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RPW Operation Centre

RPW Calibration Software User Manual for THR_CALBAR

ROC-PRO-SFT-SUM-00124-LES
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Change Record

Issue	Rev.	Date	Authors	Modifications
1	0	31/08/2020	A.Vecchio	First issue

Acronym List

Acronym	Definition
RCS	RPW Calibration Software
ROC	RPW Operation Centre
RPW	Radio and Plasma Waves instrument
SUM	Software User Manual

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List of Tables

1 GENERAL

1.1 Scope of the Document

This document is the software user manual (SUM) of the THR CALBAR S/W. It describes the purpose, content, functions and procedures to retrieve, configure and run THR CALBAR on a validated system environment.

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-DAT-NTT-00006-LES_Iss01_Rev02	ROC_Data_Products	X.Bonnin	18/04/2019
AD2	ROC-TST-CAL-PRC-00031-LES	THR-Calibration Procedures	A.Vecchio	Iss.01, Rev.00
AD3	ROC-PRO-PIP-ICD-00037/1/0	RPW Calibration Software Interface Control Document	M.Duarte, X.Bonnin	16/11/2016
AD4	ROC-GEN-SYS-SPC-00036-LES/1/0	ROC Software System Design Document	X.Bonnin	02/12/2016
AD5	ROC-PRO-PIP-ICD-00037-LES_Iss01_Rev03	RPW_Calibration_Software_ICD	X.Bonnin	19/05/2020
AD6	ROC-TST-GSE-NTT- 00017-LES_ Iss02_Rev01	Data format and metadata definition for the ROC-SGSE data	X.Bonnin	14/10/2016

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				

2 CONVENTIONS

The ground segment calibration software for RPW THR data (THR_CALBAR) will be referenced in the following as S/W. S/W installation directory will be referenced as $SW_HOME in the next sections.

3 DESCRIPTION OF THE SOFTWARE

3.1 Purpose of the software

S/W is designed to convert THR Level 1 CDF files [AD1] to Level 2 CDF files where the measured electrical (TNR and HFR) and magnetic (TNR) spectral densities are provided in physical units.

3.2 Operations environment

S/W is executable on the ROC server environment (and similar systems) based on a Linux Debian Operating System (OS) with Bourne-Again Shell (BASH) as a primary shell (see [AD3] for details).

3.3 Software design overview

THR CALBAR software implements the modes of operation described in Table 1

3.4 Software operating modes

Table 1: Operating mode of CALBAR.

Mode	Description	Input data	Output data
tnr_l2_cal	Produce calibrated science TNR data file at antenna level	solo_L1_rpw-tnr-surv	solo_L2_rpw-tnr-surv
hfr_l2_cal	Produce calibrated science HFR data file at antenna level	solo_L1_rpw-hfr-surv	solo_L2_rpw-hfr-surv

3.5 Description of the software data

3.5.1 Software input data

S/W expects input data in RPW L1 level and in NASA CDF format. Data are uncompressed and UTC-tagged. Electric and magnetic spectra are in telemetry units (uncalibrated) and in spacecraft coordinate system. All input data processed by S/W are listed in Table 2.

Table 2: Software input data list

Input data name	Description	Format	Required in the following mode(s)
solo_L1_rpw-tnr-surv	Contains RPW TNR L1 spectral data in normal and burst survey mode, time- tagged	CDF	tnr_l2_cal
solo_L1_rpw-hfr-surv	Contains RPW HFR L1 spectral data in normal and burst survey mode, time- tagged	CDF	hfr_l2_cal

The CDF structure of both TNR (SOLO_L1_RPW-TNR-SURV_V06.skt) and HFR (SOLO_L1_RPW-HFR-SURV_V06.skt) L1 data files is available at the ROC git software repository.

3.5.2 Software output data

The L2 level data represents the RPW calibrated science data files produced by the RCS from the un-calibrated data files (L1). All the L2 data products generated by S/W are listed in Table 3.

Table 3: Software output data list

Output data name	Description	Format	Product of the following mode(s)
solo_L2_rpw-tnr-surv	Contains RPW TNR L2 spectral data in normal and burst survey mode, time- tagged	CDF	tnr_l2_cal
solo_L2_rpw-hfr-surv	Contains RPW HFR L2 spectral data in normal and burst survey mode, time- tagged	CDF	hfr_l2_cal

The CDF structure of both TNR (SOLO_L2_RPW-TNR-SURV_V08.skt) and HFR (SOLO_L2_RPW-HFR-SURV_V08.skt) L2 data files is available at the ROC git software repository.

3.5.3 Software installation and configuration files

S/W can be downloaded from the official ROC git repository (https://gitlab.obspm.fr/ROC/RCS/THR_CALBAR). Some environment variables need to be set prior

S/W run. A description on how to properly configure the environment properly is presented in sections 4.2.1 and 5.3 .

3.5.4 Software internal data files

Table 4: list of the software internal data files

File name	Description	Format	Used for the following mode(s)
SOLO_CAL_RPW-THR-TNR	Contains the factors as a function of the temperature and frequency (from system level calibration tests) to calibrate electric TNR data	CDF	tnr_l2_cal
SOLO_CAL_RPW-THR-TNRSA	Contains the factors as a function of the temperature and frequency (from stand-alone calibration tests) to calibrate magnetic TNR data	CDF	tnr_l2_cal
SOLO_CAL_RPW-THR-HFR	Contains the factors as a function of the temperature and frequency (from system level calibration tests) to calibrate HFR data	CDF	hfr_l2_cal
SOLO_CAL_RPW-THR-ANT-HF_PARAMS	Contains antennas parameters to convert data in $W/(m^2\ Hz)$	CDF	tnr_l2_cal hfr_l2_cal
SOLO_CAL_RPW-SCM_SCM-FS-MEB-PFM	Contains the transfer function of the MF SCM.	CDF	tnr_l2_cal
THR_Calbar_Config	THR configuration file	JSON	tnr_l2_cal hfr_l2_cal

4 REFERENCE MANUAL

4.1 Software configuration requirements

4.1.1 General

S/W is executable by one script on the ROC server environment: a Linux Debian Operating System (OS) with Bourne-Again Shell (BASH) as a primary shell (see [AD1] for details). The name of the executable contains alphanumeric characters only.

4.1.2 Hardware configuration requirements

S/W has no specific hardware requirements and shall run on most modern x86-64 systems. At least 4GB of RAM and adequate disk space are required.

4.1.3 Software configuration requirements

S/W is compatible with a Linux Debian Operating System (OS) with Bourne-Again Shell (BASH). S/W requires the IDL interpreter in version 8.5 or higher.

4.2 Operations manual

The RCS descriptor file (`descriptor.json`) must be present in `$SW_HOME`. The file contains information about the RCS that helps the ROC pipelines to automatically identify S/W, execution environment and a detailed description of the output files produced by S/W. The information is used, among others, by the ROC pipelines to automatically build the command line interface calling sequence for a given RCS function, and to monitor the outputs creation. The ROC pipeline is not able to run a RCS delivered without, or with a badly formatted, descriptor file. The content of the descriptor is described in [AD4].

4.2.1 Set-up and initialisation

Prior S/W execution two steps must be done.
In the first step all environment variables required for S/W run are defined. Three BASH commands are needed to set the SW absolute path and to allow the S/W to have access to the directories of the master cdfs (hereafter MASTERCDF) and calibration files (CALTABLES).

```
$ export ROC_RCS_ABS_PATH= $SW_HOME
```

```
$ export ROC_RCS_CAL_PATH= $CALTABLES
```

```
$ export ROC_RCS_MASTER_PATH= $MASTERCDF
```

In the second step the IDL executable is created by launching the following commands:

```
cd $SW_HOME/src
```

```
idl
```

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```
@Compile_THR_Calibration
```

4.2.2 Getting started

4.2.2.1 Run THR_CALBAR on IDL.

To run the S/W executable, five input parameters need to be provided in the following order:

1. `CalFunction`: a string equal to 'tnr_l2_cal' or 'hfr_l2_cal' for TNR or HFR calibration, respectively.

2. `input`: string of the full path name of the .cdf file of L1 data

3. `output`: string of the full path name of the .cdf file of L2 data

4. `log`: string of the full path name of the log file

5. `inputfile_HK_LFR`: string of the full path name of the .cdf file of the HK data LFR needed for the calibration of the magnetic data.

The S/W executable calling sequence is the following:

```
THR_Calibration, CalFunction, input, output, log,
inputfile_HK_LFR
```

4.2.2.2 Run THR_CALBAR on the ROC pipeline.

To run the S/W from the ROC pipeline only the executable
`$SW_HOME/bin/THR_Calibration.sav` is used

The syntax for TNR and HFR, respectively, is:
```
$SW_HOME /bin/THR_Calibration tnr_l2_cal --input_l1_tnr input --
input_hk_lfr inputfile_HK_LFR --output_l2_tnr output --log log
```

```
$SW_HOME /bin/THR_Calibration  hfr_l2_cal --input_l1_hfr input --
input_hk_lfr inputfile_HK_LFR --output_l2_hfr output --log log
```

4.2.3 Normal operations

During normal operation there are no outputs in a standard output (stdout)

4.2.4 Normal termination

If S/W execution has succeeded the error code is 0. If there are no errors, S/W returns the `log` file with the following information:

```
Time -- INFO -- Normal end
```

```
Time -- INFO -- Return code : 0
```

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4.2.5 Error conditions

CALBAR raises an error if it encounters one of the events described in [AD1]. If the execution encounters an error then the return code is 1. The error information is written in the `log` file in format introduced in [AD1].

4.2.6 Recover runs

There is no special procedure to restart or recovery. In case of errors or malfunctions see the log file.

4.2.7 Help method

This section has been left blank intentionally.

4.2.8 Commands and operations

4.2.9 Error messages

CALBAR raises an error if it encounters one of the events described in [AD1]. If the execution encounters an error then the return code is 1. The error information is written in the `log` file in format introduced in [AD1].

4.2.10 Software testing operations

This section has been left blank intentionally.

4.2.11 Software upgrading operations

The most recent version of S/W is stored in the master branch of the ROC Git repository.

4.2.12 Software uninstalling operations

There is no special procedure to uninstall the S/W.

5 TUTORIAL

5.1 Introduction

In this section a typical use case of the software is presented.

5.2 Getting started

This section has been left blank intentionally.

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5.3 Using the software on a typical task

5.3.1 Set-up and initialisation

In the first step all environment variables required for S/W run are defined. Three BASH commands are needed to set the SW absolute path and to allow the S/W to have access to the directories containing master cdfs (hereafter MASTERCDF) and calibration files (CALTABLES).

```
$ export ROC_RCS_ABS_PATH= $SW_HOME

$ export ROC_RCS_CAL_PATH= $CALTABLES

$ export ROC_RCS_MASTER_PATH= $MASTERCDF
```

Launch idl environment from the directory src:

```
cd $SW_HOME/src
idl
```

Compile the S/W script:

```
@Compile_THR_Calibration
```

5.3.2 TNR calibration on IDL

To calibrate TNR L1 files by launching the S/W on IDL :

```
CalFunction='tnr_l2_cal'
```

Define input files (where `$filepathin` is the path of the directory of input files and `$filepathout` is the directory where we want to put output and log files)

```
input='$filepathin/solo_L1_rpw-tnr-surv-cdag_YYYYMMDD_Vxx.cdf'
output='$filepathout/solo_L2_rpw-tnr-surv-cdag_YYYYMMDD_Vxx.cdf'
log='$filepathout/LOG_TNR.log'
inputfile_HK_LFR='$filepathin/solo_HK_rpw-lfr_YYYYMMDD_Vxx.cdf'
```

Run the calibration script:

```
THR_Calibration, CalFunction, input, output, log, inputfile_HK_LFR
```

5.3.3 TNR calibration on ROC pipeline

To run the S/W from the ROC pipeline only the executable `$SW_HOME/bin/THR_Calibration.sav` is used

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The syntax for TNR is:

```
$SW_HOME /bin/THR_Calibration tnr_l2_cal --input_l1_tnr input --
input_hk_lfr inputfile_HK_LFR --output_l2_tnr output --log log
```

5.3.4 An example of a log file

An example of the LOG_TNR.log file, when no errors have been raised, is shown below:

```
2020-07-24T10:05:58 -- INFO -- THR_CALBAR VERSION 2.2.2

2020-07-24T10:05:58 -- INFO -- THR CALIBRATION FUNCTION : tnr_l2_cal
- START...

2020-07-24T10:05:58 -- INFO -- Input file - L1  :
/Users/avecchio/RPW/SPACE/11_07/solo_L1_rpw-tnr-surv-
cdag_20200711_V04.cdf

2020-07-24T10:05:58 -- INFO -- Input file - HK  :
/Users/avecchio/RPW/SPACE/11_07/solo_HK_rpw-lfr_20200710_V04.cdf

2020-07-24T10:05:58 -- INFO -- Calibration file :
/Users/avecchio/RPW/CALBAR/calbar0/CALBAR_TABLES/final/SOLO_CAL_RPW-
THR-TNR_V20200613000000.cdf

2020-07-24T10:05:58 -- INFO -- Master CDF :
/Users/avecchio/RPW/CALBAR/calbar0/CALBAR_SKELETON/SOLO_L2_RPW-TNR-
SURV_V08.cdf

2020-07-24T10:07:40 -- INFO -- Output file :
/Users/avecchio/RPW/SPACE/11_07/solo_L2_rpw-tnr-surv-
cdag_20200711_V00.cdf

2020-07-24T10:07:40 -- INFO -- THR CALIBRATION FUNCTION : tnr_l2_cal
- END!

2020-07-24T10:07:40 -- INFO -- Normal end

2020-07-24T10:07:40 -- INFO -- Execution duration : 107.00003 s

2020-07-24T10:07:40 -- INFO -- Return code : 0
```

5.3.5 HFR calibration on IDL

To calibrate HFR L1 files by launching the S/W on IDL :

```
CalFunction='hfr_l2_cal'
```

Define input files (where $filepathin is the path of the directory of input files and $filepathout is the directory where we want to put output and log files)

```
input='$filepathin/solo_L1_rpw-hfr-surv-cdag_YYYYMMDD_Vxx.cdf'
output='$filepathout/solo_L2_rpw-hfr-surv-cdag_YYYYMMDD_Vxx.cdf'
```

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```
log='$filepathout/LOG_HFR.log'
inputfile_HK_LFR='$filepathin/solo_HK_rpw-lfr_YYYYMMDD_Vxx.cdf'
```

Run the calibration script:

```
THR_Calibration, CalFunction, input, output, log, inputfile_HK_LFR
```

5.3.6 HFR calibration on ROC pipeline

To run the S/W from the ROC pipeline only the executable
`$SW_HOME/bin/THR_Calibration.sav` is used

The syntax for HFR is:
```
$SW_HOME /bin/THR_Calibration hfr_l2_cal --input_l1_hfr input --
input_hk_lfr inputfile_HK_LFR --output_l2_hfr output --log log
```

5.3.7 An example of a log file

An example of the LOG_HFR.log file, when no errors have been raised, is shown below:

```
2020-07-24T10:10:26 -- INFO -- THR_CALBAR VERSION 2.2.2

2020-07-24T10:10:26 -- INFO -- THR CALIBRATION FUNCTION : hfr_l2_cal
- START...

2020-07-24T10:10:26 -- INFO -- Input file - L1  :
/Users/avecchio/RPW/SPACE/11_07/solo_L1_rpw-hfr-surv-
cdag_20200711_V04.cdf

2020-07-24T10:10:26 -- INFO -- Input file - HK  :
/Users/avecchio/RPW/SPACE/11_07/solo_HK_rpw-lfr_20200710_V04.cdf

2020-07-24T10:10:26 -- INFO -- Calibration file :
/Users/avecchio/RPW/CALBAR/calbar0/CALBAR_TABLES/final/SOLO_CAL_RPW-
THR-TNR_V20200613000000.cdf

2020-07-24T10:10:26 -- INFO -- Master CDF :
/Users/avecchio/RPW/CALBAR/calbar0/CALBAR_SKELETON/SOLO_L2_RPW-HFR-
SURV_V08.cdf

2020-07-24T10:12:34 -- INFO -- Output file :
/Users/avecchio/RPW/SPACE/11_07/solo_L2_rpw-hfr-surv-
cdag_20200711_V00.cdf

2020-07-24T10:12:34 -- INFO -- THR CALIBRATION FUNCTION : hfr_l2_cal
- END!

2020-07-24T10:12:34 -- INFO -- Normal end

2020-07-24T10:12:34 -- INFO -- Execution duration : 127.99997 s

2020-07-24T10:12:34 -- INFO -- Return code : 0
```

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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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Reference/Page/Location	Description	Type	Status

8   DISTRIBUTION LIST

LISTS 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	
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