SOLAR ORBITER ENERGETIC PARTICLE DETECTOR

STEP FM Functional test plan and procedure

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	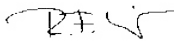		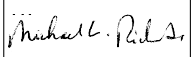		
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Changes Record

Issue	Revision	Date	Modified by	Section modified	Change implemented
1	0	2016-01-26	Panitzsch	All	Initial release, derived from PQM document

Contents

1 INTRODUCTION

1.1 Scope

During the FM/FS environmental test campaigns it will be required to check the functionality and performance of the unit at certain points and to observe both aspects continuously during some of the tests. The functionality checks as described in this procedure will return the status of the unit with respect to the general functionality, whereas the performance checks will return an estimate for the performance of the unit. The results of the performance tests are for information only, whereas the results of the functionality checks serve as PASS/FAIL criteria. How to run the above mentioned checks will be described in detail in this procedure. In general, the unit needs to be connected to a notebook and powered via the EGSE. Then, scripts are executed to run the desired analysis. Also, an abbreviated safe-to-mate test and an impedance check are included.

2 GLOSARY AND DEFINITIONS

2.1 Acronyms and Abbreviations

FM/FS Flight Model/ Flight Spare

EGSE Electrical Ground Support Equipment

PQM Proto Qualification Model

SSD Solid State Detector

STEP SupraThermal Electrons and Protons

3 APPLICABLE AND REFERENCE DOCUMENTS

3.1 Applicable Documents

ID.	Title	Reference	Iss./Rev.	Date
AD-1	Experiment Interface Document part A	SOL-EST-RCD-0050	5	16/03/2015
AD-2	STEP PQM Functional test plan and procedure	SO-EPD-KIE-TP-0026	1/0	01/06/2015

3.2 Reference Documents

ID.	Title	Reference	Iss./Rev.	Date
RD-1	EPT-HET-STEP safe to mate procedure	So-EPD-PO-PR-0041	1/1	29/09/2014

4 TEST PROCEDURE FOR SO-EPD-STEP PQM/FM/FS

4.1 Required Hardware

In order to perform the functional tests, the following hardware is needed:

- STEP unit (FM or FS, but also works for PQM)
- EGSE consisting of: (see figure 1)
  - power strap cable
  - USB cable
  - small black box 'SoloGSE'
  - two 'FROG'-cables
- laboratory power supply ($U > 29\,V$, $I > 500\,mA$)
- laptop with needed scripts/software installed

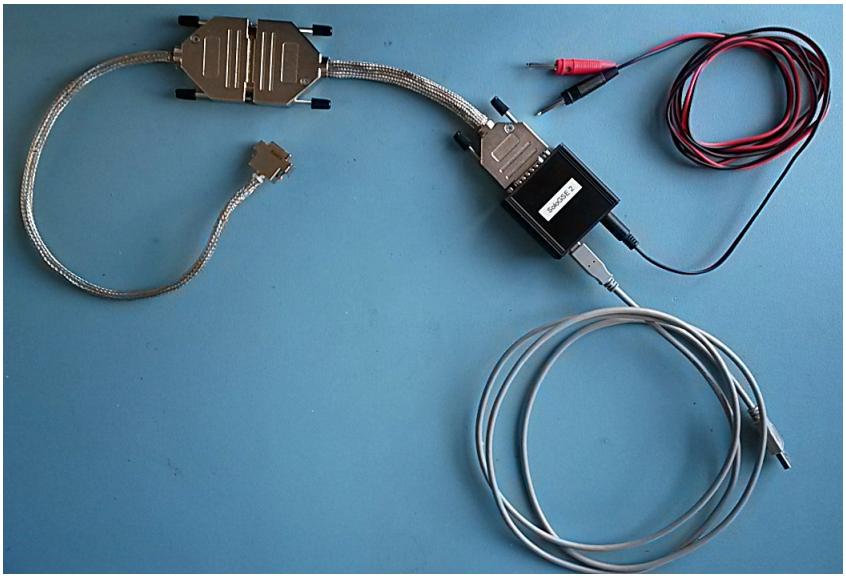

Figure 1: EGSE

After transport and before establishing the first connection between the EGSE and the unit, a safe-to-mate test on the EGSE side is required to be performed. On the other side, after transport and after certain tests with the risk of damaging the unit, the impedances of the unit have to checked against the expected values as given in the corresponding subsection. The function calls as described in the following chapters may be subject of change. However, the general procedure is not expected to change.

4.2 Test Set-up

To prepare the set-up for the functional tests, the EGSE needs to be assembled (see figure 1, 8) and connected to the unit (see figure 2, p. 10). To do so, obey the following steps:

- switch on the laboratory power supply and set the voltage to 28 V; current limitation shall be set to 400 mA
- switch OFF the laboratory power supply
- connect both 'FROG' cables (connectors: DSub25)
- connect the DSub15 connector of the 'FROG' cable to the SoloGSE black box (DSub15)
- connect the SoloGSE black box to the laptop using the USB cable
- connect the power strap to the SoloGSE black box (the banana plugs are not yet connected to the laboratory power supply!)
- connect the banana plugs of the power strap to the laboratory power supply with correct polarity: RED = +28V; BLACK = GND! The power supply is still OFF.
- connect the 'FROG' cable (MDM25) to the MDM25 port of the unit to be tested

It is recommended NOT to disassemble this set-up after each functional test. To remove the unit from this set-up it is required to switch OFF the power supply first, then unplug the MDM25 connector at the unit. In order to integrate the unit to this set-up the sequence is vice versa. In summary:

TO REMOVE THE UNIT FROM THE SET-UP:

- switch OFF the laboratory power supply
- dissolve the MDM25 connector from the unit

TO REINTEGRATE THE UNIT TO THE SET-UP:

- make sure that the power supply is OFF
- connect the MDM25 connector of the 'FROG' cable to the unit
- switch ON the laboratory power supply

In order to disassemble the whole set-up, switch OFF the power supply first. After that, all remaining connectors can be dissolved in arbitrary order.

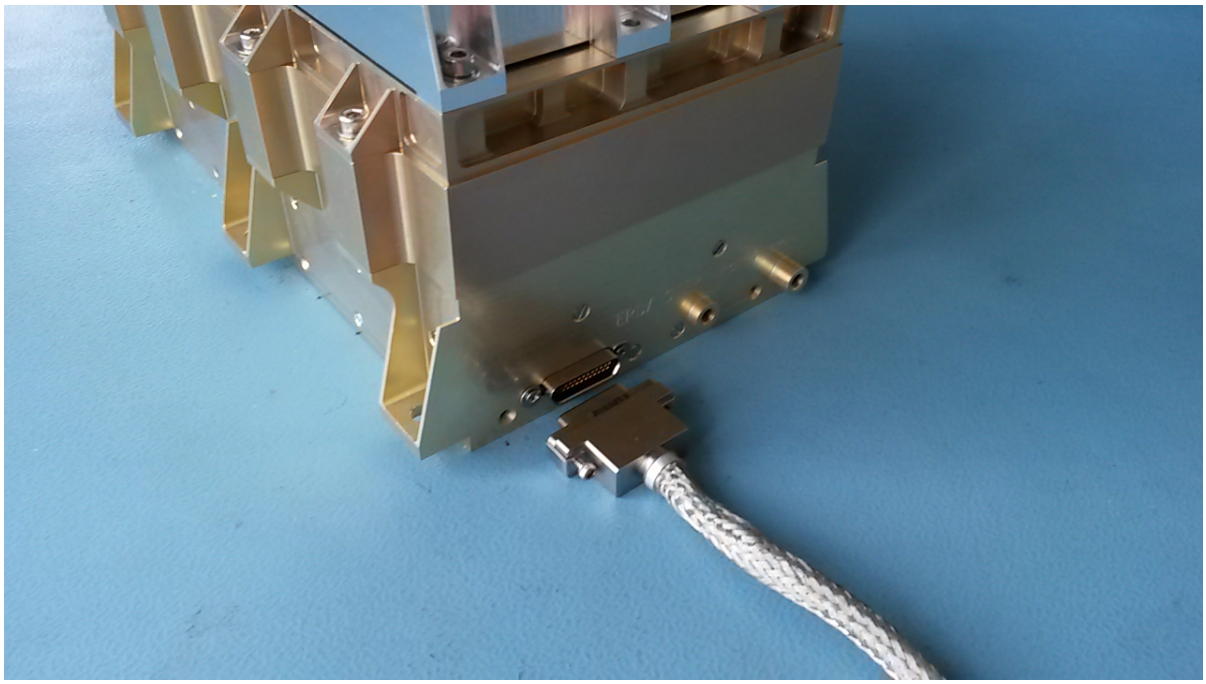

Figure 2: STEP MDM25 connectors

4.3 Unit Impedance Check

After transport, before the first connection to the EGSE, and after tests with higher risks to damage the unit the impedances of the unit shall be measured and compared with the expected values as given in the table (based on RD-1):

Pin (+)	Signal	Pin (-)	Signal	Expected [Ω]	Measurement
Nominal power lines and grounding					
24	Chassis gnd	Chassis	Instrument chassis	<1	
15	Chassis gnd	Chassis	Instrument chassis	<1	
1	Nom. power	Chassis	Instrument chassis	>100k	
1	Nom. power	14	Nom. power return	>100k	
Chassis	Instrument chassis	14	Nom. power return	100k	
Redundant power lines					
13	Red. power	Chassis	Instrument chassis	>100k	
13	Red. power	25	Red. power return	>100k	
Chassis	Instrument chassis	25	Red. power return	100k	
Nominal communication lines					
Chassis	Instrument chassis	4	LVDS I2S-	>100k	
Chassis	Instrument chassis	6	CLK I2S+	>100k	
Chassis	Instrument chassis	8	LVDS S2I+	>100k	
Chassis	Instrument chassis	16	LVDS I2S+	>100k	
Chassis	Instrument chassis	19	CLK I2S-	>100k	
Chassis	Instrument chassis	21	LVDS S2I-	>100k	
4	LVDS I2S-	16	LVDS I2S+	100	
6	CLK I2S+	19	CLK I2S-	100	
8	LVDS S2I+	21	LVDS S2I-	50	
Redundant communication lines					
Chassis	Instrument chassis	5	LVDS I2S-	>100k	
Chassis	Instrument chassis	7	CLK I2S+	>100k	
Chassis	Instrument chassis	10	LVDS S2I-	>100k	
Chassis	Instrument chassis	17	LVDS I2S+	>100k	
Chassis	Instrument chassis	20	CLK I2S-	>100k	
Chassis	Instrument chassis	22	LVDS S2I+	>100k	
5	LVDS I2S-	17	LVDS I2S+	100	
7	CLK I2S+	20	CLK I2S-	100	
10	LVDS S2I-	22	LVDS S2I+	50	

4.4 Abbreviated Safe-to-Mate Test and Power Consumption Check

The abbreviated safe-to-mate test shall be performed before the first connection of EGSE to the unit and after transport of the EGSE.

Pin (+)	Signal	Pin (-)	Signal	Expected [V]	Measurement
1	Nom. power	14	Nom. power ret.	28 or 0 *	
13	Red. power	25	Red. power ret.	28 or 0 *	
* 28V expected if connected to the corresponding NOM or RED port, 0V otherwise.					
any other pin		15	Chassis gnd	< 3	

After successful safe-to-mate test, the unit can be powered. The power consumption of the unit is not supposed to change significantly. When powered, the unit shall drain about 110 mA at 28 V, so about 3.1 W. The current limitation of the power supply shall be set to 500 mA. Document the power consumption as part of the standard procedure. This condition resembles the "Unit unconfigured" as per the table below.

Parameter	Expected	Measured
Voltage	28.0 V	
Current	110 mA	

To define the units power consumption under the different operational modes, document the power consumption under the conditions as given below:
This part of the procedure is required to be conducted only once!

Condition	Voltage (set to 28.0 V)	Current
Unit unconfigured (after POWER ON)		
Unit in HK mode		
Unit in SCI mode (low activity)		
Unit in SCI mode (high activity, testpulser)		

4.5 Setting up Unit Communication

This short sequence describes how to set up the unit and to establish and check the communication with the EGSE. **This sequence has to be obeyed before performing any of the following tests.**

- Make sure the laptop is switched ON
- Switch ON the laboratory power supply. Make sure that the supply voltage is at 28 V, or at least within the margins given in AD-2. After power-on the STEP unit will drain about 3.1 W, i.e. the current will be roughly 110 mA.
- On the laptop follow these steps:
  - in a terminal browse to **/data/etsolo1/step/svn/solo/eda/gse/**
  - start a session with typing **./sologse.py** and press enter
  - in the prompt you then should read amongst others:
    Connected to UNIT via /dev/ttyUSBx
    Connected to GSE via /dev/ttyUSBx
  - test the communication with the unit (each line followed by an enter):

    reset()
    status()

    If **status()** returns an **SoloGSE timeout** error, close the session (**Ctrl + D**), re-plug the USB cable, restart the session, and repeat the communication test. If **status()** returns a list of parameters, the connection to the unit has been established successfully. Use this session to perform the below listed tests.

4.6 Performing an Ad-Hoc Functional Test

The ad-hoc functional test is used to check the ad-hoc functionality of the unit and its sub-assemblies. This test checks the communication with and the functionality of the different sub-assemblies (FPGA, SRAM, EEPROM, IdeF-X, ADCs). The results of the various operations are internally checked for correctness. In the case of the ADCs, the user has to judge whether the determined temperatures are plausible. It shall be noted that the IdeF-X (IX) temperatures always tend to be a few degrees higher than the other temperatures if the system is in a thermally stable condition. To perform the functional test, the following procedure needs to be obeyed:

In the prompt of the session type (each line followed by an enter):

reset()

import step_sft

s = step_sft.sft(msg)

\+ **s.test()**

The results of this test are summarized in the output. An **OK** means that the subsystem test was successfully passed. In some cases it is required to check whether the output (temperatures) are plausible. If so, these subsystem tests can be interpreted as passed. To repeat the test, the command marked with a preceding "+" needs to be repeated.

4.7 Performing an Ad-Hoc Performance Test

The ad-hoc performance test is used to check the ad-hoc performance of the unit. This test checks the noise levels of the IdeF-X channels. As the noise levels depend on several environmental parameters (temperatures, stray light, and EMI) this test is for information only and the results do not serve as PASS/FAIL criteria. Nevertheless, this check may serve as an indicator for a potential degradation of the units performance. To perform the ad-hoc performance test, the following procedure needs to be obeyed:

In the prompt of the session type (each line followed by an enter):

reset()

config_STEP()

optimize_thresholds(ix=1, freq=0.4, int_time=5, start=25, offset=0)

config_STEP()

optimize_thresholds(ix=2, freq=0.4, int_time=5, start=25, offset=0)

The results of this test are printed to the screen.

4.8 Configuring the Unit to Operational Mode

The only mode the unit will be set to during the tests is the mission-like operational (streaming) mode. In that mode the unit will autonomously perform well-defined operations at well-defined frequencies and sequences, and acquire data (science and housekeeping). The data stream is sent via the EGSE to the notebook and stored in user-defined files. To set the unit to that operational mode, follow the sequence as given below. The continuous functionality and performance checks will be performed by analyzing the data instantaneously and continuously when it arrives. The details of the analysis will be explained in the following subsection 4.9.

In the prompt of the session type (each line followed by an enter):

+ **reset()**
  c = get_unit_configtables(unit ="STEP")
+ **Start(“**folder and filename**.dat")**
+ **status()**
+ **c[2](msg)**

It will take up to two minutes until the unit is fully configured. When configured, the prompt in the shell will get available, again. To stop the test, enter **reset()** followed by **Stop()**. To optionally parse the data, open a second shell, navigate to the same folder and execute the following command:

./itf_parser -S -f < **“**folder and filename**.dat"**

To stop the parser, press **Ctrl + C**.

4.9 Continuous Functionality and Performance Check: Unit Monitoring Software

The unit monitoring software is used to continuously parse and plot the data generated by the unit. For running this software, the unit has to be configured to the operational mode, as described in the preceding subsection 4.8. The generated plot is separated to two sub-plots. The upper plot shows the sum of the level-2-trigger counters (acks and nacks for both IdeF-Xs) separated for the small and large pixels. The lower plot shows housekeeping data (temperatures and/or voltages). Both plots will be updated regularly when new data arrives. The terminal where this monitoring software is run, simultaneously prints how many new lines have been received since the last print. To run the monitoring software, set the unit into operational mode, and follow the sequence as given below:

Start a new command prompt

Navigate to **/data/etsolo1/step/svn/solo/eda/gse/step**

+ Enter the command **./itf_parser -S -f < "** path and filename of file to analyze**.dat"** | **./step_monitor.py**

The optional test PASS/FAIL criteria are as follows:

fully passed:
The unit stays in an operational mode and provides data continuously.

passed:
The communication with the unit is lost during the tests but can be resumed after the tests.

not passed:
The communication to the unit is lost during the tests and cannot be resumed after the tests.

IMPORTANT NOTE:
The most reliable way to check whether the data transmission (so communication) is still OK is to check the output of the parser in the terminal. If communication fails and is not resumed after the test autonomously, it is mandatory to check whether the GSE or the unit itself has caused the failure. To do so, follow the sequence as given below:

Press **Ctrl + D** in the terminal that was used to set the unit to operational mode

Unplug and replug the USB cable connecting GSE and notebook

Start a new session with typing **./sologse.py** and press enter

Type **Start("**filename_**cont.dat")**

Check whether new data is written to the new file

If new data is stored in the file the unit is still operational and the test is considered as passed.

4.10 As Run Functional Test Report

Date and Time	

4.10.1 Functional Test Readiness

Location	
Personnel	
Instrument ID	
Firmware revision	
Reason for FT	
Test to be performed	

4.10.2 FT Constraints (if applicable)

Safe-to-mate	
Impedance check	
Set up communication	
Additional constraints	

4.10.3 FT Details

Step #	Activity	Result
1	Data file name if applicable	
2	Test started / stopped	
3	Test result	
4	Comments	
Signatures		