RPW Operation Centre

ROC Data Products

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Change Record

Issue	Rev.	Date	Authors	Modifications
01	00	23/12/2016	X.Bonnin	First issue
01	01	17/11/2017	X.Bonnin	Introduced the following changes: • Add IDB_source meta-data in the LZ, L0, L1 and HK data • Add PacketTime attribute in the LZ data • Add sections about L1R, L3, L4 and ANC datasets • Complete sections about L2 dataset • Start the list of quicklook and L3 datasets • Add list of CDF skeleton tables in the appendix
01	02		X.Bonnin	Section 3.5.2: • gives list of specific attributes/zVars for L1R CDF Section 3.6.2: • gives list of specific attributes/zVars for L2 CDF Section 3.9: • Rename section title to “RPW summary plot data sets” • Upgrades the summary plot data set ID naming convention

Acronym List

Acronym	Definition
ANC	Ancillary data
CDF	Common Data Format
CDPP	Centre de Données de Physique des Plasma
CWF	Continuous Waveform
DDS	Data Dissemination System
ESA	European Space Agency
ESAC	European Space Astronomy Centre
ESOC	European Space Operation Centre
GSE	Ground Support Equipment
HDF5	Hierarchical Data Format 5
HK	House Keeping
IACG	Inter-Agency Consultative Group
ICD	Interface Control Document
ID	Identifier
IDB	Instrument Database
ISTP	International Solar Terrestrial Physics
LL	Low Latency
MADAWG	Modelling And Data Analysis Working Group
MOC	Mission Operation Centre
OBT	On-Board Time
PDF	Portable Document Format
PNG	Portable Network Graphics
RCS	RPW Calibration Software
ROC	RPW Operation Centre
RODP	ROC Operations and Data Pipeline
RPW	Radio and Plasma Waves instrument
RSWF	Regular Snapshot Waveform
SGS	Science Ground Segment
SOC	Science Operation Centre

SRDB	Spacecraft Reference Database
SWF	Snapshot Waveform
TC	Tele Command
TM	Telemetry
TBC	To Be Confirmed
TBD	To Be Determined
TBW	To Be Written
TSWF	Triggered Snapshot Waveform
UTC	Universal Time Coordinated
UUID	Universal Unique Identifier
WF	Waveform
XML	eXtended Markup Language

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1 GENERAL

1.1 Scope of the Document

This document presents the data produced by the RPW Operations Centre (ROC).

It includes:

- RPW science data products generated by the ROC during the Solar Orbiter mission, including data to be delivered to the Solar Orbiter Data Archive (SOAR) at ESAC (Madrid, Spain)
- RPW operation specific data products
- RPW Ground Support Equipment (GSE)-related data produced by the ROC

The RPW science data archived at the SOAR are described in more details in the RPW Data Product Description Document (DPDD) [RD14].

The standards related to the Solar Orbiter RPW science, low latency (LL) and GSE data are defined in [AD1], [AD2] and [AD3] respectively.

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	Solar Orbiter MADA WG	23/07/2015
AD2	SOL-SGS-ICD-0004/1/4	Solar Orbiter Interface Control Document for Low Latency Data CDF Files	A.Walsh	07/11/2017
AD3	ROC-TST-GSE-NTT-00017-LES/2/2	Data format and metadata definition for the ROC-SGSE data	X.Bonnin	13/03/2019
AD4	ROC-GEN-SYS-URD-00064-LES/1/0	ROC User Requirements	RPW team	
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-GEN-SYS-PLN-00002-LES/01/04	ROC Concept and Implementation Requirements Document (CIRD)	Y. De Conchy, X.Bonnin	17/11/2017
RD2	SOL-SGS-TN-0003/1/2	Solar Orbiter Low-Latency Data: Concept and Implementation	A. De Groof	19/09/2017
RD3	cdf36ifd.pdf	CDF Internal Format Description, V3.6.0	NASA/GSFC	02/02/2015
RD4	ROC-OPS-PIP-NTT-00008-LES/1/3	ROC Engineering Guidelines (REG)	X.Bonnin	17/11/2017
RD5	https://support.hdfgroup.org/HDF5/doc/UG/HDF5_U	HDF5 User's Guide	HDF5 group	March 2016

	sers_Guide-Responsive%20HTML5/index.html#t=HDF5_Users_Guide%2FHDF5_UG_Title%2FHDF5_UG_Title.htm			
RD6	https://www.w3.org/TR/REC-xml/	Extensible Markup Language (XML) 1.0 (Fifth Edition)	W3C	26/11/2008
RD7	SOL-ESC-IF-05011/1/0	Solar Orbiter Data Delivery Interface Control Document	L. Michienzi	10/09/2013
RD8	EGOS-GEN-EDDS-EUICD/6/0	External user interface control document : EGOS Data Dissemination System (EDDS)	EDDS Team	28/05/2014
RD9	ROC-OPS-LLD-NTT-00028-LES/1/1	Dataset Description Document for RPW Low Latency CDF Files	X.Bonnin	06/03/2017
RD10	SOL.S.ASTR.RS.00061/4/0	Solar Orbiter Spacecraft SRDB Naming Convention & Population Rules	S.Brady	Febuary 19, 2014
RD11	ROC-GEN-OTH-NTT-00036-LES/1/0	ROC Project Glossary of Terms	X.Bonnin	24/01/2017
RD12	https://naif.jpl.nasa.gov/naif/index.html	SPICE : An Observation Geometry System for Space Science Missions	NASA NAIF team	Sept. 2017
RD13	RPW-SYS-SSS-00013-LES/4/3	RPW Software System Specification (SSS)	P.Plasson	Dec. 12, 2016
RD14	ROC-PRO-DAT-NTT-00075-LES/1/0 (draft)	Solar Orbiter RPW Data Product Description Document (DPDD)	X.Bonnin	
RD15	SOL-SGS-TN-0017-ANCData/0/2	SOC-provided Ancillary Data for Solar Orbiter	A.Walsh	18/09/2017
RD16	ROC-TST-GSE-SPC-00004-LES/00/02	ROC-SGSE Description	X.Bonnin	06/11/2015

1.4 Terminology

Except if it is explicitly mentioned, the definition of the terms listed in [RD11] is also applicable in this document.

2 SOLAR ORBITER RPW SCIENCE DATA PRODUCTS

This section presents the RPW science data products to be generated by the ROC during the Solar Orbiter. Section 2.1 gives the metadata definition. Sections 2.2 and 2.3present respectively the data description and the list of expected products.

2.1 Metadata definition

Table below lists the data processing levels to be applied to the RPW data products.

The RPW L0, L1, L2, L3, ANC and CAL data products, generated by the ROC and archived at ESAC, must comply with the convention defined by the Solar Orbiter Science Operation Centre (SOC) in [AD1].

Additional 'HK', 'LZ', 'L1R' and 'L4' levels, not defined in [AD1] but required to perform the data processing, are named in italic.

The expected data provider ("source") and main users are provided for information.

Level	Description	Source	Users
LZ	*Raw RPW telemetry (TM) as delivered by the Solar Orbiter Mission Operation Centre (MOC).* *ApID-separated, sorted, cleaned.* *Binary packet data encapsulated in XML files, as returned by the Data Dissemination System (DDS) of the MOC.* *Daily XML format files.*	MOC	ROC
L0	« Raw » data, unpacked and decompressed data Daily HDF5 format files.	ROC	ROC
HK	*Uncompressed and decommuted HK, engineering values, UTC-tagged.* *Daily CDF format files, 1 file per sub-system.*	ROC	ROC, RPW consortium
L1	Uncompressed and decommutated L0 + UTC-tagged, waveform and spectral data in telemetry units (uncalibrated) in spacecraft coordinate system. Data affinity group. E + B components in the same files. Daily SOC-compliant CDFs, Quik Look and daily/orbital summary plots	ROC	ROC, RPW consortium, Solar Orbiter consortium, ESAC data archive centre, CDPP data archive centre

L1R	*Same than L1, but including table index to link data with the associated calibration table.*	ROC	ROC, RPW consortium
L2	L1 + waveform and spectral data in fully calibrated physical units [V, mV/m, nT, W/m^2/Hz, nT^2/Hz] in spacecraft and heliophysical coordinates systems. Separated E and B Waveform products. SOC-compliant CDFs, Quik Look and daily/orbital summary plots	ROC, using the RPW Calibration Software (RCS)	ROC, RPW consortium, Solar Orbiter consortium, ESAC data archive, CDPP data archive
L3	L2 + VxB removal for DC E-field measurement, offsets and corrections with data quality flags. Poynting flux. Plasma density. Spacecraft potential. Merged B. Merged density and temperature. Gonio-polarimetry. SOC-compliant CDFs, Science data plots.	RPW sub-systems teams	
L4	*Event time tags and parameters*		
CAL	RPW sub-system calibration data in CDFs	RPW sub-systems teams	ROC, RPW consortium, ESAC data archive centre
ANC	Ancillary data (ANC) in SPICE kernels and CDFs	SOC (for data defined in [RD15] ROC	ROC, RPW consortium
LL01	LL engineering data, output of the LL pipeline Specific CDF format files [AD3]	SOC (except RPW BIAS LL01 data product) ROC (for the RPW BIAS LL01 data product only)	SOC, ROC, Solar Orbiter Instrument Teams (IT)
LL02	Operational LL data, enhanced with S/C HK Specific CDF format files [AD2]	SOC	SOC, ROC, Solar Orbiter Instrument Teams (IT)
LL03	Visualisation of operational LL data, in “quicklook” format Data in PNG or JPG2000 (TBC)	SOC	SOC, ROC, Solar Orbiter Instrument Teams (IT)

2.2 Data description

2.2.1 RPW L0, L1, L2, L3, ANC and CAL data description

The description of the RPW L0, L1, L2, L3, ANC and CAL data products for the Solar Orbiter mission is presented in [RD14].

2.2.2 RPW Level Z (LZ) data description

2.2.2.1 Purpose

The RPW LZ data must store the RPW raw telemetry (TM) data as daily files.

It results from the pre-processing, i.e., parsing, identification, time ordering and classification, of the RPW raw TM data returned by the Solar Orbiter MOC Data Dissemination System (DDS) [RD7].

2.2.2.2 File format

The RPW LZ data files must be written in the XML V1.0 format [RD6]. The expected LZ XML schema (.xsd) is provided in the section 7.2.1.

2.2.2.3 File naming

The naming convention defined in [AD1] for daily files must be applied for the LZ data products, but using "LZ" as a value for the "level" field.

2.2.2.4 Data versioning

The data versioning defined in [AD1] must be applied for LZ data products.

2.2.2.5 Nominal production cadence

A single daily LZ data file is produced by the ROC in the nominal case. This file contains the entire RPW TM packet data acquired by the instrument for this day.

2.2.2.6 File content description

Tables below gives the description of the expected structure. The first column (**Field**) provides the name of the element (tag value) or attribute as seen in the resulting XML file. The second column (**E/A**) indicates whether the field is an XML element (using 'E'), or an attribute (using 'A') of an XML element. The third column (**Type**), describes the basic type of the field. The fourth field (**Description**) provides a textual definition of the field which may contain examples, format specifications and conditional statements about what the field may contain. The final column (**Need**) indicates whether the field's value is Mandatory (M), Optional (O), or Qualified (Q) – the latter requiring explanation in the Description column.

2.2.2.6.1 Header

Field	E/A	Type	Description	Need
Datetime	E	date	Date of Observation (YYYYMMDD)	M
TimeMin	E	dateTime	Creation date/time of the first packet in the file (in RPW on-board time reference)	M
TimeMax	E	dateTime	Creation date/time of the last packet in	M

			the file (in RPW on-board time reference)	
GenerationDate	E	dateTime	Local date/time of the LZ file creation	M
DataVersion	E	integer	Data version	M
FileId	E	string	Unique ID of the file. (Generated by the software when the file was created)	M
DatasetId	E	string	RPW dataset ID for LZ in the ROC system. It must be "SOLO_LZ_RPW"	M

Table 1. LZ Header element fields.

2.2.2.6.2 PacketList

Field	E/A	Type	Description	Need
Packet	E	ComplexType	Complex type containing the list of RPW TM/TC packets	M

Table 2. LZ Data element fields.

The Packet ComplexType must contain the following fields.

Field	E/A	Type	Description	Need
RawData	E	hexBinary	A TM/TC raw packet in hexadecimal	M
Palisade_id	A	long	PALISADE ID of the TM/TC packet	M
Type	E	string	Type of packet ('TC' or 'TM')	M
Name	E	string	SRDB ID of the TM/TC packet	M
SrdbID	A	string	ID of the TM in SRDB. Only required if the value of `Status` is "Valid"	Q
UtcTime	E	dateTime	UTC Date and time of the TM/TC packet generation/execution on-board	M
SyncFlag	E	integer	Time clock synchronization flag (0=synchronized, 1=no) Only for TM	M
Category	E	string	Packet category, as defined in PALISADE	M
AckExecState	E	string	TC execution state	M

AckAccState	E	string	TC acceptance state	M
UniqueId	E	string	TC unique ID	M

Table 3. LZ TmRaw element fields.

2.2.3 RPW Housekeeping (HK) data description

2.2.3.1 Purpose

The RPW HK data provides "digest" HK parameters, sorted by instrument sub-system and written with "engineering" values.

2.2.3.2 File format

The RPW HK data files must be written in the Common Data Format (CDF) [RD3].

2.2.3.3 File naming

The naming convention defined in [AD1] for daily files must be applied for the RPW HK data products, but using "HK" as a value for the "level" field.

2.2.3.4 Data versioning

The data versioning defined in [AD1] must be applied for HK data products.

2.2.3.5 Nominal production cadence

There is a single daily HK file produced for each RPW sub-system.

Note that in the case of the on-demand "TM_*_PARAMETER_DUMP" packets, distinct files are generated containing all of the packets for the day.

The HK files for a given day are processed from the analysis of the parent L0 daily file.

2.2.3.6 File content description

The RPW HK data products must comply the SOC conventions for CDF [AD1].

Additionally, the following attributes must be found in the files.

Attribute name	Attribute type	CDF data type	Description	Need
PACKET_CATEGORY	Global	CDF_CHAR	RPW TM packet category as defined in [RD13]	M
PACKET_PID	Global	CDF_CHAR	RPW TM packet process ID	M
PACKET_SERVICE_SUBTYPE	Global	CDF_CHAR	RPW TM packet service subtype	M
PACKET_SERVICE_TYPE	Global	CDF_CHAR	RPW TM packet service	M

			type	
PACKET_SID	Global	CDF_CHAR	RPW TM packet source ID	M
PACKET_SRDB_ID	Global	CDF_CHAR	RPW TM packet SRDB ID	M
APPLICABLE	Global	CDF_CHAR	Reference to the applicable document. It must be the current one (i.e., "ROC-PRO-DAT-NTT-00006-LES")	M
SKELETON_PARENT	Global	CDF_CHAR	Name of the skeleton file used to generate the current file, without the extension.	M
SRDB_ENUM_ID	Variable	CDF_CHAR	SRDB ID of the associated enumeration	Q (only if the parameter is associated with an enumeration list)
SRDB_PARAM_ID	Variable	CDF_CHAR	SRDB ID of the parameter in the packet	Q (only if the zVariable is a packet parameter with a valid SRDB ID)

Table 4. RPW HK CDF-specific items.

There must be a single CDF zVariable per HK parameter inside the file, and one CDF record per HK packet.

2.2.4 RPW Level 1R (L1R) data description

2.2.4.1 Purpose

The RPW L1R level data products only concern the LFR/TDS waveform (WF) data (snapshot and continuous). They provide L1 data plus additional parameters, which allow the Bias and SCM calibration software to generate the child RPW L2 data products.

The RPW L1R intermediary data will be for ROC internal purpose only, and thus should be not distributed to teams outside the RPW consortium.

2.2.4.2 File format

The RPW L1R data files must be written in the CDF format [RD3].

2.2.4.3 File naming

The naming convention defined in [AD1] for daily files must be applied for the L1R data products, but using "L1R" in the "level" field.

2.2.4.4 Data versioning

The data versioning defined in [AD1] must be applied for L1R data products.

2.2.4.5 Nominal production cadence

The RPW L1R data files are generated from the analysis of the parent L1 files, i.e., at the same production cadence.

2.2.4.6 File content description

The RPW L1R data file structure is the same than the L1 parent data file(s), except that:

- The electrical (E) and magnetic (B) components WF data must be delivered in separated files. It means that only zVariables related to the E/B components must be found on the E/B L1R data files
- Specific attributes and zVariables listed in the following table must be added depending of the L1R datasets.
- The L1R must be delivered with up-to-date calibration table files (see section **Erreur ! Source du renvoi introuvable.** for more details). These files are required to generate L2 data files.

In addition to the L1 attributes and zVariables, the L1R files must contain the following extra items.

Name	Type	Description	Comment
CAL_ENTITY_NAME	Global attribute (CDF_CHAR)	Entity in charge of the calibration (person or team)	There must as many as entries than the number of calibration table files associated to the L1R file.
CAL_ENTITY_AFFILIATION	Global attribute (CDF_CHAR)	Affiliation of the entity in charge of the calibration	There must as many as entries than the number of calibration table files associated to the L1R file.
CAL_EQUIPMENT	Global attribute (CDF_CHAR)	RPW equipment associated to the calibration table. The values can be: "LFR", "TDS" or "THR"	There must as many as entries than the number of calibration table files associated to the L1R file.
CALIBRATION_TABLE	Global attribute (CDF_CHAR)	Filename of the calibration table(s).	There must as many as entries than the number of calibration table files associated to the L1R file.
CALIBRATION_TABLE_INDEX	zVariable (CDF_UINT1)	Index of the calibration	Each CDF record must contain 2 elements: the

		table(s) value required to generate L2 data files.	first element must gives the index of the associated CALIBRATION_TABLE entry (i.e., 0 for the first entry, 1 for the second, etc.). The second element must refer to the index of the value to be used inside the calibration table file.
CALIBRATION_VERSION	Global attribute (CDF_CHAR)	Version of the calibration table.	There must as many as entries than the number of calibration table files associated to the L1R file.

Table 5. RPW L1R data CDF-specific items.

2.2.5 RPW Level 4 (L4) data description

TBW

2.3 Solar Orbiter RPW science data product summary list

Table below summarizes the RPW data to be produced by the ROC during the Solar Orbiter mission. The detailed content of the CDF format file can be viewed in the skeleton tables (see the list of files in the appendix).

RPW Data Product	Description	Data format file	Production cadence	Parent(s)
SOLO_LZ_RPW	RPW TM binary data, packeted and compressed	XML format	Daily	N/A
SOLO_L0_RPW	RPW TM data, unpacked and uncompressed, after analysis of the corresponding LZ data file with the IDB	HDF5	Daily	SOLO_LZ_RPW
SOLO_HK_RPW-DBS	Contains HK parameters from the TM_DPU_DBS_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-DAS	Contains HK parameters from the TM_DPU_DAS_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-DAS-STATISTICS	Contains HK parameters from the TM_DPU_DAS_STATISTICS_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-TDS	Contains HK parameters from the TM_TDS_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-LFR	Contains HK parameters from the TM_LFR_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-THR	Contains HK parameters from the TM_THR_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-BIA	Contains HK parameters from the TM_DPU_BIA_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK_RPW-PDU	Contains HK parameters from the TM_DPU_PDU_HK packets	CDF	Daily	SOLO_L0_RPW

SOLO_HK-RPW-DBS-DUMP	Contains HK parameters from the TM_DPU_PDU_HK packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK-RPW-DBS-DUMP	Contains HK parameters from the TM_DPU_DBS_PARAMETER_DUMP packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK-RPW-DAS-DUMP	Contains HK parameters from the TM_DPU_DAS_PARAMETER_DUMP packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK-RPW-TDS-DUMP	Contains HK parameters from the TM_TDS_PARAMETER_DUMP packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK-RPW-LFR-DUMP	Contains HK parameters from the TM_LFR_PARAMETER_DUMP packets	CDF	Daily	SOLO_L0_RPW
SOLO_HK-RPW-THR-DUMP	Contains HK parameters from the TM_THR_PARAMETER_DUMP packets	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TNR-SURV	Contains RPW TNR L1 spectral data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-HFR-SURV	Contains RPW HFR L1 spectral data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-RSWF	Contains RPW TDS L1 regular snapshot waveform data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-TSWF	Contains RPW TDS L1 triggered snapshot waveform data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-HIST1D	Contains RPW TDS L1 1D histogram data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-HIST2D	Contains RPW TDS L1 2D histogram data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-STAT	Contains RPW TDS L1 statistical data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SURV-MAMP	Contains RPW TDS L1 continous HF signal maximum data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-LFM-RSWF	Contains RPW TDS L1 regular snapshot waveform data in low frequency mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-LFM-CWF	Contains RPW TDS L1 continuous waveform data in low frequency mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-LFM-SM	Contains RPW TDS L1 spectral matrix data in low frequency mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-LFM-PSD	Contains RPW TDS L1 single power spectrum data in low frequency mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-TDS-SBM1-RSWF	Contains RPW TDS L1 regular snapshot waveform data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In	SOLO_L0_RPW

			this case, the event time range is provided in the filename.	
SOLO_L1_RPW-TDS-SBM2-TSWF	Contains RPW TDS L1 triggered snapshot waveform data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SURV-ASM	Contains RPW LFR L1 averaged spectral matrix data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SURV-BP1	Contains RPW LFR L1 basic parameters 1 data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SURV-BP2	Contains RPW LFR L1 basic parameters 2 data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SURV-CWF	Contains RPW LFR L1 continuous waveform data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SURV-SWF	Contains RPW LFR L1 snapshot waveform data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SBM1-CWF	Contains RPW LFR L1 continuous waveform data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SBM1-BP1	Contains RPW LFR L1 basic parameters 1 data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SBM1-BP2	Contains RPW LFR L1 basic parameters 2 data in SBM1 mode, time-tagged	CDF	One single file per SBM1	SOLO_L0_RPW

			event. In this case, the event time range is provided in the filename.	
SOLO_L1_RPW-LFR-SBM2-CWF	Contains RPW LFR L1 continuous waveform data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SBM2-BP1	Contains RPW LFR L1 basic parameters 1 data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-LFR-SBM2-BP2	Contains RPW LFR L1 basic parameters 2 data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L0_RPW
SOLO_L1_RPW-BIA-SWEEP	Contains RPW BIAS L1 parameters from a given sweeping	CDF	One single file per Bias sweeping. In this case, the sweeping time range is provided in the filename.	SOLO_LL01_RPW-BIA + the CP_DPU_BIA_SWEEP_STEP_CUR Bias current step values from the TC_DPU_LOAD_BIAS_SWEEP (ZIW00060), used when performing the Bias sweeping
SOLO_L1R_RPW-TDS-SURV-RSWF-E	Contains RPW TDS L1R RSWF science electric data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-RSWF
SOLO_L1R_RPW-TDS-SURV-	Contains RPW TDS L1R RSWF science magnetic data in survey	CDF	Daily	SOLO_L1_RPW-TDS-SURV-RSWF

RSWF-B	mode, time-tagged			
SOLO_L1R_RPW-TDS-SURV-TSWF-E	Contains RPW TDS L1R TSWF science electric data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-TSWF
SOLO_L1R_RPW-TDS-SURV-TSWF-B	Contains RPW TDS L1R TSWF magnetic electric data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-TSWF
SOLO_L1R_RPW-TDS-LFM-RSWF-E	Contains RPW TDS L1R RSWF electrical science data in LFM mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-LFM-RSWF
SOLO_L1R_RPW-TDS-LFM-RSWF-B	Contains RPW TDS L1R RSWF magnetic science data in LFM mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-LFM-RSWF
SOLO_L1R_RPW-TDS-LFM-CWF-E	Contains RPW TDS L1R CWF electrical science data in LFM mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-LFM-CWF
SOLO_L1R_RPW-TDS-LFM-CWF-B	Contains RPW TDS L1R CWF magnetic science data in LFM mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-LFM-CWF
SOLO_L1R_RPW-TDS-SBM1-RSWF-E	Contains RPW TDS L1R RSWF science electric data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-TDS-SBM1-RSWF
SOLO_L1R_RPW-TDS-SBM1-RSWF-B	Contains RPW TDS L1R RSWF science magnetic data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-TDS-SBM1-RSWF
SOLO_L1R_RPW-TDS-SBM2-TSWF-E	Contains RPW TDS L1R TSWF science electric data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-TDS-SBM2-TSWF
SOLO_L1R_RPW-TDS-SBM2-TSWF-B	Contains RPW TDS L1R TSWF science magnetic data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event	SOLO_L1_RPW-TDS-SBM2-TSWF

			time range is provided in the filename.	
SOLO_L1R_RPW-LFR-SURV-CWF-E	Contains RPW LFR L1R CWF electrical science data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-CWF
SOLO_L1R_RPW-LFR-SURV-CWF-B	Contains RPW LFR L1R CWF magnetic science data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-CWF
SOLO_L1R_RPW-LFR-SURV-SWF-E	Contains RPW LFR L1R SWF electrical science data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-SWF
SOLO_L1R_RPW-LFR-SURV-SWF-B	Contains RPW LFR L1R SWF magnetic science data in survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-SWF
SOLO_L1R_RPW-LFR-SBM1-CWF-E	Contains RPW LFR L1R CWF electrical science data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM1-CWF
SOLO_L1R_RPW-LFR-SBM1-CWF-B	Contains RPW LFR L1R CWF magnetic science data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM1-CWF
SOLO_L1R_RPW-LFR-SBM2-CWF-E	Contains RPW LFR L1R CWF electrical science data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM2-CWF
SOLO_L1R_RPW-LFR-SBM2-CWF-B	Contains RPW LFR L1R CWF magnetic science data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is	SOLO_L1_RPW-LFR-SBM2-CWF

			provided in the filename.	
SOLO_L2_RPW-TNR-SURV	Contains RPW TNR L2 spectral data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TNR-SURV
SOLO_L2_RPW-HFR-SURV	Contains RPW HFR L2 spectral data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-HFR-SURV
SOLO_L2_RPW-TDS-SURV-RSWF-E	Contains RPW TDS L2 regular snapshot waveform data – electral components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-SURV-RSWF-E
SOLO_L2_RPW-TDS-SURV-RSWF-B	Contains RPW TDS L2 regular snapshot waveform data – magnetic components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-SURV-RSWF-B
SOLO_L2_RPW-TDS-SURV-TSWF-E	Contains RPW TDS L2 triggered snapshot waveform data – electrical components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-SURV-TSWF-E
SOLO_L2_RPW-TDS-SURV-TSWF-B	Contains RPW TDS L2 triggered snapshot waveform data – magnetic components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-SURV-TSWF-B
SOLO_L2_RPW-TDS-SURV-HIST1D	Contains RPW TDS L2 1D histogram data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-HIST1D
SOLO_L2_RPW-TDS-SURV-HIST2D	Contains RPW TDS L2 2D histogram data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-HIST2D
SOLO_L2_RPW-TDS-SURV-STAT	Contains RPW TDS L2 statistical data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-STAT
SOLO_L2_RPW-TDS-SURV-MAMP	Contains RPW TDS L2 continous HF signal maximum data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-SURV-MAMP
SOLO_L2_RPW-TDS-LFM-RSWF-E	Contains RPW TDS L2 regular snapshot waveform data – electrical components - in low frequency mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-LFM-RSWF-E
SOLO_L2_RPW-TDS-LFM-RSWF-B	Contains RPW TDS L2 regular snapshot waveform data – magnetic components - in low frequency mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-LFM-RSWF-B
SOLO_L2_RPW-TDS-LFM-CWF-E	Contains RPW TDS L2 continuous waveform data – electric components - in low frequency mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-LFM-CWF-E
SOLO_L2_RPW-TDS-LFM-CWF-B	Contains RPW TDS L2 continuous waveform data – magnetic components - in low frequency mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-TDS-LFM-CWF-B
SOLO_L2_RPW-TDS-LFM-PSDSM	Contains RPW TDS L2 single power spectrum and spectral matrix data in low frequency mode, time-tagged	CDF	Daily	SOLO_L1_RPW-TDS-LFM-PSD SOLO_L1_RPW-TDS-LFM-SM
SOLO_L2_RPW-TDS-SBM1-	Contains RPW TDS L2 regular snapshot waveform data – electrical	CDF	One single file	SOLO_L1R_RPW-TDS-SBM1-RSWF-E

RSWF-E	compenents - in SBM1 mode, time-tagged		per SBM1 event. In this case, the event time range is provided in the filename.	
SOLO_L2_RPW-TDS-SBM1-RSWF-B	Contains RPW TDS L2 regular snapshot waveform data – magnetic compenents - in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-TDS-SBM1-RSWF-B
SOLO_L2_RPW-TDS-SBM2-TSWF-E	Contains RPW TDS L2 triggered snapshot waveform data – electrical components- in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-TDS-SBM2-TSWF-E
SOLO_L2_RPW-TDS-SBM2-TSWF-B	Contains RPW TDS L2 triggered snapshot waveform data – magnetic components - in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-TDS-SBM2-TSWF-B
SOLO_L2_RPW-LFR-SURV-ASM	Contains RPW LFR L2 averaged spectral matrix data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-ASM
SOLO_L2_RPW-LFR-SURV-BP1	Contains RPW LFR L2 basic parameters 1 data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-BP1
SOLO_L2_RPW-LFR-SURV-BP2	Contains RPW LFR L2 basic parameters 2 data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1_RPW-LFR-SURV-BP2
SOLO_L2_RPW-LFR-SURV-CWF-E	Contains RPW LFR L2 continuous waveform data – electrical components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-LFR-SURV-CWF-E
SOLO_L2_RPW-LFR-SURV-CWF-B	Contains RPW LFR L2 continuous waveform data – magnetic components - in normal and burst	CDF	Daily	SOLO_L1R_RPW-LFR-SURV-CWF-B

	survey mode, time-tagged			
SOLO_L2_RPW-LFR-SURV-SWF	Contains RPW LFR L2 snapshot waveform data in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-LFR-SURV-SWF-E
SOLO_L2_RPW-LFR-SURV-SWF-B	Contains RPW LFR L2 snapshot waveform data – magnetic components - in normal and burst survey mode, time-tagged	CDF	Daily	SOLO_L1R_RPW-LFR-SURV-SWF-E
SOLO_L2_RPW-LFR-SBM1-CWF -E	Contains RPW LFR L2 continuous waveform data - electrical components - in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-LFR-SBM1-CWF-E
SOLO_L2_RPW-LFR-SBM1-CWF -B	Contains RPW LFR L2 continuous waveform data – magnetic components - in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-LFR-SBM1-CWF-B
SOLO_L2_RPW-LFR-SBM1-BP1	Contains RPW LFR L2 basic parameters 1 data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM1-BP1
SOLO_L2_RPW-LFR-SBM1-BP2	Contains RPW LFR L2 basic parameters 2 data in SBM1 mode, time-tagged	CDF	One single file per SBM1 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM1-BP2
SOLO_L2_RPW-LFR-SBM2-CWF-E	Contains RPW LFR L2 continuous waveform data - electrical components - in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event	SOLO_L1R_RPW-LFR-SBM2-CWF-E

			time range is provided in the filename.	
SOLO_L2_RPW-LFR-SBM2-CWF -B	Contains RPW LFR L2 continuous waveform data – magnetic components - in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1R_RPW-LFR-SBM2-CWF-B
SOLO_L2_RPW-LFR-SBM2-BP1	Contains RPW LFR L2 basic parameters 1 data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM2-BP1
SOLO_L2_RPW-LFR-SBM2-BP2	Contains RPW LFR L2 basic parameters 2 data in SBM2 mode, time-tagged	CDF	One single file per SBM2 event. In this case, the event time range is provided in the filename.	SOLO_L1_RPW-LFR-SBM2-BP2

Table 6. Solar Orbiter RPW data product summary list.

3 SOLAR ORBITER RPW LOW LATENCY (LL) DATA PRODUCTS

3.1 Metadata definition

The standard convention related to the Solar Orbiter RPW Low Latency data products are defined in [AD2].

3.2 Data description

The RPW LL01 data products are described in [RD9].

3.3 Solar Orbiter RPW LL data product summary list

RPW DS ID	Description	Data file format	Production Cadence	Parent data set RPW DS ID
SOLO_LL01_RPW-	Contains the RPW	CDF	As soon as new LZ	ROC_LZ_RPW

TNR	LL01 data from TNR-HFR LL packets		files are available	
SOLO_LL01_RPW-BIA	Contains the RPW LL01 data from the LFR LL packets for BIAS calibrations	CDF	As soon as new LZ files are available	ROC_LZ_RPW
SOLO_LL01_RPW-SBM1	Contains the RPW LL01 data from the SBM1 LL packets	CDF	As soon as new LZ files are available	ROC_LZ_RPW
SOLO_LL01_RPW-SBM2	Contains the RPW LL01 data from the SBM2 LL packets	CDF	As soon as new LZ files are available	ROC_LZ_RPW

Table 7. Solar Orbiter RPW LL01 data product summary list.

4 SOLAR ORBITER RPW SUMMARY PLOT DATA PRODUCTS

4.1 Metadata definition

Summary plot data products must comply the convention defined in [AD1] in terms of file naming, data versioning and level.

Especially the summary plots must be labelled as level 3 (L3) products and be written in the Portable Document Format (PDF) (TBC).

4.2 Data description

TBW

4.3 Solar Orbiter RPW summary plot data product summary list

The table below gives an overview of the RPW summary plot data sets, which are expected to be directly produced by the RODP only.

This list is not exhaustive, and is susceptible to be extended. Especially, the L2/L3-related summary plots, units and graphical details to be found in the quick-looks are not fully defined at this stage of the project.

RPW DS ID	Description	Data file format	Production Cadence	Parent data set RPW DS ID
SOLO_L3_RPW-THR-SURV	Daily plots of the TNR-HFR dynamic spectra (Intensity in Db as a function of MHz and UTC)	PDF	Daily	SOLO_L1_RPW-TNR-SURV and SOLO_L1_RPW-HFR-SURV
SOLO_L3_TDS-SURV-CWF	TDS daily CWF amplitude in dB as a function of time for each of the channel	PDF	Daily	SOLO_L1_TDS-SURV-CWF
SOLO_L3_RPW-TDS-SURV-SWF	TDS daily RSWF/TSWF as a function of time for each of the channel (one snapshot per file)	PDF	One snapshot per file	SOLO_L1_RPW-TDS-SURV-RSWF

SOLO_L3_RPW-LFR-SURV-CWF	LFR daily CWF as a function of time for each of the channel	PDF	Daily	SOLO_L1_RPW-LFR-SURV-CWF
SOLO_L3_RPW-LFR-SURV-ASM	LFR daily ASM data	PDF	Daily	SOLO_L1_RPW-LFR-SURV-ASM
SOLO_L3_RPW-LFR-SURV-BP1	LFR daily BP1 data	PDF	Daily	SOLO_L1_RPW-LFR-SURV-BP1
SOLO_L3_RPW-LFR-SURV-BP2	LFR daily BP2 data	PDF	Daily	SOLO_L1_RPW-LFR-SURV-BP2
SOLO_L3_RPW-LFR-SURV-SWF	LFR daily SWF as a function of time for each of the channel	PDF	One snapshot per file	SOLO_L1_LFR-SURV-SWF
SOLO_L3_RPW-SBM1-EVENT	Summary plots gathering the TDS/LFR SBM1 data. Details to be defined.	PDF	One file per SBM1 event	SOLO_L1_RPW-LFR-SBM1-* SOLO_L1_RPW-TDS-SBM1-* SOLO_LL01_RPW-SBM1
SOLO_L3_RPW-SBM2-EVENT	Summary plots gathering the THR/TDS/LFR SBM2 data. Details to be defined.	PDF	One file per SBM2 event	SOLO_L1_RPW-LFR-SBM2-* SOLO_L1_RPW-TDS-SBM2-* SOLO_L1_RPW-TNR-SURV SOLO_LL01_RPW-SBM2
SOLO_L3_RPW-BIA-SWEEP	Plots a given Bias sweeping (I vs V)	PDF	One bias sweeping per file	SOLO_LL01_RPW-BIA SOLO_L01_RPW-BIA-SWEEP
SOLO_L3_RPW-SBM1-MAG-SWA (TBC)	Plots LL01 data from MAG, SWA and RPW for SBM1 event detection	PDF	Daily	SOLO_LL01_RPW-SBM1 TBD
SOLO_L3_RPW-SBM2-MAG-SWA (TBC)	Plots LL01 data from MAG, SWA and RPW for SBM2 event detection	PDF	Daily	SOLO_LL01_RPW-SBM2 TBD

Table 8. RPW summary plot data products.

5 RPW OPERATION SPECIFIC DATA PRODUCTS

5.1 RPW status report files

5.1.1 RPW commands status report file

5.1.1.1 Purpose

The ROC must generate a report file containing the status of the RPW instrument, as defined in [AD4].

5.1.1.2 File format

The RPW status report file shall be written in XML 1.0 format, with UTF-8 encoding.

5.1.1.3 File naming convention

TBW

5.1.1.4 Data versioning

5.1.1.5 Nominal production cadence

5.1.1.6 File content description

5.1.2 RPW configuration report file

5.1.2.1 Purpose

According to [AD4], the ROC must produce a file that reports the instrument configurations over time.

5.1.2.2 File naming convention

TBW

5.1.2.3 File format

TBW (probably use the TC-report XML or text files retrieved from MOC)

5.1.3 RPW DPU software status report file

5.1.3.1 Purpose

5.1.3.2 File naming convention

TBW

5.1.3.3 File format

TBW

5.1.4 RPW LFR status report file

5.1.4.1 File naming convention

TBW

5.1.4.1.1 File format

TBW

5.1.5 RPW TDS status report file format

5.1.5.1 File naming convention

5.1.5.2 File format

6 ROC SOFTWARE GROUND SUPPORT EQUIPMENT (ROC-SGSE) DATA PRODUCTS

This section presents the data products generated by the ROC-SGSE pipeline [RD16].

6.1 Metadata definition

Conventions related to the ROC-SGSE metadata are defined in [AD3].

6.2 Data description

6.2.1 ROC-SGSE LZ data description

6.2.1.1 Purpose

The ROC-SGSE LZ data contains descriptive information about a given MEB GSE test log and the corresponding list of events (i.e., TC/TM in binary format, EGSE HK, etc.) produced during the test.

6.2.1.2 File format

The ROC-SGSE LZ data are saved as XML V1.0 format files [RD6].

6.2.1.3 File naming

Following the convention defined in [AD3], a ROC-SGSE LZ data file looks like:

```
solo_LZ_rpw-gse-test-log_<Test_launched_date>-
<Test_terminated_date>_V<Data_version>_<Provider>-<Test_id>.xml
```

Where `<Test_launched_date>`, `<Test_terminated_date>`, `<Data_version>`, `<Provider>` and `<Test_id>` are respectively the test log start date and time, the test log end date and time, the Data_version and Provider of the corresponding global attributes as described in [AD3], and the test uuid of the test log.

6.2.1.4 Data versioning

The data versioning defined in [AD3] must be applied.

6.2.1.5 Nominal production cadence

There is one ROC-SGSE LZ data file per MEB GSE test log.

6.2.1.6 File content description

Figure below gives the XSD schema of the ROC-SGSE LZ data files. 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.

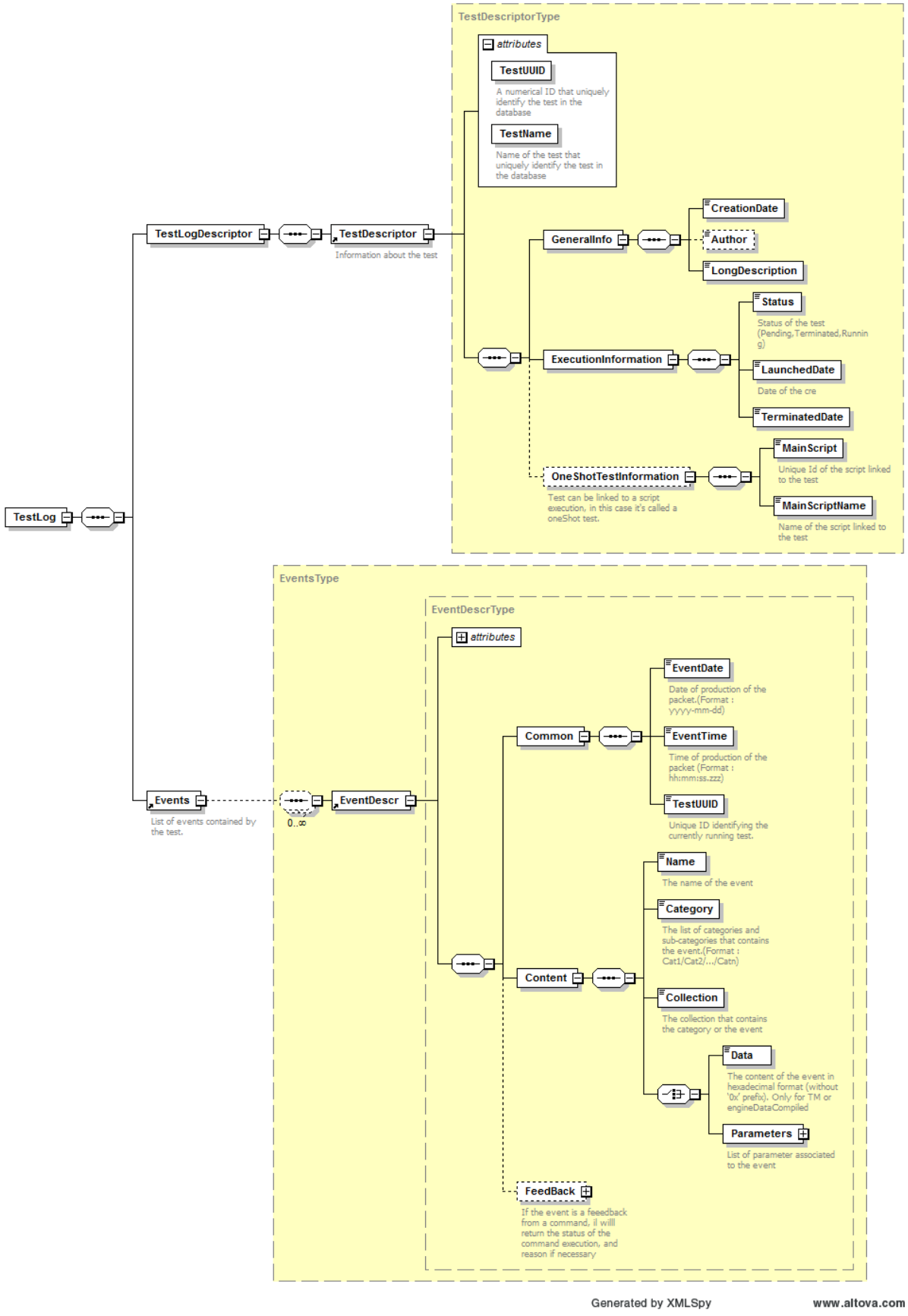

Figure 1. ROC-SGSE LZ test log file structure.

6.2.2 ROC-SGSE L0 data description

6.2.2.1 Purpose

The ROC-SGSE L0 data contain all of the RPW packet data produced during a given test, but after de-commutation/decompression processes.

6.2.2.2 File format

The ROC-SGSE L0 data are saved as HDF5 format files [RD5].

6.2.2.3 File naming

Following the convention defined in [AD3], a ROC-SGSE L0 data file looks like:

```
solo_L0_<Descriptor>_<Test_launched_date>-
<Test_terminated_date>_V<Data_version>_<Provider>-<Test_id>.xml
```

Where `<Descriptor>`, `<Test_launched_date>`, `<Test_terminated_date>`, `<Data_version>`, `<Provider>` and `<Test_id>` are respectively are the values of the L0 root metadata attributes (see section 6.2.2.6), but provided with the convention defined in [AD3].

6.2.2.4 Data versioning

The data versioning defined in [AD3] must be applied.

6.2.2.5 Nominal production cadence

There is one ROC-SGSE L0 data file generated for each ROC-SGSE LZ data file.

6.2.2.6 File content description

The structure is similar to the Solar Orbiter RPW L0 data product (see [RD14]), except that in the case of the ROC-SGSE the L0 files can also store RPW command (TC) packet data as provided in the test log parent files.

Additionally, the ROC-SGSE L0 files must contain the following *root* metadata attributes:

- `Descriptor` must be “rpw”.
- `Test_launched_date`, string containing the date and time at which the test log started, in the ISO 8601 format, but without the “Z” suffix
- `Test_terminated_date`, string containing the date and time at which the test log ended, in the ISO 8601 format, but without the “Z” suffix
- `Data_version`, string containing the version of the data file, following the convention defined in [AD3]
- `Provider`, string containing the data provider as defined for the ROC-SGSE LZ data files
- `Test_id`, string containing an UUID as defined in the MEB GSE test log.

6.2.3 ROC-SGSE ANC MEB EGSE data description

6.2.3.1 Purpose

The MEB EGSE [RD13], also called RPW EGSE, is 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. Hence, the MEB EGSE will be intensively used during the ground calibrations at system level.

After each run, the MEB EGSE produces 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.

The ROC-SGSE must 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 ROC-SGSE ANC EGSE data files can be distributed to RPW consortium.

6.2.3.2 File format

The ROC SGSE ANC RPW EGSE data file is written using the XML 1.0 format [RD6].

6.2.3.3 File naming

Following the convention defined in [AD3], a ROC-SGSE ANC RPW EGSE data file looks like:

```
solo_ANC_rpw-egse-log_<Test_launched_date>-
<Test_terminated_date>_V<Data_version>_<Provider>-<Test_id>.xml
```

Where `<Test_launched_date>`, `<Test_terminated_date>`, `<Data_version>`, `<Provider>` and `<Test_id>` have the same values than for the L0 root metadata attributes (see section 6.2.2.6), but provided with the convention defined in [AD3].

6.2.3.4 Data versioning

The data versioning defined in [AD3] must be applied.

6.2.3.5 Nominal production cadence

There is one ROC-SGSE ANC RPW EGSE XML file per RPW EGSE log file.

6.2.4 File content description

During the tests, the ROC-SGSE must 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 must 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 must 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 9. E-GSE stimuli XML file items.

7 APPENDIX

7.1 ROC pipeline dataset description

7.1.1 ROC pipeline dataset concept & definition

The traceability of the data produced by the ROC pipelines is ensured using the concept of *ROC (pipeline) dataset*. It is a specific category of data products that is uniquely referenced into the ROC pipelines.

A ROC dataset must:

- Be generated by the ROC pipelines, or any software called by the latter (e.g., RPW L2 data generated by the RPW Calibration Software, RCS)
- Be uniquely identified in the ROC pipelines, using a dedicated dataset identifier (hereafter also called RPW DS ID)
- Follow the convention defined in the present document.

A data product that does follow the rules above cannot be considered as a data set, and cannot be hence identified and processed by the ROC pipelines.

7.1.2 ROC dataset identifier naming convention

Each RPW data set must be identified with a unique uppercase string of the following form:

`[Source_name]_[Level]_[Descriptor]`

Where `[Source_name]`, `[Level]` and `[Descriptor]` are respectively the source of data (it must always be “SOLO” for the data generated on-board during the mission), the RPW data processing level as defined in the section **Erreur ! Source du renvoi introuvable.**, and the data descriptor.

The data descriptor is a string that must be explicit enough to uniquely identify the data set. It must: (i) contain only alphanumerical characters, (ii) use only the hyphen “-“ as separator, (iii) always start with the string “RPW”.

In the case where the data set is associated to a single RPW sub-system, the data descriptor must always start with the prefix “RPW-*[sub-system]*”, where *[sub-system]* can be “PDU”, “DPU”, “DAS”, “DBS”, “THR”, “TNR”, “HFR”, “TDS”, “LFR” or “BIA”.

Note that the value of the data source, level and descriptor must be the same than the `[Source_name]`, `[Level]` and `[Descriptor]` prefix values of the CDF global attributes, as defined in [AD1].

7.1.1 RPW calibration table file description

7.1.1.1 Purpose

RPW calibrated L2 science data are produced using dedicated "RPW calibration tables" files (RCT), containing all the required information (e.g., gains and phases).

These data correspond to the "CAL" level definition in [AD1].

7.1.1.2 Data format

The RCT files must be written using the CDF format.

7.1.1.3 File naming

The RCT must comply the following file naming convention:

`SOLO_CAL_[Descriptor]_[free-field]_V[CALIBRATION_VERSION].cdf`

Where `[receiver]` is the name of the receiver in uppercase characters (i.e., "TDS" pr "LFR") of the corresponding RPW L1R data set, `[free-field]` is a field that can be used to specify the content of the file (e.g., "BIAS-F0") and `[CALIBRATION_VERSION]` is the version of the calibration table file (see next section).

N.B. The RCT naming convention is not fully compliant with the SOC definition [AD1]. It is thus envisaged to gather the RCT for a given period of time - time when the RCT values have not changed (TBC) – into a single file, which complies SOC specification. This file will have to be delivered for the Solar Orbiter data archive.

7.1.1.4 Data versioning

The version of the RCT CDF data file must be the local date and time of creation of the file, in the format: "YYYYMMDDHHNN", where "YYYY", "MM", "DD", "HH" and "NN" are respectively the 4-digits year, 2-digits month, 2-digits day, 2-digits hours, 2-digits minutes of the file creation.

In the RCT filename, the version number must appear with the "V" prefix (e.g., "V202210122359".

7.1.1.5 Nominal production cadence

A new RCT file must be generated each time modifications have been made to the calibration data (e.g., gain or phase values).

7.1.1.6 File content description

The content of a RCT CDF file can differ from a RPW sub-system to another and the teams in charge are free to define the content. Nevertheless, the file must at least contain the following global attributes:

Name	Type	Description	Comment
CAL_ENTITY_NAME	Global attribute (CDF_CHAR)	Entity in charge of the calibration (person or team)	
CAL_ENTITY_AFFILIATION	Global attribute (CDF_CHAR)	Affiliation of the entity in charge of the calibration	

CAL_EQUIPMENT	Global attribute (CDF_CHAR)	RPW equipment associated to the calibration table. The values can be: “LFR”, “TDS” or “THR”	
CALIBRATION_TABLE	Global attribute (CDF_CHAR)	Filename of the calibration table, without the “.cdf” extension.	
CALIBRATION_VERSION	Global attribute (CDF_CHAR)	Version of the calibration table.	Same value than provided in the RCT file name
Descriptor	Global attribute (CDF_CHAR)	Same definition than [AD1]. Must always start with the prefix “RPW-“.	
LEVEL	Global attribute (CDF_CHAR)	Level of the calibration table. Must be “CAL”.	
MODS	Global attribute (CDF_CHAR)	Same definition than [AD1].	
Project	Global attribute (CDF_CHAR)	Same definition than [AD1].	
Source_name	Global attribute (CDF_CHAR)	Same definition than [AD1].	

7.2 XML schemas

7.2.1 RPW LZ data set XML schema

```
<xml version "1.0" encoding "UTF-8">
<xsd:schema xmlns:xsd "http://www.w3.org/2001/XMLSchema">
       <xsd:element name "RpwLz">
       <xsd:complexType>
                     <xsd:sequence>
                            <xsd:element name "Header" type "HeaderType"/>
                            <xsd:element name "Data" type "DataType"/>
                     </xsd:sequence>
              </xsd:complexType>
       </xsd:element>

       <xsd:complexType name "HeaderType">
      <xsd:sequence>
       <xsd:element name "Project" type "xsd:string"></xsd:element>
       <xsd:element name "Source_name" type "xsd:string"></xsd:element>
       <xsd:element name "Descriptor" type "xsd:string" />
       <xsd:element name "StartTime" type "xsd:dateTime" />
```

```
        <xsd:element name "EndTime" type "xsd:dateTime" />
        <xsd:element name "Level" type "xsd:string" />
        <xsd:element name "Generation_date" type "xsd:dateTime" />
        <xsd:element name "Data_version" type "xsd:integer" />
        <xsd:element name "Software_name" type "xsd:string"></xsd:element>
        <xsd:element name "Software_version" type "xsd:string" />
        <xsd:element name "Pipeline_name" type "xsd:string"></xsd:element>
        <xsd:element name "Pipeline_version" type "xsd:string" />
        <xsd:element name "File_UUID" type "xsd:string" />
        <xsd:element name "Dataset_ID" type "xsd:string" />
        <xsd:element name "Provider" type "xsd:string"></xsd:element>
        <xsd:element name "IDB_version" type "xsd:string"></xsd:element>
      </xsd:sequence>
       </xsd:complexType>

       <xsd:complexType name "DataType">
      <xsd:sequence>
       <xsd:element name "TmRaw" type "TmRawType" minOccurs "1"/>
      </xsd:sequence>
    </xsd:complexType>


       <xsd:complexType name "TmRawType">
              <xsd:sequence>
                     <xsd:element name "Packet" type "xsd:hexBinary" minOccurs "1"/>
              </xsd:sequence>
              <xsd:attribute name "PacketID" type "xsd:long" use "required"
></xsd:attribute>
              <xsd:attribute name "Status" type "xsd:string"
use "required"></xsd:attribute>
              <xsd:attribute name "Name" type "xsd:string" use "optional"></xsd:attribute>
              <xsd:attribute name "SrdbID" type "xsd:string"
use "optional"></xsd:attribute>
       </xsd:complexType>

</xsd:schema>
```

7.3 CDF binary file creation mechanism

Every CDF data files must 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 may not be familiar with the skeleton table creation mechanism, the ROC team proposes to deliver CDF skeletons specific formatted Excel 2007 table files. These Excel files can be then converted into usual ASCII skeleton tables using a dedicated python library “maser4py” (https://pypi.org/project/maser4py/).

Figure 2 summarizes the RPW CDF file creation process.

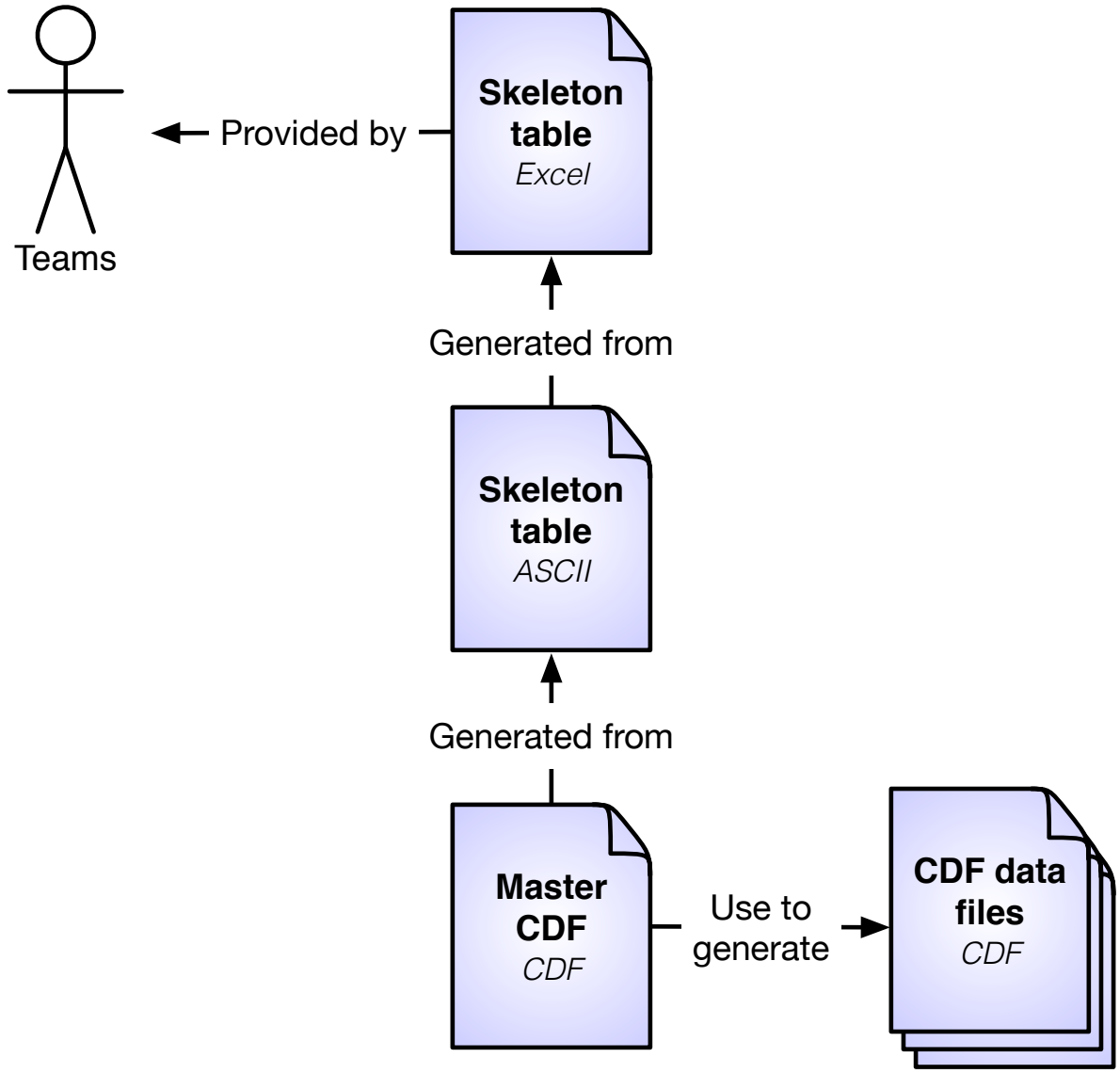

Figure 2. CDF creation process.

The file naming convention for the skeleton/master CDF related to the Solar Orbiter RPW data files must be:

<DATASET_ID>_V<Skeleton_version>.ext

, where "**<DATASET_ID>**" is the ROC dataset ID, as defined in the section **Erreur ! Source du renvoi introuvable.** (e.g., 'SOLO_L1_RPW-TNR-SURV_V02.xlsx).

N.B. The convention is the same for the ROC-SGSE RPW CDF skeleton/master files, except that the "SOLO_" prefix must be replaced by "ROC-SGSE_" to avoid confusions.

The way to deliver the skeleton CDF files is presented in [RD15].

7.4 MEB EGSE setup overview and data

7.4.1 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 next section.

7.4.2 Overview of the MEB EGSE

7.4.2.1 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:

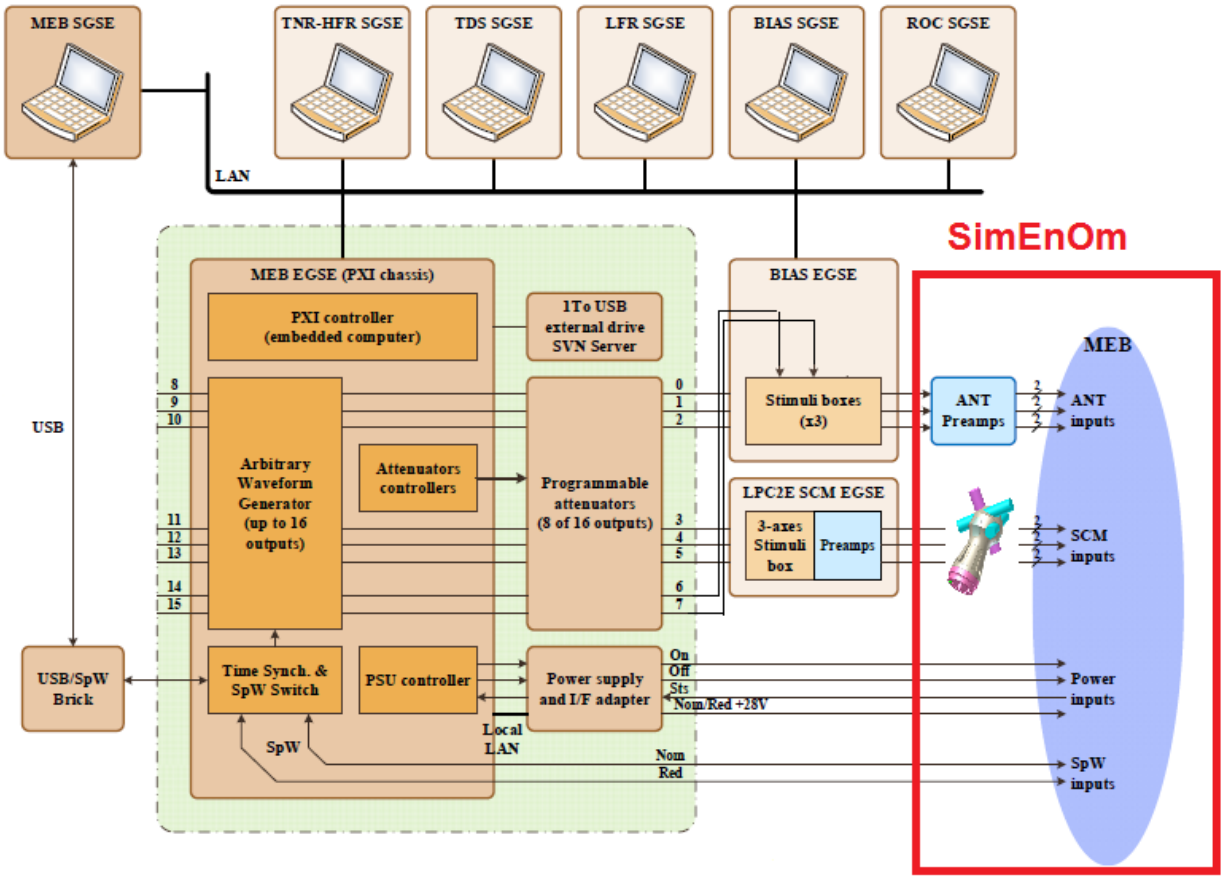

Figure 3. MEB EGSE setup 1.

7.4.2.2 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:

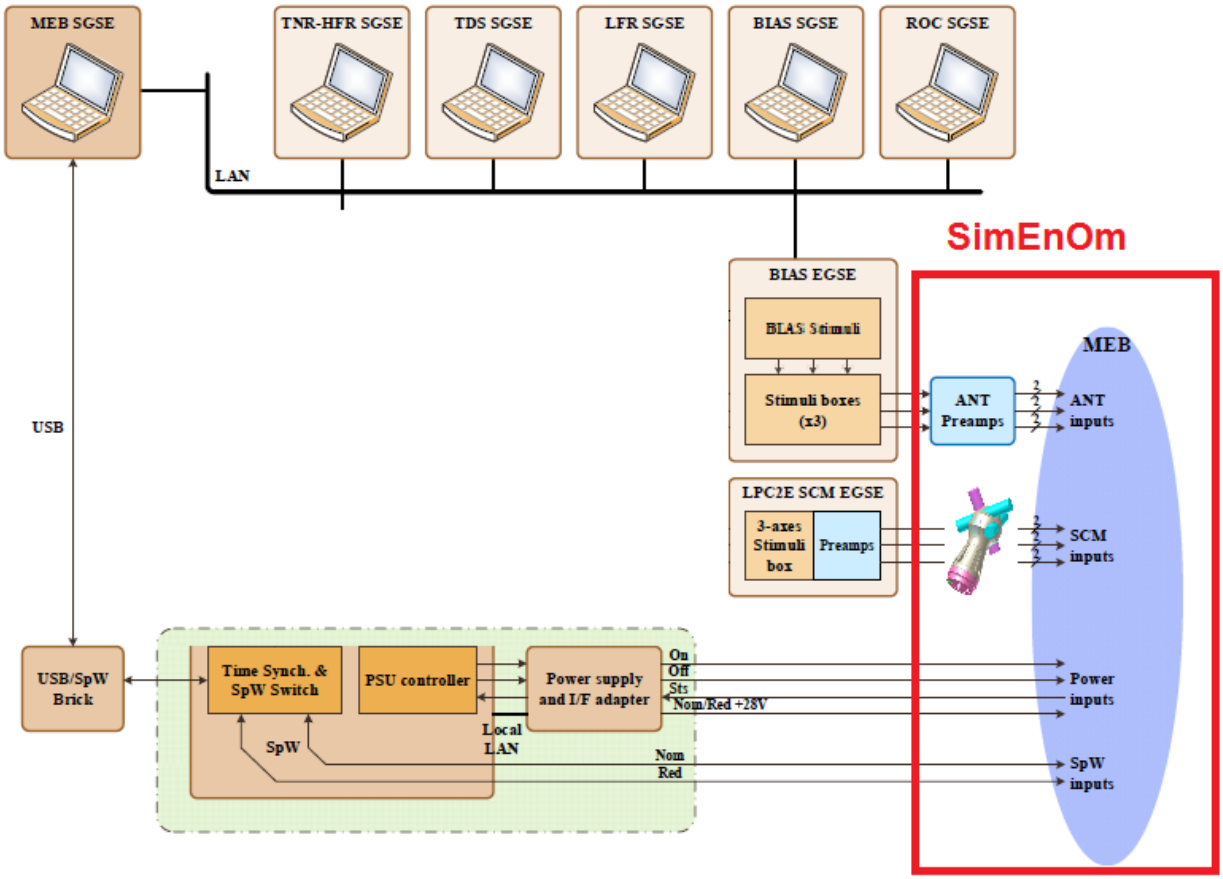

Figure 4. MEB EGSE setup 2.

7.5 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.

7.5.1 Type of EGSE setup metadata

7.5.1.1 Setup 1: AC Measurement

The following measurement must be done before each calibration campaign.

7.5.1.1.1 Electrical part

The MEB EGSE must 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 must be tested:

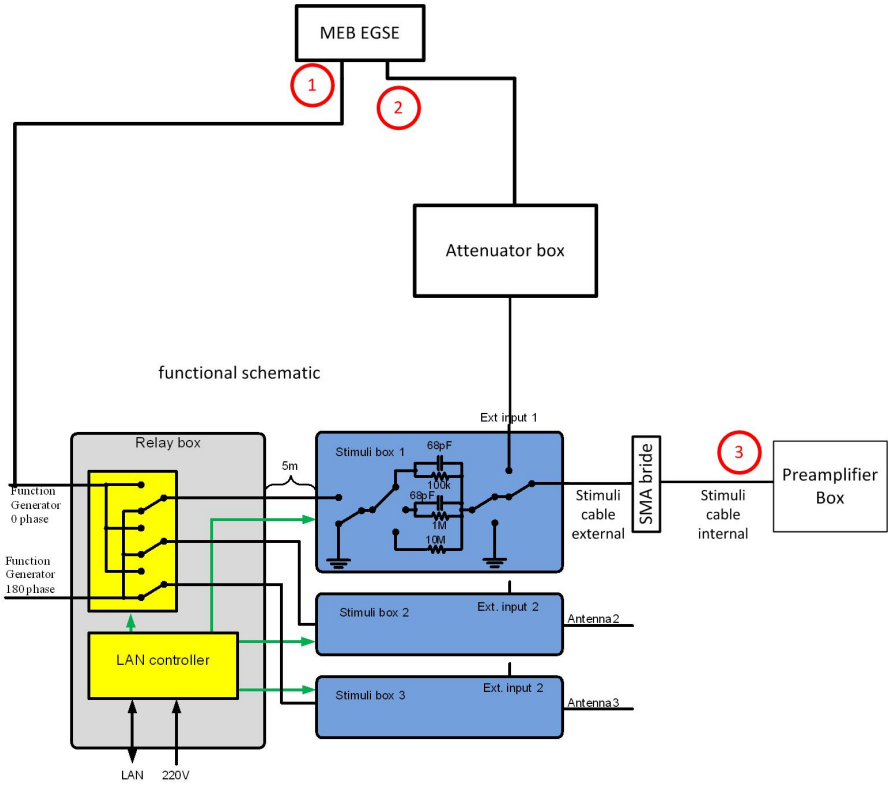

Figure 5. MEB EGSE calibration for electrical fields

7.5.1.1.2 Magnetic part

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

Figure 6. SCM injection setup

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

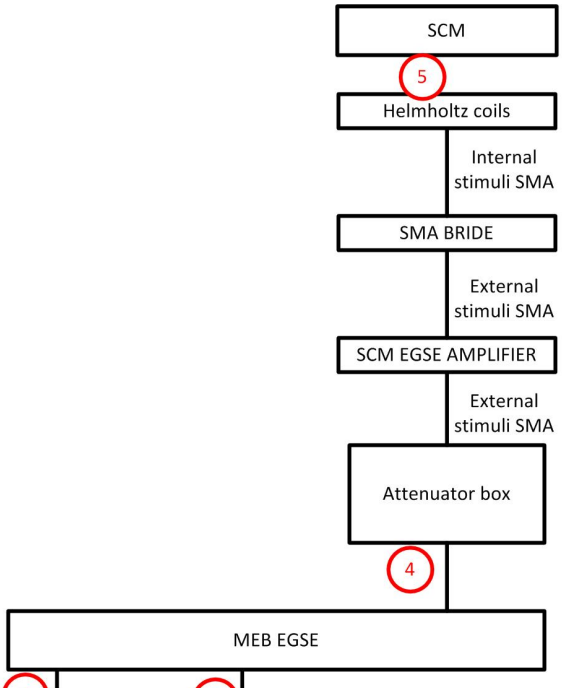

Figure 7. MEB EGSE calibration for magnetic fields

WARNING : The measurement done on point (5) must 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).

7.5.1.1.3 Capacitance

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

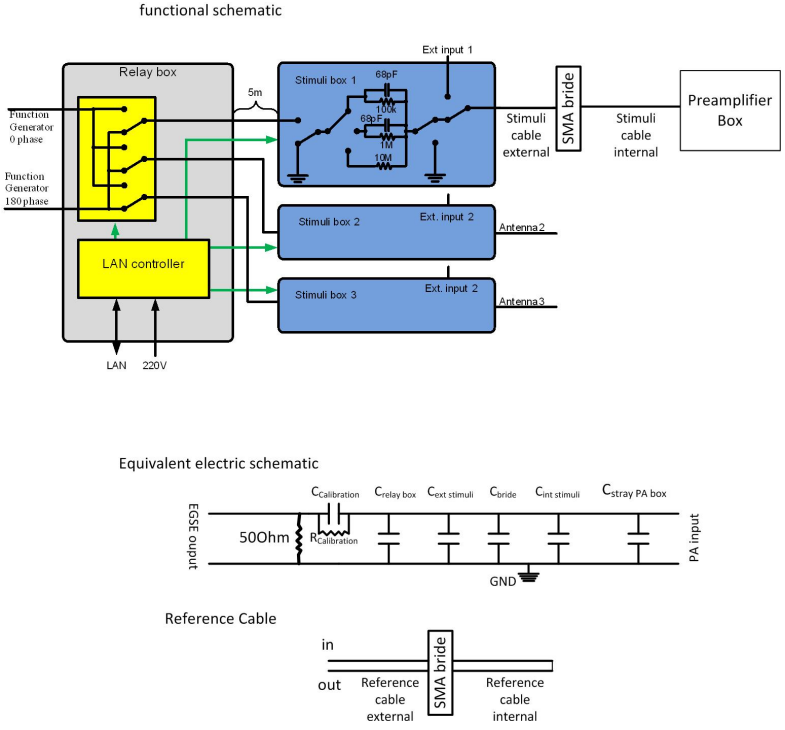

Figure 8 . Equivalent electric schematic of the thermal setup

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 must 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 must be periodically measured to guarantee that the cable impedance doesn't change with temperature.

7.5.1.1.4 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

7.5.1.2 Setup 2: DC measurements

7.5.1.2.1 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.

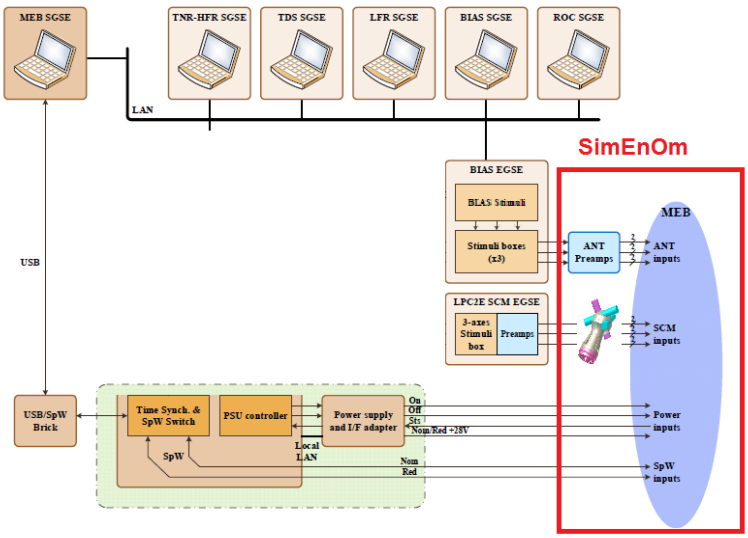

Figure 9 . DC Voltage measurement Setup

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.

7.5.1.2.2 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.

7.5.2 Data format

7.5.2.1 Transfert functions

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

7.5.2.2 Capacitance functions

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

7.5.2.3 DC measurements

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

7.5.1 File naming convention

7.5.1.1 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

7.5.1.2 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

7.5.1.3 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

7.5.2 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.

7.5.3 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

8 LIST OF TBC/TBD/TBWS

TBC/TBD/TBW			
Reference/Page/Location	Description	Type	Status

9 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-]CoIs
		Science-CoIs

INTERNAL

LESIA CNRS		

LESIA CNRS		

EXTERNAL (To modify if necessary)

CNES		C. FIACHETTI
		C. LAFFAYE
		R.LLORCA-CEJUDO
		E.LOURME
		M-O. MARCHE
		E.GUILHEM
		J.PANH
		B.PONTET
IRFU		L. BYLANDER
		C.CULLY
		A.ERIKSSON
		SE.JANSSON
		A.VAIVADS
LPC2E		P. FERGEAU
		G. JANNET
		T.DUDOK de WIT
		M. KRETZSCHMAR
		V. KRASNOSSELSKIKH
SSL		S.BALE

AsI/CSRC		J.BRINEK
		P.HELLINGER
		D.HERCIK
		P.TRAVNICEK
IAP		J.BASE
		J. CHUM
		I. KOLMASOVA
		O.SANTOLIK
		J. SOUCEK
		L.UHLIR
IWF		G.LAKY
		T.OSWALD
		H. OTTACHER
		H. RUCKER
		M.SAMPL
		M. STELLER
LPP		T.CHUST
		A. JEANDET
		P.LEROY
		M.MORLOT