



# RPW Calibration Data Visualization User Requirements

Ref: ROC-TST-GSE-SWU-00003-LES  
Issue: 01  
Revision: 02  
Date: 12/02/2016

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SOLAR ORBITER



## RPW Operation Centre

# RPW Calibration Data Visualization User Requirements

ROC-TST-GSE-SWU-00003-LES  
Iss.01, Rev.02

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CLASSIFICATION

PUBLIC



RESTRICTED



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## Change Record

Issue	Rev.	Date	Authors	Modifications
1	0	01/10/14	X.Bonnin	First release
1	1	10/02/15	X.Bonnin	Change Data Viewer to Test Data Viewer. Add Software requirements section
1	2	12/02/16	X.Bonnin	Requirements are referenced with unique IDs. See appendices

## Acronym List

Acronym	Definition	Acronym	Definition
ROC	RPW Operation Centre	HK	House Keeping
SGSE	Software Ground Support Equipment	CDF	Common Data Format
EGSE	Electronic Ground Support Equipment	PDF	Portable Document Format
SGS	Science Ground Segment	JPEG	Joint Photographic Experts Group
TC	Telecommand	XML	Extensible Markup Language
TM	Telemetry	IDL	Interactive Data Language
GUI	Graphical User Interface	CNES	Centre National d'Etudes Spatiales
ESAC	European Space Astronomy Centre	FFT	Fast Fourier Transform
SOC	Science Operation		



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	Centre		
MEB	Main Electronic Box		



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## 1 GENERAL

### 1.1 Scope of the Document

The scope of the document is to define the user requirements in terms of visualization tools to be developed by the RPW Operation Centre (ROC) for the RPW calibration tests at the system level.

### 1.2 Applicable Documents

This document responds to the requirements of the documents listed in the following table:

Mark	Reference/Iss/Rev	Title of the document	Author s	Date
AD1	SOLO-RPWSY-PT-1235-CNES/01/00	RPW Instrument Calibration Plan	Milan Maksi movic	11/12/2014
AD2				
AD3				
AD4				
AD5				

### 1.3 Reference Documents

This document is based on the documents listed in the following table:

Mark	Reference/Iss/Rev	Title of the document	Authors	Date
RD1	RPW-SYS-MEB-THR-SPC-00043-LES/01/01	Thermal Noise and High Frequency Receiver (TNR-HFR)	M.Dekkal i	15/02/201 2
RD2	RPW-MEB-LFR-SPC-00003/01/04	LFR Low Frequency Receiver	P.Leroy	21/02/201 2
RD3	SO-RPW-TDS-SPEC/02/04	Time Domain Sampler	J.Soucek	28/02/201 2
RD4	RPW-SYS-MEB-BIA-SPC-00001-IRF/01/10	BIAS	Sven-Erik Jansson Lennart Ahlen	02/10/201 3
RD5	RPW-SYS-MEB-GSE-SPC-00125-LES/01/01	MEB GSE Description	L.Guegue n	26/11/201 2



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## 2 INTRODUCTION

The ROC shall provide data visualization tools to the RPW consortium in order to analyze and validate the instrument calibration tests at the system level. In particular these tools shall be consistent with the requirements described in the calibration plan document [AD1].

The following main capabilities shall be supported:

- TM/TC packet monitoring
- HK visualization
- RPW system and sub-system data visualization

In order to cover both engineering and scientific user requirements, the ROC shall develop and maintain two types of visualization tools:

- A fully integrated data viewer, which offers a user-friendly interface to easily read, display and extract RPW data produced during the calibration tests at the system level.
- Libraries of routines, which allow users to retrieve and plot RPW data from their own programs.

User libraries shall be developed at least in one or two programming languages commonly used by the RPW teams.

The Data viewer source code shall be as much as possible re-usable to develop the visualization tool that will be employed during the RPW in-flight operations.

## 3 RPW TEST DATA VIEWER

A dedicated data viewer shall be available to easily read, display and export RPW calibration test data. Moreover it shall be able to be deployed and run at CNES (Toulouse, France) during the calibration tests.

This software shall be satisfies the following user requirements:

- Display instrument status
- Display RPW system and sub-system status
- Display data product availability
- Engineering and HK product access
- Engineering and HK product viewer
- Calibration product access
- Calibration product viewer

### 3.1 Technical requirements

In terms of technical requirements, the viewer shall be able to:

- Run on Linux and Windows environments (i.e., software portability)
- Be launched as a script (or executable binary file)



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- Be as much as possible configurable. The use of configuration files is thus highly recommended.

## 3.2 Common visualization requirements

### 3.2.1 General

The following general requirements shall be available:

- Both graphical and tabular views shall be available for data visualizations.
- A console shall be accessible through a dedicated window in order to display the software activity log.
- The viewer shall provide scripts for TBD tasks that can be run from a command line interface.

### 3.2.2 Data plotting

The following general requirements for plotting shall be available:

- It shall be possible to plot data for a given test file or a given set of test files. Especially, it shall possible to over-plot data from different test files for a given sub-system on the same plot.
- It shall be possible to pop-up the current plot in a new window.
- For a given axis, it shall be possible to modify the range values (i.e., zoom option).
- For a given axis, it shall be possible to display values using linear or logarithm scale.
- For a given axis, it shall be possible to display point indices starting at 0 or physical values (e.g., actual time in seconds, frequency values in kHz, etc.).
- It shall be possible to get the value pointed by the mouse on the plot.
- For an image visualization, it shall be possible to plot a 1D view over a given axis. (e.g., plot time series for a given frequency or a spectra for a given time on a dynamical spectrum).
- The list of RPW sub-systems involved in the current tests in the relevant order shall be indicated (e.g., PA\_LF --> BIAS --> LFR).
- It shall be possible to plot two different types of curves using two distinct Y-axis (e.g., Current consumption and temperature).

### 3.2.3 TM/TC monitoring

Dedicated panel view shall be developed to monitor the list of TM/TC packets of a given test file or a given set of test files. This panel view shall permit to select a given TM or TC packet from a list, and print the header content and relevant information about the data inside. Filters shall allow displaying only packets for a given sub-system or a given set of sub-systems.

### 3.2.4 HK visualization

A panel view dedicated to the HK visualization shall be available. It shall permit to select and display one or more HK parameters for a given test file or a given set of test files. The





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selection shall be done from the list of loaded HK packets. Options shall be implemented to make easier the selection between one or more sub-system HK. HK parameters shall be viewable as time series or tables.

### 3.2.5 RPW sub-system data visualization

A panel view allowing data visualization for each RPW sub-system independently and/or commonly shall be implemented.

The following features shall be available:

- It shall be able to compute FFT on the TDS/LFR waveform data.
- It shall be possible to distinguish between actual time and interpolated time values.
- Depending on the sub-system data, it shall be possible to display the BIAS status (e.g., ON/OFF, ...)
- Depending on the sub-system data, it shall be possible to plot individual E and/or B component separately (i.e., E1, E2, E3, B1, B2, B3).

The list of RPW sub-system data to display is described in details in the section 2.2.

### 3.2.6 Activity log

A panel view shall allow visualizing a history of the software current internal activity in terms of data loading, warning/error summary reports, etc. In addition, full internal activity shall be saved in real time in a log file.

## 3.3 Data visualization requirements

This section provides user requirements in terms of RPW data to be viewable from the data viewer.

### 3.3.1 Test configuration parameters

An overview of the configuration parameters used for a given test shall be easily viewable from the user interface.

### 3.3.2 Input stimuli data

It shall be possible to visualize input stimuli data associated with a given test.

### 3.3.3 DPU

The data viewer shall provide the following features for the RPW-DPU:

- A dedicated panel view for the DPU status parameter visualization (mainly HK)
- Possibility to easily check DPU TC acceptances (error, warning, etc.) from returned TM.
- Data rate, CPU load as a function of the power consumption

It shall possible to switch between the DPU Application Software (DAS) or the DPU Boot Software (DBS) data.



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### 3.3.4 TNR

The data viewer shall be able to display the following TNR data for a one or more test files:

- AGC values as a function of time.
- Auto-correlation and cross-correlation values as a function of time for a given frequency range. If more than one time series are found in the frequency range, it shall be able to plot the individual data curves, an integrated curve or the maximal values.
- Auto-correlation and cross-correlation values as a function of frequency for a given time range. If more than one spectrum are in the time range, it shall be able to plot individual data curves, an integrated curve, or max.
- Auto-correlation and cross-correlation values as functions of time and frequency (i.e., dynamical spectrum).
- Phase in degrees as a function of frequency.

It shall be able to display AGC, auto and cross-correlation values in TM units or calibrated values (i.e.,  $\text{dB}(\text{V}^2/\text{Hz})$ ) if possible. Time shall be given in count since the beginning of the test or in seconds and frequency in kHz.

Moreover it shall be possible to plot TNR data for one or both channels (1 and 2) on the same plot and for each receiver band (A, B, C and D).

### 3.3.5 HFR

The data viewer shall be able to display the following HFR data for a given test file:

- AGC values as a function of time for a given frequency range. If more than one time series are found in the frequency range, it shall be able to plot individual data curves or an integrated curve.
- AGC values as a function of frequency for a given time range. If more than one spectrum are found in the time range, it shall be able to plot individual data curves or an integrated curve.
- AGC values as functions of time and frequency (i.e., dynamical spectrum).

It shall be able to display AGC values in TM units or calibrated values (i.e.,  $\text{dB}(\text{V}^2/\text{Hz})$ ) if possible. Time shall be given in count since the beginning of the test or in seconds and frequency in kHz.

Moreover it shall be possible to plot HFR data for one or both channels (1 and 2) on the same plot and for each receiver band (HF1 and HF2). Figure 2 gives an idea of what a time series plot should look like in the HFR panel view.

#### 3.3.5.1 TNR and HFR

It shall be able to combine TNR and HFR spectra plots or tables for a given time range.

### 3.3.6 LFR

The data viewer shall be able to display the following data for the LFR sub-system [RD2]:

- Snapshots waveforms



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- V, E1, E2, BA, B2, B3 of a given frequency  $f_0$ ,  $f_1$  or  $f_2$  at the same time or separately.
- Snapshot waveforms should be displayed for a given time range and in TM units
- Continuous waveforms
  - V, E1, E2, BA, B2, B3 of a given frequency  $f_1$ ,  $f_2$  or  $f_3$  at the same time or separately.
  - Continuous waveforms should be displayed for a given time range and in TM units.
- Average spectral matrices (ASM)
  - values in TM and float units
  - Possibility to plot frequency spectra (up to 9 elements of the matrix amongst 25 on the same window to be chosen by user).
  - Possibility to plot color dynamical spectra: all frequencies (from  $f_0$ ,  $f_1$  and  $f_2$ ) for a given time range and for up to 9 elements of the matrices.
- Basic parameters (BP)
  - For BP2, same as ASM
  - For BP1, same as ASM applied to the decommuted BP1 parameters (11 max.): PE, PB, NVEC\_V0/V1/V2, ELLIP, DOP, SX, SX\_Arg, VPHI, VPHI\_Arg.
- LFR waveforms versus TDS waveforms
  - TDS “Low frequency mode” parameters (TC\_TDS\_LOAD\_LFM\_PAR)
  - It shall be able to combine LFR and TDS “low frequency mode” waveforms, cross and power spectrum plots (TM\_TDS\_SCIENCE\_LFM\_\*) for a given time range overlayed on same graph/window.

It could be useful to be able to overlay snapshots and continuous waveforms of the different frequencies ( $f_0$ ,  $f_1$ ,  $f_2$  and  $f_3$ ).

### 3.3.7 TDS

The data viewer shall be able to display the following data for the TDS sub-system [RD3]:

- Regular Waveform Snapshots (E+B)
- Triggered Waveform Snapshots (E+B)
- 1D histogram
- 2D histogram
- Low rate information
- LFR redundancy mode parameters
- TDS LFR redundancy parameters versus actual LFR parameters

### 3.3.8 BIAS

The data viewer shall be able to display the following BIAS sub-system [RD4] parameters:

- BIAS currents as a function of LFR voltage

### 3.3.1 PA

The status of the Pre-Amplifier (e.g., ON, OFF) shall be available.



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### 3.3.2 ANT

No specific needs are required in terms of visualization for the electrical antenna data for the moment.

### 3.3.3 SCM

The status of the SCM (e.g., ON, OFF) shall be available.

### 3.3.4 Ancillary data

No specific needs are required in terms of visualization for the ancillary data for the moment.

### 3.3.5 SBM

No specific needs are required in terms of visualization for the Selected Burst Modes (SBM) data for the moment.

## 3.4 Miscellaneous requirements

A dedicated panel shall allow users to write a comment for a given test. It shall be possible to save and re-load this comment for later use.

## 3.5 Data exporting requirements

The following requirements for data exporting shall be available in the data viewer:

- RPW data for current test files can be exported into an Excel spreadsheet.
- Data plotted in the current active window can be saved in standard format file for image such as JPEG or PDF.

## 4 USER LIBRARIES

In addition to the data viewer, the ROC shall provide routine libraries in the following programming languages:

- IDL (8.3 or higher)
- Python (2.7)

These libraries shall be easily accessible and shall allow users to perform at least basic actions (e.g., download, read, handle and/or plot) on the ROC ground test data products for their own purposes.

### 4.1 Basic features

The libraries shall be able to perform the following basic actions:

- Read one ore more RPW CDF format files produced by the ROC
- Plot one ore more RPW CDF variables as function of another CDF variable
- Download or stream RPW CDF format files stored in the ROC server.

### 4.2 Advanced features

TBW



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## 5 DISTRIBUTION LIST

<p><b>LISTS</b></p> <p>See Contents lists in “Baghera Web”: Project’s informations / Project’s actors / RPW_actors.xls and tab with the name of the list or NAMES below</p>	x	Tech_LESIA
	x	Tech_MEB
	x	Tech_RPW
	x	[Lead-]Cols
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	x	ELEONORE HOLLE

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