BC-SIM-TR-028
SIMBIO-SYS ICO#03 Interchannel Test Report

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Approvation

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Document change record

Issue	Revision	Date	Affected Pages	Change description
1	0	07/11/2022	All	First issue

1 Introduction

1.1 Scope

This document contains the results and the discussion on the interchannel test performed during the Instrument Check Out Phase (ICO#3) of the Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem (SIMBIO-SYS) described in [RD.1].

1.2 Reference Documents

[RD.1] BC-SIM-PL-005_-_SIMBIO-SYS_Checkout_03_Test_Summary, 10.20371/INAF/TechRep/172

[RD.2] BC-SIM-TN-003_-_Reports_and_Note_Layout_and_Flow, 10.20371/INAF/TechRep/36

[RD.3] BC-ALS-TN-00099 MPO PFM Monitoring Thermistors Location

[RD.4] BC-SIM-TR-025_-_HRIC_ICO#03_report, 10.20371/INAF/TechRep/190

[RD.5] BC-SIM-TR-026_-_STC_ICO#03_report, 10.20371/INAF/TechRep/186

[RD.6] BC-SIM-TR-027_-_VIHI_ICO#03_report

[RD.7] SIMBIO-SYS Instrument CheckOut #02 Test Report, 10.20371/INAF/TechRep/146

[RD.8] BC-SIM-TR-018_-_HRIC_ICO#02_report, 10.20371/INAF/TechRep/134

[RD.9] REPORT EGSE BC-SIM-TR-024_-_EGSE_ICO#03_report, 10.20371/INAF/TechRep/185

[RD.10] STC ICO2 REPORT BC-SIM-TR-019_-_STC_ICO#02_report, 10.20371/INAF/TechRep/138

1.3 Acronyms

ACK	Acknowledgment
ADC	Analogical Digit Converter
APID	Application Process IDentifier
ASW	Application SoftWare
CF	Cold Finger
CM	Color Mode

CSV	Comma Separated Values
DC	Dark Current
DN	Digital NUmber
DSNU	Dark Signal Not Uniformity
EGSE	Electrocal Ground Support Equipment
FOP	Flight Operation Procedure
FPA	Focal Plane Assembly
HK	HouseKepping
HRIC	High spatial Resolution Imaging Channel
ICO	Instrument CheckOut
IT	Integration Time
ME	Main Electronics
NECP	Near Earth Commissioning Phase
OBCP	On-Board Control Procedure
OB	Optical Bench
OBSW	On Board Software
ODS	Offset Dark Subtracion
PDOR	Payload Direct Operation Request
PDS	Planetary Data System
PE	Proximity Electronics
PNG	Portable Network Graphics
PSC	Packet Sequence Control
RT	Repetition Time
SIMBIO-SYS	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem
SSC	Source Sequence Count
SSMM	Solid State Mass Memory
STC	STereo imaging Channel
S/C	SpaceCraft
TC	TeleCommand
TEC	Thermo-Electric Cooler
TM	Telemetry
VIHI	VIsible and Hyper-spectral Imaging channel
XML	eXtensible Markup Language

1.4 Document Format and Repository

This document is compliant with the SIMBIO-SYS Report and Note Layout and Flow [RD.2] and will be archived both on the INAF Open Access repository and the SIMBIO-SYS team Archive.

1.5 Document Organization

This document is organized in sections whose topics are listed as follows:

- Section 2 – SIMBIO-SYS thermal environment description, with a brief description of the aboard units and sensors used to control the operative temperature of the instrument during the test
- Section 3 – Interchannel tests, with a brief description of the executed tests and a report on obtained HKs and data

2 SIMBIO-SYS thermal environment description

The SIMBIO-SYS thermal environment is controlled by means of the Space- Craft (S/C) dedicated Cold Fingers (CFs) and several thermal sensors which are described in the following subsections.

2.1SIMBIO-SYS CF sensors

In the following table the list of CF temperature sensors for the three channels is reported. To note that all sensors are fixed on the S/C CF.

Channel	Sensor name	ESA ID	THALES ID
HRIC	MPO-TEMP-SIMBIO-HRIC-CF	NRUD2079	THT-B6T133
STC	MPO-TEMP-SIMBIO-STC-CF	NRUD2087	THT-B6T136
VIHI	MPO-TEMP-SIMBIO-VIHI-CF	NRUD2091	THT-B6T137

Table 1: CF sensors of the SIMBIO-SYS channels together with their reference to ESA and Theles Alenia nomenclature (see [RD.3] for details)

For more details on their positions see [RD.3].

2.2SIMBIO-SYS CF thermal sensors

For the monitoring of its thermal behaviour, the SIMBIO-SYS instrument is equipped by the following sensors:

- **HRIC**

PACKET ID: YSS40001		
Param ID	**Param Name**	**Unit**
NSS11040	Temperature FPA1	K
NSS11041	Temperature FPA2	K
NSS11042	Temperature PE	K
NSS11043	Temp TIRD filter	K
NSS11044	Temp FPA package	K

Table 2: Main HRIC temperature sensors

See [RD.4] for more details on their definition and position.

- **STC**

PACKET ID: YSS40002		
Param ID	**Param Name**	**Unit**
NSS21040	Temperature FPA1	K
NSS21041	Temperature FPA2	K
NSS21042	Temperature PE	K
NSS21043	Temp channel fw	K
NSS21044	Temp channel bw	K

Table 3: Main STC temperature sensors.

See [RD.5] for more details on their definition and position.

- **VIHI**

PACKET ID: YSS40003		
Param ID	**Param Name**	**Unit**
NSS31040	Temperature FPA1	K
NSS31041	Temperature FPA2	K
NSS31042	Temperature PE	K
NSS31062	Temp Spectrometer	K
NSS31063	Temp Calibration unit	K

Table 4: Main VIHI temperature sensors.

See [RD.6] for more details on their definition and position.

3 SIMBIO-SYS Interchannel Tests

3.1 Test description

The aim of the test is the monitoring of the detector low frequency behaviour (see Open Issue #1 in [RD.7]) for both HRIC and STC cameras and the possible mutual interference while operating parallel. Previous analysis showed a carrier wave with an amplitude of 6 Digital Number (DN) and a period of 3 minutes on the mean signal of the STC and HRIC acquisitions.
This phenomenon, measured for STC during the Orbit test and for HRIC during the Functional Test in ICO#02 ([RD.8]) was not clear if it was in phase or not with the HRIC one indicating, in the former case, an internal common source (i.e., SIMBIO-SYS power supply) of the disturbance or, in the latter case, an external one (i.e., S/C) [RD.1].
For this reason this test foreseen a STC acquisition with fixed Integration Time (IT) and Repetition Time (RT) and an acquisition (with same RT) of HRIC. The two acquisitions were overlapped for 5 minutes.

Commanding

This test has been performed through the execution of a pre-defined POR named "STC_-_HRIC_Interference_Test" (see attachment of [RD.1] for details).

Timing	ID FOPs	Name FOP	RT [s]
00:00:00	ASSF008A	OBCP STC ON	
00:05:00	ASSF005A	OBCP HRIC ON	
00:15:00	ASSF307A	STC SciSurfNomnl GM v02	2
00:05:00	ASSF101A	HRICSciShortIntFPAN v03	2
00:10:00	ASSF368A	STOP STC	
00:00:05	ASSF110A	STOP HRIC	
00:00:05	ASSF007A	OBCP STC OFF	
00:05:00	ASSF004A	OBCP HRIC OFF	

Table 5: Timeline of the HRIC INTERFERENCE with the references to the commanded. All TCs were commanded 2 consecutive acquisitions. IT was always commanded to 104 (raw). RTs are reported in seconds. Table reports the FCP commanded, for more details see [RD.1].

The resulting database derived by means of the Electric Ground Segment Equipment (EGSE) telemetry-to-raw pipeline is reported in Table 6, Table 7 and Table 8 (see [RD.9] for details).

EGSE_TC#	1st acq (UTC)	Duration (s)	# acq
1	2020-06-24T23:51:30.087583	900	450

Table 6: Resulting database of the Interchannel test for the HRIC channel.

EGSE_TC#	1st acq (UTC)	Duration (s)	# acq
1	2020-06-24T23:46:30.086975	900	450

Table 7: Resulting database of the Interchannel test for the STC channel. All the acquisitions have been performed with RT=2s.

3.2Test outcome

The test has benn executed nominally with no errors and all commanded data received correctly.
Details on TEC activation and curves together with sensors temperature profiles for both channels can be found in [RD.4] and [RD.5].

3.3Test discussion

For the STC channel, a first reduction of the dataset is shown in Figure 1. The image show, for each acquisition, the mean value of the acquired windows. Right y-axis (yellow) reports the time delay between each acquisition and the previous one.

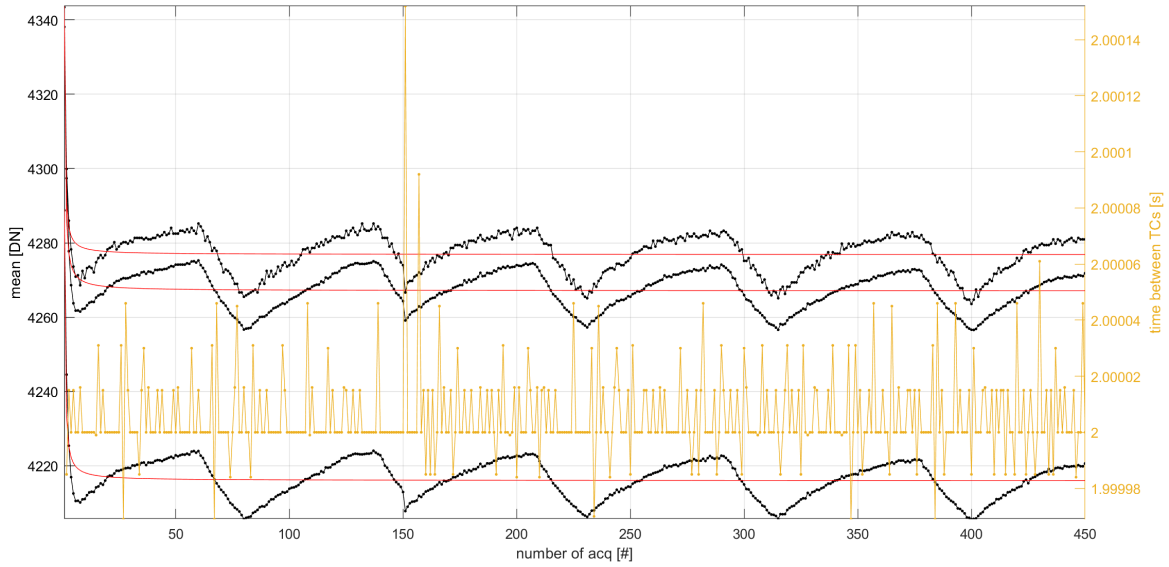

Figure 1: The figure reports the reduction in mean of the images of the test. Red lines represent the exponential curves which model by nonlinear fit each set of acquisition. Right y-axis (yellow) report the distance between each acquisition and the previous one.

It can be seen that the fluctuation of STC detector signal is still with a period around 3 minutes but its amplitude is a little increased (9 DN). The wave has a typical electronical shape.

Thermal investigation are not in planning because of the 0.1° resolution of TFPA1 TFPA2 (see [RD.5]) which should not allow to appreciate DC variation greater than 1% (STC -FPA increases its DC of the 10% every degree).

Finally, this issue will have no impact on the channel radiometric capabilities because of the Offset Dark Subtracion (ODS) approach reported in [RD.10] (Section 4.4).

In case of HRIC, the frames average shows that the detector fluctuation presents the same peak to peak value but with a significant (i.e., about double) increment in the oscillation period (Figure 2) with respect to the behaviour observed during the Functional Test or previous ICO#02 (see [RD.8]).

This difference seems to be linked to the repetiton time, in fact, the activation and deactivation of the STC channel seems to be non relevant for the behavior of HRIC channel.

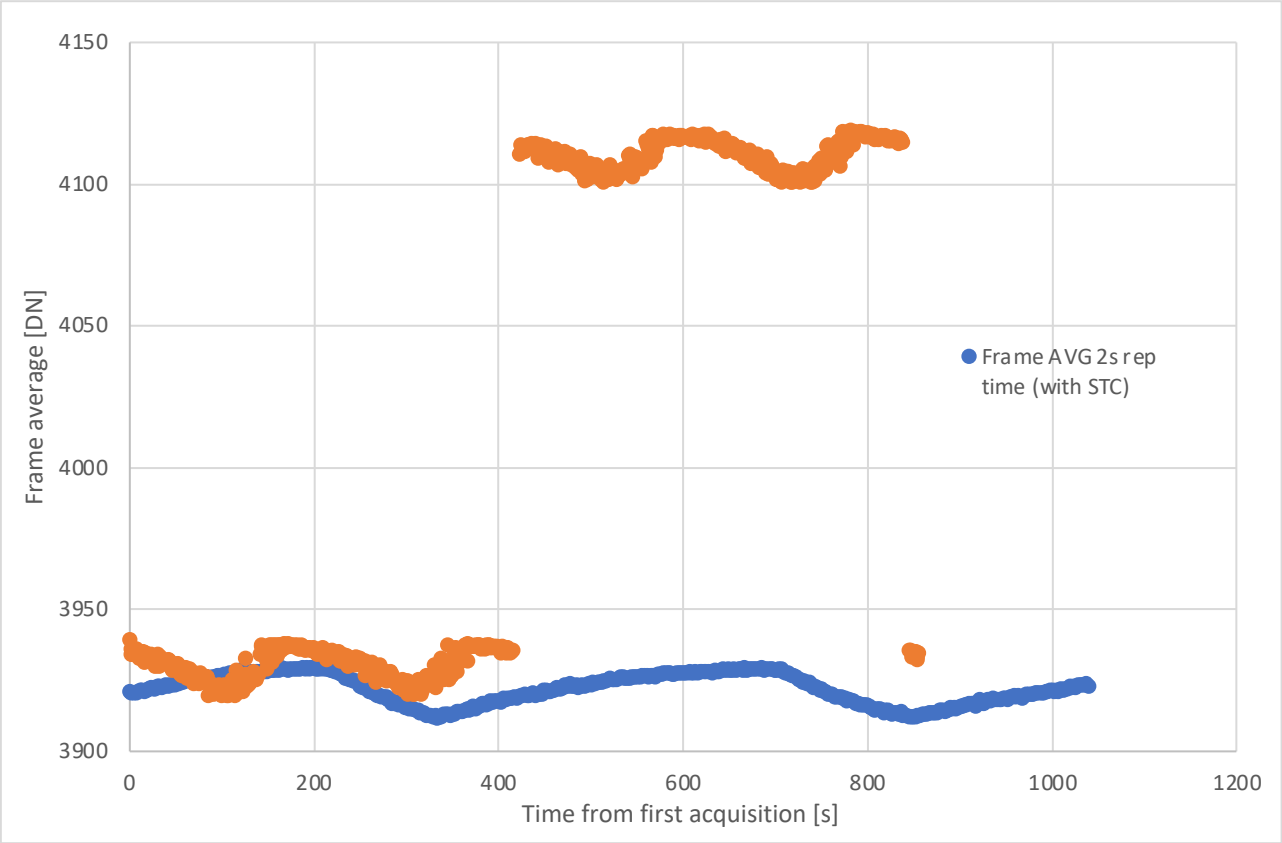

Figure 2: Comparison between functional test acquisitions (orange line) and the interchannel test ones (blue line).

Finally, to note that Detector fluctuations of the two channel seems to be not correlated (Figure 3).

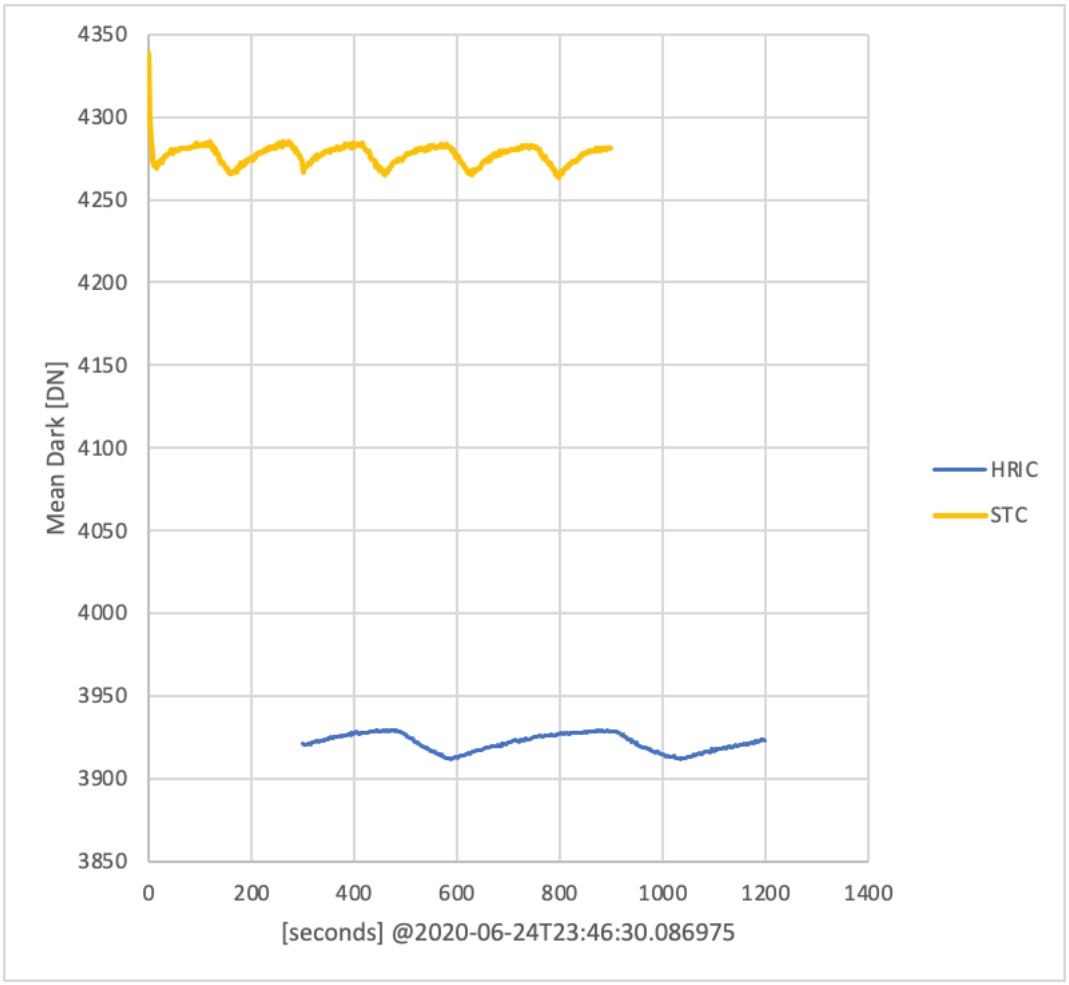

Figure 3: Time comparison between the detectors fluctuation of the cameras. The two efffects are not in phase.

Anyhow, the results of the test are not conclusive and additional tests shall be performed in future ICOs.