1. Introduction

This document reports on the WARM FUNCTIONAL TESTS carried out on the SPIRE Flight Instrument Model in the FM IST test campaign to verify that the pixel anomalies referred to in HP-112000-ASED-NC-3725, as raised during SPIRE IST WFT2 (see RD10), the correct functioning of each of its subsystems before cool down. The Herschel cryostat chamber was in the vertical configuration following bakeout. All these tests were performed on 11th February 2008.

The conclusion of the tests was that pixels PTC-3 and PSW-D15 were correctly repaired while pixel PMW-B6 still shows reverse polarity, implying that it was not repaired.

1.1 Scope

To judge the success or failure of a warm functional test by checking that:

- The telecommand sequence generated for a particular functional test is correctly received and executed on board by the SPIRE DPU.
- No error/event reports or command failures are generated during the execution of these commands.
- Telemetry is generated by the instrument as a result of telemetry requests to its different subunits.
- Particular telemetry parameters for each functional test change in an expected manner.
- Success criterion/criteria (specified in this document) is/are met.

1.2 Reference Documents

Ref	Document	Name	Version/Issue Nb.
RD01	SPIRE-RAL-DOC-001652	SPIRE Functional Tests Specification	Issue 1.4
RD02	SPIRE-RAL-DOC-001630	SPIRE EGSE-ILT Start-Up Procedures	Issue 0.7
RD03	SPIRE-RAL-PRC-002222	DRCU Switch ON Procedure	Issue 1.0
RD04	SPIRE-RAL-PRJ-001078	SPIRE Data ICD	Issue 2.1
RD05	Sap-SPIRE-CCa-076-02	DRCU/DPU Interface Control Document	Issue 1.2
RD06	LAM.PJT.SPI.NOT.011011	MCU/DPU Command List ICD	Issue 5.0
RD07	SPIRE-IFS-PRJ-001391	SPIRE OBS User Manual	Issue 2.2
RD08	SPIRE-IFS-PRJ-000650	SPIRE DPU Interface Control Document	Issue 1.1
RD09	SPIRE-RAL-PRC-002841	SPIRE I-EGSE Setup Procedure	Issue 2.1
RD10	SPIRE-RAL-PRC-002991	SPIRE IST Warm Functional Test Report II – Prime Side	Issue 1.1
RD11	HP-2-ASED-SD-0203	SPIRE WFT after repair of pixel anomalies on SVM-SIH connectors based on HP-112000-ASED-NC-3725	Issue 01

1.3 Change Record

Document	Change date	Changes
Issue 1.0		First version
Issue 1.1		Corrected incomplete sentence in the Introduction. Included reference to NCR HP-130000-ASED-NC-3954.

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2. Functional Tests Configuration

2.1 SPIRE Instrument Configuration (PRIME)

SPIRE FPU:

- FPU in tank.
- Cryo-harness connected to FPU
- DRCU to Cryostat harnesses connected (Grounding pins not connected)
- DRCU-DPU Harness connected
- Cryostat open

2.2 Software Configuration (PRIME)

The current EGSE software configuration for the PRIME side tests:

EGSE component	Version/Build number	Comment
SCOS2000	SCOS2.3e Patch 5	SCOS archives IST_FM1 under /data/SPIRE/hfiles and /data/SPIRE/TMD SCOS MIB is FM_2.2.G6_PR_
CDMS Simulator	v2.5	NA
HCSS	#1206	
QLA	3.3 Build #555	
QLA scripts	Latest CVS versions	
Test Control scripts		CCS Handler scripts CVS v1.4
CUS Scripts		Mission config fm_ist_wft_config_prime4
Versant	7.0.0.1	
TFCS		NA
TFTS		NA

2.3 EGSE Configuration Checks

To check for the success of failure of a functional test, the real time telemetry of the instrument has to be monitored. The following applications must be running to do so. Before the test sequence starts, make the following checks:

Workstation	EGSE component	Status	Check	Comments
hspireegse	EGSE Router	Started	✓	Running
hspireegse	EGSE Gateway	Started	✓	Running
hspireegse	Pipe GW	Started	✓	Running
spireqla	Telemetry Ingestion	Started	✓	Running
spireqla	Packet Display	Started	✓	Running

spireqla	CCS Handler Server	Started	✓	Running
spires2k	SCOS2000	Started	✓	Running
spireqla	QLA	Started	✓	Running

The following checks were performed to verify the correct initial instrument configuration for the tests.

Step#	Action	Comments	Check
1.	In SCOS open **DPU_AND_OBS_PARAMETERS display** Check if : TM2N is incrementing by one @1Hz. TM1N is incrementing by one @0.5Hz. - If they are, go to step 5. - If they are not, go to step 2.	**Both TM1N and TM2N are incrementing at their nominal rates.** **Will go to step 5.** **DPUM15V=-15.88V** **DPUTEMP = 299.06K**	✓
2.	In SCOS open **SCU PARAMETERS display** - If SCUP5V/P9V/M9V are jittering and **BIAS_PARAMETERS display** - If BIASTEMP show ambient temperature, the DRCU is ON.Go to step 6. - If DRCU is not ON, refer to RD03 on how to start up the DRCU.	**ALL SCU VOLTAGES LOOKING GOOD.** SCUP5V = 5.24V SCUP9V =9.08V SCUM9V = -9.08V **ALL BIAS VOLTAGES LOOKING GOOD.** BIASP5V = 5.18V BIASP9V = 8.99V BIASM9V= -9.05V BIASTEMP=293.8K	✓
3.	**In SCOS open** DPU_AND_OBS_PARAMETERS display **and check that the MODE housekeeping parameter is DRCU_ON.**	**MODE (RAW)= 0x100** **MODE (ENG) = DRCU_ON**	✓

Table 1. Initial configuration check

3. Test procedure

The following two sections describe general pass/fail criteria (Section 3.1), the general test procedure layout (Section 3.1) and the detailed procedure for each functional test (Section 3.2).

3.1 General Pass/Fail Criteria

The general criterion for declaring a single test failed is the repeated failure of 2 consecutive runs of this test. In that case the functional test procedure should be aborted and the overall functional testing declared FAILED.
In the case of a 'first run' failure followed by a successful execution a third run of the same test should be performed and in the unlikely event of this third run being a failure the test procedure should be also aborted and the overall functional testing declared FAILED, as this would imply a not reliable operability of the instrument.
As a general remark ANY failure should be closely analyzed.

4. Detailed Test Results on PRIME instrument.

The following is a detailed (test by test) procedure including the steps performed on each test and the results obtained.

4.1 FUNC-DCU-04-PHOT: Photometer LIAs Check

Test Id:	**FUNC-DCU-04P: Photometer LIAs Check**
Initial Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON
Final Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON + Photometer LIAs ON
Success Criteria:	Test passed if : 1. SCUDCDCSTAT parameter goes from 4 to 5. 2. Photometer LIA card voltages are showing correct readings of +5V,+9V,-9V. 3. Photometer LIA temperatures show an increase indicating that they are ON.

Test Procedure:

Step#	Action	Comments
1	On QLA bring up a time series display of the HK parameters: PLIAP5V PLIAP9V PLIAM9V LIAP1/2/3/4/5/6/7/8/9TEMP	
2	Run FUNC-DCU-04-PHOT test procedure from the CCS	
5	Contingency: If test fails repeat steps 1 and 2.	

Test Log:

Test Id	Key Parameter(s)	Expected Value Before/After	Actual Value Before/After	Nb. of frames received	Test Result
FUNC-DCU-04-PHOT	**SCUDCDCSTAT** **PLIAP5V** **PLIAP9V** **PLIAM9V** **LIAP1TEMP to LIAP9TEMP**	**4/5** **0/~ +5V** **0/~+11V** **0/~-11V** **N/A/ [290-300]K**	**4/5** 0/+5.23V 0/+11.58V 0/-11.58V ~293/warming up		**Success**

Start time: 15:27
OBSID: 0xb00003ec

CUS Input Default Parameters:
int mcu_status = 1; //default 0 = off, 1= on

Comments: PLIABITSTAT 0 to 1

Photometer LIAs switched on OK

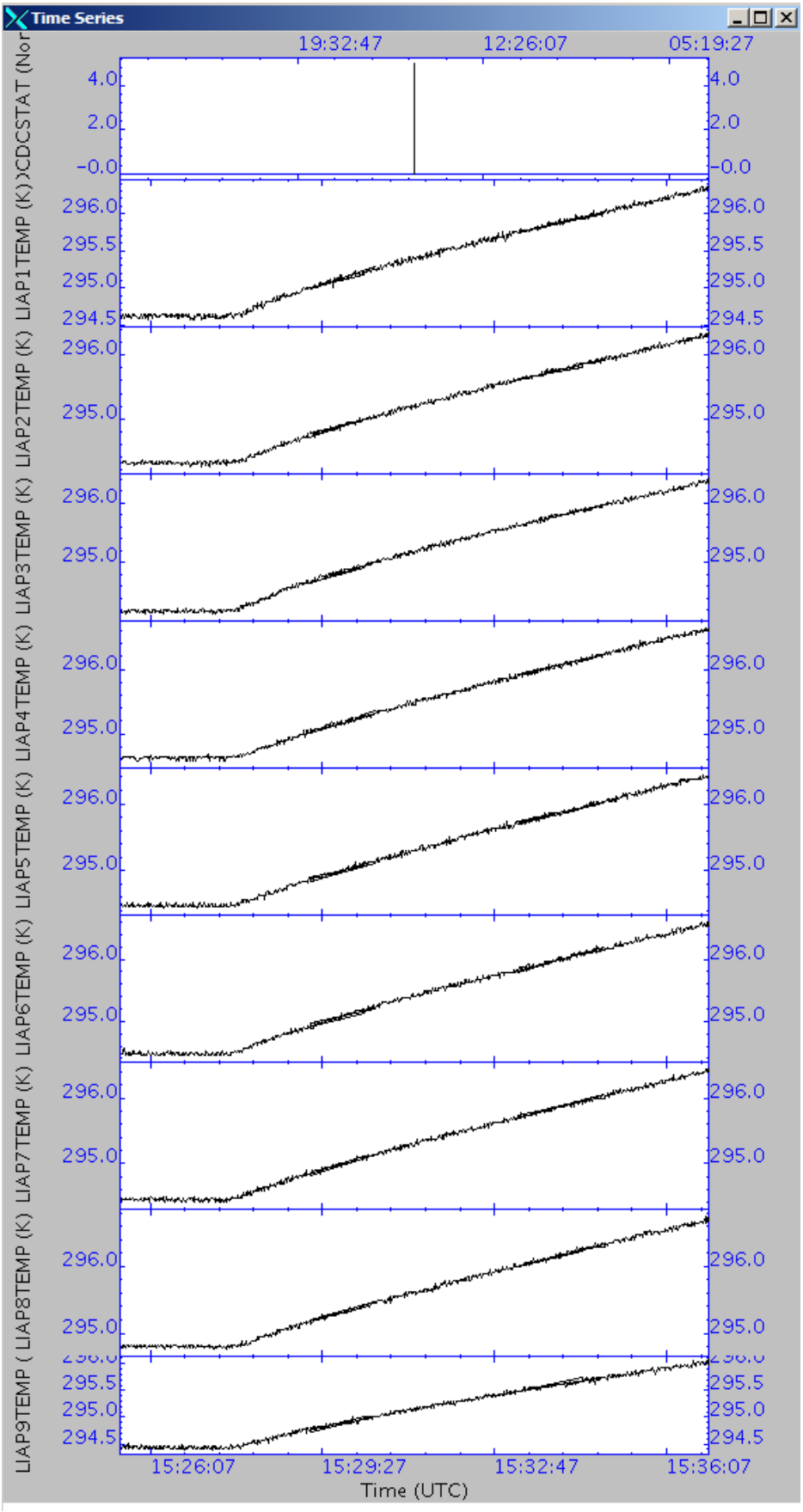
Output file FUNC-DCU-04p_B00003EC.txt from QLA script:

```
DCU-04-phot
Start time @: 11-Feb 15:27:14
End time @: 11-Feb 15:27:27
OBSID: 0xB00003EC

PLIABITSTAT:
Start value: OFF
End value: 1.0

                 Before/After
SCUDCDCSTAT     0/5
PLIAP5V         0.23/5.23 V
PLIAP9V         0.02/11.58 V
PLIAM9V         0.02/-11.57 V
```

QLA plots below for Phot LIA temperatures


Time Series
19:32:47
12:26:07
05:19:27
LIAP9TEMP (LIAP8TEMP (K) LIAP7TEMP (K) LIAP6TEMP (K) LIAP5TEMP (K) LIAP4TEMP (K) LIAP3TEMP (K) LIAP2TEMP (K) LIAP1TEMP (K))CDCSTAT (Nor
4.0
2.0
-0.0
296.0
295.5
295.0
294.5
15:26:07
15:29:27
15:32:47
15:36:07
Time (UTC)

4.2 FUNC-DCU-11-PHOT: Photometer BDAs Switch ON Check

Test Id:	FUNC-DCU-11-PHOT: Photometer BDAs Switch ON Check
Initial Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON+ Photometer LIAs ON
Final Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON+ Photometer LIAs ON + Photometer BIAS ON +Photometer JFETs ON
Success Criteria:	Test passed if Photometer JFET source and drain voltages are as commanded: 1. PSWJFETVSS1/2/3/4/5/6 2. PMLWJFETVSS1/2/3/4 3. PSWJFETSTAT = 0x3F 4. PMLWJFETSTAT = 0x7F

Test Procedure:

Step#	Action	Comments
1	Run FUNC-DCU-11-PHOT test procedure	
2	After the test Write the values RAW and converted values of: PSWJFETSTAT,PMLWJFETSTAT, PSWJFET1/2/3/4/5/6V PMWJFET1/2/3/4V PLWJFET1/2V located in DCU PARAMETERS AND	
3	Contingency: If test fails repeat steps 1 and 2.	

Test Log:

Test Id	Key Parameter(s)	Expected Value Before/After	Actual Value Before/After	Nb. of frames received	Test Result
FUNC-DCU-11P	**PSWJFETSTAT** **PMLWJFETSTAT** **PSWJFET1/2/3/4/5/6V** **PMWJFET1/2/3/4V** **PLWJFET1/2V**	**0/0x3f** **0/0x7f** **0V/-1.5V** **0V/~-1.5V** **0V/~-1.5V**	0/0x03f 0/0x07f See comments	**N/A**	**Pass**

Start time: 15:44
OBSID: 0xb00003ee
CUS Input Default Parameters:
int heater_V = 0; // Specifies if the heater is to be switched ON or not
string array = "PF"; //default array to switch ON
Comments:
The Vss values were the ~ -1.5V, as agreed with SPIRE instrument team, i.e.

PSWJFET1V: -1.47V
PSWJFET2V: -1.47V
PSWJFET3V: -1.47V
PSWJFET4V: -1.47V
PSWJFET5V: -1.47V
PSWJFET6V: -1.47V
PMWJFET1V: -1.47V
PMWJFET2V: -1.47V
PMWJFET3V: -1.47V
PMWJFET4V: -1.47V
PLWJFET1V: -1.47V
PLWJFET2V: -1.47V
TCJFETV: -1.47V

The PSW, PMW and PLW arrays on QLA are all OK
DCU data were generated for ~1min after JFET switch on.
QLA produced output file FUNC-DCU-11p_B00003EE.txt:

```
DCU-11-phot
Start time @: 11-Feb 15:44:04
End time @: 11-Feb 15:45:53
OBSID: 0xB00003EE

PLIABITSTAT:
Start value: 0x0
End value: 0x4C

                 Before/After
PSWJFETSTAT     0x0/0x3F
PMLWJFETSTAT    0x0/0x7F

PSWJFET1V       -0.00/-1.47 V
PSWJFET2V       -0.00/-1.47 V
PSWJFET3V       -0.00/-1.47 V
PSWJFET4V       -0.00/-1.47 V
PSWJFET5V       -0.00/-1.47 V
PSWJFET6V       -0.00/-1.47 V

PMWJFET1V       -0.00/-1.47 V
PMWJFET2V       -0.00/-1.47 V
PMWJFET3V       -0.00/-1.47 V
PMWJFET4V       -0.00/-1.47 V

PLWJFET1V       -0.00/-1.47 V
PLWJFET2V       -0.00/-1.47 V

TCJFETV         -0.00/-1.47 V
```

4.3 FUNC-DCU-13-PHOT: Photometer BDAs Integrity Check

Test Id:	FUNC-DCU-13P: Photometer BDAs Integrity Check
Initial Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON+ Photometer LIAs ON + Photometer BIAS ON +Photometer JFETs ON
Final Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON+ Photometer LIAs ON + Photometer BIAS ON +Photometer JFETs ON
Success Criteria:	Test passed if : The photometer detectors show a small linear variation on the output voltage when different bias is applied through the load curve.

Test Procedure:

Step#	Action	Comments
1	On QLA bring up a time series display of a couple of pixels on each of the photometer BDAs	
2	Run FUNC-DCU-13-PHOT test procedure from the CCS	
3	Contingency: If test fails repeat step 1 and 2.	

Test Log:

Test Id	Key Parameter(s)	Expected Value Before/After	Actual Value Before/After	Nb. of frames received	Test Result
FUNC-DCU-13-PHOT				**N/A**	**Success**

Start time: 15:48
OBSID: 0xb00003ef

CUS Input Default Parameters:

string dcumode = "PF"; // Specifies array in which to perform LC
int mclkdiv = 0x95; // Master clock divisor ,which specifies bias freq
int biasdiv = 0x6; // Sampling divisor ,which specifies sampling rate
int psw_phase = 0x80; // PSW demod phase
int pmw_phase = 0x80; // PMW demod phase
int plw_phase = 0x80; // PLW demod phase
int ftime = 10; // Time at each bias level

– Took ~2 minutes to receive all the TC stream from the I-EGSE from the start of execution from the CCS

Comments:

1) Pixels which showed wrong polarity in IST WFT II (see RD10) and which now shows correct polarity are:

PMW-F7
PSW-D15
PTC3

2) Pixels which showed wrong polarity in IST WFT II and which still show wrong polarity are:

PMW-B6

This implies that the proposed pixel harness repairs in RD11 have been only partially completed.

QLA load curve plots in Annexe 1.

Photometer detector settings at the end of the test:

Bias F: ~130.2 Hz
Samp F: 18.6 Hz
Phases: all ~180.7 deg
Biases are ~31mV,
TC BIAS: ~61mV

4.4 FUNC-DCU-14-PHOT: Photometer BDAs Noise Check

Test Id:	FUNC-DCU-14-PHOT: Photometer BDAs Noise Check
Initial Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON + Photometer LIAs ON + Photometer BIAS ON + Photometer JFETs ON
Final Configuration:	**DRCU_ON** + AC/DC thermometry ON+MCU ON + Photometer LIAs ON + Photometer BIAS ON + Photometer JFETs ON
Success Criteria:	Test passed if : The Photometer detectors don't show excess noise.

Test Procedure:

Step#	Action	Comments
1	Run FUNC-DCU-14-PHOT test procedure from the CCS	
2	Contingency: If test fails repeat step 1.	

Test Log:

Test Id	Key Parameter(s)	Expected Value Before/After	Actual Value Before/After	Nb. of frames received	Test Result
FUNC-DCU-14-PHOT				**N/A**	**Success**

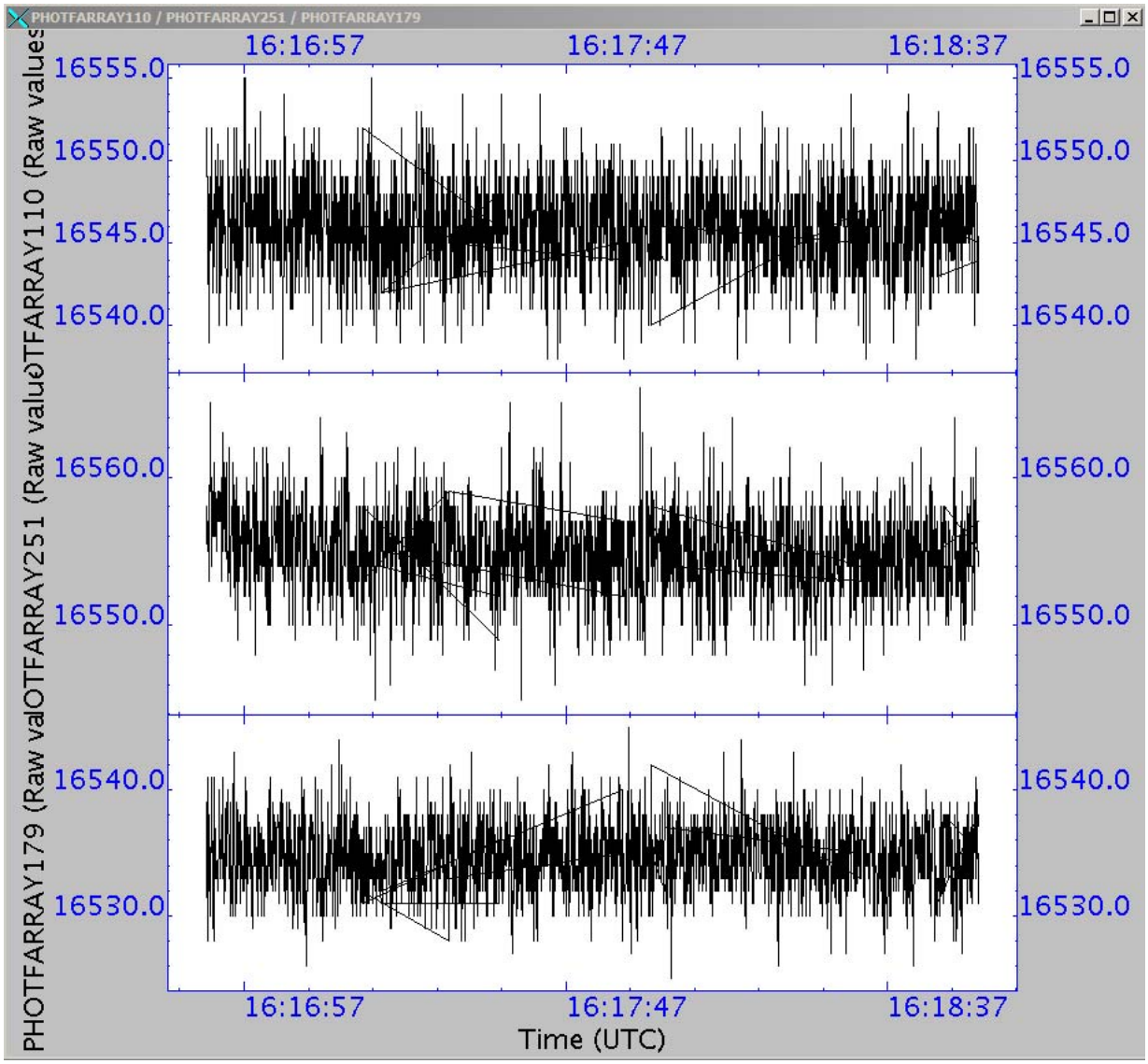
Start time: 16:17
OBSID: 0xb00003f0

CUS Input Default Parameters:
string dcumode = "PF"; //Array
int ftime = 120; //time

Comments: Test OK
Detectors settings:
Bias frequency: 130.2Hz
Sampling frequency: 18.6 Hz
PSW phase: 180.71 deg
PMW phase: 180.71 deg
PLW phase: 180.71 deg
PSW bias : ~ 31mV
PMW bias : ~ 31mV
PLW bias : ~ 31mV
TC bias : ~ 62 mV

Duration of test: 2 minutes

QLA plots below (one pixel per array) PSW-E8, PMW-D7, PLW-C5


PHOTFARRAY110 / PHOTFARRAY251 / PHOTFARRAY179
16:16:57
16:17:47
16:18:37
16555.0
16550.0
16545.0
16540.0
16560.0
16550.0
16540.0
16530.0
PHOTFARRAY179 (Raw valOTFARRAY251 (Raw valueOTFARRAY110 (Raw values
Time (UTC)

Switched off the Photometer:

PDET_OFF: 0xb00003f1

Start time: 16:39

Switched off the DRCU:

DRCU_OFF: 0xb00003f2

Start time: 16:42

During power off of the DRCU the CCS reported that the LCL current WM408565 was reading a higher value than expected

(ca. 0.8/0.9A expected 0.38-0.5A). NCR HP-130000-ASED-NC-3954 was raised.

During both nominal and redundant SFTs carried out earlier in the day the current was reading the nominal value.

5. ANNEXE 1 (RESULTS OF LOAD CURVES)

The following graphs (1-12) show the response of the 288 Photometer detectors to the input voltage during the Load Curve (FUNC-DCU-13). The graph (13) shows the response of the 3 PTC channels to the input voltage during the Load Curve. These plots are for OBSIDs B00003EF

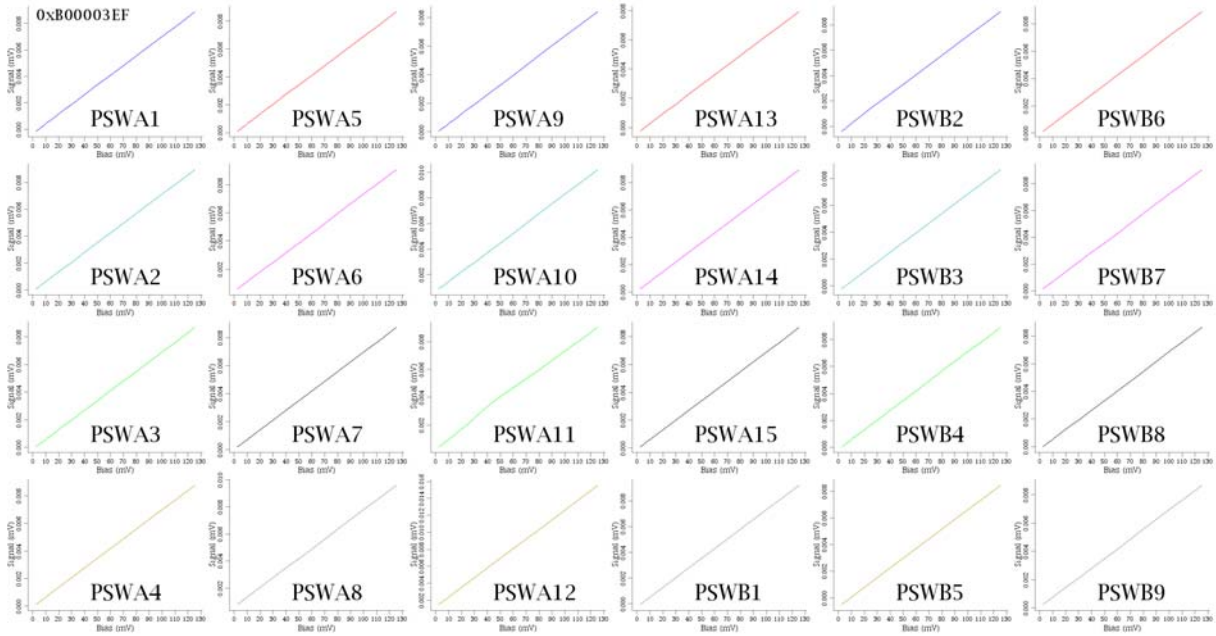


Figure 1. PSW Detectors (1)

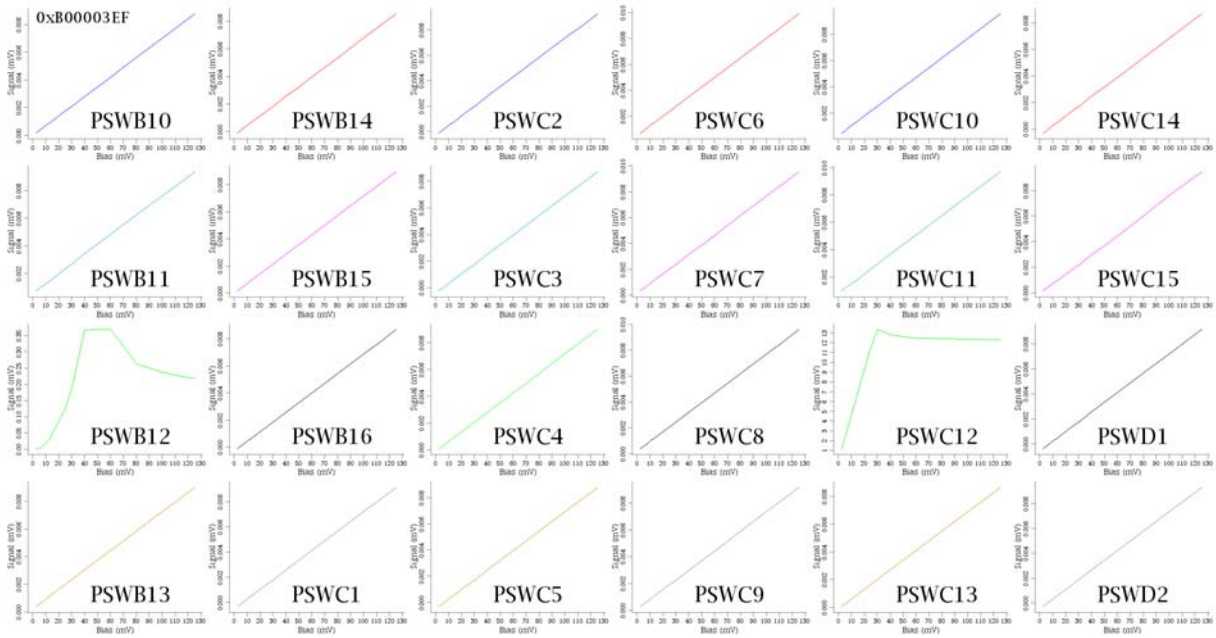


Figure 2. PSW Detectors (2)

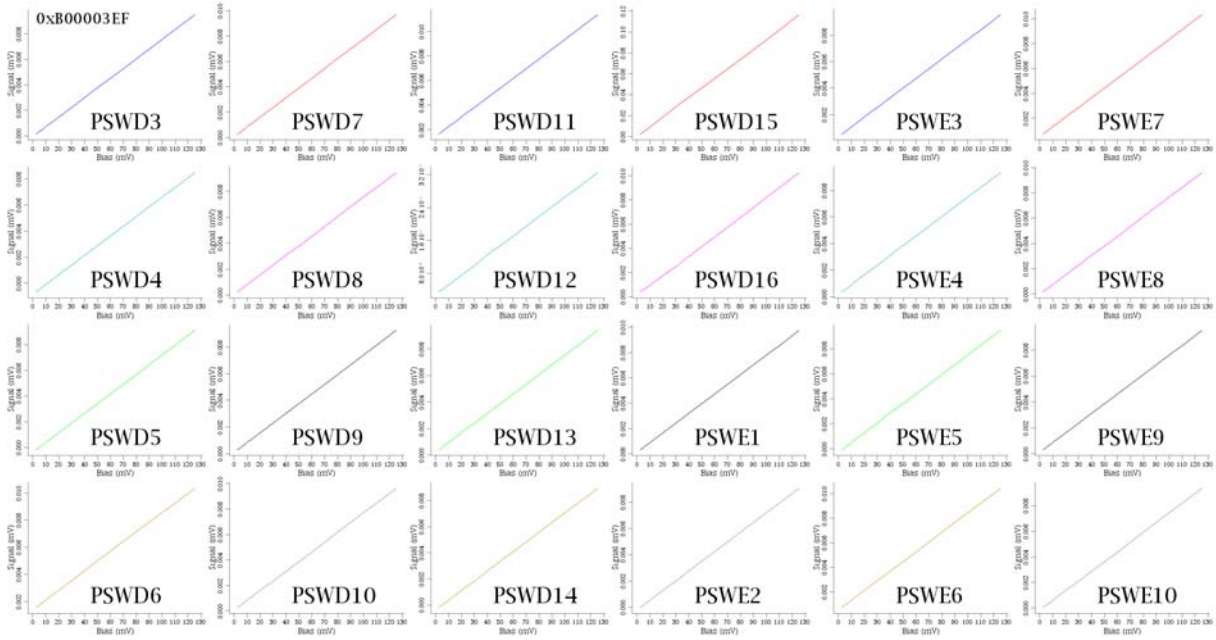


Figure 3. PSW Detectors (3)

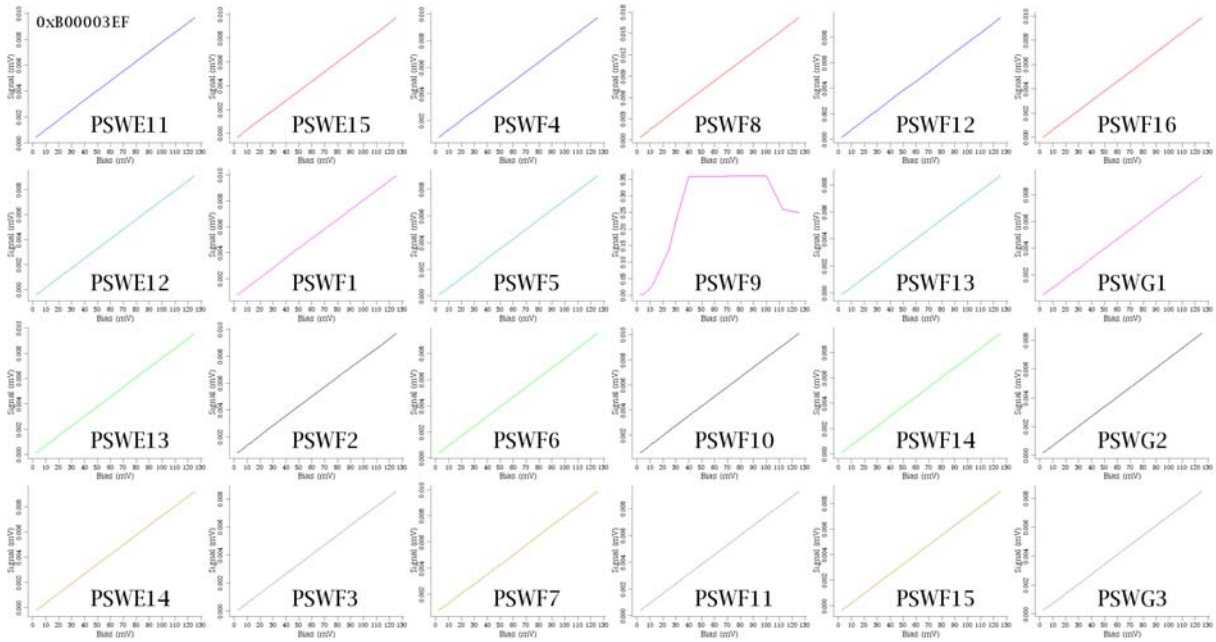


Figure 4. PSW Detectors (4)

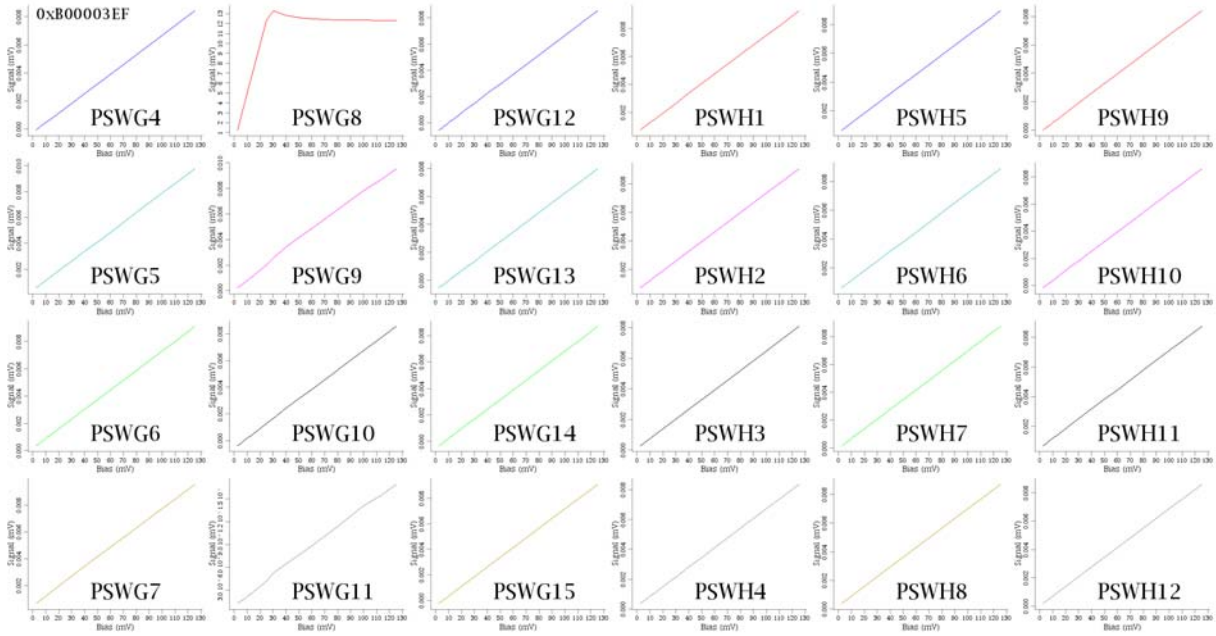


Figure 5. PSW Detectors (5)

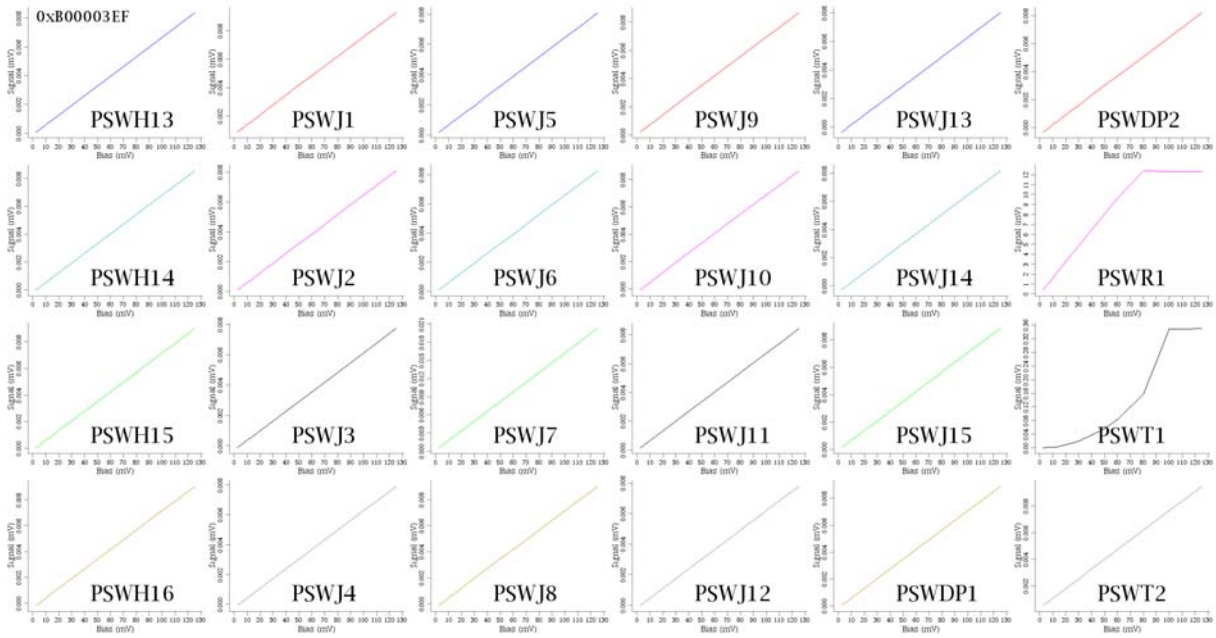


Figure 6. PSW Detectors (6)

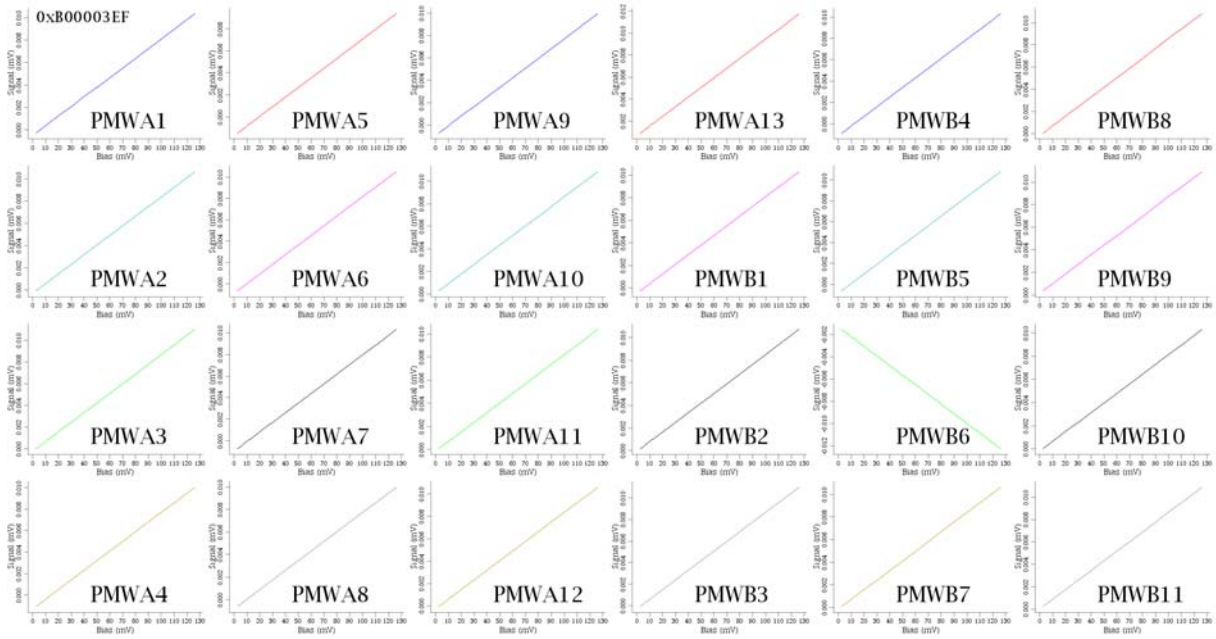


Figure 7. PMW Detectors (1)

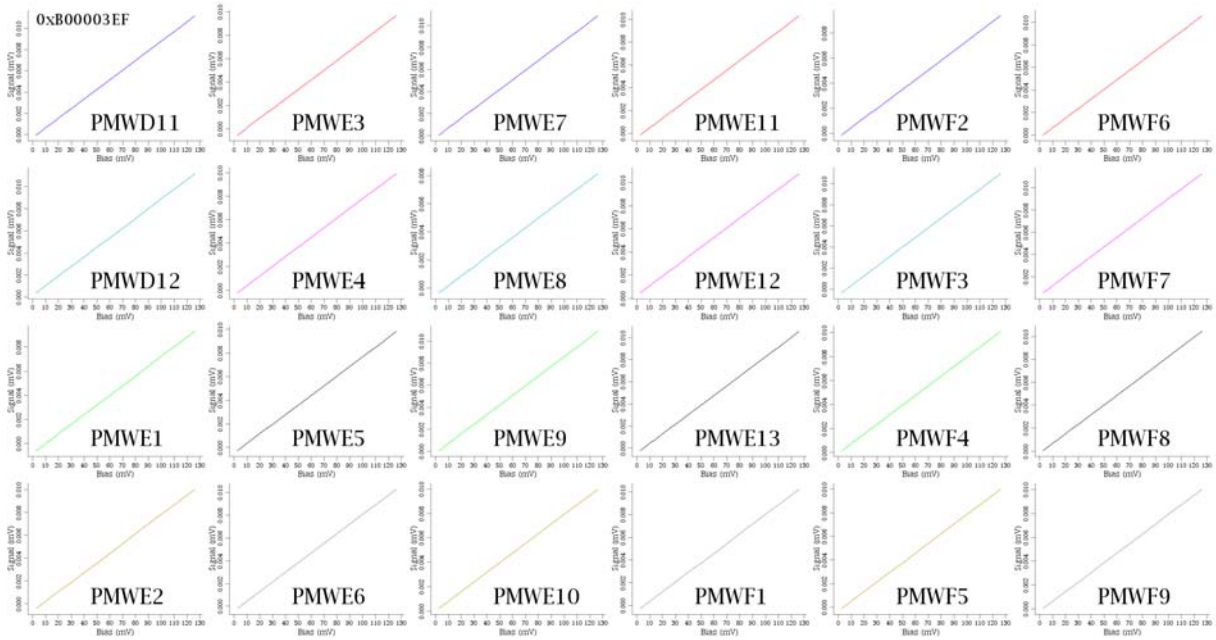


Figure 8. PMW Detectors (2)

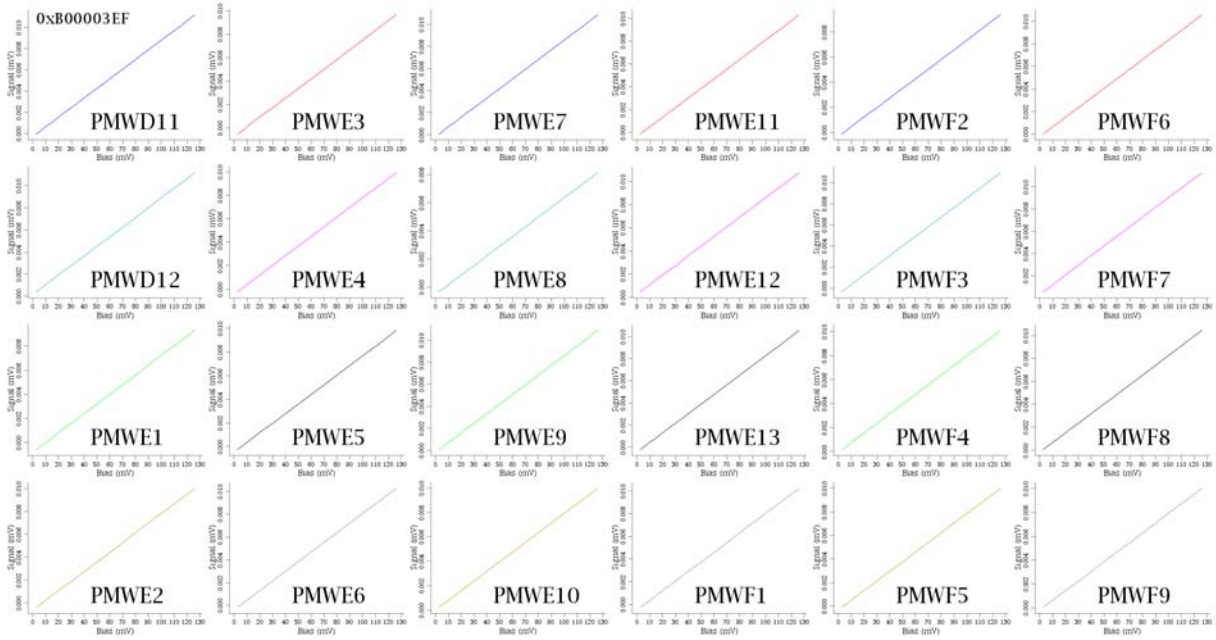


Figure 9. PMW Detectors (3)

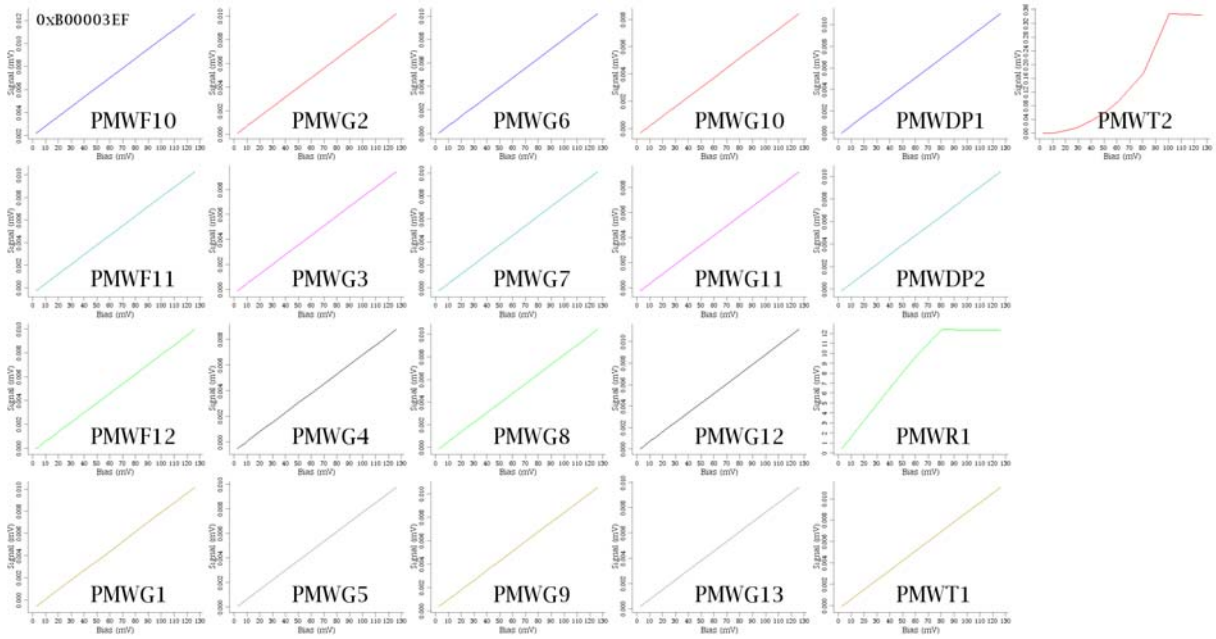


Figure 10. PMW Detectors (4)

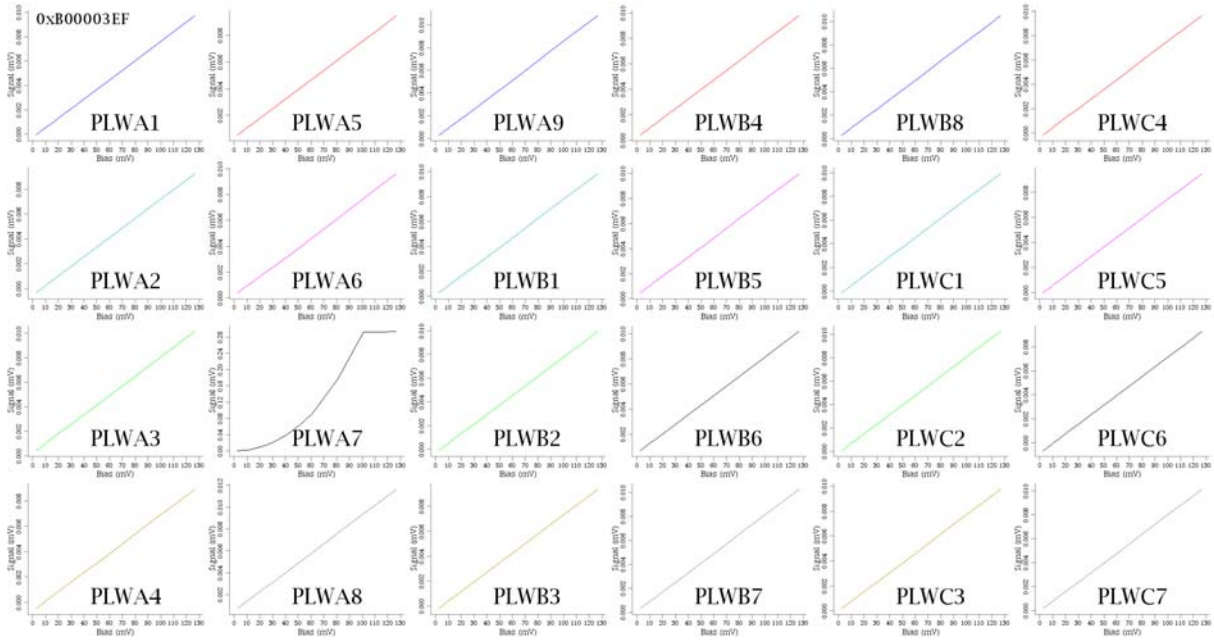


Figure 11. PLW Detectors (1)

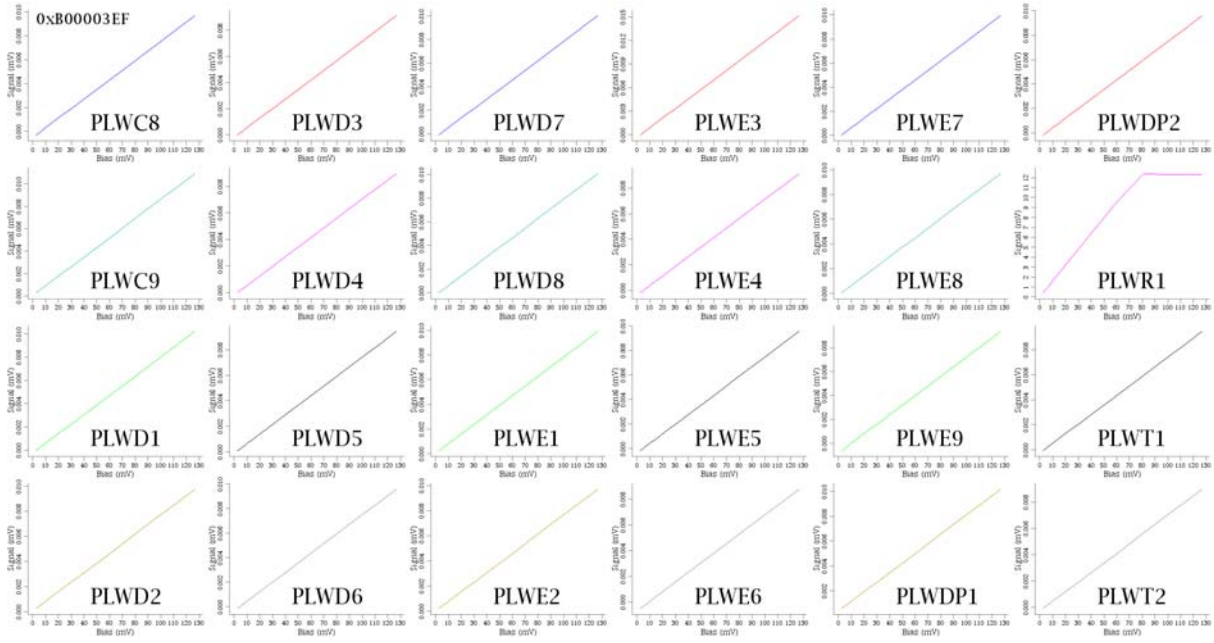


Figure 12. PLW Detectors (2)

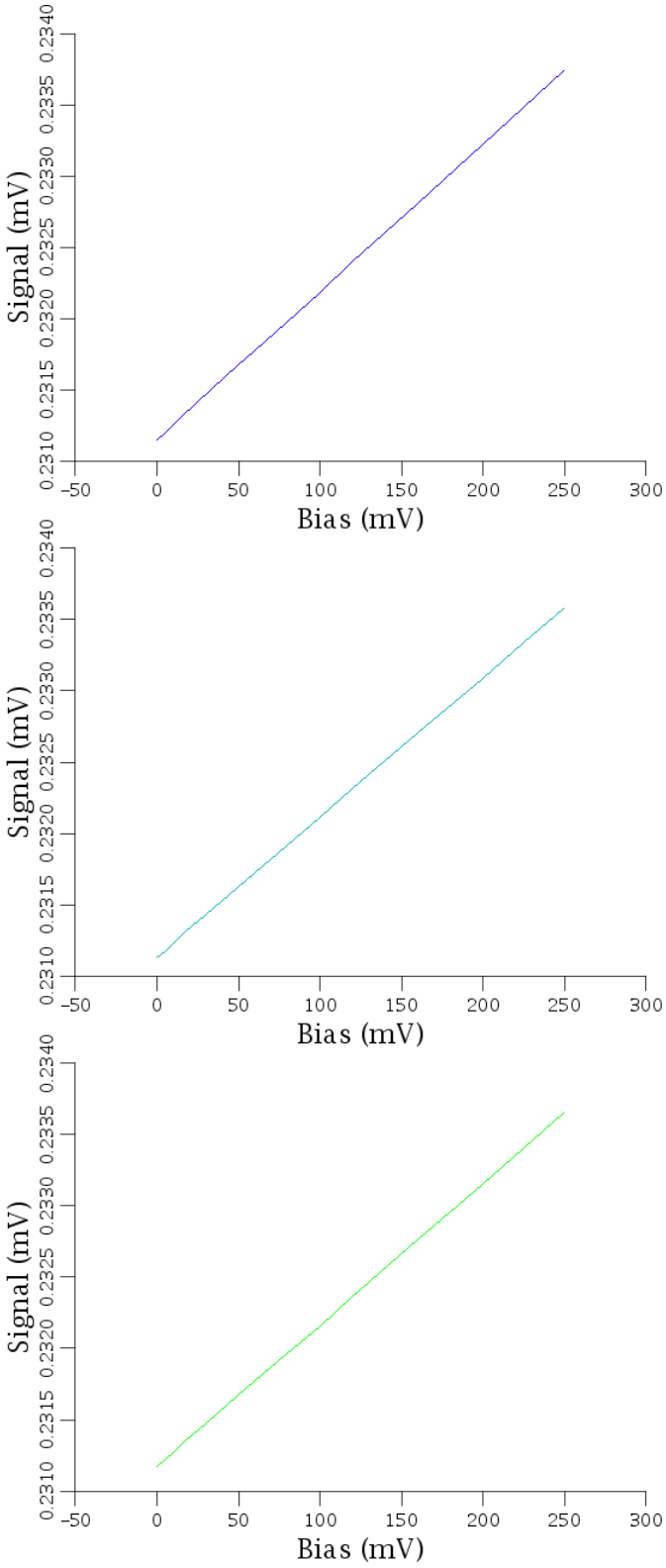


Figure 13. PTC Detectors (1)