TITLE: # Testing Plan of the LFI instrument during the Planck Commissioning and CPV phase

DOC. TYPE: **PLAN**

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CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.1	Jan 2007	All	First Draft of the Document	
0.2	July 2007	All	First complete draft of the document	
1.0	July 2007	All	First issue of the document	1.0
1.1	October 2007	All	Modified version after ICWG #16 and CPV meeting of 18-19 October 2007 (Milano)	1.1
1.2	January 2008	All	Completed TODO items # 1, 3, 9	1.2
2.0	April 2008	All	Completed TODO items # 10, 20, 21, 22, changed timing of LFI19 from 24 to 48 hours, changed verification of DAE offset table to 24 hours	2.0
3.0	November 2008	All	Major revison of the document. Main changes to: Flow diagram (Figure 1) Functional tests: Health check split into 2.4 and 2.5 SPLIT LFI-01-1 spikes 01 into 2 test: LFI-01-1-BIS after cryo 01 to avoid pw.groups switch off. Introduced Drain current verification test (2.10) LNAs tuning section: standard Vg1-Vg2 Tuning modified into Hyper Matrix Tuning (3.2.2.2) that foresees a pre-tuning screening section (3.2.2) exchanged the test sequency for , DAE calibration (3.2.3), Functionality Reference (3.3) Test Vg Tuning verification (3.3.1) Modified the Vg Tuning verification with 4K modulation (3.3.1) Added PH SW Tuning verification after LNAs Tuning (3.3.2) BT test duration reduced from 6 hours to 1 hour. Modified Dynamic thermal response to FPU temperature (introduced possible control by SCS PID) 4.3 Dropped Thermal response test to 3rd Vgroove (4.4) Modified HFI Interference with LFI (required by HFI,) (5.5) Dropped LFI-21 Internal EMC Test Filled some parts in setions Optical calibration (§6) and Focal Plane geometry (§7)	
4.0	January 2009		CHANGED TEST FLOW : Fig 1	
			Dropped tests from LFI 31 to LFI 37 (they are a product of analysis from LFI 30)	

			Swapped position for tests LFI-25 and LFI-01-BIS	
			(TBC) swap between LFI-04 and LFI-05-1	
			Swapped LFI-08 and LFI-13	
			Separated LFI-15 and LFI -16	
			Moved LFI-16 just before LFI-20	
			INSERTED LFI_02_2-BIS	
			LFI-01-1 SPIKE TEST #1 TEST duration canged to 4h	
			LFI 14 Blanking time test duration reduced to 1h	
			LFI-10 duration reduced to 3h30’	
			LFI-16 duration reduced to 24 h	
4.1	March, 2009-03-17		LFI-16 :modified test description; duration restored to the previous issue 3.0 from 24 to 48 h , (as it was agreed on november 2008).	
			Modified § 3.2.2 : detailed description of the Hyper matrix Tuning basing on results from HFI 4K stage cooldown model.	
			5.1.1 and 5.1.2: modified test description (LFI 18 and LFI 19)	
			Figure 1 :modified test flow (Figure 1)	
			Minor changes along the document	
4.2	March, 2009-03-31		Added references to User Manual	
			LFI 14 (§3.5) : REBA tuned added in the constraint section (but the test was already foreseen to be performed sequential to REBA check)	
			LFI 30 (6.1): changed TYPE from 1 to 5	
			Short introduction added (§1)	
			LFI 30: Table 1, filled gaps	
			Reference documents list completed	
			Included references to modules of analysis	
			LFI-10 : modified pointing requirements	

TABLE OF CONTENTS

0 APPLICABLE AND REFERENCE DOCUMENTS

0.1 APPLICABLE DOCUMENTS

[1] Laureijs, R. J., Planck in-orbit calibration and test requirements. Planck/PSO/2003-024 2.0, July 2007

0.2 REFERENCE DOCUMENTS

[RD1] Planck LFI User Manual PL-LFI-PST-MA-001 Issue 3.0
[RD2] TV-TB Test: LFI Test Under cryohenic Vacuum PL-LFI-PST-PR-021
[RD3] TUNINING OF PLANCK-LFI LNAs IN CPV: REQUIREMENTS SPECIFICATION, PL-LFI-PST-SP-017

[RD4] 'Matrix Tuning Strategy for CSL' , PL-LFI-PST-TN-090.
[RD5] Proposal for bias tuning during the CPV phase after the CSL test campaign experience", PL-LFI-PST-SP-017
[RD6] Planck-LFI TV-TB test report: executive summary, PL-LFI-PST-RP-040

0.3 ACKNOWLEDGMENTS

This document has been issued as a part of the activity performed under the ASI contract for Planck phase E2.

1 INTRODUCTION

This document describes the architecture of LFI tests to be performed during Commissioning and CPV phases.It is important to highlight that LFI CPV superposes in the timeline to HFI commissioning phase. The document shows the test flow to be followed, and contains the objective and description of tests to be performed, together with the specific requirements, hold points in the expected timeline, environmental conditions, references to procedures and User manual.
The test sequence and other details could change to accomplish with the CoP and CPV Timelines, still to be frozen for the time being.

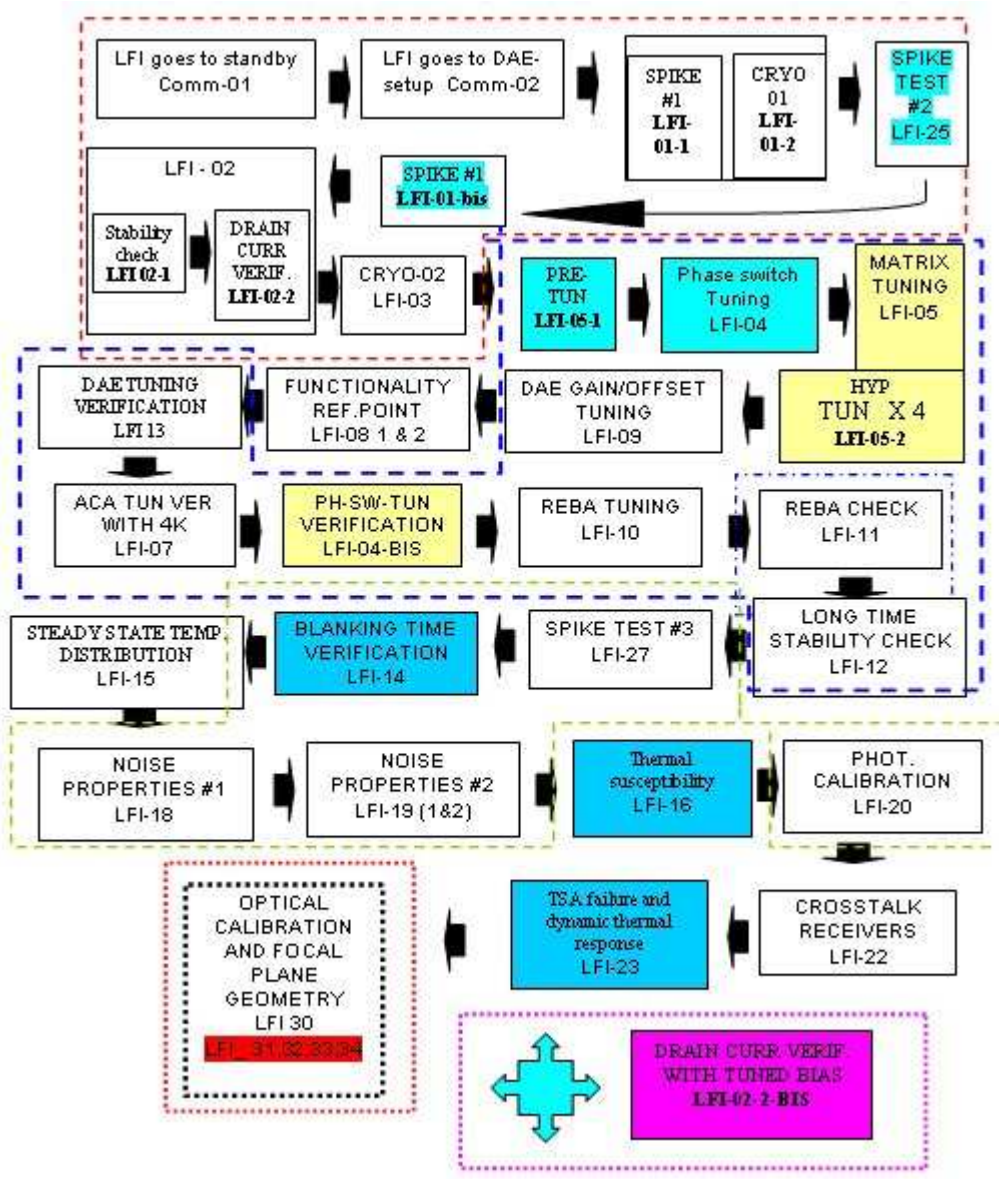

Figure 1Flow diagram of LFI Commissioning and CPV tests: colors are representative ofdifferent phases: red dashed rounded is the commissioning and merely functional phase, blue dashed is tuning phase, green dashed is RF calibration, red dot is optical calibration and focal plane geometri characterisation., Yellow filled cells are new test added or strongly modified with respect to the previous version of the document, red filled cells or barred labels indicate suppressed tests.,Green filled labels are tests changed in the name; Light blue labels are tests changed in position (w.r.t. timeline) Some tests, as LFI-01 and LFI-05 have been split in two parts referring to the same label and individuated by a second index. (-1, -2) ; Magenta indicates a new test (drain current verification with LNAs nominally tuned) that could be performed anywhere after LNAs tuning. Procedure is the same as LFI_02_2 and time required is 2,5 hr. Blancking time verification (LFI4) was moved after REBA check, to be compliant with test constraints)

2 FUNCTIONALITY

2.1 COMM-1 LFI GOES TO STAND BY

Item	
Sequence number	Commissioning 1
Test name	LFI goes to Stand by
Instrument	LFI
Point of Contact	Anna Gregorio
Test objective	Switch on the LFI REBA and check its functionality
Test duration (including overhead)	4 hours
Test frequency	Once
Constraints	During DTCP;
LFI mode	From off condition to Stand By mode
SCS mode	Start up
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	Tref > 50K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	N/A
Contact with SPACON	Yes
Near Real Time	Yes
TMTC procedure	• Switch on the REBA unit [RD-1] Tab 13.2-61, Tab. 13.2-20 • Perform the DPU memories commissioning [RD-1] Tab 13.1-2 • Start the DPU ASW [RD-1] Tab 13.2-20 • Perform the SPU memories commissioning [RD-1] Tab 13.1-4 • Start the SPU ASW [RD-1] Tab 13.2-20 • Perform REBA Synchronization [RD-1] Tab 13.2-22 See also [RD-1] § 13.1.1 steps 1.1 to 1.8
Data analysis timing	Included in the procedure. Memories analysis will be performed offline before next DTCP.
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• Most of data analysis is done looking at TM in real time. • Dump packets of the memories will be analised off line
Pass/Fail criteria	• REBA Autocheck passed • REBA power consumption compliant with specification and requirements • REBA memories dump packets as expected • ASW is producing REBA HK telemetry as expected. • REBA synchronization achieved
Action in case of failure/anomalies	Stop the sequence. Verify possible contingency actions as described in [RD-1] § 13.3. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.

Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	No
Comments/Questions	
Sequential to	It is the first LFI test
Criticality for CPV cont.	Yes

2.2 COMM-2 LFI GOES TO DAE SETUP

Item	
Sequence number	Commissioning 2
Test name	LFI goes to DAE Set Up
Instrument	LFI
Point of Contact	Anna Gregorio
Test objective	Switch on the LFI DAE and check its functionality
Test duration (including overhead)	4 hours
Test frequency	Once
LFI mode	From Stand By mode to DAE setup
Constraints	During DTCP;
SCS mode	Start up
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	T > 50K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	N/A
Contact with SPACON	Yes
Near Real Time	Yes
TMTC procedure	1. Switch on the DAE unit [RD-1] Tab 13.2-61, Tab. 13.2-24 2. Perform DAE synchronization [RD-1] Tab 13.2-26 3. Perform the DAE memories commissioning [RD-1] Tab 13.2-69, Tab 13.1-6 4. Start Science Processing [RD-1] Tab 13.2-50, Tab 13.2-77, Tab 13.2-71, Tab 13.2-34 See also [RD-1] § 13.1.1 steps 1.9 to 1.13
IOTCRD section	NA
Data analysis timing	Included in the procedure. Memories analysis will be performed offline before next DTCP.
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• Most of data analysis is done looking at TM in real time. • Dump packets of the memories will be analised off line

Pass/Fail criteria	• DAE power consumption compliant with specification and requirements • DAE memories dump packets as expected • Production of DAE HK telemetry as expected. • DAE syncrhonization achieved
Action in case of failure/anomalies	Stop the sequence. Verify possible contingency actions as described in [RD-1] § 13.3. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	No
Comments/Questions	
Sequential to	LFI goes to standby (Comm 1)
Criticality for CPV cont.	Yes

2.3 LFI-01 LFI SWITCH ON AND BASIC HEALTH CHECK

It has been split into two independent blocks:

LFI-01-1 SPIKE 01
LFI-01-2 CRYO 01

2.4 LFI-01-1 SPIKE TEST 01

Item	
Sequence number	1
Test name	LFI RADIOMETERS HEALTH CHECKS (SPIKE 01)
Instrument	LFI
Point of Contact	Aniello Mennella, Francesco Cuttaia
Test objective	1. Switch on the LFI without biasing the DC/DC and the LNAs and check for each units work as expected. 2. Characterise frequency spikes in the scientific output from DAE alone
Test duration (including overhead)	4h
Test frequency	Once
Constraints	1. Starting sorption cooler temperature @ about 40 K 2. No activity from HFI
LFI mode	From DAE Set up to nominal science production TYPE 1
SCS mode	Start up
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	30K < Tref < 50K (NOT RELEVANT FOR THIS TEST)
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	N/A

Contact with SPACON	Yes
Near Real Time	spike characterisation can be executed outside visibility
TMTC procedure	• LFI go to DAE setup **Spike characterisation** [RD-1] § 13.1.2.1 and § 13.1.2.1.1 • Acquire scientific data for 2 hours • Switch off the HK sequencer • Acquire scientific data for 2 hours • Switch on the HK sequencer
IOTCRD section	4.1.1.1 (need include requirements for spikes characterisation)
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• Real time visualisation on TQL. • LIFE can be used offline in case of anomalies and to check housekeeping parameters.
Dedicated LIFE SW	• - plot_spectra • - plot_spectrum • - rca_spike_plotter • Pegaso_view interface
Pass/Fail criteria	All subunits respond as expected when stimulated: - SCIENTIFIC TM received from each channel. - spikes are consistent with CSL test campaign
Action in case of failure/anomalies	Stop the sequence. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	No
Comments/Questions	
Sequential to	LFI goes to DAE setup (LFI Commissioning 2)
Criticality for CPV cont.	Yes

2.5 LFI-01-2 CRYO 01

Item	
Sequence number	1
Test name	LFI RADIOMETERS HEALTH CHECKS (CRYO 01)
Instrument	LFI
Point of Contact	Francesco Cuttaia
Test objective	1. Switch on the LFI and check for each units work as expected.
Test duration (including overhead)	At least 3 DTCP (> 4h30' acquisition each) for almost 15-hours contact sessions
Test frequency	Once

Constraints	1. During DTCP; 2. Starting sorption cooler temperature @ < 40 K 3. No activity from HFI
LFI mode	From DAE Set up to nominal science production TYPE 1
SCS mode	T_{FPU}< 40K
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	30K < Tref < 40K , depending on the 4Kstage cooldown profile
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	N/A
Contact with SPACON	Yes
Near Real Time	Yes
TMTC procedure	**FEM functionality** [RD-1] § 13.1.2.3 • When focal plane is less than 40 K for each radiometer , each channel is switched on and off to verify ACAs and P/S health (Use CSL biases). After the check both channels are swiched on before checking the next radiometer • Double check switch on procedure of LFI28 • The channel just tested will be left in on condition. • DAE is configured with *gain 1 and offset coming from CSL test*; however OFFSET will be optimised in real time for the particular setup condition, whenever DAE saturation requires to do that.
IOTCRD section	4.1.1.1
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• Real time visualisation on TQL. • LIFE can be used offline in case of anomalies and to check housekeeping parameters.
Dedicated LIFE SW	• pegaso_bscope
Pass/Fail criteria	All subunits respond as expected when stimulated: - SCIENTIFIC TM received from each channel. - Scientific op. changes with Vg1 and Vg2 changes - Separation observed when 4KHz is enabled - No unexpected event packets. - Check on qualitative behaviour of drain currents (need to be consistent with CSL test) - [RD-1] § 13.1.2.3
Action in case of failure/anomalies	Stop the sequence. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	No
Comments/Questions	
Sequential to	SPIKE 01
Criticality for CPV cont.	Yes

2.6 LFI-25 Spike characterisation test #2

Item	
Sequence number	25
Test name	SPIKE CHARACTERISATION TEST #2
Instrument	LFI
Point of Contact	Mennella
Test objective	Check for spikes in data coming from radiometers in all phase switch configurations with the HK sequencer both on and off.
Test duration (including overhead)	16 hours
Test frequency	Twice (repeated in LFI-27 after tuning)
Constraints	LFI functionality verified
LFI mode	Nominal science production TYPE 1
SCS mode	Nominal
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	22K < Tref < 35K
Spacecraft state	Nominal
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.1 and § 13.1.2.1.2 • LFI go to nominal mode • Acquire scientific data for 1 hour for each phase switch state (4 hours total acquisition time) • Switch off 4 KHz switching • Acquire data for 1 hour for each phase switch state (4 hours total acquisition time) • Switch off the HK sequencer • Acquire scientific data for 1 hour for each phase switch state (4 hours total acquisition time) • Switch on 4 KHz switching • Acquire scientific data for 1 hour for each phase switch state (4 hours total acquisition time) • Switch on HK sequencer
IOTCRD section	
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	LIFE visualisationa and analysis routines (spectrum calculation, spike finding procedures).
Dedicated LIFE SW	See Spike 01
Pass/Fail criteria	• Measured frequency spikes are as expected in frequency and amplitude • Frequency spikes systematically disappear when the HK sequencer is turned off • [RD-1] § 13.1.2.1

Action in case of failure/anomalies	NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Medium
Include in mini CPV	No
Comments/Questions	Same test must be performed at CSL
Sequential to	LFI functionality test (LFI-01-2)
Criticality for CPV cont.	Yes

2.7 LFI-01-1-BIS SPIKE TEST 01-BIS

Item	
Sequence number	1
Test name	LFI RADIOMETERS HEALTH CHECKS (SPIKE 01- bis)
Instrument	LFI
Point of Contact	Mennella, Cuttaia
Test objective	Characterise frequency spikes in the scientific output from BEMs
Test duration (including overhead)	4 HOURS
Test frequency	Once
Constraints	1. During DTCP; 2. Starting sorption cooler temperature @ 40 K No activity from HFI
LFI mode	From DAE Set up to nominal science production TYPE 1
SCS mode	Start up
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	22K < Tref < 35K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	N/A
Contact with SPACON	Yes
Near Real Time	spike characterisation can be executed outside visibility
TMTC procedure	**Spike characterisation** [RD-1] § 13.1.2.1 and § 13.1.2.1.1 • INITIALIZE TO 0 POWER GROUPS • Switch off the HK sequencer • Acquire scientific data for 2 hours • Switch on the HK sequencer • Acquire scientific data for 2 hours
IOTCRD section	4.1.1.1 (need include requirements for spikes characterisation)
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure

Data analysis tools	• Real time visualisation on TQL. • LIFE can be used offline in case of anomalies and to check housekeeping parameters.
Dedicated LIFE SW	• See spike 01
Pass/Fail criteria	All subunits respond as expected when stimulated: - SCIENTIFIC TM received from each channel. - spikes are consistent with CSL test campaign
Action in case of failure/anomalies	Stop the sequence. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	No
Comments/Questions	
Sequential to	LFI-25
Criticality for CPV cont.	Yes

2.8 LFI-02 LFI FUNCTIONALITY TEST

It contains two tests:
LFI 02-1 : Stability check
LFI 02-2 : Drain current verification

2.9 LFI-02-1 Stability check (spikes, popcorn noise, current drops)

Item	
Sequence number	3
Test name	LFI STABILITY CHECK
Instrument	LFI
Point of Contact	Maura Sandri
Test objective	Check for instabilities (Scientific signal and HK) in undisturbed conditions
Test duration (including overhead)	12 hours (No operations)
Test frequency	Once
Constraints	• LFI in nominal Type 1. • TSA Tuned • DAE Offset set to avoid DAE saturation, Gain 1 • 4K load Target temperature within 30 and 40K
LFI mode	Nominal science production TYPE 1.
SCS mode	Nominal
HFI mode	Configuration
HFI state	N/A
4K cooler state	22K < Tref < 35K

Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A (no operations during this test)
IOTCRD section	4.1.1.3
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• LIFE visualisation modules • TQL replay of acquired data • LIFE batch procedures to estimate noise properties (1/f noise slope, spikes)
Dedicated LIFE SW	See spike 01
Pass/Fail criteria	• All subunits respond as expected when stimulated: • No unexpected features (Pop corn Noise, Spike, Current drop) • Measured frequency spikes are as expected in frequency and amplitude • No unexpected event packets. • 1/f noise slopes have a slight dependence on the switching configuration (comparison with CSL tests)
Action in case of failure/anomalies	NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency. Stop next sequences in case of a safety issue, otherwise prepare for additional tests to be performed after tuning (see section 4.5).
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	
Sequential to	Spike characterisation test #2 (LFI-25)
Criticality for CPV cont.	Yes

2.10 LFI-02-2 DRAIN CURRENTS VERIFICATION

Item	
Sequence number	4
Test name	LNAs drain currents verification
Instrument	LFI
Point of Contact	Francesco Cuttaia

Test objective	Characterise the i-V response of LNAs when Vg1 and Vg2 are independently changed over a defined set of values. It allows to investigate possible drain chganges due to ground shift or any other possible non ideal response of LNAs. Eventually correct Hyper Matrix tables accounting for bias shift. Channels are grouped in six groups following the scheme: Group 1: RCA 18 + RCA 21 Group 2: RCA 19 + RCA 22 Group 3: RCA 20 + RCA 23 Group 4: RCA 25 + RCA 24 Group 5: RCA 26 + RCA 27 Group 6: RCA 28
Test duration (including overhead)	3 hours
Test frequency	At least twice, the second after LNAs tuning completion (but it could be repeated at any time, if required, during the mission)
Constraints	20 K SCS; TSA can also be not tuned yet.
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuning not mandatory)
HFI mode	Configuration.
HFI state	N/A
4K cooler state	Tref ~ 22K < T< 35K (depending on the 4K cooldown profile)
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	YES
TMTC procedure	[RD-1] § 13.1.2.4
IOTCRD section	
Data analysis timing	18 hours
Pass/fail assessment timing	Included in the procedure: • No unexpected event packets • Every ACA is responding as expected from CSL results • Correct biases Applied and checked.
Data analysis tools	LIFE tuning batch procedures
Dedicated LIFE SW	iV_curves
Pass/Fail criteria	i-V curves as expected from CSL tests and ILT [RD-1] § 13.1.2.4
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	About 24 hours to eventually correct bias tables before phase switch bias tuning.
Set parameters	Yes
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	
Sequential to	Functional Test CRYO 01 (2.4)
Criticality for CPV cont.	Yes

2.11 LFI-03 CRYO-02

Item	
Sequence number	2
Test name	LFI FUNCTIONAL TEST (CRYO 02)
Instrument	LFI
Point of Contact	Francesco Cuttaia
Test objective	1. Acquire data while the status of the P/S is changed by TC in the two possible configuration 2. Check for spikes in data coming from radiometers in all phase switch configurations.
Test duration (including overhead)	2,5 h
Test frequency	Once
Constraints	LFI in nominal Type 1. TSA Tuned DAE Offset and Gain with CSL values from CRYO 02 (in the case that they produce DAE saturation they will be updated in real time) 4K load Target temperature ~ 22K LFI biased with on-ground tuned biases
LFI mode	Nominal science production TYPE 1.
SCS mode	Nominal
HFI mode	Configuration
HFI state	N/A
4K cooler state	Tref ~ 22K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	Yes
Near Real Time	Yes
TMTC procedure	[RD-1] § 13.1.2.5 • LFI goes to nominal mode • Acquire scientific data for more than 1 hour for each phase switch state (more than 4 hours total acquisition time)
IOTCRD section	4.1.1.2
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• Real time visualisation on TQL. • Life batch procedures (LAMA B-scope)
Dedicated LIFE SW	Pegaso_bscope
Pass/Fail criteria	• All subunits respond as expected when stimulated: • Comparison with results from CSL tests and agreement within 5 % in current consumption of FEM units; Voltage output iwill be considered as a requirement only in the case the setup conditions will be comparable with CSL; only in that case the requirement will be 10% • No unexpected event packets. [RD-1] § 13.1.2.5

Action in case of failure/anomalies	Stop the sequence. NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in mini CPV	Yes (same test with instrument in the final nominal bias configuration)
Comments/Questions	
Sequential to	LNAs drain currents verification
Criticality for CPV cont.	Yes

3 TUNING

3.1 GENERAL REMARKS

3.2 FRONT-END BIAS TUNING

3.2.1 LFI-04 Phase switch bias tuning

Item	
Sequence number	4
Test name	LFI phase switch tuning
Instrument	LFI
Point of Contact	Villa, Terenzi
Test objective	Apply a bias matrix set of I1 and I2 phase switches currents for LFI 24, 25, 26, 27, and 28 to seek for the optimal balancing of each Phase shifter. Data analyzed to verify optimum bias and check for pass-fail. Channels are exercised grouped following the scheme: Group1: RCA 24 + RCA 25 Group2: RCA 26 + RCA 27 Group3: RCA 28
Test duration (including overhead)	10 hours (20” per step)
Test frequency	twice
Constraints	SCS nominal (FPU temperature around 20K) better if with TSA already tuned (but not mandatory).
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)
HFI mode	Configuration.
HFI state	N/A
4K cooler state	Tref ~ 27K-22K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline

Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.6
IOTCRD section	4.1.2.1
Data analysis timing	>8 hours
Pass/fail assessment timing	Included in the procedure. • No unexpected event packets • Every P/S is responding to biases stimulus as expected • Correct biases for P/S balancing Applied and checked.
Data analysis tools	pegaso_tune_phase_switch_currents
Pass/Fail criteria	Phase switch signals balancing (Vsky – Vref) in agreement with previous tests [RD-1] § 13.1.2.6
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	8 hours
Set parameters	Yes
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	
Sequential to	LNAs Drain Currents verification(2.10)
Criticality for CPV cont.	Yes

3.2.2 HYPER MATRIX PRE-TUNING

The tuning of LNAs bias will be performed simultaneously operating over Vg1 and Vg2 of both the paired ACAs of each radiometer.For a limited number of combinations Vg1Vg2, also Vd will be tuned.
The HYM is divided into two different phases: a pre tuning phase and the tuning phase .
During the pre tuning phase the Vg1Vg2 bias space is explored to re-centre the bias region around the expected optimal bias quadruplets;this operation can be done advantaging of the signal unbalancing sky-ref and of the differential architecture of the LFI radiometers.
Once Tuning Matrixes have been identified by pre-tuning, four tuning runs are foreseen at different temperatures of the 4K reference load, advantaging of the 4K stage cooldown in the range from 25K to 4K .
The temperature steps are based on the simulation of 4K stage cooldown profile provided by HFI team .
The simulated profile is reported below, together with the scheme of the test .
Scope of the Tuning is twofold: determine the optimal bias configuration and characterise the Noise temperature , Isolation and linearity properties of LFI radiometers.
To do that, temperature stability of the 4K stage is required .
Two runs will be performed in very stable conditions (at 17.5 K about and at 4.5 K about) , that is when the 4K temperature approaches equilibrium with LVHX1 (SCS) temperature (about 17.5K) and when the 4K cooler is in nominal conditions at about 4.5K .It was agreed with HFI team that the following scheme be applied, playing with the 4K PID and with 4K-1.6K heat switches and heaters.

i) when 4K stage temperature reaches 25K
- switch ON the 4K-1.6K heat switch nominal and redundant heaters
- switch ON the 4K PID nominal and redundant heaters

This adds about 8mW power on the 4K stage and slows down the cool down

- let the cooldown continue until the temperature of the 4K "lands" on the temperature of the 20K stage (at about 18K). LFI performs activities [Matrix pre-tuning, HYMatrix tuning 1st run and HYMatrix tuning 2nd run] during this phase.

ii) - switch OFF 4K-1.6K heat switch heaters after the end of 2nd run HYMatrix Tuning
- switch OFF the 4K PID heaters
- switch OFF the 20K-4K heat switch
- activate 4K cooler at nominal stroke
  - let cool down continue for *1 day* (until next DTCP)

iii) when 4K stages approaches 15K (according to the HFI thermal model), temperature is supposed to be stabilized by applying the following procedure:
- switch ON the the 20K-4K heat switch but with lower power on the charcoal pump (reduced conductance)
- the temperature is kept stable around 15K for *2 days*. LFI performs [HYMatrix tuning 3rd run]

iv) At the end of HYM 3rd run the 4K cooldown is resumed and speded up by switching OFF the 20K-4K PID
  - 4K is supposed to reach 4K in about *1 day*

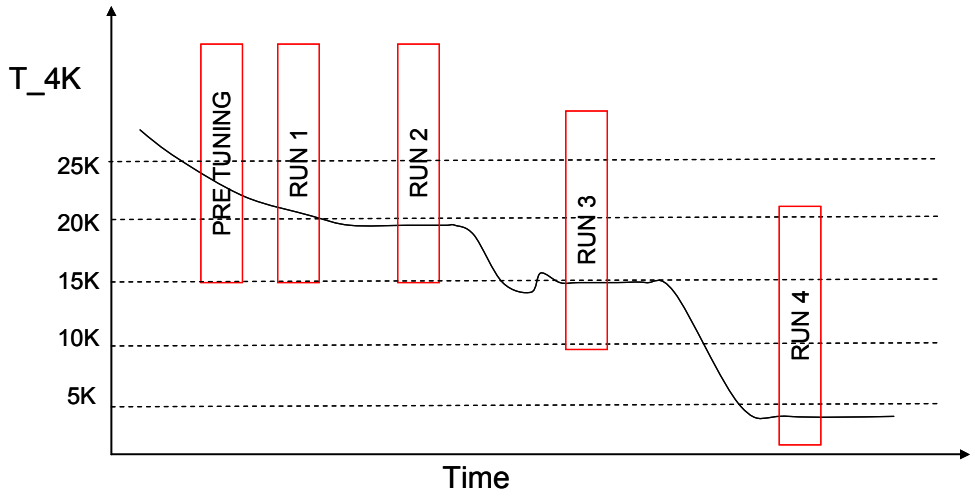

Figure 2 concept scheme of the Tuning test

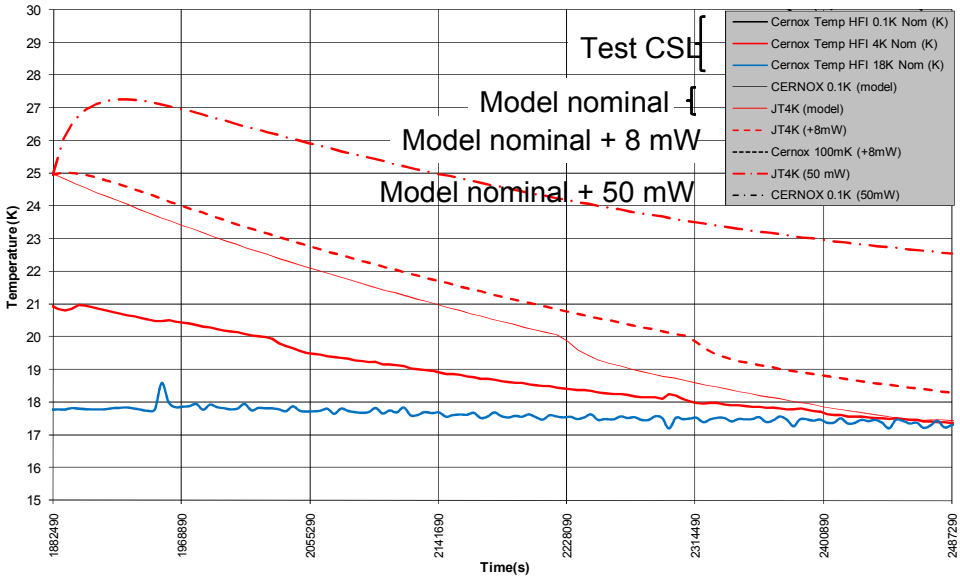

Figure 3 simulated (curves courtesy from HFI team) 4K stage cooldown profile from 25K to 18 K ; the pre-Tun, HYM 1st and 2nd Runs have to be performed here.

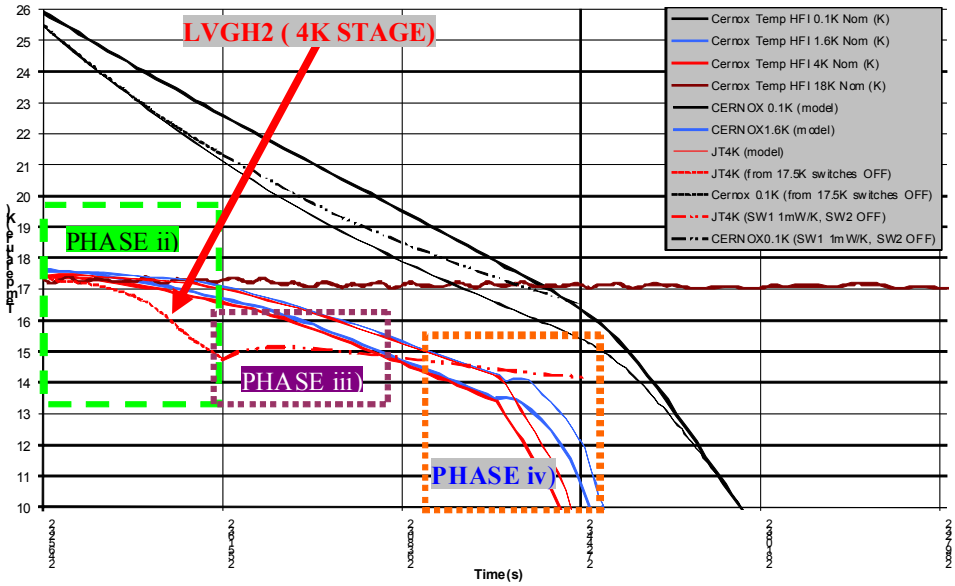

Figure 4 simulated (curves courtesy from HFI team) 4K stage cooldown profile from 18K to 4 K ; the 3rd HYM Run has to be performed during PHASE ii)

3.2.2.1 LFI-05-1 HYPER MATRIX PRE-TUNING SCREENING

Item	
Sequence number	5
Test name	LFI FEM Vg1 Vg2, PRE- Tuning Screening
Instrument	LFI
Point of Contact	Cuttaia, Mennella, Terenzi
Test Objective	Apply an Hyper Matrix of Vg1XVg2XVg1XVg2 biases over a wide range to seek for the optimal noise and gain balance region each radiometer. Pre-Tuning is performed by setting the bias values once and recording scientific data. The 4K cooler stage temperature is required 25K< T < 22 K, Data analysis is performed at the end of the test: Hyper Matrix tables will be produced to be used as input for Hyper Matrix Tuning (phase 5-02). Channels are grouped following the scheme: Group 1: RCA RCA 18+ RCA 19 + RCA 22 Group 2: RCA 20 + RCA 21 + RCA 23 Group 3: RCA 24 + RCA 26 + RCA 28 Group 4: RCA 25 + RCA 27
Test duration (including overhead)	26h
Test frequency	Once
Constraints	SCS TSA can also not be tuned yet. 4K Reference Load temperature stable within 40 mK@25K<T<22K. Phase shifters can also be not already tuned. 4KHz enabled. Procedure to be started during DTCP.
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned or not yet)
HFI mode	Configuration.
HFI state	N/A
4K cooler state	Tref (start) ~ 25K<T<22K . Tref (end) > [Tref(start)- 1K]
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	N/A
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.7 and § 13.1.2.7.2
IOTCRD section	4.1.2.2.
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	LIFE tuning batch procedures PRE TUNA
Pass/Fail criteria	Comparison with results from CSL test campaign within +/- 20 % of the achieved T-Noise. Isolation can not be calculated with this method. [RD-1] § 13.1.2.7
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	24 hours after receiving the full data set)
Set parameters	Yes

Priority	Essential
Include in mini CPV	N/A
Comments/Questions	This test is so critical that failure might lead to consider repeating the test all over again
Sequential to	PHASE SWITCH TUNING (3.2.1) (not mandatory)
Criticality for CPV cont.	Yes

3.2.2.2 LFI-05-2 HYPER MATRIX TUNING

Item	
Sequence number	5
Test name	LFI FEM Vg1 Vg2, Vd Tuning
Instrument	LFI
Point of Contact	Cuttaia, Mennella, Terenzi
Test Objective	Apply an Hyper Matrix of Vg1XVg2XVg1XVg2 biases to seek for the optimal noise and gain balance each radiometer.For each radiometer, also the drain voltage is tuned over three values corresponding to the best 15 Vg quadruplets. Tuning is performed by setting the bias values four times (at four different temperature states of the 4K Reference Load) and recording scientific data. The first temperature state is before the start of the 4K cooler cooldown, i.e. at about 23 K, the second is when the 4K temperature stabilizes around the LVHX1 temperature (18K) , the third temperature when $16K<T_{4K}<14K$), the fourth state is with after the cooldown (at ~ 4.5 K). Data analysis is performed according to the procedure specified
Test duration (including overhead)	33 hr each of the four steps.
Test frequency	Once
Constraints	SCS TSA tuned. 4K Reference Load temperature stable within 15 mK@18K (2^{nd} run) and @4.5K, within 40 mK in the third run. Phase shifters already tuned; 4KHz enabled.
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)
HFI mode	Configuration.
HFI state	N/A
4K cooler state	Tref (start) ~ 23K (first step), Tref (end) ~ 4.5K (second step)
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	N/A
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.7 and § 13.1.2.7.3
IOTCRD section	4.1.2.2.
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	LIFE tuning batch procedures TUNA
Pass/Fail criteria	Comparison with results from CSL test campaign within TBD % of the achieved T-Noise and isolation. [RD-1] § 13.1.2.7

Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	At least 24 hours after receiving the last file data (RUN 4)
Set parameters	Yes
Priority	Essential
Include in mini CPV	N/A
Comments/Questions	This test is so critical that failure might lead to consider repeating the test all over again
Sequential to	PRE TUNING SCREENING (3.2.2)
Criticality for CPV cont.	Yes

3.2.3 LFI-09 Tuning of DAE parameters (Gain and Offset)

Item	
Sequence number	9
Test name	LFI DAE Tuning
Instrument	LFI
Point of Contact	Maurizio Tomasi
Test Objective	The DAE Offset and Gain circuitry has to deliver the best dynamic range as input of ADC. The DAE parameters shall be optimized for all Channels
Test duration (including overhead)	23 Hours
Test frequency	Once
Constraints	FEM already tuned and stable temperature of FPU and Reference Load target HFI is requested to not perform any activity (Same CSL configuration)
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)
HFI mode	Configuration
HFI state	nominal
4K cooler state	Nominal
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	Yes
TMTC procedure	[RD-1] § 13.1.2.8 The procedure could be described in some steps: - Acquiring data - Perform data analysis to find best values - Applying new values and check form scientific data output.
IOTCRD section	4.1.3.1
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure

Data analysis tools	tune_gain_offset
Pass/Fail criteria	There is no a real pass/fail criteria but two constrains: - When applied offset the signal MUST be positive - When applied Gain signal MUST not above 80% of the dynamic range [RD-1] § 13.1.2.8
Action in case of failure/anomalies	Leave Offset and Gain as in previous step Find offset and gain that do not cause problem Apply offset and gain again
Data analysis duration before set parameters	8 hours
Set parameters	Yes
Priority	Essential
Include in mini CPV	TBD
Comments/Questions	DAE gain must be optimised also in order to avoid *quantisation saturation* when REBA parameters are applied (see RD06)
Sequential to	Hyper Matrix Tuning (3.2.2.2)
Criticality for CPV cont.	Yes

3.3 LFI-08 FUNCTIONALITY REFERENCE POINT

Item	
Sequence number	8-1 AND 8-2
Test name	LFI Functionality Reference Point (composed by CRYO 02 verification and Reference Point)
Instrument	LFI
Point of Contact	Francesco Cuttaia
Test objective	The scope of this test is double: 1) to compare with results from CRYO 02 before Tuning (1st part of the test) 2) to fix a reference point with the radiometers in nominal Tuned conditions (2nd part of the test). This test could be useful to compare with in case of suspected radiometric failure during mission.
Test duration (including overhead)	2hr + 2,5 hr
Test frequency	Once (but it can be applied to one or more Channels, if required , during the mission)
Constraints	Tref stable within 10 mK /h , 5K < Tref < 4K Optimum biases uploaded and checked. DAE GAIN set to 1 and DAE Offset set as for cryo 02 in the 1st part (and as for HYM tuning in the 2nd part)
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal
HFI mode	ON
HFI state	N/A

4K cooler state	Nominal
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.9
IOTCRD section	To be written.
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	Same of Cryo 01 and Cryo 02
Processing and timing	Included in the procedure
Pass/Fail criteria	Comparison with data taken before Tuning (CSL Tuned bias) within 5 % in current consumption of FEM units No unexpected features (spikes, drops, phase switch functionality ….) No unexpected event packets [RD-1] § 13.1.2.9
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	
Set parameters	N/A
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	.
Sequential to	DAE Gain and Offset Tuning
Criticality for CPV cont.	YES

3.3.1 LFI-07 ACAs gate 1 and 2 hyper-matrix tuning verification with 4K modulation

Item	
Sequence number	7
Test name	LFI FEM ACA Tuning verification
Instrument	LFI
Point of Contact	Peter Meinhold- Mennella
Test objective	Apply the same HYPER MATRIX of 3.2.2.2, using same grouping and timing, to check results from white noise, once DAE is tuned.. Verification is performed running the Hyper Matrix twice over two Tref values obtained by applying a change in the HFI 4K shield (operating on the HFI 4K PID controllers and inducing onetemperature step of > 60 mK. Data are recorded and analysis is performed to compare with previous results from Tuning.
Test duration (including overhead)	33hr +33hr

Test frequency	Once and only if necessary
Constraints	SCS TSA tuned. 4K Reference Load temperature stable within 10 mK /h .ACA Tuning already performed; DAE Tuning already performedoptimal Vg1 and Vg2 bias applied to each ACA. 4KHz enabled.
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)
HFI mode	Configuration.
HFI state	N/A
4K cooler state	Tref ~ 4.5K increasing and then decreasing by ~ TBD K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.7 and § 13.1.2.7.3
IOTCRD section	4.1.2.4
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	LIFE tuning batch procedures: TUNA
Pass/Fail criteria	Comparison with results from ACA tuning within 25% [RD-1] § 13.1.2.7
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	>24 hours
Set parameters	Only if necessary to perform some change w.r.t. Hyper Matrix results.
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	Possibility to vary 4K cooler temperature to be verified and agreed with HFI
Sequential to	DAE tuning (LFI-09)
Criticality for CPV cont.	No

3.3.2 LFI-04-bis Phase switch bias tuning VERIFICATION

Item	
Sequence number	4
Test name	LFI phase switch tuning verification
Instrument	LFI
Point of Contact	Villa-Terenzi
Test objective	Run the same procedure of Phase Switch Bias tuning in order to verify that the PH-SW bias dependency on the Vg1 , Vg2 , Vd bias applied after Tuning.
Test duration (including overhead)	10 hours
Test frequency	Once
Constraints	20 K SCS with TSA tuned.
LFI mode	nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)

HFI mode	Configuration.
HFI state	N/A
4K cooler state	nominal (Tref ~ 4.5 K)
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.6
IOTCRD section	4.1.2.1
Data analysis timing	8 hours (already included in the procedure)
Pass/fail assessment timing	Included in the procedure • No unexpected event packets • Every P/S is responding to biases stimulus as expected • Correct biases for P/S balancing Applied and checked. • Results in agreement with Phase switch Tuning
Data analysis tools	Same as LFI-04
Pass/Fail criteria	Phase switch signals balanced within TBD LSB
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	TBD
Set parameters	Yes
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	
Sequential to	ACAs gate 1 and 2 hyper-matrix tuning verification with 4K modulation (3.3.2)
Criticality for CPV cont.	No

3.4 DAE VERIFICATION AND REBA TUNING AND VERIFICATION

3.4.1 LFI-13 DAE TUNING VERIFICATION

Item	
Sequence number	13
Test name	Verification of DAE offset calibration table #1
Instrument	LFI
Point of Contact	Maurizio Tomasi

Test objective	There are two objectives for this test: 1. During LFI ground tests an anomalous behaviour has been identified for a limited number of DAE offset values. This offset range must be recognized and flagged in flight because it can be a source of systematic errors. 2. The DAE offset calibration table consistency must be verified and, in case, recalibrated.
Test duration (including overhead)	24 hours
Test frequency	Once during CPV. May be repeated TBD times during operations to verify offset calibration table consistency in time (we know it depends on DAE temperature, we do not know if it suffers aging)
Constraints	1.Sorption cooler and 4K cooler nominally stable (with active thermal controls on and tuned) 2.Performed for all DAE gains (10 values in total) 3.REBA on (the processing type used is not relevant) 4.4KHz on
LFI mode	Nominal Type 1
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	ON
Spacecraft state	Spinning 1 rpm
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A data acquisition
IOTCRD section	4.1.3.3
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	verify_gain_offset
Pass/Fail criteria	DAE offset calibration table must be consistent with the one verified during satellite . The range of DAE offset values where the differential offset removal is found must not exceed 5% of the entire 0-255 DEC offset range
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	Yes
Comments/Questions Sequential to	Data analysis must be run immediately after having received data, The test is repeated for each of the DAE gain values (10 in total) ACAs gate 1 and gate 2 tuning (LFI-05) / LFI-07
Criticality for CPV cont.	Critical for all tests concerning RF calibration

3.5 LFI-14 BLANKING TIME VERIFICATION

Item	
Sequence number	14
Test name	LFI Blanking time verification
Instrument	LFI
Point of Contact	Maura Sandri
Test objective	Check receiver noise properties in different DAE blanking time conditions: • Check that whine noise scales correctly with BT • Check that frequency spikes do not change with BT (this last point is preferred to be verified using TYPE 5 to explore a reasonably wide frequency range
Test duration (including overhead)	1h
Test frequency	Once
Constraints	FEM already tuned DAE parameters optimized with values from test LFI09 and LFI13 **REBA already tuned (TYPE5 is used)** Need pointing information (Need to be able to remove sky signal from data) Stable temperature of FPU and Reference Load target
LFI mode	nominal science production TYPE 5.
SCS mode	Nominal (TSA tuned)
HFI mode	Conf.
HFI state	N/A
4K cooler state	Nominal
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.14
IOTCRD section	4.1.3.4
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	verify_blanking_time
Pass/Fail criteria	The white noise scales with the change in blanking time The spurious spikes in radiometric data do not change with the blanking time [RD-1] § 13.1.2.14
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	24 hours
Set parameters	Yes (only in case non nominal features are observed)
Priority	Essential

Include in mini CPV	No
Comments/Questions	The nominal blanking time is 7.5 us (the minimum). The test does not imply any change of this default value unless there are unexpected features that depend on the blanking time.
Sequential to	Long time stability check (LFI-12)
Criticality for CPV cont.	Not critical

3.5.1 LFI-10 Tuning of REBA parameters

Item	
Sequence number	10
Test name	LFI REBA Parameters tuning
Instrument	LFI
Point of Contact	Maurizio Tomasi
Test objective	Tune REBA science parameters to have the best performance of the compression algorithm.
Test duration (including overhead)	3h30' hours
Test frequency	Once (must be verified that the dynamic change of the sky input signal during the mission does not affect the REBA tuning)
Constraints	FEM already tuned and DAE parameters optimized and stable temperature of FPU and Reference Load target
LFI mode	Nominal science production TYPE 1.
SCS mode	Nominal (TSA tuned)
HFI mode	Conf.
HFI state	N/A
4K cooler state	Nominal
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	From calculations assessing the impact of point sources on REBA tuning it come out that no specific requirements are relevant for this test.
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.10 and [RD6] §4.1.12
IOTCRD section	4.1.3.2
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure [RD-1] § 13.1.2.10
Data analysis tools	oca2k
Pass/Fail criteria	see also corresponding pass/fail criteria in [RD-1]
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.

Data analysis duration before set parameters	8 hours
Set parameters	Yes
Priority	Essential
Include in mini CPV	Yes
Comments/Questions	
Sequential to	LFI-02-2 Drain current verification with tuned bias
Criticality for CPV cont.	Yes

3.5.2 LFI-11 REBA check

Item	
Sequence number	11
Test name	REBA check
Instrument	LFI
Point of Contact	Maurizio Tomasi
Test objective	Verify that the optimal REBA parameters are compliant with the telemetry budget (average compression rate equal or better than 2.4) and the scientific requirements (sigma/q ratio equal or larger than 2)
Test duration (including overhead)	24 hours – this time is enough to run the REBA check twice
Test frequency	Once (see comment below)
Constraints	DAE TUNED; REBA TUNED
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Spinning 1 rpm
Pointing requirements	From calculations assessing the impact of point sources on REBA tuning it come out that no specific requirements are relevant for this test
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A data acquisition
IOTCRD section	4.1.3.2
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	reverie
Pass/Fail criteria	• Compression rate : (weighted) average over all channels must be 2.4 or higher. The weights are provided by the different Naver parameters for the various channels • Sigma / q: it must be equal or greater than 2 for each channel
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.

Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	Yes
Comments/Questions	• The REBA check will also be periodically performed (period from daily to weekly) during nominal operations and the results will appear in the LFI internal section of the weekly/daily reports • The stability of REBA tuning against the sky signal strength during the mission (e.g. the variation of the dipole during the six months scan) must be checked
Sequential to	Tuning of REBA parameters (LFI-10)
Criticality for CPV cont.	Yes

3.6 LFI-27 SPIKE CHARACTERISATION TEST #3

Item	
Sequence number	27
Test name	SPIKE CHARACTERISATION TEST #3
Instrument	LFI
Point of Contact	TBD
Test objective	Repeat spike characterisation after tuning to verify any dependency of spikes on tuning parameters
Test duration (including overhead)	16 hours
Test frequency	Twice (the first time in LFI-25 after functionality tests)
Constraints	LFI front end tuned
LFI mode	Nominal science production TYPE 1
SCS mode	Nominal
HFI mode	Configuration mode
HFI state	N/A
4K cooler state	Nominal (5K < Tref < 4K)
Spacecraft state	Nominal
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	Same as in LFI-25
IOTCRD section	
Data analysis timing	Same as in LFI-25
Pass/fail assessment timing	Same as in LFI-25
Data analysis tools	See spike 01
Pass/Fail criteria	Same as in LFI-25
Action in case of failure/anomalies	NCR raised. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.

Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Important
Include in mini CPV	No
Comments/Questions	Same as performed at CSL
Sequential to	LFI-10
Criticality for CPV cont.	No

3.6.1 LFI-12 Long time stability check

Item	
Sequence number	12
Test name	Stability test
Instrument	LFI
Point of Contact	IOM
Test objective	Recheck of signal stability and electrical parameters (e.g. drain currents) after all tuning procedures.
Test duration (including overhead)	N/A: uses data acquired during LFI11
Test frequency	Once
Constraints	Sorption and 4 K coolers at nominal conditions DAE TUNED; REBA TUNED Need pointing information (Need to be able to remove sky signal from data)
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Spinning 1 rpm
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A
IOTCRD section	
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	receiver_noise_properties
Pass/Fail criteria	Signal stability characteristics (drifts, spikes, popcorn noise, etc) are similar to those measured on ground during TV tests .

Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Set parameters	No
Data analysis duration before set parameters	N/A
Priority	Essential
Include in miniCPV	Yes
Comments/Questions	
Sequential to	REBLFI-27
Criticality for CPV cont.	Yes

4 THERMAL VERIFICATION

4.1 GENERAL REMARKS

4.2 LFI-15 STEADY STATE TEMPERATURE DISTRIBUTION

Item	
Sequence number	15
Test name	LFI steady state temperature distribution
Instrument	LFI
Point of Contact	L. Terenzi / M. Tomasi
Test objective	Characterise spatial thermal gradient in the focal plane. The test consists in acquiring thermal sensors data in steady state.
Test duration (including overhead)	24 hours
Test frequency	Once
Constraints	• 4K cooler nominally stable (with active thermal controls on and tuned) • Sorption Cooler in Nominal (TSA ON) • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	ON, Nominal
SCS mode	ON, Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Nominal
Pointing requirements	Baseline
Contact with SPACON	(IOM)
Near Real Time	No
TMTC procedure	No specific procedure is foreseen
IOTCRD section	4.1.3
Data analysis timing	Offline processing

Pass/fail assessment timing	N/A
Data analysis tools	LIFE
Pass/Fail criteria	All LFI FEU T sensors values should be lower than 24 K.. The LFI FEU sensors close to the HFI IF points should be lower than 22.5K.
Action in case of failure/anomalies	If one or more sensors do not comply with the test criteria the passive/active dissipation and the thermal behaviour of those particular areas will be checked
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	No
Comments/Questions	The test conditions will depend on the time celestial sources are entering the FOV. If it occurs in early CPV stage the LFI cannot be properly tuned. It is recommended that during measurements no other tests will be performed in parallel.
Time for P/F assessment	
Sequential to	LFI-27
Criticality for CPV cont.	None

4.3 LFI-16 THERMAL SUSCEPTIBILITY

Item	
Sequence number	16
Test name	FPU dynamic thermal response
Instrument	LFI
Point of Contact	M. Tomasi / L. Terenzi
Test objective	The SCS PID will be used to characterise the radiometers THF (temperature is changed over 4 values, each step having a duration > 3h , depending on the step) Instrument FPU is excited with delta T –variations of about (TBC) 1K each. Space and time thermal gradient are monitored
Test description	1st DTCP (DAY1): -from T0 (nominal set point) to T3 (3h) -from T3 to T1 (2h) stable in T1 out of the DTCP (19h) 2nd DTCP (DAY2) -from T1 to T2 (3h) -from T2 to T0 (2h, TSA nominal set point) acquire data (19 h) out of the DTCP until next DTCP
Test duration (including overhead)	48 hours; at least 2 DTCP required
Test frequency	Once
Constraints	• 4K cooler nominally stable • Sorption Cooler (TSA must be operated in PID and Open Loop) • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	Nominal

SCS mode	Nominal (TSA will be operated to execute test)
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Nominal, Spinning 1 rpm
Pointing requirements	No major celestial sources should enter the FOV
Contact with SPACON	IOM
Near Real Time	Yes
TMTC procedure	SCS LookUpTable updates.
IOTCRD section	4.1.3
Data analysis timing	Offline processing
Pass/fail assessment timing	Test sequence succesfully run
Data analysis tools	input_THF_0011_All_Chains.pro
Pass/Fail criteria	N/A
Action in case of failure/anomalies	To be analysed depending on the contingency
Data analysis duration before set parameters	N/A
Set parameters	Yes but according to procedures
Priority	Essential
Include in miniCPV	No
Comments/Questions	
Time for P/F assessment	
Sequential to	LFI-19
Criticality for CPV cont.	None

~~4.4 LFI-17 DEPENDENCY OF FOCAL PLANE TEMPERATURE DISTRIBUTION AS A FUNCTION OF 3RD V-GROOVE TEMPERATURE~~

~~Item~~	
~~Sequence number~~	~~17~~
~~Test name~~	~~FPU T distribution as a function of VG3 T~~
~~Instrument~~	~~LFI~~
~~Point of Contact~~	~~G. Morgante, L. Terenzi~~
~~Test objective~~	~~Change VG3 temperature and monitor FPU sensors (TBC)~~
~~Test duration (including overhead)~~	~~24 hours~~
~~Test frequency~~	~~Once~~
~~Constraints~~	~~• 4K cooler nominally stable (with active thermal controls on and tuned)~~ ~~• Sorption Cooler in Nominal (TSA ON)~~ ~~• LFI instrument nominally tuned (biases, REBA and DAE).~~
	~~Nominal~~

~~DROPPED~~

~~SCS mode~~	~~Nominal~~
~~HFI mode~~	~~Nominal~~
~~HFI state~~	~~ON~~
~~4K cooler state~~	~~Nominal~~
~~Spacecraft state~~	~~Nominal, Spinning 1 rpm~~
~~Pointing requirements~~	~~No major celestial sources should enter the FOV~~
~~Contact with SPACON~~	~~IOM~~
~~Near Real Time~~	~~Yes~~
~~TMTC procedure~~	~~TBW~~
~~IOTCRD section~~	~~4.1.3~~
~~Data analysis timing~~	~~48 hours (TBC)~~
~~Pass/fail assessment timing~~	~~48 hours (TBC)~~
~~Data analysis tools~~	~~LIFE, IDL~~
~~Pass/Fail criteria~~	~~LFI thermal parasities within requirements~~
~~Action in case of failure/anomalies~~	~~Thermal behaviour to be investigated by analysis and simulations.~~
~~Data analysis duration before set parameters~~	~~N/A~~
~~Set parameters~~	~~Yes, according to procedure.~~
~~Priority~~	~~Essential~~
~~Include in miniCPV~~	~~No~~
~~Comments/Questions~~	~~This test would provide important information on 3rd VG and LFI thermal interaction. It would give a direct measurement of LFI passive dissipation. The basic procedure for this test execution would require for changing VG3 temperature while observing LFI thermal response. It is still to be confirmed and investigated whether this can be done in flight Using the VGroove heaters.~~
~~Time for P/F assessment~~	
~~Sequential to~~	~~Dynamic thermal response (LFI-16)~~
~~Criticality for CPV cont.~~	~~None~~

4.5 LFI-23 TSA FAILURE AND THERMAL DYNAMIC RESPONSE

Item	
Sequence number	23
Test name	TSA Failure And Thermal Dynamic Response
Instrument	LFI
Point of Contact	Luca Terenzi
Test objective	Characterise the dynamic behaviour of Thermal Model and susceptibility.
Test duration (including overhead)	24 hours
Test frequency	Once

Test description	Scientific data are acquired for 3h with TSA nominal. Then, TSA is switched OFF during the same DTCP and scientific data are acquired until next DTCP. TSA is restored to nominal in the second DTCP (duration of this negligible)
Constraints	• 4K cooler nominally stable (with active thermal controls on and tuned • Sorption Cooler TSA ON at the beginning. • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	Nominal
SCS mode	Nominal at the beginning of DTCP, hence TSA is switched off until next DTCP (about 24 h)
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Spinning 1 rpm
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	SCS LUT upload procedure
IOTCRD section	4.1.5.5
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	LIFE thermal susceptibility analysis procedures
Pass/Fail criteria	• Test sequence successfully run
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	TBD
Sequential to	LFI-20 (LFI 16 is supposed fully performed before)
Criticality for CPV cont.	NO

5 RF CALIBRATION

5.1 NOISE PROPERTIES AND STABILITY

5.1.1 LFI-18 LFI noise properties – 4KHz off

Item	
Sequence number	18
Test name	LFI total power noise properties – 4KHz off
Instrument	LFI
Point of Contact	Aniello Mennella
Test objective	• Check that 1/f noise does not depend on the phase switch state. • Check that 1/f slopes are consistent with ground measured ones. • Check for frequency spikes and their behaviour with DAE HK sequencer status
Test duration (including overhead)	24 hours
Test frequency	Once
Constraints	• Sorption cooler and 4K cooler nominally stable (with active thermal controls on and tuned) • Need pointing information (Need to be able to remove sky signal from data) • LFI instrument nominally tuned (biases, and DAE) • REBA in extended science mode (AVR1 with nominal binnings)
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Spinning 1 rpm
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.15 • Channels are grouped (5 groups , following the scheme of REBA tuning) to be compliant with telemetry rate requirements ; • The 4KHz is disabled • All the 4 PS combinations are tested , acquiring data for 45 min each setup; • The same is repeated with the HK sequencer off • DATA are acquired in TYPE1
IOTCRD section	4.1.5.1.1

Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	See Long time stability check • TQL data replay • LIFE visualisation tools • LIFE noise properties analysis procedures • LIFE spike finding procedures • Need a tool to remove sky signal from datastream
Pass/Fail criteria	• 1/f spectrum does not depend on phase switch state (confirmation of ground tests). • 1/f slope is consistent (at 50% level) with slope measured on ground during satellite-level tests • Presence of frequency spikes is completely correlated with DAE HK sequencer being on and off • Frequency spikes are consistent (in frequency and amplitude) with those measured on ground [RD-1] § 13.1.2.15
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	No
Comments/Questions	Currently this test in CSL is planned with Naver=256 on all channels, which corresponds to a sampling frequency of 16 Hz. In case it will not be possible to run the test on ground specular to how it is planned here the check will be performed on a limited frequency range
Sequential to	LFI-15
Criticality for CPV cont.	Critical, phase switch properties must be assessed before characterizing instrument noise in nominal conditions

5.1.2 LFI-19 LFI noise properties – phase switches on

Item	
Sequence number	19
Test name	LFI noise properties – phase switches on
Instrument	LFI
Point of Contact	Aniello Mennella

Test objective	• Check noise differenced and undifferenced noise properties and compare with ground measured ones • Check frequency spikes behaviour with DAE HK sequencer status • Characterise frequency spikes in frequency, amplitude and phase
Test duration (including overhead)	48 hours
Test frequency	Once
Constraints	• Sorption cooler and 4K cooler nominally stable (with active thermal controls on and tuned) • Need pointing information (Need to be able to remove sky signal from data) • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Nominal
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	[RD-1] § 13.1.2.15 • Set the LFI in nominal 4 KHz switching configuration (A/C switching) • Set COM5 mode 1. Acquire data for 12 hours 2. Switch off DAE HK sequencer 3. Acquire data for 12 hours 4. Switch on DAE HK sequencer • Disable switching on A/C and enable on B/D • Repeat from 1 to 4 • Scientific output are acquired on all channels (because of the TYPE5 mode allowing to satisfy the TM rate)
IOTCRD section	4.1.5.1.2
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	• TQL data replay • LIFE visualisation tools • LIFE noise properties analysis procedures • LIFE spike finding procedures • Need a tool to remove sky signal from datastream

Pass/Fail criteria	• Noise properties of differential data (white noise, eff. Bandwidth, knee frequency,) must be within 10 % of the ground-measured values • 1/f slope of differenced and total power data must be within 50 % of the ground-measured values • Spurious frequency spikes amplitudes in differential data must be within 20 % of the ground-measured values • Gain modulation factor stability must be within 20 % of the ground-measured values
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	Yes
Comments/Questions	Data analysis must be performed both on total power and differenced data
Sequential to	Noise properties – unswitched (LFI-18)
Criticality for CPV cont.	Critical

5.2 LFI-20 PHOTOMETRIC CALIBRATION

Item	
Sequence number	20
Test name	LFI photometric calibration
Instrument	LFI
Point of Contact	Marco Bersanelli
Test objective	Check photometric calibration stability (relative calibration) and absolute calibration against the dipole.
Test duration (including overhead)	24 hours –
Test frequency	Once
Constraints	• 4K and Sorption coolers nominally stable (with active thermal controls on and tuned) • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal
Spacecraft state	Nominal
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A
IOTCRD section	4.1.5.2

Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	Pegaso
Pass/Fail criteria	• Procedure run as expected • Data correctly stored
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	No
Comments/Questions	The test consists in acquiring data for 24 hours in nominal mode and calibrate against the dipole each hour. Therefore we end up with 24 values of the photometric constant G that provide a gain variation model. Data are then corrected by the relative gain variation and then calibrated using the whole 24 hours dataset (similarly to what is done during the mission with the difference that the final absolute calibration is fixed using the whole mission dataset)
Sequential to	LFI-16
Criticality for CPV cont.	Critical

~~5.3 LFI-21 INTERNAL EMC~~

~~Item~~	
~~Sequence number~~	~~21~~
~~Test name~~	~~LFI internal EMC~~
~~Instrument~~	~~LFI~~
~~Point of Contact~~	~~Maura Sandri~~
~~Test objective~~	~~Characterise internal interferences between receivers.~~
~~Test duration (including overhead)~~	~~6 hours (TBC)~~
~~Test frequency~~	~~Once (maybe two or room for a repetition in case problems arise that require an extra test)~~
~~Constraints~~	~~• 4K and Sorption coolers nominally stable (with active thermal controls on and tuned)~~ ~~• LFI instrument nominally tuned (biases, REBA and DAE)~~ ~~• No activity from HFI and satellite (i.e. no telecommands during this test)~~
~~LFI mode~~	~~Nominal~~
~~SCS mode~~	~~Nominal~~
~~HFI mode~~	~~Nominal~~
~~HFI state~~	~~ON~~

~~4K cooler state~~	~~Nominal~~
~~Spacecraft state~~	~~Spinning 1 rpm~~
~~Pointing requirements~~	~~Baseline~~
~~Contact with SPACON~~	~~No~~
~~Near Real Time~~	~~No~~
~~TMTC procedure~~	~~PL-LFI-PST-PR-021; "Planck FM TV test sequence_6_3"~~
~~IOTCRD section~~	~~4.1.5.3~~
~~Data analysis timing~~	~~Included in the procedure (TBW)~~
~~Pass/fail assessment timing~~	~~Included in the procedure (TBW)~~
~~Data analysis tools~~	~~LIFE noise properties analysis procedures~~ ~~Need a tool to remove sky signal from datastream~~
~~Pass/Fail criteria~~	~~Switching on/of other receivers should not result in frequency spikes~~
~~Action in case of failure/anomalies~~	~~NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency~~
~~Data analysis duration before set parameters~~	~~N/A~~
~~Set parameters~~	~~No~~
~~Priority~~	~~IMPORTANT~~
~~Include in miniCPV~~	~~TBD~~
~~Comments/Questions~~	
~~Sequential to~~	~~Blanking time verification (LFI-14)~~
~~Criticality for CPV cont.~~	~~No~~

5.4 LFI-22 CROSSTALK BETWEEN RECEIVERS

Item	
Sequence number	22
Test name	LFI crosstalk between receivers
Instrument	LFI
Point of Contact	Cuttaia - Villa
Test objective	Check and characterize crosstalk between receivers.
Test duration (including overhead)	2 hours per radiometer chain
Test frequency	TBD
Constraints	• 4K and Sorption coolers nominally stable (with active thermal controls on and tuned) • LFI instrument nominally tuned (biases, REBA and DAE)
LFI mode	Nominal
SCS mode	Nominal
HFI mode	Nominal
HFI state	ON
4K cooler state	Nominal

Spacecraft state	Spinning 1 rpm
Pointing requirements	Strong point source (e.g. Jupiter) in the beam of the radiometric chain under test
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A
IOTCRD section	4.1.5.4
Data analysis timing	Included in the procedure
Pass/fail assessment timing	Included in the procedure
Data analysis tools	Need a tool to look for correlated signals between RCAs
Pass/Fail criteria	TBD
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential
Include in miniCPV	No
Comments/Questions	This test will be part of the planet scan test (see optical calibration) This is done by observing a strong point source and looking for a correlated response in other radiometric chains in the focal plane pointing away from the point source Need to take into account the effect of having the planet in the sidelobes of the other detectors
Sequential to	TBD (Depends on when the planet is observable during CPV)
Criticality for CPV cont.	Not critical

5.5 LFI-28 HFI INTERFERENCE WITH THE LFI

The procedure run during ground TVTB test caused some problems on 4K cooler and can not be reproduced in flight. Anyway, when HFI will start its calibration phase, LFI will be ON and almost tuned. From the LFI point of view this phase can be helpful in investigating HFI to LFI interference test.
If during flight is appears that there is an effect, we would like to have the possibility to perform an additional check. Of course if this would be the case, the terms should be agreed with HFI and ESA

6 OPTICAL CALIBRATION

It is intended to measure and calibrate the beam pattern (shape and pointing direction) of LFI detectors with the point-like bright sources scanning each beam.

6.1 LFI-30 MAIN BEAM , POINTING DIRECTION CALIBRATION AND FOCAL PLANE GEOMETRY

Jupiter is the best candidate to be used for optical calibration since it it the brightest source. However a list of source (see table below) will be compiled in order to have the possibility to perform the test in case Jupiter will not be visible.
For planet brightness

Source Name	Planet peak level (mK)		
	30GHz	44GHz	70GHz
Jupiter	38	62	280
Saturn	8.3	12	53
Mars	2.3	3.4	15
Uranus	0.28	0.45	2.2

Table 1 Table of celestial source candidate for the test.

Item	
Sequence number	TBD depending when the source crosses the beams
Test name	LFI Main beam and pointing Calibration
Instrument	LFI
Point of Contact	Fabrizio Villa
Test objective	Measure the beam response of all LFI detectors when the source crosses the beams
Test duration (including overhead)	The FOV of Planck is 10° x 10° so that the entire FOV is scanned by the source in 240 hours
Test frequency	once
Constraints	The satellite and instruments during measurements needs to be stable.
LFI mode	nominal science
SCS mode	Nominal (TSA tuned)
HFI mode	Configuration.

HFI state	N/A
4K cooler state	Nominal
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	No
Contact with SPACON	No
Near Real Time	No
TMTC procedure	N/A
IOTCRD section	4.1.6.1
Data analysis timing	8 hours
Pass/fail assessment timing	Included in the procedure
Data analysis tools	DPC pipeline
Pass/Fail criteria	1.Minimum requirement to pass the test: ability to reconstruct the pointing and the –3 dB contour of all the LFI beams. Note that the radiometers should not be tuned in advance so that the sensitivity may not be optimal. 2.Pass criteria: Differences between measured FWHM_ave and expected FWHM_ave <= uncertainty from RF model* 3.Pass Criteria: Differences between measured Ellipticity – expected ellipticity <= uncertainty from RF model* 4.Pass criteria: Measured Pointing direction – expected pointing direction < = pointing error ^2 + model uncertainty^2 * the model uncertainty will be set by the ongoing industrial activity (ESA - RF prediction plan)
Action in case of failure/anomalies	1.Optimise the test procedure for next source scanning. 2.Revision of the RF model and error estimation for next source scanning
Data analysis duration before set parameters	N/A
Set parameters	No
Priority	Essential but depends on the source visibility
Include in mini CPV	No
Comments/Questions	The test conditions will depend on the time celestial sources are entering the FOV. If it is occurs in early CPV stage the LFI can be not properly tuned. It is mandatory that during beam calibration no other tests will be performed in parallel.
Sequential to	LFI 30
Criticality for CPV cont.	No

~~6.2 LFI-31 SIDELOBES CALIBRATION~~

~~N/A~~

6.3 LFI-32 OPTICAL POLARISATION

N/A

N/A

7 FOCAL PLANE GEOMETRY

7.1 LFI 34

Pointing of beams and shape are strictly related to X,Y and orientation of feed horn in the focal plane. By studying aberrations and knowing the plate scale of the telescope it is possible (TBC) to determine reconstruct the geometry of the Focal Plane. Advantages can be reached using FPU symmetries and specifically the LFI24 channel at the median line of the FPU

Eventually, a warning flag will be raised if the differences are higher than expected.

Work in progress:
Relation between beam on sky and Horn geometry

Item	
Sequence number	TBD depending when Jupiter or Bright sources cross the beams
Test name	Focal Plane Geometry reconstruction
Instrument	LFI
Point of Contact	Fabrizio Villa
Test objective	Derive the focal plane geometry form beam measurements (test before)
Test duration (including overhead)	Data analysis only
Test frequency	N/A
Constraints	Beam- measurements already performed
LFI mode	N/A
SCS mode	N/A
HFI mode	N/A
HFI state	N/A
4K cooler state	N/A
Spacecraft state	N/A
Pointing requirements	N/A
Contact with SPACON	N/A
Near Real Time	Off line analysis
TMTC procedure	To be written. Ref. PL-LF-PST-RP-21
IOTCRD section	????
Data analysis timing	1 week (in parallel to other tests since is an off-line analysis)

~~Pass/fail assessment timing~~	~~TBD~~
~~Data analysis tools~~	~~DPC pipeline and optical tools~~
~~Pass/Fail criteria~~	~~Geometry of the focal plane needs to be in agreement on what expected.~~
~~Action in case of failure/anomalies~~	~~TBD~~
~~Data analysis duration before set parameters~~	~~N/A~~
~~Set parameters~~	~~No~~
~~Priority~~	~~Essential~~
~~Include in mini CPV~~	~~No~~
~~Comments/Questions~~	
~~Sequential to~~	~~Main beam calibration~~
~~Criticality for CPV cont.~~	~~No~~

~~7.2 LFI-35ALIGNMENT OF FEED PAIRS~~

~~7.3 LFI-36 ALIGNMENT OF THE FOCAL PLANE~~

~~7.4 LFI-37 CALIBRATION OF THE POINTING DIRECTION~~

7.5 LFI-02-2-BIS DRAIN CURRENTS VERIFICATION

Item	
Sequence number	4
Test name	LNAs drain currents verification
Instrument	LFI
Point of Contact	Francesco Cuttaia
Test objective	Characterise the i-V response of LNAs (WITH RADIOMETERS ALREADY TUNED) when Vg1 and Vg2 are independently changed over a defined set of values. It allows to investigate possible drain chganges due to ground shift or any other possible non ideal response of LNAs. Eventually correct Hyper Matrix tables accounting for bias shift. Channels are grouped in six groups following the scheme: Group 1: RCA 18 + RCA 21 Group 2: RCA 19 + RCA 22 Group 3: RCA 20 + RCA 23 Group 4: RCA 25 + RCA 24 Group 5: RCA 26 + RCA 27 Group 6: RCA 28
Test duration (including overhead)	2,5 hours

Test frequency	This is the second time it is performed, (but it could be repeated, if required, during the mission)
Constraints	20 K SCS; TSA can also be not tuned yet.
LFI mode	nominal science production TYPE 1., LNAs TUNED
SCS mode	Nominal
HFI mode	Nominal
HFI state	N/A
4K cooler state	Tref ~ 4K < T< 5K
Spacecraft state	Nominal Mode of the Satellite
Pointing requirements	Baseline
Contact with SPACON	No
Near Real Time	YES
TMTC procedure	[RD-1] § 13.1.2.4
IOTCRD section	
Data analysis timing	18 hours
Pass/fail assessment timing	Included in the procedure • No unexpected event packets • Every ACA is responding as expected from CSL results • Correct biases Applied and checked.
Data analysis tools	Same as LFI_02_2
Pass/Fail criteria	i-V curves as expected
Action in case of failure/anomalies	NCR raised at the end of data analysis. NRB meeting called. IOM contacts specialists to analyze and solve the contingency.
Data analysis duration before set parameters	N/A
Set parameters	NO
Priority	ESSENTIAL
Include in mini CPV	Yes
Comments/Questions	
Sequential to	LFI-05-2-SET AT ANY TIME
Criticality for CPV cont.	Yes