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SIT Test Report

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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
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 the functionality of the LFI instrument during the SIT (Satellite Integrated Tests) Test Campaign

The document is divided in two section. 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 **TBC**

LFI Gateway Version **TBC**

TQL **TBC**

LIFE Machine version OM **TBC**

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] Planck LFI REBA Herschel PACS SPU: LFI REBA FMs User's Manual
FPL-MA-1214-04 CRS Issue 1.0
- [RD4] LFI- REBA application Software User Manual (SUM)
DS/UM_FIR/178v.4
- [RD5] LFI Warm Functional Test Procedure (WFT)
PL-LFI-PST-PR-017_2_1
- [RD6] PLM SIT Test Specification
H-P-3-ASP-TS-1421 Issue 2.0
- [RD07] IST1 and IST2 Combined LFI HFI tests
PL-LFI-PST-PR-019 Issue 3.1



4 SIT Test Execution

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

4.1 Switch on LFI in nominal science (Nominal Unit)

4.1.1 Procedure/ Test sequence

LFI SIT: Switch on (Nominal Unit)				1.00.00	
Switch ON LFI				1	0.39.00
	Go to Stand By Mode	OFF to standby	0.32.00	1	0.32.00
	Go to DAE Set Up Mode	Standby to DAE set up	0.07.00	1	0.07.00
LFI in Normal Science (Warm test Config..)				1	0.19.00
	Setting Telemetry Rate	Nominal Values	0.02.00	1	0.02.00
	Event Packet Enabling		0.02.00	1	0.02.00
	Definition of science Processing Parameters	Naverage set to 256	0.02.00	1	0.02.00
	Changing Processing Type to 1		0.05.00	1	0.05.00
	Spu Connection		0.02.00	1	0.02.00
	Science Activation Type 1		0.04.00	1	0.04.00
	RCA Activation		0.02.00	1	0.02.00
	Set DAE Default configuration		0.02.00	1	0.02.00

At the end of the Procedure LFI will stay in listening mode while HFI and SCS had performed WFT and Healthcheck

4.1.2 Results and Conclusions

The procedure has run on the 23rd of October 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%)	PASSED
No unexpected features in FFT spectrum (Spike, Pop corn noise, currents drops...)	TBC

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	0.06	0.73	0.06	0.13
CH24	0.14	0.11	0.17	0.14
CH21	0.05	0.17	0.11	0.26
CH22	0.05	0.16	0.11	0.21
CH23	0.06	0.10	0.17	0.17
CH25	0.15	0.19	0.15	0.11
CH28	0.06	-0.06	-0.06	-0.06
CH20	0.05	0.05	0.10	0.00
CH19	0.10	0.05	0.05	0.05
CH18	0.00	0.06	0.06	0.00
CH26	0.18	0.08	0.15	0.11

LFI ON: drain currents w.r.t WFT

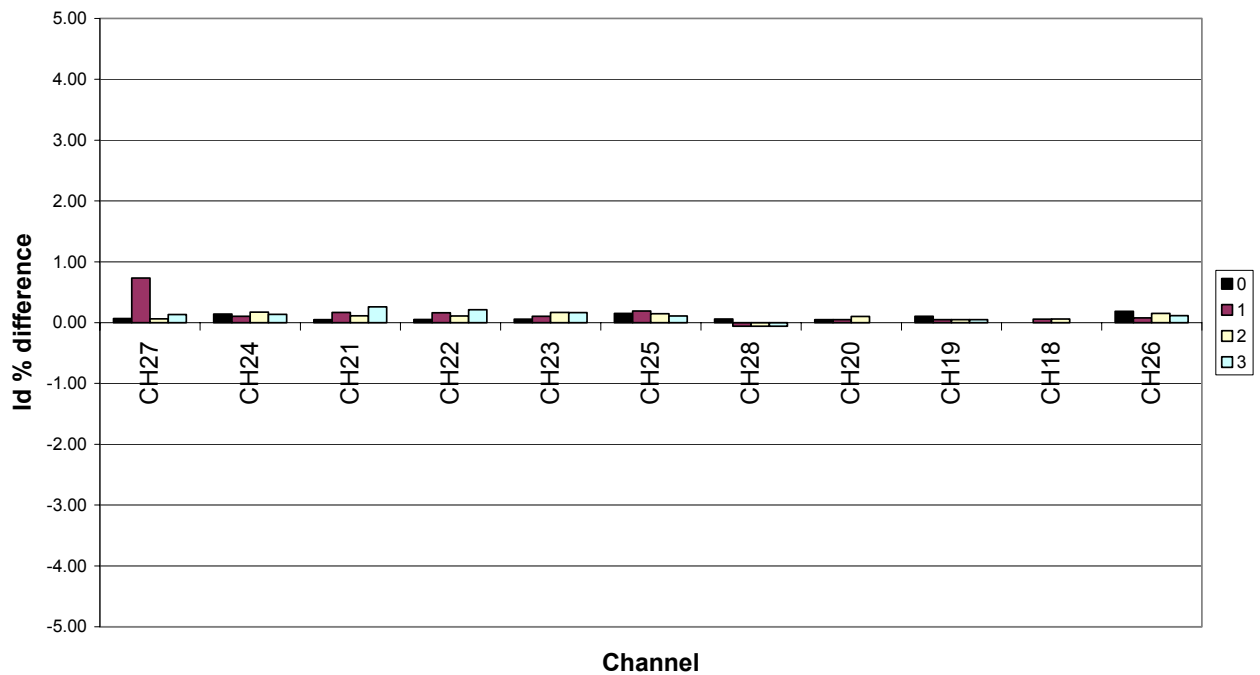


Figure 1 Drain currents with LFI – N on



4.2 Nominal Science with nominal unit

During this step HFI and SCS are performing their WFT. LFI stays in nominal acquisition acquiring data for analysis.

4.2.1 Procedure/ Test sequence

No test sequence for LFI is requested to be applied here.

4.2.2 Results and Conclusions

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
No unexpected features during HFI activity in Scientific signal	PASSED
No unexpected features during SCS activity in Scientific signal	TBC

Some NCRs have been raised:

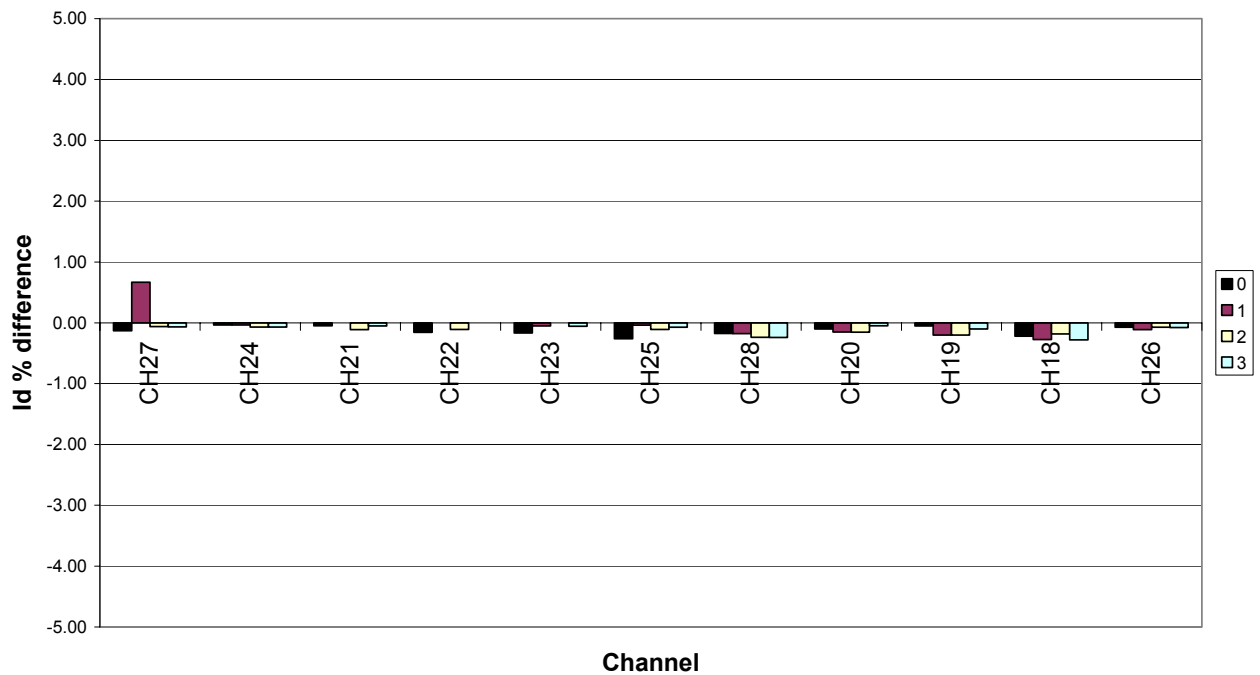
NCR	Description
	Monitored the presence of unexpected spikes during the start up of the SCS electronic. Data analysis on going



4.2.2.1 Currents monitoring during HFI WFT

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	-0.13	0.67	-0.06	-0.07
CH24	-0.03	-0.04	-0.07	-0.07
CH21	-0.05	0.00	-0.11	-0.05
CH22	-0.16	0.00	-0.11	0.00
CH23	-0.17	-0.05	0.00	-0.06
CH25	-0.26	-0.04	-0.11	-0.07
CH28	-0.18	-0.18	-0.24	-0.24
CH20	-0.10	-0.15	-0.15	-0.05
CH19	-0.05	-0.20	-0.20	-0.10
CH18	-0.22	-0.28	-0.18	-0.28
CH26	-0.07	-0.11	-0.07	-0.08

LFI ON: drain currents w.r.t WFT

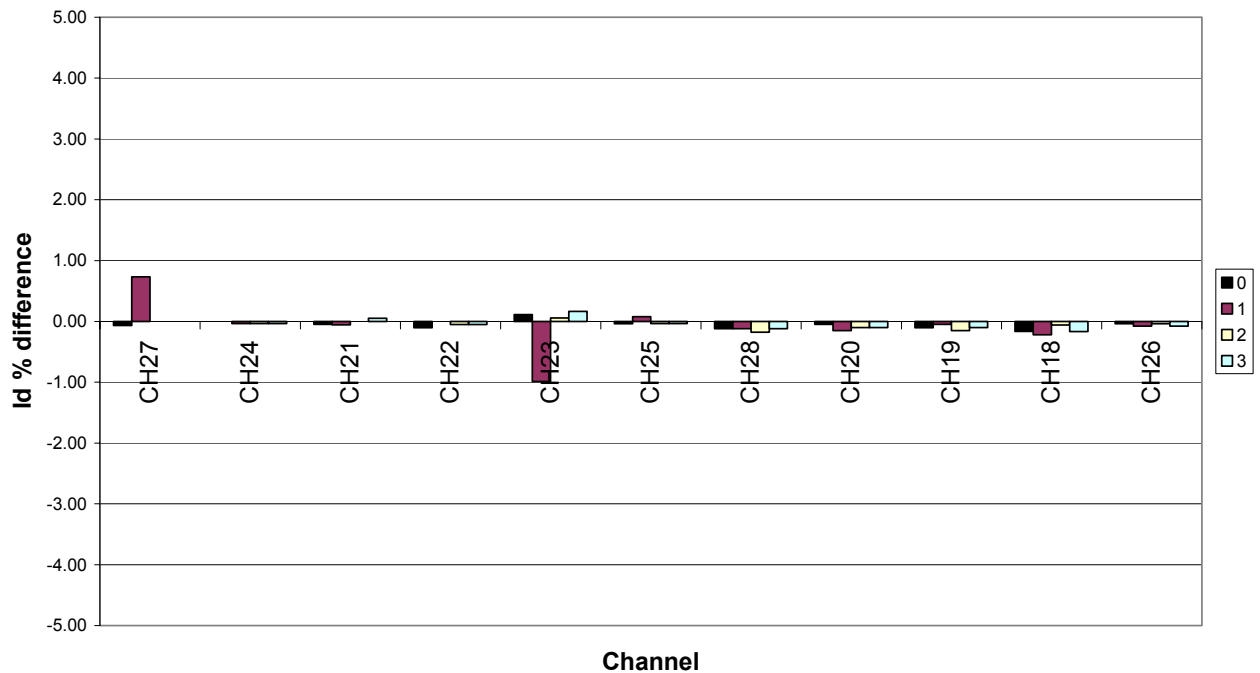




4.2.3 Currents monitoring during SCS-N HC

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	-0.06	0.73	0.00	0.00
CH24	0.00	-0.04	-0.03	-0.03
CH21	-0.05	-0.06	0.00	0.05
CH22	-0.10	0.00	-0.05	-0.05
CH23	0.11	-0.99	0.06	0.17
CH25	-0.04	0.08	-0.04	-0.04
CH28	-0.12	-0.12	-0.18	-0.12
CH20	-0.05	-0.15	-0.10	-0.10
CH19	-0.10	-0.05	-0.15	-0.10
CH18	-0.16	-0.22	-0.06	-0.17
CH26	-0.04	-0.08	-0.04	-0.08

LFI ON: drain currents w.r.t WFT





4.3 Switch off of the Nominal Unit

4.3.1 Procedure/ Test sequence

LFI SIT: Switch off (Nominal Unit)				0.20.00	
Switch OFF LFI				1	0.20.00
	Science De-Activation		0.05.00	1	0.05.00 0.05.00
	RCA De-Activation		0.05.00	1	0.05.00 0.10.00
	LFI to Standby	DAE Set Up to Standby	0.05.00	1	0.05.00 0.15.00
	Switch OFF	Standby to OFF	0.05.00	1	0.05.00 0.20.00

4.3.2 Results and Conclusions

The test was successfully completed.

Pass and Fail Criteria

No un-expected event Packets	PASSED
No more telemetry coming from LFI	PASSED

No NCRs have been raised:

4.4 LFI Switch on using Redundant Unit

4.4.1 Procedure/ Test sequence

LFI SIT: Switch on (Redundant Unit)				1.20.00	
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	0.19.00
	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 256	0.02.00	1	0.02.00 0.45.00
	Changing Processing Type to 1		0.05.00	1	0.05.00 0.50.00
	Spu Connection		0.02.00	1	0.02.00 0.52.00
	Science Activation Type 1		0.04.00	1	0.04.00 0.56.00
	RCA Activation		0.02.00	1	0.02.00 0.58.00
	Set DAE Default configuration		0.02.00	1	0.02.00 1.00.00

4.4.2 Results and Conclusions

The test was successfully completed.

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

Some NCRs have been raised:

NCR	Description
TBD	The Default values of the redundant REBA were not the right ones because the WFT, when these values were saved, was performed only using the nominal Unit. The procedure has been corrected on the fly.
TBD	Unexpected high magnitude of the pop corn noise in Channel 23 (20mV respect to 2mV). Data analysis on going
TBD	One channel of the RCA 25 swaps Reference with Sky in the scientific output without any correlation with physical temperature changes (actually in warm temperature condition there is no change in temperature). Data analysis on going

4.5 Nominal Science with Redundant unit

During this step SCS redundant is performing its health check. LFI stays in nominal acquisition acquiring data for analysis.

4.5.1 Procedure/ Test sequence

No test sequence for LFI is requested to be applied here.

4.5.2 Results and Conclusions

Pass and Fail Criteria



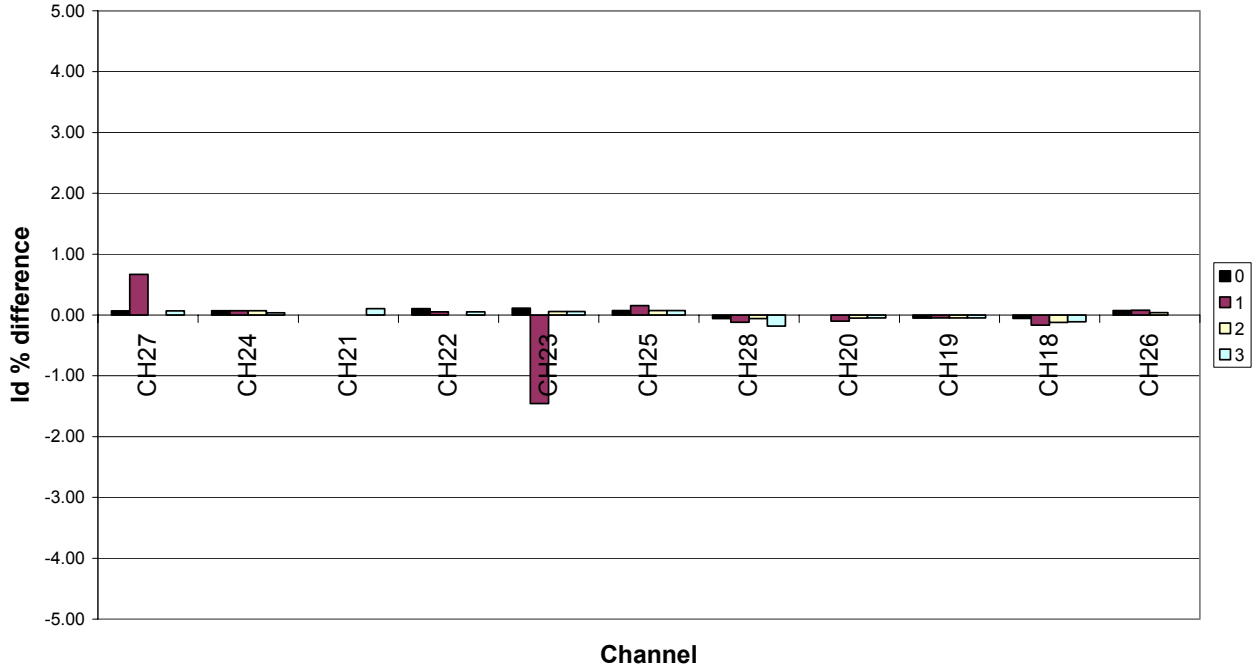
No un-expected event Packets	PASSED
REBA Power Consumption within the ranges of expected values	PASSED
DAE Power Consumption within the ranges of expected values	PASSED
No unexpected features during SCS activity in Scientific signal	TBC

No NCRs have been raised:

Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	0.06	0.67	0.00	0.07
CH24	0.07	0.07	0.07	0.03
CH21	0.00	0.00	0.00	0.10
CH22	0.10	0.05	0.00	0.05
CH23	0.11	-1.46	0.06	0.06
CH25	0.07	0.15	0.07	0.07
CH28	-0.06	-0.12	-0.06	-0.18
CH20	0.00	-0.10	-0.05	-0.05
CH19	-0.05	-0.05	-0.05	-0.05
CH18	-0.05	-0.17	-0.12	-0.11
CH26	0.07	0.08	0.04	0.00



LFI ON: drain currents w.r.t WFT



4.6 LFI Preparation to AMB02 go to Stand By Mode

4.6.1 Procedure/ Test sequence

LFI SIT: AMB 02 Preparation Go back to Standby Mode				0.17.00
Switch OFF LFI			1	0.17.00
	Disable 4KHz Switching	0.02.00	1	0.02.00
	Change PS status to zero	0.02.00	1	0.04.00
	Update Channel config. (Switch off all ACAs in FEM)	0.02.00	1	0.06.00
	Science De-Activation	0.02.00	1	0.08.00
	RCA De-Activation	0.02.00	2	0.12.00
	Switch off RAA from Satellite	0.05.00	1	0.17.00

Once LFI is in Stand By mode the following procedure has been executed.



LFI SIT: AMB02 Preparation Cont. Go to nominal science				0.24.00	
Switch ON LFI			1	0.07.00	
	Go to DAE Set Up Mode	Standby to DAE set up	0.07.00	1	0.07.00 0.07.00
LFI in Normal Science (Warm test Config..)			1	0.17.00	
	Setting Telemetry Rate	Nominal Values	0.02.00	1	0.02.00 0.09.00
	Event Packet Enabling		0.02.00	1	0.02.00 0.11.00
	Definition of science Processing Parameters	Naverage set to 256	0.02.00	1	0.02.00 0.13.00
	Changing Processing Type to 1		0.05.00	1	0.05.00 0.18.00
	Spu Connection		0.02.00	1	0.02.00 0.20.00
	Science Activation Type 1		0.04.00	1	0.04.00 0.24.00

4.6.2 Results and Conclusions

The test was successfully completed.

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
DAE Synchronization achieved	PASSED
Science production as expected	PASSED

No NCRs have been raised



4.7 LFI Execution of AMB02

4.7.1 Procedure/ Test sequence

LFI SIT: AMB02 execution				3.24.00		
Switch ON LFI				1	0.05.00	
	RCA Activation		0.05.00	1	0.05.00	0.05.00
	Perform DAE Initialization		0.10.00	1	0.10.00	0.15.00
	Wait for thermalization of power groups		0.30.00	1	0.30.00	0.35.00
	Configure DAE (Switch ACA on)		0.02.00	1	0.02.00	0.37.00
	Wait for thermalization of FPU		0.25.00	1	0.25.00	1.02.00
	Enable 4KH switching A/C		0.02.00	1	0.02.00	1.04.00
	Acquire data		0.30.00	1	0.30.00	1.34.00
	Change PS status to one on B/D		0.02.00	1	0.02.00	1.36.00
	Acquire data		0.30.00	1	0.30.00	2.06.00
	Disable 4KH switching A/C		0.02.00	1	0.02.00	2.08.00
	Enable 4KHz switching B/D		0.02.00	1	0.02.00	2.10.00
	Change PS status to zero on A/C		0.02.00	1	0.02.00	2.12.00
	Acquire data		0.30.00	1	0.30.00	2.42.00
	Change PS status to one on A/C		0.02.00	1	0.02.00	2.44.00
	Acquire Data		0.30.00	1	0.30.00	3.14.00

4.7.2 Results and Conclusions

The procedure has run on the 23rd of October 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%)	PASSED
No unexpected features in FFT spectrum (Spike, Pop corn noise, currents drops...)	TBC

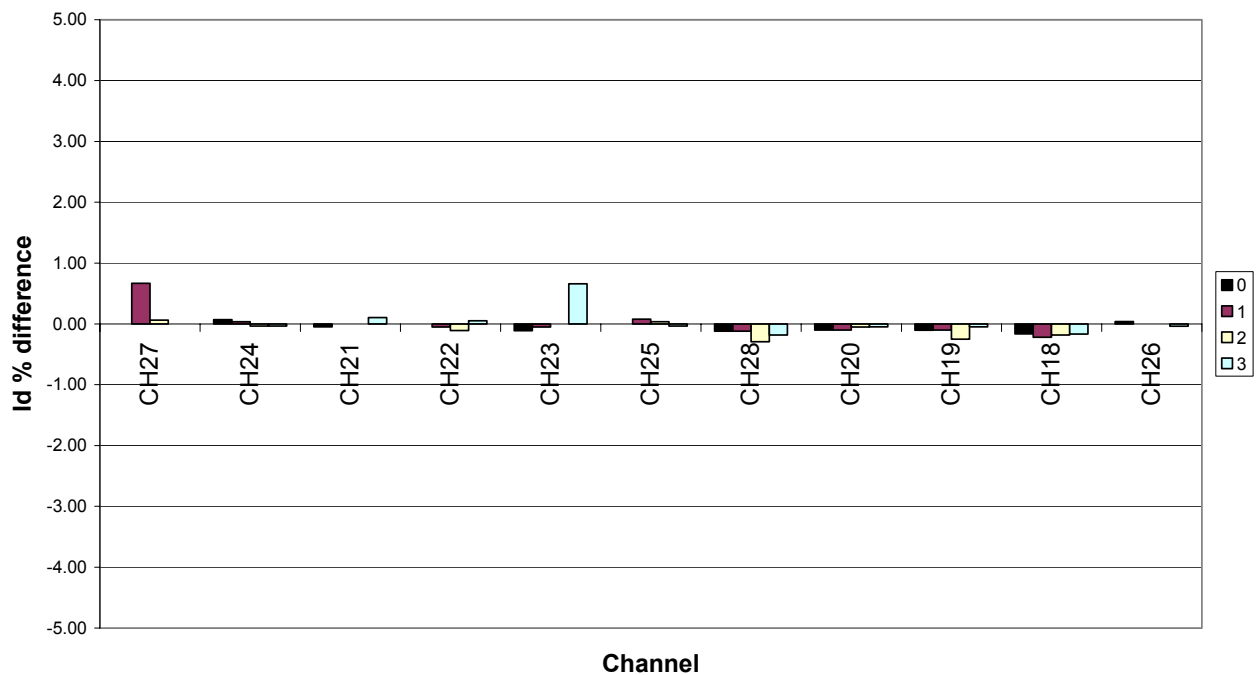
No NCRs have been raised.



Id w.r.t WFT				
CH	<00>	<01>	<10>	<11>
CH27	0.00	0.67	0.06	0.00
CH24	0.07	0.04	-0.03	-0.03
CH21	-0.05	0.00	0.00	0.10
CH22	0.00	-0.05	-0.11	0.05
CH23	-0.11	-0.05	0.00	0.66
CH25	0.00	0.08	0.04	-0.04
CH28	-0.12	-0.12	-0.29	-0.18
CH20	-0.10	-0.10	-0.05	-0.05
CH19	-0.10	-0.10	-0.25	-0.05
CH18	-0.16	-0.22	-0.18	-0.17
CH26	0.04	0.00	0.00	-0.04

Figure 2 currents during AMB02

LFI ON: drain currents w.r.t WFT



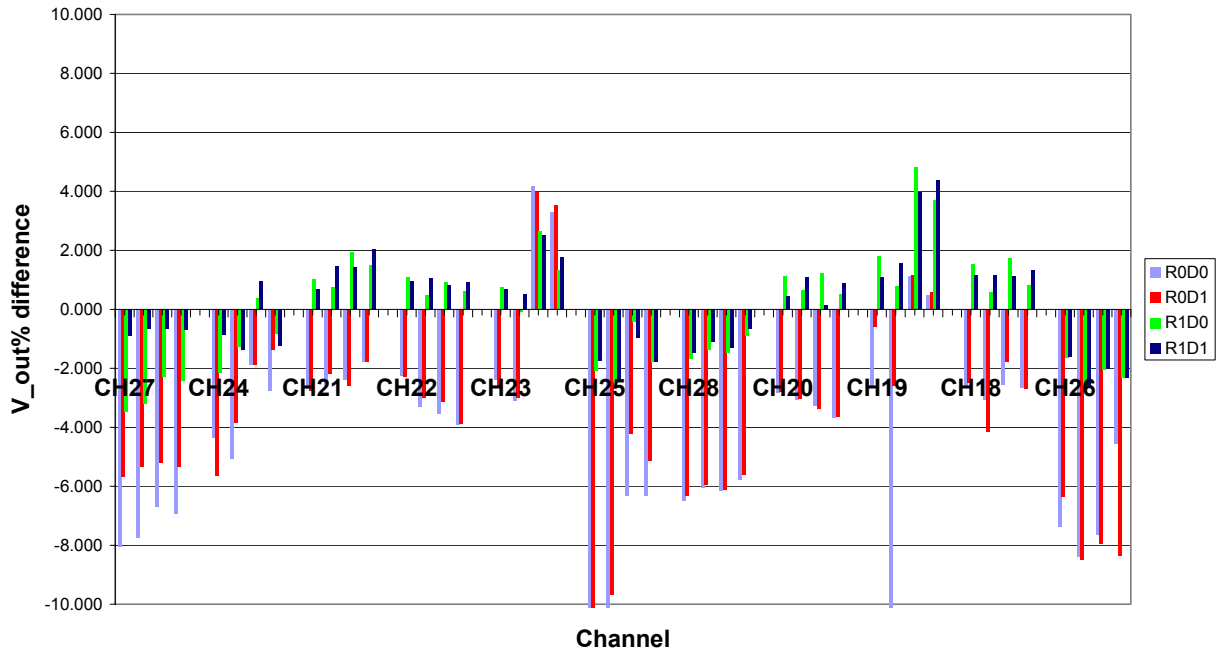


LFI ON VOUT (w.r.t WFT)						
	B/D SW		A/C SW		average B/D	average A/C
	REF	Remarks	Remarks	Remarks		
CH27	-8.07	-5.68	-100.00	-100.00	-6.37	-100.00
	-7.74	-5.33	-100.00	-100.00		
	-6.69	-5.20	-100.00	-100.00		
	-6.92	-5.33	-100.00	-100.00		
CH24	-4.35	-5.63	-2.14	-0.86	-3.35	-0.80
	-5.06	-3.85	-1.27	-1.39		
	-1.89	-1.89	0.38	0.94		
	-2.78	-1.39	-0.82	-1.23		
CH21	-2.71	-2.75	1.02	0.68	-2.36	1.35
	-2.62	-2.21	0.75	1.48		
	-2.41	-2.60	1.94	1.42		
	-1.80	-1.79	1.48	2.03		
CH22	-2.25	-2.60	-100.00	-100.00	-2.46	-75.00
	-3.29	-1.79	-100.00	-100.00		
	-3.55	0.00	0.00	0.00		
	-3.92	-2.28	-100.00	-100.00		
CH23	-2.40	-2.59	0.76	0.68	0.48	1.27
	-3.10	-3.02	-0.07	0.51		
	4.18	3.97	2.64	2.52		
	3.29	3.53	1.32	1.77		
CH25	-10.71	-10.61	-2.10	-1.74	-7.90	-1.71
	-10.23	-9.67	-2.45	-2.43		
	-6.32	-4.21	-0.43	-0.95		
	-6.33	-5.13	-1.77	-1.79		
CH28	-6.50	-6.33	-1.69	-1.48	-6.07	-1.25
	-6.06	-5.97	-1.37	-1.10		
	-6.16	-6.12	-1.49	-1.30		
	-5.79	-5.61	-0.90	-0.66		
CH20	-2.84	-2.80	1.13	0.44	-3.22	0.77
	-3.09	-3.02	0.66	1.11		
	-3.29	-3.39	1.21	0.16		
	-3.70	-3.65	0.53	0.90		
CH19	-2.59	-0.60	1.81	1.11	-11.60	2.77
	-90.33	-2.61	0.79	1.56		
	1.13	1.15	4.82	3.97		
	0.50	0.59	3.72	4.39		
CH18	-2.63	-2.51	1.55	1.18	-2.76	1.18
	-3.07	-4.14	0.57	1.14		
	-2.58	-1.78	1.72	1.13		
	-2.67	-2.71	0.81	1.33		
CH26	-7.38	-6.35	-1.65	-1.63	-7.40	-2.16
	-8.39	-8.50	-2.65	-2.61		
	-7.65	-7.96	-2.04	-2.01		
	-4.57	-8.37	-2.33	-2.33		

Figure 3 Bias and Vout table during test AMB_02



LFI ON: scientific output w.r.t. WFT



4.8 Nominal Science with Redundant unit

During this step HFI and SCS are switching off. LFI stays in nominal acquisition acquiring data for analysis.

4.8.1 Procedure/ Test sequence

No test sequence for LFI has requested to be applied here.

4.8.2 Results and Conclusions

Pass and Fail Criteria



No un-expected event Packets	
REBA Power Consumption within the ranges of expected values	
DAE Power Consumption within the ranges of expected values	
No unexpected features during SCS activity in Scientific signal	
No unexpected features during HFI activity in Scientific signal	

Some NCRs have been raised:

NCR	Description

4.9 Switch off of the Nominal Unit

4.9.1 Procedure/ Test sequence

LFI SIT: Switch off (Redundant Unit)				0.20.00		
Switch OFF LFI			1	0.20.00		
	Science De-Activation		0.05.00	1	0.05.00	0.05.00
	RCA De-Activation		0.05.00	1	0.05.00	0.10.00
	LFI to Standby	DAE Set Up to Standby	0.05.00	1	0.05.00	0.15.00
	Switch OFF	Standby to OFF	0.05.00	1	0.05.00	0.20.00

4.9.2 Results and Conclusions

The test was successfully completed.

Pass and Fail Criteria

No un-expected event Packets	PASSED
No more telemetry coming from LFI	PASSED

No NCRs have been raised:

4.10 NEW FEATURES



4.10.1 Current drops in RCA 23

During all the **AMB_0113** and **AMB_0114** the RCA23 scientific output detectors **R0D1** and **R0D1** showed unstable signal level correlated to unexpected drain current variations. The jumps on the signal were higher, up to about 20mV, than the jumps observed during LFI RAA test campaign. The nature of such instabilities is not yet explained but the instabilities seem to be originated by electrical disturbances on the drain circuitry or electromagnetic induced by some other effect. The instabilities are observed both in the sky and ref signals in the same way, so that it is expected that the differenced data shows a more clean behaviour (**to be checked**). It should be noted that some jumps are so high that they have been observed also in the R1 radiometer. For these instabilities an analysis needs to be performed also in relation with the HK electrical and thermal probes to investigate interference between LFI and S/C and HFI.

When drops are evident, Id limits exceed the requirement. NCR must be raised

4.10.2 Packet LOST

LFI28 losing packets at the end of AMB114

During some phases of the SIT a packet lost in scientific output was observed. It was explained as correlated with compression rate in the HFI data. Actually, when the problem on HFI was solved (changing the compression rate), voids in data stopped to be shown.

Just at the end of AMB 02 a data loss is observed in LFI 28. a deeper analysis is needed.

4.10.3 Scientific output crossing in RCA 25

It was monitored an anomalous feature come out from last SFT test deep analysis. The feature consists in an asymmetric variation of sky and ref signals exiting the same diode. The problem seems to be at first saw not present on the other diode associated to that side of the radiometer. During the entire SIT the asymmetry was observed just once but a deeper analysis is required.

It is a not understood problem., NCR must be raised on this topic.

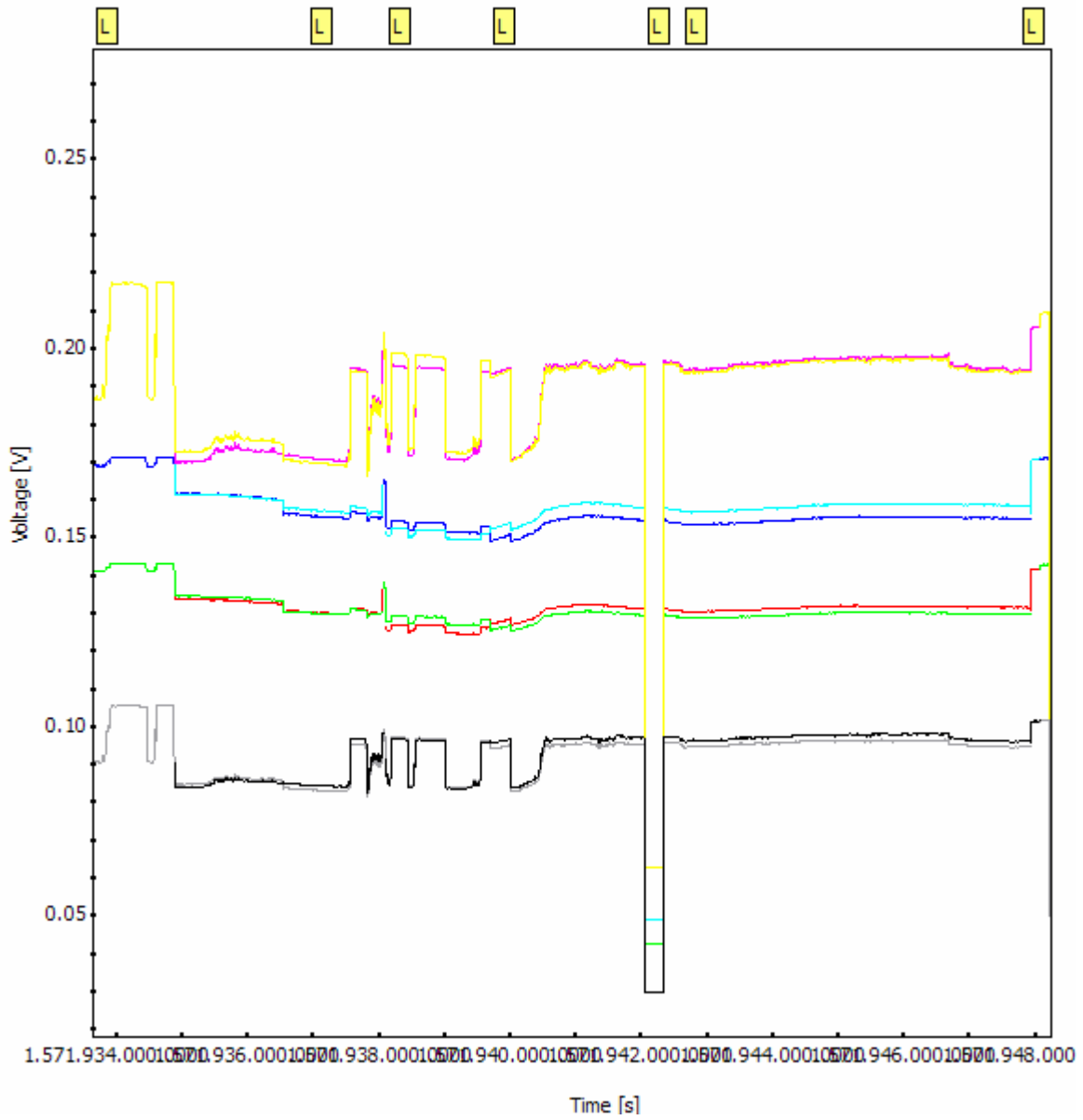


Figure 4 Voltage changes in RCA 23. changes are observed to anticorrelated with current drops observed in Id.

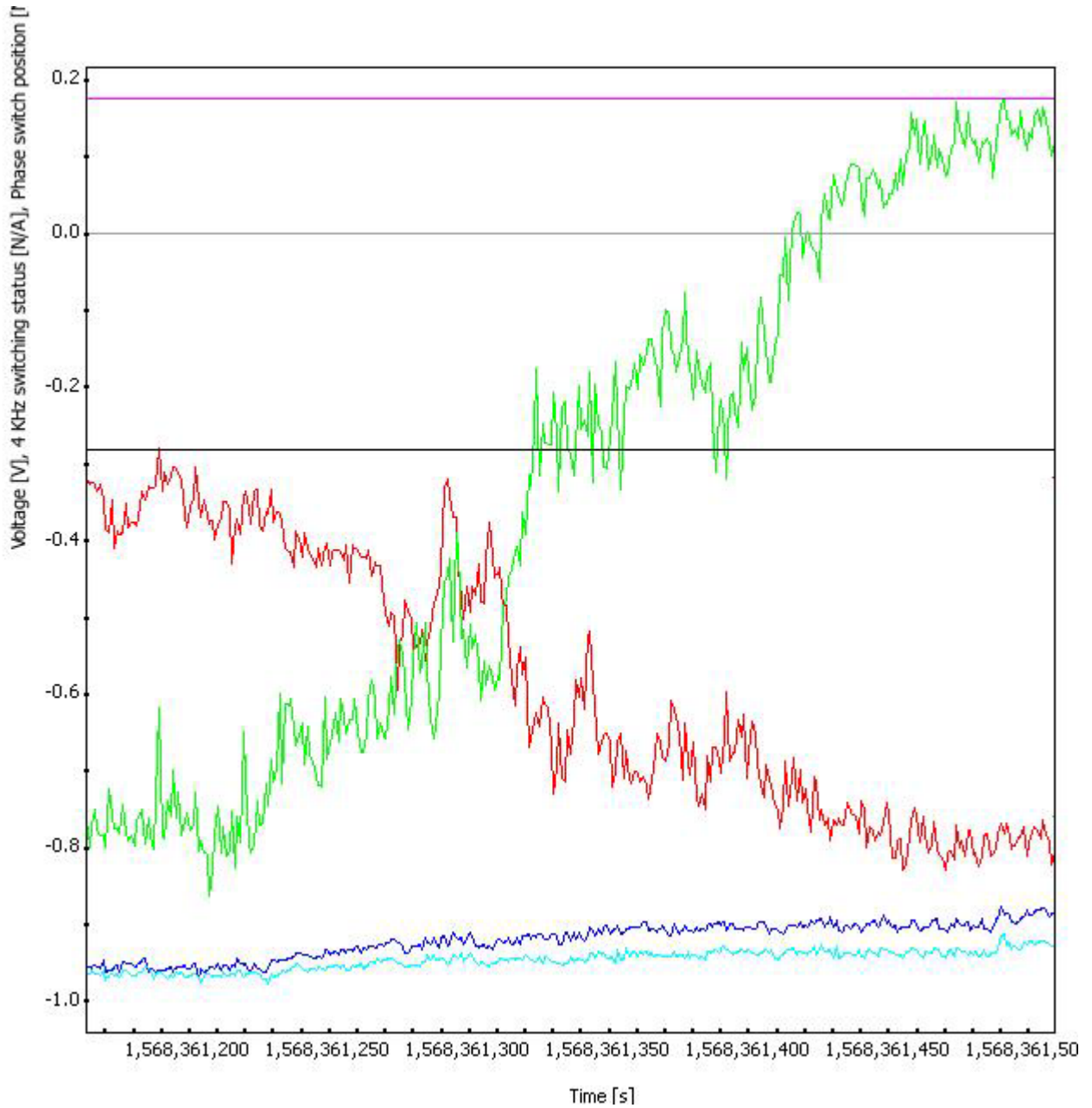


Figure 5 RCA 25 signal crossing during last SFT

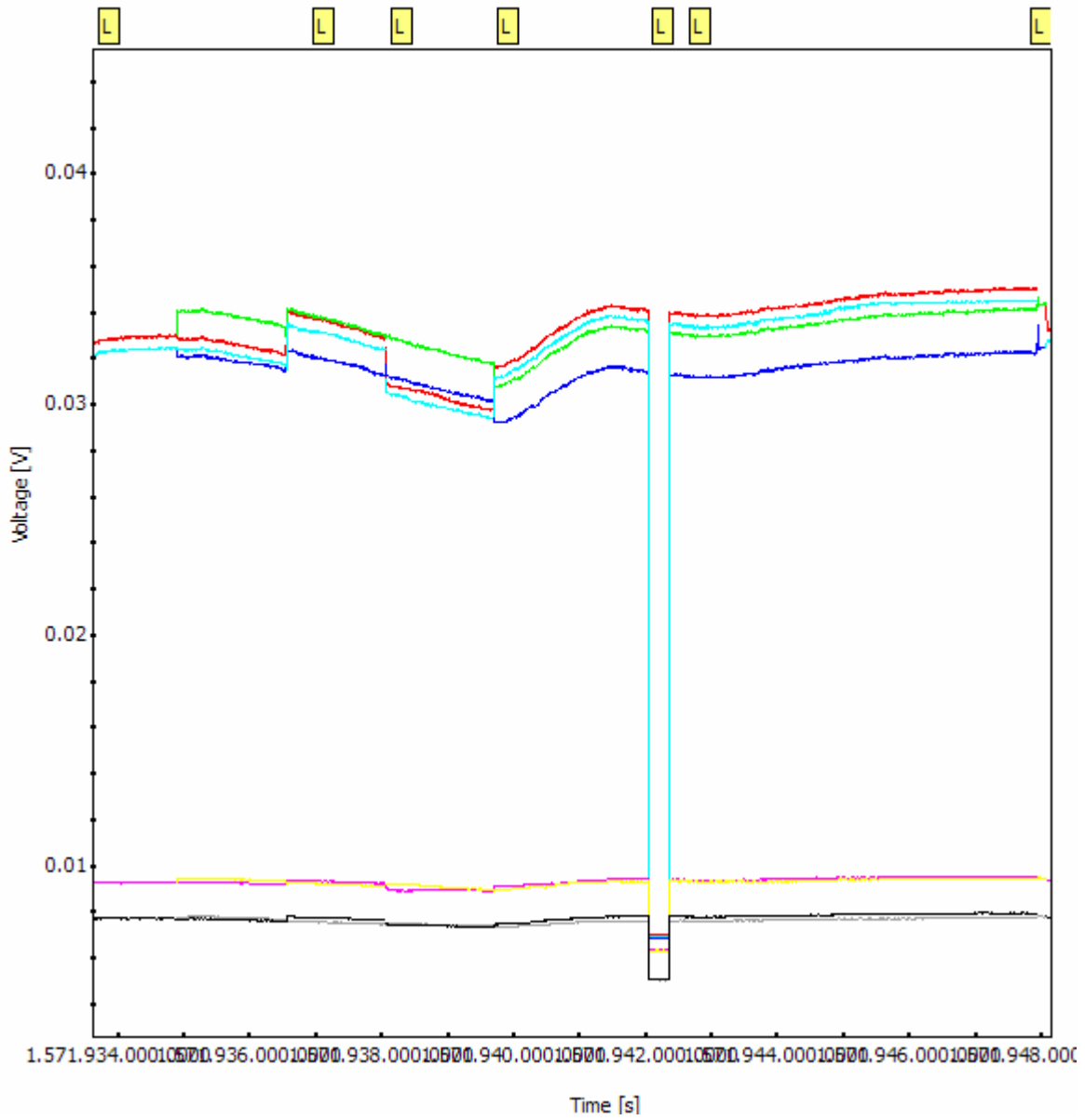
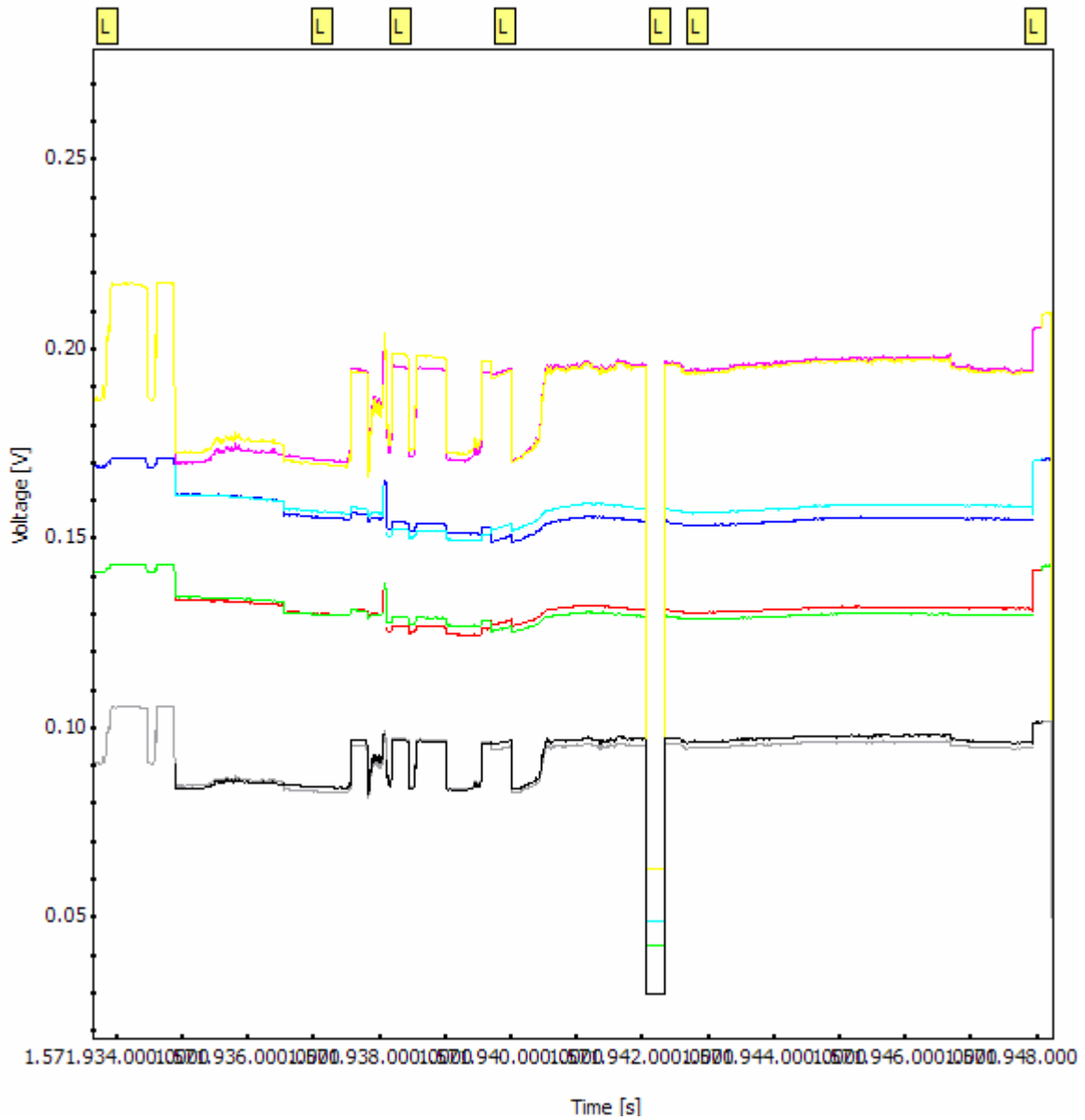


Figure 6 feature observed in RCA 25



4.10.4 Noise / spikes in signal corresponding to some SCS activities

Noise in signal during some operations of the SCS unit, in particular the redundant unit. This problem must be investigated better cross correlating analysis on LFI data with list of TM sent on SCS units.