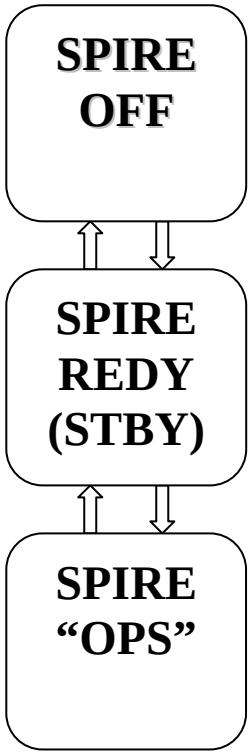
1. Introduction

This document describes the procedures to be used for IST SAT debugging activities. These procedures, which are valid for the SPIRE AVM and FM, allow the SPIRE instrument to be switched between three basic operating modes. To facilitate these activities, four mode transitions are defined:

- **OFF to STBY. Note that the STBY mode is known as REDY mode in SPIRE terminology.** In this mode only SPIRE HK is being generated.
- **STBY to "OPS"**, where "OPS" refers to a dummy mode where SPIRE is Prime Instrument and generating both science and HK data at the nominal data rate.
- **"OPS" to STBY**
- **STBY to OFF**



For FM these procedures can be used before and after integration with the FPU. **Since these procedures use standalone TCL scripts they do not require the presence of SPIRE personnel and the I-EGSE will not be used.**

1.1 Scope

Unless otherwise indicated, it is assumed that both the FM and AVM procedures are the same. Any differences are noted in the detailed procedures in section 4.

1.2 Applicable Documents

AD#	Title	Reference	Issue#	Date
AD01	SPIRE Functional Test Specification	SPIRE-RAL-DOC-001652	1.4	22/07/2005

AD02	SPIRE ILT Warm Functional Test Procedure	SPIRE-RAL-PRC-002322	1.2	27/01/2006

1.3 Reference Documents

RD#	Title	Reference	Issue#	Date
RD01	SPIRE Instrument User Manual	SPIRE-RAL-PRJ-002395	1.0	08/04/2005
RD02	H/P OBT-UTC Time Synchronisation Technical Note	PT-CMOC-OPS-TN-6604-OPS- OGH	1.3	Sep 2004
RD03	Spire Instrument Block Diagram	SPIRE-RAL-DWG-000646	6.1	
RD04	DRCU Simulator HW/SW User Manual		1.0	26/11/2003

1.4 Change Record

Doc	Issue#	Changes	Date of Change
Issue	1.0	First version prepared for IST SAT debugging activities	02/03/2007

1.5 Open Issues

There are some known issues with regard to the DRCU simulator behaviour which will be present only on the AVM scenario. For example, the DRCU Simulator does not recognize certain SPIRE Get HK commands contained in both the nominal and critical HK requests. As a result, whenever the OBS is started the HK parameter values relating to these requests enter into their hard limits (red alarms on SCOS), as specified in the SPIRE MIB. These are unavoidable design features of the DRCU simulator that cannot be corrected at this stage. Hence, where applicable, the affected procedures make reference to this 'anomalous' behaviour explicitly.

For the purposes of these debugging activities these OOL conditions can be ignored.

1.6 List of Acronyms

AVM	Avionics Model
CCS	Central Checkout System
CDMU	Command and Data Management Unit
DPU	Digital Processing Unit
DRCU	Detector Readout and Control Unit
EGSE	Electrical Ground Support Equipment
FM	Integrated System Test
FPU	Focal Plane Unit
I-EGSE	Instrument EGSE
IST	Integrated Systems Test
OBT	On Board Time
OOL	Out Of Limit

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2. Test Configuration

The main differences between the AVM and the FM configurations are with respect to the hardware. On the SPIRE AVM hardware the Warm Units and the FPU are substituted by a DRCU simulator.

2.1 FM Test Configuration

This is the required configuration prior to the start of the test:

SPIRE WU:

- The SPIRE FM DRCU should be interconnected with the SPIRE FM DPU, both PRIME and REDUNDANT interfaces.
- The SPIRE FM DRCU NOMINAL and REDUNDANT power interfaces to the Herschel satellite should be connected.
- The SPIRE FM DPU NOMINAL and REDUNDANT 1553 interfaces to the Herschel satellite should be connected.
- The SPIRE FM DPU NOMINAL and REDUNDANT power interfaces to the Herschel satellite should be connected.

HCDMU:

- The Bus list selected on the HCDMU should be as appropriate for the planned activity. If SPIRE is to put into an “Operations” mode then bus list should be for SPIRE Prime Instrument, (i.e., 27 TM slots allocated for SPIRE telemetry). For the NOMINAL side tests the BUS Configuration should be SPIRE Nominal (i.e, RT=21) and for the REDUNDANT side test the BUS Configuration should be SPIRE Redundant (i.e, RT=22).
- The HCDMU and CCS should be interconnected.

CCS:

- The SPIRE MIB should be imported on the CCS.

2.2 AVM Test Configuration

Note: There is no redundancy on the AVM configuration

This is the required configuration prior to the start of the test:

SPIRE WU:

- The SPIRE DRCU Simulator PC should be powered ON and the operating system running.
- The SPIRE DRCU Simulator PC should be interconnected with the SPIRE FM DPU following RD04.
- The SPIRE FM DPU NOMINAL 1553 interface to the Herschel satellite should be connected.
- The SPIRE FM DPU NOMINAL power interface to the Herschel satellite should be connected.

HCDMU:

- The Bus list selected on the HCDMU should be as appropriate for the planned activity. If SPIRE is to be put into "Operations" mode then bus list should be for SPIRE Prime Instrument, (i.e., 27 TM slots allocated for SPIRE telemetry).
- The HCDMU and CCS should be interconnected.

CCS:

- The SPIRE MIB should be imported on the CCS.

3. IST SAT Debugging Procedures Overview

3.1 General instructions for executing the test procedures

- Section 3.2 of this document specifies the sequence to be executed. Each of the steps in the sequence has a detailed specification in section 4.
- The detailed procedures in section 4 include blank boxes where the actual values of parameters can be noted. Based on the comparison with the expected values the success or failure of a step should be recorded in the final column of the table.
- If the tests are to be performed with the FM then the operator has to select either the NOMINAL or REDUNDANT instrument – in such cases these choices are indicated by a switch in Procedure Step Description, e.g. **NOMINAL/REDUNDANT (21/22)**
- The last row in a procedure table should be used to record the overall Pass/Fail result of each test.
- In general any text in boldface in the procedural steps indicates an action which may have to be performed manually by the CCS staff.

3.2 Test Sequence

This section specifies the sequence to be executed with estimated times for each execution.

Step #	Procedure Name	Purpose	Duration
1	SPIRE-IST-DBG-OFF-TO-STBY	To switch SPIRE from OFF to STBY mode	5 min
2	SPIRE-IST-DBG-STBY-TO-OPS	To switch SPIRE from STBY to “OPS” mode	5 min
3	SPIRE-IST-DBG-OPS-TO-STBY	To switch SPIRE from “OPS” to STBY mode	5 min
4	SPIRE-IST-DBG-STBY-TO-2OFF	To switch SPIRE from STBY to OFF	5 min

Total: ~ 20 min

4. Detailed IST Debugging Procedures

4.1 Procedures

4.1.1 Procedure SPIRE-IST-DBG-OFF-TO-STBY

Version	1.0
Date	2nd April 2007
Purpose	To switch the SPIRE instrument from OFF to STBY mode
Initial configuration	SPIRE DPU and DRCU are switched off
Final configuration	SPIRE is in STBY mode: • SPIRE DPU and DRCU are on • Generating Nominal HK reports at 4 second intervals • Generating Critical HK reports at 2 second intervals
Preconditions	• SPIRE FM DPU and DRCU are electrically integrated with the Herschel Satellite • SPIRE MIB is imported in the CCS database. • CCS is up and running • DPU AND OBS PARAMETERS display is selected on the CCS
Duration	5 minutes
Pass/Fail criteria	Nominal and Critical HK reports start being generated at their nominal rates of 0.25Hz and 0.5Hz respectively.

Procedure Steps:

Step	Description	Parameter	Expected Values Before/After	Actual Values Before/After	Pass/ Fail
1	**Power ON the SPIRE DPU NOMINAL/REDUNDANT unit using the dedicated spacecraft LCL line and configure 1553 Spacecraft bus for SPIRE DPU (RT = 21/22)**	—	—	—	
2	Wait for the boot software to produce at least 2 event packets (5,1)				
3	Execute TCL script SPIRE-IST-DBG-OFF2DPUON.tcl	—	—	—	
4	Nominal and Critical HK packets should arrive at the CCS for 10 seconds: **SPIRE Nominal HK:** • (type ,subtype) : (3,25) • APID : 0x502/0x503 **SPIRE Critical HK:** • (type ,subtype) : (3,25) • APID: 0x500	—	—	—	
5	For this 10 second period check that TM1N and TM2N parameters incremented as indicated	TM1N TM2N	@ 0.5Hz @ 1Hz		
6	After this 10 second interval check that all HK TM reception has stopped	TM1N TM2N	Not incrementing Not incrementing	— —	
7	**Power ON the SPIRE DRCU NOMINAL/REDUNDANT unit using the dedicated spacecraft LCL line.** **For the AVM the DRCU simulator has to be switched on.**	—	—	—	
8	Execute TCL script SPIRE-IST-DBG-DPUON2STBY.tcl	—	—	—	
9	Check that the THSK parameter is refreshing every 4 seconds	THSK	Refreshing @ 0.25Hz	—	
10	Check that TM1N and TM2N parameters are incrementing as indicated	TM1N TM2N	Incrementing by one every 4 seconds Incrementing by 2 every 4 seconds	— —	
11	Check that the SCU/DCU voltages show nominal values. *Note that for the AVM some parameters will be in hard limits.*	SCUP5V SCUP9V SCUM9V BIASP5V BIASP9V BIASM9V	~ 5.2 ± 0.5V ~ 9.0 ± 0.2V ~ -9.0 ± 0.2V ~ 5.1 ± 0.5V ~ 9.0 ± 0.2V ~ -9.0 ± 0.2V		
12	Check that SPIRE is in REDY mode	MODE	DRCU_ON/REDY	—	
Test Result (Pass/Fail):					

4.1.2 Procedure SPIRE-IST-DBG-STBY-TO-OPS

Version	1.0
Date	2nd April 2007
Purpose	To switch SPIRE from STBY to "OPS" mode
Initial configuration	• SPIRE DPU and DRCU are ON • SPIRE is in REDY mode
Final configuration	SPIRE is Prime Instrument and in "OPS" mode: • Generating critical and nominal HK at 0.5Hz and 1Hz respectively • Generating photometer science data at ~ 18 packets/s
Preconditions	• SPIRE MIB is imported in the CCS database. • CCS is up and running • DPU AND OBS PARAMETERS and FUNCTIONAL TEST PARAMETERS displays are selected on the CCS
Duration	5 minutes
Pass/Fail criteria	SPIRE is Prime Instrument and in "OPS" mode: • Generating critical and nominal HK at 0.5Hz and 1Hz respectively • Generating photometer science data at ~ 18 packets/s

Procedure steps:

Step	Description	Parameter	Expected Values Before/ After	Actual Values Before/After	Success/ Failure
1	Execute TCL script SPIRE-IST-DBG-STBY2OPS.tcl	—	—	—	
2	Check that THSK parameter is refreshing every second	THSK	Refreshing @ 1Hz	—	
3	Check that TM1N and TM2N parameters are incrementing as indicated	TM1N TM2N	@ 0.5Hz @ 1Hz	—	
4	Check that TM3N is incrementing as indicated	TM3N	~18-20 Hz	—	
5	Check that DCUFRAMECNT on the FUNCTIONAL TEST PARAMETERS display is incrementing as indicated	DCUFRAMECNT	~18-20 Hz	—	
6	Check that the MODE parameter is set to 0xFFFF for the “OPS” mode *Note that “OPS” is a dummy value for the debugging activities – no converted value is defined.*	MODE	REDY/ 0xFFFF		
Test Result (Pass/Fail):					

4.1.3 Procedure SPIRE-IST-DBG-OPS-TO-STBY

Version	1.0
Date	2nd April 2007
Purpose	To switch SPIRE from "OPS" to STBY mode
Initial configuration	• SPIRE DPU and DRCU are ON • SPIRE is Prime Instrument • SPIRE is in "OPS" mode and generating photometer science data as well as HK
Final configuration	SPIRE is in STBY mode:: • Generating only critical and nominal HK at 0.5Hz and 0.25Hz respectively
Preconditions	• SPIRE MIB is imported in the CCS database. • CCS is up and running • DPU AND OBS PARAMETERS and FUNCTIONAL TEST PARAMETERS displays are selected on the CCS
Duration	5 minutes
Pass/Fail criteria	

Procedure steps:

Step	Description	Parameter	Expected Values Before/After	Actual Values Before/After	Success/ Failure
1	Execute TCL script SPIRE-IST-DBG-OPS2STBY.tcl	—	—	—	
2	Check that the THSK parameter is refreshing every 4 seconds	THSK	Refreshing @ 0.25Hz	—	
3	Check that TM1N and TM2N parameters are incrementing as indicated	TM1N TM2N	Incrementing by one every 4 seconds Incrementing by 2 every 4 seconds	—	
4	Check that TM3N has stopped incrementing	TM3N	—	—	
5	Check that DCUFRAMECNT on the FUNCTIONAL TEST PARAMETERS has stopped incrementing	DCUFRAMECNT	—	—	
6	Check that SPIRE is in REDY mode (RAW 0x200)	MODE	0xFFFF/0x200		

Test Result (Pass/Fail):

4.1.4 Procedure SPIRE-IST-DBG-STBY-TO-OFF

Version	1.0
Date	2nd April 2007
Purpose	To switch SPIRE from "OPS" to STBY mode
Initial configuration	• SPIRE DPU and DRCU are ON • SPIRE is in STBY mode:: Generating only critical and nominal HK at 0.5Hz and 0.25Hz respectively
Final configuration	SPIRE is OFF: • DPU and DRCU are both OFF
Preconditions	• SPIRE MIB is imported in the CCS database. • CCS is up and running • DPU AND OBS PARAMETERS is selected on the CCS
Duration	5 minutes
Pass/Fail criteria	SPIRE instrument is OFF

Procedure steps:

Step	Description	Parameter	Expected Values Before/After	Actual Values Before/After	Success/ Failure
1	Execute TCL script SPIRE-IST-DBG-STBY2OFF.tcl	—	—	—	
2	Check that TM1N and TM2N parameters have both stopped incrementing	TM1N TM2N	— —	— —	
3	Check that SPIRE is in DRCU_ON mode	MODE	DRCU_ON	—	
4	**Power OFF the SPIRE DRCU NOMINAL/REDUNDANT unit.** **For the AVM the DRCU simulator has to be switched off.**	—	—	—	
5	**Power OFF the SPIRE DPU NOMINAL/REDUNDANT unit.**	—	—	—	
Test Result (Pass/Fail):					