# BC-SIM-TR-015
# SIMBIO-SYS Instrument CheckOut #01 Test Report

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# Approvation

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# Document change record

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# 1. Introduction

## 1.1. Scope

This document will briefly report the results of the tests performed during the Instrument Checkout (ICO) # 01 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-002_-_SIMBIOSYS_ Checkout_01_Test_Summary_Issue1_Revision0, 10.20371/INAF/TechRep/64

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

**[RD.3]** BC-SIM-TR-012_-_HRIC_ICO#01_report, 10.20371/INAF/TechRep/97

**[RD.4]** BC-SIM-TR-013_-_STC_ICO#01_report, 10.20371/INAF/TechRep/89

**[RD.5]** BC-SIM-TR-014_-_VIHI_ICO#01_report

**[RD.6]** BC-SIM-TN-004_-_SIMBIO-SYS_FOP_update_after_NECP, 10.20371/INAF/TechRep/58

**[RD.7]** BC-SIM-TR-005_-_SIMBIO-SYS_NECP_Report, 10.20371/INAF/TechRep/42

**[RD.8]** BC-SIM-GAF-TN-113 rev.0_TEC Control Parameters Revision for Commissioning_F1

**[RD.9]** BC-SIM-TR-010_-_SIMBIO-SYS_deltaNECP_Test_Report_Issue1_Revision0, 10.20371/INAF/TechRep/83

**[RD.10]**BC-SIM-TR-007_STC_dNECP_Report, 10.20371/INAF/TechRep/71

**[RD.11]**BC-SIM-TR-001_-_EGSE_NECP_report, 10.20371/INAF/TechRep/22

**[RD.12]**BC-ESC-RP-10110, BepiColombo Mission Operations Report (MOR#28)


## 1.3. Acronyms

| | |
|---|---|
| **APID** | Application Process IDentifier |
| **ASW** | Application SoftWare |
| **CSV** | Comma Separated Values |
| **FPA** | Focal Plane Assembly |
| **FOP** | Flight Operation Procedure |
| **HK** | Housekeeping |
| **HRIC** | High spatial Resolution Imaging Channel |
| **ICO** | Instrument Checkout |
| **ME** | Main Electronics |
| **NECP** | Near Earth Commissioning Phase |
| **OBCP** | On-Board Control Procedure |
| **PDOR** | Payload Direct Operation Request |
| **PDS** | Planetary Data System |
| **PE** | Proximity Electronics |
| **PNG** | Portable Network Graphics |
| **PSC** | Packet Sequence Control |
| **SIMBIO-SYS** | Spectrometers and Imagers for MPO<br>BepiColombo Integrated Observatory SYStem |
| **SSC** | Source Sequence Count |
| **SSMM** | Solid State Mass Memory |
| **STC** | STereo imaging Channel |
| **S/C** | Space-Craft |
| **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 – ICO#01 objectives, with a brief description of the performance and inter-channel tests executed.
- Section 3 – ICO#01 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]).

# 2. ICO#01 Objective

The scope of the SIMBIO-SYS ICO#01 was to verify the health status of the instrument at channel level 6 months 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 Near Earth Commissioning Phase (NECP).

# 3. Test Implementation

The SIMBIO-SYS ICO#01 tests have been executed June 7th 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 represent the first inflight validation of the new version of SIBIOSYS FOPs (detailed in [RD.6]).

## 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], with reference to the issues 1 and 2 raised in NECP and summarized in Section 4.2 of [RD.7] new parameters have been used for the HRIC Thermo-Electric Cooler (TEC) activation according to the study described in [RD.8]. However, the new gentle activation, **differently from what expected**, produced a non-nominal oscillation in the current profile whose effects can be noted also in the FPA temperature profile. Apart from this issue, the test **continued with no other issues**. More details on the test results can be found in [RD.3].

### 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 encountered a problem with the used parameters** with a non-nominal oscillation in the current.
It should be underlined that STC Functional test (for more details see Sections 4.2 end 6 of [RD.4]) confirmed the ME TC granularity highlighted by dNECP phase (defined as Issue-3 in System Level report [RD.9] and highlighted in [RD.10])
Apart from these two issues, the test **continued with no other errors**. More details on the test results can be found in [RD.4].

## 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 6 months 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].

### 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 6 months 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].

### 3.2.3. VIHI Internal Calibration

#### 3.2.3.1. Scope

The scope of this test was to perform a VIHI internal calibration using the LED shall with its nominal current and to verify the shutter operability with reference to the issue 4 raised in NECP and summarized in Section 4.2 of [RD.7].
This specific test also covers the functional verification of the channel.

#### 3.2.3.2. Results and discussion

The test was executed **with no errors**. 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].

# 4. Conclusions

## 4.1. Summary

During the SIMBIO-SYS ICO#01, some tests have been executed to evaluate the instrument's health status and the evolution of its performance after 6 months from launch. 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, and the new FOP package provided is in line with the requirements.
Finally, during the ICO#01, it has been possible to validate some improvements in Ground Segment Equipment (GSE) and the data analysis tools developed by the team. Some issues raised on the telemetry downloaded from the ESA repository and related to the duplication of the diagnostic HK and the order of some Science packets (see [RD.11] for details).

## 4.2. Open issues

During the execution of the ICO#01 tests, the following issues raised:

| # | Name | Description | Occurrence | Connected ARs |
|---|---|---|---|---|
| 1 | TEC-INIT | Non-nominal built-in TEC activation parameters | HRIC and STC Functional Test | - |
| 2 | ME-GRANULARITY | Variation in the ME TC granularity | STC Functional Test | BC_SC-75 |

As indicated in the above table, some issues are associated to the Anomaly Reports [RD.12]. The status of the issues at the end of ICO#01 phase is reported in following table:

| # | Name | Status at the end of the NECP |
|---|---|---|
| 1 | TEC-INIT | **Open**: the used TEC parameters derived from a new study of the Prime but seems to not be the right one to be used in Cruise phase. A new study it is necessary also considering the S/C thermal environment around the instrument. The parameters must be uploaded before the TEC activation pending the update of the ME ASW where these parameters are fixed. |

| | | |
|---|---|---|
| 2 | ME-GRANULARITY | **Open**: it has been found that the ME granularity managing TC execution could be modified by the Repetition Time (RT) parameter of a Science TC determining that some TC can be accepted but not executed. |