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# BC-SIM-TR-021

## SIMBIO-SYS Instrument

### CheckOut #02 Test Report

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	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	1 of 16		

## Index

Approval	3
Document change record	3
1. Introduction	4
1.1. Scope	4
1.2. Reference document	4
1.3. Acronyms	5
1.4. Document format and repository	6
1.5. Document organization	6
2. ICO#02 Objective	7
3. Test Implementation	8
3.1. SIMBIO-SYS Functional Tests	9
3.1.1. HRIC Functional Test	9
3.1.1.1. Scope	9
3.1.1.2. Results and discussion	9
3.1.2. STC Functional Test	10
3.1.2.1. Scope	10
3.1.2.2. Results and discussion	10
3.2. SIMBIO-SYS Performance Tests	11
3.2.1. HRIC Performance Test	11
3.2.1.1. Scope	11
3.2.1.2. Results and discussion	11
3.2.2. STC Performance Test	12
3.2.2.1. Scope	12
3.2.2.2. Results and discussion	12
3.2.3. STC All-FPA Test	13
3.2.3.1. Scope	13
3.2.3.2. Results and discussion	13

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	2 of 16		

3.2.4.	VIHI Internal Calibration	14
3.2.4.1.	Scope	14
3.2.4.2.	Results and discussion	14
4.	Conclusions	15
4.1.	Summary	15
4.2.	Open issues	15


	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	3 of 16		

## Approvation

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	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	4 of 16		


## 1. Introduction

### 1.1. Scope

This document will briefly report the results of the tests performed during the Instrument Checkout (ICO) # 02 for the Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYSTEM (SIMBIO-SYS) whose details are reported in [RD.1].


### 1.2. Reference document

- [RD.1]** BC-SIM-PL-004\_-\_SIMBIO-SYS\_Checkout\_02\_Test\_Summary\_Issue1\_Revision0,  
[10.20371/INAF/TechRep/100](https://doi.org/10.20371/INAF/TechRep/100)
- [RD.2]** BC-SIM-TN-003\_-\_Reports\_and\_Note\_Layout\_and\_Flow,  
[10.20371/INAF/TechRep/36](https://doi.org/10.20371/INAF/TechRep/36)
- [RD.3]** BC-SIM-TR-018\_-\_HRIC ICO2 Report,  
[10.20371/INAF/TechRep/100](https://doi.org/10.20371/INAF/TechRep/100)
- [RD.4]** BC-SIM-TR-019\_-\_STC\_ICO#02\_report,  
[10.20371/INAF/TechRep/138](https://doi.org/10.20371/INAF/TechRep/138)
- [RD.5]** BC-SIM-TR-020\_-\_VIHI\_ICO#02\_report
- [RD.6]** BC-SIM-TN-004\_-\_SIMBIO-SYS\_FOP\_update\_after\_NECP,  
[10.20371/INAF/TechRep/58](https://doi.org/10.20371/INAF/TechRep/58)
- [RD.7]** BC-SIM-GAF-MA-002 10 001 – SIMBIO-SYS User Manual
- [RD.8]** BC-SIM-TR-005\_-\_SIMBIO-SYS\_NECP\_Test\_Report\_Issue1\_Revision0,  
[10.20371/INAF/TechRep/42](https://doi.org/10.20371/INAF/TechRep/42)
- [RD.9]** BC-SIM-TR-015\_-\_SIMBIO-SYS\_ICO#01\_Test\_Report\_Issue1\_Revision0,  
[10.20371/INAF/TechRep/98](https://doi.org/10.20371/INAF/TechRep/98)

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	5 of 16		

### 1.3. Acronyms

<b>APID</b>	Application Process Identifier
<b>ASW</b>	Application SoftWare
<b>CSV</b>	Comma Separated Values
<b>FPA</b>	Focal Plane Assembly
<b>FOP</b>	Flight Operation Procedure
<b>HK</b>	Housekeeping
<b>HRIC</b>	High spatial Resolution Imaging Channel
<b>ICO</b>	Instrument Checkout
<b>ME</b>	Main Electronics
<b>NECP</b>	Near Earth Commissioning Phase
<b>OBCP</b>	On-Board Control Procedure
<b>PDOR</b>	Payload Direct Operation Request
<b>PDS</b>	Planetary Data System
<b>PE</b>	Proximity Electronics
<b>PNG</b>	Portable Network Graphics
<b>PSC</b>	Packet Sequence Control
<b>SIMBIO-SYS</b>	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory SYStem
<b>SSC</b>	Source Sequence Count
<b>SSMM</b>	Solid State Mass Memory
<b>STC</b>	STereo imaging Channel
<b>S/C</b>	Space-Craft
<b>TC</b>	TeleCommand
<b>TEC</b>	Thermo-Electric Cooler
<b>TM</b>	Telemetry
<b>VIHI</b>	VIisible and Hyper-spectral Imaging channel
<b>XML</b>	eXtensible Markup Language

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	6 of 16		


## 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 – ICO#02 objectives, with a brief description of the performance and inter-channel tests executed.
- Section 3 – ICO#02 implementation, with a brief description of the Flight Operation Procedures (FOPs) and Payload Direct Operation Requests (PDORs) used to perform the required tests and a discussion on the obtained results. More details are reported in each channel report ([RD.3], [RD.4] and [RD.5]).

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	7 of 16		

## 2. ICO#02 Objective

The scope of the SIMBIO-SYS ICO#02 was to verify the health status of the instrument at channel level 1 year after launch. To do this, two kinds of tests were defined (see [RD.1] for details):


1. **Functional Tests**, to verify the functionality of all the SIMBIO-SYS units (i.e., ME, HRIC, STC, and VIHI) and their components (e.g., TECs, Detectors, etc.).
2. **Performance Tests**, to monitor the evolution of the performance of all the SIMBIO-SYS channels (i.e., HRIC, STC, and VIHI) with respect to the results obtained during the on-ground calibration campaign and the tests performed during the Cruise.

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	8 of 16		

### 3. Test Implementation

The SIMBIO-SYS ICO#02 tests have been executed November 27<sup>th</sup>, 2019. In this document, after a brief introduction on the foreseen tests, their results are summarized evidencing eventual issues, more deeply discussed in referenced Technical Notes ([RD.3], [RD.4] and [RD.5]).

All tests described in the following sections have been executed by means of proper FOPs, On-Board Control Procedures (OBCPs), and PDORs whose description can be found in [RD.1]. All the tests used the last version of SIBIOSYS FOPs (detailed in [RD.6]).

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	9 of 16		

## 3.1. SIMBIO-SYS Functional Tests


### 3.1.1. HRIC Functional Test

#### 3.1.1.1. Scope

The aim of this test is to check the channel functionality and its capability to perform some science acquisitions.

#### 3.1.1.2. Results and discussion

As indicted in the test definition reported in [RD.1], the HRIC TEC has been switch-on using the nominal activation parameters reported (see [RD.7]) while the S/C was guaranteeing a hotter thermal environment (i.e., higher Cold Finger temperature – see sections 2.2 of [RD.3] and [RD.4]) by means of higher thresholds for the heaters. With this new thermal configuration, the **TEC current profile was nominal, and all the test has been executed as expected**. As a final remark, a not expected fluctuation of the detector reset level (around the 0.1% of the dynamical range) has been observed. More details on the test results can be found in [RD.3]. Same fluctuation was revealed on the STC data analysis (see [RD.4]).

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	10 of 16		


### 3.1.2. STC Functional Test

#### 3.1.2.1. Scope

The aim of this test is to check the functionality of the channel units and the capability to perform some science acquisitions.

#### 3.1.2.2. Results and discussion

As per the HRIC Functional Test, the **STC TEC activation was nominal.** Apart for a SpW error of out-of-limit on "STC last event TC Timer Ovrfl." which has been correctly (as expected) managed by the Main Electronics (ME) Application SoftWare (ASW), **the test has been executed as expected.** More details on the test results can be found in [RD.4].

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	11 of 16		

## 3.2. SIMBIO-SYS Performance Tests


### 3.2.1. HRIC Performance Test

#### 3.2.1.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel Dark Current (DC) performance after 1 year from launch.

#### 3.2.1.2. Results and discussion

The test was executed **with no errors**. The obtained data, once reduced by the scientific team, demonstrate the channel performances are in line with what expected because aligned with the one obtained during the on-ground calibration campaign and after the tests executed during NECP. More details on the test results can be found in [RD.3].

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	12 of 16		


### 3.2.2. STC Performance Test

#### 3.2.2.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel DC performance after 1 year from launch.

#### 3.2.2.2. Results and discussion

As per the HRIC channel the test was executed **with no errors** and the obtained data demonstrate the channel performances are in line with what expected. More details on the test results can be found in [RD.4].

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	13 of 16		


### 3.2.3. STC All-FPA Test

#### 3.2.3.1. Scope

The aim of this test is to perform several science acquisitions to evaluate the channel DC performance after 6 months from launch.

#### 3.2.3.2. Results and discussion

As per the HRIC channel the test was executed **with no errors** and the obtained data demonstrate the channel performances are in line with what expected. More details on the test results can be found in [RD.4].

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	14 of 16		

### 3.2.4. VIHI Internal Calibration

#### 3.2.4.1. Scope

The scope of this test was to perform a VIHI internal calibration using the LED with its nominal current; in addition, with reference to the issue 4 raised in NECP and summarized in Section 4.2 of [RD.8], the nominal shutter operability has been verified.


This specific test also covers the functional verification of the channel.

#### 3.2.4.2. Results and discussion

The Thermo-Electric Cooler (TEC) activation, **differently from what expected**, follows a hard start due to a wrong thermal configuration determining a peak of about 1 A in the current. This problem seems to be similar to the one found (and then solved) for the cameras and not seen before just for an insufficient sampling rate of the HK. Further analyses are required to identify if a solution like the one identified for the cameras could be applied also for the VIHI channel.

Apart from this issue, the test continued with **no other issues**.

As per both cameras, the obtained VIHI data demonstrate the channel performances are in line with what expected. More details on the test results can be found [RD.5].

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	15 of 16		

## 4. Conclusions

### 4.1. Summary

During the SIMBIO-SYS ICO#02, some tests have been executed to evaluate the instrument's health status and the evolution of its performance after 1 year journey. With these tests, all the units (i.e., ME, HRIC, STC, and VIHI) have operated nominally, allowing us to check their operativity and performance. The obtained results demonstrate that all SIMBIO-SYS units and subsystems work nominally.

Finally, during the ICO#02, it has been possible to validate some improvements in Ground Segment Equipment (GSE) and the data analysis tools developed by the team.


### 4.2. Open issues

During the execution of the ICO#02 tests, the following issues raised:

#	Name	Description	Occurrence	Connected ARs
1	LFB	Not expected fluctuation of the detector reset level	HRIC Functional Test	-
2	SpW-error	SIMB HK discarded to SPW error and YSS40408 SIMB PE HK Frame Restart	STC Functional Test	-
3	TEC-current	Peak in the TEC current during activation	VIHI Performance Test	-

The status of the issues at the end of ICO#02 phase is reported in following table:

#	Name	Status at the end of the NECP
1	TEC-INIT	<b>Closed:</b> both HRIC and STC have to use the nominal TEC activation parameters while the S/C has to use new (higher) threshold for the heaters that controls the CF temperature.
2	ME-GRANULARITY	<b>Open:</b> it has been found that the ME granularity managing TC execution could be modified by the Repetition Time (RT)

	Document	BC-SIM-TR-021 SIMBIO-SYS ICO#02 Test Report		
	Date	29/03/2022		
	Issue	1	Revision	0
	Page	16 of 16		

		parameter of a Science TC determining that some TC can be accepted but not executed (see section 4.2 of [RD.9]).
3	LFB	<b>Open:</b> Both HRIC and STC channels reports a not expected fluctuation of the detector reset level (around the 0.1% of the dynamical range).
4	SpW-error	<b>Closed:</b> it has been verified the issue was unexpected but correctly managed by the ME ASW.
5	VIHI TEC-current	<b>Open:</b> a study is required to find out new parameters to be used in Cruise conditions.