SPIRE

SUBJECT: SPIRE AVM Definition

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Glossary

AVM	Avionics Model
CQM	Cryogenic Qualification Model
HSDPU	SPIRE Digital Processing Unit
HSDRCU	SPIRE Detector Readout and Control Unit
HSFPU	SPIRE Focal Plane Unit
HSJFP	SPIRE JFET box for the photometer
HSJFS	SPIRE FET box for the spectrometer
HSWIH	SPIRE Warm Interconnect Harness
IIDR	Instrument Intermediate Design Review
SPIRE	Spectral and Photometric Imaging REceiver

1. SCOPE

The Instrument Interface Document, Part A (AD1) requires the delivery of an Avionics Model (AVM) of the Herschel instruments to be delivered to ESA. This document defines the configuration of the SPIRE Avionics Model.

2. DOCUMENTS

2.1 Applicable Documents

AD1 Herschel Instrument Interface Document (IID) Part A

2.2 Reference Documents

RD 1 CQM Test Requirements (SPIRE-RAL-DOC-000389, Issue 1.0)

3. INTRODUCTION

ESA require (in AD1) that an AVM model of the SPIRE instrument is delivered as part of the system test programme for the Herschel satellite. In addition, a second model (the CQM see RD1) also has to be delivered on a similar time frame for compatibility testing of the Herschel instruments.

As both models make use of the SPIRE warm electronics units, and ESA have agreed that the AVM and CQM tests will be arranged such that the AVM electronics can be used to operate the CQM during all its tests, SPIRE will deliver one version of each SPIRE unit to ESA. These units will be used in various configurations to accommodate all of the tests of these two models.

Our intention is to deliver the following:

CQM units: HSFPU, HSJFP.,HSJFS, HSDRCU, HSWIH
AVM units: HSDPU, DRCU Simulator
Support Equipment: FPU Simulator, EGSE

3.1 CQM

The SPIRE Focal Plane Unit (HSFPU) and FET boxes (HSJFP and HSJFS) will be manufactured to the required standard for the CQM as given in the IID part A.

The HSDRCU and HSWIH will be manufactured to the standard necessary to complete the tests foreseen for the CQM.

The FPU Simulator is provided to verify integration of the Warm Electronics (HSDPU, HSDRCU and HSWIH) in the CQM test environment. It has sufficient simulation of the FPU, and FET Boxes to allow the electronics to be switched on and a simple functional test to be performed. This will be implemented with passive components for each subsystem, except for the FTS and BSM subsystems, which may require active simulation to test functionality of the control electronics (TBC).

4. AVM

We do not propose to use the DRCU and the FPU simulator as part of the AVM, as simulation of the response to an astronomical object is not possible, and because of the difficulty of simulating the high-speed analogue signals from the detectors to the DRCU. We propose therefore to provide a simulator of the DRCU FPU for those tests that require this functionality. This simulator (the DRCU Simulator) would have a relatively simple digital interface with the HSDPU, which could be provided from a PC running suitable software.

4.1 AVM Functionality

The HSDPU will be manufactured to the standard necessary to complete the tests foreseen for the AVM (we assume the CQM tests do not imply further requirements). We believe that this, along with the DRCU simulator will provide the necessary functionality to satisfy the test objectives given in the IID Part A section 9.2.2.1. Our interpretation of these is:

- Verification of all electrical and software interfaces
  - *Electrical Interfaces: all interfaces to the spacecraft are provided, including the DRCU interface to the Power Subsystem, if necessary. It may not be possible to simulate the power consumption for all modes of the instrument.*
  - *Software interfaces:*
    - *TC reception and verification can be tested*
    - *TM generation can be tested*
- Verification of subsystem and instrument functional performance within system environment
  - *Peak-up mode: it is difficult to see how we could test this operation without a simulation of the response to an astronomical source. The DRCU simulator should provide this.*
  - *Autonomy:*
    - *Simulation of failures of the FPU subsystems will be built into the DRCU Simulator, but in any case we do not expect any failures in this unit to propagate to the system level. They will be dealt with by the DPU.*
    - *Simulation of failures of the DRCU will be built into the DRCU Simulator. Again we expect these failures to be handled by the DPU.*
    - *Simulation of failures of the DPU has to be done by OBS modification.*
- Qualification of on-board software
  - *These tests are still TBD*
- Verification of system performance
  - *These tests are still TBD*
- Verification of operational procedures.
  - *Switch-on, switch off: Should be possible, all interfaces are operational*
  - *Cooler recycle: OK, the DRCU simulator responds to commands to the cooler*
  - *Response to anomalies: Simulation of failures of the FPU subsystems will be built into the DRCU Simulator.*
  - *OBS update: OK, the DPU is now the only unit containing software and it can be updated as needed.*

4.2 DPU Configuration

The DPU will conform to the description given in the IID Part A (except where indicated)

- **Electronics:** flight standard except for parts.
  We cannot use commercial parts of the 'same technology, same supplier as FM parts' because until the Common Procurement exercise is complete we do not know the provider of the parts and this will occur after the date the DPU is needed for instrument level testing.
- **Mechanisms:** flight representative for electrical actuators.
  We have no actuators in the electronics, those in the FPU will be simulated.
- **Software:**
  - flight standard.
    The software delivered will be that available at the time of AVM testing. It will not be the final flight software, as that will only be available after delivery of the PFM. The DPU will allow upload of the new software when available.
  - flight quality s/w shall be able to be run.
    Because of the simulation of the DRCU and FPU, all flight software should run without change.
  - **Form, fit and function:** same as the flight model
    This is true for the DPU. There is no DRCU as part of the AVM.
- **Redundancy:**
  - *No automatic switchover function is foreseen therefore cold redundant units or channels may not be provided.*
  - *No hot redundant units or modules are foreseen.*

4.3 Support Equipment:

The EGSE is a version of the instrument EGSE used for all system-level testing at ESTEC. We assume the interface to the test environment for CQM testing will be identical to that for later system-level tests. This equipment will remain at ESA for testing future models.