SUBJECT: SPIRE
Functional test specifications

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Change Record

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0.1	08 April 2003	1st Draft for comment
0.2	28th April 2003	Updated Draft incorporating comments
0.3	23 May 2003	test MCU-05 changed into test SMEC-02 10 DCU test specification added
0.3_1	2nd June 2003	Page Headers Corrected

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Glossary

AD	Applicable Document
AIV	Assembly Integration and Verification
AVM	Avionics Model
BSM	Beam Steering Mechanism
CQM	Cryogenic Qualification Model
DCU	Detector Control Unit
DPU	Digital Processing Unit
DRCU	Detector Readout and Control Unit
EGSE	Electrical Ground Support Equipment
FLT	Flight Level Test
FTS	Fourier Transform Spectrometer
HOB	Herschel Optical Bench
ILT	Instrument Level Test
IST	Integrated System Test
MCU	Mechanism Control Unit
MGSE	Mechanical Ground Support Equipment
N/A	Not Applicable
PCAL	Photometer Calibrator source
PFM	Proto-Flight Model
PLT	Payload Level Test
RAL	Rutherford Appleton Laboratory
RD	Reference Document
SCAL	Spectrometer Calibrator source
SCU	Subsystem Control Unit
SMEC	Spectrometer Mechanism
SPIRE	Spectral and Photometric Imaging Receiver
STM	Structural Test Model
TBC	To Be Confirmed
TBD	To Be Defined
TFCS	Test Facility Control System
AD	Applicable Document
AIV	Assembly Integration and Verification
AVM	Avionics Model

1. INTRODUCTION

1.1 Scope

This document contains the functional test specification for SPIRE. These are tests of different subsystems (SCU, MCU, SMEC, BSM, PCAL, SCAL, DCU) that will be performed on different model of the instrument (AVM, CQM, PFM, FS). They consist of integrity check and characterisation tests. These tests are not calibration or scientific tests.

1.2 Structure of Document

A summary of each test is given first (name, short description) and in the next section, we give the specification of each test. They are grouped together per subsystem (respectively SCU, MCU, SMEC, BSM, PCAL, SCAL, and (TBW) DCU)

1.3 Documents

1.3.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	SPIRE Data ICD	K.J. King	SPIRE-RAL-PRJ-001078, issue 1.0	15/01/2003
AD2	MCU/DCU Command list ICD an user manual	Didier Ferrand	LAM/ELE/SPI/011011, issue 3.0	15/01/2003
AD3	DRCU/DPU ICD	Pinsard, Ferrand, Mur	Sap-SPIRE-Cca-076-02, issue 1.0	14/02/2003

1.3.2 Reference Documents

	Title	Author	Reference	Date
RD 1	EGSE specification			
RD 2				
RD 3				

2. TEST SUMMARIES

2.1 SCU tests

2.1.1 SCU-01, SCU Science packet generation check

Integrity check of the SCU science packet generation (check that the number of frames generated matches the number commanded)

2.1.2 SCU-02, SCU Science data check

Integrity check of the SCU science data (check that content of science frames matches that in HK telemetry)

2.1.3 SCU-03, SCU DC thermometry check

Integrity check of DC thermometers (switch on thermometers and check values)

2.1.4 SCU-04, SCU PCAL check

Integrity check of PCAL (switch on PCAL, set a current and check voltage and current, then switch off)

2.1.5 SCU-05, SCU SCAL check

Integrity check of SCAL (switch on SCAL, set a current and check voltage, current and temperature changes, then switch off)

2.1.6 SCU-06, SCU AC thermometry check

Integrity check of AC thermometer (switch on AC thermometers and check values)

2.1.7 SCU-07, SCU cooler heater check

Integrity check of heaters (switch on heaters, check voltage)

2.1.8 SCU-08, SCU Test pattern test

Integrity check of test pattern generation (load test pattern and check content of packets)

2.2 MCU tests

2.2.1 MCU-01, MCU power on

Integrity check of MCU (power on MCU from SCU, check all voltage, check threshold flags, check if DSP booted. Check HK)

2.2.2 MCU-02, MCU Science packet generation check

Integrity check of the MCU science packet generation (check that the number of frames generated matches the number commanded. Perform test for each type of packet: SMEC, BSM, ENG)

2.2.3 MCU-03, MCU Science data check

Integrity check of the MCU science data (check that content of science frames matches that in HK telemetry. Perform test for each type of packet: SMEC, BSM, ENG)

2.2.4 MCU-04, MCU test pattern test

Integrity check of test pattern generation (load test pattern and check content of packets. Perform test for each type of packet: SMEC, BSM, ENG)

2.3 SMEC tests

2.3.1 SMEC-01, SMEC switch on

Integrity check of SMEC (switch on LVDT, fringe encoder and motor. Check encoder signal, status bits, and current)

2.3.2 SMEC-02, SMEC launch latch check

Functional test of the launch latch (open launch latch, move SMEC short distance and check response)

2.3.3 SMEC-03, SMEC initialisation

Integrity test of SMEC (initialise SMEC. Check LVDT, fringe encoder and current)

2.3.4 SMEC-04, SMEC position test

Integrity test of SMEC (move to set positions and measure read back position, currents, back emf)

2.3.5 SMEC-05, SMEC multiple position test

Characterisation test of SMEC (move to number of set positions and measure positions, current, back emf – repeat for different position)

2.3.6 SMEC-06, SMEC saw tooth scan test

Characterisation test of SMEC (scan over range (saw tooth) and measure positions, current, back-emf – repeat for different scan)

2.3.7 SMEC-07, SMEC triangular scan test

Characterisation test of SMEC (scan over range (triangular) and measure positions, current, back-emf – repeat for different scan)

2.4 BSM tests

2.4.1 BSM-01, BSM power on motor and sensor

Integrity check of BSM (power on motors en sensors, check telemetry responses, consumed power)

2.4.2 BSM-02, BSM move to position

Integrity test of BSM (move BSM to set positions. Check telemetry responses, consumed power)

2.4.3 BSM-03, BSM scan test

Characterisation test of BSM (move BSM to multiple set positions. Check telemetry response, consumed power.

2.4.4 BSM-04, BSM operating mode test

Characterisation test of BSM (set BSM to each mode (Chop, jiggle…). Check telemetry response, consumed power)

2.5 PCAL test

2.5.1 PCAL-01, PCAL characterisation test

Characterisation test of PCAL (step through each setting and measure telemetry response)

2.6 SCAL tests

2.6.1 SCAL-01, SCAL characterisation test

Characterisation test of SCAL (set current and record temperatures)

2.6.2 SCAL-02, SCAL PID test

Characterisation test of SCAL (set temperatures and record temperatures)

2.7 DCU tests

2.7.1 DCU-01, DCU Science Packet generation check

Integrity of the DCU science packet generation (check that the number of frames generated matches the number commanded)

2.7.2 DCU-02, DCU Science data check

Integrity of DCU science data (check content of science frames)

2.7.3 DCU-03, DCU Test pattern test

Integrity check of test pattern generation (load test pattern and check content of packets. Perform for each type of packet (Photometer and Spectrometer)

2.7.4 DCU-04, DCU Offset test

Integrity check of the Offsets (Change offsets up and down, record output)

2.7.5 DCU-05, DCU LIAs switch on

Characterisation test of LIAs (switch on LIAs. Measure signals, noise)

2.7.6 DCU-06, DCU JFET heaters switch on

Characterisation test of JFET heaters (Switch on JFET heaters. Measure temperature vs. time)

2.7.7 DCU-07, DCU JFET test

Characterisation test of JFET (switch on JFETS with Vdd on. Activate auto-offset control. Measure noise. Vary Vss and measure noise)

2.7.8 DCU-08, DCU Bias frequency test

Characterisation of the bias current (set up bias frequency. Measure noise)

2.7.9 DCU-09, DCU Bias amplitude test

Characterisation of the bias current (set bias amplitude. Measure change in signal level, measure noise, read out offsets)

2.7.10 DCU-10, DCU Phase shift test.

Characterisation test (set phase to $\pi/2$ and $3\pi/2$ adjust phase by small amounts to find minimum at $\pi/2+d\phi$, $3\pi/2+d\phi$– set phase back to $+d\phi$. Check signal)

3. TEST SPECIFICATION

3.1 SCU-01, SCU science packet generation check

ID:	SCU-01
Test name:	SCU Science Packet Generation Check
Description of test:	Check the integrity of the SCU science data by checking that the number of frames generated matches the number commanded.
Test Type:	Integrity Check
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. In SCOS, select the appropriate display *(DPU and OBS PARAMETER)* 2. Send request for N nominal SCU science frames at a rate of 80 Hz 3. Wait for packets to be generated 4. Check that M SCU science packets were generated, i.e. that parameter TM5N (sequence count of TM packets for SCU Science) increases until M
Success/Failure Criteria:	Test passed if number of packets generated = number requested

Comments/Open issues:
N is the number of frames. M is the number of packets. This test needs a DPU frame counter.

3.2 SCU-02, SCU Science data check

ID:	SCU-02
Test name:	SCU Science Data Check
Description of test:	Check the integrity of the SCU science data by checking that content of science frames matches that in HK telemetry
Test Type:	Integrity Check
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required? QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	SCU thermometry needs to be switched on – see test SCU-03
Outline procedure and analysis:	1. Run QLA 2. Execute the sequences of test SCU-01 3. Compare contents of science frames with HK parameters *Complete list of the parameters to compare*: TCHeaterVolt, PhCalCur, SCal4Cur, SCal2Cur, PhCalVolt, SCal4Volt, SCal2Volt, CPHPtemp, CPHStemp, CEHStemp, CSHTtemp, SOBtemp, SL0temp, PL0temp, SUBtemp, BAFtemp, BSMStemp, SCL2temp, SCL4temp, SCSTtemp, FTSStemp, FTSMtemp, BSMMtemp, CEVTemp
Success/Failure Criteria:	Test passed if values in the science frame are identical to those in the HK nominal report.

Comments/Open issues:
It is similar to test SCU-01, with QLA running in addition. Needs an automatic procedure with QLA that compare values of the parameters

3.3 SCU-03, SCU DC thermometry check

ID:	SCU-03
Test name:	SCU DC Thermometry Check
Description of test:	Switch on thermometers all at once and check values
Test Type:	Integrity Check
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Select the appropriate display *(SCU PARAMETER)* 2. Send command to switch on SCU thermometer 3. Wait 5 seconds (allow time for sensor to activate) 4. Check values of the parameters *Complete list of parameter to check*: CPHPtemp, CPHStemp, CEHStemp, CSHTtemp, SOBtemp, SL0temp, PL0temp, SUBtemp, BAFtemp, BSMStemp, SCL2temp, SCL4temp, SCSTtemp, FTSStemp, FTSMtemp, BSMMtemp
Success/Failure Criteria:	Test passed if all thermometer channels are reading expected values.

Comments/Open issues:

3.4 SCU-04, SCU PCAL check

ID:	SCU-04
Test name:	SCU PCAL
Description of test:	Switch on PCAL, set a current and check voltage and current, then switch off
Test Type:	Integrity
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm (TBC) and cold
Constraints:	
Outline procedure and analysis:	1. Switch on PCAL 2. Select the appropriate display *(SCU PARAMETER)* 3. Send a command to set a current value 4. Check values of the parameters (PhCalCur and PhCalVolt). 5. Switch off PCAL.
Success/Failure Criteria:	Test passed if value of current read = current set and voltage has value expected

Comments/Open issues:
This test needs a calibration curve. Voltage expected is dependent on instrument model and version of MIB
Is it possible to perform this test warm? (I am waiting for an answer from Peter Hargrave)

3.5 SCU-05, SCU SCAL check

ID:	SCU-05
Test name:	SCAL check
Description of test:	Switch on SCAL, set a current and check voltage, current and temperature changes, then switch off
Test Type:	Integrity
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Switch on SCAL 2. Select the appropriate display *(SCU PARAMETERS)* 3. Send a command to set a current value 4. Wait 1 minute (TBD) 5. Check values of the parameters for voltage, current and temperature (SCal2Volt, SCal4Volt, SCal2Cur, SCal4Cur, SCL2temp, SCL4temp). 6. Switch off SCAL
Success/Failure Criteria:	Test passed if value of current read = current set and voltage and temperature have values expected

Comments/Open issues:
This test needs a calibration curve.
Time constant is long and may be we do not wait enough for the stable temperature to be achieved, but it is not the purpose of this test. We just make sure that the wires are OK.

3.6 SCU-06, SCU AC thermometry check

ID:	SCU-06
Test name:	AC thermometry check
Description of test:	Switch on AC thermometers and check values
Test Type:	integrity
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY or STAND-BY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	Temperature is dependent on cooler condition.
Outline procedure and analysis:	1. Select the appropriate display *(SCU PARAMETER)* 2. Send command to switch on SCU thermometer channel TBD 3. Wait 5 seconds (allow time for sensor to activate) 4. Check values of the parameters Parameter to check*: CEVTemp*
Success/Failure Criteria:	Test passed if thermometer channel is reading expected value

Comments/Open issues:
If SPIRE is in READY mode, temperature expected is > 4K
If in STAND-BY mode, temperature expected is 300 mK

3.7 SCU-07, SCU cooler heater check

ID:	SCU-07
Test name:	SCU Cooler Heater Check
Description of test:	Switch on heaters, check voltage
Test Type:	integrity
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	SCU-06 should be completed successfully
Outline procedure and analysis:	1. Select the appropriate display *(SCU PARAMETER*) 2. Execute command list to switch on the heaters 3. Send a command to set a small value (TBD) of current 4. Wait 1 minute 5. Check values of parameters (SPHSHeatCurSP, EVHSHeatCurSP, SPHeaterCurSP, SPHSHeatVolt, EVHSHeatVolt, SPHeaterVolt) 6. Set current down to 0
Success/Failure Criteria:	Test passed if voltages are read and have the value expected.

Comments/Open issues:
Waiting 1 minute is not enough for the voltage to stabilize but it is not the purpose of this test. It is long enough for the voltage to move. We just check the wires by checking that voltage is in range

3.8 SCU-08, SCU Test pattern test

ID:	SCU-08
Test name:	Test pattern test
Description of test:	Load test pattern and check content of packets. Perform test for each type of packet (SMEC, BSM, ENG)
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	warm and cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at SCU test pattern packet 2. Request N test pattern packet. 3. Check content
Success/Failure Criteria:	test passed if the test pattern is properly generated

Comments/Open issues:
I admit that this description is poor, but this test pattern test is not clear for me and I don't find a lot of information in the documents. Should this test be similar to SCU-02, but with simulated values?

3.9 MCU-01, MCU power on

ID:	MCU-01
Test name:	MCU Power On
Description of test:	Power on MCU from SCU, check all voltage, check threshold flags, check if DSP booted. Check HK
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	SCU switched on
Outline procedure and analysis:	1. Select the appropriate display *(MCU PARAMETER)* 2. Send command to power MCU from SCU 3. Check voltages (parameters *MCUP15V, MCUM15V, MCUP13V, MCUM13V, MCUP5V)* 4. Check threshold flag 5. Check boot status register *(MCUBOOT STAT)* to see if DSP booted
Success/Failure Criteria:	Test passed is all voltage come up and are in range (15, 13 and 5 volts) and if DSP booted. if DSP not booted, then OBS should cope with this

Comment/Open Issue:

3.10 MCU-02, MCU Science packet generation check

ID:	MCU-02
Test name:	MCU Science packet generation check
Description of test:	Integrity of MCU science data: check that the number of frames generated matches the number commanded. Perform test for each type of packet. (SMEC, BSM, ENG)
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. In SCOS, select the appropriate display *(DPU and OBS PARAMETER)* 2. Send request for N SMEC science frames 3. Wait for packets to be generated 4. Check that M science packets were generated, i.e. that parameter TM5N (sequence count of TM packets for SMEC Science) increases until M 5. Repeat steps 2 to 4 for BMS and ENG science packet
Success/Failure Criteria:	Test passed if number of packets generated = number requested.

Comment/Open Issue:
N is the number of frames. M is the number of packets. This test needs a DPU frame counter.

3.11 MCU-03, MCU Science data check

ID:	MCU-03
Test name:	MCU Science Data Check
Description of test:	Check of integrity of MCU science data. Perform test for each type of packet. (SMEC, BSM, ENG)
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required? QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Run QLA 2. Execute the sequence of test MCU-01 3. Compare contents of science frames with HK parameters parameters to compare: • SMEC: *Optical encoder coarse position, fine position, LVDT DC signal, Motor BEMF* • BSM*: Chop position, Chop motor current, Chop BEMF, Jiggle position, Jiggle motor current, Jiggle BEMF* • ENG: *SMEC encoder signal 1/2/3, SMEC LVDT AC/DC signal, SMEC motor current/voltage, chop/jiggle magneto resistor, chop/jiggle motor current, chop/jiggle servo error.*
Success/Failure Criteria:	Test passed if values in the science frames are identical to those in the HK nominal report

Comments/Open issues:
It is similar to test MCU-01, with QLA running in addition. Needs an automatic procedure with QLA that compare values of the parameters
These parameters are called *Pack[frameID]Param#* in the DRCU/DPU ICD, issue 1.0, p77

3.12 MCU-04, MCU test pattern test

ID:	MCU-04
Test name:	MCU Test Pattern test
Description of test:	Load test pattern and check contents of packets. Perform test for each type of packet (SMEC, BSM, ENG)
Test Type:	Integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at MCU test pattern packet 2. Request N test pattern packet. 3. Check content. 4. Repeat for each type of packet (SMEC, BSM, ENG)
Success/Failure Criteria:	test passed if the test pattern is properly generated

Comments/Open issues:
same comment as for SCU-08

3.13 SMEC-01, SMEC switch on

ID:	SMEC-01
Test name:	SMEC Switch On
Description of test:	Switch on LVDT, fringe encoder and motor. Check encoder signal, status bits, current
Test Type:	Integrity
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	MCU-04 completed successfully
Outline procedure and analysis:	1. Select appropriate display (SMEC PARAMETERS) 2. Send command to switch on LVDT 3. Send command to switch on fringe encoder 4. Send a command to switch on motors 5. Check LVDT position (SMECLVDTPOSN, SMECLVDTACSIG, SMECLVDTDCSIG) 6. Check encoder signals (SMECSINE000SIG, SMECSIG120SIG, SMECSIG240SIG, SMECENCPOSN) 7. Check status bit (SMECSTAT) 8. Check current (SMECMOTORCURR)
Success/Failure Criteria:	Test passed if values read are values expected

Comment/Open Issue:
If I understand well, SMEC doesn't move here, so there are not really values expected for SMEC position, but we just make sure that we can read something? Otherwise, how do we check that position is correct?
Need conversion curve between signals and physical position.
I have put here the names of the parameters found in the DATA ICD because it gives a description of a nominal HK report and this is what we look at in this test (the same parameters in the DRCU/DPU ICD would be: LVDTPosition, LVDTAC, LVDTDC, SEncoderSignal1, SEncoderSignal2, SEncoderSignal3, EncoderFinePosition, SEncodIncrPos, SMECStatus, SmotorCurrent).

3.14 SMEC-02, SMEC launch latch check

ID:	SMEC-02
Test name:	MCU launch latch check
Description of test:	Open launch latch, move SMEC short distance and check response
Test Type:	Integrity
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	LAM EGSE only
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	Can only be performed in cryostat configuration SMEC needs to be switched on (see test SMEC-01)
Outline procedure and analysis:	1. (Select appropriate display *(SMEC PARAMETERS))* 2. Check SMEC position (SMECLVDTPOSN, SMECLVDTACSIG, SMECLVDTDCSIG, SMECSINE000SIG, SMECSIG120SIG, SMECSIG240SIG, SMECENCPOSN) 3. Send command to open launch latch 4. Send command to move SMEC by a short distance 5. Check new SMEC position
Success/Failure Criteria:	Test passed if SMEC moves.

Comments/Open issues:
What is LAM EGSE? Can't we then check the parameters with SCOS?

3.15 SMEC-03, SMEC initialisation

ID:	SMEC-03
Test name:	SMEC initialisation
Description of test:	Initialise SMEC. Check LVDT, fringe encoder and current
Test Type:	Integrity
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Send command to initialise SMEC 2. Check LVDT position (SMECLVDTPOSN, SMECLVDTACSIG, SMECLVDTDCSIG) 3. Check encoder signals (SMECSINE000SIG, SMECSIG120SIG, SMECSIG240SIG, SMECENCPOSN) 4. Check current (SMECMOTORCURR)
Success/Failure Criteria:	Test passed if values read are values expected (initialisation sends SMEC to the home position).

Comment/Open Issue:
Need conversion curve between signals and physical position.

3.16 SMEC-04, SMEC position test

ID:	SMEC-04
Test name:	SMEC position test
Description of test:	Move to set positions and measure read back position, currents, back emf
Test Type:	Integrity
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Select appropriate display (*SMEC PARAMETERS)* 2. Send command to move SMEC to a chosen position 3. Read position (SMECLVDTPOSN, SMECLVDTACSIG, SMECLVDTDCSIG, SMECSINE000SIG, SMECSIG120SIG, SMECSIG240SIG, SMECENCPOSN) 4. Check current (SMECMOTORCURR) and back emf (SMECMOTORBEMF) 5. Repeat for a TBD set of positions
Success/Failure Criteria:	Test passed if SMEC moves to the set position and current and back emf have expected values

Comment/Open issue:
Need conversion curve between signals and physical position.

3.17 SMEC-05, SMEC multiple position test

ID:	SMEC-05
Test name:	SMEC Multiple position test
Description of test:	Move to number of set positions and measure positions, current, back emf – repeat for different speed and positions
Test Type:	Characterisation
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for SMEC position 2. Record position sensor signal, motor current, back emf 3. Send command to move SMEC to a chosen position 4. Check SMEC movement (length, velocity and stability of the scan) 5. Repeat for a TBD set of scan speeds, a TBD set of positions. - Parameters present in an "Engineering" frame : *Servo error, Encoder signal 1/2/3, LVDT AC/DC signal, motor current, motor voltage* - Parameters present in a "SMEC" frame : *opt. enc. coarse position, opt. enc. fine position, LVDT DC signal, Back EMF*
Success/Failure Criteria:	Test passed if SMEC moves to the set position with the requested scan speed, and current and back emf have expected values

Comment/Open issue:
Should this test start from home?
Need conversion curve between signals and physical position.
Actually, the parameters to check are the same than in the previous test, but here I wrote them as found in the DRCU/DPU ICD (issue 1.0, p77) where a description of the frame is given, because we are looking at science frame with QLA in this test and not at HK with SCOS…Am I right? Does it make sense to you?
These parameters are called *Pack[frameID]Param#* in the DRCU/DPU ICD, issue 1.0, p77

3.18 SMEC-06, SMEC saw tooth scan test

ID:	SMEC-06
Test name:	SMEC Saw tooth scan test
Description of test:	Scan over range and measure positions, current, back-emf – repeat for different scans
Test Type:	Characterisation
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for SMEC position 2. Record position sensor signal, motor current, back emf 3. Send command for SMEC to do a saw tooth scan 4. Check SMEC movement (length, velocity and stability of the scan) 5. Repeat for a TBD set of scan speeds, a TBD set of scan length - Parameters present in an "Engineering" frame*: Servo error, Encoder signal 1/2/3, LVDT AC/DC signal, motor current, motor voltage* - Parameters present in a "SMEC" frame*: opt. enc. coarse position, opt. enc. fine position, LVDT DC signal, Back EMF*
Success/Failure Criteria:	Test passed if SMEC does the requested scan and current and back emf have expected values

Comment/Open issue:
Should this test start from home?
Need conversion curve between signals and physical position.
Same comment than previous

3.19 SMEC-07, SMEC triangular scan test

ID:	SMEC-07
Test name:	SMEC triangular scan test
Description of test:	Scan over range and measure positions, current, back-emf – repeat for different scans
Test Type:	Characterisation
Instrument Models:	PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for SMEC position 2. Record position sensor signal, motor current, back emf 3. Send command for SMEC to do a triangular scan 4. Check SMEC movement (length, velocity and stability of the scan) 5. Repeat for a TBD set of scan speeds, a TBD set of scan length - Parameters present in an "Engineering" frame *: Servo error, Encoder signal 1/2/3, LVDT AC/DC signal, motor current, motor voltage* - Parameters present in a "SMEC" frame*: opt. enc. coarse position, opt. enc. fine position, LVDT DC signal, Back EMF*
Success/Failure Criteria:	Test passed if SMEC does the requested scan and current and back emf have expected values

Comment/Open issue:
Should this test start from home?
Need conversion curve between signals and physical position.
Same comment than previous

3.20 BSM-01, BSM power on motor and sensor

ID:	BSM-01
Test name:	BSM Power on motors and sensors
Description of test:	Check telemetry responses, consumed power
Test Type:	Integrity
Instrument Models:	CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Select appropriate displays (*CHOP PARAMETERS* and *JIGGLE PARAMETERS)* 2. Send command to switch on BSM motors 3. Check parameters: MCUBSMTEMP, CHOPSENSPOSN0, CHOPSENSPOSN1, CHOPMOTORCURR, CHOPBEMF, JIGGSENSPOSN0, JIGGSENSPOSN1, JIGGMOTORCURR, JIGGBEMF 4. Check consumed power
Success/Failure Criteria:	test passed if BSM is switched on and parameters have the values expected

Comment/Open issue:
Are they correct parameters to check?
Do we really have to derive consumed power from the HK parameters? Shouldn't it be a characterisation test rather than an integrity test?
Are there "expected" values? Do we then have a "home" position and an initialisation as for SMEC?
Need conversion curve between position and sensor output.

3.21 BSM-02, BSM move to position

ID:	BSM-02
Test name:	BSM Move to Position
Description of test:	Move BSM to set positions. Check telemetry responses, consumed power
Test Type:	Integrity
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm and cold
Constraints:	
Outline procedure and analysis:	1. Select appropriate displays (*CHOP PARAMETERS* and *JIGGLE PARAMETERS, TBC)* 2. Send command to move BSM to set positions 3. Check parameters: MCUBSMTEMP, CHOPPOSN, CHOPPOSNERR, CHOPSENSPOSN0, CHOPSENSPOSN1, CHOPMOTORCURR, CHOPBEMF, JIGGPOSN, JIGGPOSNERR, JIGGSENSPOSN0, JIGGSENSPOSN1, JIGGMOTORCURR, JIGGBEMF 4. Check consumed power
Success/Failure Criteria:	test passed if BSM moves to the requested position and parameters have the values expected

Comment/Open issue:
Same comment as previous.

3.22 BSM-03, BSM scan test

ID:	BSM-03
Test name:	BSM Scan test
Description of test:	Move BSM to multiple set positions. Check telemetry response, consumed power.
Test Type:	Characterisation
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for BSM 2. Record motor current, position sensor signal 3. Send command to move BSM to a chosen position 4. Repeat for a TBD set of position 5. Derive characteristics from *Position* vs *Time* (scan velocity and stability,…) 6. Derive consumed power from measured current and voltage – Parameters present in an "Engineering" frame: *Magneto resistor signal, Motor current, Servo Error (for chopper and jiggle)* – Parameters present in a "BSM" frame: *magneto resistor signal, Motor setting current, motor measured voltage (for chopper and jiggle)*
Success/Failure Criteria:	test passed if BSM moves to the set positions, if characteristics are as expected

Comment/Open issue:
Same comment as for SMEC-05

3.23 BSM-04, BSM operating mode test

ID:	BSM-04
Test name:	BSM Operating mode test
Description of test:	Set BSM to each mode (Chop, jiggle…). Check telemetry response, consumed power
Test Type:	Characterisation
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for BSM 2. Record motor current, position sensor signal 3. Send command for BSM to chop 4. Derive characteristics from *Position* vs *Time* (period, amplitude, velocity, stability…), derive consumed power. 5. Repeat for a TBD set of chop throws, TBD set of chop periods 6. Repeat for the jiggle mode - Parameters present in an "Engineering" frame: *Magneto resistor signal, Motor current, Servo Error (for chopper and jiggle)* - Parameters present in a "BSM" frame: *Magneto resistor signal, Motor setting current, motor measured voltage (for chopper and jiggle)*
Success/Failure Criteria:	test passed if BSM behave as requested, if characteristics are as expected

Comment/Open Issue:
I include here Tanya's comment:
"Presumably you will be repeating this for 'chopping in chop axis', 'chopping in jiggle axis', 'chopping in both axes', '7 point jiggle', '64 point jiggle' plus any other n point jiggle? Might be best to separate these into separate tests"
Same comment as SMEC-04

3.24 PCAL-01, PCAL characterisation test

ID:	PCAL-01
Test name:	PCAL characterisation test
Description of test:	Step through each setting and measure telemetry response
Test Type:	Characterisation
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for PCAL 2. Set a current 3. Record temperatures, current and voltage 4. Repeat for a TBD set of currents 5. Derive PCAL characteristics (stability, consumed power) Parameters present in a SCU science packet: PhCalCurSP, PhCalCur, PhCalVolt
Success/Failure Criteria:	

Comment/Open issue:
PhCalCurSP is the current set (Set Point), to compare with the current measured

3.25 SCAL-01, SCAL characterisation test

ID:	SCAL-01
Test name:	SCAL Characterisation tests
Description of test:	Set current and record temperatures
Test Type:	Characterisation
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for SCAL 2. Record temperatures and voltage 3. Set a current (Heaviside step) 4. Derive time constant from Tp vs Time 5. Repeat for a TBD set of currents 6. Set current to 0 7. Derive cooling time constant from Temperature vs Time 8. Derive other characteristics? (Consumed power…) Parameters present in a SCU nominal science packet: SC2temp, SC4temp, SCal2Cur, SCal4Cur, SCal2CurSP, SCal4CurSP, SCal2Volt, SCal4Volt
Success/Failure Criteria:	Test passed if SCAL characteristics are as expected

Comment/Open issue:
SCal2CurSP and SCal4CurSP are the currents set (Set Point), to compare with the currents measured.
Do we have to wait until the stable temperature is achieved?

3.26 SCAL-02, SCAL PID test

ID:	SCAL-02
Test name:	SCAL PID tests
Description of test:	Set temperatures and record temperatures
Test Type:	Characterisation
Instrument Models:	CQM/PFM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the parameters for SCAL 2. Set temperature 3. Record temperatures and voltages 4. Repeat for a TBD set of temperature 5. Derive stability from Temperature vs Time Parameters present in a SCU nominal science packet: SC2temp, SC4temp, SCal2Cur, SCal4Cur, SCal2CurSP, SCal4CurSP, SCal2Volt, SCal4Volt
Success/Failure Criteria:	Test passed if SCAL characteristics are as expected, if the stability is within requirement

Comment/Open issue:
SCal2CurSP and SCal4CurSP are the currents set (Set Point), to compare with the currents measured.
Do we have to wait until the stable temperature is achieved?

3.27 DCU-01, DCU Science Packet generation check

ID:	DCU-01
Test name:	DCU Science packet generation check
Description of test:	Check the integrity of the DCU science data by checking that the number of frames generated matches the number commanded
Test Type:	Integrity Check
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	SCOS-2000 required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	5. In SCOS, select the appropriate display *(DPU and OBS PARAMETERS)* 6. Send request for N nominal Photometer Full Array science frames at a given rate (50 to 300Hz) 7. Wait for packets to be generated 8. Check that M science packets were generated, i.e. that parameter TM3N (sequence count of TM packets for Photometer Full Array) increases until M 9. Repeat for nominal Spectrometer Full Array frames (check parameter TM4N)
Success/Failure Criteria:	

Comment/Open issue:
Shall we do the same for all the frames related to DCU (PSW, PMW, PLW, SSW, SLW Arrays, Ph Offset, SP Offset)? Or just for the nominal science data report?

3.28 DCU-02, DCU Science data check

ID:	DCU-02
Test name:	DCU Science Data Check
Description of test:	Check the integrity of the DCU science data by checking some values
Test Type:	Integrity Check
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	4. Run QLA 5. Execute the sequences of test DCU-01 6. Check contents of science frames with QLA *List of values to check*: dark pixels of PSW, PMW, PLW, SSW, SLW (2 pixels each), thermistors of PSW, PMW, PLW, SSW, SLW (2 thermistors each), 5 MOhm resistor of PSW, PMW, PLW, SSW, SLW (1 resistor each)
Success/Failure Criteria:	Test passed if correct values are read

Comment/Open issue:
Do we know the values expected? Depend whether if the test is performed warm or cold.
There are also “spares” in SSW and PMW BDAs. What are they? Shall we check their values?

3.29 DCU-03, DCU Test pattern test

ID:	DCU-03
Test name:	DCU test pattern test
Description of test:	Load test pattern and check content of packets. Perform for each type of packet (Photometer and Spectrometer)
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at test pattern frames 2. Send request for N Photometer test Pattern frames 3. Check content 4. Repeat for Spectrometer test pattern
Success/Failure Criteria:	test passed is the test pattern is properly generated

Comment/Open issue:
Should this test be just the same as DCU-02 but with simulated values?

3.30 DCU-04, DCU Offset test

ID:	DCU-04
Test name:	DCU Offsets test
Description of test:	Change offsets up and down, record output.
Test Type:	integrity
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to record offsets 2. Send command to set an offset on LIA photometer channel 1 3. Record output 4. Repeat for a TBD set of offset values 5. Repeat for other channels 6. Repeat for the spectrometer LIAs *Parameters to check:* Offset_P1, Offset_P2, Offset_P3, Offset_P4, Offset_P5, Offset_P6, Offset_P7, Offset_P8, Offset_P9, Offset_S1, Offset_S2, Offset_S3
Success/Failure Criteria:	Test passed if Offset have values set.

Comment/Open issue:

3.31 DCU-05, DCU LIAs switch on

ID:	DCU-05
Test name:	DCU LIAs switch on
Description of test:	Switch on LIAs. Measure signals, noise
Test Type:	Characterisation
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at LIAs signals 2. Send command to switch on LIAs 3. Measure signal during a TBD time 4. Derive noise from Signal Vs time 5. Repeat DCU Offset test (DCU-03)
Success/Failure Criteria:	Test passed if LIAs are switched on and if DCU-03 is passed also once the LIAs are switched on.

Comment/Open issue:
Which signal is it? Which parameter? I cannot find a command to switch on LIAs…

3.32 DCU-06, DCU JFET heaters switch on

ID:	DCU-06
Test name:	DCU JFET heaters switch on
Description of test:	Switch on JFET heaters. Measure temperature vs. time
Test Type:	Characterisation
	STM/CQM
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	
Test Conditions:	Warm and Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at parameter for JFET heaters 2. Send command to switch heaters on 3. Set a current (or a voltage? or a temperature?) 4. Record response during a TBD time 5. Derive characteristics from temperature vs. time
Success/Failure Criteria:	

Comment/Open issue:
I don't find any parameter in the DRCU/DCU ICD related to this…?????
What do we read? A voltage? This test then require a conversion curve?

3.33 DCU-07, DCU JFET test

ID:	DCU-07
Test name:	DCU JFET test
Description of test:	Switch on JFETS with Vdd on. Activate auto-offset control. Measure noise. Vary Vss and measure noise
Test Type:	Characterisation
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the JFETs voltages 2. Send command to switch on all JFETs drain voltage Vdd 3. Activate auto-offset control 4. Set a value for Vss 5. Record outputs during a TBD time 6. Evaluate noise 7. Repeat for a TBD set of values for Vss *Parameters:* drain: PSW_JFETx (x=1..6), PMW_JFETx (x=1..4), PLW_JFETx (x=1..2), SLW_JFET1, SLW_JFETx (x=1..2) source : PSW_VSSx (x=1..6), PMW_VSSx (x=1..4), PLW_VSSx (x=1..2), SLW_VSS1, SLW_VSSx (x=1..2)
Success/Failure Criteria:	

Comment/Open issue:
Refer also to performance test ILT-PERF-DAN

3.34 DCU-08, DCU Bias frequency test

ID:	DCU-08
Test name:	DCU Bias frequency test
Description of test:	Set up bias frequency. Measure noise
Test Type:	Characterisation
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set-up QLA to look at the bias voltage 2. Send command to set a bias frequency (parameter PhotoMClkDiv) on channel PSW, between 38 Hz and 305 Hz 3. Record output voltage during a TBD time 4. Evaluate noise 5. Repeat for a TBD set of bias frequency 6. Repeat for channels PMW, PLW, SSW, SLW *Parameters:* PhotoBiasAmplSW, PhotoBiasAmplMW, PhotoBiasAmplLW, PhotoBiasAmplTC, SpectroBiasAmplSW, SpectroBiasAmplLW
Success/Failure Criteria:	

Comment/Open issue:

3.35 DCU-09, DCU Bias amplitude test

ID:	DCU-09
Test name:	DCU Bias amplitude test
Description of test:	Set bias amplitude. Measure change in signal level, measure noise, read out offsets
Test Type:	Characterisation
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	7. Set-up QLA to look at the bias voltage 8. Send command to set a bias amplitude (parameter PhotoBiasAmplxx) on channel PSW, between 0 and 200 mV 9. Record output voltage during a TBD time 10. Evaluate change in signal level and noise 11. Read out offsets 12. Repeat for a TBD set of bias amplitude 13. Repeat for channels PMW, PLW, TC, SSW, SLW *Parameters:* PhotoBiasAmplSW, PhotoBiasAmplMW, PhotoBiasAmplLW, PhotoBiasAmplTC, SpectroBiasAmplSW, SpectroBiasAmplLW, Offset_Px (x=1..9), Offset_Sx (x=1..3)
Success/Failure Criteria:	

Comment/Open issue:

3.36 DCU-10, DCU Phase shift test.

ID:	DCU-10
Test name:	DCU Phase shift test
Description of test:	Set phase to $\pi/2$ and $3\pi/2$ adjust phase by small amounts to find minimum at $\pi/2+d\phi$, $3\pi/2+d\phi$ – set phase back to $+d\phi$ - for short functional test perform test at $\pi/2+d\phi$ and verify that signal = 0
Test Type:	
Instrument Models:	AVM/CQM/PFM/FS
Redundancy:	As applicable
Instrument Configuration:	SPIRE in READY mode
EGSE Configuration:	QLA required
Level	ILT/PLT/IST/FLT
Test Conditions:	Warm or Cold
Constraints:	
Outline procedure and analysis:	1. Set phase to $\pi/2$ on channel PSW 2. Look at signal with QLA 3. Adjust phase by small amount to find minimum signal (=0) at $\pi/2+d\phi$ 4. Set phase back to $d\phi$ 5. Vary bias amplitude (cf. test DCU-08) 6. Check if signal changes 7. Repeat for a phase of $3\pi/2$ 8. Repeat for channel PMW, PLW, TC, SSW, SLW *Parameters:* PhotoDemodSW, PhotoDemodMW, PhotoDemodLW, PhotoDemodTC, SpectroDemod
Success/Failure Criteria:	

Comment/Open issue: