INAF
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LFI Project System Team

Planck LFI

TITLE:	**Quick Look Data Analysis of LFI from CRYO-02 functional test**	
DOC. TYPE:	**Test Report**	
PROJECT REF.:	**PL-LFI-PST-RP-046**	**PAGE: I of IV, 19**
ISSUE/REV.:	**1.0**	**DATE: August 2008**

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CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.1	21-08-2008		Draft issue: quick look analysis	0.1
1.0	15-09-2008		First Issue: minor revisions	

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1 ACRONYMS

AIV	Assembly Integration Verification
ASW	Application Software
BEM	Back End Module
BEU	Back End Unit
CCS	Central Check-out System
CDMU	Central Data Management Unit
DAE	Data Acquisition Electronics
DPU	Digital Processing Unit
EGSE	Electrical ground Support Equipment
FEM	Front End Module
I-EGSE	Instrument EGSE
IST	Integrated Satellite Test
OBC	On Board Clock
RAA	Radiometer Array Assembly
REBA	Radiometric Electronic Box Assembly
S/C	Spacecraft
SCOE	Spacecraft Control and Operation System
SPU	Signal Processing Unit
SUSW	Start- Up Software
SVM	Service Module
TBA	To Be Added
TBC	To Be Completed
TBW	To Be Written
TC	Telecommand
TM	Telemetry
UFT	Unit Functional Test

2 INTRODUCTION

This document ha sbeen issued in the frame of ASI contract that has been released for the activities of Planck-LFI Phase E2

2.1 Purpose and Scope

Scope of this document is to give a first quick look analysis response of the functionality of the LFI instrument during its first Functional cryogenic Test in nominal conditions (CRYO 02) performed in CSL- Liegi on July 2008 the 6th .

2.2 Test configuration

The test configuration is the following (TBC)

SCOS 2 K HPCCS Version 2.0.787
LFI Gateway Version V0R9P1
TQL 3.1.2
LIFE Machine version OM 3.00

LFI Personnel involved during the test is:

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3 APPLICABLE AND REFERENCE DOCUMENTS

3.1 Applicable Documents

[AD01] LFI Short Functional Test Procedure (SFT)
HP-LFI-PST-PR_018 Issue 3.0

[AD02] TV-TB LFI test procedure
PL-LFI-PST-PR-021

3.2 Reference Documents

RD 1. LFI Short Functional Test Procedure (SFT)

RD 2. LFI Warm Functional Test Procedure (WFT)
PL-LFI-PST-RP-017

RD 3. HP-LFI-PST-PR_018 Issue 3.0

RD 4. PL-LFI-PST-TN-0082 (1.0) Analysis of Signal Swap in output of Channel 2510 (Action#4 H-PTASF-MN-9737)

RD 5. PL-LFI-PST-TN-080 (1.0) Proposal for LFI test dedicated to characterize New Spikes in the FFT spectrum of Scientific Data

4 CRYO 02 test Execution

The test is from a procedural point of view the same of AMB 02 already performed in THAS-F Cannes during the functional test campaign in warm conditions and to the CRYO 02 performed in THALES Milan during ILT test campaign: some results shall be here compared with those coming from this test
The entire test is divided into modular blocks: for each block test results and conclusions are presented.

4.1 Starting point:

CRYO 02 is performed with the LFI already on from the previous section where the contingency procedure was applied to verify FEM drain currents (test file XXX_0153). The FPU temperature is nominal after the SCS TSA has been tuned (test file XXX_0152): the FPU temperature fluctuation on LVHX2 is about 70 mK peak to peak . FPU Temperature was around 20K (XX TBC) that is much lower (by about 6.5 K) than during the same ILT test (26.2 K). Also the BEU temperature is sensibly lower (9.9 C against about 30 C in ILT)

These differences can imply several consequences:

FEM drain currents are different implying different gain and consequently different power flowing the RF chain up to the BEMs: differences depend on the channels considered since they have a different response depending on the architecture of radiometers.
Voltage outputs (scientific output) are different because of the gain changes in BEU amplifiers with temperature. Also in this case as for the FEMs the qualitative behaviour vary according with the architecture of each device (but amplifiers operating in the same frequency range respond observing to a same rule).
4KRL Temperature: is different than during ILT (23.3 K against TBC K)
SKY Load temperature is lower than in ILT(4.5 K vs. 27 K)

The initial configuration is summarized in the following table

LFI	*HFI*	*SCS*	*SVM*	*4K stage(K)*	*SKL (K)*	*FPU (K)*	*LBEM (C)*	*RBEM (C*
ON	ON	ON (TSA)	TBC	23.25 K	4.5	20 K	TBC	9.9 K

The bias configuration adopted for the test is the cryo default coming from ILT with the exception of RCA 24 M1 that was changed from 234 DEC to204 DEC: actually the value 234 DEC at ILT came from a tuning performed with RCA 24 M1 Vg1 suffering a failure. The final table used is however reported in the tables below.

In several cases DAE saturation was observed due to the high voltages: DAE gain and offset were so changed in accordance with needs. The changes were required to allow the full execution of the test.
The table of the values used is reported below.

	R0D0	R0D1	R1D0	R1D1
Rca 27	21	0	51	92
Rca 28	102	41	112	143
Rca 24	255	255	255	255
Rca 25	255	255	255	255
Rca 26	255	255	255	255
Rca 18	0	0	204	204
Rca 19	214	204	255	224
Rca 20	204	204	153	143
Rca 21	194	204	255	255
Rca 22	255	255	255	255
Rca 23	173	122	255	255

Table: DAE GAIN – OFFSET

A new TQL section was open : the file collecting the test is XXX_0154

4.2 Procedure/Test sequence

The test sequence followed is described in the table below. Channels have been operated all at the same time changing the P/S and 4KHz polarization in a wise to check functionality for all the possible configurations available.
For each different status data have been registered for 30 minutes.

		Radiometric functional tests			3.14.00
TS4		RCA Activation		0.05.00	0.05.00
		Wait for thermalization of the power group		0.30.00	0.30.00
		Configure DAE (Switch ACA on)		0.02.00	0.02.00
		Wait for thermalization of the FPU		0.15.00	0.15.00
		Acquiring data		0.10.00	0.10.00
		Enable 4Khz switching ON A/C		0.02.00	0.02.00
		Acquiring data		0.30.00	0.30.00
		change P/S status on B/D to 1		0.02.00	0.02.00
		Acquiring data		0.30.00	0.30.00
		Disable 4Khz switching ON A/C		0.02.00	0.02.00
		change P/S status on A/C and B/D to 0		0.02.00	0.02.00
		Enable 4Khz switching ON B/D		0.02.00	0.02.00
		Acquiring data		0.30.00	0.30.00
		Conf . Polar : change the A/C Status to 1		0.02.00	0.02.00
		Acquiring data		0.30.00	0.30.00

4.3 Pass /fail criteria

No unexpected event-packets
FEM current consumption as expected
FEM power consumption as expected
All the FEMs respond as expected when the P/S and 4KHz are exercised in different status.

4.3.1 Results and Conclusions

Session saved in test file **XXX_0154**

Pass and Fail Criteria

No un-expected event Packets	PASSED
REBA Power Consumption within the ranges of expected values	PASSED
DAE Power Consumption within the ranges of expected values	PASSED
P/S functionality	PASSED
4KHz functionality	PASSED
The FEM I Drain Currents obtained from Telemetry are within the ranges expected (5%)	NOT PASSED *
No unexpected features (apart from those already known) in FFT spectrum (Spike Pop corn noise currents drops…)	Analysis on going: extra features section to be fulfilled

For * look at next sections of the document

notes	Description
	Observed some fluctuations in the scientific output
	Wrong assignation in tag sky/ref observed in RCA 28 when A/C switching: problem already known from ILT
NCR	High drain currents in several cases

RCA #	Detector ID			SCOS Parameter	CRY002
CH27	00	00	M1	LM051322	8,2
	01	01	M2	LM052322	7,8
	02	10	S1	LM053322	8,5
	03	11	S2	LM054322	8,7
CH24	04	00	M2	LM055322	7,2
	05	01	M1	LM056322	10,08
	06	10	S2	LM057322	15,06
	07	11	S1	LM058322	10,72
CH21	08	00	S2	LM059322	16,5
	09	01	S1	LM060322	18,8
	0A	10	M1	LM061322	19,3
	0B	11	M2	LM062322	20,1
CH22	0C	00	S2	LM063322	16,3
	0D	01	S1	LM064322	16,05
	0E	10	M1	LM065322	12,9
	0F	11	M2	LM066322	14,9
CH23	10	00	S2	LM067322	16,1
	11	01	S1	LM068322	20,4
	12	10	M1	LM069322	16,6
	13	11	M2	LM070322	17,5
CH25	14	00	M1	LM071322	12,2
	15	01	M2	LM072322	10,1
	16	10	S1	LM073322	11,2
	17	11	S2	LM074322	12
CH28	18	00	M1	LM075322	9,66
	19	01	M2	LM076322	9,2
	1A	10	S1	LM077322	8,8
	1B	11	S2	LM078322	10,47
CH20	1C	00	S2	LM079322	20,5
	1D	01	S1	LM080322	18,8
	1E	10	M1	LM081322	20,9
	1F	11	M2	LM082322	20,7
CH19	20	00	S2	LM083322	17,9
	21	01	S1	LM084322	17,2
	22	10	M1	LM085322	16,8
	23	11	M2	LM086322	18,8
CH18	24	00	S2	LM087322	20,7
	25	01	S1	LM088322	20,8
	26	10	M1	LM089322	13,2
	27	11	M2	LM090322	13,8
CH26	28	00	M2	LM091322	11,6
	29	01	M1	LM092322	11,3
	2A	10	S2	LM093322	10,4
	2B	11	S1	LM094322	13,4

Drain currents : in red RCA 24 M1 was changed from 234 to 204 after contingency procedure (test file XXX_0153) and according with nominal drain current from manufacturer. In light blue RCA 18 (½ FEM changed during ILT (Y 2006): no comparison is possible with previous tests.

RCA #		CRYO02	HARD LIMIT		SOFT LIMIT		DELTA %	Measured LIS 014	Measured TUN Vg2
CH27	M1	8,2	7,36	8,14	7,60	7,91	5,81	7,8	7,7
	M2	7,8	7,03	7,77	7,25	7,55	5,41	7,4	7,4
	S1	8,5	7,70	8,51	7,94	8,26	4,94	8,1	8,1
	S2	8,7	7,89	8,72	8,13	8,47	4,82	8,3	8,3
CH24	M2	7,2	10,36	11,45	10,68	11,12	12,5	6,4	6,45
	M1	10,08	17,77	19,64	18,33	19,07	-12,35	18,6	18,8
	S2	15,06	13,21	14,60	13,62	14,18	8,35	13,9	13,9
	S1	10,72	9,36	10,34	9,65	10,05	8,83	9,9	9,8
CH21	S2	16,5	14,49	16,01	14,95	15,56	8,2	15,1	15,4
	S1	18,8	16,67	18,43	17,20	17,90	7,12	17,6	17,5
	M1	19,3	16,34	18,06	16,86	17,54	12,21	17,3	17,1
	M2	20,1	17,34	19,16	17,89	18,62	10,14	18,4	18,1
CH22	S2	16,3	13,73	15,17	14,16	14,74	12,8	14,4	14,5
	S1	16,05	14,25	15,75	14,70	15,30	7	14,9	15,1
	M1	12,9	11,54	12,76	11,91	12,39	6,17	12,1	12,2
	M2	14,9	13,11	14,49	13,52	14,08	7,97	13,9	13,7
CH23	S2	16,1	14,63	16,17	15,09	15,71	4,55	15,2	15,6
	S1	20,4	18,50	20,45	19,09	19,86	4,75	19,6	19,35
	M1	16,6	14,87	16,43	15,34	15,96	6,07	15,6	15,7
	M2	17,5	15,15	16,75	15,63	16,27	9,72	15,8	16,1
CH25	M1	12,2	10,83	11,97	11,17	11,63	7,02	11,4	11,4
	M2	10,1	8,74	9,66	9,02	9,38	9,78	9,2	9,2
	S1	11,2	9,98	11,03	10,29	10,71	6,67	10,5	10,5
	S2	12	10,83	11,97	11,17	11,63	5,26	11,4	11,4
CH28	M1	9,66	8,93	9,87	9,21	9,59	2,77	9,4	9,4
	M2	9,2	8,36	9,24	8,62	8,98	4,55	8,8	8,8
	S1	8,8	8,08	8,93	8,33	8,67	3,53	8,5	8,5
	S2	10,47	9,50	10,50	9,80	10,20	4,7	10	10
CH20	S2	20,5	18,29	20,21	18,87	19,64	6,49	19,5	19
	S1	18,8	16,72	18,48	17,25	17,95	6,82	17,6	17,6
	M1	20,9	19,24	21,26	19,85	20,66	3,21	20,2	20,3
	M2	20,7	18,81	20,79	19,40	20,20	4,55	19,8	19,8
CH19	S2	17,9	16,15	17,85	16,66	17,34	5,29	17,2	16,8
	S1	17,2	15,15	16,75	15,63	16,27	7,84	16	15,9
	M1	16,8	14,20	15,70	14,65	15,25	12,37	15,2	14,7
	M2	18,8	16,72	18,48	17,25	17,95	6,82	17,4	17,8
CH18	S2	20,7	19,43	21,47	20,04	20,86	1,22	20,4	20,5
	S1	20,8	19,33	21,37	19,94	20,76	2,21	20,3	20,4
	M1	13,2	18,91	20,90	19,50	20,30	-33,67	19,7	20,1
	M2	13,8	8,03	8,87	8,28	8,62	63,31	8,6	8,3
CH26	M2	11,6	10,31	11,39	10,63	11,07	6,91	11	10,7
	M1	11,3	10,31	11,39	10,63	11,07	4,15	10,7	11
	S2	10,4	9,36	10,34	9,65	10,05	5,58	9,9	9,8
	S1	13,4	12,28	13,58	12,67	13,19	3,63	12,9	12,96

Table:comparison with soft and hard limits coming from the averaging of LIS014 and VG2 TUN at ILT. Major differences are due to Vg2 change in RCA 24 M1 and to main side refurbishment in RCA 18.

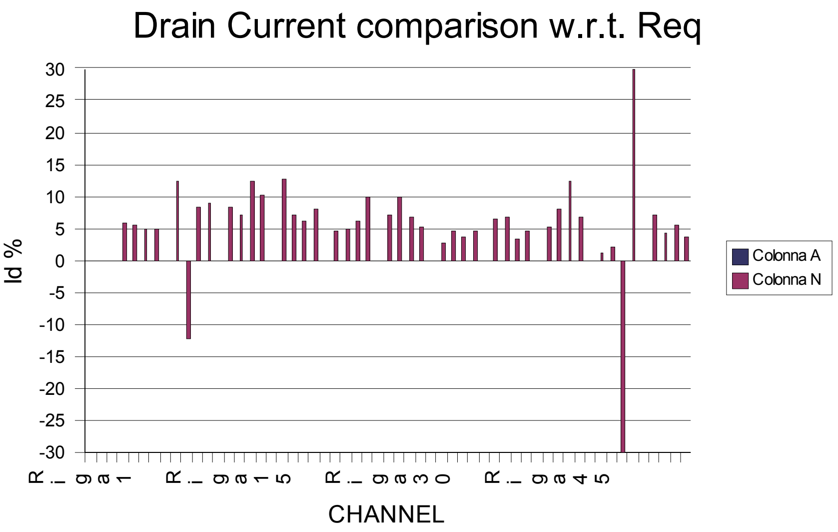

Figure 1 Current consumption of LFI from CRYO-02 respect to average ILT results. Values are expressed in percentage of Id. The hard requirement is +- 5%. Channel RCA 18 main is here different w.r.t. ILT because it was substituted with the Flight Spare after a failure occurred at phase switch level.

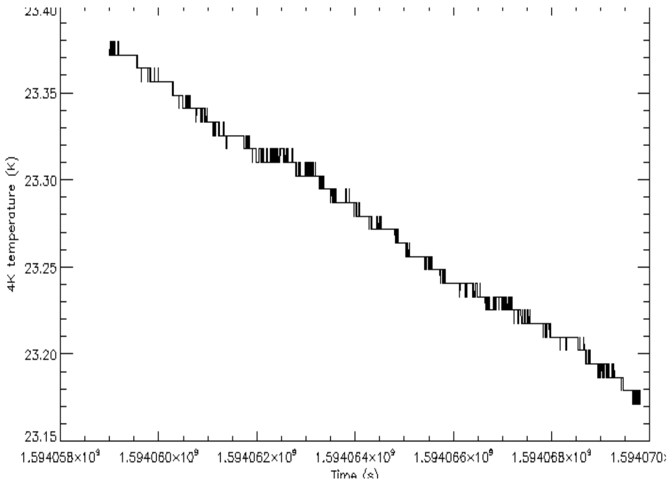

Figure 2 4KRL temperature during the test: the absolute change p2p is by about 25 mK.

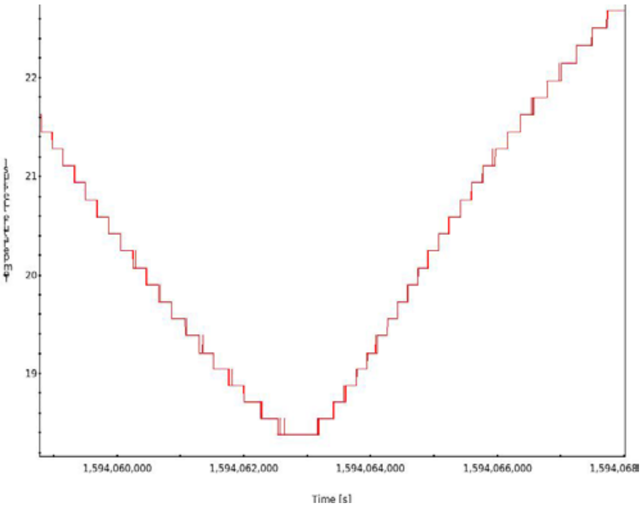

Figure 3 SPU temperature variation during the test: the net change (p2p) is about 3K

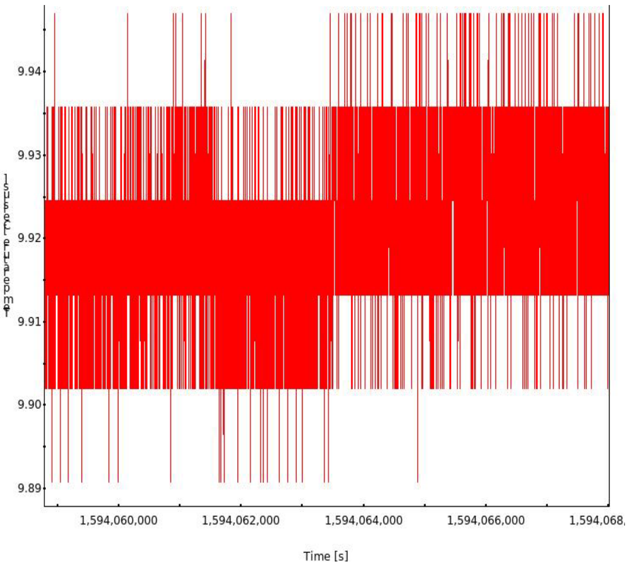

Figure 4 BEU temperature (R-BEM sensor displayed) : it is very stable during the test but far from the condition at ILT where it was about 30 K

4.4 Save DAE default configuration

The further step has been to store the final configuration (the one chosen as nominal default) in the EEPROM. It was done with the channel LFI28 set in Zero-bias condition in order to avoid saturation when switched on (the 'soft procedure ' will be then used)

5 Other Features

5.1 Fluctuations in scientific output

From the TQL quick look real time analysis a deeper analysis was suggested although it was not strictly required to verify a specific requirement. Actually a strange modulation was observed in scientific output possibly correlated with some systematic (look for example the temperature change in SPU sensor during the test : more analysis in the next issue of he document.

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5.2 Signal inversion in RCA25 R0D1

During EMC performed in October 2007 a strange inversion between sky and reference signal from RCA25 Channel R1D0 was observed. A deeper analysis on previous tests allowed to find a similar behaviour shown already during SFT test. This feature is traced by Action#4 H-P-TASF-MN-9737.

The RCA 25 behaviour was carefully monitored by TQL to look for similar effects: nothing like that was observed enforcing the original explanation that it exhibits when RCA 25 R1D0 shows a very defined input power level a the DAE.

5.3 TAG sky/ref inversion in RCA 28

The problem was already known: the DAE looses knowledge about which is sky and which is ref when it is set in a certain combination of 4KHz switching and P/S polarization: results from this test just confirm what already known from ILT traced by NCR 4011 (TBC)

5.4 RCA 24 saturation

Beacause of the test started from the condition RCA on it was not necessary to change bias in RCA 24 and hence it was not possible to verify whether this effect occurred or not.

5.5 Spike Analysis

This analysis is devoted to compare XXX_0154 with the data set acquired during the ILT in THALES – Milan in 2006. Although this analysis is not strictly required and dedicated test have been performed however it can be useful anyway.

The complete analysis in the four combinations of P/S polarization and 4KHz status will be added in the next issue of this document

6 Conclusion

All the pass/fail criteria apart the drain current consumption requested form the procedure have been checked and passed:the CRYO-02 test is considered at this level of the analysis completed and passed. Data have been stored and analysed.
In many cases higher drain currents have been measured with respect to the respective CRYO 02 at ILT . However the thermal situation is here different especially because of the different FEM temperature . A generally systematic increasing of values is observed that suggests a systematic effect .
More analysis is foreseen in the next issue trying to explane the changes just basing on the lower temperature of FEU. However a different source of changes could be ascribed to a ground shift and it is to be carefully taken into account.
From a 'a posteriori' consideration probably the hard requirement set on drain currents when the instrument is in cold condition was too tight.
The scientific voltage comparison with the ILT was not required because of the different conditions although in the next issue will be hopefully added since it could be helpful in understanding the effect from the different thermal setup

6.1 To be added (in the next issue) list

Drain current extrapolation	Extrapolate drain currents basing on different FPU temperature
Scientific voltage	Comparison with ILT taking into account different FPU and BEU temperatures
Spike analysis	In the 4 P/S and 4KHz combinations

6.2 NCR list

Type	Number	Description	Notes
NC	TBC	High drain currents (out of hard limits)	To be further investigated but partly expected because of the different setup.

7 Annex : SPIKES FULL ANALYSIS

COMPARISON: CRYO 02 VS CRYO 02 AT ILT (MILAN 2006)

TBA in the next issue