SMOS DPGS V3 Calibration Baseline

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1. INTRODUCTION

1.1. Purpose and Scope

This document describes the processing approach to be used operationally for calibrating L1a data during the Commissioning Phase. This baseline has been agreed after several meetings with ESA, EADS CASA Espacio and UPC, and includes all recommendations derived from using IVT test data from the operational MIRAS instrument.

1.2. Acronyms and Abbreviations

L1PP	Level 1 Processor Prototype
NIR	Noise Injection Radiometer
PMS	Power Measurement Signal

For the complete list of acronyms, please refer to the "Directory of Acronyms and abbreviations" [RD.05].

1.3. Applicable and Reference Documents

1.3.1. Applicable Documents

Ref.	Code	Title	Issue
SOW	SO-SOW-CASA-PLM-0385	Level 1 Processor Prototype Development Phase 4 and Support Activities. Statement of Work	01
SRD	SO-RS-ESA-PLM-0003	SMOS System Requirements Document	3.0
ECSS	ECSS-E-40B	ECSS E-40 Software Engineering Standards	
FFS	PE-TN-ESA-GS-001	Earth Explorer Ground Segment File Format Standard	1.4

Table 1: Applicable Documents

1.3.2. Reference Documents

Ref.	Code	Title	Issue
RD.01	SO-IS-DME-L1PP-0003	SMOS L1PP Auxiliary Data File Format	2.2
RD.02	SO-IS-DME-L1PP-0002	SMOS L1PP Product Data Files Format	2.2
RD.03	SO-TN-ESA-GS-1250	SMOS Product Definition	1.1
RD.04	SO-TN-UPC-PLM-01	IN-ORBIT CALIBRATION PLAN	3.3

RD.05	SO-LI-CASA-PLM-0094	Directory of Acronyms and abbreviations	
RD.06	SO-DS-DME-L1PP-0007	SMOS L1PP Detail Processing Model L0 to L1a	***2.3***
RD.07	SO-TN-UPC-PLM-0019	IN-ORBIT CALIBRATION PLAN Phase C/D	***1.2***

Table 2: Reference Documents

2. DPGS V2 CALIBRATION BASELINE

2.1. Outline

This calibration baseline was derived between 2006 and 2007 from preliminary instrument data, and predicted temperature variability associated to the instrument relative position within the orbit. This baseline is described in [RD.06] and will not be repeated here, just a brief outline shall be performed in order to assess the impact of the new baseline.

Instrument parameter calibration was planned to be performed every 1.25 orbits, and the calibration parameters derived from such event would be associated to the relative orbit time in which they had been acquired (orbital bins). This calibration encompassed PMS and FWF at the origin calibration derived from Correlated Noise Injection sequences.

Whenever values of PMS or FWF were needed to calibrate scientific data, the retrieval would be based on two separate interpolations:

- Two initial interpolations in temperature from the two closest orbital bins. This interpolation used the temperature at the time of calibration, the temperature at which the parameters are desired and the temperature sensitivity of the calibration parameter in question
- A weighted interpolation between the two values obtained previously, but this time using relative weights to correct for the relative time difference within the orbit of the two calibration points and the instant in which the calibration data is desired

In addition to this calibration based on orbital bins, it was also possible to perform a “long” calibration orbit, in which the instrument would be constantly performing a continuous calibration loop during a complete orbit. Out of this “long” calibration orbit, it would be possible to derive sensitivity values for PMS and FWF parameters by fitting the values to a LSQ against temperature.

Finally, the following calibrations would be performed by simply averaging the data acquired during the respective calibration sequences:

- NIR Calibration
- Uncorrelated Noise Injection Calibration
- FWF Shape Calibration

2.2. Calibration data format

Format for this calibration baseline is described in [RD.02], and essentially is important only for the Correlated Noise Injection L1a product.

Its binary structure contains the following DataSets:

- FWF Origin DataSet: containing orbital bin values for FWF at the origin (real and imaginary)
- PMS Calibration DataSet: containing orbital bin values for PMS calibration

- Consolidated “long” PMS calibration events
- PMS Sensitivity DataSet: containing values derived from the “long” calibration orbit by LSQ fitting of PMS data
- FWF Origin Sensitivity DataSet: containing values derived from the “long” calibration orbit by LSQ fitting of FWF Origin data

3. DPGS V3 CALIBRATION BASELINE

3.1. Outline

Based on analysis of ESA LSS (Large Space Simulator) data, it has been observed that the instrument behaviour wrt physical temperature changes is different than what was originally planned. The active thermal control system does not let the orbital thermal behaviour affect the instrument response, but in turn introduces a thermal oscillation of its own which needs to be tracked and accounted for.

On another issue, as the PMS system is stable and follows the on-ground characterisation, and as the PLM temperature is more stable within the PMS thermal boundaries due to the active thermal control system, the PMS system does not require such a periodic calibration as in the original baseline. However, it has been seen that the use of a single PMS measurement is affected by noise and consequently the current baseline is to average the PMS gain and offset parameters as well as the physical temperature with a longer averaging baseline in order to reduce the RMS of the calibration parameters.

Due to these two points, the calibration baseline to be used operationally for Commissioning needs to be updated in order to adapt to the real instrument response.

It shall be remarked that this calibration baseline in L1PP shall be considered as V5 for incremental reasons, and will use this naming convention.

3.2. Calibration data format

Format for this calibration baseline shall reflect the optimal way of using and consolidating the calibration parameters The only changes are applicable to the Correlated Noise Injection consolidated L1a product.

Its binary structure shall contain the following DataSets:

- PMS Calibration DataSet
- Consolidated “long” PMS calibration events
- FWF Origin Amplitude DataSet
- Consolidated “long” FWF Origin Amplitude calibration events
- FWF Origin Phase DataSet

3.3. PMS Calibration

The basic sequence for PMS Calibration remains the same as in section 3.11 of [RD.06], however, the following updates apply to the PMS Calibration computation:

- Short PMS Sequences shall be only used for monitoring and will not be consolidated into the Correlated Noise Injection L1a product
- Long PMS Sequences shall be consolidated in the same fashion as for V2.

- Whenever more than Min_Number_Subevents of Long PMS Sequences are reached inside a consolidated Correlated Noise Injection L1a product, they shall be averaged and be used to generate one DSR for the PMS Calibration DataSet. Only one DSR needs to be stored at any given time; previously available data can be stored until it is obsolete, or discarded on generation of new data.
- The Long PMS Sequences shall not generate PMS Sensitivity data
- PMS Sensitivity will only be derived through a specific campaign in the Commissioning Phase where PMS Calibration data acquired over a period of 2 weeks will be analysed. This means an offline activity which shall be performed exclusively in the CEC.

With respect to the usage of PMS Calibration data, the following updates apply:

- For a given snapshot T0, the applicable PMS Calibration DSR shall be used (applicable meaning a DSR whose time is earlier than T0)
- The PMS data from the PMS Calibration DSR shall be extrapolated in temperature to the physical temperature at T0. This interpolation will use the temperature at calibration time, the temperature at T0 and the PMS Sensitivity data from the PMS AUX ADF
- No orbital interpolation is to be performed anywhere

3.4. FWF Origin Calibration

The basic sequence for FWF Origin Calibration remains the same as in section 3.11 of [RD.06], however, there is a new sequence to be used only for calibrating the FWF Origin phase which needs to be added.

In this new baseline, the calibration of FWF Origin amplitude and phase is decoupled and the data needs to be stored in separate DSR

3.4.1. FWF Origin Amplitude

The FWF Origin Amplitude is still taken from the FWF Origin Calibration sequence. Although similar updates as for the PMS Calibration apply:

- Short FWF Origin Sequences shall be only used for monitoring and will not be consolidated into the Correlated Noise Injection L1a product
- Long FWF Origin Sequences shall be consolidated in the same fashion as for V2.
- Whenever more than Min_Number_Subevents of Long FWF Origin Sequences are reached inside a consolidated Correlated Noise Injection L1a product, they shall be averaged and be used to generate one DSR for the FWF Origin Amplitude DataSet. Only one DSR needs to be stored at any given time; previously available data can be stored until it is obsolete, or discarded on generation of new data.
- The Long FWF Origin Sequences shall not generate FWF Origin Sensitivity data, and no sensitivity shall be derived during Commissioning

With respect to the usage of FWF Origin Amplitude Calibration data, the following updates apply:

- For a given snapshot T0, the applicable FWF Origin Amplitude DSR shall be used (applicable meaning a DSR whose time is earlier than T0)
- The FWF Origin amplitude data from the FWF Origin Amplitude DSR shall be used as is, without any temperature interpolation
- No orbital interpolation is to be performed anywhere

3.4.2. FWF Origin Phase

The FWF Origin Phase can now be calibrated through the Local Oscillator Phase Tracking Sequence, described as:

LO PHASE TRACKING WITH U NOISE CALIBRATION SEQUENCE															
	Step	Epochs CMD	Epochs Valid	LICEF	NIR	NS EVEN	NS ODD	Att	PMS (V)	Corr Del	FWF(0) Mkj	NIR Dicke	NIR PMS	LICEF PMS	DATA CORRUP
LO Cal	7	2	1	U	LICEF-LU	OFF	OFF	L0	-1.27	0	M_{kj}^{U}	-	-	v_2^o	1st
LO Cal	8	2	1	C	LICEF-LC	OFF	HOT	L0	0.1	0	M_{kj}^{C2-o}	-	-	v_2^o	1st
LO Cal	5	1	1	C	LICEF-LC	HOT	OFF	L0	0.1	0	M_{kj}^{C2-e}	-	-	v_2^e	0

Figure 1: Local Oscillator Phase Tracking Sequence

Through this sequence it is possible to obtain the FWF Origin by means of the following equation, where we are only interested in the phase of g_{kj}:

$$\bar{g}_{kj}^{C}(0) = \bar{M}_{kj}^{C2}(0)\bar{S}_{k0}^{*}\bar{S}_{j0} \qquad \textbf{Eq. 1}$$

As in the case of FWF Origin calibration, the equation above is only valid for baselines sharing the same Noise Source. The system needs to be closed for the remaining baselines using the same approach as in section 3.4.2 of [RD.06]

Additionally, the FWF Origin Phase values obtained from the original FWF Origin Calibration sequences are also valid and shall be consolidated together with Local Oscillator FWF Origin Phase values as additional DSR.

All FWF Origin Phase values are consolidated into the FWF Origin Phase DataSet, and ordered by absolute time.

With respect to the usage of FWF Origin Phase Calibration data, the following strategy shall be followed:

- For each *kj* baseline, a natural spline shall be created using all FWF Origin Phase values available in the FWF Origin Phase DataSet and the absolute times applicable to each DSR.
- Natural spline implies that the second derivatives are zero at the ends of the distribution
- For a given snapshot T0, the applicable FWF Origin Phase value shall be estimated out of the spline interpolation in a similar fashion as indicated in the following figure

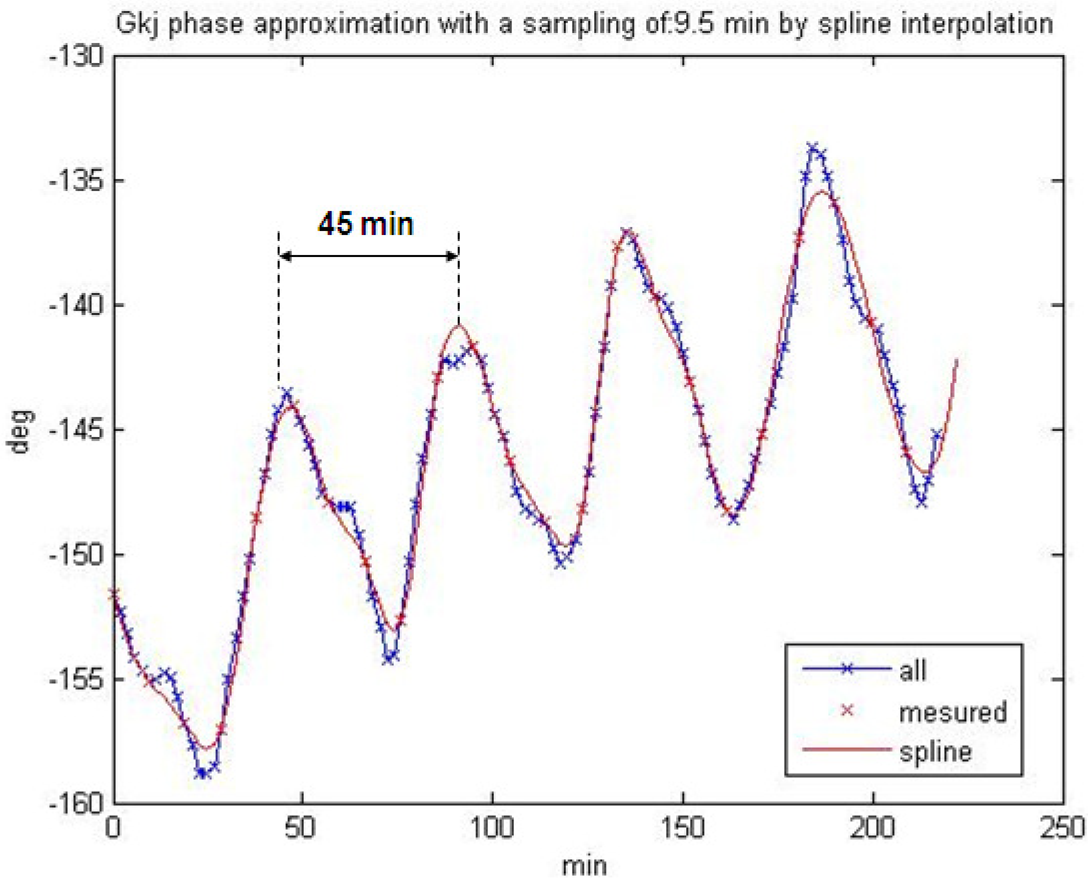

Figure 2: Local Oscillator Phase Tracking Spline Interpolation

- This procedure needs to be performed for all *kj* baselines in all science snapshots in order to derive the $\overline{g}_{kj}^{C}(0)$ term. This term needs to be combined with the applicable FWF Origin Amplitude in order to obtain the complete $g_{kj}^{C}(0)$ term.
- After the $g_{kj}^{C}(0)$ term is available, L1a processing continues in the same way as for V2.

3.5. FWF Shape Calibration

No changes with respect to V2 baseline shall be considered.

3.6. Unoise Calibration

No changes with respect to V2 baseline shall be considered.

3.7. NIR Calibration

No changes with respect to V2 baseline shall be considered.

4. CONSOLIDATED CORRELATED NOISE INJECTION CALIBRATION DATA FORMAT UPDATE

The following updates shall be needed in the Correlated Noise Injection Consolidated L1a product in order to accommodate the new baseline

4.1. Main Product Header

No changes required

4.2. Specific Product Header

No changes required.

4.3. Data set

The Reference DataSet shall be identical to V2 baseline.

The first two Measurement DataSets shall contain PMS calibration data: the first one the consolidated averaged PMS Calibration parameters, and the second one the consolidated "long" PMS Calibration parameters.

The next two Measurement DataSets shall contain FWF Origin Amplitude data: the first one the consolidated averaged FWF Origin Amplitude values and the second one the consolidated "long" FWF Origin Amplitude values.

The fifth Measurement DataSet shall contain the FWF Origin Phase data as a time series

4.3.1. Cons_PMS_Coefficients

This data set shall contain specific information on the PMS characterisation used by the L1PP after correlated noise injection in odd and even sources.

There shall be only ONE Data Set Record. The following table describes the XML schema used to decode the binary contents of this type of record. The tag element used to describe the DSR structure name in the XML schema shall be Cons_PMS_Coefficients. The size of each DSR is fixed and equal to 2140 bytes.

Each DSR shall contain information for all 72 PMS, which in this table has been shown as the need to repeat the data below the green separator as many times as PMS. The data with the Receiver Noise Temperature of the LICEF_NIR units shall also be included, as it is required to compute the System Temperatures of the mixed baselines. Data in the table have been separated, only for illustration, by green separators according to its nature (time, auxiliary or science).

Table 3: Cons_PMS_Coefficients Measurement Data Set Record

Field #	Tag name	Description	Units	Bytes	Size

Field #	Tag name	Description	Units	Bytes	Size
Time Data					
#01	Sequence_Start_Time	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence, and also start of validity for calibration matrices. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#02	Sequence_Stop_Time	UTC Time at which the calibration sequence was closed. Start of integration time period for last event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#03	Samples	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	N/A	4	4 bytes IEEE float
Science Data (Repeated per PMS id)					
#04	PMS_ID	PMS Unique identifier. Vector array of [72] unsigned byte elements	N/A	1	72*1 byte Integer formed by number of PMS
#05	Temperature	Temperature at which the PMS coefficients were obtained. Vector array of [72] float elements	K	4	72*4 bytes signed IEEE float
#06	Gain	Gain coefficient for PMS identified before and at previous temperature. Vector array of [72] double elements	mV/K	8	72*8 bytes

Field #	Tag name	Description	Units	Bytes	Size
#07	Offset	Offset coefficient for PMS identified before and at previous temperature. Vector array of [72] double elements	mV	8	72*8 bytes
		Receiver Temperature Data			
#08	T_Rec_Ref_H	Reference NIR Receiver Temperature $T_{rec_k}^{LH-CIP}$ One measurement per NIR. Order followed is AB, BC, CA. Vector array of [3] double elements	K	8	3*8 bytes
#09	T_Rec_Ref_V	Reference NIR Receiver Temperature $T_{rec_k}^{LV-CIP}$ One measurement per NIR. Order followed is AB, BC, CA. Vector array of [3] double elements	K	8	3*8 bytes
#10	T_Rec_Ref_LICEF_H	LICEF Receiver Noise Temperature at HAP, measured by U-noise injection. One measurement per LICEF Order followed is AB_03, AB_01_H, AB_01_V, A_01, …, A_21, BC_03, BC_01_H, BC_01_V, B_01, …, B_21, CA_03, CA_01_H, CA_01_V, C_01, …, and C_21. Vector array of [72] double elements	K	8	72*8 bytes
#11	T_Rec_Ref_LICEF_V	LICEF Receiver Noise Temperature at VAP, measured by U-noise injection. One measurement per LICEF Order followed is AB_03, AB_01_H, AB_01_V, A_01, …, A_21, BC_03, BC_01_H, BC_01_V, B_01, …, B_21, CA_03, CA_01_H, CA_01_V, C_01, …, and C_21. Vector array of [72] double elements	K	8	72*8 bytes

4.3.2. Cons_Long_PMS_Coefficients

This data set shall contain specific information on the PMS characterisation used by the L1PP after correlated noise injection in odd and even sources.

There shall be as many Data Set Records for each product as complete sequences spent in Correlated Noise Injection for Long PMS Calibration, whose validity period has not expired. The following table describes the XML schema used to decode the binary contents of this type of record. The tag element used to describe the DSR structure name in the XML schema shall be Cons_Long_PMS_Coefficients. The size of each DSR is fixed and equal to 2144 bytes.

Each DSR shall contain information for all 72 PMS, which in this table has been shown as the need to repeat the data below the green separator as many times as PMS. Data in the table have been separated, only for illustration, by green separators according to its nature (time, auxiliary or science).

Table 4: Cons_Long_PMS_Coefficients Measurement Data Set Record

Field #	Tag name	Description	Units	Bytes	Size
Time Data					
#01	Sequence_Start_Time	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence, and also start of validity for calibration matrices. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#02	Sequence_Stop_Time	UTC Time at which the calibration sequence was closed. Start of integration time period for last event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#03	Samples	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	N/A	4	4 bytes IEEE float
#04	Time_From_ANX	Relative time within orbit since Ascending Node Crossing.	s	4	4bytes signed IEEE float
Science Data (Repeated per PMS id)					

Field #	Tag name	Description	Units	Bytes	Size
#05	PMS_ID	PMS Unique identifier. Vector array of [72] unsigned byte elements	N/A	1	72*1 byte Integer formed by number of PMS
#06	Temperature	Temperature at which the PMS coefficients were obtained. Vector array of [72] float elements	K	4	72*4 bytes signed IEEE float
#07	Gain	Gain coefficient for PMS identified before and at previous temperature. Vector array of [72] double elements	mV/K	8	72*8 bytes
#08	Offset	Offset coefficient for PMS identified before and at previous temperature. Vector array of [72] double elements	mV	8	72*8 bytes
Receiver Temperature Data					
#09	T_Rec_Ref_H	Reference NIR Receiver Temperature $T_{rec_k}^{LH-CIP}$ One measurement per NIR. Order followed is AB, BC, CA. Vector array of [3] double elements	K	8	3*8 bytes
#10	T_Rec_Ref_V	Reference NIR Receiver Temperature $T_{rec_k}^{LV-CIP}$ One measurement per NIR. Order followed is AB, BC, CA. Vector array of [3] double elements	K	8	3*8 bytes

Field #	Tag name	Description	Units	Bytes	Size
#11	T_Rec_Ref_LICEF_H	LICEF Receiver Noise Temperature at HAP, measured by U-noise injection. One measurement per LICEF Order followed is AB_03, AB_01_H, AB_01_V, A_01, …, A_21, BC_03, BC_01_H, BC_01_V, B_01, …, B_21, CA_03, CA_01_H, CA_01_V, C_01, …, and C_21. Vector array of [72] double elements	K	8	72*8 bytes
#11	T_Rec_Ref_LICEF_V	LICEF Receiver Noise Temperature at VAP, measured by U-noise injection. One measurement per LICEF Order followed is AB_03, AB_01_H, AB_01_V, A_01, …, A_21, BC_03, BC_01_H, BC_01_V, B_01, …, B_21, CA_03, CA_01_H, CA_01_V, C_01, …, and C_21. Vector array of [72] double elements	K	8	72*8 bytes

4.3.3. Cons_Ampl_FWF_Origin

This data set shall contain specific information on the calibration parameters, formed by the fringe washing function at the origin amplitude values, computed by the L1PP after correlated noise injection in odd and even sources.

There shall be only ONE Data Set Record. The following table describes the XML schema used to decode the binary contents of this type of record. The tag element used to describe the DSR structure name in the XML schema shall be Cons_Ampl_FWF_Origin. The size of each MDR is fixed and equal to 23321 bytes.

Data in the table have been separated, only for illustration, by green separators according to its nature (time, auxiliary or science).

Table 5: Cons_Ampl_FWF_Origin Measurement Data Set Record

Field #	Tag name	Description	Units	Bytes	Size
Time Data					

Field #	Tag name	Description	Units	Bytes	Size
#01	Sequence_Start_Time	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence, and also start of validity for calibration matrices. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#02	Sequence_Stop_Time	UTC Time at which the calibration sequence was closed. Start of integration time period for last event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
Auxiliary Data					
#03	Correlator_Layer	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	N/A	1	1 char
#04	Samples	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	N/A	4	4 bytes IEEE float
Science Data					
#05	FWF_Origin_Amplitude	Amplitude value in all baselines (including redundant). It is the Fringe Washing Function at the origin for port C. Vector array of [2556] elements	N/A	8	71*36*8 bytes

Field #	Tag name	Description	Units	Bytes	Size
#06	FWF_Origin_Quality	One value per baseline (including redundant). It indicates if the baseline was measured during Correlated Noise Injection (1), if it was estimated by closures relationship (2), if it was estimated by average amplitude and phase difference (3) or if it was not measured at all (0). Vector array of [2556] elements	N/A	1	71*36 unsigned bytes
#07	Receiver_Temp	Physical temperature of receivers in Kelvin. Ordering has been described previously. Vector array of [72] float elements	K	4	72*4 bytes signed IEEE float

4.3.4. Cons_Long_Ampl_FWF_Origin

This data set shall contain specific information on the calibration parameters, formed by the fringe washing function at the origin amplitude values, computed by the L1PP after correlated noise injection in odd and even sources.

There shall be as many Data Set Records for each product as complete sequences spent in Correlated Noise Injection for Long FWF Origin Calibration, whose validity period has not expired. The following table describes the XML schema used to decode the binary contents of this type of record. The tag element used to describe the DSR structure name in the XML schema shall be Cons_Long_Ampl_FWF_Origin. The size of each DSR is fixed and equal to 23325 bytes.

Table 6: Cons_Long_Ampl_FWF_Origin Measurement Data Set Record

Field #	Tag name	Description	Units	Bytes	Size
Time Data					
#01	Sequence_Start_Time	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence, and also start of validity for calibration matrices. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned

Field #	Tag name	Description	Units	Bytes	Size
#02	Sequence_Stop_Time	UTC Time at which the calibration sequence was closed. Start of integration time period for last event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
Auxiliary Data					
#03	Correlator_Layer	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	N/A	1	1 char
#04	Samples	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	N/A	4	4 bytes IEEE float
#05	Time_From_ANX	Relative time within orbit since Ascending Node Crossing.	s	4	4bytes signed IEEE float
Science Data					
#06	FWF_Origin_Amplitude	Amplitude value in all baselines (including redundant). It is the Fringe Washing Function at the origin for port C. Vector array of [2556] elements	N/A	8	71*36*8 bytes
#07	FWF_Origin_Quality	One value per baseline (including redundant). It indicates if the baseline was measured during Correlated Noise Injection (1), if it was estimated by closures relationship (2), if it was estimated by average amplitude and phase difference (3) or if it was not measured at all (0). Vector array of [2556] elements	N/A	1	71*36 unsigned bytes

Field #	Tag name	Description	Units	Bytes	Size
#08	Receiver_Temp	Physical temperature of receivers in Kelvin. Ordering has been described previously. Vector array of [72] float elements	K	4	72*4 bytes signed IEEE float

4.3.5. Cons_Phase_FWF_Origin

This data set shall contain specific information on the calibration parameters, formed by the fringe washing function at the origin phase values, computed by the L1PP after correlated noise injection in odd and even sources during FWF Origin or Local Oscillator Calibration Sequences.

There shall be as many Data Set Records as LO Phase Tracking events plus FWF Origin Sequences. The following table describes the XML schema used to decode the binary contents of this type of record. The tag element used to describe the DSR structure name in the XML schema shall be Cons_Phase_FWF_Origin. The size of each MDR is fixed and equal to 23325 bytes.

Data in the table have been separated, only for illustration, by green separators according to its nature (time, auxiliary or science).

Table 7: Cons_Phase_FWF_Origin Measurement Data Set Record

Field #	Tag name	Description	Units	Bytes	Size
Time Data					
#01	Sequence_Start_Time	UTC Time at which the FWF0 Phase calibration sequence was started. <u>Start of first sequence consolidated</u>, and also start of validity for data. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
#02	Sequence_Stop_Time	UTC Time at which the FWF0 Phase calibration sequence was closed. <u>Stop time</u> for last event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	N/A	12	3*4 bytes First element is signed integer, remaining two are unsigned
Auxiliary Data					

Field #	Tag name	Description	Units	Bytes	Size
#03	Correlator_Layer	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	N/A	1	1 char
#04	Samples	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps	N/A	4	4 bytes IEEE float
#05	Time_From_ANX	Relative time within orbit since Ascending Node Crossing.	s	4	4bytes signed IEEE float
Science Data					
#06	FWF_Origin_Phase	Phase value in all baselines (including redundant). It is the Fringe Washing Function at the origin for port C. Vector array of [2556] elements	deg	8	71*36*8 bytes
#07	FWF_Origin_Quality	One value per baseline (including redundant). It indicates if the baseline was measured during Correlated Noise Injection (1), if it was estimated by closures relationship (2), if it was estimated by average amplitude and phase difference (3) or if it was not measured at all (0). Vector array of [2556] elements	N/A	1	71*36 unsigned bytes
#08	Receiver_Temp	Physical temperature of receivers in Kelvin. Ordering has been described previously. Vector array of [72] float elements	K	4	72*4 bytes signed IEEE float