



RPW Calibration Software User Manual Template for SCM waveforms SCMCAL User Manuel

Ref: SO-UM-RPW-SC-0270-LPC2E

Issue: 01

Revision: 00

Date: 15/12/2017

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SOLAR ORBITER



RPW Operation Centre

RPW Calibration Software User Manual Template for SCM waveforms SCMCAL User Manuel

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Change Record

Acronym List

Acronym	Definition
CDF	Common Data Format
RCS	RPW Calibration Software
RCT	RPW Calibration Table
ROC	RPW Operation Centre
RPW	Radio and Plasma Waves instrument
SUM	Software User Manual



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1 GENERAL

1.1 Scope of the Document

This document presents the user calibration software. After a short description of the software design and data, we explain how to use it.

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	Authors	Date
AD1	ROC-PRO-PIP-ICD-00037/1/1	RPW Calibration Software Interface Control Document	M.Duarte, X.Bonnin	12/10/2017
AD2	ROC-PRO-DAT-NTT-00006-LES/1/1	RPW Data Products	X.Bonnin	17/11/2017
AD3				
AD4				

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				
RD2				
RD3				
RD4				
RD5				



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2 CONVENTIONS

Command lines are always shown within a text box in Courier New font. Boldface font indicates that the variable should be substituted with a value either defined by the user or to be set among a list of expected values. Directories and source code files are indicated in Courier New.

3 DESCRIPTION OF THE SOFTWARE

3.1 Purpose of the software

The purpose of the software is to calibrate L1 data to obtain L2 data for all RPW modes.

3.2 Operations environment

The software is expected to run on any machine where IDL 8.5 is installed.

3.3 Software design overview

The software has the following components (all can be found under the `src` directory):

- A component to manage error messages and return codes [`scmcal.pro`]
- A component to check the input parameters and environment variable settings [`scmcal.pro`]
- A logger to control the program execution [`objlogger_define.pro`]
- A component to read a specific calibration from the calibration CDF file [`readcal.pro`]
- A component to calibrate a digitized signal (for a given sampling frequency) [`calibrate.pro`, `calibrate_analysers.pro`]
- Several components where specific functions can be found [`tools.pro`, `getglobatt.pro`, `timelib.pro`, `demodule.pro`, `norm_phase.pro`]
- A component to obtain a list of continuous blocks when waveforms are labelled as continuous (this does not apply to waveforms made of snapshots) [`continuousblocks.pro`]
- A mode-specific component which processes the input L1 and master CDF files to produce an output L2 CDF file. It consists in filling the master CDF file by copying some CDF attributes and variables present in the L1 CDF file, and applying the transfer functions for gains and phases to the magnetic field data written in the L1 CDF file [`lfr_sbm1_cwf_b_cal.pro`, `lfr_sbm2_cwf_b_cal.pro`, `lfr_surv_cwf_b_cal.pro`, `lfr_surv_swf_b_cal.pro`, `tds_lfm_cwf_b_cal.pro`, `tds_lfm_rswf_b_cal.pro`, `tds_sbm1_rswf_b_cal.pro`, `tds_sbm2_tswf_b_cal.pro`, `tds_surv_rswf_b_cal.pro`, `tds_surv_tswf_b_cal.pro`].

3.4 External interfaces

Before running the main script, the environment variables `ROC_RCS_PATH`, `ROC_RCS_CAL` and `ROC_PIP_NAME` must be set:



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- The value of ROC_RCS_PATH is the absolute path to the main program directory.
- The value of ROC_RCS_CAL is the absolute path to the SCM calibration file.
- The value of ROC_PIP_NAME is the name of pipeline under which the program will run.

The main program (located under the bin subdirectory) can be executed as follows:

```
bin/scmcal.sh mode_key_name
--config ${ROC_RCS_PATH}/config/config_filename.json
--log ${ROC_RCS_PATH} /log_filename.txt
--output_name ${ROC_RCS_PATH}_ROOT/some/path/output_filename.cdf
--input_name ${ROC_RCS_PATH}/some/path/input_filename.cdf
```

The table below gives the value of the parameters **mode_key_name** and **input_mode_name** for each RPW mode.

RPW Modes	mode_key_name	input_mode_name / output mode name
LFR-SBM1-CWF	lfr_sbm1_cwf_b_12s_from_11	input_lfr_sbm1_cwf_11 output lfr sbm1 cwf 12s
LFR-SBM2-CWF	lfr_sbm2_cwf_b_12s_from_11	input_lfr_sbm2_cwf_11 output lfr sbm2 cwf 12s
LFR-SURV-CWF	lfr_surv_cwf_b_12s_from_11	input_lfr_surv_cwf_11 output lfr surv cwf 12s
LFR-SURV-SWF	lfr_surv_swf_b_12s_from_11	input_lfr_surv_swf_11 output lfr surv swf 12s
TDS-LFM-CWF	tds_lfm_cwf_b_12s_from_11	input_tds_lfm_cwf_11 output tds lfm cwf 12s
TDS-LFM-RSWF	tds_lfm_rswf_b_12s_from_11	input_tds_lfm_rswf_11 output tds lfm rswf 12s
TDS-SBM1-RSWF	tds_sbm1_rswf_b_12s_from_11	input_tds_sbm1_rswf_11 output tds sbm1 rswf 12s
TDS-SBM2-TWSF	tds_sbm2_tswf_b_12s_from_11	input_tds_sbm2_tswf_11 output tds sbm2 tswf 12s
TDS-SURV-RSWF	tds_surv_rswf_b_12s_from_11	input_tds_surv_rswf_11 output tds surv rswf 12s
TDS-SURV-TSWF	tds_surv_tswf_b_12s_from_11	input_tds_surv_tswf_11 output tds surv tswf 12s

Table 1. Parameter values for all RPW modes

The configuration file **config_filename.json** depends on the pipeline used. If the pipeline is RGTS, the configuration file is scmcal_configuration_rgts.json and if the pipeline is RODP, the configuration file is scmcal_configuration_rod़.json.

log_filename.txt, **input_filename.cdf** and **output_filename.cdf** are respectively the name of the file used for logging, the name of the L1 CDF file to be processed and the output filename to be created by the program.



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3.5 Software operating modes

With the software, the user can produce L2S/L2 CDF files from L1 CDF files. Master CDF files for all modes should also be given, as well as a calibration CDF file (RCT) where a set of SCM transfer functions are stored. The user should specify the version to use in a configuration file as detailed further.

3.6 Description of the software data

3.6.1 Software input data

The list of expected input data are given in the table below:

Input data name	Description	Purpose	Format	Required in the following mode(s)
scmcal_configuration_rgts.json scmcal_configuration_rodः.json	File to configure options or parameters in the software. Should lie in the subdirectory config.	Configuration	JSON	All
SOLO_CAL_RCT-SCM_SCM-FS-MEB-EM1_V20171215000000.cdf	File that stores the SCM transfer functions . Should lie under the directory provided by the ROC_RCS_CAL environment variable.	Calibration	CDF	All
ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B_V03.cdf	Master CDF to be used for the generation of the L2 data. Should lie in the subdirectory config.	Master CDF Template for the output CDF file	CDF	LFR-SBM1-CWF
ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B_V03.cdf	LFR-SBM2-CWF			
ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B_V03.cdf	LFR-SURV-CWF			
ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B_V03.cdf	LFR-SURV-SWF			
ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B_V03.cdf	TDS-LFM-CWF			
ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B_V03.cdf	TDS-LFM-RWSF			
ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B_V03.cdf	TDS-SBM1-RSWF			
ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B_V03.cdf	TDS-SBM2-TSWF			
ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B_V03.cdf	TDS-SURV-RSWF			
ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B_V03.cdf	TDS-SURV-TSWF			
ROC-SGSE_L1_RPW-LFR-SBM1-CWF xxxxxxxx CNE V02.cdf			CDF	LFR-SBM1-CWF



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ROC-SGSE_L1_RPW-LFR-SBM2-CWF_xxxxxxx_CNE_V02.cdf	Input CDF file at L1 level. There are no requirements for the files location.	Contains the magnetic field data at L1 level.	LFR-SBM2-CWF
ROC-SGSE_L1_RPW-LFR-SURV-CWF_xxxxxxx_CNE_V02.cdf			LFR-SURV-CWF
ROC-SGSE_L1_RPW-LFR-SURV-SWF_xxxxxxx_CNE_V02.cdf			LFR-SURV-SWF
ROC-SGSE_L1_RPW-TDS-LFM-CWF_xxxxxxx_CNE_V02.cdf			TDS-LFM-CWF
ROC-SGSE_L1_RPW-TDS-LFM-RSWF_xxxxxxx_CNE_V02.cdf			TDS-LFM-RWSF
ROC-SGSE_L1_RPW-TDS-SBM1-RSWF_xxxxxxx_CNE_V02.cdf			TDS-SBM1-RSWF
ROC-SGSE_L1_RPW-TDS-SBM2-TSWF_xxxxxxx_CNE_V02.cdf			TDS-SBM2-TSWF
ROC-SGSE_L1_RPW-TDS-SURV-RSWF_xxxxxxx_CNE_V02.cdf			TDS-SURV-RSWF
ROC-SGSE_L1_RPW-TDS-SURV-TSWF_xxxxxxx_CNE_V02.cdf			TDS-SURV-TSWF

Table 2. Software input data list.

3.6.2 Software output data

Although the name of the output file can be chosen freely, it is a good idea to give a name consistent with the input file name. Examples are given in the table below.

Output data name	Description	Format	Product of the following mode(s)
ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B_xxxxxxx_CNE_V03.cdf	Output CDF file at L2S level	CDF	LFR-SBM1-CWF
ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B_xxxxxxx_CNE_V03.cdf			LFR-SBM2-CWF
ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B_xxxxxxx_CNE_V03.cdf			LFR-SURV-CWF
ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B_xxxxxxx_CNE_V03.cdf			LFR-SURV-SWF
ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B_xxxxxxx_CNE_V03.cdf			TDS-LFM-CWF
ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B_xxxxxxx_CNE_V03.cdf			TDS-LFM-RWSF
ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B_xxxxxxx_CNE_V03.cdf			TDS-SBM1-RSWF
ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B_xxxxxxx_CNE_V03.cdf			TDS-SBM2-TSWF
ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B_xxxxxxx_CNE_V03.cdf			TDS-SURV-RSWF
ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B_xxxxxxx_CNE_V03.cdf			TDS-SURV-TSWF

Table 3. Software output data list.



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3.6.3 Software installation and configuration files

The software is delivered as a compressed file and also on a git repository
<https://gitlab.obspm.fr/ROC/RCS/SCMCAL>.

The software works with a configuration file written in the JSON format with the following fields:

Configuration variable name	Description	Type	Possible values	Modes
Pipeline	Name of the pipeline	String	RGTS, RODP	All
VerboseLevel	Level of verbosity	String	debug	All
CalibrationFile	Name of the CDF calibration file used for SCM	String	config/ SOLO_CAL_RCT-SCM_SC-MFS-MEB-EM1_V20171215000000.cdf	All
CalibrationVersion	Version number of the calibration to use	String	V20171215000000	
DataVersion	Version of the data	String	03	
MasterPath	Relative path of the configuration directory	String	config	
ComputeEpoch	To indicate whether Epoch should be computed from ACQUISITION_TIME or not	String	true false	
RemoveFirstPointInBlock	To remove first point in a block	String	true false	
master_lfr_sbm1_cwf_b_l2s	Master CDF file name	String	ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B_V03.cdf	LFR-SBM1-CWF
master_lfr_sbm2_cwf_b_l2s			ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B_V03.cdf	LFR-SBM2-CWF
master_lfr_surv_cwf_b_l2s			ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B_V03.cdf	LFR-SURV-CWF
master_lfr_surv_swf_b_l2s			ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B_V03.cdf	LFR-SURV-SWF
master_tds_lfm_cwf_b_l2s			ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B_V03.cdf	TDS-LFM-CWF
master_tds_lfm_rswf_b_l2s			ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B_V03.cdf	TDS-LFM-RSWF
master_tds_sbm1_rswf_b_l2s			ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B_V03.cdf	TDS-SBM1-RSWF
master_tds_sbm2_tswf_b_l2s			ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B_V03.cdf	TDS-SBM2-TSWF
master_tds_surv_rswf_b_l2s			ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B_V03.cdf	TDS-SURV-RSWF



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master_tds_surv_tswf_b_l2s			ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B_V03.cdf	TDS-SURV-TSWF
----------------------------	--	--	--	---------------

Table 4. Software configuration file parameters.

3.6.4 Software internal data files

Not applicable.

3.6.5 Software testing data files

To be done.

4 REFERENCE MANUAL

4.1 Software configuration requirements

4.1.1 General

Not applicable.

4.1.2 Hardware configuration requirements

Not applicable.

4.1.3 Software configuration requirements

IDL 8.5 must be installed.

The leap seconds file /usr/local/CDFLeapSeconds.txt should be updated regularly.

4.2 Operations manual

4.2.1 Setup and initialisation

Before launching the RCS, the script setup_scmcal_env.sh must be sourced.

4.2.2 Getting started

Nothing.

4.2.3 Normal operations

4.2.4 Normal termination

The normal termination code (i.e., the return code) of the program is 0.

4.2.5 Error conditions

The error messages are written into the log file and also on the standard error output (stderr) when the error code is equal to 1.

4.2.6 Help method

The help information about how to run the program can be obtained with:

```
./scmcal.sh --help
```



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4.2.7 Commands and operations

4.2.8 Error messages

The list of all error messages can be found in the table below.

Error message	Action to take
The parameter --config is missing (or its value)	Provide the configuration file path
The parameter --output is missing (or its value)	Provide the output directory path
Unable to read environment variable ROC_RCS_PATH	Set the environment variable properly
Unable to read the configuration file	Check the format of the configuration file
The parameter --output is not a directory or not writable	Check that the output path provided in a directory or writable
The function name FUNC is unknown	Means that the internal function <i>FUNC</i> does not exist
The parameter --log is missing (or its value)	Provide the log file path
The parameter --input_lfr_surv_swf_b_11 (or its value) is missing	Provide the input file
The parameter "output_lfr_surv_swf_b_12s" is missing in the configuration file	Provide the output file name in the configuration file
Unable to open FILE	Make sure that FILE is indeed a file
The input file has an invalid DATASET_ID	The input file is probably not correct since its mode does not correspond to the expected mode
The parameter "MasterPath" is missing in the configuration file	Provide the MasterPath (the relative path where all master CDF files are located) in the configuration file
Unable to read FILE	Make sure that FILE is a file
The variable "var" does not exist in the input file	The attribute variable should be added to the CDF file



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The parameter "CalibrationFile" is missing in the configuration file	Provide the CalibrationFile in the configuration file
The parameter "CalibrationVersion" is missing in the configuration file	Provide the CalibrationVersion in the configuration file
The parameter "DataVersion" is missing in the configuration file	Provide the DataVersion in the configuration file
"ifreq" out of range	There are 4 indices corresponding to the sampling frequencies 24576, 4096, 256, 16 Hz. The index ifreq must lie between 0 and 3. [Internal function]
iB out of range	There are 3 indices that relates B1, B2, B3 to By, Bz and Bx. The index iB must lie between 0 and 2. [Internal function]
Wrong size for MAGNETIC variable ([3, 2048] expected)	The structure of the variable MAGNETIC in the CDF file must be corrected to be [3, 2048]
Wrong size for WAVEFORM_DATA variable (4 or 8 expected)	
There are no data for the magnetic component	Remove the CDF file
Neither SAMPLING_RATE nor FREQ figures in the input file	Provide either the SAMPLING_RATE or FREQ. [This error happens only for continuous waveform data]

Table 5. List of the possible errors and actions to take to solve them

4.2.9 Software testing operations

4.2.10 Software upgrading operations

4.2.11 Software uninstalling operations

5 TUTORIAL

5.1 Introduction

5.2 Getting started

5.3 Using the software on a typical task



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6 APPENDICES

6.1 Troubleshooting & know issues



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7 LIST OF TBC/TBD/TBWs



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8 DISTRIBUTION LIST

<p>LISTS</p> <p>See Contents lists in “Baghera Web”:</p> <p>Project’s informations / Project’s actors / RPW_actors.xls</p> <p>and tab with the name of the list</p> <p>or NAMES below</p>	<table border="1"> <tr><td>Tech_LESIA</td></tr> <tr><td>Tech_MEB</td></tr> <tr><td>Tech_RPW</td></tr> <tr><td>[Lead-]Cols</td></tr> <tr><td>Science-Cols</td></tr> </table>	Tech_LESIA	Tech_MEB	Tech_RPW	[Lead-]Cols	Science-Cols
Tech_LESIA						
Tech_MEB						
Tech_RPW						
[Lead-]Cols						
Science-Cols						

INTERNAL

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	M. KRETZSCHMAR		M. MORLOT
	V. KRASNOSEL'SKIKH		
SSL	S. BALE	LPP	