HS_FCU FLIGHT MODEL

REPORT OF FUNCTIONAL TESTS AT RAL

Reference: SAp-SPIRE-HT-xxx-06
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1 Table of contents

2 Test Configuration

We use the LTU in its latest software configuration, the fully assembled DCU and FCU, the FPU and the PSU Flight Model (PSU FM).

Before to connect any harness, we place savers on all connectors

Connect all harnesses as described below :

- Between SCU and LTU
- Between DCU and PSU FM
- Between SCU and PSU FM

```
Place savers on all connectors

Connect all harnesses as described below
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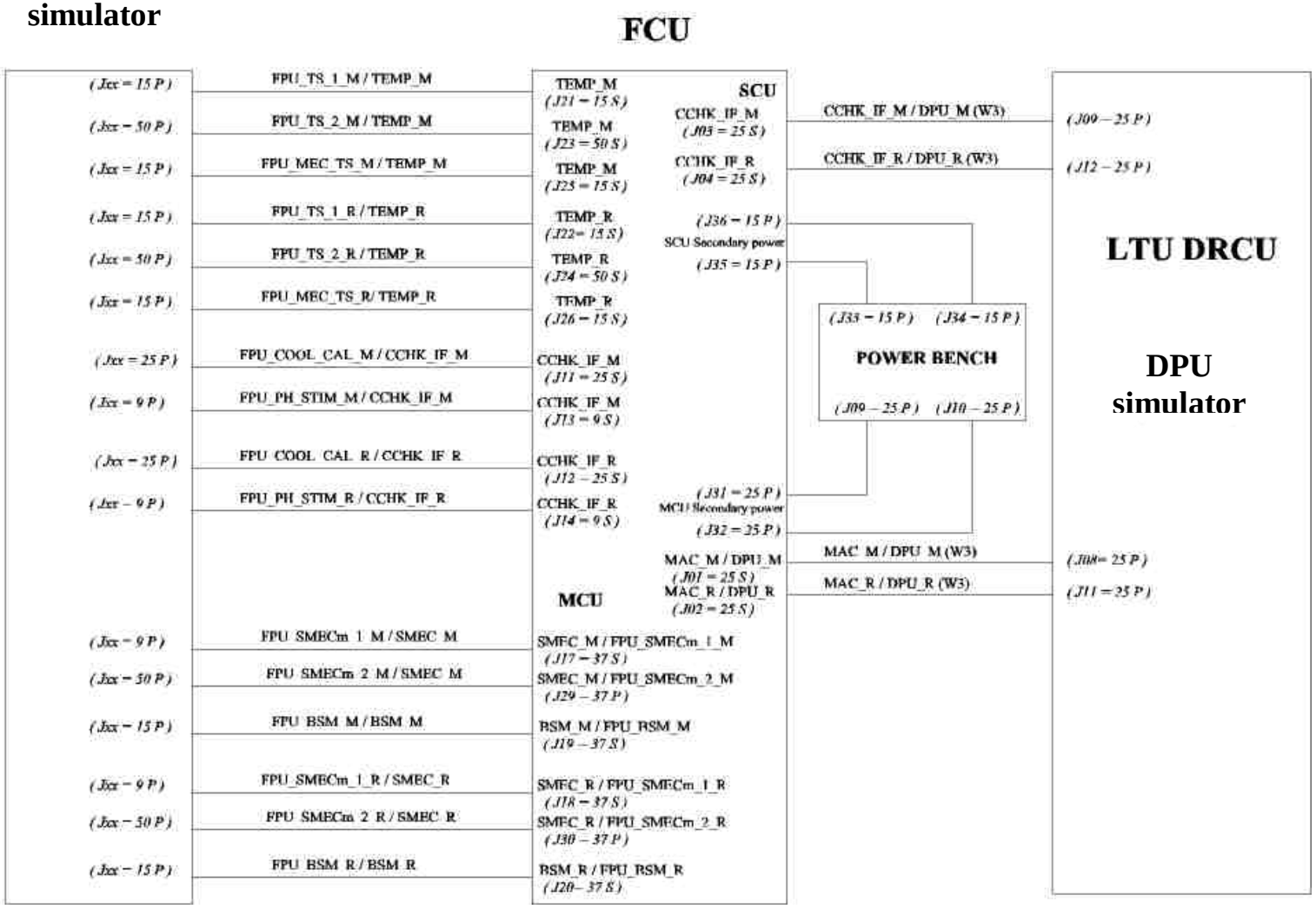


FCU FLIGHT MODEL TEST CONFIGURATION

3 POWER ON : SCU CONSUMPTION TESTS

3.1 Main side

- Set 28 V ON at LTU level (main position)
- Measure the voltages and currents (primary)

Source Channel	Primary Voltage (V)	Expected values (V)	Primary current (mA)	Expected values (mA)
28 V Prime	28 V	28 V	400 mA	400 mA

(the FPU simulator is not ON)

3.2 Redundant side

- Set 28 V ON at LTU level (redundant position)
- Measure the voltages and currents (primary)

Source Channel	Primary Voltage (V)	Expected values (V)	Primary current (mA)	Expected values (mA)
28 V Prime	28 V	28 V	400 mA	400 mA

(the FPU simulator is not ON)

If these measurements are correct, we can perform the functional tests.

Consumption TEST	OK	NON OK
Test responsible Henri TRIOU	Comments :	
Technical specialist	TEST OK	
Quality		

4 Tests des frames

⇨ FPU simulator switched ON but not used

Main Side

⇨ Batch executed by LTU : *CCHK-IF test.txt*
⇨ 4 TM files generated by LTU (DPU) (Main and Redundant)
⇨ Rename the files with the following extensions :

Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_Frame_Main.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_segment_length.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_frequency_Main.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_reset_Main.tm

Redundant side

⇨ Batch executed by LTU : *CCHK-IF test.txt*
⇨ 4 TM files generated by LTU (DPU) (Main and Redundant)
⇨ Rename the files with the following extensions :

Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_Frame_ Redundant.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_segment_length_Redundant.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_frequency_Main.tm
Renamed TM file	DCUTm(yyyy.mm.dd_hh.mm.ss)_reset_Redundant.tm

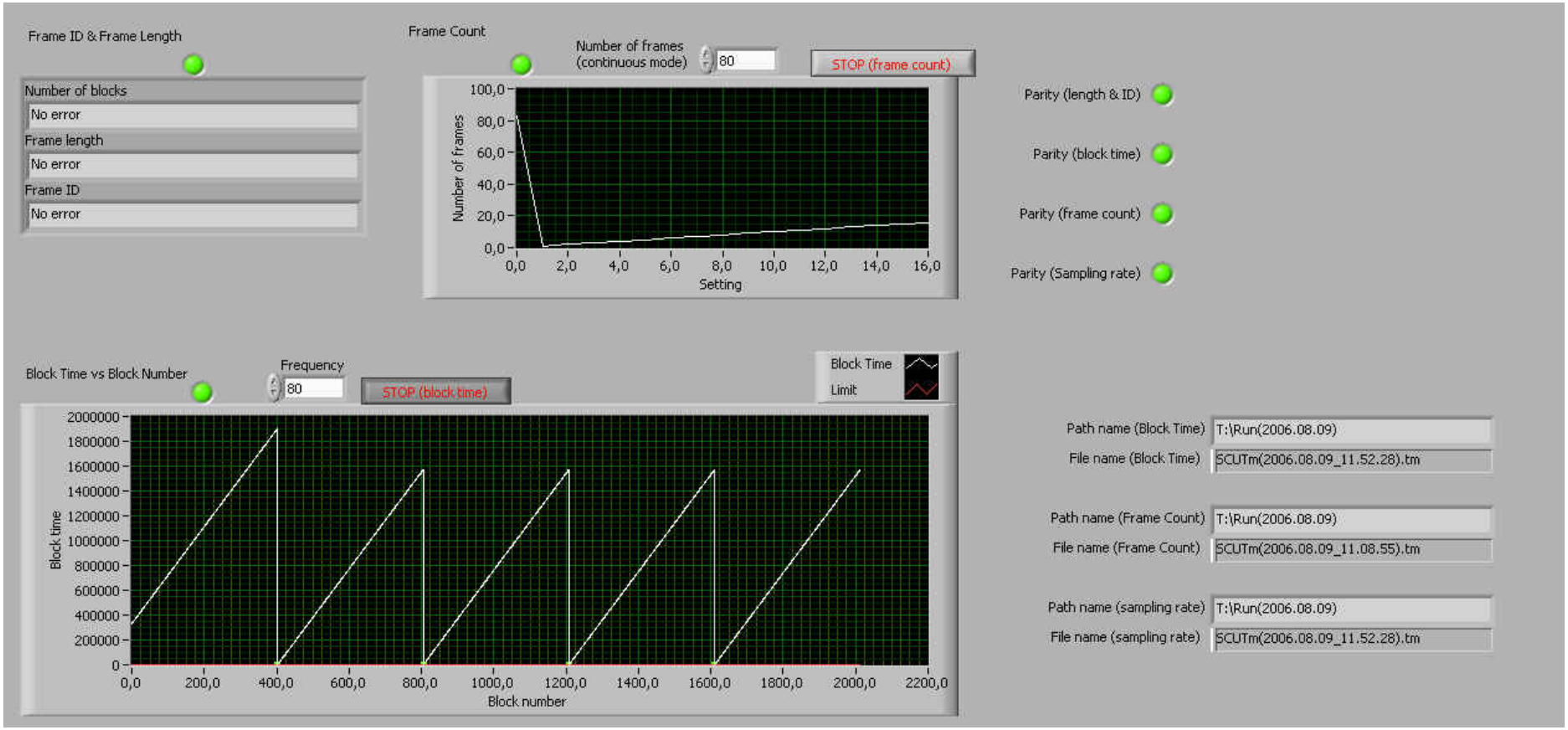
Frames :
Check consistency of frames in terms of length, frame ID and number of blocks

Length of segments :
1 sec at 80 Hz => at least 80 frames observed

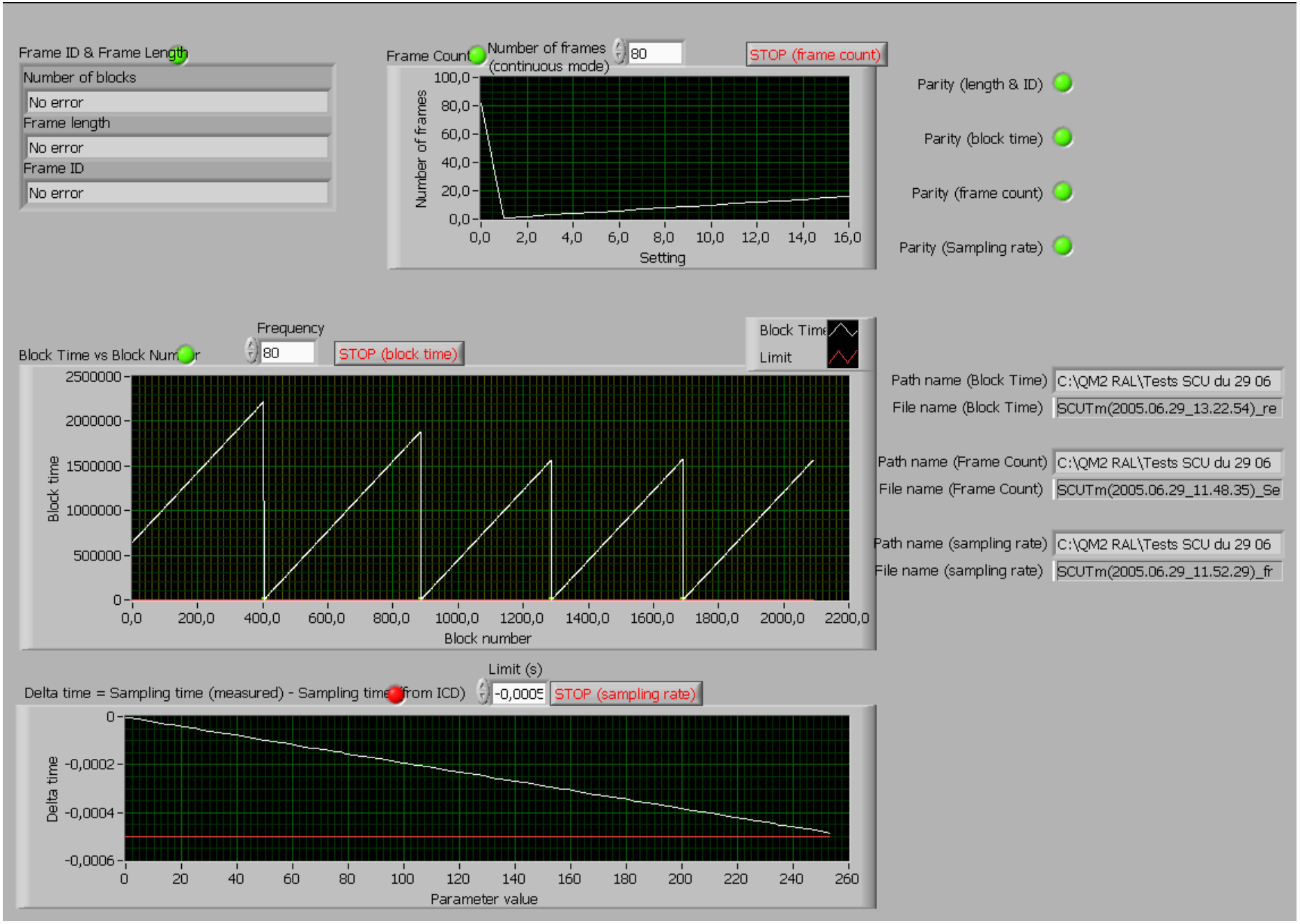
Sampling frequency
⇨ Check consistency with specification : Labview Software
⇨ delta t max = 0,0005 s (Criterion)

Reset of Time Stamp reset

We obtain the following screen copy



SCU Frames, redundant side


Frame ID & Frame Length
Number of blocks
No error
Frame length
No error
Frame ID
No error
Frame Count
Number of frames (continuous mode)
80
STOP (frame count)
Number of frames
Setting
Parity (length & ID)
Parity (block time)
Parity (frame count)
Parity (Sampling rate)
Block Time vs Block Number
Frequency
80
STOP (block time)
Block Time
Limit
Block time
Block number
Path name (Block Time)
C:\QM2 RAL\Tests SCU du 29 06
File name (Block Time)
SCUTm(2005.06.29_13.22.54)_re
Path name (Frame Count)
C:\QM2 RAL\Tests SCU du 29 06
File name (Frame Count)
SCUTm(2005.06.29_11.48.35)_Se
Path name (sampling rate)
C:\QM2 RAL\Tests SCU du 29 06
File name (sampling rate)
SCUTm(2005.06.29_11.52.29)_fr
Delta time = Sampling time (measured) - Sampling time from ICD)
Limit (s)
-0,0005
STOP (sampling rate)
Delta time
Parameter value

5 SCU Montoring (HK)

We monitored the SCU in main and Redundant sides

Main side

SCU

Status

Nom Parametre	Description	Valeur Lue H...	Valeur Nomin...
ScuStatus	SCU Status	0000	

Temperatures

Nom Parametre	Description	Valeur Conver...	Unite
Csu Temp	CCHK_IF Booard temperature	20.00	°C
Tsu Temp	Temp Board temperature	19.00	°C
Psu Temp1	PSU temperature 1	23.00	°C
Psu Temp2	PSU temperature 2	23.00	°C

Reference/Voltage

Nom Parametre	Description	Valeur Conver...	Valeur Lue H...	Min	Max
ScuCHTp05	+5V DC powe...	5.25	6980	4.77	5.28
ScuCHTp09	+9V DC powe...	9.09	68B5	8.89	9.07
ScuCHTn09	-9V DC power...	-9.08	975C	-9.07	-8.88
ScuCHT25	+2.5V DC inte...	2.52	4096	2.47	2.55
ScuCHTref	Internal voltag...	1.23	3F16	1.21	1.25
ScuCHTgnd	Internal Groun...	0.00	0009	-0.04	0.04
ScuTHTref	Internal voltag...	1.23	3F36	1.21	1.25
ScuTHTgnd	Internal Groun...	-0.00	FFFD	-0.04	0.04

Redundant side

SCU

Status

Nom Parametre	Description	Valeur Lue H...	Valeur Nomin...
ScuStatus	SCU Status	0000	

Temperatures

Nom Parametre	Description	Valeur Conver...	Unite
Csu Temp	CCHK_IF Booard temperature	19.00	°C
Tsu Temp	Temp Board temperature	19.00	°C
Psu Temp1	PSU temperature 1	22.00	°C
Psu Temp2	PSU temperature 2	23.00	°C

Reference/Voltage

Nom Parametre	Description	Valeur Conver...	Valeur Lue H...	Min	Max
ScuCHTp05	+5V DC powe...	5.24	6941	4.77	5.28
ScuCHTp09	+9V DC powe...	9.09	68B7	8.89	9.07
ScuCHTn09	-9V DC power...	-9.11	971B	-9.07	-8.88
ScuCHT25	+2.5V DC inte...	2.52	4090	2.47	2.55
ScuCHTref	Internal voltag...	1.23	3F17	1.21	1.25
ScuCHTgnd	Internal Groun...	0.00	000A	-0.04	0.04
ScuTHTref	Internal voltag...	1.24	3F4A	1.21	1.25
ScuTHTgnd	Internal Groun...	0.00	0001	-0.04	0.04

6 Temp / SubK Channels

⇨ FPU simulator switched ON in slave mode
⇨ Run the Script Script_Spire_R1R2R3R4.spt : the four set of TEMP resistances are switched on successively

⇨ Batch executed by LTU : SCUSubK_and_TEMP.txt : the LTU sets the four set of TEMP resistances successively and performs TM acquisitions.
⇨ 1 TM files generated by LTU (DPU)
⇨ Rename the files with the extension :

Main side :

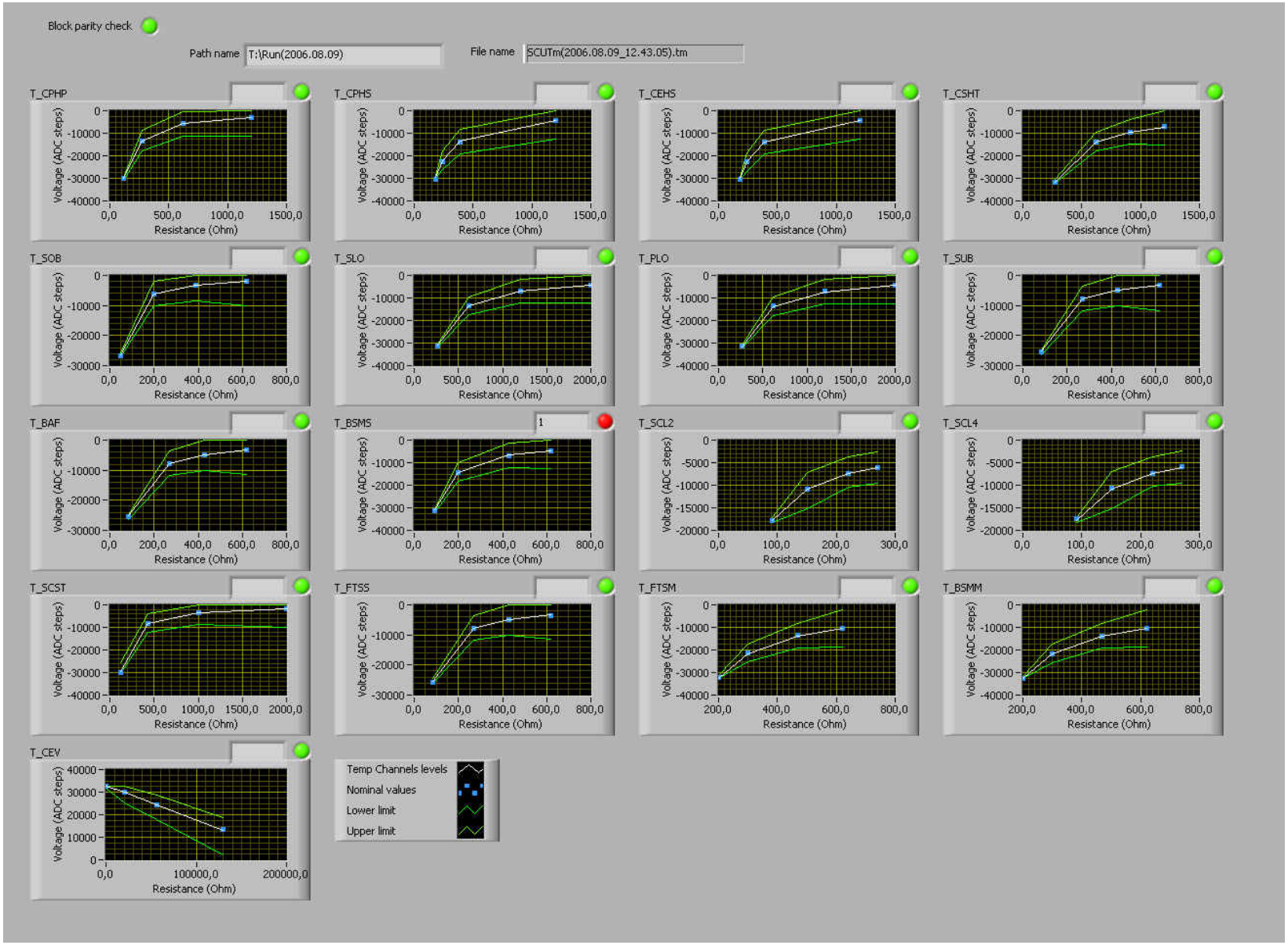
	As run (SCU TEMP/SubK)
Renamed TM file	SCUTm(yyyy.mm.dd_hh.mm.ss)_Temp_SubK_main.tm

Redundant side :

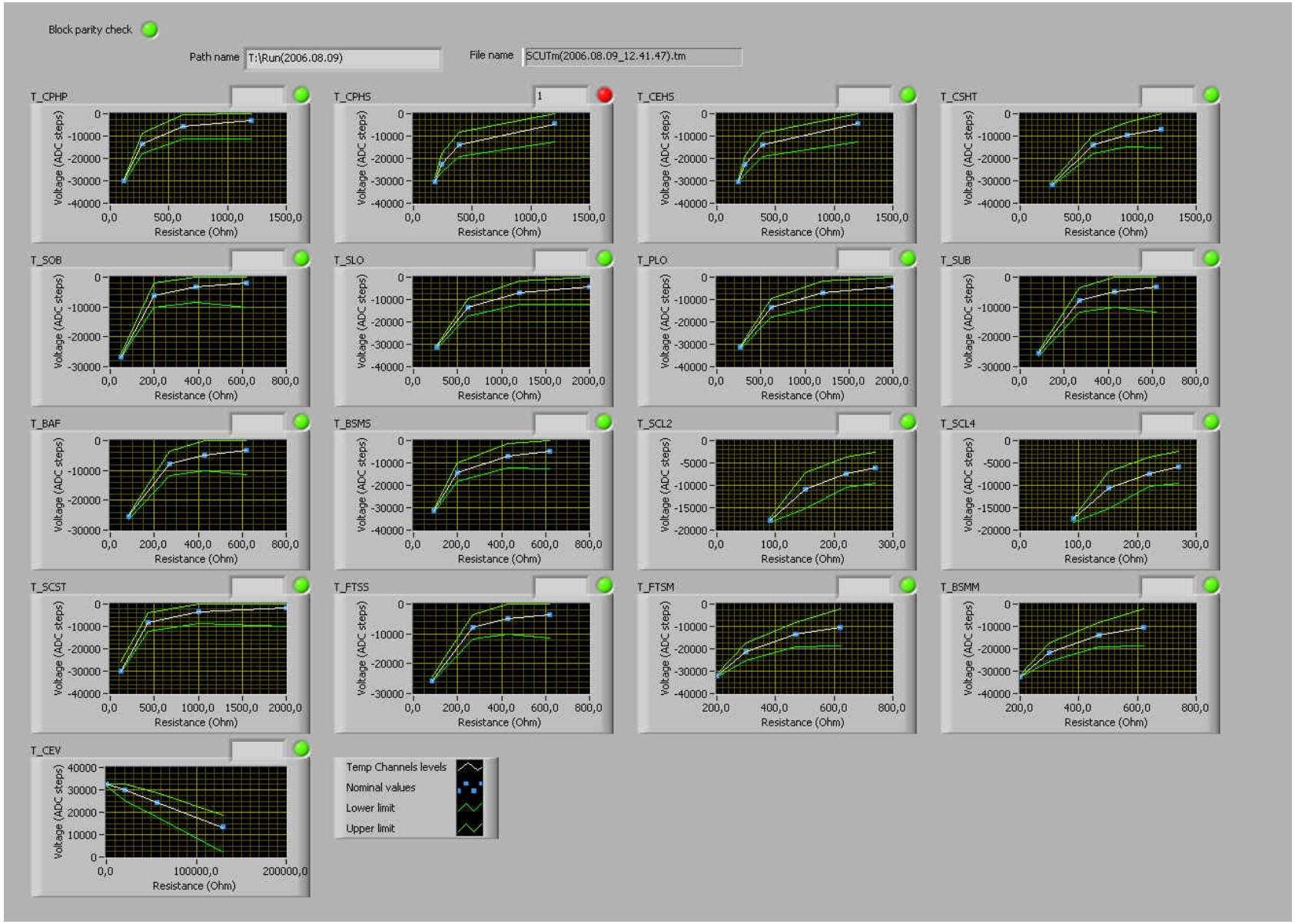
	As run (SCU TEMP/SubK)
Renamed TM file	SCUTm(yyyy.mm.dd_hh.mm.ss)_Temp_SubK_redundant.tm

The results are given on the screen copies here after :

Main side


Block parity check
Path name
T:\Run(2006.08.09)
File name
SCUTm(2006.08.09_12.43.05).tm
T_CPHP
T_CPHS
T_CEHS
T_CSHT
T_SOB
T_SLO
T_PLO
T_SUB
T_BAF
T_BSMS
T_SCL2
T_SCL4
T_SCST
T_FTSS
T_FTSM
T_BSMM
T_CEV
Voltage (ADC steps)
Resistance (Ohm)
Temp Channels levels
Nominal values
Lower limit
Upper limit

Redundant side



7 Heaters Calibrators tests

⇨ FPU simulator switched ON in stand alone mode
⇨ Run any Script

⇨ Batch executed by LTU : SCU_Heater_and_Calib.txt : the LTU sets different current levels on Heater/calibrator channels.
⇨ 1 TM files generated by LTU (DPU)
⇨ 1 H/K files generated by LTU (DPU)
⇨ Rename the files with the extension :

Main side :

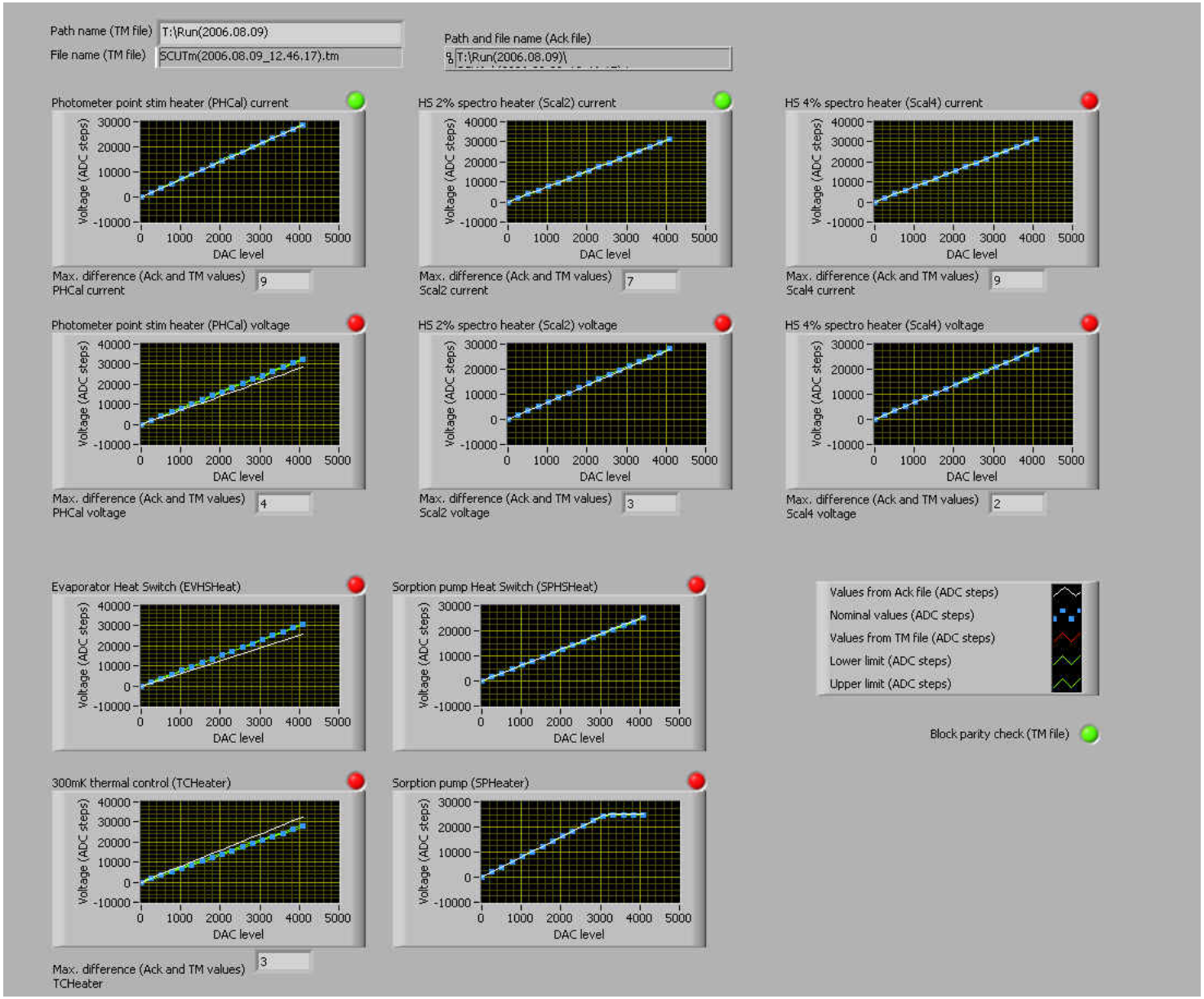
	As run (SCU Heater/Calib)
Renamed TM file	SCUTm(yyyy.mm.dd_hh.mm.ss)_Heater_Calib_main.tm
Renamed H/K file	SCUAck(yyyy.mm.dd_hh.mm.ss)_Heater_Calib_main.tm

Redundant side :

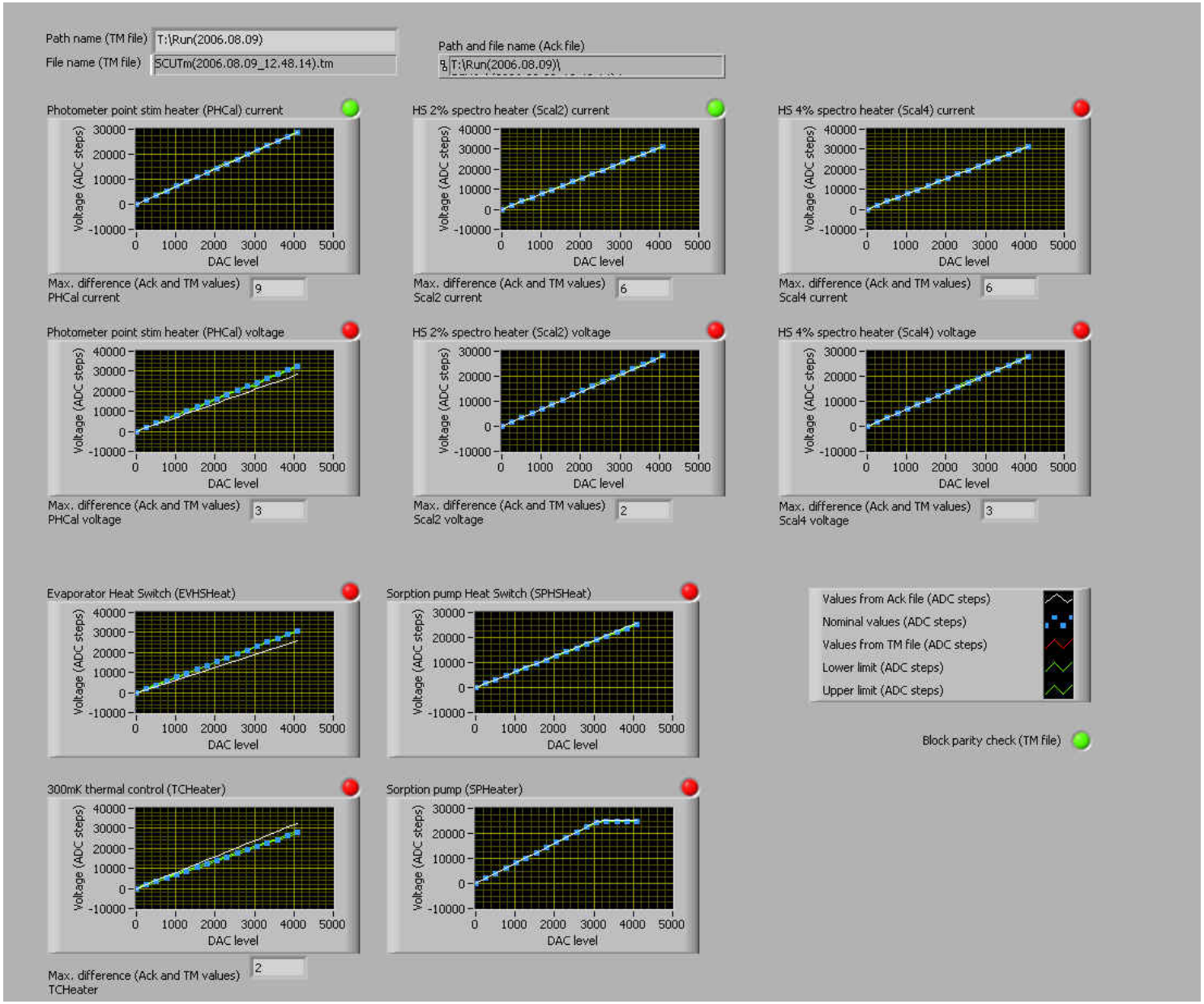
	As run (SCU Heater/Calib)
Renamed TM file	SCUTm(yyyy.mm.dd_hh.mm.ss)_Heater_Calib_main.tm
Renamed H/K file	SCUAck(yyyy.mm.dd_hh.mm.ss)_Heater_Calib_main.tm

The results are given on the screen copies here after :

Main side


Path name (TM file)
T:\Run(2006.08.09)
File name (TM file)
SCUTm(2006.08.09_12.46.17).tm
Path and file name (Ack file)
T:\Run(2006.08.09)\
Photometer point stim heater (PHCal) current
HS 2% spectro heater (Scal2) current
HS 4% spectro heater (Scal4) current
Voltage (ADC steps)
DAC level
Max. difference (Ack and TM values) PHCal current
9
Max. difference (Ack and TM values) Scal2 current
7
Max. difference (Ack and TM values) Scal4 current
9
Photometer point stim heater (PHCal) voltage
HS 2% spectro heater (Scal2) voltage
HS 4% spectro heater (Scal4) voltage
Max. difference (Ack and TM values) PHCal voltage
4
Max. difference (Ack and TM values) Scal2 voltage
3
Max. difference (Ack and TM values) Scal4 voltage
2
Evaporator Heat Switch (EVHSHeat)
Sorption pump Heat Switch (SPHSHeat)
Values from Ack file (ADC steps)
Nominal values (ADC steps)
Values from TM file (ADC steps)
Lower limit (ADC steps)
Upper limit (ADC steps)
Block parity check (TM file)
300mK thermal control (TCHeater)
Sorption pump (SPHeater)
Max. difference (Ack and TM values) TCHeater
3

Redundant side



8 Currents generated by SCU as measured by FPU simulator

⇨ FPU simulator switched ON in slave mode (the harnesses, on FPU simulator side, will be plugged on Main part so that the generated measurement files can be analysed by the labview software (it analyzes the main part)
⇨ We run any the script SPIRE_test_LGS_1.spt

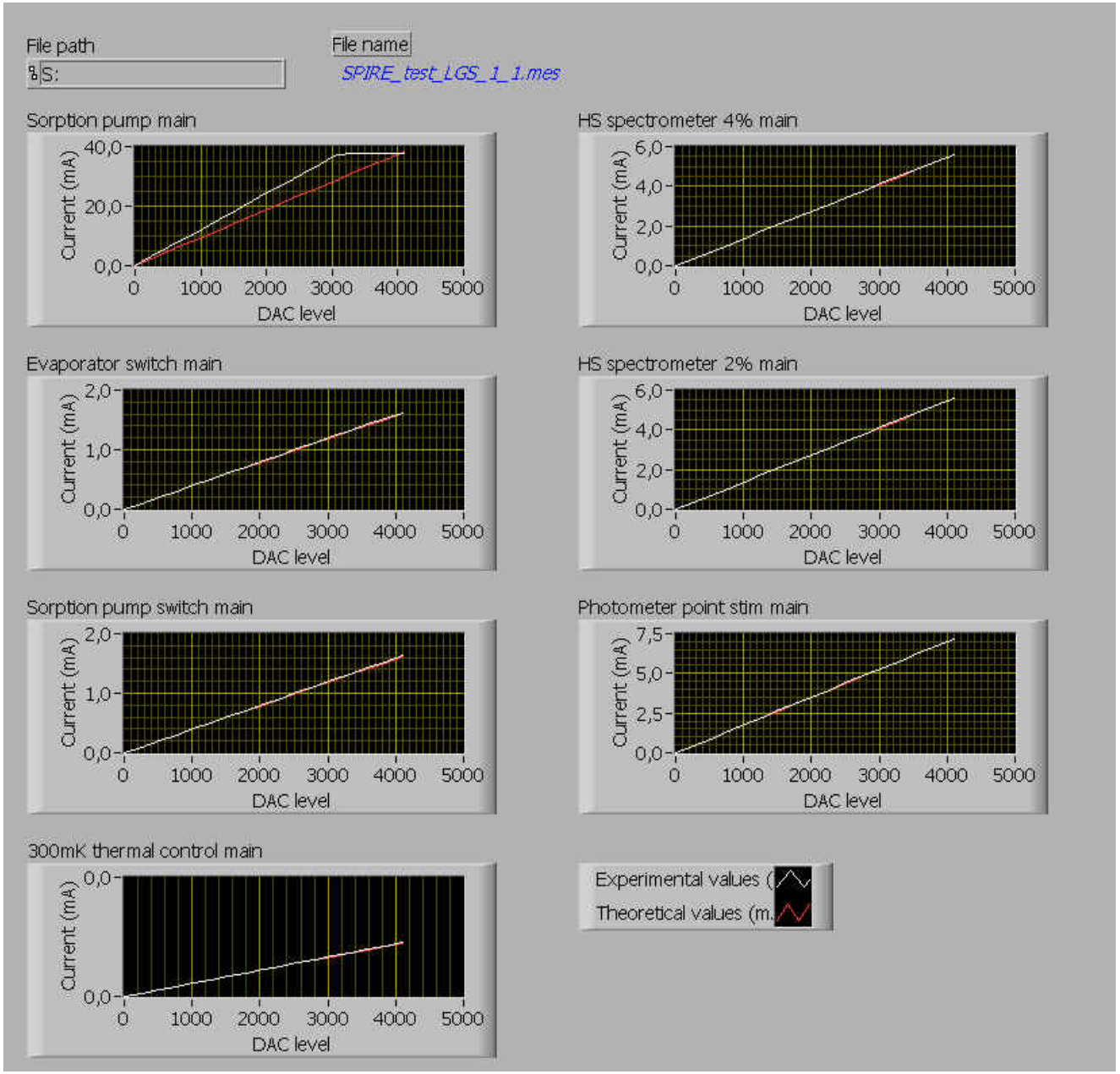
⇨ Batch executed by LTU : Heater_and_Calib_mes.txt
The LTU sends commands to that the SCU generates currents over the DAC range on all Heater/calibrator channels.

This test is performed successively in main and redundant sides so that we get 2 measurement files generated by the FPU simulator.

The measurement file obtained are :
Script_Spire_01\Script_Spire_01_090806_122652\SPIRE_test_LGS_1_1.mes for main side
Script_Spire_01\Script_Spire_01_090806_122544\SPIRE_test_LGS_1_1.mes for redundant side

The thereafter graphics represent the currents sent by SCU on Heaters calibrators channels, as measured by the FPU simulator.
We get the same results on main and redundant sides.

These results correspond to the expected nominal values.


File path
S:
File name
SPIRE_test_LGS_1_1.mes
Sorption pump main
Current (mA)
DAC level
HS spectrometer 4% main
Evaporator switch main
HS spectrometer 2% main
Sorption pump switch main
Photometer point stim main
300mK thermal control main
Experimental values (
Theoretical values (m.

9 Currents generation test in stand alone mode : Monitoring of currents

When in stand alone mode, we can check all the BIAS on a given working point. We the use the test sequence BIAS-TEST(stand alone).txt
Check the measurement file on the FPU simulator : Values of all the eaters and Calibrators currents at a given level (refer to the batch)
The measurement file obtained is : SPIRE_test_LGS_1_1.mes to be renamed as Currents.mes.

We set the DAC to their maximum (test sequence : Heater_and_Calib_DAC_MAXI_mes.txt) and measure the currents at simulator level. The results are the following :
Refer to file : Currents.mes

	Expected [1]	***Main side***	***Redundant side***
Sorption pump main :	38.157E-3 A	38.210E-3 A	38.265E-3 A
Evaporator Switch main :	1.625E-3 A	1.627-3 A	1.625-3 A
Sorption pump Switch main :	1.626E-3 A	1.627-3 A	1.627-3 A
300mK thermal control main :	4.533E-6 A	4.537-6 A	4.535-6 A
HS spect 4% main :	5.597E-3 A	5.606-3 A	5.607-3 A
HS spect 2% main :	5.598E-3 A	5.606-3 A	5.606-3 A
Photometer point stim main :	7.183E-3 A	7.193-3 A	7.188-3 A

[1] from previous tests

We check that these values are consistent with the specifications.

10 MCU Functional Tests

10.1 Test principle

The MCU functional parameters, coming from the telemetry messages, have been tested on main and redundant sides and under the following functional configurations :

- Configuration 1 : MCU ON, all currents applied to the mechanisms set at 0 level
- Configuration 2 : MCU ON, all currents applied to the mechanisms set at 0 level; latch engaged
- Configuration 3 :MCU ON, all currents applied to the mechanisms set at 10% level;
- Configuration 4 :MCU ON, all currents applied to the mechanisms set at 50% level;
- Configuration 3 :MCU ON, all currents applied to the mechanisms set at 100% level;

Under each of these configurations, the values of the thereafter parameters are read from telemetry packets. We reprogrammed the telemetry packets so as to get all these required parameters within different kind of telemetry packets. We then test the capability of receiving simultaneously all kind of telemetry packets.

- Encoder Sinus 0°,
- Encoder Sinus 120°,
- Encoder sinus 240°,
- LVDT AC
- LVDT DC
- SMEC Motor Current,
- SMEC Motor Voltage
- Chopper Sensor
- Chopper current
- Chopper Voltage
- Jiggle sensor
- Jiggle current
- Jiggle voltage

The test setup is the following :

Simulator Configuration

The MCU FPU simulator is switched ON.
The following procedure is applied to launch the simulation :

- ⇨ dSPACE control desk (on computer screen)
- ⇨ File : Recent Experiment -> c:\dSPACE\Work\testenv
- ⇨ Icon “Load application model” -> c:\MATLAB6p1\work\testenvatsteelqm2.sdf
- ⇨ Icon “Animation Mode”
  - To stop, Icone “Edit Mode”, then File Exit
  - Note : in case of problem : View-> Active Navigator -> mainlayout.lay

Test of the functional parameters of the MCU

⇨ Batch executed by LTU : MCU TESTS Main Redundant FM.txt

5 different test configurations are commanded by the LTU, these are separated by stops in the test sequence. These configurations are executed in Main and Redundant configurations.

⇨ Note : When switching from MAIN to REDUNDANT, change the harnesses.

The analysis consists in checking the values from the telemetry packets . We check consistency of these parameters with data given in the files indicating their nominal values (with associated margins). These files are provided by LAM.

- ⇨ Window HK/MCU at LTU
- ⇨ Check the displayed values depending on the configuration by comparison to expected values

10.2 Tests results

The values of the engineering parameters under each configuration have been saved in EXCEL files (“MCU_FM_main.xls” and “MCU_FM_redundant.xls”) so as to be compared to the expected values. The values of these parameters remained nominal in main and redundant sides.

The tests performed are :

Tests in Main configuration

Refer to file “MCU_FM_main.xls”

Test in configuration 1
All motors (SMEC, BSM) at zero level

Test in configuration 2
All motors (SMEC, BSM) at zero level
Tout à zero level, latch engaged

Test in configuration 3
All motors (SMEC, BSM) at 10% level

Test in configuration 4
All motors (SMEC, BSM) at 50% level

Test in configuration 5
All motors (SMEC, BSM) at 100% level

Tests in Redundant configuration

Refer to file “MCU_FM_redundant.xls”

Test in configuration 1
All motors (SMEC, BSM) at zero level

Test in configuration 2
All motors (SMEC, BSM) at zero level
Tout à zero level, latch engaged

Test in configuration 3
All motors (SMEC, BSM) at 10% level

Test in configuration 4
All motors (SMEC, BSM) at 50% level

Test in configuration 5
All motors (SMEC, BSM) at 100% level

10.3 Report of the primary current consumption (28V)

MCU Status	Main	Redundant	Expected(1)
OFF	400 mA	400 mA	400 mA
MCU ON	810 mA	810 mA	810 mA
MCU after boot	870 mA	870 mA	870 mA
Configuration 1	880 mA	870 mA	870 mA
Configuration 2	880 mA	870 mA	870 mA
Configuration 3	930 mA	940 mA	930 mA
Configuration 4	1060 mA	1060 mA	1060 mA
Configuration 5	1210 mA	1210 mA	1210 mA

(1) from previous tests