SUNRISE III

Test Procedure

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APPROVALS

ICS TV TEST

ISSUE: 1

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ACRONYMS

AC	Alignment Cube
ANG	Angle
BB	Bread Board
CCW	Counter clockwise
CSBF	Columbia Scientific Balloon Facility
CTRL	Controller
CW	Clock wise
EM	Engineering Model
EUT	Equipment Under Test
FM	Flight Model
fps	Frames per Second
GN2	Nitrogen Gas
GUI	Graphical User Interface
HSCL	High Speed Channel Link
HK	House Keeping
hPa	hectopascals
ICD	Interface Control Document
ICS	Instrument Control System
LN2	Liquid Nitrogen
LVDS	Low-voltage Differential Signalling
MPS	Max Planck Institute for Solar System Research
NASA	National Aeronautics and Space Administration
NCR	Non-Conformance report
NRB	Non-Conformance Review Board
OCP	Over Current Protection
OVP	Over Voltage Protection
PBC	Polarizing Beamsplitter Cube
PMU	Polarization Modulation Unit
PMU-DRV	PMU Driver (SCIP, SUSI)
PMU-ROT	PMU Rotator (SCIP, SUSI)
QS	Quad Steps on Stepper motor
RPM	Revolutions per minute
SFW	SUSI Filter Wheel Mechanism
SGM	SUSI Grating Mechanism
SSM	SUSI Scanning Mechanism
SUSI	Sunrise UV Spectro polarimeter and Imager
TBC	To Be Confirmed
TBD	To Be Discussed
TV	Thermal Vacuum
URP	Unit Reference Point

1 GENERAL ASPECTS

1.1 SCOPE

This document is a procedure to perform the TV test of following ICS-1 and ICS-2 units.

1. ICS hardware
2. ICS power converter
3. Connector Panel
4. Test connector

The test is conducted to

a. To verify the performance of ICS units
b. Co-relation of the thermal model with full thermal load
c. Verify the thermal concept/design of ICS.
d. Verify the air tightness of the ICS box.

1.2 APPLICABLE DOCUMENTS

Table 1.1: Applicable documents

NO.	DOCUMENT TITLE	DOCUMENT NUMBER	ISS.	REV.	DATE
AD01.	Global list of Acronyms and Synonyms	SR3-MPS-LI-GEN-002			See latest Iss/Rev
AD02.	Sunrise-3 Science, Technical and Operational Requirements	SR3-MPS-SP-GEN-003	D	b	20-March-2019
AD03.	Report: Pre-test of 1 mbar TV test at SGI-2	SR3-MPS-RP-AV700-006	D	-	11-Dec-2019
AD04.	Harness and connector overview	SR3-MPS-DR-SR800-001	1	B	28-Jan-2020
AD05.	TRR ICS TV Test	SR3-MPS-MN-IC000-001	D	-	17-Jan-2022

1.3 REFERENCE DOCUMENTS

Table 1.2: Reference documents

NO.	DOCUMENT TITLE	DOCUMENT NUMBER	ISS.	REV.	DATE
RD01.	Space engineering — Testing	ECSS-E-ST-10-03	C		01-June-2012
RD02.	ICS Block diagram	SR3-MPS-DR-IC000-001	1	-	11-May-2020
RD03.	SR3 Flight temp sensors and heaters	SR3-MPS-TN-SR000-001			

2 EQUIPMENT UNDER TEST (EUT)

The FM and FS units of ICS will be tested. Together with ICS, rest of all the supporting units as listed below will be tested together.

1. ICS Power Converter
2. Connector panel
3. I Gb ethernet switches (both +X and -X)

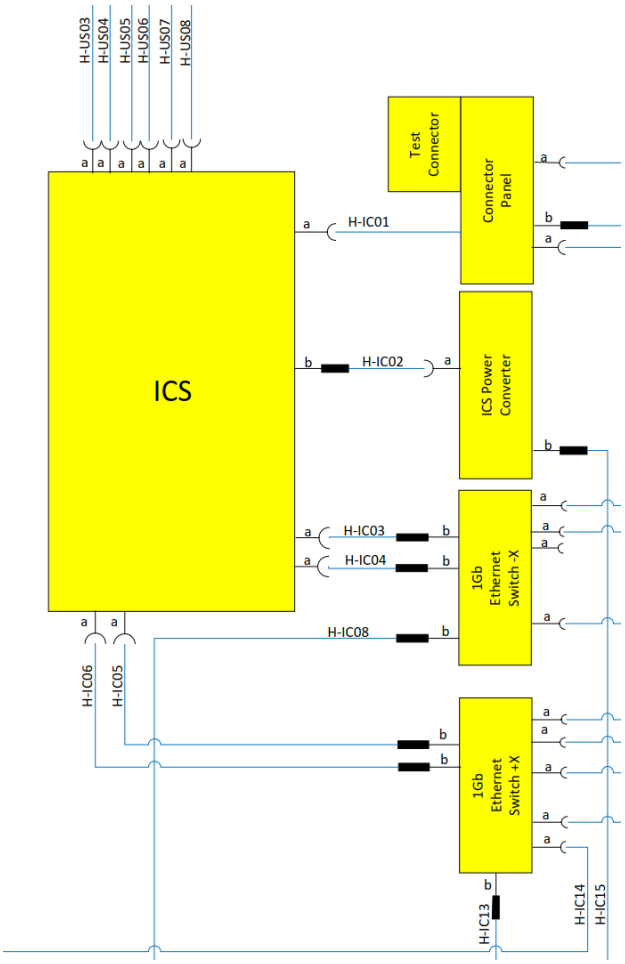

Table 2.1: Equipment Under Test

3 REQUIREMENTS MAPPING

This TV test is performed to verify the following requirements of Flight Models (FM).

Table 3.1: Requirements mapping

REQ NO.	DESCRIPTION	SPECIFICATION		SOURCE/ REMARKS
3.1 GENERAL FOR ALL UNITS.				
TV-101.	All units shall be tested for its survival during its non-operational conditions	Hot Non-Op	NA	There is no Non-OP temp for ICS as it will be switched on even before launch/ascent.
		Cold Non-Op	NA °C	
TV-102.	All units shall be tested for its functional performance during its operational conditions.	Hot Op	+30°C	
		Cold Op	-15 °C	
TV-103.	Pressure	$<10^{-5}$ mbar		
		~5 mbar		Not foreseen
TV-104.	All units will be powered with input voltage of	25.6 V		
TV-105.	All units shall be switched ON in the temperature range of	-15 °C / +30°C		
TV-106.	~~All units shall be switched ON with low voltage input~~	~~Switch on with 21 V~~		Not foreseen
TV-107.	All units shall be commanded from ICS EGSE.			
TV-108.	All units shall share the HK data to ICS EGSE			
3.2 ICS				
TV-401.	Successful operation of the unit			
TV-402.	Max temperature of internal component is not more than +80 deg C during operation.			
TV-403.	Successful commanding and HK recording.			
TV-404.	The unit shall be 'air-tight', i.e., the pressure drop during the test must be small.	< 0.05% per day (TBC!)		

REQ NO.	DESCRIPTION	SPECIFICATION	SOURCE/ REMARKS
3.3 ICS POWER SUPPLY			
TV-501.	Supply power to ICS.		
TV-502.			
3.4 ETHERNET SWITCHES			
TV-503.	Data rate as per requirements		
TV-504.			
3.5 CONNECTOR PANEL			
TV-505.	None.		
TV-506.			

4 TEST TOLERANCES

Table 4.1: Test tolerances as per RD01

NO.	TEST PARAMETER	RANGE	TOLERANCES
01.	Temperature	T above 80K (-193 °C)	T_{min} : +0/-4 °C T_{max} : -0/+4 °C
02.	Pressure in vacuum chamber	1.3E-3 mbar to 1.3 mbar	± 30 %
03.	Pressure in vacuum chamber	< 1.3E-3 mbar	± 80 %
04.	Test duration		-0 / +10%

5 TEST ACCURACIES

Table 5.1 : Test accuracies as per RD01

NO.	TEST PARAMETER	RANGE	ACCURACIES
01.	Temperature	T above 80K (-193 °C)	± 2 °C
02.	Pressure in vacuum chamber	1.3E-3 mbar to 1.3 mbar	± 30 %
03.	Pressure in vacuum chamber	< 1.3E-3 mbar	± 80 %

6 TEST CONDITIONS

6.1 CLEANLINESS DURING THE TV TEST.

The SGI-2 TV chamber is in ISO-8 Clean room and the test setup is prepared in the same room. MGSE hardware and EGSE harness were cleaned and bake-out was performed before installing in the TV chamber. The electronics boards are coated with conformal coating.

Gloves and face mask will be used while handing optical units of FM hardware.

6.2 AMBIENT TEST CONDITIONS

Table 6.1: Ambient test conditions

NO.	ITEM	DESCRIPTION	REMARKS
01.	Temperature	22 °C ± 3 °C	
02.	Relative Humidity	55 % ± 10 %	
03.	Pressure	Ambient	
04.	Cleanliness	ISO 8	

6.3 VACUUM TEST CONDITIONS

Table 6.2: Vacuum test conditions

NO.	ITEM	DESCRIPTION	REMARKS
01.	Hot Non-Op temperature	NA	Refer Table 3.1: Requirements mapping
02.	Hot Op temperature		
03.	Cold Op temperature		
04.	Cold Non-Op temperature	NA	
05.	Chamber Pressure		
06.	Rate of change of temperature	≤ 2 °C/min	
07.	Stabilisation criteria	$\Delta T/dt \leq 1$ °C/h	
08.	Dwell time	$t_E \geq 1$ h	

The temperature profile of the test is shown in Figure 9.1: Test sequence.

6.4 LOW PRESSURE TEST CONDITIONS.

Low pressure test cycles are not planned during this test. In case of change in plans, refer AD03 for detailed procedure of operation of chamber to prepare it for low pressure test cycle.

7 PASS/FAIL CRITERIA

Table 7.1: Pass/fail criteria

NO.	ITEM	DESCRIPTION	REMARKS
01.	Reaching the required temperatures (operation cases) at the interfaces of equipment under test.		Reference sensors (SRP)
02.	Achieving the required stabilisation criteria.		
03.	Operation of each unit as stated in Table 3.1		Table 3.1
04.	Maintaining the pressure level within the ICS unit.		

8 TEST FACILITY DESCRIPTION

8.1 'SGI-2' TV CHAMBER AT MPS

The chamber can be controlled and monitored using an EGSE computer placed right next to the TV chamber, at BT3.E0.539.

Table 8.1: Test facility description

NO.	ITEM	DESCRIPTION	REMARKS
01.	Designation	SGI-2	
02.	Manufacturer	SGI-Prozesstechnik.	
03.	Location	MPS, BT1.E0.539	
04.	Environment	ISO 8 cleanroom	
05.	Min Shroud Temperature	-60°C	
06.	Max Shroud Temperature	+80°C	
07.	Min Plate Temperature	-170°C	
08.	Max Plate Temperature	+100°C	
09.	Pressure Range	Up to 10^{-7} mbar	
10.	Temperature control system	BP: LN2 + Heaters Shroud: Lauda system	
11.	Effective plate area	650 x 800 x 470 mm	
12.	Fore-vacuum pump	SC 15D + VUF90/2-100	
13.	Turbo-pump	Leybold Turbo Vac Mag	

8.2 DATA ACQUISITION SYSTEM

The information on pressure of the chamber and the data from temperature sensors are acquired by Agilent 34970A system. This is visible in real time and can be saved/accessed as .csv file (with time stamp) for further data processing.

The data can be accessed from

\\pc.linmpi.mpg.de\Home\laboruser_PUBLIC_Backup-SGI2-Kammer-Daten-Copy

Figure 8.1: SGI-2 chamber in ISO8 Cleanroom (BT1.E0.539) at MPS

9 TEST SETUP

9.1 TEST SEQUENCE

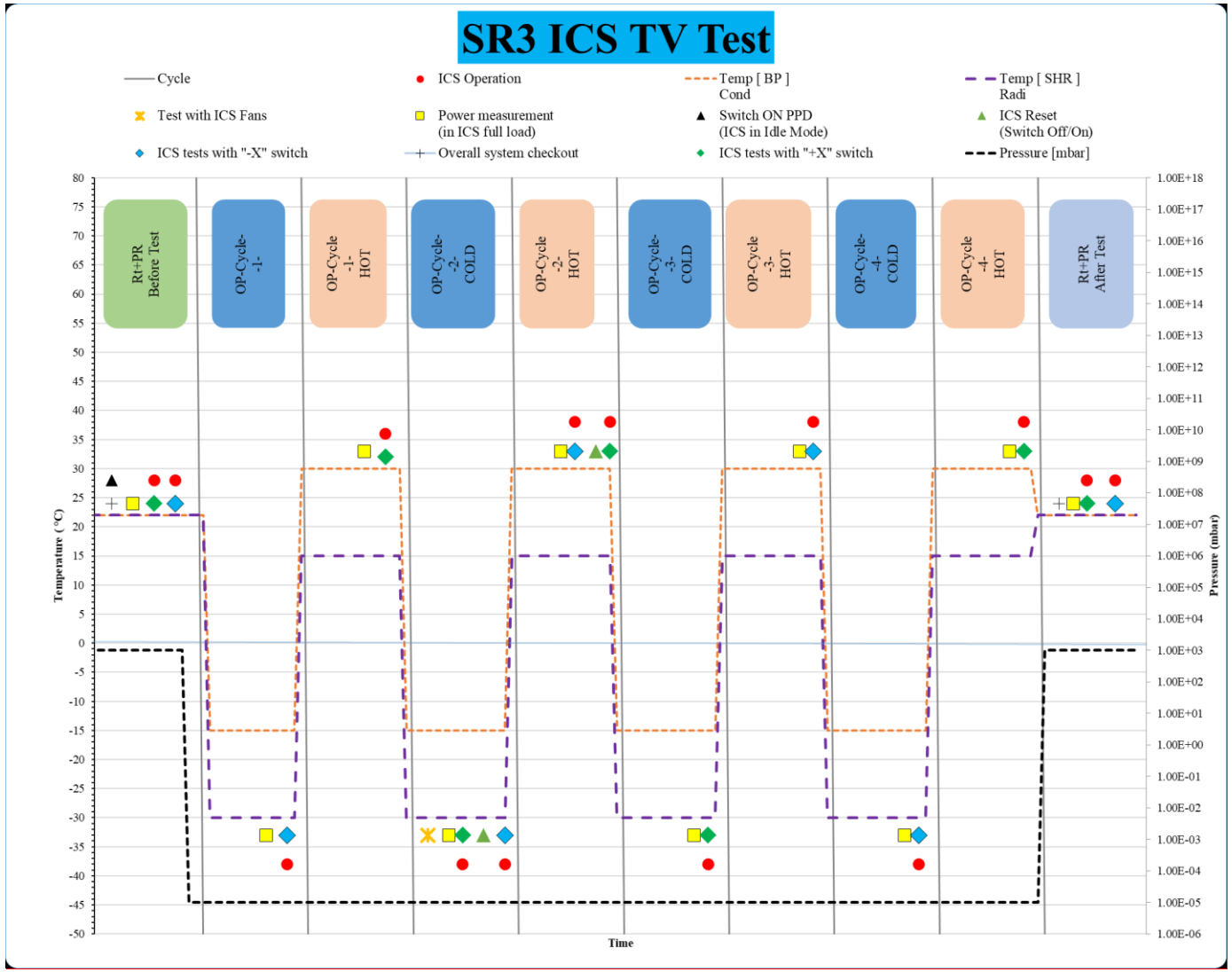

Figure 9.1: Test sequence

9.2 ELECTRICAL SCHEMATICS

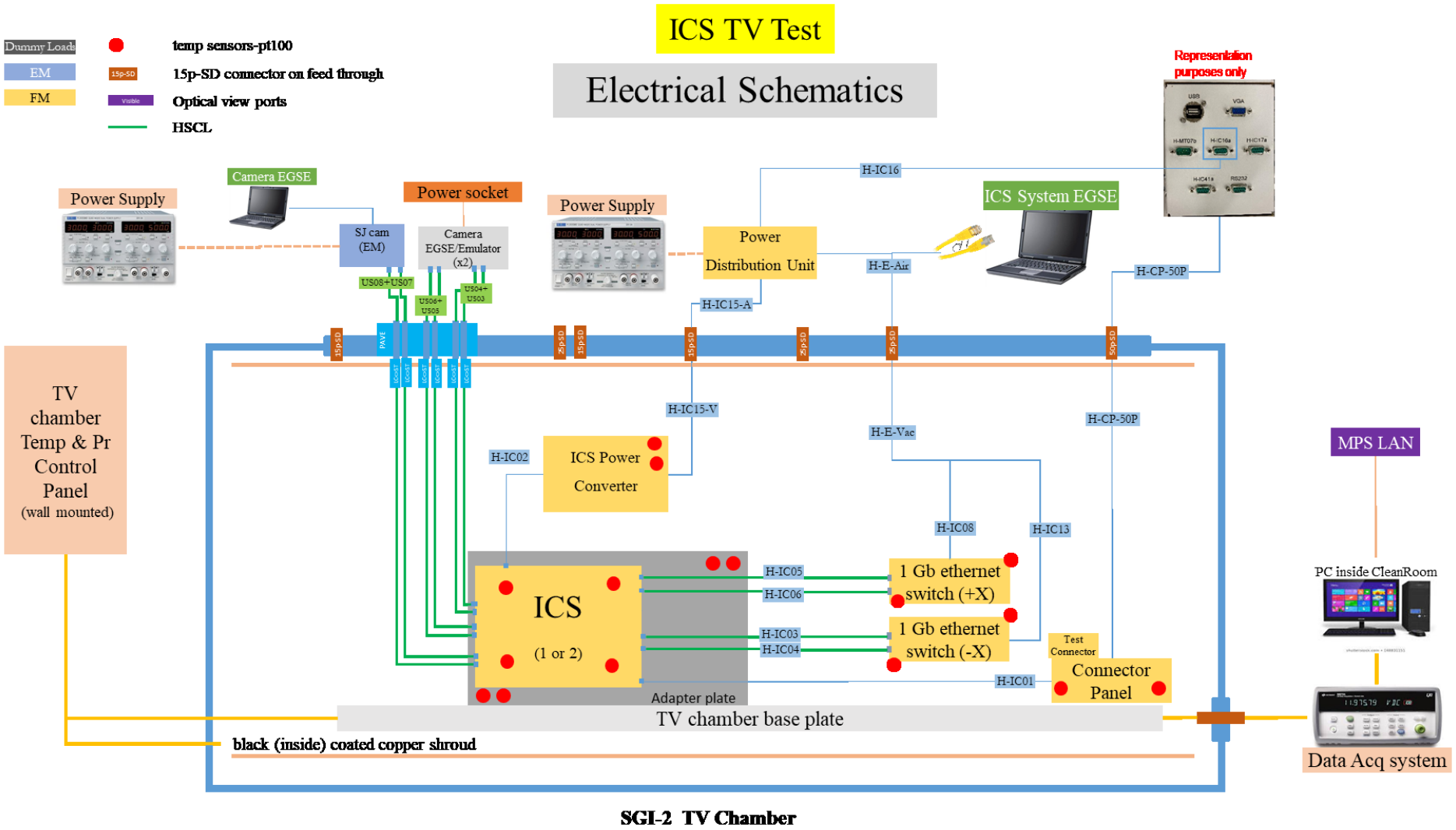

Figure 9.2: Electrical schematics for the test

9.3 TEMPERATURE SENSORS

The following is a list of temperature sensors with its location read by TV test data acquisition system, plus a list of internal temperature sensors which are read via the house keeping data from ICS.

Table 9.1: Temperature sensors

TEMP ID.	UNIT	Location	TYPE	REMARKS
TS01	On ICS adapter plate		PT100	Reference temperature (SRP)
TS02	On ICS adapter plate		PT100	2nd Ref temperature (SRP)
TS03	On ICS adapter plate		PT100	
TS04	On ICS adapter plate		PT100	
TS05	~~On ICS Top part~~	Not on Painted surface	PT100	
TS06	~~On ICS Top part~~	Not on Painted surface	PT100	
TS07	~~On ICS bottom part~~	Not on Painted surface	PT100	
TS08	~~On ICS bottom part~~	Not on Painted surface	PT100	
TS09	On 1 GB Ethernet switch '+X'		PT100	
TS10	On 1 GB Ethernet switch '+X'		PT100	
TS11	On 1 GB Ethernet switch '–X'		PT100	
TS12	On 1 GB Ethernet switch '-X'		PT100	
TS13	ICS power Converter		PT100	
TS14	ICS power Converter		PT100	
TS15	Connector panel		PT100	
TS16	Connector panel		PT100	
TS17	Extra			
TS18	Extra			
List of internal temperature sensors read via HK (excerpt from RD03)				
ETH-01	Ethernet Switch -X Heat sink		DS18B20	28 7A A3 E9 0B 00 00 2F
ETH-02	Ethernet Switch +X Heat sink		DS18B20	28 96 B1 E9 0B 00 00 84
ICS-01	Motherboard CPU heat pipe cold port			
ICS-02	Lid inner side CPU heat pipe cold port			
ICS-03	Mother Board M1			
ICS-04	Mother Board M2			
ICS-05	Mother Board M3			
ICS-06	Mother Board M4			
ICS-07	Mother Board M6 cold port			
ICS-08	Mother Board M6 lid inner side cold port			

TEMP ID.	UNIT	Location	TYPE	REMARKS
ICS-09	Frame Grabber optical fibre connector plate			
ICS-10	Frame Grabber cold port			
ICS-11	Frame Grabber lid inner side cold port			
ICS-12	A SAS Expander cold port			
ICS-13	A SAS Expander lid inner side cold port			
ICS-14	B SAS Expander cold port			
ICS-15	B SAS Expander lid inner side cold port			
ICS-16	USB-to-serial converter board U1			
ICS-17	USB-to-serial converter board U2			
ICS-18	USB-to-serial converter board U3			
ICS-19	Motherboard air – free stream			
ICS-20	DSS Frame front			
ICS-21	DSS Frame USB			
ICS-22	ICS inner lateral X+			
ICS-23	ICS inner lateral X-			
ICS-24	ICS inner lateral Y+			
ICS-25	ICS inner lateral Y-			
ICS-26	ICS inner up Z+			
ICS-27	ICS baseplate (housing lower half) inner side Z0			
ICS-28	ICS fans			

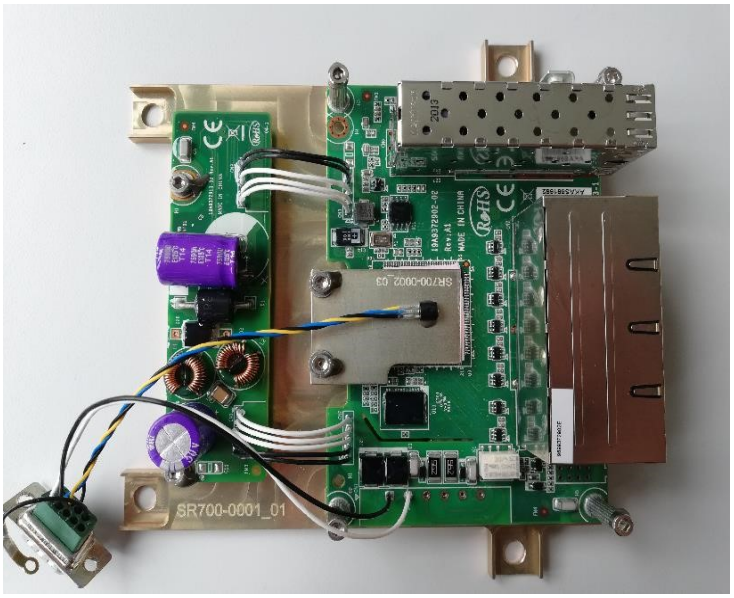

Figure 9.3: Ethernet switch temperature sensor (in the center of the image).

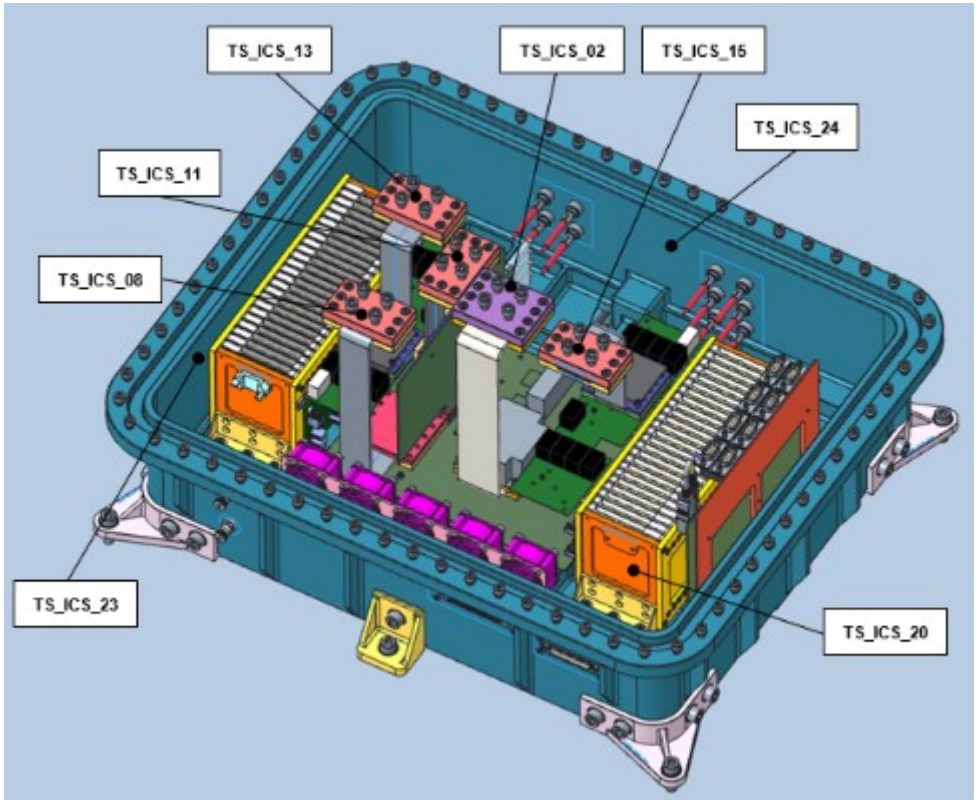

Figure 9.4: ICS temperature sensors – lower half + cold ports.

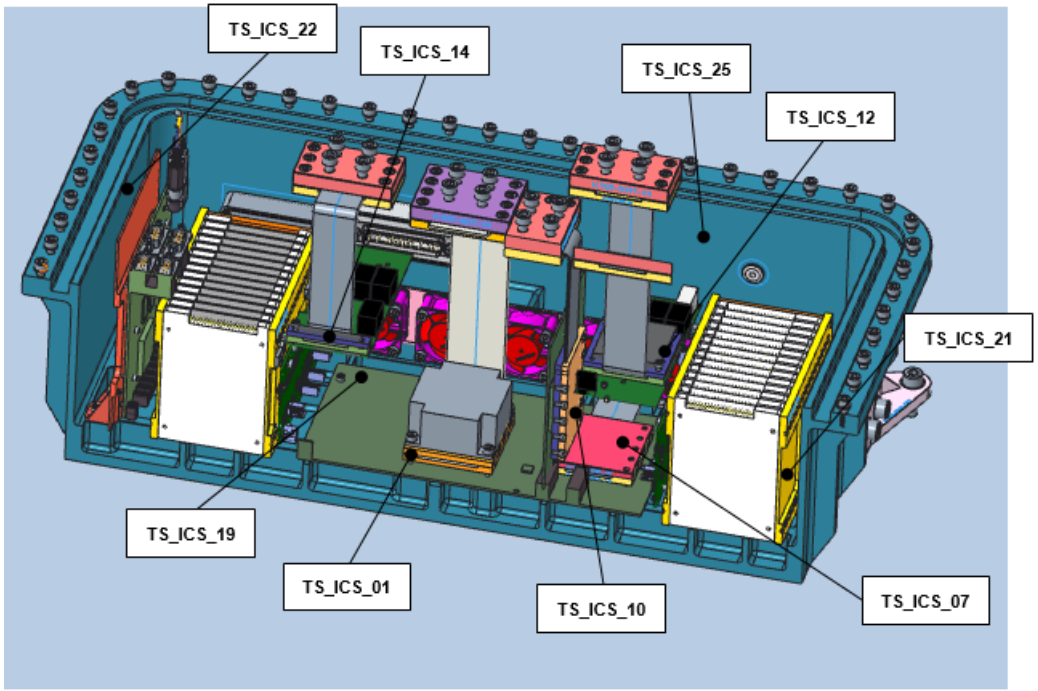

Figure 9.5: ICS temperature sensors – lower half detail.

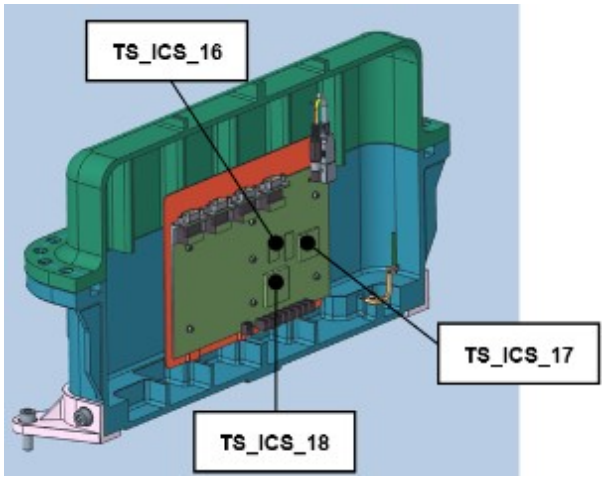

Figure 9.6: ICS temperature sensors – USB-to-serial converter PCB detail.

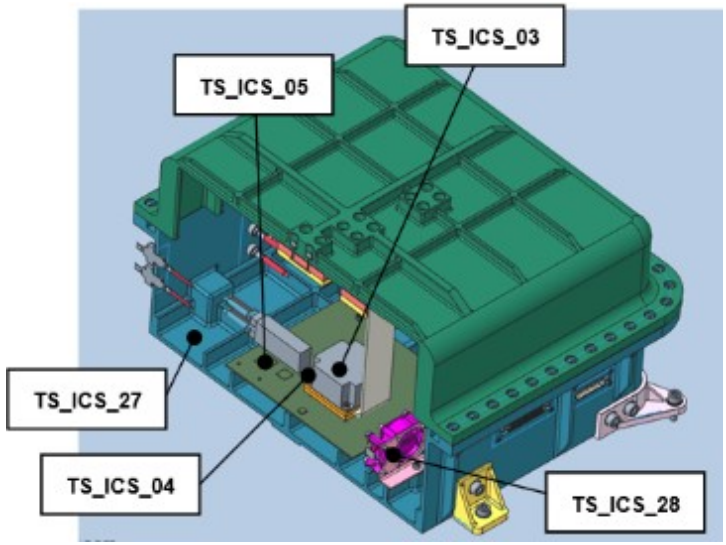

Figure 9.7: ICS temperature sensors – motherboard and baseplate detail.

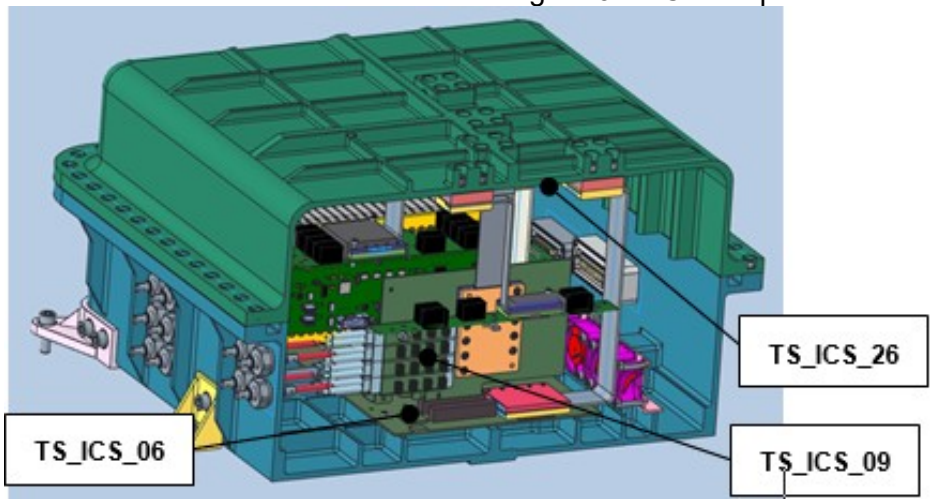

Figure 9.8: ICS temperature sensors – motherboard and frame grabber detail.

Figure 9.9: TS01-MGSE Adaptor Plate(URP)

Figure 9.10: TS02-

Figure 9.11: TS03-

Figure 9.12: TS04-

Figure 9.13: TS05-

Figure 9.14: TS06-

Figure 9.15: TS07-

Figure 9.16: TS08-

Figure 9.17: TS09-

Figure 9.18: TS10

Figure 9.19: TS11-

Figure 9.20: TS12

Figure 9.21: TS13-

Figure 9.22: TS14-

Figure 9.23: TS15-

Figure 9.24: TS16 –

Figure 9.25: TS17-

Figure 9.26: TS18-

10
10 GSE AND TEST TOOLS

10.1 MGSE

10.1.1 ADAPTOR PLATE

For good thermal contact and better placement a mounting plate is used to attach the ICS unit on to the SGI-2 Base Plate.

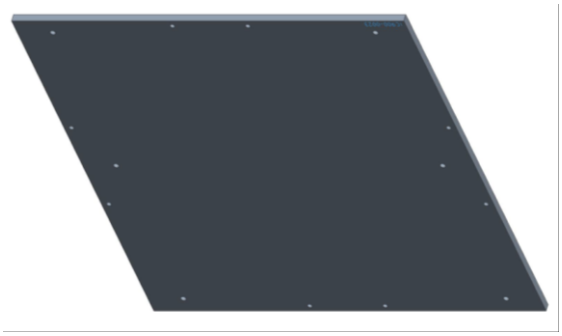

Figure 10.1: Adaptor plate for ICS unit (SR3-MPS-DM-IC900-0023)

The rest of the units will be placed directly on the SGI-2 BP and will be fixed firmly using clamps.

10.2 EGSE

10.2.1 ICS SIMULATOR

A laptop will used to command the SUNRISE III ICS.

10.2.2 CAMERA EMULATORS

Camera Emulators will be used to simulate SUSI Cameras.

10.2.3 POWER SUPPLY

Rohde & Schwarz HMP4040 power supply is used to power the units. It has 4 channels with up to 32V / 10A output. (5A at 32V, 160W max.)

10.2.4 ELECTRICAL FEED THROUGH

10.2.4.1 FLANGE FOR HSCL

An ISOK 160 flange with 3 pairs of PAVE connectors will be used to connect to the camera EGSE. One more flange, ISO K 63 will be prepared to connect the 1 GB ethernet switches.

160 ISO_K [SubD connectors]

160 ISO_K PAVE

10.2.4.2 FLANGE FOR ICS CONNECTORS

Flange ISOK-DN160 with various connectors will used to feed through the power and data connections to the TV chamber.

Table 10.1: Details of feed through at the chamber

SL NO	CONNECTOR TYPE	HARNESS	DESCRIPTION
01.	15p-SubD	HC-IC15	PPD <> ICS power converter
02.	15p-SubD		
03.	15p-SubD		
04.	25p-SubD	H-E-vac	Ethernet <> PPD+EGSE
05.	25p-SubD		
06.	25p-SubD		
07.	50p SubD	H-CP-50	One harness will be prepared to connect Connector panel
08.	ST connectors	X3 pairs of HSCL	ICS <> x3 camera With LC<>ST adapter

10.3 OGSE

NA for this test.

11 TEST INSTRUMENTATION

Table 11.1: Test instrumentations

NO.	INSTRUMENT	MODEL NO	SERIAL NO	ACCURACY	CALIBRATED ON
01.	Data acq system	Agilent 34970A			
02.	Multimeter	Fluke 89			
03.	Data logger	GL980		8 ch voltage measurement	
04.	Power Supply	HMP4040			
05.	Oscilloscope	LeCroy WaveRunner 610Zi			
06.	Current Probe(s)	LeCroy 2x CP030			
07.	Voltage Probe(s)	LeCroy 4x PP008			
08.	Differential Probe(s)	LeCroy ZD1000 (1GHz)			
09.	Cannon camera	80D			
10.	UV light source	Ocean Optics			
11.	UV LED				

12 TEST DESCRIPTION

Here we list the overview of the tests with the list of activities to be performed for each test/task.

Please note, there will be no NON-Op case as ICS will be switched on even before launch/ascent and it will be powered on all the time.

12.1 ICS UNIT: FULL LOAD TEST

To measure the final thermal steady state condition of the ICS unit under full load or maximum power consumption case, and to measure the power consumption, following activities are planned

a. ICS in full data processing mode.
b. Execution of stress commands.

12.2 FRAME GRABBER CARD – FULL LOAD TEST

a. Set the frame rate of 2 camera emulators to the total value that we expect for the 3 real cameras
b. SUSI EM camera will be used as a 3rd camera.

12.3 POWER CONSUMPTION MEASUREMENT FOR ASCENT PHASE

Cold operational case is considered the best case to estimate the power consumption during the ascent phase. Hence power consumption is measured in following cases at each step.

a. ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches
b. ICS in full load.

12.4 TESTS WITH FANS

To test the effect of fans on thermal control and its impact on the power consumption, a test is planned in COLD case (one cycle). ICS being idle condition, we will switch off x2 fans first and measure the variation in power consumption and temperature profile inside the ICS. If no dangerous temperatures are reached, then we switch off all x4 fans and monitor the power consumption and temp profile.
Fans operate at 0% or 100% of its capacity and there are no intermediate states for these fans.

12.5 PRESSURE MEASUREMENT

At each cycle we measure the pressure to see the air-tightness of the box.

13 SOFTWARE / FIRMWARE STATUS ENVISAGED FOR TEST

Table 13.1: Software /firmware for test

NO.	SUB-SYSTEM	SOFTWARE DESCRIPTION	REMARKS
01.	ICS	a. ~ FM	
02.	Cameras	a. FM status	Updated and tested.
03.	Data Analysis	a.	

14 TEST AND OPERATIONS CONSTRAINTS

14.1 GENERAL PRECAUTIONS AND SPECIAL SAFETY NEEDS

01. The test equipment and associated GSEs shall be handled with care and all safety precautions shall be observed.
02. Personnel not designated by the Test Conductor as having a necessary function for performance of the test shall not be allowed in the area.
03. Handling, mounting and testing shall be done only by qualified personnel. Precaution against unauthorized operation of equipment has to be foreseen.
04. Only the responsible test engineer, the test conductor or the support engineer will be allowed to abort a test by means of an emergency push-button.
05. The general safety requirements of the MPS laboratory shall be applied during all operations.
06. The EUT shall be grounded before performing any functional tests.

14.2 OPERATIONAL CONSTRAINS

01. Any deviation from the TV test procedure and/or functional test procedure shall be noted in Table 17.1: Procedure deviation list.

14.3 DAY TO DAY TV CHAMBER OPERATION

As the EUT are FM hardware, keeping safety and security in mind, following operation sequences for TV chamber shall be practised.

01. **Shroud of TV chamber**: Can be allowed to run with temperature control ON during overnights because it is operated via LAUDA system.

    SHR: every night : Min -10°C and Max +15°C
02. **Base plate of TV chamber**: As the temperature control is done with electrical heaters and LN2, the temperature control shall be switched OFF every evening and shall be switched ON before performing any test the next day.

15 PARTICIPANTS

Table 15.1: Test participants

NO.	NAME	DEPT / INSTITUTE	RESPONSIBILITY	EMAIL / TELE NO	REMARKS
01.	M. Bayon Laguna	MPS	Thermal Engineer.		
02.	S. Goodyear	MPS	Ele Engineer/ Test conductor		
03.	R. Enge	MPS	Ele Engineer/ Test conductor		
04.	S. Ramanath	MPS	AIV/Test conductor		
05.	G. Fernandez Rico	MPS	Thermal Engineer		
06.	W. Deutsch	MPS	Ele System Engineer		
07.	K. Heerlein	MPS	El. engineer (cameras)		
08.	A. Lagg	MPS	Project Manager, ICS supervisor		
09.	A. Zerr	MPS	Supervising the chamber		
10.	M. Eberhardt	MPS	Supervising the chamber		
11.	D. Oberdorfer	MPS	Supervising the chamber		

16 STEP BY STEP PROCEDURE

16.1 GENERAL TEST SETUP PREPARATION

Table 16.1: Step by step procedure for ICS TV Test

STEP NO.	ACTION	CHECK/COMMENTS	DATE /TIME	OPE RATOR
General test setup preparation				

16.1.1 EUT AND GSEs

1.01	Collect the following EUT a. ICS b. ICS Power converter unit + Cho therm. c. Ethernet switch (+x and -x) – verify that they are vacuum compatible. d. Connector panel. e. Harness			
1.02	Collect all MGSE	See § 10.1		
1.03	Collect all EGSE	See § 10.2		

16.1.2 SETUP INSIDE AND OUTSIDE THE TV CHAMBER

1.04	Place the adapter plate on the SGI-2 BP and fix them with appropriate screws.	*M6x16*		
1.05	Apply appropriate torque	5.8 Nm		
1.06	Mount x5 pairs of HSCL cables on ICS			
1.07	Place the ICS unit on this adapter plate and fix it with appropriate screws.	M8x20		
1.08	Apply appropriate torque	14 Nm		
1.09	Fix the grounding cable of ICS unit on base plate			
1.10	Connect the appropriate harness and then place ICS power converter on the BP.	See § 9.2		
1.11	Connect the appropriate harness and then place Connector panel on the BP	See § 9.2		
1.12	Arrange them on the BP.			
1.13	Install all temperature sensors as per Table 9.1			
1.14	Mount harness on both electrical flanges [power + data = Right side flange (50P)] [camera HSCL = left side]			
1.15	Arrange the required EGSE out side the TV camber			

1.16	Set the OCP for the power supply CH1 and CH2 to 5 A				
1.17	Set the input voltage of power supply CH1 and CH2 to 25.6 V				
1.18	Remove all the tools and foreign items				
1.19	Verify the position of all temperature sensors	TS01 TS02 TS03 TS04 TS05 TS06 TS07 TS08 TS09	TS10 TS11 TS12 TS13 TS14 TS15 TS16 TS17 TS18		

16.2 CASE: RT+PR – BEFORE TEST

16.2.1 OVER ALL SYSTEM CHECKOUT

<table>
<tr><th>Step no.</th><th>Action</th><th>Check/comments</th><th>Date /time</th><th>Ope rato</th></tr>
<tr><td></td><td colspan="4">System checkout in ambient conditions (RT+Pr – Before Test)</td></tr>
<tr><td>2.01</td><td>Start the SGI-2 data acquisition system.</td><td></td><td></td><td></td></tr>
<tr><td>2.02</td><td>Set the data acquisition interval of SGI-2 for 60 Sec</td><td></td><td></td><td></td></tr>
<tr><td>2.03</td><td>Record temperatures
<table>
<tr><td>TS01</td><td></td><td>TS10</td><td></td></tr>
<tr><td>TS02</td><td></td><td>TS11</td><td></td></tr>
<tr><td>TS03</td><td></td><td>TS12</td><td></td></tr>
<tr><td>TS04</td><td></td><td>TS13</td><td></td></tr>
<tr><td>TS05</td><td></td><td>TS14</td><td></td></tr>
<tr><td>TS06</td><td></td><td>TS15</td><td></td></tr>
<tr><td>TS07</td><td></td><td>TS16</td><td></td></tr>
<tr><td>TS08</td><td></td><td>TS17</td><td></td></tr>
<tr><td>TS09</td><td></td><td>TS18</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table></td><td></td><td></td><td></td></tr>
<tr><td>2.04</td><td>Tests with +X Ethernet switch</td><td></td><td></td><td></td></tr>
<tr><td>2.05</td><td>Switch on Power supply (CH1 +CH2) to Power ON PPD

All units should be ON now.
(Will continue to be ON for the whole test, except for a reset test)</td><td>25.6V
Input Current:
Total Power:</td><td></td><td></td></tr>
<tr><td>2.06</td><td>Over all system checkout and record HK to verify good connection and functionality of each unit.</td><td></td><td></td><td></td></tr>
<tr><td>2.07</td><td>Record temperatures of inbuilt temperature sensors.</td><td>§ 9.3</td><td></td><td></td></tr>
<tr><td>2.08</td><td>Record the pressure and RH values.</td><td>PR:
RH:</td><td></td><td></td></tr>
<tr><td>2.09</td><td>Verify the data pipe line</td><td></td><td></td><td></td></tr>
<tr><td>2.10</td><td>Date rate measurement +x switch</td><td></td><td></td><td></td></tr>
<tr><td>2.11</td><td>Power consumption measurement</td><td>See §12.3</td><td></td><td></td></tr>
<tr><td></td><td>ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches</td><td></td><td></td><td></td></tr>
<tr><td>2.12</td><td>ICS full load test</td><td>See §12.3
Monitor the temperatures</td><td></td><td></td></tr>
</table>

Step no.	Action	Check/comments	Date /time	Ope rato
	System checkout in ambient conditions (RT+Pr – Before Test)			
2.13	Power consumption measurement			
2.14	FG full load test	See §12.3 Monitor the temperatures		
2.15	Power consumption measurement			
2.16	Mark special remarks on temperatures of sub-systems.			
2.17	Tests with -X Ethernet switch			
2.18	ICS full load test			
2.19	Date rate measurement -x switch			
2.20	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.3 CASE: OP-CYCLE-1

16.3.1 PUMPING DOWN

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-1 Preparations			
5.01	Check and remove any tools and/or any foreign objects inside the TV chamber.			
5.02	Check for temp sensor cables and harness			
5.03	Close the door (x2 clamps)			
5.04	Pump down chamber to reach high vacuum.	~<5x10^{-5} mbar.		
5.05	Wait to reach high vacuum.			

16.3.2 OP COLD CASE-1

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-1 , OP Cold case-1			
5.06	Set the following temperatures at SGI-2 chamber Shroud :-30 °C Base plate: -15°C			
5.07	Wait for stabilisation			
5.08	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
5.09	Discussion on ICS temperatures with GFR /MBL	To mimic ascent temp ICS housing < 0°C		
5.10	Tests with -X Ethernet switch			
5.11	Monitor the pressure and RH inside ICS.	Pr: RH:		
5.12	Power consumption measurement	See §12.3		

Step no.	Action	Check/comments	Date /time	Ope rator
	ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches			
5.13	ICS full load test	See §12.3 Monitor the temperatures		
5.14	Power consumption measurement			
5.15	FG full load test	See §12.3 Monitor the temperatures		
5.16	Power consumption measurement			
5.17	Date rate measurement -x switch			
5.18	Mark special remarks on temperatures of sub-systems.			
5.19	Discussion on ICS temperatures with GFR /MBL	To mimic ascent temp ICS housing < 0°C		
5.20	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.3.3 OP HOT CASE-1

Step no.	Action	Check/comments	Date /time	Ope rator
	Case: OP-cycle-1 OP Hot case-1			
5.21	Set the following temperatures at SGI-2 chamber Shroud :+15 °C Base plate: +30°C			
5.22	Wait for stabilisation			
5.23	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-1 OP Hot case-1			
5.24	Tests with +X Ethernet switch			
5.25	Monitor the pressure and RH inside ICS.	Pr: RH:		
5.26	Power consumption measurement	See §12.3		
	ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches			
5.27	ICS full load test	See §12.3 Monitor the temperatures		
5.28	Power consumption measurement			
5.29	FG full load test	See §12.3 Monitor the temperatures		
5.30	Power consumption measurement			
5.31	Date rate measurement +x switch			
5.32	Mark special remarks on temperatures of sub-systems.			
5.33	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.4 CASE: OP-CYCLE-2

16.4.1 OP COLD CASE-2

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-2 OP Cold case-2			
4.01.	Set the following temperatures at SGI-2 chamber Shroud :-30 °C Base plate: -15°C			
4.02.	Wait for stabilisation			
4.03.	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 | TS10 TS02 | TS11 TS03 | TS12 TS04 | TS13 TS05 | TS14 TS06 | TS15 TS07 | TS16 TS08 | TS17 TS09 | TS18		
4.04.	Tests with +X Ethernet switch			
4.05.	Monitor the pressure and RH inside ICS.	Pr: RH:		
	ICS Fans test			
4.06.	Switch off x2 fans	ICS in idle mode.		
4.07.	Measure power consumption			
4.08.	Monitor temperate profile	Wait 30 mins. **Component temperature limit: max +80°C**		
4.09.	Operate ICS			
4.10.	Monitor temperate profile			
4.11.	If there are no temperatures crossing the limits, continue with switching off all x4 fans. If not, then switch ON x2 fans and continue the test 4.16	**Component temperature limit: max +80°C**		

Step no.	Action	Check/comments	Date /time	Operator
4.12.	Measure power consumption			
4.13.	Monitor temperate profile	Wait 30 mins. **Component temperature limit: max +80°C**		
4.14.	Operate ICS			
4.15.	Monitor temperate profile	**Component temperature limit: max +80°C**		
4.16.	Switch ON x4 fans.			
4.17.	Wait for temperature stabilization			
4.18.	ICS full load test	See §12.3 Monitor the temperatures		
4.19.	Power consumption measurement			
4.20.	FG full load test	See §12.3 Monitor the temperatures		
4.21.	Power consumption measurement			
4.22.	Date rate measurement +x switch			
4.23.	Mark special remarks on temperature sensors.			

16.4.1.1 ICS RESET (COLD CASE)

	ICS Reset			
4.24.	Tests with -X Ethernet switch			
4.25.	Operate ICS reset switch.			
4.26.	Wait for 2 min			
4.27.	ICS full load test			
4.28.	Power consumption measurement			
4.29.	FG full load test	To verify functionality of ICS		
4.30.	Power consumption measurement			
4.31.	Date rate measurement -x switch			
4.32.	Mark special remarks on temperature sensors.			

4.33.	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.4.2 OP HOT CASE-2

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-2 OP Hot case-2			
4.34.	Set the following temperatures at SGI-2 chamber Shroud :+15 °C Base plate: +30°C			
4.35.	Wait for stabilisation			
4.36.	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
4.37.	Tests with -X Ethernet switch			
4.38.	Monitor the pressure and RH inside ICS.	Pr: RH:		
4.39.	ICS full load test	See §12.3 Monitor the temperatures		
4.40.	Power consumption measurement			
4.41.	FG full load test	See §12.3 Monitor the temperatures		
4.42.	Power consumption measurement			
4.43.	Date rate measurement -x switch			
4.44.	Mark special remarks on temperature sensors.			

16.4.2.1 ICS RESET (HOT CASE)

	ICS Reset (hot case)

4.45.	Tests with +X Ethernet switch			
4.46.	Operate ICS reset switch.			
4.47.	Wait for 2 min			
4.48.	ICS full load test			
4.49.	Power consumption measurement			
4.50.	FG full load test	To verify functionality of ICS		
4.51.	Power consumption measurement			
4.52.	Date rate measurement +x switch			
4.53.	Mark special remarks on temperature sensors.			
4.54.	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.5 CASE: OP-CYCLE-3

16.5.1 OP COLD CASE-3

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-3 OP Cold case-3			
5.01	Set the following temperatures at SGI-2 chamber Shroud :-30 °C Base plate: -15°C			
5.02	Wait for stabilisation			
5.03	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
5.04	Tests with +X Ethernet switch			
5.05	Monitor the pressure and RH inside ICS.	Pr: RH:		
5.06	ICS full load test	See §12.3 Monitor the temperatures		
5.07	Power consumption measurement			
5.08	FG full load test	See §12.3 Monitor the temperatures		
5.09	Power consumption measurement			
5.10	Date rate measurement +x switch			
5.11	Mark special remarks on temperature sensors.			
5.12	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.5.2 OP HOT CASE-3

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-3 OP Hot case-3			
5.13	Set the following temperatures at SGI-2 chamber Shroud :+15 °C Base plate: +30°C			
5.14	Wait for stabilisation			
5.15	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
5.16	Tests with -X Ethernet switch			
5.17	Monitor the pressure and RH inside ICS.	Pr: RH:		
5.18	ICS full load test	See §12.3 Monitor the temperatures		
5.19	Power consumption measurement			
5.20	FG full load test	See §12.3 Monitor the temperatures		
5.21	Power consumption measurement			
5.22	Date rate measurement -x switch			
5.23	Mark special remarks on temperature sensors.			
5.24	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.6 CASE: OP-CYCLE-4

16.6.1 OP COLD CASE-4

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-4 OP Cold case-4			
6.01	Set the following temperatures at SGI-2 chamber Shroud :-30 °C Base plate: -15°C			
6.02	Wait for stabilisation			
6.03	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
6.04	Tests with -X Ethernet switch			
6.05	Monitor the pressure and RH inside ICS.	Pr: RH:		
6.06	Power consumption measurement	See §12.3		
	ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches			
6.07	ICS full load test	See §12.3 Monitor the temperatures		
6.08	Power consumption measurement			
6.09	FG full load test	See §12.3 Monitor the temperatures		
6.10	Power consumption measurement			
6.11	Date rate measurement -x switch			
6.12	Mark special remarks on temperatures of sub-systems.			

Step no.	Action	Check/comments	Date /time	Operator
6.13	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.6.2 OP HOT CASE-4

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-4 OP Hot case-4			
6.14	Set the following temperatures at SGI-2 chamber Shroud :+15 °C Base plate: +30°C			
6.15	Wait for stabilisation			
6.16	Record temperatures and check stabilisation criteria ($\Delta T/dt \leq 1$ °C/h over $t_E \geq 1$ h)	TS01 / TS10 TS02 / TS11 TS03 / TS12 TS04 / TS13 TS05 / TS14 TS06 / TS15 TS07 / TS16 TS08 / TS17 TS09 / TS18		
6.17	Tests with +X Ethernet switch			
6.18	Monitor the pressure and RH inside ICS.	Pr: RH:		
6.19	Power consumption measurement	See §12.3		
	ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches			
6.20	ICS full load test	See §12.3 Monitor the temperatures		
6.21	Power consumption measurement			
6.22	FG full load test	See §12.3 Monitor the temperatures		
6.23	Power consumption measurement			

Step no.	Action	Check/comments	Date /time	Operator
	Case: OP-cycle-4 OP Hot case-4			
6.24	Date rate measurement +x switch			
6.25	Mark special remarks on temperatures of sub-systems.			
6.26	Power supply + PPD + ICS power converter + ICS + Ethernet switches will continue to remain ON	in Idle condition		

16.7 CASE: RT+PR-AFTER TEST.

16.7.1 ANALYSIS OF THE DATA BEFORE OPENING THE CHAMBER.

Step no.	Action	Check/comments		Date /time	Ope rato
	Analysis of test results				
7.01	Identify the max temperatures of the critical subsystems				
7.02	Date rate of HSCL as per requirements?				
7.03	Check the need to conduct additional tests on ICS or FG in particular.	YES	NO		
7.04	If YES, continue with the additional ICS test as necessary and donot open the chamber.				
7.05	If NO, continue with the section §16.7.2				

16.7.2 PREPARATIONS

Step no.	Action	Check/comments	Date /time	Ope rato
	RT+Pr (After Test) Preparations			
7.06	Switch off active temperature control of Shroud + Base plate			
7.07	Vent the chamber [*Waiting time: >30 mins*]			
7.08	Open the chamber door			
7.09	Conduct visual inspection of units			
7.10	Check for slipped temperature sensors			

16.7.3 OVER ALL SYSTEM CHECKOUT

Step no.	Action	Check/comments	Date /time	Ope rato
	System checkout in ambient conditions (RT+Pr – Before Test)			
7.11	Record temperatures	TS01	TS10		
		TS02	TS11		
		TS03	TS12		
		TS04	TS13		
		TS05	TS14		

Step no.	Action	Check/comments	Date /time	Ope rato
	System checkout in ambient conditions (RT+Pr – Before Test)			
	<table><tr><td>TS06</td><td></td><td>TS15</td><td></td></tr><tr><td>TS07</td><td></td><td>TS16</td><td></td></tr><tr><td>TS08</td><td></td><td>TS17</td><td></td></tr><tr><td>TS09</td><td></td><td>TS18</td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table>			
7.12	Tests with +X Ethernet switch			
7.13	Over all system checkout and record HK to verify good connection and functionality of each unit.			
7.14	Record temperatures of inbuilt temperature sensors.	§ 9.3		
7.15	Power consumption measurement	See §12.3		
7.16	ICS Power converter ON + ICS Idle mode (minimum configuration) + x2 Ethernet switches			
7.17	ICS full load test	See §12.3 Monitor the temperatures		
7.18	Power consumption measurement			
7.19	FG full load test	See §12.3 Monitor the temperatures		
7.20	Power consumption measurement			
7.21	Date rate measurement +x switch			
7.22	Mark special remarks on temperatures of sub-systems.			
7.23	Tests with -X Ethernet switch			
7.24	ICS full load test			
7.25	Date rate measurement -x switch			
7.26	SWITCH OFF Power supply + PPD + ICS power converter + ICS + Ethernet switches			

16.7.4 FINISHING THE TEST

Step no.	Action	Check/comments	Date /time	Ope rato
	Finishing the test			
7.27	Stop the data acquisition at SGI-2.			
7.28	Save the data from SGI-2 to project folder.			
7.29	Update the SGI-2 logbook (at the holder on the wall)			
7.30	Remove FM units and store them in a box.			
7.31	Remove the FM harness and store them appropriately			
7.32	Remove EGSE and store them safely			
7.33	Remove MGSE and store them safely			

17 PROCEDURE DEVIATION LIST

Table 17.1: Procedure deviation list

STEP NO.	DEVIATION	REASON	INITIATOR SIGNATURE	APPROVER SIGNATURE