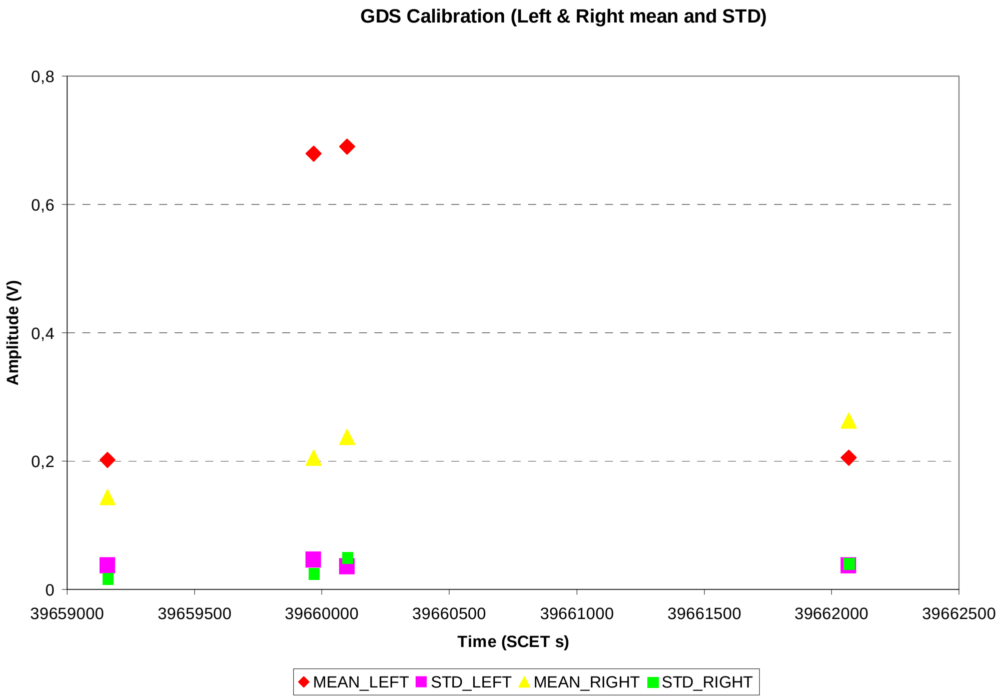

Figure 43 GDS Calibration (Left & Right mean value and STD) (REDUNDANT)

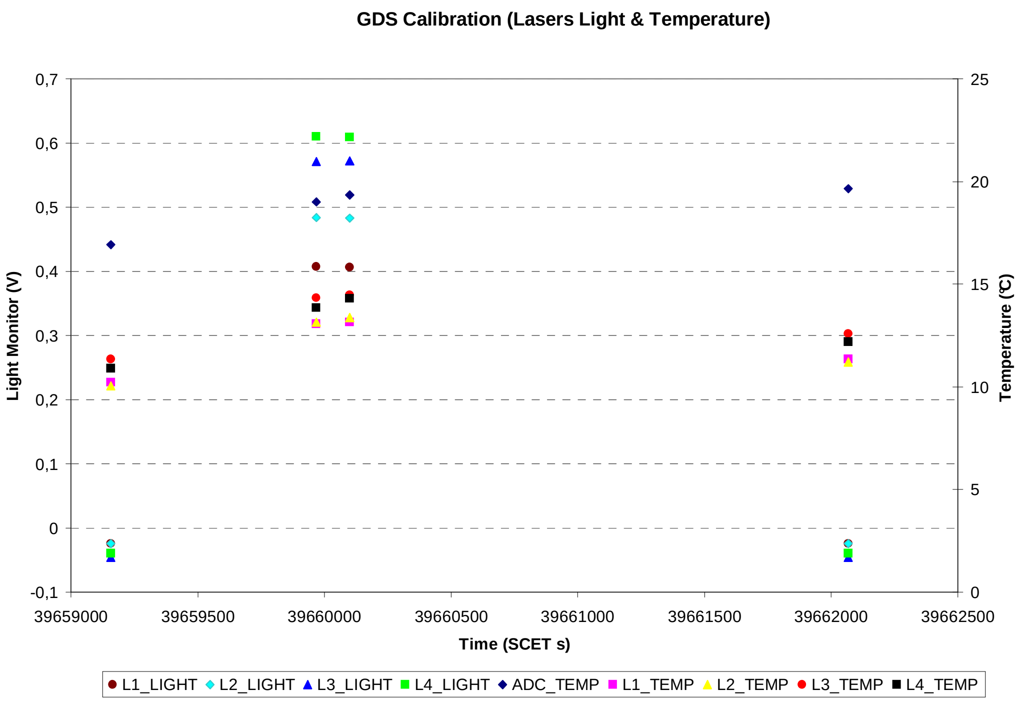

Figure 44 GDS Calibration - Lasers Light Monitor & Temperatures (REDUNDANT)

In summary, as soon as the Lasers have reached nominal power, the internal stray-light, due to contamination problem, has produced several 'ghost detections' on Left channel. The next two figures show the detections on Left and Right receivers and their relevant amplitudes.

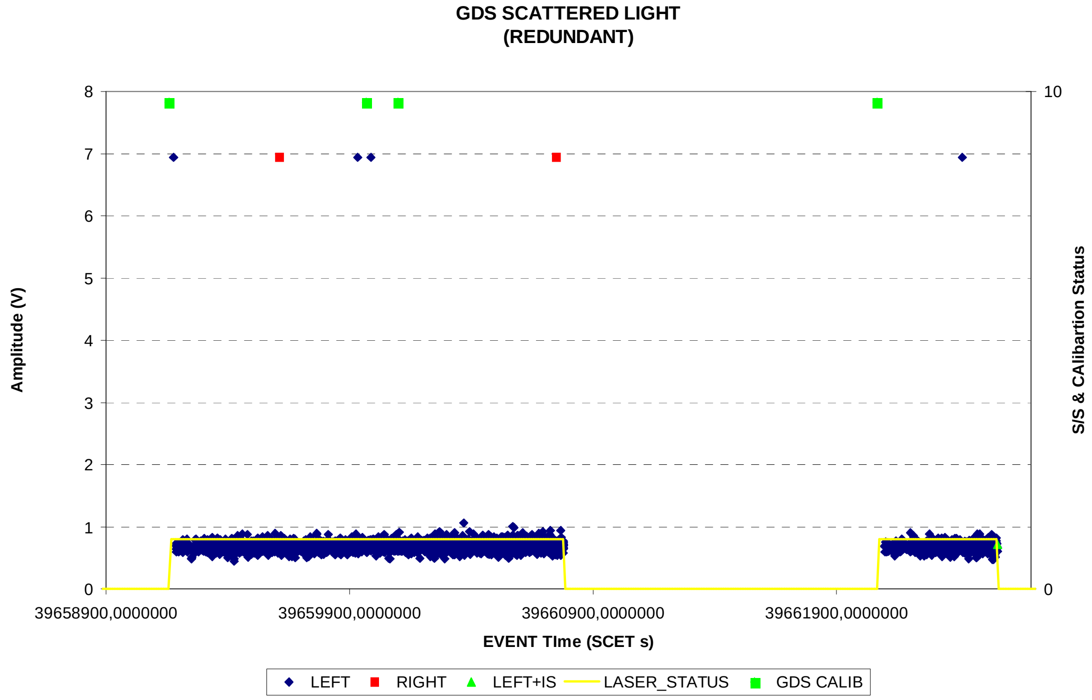

Figure 45 GDS Scattered Light (Left and Right Receivers) (REDUNDANT)

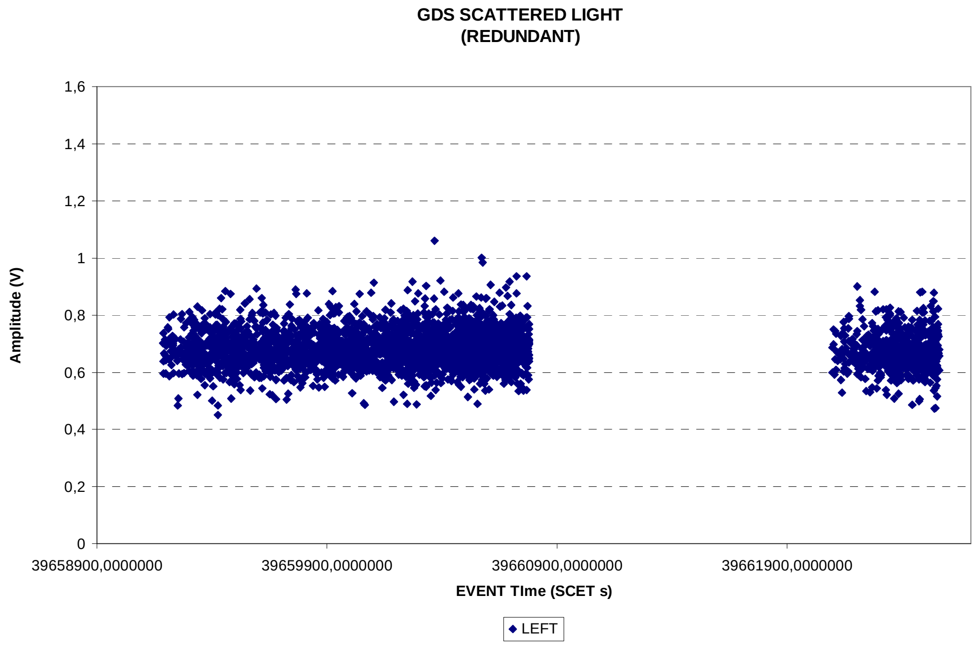

Figure 46 Amplitude of 'ghost detections' on Left receiver (REDUNDANT)

Two 'detections' types can be distinguished:

- The first, in which the detections amplitude is of the order of 0.8V (Left channel); these are 'ghost detections' due to the high level of the internal stray-light (contamination problem). The noise level is confirmed of the same order than that found before launch (refer to Figure 47). In order to minimise these numbers of detections (and thus the data rate and production), the detection threshold of Left cannel should be increased at least at 1V. It is suggested to keep under control this situation and only after a consolidated behaviour, update the value in the context file.

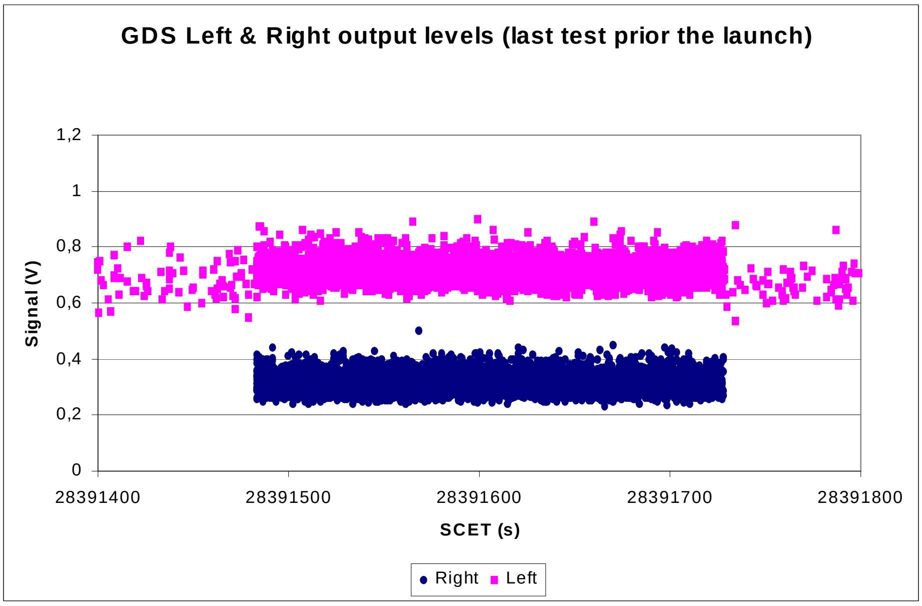

Figure 47 GDS Left & Right output levels measured prior the launch

- The second type, in which the detections amplitude is 6,9375V on Left and Right receivers. These detections were sporadic and they are seven. The amplitude of 6,9375V, means saturation. The first and fifth detections happened when laser power relay was switched-on and off: they are 'ghost detections'. The remaining detections seem not related to a particular GIADA internal activity (e.g., an internal calibration, a relay switch-on/off, etc.) and therefore can be supposed 'real' detections. Unfortunately this conclusion cannot be practically demonstrated. The science team, if needed, will perform further analysis.

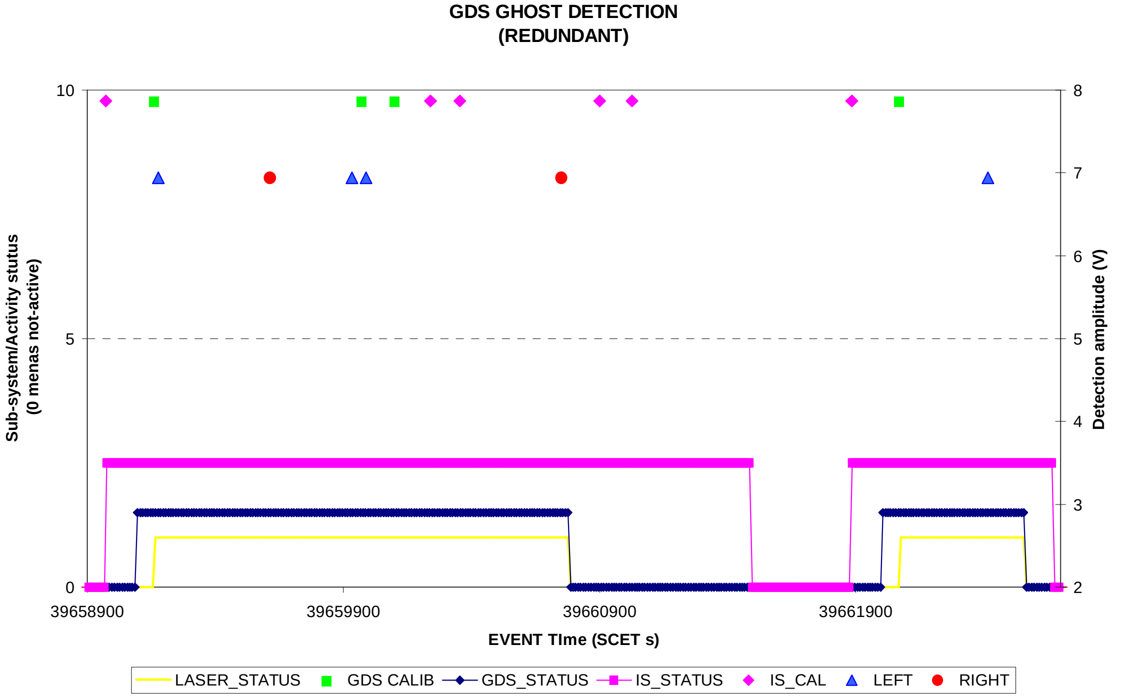

Figure 48 GDS Left & Right detections with amplitude above 7V (REDUNDANT)

6.2.3.3. MBS SUB-SYSTEM NORMAL ACQUISITION AND HEATING MODE

After the 2nd MBS sub-system power-on, the Science TM is enabled and the MBS calibration packet is received. Along the test, the MBS Calibration command is repeated several times and in different conditions (e.g., IS or/and GDS switched-on or off) in order to verify the sub-system behaviour.

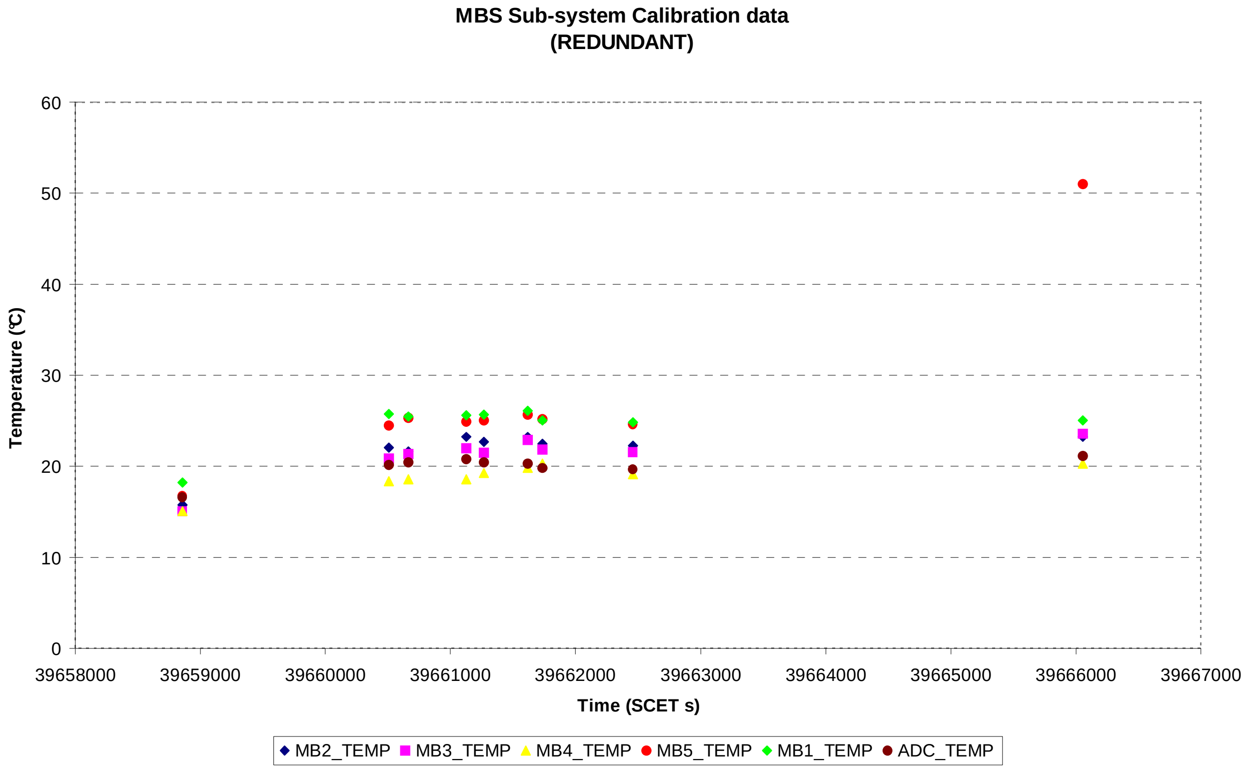

Figure 49 MBS Sub-system Calibration Data (REDUNDANT)

The figure shows no interference of the MBS temperatures reading with respect the status (on or off) of the other sub-systems. The last value of the MBS5 temperature seems incoherent with respect to the others (T above 50°C), but this is due to the execution of the calibration close to the MBS5 heating.

After the first Calibration, the MBS normal science acquisition starts @ repetition time of 300s. Before heating, the MBS reading repetition time is changed to 25s. In the following sections, it is reported the frequency variation against temperature for each of the five MBS prior and during the heating. As we can see, when the temperature increases (due to MBS heating), the frequency changes (the negative or positive variation depends on the frequency - temperature curve, which is different for each unit). Then, when the temperature returns to the initial condition, it returns to approximately the initial value. These two curves are different because of the typical MBS hystheresis mechanism. Anyhow, it is expected that the initial and final frequency values be the same.

6.2.3.3.1. MBS1 Reading

The frequency value after the completion of the heating and when the temperature is returned to its initial condition has approximately the same value before the start of the heating. The frequency shift, which is calculated from the figure of the frequency wrt. temperature during heating, is plotted in Figure 52. The frequency shift results outside the expected range: it is within the range -10/+5 Hz/°C (nominal expected range is ±3 Hz/°C).

Remarks: *This discrepancy is a known behaviour of the MBS unit, which was already detected during on-ground test campaign, when the MBS temperature changes too fast (temperature gradient > 1°C/minute), as during heating process. On MBS1, a Δt of 30°C is reached after 200s; this means a thermal gradient of about 9°C/minute, as we can see in Figure 53.*

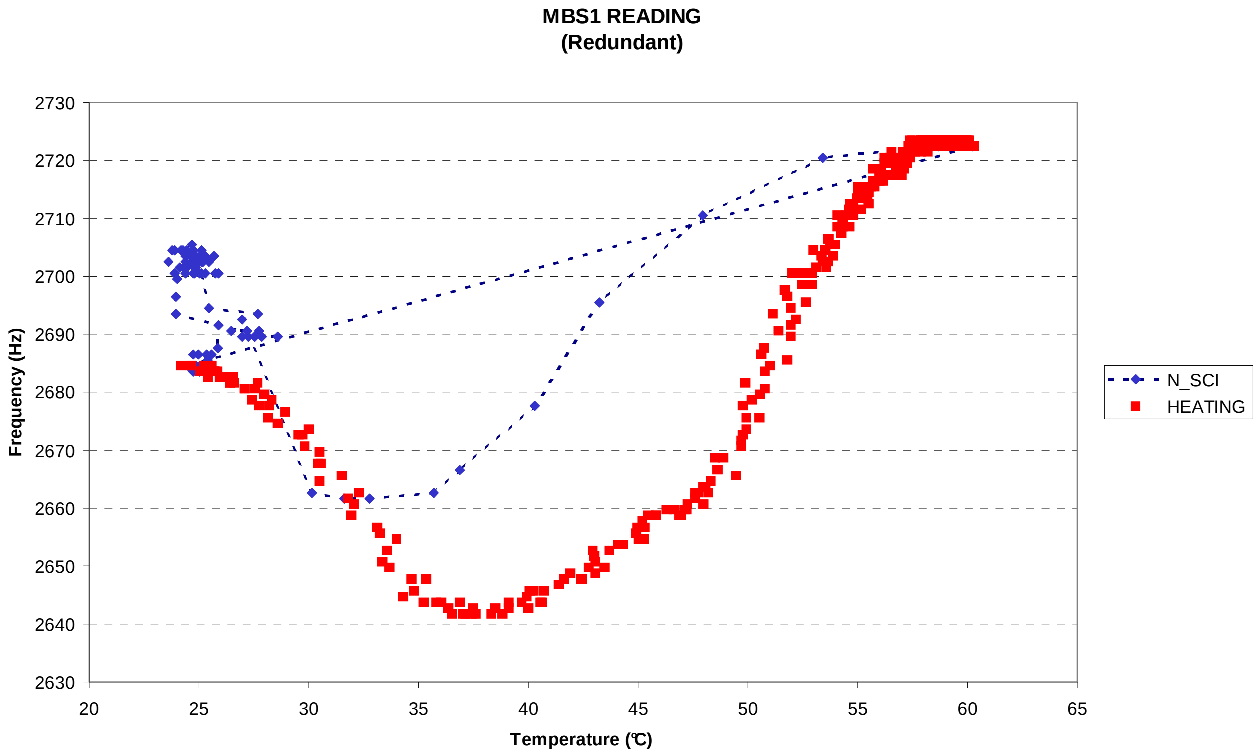

Figure 50 MBS1 Frequency wrt temperature in Normal Acquisition and heating (REDUNDANT)

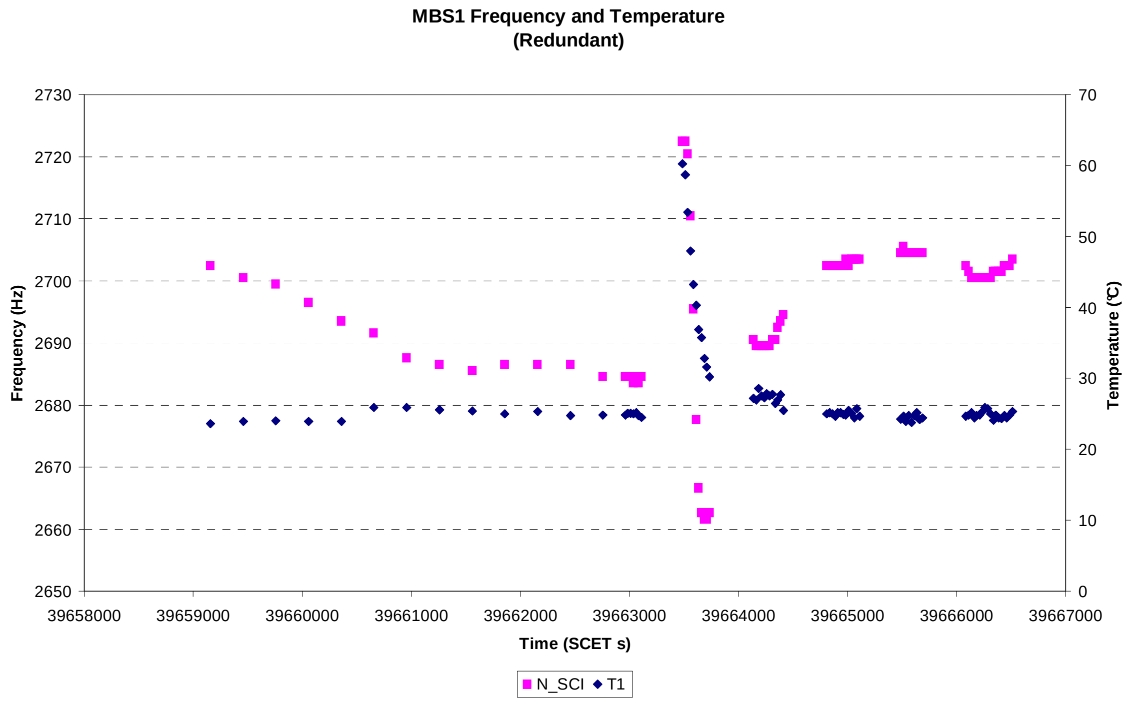

Figure 51 MBS1 (normal science) Frequency and temperature wrt time (REDUNDANT)

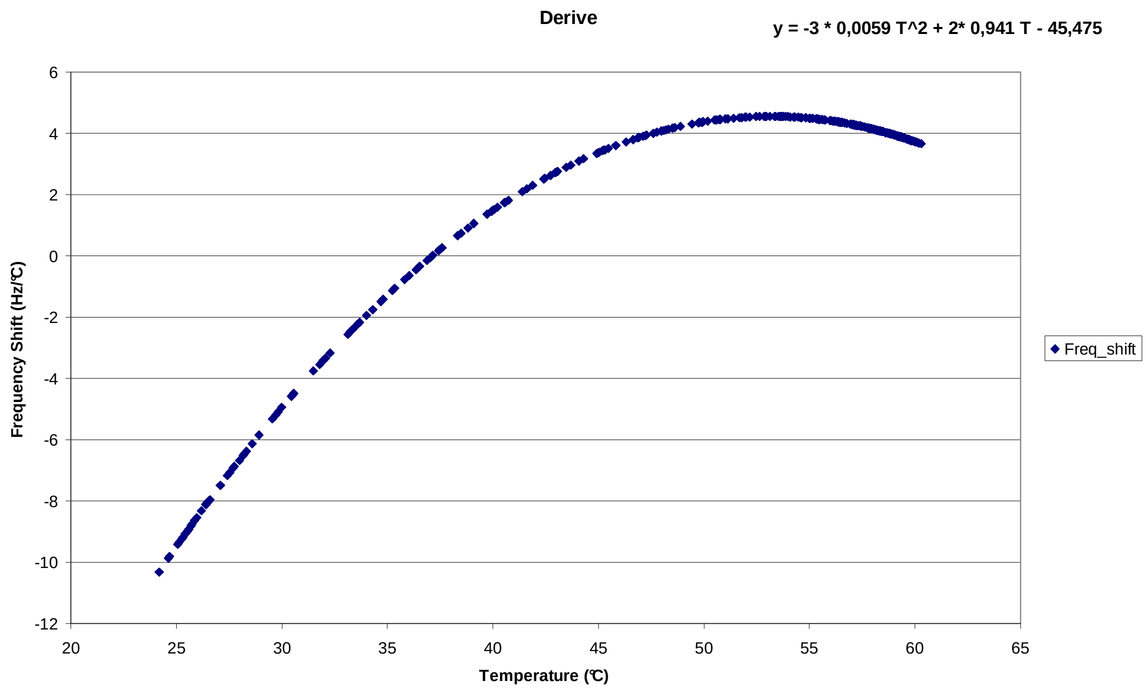

Figure 52 MBS1 Frequency shift (REDUNDANT)

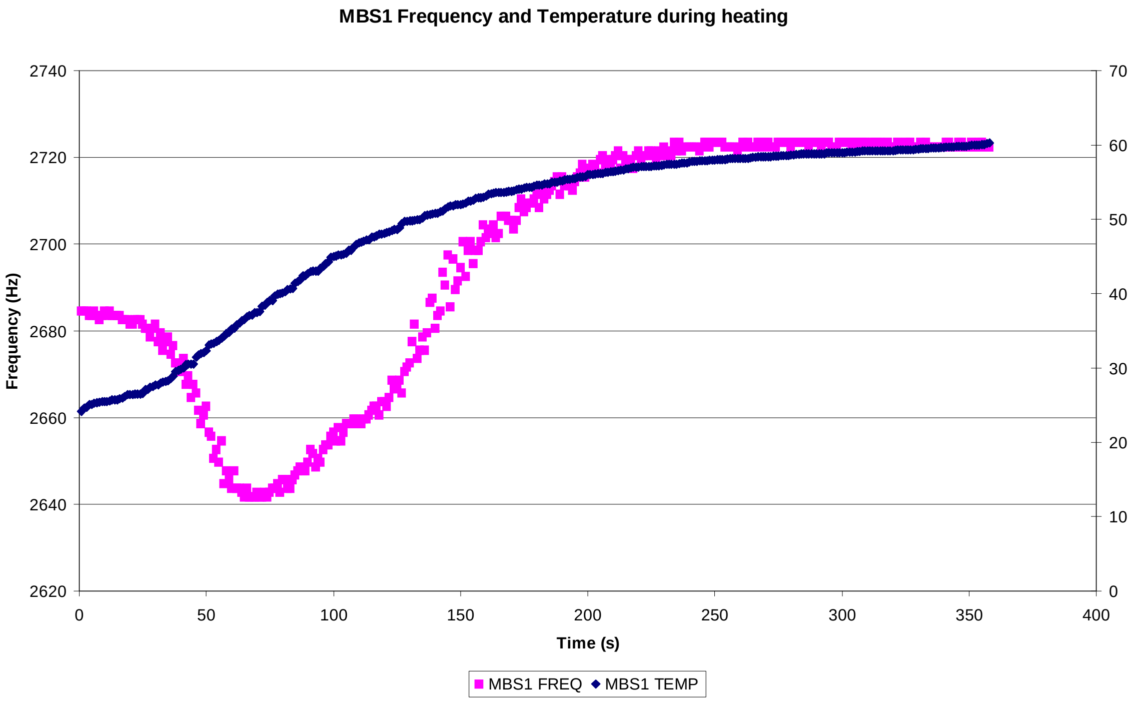

Figure 53 Frequency and Temperature during MBS1 heating (REDUNDANT)

6.2.3.3.2. MBS2 reading

The first frequency reading of the MBS2, in the TM packet during heating, jumps to a not-expected value (the expected value is about 2544 Hz in the heating TM packet, while the first value was 3972 Hz). This is a known behaviour and already happened on ground. The value has been simple discarded from the data elaboration, as indicated in the **AD4**.

As seen on MBS1, the frequency value after heating, when the temperature is returned to its initial condition, has almost the same value as before the start of the heating (the ΔFrequency is less than 3 Hz). For MBS2, the frequency shift remains inside the expected range (±3 Hz/°C).

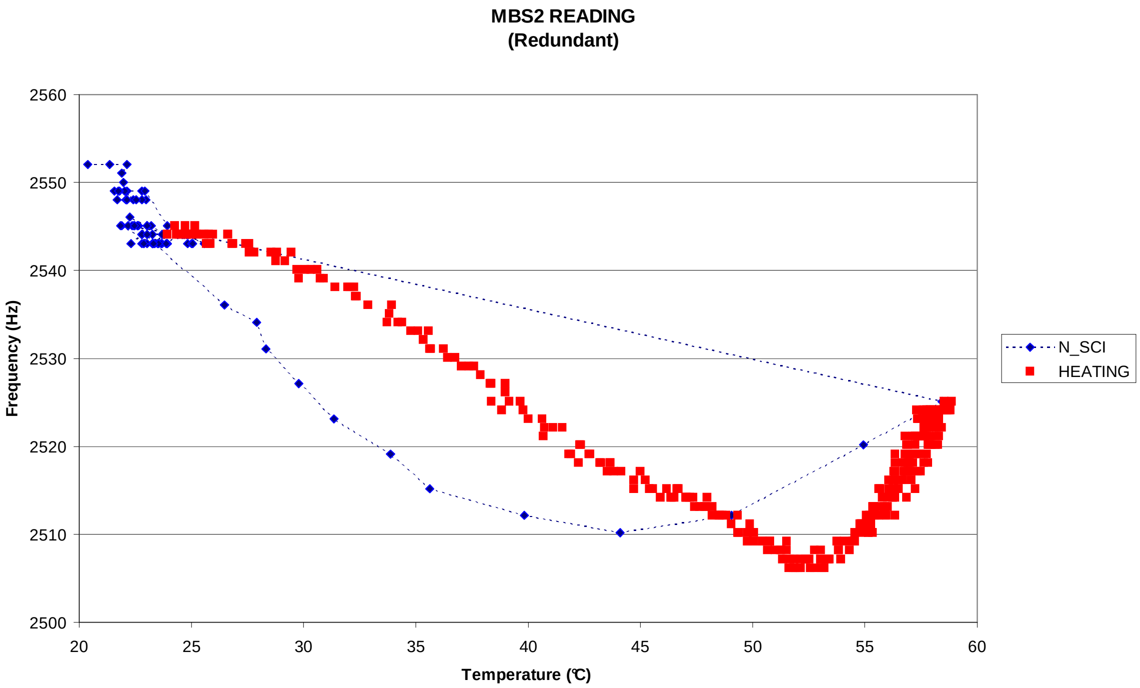

Figure 54 MBS2 Frequency wrt temperature in Normal Acquisition and heating (REDUNDANT)

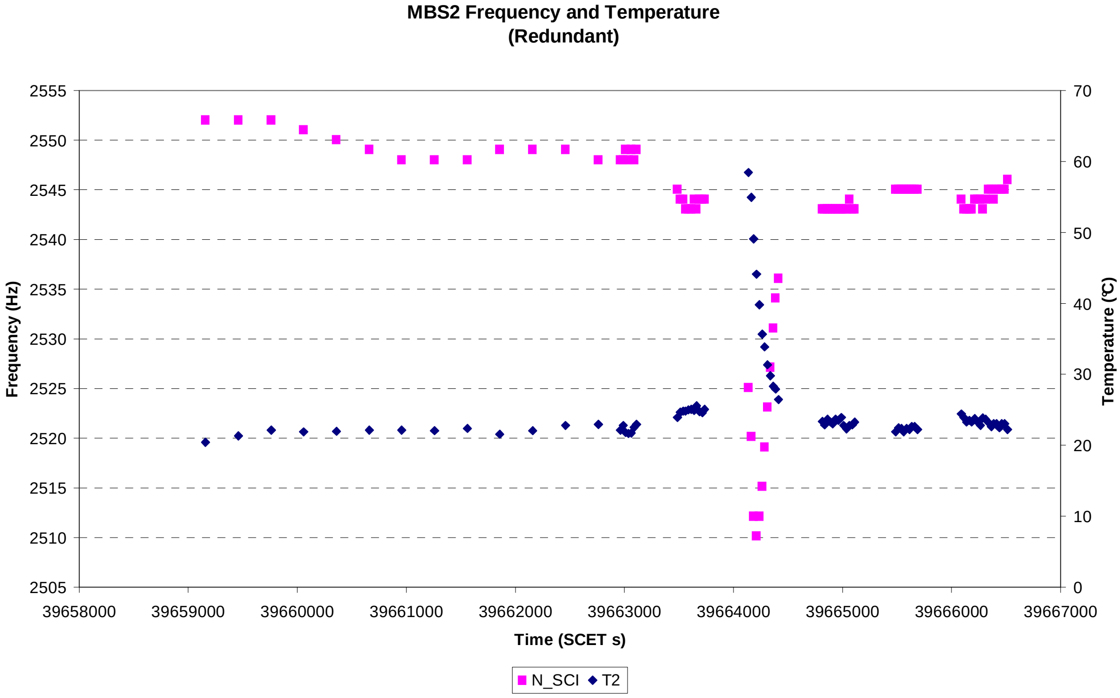

Figure 55 MBS2 Frequency and temperature wrt time (REDUNDANT)

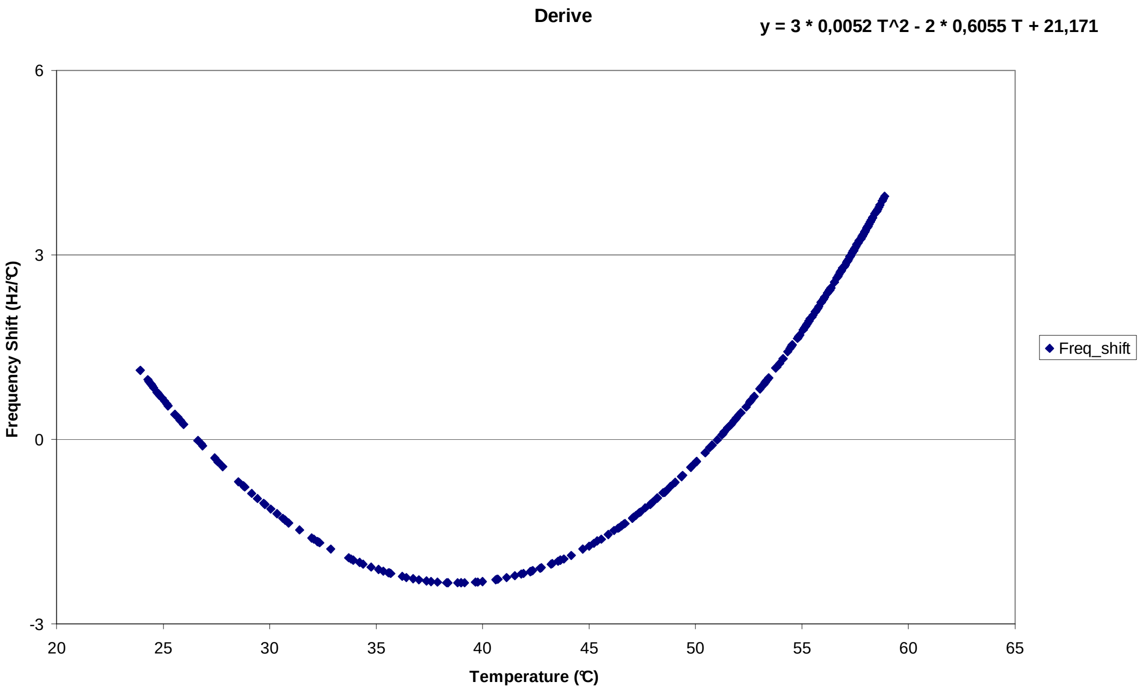

Figure 56 MBS2 Frequency shift (REDUNDANT)

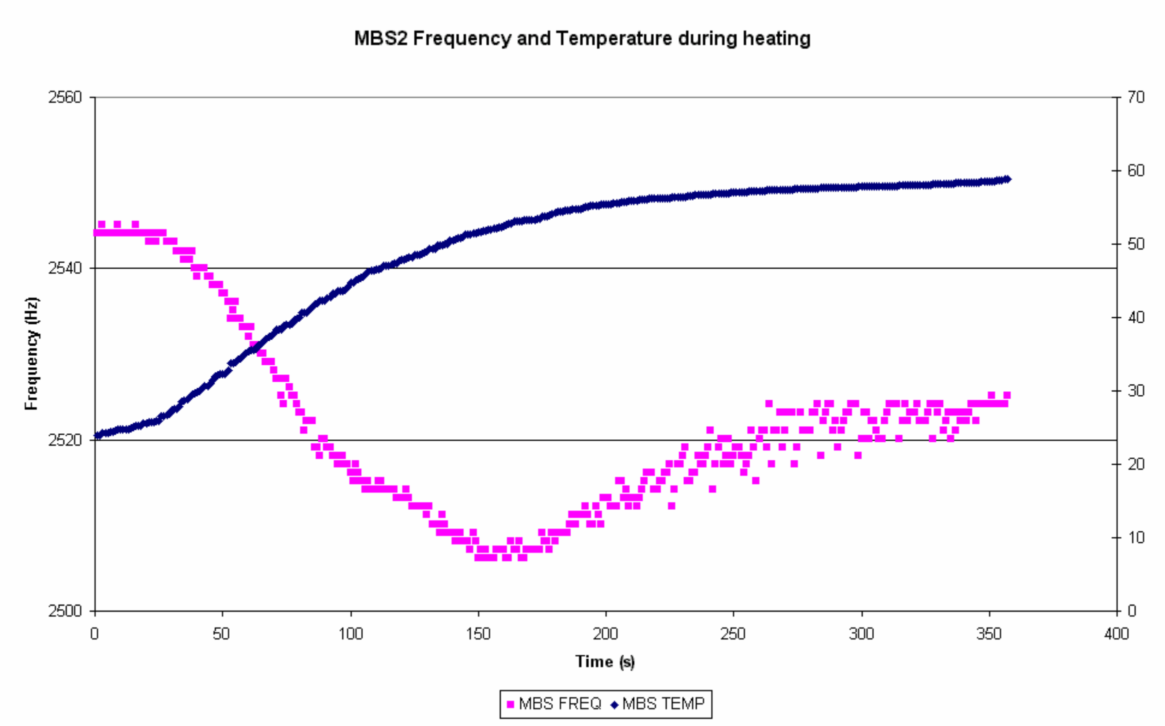

Figure 57 Frequency and Temperature during MBS2 heating (REDUNDANT)

6.2.3.3.3. MBS3 reading

As reported in Figure 58, the frequency value after the completion of the heating, when the temperature is returned to its initial condition, is different from the value before the start of the heating (measured ΔFrequency is about 11Hz). For MBS3, the frequency shift results inside the expected range (±3 Hz/°C).

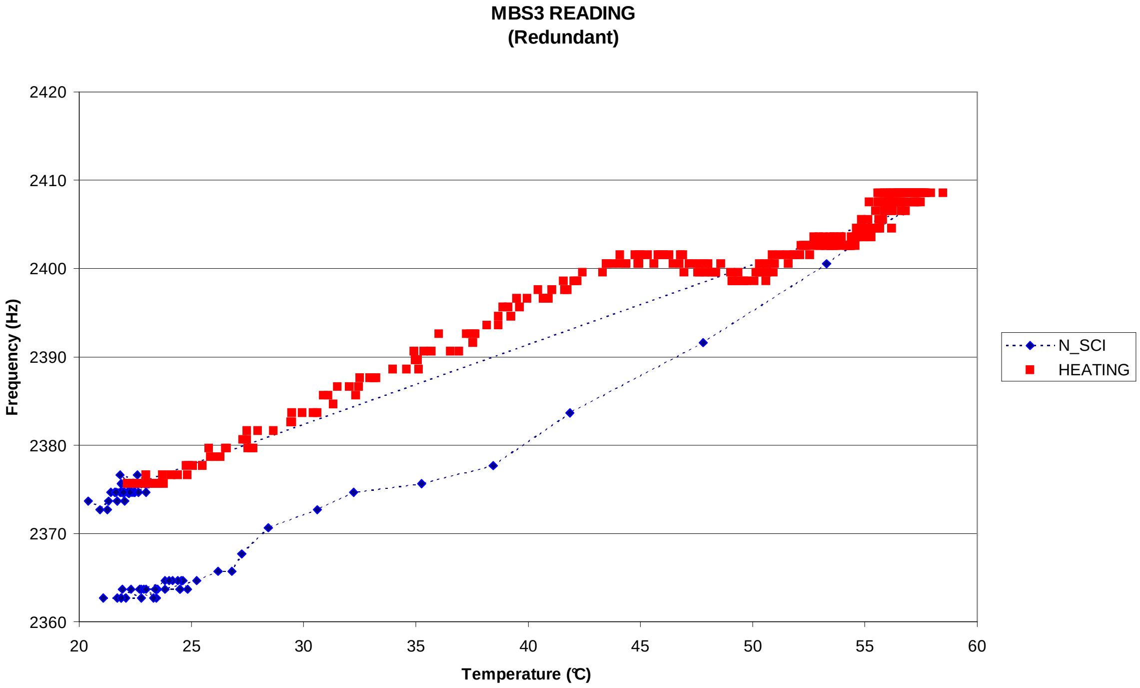

Figure 58 MBS3 Frequency wrt temperature in Normal Acquisition and heating (REDUNDANT)

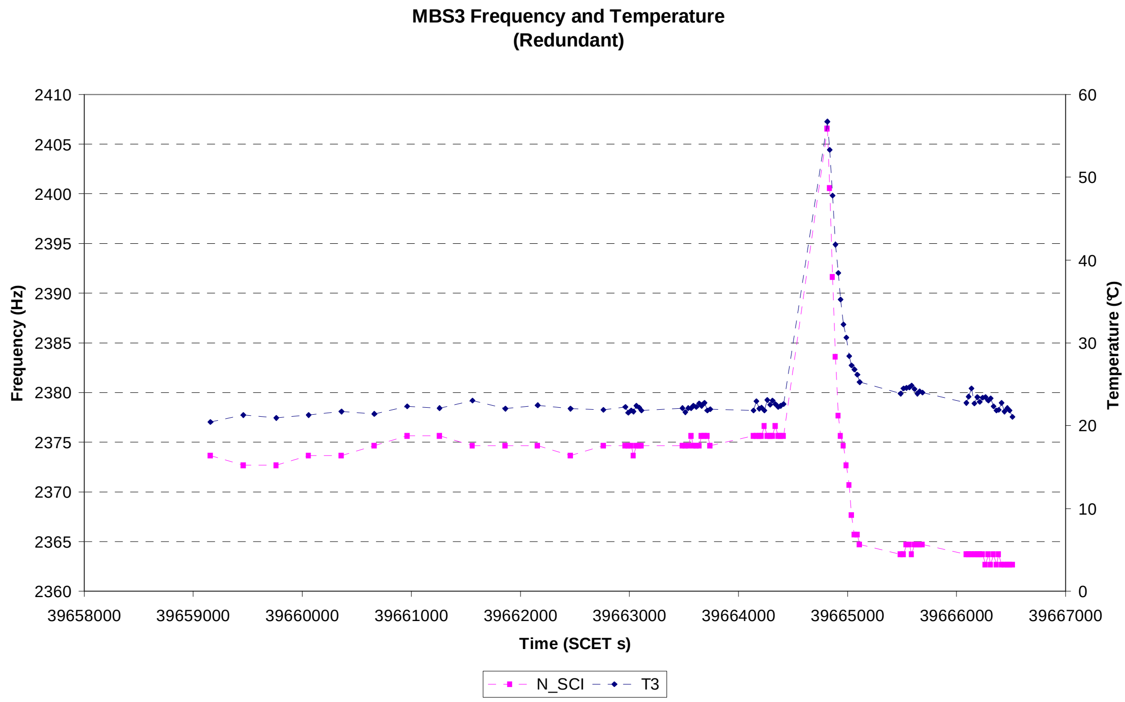

Figure 59 MBS3 Frequency and temperature wrt time (REDUNDANT)

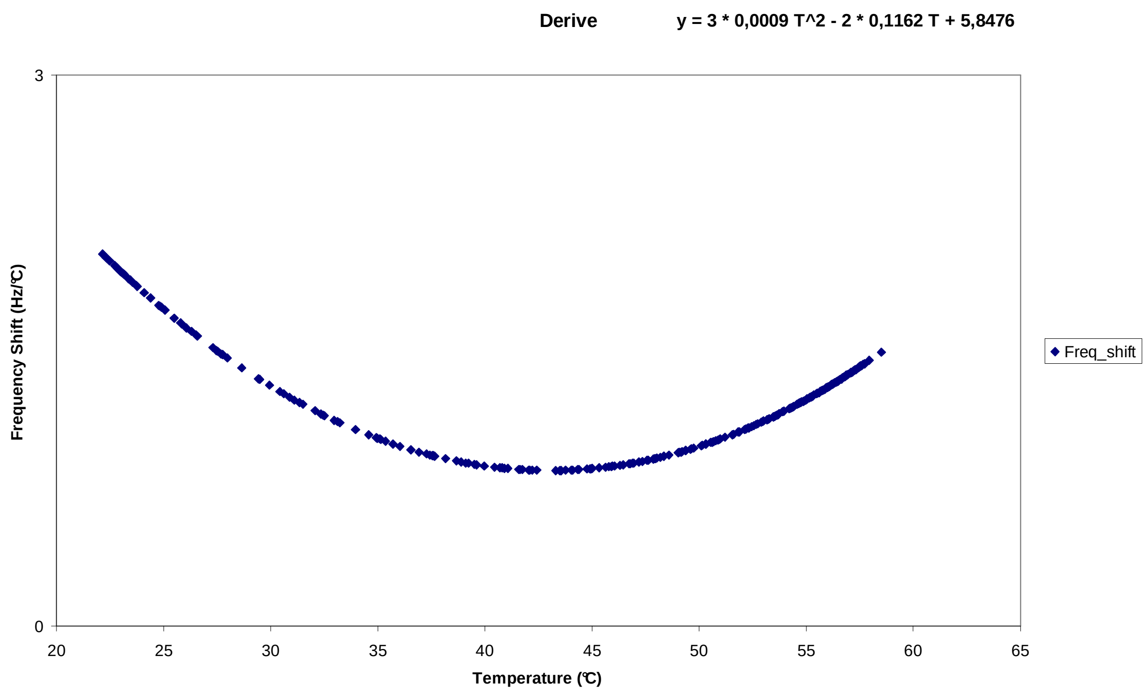

Figure 60 MBS3 Frequency shift (REDUNDANT)

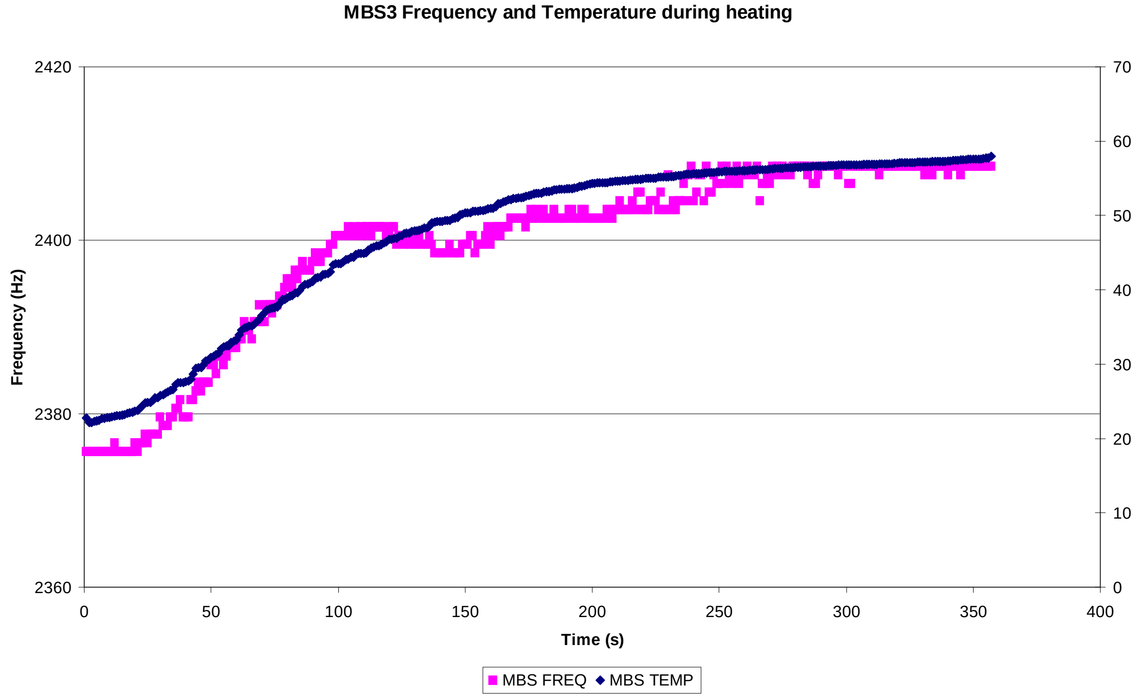

Figure 61 Frequency and Temperature during MBS3 heating (REDUNDANT)

6.2.3.3.4. MBS4 reading

As seen on MBS3, the frequency value after the completion of the heating, when the temperature is returned to its initial condition, is different from the value before the start of the heating (measured ΔFrequency is about 18Hz). For MBS4, the frequency shift results almost inside the expected range (-1/+4 Hz/°C respect to ±3 Hz/°C).

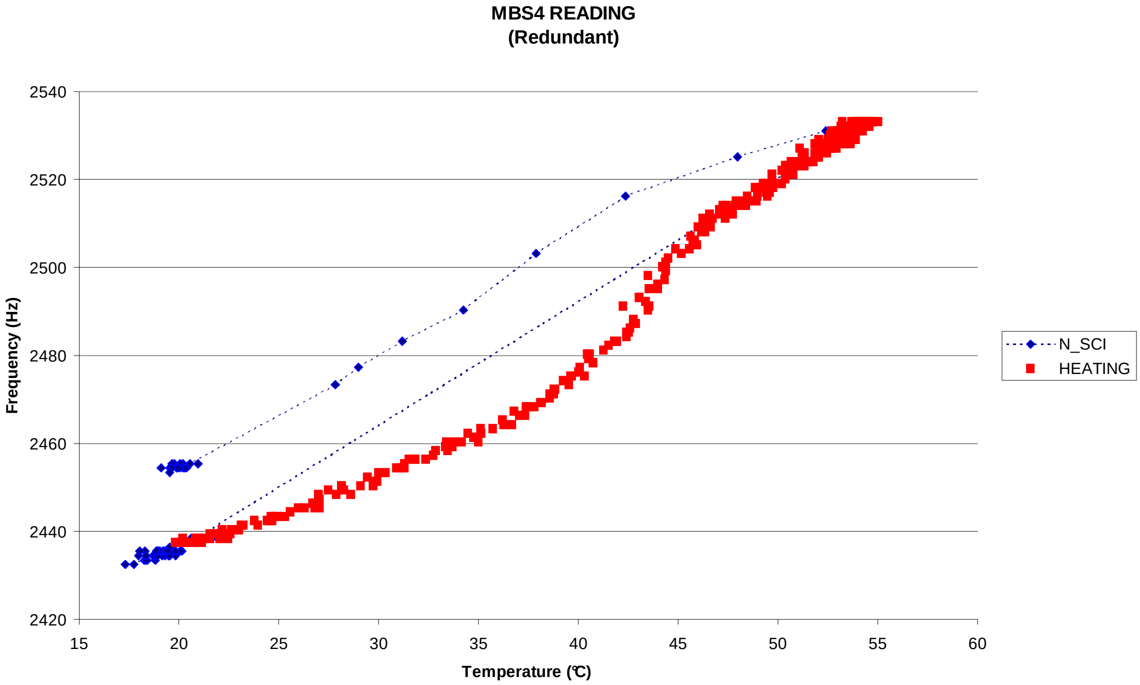

Figure 62 MBS4 Frequency wrt temperature in Normal Acquisition and heating (REDUNDANT)

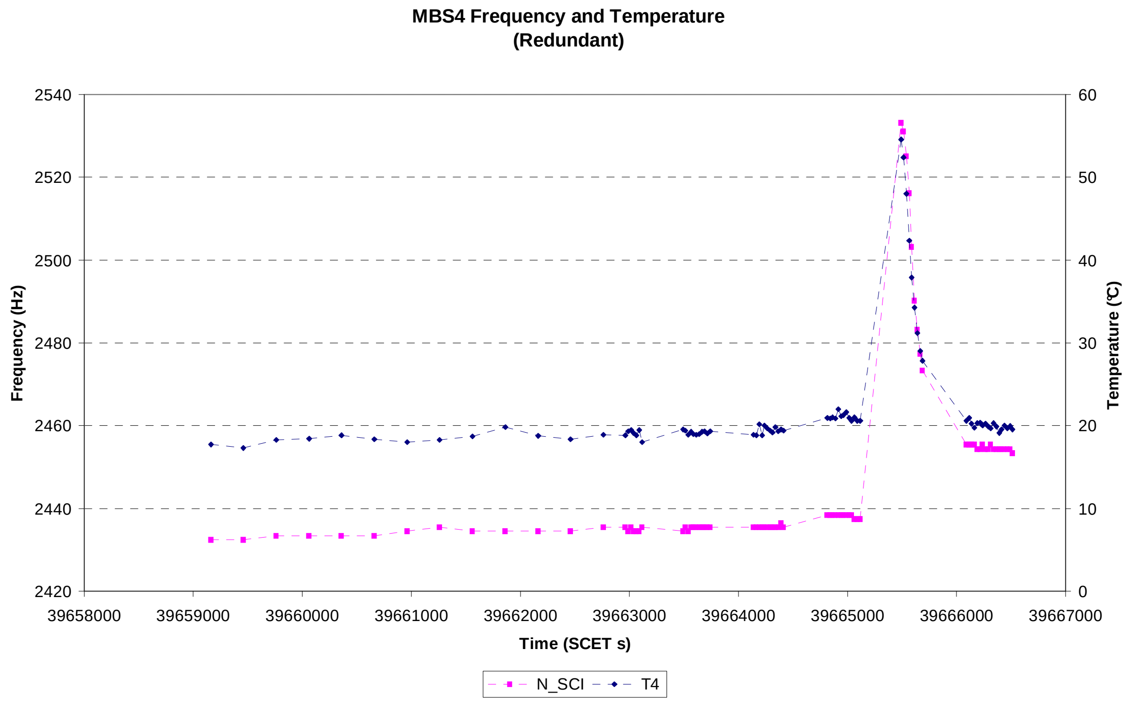

Figure 63 MBS4 Frequency and temperature wrt time (REDUNDANT)

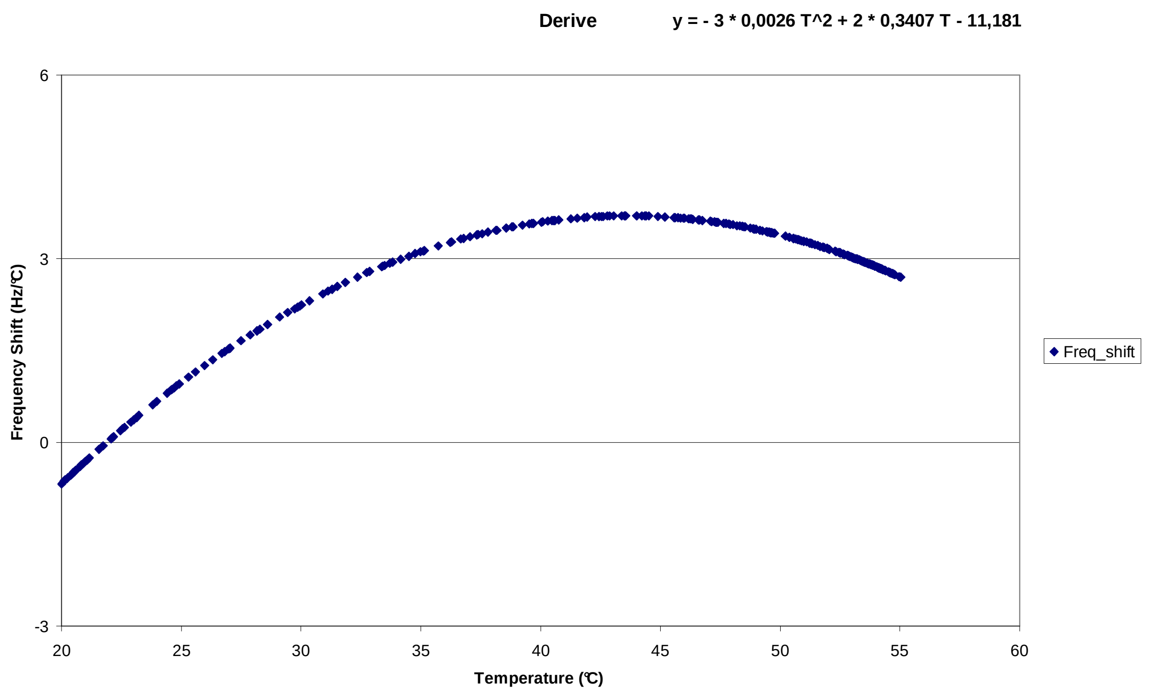

Figure 64 MBS4 Frequency shift (REDUNDANT)

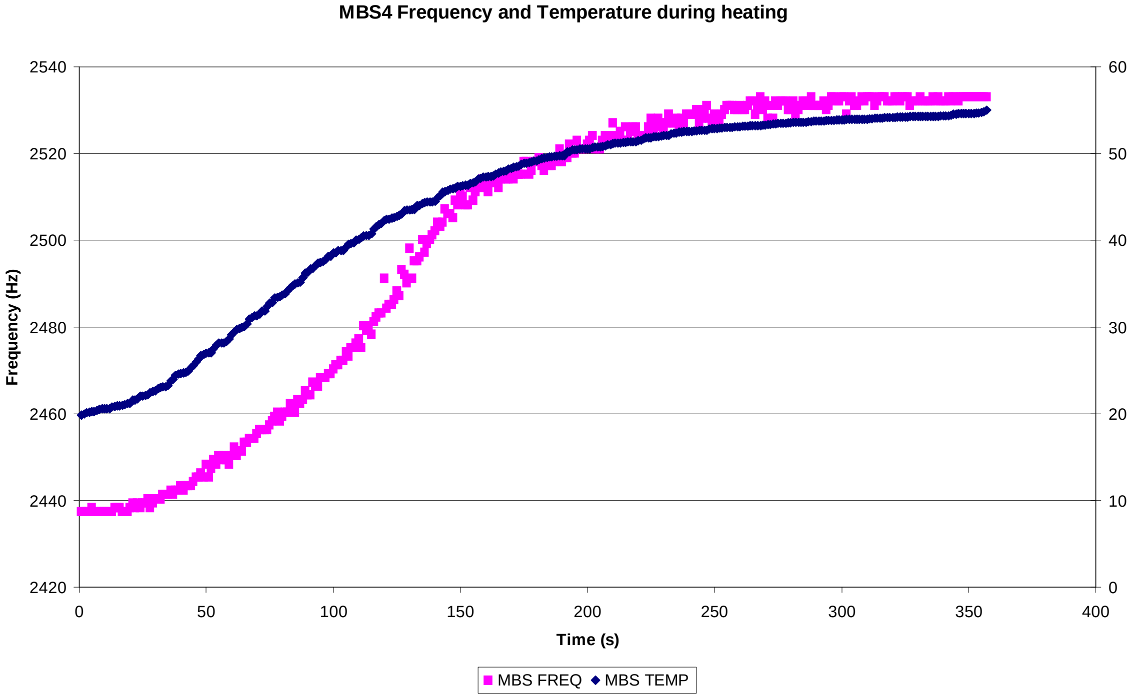

Figure 65 Frequency and Temperature during MBS4 heating (REDUNDANT)

6.2.3.3.5. MBS5 Reading

As seen on MBS3 and MBS4, the frequency value after the completion of the heating and when the temperature is returned to its initial condition, is slightly different from the value before the start of the heating (measured ΔFrequency is below of 6Hz). For MBS5, the frequency shift results almost inside the expected range (-1/+4 Hz/°C respect to ±3 Hz/°C).

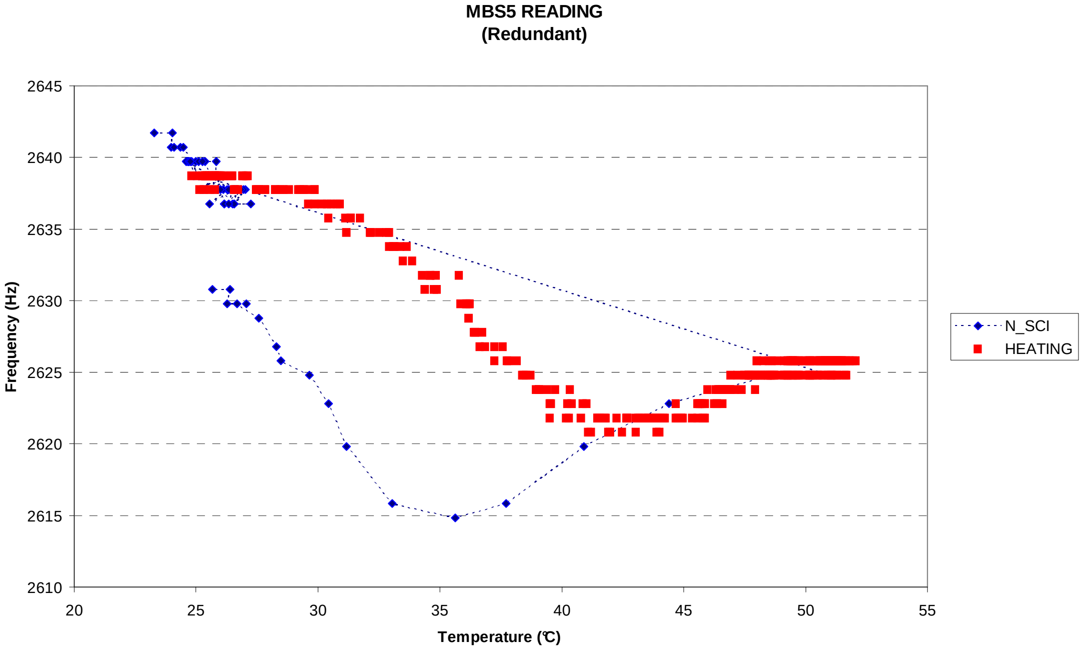

Figure 66 MBS5 Frequency wrt temperature in Normal Acquisition and heating (REDUNDANT)

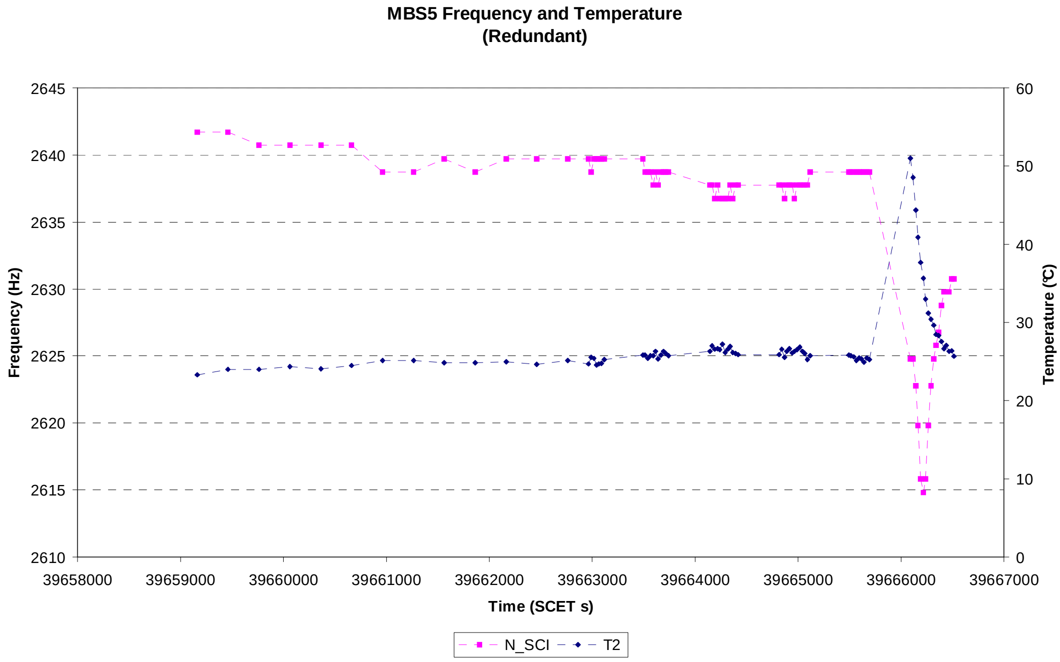

Figure 67 MBS5 Frequency and temperature wrt time (REDUNDANT)

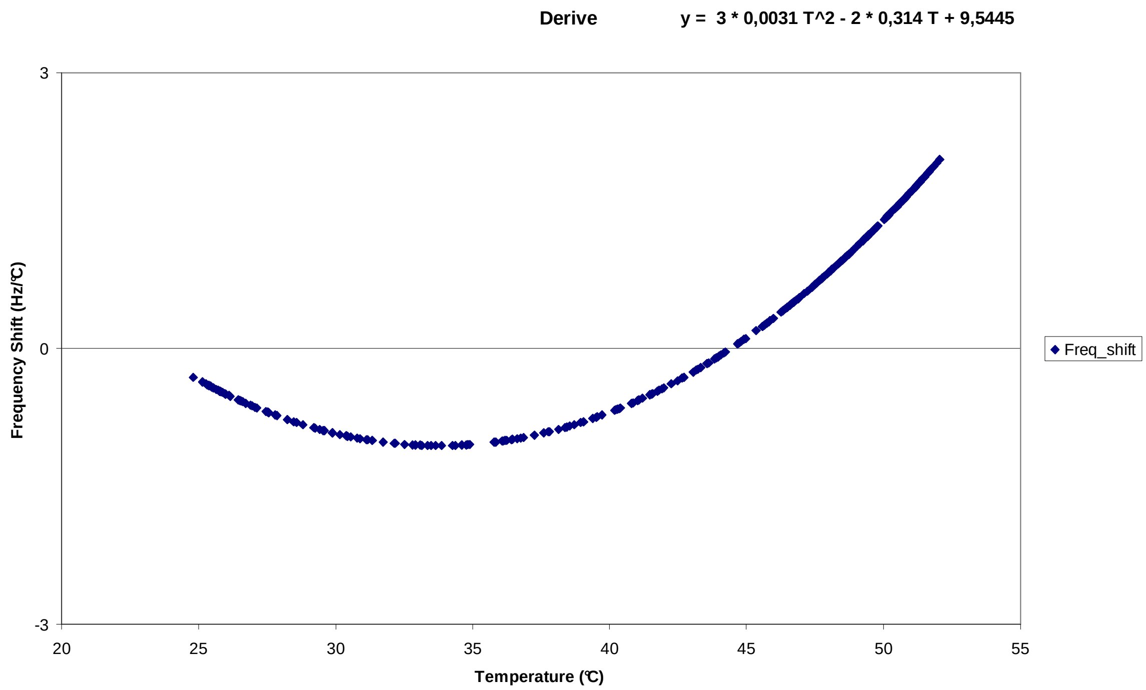

Figure 68 MBS4 Frequency shift (REDUNDANT)

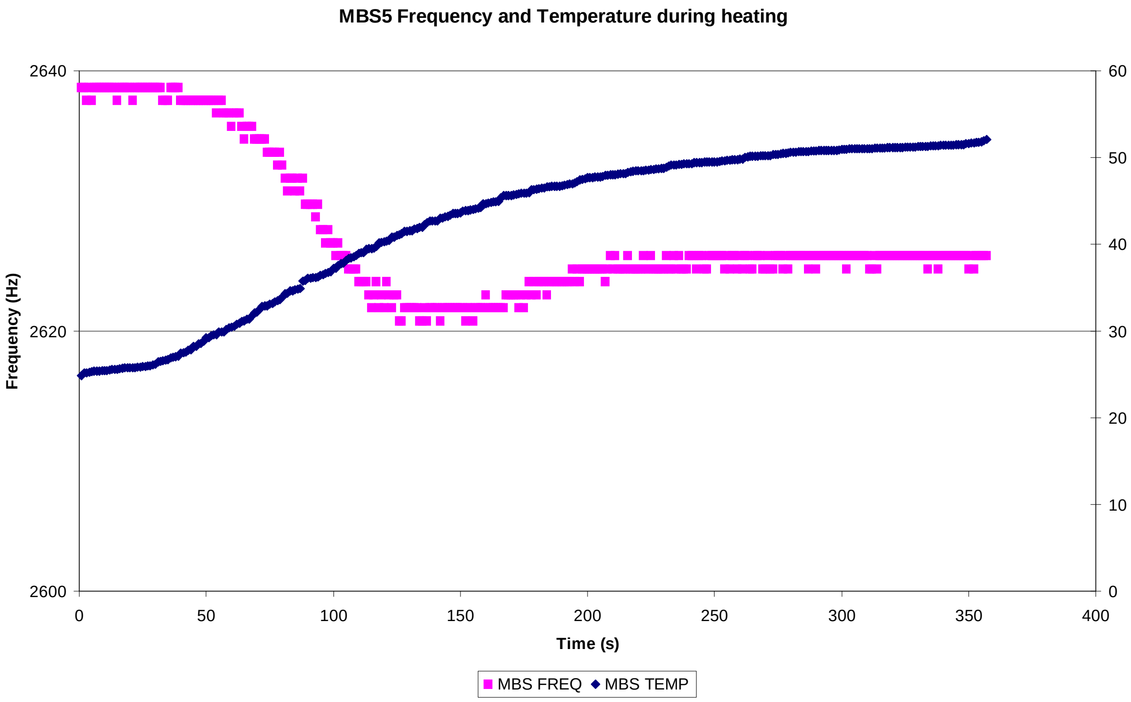

Figure 69 Frequency and Temperature during MBS5 heating (REDUNDANT)

6.2.3.4. HOUSEKEEPING SIGNALS ON SCIENCE PACKETS

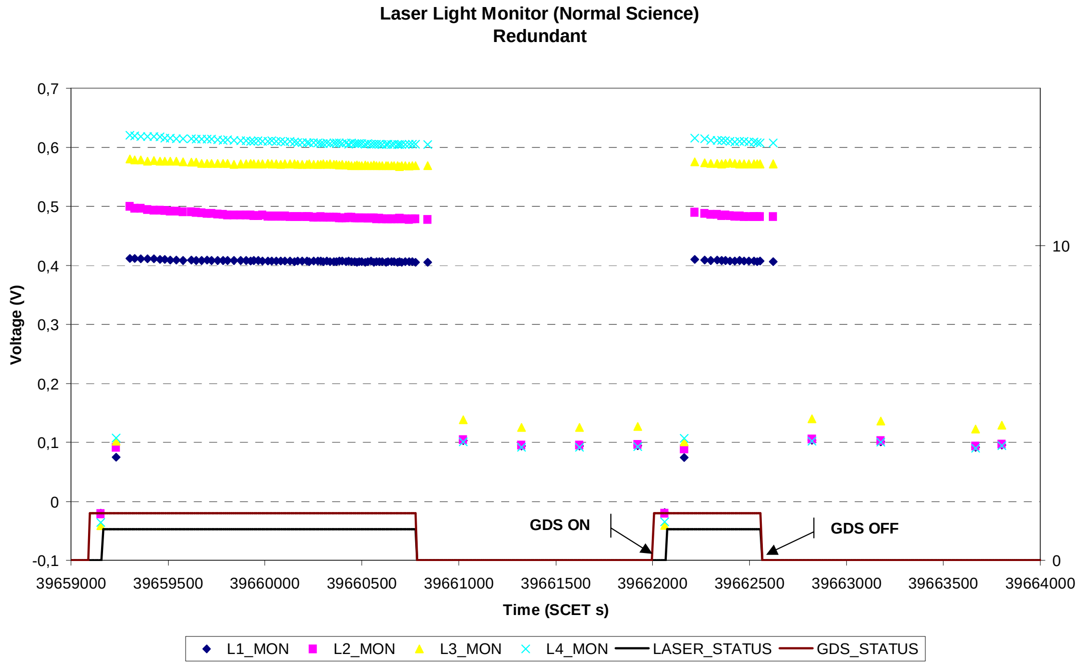

Figure 70 Laser lights monitor (Normal science packet) (REDUNDANT)

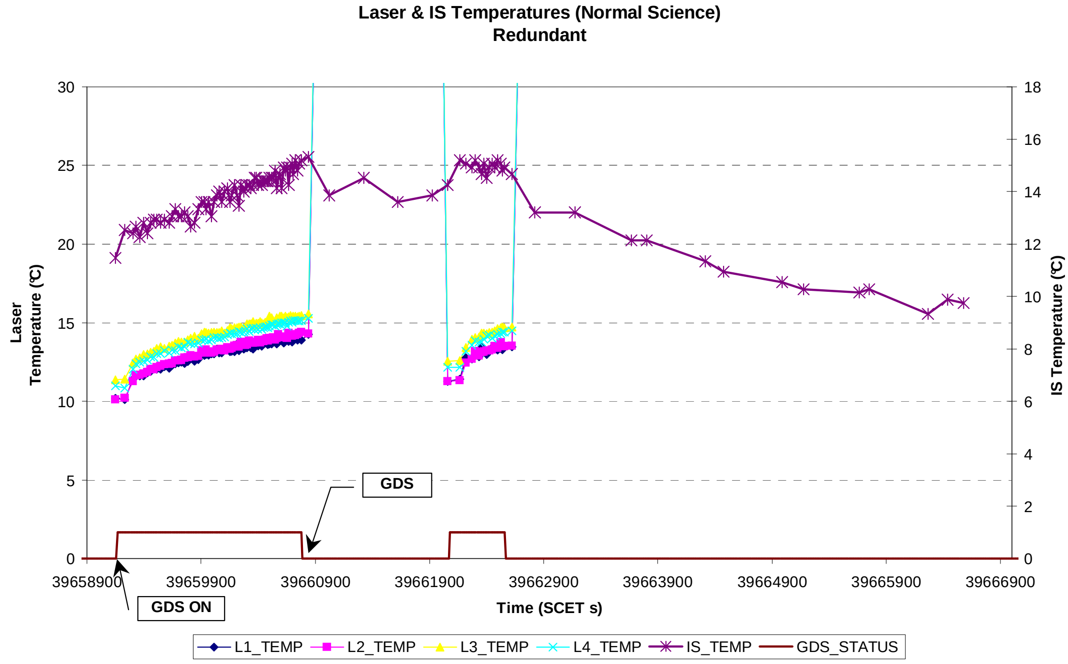

Figure 71 IS and Lasers temperatures (Normal science packet) (REDUNDANT)

6.3. THIRD PART – MAIN BUT SIX PATCHES INSTEADE OF THREE

6.3.1. ACTIVITIES LOG

The following activities have been performed in sequence

UTC	Description
4 Apr 2004 - 3:02	The next step is to switch ON now GIADA with the **new packing of patches**. The full sequence is sent with the prepared timing
4 Apr 2004 - 3:03	This switch on is done on the Main
4 Apr 2004 - 3:13	Now the patches status is **7F**: correct as 7 times 1 (1111111) is the number of uploaded patches
4 Apr 2004 - 3:14	All Dumps are received
4 Apr 2004 - 3:20	It is decided to go ahead according to the nominal procedure. The first step is Go to Safe although we are already in Safe mode: failure message is expected
4 Apr 2004 - 3:27	GIADA is switched OFF
4 Apr 2004 - 3:31	Check of Cover Report: nominal
4 Apr 2004 - 3:31	GIADA Commissioning completed successfully

The purpose of the test is to validate on flight model the new power-on procedure that will be used in a MTP (Mission Timeline Procedure), during the next commissioning block in October ‘04. In-fact during this part of commissioning, the instruments will be powered-on by MTP instead of ‘command stack’, i.e. a single command or a single command block is loaded in ‘real-time’ into S/C for next execution. The main difference, between the previous power-on procedure (that has been used during the two previous GIADA power-on) and the new one, is the length of the memory patch command that in MTP scenario are shorter than when this type runs through command stack. This means that the number of patches increases by three with respect to the previous number (i.e. four).

The GIADA switch-on procedure was applied selecting the Main I/F and with the option Context File already stored in SSMM (being this a 3rd switch-on and CF was stored into SSMM at the power-off procedure of the previous test). The Instrument was successfully powered-on by means of the GIADA POWER-ON OBCP procedure the 4th of April 2004 @ about 03:04:22.998764 (UTC time) which corresponds to a SCET Time of about 39668649.000000 sec.

The first TM packet was the normal progress event ‘GIADA in Safe mode’, which was received with synchronised SCET time. Note that, being powered-off with the reset of Virtual disk, the ‘EDAC Error during S/W Start and Dump’ event is not (as expected) received. The next packet was a synchronised HK report (default HK rate is 40s) and a ‘connection test report’ event. This means the GIADA power-on was successfully completed.

After completion of the power-on, the first patch (regarding the Context File) was sent and its dump report was successfully received.

Then six patches were sent and twenty-three successive memory dumps (via service 6,6) received. The content of memory dumps have been compared with the same packet received during the REDUNDANT I/F power-on. **As we can see in section 6.3.2.2, the conclusion is that the new power-on procedure is fully validated**. As expected, after the Context File patch, GIADA HK rate was changed to 10s rate.

Few minutes after, it has been decided to power-off GIADA by means of the nominal GIADA_FCP_060 procedure, in which GIADA goes first to SAFE mode (at this time, since GIADA was already in Safe mode, an Acceptance Failure Report has been received: 'Command can not be executed in the actual operation mode'), it dumps to ground the Context File and it is switched-off by means of the relevant OBCP.

The On-board procedure runs first the CLOSE_COVER_OBCP (with Cover and Motor Heaters Off) and then, at the end, puts again GIADA in SAFE mode, commands the storing the Context File in the SSMM (by means of the Report Context File Service), resets the Virtual Disk and finally it switches-off the instrument. The last received HK packet was time-tag with 03:25:52.694474 (UTC Time) corresponding to 39669938.695312 (SCET Time).

6.3.2. MEMORY PATCHES ANALYSIS

6.3.2.1. CONTEXT FILE COMPARE

This following text is the content of the dump memory of the Context File patch during the previous Redundant I/F power-on.

```
HEADER_START
CREATION_TIME=2004-04-03T23:04:45Z
USER=cosim0
HEADER_END
//
// Generated by 'GIADA_EGSE_SW '
//
MP_START
PROC_ID=5A
MEM_ID=51
NUM_BLOCKS=01
//
// Block N. 1
START_ADDRESS=0000903A
NUM_WORDS=0045
DATA=0000,1E00,0000,A105,A105,1E00,0000,6406,5802,0000,3200,AB00,AB00,7800,0000,7800,
     0000,03AF,1416,AFF5,DDFD,0000,0000,100E,0000,0F9F,B81A,0000,3500,0500,0505,0505,
     100E,0000,04F8,009F,4B0A,00F8,2C01,0000,F309,6801,0000,100E,0000,6D1A,CE1D,C719,
     0000,0000,0000,0000,3C00,0000,0A00,0000,2800,0000,0000,0000,0000,0100,2800,2800,
     0000,0000,0000,0000,DFC6
MP_END
```

The next is the same is the same dump, but acquired during the 2nd Main power-on. No differences are seen comparing the two images.

```
HEADER_START
CREATION_TIME=2004-04-04T03:07:34Z
USER=cosim0
HEADER_END
//
// Generated by 'GIADA_EGSE_SW '
//
MP_START
PROC_ID=5A
MEM_ID=51
NUM_BLOCKS=01
//
// Block N. 1
START_ADDRESS=0000903A
 NUM_WORDS=0045
 DATA=0000,1E00,0000,A105,A105,1E00,0000,6406,5802,0000,3200,AB00,AB00,7800,0000,7800,
    0000,03AF,1416,AFF5,DDFD,0000,0000,100E,0000,0F9F,B81A,0000,3500,0500,0505,0505,
    100E,0000,04F8,009F,4B0A,00F8,2C01,0000,F309,6801,0000,100E,0000,6D1A,CE1D,C719,
    0000,0000,0000,0000,3C00,0000,0A00,0000,2800,0000,0000,0000,0000,0100,2800,2800,
    0000,0000,0000,0000,DFC6
MP_END
```

6.3.2.2. SOFTWARE PATCHES COMPARE

The success criterion is to compare the memory dumps received before and after the procedure modification; if they are the same it means the second set of the memory patches has been fully validated.

As example, the first comparison is shown: the following is the content of the first dump memory received during the previous Redundant I/F power-on.

```
HEADER_START
CREATION_TIME=2004-04-04T03:11:51Z
USER=cosim0
HEADER_END
//
// Generated by 'GIADA_EGSE_SW '
//
MP_START
PROC_ID=5A
MEM_ID=51
NUM_BLOCKS=01
//
// Block N. 1
START_ADDRESS=00006A72
NUM_WORDS=0039
DATA=558B,EC83,EC06,8B5E,048B,4706,B108,D3E8,B400,8B57,06B6,00D3,E203,C289,46FE,C746,
  FC00,00C7,46FA,0000,8B5E,048B,5702,8B47,0489,56FC,8946,FA8B,46FC,8B56,FA3B,060E,
  DA72,0D77,063B,160C,DA76,05B8,0100,EB1D,8B46,FC8B,56FA,3B06,0EDA,750F,3B16,0CDA,
  7509,8B46,FE3B,060A,DA73,E033,C08B,E55D,C3B8
MP_END
```

The next is the same dump, but acquired during the 2nd Main power-on.

```
HEADER_START
CREATION_TIME=2004-04-03T23:09:27Z
USER=cosim0
HEADER_END
//
// Generated by 'GIADA_EGSE_SW '
//
MP_START
PROC_ID=5A
MEM_ID=51
NUM_BLOCKS=01
//
// Block N. 1
START_ADDRESS=00006A72
NUM_WORDS=0039
DATA=558B,EC83,EC06,8B5E,048B,4706,B108,D3E8,B400,8B57,06B6,00D3,E203,C289,46FE,C746,
  FC00,00C7,46FA,0000,8B5E,048B,5702,8B47,0489,56FC,8946,FA8B,46FC,8B56,FA3B,060E,
  DA72,0D77,063B,160C,DA76,05B8,0100,EB1D,8B46,FC8B,56FA,3B06,0EDA,750F,3B16,0CDA,
  7509,8B46,FE3B,060A,DA73,E033,C08B,E55D,C3B8
MP_END
```

No differences are seen comparing the two images. The criterion has been applied to all the dumps and again no differences have been found. **The conclusion is that the modified power-on procedure is fully validated.**

6.3.3. HOUSEKEEPING DATA ANALYSIS

6.3.3.1. GENERAL

As we can see in the following pictures, the GIADA experiment behaved correctly along the test. The current consumption and the Power Supply temperature are in the expected range. The Power supply temperature increases of about 5°C from the power-on and reaches its steady state @ about 18°C, being GIADA always in Safe mode with all sub-systems switched off. The IS temperature remains stable around 8°C being the sensors always switched-off. In Safe mode, the Lasers and MBS remains off and the relevant temperatures are not read. No missing HK packets have been observed during the test.

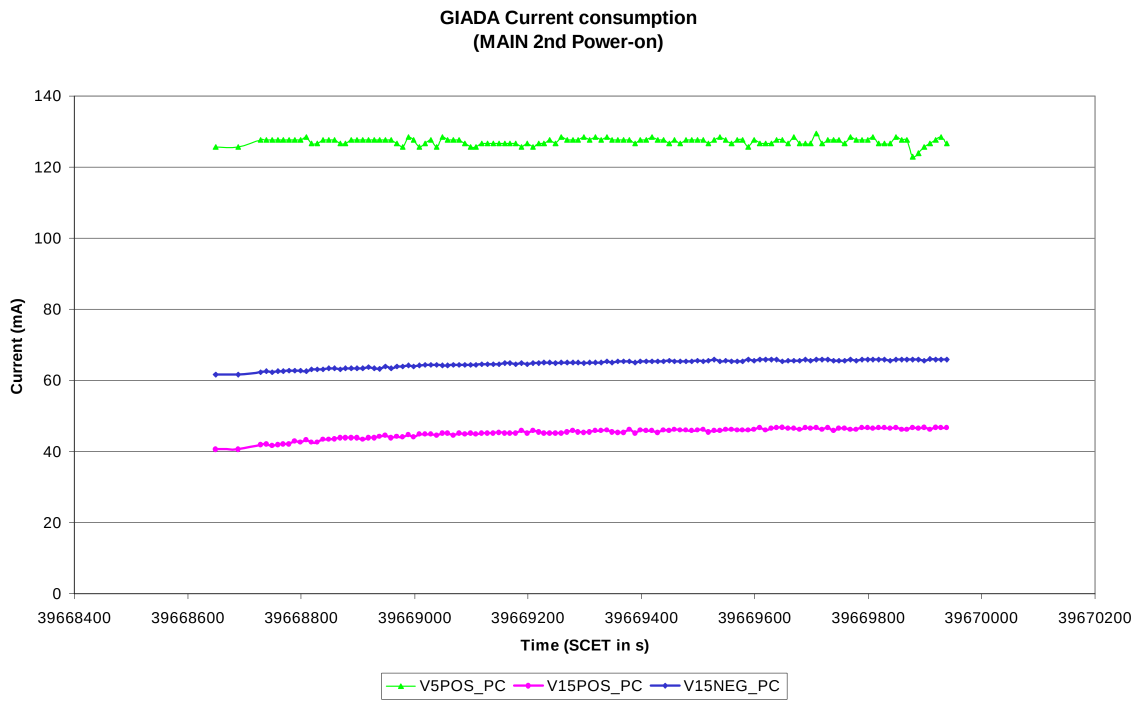

Figure 72 Current consumption on +5V, ±15V power supplies (MAIN 2nd power-on)

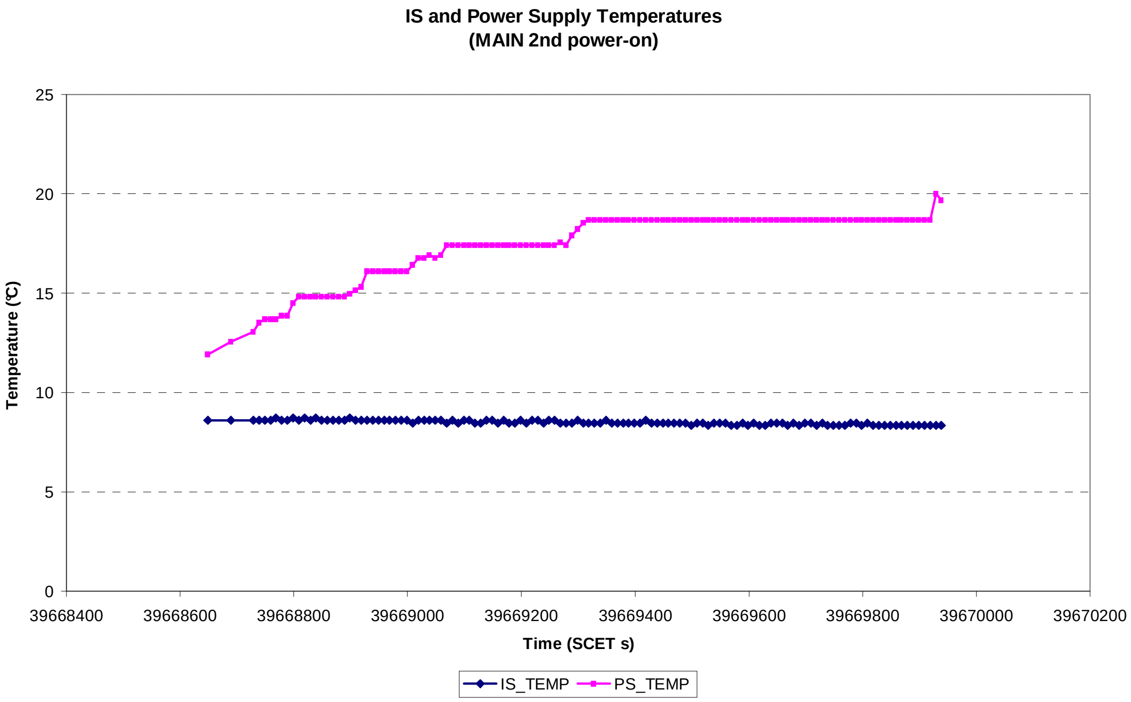

Figure 73 IS and Power Supply temperatures along the test (MAIN 2nd power-on)

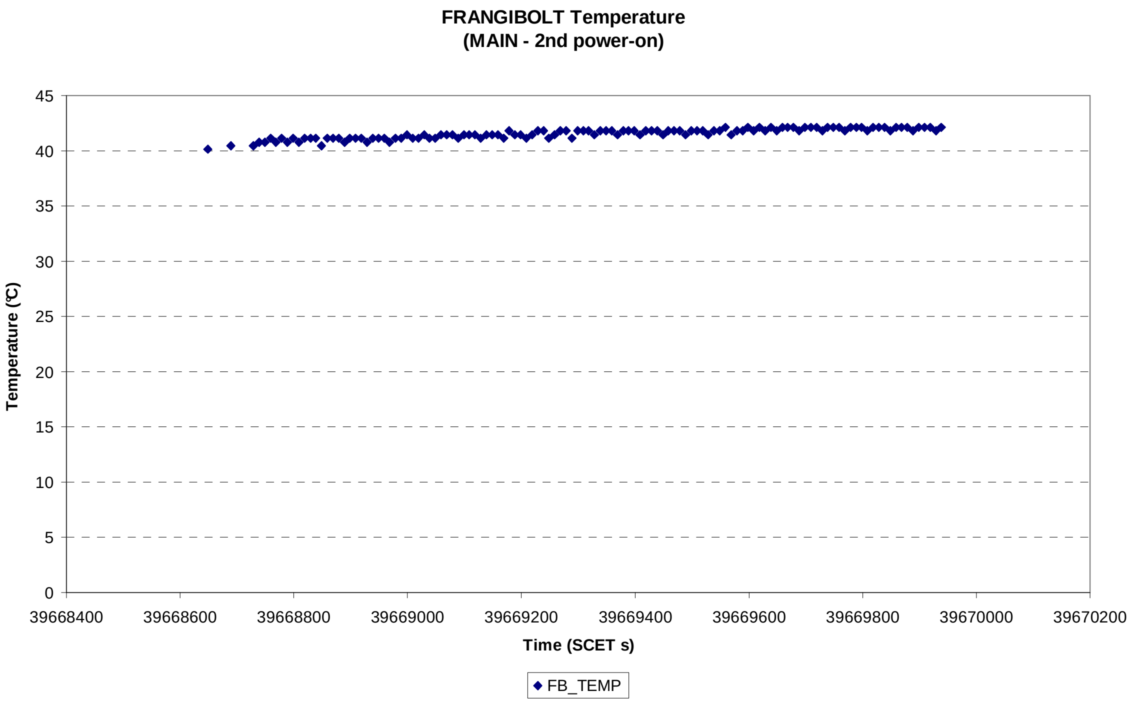

Figure 74 Frangibolt Temperatures (MAIN 2nd power-on)

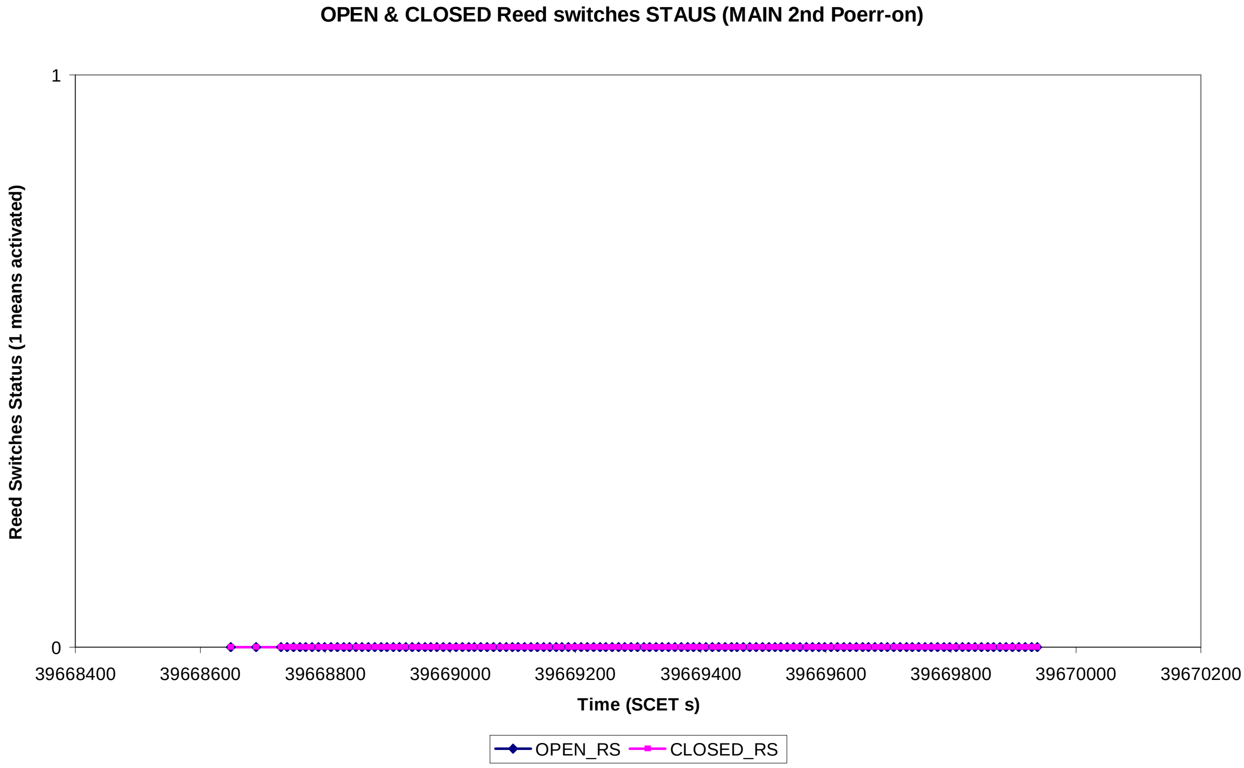

Figure 75 Status of Reed switches as extracted from Housekeeping TM (MAIN 2nd power-on)

6.3.3.2. COVER CLOSE OPERATIONS

During the power-off operation, GIADA cover is automatically closed by the OBCP (Close Cover) despite its real position. Since the cover was already closed, the new close cover operation resulted (as expected) in a continuous cover bunching over the cover support. This is the reason of the status of the two reed-switches shown in Figure 76, in which the reed switch indicating the Cover-Open position remains always not active and the other is activated several time. In fact, after a bunch on the cover support, the cover returns back and the reed switch indicating the Cover-Close position is newly activated. Considering its last status and the actual movement direction, the cover results at the end in closed position when the reed switch passes from activated to not-activated condition.

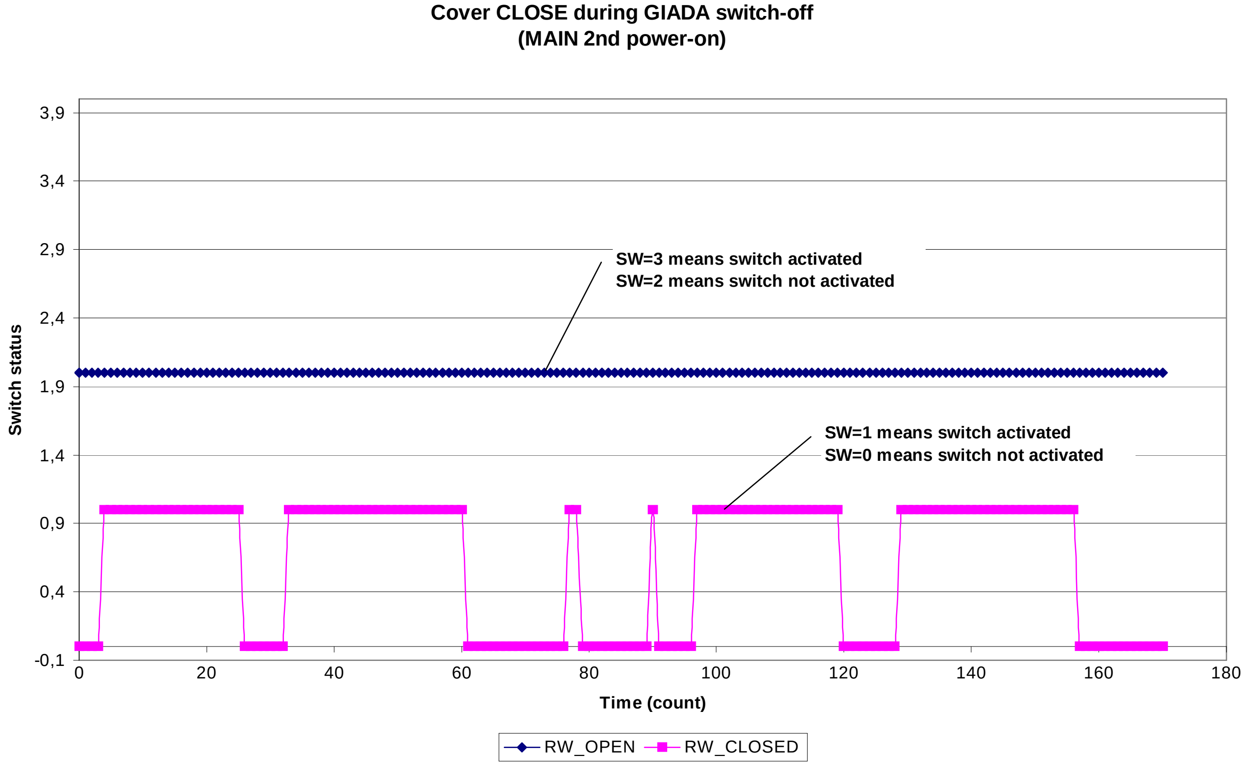

Figure 76 Reed switches Status - Cover Close operation @ power-off (MAIN 2nd power-on)

7. CONCLUSION

The GIADA commissioning can be sub-divided in three main sections:

- The first, in which the Main I/F has been successfully commissioned. No anomalies have been detected along the test on GIADA with protective cover closed.
- The second, in which the Redundant I/F and the internal detection sub-systems have been commissioned. The Frangibolt device has been activated and the protective cover has been successfully unlocked. The protective cover was fully open at the 2nd attempt (most probably the reason is due to possible cover sticking, refer to section 6.2.2.3) and was closed without any problem. The sub-systems have behaved correctly and no major discrepancies were found. A more refined control of the acquired data will require a more detailed comparison with those taken during on-ground calibration and test,
- The last, in which a new procedure (seven patches instead of the nominal four) has been successfully validated for next GIADA in-flight test.

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

- The following two points are raised on UTC time tag:
  - The UTC time of a synchronised packet is about 14s greater than the packet SCET time.
  - The UTC time of unsynchronised packet (reconstructed and assigned by ground segment) is about 2.8s delayed with respect to that of synchronised packet.

  The explanation of these two delays has to be checked with ESOC Control Centre.
- The GIADA internal stray-light is definitely higher than the detection threshold of the Left receiver, but it has not changed from the last test performed in Kourou. The possible recovery action to avoid the on-ground reception of a flood of 'GDS ghost events' (when the cover is open) is to increase the detection threshold on Left receiver. **It is suggested to wait the completion of the next commissioning tests, in particular the 'stray-light' test, to decide the new detection threshold**.
- For the Cover open operation; it is suggested to monitor the operation during the next in-flight test. In case of a systematic behaviour (i.e. number of steps to open greater then those to close the cover), it is suggested to modify the 'number of step to open' parameter in the Context File.
- The internal GIADA temperatures seem in the nominal range, even when the cover was open for few hours. However, since the cover is not completely closed (few millimetres above the GIADA support), it is suggested ***to monitor the TRP to see if its value is changed (decreased) from the date of the commissioning***.
- The behaviour of the MBS is nominal. It is suggested to monitor the variation of the reading frequencies with respect the temperature during the next tests.

- The Dust flux indication was, as expected, close to 0 (i.e. no IS detection) except during the sub-systems power-on/off, during which, in any case, it was always below 4 units. The Dust Flux indication will be monitored during the next in-flight test.
- IS internal calibration on Channel A, B, D and E has resulted stable and repeatable, while on Channel C the measurements were not completely satisfactory (the delay time and amplitude were not stable). It is suggested, during the nest commissioning phase, to repeat several times the IS calibration with different detection thresholds on channel C, to check the behaviour of the channel.

The final point refers to a needed optimisation in number and size of the Memory Load Command to upload the software patches. This optimisation has to be done in the future when new patches should be necessary, to avoid as much as possible the loose of memory space in the patch storing area (NVRAM). In-fact, using the new power-on procedure (refer to section 6.3), **six** commands are needed instead of the **three** commands, as foreseen in the original power-on procedure. Therefore in the present configuration (new power-on procedure), it will remain only 57 free areas in NVRAM (to store new software patches), respect to the 60 with the original power-on procedure. **To perform this optimisation the maximum number of words for each Memory Load Command must be known (action to ESOC Mission Control Centre).**