TITLE: **Quick Look Data Analysis of LFI During EMC Test**

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CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.1	January	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

Scope of this document is to give a first quick look analysis response of EMC tests RE/RS at system level. The tests are basically divided in two sets: the first one is dedicated to the Emission part where LFI will be switched on in nominal science production and the second one is the susceptibility tests where the satellite will be radiated by the frequencies chosen from the emission data.
The document is divided in two sections. The first section is related to the description of the work done that is to say the description of the LFI Log Book and the description of the performed tests. The second section is the summary of the results of each test coming from both real time and offline data analysis.

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 3.00

LFI Personnel involved during the test is:

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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

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

[RD6] Combined LFI EMC Tests at System Level
PL-LFI-PST-PR-020

4 RE EMC Test Execution-First Day

For each modular block of procedure test results and conclusions are presented.

4.1 Switch on LFI in nominal science (Nominal Unit)

The test has been done using the nominal unit but the results could be used also for the redundant unit.

4.1.1 Procedure/ Test sequence

LFI RE/EMC: Switch on (Nominal Unit)					1.09.00	
Switch ON LFI			1	0.39.00		
Go to Stand By Mode	OFF to standby	0.32.00	1	0.32.00	0.32.00	
Go to DAE Set Up Mode	Standby to DAE set up	0.07.00	1	0.07.00	0.39.00	
LFI in Normal Science (Warm test Config..)			1	0.30.00		
Setting Telemetry Rate	Nominal Values	0.02.00	1	0.02.00	0.41.00	
Event Packet Enabling		0.02.00	1	0.02.00	0.43.00	
Definition of science Processing Parameters	Naverage set to nominal	0.02.00	1	0.02.00	0.45.00	
Definition of science Processing Parameters	Upload Optimized Values	0.05.00	1	0.05.00	0.50.00	
Changing Processing Type to 5		0.05.00	1	0.05.00	0.55.00	
Spu Connection		0.02.00	1	0.02.00	0.57.00	
Science Activation Type 5		0.04.00	1	0.04.00	1.01.00	
RCA Activation		0.02.00	1	0.02.00	1.03.00	
Set DAE Default configuration		0.02.00	1	0.02.00	1.05.00	
Start Calibration Channel		0.02.00	1	0.02.00	1.07.00	
Start Monito function		0.02.00	1	0.02.00	1.09.00	

At the end of the Procedure LFI IOT checked the functionality of the LFI instrument because this test corresponds also to the first switch on after the vibration tests.

4.1.2 Results and Conclusions

The procedure has run on the 4th of February without any problem and the test has finished successfully.
Pass and Fail Criteria

No errors from the REBA HW Self check	PASSED
No un-expected event Packets	PASSED
REBA Power Consumption within the ranges of expected values	PASSED
EEPROM Check Sum passed	PASSED
REBA synchronization achieved	PASSED
DAE Power Consumption within the ranges of expected values	PASSED

DAE Synchronization achieved	PASSED
The FEM I Drain Currents obtained from Telemetry are within the ranges expected (5%)	PASSED
The DC voltages Outputs (Science Telemetry) are within the ranges expected. (10%)	NOT PASSED
No unexpected features in FFT spectrum (Spike, Pop corn noise, currents drops…)	On Going

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	0.13	0.73	0.13	0.07
CH24	0.17	0.18	0.10	0.14
CH21	0.10	0.28	0.22	0.47
CH22	0.05	0.11	0.16	0.70
CH23	0.22	0.26	0.23	0.22
CH25	0.11	0.19	0.04	0.18
CH28	-0.06	-0.06	-0.18	-0.12
CH20	0.15	0.00	0.05	0.10
CH19	0.05	0.05	0.20	0.00
CH18	0.33	-0.06	0.06	0.00
CH26	0.15	0.08	0.07	0.11

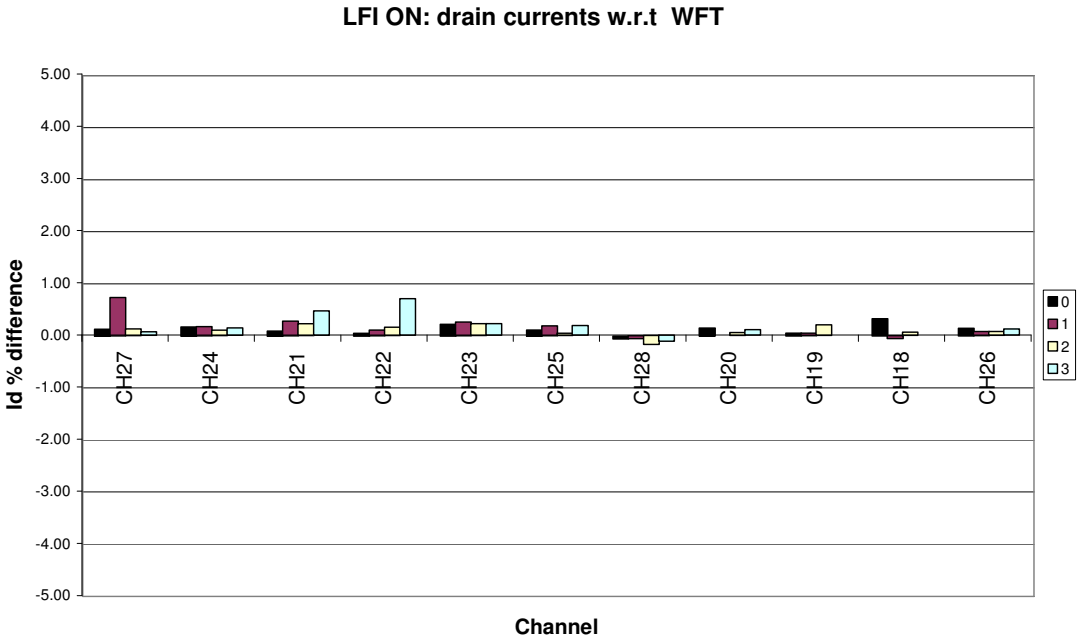


Figure 1 Drain currents Percentage variation respect to WFT with LFI – N on

Id w.r.t RAA				
CH	<00>	<01>	<10>	<11>
CH27	0.19	0.07	0.19	0.13
CH24	0.03	0.11	0.00	0.07
CH21	0.15	0.62	0.34	0.62
CH22	0.37	0.48	0.59	1.02
CH23	0.72	0.63	0.62	0.33
CH25	0.00	0.08	-0.04	0.07
CH28	-0.12	0.06	-0.12	0.00
CH20	0.56	0.45	0.36	0.60
CH19	0.42	0.56	0.35	0.15
CH18	0.77	0.17	0.37	0.56
CH26	0.11	0.00	-0.11	0.00

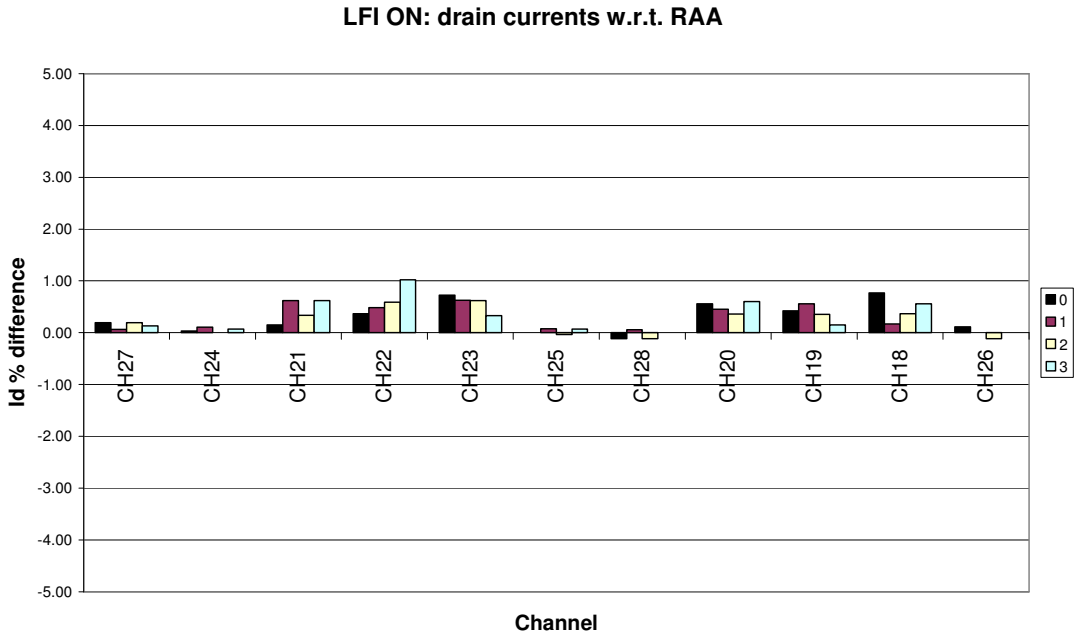


Figure 2 Drain currents Percentage variation respect toFM with LFI – N on

5 RS EMC Test Second day

5.1 Data Collection in type 5

During the night shift just after the SPIKE test Type 5 condition was recovered using a new Table for Scientific-Parameters for the REBA. The table is presented below.

RCA #	ID	RD	SCOS	GMF1	GMF2	Offset	S-Quant
CH27	0	00	LP068320	1.0043	-0.2204	-7335.16	2.95
	1	01	LP069320	0.9993	-0.2236	-7511.33	2.84
	2	10	LP070320	1.0018	-0.2226	-7186.45	3.48
	3	11	LP071320	0.9999	-0.2228	-6850.86	4.04
CH24	4	00	LP072320	1.0000	-0.2207	-5307.74	5.62
	5	01	LP073320	1.0000	-0.2822	-6128.72	5.34
	6	10	LP074320	1.0000	-0.5414	-7344.87	4.45
	7	11	LP075320	1.0000	-0.4589	-6124.59	4.7
CH21	8	00	LP076320	0.9997	-0.2425	-5150.08	5.47
	9	01	LP077320	1.0002	-0.1944	-5144.08	5.7
	0A	10	LP078320	0.9997	-0.2278	-5204.64	5.48
	0B	11	LP079320	1.0002	-0.2366	-5204.23	5.44
CH22	0C	00	LP080320	0.9995	-0.2216	-5237.94	5.47
	0D	01	LP081320	1.0001	-0.2252	-5257.99	5.43
	0E	10	LP082320	0.9995	-0.2287	-5226.54	5.45
	0F	11	LP083320	1.0006	-0.2248	-5257.35	5.43
CH23	10	00	LP083320	1.0007	-0.2199	-5347.01	5.36
	11	01	LP085320	0.9988	-0.2222	-5404.63	5.3
	12	10	LP086320	1.0002	-0.2229	-5437.54	5.26
	13	11	LP087320	0.9997	-0.2214	-5261.03	5.45
CH25	14	00	LP088320	1.0004	-0.3157	-6193.21	5.15
	15	01	LP089320	0.9991	-0.286	-6197.8	5.27
	16	10	LP090320	1.0001	0.0325	-4088.08	7.08
	17	11	LP091320	1.0000	-0.5027	-7350.37	4.56
CH28	18	00	LP092320	0.9997	-0.2242	-6207.29	4.61
	19	01	LP093320	0.9948	-0.2262	-6566.17	4.19
	1A	10	LP094320	0.9986	-0.2248	-6464.29	4.43
	1B	11	LP095320	0.9964	-0.2243	-6323.65	4.53
CH20	1C	00	LP096320	0.9991	-0.2316	-5329.14	5.34
	1D	01	LP097320	1.0007	-0.2272	-5311.72	5.37
	1E	10	LP098320	0.9994	-0.2287	-5344.55	5.33
	1F	11	LP099320	1.0004	-0.2385	-5365.61	5.26
CH19	20	00	LP100320	0.9997	-0.2587	-6315.19	5.28
	21	01	LP101320	1.0003	-0.2279	-5273.21	5.4
	22	10	LP102320	0.9991	-0.229	-5318.08	5.36
	23	11	LP103320	1.0004	-0.3078	-6359.75	5.05
CH18	24	00	LP104320	0.9995	-0.2476	-5356.7	5.24
	25	01	LP105320	1.0012	-0.2659	-6522.04	5.08
	26	10	LP106320	1.0004	-0.2213	-5269.88	5.44
	27	11	LP107320	0.9993	-0.2408	-5296.18	5.33
CH26	28	00	LP108320	1.0001	-0.5151	-7361.86	4.52
	29	01	LP109320	0.9997	0.4507	-2458.06	12.45
	2A	10	LP110320	1.0001	-0.3615	-8207.98	5.01
	2B	11	LP111320	0.9996	-0.356	-8223.79	5.02

At the end of the test the procedure for SPIKE Test was designed to recover the same configuration as was at the beginning of the test, but LFI was in a different configuration from what Expected.

- Calibration Channel was not enabled.
- Type one telemetry was not delivered
- Type 3 Telemetry is enabled on Group B but no output channel is enabled.

The wrong configuration is only a software configuration and does not effect the electrical behaviour of the instrument so it was decided to give the go-ahead to proceed with the EMC RS tests

5.1.1 Procedure/ Test sequence

TMH/TQL is set to acquire data during the injection of EM disturbance. Data are checked in real time through displays but fine analysis will be performed off Line. Data acquisition has been divided in different set of data that could be summarized in the following table.

RS test in operational mode			
Freq ID	Freq val in MHz	Level in V/m	Test name
F1	0.1	1	TBD
F2	0.13	1	AMB_131
F3	0.18	1	
F4	0.25	1	
F5	1	1	
F6	2.5	1	
F7	3.44	1	
F8	10	1	AMB_132
F9	16	1	
F10	20	1	
F11	30	1	
F12	35	1	
F13	40	1	
F14	46	1	
F15	52	1	
F16	60	1	
F17	69	1	
F18	80	1	
F19	92	1	
F20	100	1	

5.1.2 Results and Conclusions

The Pass/Fail criteria from the Requirement doc are:

No un-expected event Packets	PASSED
No Alarm/Error packet	PASSED
Power consumption as expected	PASSED
No new features (i.e.Spikes) visible in FFT	See table below
The difference between the two signals for each radiometer output shall not exceed more than three times the standard deviation of the undisturbed signal.	See table below

Freq ID	Freq val in MHz	Spike	Differential	Comments
F1	0.1	**TBC** Data Analysis on going (see note below on new Spike at 29Hz and spike at 35Hz in FFT)	**PASSED** All RCA < 1σ except RCA25 R1Do and RCA 26 R1D1 < 1.5 σ	
F2	0.13			
F3	0.18			
F4	0.25			
F5	1			
F6	2.5			
F7	3.44			
F8	10			
F9	16			
F10	20			
F11	30			
F12	35			
F13	40			
F14	46			
F15	52			
F16	60			
F17	69			
F18	80			
F19	92			
F20	100			

Id w.r.t RAA				
CH	<00>	<01>	<10>	<11>
CH27	0.00	-0.07	0.00	0.00
CH24	-0.21	-0.14	-0.14	-0.07
CH21	0.05	0.34	0.06	0.21
CH22	0.26	0.32	0.37	0.48
CH23	0.61	0.37	0.34	0.06
CH25	-0.30	-0.23	-0.18	-0.22
CH28	-0.35	-0.24	-0.24	-0.18
CH20	0.25	0.05	0.15	0.40
CH19	0.16	0.25	0.05	0.05
CH18	0.55	0.00	0.12	0.34
CH26	-0.15	-0.26	-0.37	-0.26

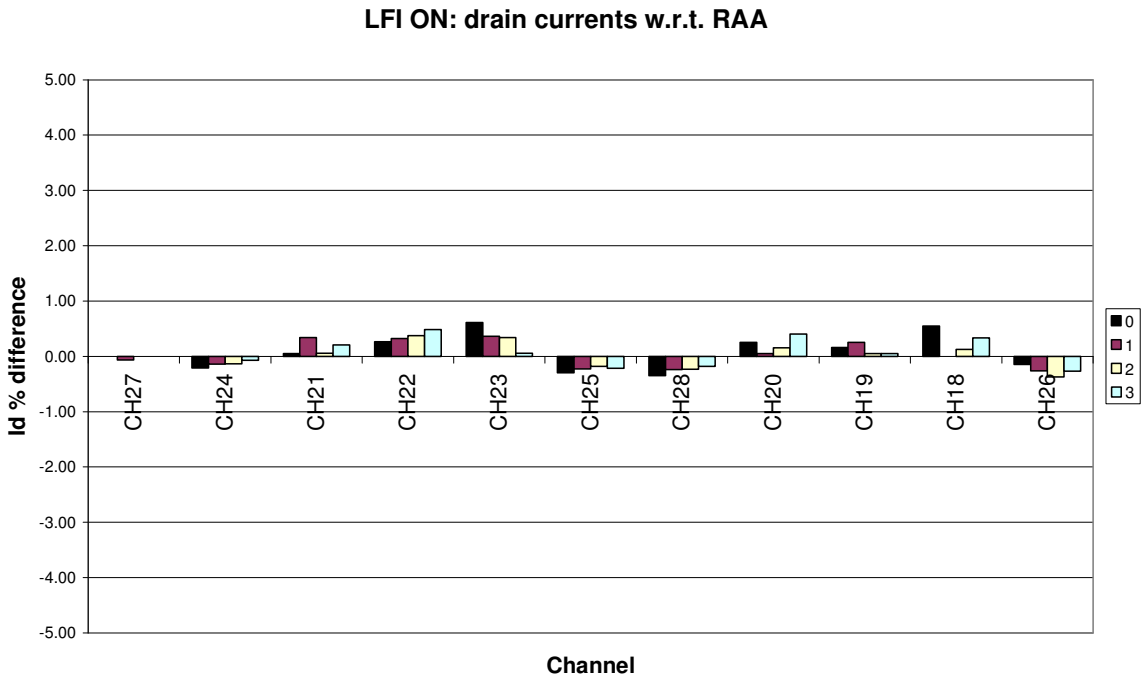


Figure 3 Drain currents Percentage variation respect toFM with LFI – N on at the end of the test

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	-0.06	0.60	-0.06	-0.07
CH24	-0.07	-0.07	-0.03	0.00
CH21	0.00	0.00	-0.06	0.05
CH22	-0.05	-0.05	-0.05	0.16
CH23	0.11	0.00	-0.06	-0.06
CH25	-0.19	-0.11	-0.11	-0.11
CH28	-0.29	-0.36	-0.29	-0.30
CH20	-0.15	-0.40	-0.15	-0.10
CH19	-0.21	-0.25	-0.10	-0.10
CH18	0.11	-0.22	-0.18	-0.22
CH26	-0.11	-0.19	-0.19	-0.15

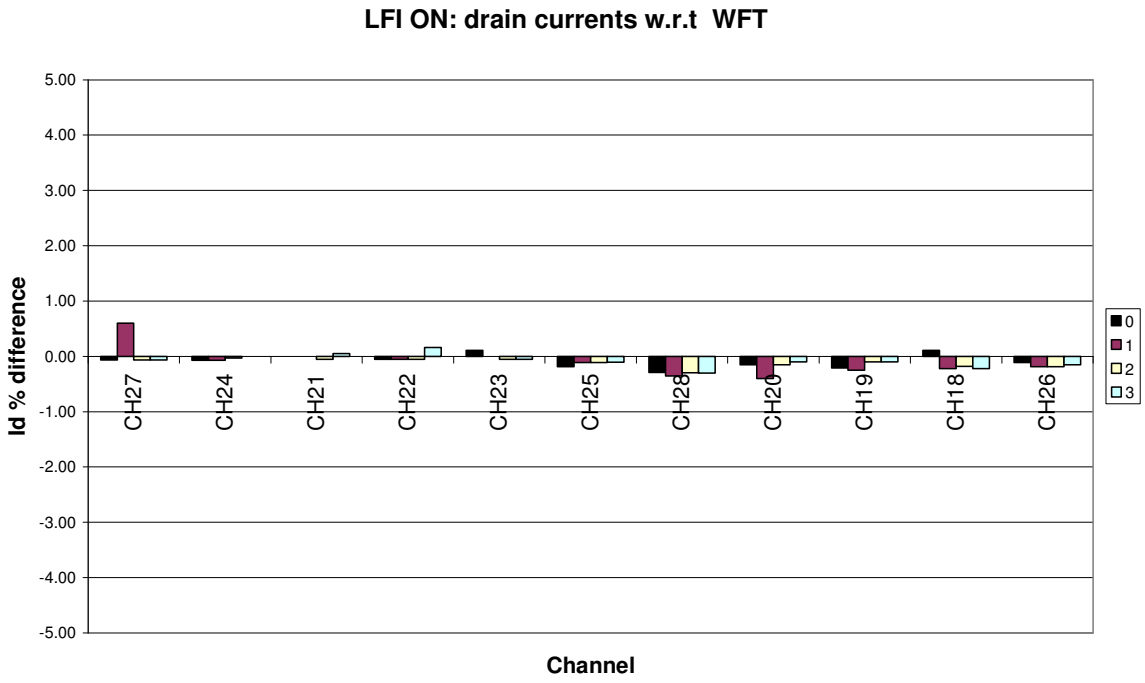
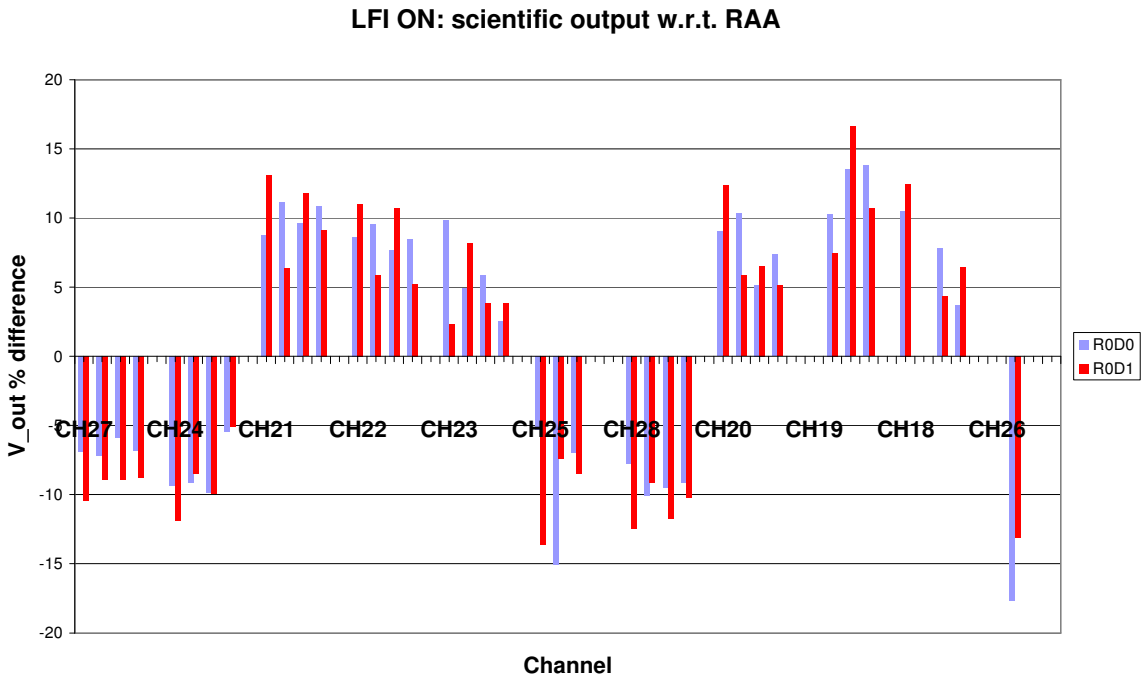
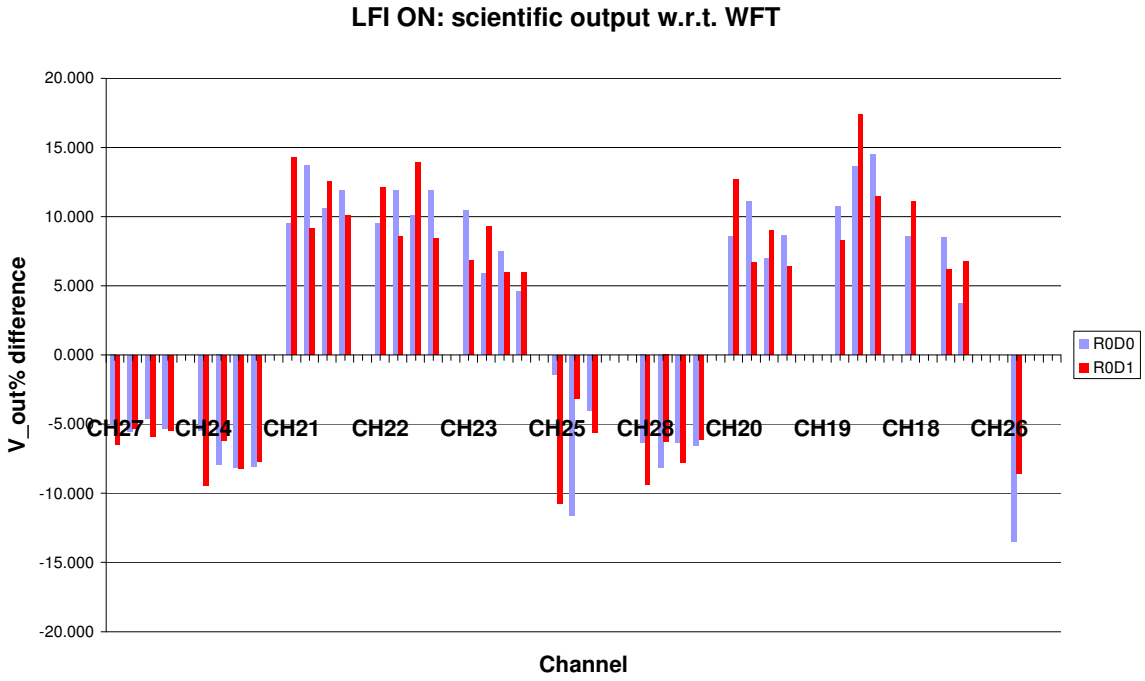


Figure 4 Drain currents Percentage variation respect to WFT with LFI – N on at the end of the test





From the two figures above you can see that the scientific output of the radiometers is sometimes surmounting the limit of the pass fail criteria. It could be

possible, from a quick analysis, that the reason of this could be found in a higher temperature of the BEU. This temperature is inside the soft limit, nevertheless LFI never operated at this temperature before. Indeed during previous tests there were at least 10 degree less at the same interface.

6 NEW FEATURES

Here below are presented unexpected features that are followed by already opened NCRs and that was agreed to monitor and new features found during this test.

6.1.1 Current drops in RCA 23 (OLD)

No current drops were found during the execution of the test.

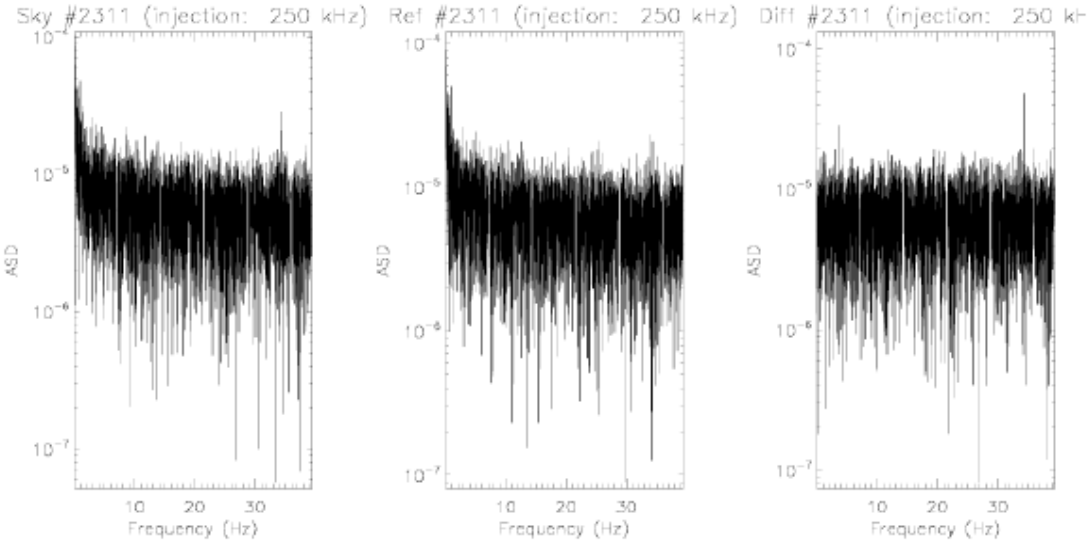
6.1.2 Scientific output crossing in RCA 25 (OLD)

No Crossing has been seen during the test, but in any case the voltage output remains under the threshold that we expect can trigger the feature.

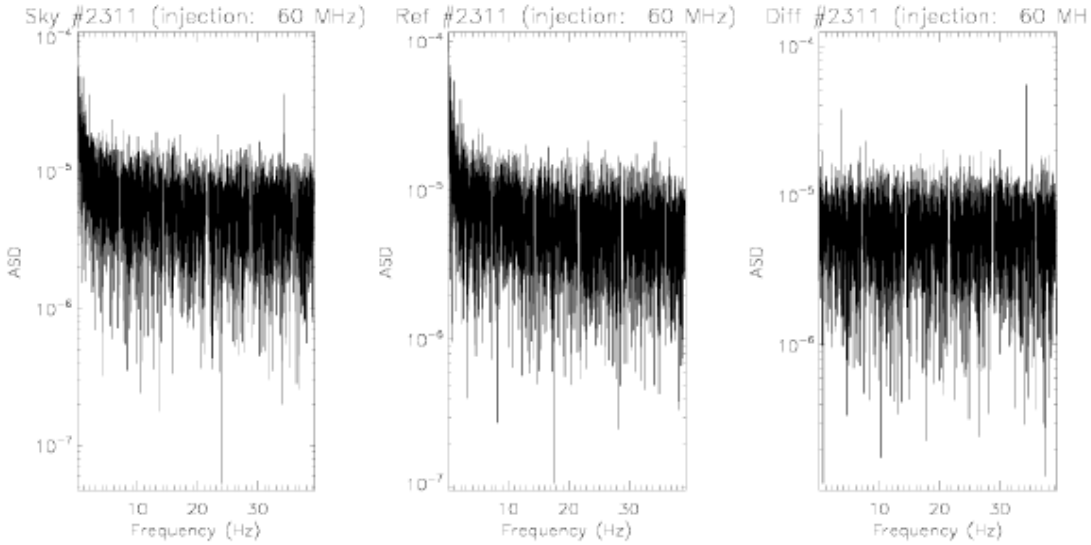
6.1.3 Spike. (NEW)

Even if the time when the disturbance signal is short, of the order of a few minutes, at higher frequency of the FFT the spectrum presents some features that were not expected. These features do not seem to be related to EMC tests because they appear even in the quite zone, when no disturbance is injected.

RCA23 R1D1



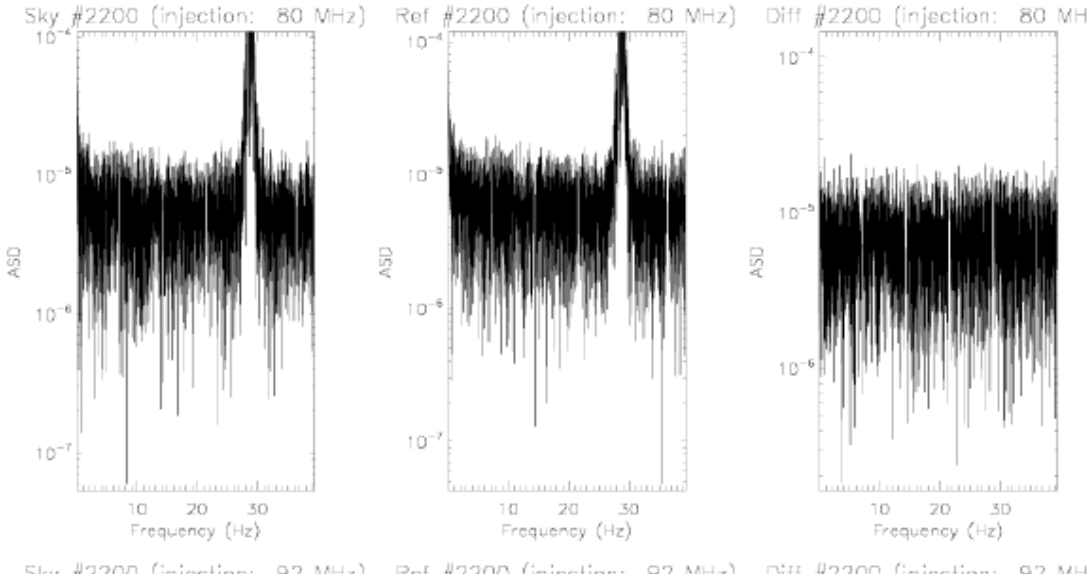
1. RCA 23 R1D1 during 250KHz injection



2. RCA 23 R1D1 during 60MHz injection

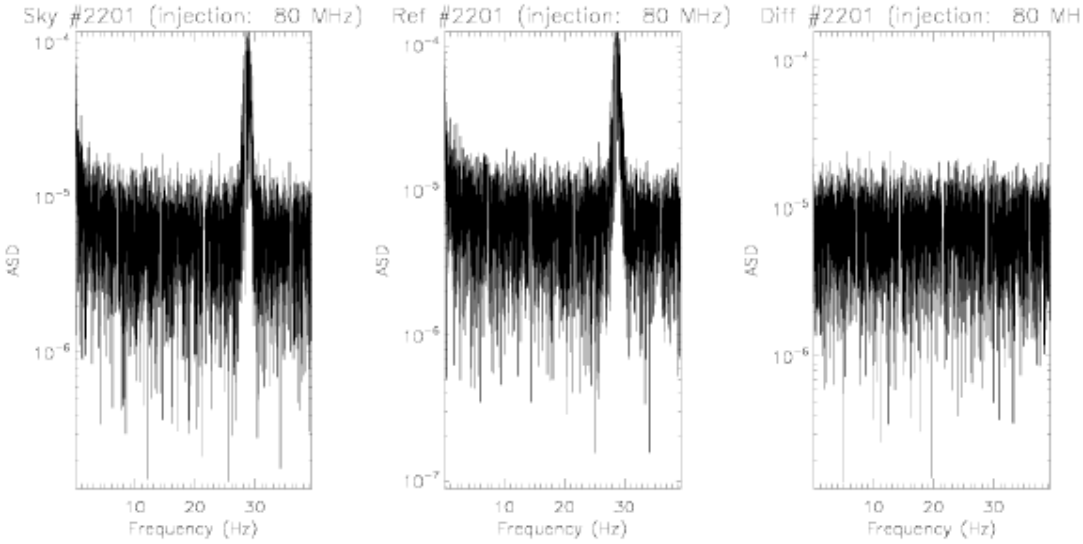
The spike is visible around 35 KHz and it is visible in the differential signal.

RCA22 R0D0



3. RCA22 R0D0 During 80 MHz signal injection

RCA 22 R0D1



4. RCA 22 R1D1 during 80MHz injection

The Huge Spike is visible in all the condition with or without the signal injection so it seems to be not related to EMC condition.

The full report will be included as attachment to the final version of the test report