TITLE:	Zero Bias Configuration - validation test using the NI-PLM setup		
Date:	04/01/2021	Issue:	1.0
Reference:	EUCL-IBO-TN-7-031		
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1. Documents

1.1. Applicable documents

AD	Title / Author	Document Reference	Issue	Date
1	NI-DPU Commanding Tables	EUCL-OPD-TN-7-004	3.0	15/01/2019

1.2. Reference documents

RD	Title / Author	Document Reference	Issue	Date
0	NISP Acronyms List	EUCL-IAP-LI-1-001	2.0	04/05/2013
1	Reset of SCA bias and clock voltages (ITAR)	EUCL-IBO-TN-7-017	1.2	28/12/2020
2	Report of Scientific Telemetry NI-TV3	EUCL-IBO-TR-7-004	1.0	22/10/2020
3	Procedure to configure NISP Focal Plane for room temperature operations – SCA Zero Bias	EUCL-IBO-TN-7-023	1.0	21/07/2020

2. Change log

Issue	Date	Page	Description of change
1.0	04/01/21	all	First issue

3. Introduction

Two procedures were tested to apply the ZBC to the NI-Focal Plane in the PLM setup. The first one performs in series the power up of a DCU, bootstrap of the related SCE and the application of the ZBC; this procedure is represented with red boxes in Figure 1. The second procedure starts will al the DCUs powered on, then each SCE is booted and the ZBC is applied, this procedure is represented with a blue box in Figure 1.

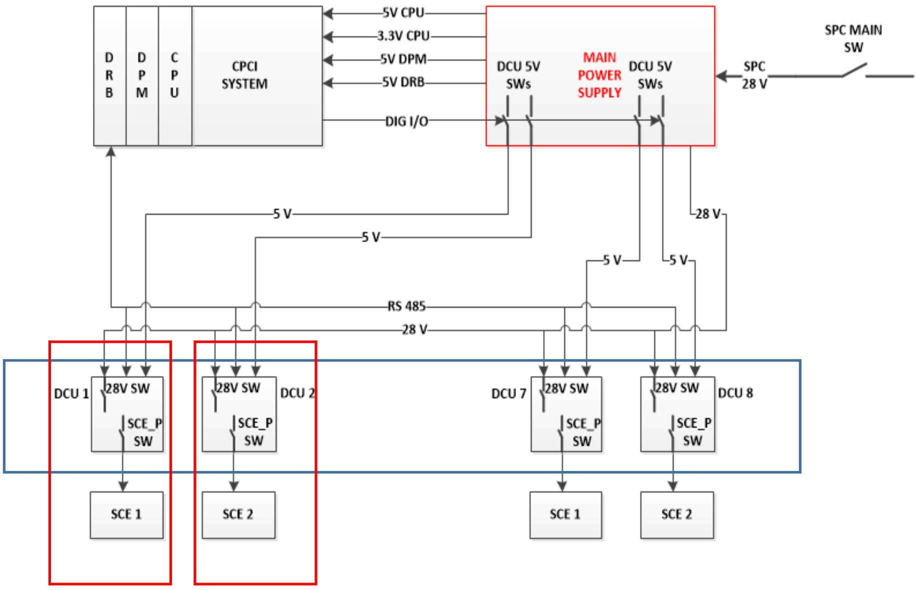

Figure 1, scheme of the ZBC procedures applied to the NI-Focal plane; a single DPU is represented. Red boxes indicate the fully serialized procedure (used in test procedure 1), while the blue box represents the partial serialization (used in test procedure 2)

In both cases the ZBC applied resets the VDDA and VDD registers at the end of the procedure, see details in RD-1, and in Appendix Section 8, table 1 in subsection 8.6. In all the cases the SCE readout mode was the nominal ZBC equal to 0x1882, see Section 2 of RD-3 (details of the test execution are stored in the NISP internal storage: elog's entry 665 title Zero Bias Test with NISP FM).

4. Test procedure 1

(TASI Script 100) Include the power up of the DCUs in the serialization process, i.e.:
- for DPU1 with only DCU1 powered up and SCE booted apply the ZBC.
- power up the next DCU (DCU2) and bootstrap the SCE (SCE2), then apply the ZBC
- continue with the next DCUs, …
- execute the same routine in DPU2 (all DCUs/SCEs)

Results:

The CCS Session for the test was: 2020_12_21T06_55_23_ccsoper_ccs-w12_REALTIME_EWI122.

- Tested with 16 DCUs/SCEs all OK see Figure 2; each ZBC register was tested correctly using a memory DUMP; 2 x repetitions of the ZBC configuration (1) were done, for each one a single broadcast nominal dither cycle was acquired.

Figure 2, entire NI-Focal Plane under ZBC, all telemetries correspond to nominal values. The image is the Focal Plane's display of the TASI synoptic.

- Test exposure data identified with PID = 86077.
- Elapsed time to put in ZBC the entire focal plane = 32 minutes
- Time of SCEs working at warm = ~25 seconds/SCE not cumulative
- register's check: mem DUMP (30 min/DPU, total 1 hour)

5. Test procedure 2

Repetition of the old procedure (only serializing the boot and the ZBC on each SCE): (using only 1 DPU with 4 SCEs), i.e.:

- power on all DCUs for both DPUs
- bootstrap SCE1, apply ZBC
- bootstrap SCE2, apply ZBC
- bootstrap SCE3, apply ZBC
- bootstrap SCE4, apply ZBC

Script: subsys_plm_nisp_dpu_dcu_off_to_boot.tcl Revison 318, TASI repository.

Results:

- Procedure correctly set to 16 DCUs/SCEs, DCUs status were the same ones showed in Figure 2 (all nominal values). In Figure 3 are represented the signal images of the entire focal plane under ZBC.
- All ZBC registers were successfully checked using a memory DUMP
- A NISP nominal broadcast Dither cycle was acquired correctly. Images for the Spectrometric exposure of all 16 detectors are shown in Figure 3. The very stable mean value of the signal of each detector (2048x2048 pixels) is plotted in Figure 4, errors (statistical) correspond to the variance of each signal distribution. A constant fit was applied, and the global mean value is equal to 1031 ± 32 [ADU].
- χ^2 distributions of all the 16 detectors are shown in Figure 4. Distribution's shapes are compatible with expected one for the case of fits performed to noise using 15 points.
- The total elapsed time to put in the ZBC the entire focal plane is 32 minutes
- The amount of time of the SCEs working at room temperature is ~30 seconds/SCE not cumulative
- The time needed to perform the register's check by applying a memory DUMP is 30 min/DPU, given a total time of 1 hour (560 registers individually checked).
- The test exposure identifier is processing ID (PID) 78791, data is stored in the instrument workstation at SCIENCETM/FITS/20201222
- Procedure (2) was repeated successfully using a Dither composed of 3xMACC(4,16,4)
- The entire sequence (2) was applied correctly for another 5 times using a test exposure MACC(4,16,4) – NISP nominal Photometric acquisition.

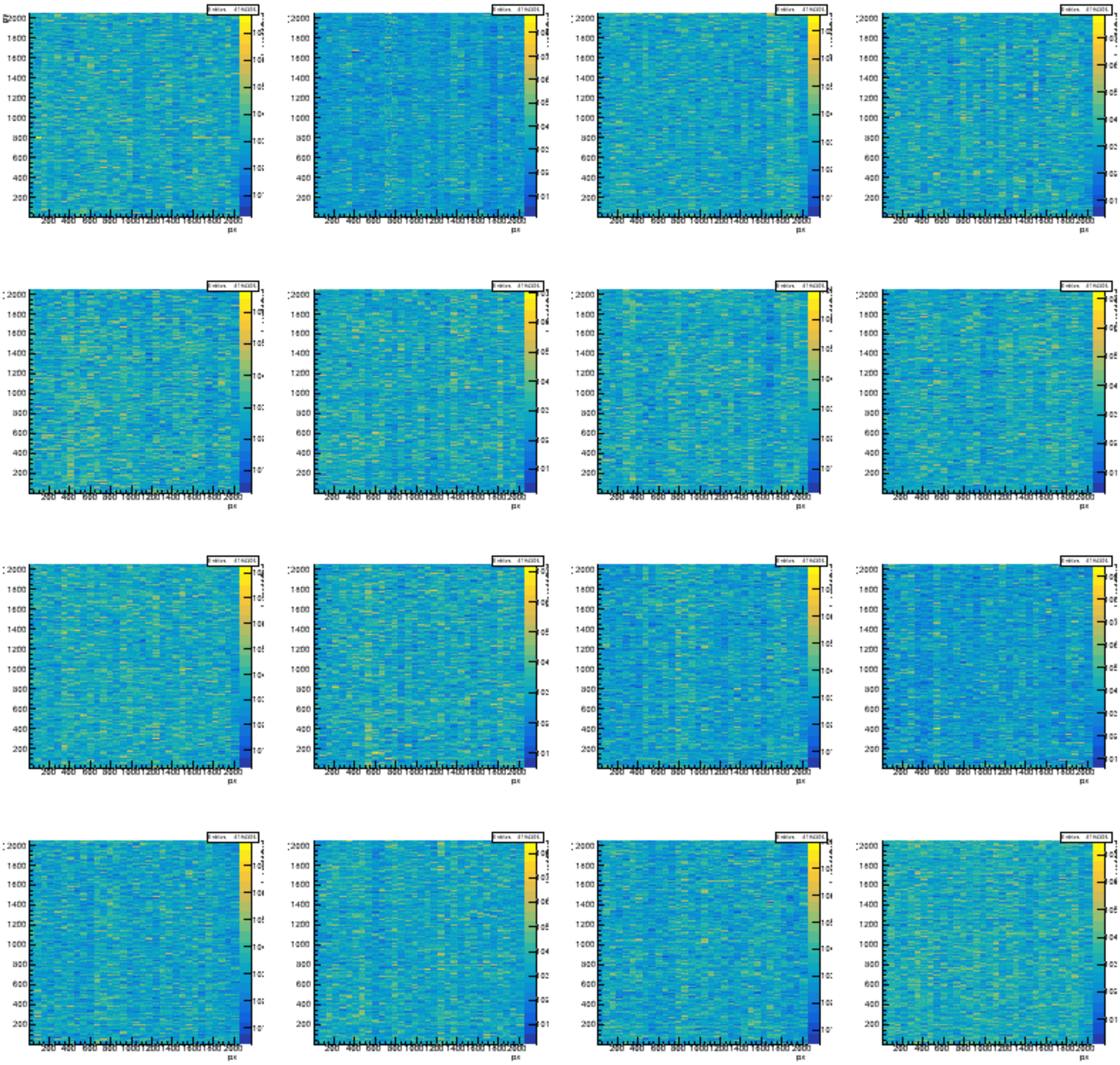

Figure 3, Mosaic view of the 16 detectors of the NI-Focal Plane (PLM setup) under ZBC; data of a nominal Spectrometric exposure MACC(15,16,11) is displayed.

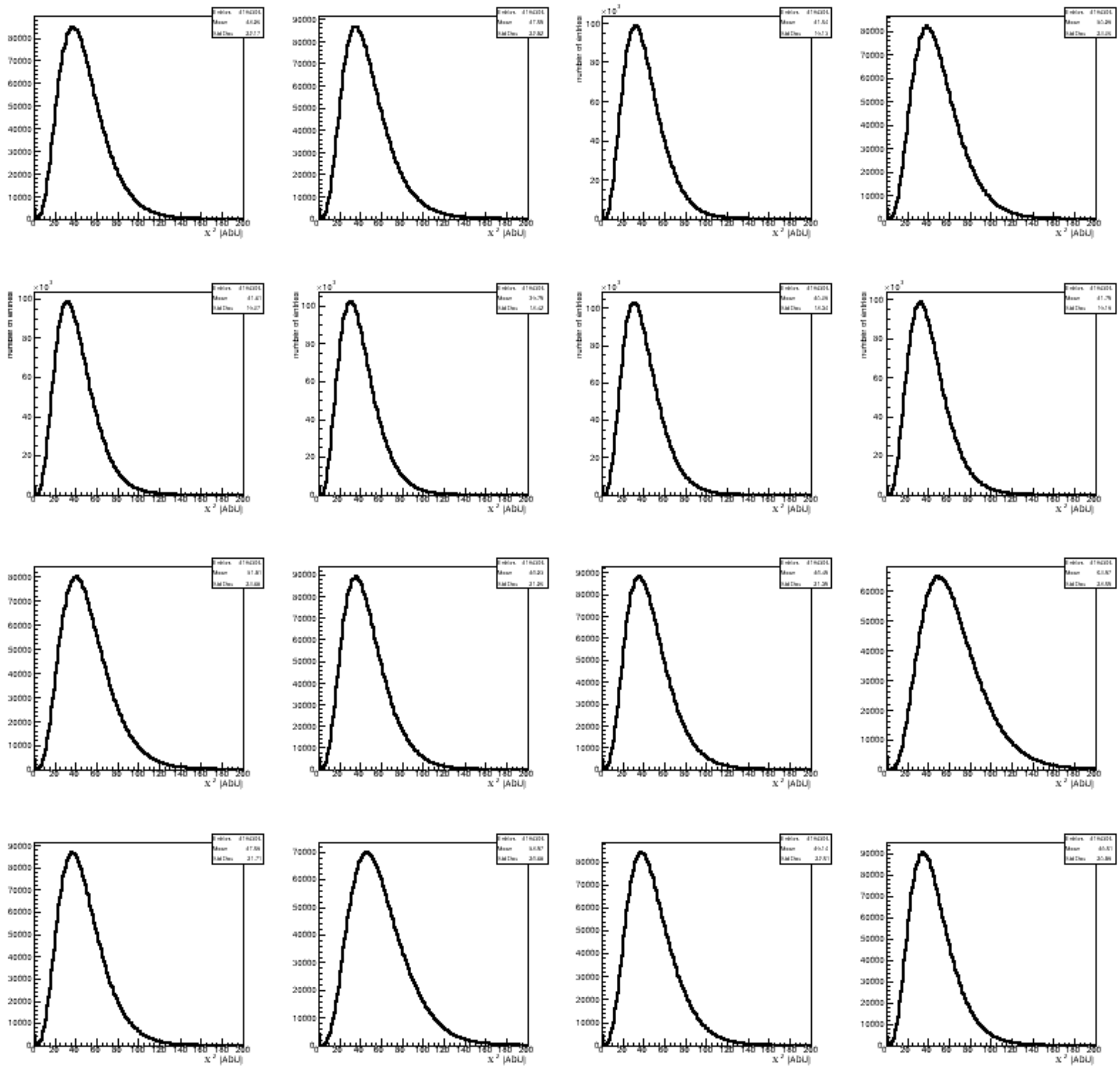

Figure 4, nominal χ^2 distributions of the 16 detectors of the NI-Focal Plane under ZBC, represented in the mosaic view.

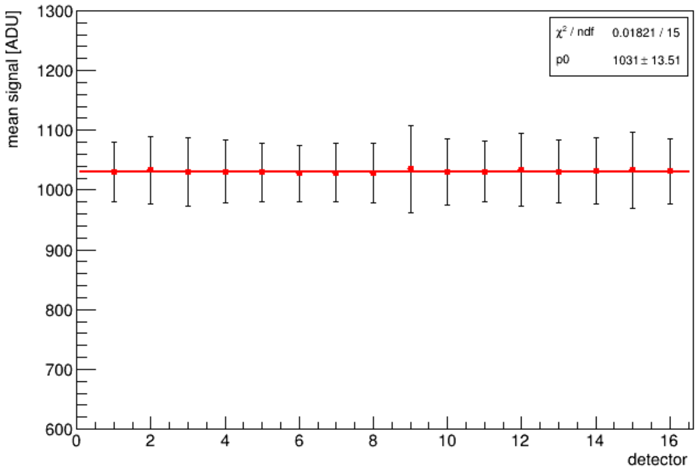

Figure 5, mean signal of each detector under ZBC, statistical errors correspond to the signal distribution's variance. A constant fit was applied resulting in a mean value equal to 1031 ± 14 [ADU].

Telemetry Analysis

CCS Session: 2020_12_23T06_54_43_ccsoper_ccs-w12_REALTIME_EWI122, IWS files used for the telemetry analysis (64 in total) stored at SCIENCETM/FITS/20201222:

NISP_DPU1_1N_20201221_122658_00001_000001.lv1 to NISP_DPU1_1N_20201221_122658_00001_0000032.lv1 and NISP_DPU2_1N_20201221_122704_00001_000001.lv1 to NISP_DPU2_1N_20201221_122704_00001_0000032.lv1

A selected subset of telemetry parameters were analyzed from the data produced under the ZBC, the following distributions shows cumulative telemetry of all the detectors acquiring a nominal Dither cycle (64 exposures). This data was cross-checked with reference telemetry of the focal plane documented in EUCL-IBO-TR-7-004_ReportTV3_NISP_ScienificTelemetry showing no relevant differences; indicating that the focal plane under this engineering configuration behaves nominally.

Figures 6 indicates the results of the DPU-ASW processing: mean processing time evaluated for a nominal Dither cycle with the Focal Plane under ZBC (64 exposures, 1 per detectors are shown), results are equal to 14.2 [s] for spectrometric exposures and 7.7 [s] for Photometric ones. Figure 7 shows the results of the compression algorithm: compression factors of signal equal to 4.2 ± 0.2 and for χ^2 equal to 1.4 ± 0.1 obtained with the Focal Plane under ZBC. Both results of Figure 6 and 7 are fully compatible with the results obtained a wide survey performed in the reference thermal-vacuum test (NI-TV3), see RD-2.

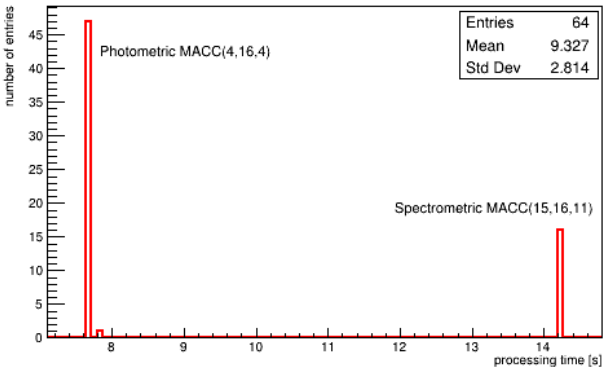

Figure 6, DPU-ASW processing time of each exposure under ZBC fully compatible with nominal one. Data from a nominal Dither cycle (1 Spectrometer and 3 Photometric exposures x 16 detectors).

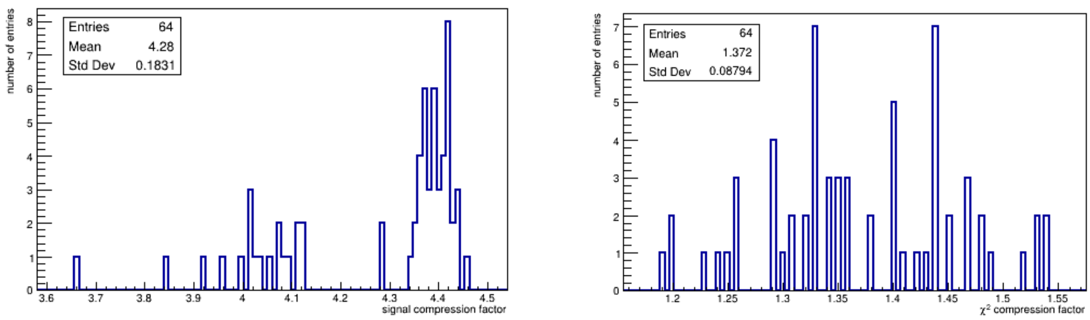

Figure 7, DPU-ASW processing signal (left) and χ^2 (right) compression factors fully compatible with nominal values. Data from a nominal Dither cycle (1 Spectrometer and 3 Photometric exposures x 16 detectors).

Figures 8, and 9, shows some SCE external biases (SCA) under ZBC with values compatible to zero:

$VDDA_{ZBC}$ = 0.01 ± 0.01 [V],
VDD_{ZBC} = 0.006 ± 0.007 [V],
$VReset_{ZBC}$ = 0.007 ± 0.008 [V],
$VDsub_{ZBC}$ = 0.008 ± 0.008 [V] ,
$VbiasGate_{ZBC}$ = 0.005 ± 0.007 [V]

While, during nominal operations the mean values of the same biases measured during NI-TV3 were, (from RD-2):

$VDDA_{nominal}$ = 3.31 ± 0.01[V],
$VDD_{nominal}$ = 3.308 ± 0.01 [V],
$VReset_{nominal}$ = 0.37 ± 0.01 [V],
$VDsub_{nominal}$ = 0.82 ± 0.01 [V] and
$VbiasGate_{nominal}$ = 2.09 ± 0.01 [V]

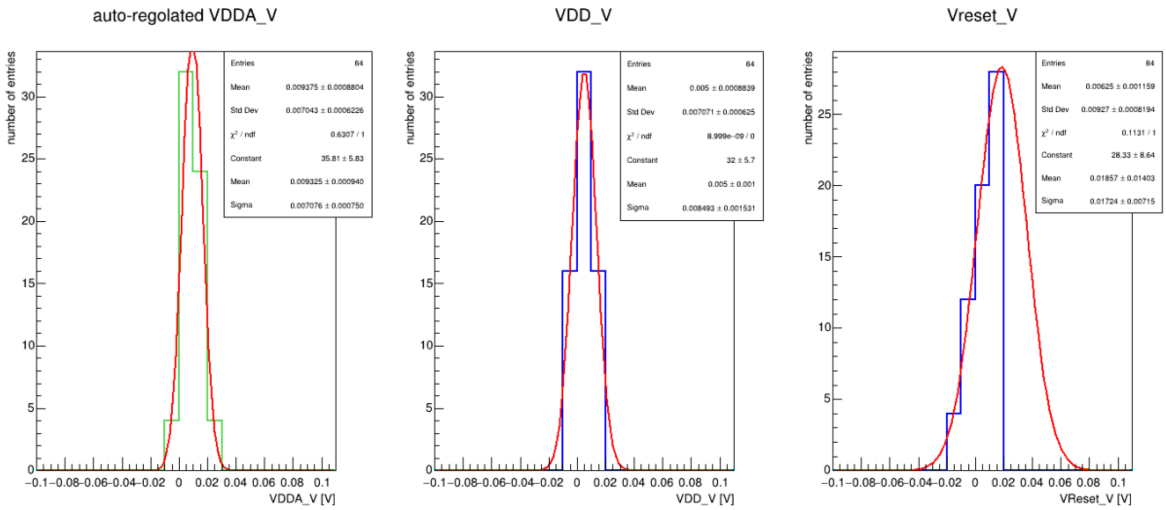

Figure 8, SCA telemetry under ZBC: VDDA (left), VDD (middle) and VReset (right) biases, all compatible with a null value.

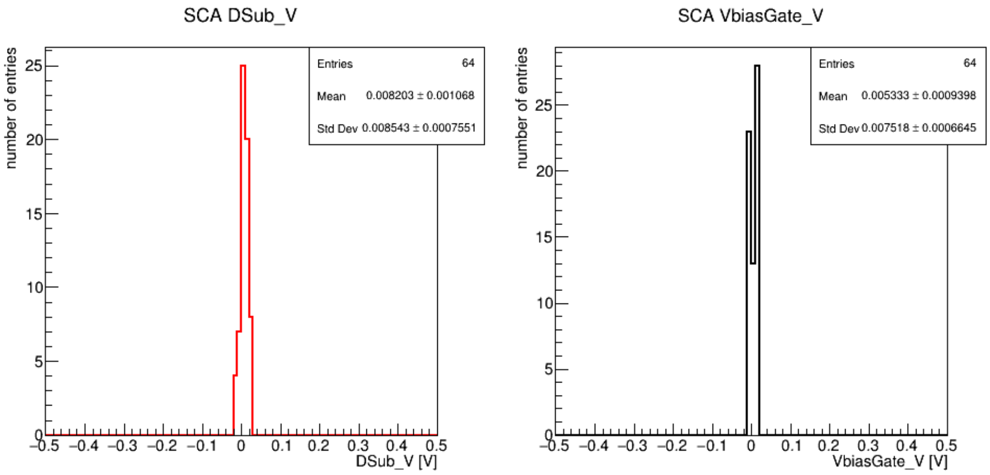

Figure 9, SCA biases under ZBC: Dsub (left) and VbiasGate (right) both compatible to zero.

Figures 10, 11, and 12 shows examples of nominal SCE's operational biases (internal):

$VRefMain_{ZBC}$ = 2.74 ± 0.02 [V],
$Vref1_{ZBC}$ = 1.813 ± 0.002 [V],
$Vref2_{ZBC}$ = 1.516 ± 0.004 [V]

all fully compatible with the values measured during nominal operations, data from NI-TV3 (RD-2):

$VRefMain_{nominal}$ = 2.73 ± 0.02 [V],
$Vref1_{nominal}$ = 1.813 ± 0.002 [V],
$Vref2_{nominal}$ = 1.517 ± 0.005 [V].

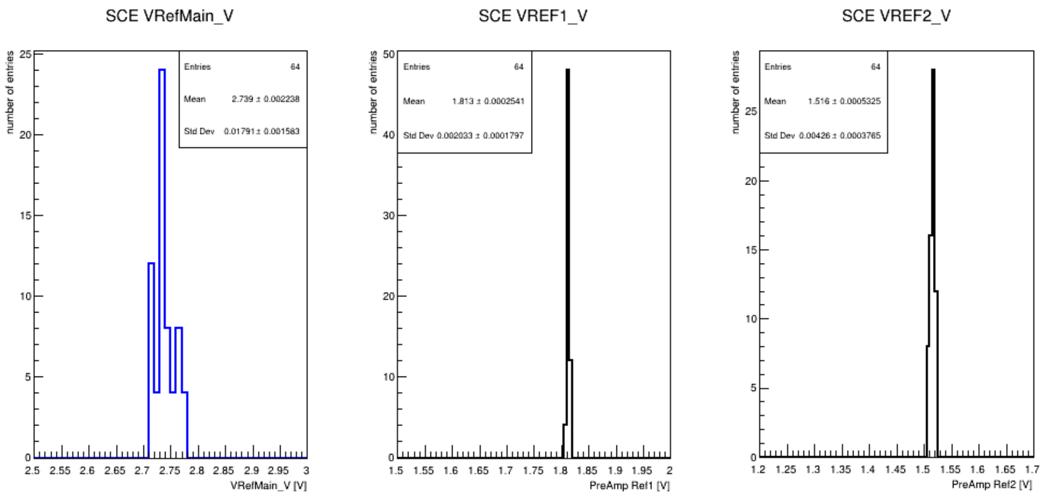

Figure 10, nominal SCE power supply voltages, VRefMain (left), VRef1 (center) and VRef2 (right), of the Focal Plane under ZBC

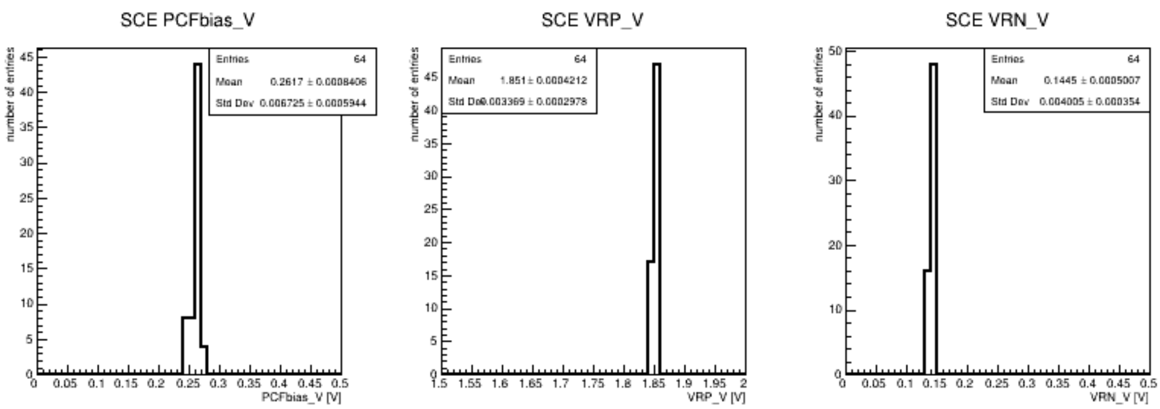

Figure 11, SCE nominal voltages: PCFbias (left), VRP (center), VRN (right) under ZBC.

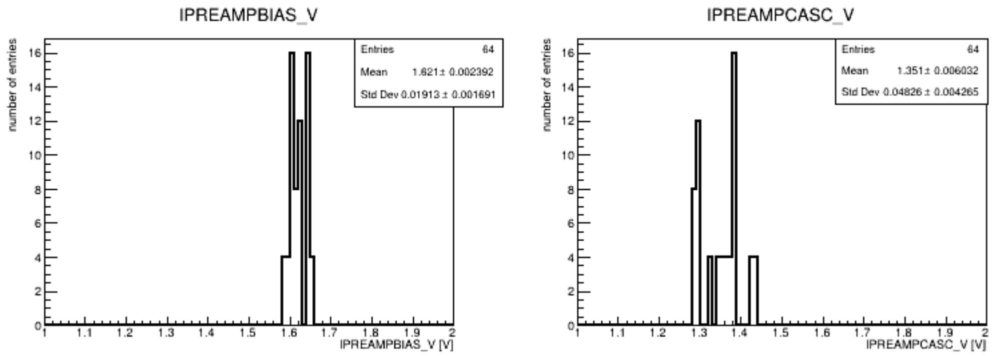

Figure 12, SCE preamplifier nominal voltages under ZBC.

6. Conclusions

There are relevant differences for the ZBC between the PLM and EMC grounding configurations, still to be identified. Leading to previous failures in the ZBC procedure using the NI-Focal Plane, but with the PLM configuration of Figure 13 both procedures (1) and (2) were correctly applied to the entire focal plane.

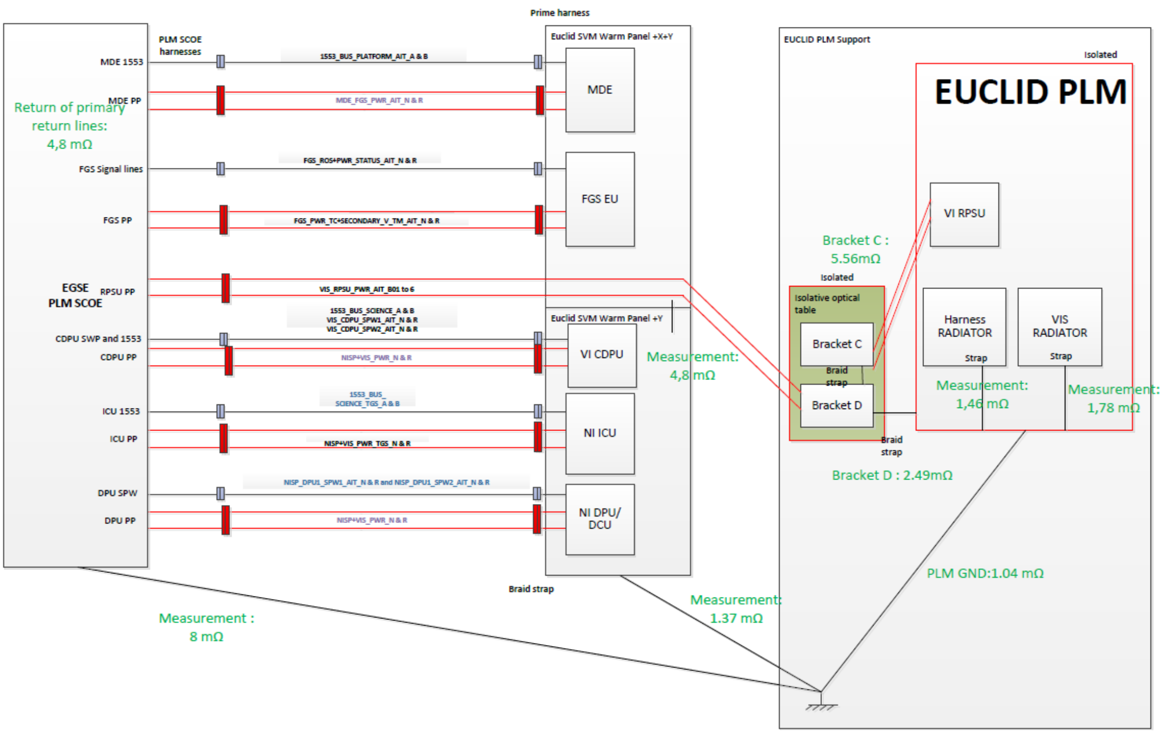

Figure 13, PLM grounding setup provided by ADS

Procedure (2) was chosen as the nominal ZBC procedure to be applied to the NI-Focal Plane during future tests using the detectors at room temperature; the PLM setup (including grounding configuration) was used during the test. The ZBC procedure was applied and tested successfully over the entire focal plane for 8 times, between each repetition the focal plane was powered off. In Figure 3 and 4 are represented the nominal signal and the chi2 distributions of all the detectors under ZBC, while in Figure 5 the very stable mean signal values of all detectors under ZBC are shown. The processing of all the images produced under ZBC was verified, Figures 6 and 7 shows examples of nominal processing parameters for a nominal Spectrometer acquisition.
The SCA biases set to null values were verified, see for example Figures 8 and 9; also, nominal operations of the SCEs were verified, for example see the distributions of Figures 10, 11, and 12.

The ZBC was applied to the complete NI-Focal Plane successfully with a confident number of repetitions. During the validation each register of the ZBC was tested by performing a memory dump. Then each time the ZBC was applied focal plane nominal operations was verified performing a nominal Dither cycle.

Timing forecast

- The elapsed time needed to configurate the complete NI-Focal Plane under ZBC is 32 minutes
- Starting from the nominal focal plane power cycle, the idle time of the SCEs working at room temperature while ZBC is applied is ~30 seconds/SCE (not cumulative).

Time budget

The comprehensive time of usage of the detectors at room temperature during the test evaluated for DCU1 of DPU1 (worst case) was ~28.5 minutes (mostly coming from the initial focal plane power up and first control exposure).

7. Anomaly reported during the tests

Low criticality errors

The following error arose during the tests 3 times the PRC_ECMPDATA generating PUS(5,2) events. This kind of errors working under the ZBC with the NI-Focal Plane at room temperature are false-positives, because it indicates that the data produced (electronic noise in the SCEs) have a higher entropy (highly uncorrelated) and the compression algorithm (NASA-CFITSIO) was not able to produce a compressed package with a smaller size with respect to the original size. In these cases, there is no data corruption nor data loss, but the error is rise because in nominal conditions these events should be monitored. This behaviour is documented in EUCL-IBO-NCR-7-028_CFITSIO Compression algorithm inefficiency, Issue 2.

The same errors could be triggered by errors PRC_ECMPX2 and PRC_ECMPTEL and the same considerations are applied. The complete list of the DPU-ASW errors can be accessed on-line at https://euclid.baltig-pages.infn.it/DPU-ASW/DPUASW_errorhandling.html#t05

Out of Limits (OOL) during the test session

Some "fake" database's OOLs (MIB 3.6) were triggered during the Focal Plane power up cycle; all correspond to non-significant telemetry (zeros or negative values) collected by the CCS before the DPU telemetry scanners were enabled for the SCEs, and DCUs. These values are DPU initialization telemetries all equal to zero which are transformed in engineering units resulting in non-physical values (negative) which are interpreted as an OOL. The complete list is the following:

NIST5907	1	2020.356.07.40.15.872223	H: NIST5907 eng -0.462440758 < low limit 243.15
NIST5914	1	2020.356.07.40.15.872223	H: NIST5914 eng -0.00082908 < low limit 0
NIST5779	1	2020.356.07.40.00.878067	H: NIST5779 eng -0.413703085 < low limit 243.15
NIST5786	1	2020.356.07.40.00.878067	H: NIST5786 eng -0.00322974 < low limit 0
NIST5651	1	2020.356.07.39.30.878250	H: NIST5651 eng -0.067149016 < low limit 243.15
NIST5658	1	2020.356.07.39.30.878250	H: NIST5658 eng -0.00457348 < low limit 0
NIST5523	1	2020.356.07.39.15.872223	H: NIST5523 eng -0.308777155 < low limit 243.15
NIST5530	1	2020.356.07.39.15.872223	H: NIST5530 eng -0.00427234 < low limit 0
NIST5395	1	2020.356.07.38.45.872223	H: NIST5395 eng 0.840668555 < low limit 243.15
NIST5402	1	2020.356.07.38.45.872223	H: NIST5402 eng -0.01340627 < low limit 0
NIST5267	1	2020.356.07.38.30.878250	H: NIST5267 eng 1.782853326 < low limit 243.15
NIST5274	1	2020.356.07.38.30.878250	H: NIST5274 eng -0.00192018 < low limit 0
NIST5139	1	2020.356.07.38.15.872223	H: NIST5139 eng -0.7327502 < low limit 243.15
NIST5146	1	2020.356.07.38.15.872223	H: NIST5146 eng -0.00108559 < low limit 0
NIST5011	1	2020.356.07.37.45.872223	H: NIST5011 eng -2.472575719 < low limit 243.15
NIST5018	1	2020.356.07.37.45.872223	H: NIST5018 eng -0.00287403 < low limit 0
NIST1683	1	2020.356.07.31.54.878250	H: NIST1683 eng 0.57991156 < low limit 243.15
NIST1690	1	2020.356.07.31.54.878250	H: NIST1690 eng -0.00030653 < low limit 0
NIST1555	1	2020.356.07.31.39.872421	H: NIST1555 eng -0.06849934 < low limit 243.15
NIST1562	1	2020.356.07.31.39.872421	H: NIST1562 eng -0.00662981 < low limit 0
NIST1427	1	2020.356.07.31.24.878250	H: NIST1427 eng -0.06849934 < low limit 243.15
NIST1299	1	2020.356.07.30.54.878265	H: NIST1299 eng -0.1913262 < low limit 243.15
NIST1171	1	2020.356.07.30.39.872421	H: NIST1171 eng 0.57991156 < low limit 243.15
NIST1178	1	2020.356.07.30.39.872421	H: NIST1178 eng -0.00347907 < low limit 0
NIST1043	1	2020.356.07.30.24.878265	H: NIST1043 eng -0.48658007 < low limit 243.15
NIST0915	1	2020.356.07.29.54.878265	H: NIST0915 eng -1.05349315 < low limit 243.15

Therefore, these OOL should not be considered during the DPU-ASW initialization phase.

In the Appendix (section 8) for completeness the validation of the ZBC performed with the NI-AVM setup in the so-called flight-like configuration is presented.

8. Appendix: ZBC Validation using NISP-AVM setup with a Flight-like configuration

8.1 Preliminary setup

At TASI premises using the NISP AVM setup using only the DPU-EQM and 3 DCUs (DCU1, DCU2, and DCU3) equipped with one type-A SCE (DCU1) and two type-B SCEs (DCU2 and DCU3) interfaced with two MUXs through flight-like Zin flex cables; to connect the DCUs with the SCEs flight like harnesses (used during the NI-TV3 tests), Figure 1.

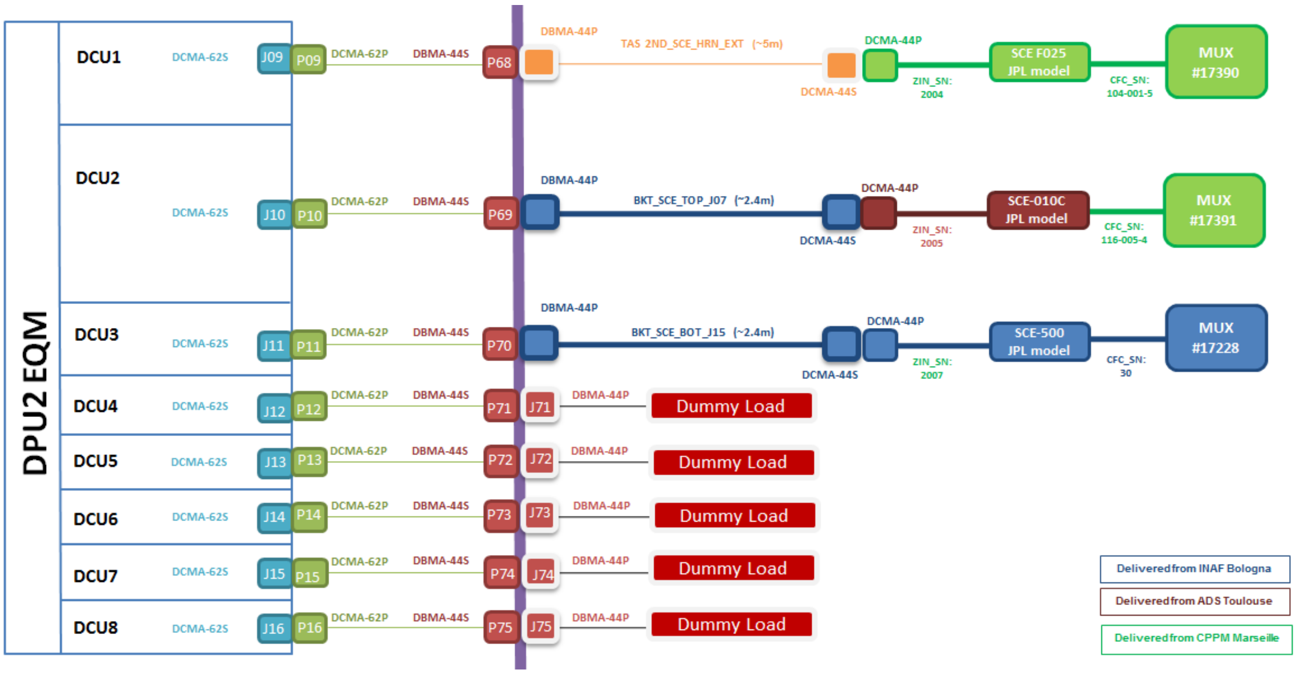

Figure 14, NI-AVM setup in a flight-like configuration (using 2 type-B and 1 type–A SCEs and MUXs (scheme provided by TASI).

In Figure 2 a photo of the test setup is shown where all SCEs and MUX are isolated with respect to ground (baseplate).

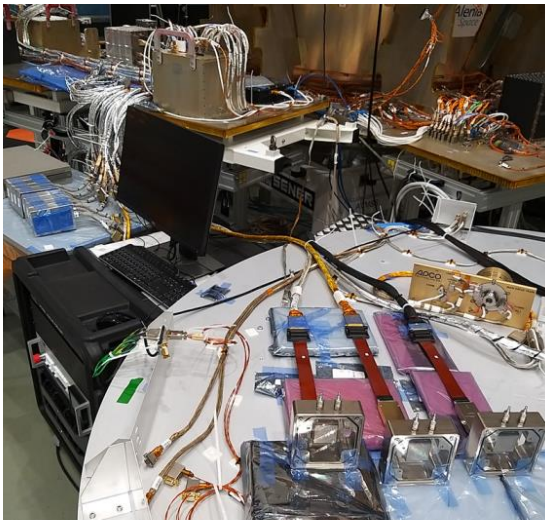

Figure 15 NI-AVM setup in a flight-like configuration (photograph provided by TASI).

In the ZBC used, the VDD_V and VDD_I are patched after VDDA_V, VDAA_I (see section 7 for register order definition).
Test sequences are referred to the Test Procedures prepared for this campaign.

Test sequence (0):
the nominal ZBC was applied serialized to the 3 SCEs correctly (the SW threshold was set to VDD3P3_I th = 20 mA)
SCE readout mode was set to 0x0082 (non ZBC nominal) by mistake, without enabling:
Temp Ref Bias 0
Temp Averaging 0
Nevertheless, this set up disable only the SCA Temperature sampling non changing the main ZBC nominal SCE readout mode

ZBC registers were verified performing a MEM DUMP and a nominal broadcast photometric MACC(4,16,4) acquisition was correctly done. Then, all the DCUs were powered off.
The complete sequence (besides the MEM CHECK) was performed for 5 times.
The sequence was correctly repeated using the nominal SCE readout mode 0x1882 with
Temp Ref Bias 1
Temp Averaging 1

New Test Sequence:
The OLD ZBC was applied serially to the 3 SCEs (the SW threshold was set to VDD3P3_I th = 20 mA), triggering an error with an over-current of the VDD3P3 (OC_3VD_PWR_CURR) with a peak value of ~35 mA in SCE1 type-A:
DCU_Fault1 = 0x400 = over-current VDD3P3_I

DCU_Fault2 = 0x03b =~ 35 mA
With the DCU1 behaving nominally:
DCU1 error register (NIST0905) = 0x00020100
DCU1 status register (NIST0898) = 0x0002

The sequence was stopped and not applied to the other SCEs after the failure.

NOTE 1: Exactly the same procedure was working correctly at the validation tests of the OLD ZBC at TASI in July, but the grounding setup was different.
Setup of the SCE Teledyne (SN-033) used to validate ZBC in July is shown in Figure 3 (GND connect on SCE case using screw on the SCE bottom)

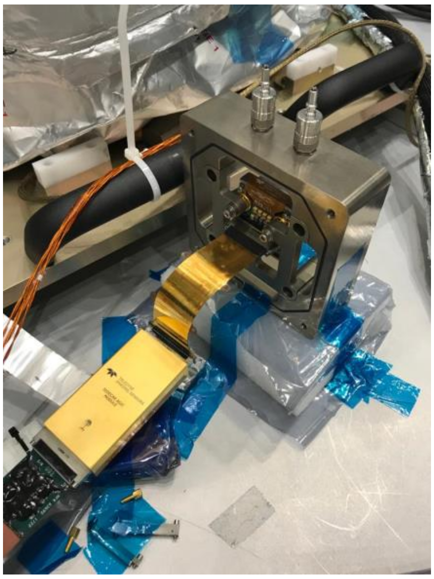

Figure 16- SCE SN033 setup for ZBC validation (photograph provided by TASI).

It is observed during the test in TASI that the OLD ZBC is triggering the event "over-current VDD3P3_I" on both SCE Type-A (SCE-F025) and SCE Type-B (SCE-010C and SCE-500).

8.2 AVM flight-like setup

Due to fact that SCE F025 was found to be not a flight like SCE it was removed from the test setup. "SCE F025 was called flight like because it was the last design before discovery of LGA problem", Jean-Claude Clemens - CPPM.
<u>Only two type-B SCEs</u> were mounted on DCU1 and DCU2, see Figure 4.

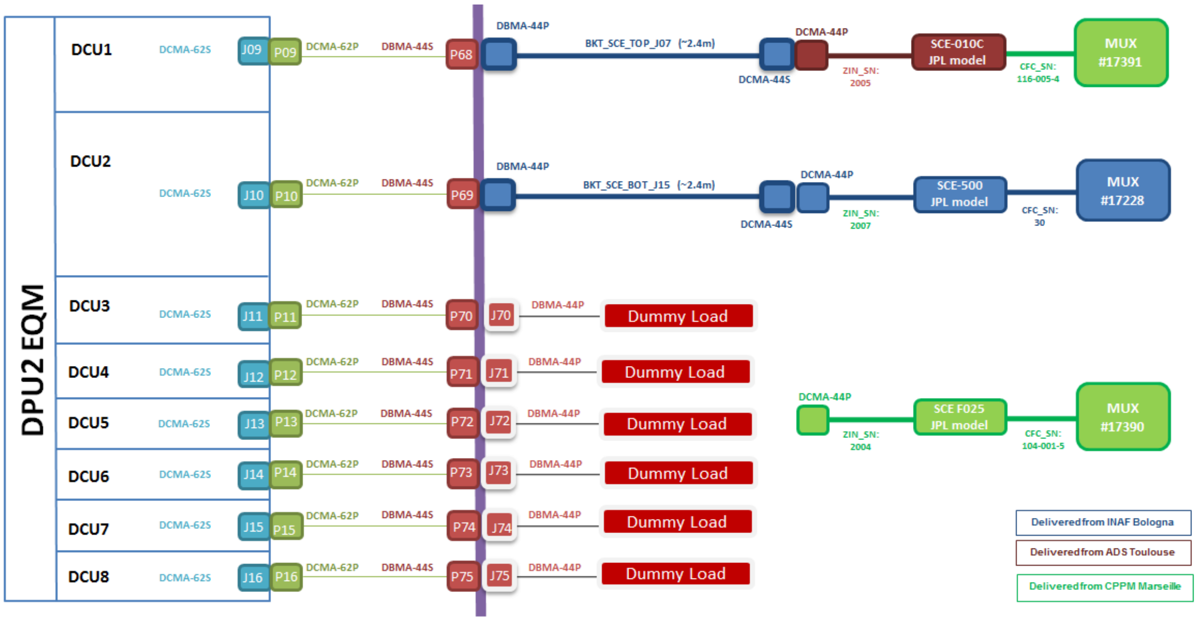

Figure 17, NI-AVM Flight-like setup using 2 type-B SCEs (scheme provided by TASI)

Test sequence (0) - error trigger:
Test done without any additional grounding connection (all SCEs-MUXs without external grounding connection).

Applied ZBC serialized to 2 SCEs correctly; check performed using MEM DUMP of ZBC registers; executed a broadcast photometric exposure MACC(4,16,4).
Repeated the last sequence 3 times successfully.

New Test Sequence:
NOTE 2: The OLD ZBC (with the VDDA and VDD voltages and currents at the middle of the registers order) was used to trigger the over-current. This procedure is not the nominal ZBC (that resets the VDDA and VDD at the end) but triggers a similar error condition observed at ADS (VDD3P3_I over-current), therefore was applied in order to study the effect of the thresholds applied to the SCE's power lines.

- The OLD ZBC was applied serially to the 2 SCEs: causing an FDIR during the ZBC in both DCUs triggering the over-current of the V3P3_I. (The SW threshold was set to VDD3P3_I th = 20 mA)

DCU1:
Fault1 = 0x0400 = over-current VDD3P3_I
Fault2 = 0x0412 =~38 mA
DCU2:
Fault1 = 0x0400 = over-current VDD3P3_I

Fault2 = 0x040B =~38 mA

- Changed of VDD3P3_I threshold to ~40 mA and applied the OLD ZBC to both DCUs, triggering the over-current.

The threshold was modified using: DCU_THSET(DCU_ID, 1, 0x0444, 0x0143)

DCU1:
Fault1 = 0x0400 = over-current VDD3P3_I
Fault2 = 0x0AD1 =~ 100 mA
DCU2:
Fault1 = 0x0400 = over-current VDD3P3_I
Fault2 = 0x0AC7 =~ 100 mA

A higher peak value of the over-current was measured.

NOTE 3: The DPU HW provided OHB-I state that the peak registered by the DCU is not implying any risk for the DCU HW, and even allow to increase the threshold to 60-80 mA in order to continue the investigation. Nevertheless, we stop the test because there was not the intention to measure the peak value higher than the limit imposed by the DCU internal regulator providing the VDD3P3 voltage set at 100 mA.

8.3 Tests using new grounding configurations of the AVM flight-like setup

The NISP nominal grounding scheme is shown in Figure 5 was reproduced at TASI; with one at the time modification to improvement of the grounding setup verifying the correctness/stability of the setup.

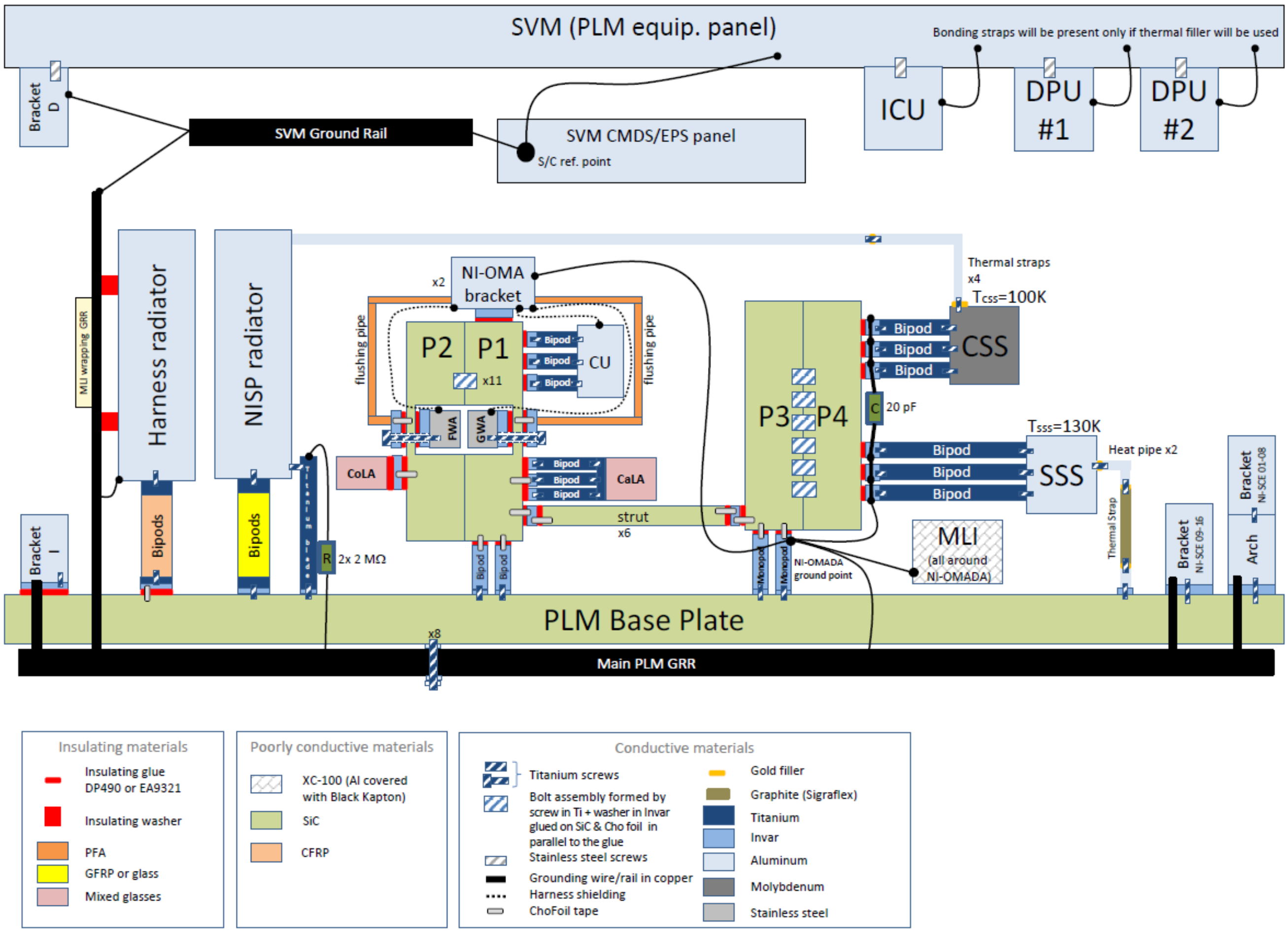

Figure 18, grounding configuration of the NI-Flight set up.

8.3.1 AVM improved grounding configuration 1

The AVM flight-like setup of section 2 was modified adding an external connection between to the SCE's cages referred to the NISP ground, see Figure 4.
(SW threshold reset to nominal, i.e. VDD3P3_I th = 20 mA)

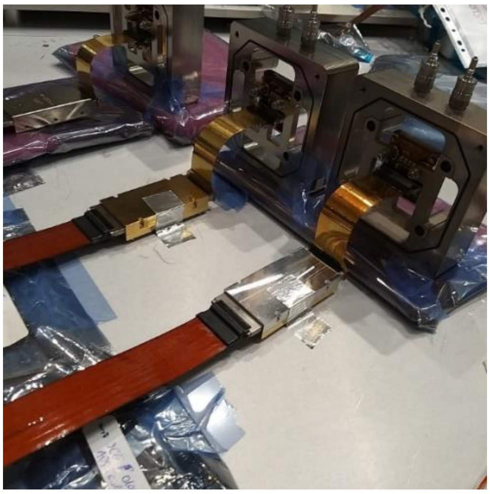

Figure 19, same setup as configuration represented in Figure 2 with a new grounding configuration connecting the SCEs (only two used) chassis to the same NISP ground reference (base plate). (Photograph provided by TASI).

- Applied the OLD ZBC: the error was triggered (over-current of V3P3_I)

Telemetry analysis:
DCU1:
Fault1 (NIST0907) = 0x0400 = over-current VDD3P3_I
Fault2 (NIST0923) = 0x03F8 =~ 37 mA
DCU2:
Fault1 (NIST0907) = 0x0400 = over-current VDD3P3_I
Fault2 (NIST0923) = 0x0400 =~ 38 mA

- Applied the nominal ZBC (HW threshold reset to nominal VDD3P3_I th = 20 mA)

Procedure correctly applied to both DCUs verified with a photometric MACC(4,16,4) correctly executed

NOTE 4: As in the case of the 3 SCEs case (test sequence (0) in section 1) the error was not triggered when the nominal ZBC is applied serially to 2 type-B SCEs.

8.3.2 AVM improved grounding configuration 2

The previous setup was enhanced connecting a capacitor of 27 pF (20pF used on NIOMADA FM) to the cooper braid connection between the SCEs and the MUXs, see Figure 5.

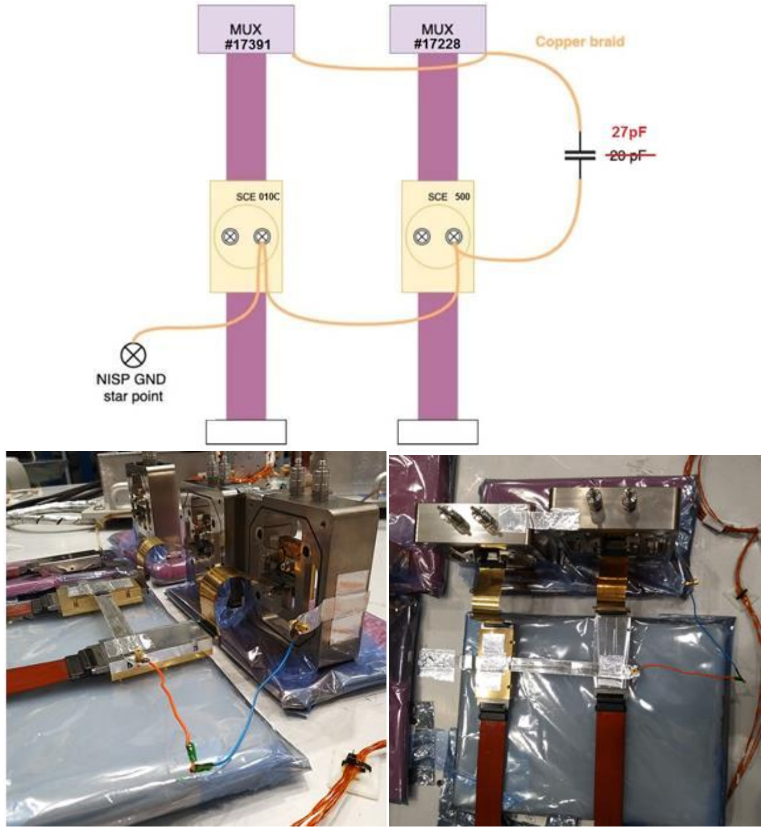

Figure 20, enhanced grounding setup fully representative of the NI nominal one (implemented at ADS); using a C = 27 pF instead of 20. The setup is the same one as Figure 2.
(Photographs provided by TASI)

- Serial ZBC procedure:

applied correctly to two SCEs (of type-B) ; ZBC registers were cross-checked with a MEM DUMP.
Also was executed a broadcast MACC(4,16,4) successfully
The complete procedure was repeated twice swapping the DCU order correctly, then total 3.

- Test procedure (11): in this test case the default VDDA and VDD (both voltages and currents) values loaded during the SCE bootstrap were modified:

VDDA_V = 0x87f0
VDDA_I = 0x5e00
VDD_V = 0x87f0
VDD_I = 0x5e00

before applying the ZBC. The default SW threshold VDD3P3_I th = 20 mA was used.

The error condition was triggered also in this case.
Telemetry analysis

DCU1:
Fault1 (NIST0907) = 0x0400 = over-current VDD3P3_I
Fault2 (NIST0923) = 0x0694 =~ 62 mA
DCU2:
Fault1 (NIST0907) = 0x0400 = over-current VDD3P3_I
Fault2 (NIST0923) = 0x0689 =~ 62 mA

8.3.3 AVM improved grounding configuration 3

The previous setup (Figure 4) was enhanced with a connector referring the grounding to the NISP one as sketch in figure 6 with a green line.

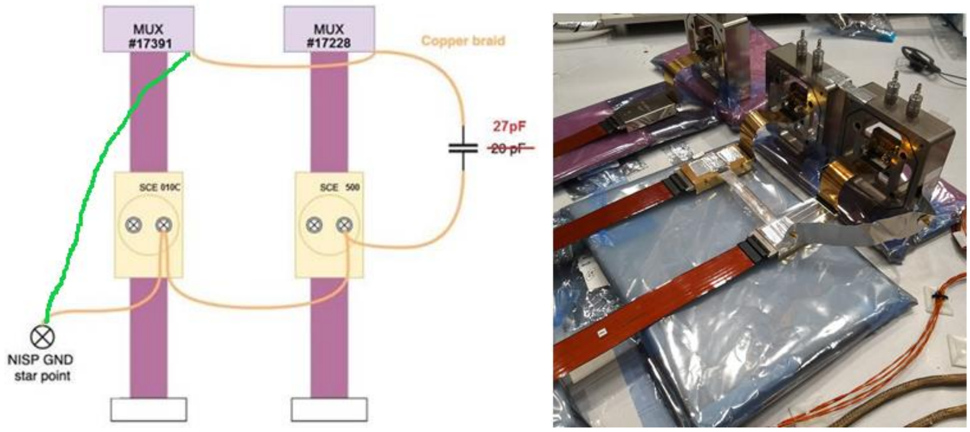

Figure 21, final grounding configuration of the AVM flight-like setup (photograph provided by TASI).

- Applied the nominal ZBC (HW threshold reset to nominal VDD3P3_I th = 20 mA)

Procedure correctly applied to both DCUs verified with a photometric MACC(4,16,4) correctly executed

8.4 Conclusions

- The ZBC was always correctly applied at TASI. The same procedure (scripts) used at ADS was repeated successfully with 2 type-B SCEs (see section 2) and 3 SCEs (including one type-A SCE, see section 1).

- Different grounding configurations were tested using 2 type-B SCEs (see section 3); in all the cases the nominal ZBC was correctly applied.

- The OLD ZBC (old order of the VDDA and VDD voltage and currents – reset in between the other ZBC registers) was used as trigger of the error condition during the ZBC, see NOTE 2. This condition was observed at ADS when the nominal ZBC was applied serially, i.e. over-current of the VDD3P3_I. With this trigger the effect of changing the thresholds was studied verifying that the over-current peak has a higher amplitude (see section 2).
Also changing the default values of the VDDA and VDD voltage and currents before the ZBC triggers the VDD3P3_I over-current with a peak value higher (62 mA) than the value measured when the OLD ZBC is applied (~37 mA) ; for this test the default DPU threshold of 20 mA was used, see section 3.

8.5 Differences with respect to ADS setup

Assuming that the grounding setup at ADS is the NISP nominal represented in Figure 5 the main differences are:

- The 2 x 2 MΩ resistance of the connection between the NI-radiator and the main PLM GRR was missing.
- 27pF capacitor used instead of 20pF.
- One component of the NI-harness was missing (TGS ~1.3m long); the setup was composed by connectors BKT_SCE_XXX (blue), and the harness part integrated on panel +Y (green), colours are referred to Figure 4.
- NISP_SCE_AIT_B0X cables are missing on the AVM test setup (~3m long). Extensions used only for ADS AIT activities; these extensions are used for E-PLM TVAC but not in flight.
- No NISP radiator on AVM bench.

8.6 ZBC register order and values

Inside the document there are different reference to OLD ZBC register order and new register order. Below the difference between registers order patched during ZBC loading (performed serially 7 register per TC):

register number	OLD ZBC register order	ZBC register order (nominal)
1	…	…
…	…	…
13	VDDA_V	…
14	VDDA_I	…
15	VDD_V	…
16	VDD_I	…
…	…	…
32	…	VDDA_V
33	…	VDDA_I
34	…	VDD_V
35	…	VDD_I

Table 1, ZBC register order. Rightmost column nominal ZBC register order (previously called NEW), while the column at the center shows the OLD register order

OLD ZBC register order defined inside library ::L3nisp_plm::get_zero_conf_register_lists
NEW ZBC register order defined inside library ::L3nisp_plm::get_zero_conf_register_lists_3

For overall register order refer to
"EUCL-IBO-TN-7-017_ResetOfSCAbias_NISPProcedure_Issue1.1"(ITAR protected)

8.7 ZBC test in ADS using SCE-010C

An investigation test campaign was performed in ADS on the 15th of October.
The test setup used SCE-010C installed on bench and using all harness as connected to NIOMADA FM. DPU1 FM units was used and no MUX installed on SCE connected to DCU1.

Test setup below in Figure 9:

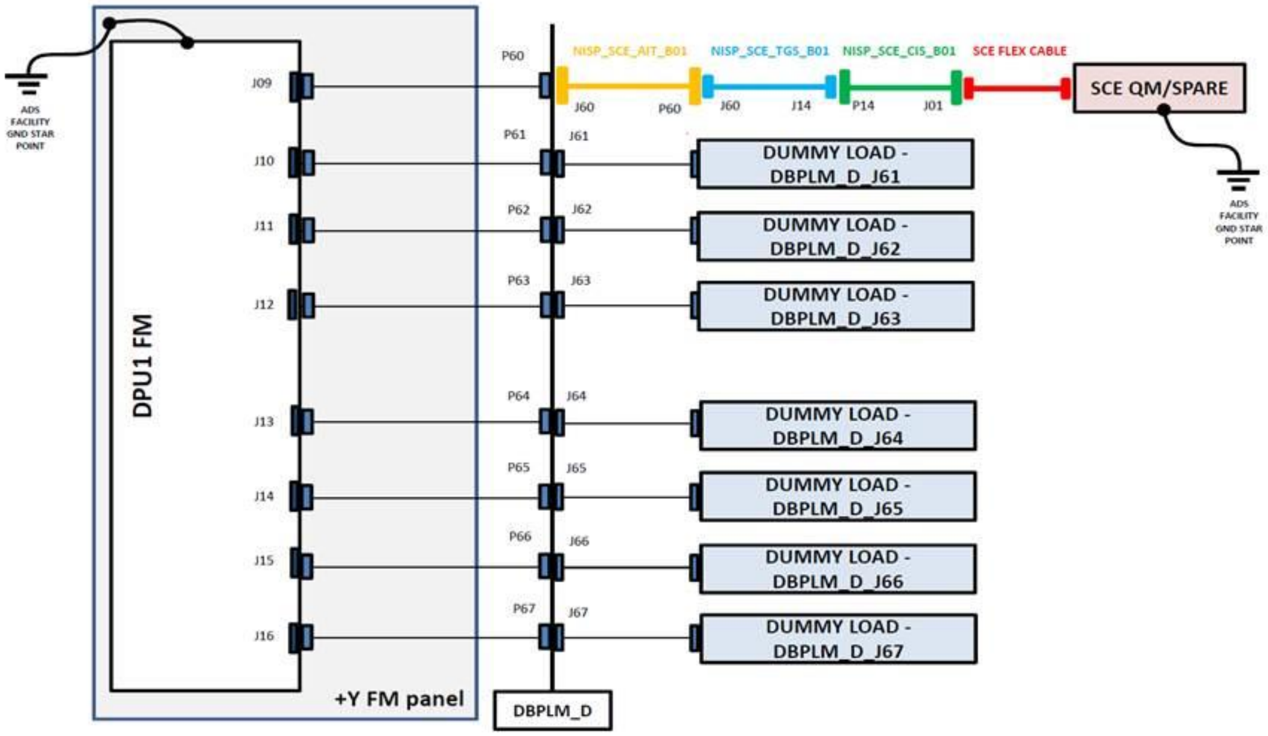

Figure 22 - Test in ADS using all harness and SCE-010C unloaded (scheme provided by TASI).

Different tests were performed using this setup:

- using OLD ZBC register order
- using NEW ZBC register order
- different timeouts between consecutive NISC0405 TCs (up to 60 sec)
- 1 register per NISC0405 TC sent to DPU
- 7 registers per NISC0405 TC sent to DPU

All the above test where successful and no issue observed. Dump of ZBC confirmed correct loading.