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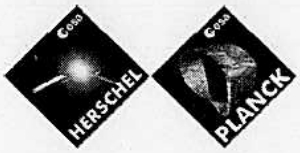

Nombre de pages / page count : 245

HERSCHEL / PLANCK

Herschel Integrated Satellite Test Specification

H-P-2-ASP-SP-0939

Product Code : 000000

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HERSCHEL/PLANCK	DISTRIBUTION RECORD

Issue 3 Rev. : 0

DOCUMENT NUMBER : H-P-2-ASP-SP-0939 Date: September 29th 2006

EXTERNAL DISTRIBUTION		INTERNAL DISTRIBUTION	
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ENREGISTREMENT DES EVOLUTIONS / CHANGE RECORDS

ISSUE	DATE	§ : DESCRIPTION DES EVOLUTIONS *§ : CHANGE RECORD*	REDACTEUR *AUTHOR*
01	November 30th 2005	First Issue.	P. COUZIN G. BEAUFILS
02	June 21st 2006	Chapters numbering is modified in order to match the AAS-F standard table of content for test specification. Besides chapter number and some addition described hereafter, the text and sequence of chapter is basically not affected. Note: no revision mark is provided for new chapter numbers.	P. COUZIN G. BEAUFILS
		Chapter "6 Success criteria" is added to match the standard table of content for test specification. The information was previously given in first paragraphs of (now) §5. Some of the information has been kept in §5 as a duplicate to ease the comparison with issue 1.0. In chapter 6, revision marks are provided with respect to the Planck IST specification issue 1.0 which already includes this chapter. This allows to highlight only the deltas, as most readers know both documents.	
		Chapter "7 Organisation and responsibilities" and "8 Documentation" are added and provide new information. Revision marks are provided with respect to the Planck IST specification issue 1.0 which already includes those chapters to highlight only the deltas.	
		Throughout document , the obsolete IMT wording is replaced by SPT to designate the instrument performance validation test to be run before launch.	
		§1.1.3 the present issue status is updated.	
		§1.2.1 the wording is corrected to clarify that EMC and TVTB tests shall not be fully made out of IST sequences, and 1) that EMC test sequences will be typically adaptations of IST sequences, and 2) that for TVTB, the replay of some IST sequences will be an integral part of the test, but not all of it.	
		§2.1 H-P-2-ASP-TS-1083 has been created to provide the details of the instrument test sequences, and is added to the applicable document list. §3.1.1 and §3.2.1 are updated to reflect those document inputs (specifically where it replaces RD07).	
		§2.1 the issues of the applicable documents are added, to provide unambiguous references, even if latest issues shall be applicable.	
		§2.2 the issues of the reference document are updated, made complete and/or detailed (SVM-UM) including amendments where applicable.	
		§2.2 RD24, RD25, RD27, RD30, RD31, RD32 and RD33 are added.	
		§3.1.1 is corrected and complemented, that the solar array is not used (SAS connected in its position), then it is not necessary mounted when IST is run.	
		§3.1.1 the baseline for satellite tilt management is defined.	
		§3.1.2 it is made more clear that instrument IEGSE are part of the global GSE configuration.	
		§3.1.2 it is added that all TC send by ground (CCS) shall be up-linked with a low priority setting unless explicitly specified for.	

		§3.1.3 it is pointed out the fact that RD12 is obsolete with respect to instrument AVM configuration, and that a better reference for this point is to be find in IID-B. It is added also that a dedicated instrument AVM upgrade is at work for PACS and SPIRE, then that the AVM references are living. It is clarified also that the main limitation of the AVM is that "all B units" configuration (as defined by §5.2) cannot be tested, and so that, on AVM all tests will be run in "all A units" configuration.	
		§5.6 regroups in a single paragraph, the older §7.6 and 7.7 content.	
		§5.7 is created to regroup technical requirements that are applicable to all the sequences.	
		§7.5.1 is created to gather general SSMM management requirements.	
		§5.7.2 is created to gather general DTCP management requirements.	
		§5.7.3 is created to gather the general cryostat management requirements. §5.8.2.3 is updated in coherence.	
		§5.8 the S/C state summary tables presentation is upgraded. The CRS status field is moved in the ACMS box. The OBT PM and SW fields in CDMS box are grouped in the same cell to allow a SCBP filed to be added. Appendix 2 is updated accordingly.	
		§5.8 the general correction is made, that the S/C configuration for cruise to L2, when S/C is not in communication session, is NOM mode, with TWTA OFF and ACMS in SCM Earth pointed.	
		§5.8 the general correction is made, that antenna configuration in SAM mode shall be LGA1 on main XPND and MGA (not LGA2) on redundant XPND (except for the specific case of a transition from launch mode).	
		§5.8 all the mode transition success criteria and procedures (TC sets) are corrected after SRD amendment 2 and 3.	
		§5.8.2.3 the specific test configuration necessary for allowing the cryostat valves V501 and V503 operation is presented. The related operation warning and details are added §5.8.4.2.1 §5.8.4.2.5 and §5.8.4.2.8.	
		§5.8.2.3 the detail requirements upon the cryo-cover NCA monitoring are transferred to the §5.8.3.12 (this text was an artefact of draft 4 when cryo-cover test was appended to the launch sequence and not as presently, to the commissioning one). Simplified requirements are kept nevertheless in §5.8.2.3 to keep an observability over any spurious activation during the launch sequence.	
		§5.8.2.4.1 a warning is added to recall the specific precautions and GSE connections that are necessary to allow without risk, the actual command of the cryostat valves.	
		§5.8.2.4.2 and §5.8.2.4.8 it is added that the CCU shall be activated with a 8s sampling interval for launch, and sets to default 512s sampling interval afterward. This specific CCU state is recalled in the S/C state summary tables in chapter §5.8.2.4.2 to §5.8.2.4.7 with a corresponding legend in appendix 2.	
		§5.8.2.4.2 is added the need of synchronising the ACC time on CDMU one as part of the satellite power on procedure. In §5.8.4.2, is added the explicit test of the automatic instrument clock synchronisation on 1553 time broadcast, as well as a fine synchronisation verification procedure (TC(9,5)) exercise in both instrument boot SW and ASW running cases.	
		§5.8.2.4.2 the observation criteria upon HPS and ES are upgraded, to reflect specifically that the automatic switch OFF of unused HPS at TCS SW	

		service initialisation is suppressed in the latest CDMU ASW versions.	
		§5.8.2.4.4 to .7 several points are corrected that were incoherent with new TTC baseline for launch : with TWTA being OFF until separation, and a later satellite acquisition by the ground. This includes a new variant for Tx chain in the S/C state tables, which is detailed in appendix 2.	
		§5.8.2.4.5 and §5.8.2.4.6 the success criteria associated with the cryostat valve actuation by CCU after ARIANE 5 dry loop signal is added.	
		§5.8.3.8 it is added that the CCU / cryostat commissioning test shall include a DLCM test.	
		§5.8.3.10 are added the references to SREM test specification (RD27) chapters which are applicable for its commissioning test.	
		§5.8.2.4.9 the EMC sequence is suppressed. A specific specification has been created.	
		§5.8.4.3 it is added that an ENV simulator open loop operation may be studied to save configuration time when the instrument needs no ACMS simulated actions during test.	
		§5.8.4.5 is added, the SPIRE commissioning test programme.	
		§5.8.4.6 is added, the HIFI commissioning test programme.	
		§5.8.4.7 is added, the PACS commissioning test programme.	
		§5.8.4.7 is added, the PARALLEL mode commissioning test programme	
		§5.8.5.2 is added a diagram that recalls the detailed mode and state transition chaining throughout the test sequence.	
		§5.8.6 the approach to stimulate a level 3 transition is modified in favour of the use of the ASW dedicated "software alarm" forcing commands (formerly were considered spurious reset or spurious SIR/CIR/AIR setting).	
		§5.8.6.1 and 5.9.3.2 a reminder is added to recall that after each sequence involving an autonomous transition, the RM registers and log shall be reset in a proper configuration before chaining an another sequence.	
		§5.8.6.2 is added a diagram that recalls the detailed mode and state transition chaining throughout the test sequence.	
		§5.8.7.2 is added a sample test of MOT and EAT operation, based on the correct detection of a spurious RF switch toggle (MOT) and SPIRE TM(5,2,0xC100) and TM(5,2,0xC110) interception (ETA).	
		§5.8.7.2 is added at the end of the test, an on board time update test (both forward and backward). Note : it is expected to create temporary SW anomalies at CDMS, ACMS and instrument level.	
		§5.8.8.2 is added as part of the DTCP worst case scenario, a SSMM download abort then resuming exercise.	
		§5.8.8.2 is added as part of the DTCP worst case scenario, the a test of the ability to upload a full new SW image to one instrument (1Mo)	
		§5.8.9.3 the new RMS sequence design is presented. §5.8.9.4 to §5.8.9.6 instrument activity are presented (completed for PACS, partial for SPIRE, TBC for HIFI).	
		§5.9.2.2 and §5.9.3.2 diagrams are added to display the expected mode transition sequences.	

		§6.2 is added a clarification upon the generic wording "out of limit" and what it addresses in term of CCS automated checking mechanism. Appendix 1, is updated, requirements are sorted by document, requirement tables and figures are inserted. Appendix 2, SCOE setting field description added. Appendix 3, applicable (available) flight operation procedure extracted from RD18 vol. 8 are listed for easier cross references. Appendix 6, obsolete LCL line power and current information is removed. Appendix 8 is added to recall some useful basic information upon CMDS and ACMS operating modes. Appendix 9 is added to provide a table that recall the alarm case tested at both S/C IST (present) and SVM IST. Note: to ease readability, the replaced text has been usually suppressed. Deleted text (no replacement) has been left to mark the modification position, but may have been compacted.	
03	September 29th 2006	§1.1.2 Definitions are updated to take into account the program evolution (this includes AI#21 of H-P-ASP-MN-8177). §1.1.2 and 1.2.1 The reference to IST on launch site is suppressed as a specific requirement specification will be issued (update). §1.1.3 Present issue status is updated. §1.2.2 Typing in Herschel name is corrected (AI#5 of H-P-ASP-MN-8177). §2.1 and §11.1 AD04 reference number correction (AI#11 of H-P-ASP-MN-8177) AD06 title and reference update §2.2 RD35 "H/P IST Thermal prediction" added. §3.1.1 Wording "any" corrected in "all" (AI#25 of H-P-ASP-MN-8177). §3.1.3 Text updated, wording clarified, and reference to appendix 10 (§18) added (internal AAS-F comment). §3.1.2 EGSE architecture diagram added (AI#35 of H-P-ASP-MN-8176) RD35 reference added for cooling fan need (was TBC-29) §3.2.1 technical constraints coming with SPT are made more explicit with rewording agreed in H-P-ASP-MN-8177 (AI#26). §3.2.2 §3.2.3 Reference made to §7.1.1, §8.3.2.2 and AD06 for details. §5 and §10 Useless "WD enable" field in state tables (always ON) is replaced by an FDIR field recalling the AFS/AFO configuration of the CDMS (old project). The information upon the ACMS AFO/AFS state is added in the previous ARAD field. The information upon the state of the MTL is added in the previous SCBP field. The information upon the survival CBH is added also in the new CDMS FDIR field. §5.1.2 and 5.2 Software image 1 usage made explicit for relevant test days in timeline table, and legend complemented in §5.2 (to answer a recurrent question). Schedule modified for SPIRE spectrometer commissioning, to cope with the 24h autonomy limitation of the cryostat in horizontal position	P. COUZIN G. BEAUFILS

		(RMS not possible in horizontal position).	
		§5.8.2.3 "Rx Ant" and "Battery" pre-existing state clarified in state table. Practical limitation with POWER SCOE LPS usage and turn around explained. LPS is used only for "launch clean run" sequence (Planck test preparation feed back).	
		§5.8.2.3 Cryo SCOE name corrected in CVSE wrt N511, N512, N513 pumping task (AI#8 of H-P-ASP-MN-8177).	
		§5.8.2.3 V103 and V106 closing to be done by TC through CCU-A, not CRYOSCOE (after AI#9 of H-P-MN-8177).	
		§5.8.2.4.2 to §5.8.2.4.4 Satellite configuration is done with telemetry set to LOW2 (5kbps) only (AI#25 of H-P-ASP-MN-8176).	
		§5.8.2.4.2 Wording about CCU commanding is corrected (AI#8 of H-P-ASP-MN-8177).	
		§5.8.2.4.2 ACC set-up operation re-ordered. "test data word bit 8" setting specifically made explicit (this is a delta for launch clean run case) (Planck test preparation feed back).	
		§5.8.2.4.2 and §5.8.2.4.4 The CRS turn ON is moved before ACC turn ON, to secure the CRS against any fault in the ACMS SCOE set-up sequence (CRS may be degraded if stimulation is activated while the unit is still OFF) (Planck test preparation feed back).	
		§5.8.2.4.3 DELETED (no unit health check or other test done under fairing before launch (was TBC-8)).	
		§5.8.2.4.5 Wording "do confirm" and dry loop names corrected (AI#8 of H-P-ASP-MN-8177). A TBC is added about dry loop signal timing to establish a link with future feed back from STM2 test results.	
		§5.8.2.4.5 to §5.8.2.4.8 A statement is added to points out the need for the availability of an emergency procedure to close V501 and V503 at cryostat responsible request (AI#10 of H-P-ASP-MN-8177).	
		§5.8.2.4.6 to §5.8.2.4.10 missing autonomous SCBP switching at separation corrected (from check of ASW SRD amendment 2 issue 7).	
		§5.8.2.4.7 A statement allowing for an emergency closing of V501 and V503 at cryostat specialist request is added (AI#10 of H-P-ASP-MN-8177).	
		§5.8.3.3 Decontamination point is updated to latest hypothesis (AI#9 & 10 of H-P-ASP-MN-8177 as overwritten by later elements).	
		§5.8.3.11 conflicting / interfering between decontamination and CDMS / PCS commissioning made explicit (resource sharing) (AI#32 of H-P-ASP-MN-8176). Decontamination settings (TBC-16 / TBW-14) are now defined (AI#9 & 10 of H-P-ASP-MN-8177 as overwritten by later elements).	
		§5.8.4.9 The science TM shall be also downloaded from SSMM for verification with real time TM (not only Hk) (AI#1 of H-P-ASP-MN-8177).	
		§5.8.5.2 to §5.8.5.19 Mode transition diagrams corrected and upgraded with extra info. as MTL and Reaction Wheel usage activation marker. Some ACMS mode and GSE states are also corrected in some satellite state tables (correction indications from different sources)	
		§5.8.5.5 Typing corrected : "force separation" TC shall be exercised in this sequence, not the nominal strap opening (feed back from Planck test preparation).	

		§5.8.5.6 Separation strap opening added to restore correct configuration after §5.8.5.5 update.	
		§5.8.6.7 SAS setting methodology clarified (feed back from Planck test preparation).	
		§5.8.7.1 Objective list is updated to reflect all the activities finally agreed to be part of this sequence (AI#1 of H-P-ASP-MN-8176).	
		§5.8.7.2 Subparagraph are created to ease test objective discrimination. The TC to command CDMS OBT update is corrected (shall be TC(9,10)).	
		§5.8.8.2 An EEPROM patch test limited to one or two word is added for each instrument (point 5 of activities, AI#29 of H-P-ASP-MN-8176). The 1Mo instrument software image upload test (point 4) is detailed according terms agreed in H-P-ASP-MN-8176.	
		§5.8.9.3 Added a diagram and a reference to H-P-ASP-MN-8338 which agree on the RMS scenario. Previous proposal for a dummy pointing cycle (appendix 5) is kept as a back-up solution.	
		§5.9.2.2 Mode transition diagrams upgraded with extra info. and corrected with respect to ACMS RM behaviour (no launch specific PAP) (feed back from test preparation).	
		§5.9.3.2 1553 bus failure simulation procedures improved by considering CDMU SCOE use (feed back from AAS-I CDMS SIT).	
		§5.8.10.2 SAS and AAD optical stimulation criteria made explicit. LPS "test data word bit 8" specific settings added, in relation with §5.8.2.3 and 5.8.2.4.2 modifications (feed back from Planck test preparation).	
		§6.3.1 The different kinds of TC check and monitoring done as routine verification following the HPSDB settings are detailed (AI#5 of H-P-ASP-MN-8176).	
		§6.3.2 Title and introducing paragraph modified to fit with additions made in §6.3.1	
		§7.1 "Organisation" completed (was TBW).	
		§7.1.2 added to detail organisation with respect to the instrument team (include AI#2 of H-P-ASP-MN-8177).	
		§7.1.3 added to detail accommodation conditions for ESA observers (AI#31 of H-P-ASP-MN-8176).	
		§7.2 "Responsibilities" completed (was TBW).	
		§7.3 "Task distribution" completed (was TBW). "heritage" wording replaced by "derived" for procedure preparation (ASED insisting demand)	
		§8.2 Systematic plot of cryostat data added (AI#13 of H-P-ASP-MN-8177).	
		§ 9 Reference to accepted RFD and RFW added when applicable (ESA accepted RFD and RFW only).	
		§10.15 a typing in "T.2 A.A" ref. is corrected (AI#8 of H-P-ASP-MN-8176).	
		§14 TBC, TBD, TBW list updated in coherence with modifications.	
		§15 TBC14, TBW13 and TBW14 responsibility corrected from ASED to AAS-F (AI#12 of H-P-ASP-MN-8177).	
		§18 AVM S/C IST applicability matrix added, with test restrictions as	

		applicable to each sequence (AI#19 of H-P-ASP-MN-8176).	
		§19 Clarification and recall tables added with respect to EGSE and S/C boot configuration (feed back from Planck test preparation).	

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1. TEST OBJECTIVES

1.1. INTRODUCTION

1.1.1. SCOPE OF THE DOCUMENT

The Integrated Satellite Test (IST) is a complete set of functional tests, performed on the fully integrated satellite, at precise time frames in the satellite final test sequence.

The objective of the present IST specification is to provide requirements to Satellite AIT, with sufficient details in order to write the relevant IST procedures, and to define the corresponding configuration of Ground Support Equipment and other interfaces of the test facilities.

Each elementary verification at the level of the subsystems, is described by relevant test specifications included in the subsystem level test specification: PCS SIT, CDMS SIT, TTC SIT, ACMS SIT.

The Instruments functional tests and the verification of their proper interaction with the full satellite are part of IST (as far as allowed by ground test condition).

It shall be pointed out that no test requiring manual intervention or intrusive measurement (ex: breakout box), will nominally be run during IST. Any exception will be clearly stated.

The present specification is applicable to the Herschel Satellite configuration.

1.1.2. NOTICE ON THE "IST" ABBREVIATION USAGE

The IST abbreviation stands for "Integrated Satellite Test". It is unfortunately used in the Herschel-Planck project documentation with several confusing deviations.

The IST abbreviation is sometime translated as "Integrated System Test". This shall be considered as a synonym.

To prevent confusion with the "SVM IST" (see below), the IST as defined by this specification is increasingly referred as "S/C IST" or "SAT IST" (S/C and SAT standing for "satellite").

The project history has led also to define tests, whose names include the IST acronym, without being related to the scope and objective of the IST as defined by this document. For clarity, please find hereafter some recall and definition.

- The **"mini IST"** is a special test that has been introduced as a prerequisite to the Planck PFM1 test. Its objective was the validation of the test sequences, resources and procedures which were needed for running the PFM1 test. This test has been run on a partially integrated Planck configuration in clean room environment (SVM+PPLM).

  The PFM1 test was a thermal vacuum balance test, whose objective is the S/C thermal model validation (no STM model for Planck). The "mini IST" is related with the herein specified IST in the way that some of its sub-sequences and procedures are inherited by the Planck IST, and through commonality, by Herschel IST.

- The **"SVM IST"** is the final integrated test performed by AAS-I on the service modules (SVM) before their delivery for their integration with the payload modules (HPLM or PPLM). There is one Herschel "SVM IST" and one Planck "SVM IST".

  The Herschel "SVM IST" is tightly related with the herein IST. It shall validate most satellite functions: in principle, all except the detailed interaction with the instruments. The IST and the "SVM IST" are complementary in the frame of the satellite validation.

- The **"IST1"** and **"IST2"** acronyms are used to designate the first and second run of the IST. The IST shall be run twice on the satellite, as this is detailed in chapter 1.2.1.

- The **"combined IST"** is the name which has been given at a time, to one merger for Planck, of "SVM IST" and the "IST1". The "combined IST" was applicable to Planck only, and is no more considered.

- The **"AVM IST"** is a preparatory run of the IST –as defined in this document– on the AVM model. The major objective of this test is to validate the IST test sequences and procedures. ~~SVT0.~~

  There is one Herschel and one Planck "AVM IST" ("AVM S/C IST").

  The applicability of this document to the "AVM S/C IST" is presented in chapter 3.1.3.

The above list of the IST acronym usage is not necessarily exhaustive. For example, IST for "Instrument Specific Test" has had some usage. But this paragraph shall clarify all the confusing cases with respect to this document context.

1.1.3. *PRESENT ISSUE STATUS*

This document issue 3.0 is the reference document for the IST test execution.

This document includes after issue 2.0, the last agreements between ESA and AAS-F upon the test program.

At this issue level, some work remains to define the detailed sequences at the command per command level. But this issue defines all the intended tests and sequences, at least at the objective, tested function list, and short description level. It gives so a completed view of what shall be tested by the IST (or not), and is the base of the ESA / AAS-F agreement.

The lower test sequence completion in their full details, is linked to the parallel work on CDMDS and ACDMS SIT, the SVM IST, the sub-systems user manuals and the flight operation procedure definition (platform and instrument). ~~This issue already includes a significant experience return from the CDMS SIT formalised through RD18 CDMS ASW SRD amendments to mode transition management.~~

This issue specifically includes with respect to 2.0, all ESA comments as agreed in H-P-ASP-MN-8176 and H-P-ASP-MN-8177~~, and the definition of the instrument sequences~~.

This document includes also the feed back from the preparation work on the Planck S/C IST run on the AVM model.

WARNING: this document does not yet consider the consequences of the "Recovery plan for CDMU ASW" (H-P-1-ASP-PL-1218, dated October 4th). This document ignores so yet the issue of managing both the "AIV branch" and "flight branch" versions of the CDMS ASW (see referred plan for detail).

1.2. TEST OBJECTIVES

1.2.1. IST OBJECTIVE

The objective of Herschel IST is twofold :

- to verify the correct performance of the satellite and the compatibility between all the integrated electrical subsystems and instruments,
- to validate the operation procedures which will be exercised during the different phases of the satellite mission.

Except where otherwise stated, the IST shall be:

- a fully automated test run from the Central Checkout System (CCS),
- utilising the Herschel Planck System Data Base (HPSDB) and,
- the test procedures and control files developed to verify the performance of the satellite, subsystems and instruments with each other.

The IST shall be essentially composed of a succession of mission representative tests, including especially the test of the special and routine operation profiles defined by the Reference Mission Scenario (RMS) for the satellite, as well as some degraded operation cases.

The basic requirement is the following:

AIAI-70: The purpose of the Integrated Satellite Test (IST) shall be to verify correct operation of the fully integrated satellite in a series of representative mission modes including autonomous (Mission Timeline – MTL and On-Board Control Procedures – OBCP) and backup modes.

For that, the IST is structured into a limited number of independent test sequences. The whole IST or only part of it, shall be possibly replayed at different times in the satellite test campaign. The satellite EMC test campaign will be so typically based on re-assembled and rescheduled IST sub-sequences. The satellite Thermal Vacuum test campaign will include as part of its program, the integral replay of some of the IST sequences.

The IST shall be the reference test for the satellite and shall be performed after that:

- the electrical subsystems and the instruments are successfully integrated onto the satellite flight models,
- the tests of the subsystems in the system environment are all completed (PCS SIT, CDMS SIT, TTC SIT, ACMS SIT, etc.),
- the instrument integration and tests (ILT) are completed (warm units and cold units),
- the HPSDB, including FDDB, is properly populated and under strict configuration control,
- the CDMS and ACMS BSW and ASW are in stable versions (definitive unless incident) and under strict configuration control,

- the generation and the validation of the necessary OBCP have been done (with the subtlety that this validation is a nominal part of AVM IST).

The IST shall be nominally run twice on the satellite in complete flight configuration, during the phase D of the program:

- the IST1 shall be run at the beginning of the FM satellite environment test campaign, after the I&T, UFT and SIT activities have been run, with all instruments integrated,
- the IST2 shall be run at the end of the environmental test campaign of the FM satellite.

~~A third IST run will be performed on the launch site, as part of the final satellite preparation (NB. formally, this is out of phase D).~~

To permit a straightforward comparison of the IST run results, the tests shall be identical. In practice, subsystems, instruments and/or on board software development constraints will likely affect the strict identity of the tests. Some of these constraints is already known, for example, the complete ACMS application software release will not be available in time for IST1. An another point is the incidence of instrument SPT objectives on IST1 (see next paragraph). Those constraints will be handled individually.

The present test specification is fully applicable to the two phase D IST runs.

Important notes:

In order to ease test design and to maintain a consistent approach for the IST runs, while taking into account the above mentioned restrictions, the IST specification is structured into smaller and modular self standing elementary test specifications.

The correlation of functional/performance tests at subsystem level under specific conditions to system functional/performance tests under similar conditions shall be possible.

At IST stage, it should be made use –to the maximum extent– of implicit testing, meaning that a number of functions are implicitly tested by using these functions, while testing other satellite system functions. They therefore do not need to be validated in a specifically dedicated session. This general rule is also valid for the verification already performed in the frame of ACMS, CDMS, PCS, or TTC SIT.

Some system requirements shall be explicitly verified during IST1 and IST2. A matrix recalling them is given in appendix 1.

1.2.2. ADD ON OBJECTIVES: INSTRUMENT VALIDATION

For project history related reasons, the instrument integration testing will not be fully completed before the Herschel IST1 test.

The IST1 objective shall be combined with the instrument functional and performance validation test (SPT).

A fact is, that the instrument functional and performance validation will be done in flight during the instrument commissioning period. The flight procedures for those tests shall be validated in the frame of the IST. So the SPT and IST tests may combine nicely.

But the actual instrument performance validation objective during the IST has many impacts.

The actual instrument performance validation requires that they are set-up in a fully acceptable state for the performance measure. Beside the ambient testing condition, this shall specifically account for the focal plane thermal condition.

A specific impact is that the cryostat shall be operated in HeII condition, a that focal plane thermal time constant shall be respected (in fact measured), with constraints on the instrument activation order, and sorption coolers operating cycles (which shall be measured).

This means also that the CRYO-SCOE support will be necessary to run the tests.

With respect to IST objective, this comes mainly with :

- the impossibility to accelerate the test sequences,
- the need to keep some operation round the clock or switch CRYOSCOE configuration daily.

The impact is mainly upon planning and scheduling.

The test combination means also that this test specification –limited to IST objective– shall be completed at instrument level by detailed performance measurement procedures managed separately (AD06).

Practical limitation of ambient testing

The IST1 and IST2 shall be run in ambient clean room environment. Cryostat configuration shall be as specified in §3.3.

For Herschel, the ambient environment brings some limitation because:

- the HIFI instrument has strict limitations when LOU is too warm. This mainly accounts for a power limitation on LOU outputs and the unavailability of the upper frequency channels.
- the cryoharness strands are not at a representative temperature, then their impedance is higher than flight with possible bias on fine instrument performance measurement or on other cryostat functionality as the NCA (the firing current should be too low on a representative NCA load).
- the straylight level at the focal plane level remains high du to the 2nd shield temperature level in ambient condition.
- the mass flow rate needs to be boosted to compensate thermal inputs and allow the instrument operation (L1 and L2 temperature).

This means that some instrument performance and even some functional validation will be get only under thermal vacuum condition.

Then for those subjects, the thermal vacuum test (TVTB) sequences will not be simply extracted from the IST, but will be complemented by many specific SPT sequences defined by AD06 which covers all the instrument tests (and not only IST associated ones).

2. DOCUMENTS

2.1. APPLICABLE DOCUMENTS

AD01 VPP	Verification Programme Plan H-P-1-ASPI-PL-0225	for reference: issue 3.0 July 19th 2004
AD02 GDIR	General Design and Interface Requirement H-P-1-ASPI-SP-0027	for reference: issue 5.0 October 7th 2004
AD03 SOFDIR	System Operation and FDIR Requirements H-P-1-ASPI-SP-0209	for reference: issue 4.4 July 20th 2004
AD04	Herschel equipment with limited cycles H-P-3-ASP-TS-1102	for reference: issue 1.0 March 24th 2006
AD05 ENV	Environment and tests requirements H-P-1-ASPI-SP-0030	for reference: issue 5.0 October 7th 2004
AD06	Test specification for Herschel Instruments AVM and PF tests performed at satellite level H-P-3-ASP-TS-1083	for reference: issue 1.0 September 29th 2006

The latest issues of the above documents are applicable. For reference, are nevertheless given the active issues with which the present specification is coherent. Any discrepancy arising from a later issue will have to be brought to the attention of the contractor for clarification and resolution.

2.2. REFERENCE DOCUMENTS

RD01	Unit Switching Status H-P-1-ASPI-TN-0386, issue 2.0, dated September 19th 2006.
RD02 RMS	Reference Mission Scenario, Herschel / Planck project SCI-PT / 12759, issue 3.1, dated August 6th 2004.
RD03	ACMS SIT Test Specification H-P-SP-AI-0059, issue 4, dated October 11th 2006.
RD04	Inhibit Function & Launch and Reconfiguration Sequences H-P-1-ASPI-TN-0903, issue 2.0, dated end of October 2006.
RD05	AIT Software management plan H-P-1-ASP-PL-0420, issue 2.2, dated November 15th 2004.

RD06	Packet store usage on Herschel / Planck PT-CMOC-OPS-TN-6603-OPS, issue 2.1, dated April 2005.
RD07	Instrument testing at PLM PFM and Satellite level HP-2-ASED-PL-0031, issue 2, dated September 3rd 2004.
RD08 SPIRE IID-B	Instrument Interface Document, Part B, instrument "SPIRE" SCI-PT-IIDB/SPIRE-02124, issue 3.3, dated June 21st 2004.
RD09 HIFI IID-B	Instrument Interface Document, Part B, instrument "HIFI" SCI-PT-IIDB/HIFI-02125, issue 3.3, dated October 21st 2005.
RD10 PACS IID-B	Instrument Interface Document, Part B, instrument "PACS" SCI-PT-IIDB/PACS-02126, issue 3.2, dated March 2nd 2005.
RD11 AVM SPEC	AVM requirements and design H-P-1-ASPI-TN-0164, issue 2.2, dated December 8th 2003.
RD12	Herschel / Planck AVM technical note H-P-TN-AI-0052, issue 2, dated June 28th 2004.
RD13 SPIRE UM	SPIRE Instrument User Manual SPIRE-RAL-PRJ-002395, issue 1.0, dated April 8th 2005.
RD14 HIFI UM	HIFI User Manual SRON-U/HIFI/UM/2004-001, issue 1.4F,dated January 18th 2006.
RD15 PACS UM	PACS User Manual to be issued (unit level user manuals)
RD16 HPLM UM	TBC-2
RD17	Instrument PLM EQM level test procedure HP-2-ASED-PR-0051, issue 1.1, dated June 24th 2005.
RD18 SVM UM	HERSCHEL PLANCK SVM USER MANUAL H-P-MA-AI-0001, Vol. 1, Herschel Planck user manual, issue 4.0, October 31st 2005 Vol. 2, CMDS, issue 5.0, March 31st 2006 Vol. 3, TTC-RF, issue 5.0, March 31st 2006 Vol. 4, ACMS, issue 5.0, March 31st 2006 Vol. 5, RCS, issue 4.0, October 31st 2005 Vol. 6, PCS, issue 5.0, March 31st 2006 Vol. 7, TCS, issue 4.0, October 31st 2005 Vol. 8, Flight procedures, issue 5.0, March 31st 2006
RD24 CDMS ASW SRD	CDMU Application software requirement specification H-P-SP-AI-0031, issue 9, dated October 12th 2005 with overwriting : amendment 2, March 2006, amendment 3, May 2206.

RD25 PSICD or PUS	Packet structure ICD SCI-PT-ICD-07527, issue 5.0, dated July 20th 2004. with amendment to appendix 3 (APID allocation).
RD27	Standard Radiation Environment Monitor test specification SCI-PT-35132, issue 2.0, dated May 11th 2005.
RD30 SRS	System Requirement Specification SCI-PT-RS-05991, issue 3.3, dated July 27th 2004
RD31 OIRD	Operations Interface Requirement Documents SCI-PT-RS-07360, issue 2.2, dated September 31st 2003.
RD33	S/C User Manual H-P-1-ASP-MA-0693, issue 2.1, May 31st 2006.
RD34	List of acronyms H-P-1-ASPI-LI-0077, issue 2, July 17th 2004.
RD35	H/P IST Thermal prediction H-P-1-ASP-TN-1170, issue 1, September 18th 2006.

2.3. ACRONYMS

The acronym definitions shall be find in RD34. For convenience, the following list recalls the most useful ones (sometime with comments) and adds a few ones.

Note: the tables summarising the satellite state along sequence steps use additional acronyms. Their specific definition is given in the dedicated appendix 2.

AAD	Attitude anomaly Detector (part of ACC RM, 1 fail operational unit)
ACC	ACMS Control Computer
ACMS	Attitude Control and Measurement Subsystem
AFO	Autonomous Fail Operational (FDIR mode)
AFS	Autonomous Fail Safe (FDIR mode)
AIT	Assembly Integration and Test
AIR	ACMS In Reconfiguration (see appendix 8)
AP	Autonomous Period (part of OD)
APID	Application Process IDentifier (specifies the identity of a TC packet user)
ASW	Application Software (upper level of OBSW)
AVM	AVionics Model
BATSIM	BATtery SIMulator (see BSSCOE)
BCR	Battery Charge Regulator (part of PCDU, 3 units)

BDR	Battery Discharge Regulator (part of PCDU, 2 units)
BSSCOE	Battery Simulator SCOE (regular AIT designation for BATSIM)
BSW	Basic Software (lower level of OBSW, common to ACC and CDMU)
CCS	Central Check-out System
CDMS	Control and Data Management Subsystem
CDMU	Control and Data Management Unit
CEL	Critical Event Log
CIR	CDMS In Reconfiguration (see appendix 8)
CLCW	Command Link Control Word
COP	Commissioning Operation Phase
CPDU	Command Packet Decoder Unit (part of CDMU RM, 2 units)
CRYO-SCOE	SCOE that ensures the CRYOstat monitoring and management for ground operations.
CSEL	CPDU Selector (part of CDMU RM, 2 units)
CVV	Cryostat Vacuum Vessel
DFE	Data Front End (SCOE)
DOD	[battery] Depth Of Discharge
DPU	Digital Processing Unit (instrument unit which ensures the I/F with the CDMS)
DTCP	Daily TeleCommunication Phase (part of OD)
EGSE	Electrical Ground Support Equipment
ESA	European Space Agency
ESOC	European Space Operation Centre
EVTR	EnVironment and Test Requirement (see AD05)
FDDB	Flight Dynamics Data Base
FDIR	Failure Detection, Isolation and Recovery
FM	Flight Model
FPU	Focal Plane Units (generally relate to the units inside the cryostat)
GSE	Ground Support Equipment
HPSDB	Herschel-Planck System Data Base
HIFI	Heterodyne Instrument for the Far Infrared
Hk	House Keeping [telemetry]
HPLM	Herschel PayLoad Module
IEGSE	Instrument Electrical Ground Support Equipment
I/F	Interface

ILT	Instrument Level Test
IOP	Initial Orbit Phase (regular name for LEOP)
IST	Integrated Satellite Test
I&T	Integration and Test
LEOP	Launch and Early Operation Phase (see IOP)
LOU	Local Oscillator Unit (part of HIFI)
MAP	Multiplexed Access Point (specifies to the TC decoder the hardware TC packet destination). The possible value for IST are : MAP1 = OBSW (any packet user), MAP0 = CPDU, MAP5 = RM/TRR reset, MAP6 = locks CPDU use for ground TC only (MAP0, MAP5 and MAP6 nominal use is limited S/C ON OFF only or the creation of specific test condition)
MLI	Multi Layer Insulation
MM	Mass Memory (full acronym shall be SSMM)
MPT	Multi Purpose Trolley
MTL	Mission TimeLine
N/A	non applicable
NCA	Non Contaminating Actuator (cryostat cover actuator)
NED	Non Explosive Device (see NCA)
OBCP	On Board Control Procedure
OBDB	On Board Data Base (ACMS)
OBSW	On Board SoftWare (i.e. BSW and/or ASW)
OD	Operation Day
OOL	Out Of Limit
PACS	Photo-detector Array Camera and Spectrometer
PCS	Power Control Subsystem
PCDU	Power Control and Distribution Unit
PM	Processor Module (part of CDMU or ACC)
PFM	Proto Flight Model
PLM	PayLoad Module
PPLM	Planck PayLoad Module
PVP	Performance Validation Phase
RM	Reconfiguration Module (part of CDMU or ACC)
RMS	Reference Mission Scenario (see reference documents)
ROP	Routine Operation Phase
S/A	Solar Array

SAS	Solar Array Simulator (see SASLPSSCOE)
SASLPSSCOE	Solar Array Simulator and Launch Power Supply SCOE (regular AIT name for SAS)
S/C	SpaceCraft
SCBP	SpaceCraft Bus Profile
SCOE	Special Check-Out Equipment
SDB	[1553] Satellite Data Bus (data handling)
SGM	SafeGuard Memory (part of CDMU and ACC RM, 2 units)
SIT	Subsystem Integrated Test
SIR	Spacecraft In Reconfiguration (see appendix 8)
SOC	[battery] State Of Charge
SPT	Special Performance Test
SPIRE	Spectral Photometer Imaging REceiver
SRD	Software Requirement Specification (see RD24)
SSMM	Solid State Mass Memory (part of CDMU)
STBY	STand-BY [state] (generic name for the state in which the instrument are inactive but ON to provide housekeeping functions and observability).
SVM	SerVice Module
TC	TeleCommand
TC(t,s [,f[,a]])	TeleCommand reference conform to the PSICD standard: t = type, s = subtype, and where applicable, f = function identification, and a = action identification (see RD25). The used prefix CPDU-, CDMS-, ACMS-, HIFI-, PACS-, SPIRE-, clarifies the destination APID (or the MAP for CPDU case).
TM	TeleMetry
TM(t,s [,f[,a]])	TeleMetry reference conform to the PSICD standard: t = type, s = subtype, and where applicable, f = function identification, and a = action identification (see RD25).
TTC	Telemetry, Tracking and Command [subsystem]
TVTB	Thermal Vacuum and Thermal Balance [test]
UFT	Unit Functional Test
4K	4K cooler

The reader is expected to be familiar with the general satellite design and mission then, the above table does not recall necessarily all acronyms. This is specifically true when addressing the on board unit names (VMC, XPND, TWTA, etc.). The system Design Report, H-P-1-ASP-RP-0666, may be used for clarification when necessary.

3. TEST SPECIMEN DEFINITION

3.1. SATELLITE AND GSE CONFIGURATION

3.1.1. SATELLITES CONFIGURATION

The satellite shall be mechanically assembled:

- the Service Module shall be assembled and all panels closed (complete MLI installation is not mandatory),
- the Payload Module shall be assembled and integrated onto the SVM,
- the instrument configuration for IST 1 and IST 2 shall be as defined in AD06,
- the installation of the solar array is not mandatory for IST. In all cases, the Solar Array Simulator shall supply the satellite for test then shall be electrically connected instead of the solar array at the SVM upper brackets level. The simulation provided by the SAS includes the SA thermal sensors. The necessary end to end test after final connection of the real solar array is not part of the IST.

All the electrical subsystems shall be integrated: the relevant I&T, UFT, and SIT test steps shall have been successfully completed.

All the instrument units shall be integrated and health check at instrument level shall have been successfully run.

Constraints related to instruments limited life items and any critical element are specified in AD04.

The skin connectors shall be installed and connected to relevant SCOE as specified in appendix §19.1.

The traffic on the 1553 SDB shall be permanently spied and recorded using the bus monitor of the CDMS SCOE connected to the skin connectors SK02 J01 and J02.

The traffic on the 1553 ACMS Bus shall be permanently spied and recorded using the bus monitor of the ACMS SCOE connected to the skin connectors SK02 J03 and J04.

The umbilical links shall be connected to allow satellite telecommands and permanent telemetry monitoring.

The RF-SCOE shall be connected to satellite through dedicated antenna test caps.

The real FM battery shall be used only when requested (Launch Mode test, "clean run" and Reference Mission Scenario). In the other cases, the battery shall be replaced by the Battery Simulator (BATSIM).

The tests shall be run with the latest HPSDB release valid for the specimen under test.

The necessary On Board Control Procedures shall be developed and validated before the test starts.

As a default configuration except for two sequences, Herschel shall be positioned with the +X axis tilted by 20° from vertical, +Y pointing down, to allow a proper instrument sorption cooler operation. For running the RMS sequence and the SPIRE spectrometer commissioning sub-sequence, the Herschel shall be tilted with its X axis horizontal, +Y pointing down to allow a proper operation of the SPIRE spectrometer as well as the instrument sorption cooler.

The baseline is to switch from the 20° to full horizontal tilt configuration for the end of the IST.

This baseline is defined to allow a higher cryostat initial loading with He and autonomy, that would be possible with running the full IST with the X axis horizontal. This baseline should allow with a good margin, to run the full IST test without the need of ~~an intermediate~~ too much cryostat refill operation ~~(several days are necessary to stabilise the He-II state after refill)~~. This baseline means nevertheless that the instrument commissioning sequence (see §5.8.4.5) will be prevented to fully test the SPIRE spectrometer mode while the cryostat is still at 20° position. A set of SPIRE commissioning test §5.8.4.5 shall be so in practice delayed until the satellite is set fully horizontal, which should be just before running the ~~RMS~~ clean run sequence (i.e. week 4 instead week 2 in reference planning given §5.1.2). ~~The initial cryostat He filling before the IST test start shall be optimised for being the highest yet guarantying, a level compatible with cryostat horizontal operation at time for running the RMS sequence (i.e. in practice: a few less than half full after 3 weeks of tests)~~.

Around this baseline, a flexibility is granted to manage contingencies and there is no strong requirement about satellite position (including vertical) for a given test while all the constraints of the different units are respected (SPIRE spectrometer, sorption coolers, cryostat). The understanding is that satellite tilting modification and cryostat refill are long and critical operations and their number shall be limited. Above baseline allows one single tilt modification after one initial fill and tilt operation.

3.1.2. GSE CONFIGURATION

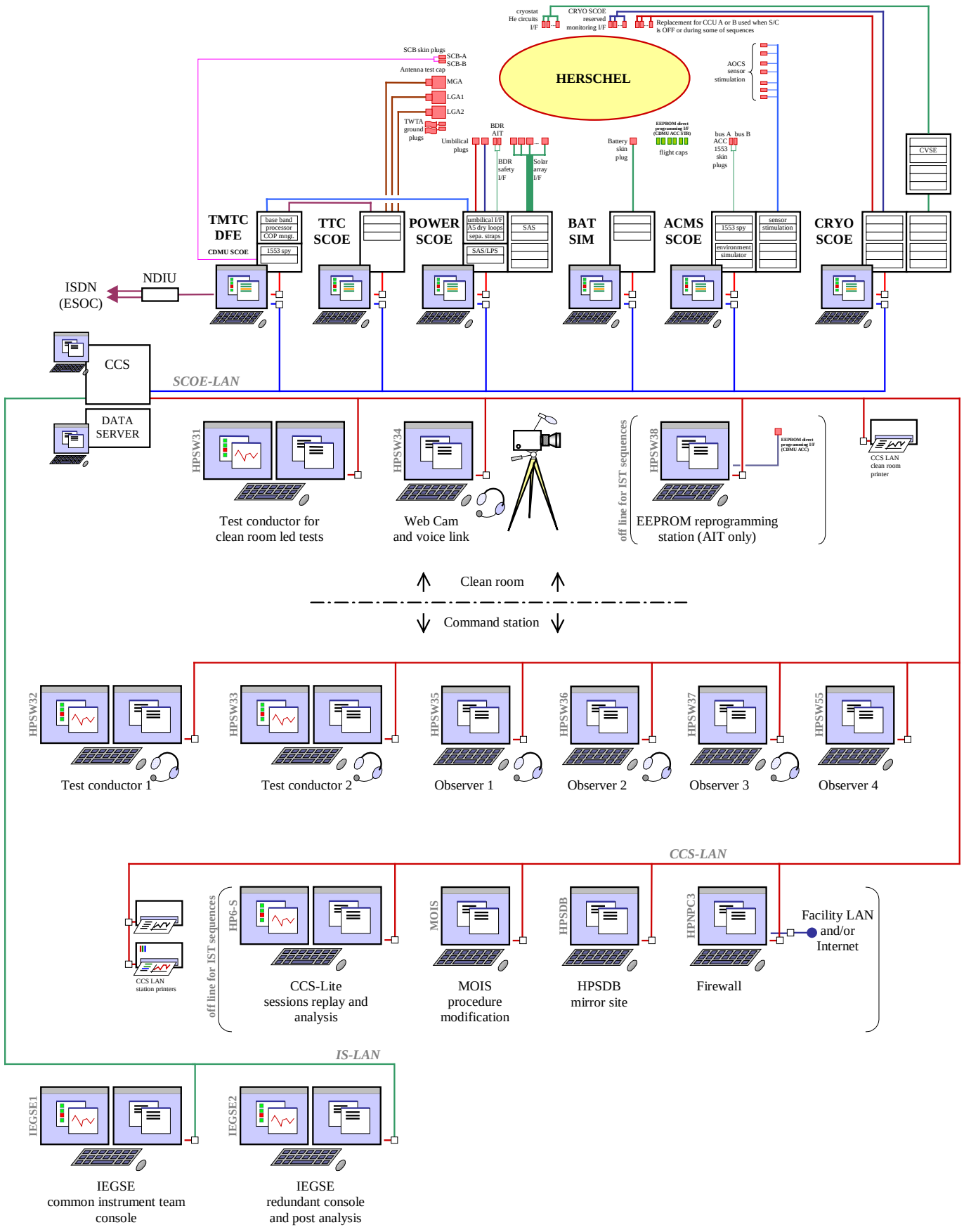
Herschel satellite shall be installed on the Multi Purpose Trolley (MPT).

The Electrical Ground Support Equipment to be used in the frame of the IST shall include :

- The Control Check-out System, properly loaded with the S/C data base and its terminals,
- The Power SCOE especially comprising the Battery Simulator, the Launch Power Supply and the Solar Array Simulator,
- The TTC SCOE,
- The TM/TC DFE,
- The ACMS SCOE including the Star Tracker UCE,
- The CDMS SCOE, including the 1553 Bus Monitor,
- The Herschel instruments IEGSE and any necessary other instrument EGSE as for activating SPIRE launch lock for example (operation under instrument responsibility, see dedicated §3.2.2).

According need, some cooling accessories (fans) may be requested to keep the SVM panel at correct operating temperature, specifically during long duration or concatenated tests ~~(reference TBC-29 under redaction at time of writing)~~. Applicable requirements are given in RD35.

The following diagram depicts the global considered CCS linked EGSE configuration.



The CCS and TMTC DFE shall be configured by default to up-link TC with normal (that is low) priority (3 most significant bits of sequence counter set to 100b). All TC generated by the CCS will be generated with a low priority setting except for a few cases which will explicitly specified in the test sequences. The high priority TC (3 most significant bits of sequence counter set to 000b) will be used in flight only to go out of a possible lock-out situation. For the IST purpose, they are used only by the test emergency procedures and a few other specific actions.

The Herschel CRYO-SCOE shall be available to monitor and manage the cryostat (specifically to manage the extra cooling effort needed in ambient condition and get the instruments at the right temperature).

3.1.3. AVM CASE

Before being run on the FM satellite, the IST test sequences shall be run on the AVM during the so called "AVM IST" campaign.

Despite not detailed in this document, it shall be understood that the AVM IST sequence shall be adapted to cope with AVM built in limitation. As a brief recall:

- open panel layout,
- no redundant units / board (both for platform and instrument) except for the CDMU PM and ACC PM,
- simulated thruster electrical load (RCS),
- simulated heaters and thermal control temperature sensors (TCS),
- single ACMS sample of hardware (1 of 4 RW, 1 STR, 1 CRS, 1 AAD, etc. others being SCOE),
- instrument limited to warm units with simulators for secondary unit and/or FPU units.

The full detailed AVM definition, configuration and limitations shall be found in RD12 (AAS-I AVM technical note) for the SVM related units.

For the 3 instruments, the current reference may be found in each instrument IID-B (RD08, RD09, RD10). But following IST instrument test sequences definition, some dedicated upgrade of the AVM unit is under study to prevent the sequences of being limited by undue false alarms. Specific upgrade are proposed by PACS and possibly by SPIRE, and AVM S/C IST run will include this ~~(future at time of writing)~~ configuration.

With respect to the IST sequence, the main limitation of AVM is that the cold redundant units are not all present ~~(except CDMS and ACMS PM-B), n~~or simulated ~~(except for XPND-2)~~, then the tests in "all B units" configuration (see definition §5.2) will not be possible, and will be run instead in "all A units" configuration (see definition §5.2). Note: as the CDMS and ACMS PM-B are part of redundant units which are present, then test in "PM B" configuration can be run on AVM.

The appendix 10 (§16) provides an applicability matrix and AVM requirement adjustments which shall be considered for each test sequence.

Warning: the other chapters of this document are written for the context of the ITS1 and IST2 onto PFM S/C (except for a few point explicitly stated). Then, to apply this document to the AVM case, statements need sometime to be transposed.

3.2. INSTRUMENTS

3.2.1. INSTRUMENT CONFIGURATION

The instruments shall be fully integrated on the satellite and already tested.

For IST test, as for all ground tests, temperature and gravity may endanger the correct instrument operation. This shall be handled by properly orienting the spacecraft axis with respect to local vertical using MPT GSE, and restrict or bias the operation. Specifically:

- The SPIRE FTS (spectrometer mode) operation shall be done with the "FPU unit on its side", that is satellite X axis horizontal (+Y pointing down).
- The SPIRE sorption cooler (all modes except "OFF", "INIT" and "ON" shall be activated also with "FPU unit on its side", that is satellite X axis horizontal or tilted by 20° (+Y axis pointing down).
- The PACS sorption cooler has the same operation restrictions as SPIRE ones.
- The HIFI LOU has restricted frequency and power ranges when operated at 25°C (default for IST test), which implies specifically that the higher frequency band may not be test (TBC-5 with HIFI for more detail). Some concerns also apply with respect to unit life time and LOU activation time shall be recorded in the instrument log book (TBC-5 with HIFI for more limitation).

Specifically, the instrument performance verification (SPT) shall come with specific constraints. The major technical constraint with SPT is that the cryostat shall be set in He II phase, cover shall be cooled, and the cryostat shall be properly tilted. Other constraints have been taken into account through test programming as reported by AD06, as they concern thermal time constants and the coolers recycling / autonomy duration.

The detailed instrument operation and tests to be run in the frame of the IST are managed through AD06.

3.2.2. INSTRUMENT IEGSE & GSE

Details are given in AD06.~~Details are TBW-31 with instruments.~~

The instrument "quick look" IEGSE shall be available and connected to the CCS, in a way more or less similar to the one foreseen for the instrument commissioning and performance verification phase.

Complementary GSE, for example, to actuate SPIRE launch lock, shall be available.

3.2.3. INSTRUMENT TEAM INVOLMENT IN IST TEST

The instrument team will be requested to support the IST with respect to operation procedure design, test success criteria definition and instrument TM post analysis, as well as test real time quick look TM critics.

Details are given in §7.1.1, §8.3.2.2 and AD06.~~Details are TBW-4 with instruments.~~

3.3. CRYOSTAT

The CRYO-SCOE shall be used to monitor and control the cryostat, specifically between test sequence.

This additional GSE that ensure proper pumping at N513, N511 and N512 throttle level when testing V501 and V503 valves, shall be used when those valve actuation function is tested (launch sequence and launch clean run).

Note : the cryostat shall have been filled with He, and shall be in He-II state when the IST sequence start (see §3.1.1). The related cryostat GSE are so not list, but it is expected that they can be made available to manage any possible contingency.

Detailed procedures are ~~TBW-32 with~~ under ASED control and responsibility.

4. TEST FACILITY REQUIREMENTS

IST shall be conducted in standard clean room environment. As a brief recall:

- Cleanliness must be class 100000, Fed Std 209-E,
- Temperature shall be controlled in the range 22°C +/-3°C,
- Relative Humidity shall be controlled in the [EVTR] range : 50% +/-10%.

All requirements shall be found in the program "Environment and tests requirements" [AD05].

5. TEST DEFINITION

5.1. GENERAL REQUIREMENTS

5.1.1. NOMINAL AND DEGRADED CASES

The IST test sequence shall be composed of 2 main parts:

- the test of the Nominal Cases,
- the test of the Degraded Cases.

The degraded cases would need strictly speaking, to be tested only once. The ability to properly operate the satellite with both nominal and redundant units (degraded configuration) shall be nevertheless validated before and after the satellite environment tests. The IST1 and IST2 test sequence shall be identical.

5.1.2. GLOBAL TEST TIMELINE

The following table gives the reference IST timeline. It gives for each instrument, its estimated activation time allocation with respect to the strict IST objective. The compatibility of those timeslots with SPT objectives remains TBW-6.

Set	Day	PM	Units	Sequence	§	HIFI	PACS	SPIRE	Comment
1	1	A1	A	Launch sequence	5.8.2	none	none	none	vent throtles circuit shall be pumped down
	2	A1	AB	S/C comissioning	5.8.3	none	none	none	
		B1	AB						
	3	AB1	AB	SPARE (pre reserved for S/C commissioning)		none	none	none	
2	1	A1	A	SPIRE commissionning	5.8.4.5	10h	OFF	OFF	management in background of sorption cooler cycles and focal plane temperature constants brings interdependencies between tests and a need for a global planning
	2	A1	B	PACS commissioning	5.8.4.6	OFF	10h	OFF	
	3	B1	A	HIFI commissionning	5.8.4.7	OFF	OFF	10h	
	4	B1	B	PARALLEL mode commissioning	5.8.4.8	STBY	5h	5h	
				SPARE					
	5	AB1	AB	SPARE (pre reseved for instrument commissioning)					

3	1	A1	A	Mode transition		5.8.5		1h	1h	1h	all those sequences can be easily splitted and concatenated, then daily planning and sub-sequences order is very flexible
	2	AB1	B	S/C reconfiguration NOM mode robustness		5.8.6 5.9.3		1h	1h	1h	
	3	AB1	A	Launch sequence robustness SPARE		5.9.2		none	none	none	
	4	AB1	AB	SPARE (pre reserved for transition and alarm tests)							
	5	A2	A	CDMS management		5.8.3		STBY	3h STBY	STBY 3h	some daily margin shall offer some spare for mode transition sub-sequence test
	6	B2	B	DTCP worst case scenario		5.8.3		STBY 3h	STBY	3h STBY	
	7	AB2	AB	SPARE (pre reserved for CDMS DTCP tests)							
4	1 2 3	A1	A	Reference Mission Scenario		5.8.9		16h	16h	16h	48h at L2 test 3 simulated OD 4 DTCP but 1 missed 28h without ground contact
	4	B1	B	S/C tilt to horizontal SPIRE spectrometer compl. tests		 5.8.4.5		none STBY	none STBY	none 3h	
	5	A1	A	Launch clean run		5.8.10		none	none	none	needs a long SCOE reconfiguration

The above timeline is a reference only. There is no strict requirement about test order. Some flexibility shall remain. Conditions for flexibility are test contrains as detailed in following chapters.

The above 20 day schedule corresponds to IST1.The test timeslots listed above are given without margin (i.e. corresponds to flaw less runs). Tree spare days and two shifts are allocated nevertheless to cope with some contingency for IST1. For IST2, the larger experience with procedures are expected to allow this schedule shrinking to fit into 16 days only.

The baseline is test days managed in two shifts, with a target of 10h of test per day, not considering initial S/C configuration, and final S/C off procedure and securing. The 10h target is not an absolute limit but intends to keep about 2h of margin daily to manage minor incidents. The endurance sequence (RMS scenario) is a special case, that will need a specific 3 shift organisation.

The "units" / "PM" allocation code is explained in next paragraph.

5.2. NOMINAL AND REDUNDANT HARDWARE TESTING

For validating redundancy health, the baseline is to alternate the configurations so that all the units have been used once during the IST, without repeating any test (except during commissioning). For this purpose, 4 base configurations are considered:

- "all A" configuration (nominal cases)
- "all B" units on "A" computers (CDMU and ACC PM),
- "all A" units on "B" computers (CDMU and ACC PM),

- "all B" configuration.

The alternative configuration testing shall validate that all the A/B units are ready and usable indifferently for satellite operation. The goal shall be to activate and to use each hardware once. The goal is not in turn to test exhaustively all possible degraded configuration cases, nor all configurations for all operations. The "units" and "PM" affectation in previous §5.1.2 table gives the baseline for the daily configuration (AB means that the sequence includes in itself several alternated configurations).

Most IST tests will be run from CDMU and ACC software image 1 (A1 o B1 in timeline table). One sequence (one for PM-A and one for PM-B) shall be nevertheless run with the software image 2 in order to check that it loads correctly (A2 or B2 in timeline table). In addition, the PM A and B EEPROM content shall be dumped as part of IST configuration archiving, and PM A / PM B, image 1 / image 2 softwares shall be checked for being identical as part of post processing. Note that some test sequences exercise the FDIR autonomous reconfiguration actions, then will alternate naturally A and B PM or unit usage. Those sequences (AB1 in timeline table) shall be started from the nominal all A configuration.

There is no constraint on IST to run all the test sequences (launch, mode transition, 48h endurance, etc.) in a dedicated order. The baseline is defined by the test order in §5.1.2 (more or less flight order) but flexibility is open for optimising test schedule with daily constrains.

IST1 schedule shall include a time margin (spare days) for handling procedure troubles. As far as possible, if this margin is not used (or fully used), it shall be used to rerun the test run with B units, in the all A nominal case (i.e. flight nominal). As far as spare will allow it for, all the tests shall be run once within nominal all A configuration. As far as spare days or debug runs will allow it for, more image 2 will be experienced also, as an option.

Note 1: in several cases, as for example the GYRO or RW, the redundancy is not organised in "A" / "cold B" logic. The A/B alternative shall be transposed in those cases, in alternating the nominal configuration with the possible degraded configurations. All the cases to be tested are listed and detailed in appendix 2.

Note 2: PM-B operation shall be associated with proper RM reprogramming to keep alarm behaviour correct (i.e. PAP set exchange).

5.3. NOMINAL CASE FRAME

The test of the Nominal Cases shall be structured around the test of the System Modes described in AD03 (SOFDIR) §2.3.1 and recalled in figure §5.6.2 or appendix 8. The test sequence shall then comprise :

- the test of the Launch Mode,
- the test of the Launcher separation, the transition to Sun Acquisition Mode after separation,
- the early in orbit activities (VMC operations, etc.) up to and including first Orbit Correction Manoeuvre,
- the test of the Nominal Mode: this test shall essentially consist in the execution of the Reference Mission Scenario as discussed and agreed with ESA (see RD02 and AD06),
- the test of the ability to perform as planned for flight, the satellite and instrument commissioning, calibration and performance validation operations,
- the test of all the transitions to and from: Nominal Mode, Earth Acquisition Mode, Sun Acquisition Mode and Survival Mode,
- a test of launcher separation called "clean run", realised in the full real launch configuration (on battery, all skin plugs –except safe plugs– disconnected).

Note 1:

The "ability to perform" wording for the commissioning / performance validation phase means that the tests shall be condensed to fit into a very limited time windows with respect to flight time scale. Ground condition will also limit many result significance. The test shall then be accelerated in time and simplified with respect to real commissioning. It shall nevertheless yet validate the future procedures and go through the different sequences to be run, that corresponds to the test of the in flight performance of each individual unit and subsystem.

Note 2:

The "clean run" test considers a launcher separation simulation in full real launch configuration (on battery, all skin plugs disconnected). This test shall check any spurious (positive) effect of skin plugs. But ACMS SCOE cannot close the loop without the skin plug data. Then, even with a Sun sensor basic (optical) stimulation, the "clean run" will bring rapidly after separation, the ACMS software to face an incoherent situation which would be in flight equivalent to a multiple failure case. The test shall then only check that all the CDMS and ACMS processes engage themselves exactly as in the nominal launch test (no delta) until the lack of coherent attitude feed back stalls the test. The ACMS ASW stall should occur a couple of minutes after separation typically.

5.4. DEGRADED CASE FRAME

The degraded cases include the satellite operation with redundant units, which is in fact merged into the nominal test cases, by using for most tests, alternated configuration of "A "and "B" units.

But the test of the degraded cases shall consider also the validation of the satellite performance against a limited set of dynamic failures. It ~~shall especially include~~ consist of:

- the test of failure cases during launch : 1 CDMU failure + 1 ACC failure,
- the test of the CDMS 1553 SDB controller failure cases.
- the test of the ACMS PM 1553 RT failure cases.

The two later tests set focus on the dynamics of the failure detection and the following recovery. Those tests are detailed in §5.9.

5.5. TEST CHAINING

It is reminded that no test context saving is implemented. As a consequence, each test sequence shall theoretically start with the satellite in OFF state and shall be completed after the satellite has been returned in OFF state.

Many tests can nevertheless be chained. This may save many test time, specifically by not losing the time consuming SSMM initialisation. On this topic specifically, if the SSMM is fully initialised (3 banks) from a previous test and a concatenated one is specified for "≥1 bank" only, the 2 other banks shall not be turned OFF. SSMM 1 bank configuration are specified only the purpose of saving about 30 minutes of satellite initialisation.

Note: the test chaining shall include A/B unit / PM switch-over step when necessary to keep sequence configuration allocation in line with table §5.1.2.

The ACC and CDMU PM recognise nevertheless a special boot condition for power on reset ("cold start") on ground (when separation straps are present). The test chaining shall remember that. For example, if the test is begun from a non OFF state, the SGM content is operational and used (against EPROM default in "cold start" case).

The test start from a satellite OFF condition is mandatory for testing the launch sequence and launch clean run.

5.6. TEST SAFETY, SUCCESS CRITERIA, NOGO AND SEQUENCE RESUMING

5.6.1. TEST SAFETY AND SEQUENCE RESUMING

It shall be possible to abort any test sequence at any moment in a safe way.

After it has been aborted, a test sequence can only be resumed by going through the Satellite Mode diagram in figure below (note: entry point from OFF state shall be launch mode, see also appendix 8).

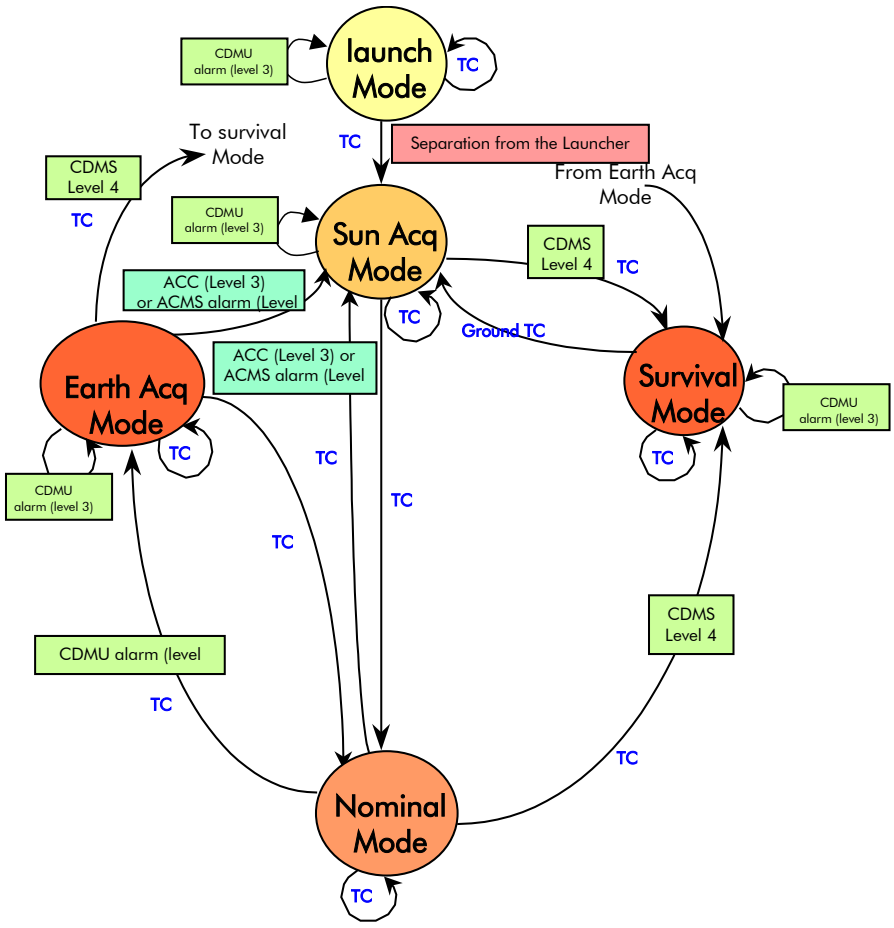
The satellite shall be operated and monitored via the nominal X-band link using the antennas caps connections, with the following exceptions :

- when the RF downlink is not available because of the satellite configuration (TWTAs are OFF), the satellite telemetry shall be acquired in real time via the TM/TC DFE connected to the umbilical connector PU2 J01, TM data and TM clock signals,
- during all IST sequences, when the configuration is such that there is a risk of excessive thermal dissipation at the level of the TWTAs, the satellite telemetry shall be acquired via the TM/TC DFE connected to the umbilical connector PU2 J01, TM data and TM clock signals (and TWTA turned off).

By default, as a minimum, during all tests, the power distribution, data handling, TT&C and ACMS functions shall be verified via the available telemetry :

- essential telemetry only for the tests of the Launch, Sun Acquisition and Survival Modes,
- essential and all periodic HK for the tests of the Nominal Mode, Earth Acquisition Modes and the commissioning phase.

During all tests, the instrument correct operation shall be confirmed after analysis of the available TM by instrument representatives.



Satellite (CDMS) mode diagram

(see appendix 8 for more information on CMDS and ACMS operating modes).

5.6.2. SUCCES CRITERIA

This point is detailed in §6, but as an executive summary:

Each test sequence shall be followed by an immediate quick-look post test evaluation from the telemetry.

The checks against the expected values shall be performed first in real time, using the SCOS limit checking facility. This requires that all parameter limits are filled in HPSDB. In most cases, automatic TM retrieve and analysis tools shall be used (analysis of trends, parameter history along the test).

The telemetry acquired through the TM/TC DFE shall be used for real time test control against anomalies (specifically for long test).

Each test success shall be however determined from TM acquired in a flight representative way, as part of post processing. This means that most tests shall end by a TM downlink session (DTCP) or specific phase to recover the available stored telemetry in SSMM. If this telemetry has been already analysed in real time from the umbilical line for test success (that is in a non flight representative way), the test post processing shall at least compare the SSMM stored telemetry with the real time umbilical acquired one for being identical, before concluding to the test success.

5.6.3. GO / NO GO CONDITIONS

This point is detailed in §6, but as an executive summary:

A NO GO condition shall be associated with any parameter being "out of limit". The applicable limits are the values defined by the HPSBD unless otherwise stated in the present specification or associated document.

The "out of limit" general wording includes indeed all the SCOS/CCS automated checking, that is : TM value monitoring against alarm thresholds, dynamic status value checking (consistency check in SCOS 2000 wording), TC pre-validation and post check tests (CEV in SCOS 2000 wording). The "out of limit" covers also the verification of some parameters by the operator as it is requested by some test scripts to allow test to continue.

A NO GO condition shall be associated with any anomaly event report TM(5,2) or TM (5,4) or TC rejection report TM(1,2) or TM(1,8), unless deliberately wanted by the test procedure (test of failure cases).

Note: the switching of S/C monitoring source between umbilical and RF will cause unavoidable TM packet loss with respect to real time S/C control by CCS (in SSMM all TM will be present). Some packets may be also lost after their down-linking is disabled as part of the sequence (mode transition or service 14 commands). This may cause false alarms by CCS, specifically with respect to TM packet counter discontinuities. This shall of course not be considered as a NO-GO.

5.7. GENERAL TECHNICAL REQUIREMENTS

5.7.1. SSMM OPERATION

The SSMM formatting is defined in appendix 4.

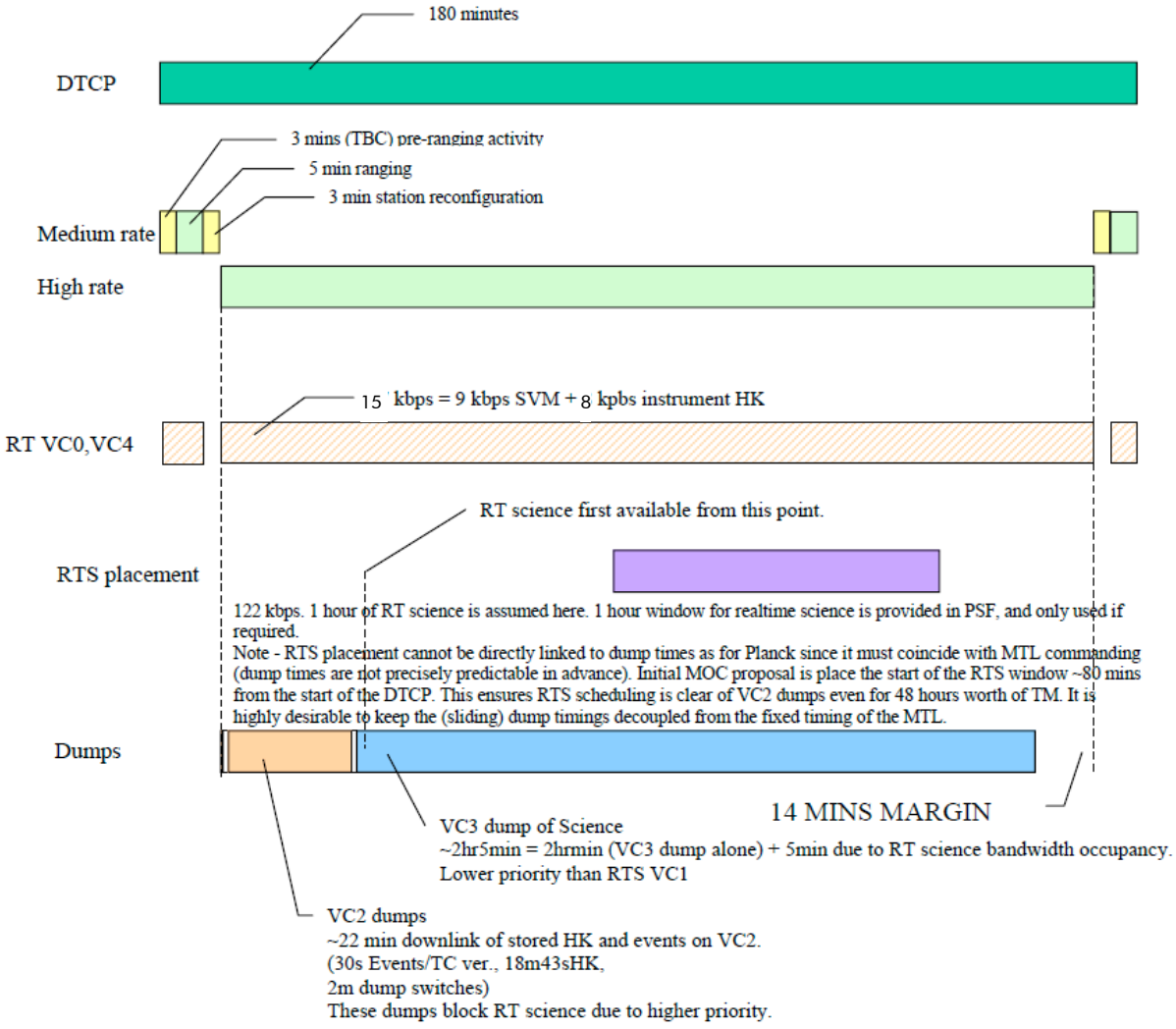
For routine simulated operation at L2, whenever the SSMM is recording or dumping, the MTL shall command a packet store report every 10 minutes.

A packet store report shall be also commanded before and after SSMM download to cross check information and SSMM pointers values.

The SSMM download shall include by default, the CEL download, even if, strictly speaking, the CEL is not in SSMM (but SGM).

5.7.2. DTCP OPERATION

The DTCP simulation operation profile shall follow the recommendations of RD2 and RD6. The generic applicable profile is the following (not considering specific test tasks that may be required for the test):



5.7.3. GSE PROGRAMMING

5.7.3.1. ACMS SCOE programming

There is no requirement about a specific realistic "simulation" date for running the test. Anyone may be used as convenient for the test definition. Specifically, the ACMS SCOE default "simulation" date (January 1st 1970) may be used.

There is no requirement about a realistic environment simulation setting with respect to perturbation. The ACMS SCOE may be used with an idealised setting with "no perturbation" (there is in any case, still some simulation noise that keeps the S/C ACMS activity observable).

~~5.7.3.~~5.7.4. CRYOSTAT RELATED OPERATION

The two CCU (A and B) shall be both connected to the cryostat sensors only for running the launch and RMS test sequences. For those two tests so, all the cryostat monitoring data will be gathered from the S/C TM (and sent back to the CRYOSCOE by CCS).

For all the other sequences, only one of the CCU shall be connected to the cryostat sensors, the other one being connected to dummy line loads to left the sensors to a permanent direct control by the CRYOSCOE. The disconnected CCU CCS monitoring alarms shall be disabled. Note: this configuration is also applicable to any debug session, of the launch and RMS sequence.

The choice of the CCU (A or B) to be disconnected is TBC-30 with ASED (i.e. always the same to limit the number of connection /disconnection, or alternate configuration to get equilibrated correlation test data from both CCU).

When the S/C is deactivated (OFF) for a long time (several hours, night), the CRYOSCOE shall be reconnected to the two set of sensors.

5.7.5. ACMS SAFE STATE IN CASE OF TEST INCIDENT

In case of test incident, if the S/C remains ON (to keep SGM and SSMM data retrievable), the ACMS shall be bring back into "SBM / pre sep" state (mode "stand-by", sub-state "pre-separation"). Note: this implies specifically, that the emergency procedure, closes back the separation straps if they are not in launch configuration, and generates a reset of the ACMS PM.

5.8. NOMINAL CASES

5.8.1. TEST SEQUENCES

The IST comprises the test of :

- the Launch, separation and early orbit activities,
- the platform commissioning and performance verification activities,
- the instrument commissioning and performance verification activities,
- the basic mode transition with instrument synchronisation,
- the spacecraft reconfiguration (level 3 and level 4 alarms),
- the test of the advanced CDMS management service (not necessarily used by the other tests),
- the test of a worst case DTCP operational scenario,
- the Nominal Mode on a long time scale, based on the Reference Mission Scenario (RMS RD02) for instrument operation,
- the launch "clean run".

Those 9 sequences are independent, and may contain even further modularity. Their listed order is the logical and preferred order for running them, but they may be run in any order to suit pragmatic constrains (specifically with the RMS sequence that requires more than 48h of continuous operation).

Note : for simplicity, all the test sequences are written considering a nominal flight configuration base, that is not an unit / PM "alternated" configuration. The alternated configuration shall be constructed when applicable, by transposing the sequence elements.

5.8.2. LAUNCH PHASE, SEPARATION AND POST SEPARATION ACTIVITIES

5.8.2.1. Objective

The objective of this sequence is to test the satellite operation with respect to nominal launch conditions, including the immediate post launch activities and the first OCM.

The sequence ends after the satellite has reached a stable post separation state, i.e. after all the necessary subsystem including possibly the payload initial transitions have been performed.

The sequence shall be ended by one OCM simulation to validate the satellite ability to support the first OCM at launch + 2 days (baseline).

Telescope decontamination is activated as part of this sequence for configuration exhaustiveness, but this functionality in itself will be tested as part of the spacecraft commissioning sequence.

5.8.2.2. Test brief description

The test is a time representative repetition of the satellite launch, from satellite initialisation under the fairing, to stable state after first OCM (separation + 2 days). The satellite waiting time for launch will be nevertheless compacted (satellite in idle state). The satellite operation before and after the first OCM will be also compacted.

The whole sequence represents about 24h of real operation but should be compacted in 8h of test ~~(pre launch and first in flight checks are yet TBC-8 with ESA and AAS-I)~~.

This sequence is in direct reference with RMS [AD02] "§6.1 Launch and Early Orbit Phase (LEOP)".

Note: there is no need for testing this sequence in an "alternated" configuration (the satellite will not be launch with already failed units). In turn, a specific sequence is part of the degraded mode, to simulate dynamic failures along a launch sequence. This is developed at §5.9.2.

5.8.2.3. Initial configuration

The satellite shall initially be in OFF state, in a "on launcher" representative way (which can imply a short satellite activation to pre-configure it properly). The battery specifically shall be connected, fully charged and both BDR shall be OFF.

Then the configuration shall be set as described in [RD04] "Inhibit Function & Launch and Reconfiguration Sequences", §4.2.2.

The global pre-existing state shall be:

Satellite state

CDMS mode	[launch]	note:	PCS BDR OFF	ACMS mode	[stand by]
TM / OBT	relay on A	Rx rate	[125bps]	OBT, PM & SW	relays on A rls on A1N, B1S
PM	relays on A1 B1	TM rate	[5kbps]	CRS / FDIR	[OFF]
SCBP / MTL	[0 / N/A]	Tx chain	[OFF]	GYROs	[OFF]
FDIR / SrvCBH	[N/A / OFF]	Rx 1 Ant.	switches on LGA1	STRs	[OFF]
launch straps	all present	Rx 2 Ant.	switches on LGA2	RWs	[OFF]
PCDU	relay on IF A	CCU	[OFF]	LV enable	[OFF]
Battery	[VEOC max]	SPIRE	[OFF]	RCS enable	[OFF]
Power Source	none	HIFI	[OFF]	SREM	[OFF]
Mass Memory	[OFF]	PACS	[OFF]	VMC	[OFF]

GSE support

Power source	[UMB(*)]	TC source	[UMB]	ENV simulator	stand by

(*): the POWER SCOE does not allow a safe transition from its LPS configuration to the SAS configuration, in the frame of a test sequence (off line hardware reconfiguration, then tests are necessary). For the launch sequence, the POWER SCOE shall be configured as SAS on the hardware point of view, and the UMB/LPS configuration shall be understood as the activation of the 6 sections of the solar array, which are cross-strapped with the umbilical plug. The result is equivalent with respect to the S/C supply, except that the current does not enter the satellite from the right harness branch. The real LPS configuration remains tested during the clean run sequence.

WARNING : this sequence shall be run using the flight battery.

Enclosed in square brackets shall be the pre-existing / default power on configuration values (TM OBT boot, PM boot, etc.).

More specifically:

- the battery shall be fully charged (taper at max configurable voltage: VEOC max),
  (NB. the BATSIM is not to be used for this test, but may be used for preparatory activations),
- the PCDU shall be OFF and pre-configured (relay) for communication on 1553 I/F A,
- the CDMS and ACMS relays shall be configured for TM OBT-A, PM-A, OBSW image 1 usage. The ACMS boot relays shall be configured for nominal boot on PM-A, survival on PM-B.
- the Herschel cryo-cover Safe plug shall be replaced by a test plug that shall provide a dummy load to the command circuit, and detection circuit that will be able to detect any spurious command occurring along the test sequence (as well as safe short circuits on the actuator side).
- the thruster Safe plug shall be replaced by a test plug that shall provide the command circuit with a representative resistance dummy of valves and CatBed heaters,
- the umbilical connectors PU1 J01 and PU2 J01 shall be connected such that the CDMU and ACC separation status signals indicate “not separated” (LPS SCOE relays),
- the CDMS DFE shall be connected such that real time TM can be acquired via the umbilical connectors, even after simulated separation,
- antenna test caps shall be connected to RF SCOE and ready to receive emission on LGA1 and send up-link TC with a ranging signal,
- the CDMS and ACMS 1553 bus monitoring GSE shall be connected to the satellite skin plugs and ready to record all bus traffic,
- the ACMS SCOE shall be connected to ACMS sensor stimulation inputs and ready for close loop simulation,
- the Solar Array Simulator shall be ready to deliver a power limited to 580 Watts (on 30V at S/C IF) by trimming the Imax / Isc setting to simulate a poor Sun light incidence on the solar panel. All the sections shall be supplied with a similar current. Some modulation is allowed, specifically if it simulate the different section illumination due to Herschel Solar Array shape. But it is forbidden to realised the power limitation by supplying a set of sections at nominal power and shutting down the others.
  (note: 6 POWER SCOE section supplies are shared with the umbilical power supply (LPS). Then in practice, they will have to be configured later in the test).
- the umbilical power supply (LPS) shall be ready for supplying the satellite, serial harness loading shall be roughly representative of the high length of cable separating the satellite and the SCOE on the launch table.

- the two CCU (A and B) shall be connected to the cryostat, including the vents valves commands (V501, V503, V103, V106). All cryostat monitoring will be so get through S/C TM for the duration of the test.
- the CVSE shall be connected, in addition to normal pumping interface, to the cryostat exhaust throttles (N511, N512, N513) and shall establish a proper vacuum condition at this level that will prevent any back flow toward the cryostat whenever the related vents valves may open (V501, V503) (i.e. whenever this occurs nominally as part of the test or by fortuitous incident). Proper outlet pressure condition shall be ensured before the other SCOE and S/C power ON and maintained until the S/C is back OFF and LPS SCOE and the TM/TC DFE at least are powered OFF).
- the phase separator valves V103 and V106 shall be closed through CCU-A (a TC(8,4,8,1) shall be used) ~~from the CRYOSCOE~~ to simulate the launch conditions (N.B. the hypothesis is that the cryostat is already in He II condition for following tests, and that those valves are held open by default).

Note : the sequence does not include the first activation of the instruments. Then there is no need the SPIRE launch lock to be secured (there is no impact on simulated activity). The function will be tested (securing with EGSE, then unlocking by TC) in the frame of the SPIRE commissioning sequence.

5.8.2.4. Test steps

5.8.2.4.1. General requirements

In the way this specification is written, each step is defined to be run immediately following the previous one. More precisely, the configuration at entry of a step is defined by the configuration at output of the previous step. The conditions at entry of the first step are defined in the Initial Configuration above (that is OFF with all latching configuration relays properly set).

Activities are listed in a chronological order. They are numbered in some case to highlight the criticality of the elementary action or check order.

WARNING: The test include the activation of the cryostat venting valves V501 and V503. This activation can generate a catastrophic contamination, if a proper vacuum level is not maintained at the exhaust throttles level to prevent any back flow. This test shall be fully conducted with the service vacuum pump system maintaining the He exhaust throttles (N511, N512 and N513) under vacuum (before test session start until full test session end with satellite and LPS SCOE being off). In addition, the launcher dry loop commands shall not be released without a control that one proper vacuum state is present at the exhaust level and "go" given by an ASED representative. An emergency procedure shall be available to close back the cryostat valves in case of trouble with maintaining a proper vacuum level at the exhaust throttles level. Despite not flight representative, but to reduce risks, the cryostat valves will be close back in the frame of the initial check out sequence.

5.8.2.4.2. Satellite power ON

This sequence shall simulate the satellite power ON under the launcher fairing.

For this:

- The satellite shall be turned on by rising up the umbilical power supply,
  - 1> TM emission start shall confirm (one) TRR (RM) start-up (idle packed, boot events and periodic time packet at low 1 (500bps) rate),
  - 2> CMDS-TM(5,1,134) shall confirm PM A start-up (BSW boot),
  - 3> CMDS-TM(5,1,101,1) shall confirm ASW initialisation in launch mode from recognised turn ON situation,
  - 4> CMDS-TM(5,1,101,9) shall confirm SGM initialisation,
  - 5> essential Hk TM Packet emission shall start.
  - 6> the above CMDS-TM(5,1,xxx) boot messages shall confirm healthy CDMS hardware and due software versions,
  - 7> essential Hk TM shall confirm the following configuration:
    - >> TM OBT A active,
    - >> PM A active,
    - >> Launch straps reported all in a "not separated" state,
    - >> PCDU 1553 I/F A active,
    - >> PCDU BDR 1 and 2 ON (they are reset to ON at PCDU power up),
    - >> PCDU FCL all ON,
    - >> PCDU LCL "CDMU PM A and B cold" ON,
    - >> PCDU LCL other : all OFF,
    - >> PCDU HPS all ON, HCS all OFF for 6minutes,
    - >> after a 6 minute delay from boot, the TCS shall become automatically active, then HCS of TCS controlled line may be switched as needed. HCS allocated for the telescope decontamination lines shall remain nevertheless all OFF.
- The PCDU LCL "CDMU PM A and B cold" shall be confirmed ON by a CDMS-TC(8,4,112,5) PCDU Management service command on LCL 31, 32, to properly configure the PCDU μST devices.
- The CDMS TRR shall be configured (this includes specifically the survival registers) and verified (for defaults from EEPROM setting).
- The CDMU Central Time Reference shall be synchronised with the ground time (UTC or local time):
  - 1> sample CTR using a Standard Spacecraft Time Source Packet (see procedure in PSS-04-106),
  - 2> set CDMS CTR to TAI using PS-ICD CDMS-TC(9,10),
  - 3> check Hk TM packets time tags and CMDS-TM(9,8) sample CTR using a standard time source.

~~The ACC Central Time Reference shall be synchronised with the CDMU one with a CDMS-TC(9,3) (to ACMS APID). The correct synchronisation will be verified both from the correct time stamping of ACMS Hk and an explicit CDMS-TC(9,6) time synchronisation verification procedure.~~

- The TM rate shall be set to ~~medium~~ LOW2 (5kbps) and to ease the configuration:

  1> a TTC management service diagnostic TM packet shall be requested with a CDMS-TC(8,5,115),

  2> the TTC management diagnostic CDMS-TM(8,6,115) shall confirm the service has been initialised, the packet information shall confirm essential Hk data as part of post processing,

  3> a configure TM encoder command CDMS-TC(8,1,115,20) shall be send to set TM rate to medium,

  4> actual TM rate shall switch to ~~medium~~ LOW2 rate (5kbps).

  5> a CDMS-TC(14,5) shall be sent to enable the downlink of all packets.

  Note 0: the CDMS-TC(8,1,115,20) command may be sent as soon as the PM is turned ON (idle packet shall confirm that the TTR board is operational). The BSW and ASW have not booted yet in such condition, but the command remains in the MAP buffer where it is found by the booting BSW. This result in the TTC in ~~medium~~ LOW2 rate rather than the default (slow) LOW1. This is the AIT usual procedure.

  Note 1: the receiving rate on the umbilical is independent from the TTC Rx setting (data and clock are provided on umbilical). The Rx rate is left on the XPND power ON default: 125bps.

  Note 2: the XPND RX 1553 I/F is yet OFF then any TTC service commands to change receiving rate which go through transponder 1553 IF will fail, and shall not be attempted.

- The two CCU shall be turned ON and initialised so that cryostat Hk can be checked.

  1> a PCDU unit ON command CDMS-TC(8,4,112,5) shall be send to CCU-A and CCU-B LCL (unit 37 and 38),

  2> configuration TC shall be sent to configure each CCU for an 8s sampling period setting,

  3> the CCU essential Hk packets shall begin to provide valid data,

  4> cryostat monitoring data in Hk packet shall be nominal.

- The CRS 1 and 2 shall be turned ON:

  1> a PCDU unit ON command CDMS-TC(8,4,112,5) shall be send to CRS 1,2,3 LCL (unit 15 and 24),

  2> essential Hk telemetry shall confirm LCL status change and nominal current consumption.

- The GYRO 1 and 2 LCL (only) shall be turned ON (unit 13 and 14).

- The ACC shall be started on PM-A (nominal boot), and configured (TRR registers, OBDB, etc.).
  Among the register settings, "test data word bit 8" flag shall be set to allow close loop operation (synchronising messages on the ACC 1553 bus). Note: this is not a full flight setting. The full flight setting is tested in frame of the "launch clean run".

  > as part of its boot sequence, the ACC shall turn ON the GYRO for operation on its I/F 1.

- ACMS essential Hk TM and ACMS "Low rate SAM" telemetry shall be enabled.

- The ACC Central Time Reference shall be synchronised with the CDMU one with a CDMS-TC(9,3) (to ACMS APID). The correct synchronisation will be verified both from the correct time stamping of ACMS Hk and an explicit CDMS-TC(9,6) time synchronisation verification procedure.

Success criteria :

The essential TM acquired during Launch shall not indicate any No-Go.

No event packet types (5,2) (5,4) or (1,2) (1,8) shall be generated.

The final state shall be:

Satellite state

CDMS mode	launch	note:	BDR enabled	ACMS mode	stand by
TM / OBT	A	Rx rate	125bps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	5kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	0 /N/A	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / OFF	Rx 1 Ant.	LGA1	STRs	OFF
launch straps	all present	Rx 2 Ant.	LGA2	RWs	OFF
PCDU	IF A ON	CCU	A, B ON 8s-Hk	LV enable	OFF
Battery	VEOC max	SPIRE	OFF	RCS enable	OFF
Power Source	UMB	HIFI	OFF	SREM	OFF
Mass Memory	OFF	PACS	OFF	VMC	OFF

GSE support

Power source	UMB	TC source	UMB 4kbps	ENV simulator	stand by

5.8.2.4.3. Short unit health check ~~(TBC-8 with AAS-I)~~

DELETED.

~~This sequence shall simulate the last short check out to be done before allowing for launch.~~

5.8.2.4.4. Configuration for launch

This sequence shall simulate the final configuration for launch.

For this specifically:

- The 2 SSMM boards shall be initialised with 3 active banks each:
  - > the SSMM buffer area shall be initialised. Specifically the OBCP buffers shall be created and loaded with flight OBCP. The MTL buffer shall also be created. The OBCP and MTL software services shall be turned back OFF after their initialisation.
  - > the packet stores shall be initialised as described in appendix 4.

> Note: the SSMM initialisation needs about 15min. per bank, which is driving the sub-sequence duration. It will be paralleled as possible with the other operations, including the unit health check (previous step).

- The storage of ALL on board generated packets shall be enabled, and all the packet stores shall be initialised for operation as recommended by RD06.
- The downlink of essential and non essential HK TM packets shall be enabled.

~~The CRS 1 and 2 shall be turned ON (if this is not done in the frame of the short unit health check):~~

~~1> a PCDU unit ON command CDMS-TC(8,4,112,5) shall be send to CRS 1 & 2 LCL (unit 15 & 24),~~

~~2> essential Hk telemetry shall confirm LCL status change and nominal current consumption.~~

~~3> CRS provided data (Earth rate) shall be checked.~~

- ~~The~~ A GYRO short health check shall be run ~~A and B shall be turned ON:~~

~~1> a PCDU unit ON command CDMS-TC(8,4,112,5) shall be send to GYROs A & B LCL (unit 13 and 14),~~

~~2> essential Hk telemetry shall confirm LCL status change but no current consumption (units still OFF).~~

~~3> ACMS shall be commanded to turn ON the GYRO and a short health check shall be run.~~

Note: the usage of real GYRO unit forces an initial Earth rate data collection, therefore the data collection first and the Earth rate compensation after (performed by properly setting dedicated Simulation SW parameters) need to be performed at least once (if no anomalous drift changes has occurred). Note that, in principle, the same values collected during the Gyro health check within ACMS SIT sequence could be used for all closed loop tests. The earth rate compensation removes any Earth rate contribution.

To this aim, any possible difference in GYRO or CRS behaviour between 0-g and non 0-g environment, and at different temperature that are considered relevant for the test purpose, shall be taken into account when setting the fictitious drift/noise/random walk/scale factor etc. of those sensors.

- ~~4> The nominal and TBC-9 redundant "survival CBH" LCL shall be turn ON by a PCDU management service CDMS-TC(8,4,112,3) on LCL 17 and TBC-9 LCL 18.~~
- The TTC subsystem shall be set ready for launch, but WARNING, with several deliberate errors:
  - > The Tx A shall be turned ON,
  - > the Rx rate shall be set on 125bps: 4kbps should be set, but this choice allows to observe the automatic configuration "confirmation" performed by the ASW at separation,
  - > the TWTA A LCL shall be turned ON from the PCS service (LCL only),
  - > the downlink TM rate shall be set to MBR 150kbps: 5kbps should be set, but this choice allows to observe the automatic configuration "confirmation" performed by the ASW at separation,
  - > the RFDN configuration shall be set in all "A" position (XPND RX1 on LGA1, XPND RX2 on LGA2, position). The all "B" should be set, but this choice allows to observe the automatic configuration "confirmation" performed by the ASW at separation. The all A position gives the same result but is not the baseline reference (ref. SVM user manual volume 3, TTC subsystem). Note: this action shall include the proper management of OBSW tables to prevent an FDIR action (RFDN state is under monitoring).

- The nominal "survival CBH" LCL shall be turn ON by a PCDU management service CDMS-TC(8,4,112,3) on LCL 17.

Note: the FDIR mode is linked to Satellite mode and is specified in the SOFDIR (requirement GEF-156-C). There is no specific setting to load for launch. Considering possible non definitive software version, and biased ground conditions, it may be necessary to load some changes in the monitoring table (the failure detection is active in any mode and issue event messages) and/or the event action table (failure associated isolation and recovery actions).

Success criteria :

The essential TM acquired during Launch shall not indicate any No-Go.

No event packet types (5,2) (5,4) (1,2) (1,8) shall be generated.

The spacecraft units status shall be as in RD01, §3 as recalled below, except for the deliberately modified TTC cases (note: the TWTA case needs an update in RD01 to reflect the latest baseline).

The final state shall be:

Satellite state

CDMS mode	launch	note:	RFDN all A (1)	ACMS mode	stand by
TM/OBT	A	Rx rate	125bps (1)	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps (1)	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	0 / OFF	Tx chain	T.1(RF OFF) A.OFF(LCL ON)	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF
launch straps	all present	Rx 2 Ant.	LGA2	RWs	OFF
PCDU	IF A ON	CCU	A, B ON 8s-Hk	LV enable	OFF
Battery	VEOC max	SPIRE	OFF	RCS enable	OFF
Power Source	UMB	HIFI	OFF	SREM	OFF
Mass Memory	3 banks	PACS	OFF	VMC	OFF

GSE support

Power source	UMB	TC source	UMB 4kbps	ENV simulator	stand by

Note (1): deliberate errors which intend to check separation CDMS ASW re-enforcement commands.

5.8.2.4.5. Launch

The sequence shall simulate the launch phase from power supply switching to battery power (Lo-7min.) to separation (Lo+27min.), just after a first final count down abort (7min. of battery discharge not restored).

For this::

- The launch phase simulation shall be started by switching the power source from umbilical to battery:

  1> umbilical power supply shall be turn down,

  2> essential Hk TM shall confirm power supply switching to BDR1 and 2 (current and MEA).

- the worst case duration of the launch phase for battery autonomy shall be simulated.

  > battery state of charge and BDR current shall be specifically monitored for excessive value.

- the ARIANE 5 dry loop commands shall be ARMED only if the ASED cryostat specialists do ~~not~~ confirm proper vacuum condition at the He venting outlets (as LPS SCOE related commands are flagged "critical", the CCS will not issue them without an operator confirmation. Note that the "critical" tag is on the SCOE arming command only so that actual command may pass with a correct timing). The flight baseline is:

  > command #1 to #4 shall be confirmed by Hk TM spying : #1 "ARM V501 (N) & ARM V503 (R)" armed at Lo+3'46", #2 "OPEN V 501 (N) & OPEN V503 (R)" actuated at 3'56", #3 ARM V101 (N) and V 106 (R)" armed at Lo+20'30" and #4 "OPEN V101 (N) & V106 (R)" actuated at 20'40" (timing TBC after STM2 test results).

  > attentive monitoring of the outlet pressure condition shall be maintained all the time the vent valves are open, and an emergency procedure to close the valves in case of trouble shall be ready.

- The Solar Array Simulator shall be turned ON 17mn after Launch phase initialisation (recall: it shall be programmed to deliver 580 Watts only by properly setting the section current).

  > the BDR shall stop to power (permanently) the satellite (580W shall be enough until separation to supply the satellite, but not enough to allow for battery recharge or cope with the extra power consumption peaks at separation),

  > the battery State of Charge (SOC) shall not be lower than 70%.

  > BCR1 2 and 3 may recharge (slowly) the battery despite the reduced current from SAS setting.

Note : the SAS turn ON after 17mn leads to a total 31mn battery autonomy test. But he limited power may lead to further discharge. This shall remain well within the sizing of 50 minutes of autonomy (sized for Planck).

During launch phase, the essential telemetry shall be acquired in real time via the umbilical connector which shall remain installed.

The ACMS SCOE S initialisation shall be performed for closed loop operation.

Note: an emergency V501 and V503 closure command sequence shall remain available for a safeguard action at any time, at cryostat responsible request (NB. this sequence shall typically include an emergency UMB up-link reactivation).

Success criteria

The essential TM acquired during Launch shall not indicate any No-Go.

No event packet types (5,2) (5,4) (1,2) (1,8) shall be generated.

The spacecraft units status shall be as in RD01, §3 as recalled below (except for TTC(TWTA) settings, deliberately biased).

Cryostat vent valves shall have open in due time and shall be still open.

The final state shall be:

Satellite state

CDMS mode	LAUNCH	note:	RFDN all A (1)	ACMS mode	SBM (presep)
TM / OBT	A	Rx rate	125bps (1)	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps (1)	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	0 / OFF	Tx chain	T.1(RF OFF) A.OFF(LCL ON)	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF
launch straps	all present	RX 2 Ant.	LGA2	RWs	OFF
PCDU	IF A ON	CCU	A, B ON 8s-Hk	LV enable	OFF
Battery	>70 %SOC	SPIRE	OFF	RCS enable	OFF
Power Source	SA	HIFI	OFF	SREM	OFF
Mass Memory	3 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 580W	TC source	none	ENV simulator	stand-by

Note (1): deliberate errors which intend to check separation CDMS ASW re-enforcement commands.

5.8.2.4.6. Separation

This sequence shall simulate the launcher separation.

For this:

- The ACMS SCOE shall start with closed loop attitude simulation (simulated S/C dynamics). The following separation condition shall be simulated:

  > initial depointing of +Zs axis = 5° with respect to the Sun, and this depointing shall be oriented TBC-10 toward the +Ys as a worst case situation.

  > longitudinal angular rate = 0.4°/s, and its sign shall be oriented TBC-10 so that it contribute to increase further the depointing from the Sun toward the +Ys axis.

  > transverse angular rate = 0.6°/s.

> details of ACMS activities related to separation and initial Sun acquisition are stated in RD03 §6.1.3.1.6.

- The separation event T_{sep} shall be stimulated by opening separation switches 3, 4, 7 and 8 of the Launch Power Supply (note: strap opening and ACMS SCOE dynamic start shall be synchronous). The ARIANE 5 dry loop simulation shall be also stopped.
- The Solar Array Simulator shall be programmed to (be able to) deliver 1700Watts 5 minutes after separation switches opening by trimming the section currents (the AOCS shall stabilise the satellite quicker, but this allows to test that all the separation sequence is robust to low power availability).
  > the battery State of Charge (SOC) shall not be lower than 70%.
  > in the time span between separation and SAS power increase, it is nominal that battery power is used to complement the spacecraft power supply.

Note: an emergency V501 and V503 closure command sequence shall remain available for a safeguard action at any time, at cryostat responsible request (NB. this sequence shall possibly include an emergency UMB up-link reactivation in the first part of the sequence).

Success criteria

- TTC :
  > the real time TM shall be available at T_{sep} + 180s on LGA –Z via the RF link using the RF SCOE.
  > the TM rate shall be 5kbps (per ASW action).
  > the TC Rx rate shall be 4kbps (per ASW action).
  > the RFDN shall remain in the same antenna configuration, but the configuration confirmation shall return the RFDN individual position to "all B" (nominal way to get the wanted configuration).

- CDMS :
  > SCBP shall be switched to SAM profile 5.
  > the Visual Monitoring Camera shall be ON (recording, then storing data, waiting for retrieval).
  > the THR and LV shall be "enabled" (i.e. LCL 45, 46, 47 and 48 shall be ON).
  > all essential packets shall be available in real time TM via VC0.
  > some non essential HK packets shall be available in real time TM via VC4 as a consequence of available bandwidth and proper VC priority management (packet content is not important).
  > no event packet types (5,2) and (5,4) shall be generated.
  > no TC rejection packet type (1,2) or (1,8) shall be generated.

- PCS :
  > the spacecraft shall run on SAS,
  > the battery State Of Charge shall not go below 70%, the value when turning ON the SAS at 1700W shall be recorded,
  > the thruster minimum CatBed heating nominal branch (LCL 17) shall be ON (the redundant one (LCL 18) shall be OFF).

- ACMS :
  - > the Rate Anomaly Detection criterion shall be enabled just after entry into SSA mode (delay time is 20s+5s ~~TBC 11~~),
  - > a stable sun pointing shall be achieved within 5 minutes after separation,
  - > the AAD Anomaly Detection criterion shall be enabled at expiration of the delay time (300s),

    ~~>> to test this, the AAD shall be stimulated as if the Sun would be out of range during 4 minutes after separation (typically, considering AAD operation, the stimulator may be off). This stimulation shall not cause any ARAD alarm generation.~~
  - > the attitude shall be monitored for 10 minutes. It shall be Verified that the ACMS limits cycles within the following boundaries:

    >> satellite maintains the sun direction at less than 5° half cone from Z axis,

    >> the transient outside the attitude defined above, for more than 5 minutes, is less than 40° from YZ plane, and its projection onto YZ plane is less than 23° from Z,

    >> S/L rate is kept below 4 degrees/min .

  > "low rate SAM" telemetry shall still be available.
- Cryostat :
  - > the separation shall not change the cryostat state, specifically, the valves position shall not be affected by the ARIANE 5 dry loop command disappearance, and the CCU shall remain operated with a 8s sampling period.

The final S/C status shall be:

Satellite state

CDMS mode	SAM	note:	**RFDN all B**	ACMS mode	**SAM (CS)**
TM / OBT	A	Rx rate	**4kbps**	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	**5kbps**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	**T.1 A.A LGA1**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	**OFF, LCL ON**
launch straps	none	Rx 2 Ant.	LGA2	RWs	**OFF, LCL ON**
PCDU	IF A ON	CCU	A, B ON 8s-Hk	LV enable	**ON, A open**
Battery	>70 %SOC CHG	SPIRE	OFF	RCS enable	**ON, A CBH ON**
Power Source	SA	HIFI	OFF	SREM	OFF
Mass Memory	3 banks	PACS	OFF	VMC	**ON images strd**

GSE support

Power source	SAS 1700W	TC source	none	ENV simulator	**closed loop**

5.8.2.4.7. Post separation

This sequence shall simulate the spacecraft control acquisition by the ground station. This shall occur nominally at Tsep+18min. (on LGA1). The delay is a few contracted at Tsep+10min. for the test.

All the TC shall be sent through LGA1 (-Z) through the RF SCOE (umbilical shall not be used any more unless for an emergency interruption of the test).

- Ground TC activities shall begin at T_{sep}+10min. with:
  1. CDMS-TC(14,5) shall be sent to disable the downlink of non essential real time packets.
  2. the XPND shall be commanded in Ranging Mode.
  3. an ACMS command TC_SET_RCS_CONTROL_MODE = fine shall be sent.

Note: an emergency V501 and V503 closure command sequence shall remain available for a safeguard action at any time, at cryostat responsible request.

Success criteria

- SAM System Mode (see AD01 Figure 2.3.3) shall be reached.
- TTC chain A shall be ON and TM shall be acquired via RF SCOE from TTC Tx A and TWTA A.
- S/C attitude shall be monitored for 10 minutes after the "fine" command and it shall be checked that the attitude remains in the same boundaries as specified in previous test step. But the S/L rate is reduced and kept below 2 degrees/min.
- All essential TM packets shall be available in real time TM.
- No event packet types (5,2) and (5,4) nor TC rejection (1,2) or (1,8) shall be generated.
- Ranging shall be nominal that is: a correct ranging echo (power, modulation index, etc.) shall be received. The verification shall ensure only that the transponder is properly programmed for ranging operation as a result of TTC initialisation (NB. it is not asked to check the S/C performance nor calibrations with respect to the ranging).
- The spacecraft units status shall be as in RD01, §4.1 and is recalled below.
- The acquired TM packets shall not indicate any No-Go.

The final satellite state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM-**(FINE)**
TM OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	5kbps + **RNG**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF, LCLs ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCLs ON
PCDU	IF A ON	CCU	A, B ON 8s-Hk	LV enable	ON, A open
Battery	>70 %SOC **CHG**	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	OFF
Mass Memory	3 banks	PACS	OFF	VMC	ON images strd

GSE support

Power source	SAS 1700W	TC source	LGA1	ENV simulator	closed loop

5.8.2.4.8. Initial check out in SAM mode

This sequence shall simulate the spacecraft initial check out in SAM mode which follows the initial spacecraft acquisition.

Note: this sequence shall be completed in flight within about 1 day from separation (TBC-12 old RMS baseline [AD02]).

- as part of TTC check out mimic:

  1> a TTC service diagnostic TM packet shall be requested with a CDMS-TC(8,5,115) (for test post analysis),

  2> the TM rate shall be commanded to medium 150kbps to ease TM downlink (150kbps communication with LGA was not a design requirement, but analysis has shown that it can be supported, and is now considered for early launch operation). In any case, this is helpful to reduce the IST test sequence duration.

- as part of Thermal Control check out, some heater operation threshold shall be adjusted. Within the purpose of IST, this adjustment will be used to trim the TCS power consumption (biased in clean room with respect o flight condition) to a flight representative level.

  1> a TCS command CDMS-TC(8,5,114) shall be sent to get and verify all loops parameters.

  2> a TCS commands CDMS-TC(8,4,114,18) shall be sent to shift relevant regulation thresholds to get the wanted power consumption (considering that clean room operation will be stable, the necessary values shall be known before test start).

  3> a TCS command CDMS-TC(8,5,114) shall be sent to read back and verify all loops parameters.

- As part of ACMS check out, the result will be also biased by ground condition, specifically the STR one.
  - > The STR-1 shall be turned ON and ~~a TBW-9 health~~ checked ~~run~~ to confirm that the STR-1 performs nominally and can support the following OCM (STR-1 shall reach the "tracking" mode).
  - > The STR shall be left ON after this test.
- The telescope heating (first step of decontamination) shall be activated.

  1> the decontamination heating service shall be started by a CDMS-TC(8,1,113).

  2> decontamination heating parameters shall be adjusted if necessary with a CDMS-TC(8,4,113,1) command.

  3> a status report shall be requested with a CDMS-TC(8,5,113) and reported TM(8,6,113) status checked.
- The VMC data downlink operation shall be run (downlink is in parallel of other operation):

  1> VMC HK packets generation, storage and down-linking shall be enabled by CDMS-TC(14,1) and CDMS-TC(14,5).

  2> Acquisition of VMC images (TM(8,8)) shall be started by CDMS-TC(8,4,5,1)

  3> The VMC shall be turned off after download of its data is completed and associated packet correctly received through downlink (data are part of VC0). For that, a PCDU unit OFF command CDMS-TC(8,4,112,5) shall be send to the VMC (unit 20).
- The SREM operation shall be initialised.

  1> a PCDU unit ON command CDMS-TC(8,4,112,5) shall be send to SREM (unit 19),

  2> the SREM operation shall be started by a CDMS-TC(8,4,4,6) to set SREM registers to proper values.

  3> the SREM data acquisition shall be started by a CDMS-TC(8,4,4,1).
- The CCU A and B shall be set to the nominal/default 512s sampling period.
- A command shall be send from the CRYOSCOE to close the cryostat vent valves V501, V503 (normal CRYOSCOE pumping through V502 remains). Note: V103 and V106 are not concerned and shall remain open.

Note: an emergency V501 and V503 closure command sequence shall remain available for a safeguard action at any time, at cryostat responsible request, until they are nominally closed as part of this sequence.

Success criteria

No event packet types (5,2) and (5,4) nor specifically TC rejection (1,2) or (1,8) shall be generated.

Ranging shall continue to be nominal all along the test sequence steps.

The spacecraft units status shall be as in RD01, §4.1 and summarised in table below (outside a specificity for STR, SREM and TM rate).

The acquired TM packets shall not indicate any No-Go. On this point however, many data will be biased with respect to the flight range (TCS specifically) and this shall not be mistaken as No-Go.

The battery shall be recharged at the end of the 1h50' of simulated correct Sun pointing. The end of charge reference is set on the total taper charging current that shall no exceed 1A (C/36) (the 2 BCR shall report a current limiting status). Note: this criteria fulfilment may extend on next sequence to save test time.

The final state shall be:

Satellite state

CDMS mode	SAM	note:	DEC ON (N2)	ACMS mode	SAM-(FINE)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps+RNG	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs (N1)	A ON (LCL B ON)
launch straps	none	RX 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU (N2)	A,B ON Hk	LV enable	ON, A open
Battery	>70 % SOC CHG	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	3 banks	PACS	OFF	VMC	OFF

N1: those units shall be left ON after their check out to the benefit of their thermal equilibrium.

N2: it is TBC-14 with ASED that the telescope shall be kept warm to prevent contamination as early in the launch sequence.

GSE support

Power source	SAS 1700W	TC source	LGA1	ENV simulator	closed loop

5.8.2.4.9. CDMS transition to NOM mode

This sequence shall simulate the satellite transition in NOM mode as part of spacecraft checking and the preparation for the first OCM (To+2 days for flight).

Note: in flight, the OCM preparation sequence shall begin at separation + 2 days. The preparation task scheduling is unknown, but the waiting delays shall be condensed anyhow. Then for IST all the activities will be concatenated.

As for real flight operation, the time slot shall be used first to set the satellite in NOM mode and a SSMM download. The transition shall consider the following activities:

1• Spacecraft CDMS shall be commanded from Sun Acquisition Mode to Nominal Mode.

> Herschel subsystems shall be set into NOM configuration as defined in AD03, figure 2.3.3.

2• The TTC RF shall be switched back for using LGA1 (and LGA2). This shall include a TWTA switch OFF and back ON. This shall allow in flight perfect observability and commandability for next steps.

3• The ACMS "low rate" telemetry shall be turned to "low rate OCM". Then the ACMS shall be commanded into OCM mode with a target corresponding to the SUN with a minor offset to allow an attitude adjustment manoeuvre to be observable ~~(no or minor slew at transition)~~.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria (same as before).

4• The ACMS shall be then commanded to target the Earth or an ARAD compatible direction with the ground station being in the MGA field of view.

> The SAS power shall be reduced to 1460W to simulate a worst case SA orientation.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria (same as before).

5• The TTC RF shall be switch back the for using MGA (and LGA1). This shall include a TWTA switch OFF and back ON.

The TTC shall be set for transmission at the high rate (1.5Mbps), to speed up the next test step.

6• CDMS-TC(15,9) then CDMS-TC(15,7) shall be sent to enable the Dump of the packet store ID 2h and 7Eh to VC2. The command shall use the default setting so that the packet store is automatically fully emptied from "last download pointer" to TC receive time (see RD06).

After SSMM downlink is completed, the VC2 downlink shall be disabled (dump of all launch data shall be nominally completed in the more than 3h of operation, and for IST the 1.5Mbps setting shall shorten this phase).

7• After download of SSMM is completed, the TTC shall be commanded back to the flight nominal medium rate (150kbps) with ranging.

Success criteria

No event packet types (5,2) and (5,4) nor specifically TC rejection (1,2) or (1,8) shall be generated.

The spacecraft units status shall be as in RD01, §4.1 and summarised in table below.

The acquired TM packets shall not indicate any No-Go.

If not already obtained during previous sequence, the battery shall be recharged at the end of the 1h50' of simulated correct Sun pointing. The end of charge reference is set on the total taper charging current that shall no exceed 1A (C/36) (the 2 BCR shall report a current limiting status). The battery shall be fully recharged at separation + 4h (taper charging current that shall no exceed 100mA).

The final state shall be:

Satellite state

CDMS mode	NOM	note:	DEC ON	ACMS mode	OCM (Earth CS)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps+RNG	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / MTL	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A ON (LCL B ON)
launch straps	none	RX 2 Ant.	LGA1	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A, B ON Hk	LV enable	ON, A open
Battery	100 % SOC	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	3 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1460W	TC source	MGA	ENV simulator	closed loop

5.8.2.4.10. Orbit Control Manoeuvre

This sequence shall simulate the preparation and realisation of the first OCM at separation +2 days.

In flight, the OCM preparation sequence itself shall begin at separation + 2 days. For IST, the operation is chained immediately.

Activities:

1• All the data for the OCM manoeuvre shall be up-loaded (ephemeris updates, etc).

2• Spacecraft shall be commanded to return on 5kbps telemetry. The TTC RF shall be commanded back the for using LGA1 (and LGA2). This shall include a TWTA switch OFF and back ON. This shall allow in flight perfect observability and commandability for next steps.

3• ACMS command TC_SET_RCS_CONTROL_MODE = fine shall be sent.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria (same as before).

4• The ACMS shall be commanded to point for a target corresponding to the delta V orientation, that will be chosen to request a large slew for test purpose.

> The SAS power shall be reduced to 1460W to simulate a worst case SA orientation.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria (same as before).

5• The ACMS shall be commanded (TC_H-DV) for performing the Delta V manoeuvre.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria after the end of thrust (same as before).

6• The ACMS shall be commanded to point for a target corresponding to the ground station.

> Attitude shall be verified for 5 minutes with respect to the attitude stability criteria (same as before).

7• The TTC RF shall be switch back the for using MGA and medium rate with ranging. This shall include a TWTA switch OFF and back ON.

8• Details of ACMS activities related to OCM are stated in RD03 §6.1.3.10.6.

After the manoeuvre completion, ACMS shall be left in OCM pointing_coarse state.

Success criteria

The system and subsystems configuration shall be in accordance with the Nominal Mode setting (AD03, figure 2.3.3).

The acquired TM packets shall not indicate any No-Go.

All essential and non essential TM packets shall be available in real time TM.

No event packet types (5,2) and (5,4) nor TC rejection (1,2) or (1,8) shall be generated.

The spacecraft units status shall be as in RD01, §4.3 and summary table below.

The pointing characteristics and performances shall be as stated in RD03 §6.1.3.10.6.

Thruster actuation timing as recorded by ACMS SCOE shall be coherent with commanded slew and ΔV.

The final state shall be:

Satellite state

CDMS mode	NOM	note:	DEC ON	ACMS mode	**OCM (PT CS)**
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B 1S]
PM & SW	A1 [B1]	TM rate	150kbps RNG	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A ON (LCL B ON)
launch straps	none	RX 2 Ant.	LGA1	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A, B ON Hk	LV enable	ON, A open
Battery	>70 %SOC CHG	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	3 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1460W	TC source	MGA	ENV simulator	closed loop

~~1.1.1.1.11.~~5.8.2.4.11. *End of the sequence*

This sequence shall retrieve all SSMM recorded data for post test analysis and experience the packet store clearing in a flight representative way.

The satellite shall be left in the OCM pointing mode and the SAS power shall be reduced to 1460W to simulate a worst case SA orientation. The TTC shall be set on high rate as in sequence 5.8.2.4.9

- VC2 allowed for downlink so that all recorded data not yet downloaded is recovered (all data will be downloaded as packet stores will be not cleared after first post separation reading).

  Note: there shall be no packet recorded on a packet store other than those associated with VC2. The download shall include the download of the SSMM default store.

  The CEL shall also be downloaded (Critical Event Log in SGM).

- After quick downloaded data checking, the packet store shall be cleared of recorded data typically up to a couple of minutes before command point, as the TM recording shall continue during this operation.

Success criteria

All stored TM shall be retrieved, and shall be identical to the TM data intercepted thanks to umbilical link monitoring.

The real time TM packets shall not meanwhile indicate any No-Go.

All essential and non essential TM packets shall continue to be available meanwhile download in real time TM.

No event packet types (5,2) and (5,4) nor TC rejection (1,2) or (1,8) shall be generated.

5.8.2.5. End of the test

After sequence completion, the satellite shall be either return to OFF state with standard procedure, or the ON state (with SSMM fully formatted) can be used to chain an other test sequence which do not require to start explicitly from the OFF state.

5.8.2.6. Special notes

The launch mode shall be run in AFS mode. It shall be checked that FDIR AFS setting remains correct all along the test sequence. This may be part of post processing.

5.8.3. SATELLITE COMMISSIONING

5.8.3.1. Objective

The objective of this sequence is to run the heath check procedure and –as applicable– the performance check procedure of each of the satellite platform subsystems. The sequence shall use –as far as possible–, the actual flight procedures of the satellite commissioning.

As part of this test, the correct functioning, in nominal operating mode, of the subsystems and units shall be verified, one by one. Where applicable, the nominal and redundant branches shall be checked: this is a "nominal operation" for the commissioning.

System calibrations shall be performed or mimicked (as possible on ground) as part of the commissioning test.

This sequence is in direct reference with RMS [AD02] "§6.2 Commissioning and Performance Verification Phases". The RMS addresses rather nevertheless the instrument commissioning which is rather the subject of next sequence.

5.8.3.2. Test brief description

The test is structured as a succession of smaller independent tests at unit and sub-system level.

Each test is rather similar to an UFT or a SIT test except that it is run while simulating in parallel the flight routine :

- the ACMS running in close loop,
- command and data transferred through simulated DTCP sessions,
- and parallel running telescope decontamination procedure (as applicable).

This simulation includes that long tests could rely on MTL command. Nevertheless, the flight baseline for the commissioning phase is an up to 10h visibility daily, then this shall allow most tests to be run without the MTL.

The sequences will be run once in PM-A and once in PM-B configuration TBC-31 (this is taken as a worst case: the actual need is that all the units are tested, when the sequence details will be defined, many sub-test iteration on PM-B will be likely not necessary to fulfil this objective). Note : the switch over of vital component as the PM is not part of nominal flight commissioning, but is added to complete the purpose of verifying the correct functioning, in nominal operating mode, of the all subsystems and units.

5.8.3.3. Test start configuration

The initial state shall simulate a satellite in a safe configuration for the cruise to L2, that is : in NOM Mode, Earth pointed.

This initial state shall be:

Satellite state

CDMS mode	NOM	note:	DEC ON	ACMS mode	SCM (PT EARTH)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	1 / OFF	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS/ N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON Hk	LV enable	ON, A open
Battery	CHARGED (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	UMB	ENV simulator	closed loop

This state may be establish either from OFF state by general procedure, or from a previous test sequence through appropriate transitions.

- The satellite pointing target shall be turned to Earth (or toward only if necessary to prevent an ARAD alarm).
- The mass memory shall be formatted so that packet storage is active. 1 bank formatting is acceptable for this test. The baseline for commissioning in flight is real time TM observation, but all TM shall be recorded in SSMM to keep a clear copy available in case of incident while running the operations.

  Note: all SSMM banks will be formatted in the frame of the CDMS commissioning.
- The battery (BATSIM) shall be simulated fully charged. No power shall be requested from the battery by the S/C during this sequence.
- The SAS shall be limited to 1475W power (30° Sun aspect angle, worst case for commissioning).
- The SREM shall be turned ON as it is planned for routine satellite operation.

- The 2 CCU shall be ON.
- The telescope decontamination shall be activated. The ASW task shall be running. The thresholds shall be tricked to limit the heating power (ON time). The decontamination heating drained power profile will be so (as for TCS) not representative of flight worst case.

5.8.3.4. Initial configuration for commissioning

This sequence shall simulate the satellite commanding into communication session with ground.

This final state shall be:

Satellite state

CDMS mode	NOM	note:	DEC ON	ACMS mode	SCM (PT **EARTH**)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	1.5Mbps+**RNG**	CRS / FDIR	1A, 2S / AFS
SCBP /MTL	1 / OFF	Tx chain	**T.1 A.A MGA**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	TRSP 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	TRSP 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON Hk	LV enable	ON, A open
Battery	CHARGED	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	**MGA**	ENV simulator	closed loop

More specifically:

- The satellite TWTA-A shall be turned ON from a blind TC.
- Ranging enable after link is established.
- The TM rate shall be switched to high rate.

This sub-sequence is the starting point of the test.

5.8.3.5. CDMS commissioning

TBW-10 with AAS-I on the basis of SVM UM RD18 §5.3.

The correct CDMU operation capability from its two PM and main / Redundant IO modules shall be tested in the frame of this sequence.

This may be largely covered by the degraded mode test in alternated configurations. This sequence may be probably reduced with respect to the flight one. In any case, as part of this sequence:

- the CDMU RAM and EEPROM shall be dump. A and B PM, and image 1 and 2 software shall be verified for being identical as part of post processing.

This sequence shall specifically include the verification that all mass memory banks can be used, on both SSMM redundancies. But this is a highly time consuming task. The commissioning of SSMM will be typically shortened, and the full verification will rely on the SSMM use in alternated configuration by other sequences.

5.8.3.6. TTC commissioning

TBW-10 with AAS-I on the basis of SVM UM RD18 §5.3.

Chains A and B operation (encoder A & B, XPND 1 and 2, TWTA A and B) shall be tested.

All antennas configurations shall be tested.

This may be largely covered by the degraded mode test in alternated configurations. This sequence shall be reduced with respect to the flight one.

5.8.3.7. PCS commissioning

TBW-10 with AAS-I on the basis of SVM UM RD18 §5.3.

The PCS commissioning shall rather passive and based on TM analysis (solar array performance, etc.).

The correct PCDU operation capability from its two 1553 interfaces shall be tested.

This may be largely covered by the degraded mode test in alternated configurations. This sequence shall be reduced with respect to the flight one.

5.8.3.8. CCU (cryostat) commissioning

All CCU modes shall be tested, using CCU A then CCU B.

TBW-11 with ASED. This procedure is closely linked to cryostat commissioning.

The sequence shall include one DLCM sequence led from CCU-A.

5.8.3.9. ACMS commissioning

5.8.3.9.1. ACC health check

More specifically:

- The ACC RAM and EEPROM shall be dump. A and B PM, and image 1 and 2 software shall be verified for being identical as part of post processing.

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.

The correct ACC operation capability from its two PM and main / Redundant IO modules shall be tested in the frame of this sequence.

This may be largely covered by the degraded mode test in alternated configurations. This sequence may be probably reduced with respect to the flight one.

5.8.3.9.2. STR Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.1.6

5.8.3.9.3. CRS Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.

5.8.3.9.4. SAS Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.1.4.

5.8.3.9.5. GYRO Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.1.2 and volume 1 §5.3.1.3

5.8.3.9.6. AAD Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.

5.8.3.9.7. RCS Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.1.5.

5.8.3.9.8. RWL Health Check

TBW-10 with AAS-I on the basis of SVM UM RD18 volume 1 §5.3.

5.8.3.10. SREM commissioning

The SREM modes of operation shall be tested according to detailed RD27 requirements:

- §5.2 Start/stop accumulation and data acquisition
- §5.3 Read/set registers
- §5.4 Dump/load memory content

The 3 test shall be run in the above defined order.

5.8.3.11. Telescope decontamination

This test sequence shall simulate the telescope decontamination procedure.

Note : the test of the decontamination function shall nominally be performed during Thermal Vacuum test. It is however considered necessary to verify, as feasible, the correct operation of the algorithm in the less constraining ambient environment (as far as test conditions and set up are concerned).

~~The exact timing for activation is also **TBC-16.**~~

The test is twofold:

- verification of the telescope decontamination functionality,
- verification that the procedure can be run in background of the other commissioning activities without interference (note : the CDMS and PCS commissioning may consider some temporary conflicting / interfering commands toward common elements if decontamination is running in background. This shall be managed on a case by case basis. Considering the telescope thermal time constant, a small decontamination service interruption may be considered nominal during some CDMS and PCS commissioning sub-sequences).

For decontamination functionality test at ambient, the decontamination thresholds shall be commanded to be the following **TBC-16** :

- o- low threshold : ambient +2°C,
- o- high threshold : ambient +4°C.

The CCS monitoring alarm levels shall be adapted to detect any over-temperature with respect to high threshold, and tolerate some temperature lag under lower threshold.

The above setting shall lead the algorithm to cycle ON and OFF the decontamination heaters. Activation pattern and timing is nevertheless not expected to be representative of flight, and sequence is not expected to be nominal. Test success criteria is limited to obtaining some ON/OFF cycles demonstrating a coherent behaviour (post analysis).

For background runs, the decontamination thresholds shall be commanded to be the following:

- o- low threshold : 14°C,
- o- high threshold : 16°C.

This setting shall lead to never actuate the decontamination heaters. The CCS monitoring alarm levels shall be adapted to detect over-temperature (same threshold as for functionality tests are acceptable) and any HCS activation.

~~More details are TBW-14 with ASED.~~

Activities :

1• Send CDMS-TC(8,1,113) to start the telescope decontamination function. The temperature thresholds shall be adjusted with CDMS-TC(8,4,113,1) to allow the test to be feasible in ambient conditions .

2• After 1 TBC-16 hours, send CDMS-TC(8,2,113) to stop the telescope decontamination function.

~~Note: to allow sequence to proceed in clean room environment, service parameters will have most probably (TBW-14) to be biased as stated above. In addition, it is possible that those parameters have to be modify along the sequence to keep the decontamination sequence going (temperature thresholds).~~

Success criteria

The acquired TM packets shall not indicate any No-Go as applicable du to biased ground condition for temperatures.

All essential and non essential TM packets shall be available in real time TM.

No event packet types (5,2) and (5,4) nor TC rejection (1,2) or (1,8) shall be generated.

Temperatures of the telescope shall be stabilised in the expected range.

5.8.3.12. Cryo Cover opening

This sequence shall simulate the cryo-cover opening sequence

The nominal opening shall be commanded when HPLM is fully outgassed and telescope temperature is below 70°K, that is about 30 days in the flight (see satellite user manual).

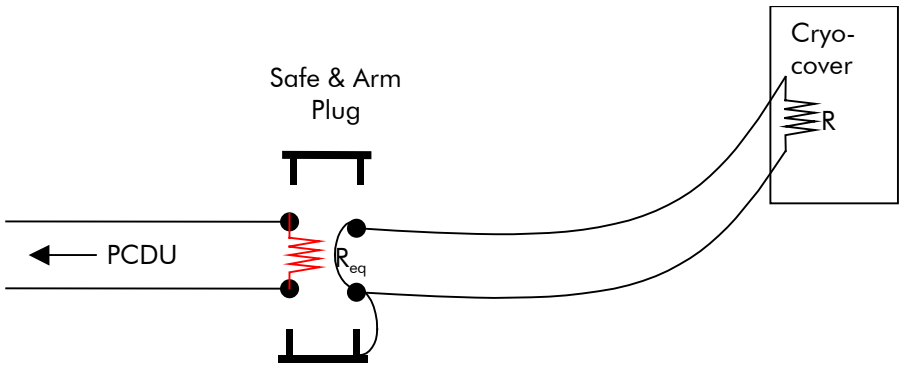
The ACMS attitude and SAS setting for this sequence remains TBW-15 but should not care.

- the Herschel cryo-cover Safe plug shall be replaced by a test plug that shall provide that:

  1) the NED command circuit is loaded with an equivalent resistance to the NED and the croy-cover + CCH harness,

  2) the NED terminals are shorted and grounded for security (note: there is no safety issue as the actuator is a non explosive device and differential pressure will keep cryostat door closed in case of inadvertent activation. The precaution shall be nevertheless taken),

  3) an oscilloscope is connected on the dummy NED load terminals to record the NED activation pulse shape (voltage or current as easiest). The oscilloscope trigger shall be allowed before the satellite turn ON to be able to detect any spurious activation, including at PCDU turn ON and turn OFF.



Note: the baseline is that the cryo-cover position sensors are not emulated. Then the telemetry will give a status "failed" to the actuation attempts. Correct NED command pulse detection (at right time) by the oscilloscope device shall be the actual NED activation success criteria.

Details are TBW-15 with ASED.

Activities :

1• Arm and Fire TC to command the Non Contaminating Actuator shall be sent.

2• The current pulse occurrence shall be monitored using an oscilloscope, as shown in Fig. 7.2 at the level of R_{eq}.

Success criteria

The duration and current amplitude of the firing pulse shall be measured and be consistent with AD02 §6.7.13 requirements.

Note: as no EGSE emulate the cryo cover position switches, no feed back in telemetry will assess from a successful opening. This is nominal in the frame of IST.

5.8.3.13. Test end

The test end shall return the satellite in a safe configuration for the autonomous cruise to L2, that is : Earth pointed, waiting for next DTCP.

This final state shall be:

Satellite state

CDMS mode	NOM	note:	DEC ON	ACMS mode	SCM (PT EARTH)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM	A1 [B1]	TM rate	**150kbps**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	1 / OFF	Tx chain	**OFF**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	TRSP 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	TRSP 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON Hk	LV enable	ON, A open
Battery	CHARGED	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS1475W	TC source	**UMB**	ENV simulator	closed loop

This is also the test start state. This state may allow to chain the sequence with an another or to split the platform commissioning in two sessions if needed.

This sequence shall include the dump of the SSMM using packet filtering instruction for the download, and the test of freeing afterward the corresponding memory space (which is usually not necessary as circular packet stores are used). This test may be considered as part of SSMM commissioning.

5.8.4. INSTRUMENTS COMMISSIONING AND PERFORMANCE VERIFICATION

5.8.4.1. Objective

This sequence shall verify the S/C ability to support the instrument commissioning and performance verification operations.

The "ability to perform" wording means that the limited test time does not allow to simulate the full flight sequence in a fully representative way. Ambient clean room environment comes also with limitations (specifically for HIFI).

The commissioning and performance verification simulation shall be condensed in time to fit a 10h test time slot per instrument.

According to the need, some time slot extension may be granted, but the full instrument commissioning test shall fit in a 1 week time slot (5 x 10h). The condition in which the instrument may possibly remain ON round the clock will have to be refined. Such a need lays typically in the SPT objective and more specifically for checking the two sorption cooler performances.

This sequence is in direct reference with RMS [AD02] "§6.2 Commissioning and Performance Verification Phases" (note nevertheless that telescope decontamination and cryo-cover opening are handled in the S/C commissioning IST sequence).

5.8.4.2. Test brief description

The test shall be structured as a succession of smaller independent tests.

Each test should be rather similar to the instrument UFT except that it shall be run while simulating in parallel the flight routine :

- the ACMS running in close loop~~, if possible TBC-32. If the instrument does not require specific ACMS operation (i.e. simulated pointing to targets) but shall remain in Earth pointing for the whole session, the operation in ENV simulation open loop may be studied in order to save configuration time while remaining transparent (i.e. ACMS shall remain active with Hk TM generation and shall generate no errors).~~
- command and telemetry transferred through simulated DTCP sessions.

The flight simulation shall include that long tests can rely on some MTL commands. The flight baseline for the commissioning phase is nevertheless to perform operation in "visibility" with up to 10h long DTCP.

The baseline of for the IST simulation is that the Medium and High rate TM downlink on the MGA is available for the commissioning at any time.

The test shall include the test of the instrument related OBCP, specifically a pre-test (OBCP commanded by TC) of the ones related to the instrument transition into STBY or SAFE state in case of an anomaly. The satellite shall nevertheless remains in NOM mode during all those tests. The complete test of the satellite reconfigurations is part of §5.8.5 and §5.8.6 IST sequence. The aim of the tests at instrument level is pre-check of the instrument and OBCP behaviour.

The instrument shall automatically synchronise their clock from 1553 time broadcast when turning ON. This shall be closely verified by checking the instrument TM packet time stamps on the tree first turn ON (specifically with respect to the boot event packet which shall be the first emitted one). As part of one of the first turn on, a time synchronisation verification procedure (CDMS-TC(9,5) on instrument APID) will be run for a more accurate checking. The procedure will be run twice: once after boot (bootstrap program answer) and once after instrument ASW initialisation (ASW answer).

Note: the instrument commissioning test shall validate the test to be run later under thermal vacuum condition ("dry run"). This may imply specific sequences.

The test shall include a mimic of the instrument line of sight calibration with respect to the ACMS frame. Far this, the STR2 will be turn on and configured to run in parallel with STR1, and the ACMS will be configured to provide the diagnostic TM to be used for the calibration (baseline ACMS SIT SAM 01 part 3 procedure).

5.8.4.3. Test start (restart) configuration

The initial state shall simulate a satellite in a safe configuration for the cruise to L2, that is : in NOM Mode, Earth pointed.

This initial state shall be, for a "PM A" "unit A" alternative, the following (1):

Satellite state

CDMS mode	NOM	note:	SPIRE locked	ACMS mode	SCM (Earth) (5)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	0 (1 (4)) / OFF	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON (He II (3))	LV enable	ON, A open
Battery	CHARGED	SPIRE	OFF (STBY (4))	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF (STBY (4))	SREM	ON
Mass Memory	≥ 1 banks (2)	PACS	OFF (STBY (4))	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	UMB	ENV simulator	closed loop (5)

(1): the baseline is to switch the S/C configuration from test day to test day in conformance to §5.1.2 table. The detailed configurations are given in appendix 2.

(2): SSMM formatting may be extended if needed. The baseline is that only HK TM justify a safe copy on SSMM during the tests. The instrument test data shall be "real time science" for commissioning (visibility). If the S/C is maintained operational round the clock (sorption cooler verification for example), the formatting will have to be 3 banks to give more SSMM management flexibility (time lost with formatting will be in turn mitigated by the longer use).

(3): Cryostat state constrains come from SPT. He II is not a need to conduct the test with respect to IST objectives.

(4): For test restart, some unit may be already in STBY, from a previous day of test, from a sorption cooler recycling having been done in masked time while the satellite was initialised for the test day.

(5): ~~TBC-32 If the instrument does not require specific ACMS operation (i.e. simulated pointing to targets) but shall remain in Earth pointing for the whole session, the operation in ENV simulation open loop may be studied in order to save configuration time while remaining transparent (ACMS active and no errors). A variant can be to run in closed loop, but to~~ To save test time, it is possible to start the instrument testing while yet in OCM (Earth) biasing the RW (this is a quite a long operation). RW biasing can be real background task while commissioning.

If the test day includes SPIRE or PACS sorption cooler activation, the S/C shall be moved (if not already done) into the proper S/C axis orientation to ensure a correct operation of those devices under 1g gravity.

In case of test day chaining without S/C shut down, the configuration includes the avionics configuration switch over at "PM" and "units" level, without instrument shut-down (when they are in stand-by). The "PM" switch over at CDMU PM level will be restricted, if the instrument are indeed running a background task (sorption cooler). Instrument TM gathering shall have precedence on the parallel avionics degraded mode tests.

The SPIRE launch lock shall be set (using dedicated EGSE) before the sequence starts, so that the configuration is representative of SPIRE state after launch (TBC-17 with SPIRE).

The satellite pointing target shall be Earth, with Earth at the border of the ARAD safe zone (i.e. 30° Sun aspect angle). This pointing may be indeed "toward Earth" only if ENV simulator setting does not allow to generate exactly a 30° Sun – Earth angle. The RWL shall be biased with enough margin to prevent any spurious dessaturation or 0 crossing during the test day.

The SAS shall be limited to 1475W power (30° aspect angle), as commissioning attitude may accommodate a worst case Solar Array illumination and good radio link performance.

5.8.4.4. Configuration for a commissioning "day"

This sequence shall simulate the satellite commanding into communication session with ground.

This final state shall be ("PM A" "unit A" day):

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (EARTH) (*)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	1.5Mbps+**RNG**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	1 (1) / OFF	Tx chain	**T.1 A.A MGA**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A ON (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON (He II)	LV enable	ON, A open
Battery	CHARGED	SPIRE	OFF (STBY)	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF (STBY)	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF (STBY)	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	**MGA**	ENV simulator	closed loop ~~(*)~~

~~(*) baseline TBC-32.~~

More specifically:

- The satellite TWTA-A shall be turned ON from a blind TC.
- Ranging enable after link is established (but no initial pure ranging session shall be simulated to save time for the test).
- The TM rate shall be switched to high rate.
- If the S/C comes in fact from a night ON (to maintain the cooler operation typically), the TM rate will be set temporarily to 1.5Mbps and SSMM stored telemetry shall be dumped in a first step.
- The 3 instrument TM shall be set for real time download. SSMM storage shall be done in parallel to secure the data in case of incident. The SSMM instrument packet stores will be deleted without downlink at the end of the test day, if no TM acquisition trouble is reported. This shall require no action as circular packet store are used. Packet store catalogue packet will be requested every hour to check that this automatic process run flawlessly.

This sub-sequence is the starting point of the test. This state is the background test for all the instrument commissioning phase.

5.8.4.5. SPIRE commissioning test

The detailed program shall conform to AD06.

The overall test sequence shall last no more than 10 hours (S/C initial and final configuration is not part of this time allocation).

The 2 other instruments are OFF during this phase.

The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
SPIRE Cold Functional Test CFT - nominal at He-II conditions	**3:00**		
□ **SPIRE Cold Functional Test CFT - nominal at He-II conditions**	3:00	x1	3:00
SPIRE Cold Functional Test CFT - redundant at He-II conditions	**3:00**		
□ **SPIRE Cold Functional Test CFT - redundant at He-II conditions**	3:00	x1	6:00
Cooler pump test CPMP	**2:00**		
□ Cooler pump test CPMP	2:00	x1	8:00
□ Switch-off	0:02	x1	8:02

(1° : x0 masked time, x1, non masked time)

5.8.4.6. PACS commissioning test

The detailed program shall conform to AD06.

The overall test sequence shall last no more than 10 hours (S/C initial and final configuration is not part of this time allocation).

The 2 other instruments are OFF during this phase.

The baseline programme is the following:

Sub-sequence	duration	(1)	effective duration
PACS Full Functional Test (FFT) at He-II conditions	10:36		
□ Switch-on (OFF – SAFE Transition)	0:06	x1	0:06
□ Memory Management Test	0:06	x1	0:12
□ Set-up Spectroscopy CS off (+L lock open)	0:18	x1	0:30
□ Grating Test	0:12	x1	0:42
□ Thermal behaviour SPEC	1:30	x1	2:12
□ Ge-Ga heater	0:18	x1	2:30
□ Ge-Ga flasher	0:15	x1	2:45
□ Set-up Spectroscopy, FW SPEC, data rates and background	2:00	x1	4:45

adjustment			
□ Chopper full FOV move	0:18	x1	5:03
□ Medium sampling grating scan (2 filters)	1:00	x1	6:03
□ Cooler recycling	2:12	x1	8:15
□ Thermal behaviour PHOT	1:30	x1	9:45
□ Set-up Photometry, FW PHOT, data rates	0:36	x1	10:21
□ Bolometer saturation check	0:06	x1	10:27
□ Enter Safe Mode	0:02	x1	10:29
□ Configure PACS to non Prime	0:05	x1	10:34
□ Switch-off	0:02	x1	10:36

(1° : x0 masked time, x1, non masked time).

5.8.4.7. HIFI commissioning test

The detailed program shall conform to AD06.

The overall test sequence shall last no more than 10 hours (S/C initial and final configuration is not part of this time allocation).

Note: LOU being at ambient temperature, IMT objectives on HIFI will be limited. Specifically, the LO power should be limited and higher frequency channel should not used (IID-B). The bias range to the mixers and electromagnets should also be restricted (IID-B).

The 2 other instruments are OFF during this phase.

The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
□ HIFI switch ON (OFF -> Stand-by)	0:10	x1	0:10
Functional tests HIFI Subsystems	**0:40**		
□ ICU SFT	0:40	x1	0:40
□ FPU SFT on Band 0			
□ HRS SFT			
□ WBS SFT			
□ LOU SFT			
FPU Functional test	**2:05**		
□ LO stabilisation	0:55	x1	1:35
□ Spectrometer Attenuation Tuning		x0	
□ LO Tune	0:05	x1	1:40

◻ Diplexer Scan Fast		x0	
◻ Magnet Tune		x0	
◻ FT Pumped	0:30	x1	2:10
◻ LCU Stand-By		x0	
◻ FT unpumped	0:20	x1	2:30
◻ LCU Config Safe		x0	
◻ Magnet Tune		x0	
◻ Diplexer Scan Slow	0:05	1	2:35
◻ Chopper Scan Slow	0:10	1	2:45
additional test	TBC		
◻ TBW	TBC	x1	
◻ Stand-by /S witch off	0:10:00	x1	2:55

(1° : x0 masked time, x1, non masked time).

5.8.4.8. SPIRE and PACS parallel mode

The detailed program shall conform to AD06.

The test start and end point shall be with the 3 instruments in STBY.

Then SPIRE and PACS shall be set for parallel operation test.

The overall test sequence shall last no more than 5 hours (S/C initial and final configuration is not part of this time allocation).

The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
PACS/SPIRE Parallel Mode Test during IST	6:30		
◻ CCS Parallel mode 1553	0:02	x1	0:02
◻ SPIRE Cooler recycle	2:00	x1	2:02
◻ PACS Cooler recycle	0:45	x1	2:47
◻ SPIRE Set up Photometer (Get parameter from IEGSE)	0:10	x1	2:57
◻ SPIRE Set the nominal bias level for all photometer arrays	0:02	x1	2:59
◻ SPIRE Stop data generation	0:02	x1	3:01
◻ SPIRE Perform a PCAL Flash	0:02	x1	3:03
◻ SPIRE Switch to parallel mode set-up for full photometer data sampling at ~10Hz	0:02	x1	3:05
◻ SPIRE Mark the parallel mode science data with an OBSID	0:02	x1	3:07

□ PACS Thermal Behaviour Test in Photometry	1:30	x1	4:37
□ PACS Set-up Photometry	0:36	x1	5:13
□ PACS Single Band Photometry	0:30	x1	5:43
□ PACS Dual Band Photometry	0:30	x1	6:13
□ SPIRE Switch to CCS handler on I-EGSE	0:06	x1	6:19
□ SPIRE End the parallel observation	0:02	x1	6:21
□ SPIRE to photometer standby	0:02	x1	6:23
□ SPIRE Perform a PCAL Flash	0:02	x1	6:25
□ SPIRE Stop data generation	0:02	x1	6:27
□ SPIRE to ready from photometer standby	0:02	x1	6:29
□ PACS to stand-by	0:01	x1	6:30

(1° : x0 masked time, x1, non masked time).

5.8.4.9. Test end or restart

The test end shall return the satellite in a safe configuration that is : NOM mode, Earth pointed, waiting for next DTCP.

This final state shall be ("PM A", "units A" case):

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (PT EARTH)
TM / OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	**150kbps**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	1 / OFF	Tx chain	**OFF**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A, B ON (He II)	LV enable	ON, A open
Battery	CHARGED	SPIRE	OFF (STBY (1))	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF (STBY (1))	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF (STBY (1))	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

(1): the instrument shall be OFF, if no IMT objective needs the instrument to remain activated between day shift. The instrument shall be OFF if the S/C is shut down as a final step.

This is also the test start state.

This state may allow to chain the sub-sequence with an another. This is the case specifically if the instrument objective requests to maintain the instrument (or cooler) active around the clock.

This sequence shall specifically include the dump of the SSMM ~~(for Hk)~~.

5.8.5. MODE TRANSITIONS

5.8.5.1. Objective

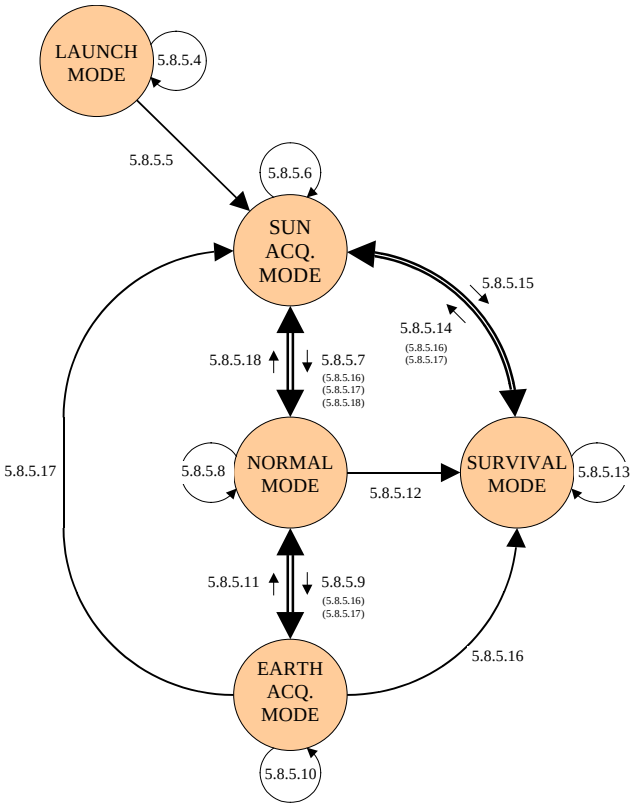
The objective of this sequence is to test the satellite (manual) mode transitions, and specifically the ones implying the instrument command in STAND-BY mode.

This sequence considers the satellite commanding in its different possible modes. This kind of operation in flight is expected to be nominally run from ground or at least in "visibility".

5.8.5.2. Test brief description

The test is structured as a suite of small independent tests.

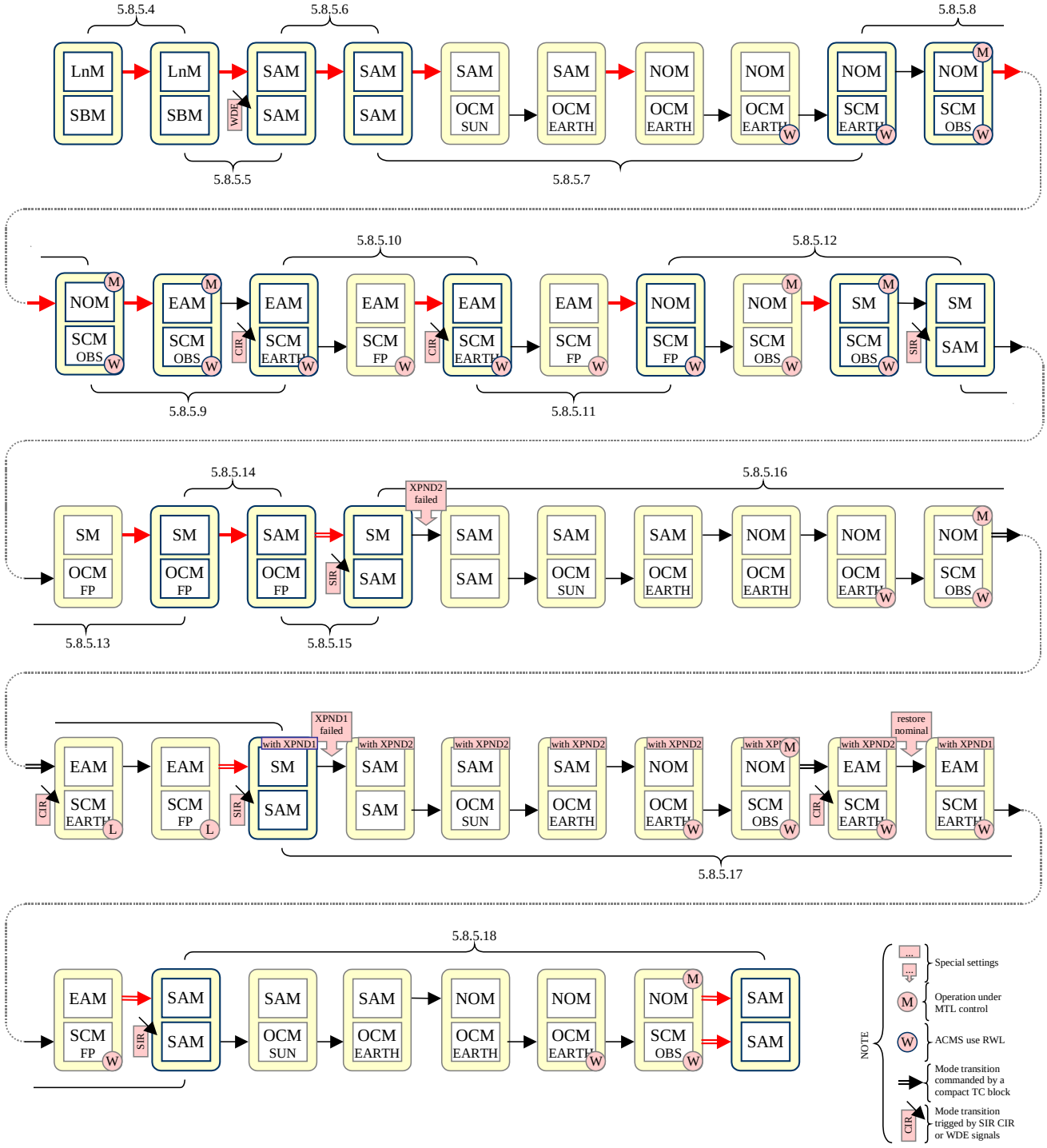
In the way this specification is written, each step is defined to be run immediately following the previous one. More precisely, the configuration at entry of a step is defined by the configuration at output of the previous step. The chaining with respect to the specification paragraph is summarised on the following figure:



mode transition test summary

Activities are listed in a chronological order.

The following diagram depicts the CDMS and ACMS mode and state chaining along the full sequence (in bold red, are the CDMS transitions that are the subject of each sub-sequence).



(dark bleu steps are the one for which a satellite state table is given in the following chapters).

Note : in above diagram, as for satellite state table, "Earth" and "Sun" pointing refers to the "V_{CIR}" and "V_{SIR}" vectors respectively. Those are fixed inertial vectors, that are nominally updated every day (operation also called "ephemeris" upload in the sub-sequences). When those settings are actives, the ACMS pointing success criteria shall be defined with respect to the uploaded active value (not the actual Sun / Earth position in ENV simulation).

The transition chaining implies that more than one SM to SAM, SAM to NOM and NOM to EAM transition shall be commanded (small chapter references in the previous page figure). This is used to vary the initial configuration to test the proper reconfiguration. This specifically includes:

- some "A" unit marked failed,
- some "B" unit marked failed (with survival register handling exercise),
- some ASW "service" disabled,
- different instrument being ON (which allow to test their respective OBCP when applicable).

The test does not intend to be exhaustive with all the possible cases. This shall be covered at lower level by CDMS and SVM SIT. But the objective is to sample realistic cases, and most of all, to provide observable for the automatic ON / OFF sequences that the mode transitions shall -or shall not- ensure.

5.8.5.3. Test start configuration

The initial state shall simulate a satellite in launch mode, waiting for launch.

This initial state shall be:

Satellite state

CDMS mode	launch	note:		ACMS mode	SBM (pre sep)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	5kbps	CRS / FDIR	1A, 2S / AFS
SCBP /MTL	0 / OFF	Tx chain	T.1(RF OFF) A.OFF(LCL ON)	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF
launch straps	all present	Rx 2 Ant.	LGA2	RWs	OFF
PCDU	IF A ON	CCU	A,B ON 8s-Hk	LV enable	OFF
Battery	charged (BS (1))	SPIRE	OFF	RCS enable	OFF
Power Source	UMB	HIFI	OFF	SREM	OFF
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	UMB	TC source	UMB	ENV simulator	stand-by

(1): there no need to force the battery to VEC-MAX, as this is not a test objective to run a representative launch sequence.

The ENV simulation shall be set-up so that the Sun and Earth directions are separated by 30°. The ENV simulator initial condition for separation shall be similar to those specified for the launch sequence. The ENV simulation shall be set-up so that the Sun and Earth position propagation during the test time is limited, in order to limit the risk of ARAD alarm whenever ACMS commands would be a few offset from their planed timeline. Note : the setting can be typically a L2 position, but does no need to be representative of any possibly real flight condition (specifically for separation step).

5.8.5.4. Launch to Launch

The S/C configuration shall be altered the following way:

- The TM rate shall be set to 150kbps, and TC rate shall be set to 125bps.
- The Rx 2 antenna shall be transferred on MGA.
- The umbilical power supply shall be turned off so that satellite is supplied from the BS.

The TC shall be sent to request the satellite to be set in launch mode (arm / fire).

success criteria

The satellite shall be reset with default launch configuration (test start configuration).

Satellite state

CDMS mode	launch	note:		ACMS mode	SBM (pre sep)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	5kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTM	0 /OFF	Tx chain	T.1(RF OFF) A.OFF(LCL ON)	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF
launch straps	all present	Rx 2 Ant.	LGA2	RWs	OFF
PCDU	IF A ON	CCU	A,B ON 8s-Hk	LV enable	OFF
Battery	charged	SPIRE	OFF	RCS enable	OFF
Power Source	BAT (BS)	HIFI	OFF	SREM	OFF
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	BS	TC source	UMB	ENV simulator	stand-by

5.8.5.5. Launch to SAM

The S/C configuration shall be altered the following way:

- The TM rate shall be set to 150kbps, and TC rate shall be set to 125bps.
- the RFDN configuration shall be set in all "A" position (XPND RX1 on LGA1, XPND RX2 on LGA2, position). The all "B" should be set, but this choice allows to observe the automatic configuration "confirmation" performed by the ASW at separation. The all A position gives the same result but is not the baseline reference (ref. SVM user manual volume 3, TTC subsystem).
- the RW 3, STR 1 and GYRO IF 2 LCL shall be turned OFF (warning : the GYRO IF 1 LCL shall remain ON).
- The umbilical power supply shall be off so that satellite is supplied from the BS.

The ~~launch straps~~"force separation" TC shall be ~~open~~ sent to trig the mode transition.

success criteria

The final satellite state and the sequence of event shall be similar to the launch sequence case specifically w.r.t to ACMS performance.

Specifically: the RFDN shall remain in the same antenna configuration, but the configuration confirmation shall return the RFDN individual position to "all B" (nominal way to get the wanted configuration). The STR LCL shall be all ON (nominal and redundant).

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM (PT CS)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	5kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF LCLs ON
launch straps	**all present**	Rx 2 Ant.	LGA2	RWs	OFF LCLs ON
PCDU	IF A ON	CCU	A,B ON 8s-Hk	LV enable	ON, A open
Battery	charged (1)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	BAT (BS)	HIFI	OFF	SREM	OFF
Mass Memory	≥ 1 banks	PACS	OFF	VMC	**ON image strd**

GSE support

Power source	BS	TC source	UMB	ENV simulator	closed loop

(1): the test do not follow a representative launch timing, then SOC is not a criteria.

Specifically: the RFDN shall remain in the same antenna configuration, but the configuration confirmation shall return the RFDN individual position to "all B" (nominal way to get the wanted configuration). The GYRO, STR and RW LCL shall be all ON (nominal and redundant).

5.8.5.6. SAM to SAM

As preparatory tasks:

- the S/C power supply shall be transferred to SAS (1700W setting),
- the separation straps shall be open to restore nominal operation conditions,
- the CCS TC source shall be transferred from UMB to LGA1,
- the VMC shall be turned OFF (there is no need to retrieve the images),
- the SREM shall be turn ON and configured for normal operation including TM storage and real time downlink.

The S/C configuration shall be altered the following way:

- The TM rate shall be set to 150kbps,
- Enable downlink of periodic non essential Hk TM packets.
- The THR B LCL shall be disabled (action at CDMS level),
- The STR B LCL shall be turned OFF.

The TC shall be sent to request the satellite to be set in SAM mode (arm / fire).

success criteria

The satellite shall be reset with default SAM configuration (test start configuration).

Warning: the default SAM configuration is not the default SAM configuration which shall be obtained when the transition is performed from launch mode when the separation event is detected. The obtained TTC setting shall be modified, and TM data shall be reduced to sub-sampled essential Hk.

Warning: as the transition is commanded from TC, there is no specific SW re-initialisation, then the SREM operation shall be unaffected except for the disabling of its TM down link in real time. The SREM TM stored in SSMM shall be specifically unaffected.

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM (PT CS)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF LCLs ON
launch straps	none	Rx 2 Ant.	MGA	RWs	OFF LCLs ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1700W	TC source	LGA1	ENV simulator	closed loop

The ACMS and SREM, shall have been unaffected.

5.8.5.7. SAM to NOM

As preparatory tasks:

The ACMS shall be loaded with the proper data to operate in OCM mode (ephemeris, etc.). To quicken this task, the TC-TM can be commanded back to 4k/5k, but the initial state shall be restore after that. The command to set the ACMS in OCM mode, pointing to the SUN. This shall include:

- in a first step to set the RCS in "FINE" to enter the SAM /FINE state,
- The STR-1 diagnostic telemetry shall be activated, then the unit shall be turned ON, configured and checked for proper operation ("tracking" mode).
- The ACMS "low rate OCM" telemetry shall be activated and "law rate SAM" telemetry de-activated.
- when stabilised, the ACMS shall be commanded in OCM with a target corresponding to Sun (with a small offset to keep the transition observable).the attitude shall be controlled for 5 minutes.
- The command shall be sent to set the ACMS to point the Earth (arm/fire).
- The SAS power shall be reduced to 1475W.

- When the S/C Earth pointing is established, the TC shall be sent to request the satellite to be set in NOM mode (arm / fire). This command shall specifically results in the TTC reconfiguration.

The sequence shall then be complemented at the ACMS level by setting up the RW.

- the RW shall be turned ON,
- the RW shall be biased at a low level to save test time, yet a level large enough to support the following sequence of slews and manoeuvres without an RW speed alarm,
- the ACMS FDIR shall be switched to AFO.

Then the ACMS shall be finally commanded in SCM mode.

success criteria

The final satellite state and the sequence of event shall be similar to the one experienced in the frame of the launch test sequence.

~~All telemetry shall be enabled and specifically all Hk TM (essential and non essential, including CCU monitoring TM) shall be enabled and present in the TM flow. FDIR mode shall be AFO.~~

This final state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (PT Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / OFF	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.5.8. NOM to NOM

As preparatory tasks:

- the SREM shall be turned OFF.
- The CDMS FDIR shall be turned to AFS.
- the 3 instruments shall be turned ON and brought to their stand-by state.
- a short MTL with shall be loaded with a timing such that any spurious sub-schedule skip generated by the NOM to NOM command may be observable. The MTL shall present a rate of command of 1 per second or more, such that (large) command delays may be observable. Those MTL command may be made of any incautious command or command pattern repetition (i.e. do not need to make a functional meaning).
- volunteer instrument for this sequence, PACS shall be configured for operation in spectrometer mode with parameters optimised for generating a maximum of science packet data flow.
- the PACS observation setting shall be associated with a minimum MTL TC activity and an MTL managed ACMS setting for a line scan or raster.
- Real time science downlink shall be enabled.

The S/C configuration shall be altered the following way:

- The TM rate shall be set to 1.5Mbps, the TC rate to 125bps, and Rx 2 to LGA2.
- The CCU monitoring TM and periodic CDMS ~~periodic~~ Hk TM downlink shall be disabled.
- The STR 2 and GYRO IF 2 LCL shall be turned OFF.

This intermediate reference state shall be:

*Satellite **INTERMEDIATE** state:*

CDMS mode	NOM	note:		ACMS mode	**SCM (OBS)**
TM/OBT	A	Rx rate	**125bps**	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	**1.5Mbps**	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	4 / ON	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A ON **B OFF**
launch straps	none	Rx 2 Ant.	**LGA2**	RWs	1,2,3,4 ON **(IF2 OFF)**
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	OFF
Mass Memory	≥ 1 banks	PACS	SPECTRO	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

The TC shall be sent to request the satellite to be set in NOM mode (arm / fire).

No ACMS command shall be sent (ACMS shall be unaffected by the CDMS mode change command).

No Instrument command shall be sent (instruments shall be unaffected by the CDMS mode command).

success criteria

The satellite shall be reset with default NOM configuration with the following specificities.

- The ACMS operation continuity shall have not been affected (including AFO mode).
- The instrument and ACMS operation by MTL shall not be affected (the bus profile shall be unaffected).
- All the TM shall be again available in the downlink (including real time science).
- The CDMS FDIR shall be set back to AFO.
- The GYRO IF 2 LCL and STR 2 LCL shall be back ON.
- The SREM shall still be OFF.

This final state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (OBS)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	4 / ON	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	STBY	SREM	OFF
Mass Memory	≥ 1 banks	PACS	SPECTRO	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.5.9. NOM to EAM

As preparatory task, starting from previous sequence end state:

- the SREM shall be turned back in operation.

The instrument shall still be running, and ACMS still scanning the sky with periodic MTL command, but the MTL contain shall be designed so that it contain only ACMS commands and instrument commands that are harmless when spuriously sent when the instrument is in STBY rather than current SPECTRO meter. They shall be specifically chosen to prevent that a spurious reception of those commands by the instrument generate any event with an entry in the EAT table (FDIR).

The EAM Earth pointing data (including propagation) loaded in ACMS earlier in the test and the ENV simulator setting shall still be coherent and not possibly trig an AAD alarm, nor RW speed trouble (RW biasing) when commanding back the S/C toward Earth.

The S/C configuration shall be altered the following way:

- The TM rate shall be set to 1.5Mbps, the TC rate to 125bps, and Rx 2 to LGA2.
- The CCU monitoring TM and periodic CDMS periodic Hk TM downlink shall be disabled.
- The STR 2 and GYRO IF 2 LCL shall be turned OFF.

This intermediate reference state shall be so the same as for the NOM to NOM transition except for SREM being ON and AFO mode being valid.

The TC shall be sent to request the satellite to be set in EAM mode (arm / fire).

No ACMS command shall be sent.

No instrument command shall be sent.

Warning: this is not a nominal way to command EAM by TC.

success criteria

The satellite shall be set with default EAM configuration, as set by the CDMU ASW (i.e. without the actions initiated in case of level 3 FDIR transition, by the RM and the BSW / ASW reset). Specifically:

- The instrument operation shall have been stopped and the 3 of them shall be in STBY.
- CDMS FDIR shall be AFS.
- Only HK TM shall be enabled (including periodic and non essential, including CCU and instrument). As the instrument will be set in STBY, the fact that real time science is disabled will be checked by requesting the list of enabled packets to service 14.
- THE MTL SHALL STILL BE RUNNING UNAFFECTED.
- The SREM and SCBP state shall be unaffected.
- The ACMS shall be unaffected, with respect to its last MTL command before the EAM command.

The final state shall be:

Satellite state

CDMS mode	EAM	note:		ACMS mode	SCM (OBS)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	4 / ON	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 banks	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

test completion

After proper observation of the above criteria, the EAM transition will be completed.

A TC shall be sent to stop the MTL.

A TC shall be sent to set back the SCBP to profile 1.

Two direct TC to the CPDU shall be sent to set the CIR flag, then reset it after 14s.

test completion success criteria

The satellite shall be set with full EAM configuration, specifically:

- the MTL shall be stopped,
- the S/C shall be pointed to the Earth.

The final state shall be:

Satellite state

CDMS mode	EAM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (LCL B ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.5.10. EAM to EAM

As preparatory task:

- the ACMS pointing shall be offset with respect to EAM reference for one fix pointing about mid course between Earth and Sun (with proper margin w.r.t. ARAD).

The S/C configuration shall be altered in the following way:

- the STR-2 shall be turned ON (simulating a check out : diagnostic telemetry shall be activated).
- the volunteer instrument, SPIRE shall be set again in serendipity mode (which requires SCBP 3 selection).
- MTL shall nevertheless not be started.
- the real time downlink of SPIRE science data shall be enabled.
- CDMS FDIR setting shall be set to AFO.
- The TM rate shall be set to 1.5Mbps, the TC rate to 125bps, and Rx 2 to LGA2.
- The CCU monitoring TM and periodic CDMS periodic Hk TM downlink shall be disabled.
- The GYRO IF 2 LCL shall be turned OFF.

The nominal quad of TC to request the satellite to be set in EAM mode shall be sent:

- Disable MTL, set CIR flag, set EAM mode (arm / fire), set SCBP to profile 1.

No ACMS command shall be sent.

No instrument command shall be sent.

success criteria

The satellite shall be in default EAM configuration (except STR), specifically :The CIR flag shall be cleared.

The TTC hardware configuration shall be reset to nominal EAM configuration.The instrument operation shall have been again stopped and the 3 of them shall be in STBY.

The CDMS FDIR mode shall be AFS.

Only HK TM shall be enabled (including periodic and non essential, including CCU and instrument). As the instrument will be set in STBY, the fact that real time science is disabled will be checked by requesting the list of enabled packets to service 14.

The MTL operation shall still be disabled (the MTL disabling reinforcement attempt shall generate no perturbation).

The STR B ON state shall be unaffected, the GYRO I/F2 LCL shall be back ON.

The final state shall be:

Satellite state

CDMS mode	EAM	note:		ACMS mode	SCM (FP 1/2)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A, A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A & B ON
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 banks	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.5.11. EAM to NOM

As preparatory task:

- the ACMS pointing shall be offset with respect to EAM reference pointing for one fix pointing about mid course between Earth and Sun (with proper margin w.r.t. ARAD).

The S/C configuration shall be altered the following way:

- the volunteer instrument, SPIRE shall be set in PHOTOMETER mode (which requires SCBP 3 selection).
- MTL shall nevertheless not be started.
- the real time downlink of SPIRE science data shall be enabled.
- the STR-2 shall be turned ON (simulating a check out : STR-2 diagnostic telemetry shall be activated, and the unit shall achieve the "tracking" state).
- The TM rate shall be set to 1.5Mbps, the TC rate to 125bps, and Rx 2 to LGA2 (recall: this last operation requires to turn off the TWTA during RFDN switching).
- The CCU monitoring TM and periodic CDMS periodic Hk TM downlink shall be disabled.
- The GYRO IF 2 LCL shall be turned OFF.
- The SREM operation shall be stopped and the unit turned OFF.

The TC shall be sent to request the satellite to be set in NOM mode (arm / fire).

No ACMS command shall be sent (ACMS shall be unaffected by the CDMS mode change).

No instrument command shall be sent.

success criteria

The satellite shall be set with default NOM configuration, specifically:

The TTC hardware configuration shall be reset to nominal NOM configuration.

All the TM shall be enabled, including the SPIRE real time science.

The CDMS FDIR mode shall be AFO.

But :

The ACMS operation and pointing shall be unaffected.

The instrument operation shall be unaffected (including SCBP).

The MTL operation shall still be disabled.

The STR-2 and SREM state shall be unaffected.

The final state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (FP 1/2)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	3 / Disabled	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A & B ON
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	PHOTOMETER	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	OFF
Mass Memory	≥ 1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.5.12. NOM to SM

As preparatory task:

- the MTL shall be started for an observation with SPIRE ~~associated with a line scan or raster. The ACMS setting shall include the SRPE option activation~~.
- the ACMS pointing (line scan or raster) shall have a significant offset with respect to SUN in the AAD range.
- the SREM operation shall be restart (unit back ON).

The S/C configuration shall be altered the following way:

- The CCU monitoring TM and essential CDMS Hk TM downlink shall be disabled.
- The CCU monitoring shall be set for 8s sampling.
- The GYRO IF 2 LCL shall be turned OFF.
- Some TCS table entries shall be modified with respect to default value. The modification shall be harmless if this procedure shall be repeated in TVTB, but may be smaller than 1° when change remain observable.

The TC shall be sent to request the satellite to be set in SM mode (arm / fire).

No ACMS command shall be sent.

No instrument command shall be sent.

success criteria

The satellite shall be set with default SM configuration (see below).

The instrument shall have been turned OFF.

CDMS FDIR shall be AFS.

The TCS table shall have default settings (verification requires a diagnostic TM request).

The TM downlink shall be limited to sub-sampled essential Hk.

The CCU setting shall be restored to default (512s sampling period).

But:

The MTL shall still be running, WHICH SHALL NOMINALY GENERATE ERROR EVENTS W.R.T. INSTRUMENT COMMANDS.

The ACMS operating shall be unaffected.

The SREM and STR-2 state shall be still ON.

The final state shall be:

Satellite state

CDMS mode	**SM**	note:		ACMS mode	SCM (OBS)
TM/OBT	A	Rx rate	**125bps**	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	**500bps**	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	**6** / ON	Tx chain	**T.2 A.B LGA1**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	**LGA2**	STRs	A (B ON unused)
launch straps	none	Rx 2 Ant.	**LGA1**	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	**OFF**	RCS enable	ON A CBH ON
Power Source	SA	HIFI	**OFF**	SREM	ON
Mass Memory	≥ 1 bank	PACS	**OFF**	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

transition completion

After verification of the previous success criteria verification, the S/C configuration (i.e. transition) shall be completed the following way:

- The MTL shall be stopped.
- The SIR signal shall be set by a CPDU command and cleared 14s later.

No ACMS command shall be sent.

No instrument command shall be sent.

success criteria

The satellite shall be set with default SM configuration, and specifically:

The ACMS shall be in SAM, RW and STR (both) shall be OFF.

The MTL shall be stopped and no more error event shall be reported.

the SREM shall be ON.

The final state shall be:

Satellite state

CDMS mode	SM	note:		ACMS mode	SAM (CS)
TM/OBT	A	Rx rate	**125bps**	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	**500bps**	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	6 / Disabled	Tx chain	**T.2 A.B LGA1**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	**LGA2**	STRs	**OFF** (LCL -ON)
launch straps	none	Rx 2 Ant.	**LGA1**	RWs	**OFF** (LCL ON)
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	**OFF**	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	**OFF**	SREM	ON
Mass Memory	≥ 1 banks	PACS	**OFF**	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.13. SM to SM

The S/C configuration shall be altered the following way:

- the TM rate shall be set to medium, the TC rate to 4kbps, the Rx 1 antenna shall be turned to MGA and the Rx 2 antenna to LGA 1 (DTCP type configuration).
- the volunteer instrument, HIFI shall be activated on and set in STBY (which imply to set SCBP 1).
- the STR-1 and 2 shall be turned ON (1 for nominal operation, 2 for simulating a check out : both STR diagnostic TM shall be activated, both shall reach the "tracking" state).
- the ACMS shall be set in SAM fine, then OCM (no RW), with a pointing target between Earth and Sun.

The TC shall be sent to request the satellite to be set in SM mode (arm / fire).

No ACMS command shall be sent.

No instrument command shall be sent.

success criteria

The default SM configuration shall be restored for CDMS (test start condition) and unaffected for ACMS.

The final state shall be:

Satellite state

CDMS mode	SM	note:		ACMS mode	OCM (FP 1/2)
TM/OBT	A	Rx rate	**125bps**	OBT, PM & SW	A- A1N [B1S]
PM & SW	A1 [B1]	TM rate	**500bps**	CRS / FDIR	1A, 2S/ AFO
SCBP / MTL	0 / Disabled	Tx chain	**T.2 A.B LGA1**	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	**LGA2**	STRs	A and B ON
launch straps	none	Rx 2 Ant.	**LGA1**	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	**OFF**	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.14. SM to SAM

The S/C configuration shall be altered the following way:

- the TM rate shall be set to medium, the TC rate to 4kbps, the Rx 1 antenna shall be turned to MGA and the Rx 2 antenna to LGA 1 (DTCP type configuration).
- the volunteer instrument, HIFI shall be activated on set in STBY (which implies to set SCBP 1).
- the STR-2~~B~~ shall be left ON (simulating a check out: STR-2 diagnostic TM shall be activated). The RW and GYRO IF 2 LCL shall be turned OFF.

The TC shall be sent to request the satellite to be set in SAM mode (arm / fire).

No instrument command shall be sent.

success criteria

The default CDMS hardware SAM configuration shall be restored.

This shall specifically include the TWTA A/B and XPND 1/2 function exchange.

The ACMS, HIFI, SCBP and SREM configuration shall be unaffected.

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	OCM (FP 1/2)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	A and B ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.15. SAM to SM

The S/C configuration shall be altered the following way:

- the TM rate shall be set to medium, the TC rate to 4kbps, the Rx 1 antenna shall be turned to MGA and the Rx 2 antenna to LGA 1 (DTCP type configuration).
- the STR-2~~B~~ shall be turned ON (simulating a check out : STR-2 diagnostic TM shall be activated).

The TC shall be sent to request the satellite to be set in SM mode with the full triad of TC.

- Disable MTL, Set SIR flag, Set SM mode (arm/fire).

No ACMS command shall be sent.

No instrument command shall be sent.

success criteria

The full default SM configuration shall be restored but for SREM being ON and nominally operated.

The final state shall be:

Satellite state

CDMS mode	SM	note:		ACMS mode	SAM (CS)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	6 / Disabled	Tx chain	T.2 A.B LGA1	GYROs	A,B,C IF 1 ON
FDIR /SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF, LCL ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.16. EAM to SM (needs new SM to SAM, SAM to NOM and NOM to EAM)

As preparatory task:

- The same configuration that the one used for EAM to NOM test shall be rebuilt.
- The new SM to SAM, SAM to NOM and NOM to EAM shall be run the same way as specified for the previous sequence.
- To extend the test nevertheless, the XPND 2 (Rx and Tx) shall be marked failed. This shall include the update of the survival register.
- The volunteer instrument for the sequence is HIFI for both NOM to EAM and for EAM to SM (reactivation of the instrument for check out simulation).

The TC shall be sent to request the satellite to be set in SM mode with the full triad of TC.

- Disable MTL, Set SIR flag, Set SM mode (arm/fire).

No ACMS command shall be sent.

success criteria

The satellite shall be set with default SM configuration, except for the XPND that shall remain the 1, and the SREM being still ON and operated.

The ACMS operating shall have searched and found the SUN.

The instrument operation shall have been again stopped and turned OFF.

The MTL operation shall still be disabled. The STR-2~~-B~~ state shall be OFF.

Satellite state

CDMS mode	SM	note:		ACMS mode	SAM (CS)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	6 / Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF, LCL ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	≥ 1 bank	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.17. EAM to SAM (needs new SM to SAM, SAM to NOM and NOM to EAM)

As preparatory task:

- The same configuration that the one used for EAM to SM test shall be rebuilt.
- The new SM to SAM, SAM to NOM and NOM to EAM shall be run the same way as specified for the previous sequence. To vary the case, the active XPND (Tx) shall be manually switched over to XPND 2, and the XPND 1 (Rx and Tx) shall be marked failed. This shall include the update of the survival register, which in the context, is equivalent to restore its nominal value. The success criteria of the SM to SAM, SAM to NOM and NOM to EAM shall be add the correct management of this degraded case (for example, the SM to SAM transition shall not trig a return on XPND 1). The configuration shall be returned to full nominal for testing the EAM to SAM transition.
- The volunteer instrument shall be turned to HIFI (NOM to EAM) .

The TC shall be sent to request the satellite to be set in SAM mode with the triad command.

- Disable MTL, Set SAM mode (arm / fire), Set SCBP 5.

The ACMS command shall then be sent according nominal for SAM transition procedure.

success criteria

The satellite shall be set with default SAM configuration.

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM (CS)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	5 / Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF, LCL ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 banks	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

The ACMS operating shall have achieved a stable pointing in SAM.

The instrument operation shall have been again stopped and turned OFF.

The MTL operation shall still be disabled. The STR-2-~~B~~ state shall be OFF.

5.8.5.18. NOM to SAM (needs new SAM to NOM)

As preparatory task:

- The same configuration that the one used for NOM to SM test shall be rebuilt (MTL, AFO, etc.).
- The volunteer instrument shall be turned to PACS in burst mode.

The TC set shall be sent to request the satellite to be set in SAM mode (arm / fire).

- Disable MTL, Set SAM mode, Set SCBP 5.

The ACMS command shall be sent according nominal for SAM transition procedure.

success criteria

The satellite shall be set with default SAM configuration.

The ACMS operating shall have search and found the SUN.

The instrument operation shall have been again stopped and turned OFF.

The MTL operation shall still be disabled.

The STR-2-~~B~~ state shall be unaffected.

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM (FN)
TM/OBT	A	Rx rate	125bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	5 /Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	A OFF B ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	ON
Mass Memory	≥ 1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.5.19. Test end

The test end shall recover all the data stored inside the CDMS memory for post analysis.

The SAM mode may be used for this purpose.

The communication session may use nevertheless an increased TC and TM rate to reduce the data recovery time.

This sequence shall specifically include the dump of the CEL, SSMM and the RM log.

Note : small dump sessions (configuring only the TM encoder on 1.5Mps TM and getting data from the UMB I/F) may be inserted between the test sub-sequences , whenever it would be wished to make the sub-sequences more modular or independent.

This final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SAM (FN)
TM/OBT	A	Rx rate	**4kbps**	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	**1.5Mbps**	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / AFS	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF, LCL ON
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF, LCL ON
PCDU	IF A ON	CCU	A,B ON HK	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	OFF
Mass Memory	≥ 1 bank	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	UMB	ENV simulator	closed loop

From this state, the satellite may be turned OFF or a new sequence may be started.

5.8.6. S/C RECONFIGURATION

The objective of this sequence is to test the satellite for critical mode transition cases after a system level FDIR trigger.

The test is conducted from the likely configuration of one S/C out of visibility, instrument running when relevant.

5.8.6.1. Test brief description

The test shall validate the S/C autonomous reconfiguration (level 3 and 4 alarms).

The test consider the generation of false alarms by:

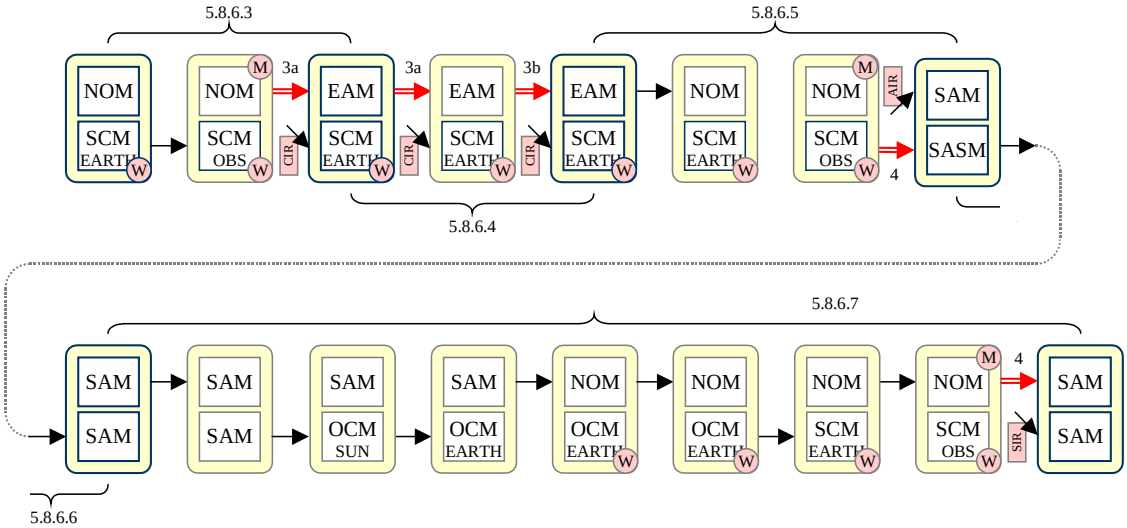
- CDMU PM reset (from CPDU),
- forcing software alarms from the special FDIR services TC (CDMS-TC(8,4,116,42) and ACMS-TC(8,1,206)) or,
- stimulating the DOD alarm.

In the way this specification is written, each step is defined to be run immediately following the previous one. More precisely, the configuration at entry of a step is defined by the configuration at output of the previous step.

But each sequence may be considered as independent with respect to the other if the test shall be stopped and resumed. A special care in chaining shall be brought upon the proper state of the RM registers and RM log after each sequence (as shall be done in the frame of a proper recovery).

Within each sequence, the activities are listed in a chronological order.

The following diagram depicts the CDMD and ACMS mode and state chaining along the full sequence (in bold red, are the CDMS transitions that are the subject of each sub-sequence).



(dark bleu steps are the one for which a satellite state table is given in the following chapters).

5.8.6.2. Test start configuration

The initial state shall simulate a satellite in a safe configuration in NOM Mode, Earth pointed.

This initial state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON IF1
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	ON
Mass Memory	≥1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	UMB	ENV simulator	closed loop

This state may be establish either from OFF state by general procedure, or from a previous test sequence through appropriate transitions.

- The mass memory shall be formatted with ≥1 bank.
- The SREM shall be ON as for routine satellite operation.
- The instrument shall be ON and running in STBY.
- The hypothesis for success criteria is that the CDMS and ACMS RM are in their default reset state, then that toggle delay will give the hand to RM-A to process the first alarm event, RM-B the second alarm event, etc.

5.8.6.3. NOM Mode to EAM transition (CDMS level 3a)

As preparatory task:

- the volunteer instrument HIFI shall be activated in PRIME mode (and generating science data).
- the MTL shall be activated, regularly issuing instrument and ACMS observation commands (typically around a point mid distance between Earth and Sun).
- NB. FDIR mode shall be AFO and SCBP shall be 2.

A software alarm shall be generated from the special FDIR services TC CDMS-TC(8,4,116,42).

Success criteria

The spacecraft shall be in Earth Acquisition Mode as defined in AD03, Figure 2.3.3.

EAM Bus profile SCBP 1 shall be used.

TM shall be received 20s max after command (to be seen from the umbilical).

TM shall be received 200s max after command (to be seen from MGA).

The acquired TM packets shall not indicate any No-Go, not considering packet counter discontinuities.

All essential and non essential TM packets shall be available in real time TM after the TM lock is achieved, via the RF SCOE from the TTC chain A, Tx A and TWTA A.

No event packet types (5,2) and (5,4) shall be generated.

The spacecraft units status shall be as in RD01, §6.3.

ACMS shall be in SCM and point in the Earth direction in consistence with TC_update_ephemerides command parameters.

All the instrument shall be in stand-by.

The MTL software service shall be OFF.

The SREM shall still be ON, but its management software (BSW) shall be OFF.

The FDIR mode shall be AFS.

The CDMU RM Log shall indicate that the origin of the recovery has been a level3a alarm detection by RM-A (based on respect of the previous sequence, to be transpose in an another case).

This final state shall be:

Satellite state

CDMS mode	EAM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A1 [B1]	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / OFF	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON IF1
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	**ON (SW off)**
Mass Memory	≥1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	MGA	ENV simulator	closed loop

5.8.6.4. EAM to EAM (CDMS level 3b)

As preparatory task:

- Tx A and TWTA shall be turned OFF by TC.
- The STR-2 ~~B~~ shall be turn ON (simulating a check out).
- The TM rate shall be turn to the high rate (1.5Mbps).
- The SREM software management shall be turn ON.

A software alarm shall be generated from the special FDIR services TC CDMS-TC(8,4,116,42).

preliminary transition success criteria

This shall result in a second level 3a conducted from RM-B this time (to be verified in RM log), a return in the exact starting condition.

configuration follow on

As preparatory task, the previous altered configuration shall be rebuilt:

- Tx A and TWTA shall be turned OFF by TC.
- ~~The STR B shall be turn ON (simulating a check out).~~
- The TM rate shall be turn to the high rate (1.5Mbps).
- The SREM software management shall be turn ON.

A new software alarm shall be generated from the special FDIR services TC CDMS-TC(8,4,116,42).

Success criteria

The spacecraft shall be in Sun Acquisition Mode as defined in AD03, Figure 2.3.3. SAM Bus profile shall be used.

EAM Bus profile SCBP 1 shall be used.

TM shall be received 20s max after Reset is performed (to be seen from the umbilical).

TM shall be received 200s max after Reset (to be seen from MGA).

All the instrument shall be in stand-by.

The MTL software service shall be OFF.

The SREM shall still be ON, but its management software (BSW) shall be OFF.

The FDIR mode shall be AFS.

The acquired TM packets shall not indicate any No-Go, not considering packet counter discontinuities.

After the reset is performed, a subsampling of the essential TM packets shall be available in real time TM after the TM lock is achieved, via the RF SCOE from the TTC chain A, Tx A and TWTA A.

No event packet types (5,2) and (5,4) shall be generated.

ACMS shall be in ~~SAM~~SCM pointing to the Earth.

The spacecraft units status shall be as in RD01, §6.4.

The CDMU RM Log shall indicate that the origin of the recovery has been a level3b alarm detection by RM-A (based on respect of the previous sequence, to be transpose in an another case).

This final state shall be:

Satellite state

CDMS mode	EAM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	150bps	OBT, PM & SW	A-A1N [B1S]
PM & SW	B1 [B1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / OFF	Tx chain	T.1 A.A MGA	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	MGA	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON IF1
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	**ON (SW off)**
Mass Memory	≥1 bank	PACS	STBY	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.6.5. NOM mode to SAM (ACMS level 4 (ACMS in Survival Mode))

As a first preparatory task:

- The S/C CDMS shall be configured for continuing operation on PM-B (this shall include RM PAP and survival register reprogramming, and the clearing of the attempt registers).
- Spacecraft shall be commanded back into the CDMS level3a test configuration state (NOM Mode).
- the volunteer instrument PACS shall be activated in PRIME mode (and generating science data).
- NB. FDIR mode shall be AFO and SCBP shall be 2.

Then the following action shall be done:

~~1.Disable ACMS ASW TC check to inhibit the verification of the ACMS target domain.~~

~~2.Command a slew manoeuvre with parameters which clearly violate the pointing domain (this will trigger ACMS level 4)~~

Using the ACMS SCOE error injection function, the AAD stimulation shall be programmed t correspond to an angle which clearly violate the pointing domain. Note: the simulated S/C attitude shall be left unaffected, and only the AAD information shall be biased.

Success criteria

SAM System Mode (see AD03 Figure 2.3.3) shall be reached. SAM Bus profile shall be used.

The ACMS shall switch over to PM-B, and ~~ACMS~~ shall be in Survival Mode. Control and monitoring shall be based on the configuration programmed in the ACC Survival Context register indicated in RD04 §4.2.2.4. The RWL and the STR shall be OFF.

A subsampling of the essential TM packets shall be available in real time TM via the RF SCOE from the TTC chain A, Tx A and TWTA A.

The acquired TM packets shall not indicate any No-Go, not considering packet counter discontinuities.

No event packet types (5,2) and (5,4) shall be generated.

The spacecraft units status shall be as in RD01, §6.4 for all subsystem/instruments/units except RCS and ACMS and §6.5 for ACMS and RCS units.

SREM shall be ON and continue normal operation.

MTL shall be disabled.

The ACMS RM Log shall indicate that the origin of the recovery has been a level4 alarm detection by RM-A (based on respect of the previous sequence, to be transpose in an another case)

This final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	SASM
TM/OBT	A	Rx rate	150bps	OBT, PM & SW	A-B1S [A1N]
PM & SW	B1 [A1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFS
SCBP / MTL	5 / Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF (LCL ON)
launch straps	none	Rx 2 Ant.	MGA	RWs	OFF (LCL ON)
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	OFF	SREM	**ON (SW off)**
Mass Memory	≥1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.6.6. SAM (ACMS in Survival Mode) to SAM (ACMS in SAM on B chain)

As a first preparatory task:

- PAP table selection shall be changed to PAP1 (PMB nominal, PMA redundant).
- PMB bit 0 shall be set to "NOMINAL", PMA bit 0 shall be set to "SURVIVAL".
- Configuration in Use shall be updated.
- Tx A and TWTA shall be turned OFF.

A reset ACC B command shall be sent via CDPU (this triggers ACC B level 3 FDIR recovery).

Success criteria

1. Sun Acquisition Mode as defined in AD03, Figure 2.3.3 shall be maintained.
2. The acquired TM packets shall not indicate any No-Go, not considering ACMS packet counter discontinuities.
3. A subsampling of the essential TM packets shall be available in real time TM via the RF SCOE from the TTC chain A, Tx A and TWTA A.
4. No event packet types (5,2) and (5,4) shall be generated.
5. ACMS shall be in SAM on "B" side.
6. The spacecraft units status shall be as in RD01, §6.4.

The final state shall be:

Satellite state

CDMS mode	SAM	note:		ACMS mode	**SAM**
TM/OBT	A	Rx rate	150bps	OBT, PM & SW	A-**B1N [A1S]**
PM & SW	B1 [A1]	TM rate	500bps	CRS /FDIR	1A, 2S / AFS
SCBP / MTL	5 / Disabled	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	MGA	RWs	OFF (LCL ON)
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	charged (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	OFF	SREM	**ON (SW off)**
Mass Memory	≥1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.6.7. NOM Mode to Survival Mode (CDMS level 4)

As a first preparatory task:

- Spacecraft shall be commanded back into the level 3a test configuration state (NOM Mode).
- the volunteer instrument PACS shall be activated in PRIME mode (and generating science data).
- NB. FDIR mode shall be AFO (for CDMS and ACMS) and SCBP shall be 2.
- MTL shall be activated, regularly issuing instrument and ACMS commands (around PT ½).
- the BS shall be set to simulate a low battery charge, yet above all the alarm thresholds.

Then the following action shall be done:

1. Disable CDMU RM, change the setting of the CDMU Pulse Mask Register (by BSW commanding) to set encoder B, Tx B and TWTA B as survival context, then enable CDMU RM.
2. Ramp down the Solar Array Simulator until this triggers the battery discharge at about 200W rate (the SAS shall not be abruptly reduced nor fully stopped in order not to create an abrupt bus collapse. For a similar raison, a large margin shall be kept on the battery mean delivered power to absorb transient peak demands (RW for example)). The applicable SAS setting shall be determined before the sequence run, from measured typical consumption of the test specimen in NOM mode).
3. Wait until triggering of DOD alarm (the waiting delay may be reduced by an action on the BS, but this action on the BS shall not create a perturbation on the S/C power bus operation).
4. Turn OFF the Solar Array Simulator, for 2 minutes, and then ramp it back ON to deliver 1700 Watts.

Success criteria

The CDMS shall have switched over back to CDMS-PM-A.

The CDMS shall be in Survival Mode (see AD03, Figure 2.3.3); spacecraft control shall be based on the configuration programmed in the CDMU Survival Context register indicated in RD04 §4.2.2.2. and modified in activities point 2. Survival Bus profile shall be used.

TM shall be received 20s max after DOD trigger is performed (to be seen from the umbilical).

TM shall be received 200s max after DOD trigger (to be seen from LGA1).

A subsampling of the essential TM packets shall be available in real time TM via the RF SCOE from the TTC chain B, Tx B and TWTA B not more than 3mn (EPC B pre heating time) after TM is lost.

The acquired TM packets shall not indicate any No-Go, not considering packet counter discontinuities.

The CDMU RM Log shall indicate that the origin of the recovery has been a DOD alarm detection by RM-B (based on respect of the previous sequence, to be transpose in an another case).

The Battery state of charge shall not go below 20% at any test time.

No event packet types (5,2) and (5,4) shall be generated.

ACMS shall be in SAM.

The MTL software service shall be OFF.

The SREM and its management software service shall both be OFF.

The spacecraft units status shall be as in RD01, §6.5 for all subsystems/instruments/units excepted ACMS units and §6.4 for ACMS units.

It shall be Verified that the ACMS limits cycles within the following boundaries :

- satellites maintains the sun direction at less than 5° half cone from Z axis.
- the transient outside the attitude defined above, for more than 5 minutes, is less than 40° from YZ plane, and its projection onto YZ plane is less than 23° from Z.
- satellite rate is kept below 4 degrees/min .

The final state shall be:

Satellite state

CDMS mode	SM	note:		ACMS mode	SAM
TM/OBT	A	Rx rate	150bps	OBT, PM & SW	A-B1N [A1S]
PM & SW	A1 [A1]	TM rate	500bps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	6 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	OFF (B-LCL ON)
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF (LCL ON)
PCDU	IF A ON	CCU	ON Hk	LV enable	ON, A open
Battery	>20% CHRG charging (BS)	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SAS	HIFI	OFF	SREM	OFF
Mass Memory	≥1 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS 1475W	TC source	LGA1	ENV simulator	closed loop

5.8.6.8. Test end

The test end shall recover all the data stored inside the CDMS memory for post analysis.

The SM mode may be used for this purpose.

The communication session may use nevertheless an increased TC and TM rate to reduce the data recovery time.

This sequence shall specifically include the dump of the SSMM and the RM log.

Note : small dump sessions (configuring only the TM encoder on 1.5Mps TM and getting data from the UMB I/F) may be inserted between the test sub-sequences , whenever it would be wished to make the sub-sequences more modular or independent.

This final state shall be:

Satellite state

CDMS mode	SM	note:		ACMS mode	SAM (CS)
TM/OBT	A	Rx rate	**4kbps**	OBT	A-B1N [A1S]
PM & SW	A1 [A1]	TM rate	**150kbps**	CRS	ON, 1A, 2S
SCBP / MTL	6 / OFF	Tx chain	T.1 A.A LGA1	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFS / N only	Rx 1 Ant.	LGA1	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA2	RWs	OFF (B LCL ON)
PCDU	IF A ON	CCU	ON HK	LV enable	ON, A open
Battery	>20% CHRG	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	OFF
Mass Memory	≥ 1 bank	PACS	OFF	VMC	OFF

GSE support

Power source	SAS	TC source	UMB	ENV simulator	closed loop

From this state, the satellite may be turned OFF or a new sequence may be started.

5.8.7. CDMS MANAGEMENT

5.8.7.1. Objective

The objective of this sequence is to test the non routine MTL, OBCP and SSMM management, that are not naturally experienced through the other sequences, as well as sample set of level 1 and level 2 FDIR cases.

5.8.7.2. Test short description

5.8.7.2.1. General sequence

The test shall simulate a standard DTCP session. The spacecraft shall be downloading recorded data.

5.8.7.2.2. MTL management

The aim of the test is to experience the MTL management commands that shall be seldom used unless trouble with the operation. This concerns specifically:

- deleting individual MTL command,
- deleting MTL command in a time segment,
- inserting new MTL commands in the middle of an existing MTL,
- disabling / enabling MTL command set from their subschedule reference,
- disabling / enabling MTL commands set from their APID,
- etc.

The sequence shall be derived from §9.1.9 of CDMS SIT specification “On board scheduling”.

5.8.7.2.3. OBCP management

The aim of the test is to experience also the OBCP management commands that shall be seldom used unless trouble with the operation. This concerns specifically:

- load, start, stop, suspend, resume from ground, delete and dump.

The baseline is to used an MTL extract of the Reference Mission Scenario to support the sequence.

The baseline for the OBCP exercise is :

- to use dummy OBCP, that will be used later to provide an additive “loading” on the DTCP worst case scenario sequence.
- to create an OBCP to replace a command sequence of the MTL, and the opposite (disabling of an OBCP).

The test sequence shall include the actual run of the MTL after its modification. The modification will so concern time tags in the hours that just follows the exercise.

5.8.7.2.4. SSMM management

The test shall also be used to support some seldom used packet store management commands:

- enable, disable, by Packet Store, Application ID, packet type…

5.8.7.2.5. FDIR level 1 and level 2

The test shall be used also for testing the proper operation of the EAT and MOT function on sample cases:

- a spurious switching of one RF switch will be simulated by a CPDU direct command (MAP 0) at the beginning (or end) of the DTCP session when the TWTA is yet (or already) OFF. The direct command will act out of ASW knowledge then the MOT should detect an incoherence between the RF switch position and ASW statuses. MOT shall generate an event, that shall trig an FDIR corrective action.
- SPIRE being PRIME, the test mode will be entered from ground TC (in command free MTL time interval) to generate first a spurious event SPIRE-TM(5,2,0xC100) then a few minutes later one SPIRE-TM(5,2,0xC110). The two events shall detected by the EAT and shall trig the two SPIRE OBCP which disables the SPIRE commanding from MTL (0xC100) and re-enables it on next subschedule (0xC110) respectively. The SPIRE MTL shall be designed to include a new subschedule starting a few minutes later to check proper resuming. Note: any way of stimulating the TM other than entering the SPIRE test mode is available, may be alternatively used, specifically if it adds a test interest at instrument level.

5.8.7.2.6. OBT management

At the end of the test, an on board time update exercise will be performed, first forward in time, then backward. The time jump will represent a few seconds, but not an integer number. A 3.14s value may be used as a baseline.

The procedure will be run in nominal DTCP configuration (Earth pointed) with the 3 instrument in stand-by, but no SSMM or MTL activity. The test will be run after the sequence end (all other sequence data in SSMM recovered) just before running the OFF sequence.

The time update will be commanded from a CDMS-TC(9,10). The CDMS shall update its clock, and the instruments shall synchronise their clock automatically. The ACMS shall be synchronised then by a CDMS-TC(9,3) on its APID. The two CCU time shall be updated after that.

This time update (specifically with a non integer number of second) shall generate many troubles in the different software execution (SW cycle cut, process time trigger missed or delayed, etc.). The generation of many error events shall so be considered as nominal as part of this test. Such a procedure should never be nominal experienced in flight despite possible (time is correlated and corrected on ground). The test success will be restricted to the ability after a small time (possibly including some service of function reset) to recover a normal operation.

5.8.7.2.7. Test merging possibility in an another sequence

This test may be appended with an another test to benefit from its configuration and already recorded MTL and stored SSMM data. The test may be specifically combined with the DTCP worst case scenario. The useful part of those both tests correspond to a small sequence in a full DTCP session.

5.8.8. DTCP WORST CASE SCENARIO

5.8.8.1. Objective

The objective of this sequence is to test a DTCP scenario which combines the highest realistic number of parallel operations at the same time.

This is not a saturation test in a way that the scenario shall remain a possible one with respect to nominal operation rules.

5.8.8.2. Test short description

The test shall simulate a specifically loaded DTCP session. The spacecraft shall be downloading recorded data for about 3h of downlink at high rate. The scenario is a DTCP during which, some real time science is performed in parallel to the download (from MTL) (see RD06 for DTCP profile).

The test is concentrated during this DTCP part and shall superpose the following operation:

1. Science packet store data download,
2. Real time science, with the following details:
   - the real time science operation shall be run from the MTL,
   - the real time science operation shall be chosen to require many OBCP (instrument mode transition typically rely on OBCP),
   - the MTL shall request diagnostic packet from CDMS and ACMS at the same time,
   - the real time science TM shall be recorded in the SSMM,
3. Loading of the new MTL data at a high rhythm (up to ~~10~~ 8.5TC per second ~~TBC-21 (CDMS SIT basis)~~).
4. Upload of a full instrument dummy ASW ~~memory~~ image of about 1Mo shall be loaded in one of the instrument (being in STBY) as a background task. This upload shall be done in the instrument RAM area, so that this operation does not affect the instrument flight ASW image resident in EEPROM. This test shall only verify the ability to upload a large quantity of data toward an instrument (the upload result shall be verified, but there is no need to boot the instrument on this upload, which may be so, made of a simple test pattern).

5. Patch of one or two words in one "page" of the instrument ASW EEPROM, agreed and reserved for this test purpose. The test shall be repeated for the 3 instruments TBC (PACS does not support such a single/two word patch, but supports only full ASW image patches). This test shall only verify the ability to re-write the instrument EEPROM on a small sample case.

The baseline is to use an MTL extracted of the Reference Mission Scenario to support the sequence.

As part of this test, a SSMM download interrupt then resuming will be experience during VC3 dump, considering the following procedure:

- abort the SSMM download,
- request a packet store report,
- determine a proper time tag from which to resume the dump (i.e. from the store indexed entry just older than the latest downloaded packets),
- clear the SSMM from packet older than the time tag (read pointers are not updated in case of abort),
- resume the dump from that time tag.

Note that du to the way the SSMM pointers are managed, the abort / resume operation implies some overlap in the download, then it shall be considered as nominal that the CCS generate some alarm upon packet counter discontinuity and/or duplicated packet when the dump is resumed.

This test may be appended with an another test to benefit from its configuration and already recorded MTL and stored SSMM data.

This test may be appended with an another test to benefit from its configuration and already recorded MTL and stored SSMM data. The test may be specifically combined with the MTL management test. The useful part of those both tests correspond to a small sequence in a full DTCP session.

5.8.9. REFERENCE MISSION SCENARIO

5.8.9.1. Objective

The objective of this sequence is to test the satellite during its nominal long term operation, especially comprising the scientific instruments operations.

It is organised around the Reference Mission Scenario (RMS RD02) which defines the activities to be carried out during a typical operational day.

The requirements applicable of the Reference Mission Scenario are stated in RD02, §5.1.

5.8.9.2. Test start configuration

The initial state shall simulate a satellite in a safe configuration in NOM Mode, Earth pointed.

This initial state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A image 1	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged	SPIRE	STBY	RCS enable	ON A CBH ON
Power Source	SA	HIFI	STBY	SREM	ON
Mass Memory	3 banks	PACS	BURST (1)	VMC	OFF

GSE support

Power source	SAS	TC source	UMB	ENV simulator	closed loop

(1) PACS shall be turn in burst mode as early as possible to use the initialisation long operation to feel the SSMM with data (example: ENV simulation close loop locking, initial MTL loading, etc.).

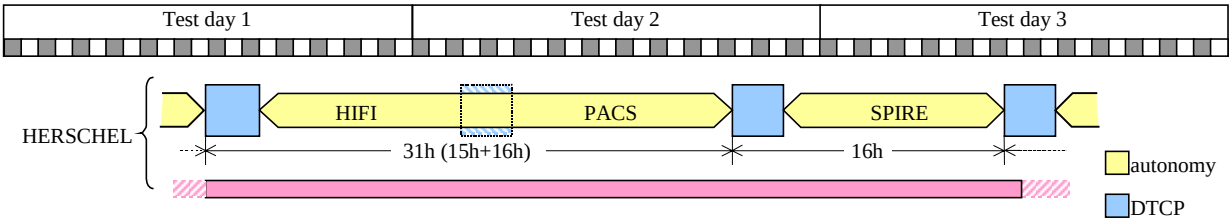
WARNING : this sequence shall be run using the flight battery.

This state may be establish either from OFF state by general procedure, or from a previous test sequence through appropriate transitions.

- The mass memories shall be formatted with 3 banks.
- The battery shall be fully charged and shall not be useful during this sequence.
- The SREM shall be ON as for routine satellite operation.
- The instrument shall be ON and running.
- the two CCU (A and B) shall be connected to the cryostat, (TBC-33 with ASED for the vents valves command plugs to be left disconnected from CCU to prevent a spurious activation). All cryostat monitoring will be so get through S/C TM for the duration of the test.

5.8.9.3. Test steps

The sequence is organised to provide one 15h/16h OD test slot to each instrument (12H/13h in autonomous condition with custom pointing, and 2h as part of the leading and trailing DTCP session). A short autonomous phase simulation is added at test beginning and end so that the DTCP 1 and 4 presents a complete DTCP profile.



Note, this table is the baseline discussed with the instrument in frame of AD06, with waivers with respect to RD02 accepted in frame of H-P-ASP-MN-8338. ~~TBC-34.~~

Step	simulated flight duration	Note
S/C turn on and initialisation		
SSMM pre-loading with PACS burst mode		MTL for next 5 steps is loaded
AP 1 end with PACS prime (introduction)	½h	
DTCP 1 with switch over from PACS prime to HIFI prime	3h	
AP 2 with HIFI prime	12h	The sequence includes observations in peak-up mode.
DTCP 2 with switch over from HIFI prime to PACS prime, and no ground contact established	3h	S/C is pointed to Earth and RF activated but no link is established. At end of the time slot, the DTCP is closed by the MTL which go on with next OD
AP 3 with PACS prime	13h	
DTCP 3 with switch over from	3h	SSMM is dump only partly of the over-accumulated VC3

PACS prime to SPIRE prime, and missed DTCP 2 compensation		data.
AP 4 with SPIRE prime	13h	The sequence includes observations in peak-up mode.
DTCP 4 with switch over from SPIRE prime to HIFI prime, and continuation of missed DTCP 2 compensation	3h	The sequence includes serendipity observation. The MTL is loaded with dummy following OD commands.
AP 5 beginning with HIFI prime (sequence trailer)	½h	
end of sequence		

Note: 1 OD (operational day) covers 1 AP (autonomous period) and 1 DTCP, from an operation point of view. For instrument, this definition is indeed a few offset, as configuration begins nominally during previous DTCP, and ends during the following one.

The AP includes observation calling upon the slews, line scanning, raster scanning, peak-up (as applicable) and SRPE AOCS functions.

5.8.9.4. HIFI OD

The detailed program shall conform to AD06.

The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
TBW			

(1° : 0 masked time, 1, non masked time)

5.8.9.5. PACS OD

The detailed program shall conform to AD06.

The detailed program shall conform to AD06.The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
□ Switch ON, Configure PACS to Prime	0:06	x1	0:06
□ Cooler Recycling	2:12	x1	2:18
□ One Hour DTCP With PACS ON (starts with cooler recycling	1:00	x0	2:18
□ Spectroscopy Set Up	0:45	x1	3:03
□ Window to Schedule AOT, or observation in Spectroscopy	4:00	x1	7:03

◻ Detector Curing	0:30	x1	7:33
◻ Window to Schedule AOT, or observation in Spectroscopy	3:30	x1	11:03
◻ Enter Safe Mode	0:02	x1	11:05
◻ Photometry Set Up	0:45	x1	11:50
◻ Window to Schedule AOT, or observation in Photometry	3:00	x1	14:50
◻ Enter Safe Mode	0:02	x1	14:52
◻ Configure PACS to non Prime	0:05	x1	14:57
◻ One Hour DTCP With PACS ON	1:00	x1	15:57
◻ Switch-off	0:01	x1	15:58
Total	**15 :58**		

(1° : 0 masked time, 1, non masked time)

5.8.9.6. SPIRE OD

The detailed program shall conform to AD06.

The baseline programme is the following:

Sub-sequence	duration	(1)	total duration
SPIRE cooler recycle (automatic)	**3:20**		
◻ Automatic cooler recycle CREC	2:00	x1	2:00
◻ Wait for stable temperature conditions	1:00	x1	3:00
Photometer mode test	**4:10**		
◻ Photometer scan mode POF5	2:00	x1	5:00
◻ Photometer chop / jiggle mode POF2	2:00	x1	7:00
◻ Switch to SPEC STBY	0:10	x1	7:10
Spectrometer mode test	**6:10**		
◻ Switch to SPEC high resolution mode SOF1	0:10	x1	7:20
◻ **Spectrometer Mode Test SOF1 part 1**	1:00	x1	8:20
◻ Switch to spectrometer high resolution mode SCAL null check		x0	
◻ Set SCAL temperature incrementally to null background from cryo-cover	2:00	x1	10:20
◻ **Spectrometer Mode Test SOF1 part 2**	1:00	x1	11:20
◻ Switch to spectrometer high resolution mode SCAL null check		x0	
◻ Set SCAL temperature incrementally to null background from cryo-	2:00	x1	13:20

cover			
□ SPIRE return to STBY	0:10	x1	13:30

(1° : x0 masked time, x1, non masked time)

5.8.9.7. Test end

The test end shall recover all the data stored inside the CDMS memory for post analysis.

The current may be used for this purpose.

This sequence shall specifically include the dump of the SSMM and the RM log.

The final state shall be:

Satellite state

CDMS mode	NOM	note:		ACMS mode	SCM (Earth)
TM/OBT	A	Rx rate	4kbps	OBT, PM & SW	A-A1N [B1S]
PM & SW	A image 1	TM rate	150kbps	CRS / FDIR	1A, 2S / AFO
SCBP / MTL	1 / Disabled	Tx chain	OFF	GYROs	A,B,C IF 1 ON
FDIR / SrvCBH	AFO / N only	Rx 1 Ant.	MGA	STRs	A (B LCL ON)
launch straps	none	Rx 2 Ant.	LGA1	RWs	1,2,3,4 ON
PCDU	IF A ON	CCU	A,B ON Hk	LV enable	ON, A open
Battery	charged	SPIRE	OFF	RCS enable	ON A CBH ON
Power Source	SA	HIFI	OFF	SREM	ON
Mass Memory	3 banks	PACS	OFF	VMC	OFF

GSE support

Power source	SAS	TC source	UMB	ENV simulator	closed loop

5.8.9.8. Additional requirements

The baseline is that the pointing commands during the RMS, will be determined from the mission planning exercise perform under ESOC coordination, to produce the RMS MTL (see §7.3). As a back-up, for a "manual" MTL generation, the ACMS manoeuvres and pointing to be achieved during the RMS are defined in appendix 5.

5.8.9.9. Success criteria

The system and subsystem configuration shall be in accordance with the operations defined by the reference scenario.

The acquired TM packets shall not indicate any No-Go.

All essential, non essential and science TM packets shall be available in real time TM.

No event packet types (5,2) and (5,4) nor TC rejection packet shall be generated.

The spacecraft units status shall be as in RD01, §6.1.

The spacecraft pointing shall be consistent with MTL pointing targets and modes, with :

a- In inertial pointing Mode :

- Absolute Pointing Error LOS <= 3.7arcsec
- APE around LOS = 3 arcmin

b- In scanning Mode :

- APE LOS <= 3.7 + 0.05 *scan rate arcsec

5.8.10. LAUNCH CLEAN RUN

5.8.10.1. Objective

The objective of this sequence is to test that the umbilical connections do not bias or mask in a positive way, the satellite behaviour with respect to the real flight one.

The test is limited by to the launch separation sequence. The test shall demonstrate that the satellite behaviour is strictly identical to the one recorded during the launch sequence until the lack of coherent close loop information stalls the ACMS.

5.8.10.2. Test brief description

The satellite is set in real flight configuration except that:

- the thrusters and the latch valve shall not be connected (resistive loads in test plugs),
- the antenna cap shall remain and be connected to the RF-SCOE,
- an optical raw SAS and AAD optical stimulation shall be installed (strong light in field of view). This stimulation shall prevent the immediate ARAD alarm trigger (AAD) and prevent the ACMS SW to branch into the Sun search contingency procedure (trigged when no valid Sun signal appears in any of the SAS field of views). The Sun aspect angle returned by the front SAS (-X) needs not to have a specific value while looking like a valid reading. The signal from the rear SAS (+Y) shall remain under Sun presence validity threshold (this should be the case in with ambient light, but a cover may be considered if not for sensor protection)-.
- the POWER SCOE shall be really configured as LPS.

All the signal passing through the umbilical shall be limited to the ones present on the launch pad. The other functions shall be physically disconnected (EGSE).

The launch preparation sequence shall be repeated as per launch sequence test (§7.8.2) , except that:

- the ACC "test data word bit 8" shall be configured as for flight (ACMS SCOE synchronisation message software sub-routine disabled).
- the supply from the Solar Array is not activated (POWER SCOE SAS not available), and the test sequence continue thanks to the battery power.

At separation, all the umbilical circuit shall be disconnected.

At separation + 200s, some observability (and emergency commandability) over the S/C will be recovered from the RF link. But the satellite will be fully on itself.

~~The AAD and SAS will be stimulated to prevent a too quick divergence of ACMS and attitude alarms.~~

After 10 TBC-23 minutes, the test shall be stopped by umbilical communication will be re-established and the S/C.

This test is typically the last of the IST. The baseline is that the work of the almost complete satellite disconnection is combined with the need to move the satellite to the environment testing facilities.

WARNING : this sequence shall be run using the flight battery.

5.9. DEGRADED CASES

5.9.1. S/C ABILITY TO BE OPERATED IN DEGRADED MODES

5.9.1.1. Objective

The objective of this test is to demonstrate that all the redundancies which are implemented on the S/C are functional.

This does not intend to be an overall verification, but only to sample the functionality of all the physical hardware units present on board.

5.9.1.2. Test description

To limit the test time, the baseline is to run in fact, most test in a degraded configuration, by alternating the use of "A" units (nominal) and "B" units (degraded case).

To accelerate even further the test, the baseline is to switch between the nominal all "A" configuration with the :

- (ACC and CDMU) PM "B", all other units "A" configuration,
- (ACC and CDMU) PM "B", all other units "B" configuration,
- (ACC and CDMU) PM "A", all other units "B" configuration,

To manage separately the PM from the other units is necessary in order that the satellite operation rely successively on all the possible cross straps in the ACC and CDMU units.

The global "alternative" configuration are not realistic with respect to flight. They would correspond to numerous failures at all level. But the setting shall not disturb the proper satellite operation, and allow to go quickly with experiencing all the redundant hardware.

This sequence is so in fact merged with the other sequences.

As a baseline, the "PM" and "units" configuration may be fully random, as far as all the "A" and "B" units have been used effectively once during the IST.

It shall be noted that all the other sequence are presented with state tables which correspond to the all "A" nominal case. When use in "alternated" configuration, those table shall be transposed.

The ANNEXE 2 details the exact "B" configuration, specifically when the redundancy is not as simple as a 1 to 1 cold redundancy.

5.9.2. LAUNCH SEQUENCE ROBUSTNESS

5.9.2.1. Objective

The objective of this test is to demonstrate that the launch mode is robust to a trouble with a unit during ascent.

This does not intend to be an overall verification, but only to sample the failure cases among the most critical. This concerns a level 4 failure at CDMS and ACMS level, as well as a trouble with the launch straps.

5.9.2.2. Test description

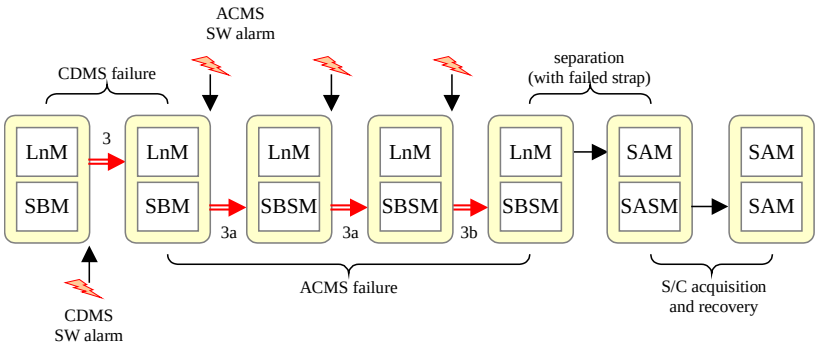
To limit the test time, the test baseline is to run a launch sequence with successive failure scenario. This is more severe than the design case (single point failure), but is acceptable by the design as long as the incident are not simultaneous.

The considered incident are the following:

- spurious CDMU PM A failure (SW alarm TC),
- spurious ACC PM A failure (SW alarm TC),
- launch strap 3 open too early,
- launch strap 5a do not open,

The launch sequence will shorten the preparation sequence with respect to §7.8.2 and will stop after correct stabilisation of the correct transition of the satellite in NOM mode.

The following diagram present the CDMS / ACMS mode state succession associated to the sequence:



5.9.3. NOM MODE ROBUSTNESS

5.9.3.1. Objective

The objective of this test is to demonstrate that the NOM mode is robust to a trouble with a communication problem between the sub-systems.

This does not intend to be an overall verification, but only to sample the failure cases among the most critical. This concerns troubles with the CDMS 1553 bus, as this will affect simultaneously most sub-systems.

5.9.3.2. Test description

Two tests are consider to consider the two following scenarios:

- failure of the CDMS bus controller,
- failure of the ACC Remote Terminal.

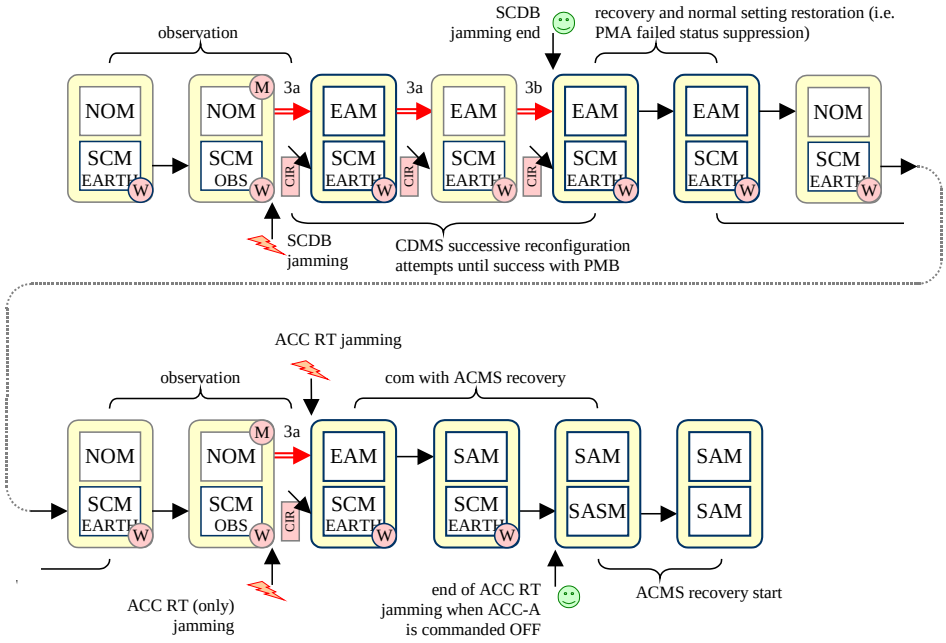
The two cases will be simulated from the S/C in NOM Mode, performing science out of DTCP. The science operation will be coupled with a raster or line scan mode that imply some level of synchronisation between the ACMS and the instruments (through MTL).

The two cases will be simulated the following ways:

- the 1553 bus circuit will be open (bus A and B) at the bus spy level (skin plug). Du to the SVM 1553 topology, this implies that the 3 instruments and ~~TBC-24~~ the transponder will be isolated from the CDMU. This shall be seen as a simultaneous loss a several RT answers by the CDMS and the FDIR shall diagnostic a bus controller failure. This shall imply a CDMS reconfiguration of the CDMS on the PM B as specified in SOFDIR annexe 1. The bus connection will be restored on behalf of BSW boot event to complete the simulation. A jamming of the XPND and instrument addresses using the CDMU SCOE may be used as an alternative to SCB physical disconnection (this as the same effect : the CDMU is programmed to answer on the different unit addresses jamming the different RT answer, making them appearing failed. This procedure has been used at SIT level)).
- the 1553 ACC RT failure will be simulated by ~~changing by TC~~jamming the ACC 1553 address using the CDMU SCOE~~in the bus RT address table to a non existing one~~. The loss of the vital communication with the ACC shall imply a CDMS reconfiguration. This reconfiguration shall be associated with a delay before the restart of the communication with the ACMS (provided in case this one is also in reconfiguration). This delay will be used deactivate the CDMU SCOE jamming~~to patch again the 1553 RT table~~, so the communication cannot restart (consolidating the scenario). The ACC shall not reconfigure itself as it shall not consider an error at its own level, but shall react to the spacecraft in reconfiguration signal. The situation shall remain stable in SAM with no communication between the ACMS and CDMS until ground recover the satellite and command manually a ACC switch over.

The tests shall include the satellite recovery from the ground (specifically in the second case).

The following diagram present the CDMS / ACMS mode state succession associated to the two concatenated sequences:



The two sequences shall be considered as independent if the test shall be stopped and resumed. A special care in chaining the two test shall be brought upon the proper state of the RM registers and RM log after each sequence (as shall be done in the frame of a proper recovery).

6. SUCCESS CRITERIA

6.1. DETAILED APPLICABLE CRITERIA

Considering that the present specification is a top level document which call after many sequences, the detailed success criteria are listed for each step of the sequence and sub sequence as part of the test definition (chapter 5).

6.2. NO GO CONDITIONS

As a generic statement, as introduced at §5.7, and considering test execution:

- A NO GO condition shall be associated with any parameter being "out of limit". The applicable limits are the values defined by the HPSBD unless otherwise stated in the present specification or associated document. The "out of limit" general wording includes indeed both all the SCOS/CCS automated checking, that is : TM value monitoring against alarm thresholds, dynamic status value checking (consistency check in SCOS 2000 wording), TC pre-validation and post check tests (CEV in SCOS 2000 wording). The "out of limit" covers also the verification of some parameters by the operator as it is requested by some test scripts to allow test to continue.
- A NO GO condition shall be associated with any anomaly event report TM(5,2) or TM (5,4) or TC rejection report TM(1,2) TM(1,8), unless deliberately wanted by the test procedure (test of failure cases).

Except for additional criteria detailed at each step level, the main test success criteria is the absence of NO GO condition.

6.3. "OUT OF LIMIT" AND TC CHECKING

6.3.1. BASIC PRINCIPLE

The test success relies except for few test step specificity, on the automated checking realised by the CCS based on HPSDB settings, and specifically the TC checks associated with each TC command.

The baseline is that the TC checking is realised by the CCS in real time whenever possible.

This includes 5 automated processes:

TC precondition checking by CCS (SCOS PTV)
(a TC may be associated at data base level to a set of TM status or value to be in given state / value interval to allow the TC up-link),

TC correct reception by TC decoder (part of SCOS/CCS DCVS)
(the TM/TC transfer protocol provides a feed back from CDMU TC decoder hardware when a TC is properly received),

TC acknowledge by TC verification service 1 TM (SCOS CVS of "CVS_source" type "R")
(a TC may be associated with a request for a telecommand verification service 1 TM packet from the unit or function addressed by the TC, to acknowledge the TC acceptance and/or execution steps achievement and/or execution end of the TC. This TM feed back (TM reception reporting success) may be defined at data base level as a systematic and automated verification. Note 1: the service 1 flags are not all supported by all unit and function. "Execution step" flag is specifically supported only by some TC which execution takes a very long, for which a "still alive" signal may be useful. Some TC supports no flags (ex. MAP 0 CPDU_TC). Note 2: as a rule, only one kind of acknowledge shall be requested, as asking for several can overwhelm the S/C bus bandwidth. Note 3: a service 1 flag may be activated in a TC header to have a feed back for information only (i.e. without a automated CVS monitoring to rise an alarm). Note 4: data base defines the time delay that the unit/function may need to generate the TM (worst case value), SCOS adds automatically constants to take into account system/processing delays and RF link delays (in flight), an alarm is generated when the TM is overdue or negative (TX(1,2) or TM(1,8)).),

TC acknowledge by TM parameter monitoring (SCOS CVS of "CVS_source" type "V" or "CVE")
(a TC may be associated with one or several TM parameters (direct or derived) status or value to be in a given state / value interval to confirm the TC acceptance and/or execution step achievement and/or execution end. The checking at the end of the time window defined for the transition, may be extended by defining at data base level, a "consistency check" on the TM parameter, that is a permanent monitoring of the parameter with an alarm if its status / value change / go out of value interval defined by the last TC CVE affecting it (see also OOL below). Note 1: data base defines the time delay that the unit/function may need to generate a stable TM (worst case value), SCOS adds automatically constants to take into account system/processing delays and RF link delays (in flight), an alarm is generated if the TM does not match the defined condition at the end of the window. Note 2: SCOS allow several complex options to define expected TM value else than a fixed predefined value, specifically the cased of an echo of the TC parameter value.),

TM parameter monitoring ("OOL")
(a TM parameter may be associated at data base level, with a permanent verification of its value with respect to several limits. The different limits allow to define different level of alarm severity. SCOS defines 5 type of severity "soft OOL", "hard OOL", "delta OOL", "consistency" and "event". The "consistency" case is very specific, because the limits dynamically changes as a function of the CVE history. §6.3.2 recalls the "soft OOL", "hard OOL", "delta OOL", "consistency" and "event" reserved usage for Herschel and Planck projects. Note 1: the monitoring takes automatically into account the validity criteria associated by the data base to the TM parameter to prevent undue alarms. The validity criteria (SCOS) may be a derived parameter (i.e. a function of several direct TM parameters). Note 2: the out of limit alarm is associated at data base level with a repetition filter, so that the alarm is generated only if the fault condition exist for 1 (no filter) to 16 consecutive parameter checks. This setting prevents alarm on transient or spurious. Note 3: a parameter may be associated to up to 16 out of limit criteria, meaning that several "SOFT" or "DELTA" limits may be defined for gradual alarms (see §6.3.2).

The process is straightforward when simulating operation in "visibility". For the others: as:

- launch sequence,
- operation from MTL,

The real time control relies on the real time spying of S/C generated TM from the umbilical connection (for MTL operation the hypothesis is that the CSS will run a copy of the MTL in parallel to S/C to keep its model of the status up to date).

Nevertheless, as introduced at §5.6, each test success shall be determined from TM acquired in a flight representative way. This means that most tests shall end by a simulation of a TM downlink session (DTCP) or specific phase to recover the available stored telemetry in SSMM.

When this telemetry has been already analysed from the umbilical line for test success (that is usually in a non flight representative way), the test success shall be verified by at least comparing the SSMM stored telemetry with the real time acquired one, for being identical. This comparison may be done bit level, packet per packet, which is expected quicker than a "replay" of the test (the comparison method is TBC-37).

For a remaining set of test sequences and test steps, a real time control will not be possible:

- the clean run (by test principle),
- a few case of saturation or filtering of the real-time TM sent onto the umbilical.

For those later cases, the test success will rely on a test session "replay" on the CCS from the retrieved SSMM data (note: test timeline at §5.1.2 does not include the time necessary fore those full or partial replays).

6.3.2. OUT OF LIMIT CONDITION HIERARCHY

CCS monitoring considers 5 classes of monitoring limits: "soft OOL", "hard OOL", "delta OOL" and "consistency" and "event".

- a "event" limit triggering shall be associated with an automated emergency stop procedure run by the CCS.
- a "HARD OOL" and "consistency" limit triggering shall be associated with a test sequence abort (operator led procedure).
- a "SOFT" or "DELTA OOL" limits triggering, shall call upon the responsibility of the supporting engineering team for deciding in real time either the test abort or its continuation. A SOFT limit is a test failure indicator in any case, but not critical with respect to immediate safety of units under test. Real time decision shall considers if there is a danger for the S/C health (abort), and if not (shall be the case with a soft limit), the decision shall consider with respect to the test objective:
  - if there is no more way to consider the test successful, then test is worth to abort to save time or,
  - if the alarm open (likely) only minor anomaly on test results, then test is worth to continue (NB. from available real time data, as only post analysis will determine if sequence is acceptable or shall be re-run).

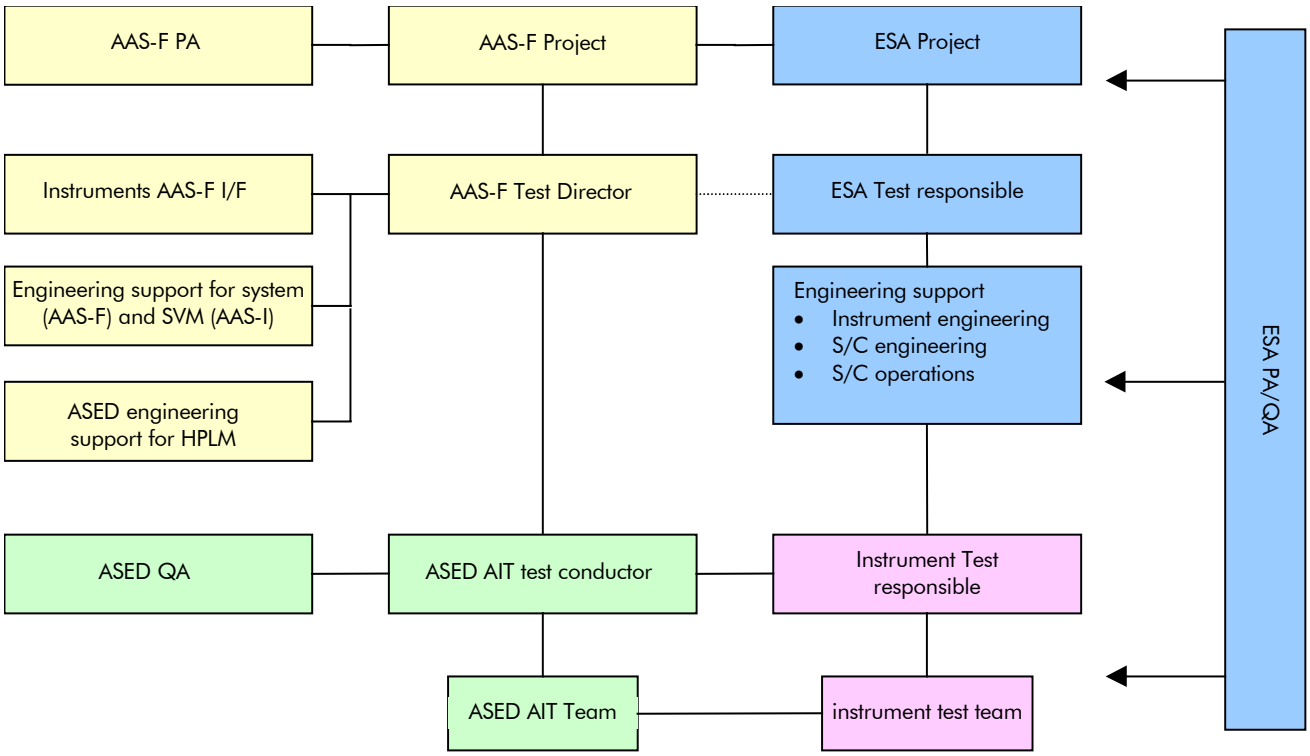
7. ORGANISATION AND RESPONSIBILITIES

7.1. ORGANISATION

7.1.1. GENERAL ORGANISATION

ASED will realise the test with a support of the instrument team for a real time critical quick look on the instrument data, and success criteria determination when they concern evolved TM analysis not covered by automated Hk TM checks realised by the CCS (IEGSE level data analysis).

The test organisation shall be as follow: ~~Further details are TBW-33.~~



See §7.2 for each actor responsibility definition.

7.1.2. INSTRUMENT TEAM SUPPORT

7.1.2.1. Instrument team support to S/C monitoring

The CCS provides very few statistics upon the science TM(21,x) packets. It is so difficult to detect (in real time) any trouble with the science packet management (or more exactly to discriminate a problem occurring at their level when other packets are also involved).

The instrument team, thanks to IEGSE, shall be able to report in real time upon :

1- any discontinuity in the TM packet counter, including nominal ones.

2- any TM packet CRC error.

3- any TM packet header formatting error.

The above information shall be discriminated between TM(21,X) and the others (House keeping, diagnostic or events, under parallel monitoring by CCS). Note: no packet format error (type 2 or 3) should be detected as the TM/TC DFE shall filter out such packets (leading then to a counter discontinuity of type 1). Such error shall be nevertheless reported as an indicator of a problem at the EGSE system level.

7.1.2.2. Instrument team involvement in GO-NOGO

The instrument team, thanks to IEGSE, shall report at each test step, if the quick look monitoring remains GO, or a NO-GO condition has been detected.

By default, if the CCS monitoring detects no out of limit condition, no anomaly event report TM(5,2) or TM (5,4) and no TC rejection report TM(1,2) TM(1,8) (unless deliberately wanted by the test procedure for failure case test), the test lead will consider the condition "GO" for the next test step.

7.1.2.3. Instrument team involvement in (first level) test success confirmation

Within 2 hours from test sequence end, the instrument team shall be able in a first approach, whether the test is successful at instrument level or not. This statement shall be limited to the fact that:

1- the instrument first level behaviour (mode, main status) has been as expected,

2- the instrument first level performance (as applicable) has been roughly in expected range,

3- all the TM data has been properly collected for post analysis.

This statement will not preclude later finding in the frame of the data detailed post analysis. But it shall report about the confidence that results are successful and that next test can be run in confidence of no generic flaw.

7.1.2.4. Post analysis

The detailed post analysis of the instrument TM is an instrument team task. The criteria are under the instrument team responsibility, but, as minimum, the following points shall be confirmed:

1- the TM data set as obtained from SSMM dump is complete (no lost packet, no packet format error),

2- there is no incoherence between the TM packet data monitored in real time (when available), and the SSMM dumped telemetry,

3- all the collected data are correct with respect to their format (i.e. packet structure, limits, calibration),

4- instrument behaviour (mode and all status) are as expected (including no spurious),

5- instrument performance (as applicable) are in expected range (or explained).

The instrument power supply parameter plots (voltage and current on all lines) will be made available to the instrument team for inclusion in the above analysis point 5.

Note: above list is not a requirement for a report format, and any other relevant synthesis point may be considered by the instrument team.

7.1.3. TEST OBSERVATION BY ESA TEAM

One CCS LAN station is reserved for ESA observer for real time test monitoring.

7.2. RESPONSIBILITIES

ASED is responsible for the test. The overall responsibility during the test is as in following table. ~~TBW-33.~~

The responsibilities linked to the test progress shall be mentioned in the AAS-F test leading procedure.

Organisation	Responsibility
AAS-F Project Representative	Alcatel project interface Represents AAS-F during the test and he is also the I/F point with the ESA representative
AAS-F PA	AAS-F Project Assurance Manager
AAS-F Test Director	Issue the test specification of the relevant test to be performed Go ahead for the test reviews (TRR, key point, PTR) Single point of contact with the AAS-F Evaluation team concerning the test result status.
ESA project representative	ESA project interface Represents ESA during the test and he is also the I/F point with the AAS-F representative.
ESA Instruments I/F	I/F with AAS-F test director & instrument evaluation teams
ASED AIT Conductor	Responsible of the ASED AIT Team Issue the leading procedure of all activities Manage all activities done during the test including "key point" meeting. I/F point with the Test Facility Team Responsible I/F point with the Instrument AIT Team Responsible Organise the Daily meeting Initialise NCR…
ASED AIT Team	Realise all S/C AIT activities within the arrival and the leaving

Organisation	Responsibility
	Issue of the relevant test procedures Operate the GSE (except I-EGSE) Provide the test data Issue the test report.
Instruments AAS-F I/F	Issue section of the test specification relevant to the instrument. AAS-F instrument expert
ASED QA	Organise the review (TRR/PTR…) Minute the running meeting (Key point)
Instrument AIT Team Responsible	I/F point with the ASED test conductor Provide relevant test data in order to help the test director concerning the "Key point" status.
Instrument AIT Team	IEGSE full use Issue the relevant test procedures Process the instrument test data and Test data analysis Issue the test report.
Evaluation teams	Evaluate the test results (depending of test: electrical integration, IST, TV, EMC, ….)

7.3. TASK DISTRIBUTION

The preliminary task distribution is the following:

- global specification (present document) AAS-F,
- test organisation and preparation ASED,
- test procedure writing and debugging ASED (to be derived from AAS-I and INST ones),
- test session direction ASED,
- test data analysis ASED,
- test report ASED,
- test evaluation for HPLM ASED,
- test evaluation for instruments INST teams,
- test evaluation satellite AAS-F.

~~Further details are TBW-33.~~

AAS-F is in charge of Herschel FM AIV

- the satellite activities and test management:
- Responsible of the test management and for interfaces between the satellite, instruments and facility.

ASED is in charge of Herschel FM AIT

- Preparation (tests definition, except for instruments) and execution
- S/C Cleaning, handling, mechanical mounting, electrical checkout, instruments modes set-up.
- Test management (reviews, leading procedure, daily meeting, key points , …)
- Dedicated GSE installation/validations and use
- S/C data analysis.
- Running the test (Satellite & Instruments Operator)

AAS-I is in charge of SVM FM & Herschel AVM AIT

- Provide SVM IST and SIT procedures as a base for S/C IST test procedure definition (inputs).
- On the spot engineering evaluation during tests.

Instrument teams are in charge of:

- Preparation, tests definition for the instruments
- Dedicated GSE installation/validations and use (I.EGSE)
- Responsible for interfaces between the instrument GSE and test facility.
- Execution and interpretation of instrument performance data
- Provide relevant test data in order to help the test director concerning the "Key point" status.
- Instrument test report

8. DOCUMENTATION

8.1. DOCUMENTS REQUIRED BEFORE THE TEST

The satellite documentation shall be available and up to date, specifically with respect to:

- S/C configuration (CIDL, etc.)
- Test set-up configuration (CIDL, Definition drawings)
- all units and sub-systems ICD,
- all units and sub-systems User Manuals,
- Test Set-up validation and calibration status,
- Test specification,
- Instrumentation plan (auxiliary thermal sensors list and location as relevant),
- Test leading procedure + elementary procedures,
- all relevant lower level test procedures

Further details are TBW-33.

8.2. DATA ACQUIRED DURING THE TEST

All the TM and TC generated for the test shall be recorded for post processing availability.

For the support of test post analysis (first level), a reduced set of data will be selected for real time display and plotting (raw data formatted in spread sheet compatible ASCII format). Those displayed and plotted TM are sequence and sub-sequence specific, but shall allow as a basic requirement, to check the values and timings of the parameters associated with the success criteria as defined for each step, as part of chapter 5.

To this above requirement, shall be added as a generic requirement, the plotting of the satellite power consumption profile with its sharing at lest between:

- Each instrument and coolers,
- TCS (heaters distributed power),
- The auxiliary payloads (SREM and VMC),
- The TTC (TWTA and TRSP),
- The RCS (Thruster and CBH supply lines).

The cryostat data (CRYOSCOE and CCU) shall also be plotted systematically.

In a similar manner, as a generic requirement, the plotting of the CDMS, ACMS and Instrument mode transition timing shall be available.

Further details are TBW-33.

8.3. DOCUMENTS ISSUED AFTER THE TEST

8.3.1. TEST REPORTS

8.3.1.1. Specimen AIT reports

As a minimum, the specimen AIT reports shall include:

- Test progress description,
- Contamination control report,
- Logbook reporting all significant events about specimen,
- Pictures taken on the specimen in test configuration,
- Record (CD-ROM) of all acquired data during test,
- Test measurements devices calibration reports.

Further details are TBW-33.

8.3.1.2. Test environment

As a minimum, the specimen AIT reports shall include:

- Test progress description,
- Pictures taken on the test set-up,
- Logbook reporting all significant events about test set-up,
- Record (CD-ROM) of all acquired data during test (as relevant),
- Test measurements devices calibration reports

Further details are TBW-33.

8.3.2. EVALUATION REPORTS

8.3.2.1. Evaluation report for S/C

As a minimum, the S/C evaluation reports shall include:

- Logbook reporting all significant events about each sequence success criteria,
- a short S/C test report including:
  - measured values for success criteria associated with analogue values (ex. DoD, pointing errors, at key steps etc.),
  - test results processing for all phases (plots and specific data processing possibly required step per step).

Further details are TBW-33.

8.3.2.2. Evaluation report for the instrument

As a minimum, the instrument evaluation reports (provided by the instrument support team) shall include:

- Logbook reporting all significant events about each sequence success criteria, and specifically the ones only available from monitoring at IEGSE level,
- a short S/C test report including:
- measured values for success criteria associated with analogue values (ex. DoD, pointing errors, at key steps etc.),
- test results processing for all phases (plots and specific data processing possibly required step per step).

  specifically for the ones only available from processing at IEGSE level.

Further details are TBW-33.

END OF MAIN DOCUMENT

APPENDIXES FOLLOW

9. APPENDIX 1 : IST 1 VERIFIED REQUIREMENTS

The IST test shall specifically verify the following requirements (IST applicable requirements according to system level VCD, thanks to DOORS tracking).

The list recalls also where request for waiver or deviation have been accepted (pending requests are not included). The requests for waiver or deviation state is given for information only, and shall be updated in the frame of the Test Readiness Review.

9.1. SRS

SRS 3.3 - Ch.4 [MISS-015 H/P a]

Both spacecraft shall be compatible with a direct ignition of the launcher upper stage, shall be supported by internal power and withstand the mechanical and thermal environment.

SRS 3.3 - Ch.4 [MISS-020 H/P]

During the launch phase, both spacecraft shall be in a minimum power mode using on-board batteries. All instruments are switched off with the exception of the launch lock of the mechanical coolers for the Planck S/C. Command for cryogenic valve actuation, if necessary during launch, could be supplied by the launch vehicle.

SRS 3.3 - Ch.4 [MISS-045 H/P]

The spacecraft shall autonomously detect separation from the launch vehicle and reorient itself to achieve Sun-pointing of the solar arrays.

SRS 3.3 - Ch.4 [MISS-050 H/P]

The spacecraft shall autonomously detect correct Sun-acquisition and switch to the solar array power mode.

SRS 3.3 - Ch.4 [MISS-055 H/P]

20 seconds after separation, the spacecraft shall provide telemetry data for spacecraft monitoring and check-out.

SRS 3.3 - Ch.4 [MISS-060 H/P]

The spacecraft shall provide attitude information for attitude reconstitution by the ground.

SRS 3.3 - Ch.4 [MOFM-025 H/P]

Where redundancy is employed, the design shall allow to operate and verify the redundant item/function independently of the nominal use.[H-P-376000-TNO-RD-0021] SAS redundancy

NOTE: this requirement is affected by [H-P-376000-TNO-RD-0021 0] SAS redundancy [accepted by ESA]

SRS 3.3 - Ch.4 [MOFM-030 H/P]

Each redundant path or function shall meet the full performance requirements.

SRS 3.3 - Ch.4 [MOFM-060 H/P]

It shall be possible to enable, disable or reverse any on board autonomous function or action by ground command. Exceptions (e.g. Power distribution , DC/DC converters over-voltage protections , …) shall be identified and agreed .

NOTE: this requirement is affected by [FMF-070C-C] / [H-P-361000-ETCA-RD-004 1]PCDU: Protections inhibition, and [GEF-097-C a] / [H-P-361000-ETCA-RD-004]PCDU: Protections Inhibition [Accepted by ESA]

SRS 3.3 - Ch.4 [MOFM-070 H/P]

All relevant anomalies shall be properly detected and unambiguously reported.

SRS 3.3 - Ch.4 [MOFM-085 H/P]

An expedite and reliable procedure, under ground control, shall be provided to return to nominal operations after a failure.

SRS 3.3 - Ch.4 [MOFM-120 H/P]

For any on-board autonomous reconfiguration, telemetry data shall indicate the time and the conditions, at/under which the event occurred.

SRS 3.3 - Ch.4 [MOGE-005 H]

The Herschel spacecraft shall support the scientific observations of the Herschel instruments

SRS 3.3 - Ch.4 [MOGE-015 H/P]

The spacecraft design shall enable the operational control by the ground segment during all mission phases and modes in both nominal and contingency situations.

SRS 3.3 - Ch.4 [MOGE-020 H/P]

The spacecraft shall be able to support continuous communications with the ground during station visibility periods.

SRS 3.3 - Ch.4 [MOGE-030 H/P]

The spacecraft design shall support the following telemetry modes:

Real time housekeeping data (spacecraft and payload)

Real time science + real time housekeeping data

Real time housekeeping data + dump of on-board mass memory

Real time housekeeping +real time science + dump of the on-board mass memory

SRS 3.3 - Ch.4 [MOGE-035 H/P]

Each spacecraft shall be equipped with a set of Visual Monitoring Camera(s) (VMC). The purpose being Public Relations effort, the performance (resolution, colour image, etc.), location and field of view shall be selected accordingly. Note : The VMC's will be used on a non-interference basis with the science / payload operations . [H-P-200000-ASP-RD-009]

SRS 3.3 - Ch.4 [MOGE-040 H/P a]

Each spacecraft shall be equipped with a Radiation Monitor according to AD2-3. Its intended operation is also described in AD2-3.

SRS 3.3 - Ch.4 [MOGE-045 H/P]

Each spacecraft shall be able to operate out of ground contact and follow a programme of operations loaded by the ground during the communication period (DTCP).

SRS 3.3 - Ch.4 [MOOF-005 H/P]

The spacecraft shall be capable of autonomous wheel off-loading.

SRS 3.3 - Ch.4 [MOOF-015 H/P]

Initiation of wheel off-loading shall be possible by ground command as well as trough the MTL (Mission Timeline).

SRS 3.3 - Ch.4 [MOOF-020 H/P]

Off-loading, as well as up-loading, of each reaction wheel shall be possible to a ground-commanded value.

SRS 3.3 - Ch.4 [MOOF-080 H]

It shall be possible to change by command, scan rate between 0.1 arcsec/s and 1 arcmin/s with a resolution of 0.1 arcsec/s.

SRS 3.3 - Ch.4 [MOOM-010 H]

During Herschel Science Observations, the spacecraft shall provide the pointing modes defined in Herschel Pointing Modes, Annex 1.[H-P-370000-DS-RD-0022] Not all scan sizes and orientations are possible without violating the safe region

SRS 3.3 - Ch.4 [MOOM-020 H a]

During the Observation Period it shall be possible to point the LOS of the prime instrument to any target within the FOR according to any of the operational pointing modes as described in Annex 1.

SRS 3.3 - Ch.4 [MOOM-060 H]

The Herschel spacecraft must as a minimum support the modes of instrument operation as specified in Table 4.3.1.1.

SRS 3.3 - Ch.4 [MOOM-075 H]

During the DTCP, the Herschel satellite shall provide all the resources required to operate the instruments in the operational modes defined in table 4.3.1.1. Such observations shall be executed at an attitude compliant with the attitude constraints during the DTCP .

SRS 3.3 - Ch.4 [MOOM-105 H a]

The spacecraft shall communicate, on-board and to ground, a request for pointing correction from the prime instrument per single pointing mode as defined in Annex 1 (excluding line scanning).

SRS 3.3 - Ch.4 [MOOM-110 H]

After reception of the request for pointing correction from the instrument, the spacecraft shall autonomously readjust its attitude accordingly.

SRS 3.3 - Ch.4 [MOOM-115 H]

The correction shall only be allowed within predefined boundaries , <10 arcsec around Y and Z axes.

SRS 3.3 - Ch.4 [MOOM-135 H/P]

The survival mode shall be activated automatically by the S/C after a major on-board failure or a violation of the attitude constraints of Section 4.2.7.

SRS 3.3 - Ch.4 [MOOM-140 H/P]

The survival mode shall maintain a safe attitude within the constraints allowing a continuous supply of power and maintaining a thermal environment compatible with the spacecraft and essential loads.

SRS 3.3 - Ch.4 [MOOM-150 H/P]

It shall maintain spacecraft and instruments in safe conditions and broadcast a safe mode flag to the instruments upon entry to the safe mode.

SRS 3.3 - Ch.4 [MOOM-155 H/P]

It shall be possible to enter the survival mode by ground command. Exit from the survival mode shall only be possible by ground command.

SRS 3.3 - Ch.4 [MOOM-165 H/P]

The survival mode shall not rely on any volatile memory (Random Access Memory or other) stored data.

SRS 3.3 - Ch.4 [MOOM-175 H/P]

Upon entry in the survival mode, the Mission Time-Line shall be discontinued. The TM format shall be switched to HK mode only.

SRS 3.3 - Ch.4 [MOOM-195 H/P]

The spacecraft shall support on-board storage of the mission timeline for a 48 hours mission time.

SRS 3.3 - Ch.4 [MOOM-200 H/P]

The spacecraft shall support autonomous (i.e. without ground contact) execution of the mission timeline.

SRS 3.3 - Ch.4 [MOOM-205 H/P]

The spacecraft shall support rescheduling of planned events in the mission timeline as defined in AD3-2.

SRS 3.3 - Ch.4 [MOOM-215 H/P]

It shall be possible to exit from the Autonomy Mode by Ground Command.

SRS 3.3 - Ch.4 [MOOM-220 H/P]

The spacecraft shall support on-board storage of all mission data generated during 48 hours (e.g. science and HK data, events, reports etc).

SRS 3.3 - Ch.5 [SCME-120 H/P]

The mechanisms shall comply with the relevant power supply and harness requirements specified in Sections 6.5 and 6.11, respectively.

SRS 3.3 - Ch.5 [SFUN-005 H/P]

Each spacecraft shall collect, store and transmit to the ground station all data (scientific and housekeeping) coming from the scientific instruments.

SRS 3.3 - Ch.5 [SINT-050 H]

For the Herschel Mission, a "On Target Flag" (OTF) shall be generated when the commanded target has been acquired.

SRS 3.3 - Ch.5 [SINT-055 H]

The OTF shall be made available in the TM (required for instrument data processing). The OTF shall indicate the time at which the OTF conditions start and end .

SRS 3.3 - Ch.5 [SINT-105 H]

The Herschel spacecraft design shall permit the dump of 24 hours stored telemetry with the real time science and housekeeping telemetry and simultaneously upload of the mission timeline in less than 3 hours at the maximum distance from the earth around L2 and with the Perth / New Norcia ground station.

SRS 3.3 - Ch.6 [SMCD-020 H/P]

The CDMS shall be fully redundant including cross strapping to improve reliability. It shall survive any single point failure and no failure shall propagate outside the unit level, or even sub-unit level for complex units.

SRS 3.3 - Ch.6 [SMCD-025 H/P]

The CDMS shall be fully operational after start-up.

SRS 3.3 - Ch.6 [SMCD-040 H/P]

The CDMS shall exchange TM / TC packets with all on-board units, which can encode / decode TM / TC packets.

SRS 3.3 - Ch.6 [SMCD-045 H/P]

The CDMS shall acquire the scientific and periodic and non-periodic housekeeping data from the scientific instruments.

SRS 3.3 - Ch.6 [SMCD-050 H/P]

The CDMS shall acquire the periodic and non-periodic housekeeping data from the spacecraft subsystems.

SRS 3.3 - Ch.6 [SMCD-070 H/P]

The CDMS shall store all commands, housekeeping and science data generated on-board.

SRS 3.3 - Ch.6 [SMCD-100 H/P]

The CDMS shall perform its own initialisation and monitoring.

SRS 3.3 - Ch.6 [SMPC-010 H/P]

The PCS shall condition, control and distribute all the electrical power required by the scientific instruments and spacecraft subsystems and/or units as defined in AD4-2 to AD4-6.

SRS 3.3 - Ch.6 [SMPC-015 H/P]

In case there is no solar array power or if its power is not sufficient to meet the scientific instruments and/or spacecraft power demand, the required (additional) power shall be provided by the batteries of the PCS.

SRS 3.3 - Ch.6 [SMPC-020 H/P]

The PCS shall maintain proper operating conditions for the batteries and shall manage the charge/discharge cycles of the batteries to fulfil power demands as required.

SRS 3.3 - Ch.6 [SMPC-040 H/P]

The subsystem shall provide adequate status monitoring and telecommand interfaces necessary to operate the subsystem and permit evaluation of its performance during ground testing and in-flight operations.

SRS 3.3 - Ch.6 [SMPC-045 H/P]

Sufficient telemetry parameters shall be assigned such that the power available and requested can be established.

SRS 3.3 - Ch.6 [SMPC-070 H/P]

The PCS equipment shall be capable of operating continuously under all operational conditions of the mission including contingency situations. No damage or degradation shall result from intermittent or cycled operation.

SRS 3.3 - Ch.6 [SMPC-080 H/P]

The PCS shall be able to distribute sufficient power to the scientific instruments and spacecraft subsystems to operate these according to the mission requirements, for all operational modes and during all mission phases.

SRS 3.3 - Ch.6 [SMTT-100 H/P]

Limited housekeeping data will be routinely delivered to the LGA's for transmission upon ground request.

SRS 3.3 - Ch.6 [SMTT-170 H/P]

The TT&C subsystem shall be designed such as to be launched power "ON"; however, the telemetry function shall be disabled during launch.

9.2. OIRD

OIRD 2.2 + MN-3689/11 [AUT-1]

During all active mission phases the spacecraft shall be able to operate without ground contact for a period of 48 hours without interrupting mission product generation. Beyond the 48 hours the spacecraft shall be able to survive in a safe mode for 7 days without the need for ground intervention. Note: the requirement is applicable to the S/C, and allows the dimensioning of the on-board time tag commanding capability. After the last time tagged command is executed, and in absence of direct ground commands, the S/C CDMS (e.g. using a set of pre-defined OBCPs) shall ensure that the spacecraft and instruments are in a safe configuration.

OIRD 2.2 + MN-3689/11 [AUT-3 a]

In principle the S/C shall be capable of recovering from a first failure and continue normal operations.

OIRD 2.2 + MN-3689/11 [AUT-4]

The Survival Mode shall initiate any payload re-configuration activities necessary to put the payload in a safe and recoverable mode. The "Survival Mode" is here assumed to be the mode to which the system falls back when all autonomous recovery actions have been exhausted, whereby a minimal functionality is retained to control the system within the set of constraints necessary for the survival of the S/C and instruments until the ground can intervene.

OIRD 2.2 + MN-3689/11 [AUT-5]

When in Survival Mode the spacecraft shall start generating a minimum set of telemetry packets which allow unambiguous and rapid identification of the Survival Mode. The reason for the triggering of the Survival Mode and the history of the defined events occurred before and after the detection of the failure condition shall also be accessible in telemetry either directly or stored in memory areas that can be later dumped and reset by the ground.

OIRD 2.2 + MN-3689/11 [AUT-8]

No nominal operation shall require inhibition of the Survival Mode nor a forced entry into Survival Mode.

OIRD 2.2 + MN-3689/11 [CPM-1 a]

It shall be possible to control OBCPs , via specific telecommand packets, in the following manner:

Load an OBCP

start an OBCP;

stop an OBCP;

suspend an OBCP;

resume an OBCP;

delete an OBCP

dump an OBCP

OIRD 2.2 + MN-3689/11 [CPM-3]

It shall be possible for the ground to inspect the loaded data/control parameters utilised by an OBCP at any time before, during or after the OBCP run.

OIRD 2.2 + MN-3689/11 [CPM-4]

It shall be possible for the ground to request a list of all OBCPs stored on-board.

OIRD 2.2 + MN-3689/11 [CTRL-4]

HK Telemetry shall be continuously generated and recorded in all modes of operations, including Survival Mode. However, when a Subsystem or Instrument - which nominally generates or relays HK Telemetry - is in a specific non-nominal mode (as : processor halted / reset) , this requirement does not apply to the concerned Subsystem or instrument.

OIRD 2.2 + MN-3689/11 [EVRP-4]

Input data to the anomaly detection function shall be recorded on-board such that they can be reported by the anomaly report packet for an appropriate interval of time centred around the time of occurrence of the anomaly. This requirement will in general be satisfied by nominal recording of data on the SSMM - only in the case of SSMM outage are special arrangements required.

OIRD 2.2 + MN-3689/11 [FTS-3]

It shall be possible by the ground to request the initiation of this connection test between CDMS and the on-board intelligent user

OIRD 2.2 + MN-3689/11 [INFT-1]

It shall be possible to activate any provided diagnostic mode of a unit without entering safe or survival mode of the spacecraft.

OIRD 2.2 + MN-3689/11 [INFT-2]

No fault management function shall trigger on test data generated by a unit operating in test mode.

OIRD 2.2 + MN-3689/11 [INFT-3]

Entering a test mode shall not require (or imply) disabling of fault management functions.

OIRD 2.2 + MN-3689/11 [MTL-1]

It shall be possible to load any telecommand (including those which operate on the MTL itself) into storage on-board for execution at a time specified at the time of uplink within the telecommand packet.

OIRD 2.2 + MN-3689/11 [MTL-10]

It shall be possible to request a report of the contents of the MTL, with the option of a full report or a summary only (limited to TC header and no data field).The options for MTL report shall include:

all commands;

commands between specified times;

individual commands.

These options shall be possible for either "all Application Process IDs" or "specified Application Process IDs only" or "specified filter class (Sub-schedule) only".

OIRD 2.2 + MN-3689/11 [MTL-3]

The MTL shall be capable of storing any and all the telecommands needed for the execution of all routine operations.

OIRD 2.2 + MN-3689/11 [MTL-5]

It shall be possible to suspend/resume MTL execution by telecommand.

OIRD 2.2 + MN-3689/11 [MTL-6 a]

It shall be possible to prevent execution of a specified subset of telecommands contained in the running MTL without having to stop the entire MTL. The selection shall be made by telecommand APID (or by using a filter class (Sub-schedule Identifier) defined at the time of the uplink.

OIRD 2.2 + MN-3689/11 [MTL-7]

It shall be possible to insert and append commands to the MTL, without the necessity of first stopping it.

OIRD 2.2 + MN-3689/11 [MTL-8 a]

It shall be possible to delete commands from the MTL, without the necessity of first stopping it. The delete options shall include:

all commands (i.e. to reset the MTL contents);

commands between specified times;

individual commands.

These options shall be possible for either "all Application Process IDs" or "specified Application Process IDs only" or "specified filter class (Sub-schedule) only"

OIRD 2.2 + MN-3689/11 [OBCP-1]

An OBCP shall be controllable (e.g. loaded, started, stopped…) from any command source.

OIRD 2.2 + MN-3689/11 [OBCP-2]

An OBPC shall be able to access telemetry , issue telecommands and issue event packets.

OIRD 2.2 + MN-3689/11 [OBMF-2.1]

The OBMF shall be active by default whenever the CDMS is active

OIRD 2.2 + MN-3689/11 [OBSR-10 a]

The storage of packets shall not be interrupted if the ground requests a deletion from, retrieval from, or reset of, the onboard storage.

OIRD 2.2 + MN-3689/11 [OBSR-2 a]

It shall be possible to record on the on-board storage all telemetry packets that are generated on-board , independent of the status of the transmission to ground.

OIRD 2.2 + MN-3689/11 [OBSR-2.1]

Storage shall be organised in virtual stores called Packet Stores. The selection of which Application ID and which packet type shall be stored in which Packet Store shall be maintainable by means of dedicated telecommands. Any number of different APIDs can be assigned to a specific Packet Store..

OIRD 2.2 + MN-3689/11 [OBSR-2.2 a]

It shall be possible to define a default Packet Store: i.e for each APID and packet type it shall be known to which packet store it shall be routed to by default. This default set of packet stores shall be active after initialisation or reset of the CDMU, if the packet store definition has been lost in the reset process.

OIRD 2.2 + MN-3689/11 [OBSR-5]

It shall be possible for the ground to retrieve selected telemetry packets (by Packet Store, Application ID, and packet time) from the on-board storage. Note: the most obvious use of this functionality will be to dump, at the start of the visibility period, all the event and TC verification packets (and selected housekeeping packets, TBD) with a shorter delay than all other packets.

OIRD 2.2 + MN-3689/11 [OBSR-6]

Housekeeping information shall be provided on the state of the onboard storage and retrieval function and to request details of which packets are assigned to which stores.

OIRD 2.2 + MN-3689/11 [OBSR-7 b]

Information on the used and available space on the onboard storage shall be reported in telemetry on request. Tthe information shall be provided for each packet store.

OIRD 2.2 + MN-3689/11 [OBSR-8]

It shall be possible for the ground to enable and disable the storage function for selected packets (all packets, by Packet Store, Application ID, packet type).

OIRD 2.2 + MN-3689/11 [OBSR-9 b]

It shall be possible for the ground (and only the ground) to clear the contents of the Packet Stores (specific stores or all) up to a specific storage time or completely. An acceptable implementation of complete deletion could be to allow a clear contents command with a time later than the last packet stored

OIRD 2.2 + MN-3689/11 [OBTM-2 a]

It shall be possible for the ground to request that the time reference within any on-board application (or on-board intelligent user) be synchronised with the CDMS Central Time Reference.

OIRD 2.2 + MN-3689/11 [OBTM-3 a]

It shall be possible for the ground to request generation of time verification report packets, to confirm that the time of any application or user is synchronised with the CDMS Central Time Reference.

OIRD 2.2 + MN-3689/11 [OBTM-6 a]

It shall be possible to synchronise the CDMS Central Reference Time with a ground-based clock.

OIRD 2.2 + MN-3689/11 [OTFM-7]

It shall be possible to enable/disable the routing of telecommand packets from a particular source to the destination by means of a dedicated telecommand.

Note: A possible use of this command would be to disable commands from the MTL whilst an instrument or subsystem was being recovered by commanding from the ground.

OIRD 2.2 + MN-3689/11 [PACK-9]

Telemetry parameters shall be sampled at a frequency ensuring that no information of operational significance, for all nominal and contingency operations, is lost.

OIRD 2.2 + MN-3689/11 [PERP-1]

An appropriate reserved downlink bandwidth shall be provided for the subset of telemetry housekeeping data which is essential and sufficient to characterise the current status of the spacecraft (and its payloads) and indicate whether there is an anomalous condition that requires ground intervention. Note: This will require the definition of a downlink priority scheme.

OIRD 2.2 + MN-3689/11 [PERP-6]

A pre-defined set of housekeeping report telemetry packets with a default generation frequency structured according to the different sources shall be available on-board. Note: Spare SIDs shall be available for the definition of new housekeeping telemetry packets.

OIRD 2.2 + MN-3689/11 [SCI-1 a]

Science data Packets shall be type 21.

OIRD 2.2 + MN-3689/11 [TC-11]

The telecommand history (including content) of on-board issued commands shall be kept on-board for interrogation (and/or deletion) by ground.

OIRD 2.2 + MN-3689/11 [TC-5]

It shall be possible to command the spacecraft or any subsystem or instrument into each of their pre-defined operation modes by means of a single telecommand Note: This could be achieved by initiating a high level On-Board Control Procedure via telecommand (see description 1.5.6 On-Board Procedures)

OIRD 2.2 + MN-3689/11 [TCV-9]

Direct confirmation of the effects of all executed telecommands should be provided in the housekeeping telemetry.

OIRD 2.2 + MN-3689/11 [TIM-4]

After switch on or reset, any unit shall flag in each packet with the time field that the time has not yet been synchronised

OIRD 2.2 + MN-3689/11 [TM-1]

The MOC shall be provided throughout the mission with the data, in raw form, required for the execution and analysis of all nominal operations and foreseen contingency operations for the spacecraft subsystems and instruments. Note: this top-level requirement covers the availability of all the data from any unit/payload, required for the conduct of operations, in the telemetry streams that is accessible at and processed by the MOC . This to avoid that essential telemetry might be downlinked in the science packets only, (which is not processed in the MOC).

OIRD 2.2 + MN-3689/11 [TM-3]

Telemetry data shall be provided to the ground such that complete and unambiguous assessment of the spacecraft and payload status and performance is possible without the need for reference to the telecommand history to interpret the data. Note: performance of instruments is related to the engineering data only and doesn't refer to the quality of scientific data production.

OIRD 2.2 + MN-3689/11 [TM-7]

Note: a mission critical action at the wrong time or in the wrong configuration could cause the loss of the spacecraft, or the degradation of the mission.

9.3. PSICD

PSICD 5.0 [6600-INFO]

Nominal Science Data Report (21,1)

PSICD 5.0 [6620-INFO]

Science Type B Data Report (21,2)

PSICD 5.0 [6640-INFO]

Diagnostic Science Report (21,3)

PSICD 5.0 [6660-INFO]

Auxiliary Science Data Report (21,4)

9.4. SOFDIR

SOFDIR 4.4 DR1 [ACF-001-C]

Nominal mode shall allow transition to an operational pointing mode under ground or MTL control.

SOFDIR 4.4 DR1 [CDF-001-C]

When the Sun Acquisition Mode is reached at separation from the Launcher, communication with Earth for TC shall be performed using omni-directional coverage provided by the LGA. By default, the TC Nominal rate (4kbps) shall be used.

SOFDIR 4.4 DR1 [CDF-003-C]

It shall be possible to use all TM/TC modes [F N: TM/TC modes are described in section 2.3.2.3] in Satellite Nominal Mode. Default TTC mode shall be :

SOFDIR 4.4 DR1 [CDF-004-C]

During Nominal Mode, all Housekeeping and science data from the instruments (if switched ON) and housekeeping from the spacecraft shall be stored in the mass memory.

SOFDIR 4.4 DR1 [CDF-006-C]

Communication with ground in TM and TC during survival mode shall be performed using the LGAs. The TC path shall use the low rate. The TM path shall use the 500bps low rate.

SOFDIR 4.4 DR1 [CDF-007-C]

All critical and modes change Commands shall use a secure command protocol (e.g. based on arm and fire mechanism).

SOFDIR 4.4 DR1 [CDF-008-C]

When the Sun Acquisition Mode is reached from any condition apart from separation from the Launcher, communication with Earth for TC shall be performed using omni-directional coverage provided by the LGA. By default, the TC low rate (125bps) shall be used.

SOFDIR 4.4 DR1 [GEF-004-C]

Launch Mode shall be the active mode from launch pad CheckOut Test Equipment disconnection up to completion of the On board activities performed after separation from the Launcher, aiming to set the spacecraft in flight operational configuration. S/C status and mandatory transition during Launch Mode shall be as described in RD8, unless specified in the present document.

SOFDIR 4.4 DR1 [GEF-005-C]

During launch mode, at a minimum, :

SOFDIR 4.4 DR1 [GEF-006-C]

During launch mode, HK data shall be stored in Mass Memory.

SOFDIR 4.4 DR1 [GEF-008-C]

When physical separation is detected :

SOFDIR 4.4 DR1 [GEF-011-C]

As a design goal considering the major launcher safety constraints, 20 seconds after separation the spacecraft shall be able to transmit telemetry and the ACMS shall be fully operational.

SOFDIR 4.4 DR1 [GEF-012-C]

In Sun Acquisition Mode mode, the spacecraft shall be in Sun-pointed attitude.

SOFDIR 4.4 DR1 [GEF-014-C]

In Sun Acquisition, the spacecraft real time HK rate shall be kept low enough (4kbps max) such that progressive download of the HK data stored during launch can be performed, upon ground request, when the Sun Acq Mode is reached after separation from the launcher.

SOFDIR 4.4 DR1 [GEF-020-C]

Transition to Nominal mode shall be performed from Sun Acquisition Mode or Earth Acquisition Mode only upon telecommand.

SOFDIR 4.4 DR1 [GEF-021-C]

It shall be possible to perform transition from Nominal modes to Sun Acquisition Mode or Earth Pointing Mode upon telecommand.

SOFDIR 4.4 DR1 [GEF-026-C]

During Nominal mode, the operations on both Herschel and Planck shall follow the commands defined by the on-board Mission TimeLine service defined in section 2.2.2.2.

SOFDIR 4.4 DR1 [GEF-028-C]

During Nominal mode, when ground link is available, the spacecraft shall be Earth pointed to download the scientific data stored in the mass memory during the whole duration of the visibility period.

SOFDIR 4.4 DR1 [GEF-030-H]

Herschel shall allow scientific observation and telecommunication in parallel.

SOFDIR 4.4 DR1 [GEF-032-C]

In survival mode, the spacecraft shall be put in safe conditions and it shall be able to survive for at least 7 days without ground contact.

SOFDIR 4.4 DR1 [GEF-033-C]

The Spacecraft safe condition shall be defined by :

SOFDIR 4.4 DR1 [GEF-040-C]

In Sun Acq Mode, Instruments shall be put in a safe mode following a sequence defined by each instrument

SOFDIR 4.4 DR1 [GEF-043-C]

As this could result in the loss of a significant mission time (e.g. to bring back the Planck cooling system to the right temperature), spacecraft shall switch to Survival Mode only in case of major power loss.

SOFDIR 4.4 DR1 [GEF-045-C]

Satellite mission shall be maintained without ground contact for any 48 hours period during the operational life, assuming no major failure condition.

SOFDIR 4.4 DR1 [GEF-049-C]

The FDIR shall provide means to :

SOFDIR 4.4 DR1 [GEF-050-C]

The FDIR process shall provide means to :

SOFDIR 4.4 DR1 [GEF-051-C]

The FDIR process shall provide means to :

SOFDIR 4.4 DR1 [GEF-052-C]

The FDIR shall provide means to :

SOFDIR 4.4 DR1 [GEF-053-C]

Any identified failure shall be suitably reported in Telemetry

SOFDIR 4.4 DR1 [GEF-064-C]

Every bus coupler shall be checked by the mean of :

SOFDIR 4.4 DR1 [GEF-068-C]

FDIR Level 3 corresponding errors shall be detected either by Hardware or Software while the recovery is performed by H/W, via the relevant reconfiguration module (i.e. CDM_RM or the ACC_RM).

SOFDIR 4.4 DR1 [GEF-070-C]

The failure which induces global system malfunction and which detection time is inconsistent with the spacecraft safety shall be detected by system alarms independent from software.

SOFDIR 4.4 DR1 [GEF-073-C]

When a level 4 alarm is activated on ACC, it shall be instantaneously taken into account and satellite shall directly go to Sun Acq Mode with ACMS in SM using the "survival set" of equipment and the redundant ACC Processor Module.

SOFDIR 4.4 DR1 [GEF-117-C]

When a level 4 alarm is activated on CDMU, it shall be instantaneously taken into account and satellite shall directly go to S/C Survival Mode.

SOFDIR 4.4 DR1 [GEF-123-C]

Following a CDMU level 3b alarm occurrence, the spacecraft Modes transitions and associated subsystem and functional modes shall be as specified in Fig 2.3.2 and tables 2.3.3 and 2.3.4 : the Mission TimeLine service execution shall be disabled and no OBCP shall be started by default. The MTL service execution shall only be re- enabled by TC .

SOFDIR 4.4 DR1 [GEF-124-C]

In case of CDMS Level 4 failures, the spacecraft Modes transitions and associated subsystem and functional modes shall be as specified in Fig 2.3.2 and tables 2.3.3 and 2.3.4 : the Mission TimeLine shall be disabled and no OBCP shall be started by default. MTL shall only be re-enabled by TC.

SOFDIR 4.4 DR1 [GEF-130-C]

The set of units to be used in S/C Survival Mode shall be modifiable by ground TC's.

SOFDIR 4.4 DR1 [GEF-133-C]

When the spacecraft switches to S/C Survival Mode, the alarm inputs able to trigger S/C Survival shall be inhibited.

SOFDIR 4.4 DR1 [GEF-140-C]

The execution of commands within the on board systems shall be based, where meaningful, on the following priority scheme

SOFDIR 4.4 DR1 [GEF-141-C]

The Housekeeping telemetry shall be continuously generated and acquired in all S/C operating modes, including Survival Modes. Obvious agreed exceptions are when the monitored unit is OFF/invalid.

SOFDIR 4.4 DR1 [GEF-147-C]

The Sun Acquisition Mode shall be entered (OR) :

SOFDIR 4.4 DR1 [GEF-150-C]

In Sun Acq Mode, the downlink TM rate shall be the Low1 rate (500bps) and use the omni directional antennae. Exception is when the Sun Acq Mode is engaged upon separation from the Launcher ; in that case the TM shall be set to Low2 (5kbps).

SOFDIR 4.4 DR1 [GEF-151-C]

Transition to Earth Acquisition Mode shall be performed (OR) :

SOFDIR 4.4 DR1 [GEF-152-C]

In Earth Acquisition Mode the spacecraft shall be maintained in an Earth pointing attitude using the nominal ACMS set of equipment

SOFDIR 4.4 DR1 [GEF-153-C]

The Default TM/TC configurations in EAM shall be:

SOFDIR 4.4 DR1 [GEF-154-C]

In EAM, instruments shall be turned into a safe (eg. standby) mode (defined by the instruments) or remain OFF.

SOFDIR 4.4 DR1 [GEF-155-C]

The EAM shall be exit upon :

SOFDIR 4.4 DR1 [GEF-160-C]

A permanent subschedule is defined by the fact that it is always enabled at the start or re-start of the MTL (eg. when the MTL service gets enabled)

SOFDIR 4.4 DR1 [GEF-161-C]

A transient subschedule is defined by the fact that it is always disabled at the start or re-start of the MTL (eg. when the MTL service gets enabled).

SOFDIR 4.4 DR1 [GEF-167-C]

An OBCP Shall only be stopped under one of the following conditions :

SOFDIR 4.4 DR1 [GEF-170-C]

It shall be possible to use ACMS Nominal (SCM and HCM for Planck) and Orbit Control Modes in Satellite Nominal Mode.

SOFDIR 4.4 DR1 [HP-SOFDIR-1553-REQ-0025]

DLL FDIR shall remain enabled by default in FDIR AFS Mode.

SOFDIR 4.4 DR1 [INF-002-C]

In this Sun Acquisition mode, the payload instruments shall be :

SOFDIR 4.4 DR1 [INF-003-C]

The instruments shall be individually powered ON by ground TC or MTL service and set to a safe mode (e.g. instrument safe mode), following procedures defined in the relevant IIDBs (AD5 to 9) and using services from the PS-ICD (AD2).

SOFDIR 4.4 DR1 [INF-005-C]

It shall be possible to operate all (or a subset of) Payload and Instruments modes in Satellite Nominal mode.

SOFDIR 4.4 DR1 [PCF-001-C]

Once sufficient Sun pointing is achieved, power generation shall be automatically switched to Solar Array.

SOFDIR 4.4 DR1 [PCF-002-C]

It shall be possible to use all Power Control Subsystem modes [F N: PCS modes are described in section 2.3.2.4] in Satellite Nominal mode. Default shall be SA mode.

SOFDIR 4.4 DR1 [TCF-001-C]

It shall be possible to use all Thermal Control Subsystem modes in Satellite Nominal mode.

9.5. IIDB HIFI

IIDB-HIFI 3.3 [HP-HIFI-REQ-0010]

The estimate for power load on the 28V main bus for the instrument is as the table below:

(Loads on the primary power bus for the different LCL's)

Unit code	Maximum Average Power.[3]) EOL (W)	Long Peak (W)	Short Peak (W)
FHICU main [1])	49.6	54.6	68.3
redundant		0	0
FHLCU main [2])	100.2	109	127
redundant		0	0
FHHRH	70.0	76	76
FHHRV	70.0	76	76
FHWEH	30.0	N.A.	32.8
FHWEV	30.0	N.A.	32.8
Total HIFI	**349.8**		

[1]) Including power for the FHFCU and FHIFH/V.

[2]) Including power for the FHLOU and FHLSU.

[3]) Maximum average of each line are not correlated. They are to be used for sizing the LCL, not for the power budget (use power dissipation for that).

Each unit with primary power requires separate LCL.

Table: 5.9.5-1 Load on Main bus, Primary Mode and Standby Mode

Note : The units power values of this table take precedence on values indicated in all ICD's given in Annex 1

IIDB-HIFI 3.3 §5.11.1.1

The resultant housekeeping and science data rate requirements for TM/storage are as follows:

Housekeeping data rate	2 Kbps*
Science data rate	98 Kbps

The resultant housekeeping and science data rate requirements for TM/storage are as follows:

Housekeeping data rate	2 Kbps*
Science data rate	98 Kbps

* Housekeeping data shall not be compressed.

IIDB-HIFI 3.3 §5.7.3

For the HIFI SVM units, the SVM TCS will provide monitoring during flight to verify the thermal slope for timescales >= 100s (ref CR 87 and IIDA section 5.7.5)

9.6. IIDB PACS

IIDB-PACS 3.3 [HP-PACS-5.9-0030]

The S/C shall provide the "Maximum Average", "Short Peak" and "Long Peak" power requirements (all values including DC/DC convert-er losses) of the SVM-mounted PACS units, as described in the table below.

Values of Power Power table 5.9-3 below are the only one applicable for all Industry budgets estimation and analysis, the values indicated in ICD drawings of Annex 1 are not to be used.

PROJECT CODE	Maximum average power demand (EOL, incl. margins) E^2 Writing (W)	Maximum average power demand (EOL, incl. margins) Spectro-scopy (W)	Maximum average power demand (EOL, incl. margins) Photo-metry (W)	Short Peak power demand (W)	Long Peak power demand (W)
FPDECMEC	22.0	63.0	25.9	67.1	79.5
FPBOLC (Including Cooler control)	6.6	6.6	48.6	48.6 (no short peak)	51.0 (less than 4 ms)
FPDPU	24.0	24.0	24.0	43.2 (inrush - less than 0.5 ms)	28.8
FPSPU	30.3 (*)	33.2 (*)	33.2 (*)	33.2 (no short peak)	35.04
TOTAL	82.9	126.9	131.7	N/A	N/A

(*) : FPSPU-Power is upper limit

Table 5.9-3: Power demand of Warm Units on the SVM

IIDB-PACS 3.3 [HP-PACS-5.11-0010]

During nominal observations in PACS Prime Mode, the S/C shall be capable of receiving data from PACS via the 1553 Bus with a maximum 24 hr average rate of 130 kbit/s, including all of the following forms of data :

Science data,

PACS Housekeeping,

Command Verification,

Event Handling,

any other type of transfered data.

IIDB-PACS 3.3 [HP-PACS-5.11-0020]

During PACS Prime Mode operation, the S/C shall be capable of receiving "burst mode" data from PACS via the 1553 Bus:

Maximum total duration: 30 minutes per 24 hour period.

Maximum 30 min. average data rate: not more than 300 kbit/s, including all of the following forms of data :

Science data,

PACS Housekeeping,

Command Verification,

Event Handling,

any other type of transferred data.

IIDB-PACS 3.3 [HP-PACS-5.11-0030]

During “parallel” observations (PACS and SPIRE instruments together), the S/C shall be capable of receiving data from PACS at a maximum 24 hr average rate of 60 kbit/s, including all of the following forms of data :

Science data

PACS Housekeeping,

Command Verification,

Event Handling,

any other type of transfered data.

IIDB-PACS 3.3 [HP-PACS-5.11-0050]

When PACS is operating in non-Prime mode, the S/C shall be capable of receiving data from PACS at a maximum 24 h average rate of 2 kbit/s, including all of the following forms of data :

PACS Housekeeping,

Command Verification,

Event Handling,

any other type of non-science transferred data.

9.7. IIDB SPIRE

IIDB-SPIRE 3.3

§5.11.1.2 For the purpose of possible (up to 5 minutes) higher instrument data-rates, the bus interconnecting the instrument and the HCDMU shall have the capability of handling a telemetry rate of > 200 kbps .

IIDB-SPIRE 3.3 [HP-SPIRE-REQ-0020]

The SVM shall provide the allocated power budget as defined hereafter.

The "average" and "peak" power values correspond to "worst-case" conditions, i.e. taking into account the specified supply bus voltage range : 26V and 29V.

Spire Operating Mode	[1]Max. Ave. BOL	[1]Max. Ave. EOL	[1]Long Peak BOL/EOL
Observing	95.3 W	95.3 W	TBD
Parallel	95.3 W	95.3 W	TBD
Serendipity	95.3 W	95.3 W	TBD
Standby	95.3 W	95.3 W	TBD
Cooler Recycle	95.3 W	95.3 W	TBD
On	15.3 W	15.3 W	TBD
Off	0 W	0 W	0

Project Code	Instrument Unit	Mean load per LCL
HSDPU	HS Digital Processing Unit	15.3 W [2]
HSFCU	HS FPU Control Unit	80.0 W [3]

([1]) The "average" and "peak" power values correspond to "worst-case" conditions, i.e. taking into account the specified supply bus voltage range : 26V ~ 29V. The average "with-margin", and peak "with-margin" total power loads are also to be provided.

([2]) The maximum associated "Long Peak" load on this LCL is understood to be the mean value (above) X 1.20, i.e. 18.5 W.

([3]) The **maximum** associated "Long Peak" load on this LCL is understood to be the mean value (above) X 1.20, i.e. 96 W.

Table 5.9-4: Power load on main bus

IIDB-SPIRE 3.3 [HP-SPIRE-REQ-0150 a]

SPIRE requires an average of 126 kbps of TM data rate during operations, and 2.0 kbps when in non-prime mode.

IIDB-SPIRE 3.3 [HP-SPIRE-REQ-0160 a]

For the purpose of possible (up to 5 minutes) higher instrument data-rates, the bus interconnecting the instrument and the HCDMU shall have the capability of handling a telemetry rate of > 200 kbps .

IIDB-SPIRE 3.3 [HP-SPIRE-REQ-0170 a]

In order to prevent data overflow in this Spire data storage, the HCDMU shall request packets from Spire at least as frequently as once per second .

IIDB-SPIRE 3.3 [HP-SPIRE-REQ-0630]

For pointed observations, SPIRE requires, an On-Target Flag. It will be provided in the spacecraft telemetry, and will specify the acquisition time to a precision of better than 0.1 second (TBC, to be relaxed). This is required for the correct processing of the Spire data on the ground; it is not required for Spire operations.

10.APPENDIX 2: SATELLITE STATE SUMMARY TABLES

10.1. GENARAL TABLE ORGANISATION

The specification uses the following state summary tables.

Satellite state

CDMS mode		notes:		ACMS mode	
TM / OBT		Rx rate		OBT, PM & SW	
PM & SW		TM rate		CRS / FDIR	
SCBP / MTL		Tx chain		GYROs	
FDIR / SrvCBH		Rx 1 Ant.		STRs	
launch straps		Rx 2 Ant.		RWs	
PCDU		CCU		LV enable	
Battery		SPIRE		RCS enable	
Power Source		HIFI		SREM	
Mass Memory		PACS		VMC	

GSE support

Power source		TC source		ENV simulator	

The table specification considers the global effective result and that implies typically the verification of several independent observable coherency.

The used "summarised" state values and their acronyms are explicated hereafter.

10.2. CDMS MODE

The "CDMS mode" field specifies the CDMS ASW operating mode that shall be active.

The possible values are the following:

Acronym	*Full signification*		
Launch	Launch Mode		
SAM	Sun Acquisition Mode		
EAM	Earth Acquisition Mode		
NOM	Nominal Mode		
SM	Survival Mode		

(see also appendix 8)

10.3. TM / OBT

The "TM / OBT" field specifies which of the two TRR board shall be selected provide the satellite with TM encoding and On board Time.

This state is determined from the "TM Encoder and ObtClk ACTIVE" relay position. This single relays is available for command only from ground (direct TC to CPDU on MAP-0) or from the RM (PAP).

The possible values are:

Acronym	Full signification		Note
A	TTR A is master	both TRR enable	nominal
B	TRR B is master	both TRR enable	degraded case
		TRR A or B disabled	degraded case not tested at IST level

Note; the other TRR functions –RM and CPDU– are dynamically arbitrated by the CSEL device in an alternative retry delay system, then are independent of the TM / OBT setting. In IST condition, RM / CPDU A will always be the master unless :

- the RM A is disabled (each RM as a specific RM enable relays that can be commanded from ground only (direct TC to CPDU on MAP-0)),
- TRR A RM has detected an alarm and run a reconfiguration sequence (next alarm trigger will be affected with a 10ms longer reaction delay which sets RM B master).

The "unit B" configuration shall be run on TM / OBT B.

10.4. PM & SW

The "PM" field specifies which of the two PM board shall be active, and which software image shall be active.

The allowed active PM is determined from the "ACTIVE PM" relay position. This single relays is available only for a command from ground (direct TC to CPDU on MAP-0) or from the RM (PAP).

The actual active PM is determined from the PM that is supplied. The PM supply requires that the corresponding LCL (31 for A and 32 for PM B) in the PCDU is ON and the CDMU internal "PM A" and "PM B" relays that command the "cold converters" are ON.

An incoherence between the "ACTIVE PM" relay state and the actually ON PM is nominally recognised as an alarm situation by the RM (both of them). A PM that boot and recognise a bad "ACTIVE PM" relay position will remain idle (to not interfere with the active one if both are set ON by mistake or from a failure in a PM relay.

For IST, the possible configurations out of CDMU boot or reconfiguration transients:

summary	PCDU		CDMU relays			
table	LCL 31	LCL 32	PM A	PM B	ACTIVE PM	
A	ON	ON	ON	OFF	A	nominal
B	ON	ON	OFF	ON	B	degraded case
	other configuration					anomaly or non IST tested degraded case

The information field recall also which of the two PM software image 1 or 2 shall have been loaded during PM boot (low or high part of the EEPROM). This is determined from the corresponding PM board relay "PM x status bit 0" when the software boots.

The overall "PM" state summary field possible values are:

Acronym	*Full signification*		*Note*
A1	PM A active Image 1 SW		nominal case
A2	PM A active Image 2 SW	failed EPROM or transient case while patching image 1	alarm or degraded case cyclically tested in alarm case test or as "PM B" configuration
B1	PM B active Image 1 SW	nominal after 3b or 4 alarm	
B2	PM B active Image 2 SW	nominal after "3c" alarm	
[xy]	the non active PM setting (to be used in case of 3, 3b or 4 alarm) is added into square brackets.		[B1] is nominal case case of 1 permanent PM failure is not tested at IST level

10.5. SCBP / MTL

The "SCBP" field specifies which Space Craft Bus Profile (CDMS 1553 bus profile) shall be active.

The possible values are:

Acronym	*Full signification*		*Note*
0	Profile 0		nominal for launch
1	Profile 1		nominal for EAM
2	Profile 2		nominal for NOM HIFI prime
3	Profile 3		nominal for NOM PACS prime
4	Profile 4		nominal for NOM SPIRE prime
5	Profile 5		nominal for SAM
6	Profile 6		nominal for SM
7	Profile 7		nominal for NOM PACS burst
8	Profile 8		nominal for NOM Parallel
other	Customised profile		degraded case not tested at IST level

The "MTL" field specifies in which state the thruster survival heaters shall be.

The possible values are:

Acronym	Full signification		Note
N/A	MTL software service is OFF and buffers in SSMM are not yet initialised		Transient at S/C ON
OFF	MTL software service is OFF (but buffers in SSMM are initialised)		Nominal in SAM (the ASW will reject the MTL (service 11) commands and the MTL service command other than the ON CDMS_TC(8,1,105) and report request (8,5,105)
Disabled	MTL software service is ON but the MTL TC realise is disabled		Nominal in EAM (or NOM when the MTL is not used)
ON	MTL software service is ON and MTL TC realise is enabled at least for one subschedule		Nominal for operation at L2

10.6. FDIR / SRVCBH

The "~~WD enable~~FDIR" field specifies in which ~~position~~ setting the ~~PM "WD enable" relay~~CDMS FDIR software service shall be set.

Note: the CDMS FDIR software service is always AFS when CDMS mode is not NOM.

The possible values are:

Acronym	Full signification		Note
AFS	Autonomous Fail Safe		nominal outside NOM mode
AFO	Autonomous Fail Operational		nominal in for observations (in NOM mode)

The "SrvCBH" field specifies in which state the thruster survival heaters shall be.

The possible values are:

Acronym	Full signification		Note
OFF			Transient at S/C ON
N only	LCL 17 is ON, LCL 18 is OFF		Nominal
R only	LCL 18 is ON, LCL 17 is OFF	N SrvCBH failed	Degraded case

Note 1: the survival heaters are the FIDR settings are independent.
Note 2: the survival heaters are under CDMS control and are independent from the ACMS (which controls a complementary set of heaters (see ACMS / RCS field)).
Note 3: each survival heater lines (N&R) ensures the heating of both A and B thruster branch at the same time, then SrvCBH setting is independent from RCS setting (used thrusters) at ACMS level.

10.7. LAUNCH STRAPS

The "launch straps" field specifies in which position the 8 separation straps relay shall be.

Height separation straps are used by the CDMS and ACMS RM and PM to detect the launcher separation. They are used in a complex redundancy scheme (for details see H-P-TN-AI-0024 "SVM design specification").

The possible values are:

Acronym	*Full signification*		*Note*
all ON	the 8 separation straps are open (on launcher condition)		nominal case for launch until separation
none	the 8 separation straps are open (flight condition)		nominal case for orbital life
x, y OFF only	only the "x" and "y" separation straps are open		degraded case not tested at IST level

The state referred by the specification is both the state of the simulated strap presence (relays in LPS SCOE) and their reading by the S/C in CDMS and ACMS Hk TM. Both data shall be verified as been consistent (NB. this is nominally done automatically by the database checks associated with the LPS SCOE commands).

10.8. PCDU

The "PCDU" field specifies which PCDU 1553 I/F is in use for its control.

The PCDU I/F are controlled by individual relays. Then both ON or both OFF configuration are possible, and the PCDU I/F inherit its I/F configuration from previous setting when the satellite is powered ON.

The possible values are:

Acronym	*Full signification*		*Note*
IF A	IF A is active IF B is OFF		nominal case
IF B	IF B is active IF A is OFF		degraded case
both OFF	both IF are OFF		transient state when switching over between the two IF as a stationary configuration, this is a not a possible situation (multiple failure)
both ON	both IF are ON		degraded case not tested at IST level (double failure)

10.9. BAT

The "BAT" field specifies which shall be the battery state as reported by the PCDU battery management electronics.

The field informs about the battery state of charge and the battery management state.

The possible values are (first term):

Acronym	*Full signification*		*Note*
> x% SOC	Battery state of charge shall be higher than x %.		usual verification of battery margin
100% SOC	Battery is fully charge and left isolated (no need for its power)		nominal case for most of the flight configurations
CHARGED (BS)		accurate simulation not necessary	
< x% SOC	Battery state of charge shall be lower than x%.		associated to specific verification of the DoD (level 4) alarms.

The possible values are (second term):

Acronym	*Full signification*		*Note*
CHG	Battery is charged from SA		The 3 BCR are ON
DSG	Battery is providing power to the bus		The 2 DBR are ON
TPR	Battery charge from SA is ending (taper charge)		Only 1 BCR is ON
	Battery is left isolated (only monitoring is running)		nominal case for most of the flight configurations

Acronym	*Full signification*		*Note*
(BS)	The flight battery is not connected and the test is conducted with the battery simulator instead.		

10.10.POWER SOURCE

The "Power source" field specifies which shall be the origin of the S/C power supply.

The possible values are:

Acronym	*Full signification*		*Note*
SA	Solar array supplies the S/C		nominal configuration for most flight configuration
BAT	Battery supplies the S/C		nominal for the launch only and possible worst case survival mode transition tests
UMB	Umbilical supplies the S/C		nominal only for the S/C preparation under the fairing
SA + BAT	Solar array supplies the S/C		possible to handle very high power transient configuration but not a nominal stable situation

10.11.SSMM

The "SMM" field specifies which shall be the configuration of the Mass Memory.

The possible values are:

Acronym	*Full signification*		*Note*
3 banks	MM A and MM B are bath configured with bank 0,1,2 in 0,1,2 position with nominal bank formatting as per §12.4.4		nominal configuration
A312	W x,y,z : MM W is configured with bank x,y,z in 0,1,2 position. The other if not also specified use default mapping Both MM A and B are formatted as per §12.4.4	bank A0 failed	degraded case cyclically tested at IST level as "unit B" configuration. to quicken test cases, two degraded case can be tested at the same time. ex A321 only, A032-B312
A032		bank A1 failed	
A032		bank A2 failed	
B312		bank B0 failed	
B032		bank B1 failed	
B03,		bank B2 failed	
B only	Only one MM is in use with default mapping if not specified and formatting as per §12.4.4	MM A failed	
A only		MM B failed	
≥ 1 bank	MM A and MM B are bath configured with bank 0 in 0 position with nominal bank formatting as per §12.4.2		quicker setting for short test

~~1.12.~~10.12.NOTE

The "Note" field is used for important reminder in specific cases.

10.13.RX RATE

The "Rx rate" field specifies configuration in which the TC down-link shall operate.

Beside the specification concentrate on the operational "rate" issue, the configuration check shall include all the Rx parameter checking, specifically reception thresholds, modulation, etc.

The possible values are:

Acronym	*Full signification*		*Note*
125bps	XPND 1 and 2 are configured for 125bps up-link.		nominal configuration for survival condition
4kbps	XPND 1 and 2 are configured for 4kbps up-link.		nominal configuration for DTCP and LEOP
other	bad setting or XPND failure		degraded case not tested at the IST level.

10.14.TX RATE

The "Tx rate" field specifies configuration in which the TM down-link shall operate.

Beside the specification concentrate on the operational "rate" issue, the configuration check shall include all the CDMS and active Tx parameter checking, specifically the sub-carrier modulation type (in TM encoder) and the RF modulation index (in XPND), etc.

A specific suffix is added when one of the transponder is configured for ranging.

The possible values are:

Acronym	*Full signification*		*Note*
500bps	CDMS and active XPND are configured for 500bps down-link.		nominal configuration for survival condition
5kbps	CDMS and active XPND are configured for 5000bps down-link.		nominal configuration for LEOP
150bps	CDMS and active XPND are configured for 150kbps down-link.		nominal configuration for survival DTCP beginning and end
1.5Mbps	CDMS and active XPND are configured for 1.5Mbps down-link.		nominal configuration for DTCP science data down-load

The possible other values are (suffix):

Acronym	*Full signification*		*Note*
+RNG	Ranging is active		
	Ranging is deactivated		

10.15.TX CHAIN

The "Tx chain" field specifies which units are in use for the transmission function.

Beside the specification concentrate on the operational "rate" issue, the configuration check shall include all the Tx parameter checking, specifically the modulation index, etc.

The possible value are (first part):

Acronym	*Full signification*		*Note*
OFF	the XPND Tx RF and TWTA are all OFF. The "XPND Tx" LCL is ON to supply the 1553 IF and allow the full commanding of the Rx part).		~~nominal configuration outside communication sessions~~
T.1(RF OFF) A.OFF(LCL ON)	XPND 1 ON, but RF output disabled, EPC A OFF but supplied (LCL ON).		nominal for launch
T.1 RF OFF	XPND 1 ON, but its RF output is disabled and the TWTA A is OFF (EPC and LCL)		nominal configuration out of communication sessions (this configuration allow to get XPND 1 telemetry from its 1553 I/F.
T.1 A.A	XPND 1 + TWTA A are in use		nominal configuration for communication sessions
T.1 A.B	XPND 1 + TWTA B are in use	TWTA A failed	degraded case not tested at IST level (need an ASW patch)
T.2 RF OFF	XPND 2 ON, but its RF output is disabled and the TWTA B is OFF (EPC and LCL)	all "B" XPND1 or TWTA-A failed	nominal configuration out of communication sessions (this configuration allow to get XPND 1 telemetry from its 1553 I/F.
T.2 A.B	XPND 2 + TWTA B are in use	all "B" XPND1 or TWTA-A failed	non nominal degraded case (double failure) but useful to test all "units B" at once.
T.2 A.A	XPND 2 + TWTA A are in use	XPND 1 Tx failed	degraded case not tested at IST level (need an ASW patch)

A warm-up	TWTA-A is in warm-up, the XPND 1 Tx RF circuit is ~~not necessarily~~ ON		nominal configuration for launch post separation phase and turn ON transient
B warm-up	TWTA-A is in warm-up, the XPND 2 Tx RF circuit is ~~not necessarily~~ ON	all "B" XPND1 or TWTA-A failed	degraded case for launch not tested during IST ~~("units B" configuration)~~
other			degraded or transient state not tested at IST level.

Note 1: the transmission chain turn ON requires 5 commands. The XPND Tx shall be supplied (LCL), its RF output shall be enabled (HLC), the EPC shall be supplied (LCL), turned ON (HLC) and its supply of the TWTAmp shall be enabled (HLC). The TWTAmp (high voltage) supply enable command acts on the EPC sequencer which keeps this command in memory and delay its action up to if the TWTAmp 180s warm-up sequence is not yet completed. Then the Tx chain may be in warm up while commanded for being fully ON du to the protective hardware delay in the EPC.

Note 2: in nominal configuration, when XPND 1 and TWTA A are used, the XPND 2 and TWTA B remain OFF (LCL and units). When after a failure (or for an "all B" test, the XPND 2 and TWTA B are used, the XPND 1 and TWTA A remain OFF (LCL and units).

The antenna used for the transmission (RFDN configuration) is added. Possible value are:

Acronym	*Full signification*		*Note*
LGA 1	LGA 1 is used for transmission		
LGA 2	LGA 1 is used for transmission		
MGA	MGA is used for transmission		

10.16.RX 1 ANT / RX 2 ANT

The " RX 1 / 2 Ant" field specify which antenna the transponder 1/2 are respectively working with.

The possible value are:

Acronym	*Full signification*		*Note*
LGA 1	XPND 1 / 2 is associated with LGA1 for Rx at least		
LGA 2	XPND 1 / 2 is associated with LGA 2 for Rx at least		
MGA	XPND 1 / 2 is associated with MGA for Rx at leat		

Note 1: the RX and Tx antenna associated with one XPND can be different. This is however a degraded case not tested in the frame of IST.

Note 2: the RFDN symmetry implies that each antenna / XPND configuration can be realised by 4 different combinations of the switches. Only the nominal RFSW configuration will be tested in the frame of the IST, and fully altered one.

To simplify the nominal / redundant unit testing, the "units B" B test will be realised with a special configuration which correspond to a double failure : (TX / RX 1 or TWTA A) AND (RFSW 1 or 3).

The corresponding 4 tested configuration are detailed in the next table.

The RF switches position for the ALL B case have been chosen because it comes directly from the base 1B,2B,3B,4B configuration, and switch between the MGA / LGA1 configuration using RFSW 2 and 4 instead of 1 and 3. The proposed configuration allows all the redundant functions of the TTC chain to be tested at once.

Beware that the RFSW configuration is not the default FDIR configurations which are designed to handle a single failure either at XPND + TWTA or et the RFSW level, not both at the same time.

Field	*setting*	*RF SW*	*Note*
Tx chain	T.1 A.A LGA 1	1B,2B,3B,4B	Nominal for LGA 1 use
Rx 1 Ant	LGA 1		
Rx 2 Ant	LGA 2		
Tx chain	T.1 A.A MGA	1A,2B,3A,4B	Nominal for MGA use
Rx 1 Ant	MGA		
Rx 2 Ant	LGA 1		
Tx chain	T.2 A.B LGA 1	1B,2A,3B,4B	all "unit B" configuration used for LGA 1 use.
Rx 1 Ant	LGA 2		
Rx 2 Ant	LGA 1		
Tx chain	T.2 A.B MGA	1B,2B,3B,4A	all "unit B" configuration used for MGA use.
Rx 1 Ant	LGA 1		
Rx 2 Ant	MGA		
others			degraded case not tested in the frame of the IST (either SPF FDIR related or not)

10.17.CCU

The "CCU" field specify in which state are the CCU.

The possible value are:

Acronym	*Full signification*		*Note*
OFF	The 2 CCU are OFF.		This is nominally a transient state only. The OBSW CCU management service may be ON and provide HK TM filled with irrelevant data.
A,B ON Hk	The 2 CCU are ON, and the OBSW CCU management service provides cryostat HK TM packets. at default sampling rate (512s)		Nominal
A,B ON 8s-Hk	The 2 CCU are ON, and the OBSW CCU management service provides cryostat HK TM packets. at 8s sampling rate.		Nominal for launch
A ON Hk	Only 1 of the CCU is ON.	CCU B failed	all "unit B" configuration
B ON Hk	The OBSW CCU management service provides the cryostat HK TM from this single unit.	CCU A failed	
other			transient states or degraded cases not tested.

10.18.SPIRE

The "SPIRE" field specify which mode the HFI instrument is operating.

The possible values are:

Acronym	*Full signification*		*Note*
OFF	The instrument is fully OFF		
INIT	SPIRE is in "INIT" mode. This is a transient state between the OFF and ON state.		This state is the base for DPU soft patching (instrument commissioning).
ON	SPIRE is in "ON" mode. Only the PDU is ON. HK is provided.		
STBY	SPIRE is in "READY" mode. The full instrument is powered but is in standby providing only HK TM.		Warning this is not the SPIRE "STD BY" mode which produces reduced science data.
PHTM	SPIRE in "photometry" mode. It provides science data.		
SPECTRO	SPIRE in "spectrocopy" mode. It provides science data.		
Cooler	SPIRE is in "Cooler Recycle". Only HK is provided.		
SAFE	SPIRE is in "SAFE" mode. Only the DPU is ON, and provides HK TM.		Entered when the instrument self detect an error.
CMSNG	SPIRE is in "Commissioning".		DPU SW ignores all errors.
others	TBW-25 possibly		INIT and ON

The possible coupled configuration with the ACMS are called "POF" the following :

		SPIRE steering mirror mode					
		FIXED	CHOPPER	JIGGLE 7P	JIGGLE 64P		
ACMS pointing mode	POINT	X	POF1	POF2	POF3		
	NODDING	X	POF1 option	POF2 option	X		
	SCANNING	POF5	POF6	X	X		
	RASTERING	X	X	X	POF4		

POF7 = peak up mode, in association with POF2 and POF3 type of operation.

POF8 = calibration.

POF9 = debug.

The serendipity and parallel mode use the POF 5 configuration.

The POF number will be added in the table field when relevant (science).

10.19.PACS MODE

The "PACS" field specifies the ACMS ASW operating mode that shall be active.

The possible values are:

Acronym	*Full signification*		*Note*
OFF	The instrument is fully OFF		
INIT	PACS is in "INIT" mode. This is an intermediate step between the OFF state and "STBY" mode.		This state is the base for DPU soft patching (instrument commissioning).
STBY	PACS is in "SAFE" mode. The full instrument is powered but is in standby providing only HK TM.		
NON-PRM	PACS is in "NON PRIME". The mode is similar to SAFE except that HK TM rate is reduced by a factor of 2.		
OBS	PACS is in "OBS" mode. This is an intermediate step between the SAFE mode and the instrument operation.		
PRM	PACS is in "PRIME" mode. It provides science data.	PRM-CAL PRM-LNSP PRM-RGSP PRM-DBPH PRM-SBPH	Calibration Line Spectroscopy Range Spectroscopy Dual Band Photometry Single Band Photometry
PRL	PACS in "PARALLEL" mode. It provides science data.	PRL-SBPH PRL-DBPH	Single Band Photometry Dual Band Photometry
Cooler	PACS is in "Cooler Recycle". Only HK is provided.		
RESCUE	PACS is in "RESCUE" mode. This is an intermediate mode between the OFF state and "INIT" mode.		This mode is entered at boot in specific (error) conditions.
DTCCR	PACS is in "DETECTOR CURING" mode.		
others	TBW-25 possibly		

The possible coupled configuration with the ACMS are the following (TBC-25 for slicer):

		PACS CHOPPER		PACS GRATTING(*)			
		FIXED	CHOPPER	FIXED	SCAN		
ACMS pointing mode	POINT	YES	X	X	YES	1 point or point switching	
	NODDING	YES	X	?	?		
	SCANNING	YES	YES	?	?		
	RASTERING	YES	YES	?	?		

(* in spectrometer modes (slicer))

Chopper and Grating are synchronised with ACMS through the MTL.

The POINTING, RASTER and NODDING capability are used also in conjunction of Solar System Objects tracking.

10.20.HIFI MODE

The "PACS" field specifies the ACMS ASW operating mode that shall be active.

The possible values are:

Acronym	*Full signification*		*Note*
OFF	The instrument is fully OFF		
INIT	HIFI is in "INTERMEDIATE" mode. This is an intermediate step between the OFF state and "STBY" mode.		This state is the base for DPU soft patching (instrument commissioning).
STBY	HIFI is in "STAND-BY" mode. The full instrument is powered but is in standby providing only HK TM.		
PRM	HIFI is in " PRIME" mode. It provides science data.		
RESCUE	HIFI is in "RESCUE" mode. This is an intermediate mode between the OFF state and "INIT" mode.		This mode is entered at boot in specific (error) conditions.
others	TBW-25 possibly		

10.21.ACMS MODE

The "ACMS mode" field specifies the ACMS ASW operating mode that shall be active.

The possible values are the following:

Acronym	*Full signification*		
SBM	Standby Mode		Nominal for launch
SAM	Sun Acquisition Mode		
SCM	Science Mode	(SUN) (EARTH) (PT ½) (OBS)	Sun and Earth pointing are based on ACMS ~~propagators~~ephemerides. PT ½ is inertial fix pointing chosen to be about mid course between Earth and Sun at time of test. OBS is any observation mode
OCM	Orbit Control Mode	(SUN) (EARTH) (PT ½) (ΔV)	
SASM	Sun Acquisition Survival Mode		in case of ACMS alarm and ACMS reconfiguration
SBSM	Survival Stand by Mode		Transient only to SASM

The ACMS sub-state in the mode and the target (when applicable) are usually added.

Acronym	*Full signification*		
pre sep post sep	SBM sub-state "post sep" is transient only		
(CS) or (FN)	SAM and OCM stable sub-state "Coarse" or "Fine"		the sub-states is linked to the "Coarse" or "Fine" RCS setting nominal operation requires to move out of SAM or OCM mode to other modes from the "FINE" state.
Sun Acq	transient SAM and SASM sub-state the stable state is "pointing"		
slewing thrusting	transient OCM sub-state		the ACMS return to "pointing" state when the commanded manoeuvre is done. i
slewing	transient SAM and HCM mode sub-state		

(see also appendix 8).

10.22.OBT, PM & SW

The "OBT ~~, PM & SW~~" field specifies first which of the two TRR board shall be selected provide the ~~satellite with TM encoding and~~ACMS On board Time.

This state is determined from the "TM Encoder and ObtClk ACTIVE" relay position (but there is no TM encoder in ACC). This single relays is available for command only from the CDMS or from the ACC RMs (PAP).

The possible values are:

Acronym	Full signification	note	Note
A	TTR A is master	both TRR enable	nominal
B	TRR B is master	both TRR enable	degraded case
		TRR A or B disabled	degraded case not tested at IST level

Note; the other TRR functions –RM and CPDU– are dynamically arbitrated by the CSEL device in an alternative retry delay system, then are independent of the TM / OBT setting. In IST condition, RM / CPDU A will always be the master unless :

- the TRR A is disabled (each RM as a specific RM enable relays that can be commanded from ground only (direct TC to CPDU on MAP-0)),
- TRR A RM has detected an alarm and run a reconfiguration sequence (next alarm trigger will be affected with a 10ms longer reaction delay which sets TRR B master).

The "PM" field specifies which of the two PM board shall be active, and which software image shall be active.

The allowed active PM is determined from the "ACTIVE PM" relay position. This single relays is available only for a command from ground (direct TC to CPDU on MAP-0) or from the RMs (PAP).

The actual active PM is determined from the PM that is supplied. The PM supply requires that the corresponding LCL (31 for A and 32 for PM B) in the PCDU is ON and the CDMU internal "PM A" and "PM B" relays that command the "cold converters" are ON.

An incoherence between the "ACTIVE PM" relay state and the actually ON PM is nominally recognised as an alarm situation by the RMs (both of them). A PM that boot and recognise a bad "ACTIVE PM" relay position will remain idle (to not interfere with the active one if both are set ON by mistake or from a failure in a PM relay.

For IST, the possible configurations out of CDMU boot or reconfiguration transients:

summary	PCDU		CDMU relays			
table	LCL 31	LCL 32	PM A	PM B	ACTIVE PM	
A	ON	ON	ON	OFF	A	nominal
B	ON	ON	OFF	ON	B	degraded case
	other configuration					anomaly or non IST tested degraded case

The field recall also which of the two PM software image 1 or 2 shall have been loaded during PM boot (low or high part of the EEPROM). This is determined from the corresponding PM board relay "PM x status bit 0" when the software boots.

The field recall also in which mode the PM software shall boot : normal or survival (shortened boot sequence). This is determined from the corresponding PM board relay "PM x status bit 1" when the software boots.

The overall "PM" state summary field possible values are:

Acronym	*Full signification*		*Note*
A1N	PM A active Image 1 SW Normal boot mode		nominal case
B1S	PM B active Image 1 SW Survival boot mode		"nominal" case after a level A or 3b alarm
B1N	PM B active Image 1 SW Normal boot mode	inverted configuration after some non permanent trouble with PMA	degraded case cyclically tested at IST level ("PM B" configuration)
A1S	PM A active Image 1 SW Survival boot mode		
X2Y	image 2 configuration	failed EPROM or transient case while patching image 1	
[XYS]	the non active PM setting (to be used in case of 3b or 4 alarm) is added into square brackets.		[B1S] is nominal case case of 1 permanent PM failure is not tested at IST level Note: the redundant unit is always configured for survival boot mode.

10.23.CRS / FDIR

The "CRS" field specifies how the CRS 1 and 2 shall be affected.

The 2 CRS may be allocated to 2 functions : SM survival ACMS operation and ARAD (Angular Rate Anomaly Detector).

The possible values are:

Acronym	*Full signification*		*Note*
OFF	CRS 1, 2 are OFF		ground operation
ON, 1A, 2S	CRS 1 ON, used for ARAD, CRS 2 ON, used for SM.		nominal
2A, 2S (1 OFF)	CRS 2 ON, used for both ARAD and SM. CRS 1 OFF.	case CRS 1 failed	degraded case cyclically tested at IST level
1A, 1S (2 OFF)	CRS 1 ON, used for both ARAD and SM. CRS 2 OFF.	case CRS 2 failed	
other			degraded case not tested at IST level (multiple failure)

The "FDIR" field specifies in which mode the ACMS FDIR shall operate.

The possible values for the FDIR are:

Acronym	*Full signification*		*Note*
AFS	Autonomous Fail Safe		nominal for all modes except for observation
AFO	Autonomous Fail Operational		nominal for observations, but also recommended as default
other	N/A		

10.24.GYROS

The "GYROS" field specifies how the 4 GYROS heads and their redundant electronics shall be affected.

The possible values are:

Acronym	*Full signification*		*Note*
OFF	GYRO are OFF		nominal in SBM, SAM & SM
A,B,C IF 1 ON	IF 1 is turn ON, The data from the gyro heads A B and C are used. head D data is used only for FDIR		nominal in NOM or OCM
B,C,D IF 1 ON	IF 1 is turn ON, The data from the gyro heads A B and C are used.	head A failed	degraded case cyclically tested at IST level (case head D failed that implies only that FDIR check sum is no more available, is considered covered by the other cases)
A,C,D IF 1 ON	IF 1 is turn ON, The data from the gyro heads A B and C are used.	head B failed	
A,B,D IF 1 ON	IF 1 is turn ON, The data from the gyro heads A B and C are used.	head C failed	
A,B,C IF 2 ON	IF 1 is turn ON, The data from the gyro heads A B and C are used.	IF 1 failed	
other			degraded case not tested at IST level (multiple failure)

10.25.STR

The "STR" field specifies which of the two STR board shall be active.

Note that the ACMS control the STR ON/OFF at unit level but CDMS control the STR LCLs.

The possible values are:

Acronym	Full signification	note	Note
OFF	both STR are OFF		nominal for launch
LCL A B ON	STR LCL are activated by CDMS but CDMS left them OFF		nominal for SM or SAM
A (LCL B ON)	STR A is active and B LCL is set		nominal for SCM, HCM, OCM
B (LCL A ON)	STR A is active and B LCL is set		degraded case tested at IST level ("units B" configuration)
A & B ON	STR A is active for ACMS but B is also ON		nominal for testing one STR while the other is used for ACMS
B & A ON	STR B is active for ACMS but A is also ON		
other			degraded case not tested at IST level

10.26.RW

The "RW" field specifies how the 4 RW shall be affected.

The possible values are:

Acronym	*Full signification*		*Note*
OFF	The 4 RW are OFF		nominal in SBM, SAM & SM
1,2,3,4 ON	The 4 RW are used in hot redundancy.		nominal in NOM or OCM
2,3,4 ON	only 3 RW are used, the 4th is OFF	RW 1 failed	degraded case cyclically tested at IST level
1,3,4 ON		RW 2 failed	
1,2,4 ON		RW 3 failed	
1,2,3 ON		RW 4 failed	
1,2,3,4 ON	When running with "PM B", the nominal ACC IO-N IF is marked failed to force the use of the redundant IO IF.	IO-N failed	
other			degraded case not tested at IST level (multiple failure)

10.27.LV ENABLE

The "LV enable" field specifies if the use of the propulsion system is allowed or not by the CDMS and used by the ACMS.

For safety, the CDMS control the LCL that supply the ACC command electronics for the LV (tank latch valves) and the RCS (thruster flow control valves) (this provides 2 safety barriers).

The possible values are:

Acronym	Full signification	note	Note
OFF	LCL are OFF and prevent a spurious propulsion system activation		nominal for launch
ON all closed	A and B LCL are activated by CDMS to allow operation but the two LV are closed		
ON, A open	A and B LCL are activated by CDMS to allow operation and ACMS has open branch A for operation		nominal after launch
B ON, all closed	B LCL are activated by CDMS to allow operation on B only	A LV failed closed	degraded case after a failure in the LV command chain that preclude its use and A branch use.
B ON, B open	B LCL are activated by CDMS to allow operation in B only and ACMS has open branch B for operation		
B ON, A open	B LCL are activated by CDMS to allow survival operation on B, but ACMS continue to use branch A for nominal operation	B LV failed closed	degraded case not tested at IST level
other			degraded case not tested at IST level

10.28.RCS ENABLE

The "LV and RCS" field specifies if the use of the propulsion system is allowed or not by the CDMS.

For safety, the CDMS control the LCL that supply the ACC command electronics for the LV (tank latch valves) and the RCS (thruster flow control valves) (this provides 2 safety barriers).

The possible values are:

Acronym	Full signification	note	Note
OFF	LCL are OFF and prevent a spurious propulsion system activation		nominal for launch
ON, CBH A ON	A and B LCL are activated by CDMS to allow operation and ACMS has open branch A for operation		nominal after launch
ON, A FIRING			nominal transient (possibly long during OCM)
B ON, CBH ON	A and B LCL are activated by CDMS to allow full operation on B thruster	some A thruster function failed	degraded case after a thruster or thruster command failure
B ON, B FIRING			
other			degraded case not tested at IST level (for example, 20N CBH are cross strapped, then keeping A LCL on allow further degraded cases)

10.29.VMC, SREM

The "VMC and SREM " field specifies the state of the auxiliary payloads.

The possible values are for VMC:

Acronym	Full signification	note	Note
OFF	the unit is OFF		nominal for most S/C life except for the post separation sequence
ON	the unit is ON taking image		nominal after launch
ON	the unit is ON with image in memory available for down load		nominal after launch
other			degraded case not tested at IST level

The possible values are for SREM:

Acronym	Full signification	note	Note
OFF	the unit is OFF		nominal for launch and LEOP
ON	the unit is ON and integrating		nominal after launch
ON SW OFF	the unit is ON but the associated CDMS-BSW service is OFF		nominal transient after CDMS level 3 alarm or CDMS PM reset cases
other			not tested at IST level

10.30.POWER SOURCE

The "Power source" field specifies the SCOE setting for supplying the S/C.

The possible values are:

Acronym	Full signification	note	Note
UMB	the LPS provides power to S/C		nominal before launch
SAS	the SAS provides power to S/C		nominal after launch
BS	the BATSIM provide power		nominal for testing launch mode in sequence where the FM battery is not connected.
none	the S/C is OFF or supplied from FM battery		nominal for launch sequence and clean run.

Note: the fact that SAS is providing power to the S/C does not preclude that BS (or FM battery) can be also required to provide some power to handle S/C peak of power consumption (this may be necessary to handle some RW peak demand).

10.31.TC SOURCE

The "TC source" field specifies the SCOE setting for sending TC to the S/C and for getting TM (unless otherwise stated in the sequence requirements).

The possible values are:

Acronym	Full signification	note	Note
UMB	TC and TM are sent / get through the umbilical link.		nominal before launch (or to spy TM activity when the TWTA is OFF)
LGA1	the SAS provides power to S/C		nominal in Launch, SAM and SM mode.
MGA	the BATSIM provide power		nominal in NOM and EAM.

~~Note 1: the TM source switching causes necessarily some TM packet loss. For some sequence as 7.8.5 and 7.8.6, TBC-35, it could be chosen to keep the TM flux on UMB to keep monitoring continuous, being confident upon SCOE indication of correct data modulation on the RF input when necessary.~~

Note 2: the VC0 and VC1 for TC shall be used alternatively when no specific need require it else (i.e. some TRR board functions are accessible only when addressing the VC of its TC decoder). VC0 if test day is odd. VC1 if test day is even.

10.32.ENV SIMULATOR

The "ENV simulator" field specifies the ACMS SCOE setting.

The possible values are:

Acronym	Full signification	note	Note
stand by	the ACMS SCOE is ON and configured but not allowed to provide ACMS sensor stimulation		ACMS 1553 bus monitoring is active. Actuator activity monitoring is active
initialised	the ACMS SCOE only wait for a trigger command to begin close loop simulation starting from given initial condition.		
close loop	the ACMS SCOE stimulates the ACMS sensor according to the S/C attitude it computes, considering the actuator action history		Nominal case for test.

11. APPENDIX 3: OPERATION GENERAL PROCEDURE SPECIFICATION

The following paragraph gives the reference of the applicable operation specification which shall be used for running the IST tests.

WARNING: the applicable procedures are strongly linked to the satellite configuration and specifically the active CMDS and ACMS OBSW versions.

11.1. GENERAL PROCEDURES

Action	Reference	Note
Satellite turn ON	TBW-26, to be derived from: H-P-3-ASP-TS-0986, "Planck S/C ON OFF procedure for early SVM + PPLM AIT activity"	warning: the applicable procedure is strongly linked to active CMDS and ACMS OBSW version.
Satellite turn OFF		
ACMS turn ON	TBW-27	
ACMS turn OFF		
SSMM configuration	TBW-29, to be derived from appendix 4.	
Monitoring of equipment with limited life time or cycle number.	H-P-3-ASP-TS-1102, "Herschel equipment with limited cycles"	AD04

11.2. S/C OPERATION PROCEDURES (DATA MANAGEMENT)

The RD33 annexe 1 to section 3.4 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
Z010999MPFC204_ H_SC_MODE_TRANSITION	Spacecraft mode transition	LEOP, COP, PVP, ROP	
Z010999MPFC007_ H_DTCPHERSCHEL	DTCP	ROP	
Z010999MPFC00x HERSCHEL	system calibration	PVP, ROP	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.3. S/C OPERATION PROCEDURES (AOCS)

The RD33 annexe 1 to section 3.4 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
Z010999MPFC006_ H_SSO_TRACKING	Solar Object Tracking	PVP	
Z010999MPFC005_ H_PEAK_UP	Peak-up	PVP	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.4. CDMS OPERATION PROCEDURES

The RD18 vol. 8 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
	Define housekeeping or diagnostic packet	Nominal	
	Clear housekeeping or diagnostic packet	Nominal	
	Start or stop the whole ASW internal event filtering function	Nominal	
	Set timeout for ASW internal event filtering	Nominal	
	Report ASW event filter function and settings	Nominal	
	Switch to TM encoder A and OBT A	Nominal	
	Switch to TM encoder B and OBT B	Nominal	
	Switch PM A ON or OFF	Nominal	
	Switch PM B ON or OFF	Nominal	
	Read TTR CROME registers	Nominal	
	Abort current memory dump	Nominal	
	Dump and interpretation of Reconfiguration Log	Nominal	
	Dump and interpretation of Unit in Use table	Nominal	
	Dump and interpretation of CEL	Nominal	
	Dump and interpretation of SEL	Nominal	
	Map a MM ID to a MM bank	Nominal	
	Switching a MM bank ON or OFF	Nominal	
	MM ID re-initialisation	Nominal	
	Remote terminal synchronisation with bus controller	Nominal	
	Time Verification	Nominal	
	Set central time reference synchronisation	Nominal	

ID	Procedure name	Usage	Comments
	Enable or disable release of TC from MTL	Nominal	
	Clearing the complete MTL	Nominal	
	Normal MTL maintenance	Nominal	
	Starting or stopping the MTL function	Nominal	
	Report MTL function	Nominal	
	Dump MTL summary or detailed report	Nominal	
	Enable or disable the on board monitoring for a parameter	Nominal	
	Clearing the complete monitoring table	Nominal	
	Monitoring table maintenance	Nominal	
	Starting or stopping the on board monitoring	Nominal	
	Report monitoring function	Nominal	
	Enable or disable the generation of an housekeeping or diagnostic packet	Nominal	
	TM packet routing to downlink or MM or both	Nominal	
	Enable or disable storage in a MM packet store	Nominal	
	Allocate or de-allocate TM type and subtype to a MM packet store	Nominal	
	TM packet store downlink and maintenance	Nominal	
	Packet store creation and VC 2, 3 allocation	Nominal	
	Packet store deletion	Nominal	
	Perform connection test	Nominal	
	Load or delete an OBCP	Nominal	
	Start or stop an OBCP	Nominal	
	Suspend or resume an OBCP	Nominal	
	Set OBCP parameters	Nominal	
	Dump OBCP code	Nominal	
	Start or stop the whole OBCP function	Nominal	
	Report OBCP management function	Nominal	

ID	Procedure name	Usage	Comments
	Clear the complete event-action table	Nominal	
	Event-action table maintenance	Nominal	
	Start or stop the whole event-action function	Nominal	
	Report event-action management status or event detection list	Nominal	
	Bus profile maintenance	Nominal	
	Select a bus profile to be active	Nominal	
	Enable or disable burst mode for a remote terminal	Nominal	
	Configure 1553 bus FDIR for a remote terminal	Nominal	
	Enable or disable TC routing to an APID	Nominal	
	Start or stop the whole FDIR function	Nominal	
	Set AFO or AFS status of FDIR	Nominal	
	Maintenance of FDIR cross correlated checks	Nominal	
	Verify configuration matrices for FDIR	Nominal	
	Report FDIR management function and FDIR cross correlated table	Nominal	
	Start or stop the whole PCDU management function	Nominal	
	Report PCDU Management function and PCDU configuration via ASW	Nominal	
	Start or stop the whole TTC management function	Nominal	
	Report TTC management function, parameters and TM encoder	Nominal	
	Start or stop the whole mode management function	Nominal	
	Report mode management function and current spacecraft mode	Nominal	
	Start or stop the whole payload function	Nominal	
	Report payload management function and payload status	Nominal	

ID	Procedure name	Usage	Comments
	Start or stop the whole decontamination heating function	Nominal	
	Report decontamination heating function and parameters	Nominal	
	Start or stop the whole thermal control function	Nominal	
	Report thermal control function and loop parameters	Nominal	
	Start or stop the whole reconfiguration module (TTR) function	Nominal	
	Report reconfiguration module (TTR) status	Nominal	
	Set configuration of CIR relay	Contingency	
	Set configuration of SIR relay	Contingency	
	Reset MM A	Contingency	
	Reset MM B	Contingency	
	Recovery after MM A failure	Contingency	
	Recovery after MM B failure	Contingency	
	Reset PM A	Contingency	
	Reset PM B	Contingency	
	PM switchover A to B	Contingency	
	PM switchover B to A	Contingency	
	Configuration of PM A relay 0 and 1	Contingency	
	Configuration of PM B relay 0 and 1	Contingency	
	Enable or disable watchdog	Contingency	
	Enable or disable Reconfiguration Module A	Contingency	
	Enable or disable Reconfiguration Module B	Contingency	
	Dump and interpretation of SGM	Contingency	
	Update the FDIR health table	Contingency	
	Modify the on board Unit configuration for FDIR	Contingency	

ID	Procedure name	Usage	Comments
	Copy of Safeguard Memory	Contingency	
	Reconfiguration Module Hardware Alarms Maintenance	Contingency	
	Reconfiguration Module PAP Table Maintenance	Contingency	
	Enable or Disable Reconfiguration Module CPDU TC	Contingency	
	Reconfiguration Module Survival Context Maintenance	Contingency	
	Reconfiguration Module CROME Register Maintenance	Contingency	
	Enable/Disable Writing to SGM in Reconfiguration Module	Contingency	
	Force Separation Strap Detection	Contingency	
	Dump SGM memory area	Contingency	
	Read, Write, Check access to CPU RAM Memory Area	Contingency	
	Read, Write, Check access to PM EEPROM Memory	Contingency	
	Write and Check access to TTR EEPROM Memory Area	Contingency	
	Read the ERC32 Registers	Contingency	
	Read, Write the PM COCOS Registers	Contingency	
	Read, Check access to PM PROM Memory Area	Contingency	
	Copying content of a memory area to another	Contingency	
	Write, Dump and Check Mass Memory Addresses	Contingency	
	Reset TM encoder	Contingency	
	Use of special TC (map 5 and 6)	Contingency	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.5. CCU AND TELESCOPE RELATED PROCEDURES

The RD33 annexe 1 to section 3.4 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
Z010999MPFC002_ CCU_MANAGEMENTCCU	CCU management	LEOP, COP, PVP, ROP	
Z010999MPFC003_ H_START_DECONT	Start of HERSCHEL telescope decontamination	LEOP	
Z010999MPFC004_ H_STOP_DECONT	Stop of HERSCHEL telescope decontamination	COP	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.6. VMC AND SREM PROCEDURES

The RD33 annexe 1 to section 3.4 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
Z010999MPFC001_ VMC_MANAGEMENT	VMC management	LEOP	
Z010999MPFC202_ H_SREM_MANAGEMENT	SREM Management	LEOP, COP, PVP, ROP	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.7. PCS OPERATION PROCEDURES

The RD18 vol. 8 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
	Set DoD voltage threshold	Nominal	
	Set EoC level	Nominal	
	Switchover from N to R TMTC	Nominal	
	Switchover from R to N TMTC	Nominal	
	Redundant HPS switch ON	Nominal	
	Redundant HPS switch OFF	Nominal	
	Nominal HPS switch ON	Nominal	
	Nominal HPS switch OFF	Nominal	
	NCA activation	Nominal	
	BCRs isolation	Contingency	
	BDRs input switch reset	Contingency	
	BDRs APS reset	Contingency	
	DNEL reset	Contingency	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

11.8. TTC-RF OPERATION PROCEDURES

The RD18 vol. 8 procedures are applicable. They are listed hereafter.

ID	Procedure name	Usage	Comments
	Switch ON TX1 and TWTA1	Nominal	
	Switch OFF TX1 and TWTA1	Nominal	
	TX1 and TM encoder configuration for LR1	Nominal	
	TX1 and TM encoder configuration for LR2	Nominal	
	TX1 and TM encoder configuration for MR	Nominal	
	TX1 and TM encoder configuration for HR	Nominal	
	Select RX1 TC bit rate	Nominal	
	Switch ON TX2 and TWTA2	Nominal	
	Switch OFF TX2 and TWTA2	Nominal	
	TX2 and TM encoder configuration for LR1	;Nominal	
	TX2 and TM encoder configuration for LR2	Nominal	
	TX2 and TM encoder configuration for MR	Nominal	
	TX2 and TM encoder configuration for HR	Nominal	
	Select RX2 TC bit rate	Nominal	
	Configure RFDN switches	Nominal	
	Switch ON TX and TWTA in use	Nominal	
	Switch OFF TX and TWTA in use	Nominal	
	TX and TM encoder in use configuration for LR1	Nominal	
	TX and TM encoder in use configuration for LR2	Nominal	

ID	Procedure name	Usage	Comments
	TX and TM encoder in use configuration for MR	Nominal	
	TX and TM encoder in use configuration for HR	Nominal	
	Select TC bit rate on RX in use	Nominal	
	Configure TX1	Contingency	
	Configure TX2	Contingency	
	Configure TX in use	Contingency	
	Antenna switching	Contingency	

The above list is given for convenience. It is extracted from RD18 Vol. 8 issue 8. Latest issue of RD18 shall be applied for IST tests.

12.APPENDIX 4 : SSMM INITIALIZATION

The following paragraph gives the general instructions to set the SSMM in operation for the IST purpose. More details and explanations can be found in CDMS documentation, specifically the BSW user manual [P-HPL-NOT-00029-SE] and the BSW ICD [P-HPL-NOT-00076-SE].

12.1. SSMM TURN ON AND SSMM BSW SERVICE INITIALISATION

Verify that the SSMM is not already ON from the board status acquired by the TRR boards and reported in the DID_MM_ON_OFF data pool data [EEDG160 or EEDH160 for MM A and EEDJ160 or EEDZ160 for MM B, daughters of EEDF160]. A spurious reset would generate dozens of error messages. Note that those TM are not part of HK TM: a new TM packet shall be created to access them. As an alternative, a good hint at SSMM state may be considered from the individual bank state (see next paragraph for TM codes).

If OFF, turn ON the SSMM board using a CDMS-TC(2,3) of 208ms at least (16 pulse duration units) on the line:

- 53 "MM A On / MM A Reset" and /or [DCM53170],
- 69 "MM B On / MM B Reset" [DCM53170].

The pulse length is automatically managed by the HPSDB instanced commands.

The SSMM board and BSW SSMM management service shall then be initialised by a CDMS-TC(8,4,2,6) command for the related MM A and / or MM B. This initialisation has done automatically and shall not be repeated if the SSMM was already ON when the PM was reset (BSW boot checks the SSMM state and executes a CDMS-TC(8,4,2,6) automatically if it finds it ON).

Wait for the SSMM initialisation completion event by TM(1,7) (the CDMS-TC(8,4,2,6) shall be flag with a "TC execution completed" acknowledge request). This may also be monitored from the CDMS-TC(8,4,2,6) execution in progress status available in P1 HK TM [DEDT7161, daughter of DEDT0161].

12.2. SSMM MANAGEMENT INITIALISATION

Verify that the 4 banks are OFF from the board status acquired by the TRR boards and reported in the DID_MM_BANK_POWER_A and DID_MM_BANK_POWER_B data pool data [DEECG160, DEECH160, DEECZ160,DEECJ160, daughter of DDECF160 for MM A, and DEECK160, DEECK160, DEECK160, DEECK160, daughter of DDECF160 for MM B]. The command may be rejected else with some configuration. See BSW user manual and ICD for details if necessary (basics is that the bank at position 0 shall be first ON last OFF, including when position are remapped).

For the 2 SSMM boards using CDMS-TC(8,4,2,4):

- set MAP memory bank 0 to position 0,
- set MAP memory bank 1 to position 1,
- set MAP memory bank 2 to position 2,
- se MAP memory bank 3 to position 3.

As part of the degraded case sampling, the above nominal flight configuration will be alternated by filling the 4 positions with the following configurations:

- bank 3,1,2,0 (bank 0 failed),
- bank 0,3,2,1 (bank 1 failed),
- bank 0,1,3,2 (bank 2 failed).

Those alternated configuration makes sense only when needed configuration is 3 banks.

Turn ON the bank allocated to each position using CDMS-TC(8,4,2,5). Bank at position 0 shall be first ON (last OFF). Turn ON then the bank associated with position 1 and 2 as needed for the test. The baseline is that the bank at position 3 is left OFF (cold redundant).

12.3. STORE STATUS CHECK

Send CDMS-TC(8,4,3,3) to verify the allocated packet stores via TM(8,6,3,3).

Verify that the SEL and Default packet stores have been allocated in SSMM and the CEL has been allocated in SGM.

Send CDMS-TC(15,5) to verify the packet store selection definition via TM(15,6).

Verify that all is routed to the TM in the Default packet store. If any standard packet store has been allocated, verify that the Default packet store does not contain the selection definition of the standard packet store.

Verify that the configurations of SSMM A and SSMM B are the same (nominal way of using the SSMM is full hot redundancy (duplication of all stores). Note that RD06 is obsolete in this respect (it considers 3-1 and not 3-3 configuration).

12.4. PACKET STORE CREATION

12.4.1. MTL, OBCP AND AUXILIARY BUFFERS ALLOCATION

The lowest 0.1 Gibit of SSMM are allocated for buffers and auxiliary functions (RD06 allocation). This allocation is rounded to 12.75Mo to ease the address management (should be 12.8Mo).

Note that the lowest 163800 addresses (160ko) at position 0 (0x1.0000.0000 to 0x1.0002.7FFFF) are specifically reserved for the BSW and the SSMM HW controller.

The lowest start address for packet stores shall be 0x1.00CC.0000 (12.75Mo)

12.4.2. SIMPLIFIED 1 BANK CASE

Allocate a circular packet store on SSMM A and SSMM B to be dumped on VC2, using CDMS-TC(8,4,3,1) :

- "House keeping", size 4227072 bytes, store ID=0x02 (SSMM A), 0x82 (SSMM B).

Allocate a linear packet store on SSMM A and SSMM B to be dumped on VC2, using CDMS-TC(8,4,3,1) :

- "Science", size 4227072 bytes, store ID=0x7E (SSMM A), 0xFE (SSMM B);

Verify the packet stores creation via TM(8,6,3,3), send CDMS-TC(8,4,3,3): the files shall be present on SSMM A and SSMM B.

12.4.3. SIMPLIFIED 3 BANK CASE

TBC-26, with AAS-I (CDMS SIT and SVM IST use only).

Allocate 3 linear packet stores on SSMM A and SSMM B to be dumped on VC2, using CDMS-TC(8,4,3,1):

- size 1080000 bytes, store ID=2h, 82h contains Event Packets and TC verification
- size 4320000 bytes, store ID=4h, 84h contains Essential TM
- size 5400000 bytes, store ID=8h, 88h contains Non Essential TM

Allocate a circular packet store on SSMM A and SSMM B to be dumped on VC3, using CDMS-TC(8,4,3,1),

- size 2808000000 bytes, store ID=7Eh, FEh;

Verify the packet stores creation via TM(8,6,3,3), send CDMS-TC(8,4,3,3): the files shall be present on SSMM A and SSMM B;

12.4.4. NOMINAL 3 BANK CASE, SINGLE HK STORE (RD06) TBC-36

Allocate 3 circular packet stores on SSMM A and SSMM B to be dumped on VC2, using CDMS-TC(8,4,3,1):

- "default", ID = 0 for both MMA and MM B,
  start address = 0x1.00CC.0000 , length = 3407872 octets (3,25Mo)
- "Spacecraft Event Log", ID = 0x02 and 0x82 for MM A and MM B respectively,
  start address = 0x1.0100.0000 , length = 10747904 octets (10,25Mo, 0.08008Gibit),
- "House Keeping ", ID = 0x04 and 0x84 for MM A and MM B respectively,
  start address = 0x1.01A4.0000 , length = 428605440 octets (408.75Mo, 3.1934Gibit).

Allocate 1 circular packet stores on SSMM A and SSMM B to be dumped on VC3, using CDMS-TC(8,4,3,1):

- "Instrument", ID = 0x7E and 0xFE for MM A and MM B respectively,
  start address = 0x1.1B30.0000 , length = 2765029376 octets (2637Mo (-64ko), 20.601Gibit).

This allocation corresponds to RD06 sizing.

A specificity is that essential and non essential House Keeping TM are allocated in a single store (RD06 requirement).

12.4.5. NOMINAL 3 BANK CASE, 2 HK STORE (OLDER RD06)

Allocate 4 circular packet stores on SSMM A and SSMM B to be dumped on VC2, using CDMS-TC(8,4,3,1):

- "default", ID = 0 for both MM A and MM B,
  start address = 0x1.00CC.0000 , length = 3407872 octets (3,25Mo)

- "Spacecraft Event Log", ID = 0x02 and 0X82 for MM A and MM B respectively, start address = 0X1.0100.0000 , length = 10747904 octets (10,25Mo, 0.08008Gibit),
- "House Keeping essential", ID = 0X04 and 0X84 for MM A and MM B respectively, start address = 0X1.01A4.0000 , length = 76546048 octets (73Mo, 0.5703Gibit).
- "House Keeping non essential", ID = 0X08 and 0X88 for MM A and MM B respectively, start address = 0X1.0634.0000 , length = 352059392 octets (335.75Mo, 2.623Gibit).

Allocate 1 circular packet stores on SSMM A and SSMM B to be dumped on VC3, using CDMS-TC(8,4,3,1):

- "Science", ID = 0X7E and 0XFE for MM A and MM B respectively, start address = 0X1.1B30.0000 , length = 2765029376 octets (2637Mo (-64ko), 20.601Gibit).

This allocation corresponds to the older RD06 proposed sizing in which essential and non essential packet stores are not merged.

12.5. DEFINE PACKET STORE SELECTION CRITERIA

Define selection criteria for the defined packet stores using CDMS-TC(15,3) commands. The baseline shall be:

Store	Store ID	APID	Type	Subtype	Note
SEL	0x02 / 0x82	16 512 1024 / 1025 1152 / 1153 1280 / 1281	1 5 8	ALL	N1 = 15
HK essential	0x04 / 0x88	16 512 1024 / 1025 1152 / 1153 1280 / 1281	3	ALL	N1 = 7
		16	15	ALL	
		1280 / 1281	6	ALL	
HK non essential	0x08 / 0x88	18 514 1026 /1027 1154 /1155 1282 /1283	3	ALL	N1 = 5
SCIENCE	0x7E / 0xFE	1028 / 1029 1030 / 1031 1158 / 1159 1160 / 1161 1162 / 1163 1284 / 1285 1286 / 1287	21	ALL	N1 = 12

Note : the “simplified” configurations merge more or less the SEL and the 2 HK stores.

Verify the correctness of packet store selections, send CDMS-TC(15,5) to get a TM(15,6): check both that the definition of all stores are the defined ones, and that the definition of the Default store has been modified accordingly.

13. APPENDIX 5 : ACMS SETTINGS FOR TEST

The following paragraphs specifies the ACMS settings to be applied for the purpose of the IST test.

Those settings are optimised with respect to the RMS sequence, but the settings for the other sequences shall use the same basis. Specifically, the start condition are applicable to all the sequences (TBC-27 with respect to test archive management).

13.1. REFERENCES

[R1] Memo DG issue 1, "Herschel pointing commanding sequence during spacecraft IST", January 25th 2006

[R2] ESA mail – Ian Rasmussen – « Pointing modes for Herschel IST » dated 03/01/2006.

[R3] DS technical note TC definition H-P-4-DS-TN-024

13.2. INTRODUCTION

This memo defines the sequence of pointing command to be sent to the spacecraft during the mission reference scenario test case (section 7.8.9).

In absence of specific information, the commanding applies independently of instruments. The sequence is defined for 12 hours ending with same target as the first one. The sequence can then be commanded again for next instrument.

13.3. SOFTWARE VERSION

It has to be noted that ACMS OBS V2 doesn't contain all pointing mode capability. SRPE non compliance (covered by DS RFD 10) mitigation has been implemented in OBS V3.

The V2 ACMS telecommands are defined in H-P-DS-TN-024 issue 3.7 whereas V3 ACMS Telecommands are defined in issue 3.8 of the same document.

The sequence of pointing has been built independently of the software version : it is proposed same sequence is used. The detail content of the telecommand will change depending of the SW version. The memo is flagging the differences when relevant.

13.4. STARTING CONDITIONS

The following setting shall be used:

- Simulation Starting date (separation) : launch date + 2 months. Selected Launch date = 28th of February 2008 14:34:55.

- ACMS SCOE has been configured so that initial Sun vector in inertial frame is (1,0,0) and spacecraft initial attitude is $(0,1/\sqrt{2},0,1/\sqrt{2})$.
- ACMS is in SAM/fine with ACMS units (STR, RWS) needed for SCM put in configuration.
- Wheels are biased so as to achieve the next 24 hours pointing needs.
- Start ACMS FDIR mode is AFS.

13.5. SEQUENCE OF COMMANDING

13.5.1. COMMAND A FINE POINTING

A fine pointing shall be commanded by applying FCP-H-D-FINEP. Note : the manoeuvre is 5 min long, target = [accurate] sun pointing.

TC_PERFORM_SCM_FINE_POINTING ACMS-TC(8,4,101,200) shall be to be sent with following parameters :

- interlacing = **01** (no interlacing)
- q_fine = q1= **$(0,1/\sqrt{2},0,1/\sqrt{2})$** (quaternion associated with sun direction)
- t_slew = **180 s** (see note below)
- t_p = **300** s

Time tag of the TC shall be Start_date + 01:00:00 hours (TBC-28 1 hrs contingency to bias the wheel with TC .

Note : tslew could be computed using "Herschel slew time prediction" algorithm of ACMS user manual (section 9.4.1). The configuration is 4 wheels and the slew angle is below 5 deg. It gives 161 sec. 180 s is selected.

13.5.2. COMMAND AFO MODE

The ACMS AFO FDIR setting shall be commanded.

The**TC_SET_FDIR_MODE ACMS-TC(8,1,200)** shall be to be sent filled with following parameters :

- FDIR mode = **2.**

Note : this TC is a critical command.

Time tag of the TC shall be Start_date + 01:10:00 (2 minutes after end of last TC)

13.5.3. COMMAND A FINE POINTING IN SSO AFTER A SLEW OF 2° AROUND Y.

A fine pointing in SSO after a slew of 2° around Y shall be commanded by applying FCP-H-D-SSO and FCP-H-D-FINEP.

TC_TRACK_SOLAR_SYSTEM_OBJECT ACMS-TC(8,4,104,151) shall be sent with following parameters :

- SSO coefficients = (reuse the same coefficients as DS-TS-022)
- X0 = 0.0
- Y0 = 0.0
- Z0 = 0.0
- X1= 0.0
- Y1 = 0.00000245
- Z1= 0.0
- X2= 0.0
- Y2= 0.0
- Z2= 0.0
- X3= 0.0
- Y3= 0.0
- Z3 = 0.0

Time tag of the TC shall be Start_date + 01:11:00.

TC_PERFORM_SCM_FINE_POINTING ACMS-TC(8,4,101,200) shall be sent with following parameters :

- interlacing = 01 (no interlacing)
- q_fine = (0, 0.719339800338651,0, 0.694658370458997)
- t_slew = 130 s (see note below)
- t_p = 7200 s (2 hours see [R2])

Time tag of the TC shall Start_date + 01:12:00.

Note : Slew time prediction [ACMS user manual (section 9.4.1)] gives 123.3 s.

~~*1.1.4.*~~*13.5.4. COMMAND A LINE SCANNING WITH OFF POSITION,*

A line scanning with OFF position shall be commanded by applying FCP FCP-H-D-SCAN.

TC_PERFORM_SCM_LINE_SCAN ACMS-TC(8,4,101,230) shall be sent with following parameters :

- interlacing = 01 (no interlacing)
- q_scan = q_scan1 = (0, 0.719339800338651,0, 0.694658370458997) [target of start first line identical to previous fine pointing]
- N = 10 (number of lines)
- Phi = 0 deg
- D1= 0.0174532925199433 rad (1 deg - angular extension of the lines)
- d2 = 0.00174532925199433 rad (0.1 deg - angular distance between successive lines)
- r = 0.000290888208665722 rad/s (60 arcsec/s - Scan rate)
- tslew = 170 s (by similarity with DS-TS-10, see also note below)
- tll = 100 s (line-to-line manoeuvre duration - by similarity with DS-TS-10).
- qoff = $(0,1/\sqrt{2},0,1/\sqrt{2})$ (Inertial target attitude quaternion of the OFF-position = sun pointing) (WARNING to 2°).
- K = 9 (Number of consecutive lines before going to the OFF-position)
- Tsop = 200 s (by similarity with DS-TS-10)
- Top = 300 s (off position duration)

Time tag of the TC shall be Start_date + 03:13:00.

Note 1: Slew time prediction to off position [ACMS user manual (section 9.4.1)] gives 139.6 s (angle is 3.13 deg).

Note 2: Tslew and tll are filled by similarity with DS-TS-010 since the slew path prediction tool is not available.

13.5.5. COMMAND FOUR NODDING ARRANGED AS 2X2 RASTER

Four nodding arranged as 2x2 raster shall be commanded by applying FCP FCP-H-D- RASTP.

Note : items flagged in yellow are applicable **only** if version higher than V3 are used.

TC_PERFORM_SCM_RASTER_POINTING ACMS-TC(8,4,101,210) shall be sent with following parameters:

- interlacing = 01 (no interlacing)
- CP = ON (calibration point is used)
- q_rast = Q_rast 1 = (0.00560179833648578, 0.713228450830475, 0.00550487189379061, 0.700887646607351) [target of 1st raster point = end of last scan]
- N = 10 (number of lines)

- M = **2** (number of steps per line)
- Phi = **45 deg** (Tilt angle defining the rotation of the scan pattern axes)
- d1= **0.00116355283466289 rad** (4 arcmin - angular distance between successive steps)
- d2 = **0 rad** (The condition d2 = 0, means that it shall be possible to scan N times the points of a single line)
- tslew = 100 s (duration to reach first point – margin since first raster point =end of last scan)
- tp = **45 s** (Duration of stable pointing).
- Tpp = **61** s (Allowed duration of the point-to-point manœuvre- see note below)
- Tll = **61 s** (Allowed duration of the line-to-line manœuvre)
- qoff = **Q_rast 1** (Inertial target attitude quaternion of the OFF-position)
- K = **2** (Number of consecutive raster steps before going to the OFF-position)
- Tsop = **61 s** (maximum slew time from a point in the raster to the OFF position.)
- Top = **15 s** (off position duration)
- Top-init = **15 s** (duration of initial off position for calibration)

Time tag of the TC shall be **Start_date + 04:13:00**.

Note : Slew time prediction of the point-to-point manoeuvre [ACMS user manual (section 9.4.1)] gives 60.9 s (angle is 4 arcmin deg).

TC_PERFORM_SCM_RASTER_POINTING ACMS-TC(8,4,101,210) shall be sent with the same parameter values as previous one except :

- q_rast = Q_rast 2 = **(0.005602199, 0.713177479, 0.005504465, 0.700939512)**
- tslew = **25 s**

Time tag of the TC shall **Start_date + 05:13:00**

Note : Slew time prediction [ACMS user manual (section 9.4.1)] gives 23.2 s (angle is 0.5 Arcmin).

TC_PERFORM_SCM_RASTER_POINTING ACMS-TC(8,4,101,210) shall be sent with the same parameter values as previous one except :

- q_rast = Q_rast 3 = **(0.005654062, 0.71317707, 0.005555438, 0.70093911)**

Time tag of the TC shall be **Start_date + 06:13:00**

TC_PERFORM_SCM_RASTER_POINTING ACMS-TC(8,4,101,210) shall be sent with the same parameter values as previous one except :

- q_rast = Q_rast 4 = (0.005629768, 0.716228695, 0.005580056, 0.697820625)

Time tag of the TC shall be **Start_date + 07:13:00**

13.5.6. COMMAND A SLEW NEAR THE BORDER OF THE ADD ZONE

A slew near the border of the AAD zone shall be commanded.

TC_PERFORM_SCM_FINE_POINTING ACMS-TC(8,4,101,200) shall be sent with following parameters :

- interlacing = **01** (no interlacing)
- q_fine = **(0, 0.863835505204396,0, 0.503773977045526)**
- t_slew = **400** (see note below)
- t_p = **3600 s** (1 hours)

Time tag of the TC shall **Start_date + 08:13:00**.

Note : Slew time prediction [ACMS user manual (section 9.4.1)] gives 398.4 s for a slew angle of 30°.

13.5.7. COMMAND INTERLACING WHILE STAYING AT THE SAME DIRECTION

A command interlacing shall be commanded while staying in the same direction.

TC_PERFORM_SCM_FINE_POINTING ACMS-TC(8,4,101,200) shall be sent with following parameters :

- interlacing = **10** (interlacing acticated)
- q_fine = **(0, 0.863835505204396,0, 0.503773977045526)**
- t_slew = **0 s** (no slew needed)
- t_p = **3600 s** (1 hours)

Time tag of the TC shall be **Start_date + 09:13:00**.

13.5.8. COMMAND A SLEW BACK TO SUN POINTING WITH INTERLACING ACTIVATED

A slew back to Sun pointing shall be commanded while interlacing is activated.

TC_PERFORM_SCM_FINE_POINTING ACMS-TC(8,4,101,200) shall be sent with following parameters:

- interlacing = **10** (interlacing activated)
- q_fine = q1= **(0,1/$\sqrt{2}$,0, 1/$\sqrt{2}$)** (quaternion associated with sun direction)
- t_slew = **300 s**
- t_p = **3600** s

Time tag of the TC shall **Start_date + 10:13:00**.

Sequence end

As the S/C is back pointing to the simulated Sun direction, the overall sequence may be looped.

14. APPENDIX 6 : LCL LIST

Line n°	Herschel Allocation	To	P PDU Connector	Pin (+)	Pin(-)	Type	Class	OP-LCL	HLC cmd	Essential Non-Ess	PCDU Module
1	CDMU Hot A	**CDMU**	J016	4 5	2 6	FCL	I	N/A	N/A		Dist-8
2	CDMU Hot B	**CDMU**	J136	4 5	2 6	FCL	I	N/A	N/A		Dist-3
3	XPND1 Rx	**XPND1**	J04 J05	15 15	8 8	FCL	I	N/A	N/A		Dist-7
4	XPND2 Rx	**XPND2**	J04 J05	15 15	8 8	FCL	I	N/A	N/A		Dist-4
5	ACC Hot A	**ACC**	J016	4 5	2 6	FCL	I	N/A	N/A		Dist-6
6	ACC Hot B	**ACC**	J126	4 5	2 6	FCL	I	N/A	N/A		Dist-5
7	Emergency Heater Line 1 Nom	**Bat**	J05	1	4	FCL	I	N/A	N/A		Dist-10
8	Emergency Heater Line 1 Red	**Bat**	J06	1	4	FCL	I	N/A	N/A		Dist-1
9	Emergency Heater Line 2 Nom					FCL	I	N/A	N/A		Dist-9
10	Emergency Heater Line 2 Red					FCL	I	N/A	N/A		Dist-2
11	SPIRE HSDPU Nom	**HSDPU**	J01	8	4	LCL	I	YES		NE	Dist-3
12	SPIRE HSDPU Red	**HSDPU**	J02	2	4	LCL	I	YES		NE	Dist-8
13	GYRO A	**GYRE**	J01A	33	57	LCL	II			E	Dist-2
14	GYRO B	**GYRE**	J01B	33	57	LCL	II			E	Dist-9
15	QRS1	**QRS1**	J01	1	3	LCL	I			E	Dist-2
16	XPND2 Tx	**XPND2**	J04 J05	9 9	1 1	LCL	I			E	Dist-9

Line n°	Herschel Allocation	To	P PDU Connector	Pin (+)	Pin(-)	Type	Class	OP-LCL	HLC cmd	Essential Non-Ess	PCDU Module
17	Cat Bed Heaters Nom	THR20Ns	Splice			LCL	I			NE	Dist-10
18	Cat Bed Heaters Red	THR20Ns	Splice			LCL	I			NE	Dist-1
19	SREM	**SREM**	J01	8	7	LCL	I			NE	Dist-3
20	VMC	**VMC**	J01	4	3	LCL	I			NE	Dist-8
21	STR 1	**STRE1**	J01	3	1	LCL	I			E	Dist-10
22	STR 2	**STRE2**	J01	3	1	LCL	I			E	Dist-1
23	XPND1 Tx	**XPND1**	J04 J05	9 9	1 1	LCL	I			E	Dist-1
24	QRS2	**QRS2**	J01	1	3	LCL	I			E	Dist-10
25						LCL	I			E	Dist-1
26						LCL	I			E	Dist-10
27	PACS BOLC Nom	**FPBOLC**	J25	2 7	4 9	LCL	II	YES		NE	Dist-8
28	PACS BOLC Red	**FPBOLC**	J26	2 7	4 9	LCL	II	YES		NE	Dist-3
29						LCL	II	YES		NE	Dist-3
30						LCL	II	YES		NE	Dist-8
31	CDMU Cold A	**CDMU**	J015	4 5	2 6	LCL	II		YES	E	Dist-2
32	CDMU Cold B	**CDMU**	J135	4 5	2 6	LCL	II		YES	E	Dist-9
33	ACC Cold A	**ACC**	J015	4 5	2 6	LCL	II		YES	E	Dist-6
34	ACC Cold B	**ACC**	J125	4 5	2 6	LCL	II		YES	E	Dist-5
35	PACS SPU Nom	**FPSPU1**	J11	2 1	4 5	LCL	II			NE	Dist-5
36	PACS SPU Red	**FPSPU2**	J11	2 1	4 5	LCL	II			NE	Dist-6

Line n°	Herschel Allocation	To	P PDU Connector	Pin (+)	Pin(-)	Type	Class	OP-LCL	HLC cmd	Essential Non-Ess	PCDU Module
37	CCU A	CCU	J13	2	9	LCL	II			E	Dist-1
38	CCU B	CCU	J26	2	9	LCL	II			E	Dist-10
39						LCL	II			NE	Dist-4
40						LCL	II			NE	Dist-7
41	PACS DPU Nom	FPDPU	J01	2 7	4 9	LCL	II			NE	Dist-7
42	PACS DPU Red	FPDPU	J02	2 7	4 9	LCL	II			NE	Dist-4
43	HIFI WEH	FHWEH	J03	2	4	LCL	II			NE	Dist-8
44	HIFI WEV	FHWEV	J03	2	4	LCL	II			NE	Dist-3
45	ACC RCS Thrusters A	ACC	J106	1 2	4 8	LCL	III	YES	YES	E	Dist-2
46	ACC RCS Thrusters B	ACC	J116	1 2	4 8	LCL	III	YES	YES	E	Dist-9
47	ACC RCS LV A	ACC	J105	1 2	4 8	LCL	III	YES	YES	E	Dist-1
48	ACC RCS LV B	ACC	J115	1 2	4 8	LCL	III	YES	YES	E	Dist-10
49	TWTA 1	EPC1	J01 J02	2 2	5 4	LCL	III	YES		E	Dist-2
50	TWTA 2	EPC2	J01 J02	2 2	5 4	LCL	III	YES		E	Dist-9
51	SPIRE HSFCU Nom	HSFCU	J05	2	4	LCL	III	YES		NE	Dist-4
52	SPIRE HSFCU Red	HSFCU	J06	2	4	LCL	III	YES		NE	Dist-7
53	HIFI LCU Nom	FHLCU	J01	2	4	LCL	III	YES		NE	Dist-7
54	HIFI LCU Red	FHLCU	J121	2	4	LCL	III	YES		NE	Dist-4
55	Reaction Wheel 1	RWE	J01	1 6	4 9	LCL	III	YES		E	Dist-2
56	Reaction Wheel 2	RWE	J01	1 6	4 9	LCL	III	YES		E	Dist.9

Line n°	Herschel Allocation	To	P PDU Connector	Pin (+)	Pin(-)	Type	Class	OP-LCL	HLC cmd	Essential Non-Ess	PCDU Module
57	Reaction Wheel 3	**RWE**	J01	1 6	4 9	LCL	III	YES		E	Dist-1
58	Reaction Wheel 4	**RWE**	J01	1 6	4 9	LCL	III	YES		E	Dist-10
59						Par-LCL	III	YES		E	Dist-4
60						Par-LCL	III	YES		E	Dist-4
61						Par-LCL	III	YES		E	Dist-7
62						Par-LCL	III	YES		E	Dist-7
63	HIFI HRH	**FHHRH**	J01	2	4	Par-LCL	III	YES	YES	NE	Dist-5
64	HIFI ICU Nom	**FHICU**	J01	2	4	Par-LCL	III	YES		NE	Dist-5
65	PACS DEC/MEC1	**FPMEC1**	J30	2 7	4 9	Par-LCL	III	YES		NE	Dist-5
66						Par-LCL	III	YES		NE	Dist-5
67	HIFI HRV	**FHHRV**	J01	2	4	Par-LCL	III	YES	YES	NE	Dist-6
68	HIFI ICU Red	**FHICU**	J02	2	4	Par-LCL	III	YES		NE	Dist-6
69	PACS DEC/MEC2	**FPMEC2**	J130	2 7	4 9	Par-LCL	III	YES		NE	Dist-6
70						Par-LCL	III	YES		NE	Dist-6
71	PLM NCA Actuators Nom	**CBPLM1A**	J01	2	4	NCA act	NCA		YES	NE	Dist-3
72	PLM NCA Actuators Red	**CBPLM1A**	J02	2	4	NCA act	NCA			NE	Dist-8

15. APPENDIX 7: TBC TBD AND TBW LIST

TBC	location	Object	Baseline	associate
~~1~~	~~2.3~~	~~Limitation of ambient wrt instrument testing~~	~~IID-B~~	~~INST ASED~~
2	3.2	HPLM user manual reference		ASED
~~3~~	~~5.1.1~~	~~S/C axis orientation which shall be respected according to SPIRE state (for sorption cooler operation specifically)~~		~~SPIRE~~
~~4~~	~~5.1.1~~	~~S/C axis orientation which shall be respected according to PACS state (for sorption cooler operation specifically)~~		~~PACS~~
5	5.1.1	HIFI operation limitations for ambient testing and specifically the forbidden commands or restricted parameters		HIFI
~~6~~	~~5.1.2~~	~~Availability of instrument IEGSE for real time detailed view upon instrument state during IST~~	~~quick look upon detailed instrument state available~~	~~INST~~
~~7~~	~~5.2 7.8.2.4.5~~	~~Specifications and limitations associated with cryostat for test operation in clean room environment~~		~~ASED~~
~~8~~	~~5.8.2.4.3~~	~~Definition (or not) of a short overall unit health check sequence for one last S/C check under the launcher fairing~~		~~AAS-I~~
~~9~~	~~5.8.2.4.4~~	~~Applicable configuration for the "survival CBH lines" old or hot redundancy specifically for launch~~	~~hot redundancy (which is in disagreement with SVM user manual)~~	~~AAS-I~~
~~10~~	~~5.8.2.4.6~~	~~Orientation of the separation pointing error wrt S/C axis (ACMS-SCOE input)~~	~~in +Ys direction~~	~~AAS-F~~
~~11~~	~~5.8.2.4.6~~	~~Delay at separation for ARAD alarm enabling~~	~~25s (obsolete)~~	~~AAS-I~~
~~12~~	~~7.8.2.4.8~~	~~Timeline scenario for initial S/C acquisition~~	~~RMS (obsolete)~~	~~ESA~~
~~13~~	~~7.8.2.4.8~~	~~Timeline scenario for SREM activation and specifically its early activation for recording the radiation belt crossing~~	~~part of early S/C operation after separation (even if low priority)~~	~~ESA~~

~~14~~	~~5.8.2.4.8~~	~~Timeline scenario for decontamination heating activation and specifically with respect to earliest in orbit operation~~	~~telescope shall be kept warm to prevent deposits then DEC shall be activated among the early S/C operation after separation~~	~~AAS-F~~
~~15~~	~~5.8.3.3~~	~~Feasibility of decontamination heating setting allowing in ambient a representative power consumption (i.e. without any over-heat risk at telescope level)~~	hypothesis is that test at ambient is feasible but thermal analysis shall come in support to assess risk and threshold settings	AAS-F
16	5.8.3.11	Timing to be considered for testing the decontamination heating without over-heat risk at telescope level		
17		"Initial state of SPIRE launch lock for the instrument commissioning sequence ~~PACS has also a lock and the same question applies~~	NST remains locked until commissioning (that is several weeks into the flight) (alternative would be to unlock quickly after separation)	SPIRE ~~PACS~~
~~18~~	~~7.8.5.4 to 7.8.5.18~~	~~Mode transition test sequence design with respect to SVM IST level one~~	~~SVM IST to include the IST specified cases~~	~~AAS-I~~
~~19~~	~~7.8.6.3 to 7.8.6.7~~	~~Reconfiguration test sequence design with respect to SVM IST level one~~	~~S/C IST to make a larger reuse of SVM IST sequences~~	~~AAS-I~~
~~20~~	~~7.8.6.3 7.8.6.7~~	~~OBSW boot and reset observable timing~~	~~to include a feed back from CDMS SIT~~	~~AAS-I~~
~~21~~	~~5.8.8.2~~	~~MTL time tagged TC upload rate for DTCP worst case scenario sequence~~	~~10 (CDMS SIT basis but this is possibly not realistic WRT operation)~~	~~ESOC~~
22	5.8.9.3	RMS for PACS (wrt presently defined one)	TBW-24	PACS
23	5.8.10.2	Time that ACMS may support clean run sequence condition before open loop condition stall the test	10 min	
~~24~~	~~7.9.3.2~~	~~Effect on XPND of the 1553 SDB skin plug on line disconnection during NOM mode robustness test~~	~~XPND no more answers to CDMS~~	~~AAS-I~~
25	APPENDIX 2	PACS mode : ambiguity about a possible image slicer dual position		PACS

26	APPENDIX 4 §11.4.3	Usage of AAS-I simplified 3 bank SSMM configuration for IST test	none	AAS-I
27	APPENDIX 5 intro	Possibility of beginning all the test with the same simulated flight date : February 2008 14:34:55 (single ACMS SCOE setting) without jamming risk at the CCS test archive retrieval tool level.		AAS-I
28	APPENDIX 5 §12.5.1	Time necessary for biasing the RW by discrete ground TC	1h (not to be used)	AAS-F
~~29~~	~~3.1.2~~	~~Insert the reference of the TN specifying the cooling fan positions.~~	~~Analyse done. Specifying document to be issued.~~	~~AAS-F~~
30	5.7.3	Strategy for CCU choice, for sequences where only one CCU is connected to the cryostat (the other set of sensor being left for direct CROSCOE monitoring).	alternated configuration between CCU A and B	AAS-F
31	5.8.3.2	S/C commissioning procedures to be rerun on PM-B configuration (i.e. not flight nominal configuration) in order that the all units are covered by a IST commissioning test.	Worst case : all procedures are replayed.	AAS-F
~~32~~	~~5.8.4.2 5.8.4.3~~	~~Possible ACMS / ACMS SCOE simplified configuration for test not requiring specific ACMS activity, to save configuration time.~~	~~Close loop (no simplification).~~	~~AAS-F~~
33	5.8.9.2	Recommendation upon connecting or not (protection against spurious command) CCU valve command connectors to the actual cryostat during tests not requiring any activity on those devices.	not disconnected (protection against spurious command from seals on vent throttles)	ASED
~~34~~	~~5.8.9.3~~	~~Confirmation of detailed RMS sequence operation program in the frame of the action plan with AAS-F/INST/ESOC defined in H-P-ASP-MN-7959, specifically the exchange of the 27h OD, by a 31h AP (missed DTCP)~~		~~ESOC AAS-F~~
~~35~~	~~appendix 2 (10.31)~~	~~Use of UMB as permanent TM source for sequence with numerous RF switch ON and OFF (TM flux monitoring is discontinued when switching from RF reception to/from real time spying of S/C activity from UMB)~~	~~switching to RF data when available~~	~~AAS-F~~
36	appendix 4 (12.2.4)	Update of packet store mapping into SSMM address field according latest AAS-I/ESOC proposal (under discussion because of SSMM A and B non symmetric usage).	AAS-F (SSMM A and B have same organisation)	ESOC AAS-F
37	6.3.1	Best method to check for any delta between	bit to bit packet comparison	AAS-F

		real time gathered TM data (spying form UMB) and retrieved SSMM TM data.	tool	AAS-I
TBD	location	Object	Baseline	associate
~~1~~	~~7.8.6.7~~	~~Time necessary for going to DoD alarm from a BS setting above all the alarm levels.~~	~~realistic estimate (this is a test planning data) needs feed back from as built that is PCS SIT~~	~~AAS-I~~
~~2~~	~~7.8.9.3~~	~~Delays between instrument and ACMS command for proper synchronous operation (inserted TBD is wrt PACS but it applies indeed to all instrument)~~	~~TBW-24~~	~~INST AAS-F~~
~~3~~	~~7.8.9.3~~	~~Duration of the Sorption cooler recycling in frame of the RMS sequence~~	~~2h~~	~~INST~~
~~4~~	~~7.8.9.3~~	~~Duration of the PACS calibration in spectrometer mode and way to proceed~~	~~TBW-24~~	~~PACS~~
TBW	location	Object	Baseline	associate
~~1~~	~~5.1.1~~	~~Instrument configuration for test including limitations (see also TBC-3 and TBC-4)~~	~~Convergence meetings~~	~~INST~~
~~2~~	~~5.1.1~~	~~Interleaving of the IMT and IST tests to save global test time~~	~~Convergence meetings~~	~~INST~~
~~3~~	~~5.1.2~~	~~Use of instrument IEGE and GSE during test (see also TBC-6)~~	~~Convergence meetings~~	~~INST~~
~~4~~	~~5.1.3~~	~~Instrument teams involvement during IST test~~	~~Convergence meetings~~	~~INST~~
~~5~~	~~5.2~~	~~Inputs and limitation for proper cryostat management in the frame of the IST defined test sequence including IMT related need (see also TBC-7).~~	~~Convergence meetings~~	~~ASED~~
~~6~~	~~7.1.2~~	~~IST timeline considering the interleaving of IMT and IST tests~~	~~Convergence meetings~~	~~INST~~
~~7~~	~~7.8.2.2~~	~~Launch sequence update wrt to parallel work on operation procedure definition~~	~~Flight operation procedures~~	~~AAS-I~~
~~8~~	~~7.8.2.4.3~~	~~Short unit health check procedure if any shall be defined (see TBC-8)~~	~~SVM user manual~~	~~AAS-I~~
9	7.8.2.4.8	Applicable STR health check procedure	Flight operation procedures	AAS-I

		before commanding the S/C out of SAM for the first time		
10	7.8.3.5 7.8.3.6 7.8.3.7 7.8.3.7	SVM commissioning procedure (CDMS PCS TTC ACMS)	Flight operation procedures	AAS-I
11	7.8.3.8	Cryostat commissioning procedure	Flight operation procedures	ASED
~~12~~	~~7.8.3.10~~	~~SREM commissioning procedure~~	~~Flight operation procedures~~	~~ESA~~
~~13~~	~~7.8.3.11~~	~~Other activities specifically ACMS during the telescope decontamination function testing~~	~~Flight operation procedures~~	
14	7.8.3.11	Possible way to test the decontamination function at ambient (typically by biasing temperature thresholds)	Thermal analysis (yet some point to be clarified)	AAS-F
15	7.8.3.12	Other activities specifically ACMS during the telescope cover opening test	Flight operation procedures	AAS-I
~~16~~	~~7.8.4.5~~	~~SPIRE commissioning test sequence~~	~~Flight operation procedures~~	~~SPIRE~~
~~17~~	~~7.8.4.6~~	~~PACS commissioning test sequence~~	~~Flight operation procedures~~	~~PACS~~
~~18~~	~~7.8.4.7~~	~~HIFI commissioning test sequence~~	~~Flight operation procedures~~	~~HIFI~~
~~19~~	~~7.8.4.8~~	~~Commissioning of SPIRE and PACS parallel mode~~	~~Flight operation procedures~~	~~PACS SPIRE~~
~~20~~	~~7.8.4.9~~	~~Definition of the instrument configuration for EMI-EMC tests (most emitting and susceptible configuration)~~	~~EMI-EMC test spec~~	~~AAS-F INST~~
~~21~~	~~7.8.5.8~~	~~Instrument configuration during the transition and reconfiguration test sequence (small test opportunity windows)~~	~~Convergence meetings~~	~~INST~~
~~22~~	~~7.8.7.1~~	~~Scope of the MTL management sequence considering that many subjects are already covered in the frame of the other sequences~~	~~baseline is to minimise the test sequence by integrating as much as possible the test items in background of the other tests~~	~~AAS-F~~
~~23~~	~~7.8.8.1~~	~~DTCP worst case scenario~~	~~Comments to early IST spec drafts~~	~~ESOC~~
~~24~~	~~7.8.9.3~~	~~Instrument operation in the frame of the RMS sequence (inserted TBC concerns PACS but it applies indeed to the 3 instruments)~~	~~Convergence meetings~~	~~INST~~
25	APPENDIX	Instrument mode and state as interesting to report in S/C satellite summary tables (for	Convergence meetings	INST

	2	future detailed instrument operation for the commissioning and RMS test sequences)		
26	APPENDIX 3	S/C turn ON and OFF procedure under the fairing	Flight operation procedures	AAS-I
27	APPENDIX 3	ACMS turn ON and OFF under the fairing	Flight operation procedures	AAS-I
28	APPENDIX 3	TTC configuration switching procedures	Flight operation procedures	AAS-I
29	APPENDIX 3	SSMM configuration and reconfiguration procedures	Flight operation procedures	AAS-I
30	APPENDIX 3	Monitoring of equipment with limited life time or cycle number	AIT operation procedures (NB it shall be derived from Planck existing one for the SVM elements. The missing elements are the HPLM and INST related ones)	ASED INST
31	3.2.2	INST IEGSE detailed interface with CCS, specifically for science packets (CCS load for real time) and SSMM dumped data routing.	Under discussion with Therma (CCS load)	INST AAS-F
32	3.3	Detailed cryostat management procedures	convergence work to be pursued	ASED
33	6. 7. 8.	Detailed test organisation to be discussed.	convergence work to be pursued	ASED INST

16. APPENDIX 8: S/C CDMS AND ACMS OPERATING MODES

Here follows some diagrams and tables to recall the basic CDMS and ACMS operation principles.

- CDMS is in charge of S/C data handling (communication, SSMM, MTL, etc.),
- ACMS is in charge of S/C attitude and orbit control (and nothing else).

The two subsystems run in their own computer in full independence. With respect to ACMS, CDMS is just in charge to route ACMS-TC and ACMS-TM from/to ground, either in real time or through MTL (TC) and SSMM (TM).

Each subsystem computer, run on PM-A (nominal) or -after a trouble- on PM-B (cold redundant). Each subsystem is monitored for (a major) anomaly by each two independent RM operating in hot redundancy.

In case of an alarm condition detected by one of the subsystem RM (Reconfiguration Module), a reconfiguration of the faulty computer is attempted (reset of PM-A or switch-over to PM-B), and a flag is set (relay position) to notify the other subsystem of the contingency condition, and allow this one to take adapted conservative predetermined dispositions.

Then autonomous ACMS and CDMS mode transitions are linked either to an internal alarm (with internal RM action), or to the observation by the PM, of an alarm flag coming from other subsystem.

Internal autonomous mode transitions, are associated with CDMS-FDIR or ACMS-FDIR alarm of level 3 or 4.

alarm name	problem	(internal) action (2)	Note
3	anomaly detected in the PM operation (watch dog, supply disruption, CPU or CROME hardware alarm, software alarm)	switch other	for CDMS and LAUNCH only (S/C not separated)
3a		reset PM-A	occur on first alarm case (as seen by RM)
3b		switch other	occur on second alarm case (as seen by RM)
3c (1)		reset PM-B on SW image 2	CDMS only.
4	major anomaly detected through RM own sensors	switch-over	CDMS : DOD alarm (battery nearly empty) ACMS : ARAD alarm (attitude going out of range)

(1) : this is not an official naming, this is just used here for readability.
(2) : the action considers the nominal case : PM-A operating, default alarm setting (not a degraded configuration).

The above alarms, once executed by one RM, cannot be triggered again (until ground performs specific actions to valid them again). However, there is two RM operating, with a built in mechanism that insures that they acts alternatively. Then, a series of 7 PM alarms would give rise theoretically (it is impossible in reality unless two or more severe failures) to the following alarm reconfiguration pattern:

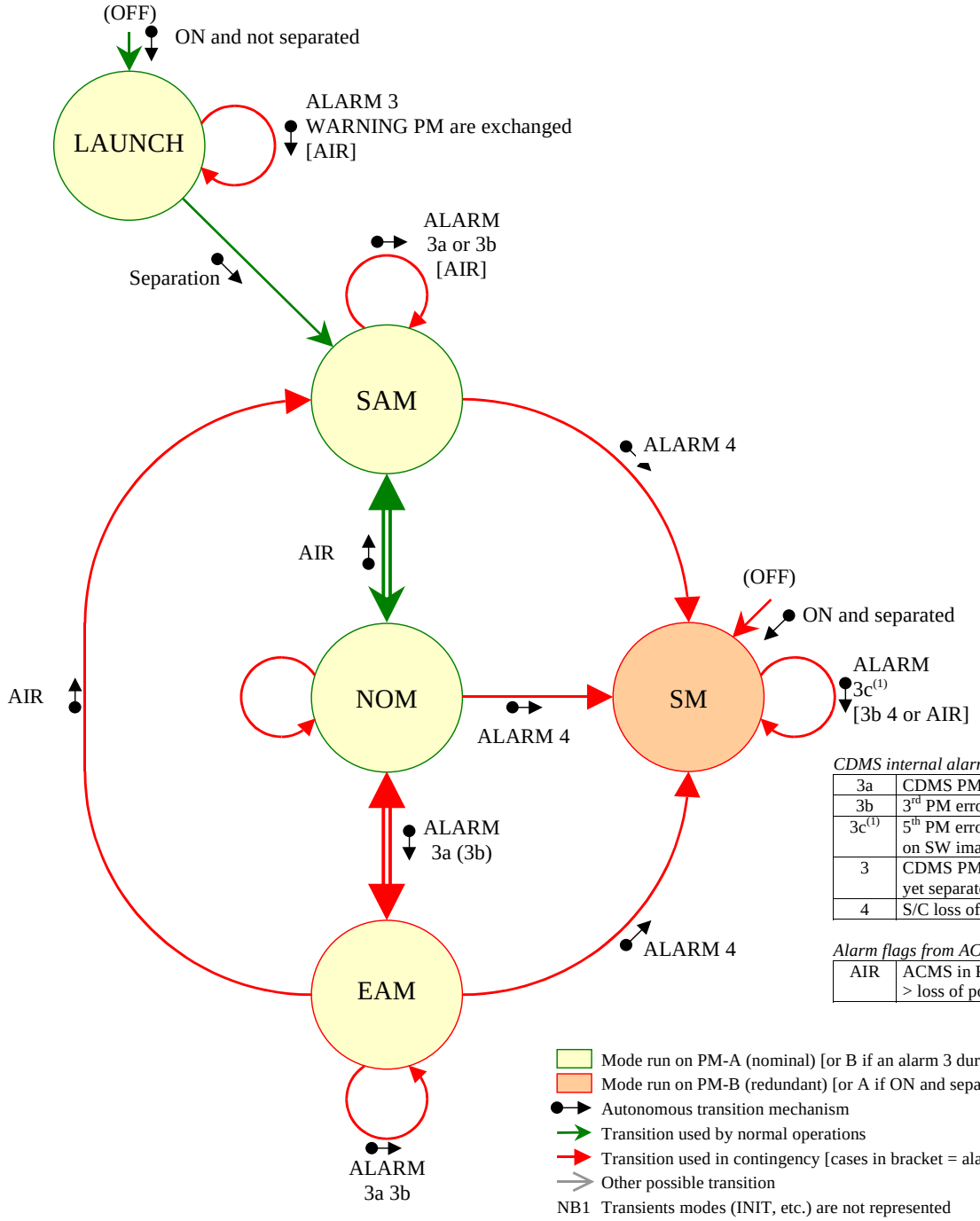
- 3a (RM-A) 3a (RM-B) 3b (RM-A) 3b (RM-B) 3c (RM-A) 3c (RM-B) ignored (RM-A and RM-B).

The notifying flags are the following:

flag name	problem	consequence	requested reaction of the other sub-system
AIR	level 3 or 4 in ACMS	ACMS restore a Sun pointing	CDMS shall adapt its TTC setting to poor antenna pointing.
CIR	level 3 in CDMS	CDMS detailed operation context is lost	ACMS shall go to Earth pointing (if it can) to wait a ground recovery action.

SIR	level 4 in CDMS (power contingency alarm)		ACMS shall go to Earth pointing (using small power) to get Sun power and then, wait for ground action.

The following figure presents the CDMS operating modes that results in a normal operation context (i.e. not starting from a CDMU degraded configurations or not considering contingency recovery cases whose management requires typically the alarms behaviour reprogramming).



CDMS internal alarms

3a	CDMS PM error > reset
3b	3rd PM error > switch over
3c(1)	5th PM error > reset PMB on SW image 2
3	CDMS PM error while not yet separated > switch over
4	S/C loss of power (DoD)

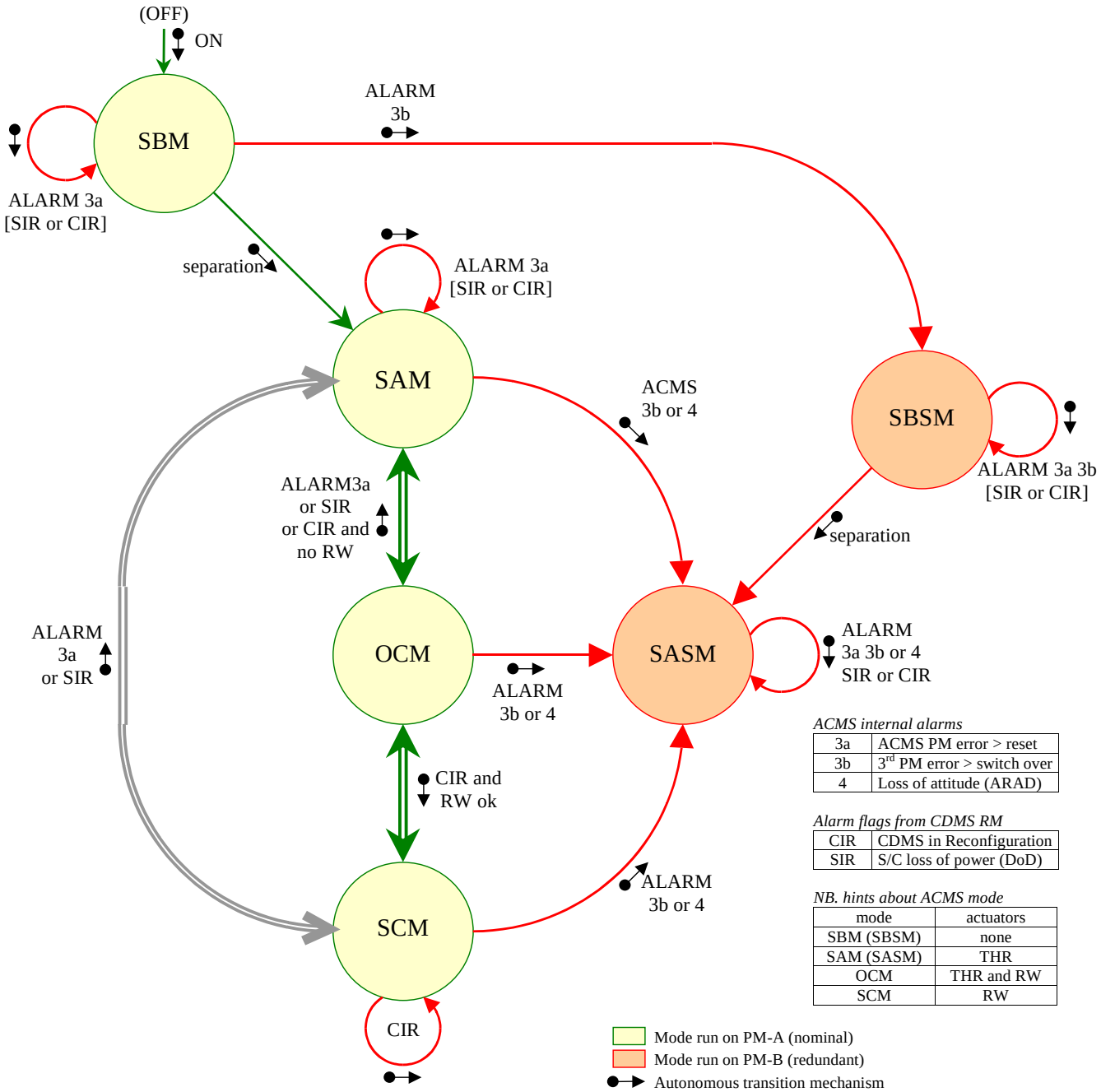
Alarm flags from ACMS RM

AIR	ACMS in Reconfiguration > loss of pointing context

Mode run on PM-A (nominal) [or B if an alarm 3 during launch]
Mode run on PM-B (redundant) [or A if ON and separated]
Autonomous transition mechanism
Transition used by normal operations
Transition used in contingency [cases in bracket = alarm ignored]
Other possible transition

NB1 Transients modes (INIT, etc.) are not represented
NB2 All transitions can be commanded by a proper TC sequence
NB3 Alarm 3 is active for launch only, 3a 3b 4 after separation only. A 3b in NOM cannot occur except maybe during complex recovery cases.
NB4 Way out of SM is SAM but the diagram may be affected by the degraded configuration. It is so not presented.
NB5 3c is not an official name, it is just used here for readability.

The following figure presents the ACMS operating modes that results in a normal operation context (i.e. not starting from a ACC degraded configurations or not considering contingency recovery cases whose management requires typically the alarms behaviour reprogramming).



ACMS internal alarms

3a	ACMS PM error > reset
3b	3rd PM error > switch over
4	Loss of attitude (ARAD)

Alarm flags from CDMS RM

CIR	CDMS in Reconfiguration
SIR	S/C loss of power (DoD)

NB. hints about ACMS mode

mode	actuators
SBM (SBSM)	none
SAM (SASM)	THR
OCM	THR and RW
SCM	RW

Starting from the above mode diagrams, any CDMS / ACMS mode combination is theoretically possible (i.e. commendable). Operation principle nevertheless limits the configurations to the following:

CDMS and ACMS modes

CDMS mode	TC / TM / ANT conf. forced by mode transition	ACMS mode (target)	Basic cases
Launch			
LAUNCH	4k / 5k / LGA 1	SBM / SBSM	Launch
LEOP (Note : those modes will also appears in contingency recovery operations)			
SAM	125 / 500 / LGA1	SAM / SASM	Immediate post launch activities
NOM	4k / 150k / MGA	OCM no RW (Earth)	LEOP activities before RW commissioning
		OCM no RW (any)	OCM1 and OCM2 after launch
		OCM with RW (Earth)	LEOP activities (after RW commissioning)
		SCM (Earth)	LEOP activities (after ACMS commissioning)
		OCM with RW (any)	OCM3 and later OCM
Routine operation			
NOM	4k / 150k / MGA	SCM (any)	Scientific observation
		SCM (Earth)	DTCP (TM temporarily set to 1.5Mbps)
		OCM with RW (any)	Orbit maintenance
		OCM with RW (Earth)	RW biasing (during DTCP)
Contingency (stable final state)			
SAM	125 / 500 / LGA1	SAM / SASM	Contingency with ACMS
EAM	4k / 150k / MGA	SCM (Earth)	Contingency with CDMS
SM	125 / 500 / LGA1	SAM / SASM	Contingency with power
EAM	4k / 150k / MGA	SAM	Contingency with CDMS while in NOM / OCM no RW i.e. during early LEOP activities or some recovery
	NB. all data rates in bps	NB. targets "any" shall be in ARAD limits	

Note1: the table (as the previous diagrams) does not include the transient modes as boot INIT.
Note2: it is not impossible that complex contingency recovery procedures needs some more configuration.

17. APPENDIX 9: ALARM CASE VERIFICATION TEST MATRIX

The following table recalls all the possible CDMS/ACMS alarm cases, and where they are tested. SVM IST column refers to H-P-SP-AI-0054, issue 02, dated February 22nd 2006, taken as preliminary specification for the SVM IST on PFM. The actual applicable document is yet to be issued, then awaited elements are marked "TBC".

SATELLITE STATE before alarm CDMS	SATELLITE STATE before alarm ACMS	SATELLITE STATE after alarm CDMS	SATELLITE STATE after alarm ACMS	occuring alarm	synchronisation	number of consecutive alarms necessary to get the situation				TESTED IN S/C IST	TESTED IN SVM IST	type of situation X = impossible unless multiple failures including from ground operation	number of failure needed (min)	Scenario for having the case with a minimum number of failures (PM failures may be hardware or software)
black : nominal case bleu : transient case orange : degraded case red : abnormal case		red : mode transition done green : mode reinforced black : no action												
LAUNCH	SBM	LAUNCH	SBM	CDMS level 3	CIR	1				5.9.2	TBC	nominal	1	CDMS-PMA failure (no 3a / 3b in LAUNCH for CDMS).
	SBM	LAUNCH	SBM	ACMS level 3a	AIR	1				5.9.2	TBC	nominal	1	ACMS-PMA transient failure.
	SBM	LAUNCH	SBSM	ACMS level 3b	AIR		3			5.9.2	TBC	nominal	1	ACMS-PMA permanent failure.
SAM	SAM	SM	SAM	CDMS level 4	SIR	1					5.3 sc2 ?	X	2	needs multiple failures to get a power outage when the S/C is Sun pointed (no ACMS level 4) and S/C is in SAM mode (minimum power consumption unless to consider a non nominal configuration).
	OCM W-off		SAM			1						X	2	needs multiple failures to get a power outage when the S/C is Sun pointed (no ACMS level 4) and S/C is in SAM mode (minimum power consumption unless to consider a non nominal configuration).
	SASM		SASM				2				(5.3 sc2)	X	2	needs multiple failures for ACMS not restoring SUN pointing before battery reserve is out.
	SAM	SAM	SAM	CDMS level 3a	CIR	1					5.3 sc 2 ?	nominal	1	CDMS-PMA transient failure.
	OCM W-off		SAM			1					TBC	nominal (low probability)	1	CDMS-PMA transient failure. NB. Low probability as SAM/OCM is a transient state on the way to/from NOM/OCM
	SASM		SASM				2				(5.3 sc2)	degraded case	2	CDMS-PMA transient failure (set-up) while ACMS is in severe anomaly (level 4 or 3b)
	SAM	SAM	SAM	CDMS level 3b	CIR			3			5.3 sc2 ?	nominal	1	CDMS-PMA permanent failure
	OCM W-off		SAM					3			TBC	hazardous attempt	1	3rd CDMS-PMA transient failure (unit dying) while attempting (for TM/TC rate) to turn the S/C toward Earth to help investigation (i.e. attempt registers not yet cleared on purpose)
	SASM		SASM						4		(5.3 sc2)	X	2	needs two severes failure in a small time delay: one first in ACMS (not yet restored) for being in SASM, then a second with having CDMS PMA permanently failing.
	SAM	SAM	SASM	ACMS level 4	AIR	1					5.3 sc1	nominal	1	ACMS severe failure (loss of attitude)
	OCM W-off		SASM			1					TBC	nominal (low probability)	1	ACMS severe failure (loss of attitude). NB. Low probability as SAM/OCM is a transient state on the way to/from NOM/OCM
	SASM		SASM				2				(5.3 sc1)	X	2	needs two severes failure in ACMS in a small time delay: one first (not yet restored) for being in SASM, then a second for loosing again (or being not able to restore) a proper (roughly Sun pointed) attitude.
	SAM	SAM	SAM	ACMS level 3a	AIR	1					TBC	nominal	1	ACMS-PMA transient failure
	OCM W-off		SAM			1					TBC	nominal (low probability)	1	ACMS-PMA transient failure. NB. Low probability as SAM/OCM is a transient state on the way from/to SAM/SAM to/from NOM/SCM
	SASM		SASM				2				TBC	degraded case (low probability)	2	ACMS-PMB transient failure (set-up), after ACMS has undergone one first and not yet recoverd severe anomaly.
	SAM	SAM	SASM	ACMS level 3b	AIR			3			TBC	nominal	1	ACMS-PMA permanent failure
	OCM W-off		SAM					3			TBC	nominal (low probability)	1	ACMS-PMA permanent failure. NB. Low probability as SAM/OCM is a transient state on the way to/from NOM/OCM
	SASM		SASM						4			X	2	needs two severes failure in ACMS in a small time delay: one first (not restored) for being in SASM, then a second with having ACMS PMB permanently failing.

SATELLITE STATE before alarm CDMS	SATELLITE STATE before alarm ACMS	SATELLITE STATE after alarm CDMS	SATELLITE STATE after alarm ACMS	occuring alarm	synchronisation	number of consecutive alarms necessary to get the situation				TESTED IN S/C IST	TESTED IN SVM IST	type of situation X = impossible unless multiple failures including from ground operation	number of failure needed (min)	Scenario for having the case with a minimum number of failures (PM failures may be hardware or software)
black : nominal case bleu : transient case orange : degraded case red : abnormal case		red : mode transition done green : mode reinforced black : no action												
NOM	SCM	SM	SAM	CDMS level 4	SIR	1				5.8.6.7	5.3 sc3	hazardous operation	2	needs multiple failures or an operation error has operating the S/C at full load while in Moon eclipse to get a power outage while the S/C is Sun pointed (no ACMS level 4).
	OCM		SAM			1					TBC	hazardous operation	2	needs multiple failures or an operation error has operating the S/C at full load while in Moon eclipse to get a power outage while the S/C is Sun pointed (no ACMS level 4).
	SCM	EAM	SCM (Earth)	CDMS level 3a	CIR	1				5.9.3 5.8.6.3	5.3 sc2	nominal	1	CDMS-PMA transient failure.
	OCM W-on		SCM (Earth)			1					TBC	nominal	1	CDMS-PMA transient failure.
	OCM W-off		SAM			1					TBC	nominal (low probability)	1	ACMS-PMA transient failure. NB. Low probability as SAM/OCM is a transient state on the way from/to SAM/SAM to/from NOM/SCM
	SCM		SCM (Earth)	CDMS level 3b	CIR			3				X		needs CDMS commanded back into operation without clearing RM attempt registers after two 3a alarms.
	OCM W-on		SCM (Earth)					3				X		needs CDMS commanded back into operation without clearing RM attempt registers after two 3a alarms.
	OCM W-off		SAM					3			TBC	hazardous attempt	1	3rd CDMS-PMA transient failure (unit dying) while having restored NOM/OCM W-off to point the Earth (TC rate) to help investigation (i.e. attempt registers not yet cleared on purpose)
	SCM	SAM	SASM	ACMS level 4	AIR	1				5.8.6.5	5.3 sc1	nominal	1	ACMS severe failure (loss of attitude)
	OCM		SASM			1					TBC	nominal	1	ACMS severe failure (loss of attitude)
	SCM	SAM	SAM	ACMS level 3a	AIR	1					TBC	nominal	1	ACMS-PMA transient failure
	OCM		SASM			1					TBC	nominal	1	ACMS-PMA transient failure
	SCM	SAM	SASM	ACMS level 3b	AIR				4			X		needs ACMS commanded back into operation without clearing RM attempt registers after two 3a alarms.
	OCM		SASM						4		TBC	hazardous attempt	1	3rd ACMS-PMA transient failure (unit dying) while having restored NOM/OCM W-off to point the Earth (TC rate) to help investigation (i.e. attempt registers not yet cleared on purpose)
EAM	SCM (Earth)	SM	SAM	CDMS level 4	SIR		2				5.3 sc2	X	3	needs two severes failure in a small time delay: one first (not yet restored) in CDMS-PM for being in EAM, then multiple in ACMS to have a full loss of power and energy.
	SAM						2					X	3	needs two severes failure in a small time delay: one first (not yet restored) in CDMS-PM for being in EAM, then multiple in ACMS to have a full loss of power and energy.
	SCM (Earth)	EAM	SCM (Earth)	CDMS level 3a	CIR		2			5.9.3 5.8.6.4	TBC	nominal	1	CDMS-PMA permanent failure (a 2nd 3a is attempted from 2nd RN, next will be 3b).
	SAM		SAM				2				TBC	nominal (low probability)	1	CDMS-PMA permanent failure while the first 3a alarm occured during a low probability SAM/OCM.
	SCM (Earth)	EAM	SCM (Earth)	CDMS level 3b	CIR			3		5.9.3 5.8.6.4	TBC	nominal	1	CDMS-PMA permanent failure (a 2nd 3a is attempted from 2nd RN, next will be 3b).
	SAM		SAM					3			TBC	nominal (low probability)	1	CDMS-PMA permanent failure while the first 3a alarm occured during a low probability SAM/OCM.
	SCM (Earth)	SAM	SASM	ACMS level 4	AIR		2				5.3 sc2	degraded case	2	ACMS severe failure (loss af attitude), short after CDMS-PMA has undergone a transient failure (I.e. not yet restore)
	SAM						2				TBC	degraded case (low probability)	2	ACMS severe failure (loss af attitude), short after CDMS-PMA has undergone a transient failure (I.e. not yet restore) which occured during a low probability SAM/OCM.
	SCM (Earth)	SAM	SAM	ACMS level 3a	AIR		2			5.8.6.4	TBC	degraded case	2	ACMS-PMA transient failure, short after CDMS-PMA has undergone a simular problem (I.e. not yet restore)
	SAM						2				TBC	degraded case (low probability)	2	ACMS-PMA transient failure, short after CDMS-PMA has undergone a simular problem (I.e. not yet restore) which occured during a low probability SAM/OCM.
	SCM (Earth)	SAM	SASM	ACMS level 3b	AIR				4			X		needs ACMS commanded back into operation without clearing RM attempt registers
	SAM								4			X		needs ACMS commanded back into operation without clearing RM attempt registers

SATELLITE STATE before alarm CDMS	SATELLITE STATE before alarm ACMS	SATELLITE STATE after alarm CDMS	SATELLITE STATE after alarm ACMS	occuring alarm	synchronisation	number of consecutive alarms necessary to get the situation				TESTED IN S/C IST	TESTED IN SVM IST	type of situation X = impossible unless multiple failures including from ground operation	number of failure needed (min)	Scenario for having the case with a minimum number of failures (PM failures may be hardware or software)
black : nominal case bleu : transient case orange : degraded case red : abnormal case		red : mode transition done green : mode reinforced black : no action												
SM	SAM	SM	SAM	CDMS level 4	SIR	1	2				TBC	possibly ciclic after a level 4	2	DOD alarms not cleared after CCS 0 retry delay
SM	SASM	SM	SASM	CDMS level 4	SIR		2					cyclic in SOHO case	3	Typical repetive situation in going out of a SOHO case
SM	SAM	SM	SAM	CDMS level 3a	CIR		2					degraded case in SOHO case	3	needs CDMS-PMB transient failure (set-up) a short time after (not yet restored) a severe multiple failure leading to S/C loss of power and energy
SM	SASM	SM	SASM	CDMS level 3a	CIR			3				degraded case in SOHO case	3	
SM	SAM	SM	SAM	CDMS level 3b	CIR				4			X	3	needs CDMS-PMB permanet failure (set-up) a short time after (not yet restored) a severe multiple failures leading to S/C loss of power and energy (levl 4)
SM	SASM	SM	SASM	CDMS level 3b	CIR				5			X	3	
SM	SAM	SM	SASM	ACMS level 4	AIR		2					X		needs double CDMS and ACMS severe failure (or entry in SOHO case if ACMS failure trigged by lack of power)
SM	SASM	SM	SASM	ACMS level 4	AIR			3				cyclic in SOHO case	3	Typical repetive situation in going out of one SOHO case
SM	SAM	SM	SAM	ACMS level 3a	AIR		2					degraded case in SOHO case	3	needs ACMS-PM transient failure (set-up) after severe multiple failures leading to S/C loss of power and energy (level 4)
SM	SASM	SM	SASM	ACMS level 3a	AIR			3				degraded case in SOHO case	3	
SM	SAM	SM	SASM	ACMS level 3b	AIR				4			X		needs ACMS-PM permanent failure after severe multiple other failures leading to S/C loss of power and energy (level 4)
SM	SASM	SM	SASM	ACMS level 3b	AIR				4			X		
OFF	OFF	SM	SAM	SOHO	SIR	1						cyclic in SOHO case	3	Restart condition after a full loss of power.

no need to be tested
not a priority for test

18. APPENDIX 10: AVM S/C IST APPLICABILITY MATRIX

18.1. SEQUENCE PRIORITY

The AVM S/C IST test shall be realised in a finite time window, starting from newly developed procedures (even if inherited from lower level tests). To manage the time contingency, the sequences shall be executed with the following priority:

priority	sequence	ref.	PM	Units	INST	note
1a	Launch	§5.8.2	A1	A	A	
1b	S/C Reconfiguration	§5.8.6	AB1	A**	A***	
1c	Degraded cases	§5.9.2	AB1	A	A	
		§5.9.3	AB1	A**	A***	
1d	DTCP worst case scenario	§5.8.8	A1*	A**	A***	
1e	REFERENCE Mission Scenario	§5.8.9	A1	A	A	
2a	Instrument commissioning	§5.8.4	A1	A	A***	SPIRE
			A1	B	A***	PACS
			B1	A	A***	HIFI
			B1	B	A***	Parallel
2b	Mode transitions	§5.8.5	A	A	A	
1f / 3a *	Launch clean run	§5.8.10	A1	A	A	
3b	CDMS management	§5.8.7	A2	A	A	
3c	S/C commissioning	§5.8.3	A1	A&B	A***	
3d			B1	B&A	A***	

The PM / Units / INST column detail the applicable configuration for the used CMDU and ACC PM and software image (PM), the unit in used (Units) not considering the instruments, and the unit in use considering the instruments (INST). This applicability matrix shall be read with the following definitions:

A1* : this sequence shall be nominally tested in B2 configuration (PM-B image 2). This may be considered as a priority 3e in frame of S/C AVM IST test, unless this simplifies the procedure / test management.

A** : this sequence shall be nominally tested in unit B configuration (SVM units). This may be considered as a priority 3f in frame of S/C AVM IST test, unless this simplifies the procedure / test management.

A*** : the AVM configuration does not allow to use an another configuration.

1f / 3a* : considering risks associated to this sequence (no observability on the satellite for a quite long period), it is not considered possible to run this sequence on the flight model before this sequence has been debugged and successfully run on the AVM. It may be so considered as a priority 1. In the other hand, this sequence is fully similar on Herschel and Planck on the critical part, that is the satellite control recovery after separation. Before the separation, this sequence is strictly identical to the Launch sequence. Then it is considered a priority 1 to run successfully this sequence either on Herschel or Planck AVM. But this is a priority 3 run this sequence on both Herschel and Planck AVM.

The priority 1 tests are the one that shall be in any case successful to consider the AVM S/C IST successful.

The priority 2 tests are the one that shall be attempted and debugged at a minimum level (see sequence dedicated paragraphs) in the frame of the test. A successful clean run may be trade against schedule time.

The priority 3 tests are the one that may be fully trade against schedule time.

18.2. CONSIDERED SEQUENCE ADAPTATION FOR AVM TEST

18.2.1. LAUNCH SEQUENCE

The AVM configuration can fully support the test, except for the instrument launch lock setting / verification.

The associated operation shall be masked.

18.2.2. S/C RECONFIGURATION, DEGRADED CASES, DTCP WORST CASE SCENARIO

The AVM configuration can fully support those tests, except for the instrument being in the wanted observation modes, on the wanted units (i.e. B).

The sequence shall be run with masking the instrument observation operations, and leaving the instrument to be PRIME, in STBY.

This limits nevertheless the scope of the emergency OBCP verification, and the instrument teams may suggest on a case by case basis to be agreed before TRR, an alternative configuration for the instrument to be PRIME for the PFM sequence.

18.2.3. REFERENCE MISSION SCENARIO

The AVM configuration can fully support this test, except for the instrument being in the wanted observation modes, which may be different from the PFM test to take into account the limitation of the AVM units.

Specifically, HIFI will be not activated during the RMS on AVM (too much limitation, it will be left in stand-by). The test slot will be used for testing a specific sequence with SPIRE in spectrometer mode (not considered for RMS on the PFM).

18.2.4. INSTRUMENT COMMISSIONING

The AVM configuration can fully support this test, except for the instrument being in the wanted observation modes on the wanted unit.

This sequence shall be run at worst with masking the instrument observation operations, and leaving the instrument to be PRIME, in STBY.

This defines the minimum objective of the test, as the validation of the procedures needed to set the S/C in A1/B, B1/A and B1/B (PM/Units) configuration.

18.2.5. MODE TRANSITIONS

The AVM configuration can fully support this test, except for the instrument being in the wanted observation modes on the wanted unit.

This sequence shall be run at worst with masking the instrument observation operations, and leaving the instrument to be PRIME, in STBY.

This limits nevertheless the scope of the emergency OBCP verification, and the instrument teams may suggest on a case by case basis to be agreed before TRR, an alternative configuration for the instrument to be PRIME for the PFM sequence.

18.2.6. LAUNCH CLEAN RUN

The AVM configuration can fully support the test, except for the instrument launch lock setting / verification.

The associated operation shall be masked.

18.2.7. CDMS MANAGEMENT

The AVM configuration can fully support those tests, except for the instrument being in the wanted observation modes, on the wanted units (i.e. B).

The sequence shall be run with masking the instrument observation operations, and leaving the instrument to be PRIME, in STBY.

The instrument teams may suggest on a case by case basis to be agreed before TRR, an alternative configuration for the instrument to be PRIME for the PFM sequence.

18.2.8. S/C COMMISSIONING

The AVM configuration can fully support those tests, except for the instrument “B” ICU/DPU being available for the 1553 link test.

The sequence shall be run with masking the instrument “B” ICU/DPU 1553 link test.

19.EGSE CONFIGURATION ELEMENTS

19.1. S/C SKIN PLUG CONFIGURATION

The following table details the S/C skin plug usage in relation with the different S/C IST sequences:

connector bracket identification	connector reference	unit or function	SCOE configuration as a function of S/C IST test sequence	Launch sequence RMS	INST commissioning Mode transition S/C reconfiguration Launch mode robustness CDMS management DTCP worst case scnr	NOM mode robustness	Clean run	Comments
PU1	J01	M	Umbilical connection	TMTC DFE	TMTC DFE	TMTC DFE	**"OPEN"** (during main sequence)	
PU2	J02	R						
SK01A	J01	M	Solar Array connector (SAS input)	POWER SCOE (LPS then SAS config)	POWER SCOE (SAS)	POWER SCOE (SAS)	**Solar Array connected (if present)**	SA1, sections 1, 4, 7, 10, 13, 16, 19, 22, 25, 28
	J05	M						
	J02	M						SA2, sections 2, 5, 8, 11, 14, 17, 20, 23, 26, 29
	J06	R						
	J03	M						SA3, sections 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
	J07	R						
SK1B	J09	M	Flight Battery power jumper	**FLIGHT PLUG** (FM battery connected)	POWER SCOE (BATSIM)	POWER SCOE (BATSIM)	**FLIGHT PLUG** (FM battery connected)	
	J10	R	(PCDU side = BATSIM input)					
	J11	M	BDR AIT ON/OFF DTC	LPS SCOE	LPS SCOE	LPS SCOE	**LPS SCOE TBC** (emergency stop capability)	
	J12	R	(emergency S/C OFF)					
SK02	J01	M	CDMS 1553 bus jumper	BUS MONITOR	BUS MONITOR	**BUS MONITOR and CDMU SCOE (jamming)**	**FLIGHT PLUG**	
	J02	R	(S/C bus monitoring)					
	J03	M	ACMS 1553 bus jumper	ACMS SCOE (bus monitor)	ACMS SCOE (bus monitor)	ACMS SCOE (bus monitor)	**FLIGHT PLUG**	
	J04	R	(S/C bus monitoring)					
	J05	M	LV / THR FCV cmd safety plugs	ACMS SCOE	ACMS SCOE	ACMS SCOE	**TEST LOADS**	
	J06	R	(safe plug with loads)					
	J07	M	PCS TANK sensor jumpers (simulation input)	ACMS SCOE	ACMS SCOE	ACMS SCOE	**FLIGHT PLUG** (sensors connected)	
	J08	M	THR thermocouple and LV status (simulation input)	ACMS SCOE	ACMS SCOE	ACMS SCOE	**FLIGHT PLUG** (sensors connected)	
	J09	M	CDMU and ACC EEPROM quick	FLIGHT CAP	FLIGHT CAP	FLIGHT CAP	FLIGHT CAP	
	J10	R	reprogramming input					
	J11	R	THR thermocouple and LV status (simulation input)	ACMS SCOE	ACMS SCOE	ACMS SCOE	**FLIGHT PLUG** (sensors connected)	
	J12	M	THR heaters cmd safety plugs	ACMS SCOE	ACMS SCOE	ACMS SCOE	**TEST LOADS**	
	J13	R	(safe plug with load)					
	J14	1	STR ON/OFF STS signal jumper	FLIGHT PLUG (STR connected)	FLIGHT PLUG (STR connected)	FLIGHT PLUG (STR connected)	FLIGHT PLUG (STR connected)	
	J15	2	(simulation input)					
	J16	1	GYRO ON/OFF STS signal jumper	FLIGHT PLUG (GYRO connected)	FLIGHT PLUG (GYRO connected)	FLIGHT PLUG (GYRO connected)	FLIGHT PLUG (GYRO connected)	
	J17	2	(simulation input)					
SK03	J01	1	TTC XPND aux. ouputs and	GROUND PLUG (with helix protection strap)	GROUND PLUG (with helix protection strap)	GROUND PLUG (with helix protection strap)	**FLIGHT CAP**	
	J02	2	TWTA safety plug					
SK04	J01	1	RWL1 signal jumper	FLIGHT PLUG (RWL connected)	FLIGHT PLUG (RWL connected)	FLIGHT PLUG (RWL connected)	FLIGHT PLUG (RWL connected)	
	J02	2	RWL2 signal jumper					
	J03	3	RWL3 signal jumper					
	J04	4	RWL4 signal jumper					
SK05	J01	1	CRS signal jumper	FLIGHT PLUG (CRS connected)	FLIGHT PLUG (CRS connected)	FLIGHT PLUG (CRS connected)	FLIGHT PLUG (CRS connected)	
	J02	2	(simulation input)					
	J03		GYRO test plug (stimulation)	ACMS SCOE	ACMS SCOE	ACMS SCOE	**FLIGHT CAP**	
	J04		CRS stimulation input					
	J05	M	AAD signal jumper (simulation input)				**FLIGHT PLUGS** (sensors connected) SAS and AAD optically stimulated (hand light)	
	J06	M	SAS 1and 2 signal jumpers					
	J07	R	(simulation input)					
	J08	R	AAD signal jumper (simulation input)					
SK06	J01	1	STR stimulation input	ACMS SCOE	ACMS SCOE	ACMS SCOE	**FLIGHT CAP**	
	J02	2						
ANT	LGA1		Low gain antenna (Earth)	RF SCOE	RF SCOE	RF SCOE	RF SCOE	
	LGA2		+X looking LGA					
	LGA3		(used for Launch and SM only)					
	MGA		Medium gain antenna (Earth)					

Values in red are delta with respect to most common test configuration.

Note: the above configuration holds for PFM tests. For AVM, the need to simulate some of the ACMS sensors and actuators leads to a specific configuration.

WARNING: the above configuration holds for test at ambient. It shall not be copied and pasted for one TVTB test.

19.2. S/C LATCHING RELAYS

The following table recalls the latching relays and switches present in the S/C design (SVM), and the configuration in which they shall be set the specified test PM / Units configuration.

S/C latching relays	TEST configuration :	PM A				PM B				command available on MAP0
		UNITS A		UNITS B		UNITS A		UNITS B		
		SW1	SW2	SW1	SW2	SW1	SW2	SW1	SW2	
CDMU	RMA enable	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	YES
	RMB enable	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	YES
	OBT select	OBT A	OBT A	OBT B	OBT B	OBT A	OBT A	OBT B	OBT B	YES
	PM select	PM A	PM A	PM A	PM A	PM B	PM B	PM B	PM B	YES
	PM A Bit 0 Software image	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	YES
	PM A Bit 1 SOHO case (boot in SM)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	YES
	PM B Bit 0 Software image	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	YES
	PM B Bit 1 SOHO case (boot in SM)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	0 (*)	YES
	PM A ON/OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	YES
	PM B ON/OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	YES
	WD enable A	ON	ON	ON	ON	ON	ON	ON	ON	YES
	WD enable B	ON	ON	ON	ON	ON	ON	ON	ON	YES
PCDU	I/F A ON/OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	
	I/F B ON/OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON	
ACC	RMA enable	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	YES
	RMB enable	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	YES
	OBT select	OBT A	OBT A	OBT B	OBT B	OBT A	OBT A	OBT B	OBT B	
	PM select	PM A	PM A	PM A	PM A	PM A	PM A	PM A	PM A	
	PM A Bit 0 Software image	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	
	PM A Bit 1 Boot mode (S/N)	Nominal (*)	Nominal (*)	Nominal (*)	Nominal (*)	Survival (*)	Survival (*)	Survival (*)	Survival (*)	
	PM B Bit 0 Software image	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	SW image1	SW image2	
	PM B Bit 1 Boot mode (S/N)	Survival (*)	Survival (*)	Survival (*)	Survival (*)	Nominal (*)	Nominal (*)	Nominal (*)	Nominal (*)	
	PM A ON/OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	
	PM B ON/OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	
	WD enable A (CDMU separated)	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	
	WD enable B (CDMU separated)	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	
CIR	*CDMU in reconfiguration*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*set only*
SIR	*S/C in reconfiguration*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*(CDMS)*	*set only*
AIR	*ACMS in reconfiguration*	*(ACMS)*	*(ACMS)*	*(ACMS)*	*(ACMS)*	*(ACMS)*	*(ACMS)*	*(ACMS)*	*(ACMS)*	
TTC-RF	RF Switch 1	B	B	B	B	B	B	B	B	YES
	RF Switch 2	B	B	B	B	B	B	B	B	YES
	RF Switch 3	B	B	B	B	B	B	B	B	YES
	RF Switch 4	B	B	B	B	B	B	B	B	YES
	XPND 1 Tx RF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	YES
	XPND 2 Tx RF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	YES

Notes:

For the (*) subscripted cases, the setting is modified as part of the S/C autonomous reconfiguration.

The red colour marks the delta-configuration from nominal PMA, UNITS A, SW1 configuration.

For relays which cannot be commanded from MAP0, the CDMU SW shall be active for modifying the relays state, then the turn ON configuration is determined from state at previous turn OFF.

The MAP0 command for “WD enable A” shall be sent on VC0, and VC1 for “WD enable B” (same command reference).

The grey colour / italic marks relays which initial state is managed by the listed sub-system.

The TTC relays and switches position change with S/C operations, but initial position for one cold start shall be coherent with the "unit in use" table as loaded with default EEPROM values. An alternative is to confirm the switches and relays position with service 115 TC after boot, so that the table flags are corrected.

END OF DOCUMENT