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## Planck-LFI commissioning: LFI from OFF to DAE setup

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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 APPLICABLE AND REFERENCE DOCUMENTS**

### **2.1 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] Data analysis and scientific performance of the LFI FM instrument, PL-LFI-PST-AN-006 3.0
- [AD6] Planck-LFI TV-TB test report: executive summary, PL-LFI-PST-RP-040 1.1

### **2.2 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 4.0
- [RD3] Testing Plan of the LFI instrument during the Planck commissioning and CPV phase, PL-LFI-PST-PL-013 Issue 4.2





### 3 INTRODUCTION

#### 3.1 Purpose and Scope

Switch On the LFI and verify the functionalities of the LFI REBA and DAE.  
The LFI is switched on in two steps.

First LFI Comm-1:

1. switch on the REBA unit,
2. perform the DPU and SPU memories commissioning
3. load and start DPU and SPU Application SoftWare
4. synchronize the REBA.

LFI goes to Stand-by mode.

Then LFI Comm-2:

1. switch on the DAE unit,
2. Perform DAE synchronization,
3. Perform the DAE memories commissioning,
4. Start Science Processing.

LFI goes to DAE Set-up mode.

#### 3.2 Test configuration

The test configuration is the following

SCOS 2K EGSE 3.1 Release 1.2  
RTSILib version 1.0  
RTSI Client version 1.2  
LEVEL1 (TMH/TQL) version 5.1  
LIFE Machine version OM 3.00

LFI Personnel involved during the test is:

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LFI IOT	Chris Butler, Cristian Franceschet
Industry support	Paolo Leutenegger



## 4 Test Execution

The Commissioning of the LFI, namely P\_COP\_LFI\_0001\_01 and P\_COP\_LFI\_0002\_01, was performed on June, 06 2009, 16:05z DoY 155 - OD 22. The duration of the test was about 1 hour and 45 minutes.

### 4.1 Pass-fail criteria, verification matrix

Verification matrix					
Check	Passed?			Recovered?	
	Yes	No	Notes	Yes	No
No unexpected events packets	Yes				
REBA switched on	Yes				
TM as expected	Yes				
REBA HK as expected	Yes				
Memories commissioning successfully accomplished	Yes				
ASW loaded and started	Yes				
REBA synchronized	Yes				
DAE switched on	Yes				
DAE connected to REBA	Yes				
DAE HK as expected	Yes				
DAE synchronized	Yes				
Science TM produced	Yes				
Real time data available	Yes				
Data saved and stored at DPC	Yes				

### 4.2 Procedure/ Test sequence

The list of operations to be performed during the LFI commissioning phase is reported below. The references are to the LFI UM [RD-2].

Commissioning activities (P\_FCP\_LFI\_NSFF) – part 1:

1. Switch the REBA On
  - 1.1. REBA Power On by the satellite (see Table 13.2 61 Summary of the REBA and RAA power ON/OFF procedure)
  - 1.2. REBA communication check (see Table 13.2 20 REBA ASW Init, step 1)



- 1.3. REBA hardware self check (see Table 13.2 20 REBA ASW Init, step 2 and 3)
2. Commissioning of DPU memories (see §13.1.1.1, Table 13.1 1 and Table 13.1 2)
  - 2.1. Dump DRAM
  - 2.2. Dump PRAM
  - 2.3. Dump EEPROM
  - 2.4. Dump PROM
3. DPU ASW startup (see Table 13.2 20 REBA ASW Init, step 4 to 7)
4. Event packets enabling (see Table 13.2 56 Event packets enabling)
5. REBA synchronisation and verification (see Table 13.2 22 REBA synchronization)
6. DPU to SPU connection (see Table 13.2 20 REBA ASW Init, step 8 to 10)
7. Commissioning of SPU memories (see § 13.1.1.2, Table 13.1 3 and Table 13.1 4)
  - 7.1. Dump PRAM
  - 7.2. Dump DRAM
  - 7.3. Dump Expanded DRAM
  - 7.4. Dump PROM
8. SPU ASW startup (see Table 13.2 20 REBA ASW Init, step 11 to 15)

The LFI is now in Stand-by mode.

Commissioning activities (P\_FCP\_LFI\_NSFS) – part 2:

9. RAA Power On by the satellite (see Table 13.2 61 Summary of the REBA and RAA power ON/OFF procedure)
10. DAE switch on connection and HK retrieval (see Table 13.2 24 RAA On check and connection to REBA)
11. DAE synchronisation and verification (see Table 13.2 26 RAA synchronization)
12. Commissioning of DAE-SPU link memory
  - 12.1. Connect DAE SPU link (see Table 13.2 69)
  - 12.2. Commissioning of DAE memories (see §13.1.1.3, Table 13.1 5 and Table 13.1 6)
13. Start science processing
  - 13.1. Set Telemetry Rate (see Table 13.2 50 Setting the telemetry rate)
  - 13.2. All channels in Mode 1 (see Table 13.2 77 Set science processing mode, parameters LP166320 (mode A) = 1, LP167320 (mode B) = 1, parameter from LP116320 to LP119320 = FFFFh bit mask of the channels to be processed in mode A and parameter from LP120320 to LP123320 = 0000h bit mask of the channels to be processed in mode B)
  - 13.3. Set N\_average to 256 for all channels (see Table 13.2 71 Definition of the N\_Ave science processing parameters)
  - 13.4. Start REBA Science processing (see Table 13.2 34 Science activation, step 4)
  - 13.5. Start DAE Science sequencer (see Table 13.2 34 Science activation, step 5)
  - 13.6. NRT data processed at the IW@MOC

The LFI is now in DAE Set-up mode. Science production is enabled (test configuration: type 1), FEU is still off.

#### 4.2.1 Results and Conclusions

All the procedures were successfully performed, no anomaly reported.



All memory commissioning activities (dumps of corresponding memory content) were correctly verified.

#### 4.2.2 Non nominal features

The thermal sensors on the back end, corresponding to LM101332, LM102332, LM108332, LM111332, LM114332, LM207332, LM209332, LM211332, LM307332, LM309332 and LM311332, give values that are below the ones reported in the LFI User Manual [RD-2] at LFI switch on. The values in the User Manual are not proper since they correspond to the nominal values when all power groups will be on while at this level they are still off. The measured values are indeed within the expected limits and report the correct values at this level.

Thermal sensors on the focal plane, namely LM201332, LM202332, LM203332, LM204332, LM205332, LM206332, LM301332, LM302332, LM303332, LM304332, LM305332 and LM306332, give values that are out of limits but this is normal because the focal plane is cooling down and it is not at its nominal temperature.

At the end of the procedure, the DAE was not yet initialized (gain and offset values) since as a baseline this initialization will be applied later on, at the beginning of cryo01 tests. It was asked to apply this initialization at the end of commissioning activities in order to avoid calibration problems in the data acquired after this phase. This procedure was successfully applied about 1 hour later, still in the visibility window.

#### 4.3 Data Analysis

Data analysis is performed in real time during the activities by looking at real time HK telemetry and verifying the corresponding values are within the expected ranges. Results are given above in § 4.2.1 and 4.2.2.

#### 4.4 Conclusions and recommendations

LFI was switched on exactly as foreseen. The time allocated for this activity was originally 4+4 hours to consider possible contingency actions and delays due to manual activities (memory commissioning).

Indeed the full procedure required less than 2 hours, exactly as when the same operation was performed during SVT-2.