RPW Operation Centre

Data format and metadata definition for the ROC-SGSE data

ROC-TST-GSE-NTT-00017-LES
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Change Record

Issue	Rev.	Date	Authors	Modifications
0	0	12/10/2014	X.Bonnin	First draft
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1	0	08/09/2015	X.Bonnin	First release
1	1	06/10/2015	X.Bonnin	Update the data processing level definition and the data set list
1	2	28/10/2015	X.Bonnin	New update of the data processing level definition. Update the file naming convention and the CDF global attributes to be compliant with the definition at Solar Orbiter level. BITMASK becomes QUALITY_BITMASK Add appendices about skeleton cdf and cal. table. management.
1	3	20/11/2015	X.Bonnin	Add AUX and LL01 data processing levels. Specify if a CDF attribute is updated or not by the ROC or S/W teams. Attribute lists are sorted in alphabetical order. Add “Test_launched_date”, “Test_terminated_date” and “Test_description global” attributes. Rename “Test_date” in “Test_creation_date”. Remove “Test_config_id”, “Test_temp_id”, “Test_request_name” and “JOB_UUID” global attributes “Acknowledgment”, “ROC_REFERENCE” and “Skeleton_version” global attributes become mandatory.
2	0	18/02/2016	X.Bonnin	Rename file reference to ROC-TST-GSE-NTT-00017-LES Add RD8 reference document TIME_MIN and TIME_MAX are CDF_DOUBLE in Julian day Add the L0 structure section Add NUM_L1 and NUM_L2r zVariables

				Change the L2 level to L2s Add section about the Epoch structure
2	1	01/06/2016	X.Bonnin	Update Data versioning section Add section about the EGSE stimuli processing Add “General convention” sub-section in “ROC-SGSE CDF data description” section. Add sections about “Epoch” variable and “FILLVAL” attribute Rename stimuli data set ROC-SGSE_AUX_MEB-EGSE-STIM-VOLT Rename NUM_L1 into L1_REC_NUM Remove NUM_L2R Add DELTA_MINUS_PLUS Rename “CDF data description” section in “ROC-SGSE CDF data description” Modify SKELETON_PARENT attribute definition Rename “ROC_REFERENCE” attribute to “APPLICABLE” “TIME_BASE” attribute for Epoch becomes “J2000”

Acronym List

Acronym	Definition
AC	Alternating Current
AIT/AIV	Assembly Integration Tests / Validation
AWG	Arbitray Waveform Generator
CCSDS	Consultative Committee for Space Data Systems
CDF	Common Data Format
CUC	CCSDS Unsegmented time Code
dB	Decibel
DC	Direct Current
EGSE	Electrical Ground Support Equipment

HDF5	Hierarchical Data Format 5
HF	High Frequency
IACG	Inter-Agency Consultative Group
ICD	Interface Control Document
IDB	Instrument Database
ISTP	International Solar Terrestrial Program
LF	Low Frequency
MD5	Message Digest 5
MEB	Main Electronic Box
MSB	Most Significant Bit
PA	Pre-Amplifier
PALISADE	Parsing Library and Structural Description
PDS	Planetary Data System
RCS	RPW Calibration Software
ROC	RPW Operation Centre
RPL	RPW Packet Parsing Library
RPW	Radio and Plasma Waves instrument
SCM	Search Coil Magnetometer
SGS	Science Ground Segment
SGSE	Software Ground Support Equipment
SHA	Secure Hash Algorithm
SOC	Science Operation Centre
TDS	Time Domain Sampler
THR	Thermal Noise and High Frequency Receivers
SWF	Snapshot Waveform
UCD	Unified Content Descriptor
UUID	Universal Unique Identifier
XML	eXtended Markup Language

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1 GENERAL

1.1 Scope of the Document

This document presents the RPW data to be produced by the RPW Operation Centre SGSE (ROC-SGSE) [RD1] during the calibration tests performed on-ground at system level. It specifies the data format, file naming convention, metadata and the data processing levels to be applied. A list of the data products is also provided at the end of the document.

The description of the RPW data to be produced by the ROC during the Solar Orbiter mission is detailed in a separated document [RD2], however some conventions specified in the current document are also based on the data definition at Solar Orbiter level [AD1].

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	SOL-SGS-TN-00009/2/2	Metadata Definition for Solar Orbiter Science Data	A. De Groof	23/07/2015
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	ROC-TST-GSE-SPC-00004-LES/00/02	ROC-SGSE Description	X.Bonnin	06/11/2015
RD2	ROC-GEN-DAT-SPC-00006-LES/0/2	RPW Data Products	X.Bonnin	06/01/2015
RD3	http://spdf.gsfc.nasa.gov/istp_guide/	ISTP/IACG Guidelines Page	NASA CDF team	December 2008
RD4	cdf35ifd.pdf	CDF Internal Format Description	NASA/GSFC	September 25, 2012
RD5	Parametres_EGSE_ROC.pdf	Lists des paramètres des stimuli E-GSE	Daniel Dias	17/06/2015
RD6	ROC-OPS-PIP-NTT-00008-LES/1/1	RPW Engineering Guidelines	X.Bonnin	January 06, 2015
RD7	HDF5_Users_Guide.pdf/1/8.16	HDF5 User's Guide	X.Bonnin	November, 2015
RD8	http://www.ivoa.net/documents/latest/UCD.html	An IVOA Standard for Unified Content Descriptors	IVOA UCD group	August, 2005

RD9	White Paper - Supporting CDF in PDS4-v4.pdf	White Paper Supporting CDF in PDS4	Todd King, Joseph Mafi	July 12, 2013
RD10	CCSDS 301.0-B-3/Issue 3	Time Code Format	CCSDS consortium	January 2002
RD11	http://www.lesia.obspm.fr/PALISADE.html	PALISADE	Loïc Gueguen	22/04/2015
RD12	ROC-TST-GSE-ICD-00023-LES/2/1	RPW Calibration Software ICD	Manuel Duarte	18/11/2015
RD13	RPW-SYS-MEB-GSE-TN-001014-LES/1/4	E-GSE User Manual	Daniel Dias	27/04/2016

2 ROC SOFTWARE SUPPORT TO ON-GROUND CALIBRATIONS

The ROC will deliver a specific SGSE for visualizing and analyzing RPW data produced during on-ground calibration tests at the RPW system level. This so-called "RPW Operation Centre Ground Tests SGSE" (hereafter called ROC-SGSE), will be developed at the LESIA, then will be deployed and run on both the LESIA and CNES sites during tests.

The ROC-SGSE will be divided into two main components:

- A data processing pipeline in back-end, which retrieves and processes, input stimuli, information about tests and the corresponding RPW packet data stored in the MEB GSE database.
- Front-end visualization tools allowing users to plot and to analyze data processed by the back-end pipeline in a standard way.

A detailed description of the ROC-SGSE software design can be found in [RD1].

According to user requirements for test data visualization, the front-end tools shall be able to monitor the following data:

- RPW housekeeping parameters (HK) as well as verification and event report data
- RPW unpacked and uncompressed science telemetry data (TM) in engineering units
- RPW calibrated science data at receiver and sensor levels. The sensor level does not include the electrical antennas, which will be not available during the calibration tests.
- Stimuli data (SD) generated by the RPW EGSE
- RPW unpacked and uncompressed telecommands data (TC) in engineering units
- Information about tests

All of these data need to be processed by the ROC-SGSE pipeline before visualization. Especially, the RPW calibrated science data shall be produced using the dedicated RPW Calibration Software (RCS) delivered by analyzer/sensor teams. The way the RCS execution is managed by the ROC-SGSE is described in [RD12].

Section 3 defines the data formats and processing levels to be applied in the framework of the ROC-SGSE. Section 4 describes the metadata to be found in the CDF data files and the section 5 is dedicated to the XML data files description. A complete list of the data sets to be processed by the ROC-SGSE can be found in the appendix.

3 DATA FORMAT AND PROCESSING LEVEL DEFINITION

3.1 RPW data processing level definition

The following table gives a description of the RPW data processing levels to be applied in the framework of the ROC-SGSE application. It must be noticed that:

- In the case of the ROC-SGSE, L0 data can also contain RPW TC packets as saved in the MEB SGSE test log files.
- An intermediate "L2R" level has been added to defined calibrated data measured at the receiver inputs ("R" stands here for "receiver"). Level of the calibrated data measured at the sensor/PAs inputs is defined as "L2S" ("S" stands here for "system"). This convention avoids any confusion between data levels applied during the ground tests and during the Solar Orbiter mission. See the section 6.3 for more details about the ROC-SGSE data level convention regarding to the system.

- No L3 level data is planned to be produced by the ROC-SGSE during the on-ground calibration tests
- A specific "HK" level is planned to store housekeeping parameters.
- The L0, L1, LL01, L2R and L2S levels definition shall comply the convention defined in the present document, otherwise the Solar Orbiter SOC data format guidelines [AD1] shall be applied.

Table 1 summarizes the data processing level definitions.

Level	Data type	Format and metadata content	Users
Lz	RPW TM/TC data, packeted and compressed	XML, as test log format exported from the MEB SGSE database. TM/TC packets are binary data.	ROC team
L0	RPW TM/TC data, unpacketed and uncompressed	HDF5, as returned by the RPL. Contains TM/TC packet data.	ROC team
L1	RPW Level 1 uncalibrated science data, engineering unit. Time-tagged.	CDF, as produced by the ROC SGSE. Contains uncalibrated RPW data organized in science data products.	ROC, RPW teams
L2R	RPW Level 2 calibrated science data at receiver level. Time-tagged.	CDF, as produced by the calibration S/W. Contains calibrated science data derived from L1 data.	ROC, RPW teams
L2S	RPW Level 2 calibrated science data at system level. Time-tagged.	CDF, as produced by the calibration S/W. Contains calibrated science data derived from L2R data.	ROC, RPW teams
LL01	RPW Level 1 low latency data.	CDF, as produced by the ROC-SGSE.	ROC
HK	RPW HK parameters	CDF, as produced by the ROC-SGSE. Contains the housekeeping parameters.	ROC, RPW teams
AUX	Auxiliary data		

Table 1. Science data processing levels.

3.2 Data file formats

All of the data files produced by the ROC-SGSE shall be saved in CDF V3.6 format files [RD4], except the L0 RPW data file written in HDF5 [RD7], and the Lz test log and the ROC-SGSE test information data, which will be written in the XML format.

3.3 Data versioning

The data versioning shall comply the conventions defined in [AD2]. It shall be identified using a 2-digits integer (e.g., "02") as a version number, and be incremented by 1 each time a new version is released.

In production, the first version of the data shall always be "01".

Then, a new version shall be released each time the data has to be re-processed. It typically happens when at least one of the following items is modified:

- The version of the parent file(s) used to produce the data
- The data structure (i.e., corresponding CDF skeleton or XML schema)
- The associated calibration table(s).
- The version of the S/W used to produce the data

For instance, the version of a L2R CDF data file will depend on the version of the corresponding L1 CDF data file, the L2R CDF skeleton file, and the calibration table file.

In order to keep track of possible changes, the version dependencies shall be reported into the data file using dedicated attributes.

3.1 File naming convention

The following convention shall be applied to the ROC-SGSE data files:

SourceName_Level_Descriptor_TestId_Provider_VXX.ext

, where "*SourceName*", "*Level*", "*Descriptor*", "*TestId*" and "*Provider*" are respectively the prefix term of the "Source_name", "Level", "Descriptor", "Test_id" and "Provider" attributes as defined in the section 4.3. "*XX*" is a 2-digits integer indicates the version number of the file as defined in the "Data_version" attribute. The "*ext*" item can be "cdf", "h5", or "xml" depending of the data file format.

The values of the attributes used in the file naming conventions shall not contain the field separator character (i.e., "_").

For instance, the filename of the L1 RPW LFR SWF data in survey mode, produced by the CNES instance of the ROC-SGSE for the TestId #1001 must be:

ROC-SGSE_L1_RPW-LFR-SWF-SURV_9de409f_CNE_V01.cdf

4 ROC-SGSE CDF DATA DESCRIPTION

The CDF variable and attributes conventions applied to the RPW on-ground CDF data shall be based on the ISTP guidelines [RD3], but will be not fully compliant.

CDF variables, global and variable attributes are divided in 2 types:

- M: Mandatory keywords.
- O: Keywords in *italic* are optional.

4.1 General convention

The following rules shall be applied concerning the CDF format files produced by the ROC-SGSE:

- MSB (Network) encoding for all values.
- Include CDF Tool compliant metadata.
- Include ISTP/IACG compliant metadata.
- Use single file CDF.
- No compression (file or variable).
- No fragmented variables (all data for a variable must be contiguous in the file).
- No sparse variables.
- All data values are physical (data for all dimensions in a variable are written).
- No unused records. (No superfluous, non decodable records).
- Use only zVariables (rVariables are not recommended by the CDF standard and should be considered deprecate. Also, multiple variable reads can be performed only if variables are of the same type.)
- No virtual (calculated) variables.
- All data records are physical (record variance for data variables is "VARY")
- CDF MD5 CHECKSUM option shall be set.
- Any CDF file shall be produced from a given Master CDF file, using the CDF skeleton mechanism described in the section 6.4.

It must be noticed that most of these rules inherit from CDF format requirements for the NASA Planetary Data System (PDS) data archiving [RD9].

4.2 CDF variables

In a CDF format file, each data parameter (e.g., time, flux, etc.) is represented by a given CDF variable. This CDF variable is identified by its name and a list of given variable attribute.

According to the ISTP/IACG guidelines, there are 3 types of CDF variables:

- "Data", which corresponds to the variables of primary importance (e.g, density, magnetic fields, flux).
- "Support_data", which corresponds to the variables of secondary importance (e.g., time, frequency, energy_bands).
- "Metadata", which provides labels for "data" and "support_data" types (e.g., "Bx, By, Bz" labels for a magnetic field components "data" variable).

4.2.1 General convention

The general conventions for the CDF variables of the RPW on-ground data sets are:

- Except “Epoch”, all CDF variable names shall contain capital letters only and shall not exceed 63 characters.
- CDF variables shall be described using the appropriated variable attributes (see "Variable attributes" section below).
- CDF data files shall contain at least the expected variables listed in the section 5.1.2 and 5.1.3.

4.2.2 Time variable convention

A CDF data file shall contain at least the following time variables:

- Epoch, the primary time variable in the CDF_TIME_TT2000 data format. The structure and variable attributes to be expected for the Epoch time variable is described in the section 6.4.1.
- ACQUISITION_TIME, a 2 elements vector variable of CDF_UINT4 type containing the coarse and fine parts acquisition time in the CCSDS CUC format [RD10], as provided in the TM packets. For the science data files, ACQUISITION_TIME shall contain the time values of the first data sample recorded in the TM packets[1]. In the case of HK data files, ACQUISITION_TIME shall contain the time of creation of the TM packets[2]. This is variable is only mandatory for the HK, L1 and LL01 data sets.
- TIME_SYNCHRO_FLAG, which is a CDF_UINT1 variable indicating if the sub-system that has produced the TM/TC is temporally synchronized with the RPW system clock. This is variable is only mandatory for the HK, L1 and LL01 data sets.

4.2.3 Data quality convention

The CDF data sets should provide information about the data quality:

- A scalar CDF_UINT1 "QUALITY_FLAG" variable can be used to indicate the quality level
- A scalar or vector CDF_UINT1 "QUALITY_BITMASK" variable can be used to indicated the details that can be valuable for the processing (e.g., BIAS failure, antenna switched-off, LFR mode change, etc.). Each team are free defined or not their own QUALITY_BITMASK values depending on their needs. If the QUALITY_BITMASK is used, a table providing its value and the corresponding meanings shall be reported in the appendices of the current document.

QUALITY_FLAG value	Meaning
0	Bad data
1	Known problems, use at your own risk
2	Survey data
3	Good for publication
4	Excellent data

Table 2. QUALITY_FLAG values and meanings.

4.2.4 Data gap conventions

A CDF_UINT1 POST_GAP_FLAG variable can be used to manage data gaps. The variable value shall be set to 255 while there is no data gap.

POST_GAP_FLAG value	Meaning
0	Instrument switched-off
1	Instrument switched-on, no data produced
2	Instrument switched-on, no data transmitted
3	Current mode switched off

[1] In the TM science packets, this information is stored as a scalar parameter "PA_[*REC*]_ACQUISITION_TIME", where [*REC*] is usually the name of the receiver (e.g., ""PA_TDS_ACQUISITION_TIME for TDS TM science packets), in the SOURCE_DATA part of the DATA_FIELD section.

[2] In the TM HK packets, this information is stored as a scalar parameter "TIME" in the DATA_FIELD_HEADER part of the DATA_FIELD section.

4	SBM initialization
5	Known Issue
6	Unknown reason

Table 3. POST_GAP_FLAG values and meanings.

4.2.5 Summary list of expected CDF variables

Following table presents a summary list of the expected CDF variables in alphabetical order.

Name	Description	Type	CDF data type	Comment
ACQUISITION_TIME	CCSDS CUC format time as provided in the RPW packets. ACQUISITION_TIME shall be a 2-elements vector of CDF_UINT4 data type, which contains the coarse and fine time parts.	M	CDF_UINT4	Only mandatory for L1, HK and LL01 levels
Epoch	Primary time variable. It corresponds to the CDF record sample time measured in the spacecraft clock reference frame, as simulated by the MEB GSE.	M	CDF_TIME_TT2000	
L1_REC_NUM	Scalar or vector providing the index of CDF record(s) from the parent CDF file at level L1 used to process the current CDF record. E.g., if a CDF record *i* in a L2r file has been processed from a CDF record *j* in a L1 file, then the value of the NUM_L1 for this record *i* will be *j*.	M	CDF_UINT4	It can be used to track a given data sample from a L1 CDF file to an L2x CDF file.
POST_GAP_FLAG	Flag indicating the reason of	O	CDF_UINT1	
QUALITY_BITMASK	Computer readable quality information flag	O	CDF_UINT1	
QUALITY_FLAG	Science data quality information flag	O	CDF_UINT1	
TIME_SYNCHRO_FLAG	Flag corresponding the	M	CDF_UINT1	

	time synchronisation bit			

Table 4. Expected CDF variable list.

4.3 CDF global attributes

There are two categories of attributes: the *static* and *non-static* attributes. The values of *static* attributes shall be fixed once in the Master CDF file, and shall be not modified a posteriori by any S/W. On the contrary, the values of *non-static* attributes can be set by S/W during CDF data processing.

Except *SPECTRAL_RANGE_MAX, SPECTRAL_RANGE_MIN, TIME_MAX* and *TIME_MIN*, which shall be CDF_DOUBLE data type attributes, all of the global attributes shall be encoded using CDF_CHAR data type.

Table below provides the list of global attributes in alphabetical order to be found in the CDF data files. Names of the attributes in red, green or blue colour indicates a value that must be set respectively by the ROC-SGSE pipeline, a RCS, or both. The *non-static* attributes are named in italic, and the *static* attributes in normal black colour font.

In practice, all of the *non-static* global attributes, which are not set by a given RCS, shall be just copied from its input CDF parent file. If several input CDF files are used, the ROC and RCS developer teams shall always ensure that the attributes to be copied have the same value from a parent file to the other.

Name	Description	Type	Default value	Comment
ACCESS_FORMAT	Format of the file	M	"CDF"	
ACCESS_URL	URL of the data file	M		Updated by the ROC after file creation
Acknowledgment	Text string at PI disposal allowing for information on expected acknowledgment if data is citable.	M	"The authors are pleased to acknowledge the RPW Operation Centre (ROC) and Solar Orbiter/RPW teams for access to data."	
APPLICABLE	Applicable document reference to the CDF format	M		It shall be the current document

Calibration_version	Version of the calibration table. It should refer to the calibration table version.	M		Only mandatory for L2r, L2s and L2 data.
CAVEAT	Information which may be important in the avoidance of the misuse of the resource, for instance the assumptions or limitations on data processing modelings or inversions.	O		It should be provided if the data has been processed using assumptions or numerical models or inversions
DATASET_ID	ROC Identifier of the RPW data set. Its naming convention shall be: *Source_name_Level_Descriptor* , where *Source_name*, *Level*, and *Descriptor* shall correspond to the PREFIX value of the *Source_name*, *Level*, and *Descriptor* attributes.	M		
Data_type	Type of data as defined in ISTP	M		http://spdf.gsfc.nasa.gov/istp_guide/gattributes.html#Data_type
Data_version	This attribute identifies the version of a particular CDF data file for a given test. See section 3.2. Its value depends on the Software_version, Skeleton_version, Calibration_version (only for calibrated data set) and the Parent_version.	M		It shall be equal to the "*XX*" item in the file naming convention for CDF file.
Descriptor	The name of the experiment, plus the sensor or detector, possibly followed by the mode and the data product. (e.g., "RPW-TDS-SURV-	M		The PREFIX value shall correspond to the "*Descriptor*"

	RSWF>RPW Time Domain Sample Regular Snapshot Waveform in survey mode")			field in the file naming convention.
Discipline	The science discipline and subdiscipline.	M	"Space Physics>Interplanetary Studies"	http://spdf.gsfc.nasa.gov/istp_guide/gattributes.html#Discipline
File_naming_convention	File naming convention built from the global attributes prefix values, without the Data_version (e.g., "V01") and the extension (".cdf")	M	"Source_name_Level_Descriptor_Test_id_Provider"	Can be used to build automatically the name of the CDF file, or to check the compliance.
FILE_UUID	UUID of the file in the ROC pipeline.	M		Updated by the ROC after file creation
Generated_by	The generating data entity (e.g., person, team, institute).	M	"The RPW Operation Centre (ROC)"	
Generation_date	Date and time stamp for the creation of the data file in the ISO8601 format ("YYYY-MM-DDTHH:MN:SS")	M		The value should be set during the file creation.
HTTP_LINK	The URL for the PI or Co-I web site holding on-line data.	M	http://rpw.lesia.obspm.fr	
IDB_version	Version of the IDB used to analyse RPW packets	M		Only mandatory for L1, LL01 and HK data.
Instrument_type	The ISTP defined instrument type. Multi-valued.	M	"Radio and Plasma Waves (space)"	
Level	Data processing level. Possible values for the PREFIX are given in the first column of the table 1. (e.g.,	M		The PREFIX value shall correspond to the "*Level*"

	"L1>Level 1"			field in the file naming convention.
LINK_TEXT	Text describing on-line data available at PI or Co-I web sites.	O		
LINK_TITLE	The title of the web site holding on-line data available at PI or Co- I web sites.	M	"The RPW Web Portal"	
Logical_file_id	The name of the CDF file without the '.cdf' extension, using the file naming convention.	M		
Logical_source	Source_name, level, and descriptor information.	M		
logical_source_description	Full words associated with the Logical_source.	M		
Mission_group	The assigned name of the mission or project.	M	"Solar Orbiter"	
MODS	History of modifications made to the CDF data set.	M		A new entry shall be added each time a modification has been done on the CDF data set. Each entry has to specify the date of the modifications, the person responsible and a summary of the changes.
PACKET_CATEGORY	RPW packet category. If the file contains data from more than one packet category, then there shall be one entry for each type.	M		Only mandatory for L1, LL01 and HK data.

PACKET_PID	RPW packet process ID. If the file contains data from more than one packet type, then there shall be one entry for each ID.	M		Only mandatory for L1, LL01 and HK data.
PACKET_SERVICE_TYPE	RPW packet service type. If the file contains data from more than one packet type, then there shall be one entry for each type.	M		Only mandatory for L1, LL01 and HK data.
PACKET_SERVICE_SUBTYPE	RPW packet service subtype. If the file contains data from more than one packet type, then there shall be one entry for each subtype.	M		Only mandatory for L1, LL01 and HK data.
PACKET_SID	ID of the RPW TM science packet associated with. If the file contains data from more than one science packet type, then there shall be one entry for each science ID.	M		Only mandatory for L1, LL01 data.
PACKET_SRDB_ID	SRDB ID of the RPW packet. If the file contains data from more than one packet type, then there shall be one entry for each ID.	M		Only mandatory for L1, LL01 and HK data.
Parents	This attribute lists the parent XML(S), HDF5(S) or CDF(S) for files of derived and merged data sets. Subsequent entry values are used for multiple parents. The syntax for a CDF parent would be *e.g.* "CDF>logical_file_id".	M		
Parent_version	Version(s) of the parent data file(s) required to produce the current file. There shall be one entry by parent files	M		
PI_affiliation	A recognizable abbreviation	M	"LESIA,	

	of the PI affiliation.		Observatoire de Paris - CNRS"	
PI_name	First initial and last name of the PI.	M	"M.Maksimovic"	
Pipeline_version	Version of the ROC-SGSE pipeline used to produce the CDF file	M		
Project	The name of the project.	M	"RPW>Radio and Plasma Waves instrument"	http://spdf.gsfc.nasa.gov/istp_guide/gattributes.html#Project
Provider	Name of the data provider	M	"LES>LESIA" if the file was produced at the LESIA (Meudon) and "CNE>CNES" if the file was generated at the CNES (Toulouse)	Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
REFERENCE	Bibcode, DOI or URL	O		It should be provided if the current data is described in one or more articles.
Rules_of_use	Citability and PI access restrictions. This may point to a World Wide Web page specifying the rules of use.	M	"Data provided are restricted to the RPW consortium use only. Data access and dissemination are not authorized without the	

			RPW PI agreement."	
SKELETON_PARENT	Name of the CDF Skeleton file (without the extension) used to produce the CDF file	O		
Skeleton_version	The skeleton file version number.	M		
Software_name	Name of the software that produces the file	M		
Software_version	The version of the software that generated the CDF.	M		
Source_name	The mission or investigation that contains the sensors. It shall use the ISTP format "PREFIX>Suffix".	M	"ROC-SGSE>RPW Operation Centre SGSE"	The PREFIX value shall correspond to the "*SourceName* " field in the file naming convention.
SPECTRAL_RANGE_MAX	Maximum value of the spectral range within the file in Hz	O		Shall be updated by the S/W for the current processed data file.
SPECTRAL_RANGE_MIN	Minimum value of the spectral range within the file in Hz.	O		Shall be updated by the S/W for the current processed data file.
Test_creation_date	Date and time of creation of the test, as saved in the Creation tag of the Lz test log file.	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_description	Description of the test, as	M		Initially

	saved in the Description tag of the Lz test log file.			provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_id	SHA identifier of the test. This number shall be unique and assigned by the ROC-SGSE. It shall use the ISTP format "PREFIX>Suffix", where PREFIX is the 7 first characters of the ID. This PREFIX shall be used in the TestId field in the file naming convention.	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_launched_date	Date and time when the test started, as saved in the LaunchedDate tag of the Lz test log file.	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_log_file	Name of the parent Lz test log file	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_name	The name of the test, as	M		Initially

	saved in the TestName attribute of Lz test log file.			provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_request_id	ID associated to the test request	O		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_temp_degrees	Mean temperature of the test in degrees	O		
Test_terminated_date	Date and time when the test ended, as saved in the TerminatedDate tag of the Lz test log file.	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data products.
Test_uuid	The universal unique identifier of the test, as saved in the Test UUID attribute of the Lz test log file. This UUID is assigned to each test by the MEB SGSE.	M		Initially provided by the ROC in the HK and L1 files. The value shall be just copied by team S/W in their data

				products.
TEXT	Description of the experiment.	M		
TEXT_supplement_1	An attribute that can be used for providing additional information about dataset.	O		
TIME_MAX	The date and time of the last acquisition in Julian day for the data contained in the file	M		Shall be updated by the S/W for the current processed data file.
TIME_MIN	The date and time of the first acquisition in Julian day for the data contained in the file	M		Shall be updated by the S/W for the current processed data file.
Validate	This attribute is written by software for automatic validation of features such as the structure of the CDF file on a simple pass/fail criterion. The software will test that all expected attributes are present and, where possible, have reasonable values.	M		Updated by the ROC pipeline after the file creation

Table 5. CDF global attributes.

4.4 CDF variable attributes

There are two categories of attributes: the *static* and *non-static* attributes. The values of *static* attributes shall be fixed once in the Master CDF file, and shall be not modified a posteriori by any S/W. On the contrary, the values of *non-static* attributes can be set by S/W during CDF data processing.

Table below provides the list of variable attributes in alphabetical order to be found in the CDF data files. The *non-static* attributes are named in italic, and the *static* attributes in normal font style.

In practice all of the *non-static* variable attributes, which are not set by a given RCS, shall be just copied from its input CDF parent file. If several input CDF files are used, the ROC and RCS developer teams shall always ensure that the attributes to be copied have the same value from a parent file to the other.

Name	Description	Type	CDF data type	Comment
Bin_Location	Relative position of time stamp to the data measurement bin, with 0.0 at beginning of time bin and 1.0 at end Default is 0.5 for the time at the center of the data measurement. Since clock readings are usually truncated, the real value may be closer to 0.0.	O	CDF_CHAR	Only for time variables
CATDESC	is an approximately 80-character string which is a textual description of the variable and includes a description of what the variable depends on.	M	CDF_CHAR	
DEPEND_0	explicitly ties a data variable to the time variable on which it depends. All variables which change with time must have a DEPEND_0 attribute defined. The value of DEPEND_0 is *'Epoch'*, the time ordering parameter for ISTP/IACG.	M	CDF_CHAR	
DEPEND_1	ties a dimensional data variable to a support_data variable on which the 2-th dimension of the data variable depends.	M	CDF_CHAR	Only mandatory for 2d variables
DEPEND_2	ties a dimensional data variable to a support_data variable on which the 3-th dimension of the data variable depends.	M	CDF_CHAR	Only mandatory for 3d variables
DEPEND_3	ties a dimensional data variable to a support_data variable on which the 4-th dimension of the data variable depends.	M	CDF_CHAR	Only mandatory for 4d variables
DISPLAY_TYPE	tells automated software what type of plot to make and what associated variables in the CDF are required in order to do so.	M	CDF_CHAR	Only mandatory for data variable
FIELDNAM	holds a character string (up to	M	CDF_CHAR	

	30 characters) which describes the variable.			
FILLVAL	is the number inserted in the CDF in place of data values that are known to be bad or missing. Fill data are always non-valid data.	M	Variable data type	Only mandatory for time varying variables. See Section 6.4.2 for allowed values.
FORMAT	is the output format used when extracting data values out to a file or screen.	M	CDF_CHAR	Only mandatory if not using FORM_PTR
FORM_PTR	has as its value a variable which stores the character strings (up to 20 characters per character string) representing the desired output format for the original variable.	M	CDF_CHAR	Only mandatory if not using FORMAT
LABLAXIS	should be a short character string (approximately 10 characters, but preferably 6 characters - more only if absolutely required for clarity) which can be used to label a y-axis for a plot or to provide a heading for a data listing.	M	CDF_CHAR	Only mandatory if not using LABL_PTR
LABL_PTR_1	is used to label a dimensional variable when one value of LABLAXIS is not sufficient to describe the variable or to label all the axes.	M	CDF_CHAR	Only mandatory if not using LABLAXIS
LABL_PTR_2	is used to label a dimensional variable when one value of LABLAXIS is not sufficient to describe the variable or to label all the axes.	M	CDF_CHAR	Only mandatory if not using LABLAXIS
LABL_PTR_3	is used to label a dimensional variable when one value of LABLAXIS is not sufficient	M	CDF_CHAR	Only mandatory if not

	to describe the variable or to label all the axes.			using LABLAXIS
MONOTON	indicates whether the variable is monotonically increasing or monotonically decreasing.	O	CDF_CHAR	
Relative_Error	Value of the relative error	O	Variable data type	
Resolution	Using ISO8601 relative time format, for example: 1s. Resolution provides the smallest change in time that is measured.	O	CDF_CHAR	Only for time variables
SCALEMAX	is value which can be based on the actual values of data found in the CDF data set or on the probable uses of the data, {\em e.g.}, plotting multiple files at the same scale.	M	Variable data type	Only mandatory for time varying data and support_data
SCALEMIN	is value which can be based on the actual value of data found in the CDF data set or on the probable uses of the data, {\em e.g.}, plotting multiple files at the same scale.	M	Variable data type	Only mandatory for time varying data and support_data
SCALETYP	indicates whether the variable should have a **linear** or a **log** scale as a default.	M	CDF_CHAR	Only mandatory for data and support_data if not using SCAL_PTR
SCAL_PTR	is used for dimensional variables when one value of SCALTYP is not sufficient.	M	CDF_CHAR	Only mandatory for data and support_data if not using SCALETYP
SI_conversion	The conversion factor to SI units. This is the factor that the variable must be	O	CDF_CHAR	See http://spdf.gsfc.nasa.

	multiplied by in order to turn it to generic SI units.			gov/istp_guide/vattributes.html#SI_conv for more details.
SRDB_ENUM_ID	If available, the SRDB enumeration ID associated with the current variable	M	CDF_CHAR	Only mandatory for HK data.
SRDB_PARAM_ID	If available, the SRDB parameter ID of the current variable	M	CDF_CHAR	Only mandatory for HK data.
Time_Base	Reference frame where the time is measured (e.g., J2000)	M	CDF_CHAR	Only mandatory for time variables
Time_Scale	Scale of the time (e.g., Terrestrial Time, UTC)	M	CDF_CHAR	Only mandatory for time variables
UCD	Unified Content Descriptor	O	CDF_CHAR	See [RD8]
UNIT_PTR	has as its value a variable which stores the character strings (up to 20 characters per character string) representing the units of the original variable, which can be added to a data listing heading or plot label.	M	CDF_CHAR	Only mandatory if not using UNITS
UNITS	is a character string (no more than 20 characters, but preferably 6 characters) representing the units of the variable.	M	CDF_CHAR	Only mandatory if not using UNIT_PTR
Utype	Utype	O	CDF_CHAR	
VALIDMAX	hold values which is the maximum value for a particular variable that are expected over the lifetime of the mission.	M	Variable data type	Only mandatory for time varying data and support_data
VALIDMIN	holds value which is the minimum value for a	M	Variable data type	Only mandatory

	particular variable that are expected over the lifetime of the mission.			for time varying data and support_data
VAR_NOTES	holds ancilliary information about the variable and can be any length.	M	CDF_CHAR	
VAR_TYPE	identifies a variable.	M	CDF_CHAR	

Table 6. CDF variable attributes.

5 LZ AND L0 DATA DESCRIPTION

5.1 ROC-SGSE LZ test log data file format and structure

The ROC-SGSE test log data files are XML format files exported from the MEB SGSE database. They contain information about a given test and the corresponding list of events (i.e., TC/TM in binary format, EGSE HK, etc.) produced in during the test. The structure of the XML schema for test log files is inherited from the TestLog MEB-SGSE export file schema delivered through the Monitoring and Analysis SGSE (MA-SGSE) user interface.

RPW data stored in the test log files correspond to the Lz processing level.

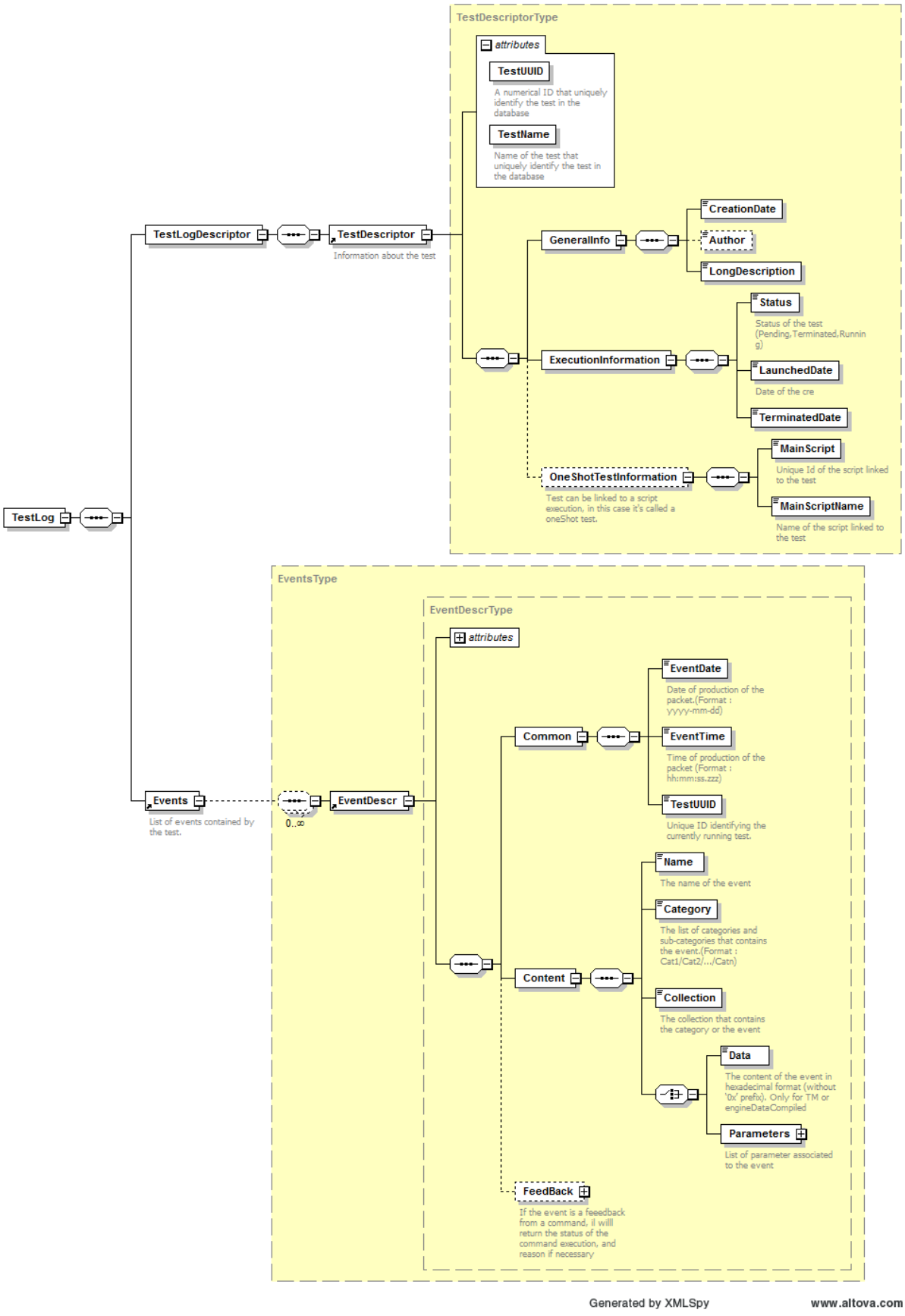


Figure 1. ROC-SGSE test log file structure.

5.2 L0 data file format and structure

The L0 data files are HDF5 format files containing all of the RPW TM packet data produced during a given test but after de-commutation/decompression processes. **In the case of the ROC-SGSE, the L0 files can also store RPW TC packet data as provided in the test log parent files**.

Figure 2 shows the structure of a ROC-SGSE L0 HDF5 format file, which is organized as follows:

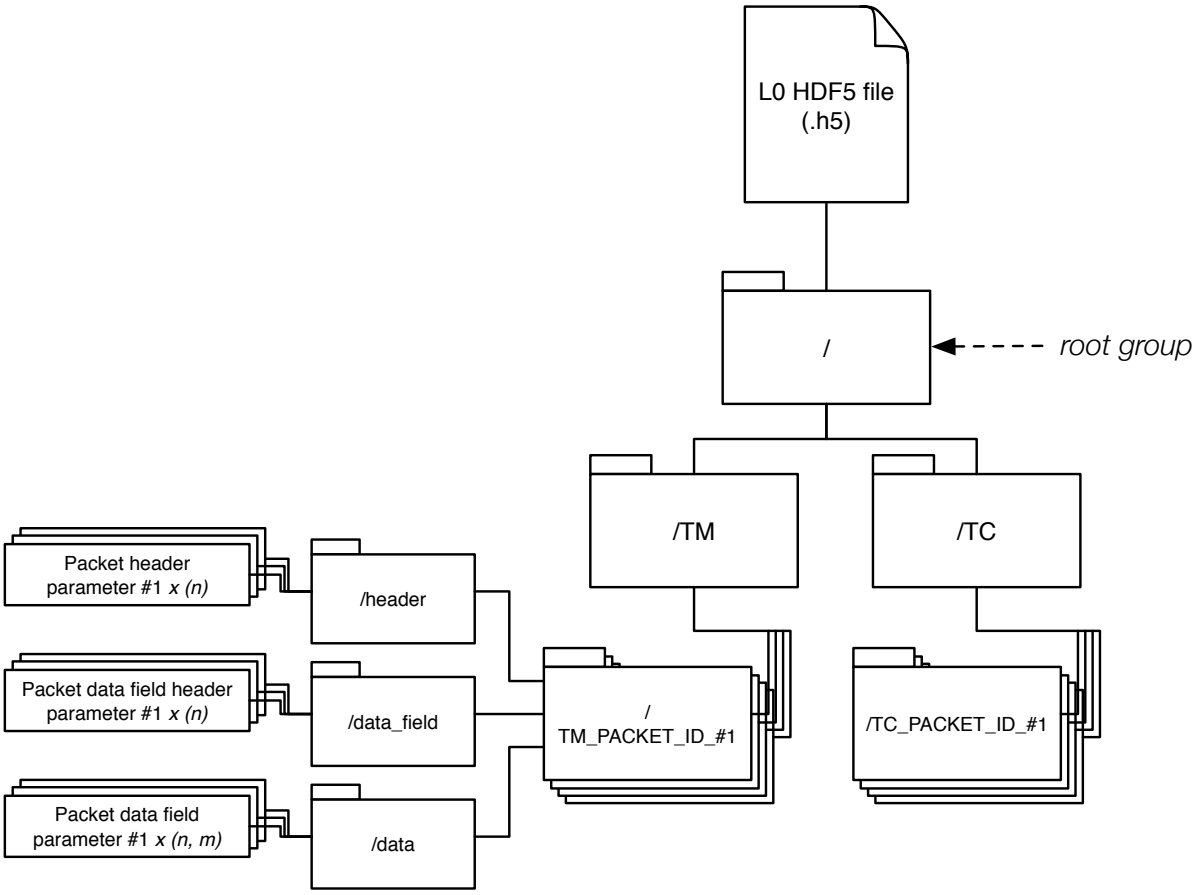
- The primary HDF5 group */root* hosts two groups called */TM* and */TC*. The */TM* group is used to store TM packet data found in the Lz test log parent file, and the */TC* group to store the TC packet data.
- Inside the */TM* and */TC* groups, a list of TM packet groups, */TM_PACKET_ID_#1, /TM_PACKET_ID_#2, /TM_PACKET_ID_#3*, etc., and a list of TC packet groups */TC_PACKET_ID_#1, /TC_PACKET_ID_#2, /TC_PACKET_ID_#3*, etc. are respectively defined. The names of these groups shall be the PALISADE IDs [RD11] of the packets, as defined in the RPW IDB. Each packet group can be thus uniquely identifiable, since each packet PALISADE IDs is unique in the IDB.
- Inside each packet group, three sub-groups */header*, */data_field* and */data* are then created to store respectively the packet header, data field header and data field parameters for the given packet.
- Inside each sub-group */header*, */data_field* and */data*, packet parameters values are stored using HDF5 datasets, which are named as the parameters PALISADE IDs in the RPW IDB. In the case of an array-type parameter providing *m* values per packet, the dataset shall contain an array of [*n, m*] values, where *n* is the number of packets found in the Lz test log parent file[3]. In the case of a scalar-type parameter providing a single value per packet (i.e. *m=1*), the dataset shall contain a vector of [*n, 1*] values, where *n* the number of values stored into the *n* packets found in the Lz test log parent file

It must be noticed that:

- The [*n,m*] values of a given packet's parameter dataset are written in the same order than the corresponding *n* packets in the test log parent file. In theory, the first dimension (i.e., along the *n*-elements axis) should then be sorted by increasing packet creation time values, since the packets are sorted by increasing creation time in the Lz test log parent file.
- The packet data stored in the L0 files are raw values, as written in the TM/TC packets.

[3] It must be noticed that this structure assumes that a given type of packet contains the same number *m* of values for a given array-type parameter. In practice the number of values *m* can differ from a packet to another, and the HDF5 dataset (*n, m*) array is thus generated taking the maximal number $max(m)_{packets}$ of values over packets. If there is a lack of values in a packet *i* (i.e., $m_i < max(m)_{packets}$), then the missing values shall be set using the dedicated default value.

Figure 2. ROC-SGSE L0



ROC-SGSE L0 HDF5 format file structure.

5.3 ROC-SGSE Test information file

The ROC-SGSE test information file shall provide users information about a given test and the corresponding data produced by the ROC-SGSE. Since the ROC databases are not accessible to external users, the file supplies a quick and human readable overview of the test's context, especially in the framework of the ROC user libraries applications.

5.4 MEB EGSE stimuli data processing

5.4.1 MEB EGSE data products

During the ground calibrations at system level, the MEB EGSE [RD13], also called RPW EGSE, will be able to generate synthetic signals, also called stimuli, to be injected into the inputs of the SCM (magnetic part) and/or PAs (electric part). The known of the measured input stimuli – voltage for electric part and magnetic field for the magnetic part - is crucial to calibrate the whole system, especially in phase.

After each run, the MEB EGSE can produce two types of file:

- A text file (.log), which provides a history of EGSE commands and status.

- Text files (.csv), which contain the normalized values of voltage amplitudes. This type of file is only produced in the case where the Arbitrary Waveform Generator (AWG) is used to generate stimuli.

5.4.2 ROC-SGSE MEB EGSE stimuli voltage data product

During the tests, the ROC-SGSE shall be able to process the .log and .csv files created by the EGSE, in order to rebuild the stimuli voltages as a function of time. The resulting data shall be stored into a dedicated XML format file - one file per EGSE log - that will be also provided to RPW consortium.

The E-GSE XML format file shall contain the following tags and attributes.

Item	Type	Parent	Description
RocEgse	Tag (complex)	None	The root tag of the file
GeneralInfo	Tag (complex)	RocEgse	Tag containing general information tags of the file
EgseLogFile	Tag (text)	GeneralInfo	Path of the E-GSE original .log file parsed
LaunchDate	Tag (text)	GeneralInfo	Date and time when the E-GSE script was launched
TerminatedDate	Tag (text)	GeneralInfo	Date and time when the E-GSE script was ended
EgseOutputs	Tag (complex)	RocEgse	Tag containing the Outputs tags
Output	Tag (complex)	EgseOutputs	Tag containing the signal status and parameters for a given E-GSE rack output during the script run
id	Attribute	Output	Provide the E-GSE rack output id
Signal	Tag (complex)	Output	Provide status and parameters of the output signal at a given relevant date and time.
waveform	Attribute	Signal	Type of waveform. If it is a AWG, it provides the name of the corresponding .csv file. If it is a Function Generator (FG), it provides the type of signal (i.e., SIN=SINUSOID, SQU=SQUARE, TRI=TRIANGLE, DC=DIRECT CURRENT). If it is OFF, the output is not used.
type	Attribute	Signal	Type of waveform. AWG or FG
time	Attribute	Signal	Date and time of the signal event
ref	Attribute	Signal	Reference of the time: RPW='RPW DPU time synchronized reference', WIN='Local

			time reference'.
action	Attribute	Signal	Type of E-GSE event/command that was happend at this time (see action definition list below this table)
Offset	Tag (text)	Signal	Amplitude offset of the signal
unit	Attribute	Offset	Unit of the amplitude offset
SampleFreq	Tag (text)	Signal	Sampling frequency of the signal (only for AWG).
unit	Attribute	SampleFreq	Unit of the sampling frequency
Frequency	Tag (text)	Signal	Frequency of the signal (only for FG).
unit	Attribute	Frequency	Unit of the frequency
Phase	Tag (text)	Signal	Phase of the signal (only for FG).
NbCycles	Tag (text)	Signal	Number of time the signal is repeated (only for AWG). If the value is 0, then the signal is repeated until the script stops it
Amplitude	Tag (text)	Signal	Amplitude factor of the signal
unit	Attribute	Amplitude	Unit of the amplitude
att	Attribute	Amplitude	Attenuation in dB to applied on the amplitude.
min	Attribute	Amplitude	Minimal amplitude value that can be supplied by the E-GSE.
max	Attribute	Amplitude	Maximal amplitude value that can be supplied by the E-GSE.

Table 7. E-GSE stimuli XML file items.

5.4.3 EGSE setup metadata

In practice the EGSE stimuli voltage data need to be “calibrated” in order to get the real signals measured by the SCM and PAs.

It mainly consists of taking account of the additional delta in gain and phase that can be introduced by the EGSE setup (BIAS/SCM EGSE, bracket interfaces, SCM caps, etc.).

In the case of:

- Alternating Current (AC) measurements, it concerns the bracket interface contribution only.
- Direct Current (DC) measurements, it concerns the BIAS EGSE and the bracket interface contributions.
- Magnetic measurements, it concerns the SCM EGSE, caps, and the bracket interface contributions.

The CNES team measures these contributions "manually" before each calibration campaign, and delivers to the ROC team the resulting "EGSE setup metadata".

Details about the EGSE setup planned during the ground calibrations, and the measured EGSE setup metadata can be found in the section 6.6.

6 APPENDICES

6.1 ROC-SGSE data set identifiers

According to [RD6] each ROC-SGSE dataset shall be identified by a unique name ID. The naming convention shall be:

SourceName_Level_Descriptor

, where "*SourceName*", "*Level*" and "*Descriptor*" are the prefix values of the corresponding global attributes. This values shall contain only alphanumeric characters in capital letters. If a separator is required the hyphen '-' character shall be used, no underscore '_'.

6.2 List of ROC-SGSE data sets

Each test will lead to produce a collection of data files. A collection will regroup series of RPW science and HK data files, as well as a L0 data file, an input stimuli data file and an associated context file. All of these files will be generated from data provided by the MEB SGSE and EGSE.

There is one file per ROC-SGSE data set and each data set will be assigned a unique identifier (ID) as defined in [AD3].

Any other category of data (e.g., TC verification, error reporting) will be saved into the dedicated ROC test database [RD1].

6.2.1 ROC-SGSE LZ data sets

There is only one data set for the ROC-SGSE test log, which is generated from information provided in the MEB SGSE database.

In the following table: the first column and the second columns provides respectively the ID name and a short description of the data set, the third column gives the file format used, and the fourth and fifth columns the values for the "Descriptor" and "Level" attributes.

Identifier	Description	Format	Descriptor	Level
ROC-SGSE_LZ_MEB-SGSE-TEST-LOG	Contains information about the test. This file is a local copy of the test export log file provided by the MEB SGSE database	XML	MEB-SGSE-TEST-LOG>MEB SGSE Test log data	LZ> Level Zero

Table 8. ROC-SGSE test log data sets.

6.2.2 ROC-SGSE L0 data sets

There is only one L0 data set derived from the ROC-SGSE test log data set.

Identifier	Description	Format	Descriptor	Data_type
ROC-SGSE_L0_RPW	RPW L0 data as produced by the ROC SGSE	HDF5	RPW>Radio and Plasma Waves	L0>Level 0

Table 9. RPW L0 data sets.

6.2.3 ROC-SGSE RPW HK data sets

Table below lists the RPW HK data sets to be produced by the ROC-SGSE during the tests. There will be one file per data set. The first column provides the data set ID names and the two last columns indicate respectively the values of the "Descriptor" and "Level" global attributes.

Identifier	Description	Format	Descriptor	LEvel
ROC-SGSE_HK_RPW-DBS	RPW DPU Boot Software HK parameters as produced by the ROC-SGSE	CDF	RPW-DBS>RPW DPU Boot Software	HK>House keeping parameters
ROC-SGSE_HK_RPW-DAS	RPW DPU Application Software HK parameters as produced by the ROC-SGSE	CDF	RPW-DAS>RPW DPU Application Software	HK>House keeping parameters
ROC-SGSE_HK_RPW-PDU	RPW PDU HK parameters as produced by the ROC-SGSE	CDF	RPW-PDU>RPW PDU	HK>House keeping parameters
ROC-SGSE_HK_THR	RPW TNR-HFR HK parameters as produced by the ROC-SGSE	CDF	RPW-THR>RPW Thermal Noise and High Frequency Receivers	HK>House keeping parameters
ROC-SGSE_HK_TDS	RPW TDS HK parameters as produced by the ROC-SGSE	CDF	RPW-TDS>RPW Time Domain Sampler	HK>House keeping parameters
ROC-SGSE_HK_LFR	RPW LFR HK parameters as produced by the ROC-SGSE	CDF	RPW-LFR>RPW Low Frequency Receiver	HK>House keeping parameters

ROC-SGSE_HK_BIA	RPW BIAS HK parameters as produced by the ROC-SGSE	CDF	RPW-BIA>RPW Bias Unit	HK>House keeping parameters

Table 10. RPW HK data sets.

6.2.4 ROC-SGSE RPW L1 science data sets

Table below provides the list of RPW science data sets at L1 level to be produced during the calibration tests.

Identifier	Description	Format	Descriptor	Level
ROC-SGSE_L1_RPW-TNR-SURV	RPW TNR science data at level 1 for normal/burst survey modes as produced by the ROC-SGSE	CDF	RPW-TNR-SURV>RPW Thermal Noise Receiver in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-HFR-SURV	RPW HFR science data at level 1 for normal/burst survey modes as produced by the ROC-SGSE	CDF	RPW-HFR-SURV>RPW High Frequency Receiver in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SURV-RSWF	RPW TDS Regular Snapshot Waveforms in normal/burst survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-RSWF>RPW Time Domain Sampler Regular Snapshot Waveform in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SURV-TSWF	RPW TDS Triggered Snapshot Waveforms in normal/burst survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-TSWF>RPW Time Domain Sampler Triggered Snapshot Waveform in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SURV-HIST1D	RPW TDS 1D histograms in normal survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-HIST1D>RPW Time Domain Sampler 1D histograms in	L1>Level 1

			survey mode	
ROC-SGSE_L1_RPW-TDS-SURV-HIST2D	RPW TDS 2D histograms in normal survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-HIST2D>RPW Time Domain Sampler 2D histograms in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SURV-STAT	RPW TDS statistical parameters in normal survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-STAT>RPW Time Domain Sampler statistical parameters in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SURV-MAMP	RPW TDS continuous HF signal maximum in normal survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-MAMP>RPW Time Domain Sampler continuous HF signal maximum in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-LFM-RSWF	RPW TDS Regular Snapshot Waveform in Low Frequency Mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-LFM-RSWF>RPW Time Domain Sampler Regular Snapshot Waveform in low frequency mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-LFM-CWF	RPW TDS Continuous Waveform in Low Frequency Mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-LFM-CWF>RPW Time Domain Sampler Continuous Waveform in low frequency mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-LFM-PSDSM	RPW TDS Single Power Spectrum and Spectral Matrix in Low Frequency	CDF	RPW-TDS-LFM-PSDSM>RP	L1>Level 1

	Mode at Level 1 as produced by the ROC-SGSE		W Time Domain Sampler Single Power Spectrum and Spectral Matrix in low frequency mode	
ROC-SGSE_L1_RPW-TDS-SBM1-RSWF	RPW TDS Regular Snapshot Waveform in Selected Burst Mode 1 at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SBM1-RSWF>RPW Time Domain Sampler Regular Snapshot Waveform in SBM1 mode	L1>Level 1
ROC-SGSE_L1_RPW-TDS-SBM2-TSWF	RPW TDS Triggered Snapshot Waveform in Selected Burst Mode 2 at Level 1 as produced by the ROC-SGSE	CDF	RPW-TDS-SBM2-TSWF>RPW Time Domain Sampler Triggered Snapshot Waveform in low frequency mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SURV-ASM	RPW LFR Averaged Spectral Matrices in normal mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-ASM>RPW Low Frequency Receiver Averaged Spectral Matrices in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SURV-BP1	RPW LFR Basic Parameters 1 in normal/burst survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP1>RPW Low Frequency Receiver Basic Parameters 1 in survey mode	L1>Level 1

ROC-SGSE_L1_RPW-LFR-SURV-BP2	RPW LFR Basic Parameters 2 in normal/burst survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP2>RPW Low Frequency Receiver Basic Parameters 2 in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SURV-CWF	RPW LFR Continuous WaveForms in normal/burst survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-CSM>RPW Low Frequency Receiver Continuous Waveforms in survey mode	L1>Level 1
ROC-SGSE_L1-RPW-LFR-SURV-SWF	RPW LFR Snapshot WaveForms in normal survey mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-SWF>RPW Low Frequency Receiver Snapshot waveforms in survey mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SBM1-CWF	RPW LFR Continuous WaveForms in SBM1 mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-CWF>RPW Low Frequency Receiver Continuous Waveforms in SBM1 mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SBM1-BP1	RPW LFR Basic Parameters 1 in SBM1 mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP1>RPW Low Frequency Receiver Basic Parameters 1 in SBM1 mode	L1>Level 1
ROC-SGSE_L1_RPW-	RPW LFR Basic	CDF	RPW-LFR-	L1>Level 1

LFR-SBM1-BP2	Parameters 2 in SBM1 mode at Level 1 as produced by the ROC-SGSE		SBM1-BP2>RPW Low Frequency Receiver Basic Parameters 2 in SBM2 mode	
ROC-SGSE_L1_RPW-LFR-SBM2-CWF	RPW LFR Continuous WaveForms in SBM2 mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-CWF>RPW Low Frequency Receiver Continuous Waveforms in SBM2 mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SBM2-BP1	RPW LFR Basic Parameters 1 in SBM2 mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-BP1>RPW Low Frequency Receiver Basic Parameters 1 in SBM2 mode	L1>Level 1
ROC-SGSE_L1_RPW-LFR-SBM2-BP2	RPW LFR Basic Parameters 2 in SBM2 mode at Level 1 as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-BP2>RPW Low Frequency Receiver Basic Parameters 2 in SBM2 mode	L1>Level 1

Table 11. RPW L1 science data sets.

6.2.5 RPW L2r science data sets

Table below provides the list of RPW science data sets at L2e level to be produced during the calibration tests.

Identifier	Description	Format	Descriptor	Level
ROC-SGSE_L2R_RPW-	RPW TNR science data at level 2r for normal/burst	CDF	RPW-TNR-SURV>RPW	L2r>Level 2 at receiver

TNR-SURV	survey modes as produced by the ROC-SGSE		Thermal Noise Receiver in survey mode	
ROC-SGSE_L2R_RPW-HFR-SURV	RPW HFR science data at level 2r for normal/burst survey modes as produced by the ROC-SGSE	CDF	RPW-HFR-SURV>RPW High Frequency Receiver in survey mode	L2r>Level 2 at receiver
ROC-SGSE_L2R_RPW-TDS-SURV-RSWF	RPW TDS Regular Snapshot Waveforms in normal/burst survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-RSWF>RPW Time Domain Sampler Regular Snapshot Waveform in survey mode	L2r>Level 2 at receiver
ROC-SGSE_L2R_RPW-TDS-SURV-TSWF	RPW TDS Triggered Snapshot Waveforms in normal/burst survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-TSWF>RPW Time Domain Sampler Triggered Snapshot Waveform in survey mode	L2r>Level 2 at receiver
ROC-SGSE_L2R_RPW-TDS-SURV-HIST1D	RPW TDS 1D histograms in normal survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-HIST1D>RPW Time Domain Sampler 1D histograms in survey mode	L2r>Level 2 at receiver
ROC-SGSE_L2R_RPW-TDS-SURV-HIST2D	RPW TDS 2D histograms in normal survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-HIST2D>RPW Time Domain Sampler 2D histograms in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-TDS-SURV-STAT	RPW TDS statistical parameters in normal survey mode at Level 2r as produced by the ROC-	CDF	RPW-TDS-SURV-STAT>RPW Time Domain	L2r>Level 2 at receiver

	SGSE		Sampler statistical parameters in survey mode	
ROC-SGSE_ L2R _RPW-TDS-SURV-MAMP	RPW TDS continuous HF signal maximum in normal survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SURV-MAMP>RPW Time Domain Sampler continuous HF signal maximum in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-TDS-LFM-RSWF	RPW TDS Regular Snapshot Waveform in Low Frequency Mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-LFM-RSWF>RPW Time Domain Sampler Regular Snapshot Waveform in low frequency mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-TDS-LFM-CWF	RPW TDS Continuous Waveform in Low Frequency Mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-LFM-CWF>RPW Time Domain Sampler Continuous Waveform in low frequency mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-TDS-LFM-PSDSM	RPW TDS Single Power Spectrum and Spectral Matrix in Low Frequency Mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-LFM-PSDSM>RPW Time Domain Sampler Single Power Spectrum and Spectral Matrix in low frequency mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-TDS-SBM1-RSWF	RPW TDS Regular Snapshot Waveform in Selected Burst Mode 1 at Level 2r as produced by the	CDF	RPW-TDS-SBM1-RSWF>RPW Time Domain	L2r>Level 2 at receiver

	ROC-SGSE		Sampler Regular Snapshot Waveform in SBM1 mode	
ROC-SGSE_ L2R _RPW-TDS-SBM2-TSWF	RPW TDS Triggered Snapshot Waveform in Selected Burst Mode 2 at Level 2r as produced by the ROC-SGSE	CDF	RPW-TDS-SBM2-TSWF>RPW Time Domain Sampler Triggered Snapshot Waveform in SBM2 mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SURV-ASM	RPW LFR Averaged Spectral Matrices in normal mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-ASM>RPW Low Frequency Receiver Averaged Spectral Matrices in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SURV-BP1	RPW LFR Basic Parameters 1 in normal/burst survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP1>RPW Low Frequency Receiver Basic Parameters 1 in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SURV-BP2	RPW LFR Basic Parameters 2 in normal/burst survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP2>RPW Low Frequency Receiver Basic Parameters 2 in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SURV-CWF	RPW LFR Continuous WaveForms in normal/burst survey mode at Level 2r as produced by	CDF	RPW-LFR-SURV-CWF>RPW Low	L2r>Level 2 at receiver

	the ROC-SGSE		Frequency Receiver Continuous Waveforms in survey mode	
ROC-SGSE_ L2R - RPW-LFR-SURV-SWF	RPW LFR Snapshot WaveForms in normal survey mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-SWF>RPW Low Frequency Receiver Snapshot waveforms in survey mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SBM1-CWF	RPW LFR Continuous WaveForms in SBM1 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SBM1-CWF>RPW Low Frequency Receiver Continuous Waveforms in SBM1 mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SBM1-BP1	RPW LFR Basic Parameters 1 in SBM1 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SURV-BP1>RPW Low Frequency Receiver Basic Parameters 1 in SBM1 mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SBM1-BP2	RPW LFR Basic Parameters 2 in SBM1 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SBM1-BP2>RPW Low Frequency Receiver Basic Parameters 2 in SBM2 mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SBM2-CWF	RPW LFR Continuous WaveForms in SBM2 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-CWF>RPW Low Frequency	L2r>Level 2 at receiver

			Receiver Continuous Waveforms in SBM2 mode	
ROC-SGSE_ L2R _RPW-LFR-SBM2-BP1	RPW LFR Basic Parameters 1 in SBM2 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-BP1>RPW Low Frequency Receiver Basic Parameters 1 in SBM2 mode	L2r>Level 2 at receiver
ROC-SGSE_ L2R _RPW-LFR-SBM2-BP2	RPW LFR Basic Parameters 2 in SBM2 mode at Level 2r as produced by the ROC-SGSE	CDF	RPW-LFR-SBM2-BP2>RPW Low Frequency Receiver Basic Parameters 2 in SBM2 mode	L2r>Level 2 at receiver

Table 12. RPW L2r science data sets.

6.2.6 RPW L2s science data sets

Identifier	Description	Format	Descriptor	Level
ROC-SGSE_L2S_RPW-TNR-SURV	Contains RPW TNR L2s science electric data in survey mode, time-tagged	CDF	RPW-TNR-SURV>RPW Thermal Noise Receiver in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-HFR-SURV	Contains RPW HFR L2s science electric data in survey mode, time-tagged	CDF	RPW-HFR-SURV>RPW High Frequency Receiver in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-E	Contains RPW TDS L2s RSWF science electric data in survey mode, time-tagged	CDF	RPW-TDS-SURV-RSWF-E>RPW Time Domain Sampler Regular	L2s>Level 2 at system

			Snapshot Waveform in survey mode. Electric component.	
ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B	Contains RPW TDS L2S RSWF science magnetic data in survey mode, time-tagged	CDF	RPW-TDS-SURV-RSWF-E>RPW Time Domain Sampler Regular Snapshot Waveform in survey mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-E	Contains RPW TDS L2s TSWF science electric data in survey mode, time-tagged	CDF	RPW-TDS-SURV-TSWF-E>RPW Time Domain Sampler Triggered Snapshot Waveform in survey mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B	Contains RPW TDS L2S TSWF science magnetic data in survey mode, time-tagged	CDF	RPW-TDS-SURV-TSWF-B>RPW Time Domain Sampler Triggered Snapshot Waveform in survey mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-HIST1D	Contains RPW TDS L2s HIST1D science data in survey mode, time-tagged	CDF	RPW-TDS-SURV-HIST1D>RPW Time Domain Sampler 1D	L2s>Level 2 at system

			histograms in survey mode	
ROC-SGSE_L2S_RPW-TDS-SURV-HIST2D	Contains RPW TDS L2s HIST2D science data in survey mode, time-tagged	CDF	RPW-TDS-SURV-HIST2D>RPW Time Domain Sampler 2D histograms in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-STAT	Contains RPW TDS L2s STAT science data in survey mode, time-tagged	CDF	RPW-TDS-SURV-STAT>RPW Time Domain Sampler statistical parameters in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SURV-MAMP	Contains RPW TDS L2s MAMP science data in survey mode, time-tagged	CDF	RPW-TDS-SURV-MAMP>RPW Time Domain Sampler continuous HF signal maximum in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-E	Contains RPW TDS L2s RSWF science electric data in SBM1 mode, time-tagged	CDF	RPW-TDS-SBM1-RSWF-E>RPW Time Domain Sampler Regular Snapshot Waveform in SBM1 mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B	Contains RPW TDS L2S RSWF science magnetic electric data in SBM1 mode, time-tagged	CDF	RPW-TDS-SBM1-RSWF-B>RPW Time Domain Sampler Regular Snapshot	L2s>Level 2 at system

			Waveform in SBM1 mode. Magnetic component.	
ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-E	Contains RPW TDS L2s TSWF science electric data in SBM2 mode, time-tagged	CDF	RPW-TDS-SBM2-TSWF-E>RPW Time Domain Sampler Triggered Snapshot Waveform in SBM2 mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B	Contains RPW TDS L2s TSWF science magnetic data in SBM2 mode, time-tagged	CDF	RPW-TDS-SBM2-TSWF-B>RPW Time Domain Sampler Triggered Snapshot Waveform in SBM2 mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-E	Contains RPW TDS L2S RSWF science electric data in LFM mode, time-tagged	CDF	RPW-TDS-LFM-RSWF-E>RPW Time Domain Sampler Regular Snapshot Waveform in low frequency mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B	Contains RPW TDS L2S RSWF science magnetic data in LFM mode, time-tagged	CDF	RPW-TDS-LFM-RSWF-B>RPW Time Domain Sampler Regular Snapshot Waveform in	L2s>Level 2 at system

			low frequency mode. Magnetic component.	
ROC-SGSE_L2S_RPW-TDS-LFM-CWF-E	Contains RPW TDS L2S CWF science electric data in LFM mode, time-tagged	CDF	RPW-TDS-LFM-CWF-E>RPW Time Domain Sampler Continuous Waveform in low frequency mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B	Contains RPW TDS L2S CWF science magnetic data in LFM mode, time-tagged	CDF	RPW-TDS-LFM-CWF-B>RPW Time Domain Sampler Continuous Waveform in low frequency mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-TDS-LFM-PSDSM	Contains RPW TDS L2S PSD and SM science data in LFM mode, time-tagged	CDF	RPW-TDS-LFM-PSDSM>RPW Time Domain Sampler Single Power Spectrum and Spectral Matrix in low frequency mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SURV-ASM	Contains RPW LFR L2s ASM science data in survey mode, time-tagged	CDF	RPW-LFR-SURV-ASM>RPW Low Frequency Receiver Averaged Spectral Matrices in survey mode	L2s>Level 2 at system

ROC-SGSE_L2S_RPW-LFR-SURV-BP1	Contains RPW LFR L2s BP1 science data in survey mode, time-tagged	CDF	RPW-LFR-SURV-BP1>RPW Low Frequency Receiver Basic Parameters 1 in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SURV-BP2	Contains RPW LFR L2s BP2 science data in survey mode, time-tagged	CDF	RPW-LFR-SURV-BP2>RPW Low Frequency Receiver Basic Parameters 2 in survey mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SURV-CWF-E	Contains RPW LFR L2s CWF science electric data in survey mode, time-tagged	CDF	RPW-LFR-SURV-CWF-E>RPW Low Frequency Receiver Continuous Waveforms in survey mode. Electric component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B	Contains RPW LFR L2S CWF science magnetic data in survey mode, time-tagged	CDF	RPW-LFR-SURV-CWF-B>RPW Low Frequency Receiver Continuous Waveforms in survey mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SURV-SWF-E	Contains RPW LFR L2s SWF science electric data in survey mode, time-tagged	CDF	RPW-LFR-SURV-SWF-E>RPW Low Frequency Receiver Snapshot waveforms in	L2s>Level 2 at system

			survey mode. Electric component.	
ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B	Contains RPW LFR L2S SWF science magnetic data in survey mode, time-tagged	CDF	RPW-LFR-SURV-SWF-B>RPW Low Frequency Receiver Snapshot waveforms in survey mode. Magnetic component.	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-E	Contains RPW LFR L2s CWF science electric data in survey mode, time-tagged	CDF	RPW-LFR-SBM1-CWF-E>RPW Low Frequency Receiver Continuous Waveforms in SBM1 mode. Electric component	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B	Contains RPW LFR L2S CWF science data in survey mode, time-tagged	CDF	RPW-LFR-SBM1-CWF-B>RPW Low Frequency Receiver Continuous Waveforms in SBM1 mode. Magnetic component	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM1-BP1	Contains RPW LFR L2s BP1 science data in SBM1 mode, time-tagged	CDF	RPW-LFR-SBM1-BP1>RPW Low Frequency Receiver Basic Parameters 1 in SBM1 mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM1-BP2	Contains RPW LFR L2s BP2 science data in SBM1 mode, time-tagged	CDF	RPW-LFR-SBM1-BP2>RPW Low	L2s>Level 2 at system

			Frequency Receiver Basic Parameters 2 in SBM1 mode	
ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-E	Contains RPW LFR L2s CWF science electric data in SBM2 mode, time-tagged	CDF	RPW-LFR-SBM2-CWF-E>RPW Low Frequency Receiver Continuous Waveforms in SBM2 mode. Electric component	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B	Contains RPW LFR L2S CWF science magnetic data in SBM2 mode, time-tagged	CDF	RPW-LFR-SBM2-CWF-B>RPW Low Frequency Receiver Continuous Waveforms in SBM2 mode. Magnetic component	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM2-BP1	Contains RPW LFR L2s BP1 science data in SBM2 mode, time-tagged	CDF	RPW-LFR-SBM2-BP2>RPW Low Frequency Receiver Basic Parameters 1 in SBM2 mode	L2s>Level 2 at system
ROC-SGSE_L2S_RPW-LFR-SBM2-BP2	Contains RPW LFR L2s BP2 science data in SBM2 mode, time-tagged	CDF	RPW-LFR-SBM2-BP2>RPW Low Frequency Receiver Basic Parameters 2 in SBM2 mode	L2s>Level 2 at system
ROC-	Contains RPW BIAS L2S	CDF		L2s>Level

SGSE_L2S_RPW-BIA-SWEEP	Sweep data			2 at system

6.2.7 RPW low latency science data sets

Table below provides the list of RPW low latency data sets to be produced during the calibration tests.

Name	Description	Format	Descriptor	Level
ROC-SGSE_LL01_RPW-TNR	RPW TNR low latency LL01 science data as produced by the ROC-SGSE	CDF	RPW-TNR>Radio and Plasma Waves – Thermal Noise Receiver	LL01>Low Latency 01
ROC-SGSE_LL01_RPW-BIA	RPW Bias low latency LL01 science data as produced by the ROC-SGSE	CDF	RPW-BIA>Radio and Plasma Waves – Bias	LL01>Low Latency 01
ROC-SGSE_LL01_RPW-SBM1	RPW SBM1 low latency LL01 science data as produced by the ROC-SGSE	CDF	RPW-TNR>Radio and Plasma Waves – Select Burst Mode 1	LL01>Low Latency 01
ROC-SGSE_LL01_RPW-SBM2	RPW SBM2 low latency LL01 science data as produced by the ROC-SGSE	CDF	RPW-TNR>Radio and Plasma Waves – Thermal Noise Receiver	LL01>Low Latency 01

6.2.1 ROC-SGSE stimuli data sets

There are three data sets for ROC-SGSE stimuli, but only the "ROC-SGSE_MEB-EGSE_STIM-CDF" is actually produced by the ROC-SGSE. The two other data sets are created by the RPW MEB EGSE S/W and imported on the ROC-SGSE data volume.

Identifier	Description	Format	Descriptor	Level
ROC-SGSE_AUX_MEB-EGSE-STIM-CSV	RPW MEB EGSE input stimuli data (only produced in the EGSE AWG mode, see [RD5])	CSV	MEB-EGSE-STIM-CSV>MEB-EGSE	AUX>Auxiliary

			stimuli csv data	
ROC-SGSE_AUX_MEB-EGSE-LOG	RPW MEB EGSE log parameters	ASCII	MEB-EGSE-LOG>MEB-EGSE log data	AUX>Auxiliary
ROC-SGSE_AUX_MEB-EGSE-STIM-VOLT	RPW MEB EGSE stimuli data as processed by the ROC-SGSE	XML	MEB-EGSE-STIM-VOLT>MEB EGSE stimuli voltage	AUX>Auxiliary

Table 13. ROC-SGSE stimuli data sets.

6.2.2 Additional data sets

Name	Description	Format	Descriptor	Level
ROC-SGSE_ROC-AUX_TEST-INFO	Contains information about the test description produced by the ROC SGSE from the ROC Test database (TDB) content. There will be one context file per test.	XML	TEST-INFO >Information about test	AUX>Auxiliary

6.3 Data processing level conventions

The two following figures illustrate which data processing levels are expected to be found during the on-ground calibration depending on the sub-systems involved.

Figure 3 presents the 2 processing levels defined for the calibration of electric part of the RPW system:

- The L2r level data is measured at the receiver during the standalone calibrations.
- The L2s level data is measured at the HF and PF preamplifiers (PAs) from stimuli generated by the MEB and BIAS EGSE respectively during the RPW system calibrations.

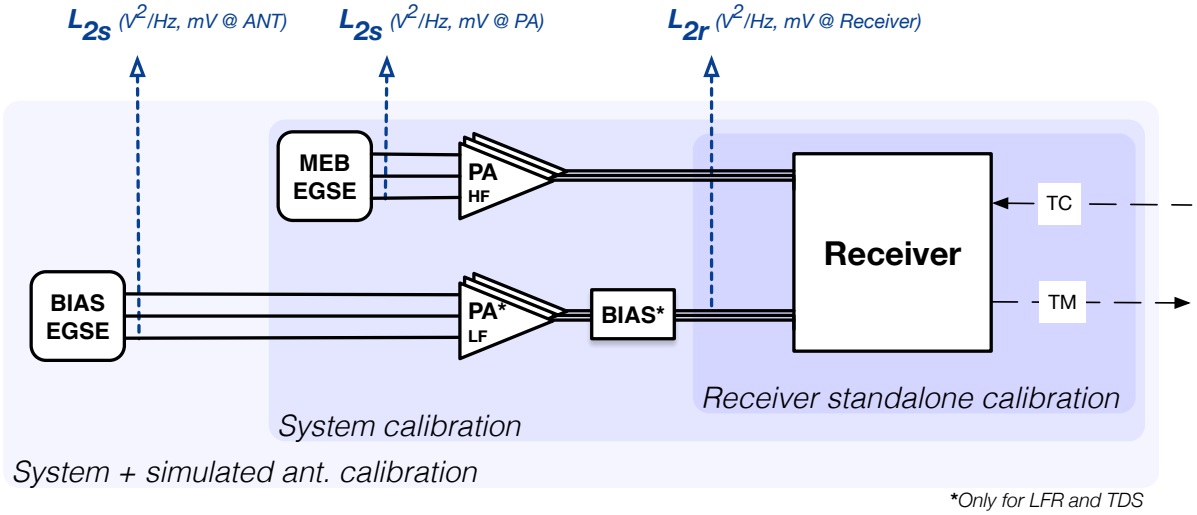


Figure 3. RPW data processing level conventions. Electric part.

Figure 4 presents the 2 processing levels defined for the calibration of magnetic part of the RPW system:

- The L2r level data is measured at the receiver during the standalone calibrations (same than for electric part).
- The L2s level data corresponds to the stimuli sent by the SCM EGSE to the SCM.

No L2 data will be produced for the magnetic part of the system during the tests, although the L2s and L2 level definitions are similar in this case.

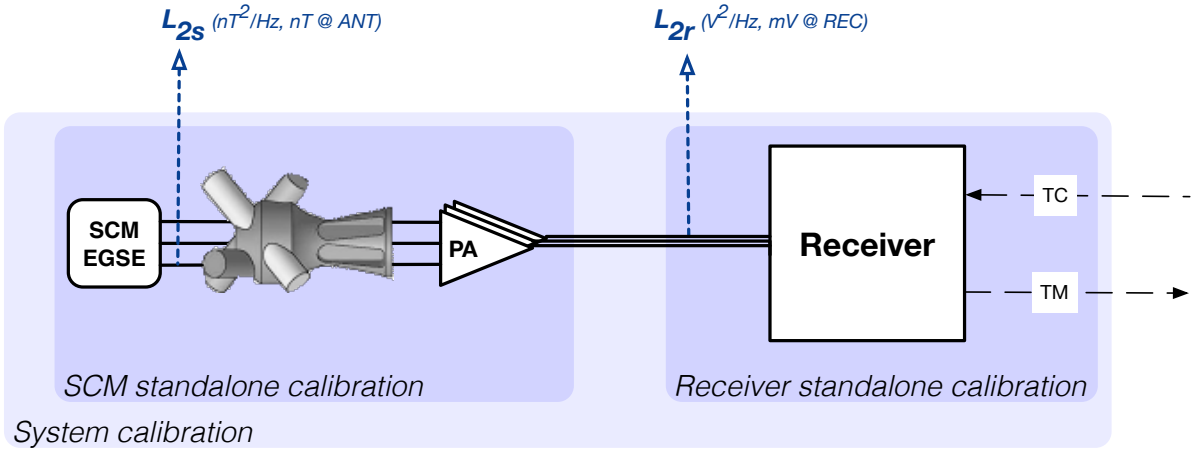


Figure 4. RPW data processing level convention. Magnetic part.

6.4 ROC-SGSE CDF format file management

6.4.1 Epoch time variable structure

The following structure shall be used to describe the Epoch zvariable in the CDF files. Values in blue are fixed. Comments are preceded by "#".

Variable_Name	Data_type	DIMS	SIZES	R_VARY	D_VARY
Epoch	CDF_TIME_TT2000	1	0	T	

ATTRIBUTES

Attribute_Name	Data_type	Value
FIELDNAM	CDF_CHAR	"Epoch"
CATDESC	CDF_CHAR	"Default time"
DISPLAY_TYPE	CDF_CHAR	"time_series"
FILLVAL	CDF_TIME_TT2000	9999-12-31T23:59:59.999999999
LABLAXIS	CDF_CHAR	"Epoch"
UNITS	CDF_CHAR	"ns"
VALIDMIN	CDF_TIME_TT2000	2000-01-01T00:00:00.000000000
VALIDMAX	CDF_TIME_TT2000	2050-12-31T23:59:59.999000000
SCALEMIN	CDF_TIME_TT2000	1990-01-01T00:00:00.000000000 #This attribute shall be updated with the minimal Epoch value found in the current CDF file.
SCALEMAX	CDF_TIME_TT2000	2050-12-31T23:59:59.999000000 #This attribute shall be updated with the maximal Epoch value found in the current CDF file.
VAR_TYPE	CDF_CHAR	"support_data"
SCALETYP	CDF_CHAR	"linear"
TIME_BASE	CDF_CHAR	"J2000"
TIME_SCALE	CDF_CHAR	"RPW DPU time"
REFERENCE_POSITION	CDF_CHAR	"MEB GSE"
Resolution	CDF_CHAR	"15258 ns" #This should be great or equal to the CUC fine part resolution (~15258 nanosec.)
Bin_location	CDF_CHAR	0.5
VAR_NOTES	CDF_CHAR	"Primary time used as reference in the file."

6.4.2 FILLVAL variable attribute allowed values

The following table, derived from the ISTP guidelines, gives the value to be used for the FILLVAL attribute depending of CDF variable data type.

CDF Data Type	FILLVAL value

CDF_REAL4, CDF_FLOAT	-1.0e31
CDF_REAL8, CDF_DOUBLE	-1.0e31
CDF_BYTE	-128
CDF_INT2	-32768
CDF_INT4	-2147483648
CDF_UINT1	255
CDF_UINT2	65535
CDF_UINT4	4294967295
CDF_TIME_TT2000	9999-12-31:23:59:59.999999999
CDF_EPOCH	9999-12-31:23:59:59.999
CDF_EPOCH16	9999-12-31:23:59:59.999999999999

Table 14. FILLVAL variable attribute allowed values.

6.4.3 Creation of the master CDF binary file

Every CDF data files shall be created using a binary CDF as template (also called “Master CDF”). This master CDF is built from a given skeleton table in ASCII format, which provides a complete description of the file content (see [RD3] for more details).

The teams are in charge of defining and delivering the skeleton tables for the CDF datasets to be produced by their own S/W. However, since teams might not be familiar with the skeleton table creation conventions and to make easier the edition step, the ROC team proposes to use specific formatted Excel 2007 table files. These Excel files can be then converted into usual ASCII skeleton tables using a dedicated python library, which is freely accessible to the team from:

https://sourcesup.renater.fr/wiki/maser/maser_python_package

Figure 5 summarizes the CDF creation process.

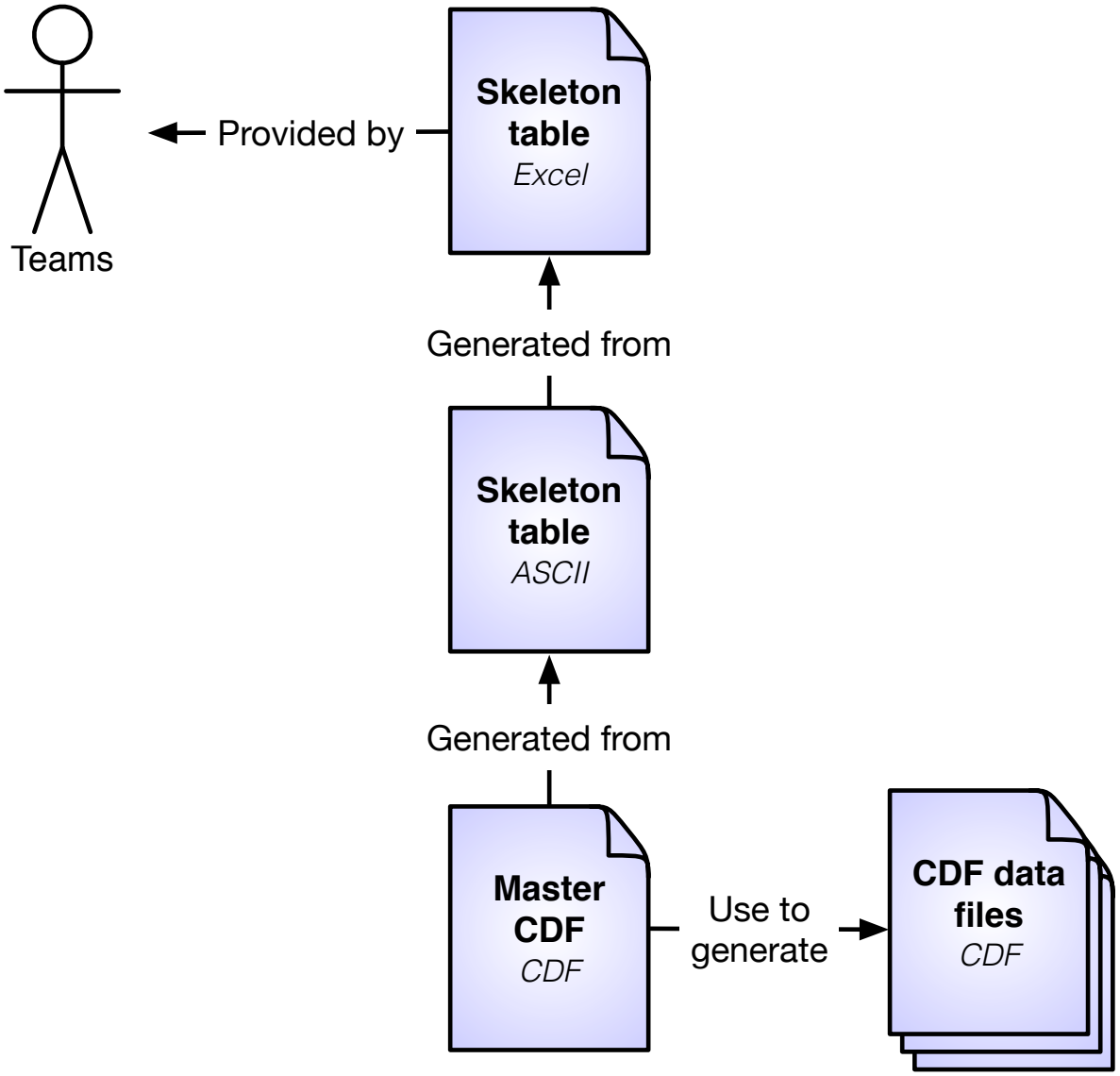


Figure 5. CDF creation process.

In practice, only the master CDF files shall be delivered within the S/W, in order to be used as an input parameter to produce the final CDF data files.

Nevertheless, all of the CDF skeleton tables in Excel format data shall be uploaded into the following directory for archiving:

https://version-lesia.obspm.fr/repos/ROC/GroundTests/ROC-SGSE/Data/Schemas/CDF/Excel/

The file naming convention for the Excel/skeleton/master CDF shall be:

datasetID_VXX.ext

, where "*datasetID*" corresponds to the dataset ID name as defined in the section 6.1 (e.g., 'ROC-SGSE_L1_RPW-TNR-SURV_V02.xlsx).

6.5 RPW calibration table management

This section addresses the way the RPW calibration tables (hereafter called CalTables) shall be managed in the framework of the ROC-SGSE application.

The CalTables are typically used by the RCS to derive RPW sub-system calibrated science data from uncalibrated science data.

Since the CalTable data might encounter several updates during the on-ground tests, special effort shall be made to standardize and optimize their use in terms of traceability, accesibility, analysis and archiving.

6.5.1 RPW calibration table versioning

The CalTables shall be released with their own version number, release date and responsible, following the same versioning conventions than for the RPW datasets.

Depending on the CalTable file format, this information shall be written inside the file as meta-data, and shall be updated each time the CalTable is updated.

6.5.2 RPW calibration table format

The teams are free to define the file format for their own CalTables. Nevertheless the ROC team strongly recommends to use one of the following wide-spread file formats, which offer structure flexibility and a standard data access:

- XML (1.0 or 1.1)
- JSON
- CDF V3.6
- HDF5
- FITS

If the same format is used, common dedicated routines can be distributed by the ROC in order to parse and easily check the CalTable files.

In any way, it is the responsibility of the RCS teams to ensure their S/W is able to correctly read the associated CalTable files.

6.6 MEB EGSE setup overview and data

6.6.1 Overview of the MEB EGSE

6.6.1.1 Test setup 1: AC measurements

The MEB EGSE is composed of:

- MEB GSE a signal generator
- Programmable attenuators from 0 to 120dB
- BIAS relay box: Selectable input impedance for the preamplifiers
- SCM EGSE: allow to inject a magnetic field on each SCM coil for LF and MF frequencies.
- Interface bracket allowing to pass into thermal vacuum chamber.

The schematic bellow represents the MEB EGSE setup 1:

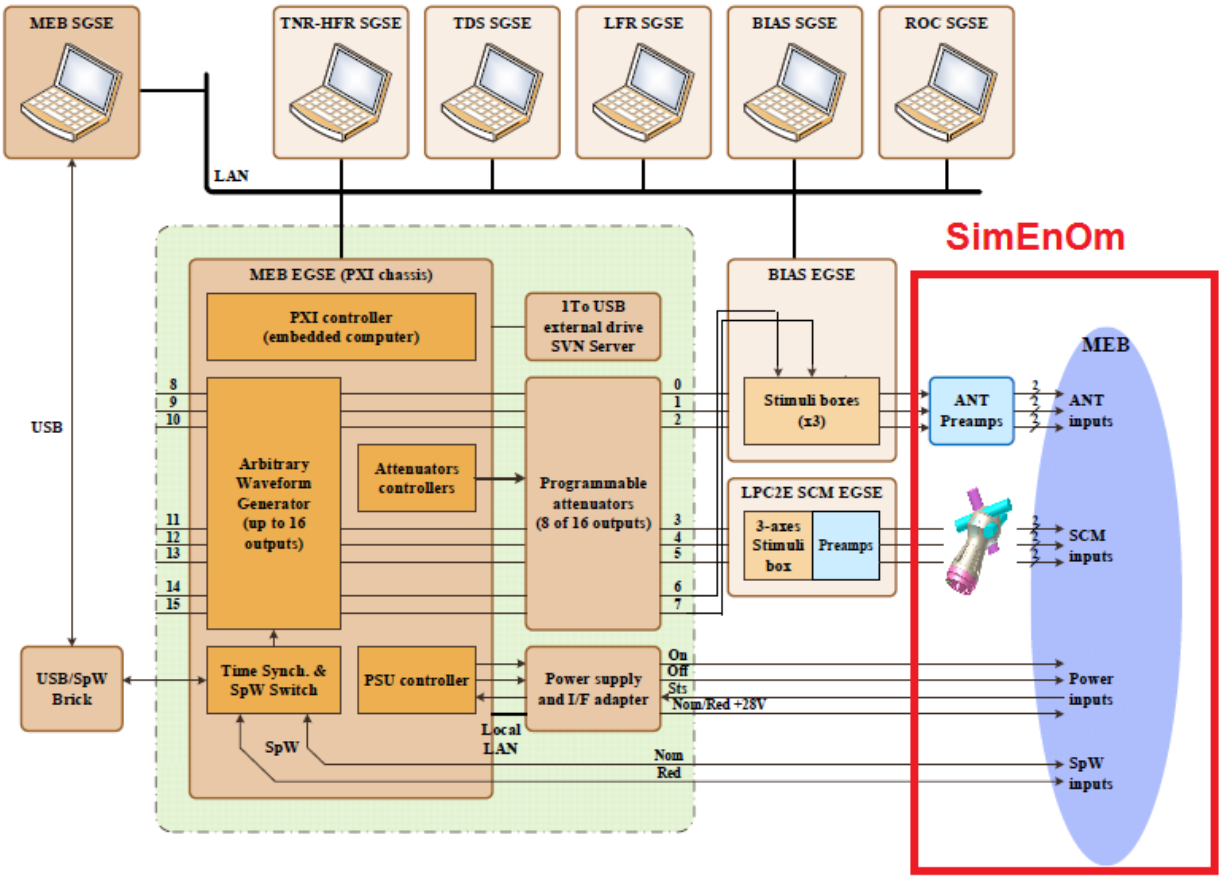


Figure 6. MEB EGSE setup 1.

6.6.1.2 Test setup 2: DC measurements

The MEB EGSE is composed of:

- BIAS Stimuli GSE a signal generator
- BIAS relay box: Selectable input impedance for the preamplifiers
- Interface bracket allowing to pass into thermal vacuum chamber.

The schematic bellow represents the MEB EGSE setup 2:

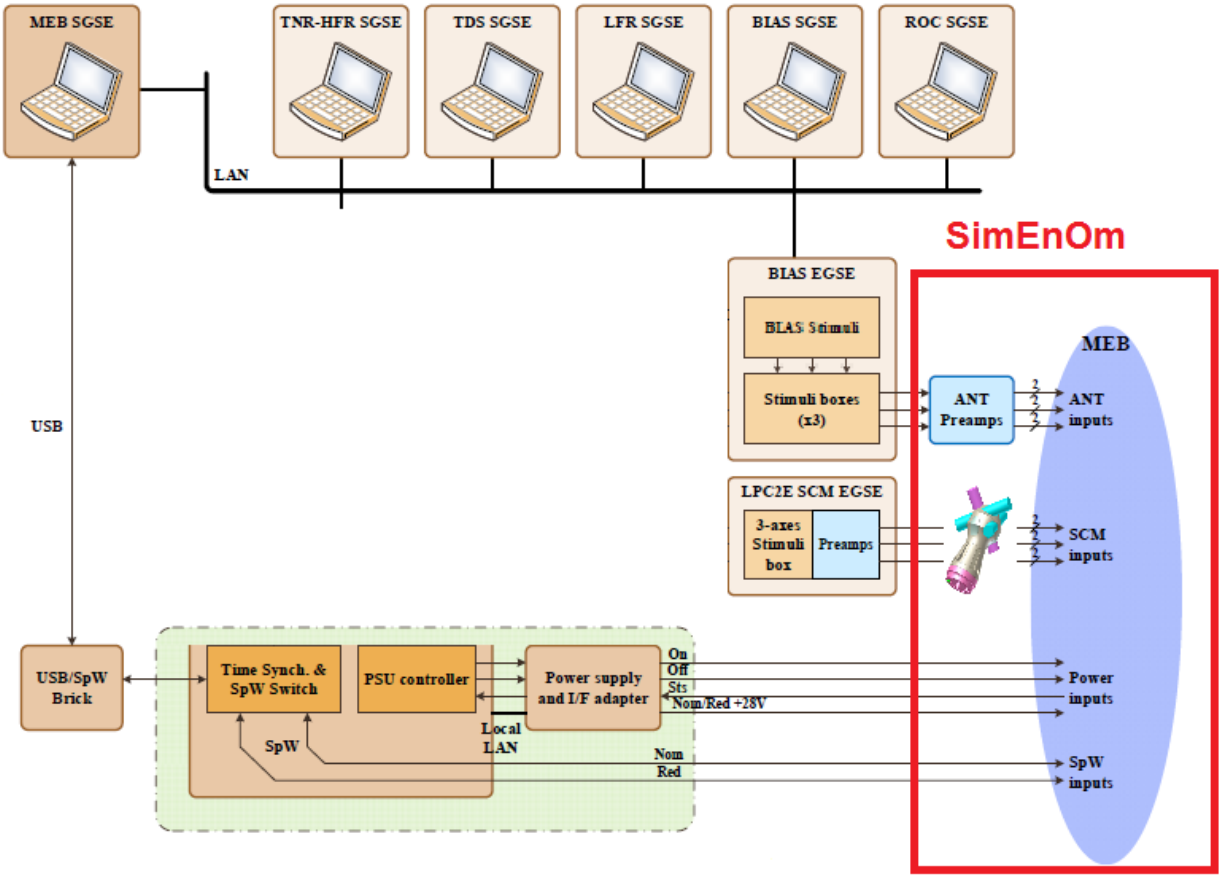


Figure 7. MEB EGSE setup 2.

6.7 MEB EGSE setup metadata

This section presents the MEB EGSE setup metadata required to retrieve and to analyse the MEB EGSE input stimuli data – voltage or magnetic field values - as actually injected into the PAs and SCM during the ground calibration tests at system level.

6.7.1 Type of EGSE setup metadata

6.7.1.1 Setup 1: AC Measurement

The following measurement shall be done before each calibration campaign.

6.7.1.1.1 Electrical part

The MEB EGSE shall be calibrated in amplitude and phase, in order to establish the delta between the signal at EGSE output (1), (2) and at Preamplifier input(3). The test setup can have a big influence on amplitude and phase, especially at high frequency (between 10MHz and 16MHz). The following setup shall be tested:

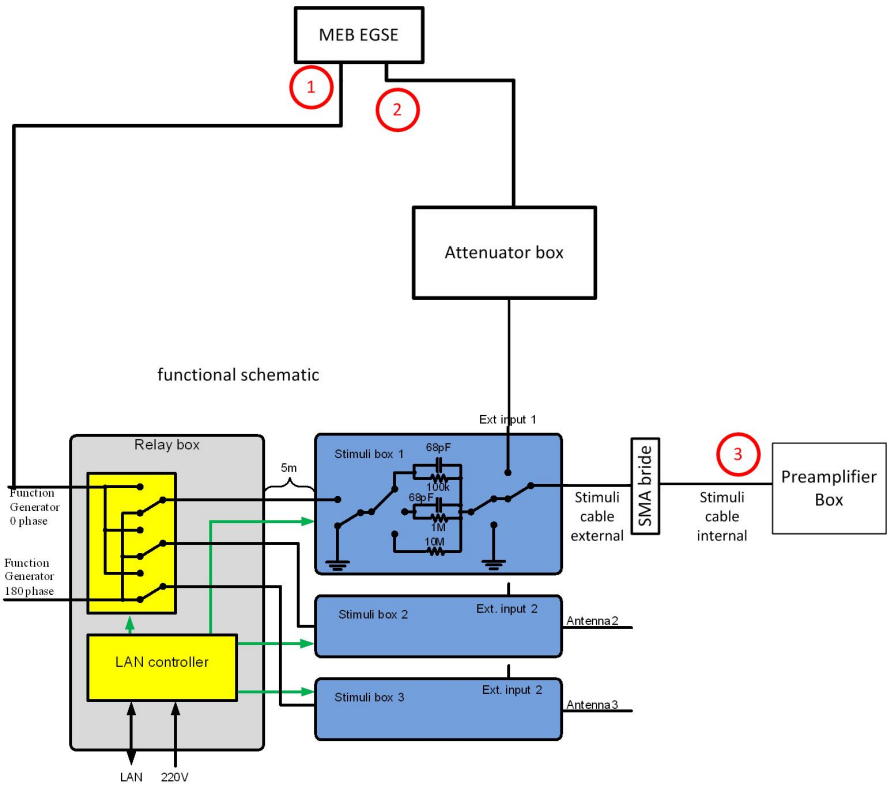


Figure 8. MEB EGSE calibration for electrical fields

6.7.1.1.2 Magnetic part

The same type of calibration shall be done talking into account the SCM injection setup, see picture below:

Figure 9. SCM injection setup

The calibration in amplitude and phase shall be done between the point (4) and the point (5) on the figure below:

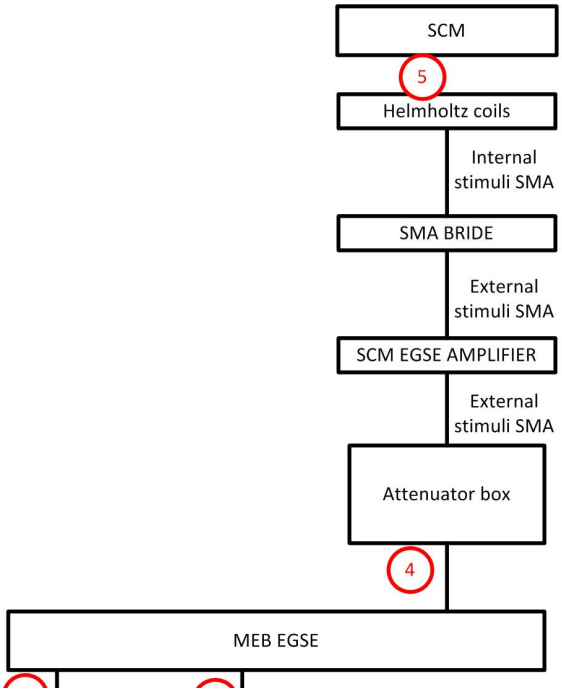


Figure 10. MEB EGSE calibration for magnetic fields

WARNING : The measurement done on point (5) shall be done in **current**, not in voltage! Because the B field generated by the Helmholtz coils is driven by the current (thanks to gauss law).

6.7.1.1.3 Capacitance

Before pumping the stimuli coaxial capacitance of the preamplifiers shall be measured, the equivalent schematic presents the capacitances to be measured:

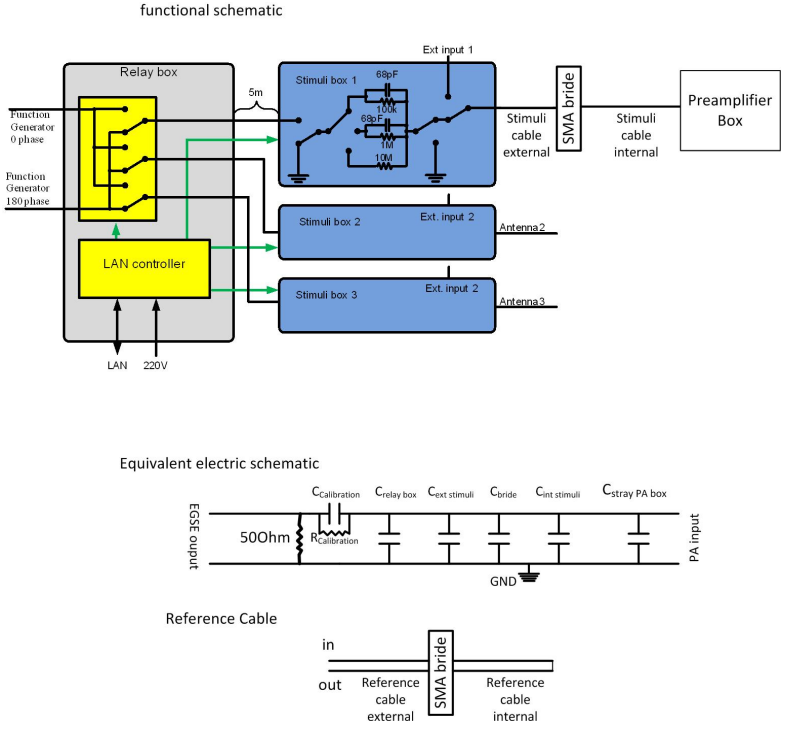


Figure 11 . Equivalent electric schematic of the thermal setup

This sum of capacitances will be comparable of the Stray capacitance of the antenna (expected: 40pF).

The PA box capacitance will be previously measured on PFM models (measured at 35pF on QM model).

The Stimuli cable external + Bride + stimuli cable internal shall be given to BIAS team for stand-alone calibrations, in order to have the same reference for L2R calibrations and L2S calibrations.

The reference cable capacitance shall be periodically measured to guarantee that the cable impedance doesn't change with temperature.

6.7.1.1.4 List of measurement for AC setup

The following measurements are performed in the AC setup:

- Transfer function : Point (1) to point (3) for the 3 preamplifiers : 3 measurements
- Transfer function : Point (1) to point (2) for the 3 preamplifiers multiplied by 2 impedances : 6 measurements
- Transfer function : Point (4) to point (5) for the 3 search coils : 3 measurements
- Capacitance : 3 LF preamplifiers multiplied by 2 impedances
- Capacitance : Reference cable multiplied by the number of thermal steps (TBD at this time) for the preamplifiers

6.7.1.2 Setup 2: DC measurements

6.7.1.2.1 Setup description

This setup is dedicated to the DC measurements. The offset proposed by MEB EGSE doesn't cover all the required dynamics for this kind of test. It will be replaced by the BIAS stimuli device.

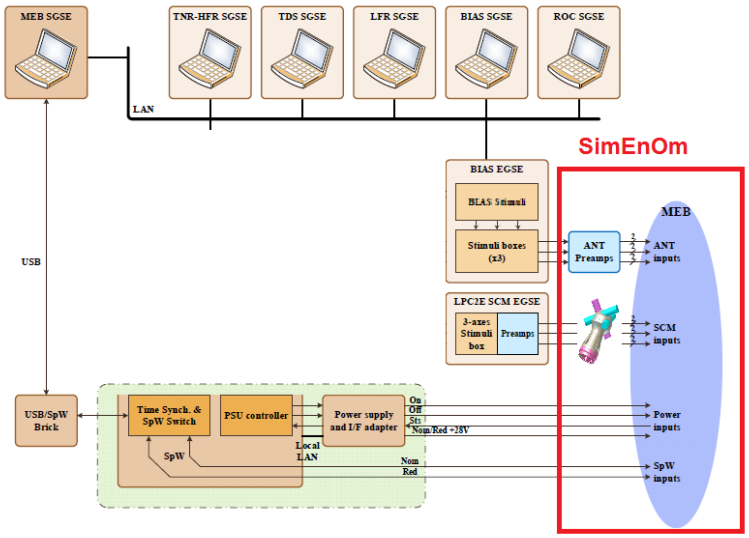


Figure 12 . DC Voltage measurement Setup

The DC measurements will be calibrated with voltmeter with a 0,1mV precision. This will be done on 20 steps between -10V to 10V. This measurement will be done on 2 impedances.

6.7.1.2.2 List of measurements for DC setup

The following measurements are peformed in DC setup:

- DC measurements 20 steps * 2 impedances * 3 preamps
- DC measurements 20 steps on reference cable for each temperature steps.

6.7.2 Data format

6.7.2.1 Transfert functions

The calibration files for transfer functions will be delivered under text format.

6.7.2.2 Capacitance functions

The calibration files for capacitance measurements can be delivered under text format.

6.7.2.3 DC measurements

The calibration files for DC measurements are a matrix it can be delivered under any format.

6.7.1 File naming convention

6.7.1.1 Transfer function

The calibration files will be named with the following convention

TransferFunction_Testcase_type_impedance_number_ed.txt

With :

- TestCase = FMcalibration or FMcalibration
- type = HF, LF, SCM
- Impedance = 50, 510k, 1M, NA for SCM (Not applicable)
- number = PA1, PA2, PA3, SCM1, SCM2, SCM3, REF

6.7.1.2 Capacitance

The calibration files will be named with the following convention

Capacitance_Testcase_type_impedance_number_ed.txt

With :

- TestCase = FMcalibration or FMcalibration
- type = LF, REF
- Impedance = 510k, 1M, NA not applicable for REF (Not applicable)
- number = PA1, PA2, PA3, REF

6.7.1.3 DC measurements

The calibration files will be named with the following convention

DC_Testcase_type_impedance_number_ed.xxx

With :

- TestCase = BlankCalibration or FMCalibration
- type = LF, REF
- Impedance = 510k, 1M, NA for REF (Not applicable)
- number = PA1, PA2, PA3, REF

6.7.2 File versioning convention

Version of the calibration files are managed in the file name Ed field

The first version is 01, each update will increment the number.

6.7.3 Data organization

The organization will be exactly the same for the 8 stimuli caps calibration files. It is divided into 2 parts:

- Header divided into lines:
  - TBD
  - Measurement date
  - File version
- Data divided into 3 columns:
  - Frequency in Hertz
  - Gain in dB
  - Phase in deg

The number of points will be):

- TBD

7 LIST OF TBC/TBD/TBWS

TBC/TBD/TBW			
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		Tech_LESIA
		Tech_MEB
		Tech_RPW
		[Lead-]Cols
		Science-Cols

INTERNAL

LESIA CNRS		

LESIA CNRS		

EXTERNAL (To modify if necessary)

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		E.GUILHEM
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		B.PONTET
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