Herschel

SPIRE DPU Electrical

Test Procedures

Document Ref: SPIRE-IFS-PRC-001590

Issue 1

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Document Status Sheet

Issue	Revision	Date	Reason for Change
Issue 1		8 April 2003	First Issue

Document Change Record

Document Title: SPIRE DPU Electrical Test Procedures	
Document Reference Number : SPIRE-IFS-PRC-001590	
Document Issue/Revision Number: Issue 1	
Section	**Reason For Change**
ALL	**Issue 1**

Acronyms

ASI	Agenzia Spaziale Italiana (Italian Space Agency)
AVM	AVionic Model
CDMS	Central Data Management System
CDMU	Central Data Management Unit
CGS	Carlo Gavazzi Space
CRT	Cathode Ray Tube (Oscilloscope)
EEPROM	Electrically Erasable Programmable Read Only Memory
EGSE	Electrical Ground Support Equipment
EIDP	End Item Data Package
EMC	ElectroMagnetic Compatibility
ESD	Electro Static Discharge
EQM	Electrical Qualification Model
DPU	Digital Processing Unit
FIRST	Far Infra-Red and Sub-millimetre Telescope
FCU	Focal plane Control Unit
FM	Flight Model
FP S/S	Focal Plane sub-system
FPU	Focal Plane Unit
FS	Flight Spare
HIFI	Heterodyne Instrument for First
HK	House-Keeping
HRS	High Resolution Spectrometer
HRSU	High Resolution Spectrometer Unit
HW	HardWare
IC	Instrument Control
ICD	Interface Control Document
ICE	In Circuit Emulator
ICU	Instrument Control Unit
I/F	Interface
ILT	Instrument Level Test
LCU	Local oscillator Control Unit
LOA	Local Oscillator Assembly
LO S/S	Local Oscillator sub-system
LOU	Local Oscillator Unit

NCR	Non Conformance Report
OBS	On Board Software
PA	Product Assurance
PACS	Photoconductor Array Camera and Spectrometer
PFM	Proto Flight Model
PROM	Programmable Read Only memory
QA	Quality Assurance
QM	Qualification Model
S/C	Spacecraft
S/S	Subsystem
SPIRE	Spectral and Photometric Imaging Receiver
SW	SoftWare
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
TLP	Transfer Layer Protocol
TRB	Test Review Board
TRRB	Test Readiness Review Board
UR	User Requirement
URD	UR Document
VCD	Verification Control Document
WBS S/S	Wide Band Spectrometer sub-system
WBSU	Wide Band Spectrometer Unit

1 INTRODUCTION

1.1 General

The content of this procedure is based on the DPU model philosophy and the DPU subsystem specification (AD03), the DPU product tree; it is consistent with the interface documents AD01 and AD02. This document specifies how the electrical tests will be carried-out on the DPU, to be sure that the DPU fulfils its electrical performances with the subsystems and with the S/C. The subsystem that is delivered for integration and tests at instrument level consists of an electronic box called DPU and of the On Board Software both appropriate for each of the delivered models. As the DPU boards are designed and manufactured by CGS, the electrical tests related to the boards are CGS responsibility and the relevant test procedures are in REF02-REF04. These procedures cover also the interfaces of the DPU with the subsystems and with the S/C. The S/C interfaces of the integrated DPU subsystem are covered from the physical layer to the SW application layer in REF05.

At integrated instrument level however the secondary power and the command/data interfaces tests should be repeated in order to check also the cabling.

The remaining electrical tests, that are typical of the DPU integrated subsystem, **continuity and bonding measurements**, are also described in this document. This procedure applies to the following deliverable models of the DPU subsystem:

EQM subsystem
FM subsystem

The letters EQM and FM identify these models respectively.

1.2 Objectives

Verification by means of testing of the DPU subsystem with respect to the subsystem specification, especially with reference to AD01-AD06.

1.3 Tools

The following electrical instruments will be used to carry out the measurements:

- for resistance measurements the PROTEK 506 Digital Multimeter;
- for capacitance measurements the Wayne Kerr Automatic LCR Meter 4250;
- for low resistance measurements CROPICO Digital Ohmmeter –D05.
- For command/data timing measurement the Oscilloscope (CRT) Tektronix TDS 380

2 DOCUMENTS

2.1 Applicable Documents

AD	Name
01	Herschel/Planck Instrument Interface Document, part A
02	Herschel/Planck Instrument Interface Document, part B-Instrument SPIRE
03	Herschel SPIRE DPU Subsystem Specification Document
04	SPIRE DPU ICD
05	DPU/ICU P.A.Plan
06	SPIRE DPU AIT Plan

2.2 Reference Documents

RD	Title
01	SPIRE DPU User manual
02	CPU BOARD Test Procedure
03	I/F BOARD Test Procedure
04	DC/DC BOARD Test Procedure
05	DPU/ICU Spacecraft Interface Acceptance Test Plan

3 Command/Data Interface Checks

The clock and the command words are generated by the DPU and are the same for all subsystems but with separated line drivers. It is checked that:

- the cabling is without faults;
- the subsystem addresses are correct;
- the command bits change on the clock falling edge;
- rise and fall times are within limits;

NOTE: the Oscilloscope COMMON is connected to GND, the 2 CRT channels should show inverted signals (positive signal on pin 2, 3, 4, 8, 10, 11 of J07, J08, J09, J10, J11, J12)

3.1 Connector JO7		**Clock Measured**	**Clock Nominal**	**Passed**
Pin	Pin			
2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		00	

16	-		11	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
3.2 Connector J10		**Clock Measured**	**Clock Nominal**	**Passed**
Pin	Pin			
2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		00	
16	-		11	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	

16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
3.3 Connector J08		**Clock Measured**	**Clock Nominal**	**Passed**
Pin	Pin			
2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		01	
16	-		10	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	

16	-		< 100 ns	
3.4 Connector J11		**Clock Measured**	**Clock Nominal**	**Passed**
Pin	Pin			
2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		01	
16	-		10	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	
16	-		< 100 ns	

3.5 Connector J09		**Clock Measured**	**Clock Nominal**	**Passed**
Pin	Pin			
2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		10	
16	-		01	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
3.6 Connector J12				**Passed**
Pin	Pin			

2	-		312500 Hz	
15	-		312500 Hz	
		Rise Time Measured	**Rise Time nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
2	-		< 100 ns	
15	-		< 100 ns	
		Command Address	**Command Addr. Sent**	
3	-		10	
16	-		01	
		Rise Time Measured	**Rise Time nominal**	
3	-		< 100 ns	
16	-		< 100 ns	
		Fall Time Measured	**Fall Time Nominal**	
3	-		< 100 ns	
16	-		< 100 ns	

NOTE: Once tested that the clock and command signals are on the expected connectors, the phasing of clock and commands will be documented with one CRT picture and the waiting time after an HK request will be documented with one CRT picture.

4 Continuity Checks

In the following table the measurements of the relevant pins with respect to the GND are reported.

NOTE: the column 1 pin is connected to the instrument COMMON.

4.1 Connector JO1		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	7		0	
2	GND		> 1 MOHM	
2	GND		< 10 nF	
4	9		0	
4	GND		> 1 MOHM	
4	GND		< 10 nF	
2	4		> 20 kOHM	
4.2 Connector JO2		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	7		0	
2	GND		> 1 MOHM	
2	GND		< 10 nF	
4	9		0	
4	GND		> 1 MOHM	

4	GND		< 10 nF	
2	4		> 20 kOHM	
4.3 Connector JO3		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	GND		> 1 MOHM	
6	GND		> 1 MOHM	
2	6		> 0 OHM	
4.4 Connector JO4		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	GND		> 1 MOHM	
6	GND		> 1 MOHM	
2	6		> 0 OHM	
4.5 Connector JO5		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	GND		> 1 MOHM	
6	GND		> 1 MOHM	
2	6		> 0 OHM	

4.6 Connector JO6		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
2	GND		> 1 MOHM	
6	GND		> 1 MOHM	
2	6		> 0 OHM	

4.6.1 Connector JO7		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	
8	GND		> 7 kOHM	
10	GND		> 7kOHM	
11	GND		> 7 kOHM	
14	GND		0	
15	GND		> 10 kOHM	
16	GND		> 10 kOHM	
17	GND		> 10 kOHM	

21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 7 kOHM	
2	15		> 20 kOHM	
3	16		> 20 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24		> 10 kOHM	
4.6.2 Connector JO8		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	
8	GND		> 7 kOHM	
10	GND		> 7kOHM	
11	GND		> 7 kOHM	
14	GND		0	
15	GND		> 10 kOHM	
16	GND		> 10 kOHM	

17	GND		> 10 kOHM	
21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 7 kOHM	
2	15		> 20 kOHM	
3	16		> 20 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24		> 10 kOHM	
4.6.3 Connector JO9		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	
8	GND		> 7 kOHM	
10	GND		> 7kOHM	
11	GND		> 7 kOHM	
14	GND		0	
15	GND		> 10 kOHM	

16	GND		> 10 kOHM	
17	GND		> 10 kOHM	
21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 7 kOHM	
2	15		> 20 kOHM	
3	16		> 20 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24		> 10 kOHM	
4.6.4 Connector J10		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	
8	GND		> 7 kOHM	
9	GND		> 7kOHM	
10	GND		> 7 kOHM	

11	GND		0	
14	GND		> 10 kOHM	
15	GND		> 10 kOHM	
16	GND		> 10 kOHM	
17	GND		> 7 kOHM	
21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 20 kOHM	
2	15		> 20 kOHM	
3	16		> 10 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24			
4.6.5 Connector J11		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	
8	GND		> 7 kOHM	

10	GND		> 7kOHM	
11	GND		> 7 kOHM	
14	GND		0	
15	GND		> 10 kOHM	
16	GND		> 10 kOHM	
17	GND		> 10 kOHM	
21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 7 kOHM	
2	15		> 20 kOHM	
3	16		> 20 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24		> 10 kOHM	
4.6.6 Connector J12		**Resistance Measured**	**Resistance Nominal**	**Passed**
Pin	Pin			
1	GND		0	
2	GND		> 10 KOHM	
3	GND		> 10 KOHM	
4	GND		> 10 KOHM	

8	GND		> 7 kOHM	
10	GND		> 7kOHM	
11	GND		> 7 kOHM	
14	GND		0	
15	GND		> 10 kOHM	
16	GND		> 10 kOHM	
17	GND		> 10 kOHM	
21	GND		> 7 kOHM	
22	GND		> 7 kOHM	
24	GND		> 7 kOHM	
2	15		> 20 kOHM	
3	16		> 20 kOHM	
4	17		> 10 kOHM	
8	21		> 10 kOHM	
10	22		> 10 kOHM	
11	24		> 10 kOHM	

5 Bonding Checks

In the following table the measurements of the resistance between the relevant parts of the box/connectors and the bonding lug are reported.

5.1 Measurements between adjacent faces of the equipment chassis

BOX PART1	BOX PART2	Measured Value (mOHM)	Maximum Value (mOHM)	PASSED
Base-plate	Front Wall		2.5	
Base-plate	Top		2.5	
Base-plate	Back Wall		2.5	
Front Wall	Top		2.5	
Back Wall	Top		2.5	

5.2 Measurements between bonding lug and underside of the mounting feet

POINT 1	POINT 2	Measured Value (mOHM)	Maximum Value (mOHM)	PASSED
Bonding lug	Ref foot (say 1)		2.5	
Bonding lug	Foot (say 2)		2.5	
Bonding lug	Foot (say 3)		2.5	
Bonding lug	Foot (say 4)		2.5	

Bonding lug	Foot (say 5)		2.5	
Bonding lug	Foot (say 6)		2.5	

5.3 Measurements between instrument star point and bonding lug

POINT 1	POINT 2	Measured Value (mOHM)	Maximum Value (mOHM)	PASSED
Bonding lug	Box Star Point		5.0	

5.4 Measurements between any shield ground and chassis

POINT 1	CONNECTORS PINS	Measured Value (mOHM)	Maximum Value (mOHM)	PASSED
Screw-lock Ass.	J07 - 1		2.5 mOHM	
Screw-lock Ass.	J07 - 14		2.5 mOHM	
Screw-lock Ass.	J08 - 1		2.5 mOHM	
Screw-lock Ass.	J08 - 14		2.5 mOHM	
Screw-lock Ass.	J09 - 1		2.5 mOHM	
Screw-lock Ass.	J09 - 14		2.5 mOHM	

Screw-lock Ass.	J10 - 1		2.5 mOHM	
Screw-lock Ass.	J10 - 14		2.5 mOHM	
Screw-lock Ass.	J11 - 1		2.5 mOHM	
Screw-lock Ass.	J11 - 14		2.5 mOHM	
Screw-lock Ass.	J12 - 1		2.5 mOHM	
Screw-lock Ass.	J12 - 14		2.5 mOHM	

5.5 Measurements between bonding lug and connectors screw-lock assembly

POINT 1	**CONNECTORS** **SCREW-LOCK ASSEMBLY**	**Measured Value** **(mOHM)**	**Maximum Value (mOHM)**	**PASSED**
Bonding lug	J01		2.5 mOHM	
Bonding lug	J02		2.5 mOHM	
Bonding lug	J03		2.5 mOHM	
Bonding lug	J04		2.5 mOHM	
Bonding lug	J05		2.5 mOHM	
Bonding lug	J06		2.5 mOHM	
Bonding lug	J07		2.5 mOHM	
Bonding lug	J08		2.5 mOHM	
Bonding lug	J09		2.5 mOHM	
Bonding lug	J10		2.5 mOHM	

Bonding lug	J11		2.5 mOHM	
Bonding lug	J12		2.5 mOHM	