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LFI Project System Team

Planck LFI

TITLE: **Data Analysis Of LFI switch on and cryogenic functionality test CRYO_01 (Ph-5-01-c of TV/TB tests)**

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CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.1	June	All	First Draft of Document	Draft

Table of Contents

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
TBC	To Be Checked
TBW	To Be Written
TC	Telecommand
TM	Telemetry
UFT	Unit Functional Test

2 INTRODUCTION

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

2.1 Purpose and Scope

The LFI CRYO_01 test has the aim to ensure the functionality of each subunit of the LFI radiometers. The test has started after the completion of the preliminary SCS/HFI tests and after the switch on of SCS.

2.2 Test configuration

The test configuration is the following

SCOS 2 K HPCCS Version 2.0.787
LFI Gateway Version V0R9P1
TQL 3.1.2
LIFE Machine version OM 3.0.3 (July 6th, 2008)

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3 APPLICABLE AND REFERENCE DOCUMENTS

3.1 Applicable Documents

[AD1] Herschel/Planck Instrument Interface document Part A - SCI-PT-IIDA-04624 Issue 3.3

[AD2] Herschel/Planck Instrument Interface document Part B - SCI-PT-IIDB-04142 Issue 3.1

[AD3] Herschel/Planck Instrument Interface document Part B - SCI-PT-IIDB-04142 Issue 3.1, Annex 3, ICD 750800115

[AD4] Herschel/Planck Instrument Interface document Part A - SCI-PT-IIDA-04624 Issue 3.3 Annex 10

[AD5] TV Tests: LFI Test Under Cryogenic Vacuum, PL-LFI-PST-PR-021 2.2

3.2 Reference Documents

[RD1] Planck Instrument Testing at PFM S/C levels - H-P-3-ASP-TN-0676, Issue 1.0

[RD2] Planck LFI User Manual - PL-LFI-PST-MA-001 Issue 2.1

[RD3] LFI Warm Functional Test Procedure (WFT) - PL-LFI-PST-PR-017_2_1

[RD4] Combined LFI EMC Tests at System Level - PL-LFI-PST-PR-020

[RD5] Proposal for LFI test dedicated to characterize New Spikes in the FFT spectrum of Scientific Data - PL-LFI-PST-TN-080

[RD5] Quick Look Data Analysis Of LFI Spike Tests during EMC tests - PL-LFI-PST-RP-031 1.0

4 Test Execution

4.1 Procedure/ Test sequence

The test has been scheduled to be run after the LVHX1 cold end of the SCS has reached 50 K. It has the purpose to exercise the components of the LFI radiometers in order to detect any non-functionality.

During the execution of CRYO01 the LFI team has recorded four TQL sessions: XXX_0142 (test on power group #1), XXX_0143 (test on power group #4), XXX_0144 (test on power group #3) and XXX_0145 (test on power group #2)

The procedure followed during the test is described in section 5.6.2.1 of [AD5]. The procedure exercised one RCA at time by following these steps:

1. The RCA under test is activated
2. The RCA parameters (Vg1, Vg2, Vd and the phase switch currents I1 and I2) are set up to their nominal values (refer to [REF?]).
3. The status of the A/C phase switch is changed
4. The 4 kHz switching of the A/C phase switch is turned on
5. The 4 kHz A/C PS is turned off
6. The status of the A/C phase switch is changed again.
7. The procedure is repeated on the second leg of the same radometer, but the phase switch to be exercised is B/D.
8. The entire procedure is repeated on the second radiometer.

4.1.1 Results and Conclusions

The CRYO01 test has been started on July, 4th 8:30 AM and has finished on July, 5th 1:24 AM. Four TQL sessions have been acquired:

Name	Power Group	RCA under test
XXX_0142	#1	#18, #26
XXX_0143	#4	#23, #25
XXX_0144	#3	#21, #22, #24, #27
XXX_0145	#2	#19, #20, #28

All the pass/fail criteria listed in [AD5] have been passed successfully:

- No unexpected events packets
- The science production telemetry has been as expected
- Every ACA has responded to biases stimuli as expected

- Every P/S has responded to bias stimuli as expected
- The correct cryogenic biases have been applied
- No unexpected features (spikes, pop-corn noise, etc.) have been found in the data

4.2 Data Analysis

During the first phases of the test we discovered that there was a large difference in the temperature of the sky and the reference loads (4 K against 60 K). This has led to large differences in the sky/reference voltages, which in some cases pushed the voltages outside the range allowed by the AC/DC converters. This resulted in the saturation of a number of channels. Therefore, the LFI team decided to perform the test using a DAE offset value of 2,5 V (dec value 0) for the 44 LFI channels. In the few cases where this was not enough, we lowered the drain voltage in order to reduce the amplification of the FEMs and make the saturation disappear.

The following paragraphs show a short summary of the test performed on each RCA and the results. Each paragraph contains a table of drain values used in the experiment. They have been extracted from the TQL test files recorded during the CRYO-01 test.

4.2.1 Power Group #1, RCA #18

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	201	205	115	255	255	23.2
S1	201	197	139/60	255	255	15.0
M1	193	193	118/60	255	255	8.8
M2	187	195	120	255	255	12.9

Every channel responded to the stimuli as expected. The only feature to note is that the drain voltages of S1 and M1 were decreased during the test in order to remove saturations experienced in the four channels.

4.2.2 Power Group #1, RCA #26

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
M2	232	219	171	152	253	12.2
M1	232	221	170	178	230	11.6
S2	232	217	170	153	249	10.6
S1	228	226	173	179	252	13.6

Every channel responded to the stimuli as expected.

4.2.3 Power Group #4, RCA #23

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	186	193	122	255	255	14.2
S1	197	166	118	255	255	22.2
M1	193	187	121	255	255	14.3
M2	196	190	120	255	255	12.7

Every channel responded to the stimuli as expected.

4.2.4 Power Group #4, RCA #25

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
M1	222	221	184	152/100	252	12.6
M2	224	212	185	153	249	10.0
S1	226	216	167	153	180	11.3
S2	219	220	166	126	178	12.1

There was no detectable separation between the sky and reference signals in R0D0 and R0D1, so the LFI team decided to decrease the I1 value of M1 from 152 to 100. After this change, every channel responded to the stimuli as expected.

4.2.5 Power Group #3, RCA #21

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	201	213	132	255	255	20.0
S1	196	197	136	255	255	21.0
M1	201	207	141	255	255	20.6
M2	210	187	136	255	255	22.0

Every channel responded to the stimuli as expected.

4.2.6 Power Group #1, RCA #22

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	220	199	123	255/160	255	16.0
S1	204	184	122	255	255	17.6
M1	179	204	118	255	255	13.9
M2	178	176	125	255	255	16.1

There was no detectable separation between the sky and reference signals in R1D0 and R1D1, so the LFI team decided to decrease the I1 value of M1 from 255 to 160. After this change, every channel responded to the stimuli as expected.

4.2.7 Power Group #3, RCA #24

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
M2	227	204	183	126	253	7.5
M1	226	234	200	152	252	22.8
S2	219	225	152	126	249	15.4
S1	219	213	157	127	252	10.6

Every channel responded to the stimuli as expected.

4.2.8 Power Group #3, RCA #27

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
M1	240	108	156/100	153	205	8.1
M2	245	108	157	178	204	7.8
S1	238	86	157	151	179	8.5
S2	250	126	156	153	179	8.7

Every channel responded to the stimuli as expected. The only feature to note is that the drain voltage of M1 was decreased from 156 to 100 during the test in order to remove saturations experienced in the R0D1 channel.

4.2.9 Power Group #2, RCA #19

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	220	201	125	255	255	20.2
S1	215	204	120	255	255	19.8
M1	215	198	124	255	255	18.7
M2	220	196	126	255	255	20.8

Every channel responded to the stimuli as expected.

4.2.10 Power Group #2, RCA #20

The biases used for this RCA were the following:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
S2	189	201	123	255	255	20.7
S1	189	201	129	255	255	16.2
M1	225	204	121	255	255	22.2
M2	231	206	127	255	255	22.0

Every channel responded to the stimuli as expected.

4.2.11 Power Group #2, RCA #28

The main arm of the RCA28 needs a dedicated ("soft") procedure to be turned on, where the Vg1 value is set to an intermediate value before switching to the nominal one. In the following table we express this with the symbol →:

Arm	Vg1	Vg2	Vd	I1	I2	Id [mA]
M1	193→243	89	155	127	181	7.3→9.6
M2	153→240	112	156	128	180	7.4→9.2
S1	235	88	157	127/80	255	8.8
S2	245	121	158	148	184	10.4

Every channel responded to the stimuli as expected. In the S1 arm we had to decrease the I1 current in order to detect a separation between the sky and the reference signals in R1D1.

4.3 Conclusions and recommendations

The test showed that all the channels responded to biasing; the Phase switch functionality was good as expected. The soft switch on procedure applied to RCA 28 was successfully completed.
No quantitative comparison was possible with the similar test performed at ILT in TAS-Italia (Mi) because of the very different environmental conditions.