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SMOS DPGS

SMOS Level 1 and Auxiliary Data Products Specifications

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Document Change Log

Iss./Rev.	Date	Section / Page	Change Description
1/0	18-Jan-2006	All	First edition of the document
1/1	17-Feb-2006	All	"Counter" field name added
		All	Type, Precision, C format and Comments columns in tables reviewed
		All	Specific Product Header fields reviewed
		All	New fields proposed for Specific Product Header, as per RID DPGS-PDR-NW-54
		All	Scientific descriptions of products included from L1PP documents to make this document stand-alone, as per RID DPGS-PDR-RC-019.
		All	Calculation od DSR size for each table, as per RID DPGS-PDR-RC-018.
		All	SPH numbering made consistent along all sub-elements, as per RID DPGS-PDR-NW-53.
		Section 1.4	References updated
		Section 2.1	Section added to highlight differences between this specifications and L1PP's.
		Section 2.1.1	Section added to introduce the conventions used in the document, as per RID DPGS-PDR-RC-018.

Iss./Rev.	Date	Section / Page	Change Description
		Section 2.2.1	Figure 2-1 updated to subtract reference to .EEF extension, as per RID DPGS-PDR-NW-50.
		Section 2.2.1	Correct text “one data block containing one dataset” to make clear that there can be several datasets, as per RID DPGS-PDR-NW-39.
		Section 3.1.1	Fixed Header specified here to make the document stand-alone, as per RID DPGS-PDR-RC-019. This also covers DPGS-PDR-NW-51.
		Section 4.1.1	Main Product Header specified here to make the document stand-alone, as per RID DPGS-PDR-RC-019. This also covers RID DPGS-PDR-NW-52.
		Section 4.1.2	Clarification on L1 Measurement Products’ SPH structure added, as per RID DPGS-PDR-NW-53
		Sections 4.2.1.1, 4.2.4.1.1	Product_Consolidation structure in SPH added to highlight product edges, as per RID DPGS-PDR-SS-88.
		Section 5.1.2	Clarification on L1 Auxiliary Data Products’ SPH structure added, as per RID DPGS-PDR-NW-53
1/2	24-Feb-2006	All	Minor error corrections
1/3	18-Apr-2006	All	Major update to align operational products specifications with L1PP’s new release.
		1.4	Update of reference documents
		3.1.1	Minor corrections in Fixed Header concerning sizes of strings and time format
		4.1.1/5.1.2.1	Product_schema changed to only Datablock_Schema and moved to SPH. Header schema is given in the first node of the header files.
		4.1.1	Change of Phase field according to L1PP new specifications
		4.1.2	Change of SPH Descriptors for external products as Ext instead of Tar, according to L1PP new specifications

Iss./Rev.	Date	Section / Page	Change Description
		4.1.2.1	Clarified definitions of Start/Stop_Time_ANX_T from L1PP new specs.
		4.1.2.1	Datablock_Schema moved to SPH
		4.1.2.1/5.1.2.1	Byte_Order from List_of_Data_Sets structure moved to higher level in SPH (applies to the whole product, not differently to each dataset)
		4.1.2.2	Byte_Order moved to 4.1.2.1
		4.1.2.2	RFI and BSCAT included in RDS list
		4.2.1.2	NIR_Brightness_Temp deleted to align it with L1PP new specs.
		4.2.1.2	Physical_Temperatures units change
		4.2.1.2	Specification of Physical_Temperatures matrix format
		4.2.2.1.2	Receiver_Temp units change
		4.2.2.2.2	Temperature units change
		4.2.2.3.2	FWF different for each polarization; size of product nearly duplicates
		4.2.2.4.2	Clarification on use of NIR_External dataset
		4.2.3.2.2/4.2.3.3.2	Temperature fields format change
		4.2.4.1.2/4.2.4.2.2	Confusion on format of Scene_BT_Fourier clarified; product size reviewed
		4.2.4.1.2/4.2.4.2.2	Temperature fields units change
		4.2.4.1.2/4.2.4.2.2	Flags field specification included
		4.2.5.1.1/4.2.5.3.1	Scale specification fields included so as to make the scaling configurable, accordingly also to L1PP new specs.
		4.2.5.1.2/4.2.5.2.2 /4.2.5.3.2	Details on snapshot dataset included
		4.2.5.1.2/4.2.5.2.2 /4.2.5.3.2	Radiometric accuracy and Footprint Axes fields changed so as to make its scaling configurable
		4.2.5.1.2/4.2.5.2.2 /4.2.5.3.2	Flags specification included
		5.2.1	Format of PMS_ID aligned with L1PP new specs.

Iss./Rev.	Date	Section / Page	Change Description
		5.2.2	L_DC_V and L_DC_H fields deleted accordingly to L1PP new specs
		5.2.4	Format of Switch_ID aligned with L1PP new specs.
		5.2.4	S_LU magnitude and phase deleted accordingly to L1PP new specs
		5.2.7	Format of LICEF_ID, NIR_ID and PMS_ID aligned with L1PP new specs.
		5.2.8	Format of angles aligned with L1PP new specs.
		5.2.11	Format of galactic maps changes accordingly to L1PP new specs.
		5.2.12/5.2.13	Format of Sun/Moon brightness temperatures changes accordingly to L1PP new specs; cross-pol terms added, size reviewed.
		5.2.15	Source of VTEC clarified accordingly to L1PP new specifications
		5.2.17	Strip adaptive apodisation coefficients format specified separately
		5.2.20	RFI mask organisation aligned with L1PP
		5.2.21	FTT product aligned with L1PP new specs; size reviewed
		5.2.21	FTT product changed to allow including more than 1 DSR (list)
		5.2.22	New product from L1PP's new specs.
		6	Product size estimations reviewed
1/4	17-May-2006	All	As per RIDs SP-01 and SP-02 at L1P-PDR, renaming of repeated field to avoid confusions
		4.2.5.1.1 and 4.2.5.3.1	Add Sensing_Time to L1C SPH
2/0	26-Jun-2006	All	Minor units corrections for alignment with last L1PP Specifications
		1.3 / 1.4	References updated
		2.1	Website reference updated
		2.1	Update of description of work performed in the document

Iss./Rev.	Date	Section / Page	Change Description
		2.2.1	Products will not be delivered to Processors as ZIP files.
		2.2.2	Specification of how file counter is obtained
		2.2.3	Presentation of the schemas and XML R/W API repositories, and the schemas versions corresponding to the products specified in this document
		3.1.1	Update of File_Description field table
		3.2	Further clarification that Reference Data Sets are not included in the product
		4.1.1	Update of MPH after harmonisation with other processing levels
		4.1.2	Simplification of SPH naming convention
		4.1.2.1	Update of SPH Main Info after harmonisation between products levels
		4.1.2.2	MDS and RDS separated in two different structures to avoid filling with null values
		4.1.2.2	Update of RDS names
		4.2.1.1	Attitude and NIR Calibration Flags added to support orchestration
		4.2.2.1/ 4.2.2.2	Change of MIR_UNC1A product to MIR_UNCN1A containing individual meas. and MIR_UAVE1A containing average, to support orchestration. Internal calib. with external attitude also considered
		4.2.2.3/ 4.2.2.4	Change of MIR_CORN1A product to MIR_CORN1A containing individual meas. and MIR_CORS1A containing short calibration curve, to support orchestration. Internal calib. with external attitude also considered
		4.2.2.5/ 4.2.2.6	Change of MIR_FWAS1A product to MIR_FWAS1A containing individual meas. and MIR_AVFW1A containing average of FWF estimations, to support orchestration. Internal calib. with external attitude also considered

Iss./Rev.	Date	Section / Page	Change Description
		4.2.2.7	NIR Calibration module receives several L1A HKTM to consolidate all NIR Calibration in one MIR_NIR_1A product
		4.2.3.2	RDS changed for L1A Calibrated Visibilities
		4.2.5.1.1	RSC flag eliminated, as RSC Module is not to be implemented in L1OP
		5.1.1	MPH not included in ADFs
		5.1.2	SPH descriptors simplified
		5.1.2.1	SPH Main Info structure changed accordingly to harmonisation of ADF products (to include info from former MPH)
		5.2.4	Fields renamed to avoid repeating names
		5.2.6/5.2.7	Antenna Patterns Coordinates in a different product than Antenna Patterns
		5.2.19	G Matrix RDS changed to include MIR_AVFW1A and not MIR_FWAS1A, and also patterns coordinates product
		5.2.23	BSCAT datablock's structure correction (missing dataset hierarchy)
		5.2.24	Added Time Correlation auxiliary data product
		6	Review of product sizes
2/1	28-Jul-2006	All	Update after L1OP-CDR
		All	Review of all document with proper corrections
		All	Changing naming convention of all internal calibration products, as per Josep Closa's e-mail of 19-Jul-06
		All	Removed the Overlap information (Product_Consolidation structure) provided in the SPHs, as per L1OP-CDR RID JC-27
		All	Gap_Info removed from Headers, as per RID JC-29

Iss./Rev.	Date	Section / Page	Change Description
		All	New fields added to identify missing epochs and maximum gap between measurements in SPH as quality information, as suggested by Josep Closa through e-mail on 28-Jul-2006
		All	Attitude_Flag kept in some products headers to allow detecting external and transition manoeuvres pointing, although not in all of them, as now products attitude are identified by their name; at EADS-CASA petition.
		2.1	Update of section presenting the work performed and highlighting the differences with L1PP specifications
		2.2.1	Review of L1 File Structure.
		2.2.2	Defined a File class for Reprocessing, as per L1OP-CDR RID NW-92
		2.2.2	Validity definition clarified as per L1OP-CR RID RC-84
		2.2.2	Clarification on ccc as per L1OP-CDR RID NW-93
		2.2.3	Update of products schemas version information accordingly to new products list
		3.1.1	Clarification on Validity Period meaning for MIRAS and auxiliary products, as per L1OP-CDR RID RC-63
		3.1.1	Fixed Header “Creator” completed as per L1OP-CDR RID RC-65
		3.1.1	Table 3-2 updated accordingly to new products list
		4.1.1	Value for Acquisition Station specified to harmonise with L0 specifications
		4.1.1	ID code of the Logical Processing Centre added, as per RID SP-01
		4.1.1	Product Confidence eliminated as conclusion of L1OP-CDR
		4.1.1	Clarification on tag of Job Order that is used to specify this field, as per L1OP-CDR RID RC-67

Iss./Rev.	Date	Section / Page	Change Description
		4.1.1	Added explanation to clarify that the state vector is given at the ascending crossing node, as per L1OP-CDR RIDs RC-68 and SP-02
		4.1.1	Leap_Second field added to the MPH, as per RID DM-02
		4.1.1	Total_Size units specified, as per L1OP-CDR RID SP-03
		4.1.2.1	Endianness for L1 products is fixed to little-endian.
		4.2.1	Clarification of UTC format used in L0 and L1.
		4.2.1.1	Clarification on NIR Calibration product usage, given current situation (NIR baseline recently changed, not consolidated in L1PP, not to be implemented in L1OP-V1 but in L1OP-V2)
		4.2.1.1	Decision tree to assign Attitude_Flag values specified, as per L1OP-CR RC-70
		4.2.1.1	Reference data sets of L1 HKTM updated
		4.2.2	Clarifications on usage on internal calibration data accordingly to its attitude, as per L1OP-CDR RID JC-34
		4.2.2.2.1	Uncorrelated noise injection quality data fields specified, as per L1OP-CDR RID JC-29.
		4.2.2.3	MIR_CORN1A product suppressed, following new consolidation baseline (measurements included in MIR_CRSD1A and MIR_CRSU1A)
		4.2.2.3.2	Location data set added to avoid latitude, time, temperature repetitions, as per L1OP-CDR RID JC-33
		4.2.2.4	FWF individual products to contain only quadrature corrected correlations measured at C-plane, as per L1OP-CDR RID JC-35
		4.2.2.5	Clarifications included on Average FWF product, as per L1OP-CDR RID JC-35

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		4.2.2.5.2	FWF measured at C-plane and obtained later at antenna polarization planes, clarification added as answer to L1OP-CDR RID JC-35
		4.2.2.6	Clarification on NIR Calibration product usage for L1OP-V1
		4.2.3.1	Correction of L1A Calib_Visib diagonal contents as per L1OP-CDR RID JC-37
		4.2.3.2.1	A field to indicate if the U -noise correction is applied to the visibilities has been added to the product, as per RID JC-39
		4.2.3.2.1	Attitude_Flag reformatted to a list of flags, allowing indication of changes of attitude modes in the same product.
		4.2.4.2.1.1	Reduced info on gaps included in SPH as conclusion of discussion with J. Closa by e-mail on 28-Jul-2006
		4.2.4.2.1.1	Direct Moon Correction Type removed as per L1OP-CDR RID JC-38
		4.2.3.4 4.2.3.5 4.2.3.6	G and J matrix and Flat Target transformation products moved from chapter 5 to chapter 4
		4.2.5.1 4.2.5.2	Explanation about the overlap land/ Sea has been added, as per RID S.P-04
		4.2.5.1.1	New fields (Mid_Lat, Mid_Lon) added to the product location structure in order to express correctly the swath location, following S. Delwart suggestion by e-mail on 18-Jul-2006.
		4.2.5.1.1	Gaps removed and missing points added as conclusion of discussion with J. Closa by e-mail on 28-Jul-2006
		4.2.5.1.1	Sensing Time information redundant with Fixed Header's; removed.
		4.2.5.1.1	Most of Mixed Pixels quality indicators removed, as per 24-Jul-2006 R.C. e-mail.

Iss./Rev.	Date	Section / Page	Change Description
		4.2.5.1.1. 4.2.5.3.1	Different Apodisation windows added for land and Sea in table 4-57: Level 1 C Browse Brightness Temperatures Quality SPH
		4.2.5.1.2 / 4.2.5.2.2	Description of Polarisation flags corrected, as per 24-Jul-2006 R.C. e-mail.
		5.1.2	List of SPH_Descriptor updated following document changes
		5.1.2.1	Validity info already provided in Fixed Header.
		5.1.2.1	Endianness defined for L1 products generated/stored/distributed by DPGS; all to be little-endian.
		5.1.2.3	Time information added to Auxiliary Products SPH in order to allow providing info on data measurement, apart from the validity time info provided in the Fixed Header.
		5.2.6	Antenna Pattern products merged in only one, as per L1OP-CDR RID JC-26
		5.2.11.1.1	Grid limits and spacing info added on header, as per L1OP-CDR RID SP-10
		5.2.11.1.2	Expected_NIR_BT_H corrected as per L1OP-CDR RID AG-15
		5.2.15	VTEC specification added, following Deimos assessment of what it should be contained in it.
		5.2.16	Geomagnetic data not considered as an ADF, but as part of the IGRF software distribution
		5.2.17	Apodisation function names and header changed accordingly to L1OP-CDR RID DM-01
		5.2.18	Description of possible strategy to update RFI product, as per L1OP-CDR RID SP-11.
		5.2.19	Following harmonisation effort between L0, L1 and L2, this product is specified in L2 and shall not be repeated here, as per L1OP-CDR RID RC-71.
		5.2.20	Origin of Time Correlation contents specified

Iss./Rev.	Date	Section / Page	Change Description
		6	Sizes calculations updated and table reformatted
2/2	25-Aug-2006	All	FTT product name changed to distinguish dual and full pol contents, as agreed in e-mail conversation with ESA, L1PP and L1OP teams on 21-Aug-2006
		All	IEEE floats cannot be unsigned, corrected thorugh all the document.
		4.1.1	Orbit information given in start sensing time instead of ANX time, as agreed with ESA and L1PP team in e-mail conversation in early August 2006
		4.2.4.2	L1B product specification changed to include the average system temperature, needed as input by L1C
		4.2.5	L1C reference data sets do not contain anymore the L1A HKTM, as all information is now in L1B product
		5.2.17	Apodisation_Coefficient_Counter removed and product changed to ASCII XML
2/3	10-Oct-2006	All	References Updated
		All	Mentions to Split and Merge removed, as per DPGS-CDR RID NW-24
		All	SPH reorganized for all the products, as per DPGS-CDR RID RC-25
		All	DSD moved to the end of the SPH, as per DPGS CDR RID NW-31
		All	Free length of strings limited to 200 char, as per DPGS-CDR RID RC-16
		All	Changed Long /Lat format from ineteger to float in the Headers, as per DPGS CDR RID RC-35
		All	Type, Precision and C Format columns in binary datablocks changed to Type, Element Precision and Variable Format, and systematically defined consistently all along the document. As per DPGS-CDR RID RC-17

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		All	Column width optimized in order to reduce the number of pages, as per DPGS-CDR RID NW-32
		All	Origin column reviewed, as per NW-32 and RC-26
		All	Scientific explanations reduced, as per DPGS-CDR MoM resolution to eventually put them in a Product Handbook
		3.1.1	Changed Validity start/ stop accuracy to seconds in Fixed Header, as per DPGS CDR RID NW-26
		3.1.1	Correction of Calibration types definition in order to descope them from operational procedures, as per DPGS-CDR RID MZ-17
		3 & 4	The string fields limited to 200 characters, as per RID RV-13
		4	Described the format of the OBET time and the EE CFI transport time, as per DPGs-CDR RID RC-19
		4.1.1	Corrected Acquisition_Station ID to ESAC, as per DPGS CDR RID NW-32
		4.1.1	MPH harmonized between L0, L1 and L2 products, as per DPGS-CDR RID NW-27
		4.1.1	Changed Logical_Processing format from a number to characters, as DPGS-CDR RID NW-27
		4.1.1	Type_of_Processing field removed from the MPH, as per DPGS-CDR RID NW-27
		4.1.1	Reason_for_Reprocessing field removed, as per DPGS-CDR RID NW-27
		4.1.2.1	For the SPH_Descriptor field, the 28-character string corrected to 14 char, as per DPGS-CDR RID NW-28
		4.1.2.1	Precise Validity Start/ Stop times, in microsecond resolution, added in the SPH of all products and ADFs, as per DPGS CDR RID NW-26

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		4.1.2.2	Byte_Order field moved from SPH Main Info to DSD, as per DPGS-CDR RID NW-31
		4.1.2.2	List_of_Reference_File_Structs opening and closing tags removed, as per RID RV-05
		4.2.1.1	Clarified that attitude flag will be set at Sensing_Start_time, as per DPGS-CDR RID RC-18
		4.2.2.2.1	N_Averaged_Measuremet comment corrected, as per DPGS-CDR RID RC-21
			In the field number 5 the reference to field #2 corrected to #4, as per DPGS-CDR RID RC-24
		4.2.4.2.1	Only 1 byte used for the description of the code to identify the image reconstruction algorithm, as per DPGS CDR RID RC-29
		4.2.4.2.1.2	Averaged physical temperature per snapshot included in the L1b, as per DPGS CDR RID RC-38
		5	Two different SPH considered for the Auxiliary Data Products, attending to the Data Blocks
		5.2.1.3	Table 5-2 (Additional Information for Auxiliary data products) removed, as per DPGS CDR RID NW-31
		5.2.11	References to SEPS removed
		5.2.13	Corrected **Sun** by **Moon**,as per DPGS CDR RID RC-29
		5.2.15	Field #1 description corrected, as per DPGS CDR RID RC-35
		5.2.17	Apodization window represented only by one field, as per DPGS CDR RID RC-27
		5.2.21	L1 Configuration ADF added as result of L1OP Delta CDR and DPGS CDR
2.4	23-Oct-2006	All	Minor corrections after DPGS-CDR update delivery
		2.2.3	Table with products schema versions updated
		4.1.2.1, 5.1.2.1, 5.2.11.1.1	Checksum shall be a 10 bytes number, not 4

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		4.2.2.2.1	Uncorrelated Product SPH does not include Quaility_Info, but just specific Uncorrelated_Quality_Information
		4.2.2.3.1	Reference to a section corrected
		4.2.2.3.1	Quality_Information added to table
		4.2.2.6.1	Added Specific_Product_Header tag
		4.2.3.1.1	Field numbering changed after including Specific_Product_Header tag
		4.2.4.1.1	Added table to specify SPH for L1B calibration products
		5.2.11, 5.2.12	Added new specification of L-Band Galaxy Maps (Original and NIR-Convoluted), as proposed by ESA in [AD.4][RD.15]
		5.2.16	Added new specification for VTEC, as proposed by ESA in [AD.4][RD.16]
3/0	24-Nov-2006	All	Final document for DPGS-V1 issued after meeting between ESA, GMV and Indra.
4/0	04-Sep-2007	4.2.2.2.2	“Samples” field has been added to the Data block.
		4.2.3.1.2	“Receiver_Noise_Temp” field as been added to the Data block.
		4.2.3.2.2	“Receiver_Noise_Temp” field as been added to the Data block.
		4.2.4.1.2	The number of Data Set records contained in the Data Set has been changed from 16008 to 15996.
		4.2.4.1.3	Numgber of rows has been changed from 16008 to 15996.
		4.2.4.1.5	The array’s length for “Ideal_Sky_Visib_HV”, “Averaged_FTT_Visib_HV” and “Ideal_Uniform_Visib_HV” have been modified.
		4.2.4.2.1.2	The followinf fields have been added to the Data block: “Foreign_Sources_Flags”, “Average_System_Temperatures” , “Direct_Moon_Pos” and “Constant_Earth_BT”.

Iss./Rev.	Date	Section / Page	Change Description
4/1	21-Sep-2007	All	Release of draft previous to the meeting to freeze the L1 Product Specifications
4/2	05-Oct-2007	All	Final release of document, baseline for DPGS-V2
4/3	29-Oct-2007	All	Final release of document, baseline for DPGS-V2, implementing comments to v4.2 from ESA, Deimos and GMV.
		All	Orbit scenario file definition updated, according to Deimos comment.
		All	L0_FILE reference data sets changed to L0_CORRELATIONS_FILE
		All	"_ " tags typos corrected to "_", according to ESA comment
		1.4	References updated
		4.1.1	Clarification in MPH Position fields on the state vector used (resulting from L2 Specs meeting)
		4.1.2.3	Clarification in Data_Set structure on DS_Name and DSR_Size being computed internally but not from schemas (resulting from L2 Specs meeting)
		4.2.1.1	NIR_Calibration_Flag added back to TLM_MIRA1A SPH
		4.2.2.2.2	PMS_ID definition modified to clarify the identifier convention.
		4.2.2.2.2	PMS_Sensitivities and FWF_Sensitivities naming typo corrected
		4.2.2.3.2	Con_FWF_Coefficients naming typo corrected
		4.2.3.1.2 4.2.3.2.2 4.2.4.2.1.2 4.2.4.2.2.2	The reference system in Antenna_Boreesight coordinates in case of MIR_TARD1A, MIR_TARF1A, MIR_TARD1B, MIR_TARF1B is specified.
		4.2.4.2.1.1	Backlobe_Contribution_Removed typo corrected
		4.2.4.2.2.1	MPL_ORBSCT added as reference data set to full pol L1B products
		5.1.2.1	Header_Schema in pure xml ADFs must be obtained from CNF.
		5.2.2	NIR_ID identifier convention clarified
		5.2.4	List_of_Switchs typo corrected
		5.2.7	List_of_LICEF_Datas
		5.2.19.1.1	Tags names reviewed to follow EEF Convention

Iss./Rev.	Date	Section / Page	Change Description
		5.2.23	Tags names reviewed to follow EEF Convention
		6	AUX_SGLINT size calculation added

Contents

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1. INTRODUCTION

1.1 OBJECTIVE

The purpose of this document is to present the structure, syntax, file naming and use of the different L1 SMOS operational Products.

1.2 SCOPE

The scope of this document is the DPGS Phase C/D/E1 project, affecting to all the DPGS subsystems that produce, archive, analyse or disseminate L1 products.

1.3 APPLICABLE DOCUMENTS

The applicable documents are approved by ESA and represent the current project baseline in terms of requirements and/or technical/administrative specifications and mandatory practices. The specifications contained in the applicable documents have to be considered as mandatory; in the case that these specifications can not be met or a discrepancy is found, a report shall be prepared and sent to ESA.

Ref.	Title	Code	Ver.	Date
[AD.1]	SMOS System Requirements Document	SO-RS-ESA-SYS-0555	4.1	28-Sep-04
[AD.2]	Earth Explorer CFI Software Mission Conventions Document	CS-MA-DMS-GS-0001	1.3	15-Jul-03
[AD.3]	Earth Explorer Ground Segment File Format Standard	PE-TN-ESA-GS-0001	1.4	13-Jun-03
[AD.4]	SMOS Tailoring of the Earth Explorer File Format Standard for the SMOS Ground Segment	XSMS-GSEG-EOPG-TN-05-0006	1.0	30-Jun-2005

Table 1.3-1 Applicable documents

1.4 REFERENCE DOCUMENTS

The reference documents contain useful information related to the subject of the project. The reference documents complement the applicable documents. The list of reference documents is included in the following table.

Ref.	Title	Code	Version	Date
[RD.1]	SMOS L1 Product Format Specification	SO-IS-DME-L1PP-0002	2.2	15-Jul-07
[RD.2]	SMOS L1 Auxiliary Data Specification Format	SO-IS-DME-L1PP-0003	2.2	15-Jul-07
[RD.3]	SMOS L1 Processor L0 to L1a Data Processing Model	SO-DS-DME-L1PP-0007	2.3	16-Jul-07
[RD.4]	SMOS L1 Processor L1a to L1b Data Processing Model	SO-DS-DME-L1PP-0008	2.3	16-Jul-07
[RD.5]	SMOS L1 Processor L1c Data Processing Model	SO-DS-DME-L1PP-0009	2.1	15-Jul-07
[RD.6]	Technical Note on SMOS DPGS Products Consolidation	SO-TN-IDR-GS-0004	2.0	TBD
[RD.7]	EE XML and Binary Schema Standard	PE-TN-ESA-GS-121	1.0	01-Jul-05
[RD.8]	EE XML/Binary File Handling Library User Manual	SO-UM-DME-L1PP-0005	1.5	02-May-05
[RD.9]	XML Guidelines	SO-MA-IDR-GS-0004	1.9	13-Jul-07
[RD.10]	SMOS DPGS Acronyms	SO-TN-IDR-GS-0010	1.10	21-Sep-07
[RD.11]	SMOS XML Read/Write Software Users Manual	SO-ID-IDR-GS-0009	1.13	19-Jun-07
[RD.12]	L0 Product Specification	SO-TN-IDR-GS-0003	3.0	15-Oct-07
[RD.13]	SMOS L1 Full Polarisation Data Processing	SO-TN-DME-L1PP-0024	1.6	16-Jul-07
[RD.14]	Removed			
[RD.15]	Galaxy Map Usage For SMOS-DPGS	XSMS-GSEG-EOPG-TN-06-0023	1.0	11-Oct-06
[RD.16]	VTEC usage for the SMOS Level 1 Operational Processor (L1-OP)	XSMS-GSEG-EOPG-TN-06-0019	2.0	17-Oct-06
[RD.17]	DPGS Master Interface Control Document	SO-ID-IDR-GS-0016	1.17	19-Oct-07
[RD.18]	Level 1 Processor ICD and Operational Constraints	SO-ID-IDR-GS-0008	2.8	06-Aug-07
[RD.19]	Ancillary Packet Description	SO-TN-CASA-PLM-0594	3.1	13-Feb-07

Table 1.4-1 Reference documents

1.5 ACRONYMS AND TERMS

The acronyms used in this document are compiled in the following document: DPGS Acronyms [RD.10].

1.6 DOCUMENT STRUCTURE

The L1 Product and Specification Document is structured as follows:

→ Chapter 1 is the introduction you are currently reading.

→ Chapter 2 introduces the conventions of this document and specifies the work done to adapt L1PP products formats to the operational environment. It also details he products files structures, names and references the document stating the XML schema guidelines

→ Chapter 3 describes the generic structure of the L1 Products headers, specifying the common features to all products

→ Chapter 4 provides a formal Specification for all types of Level 1 Products derived from instrument in-orbit measurements, including the particularities for each product's specific product header

→ Chapter 5 provides a formal Specification for all the Auxiliary Data Products types needed to perform the processing of L1 Products, including the particularities for each product's specific product header

→ Chapter 6 provides estimations of the sizes of each Level 1 and Auxiliary Data Products, based on the typical number of dataset records in each product

2. SMOS L1 PRODUCTS

2.1 GENERAL CONSIDERATIONS ON THIS DOCUMENT

This document is based mainly in the Level 1 Processor Prototype's SMOS and auxiliary product format documents (see [RD.1] and [RD.2]), and also in L1PP the products examples and schemas found in URL http://www.smos.esa.int/Level1/. Most of the specifications and scientific explanations included here are based on what is contained in those documents and examples, but has been kept instead of referencing it in order to have a stand-alone reference for L1 operational products formats.

Work has been done in order to fit the L1 specifications in the operational environment and the requirements put to the DPGS and more specifically to Level 1 Operational Processor. The main difference between L1PP and L1OP is that the L1PP is a stand-alone SW that is fed with inputs provided interactively by the user, while the L1OP is integrated in a very much automated system, interfacing the DPGS PDPC-Core that delivers inputs and receives ouputs to/from L1OP. This means that work needs to be done to make the products contain the information necessary to be handled automatedly in a proper way.

The work done in this document includes:

- Checking fulfilment of ESA requirements (mainly asking to follow the Earth Explorer Ground Segment File Format Standard –see [AD.3]- and its ESA's adaptation to the SMOS Mission needs –see [AD.4]-) on DPGS Products, as their specifications are inherited from L1PP Prototype's, which is not necessarily fulfilling the standard.
- Adding a column with Source or Origin of data to be printed in each field (e.g. specific L1 module internal processing, specific L0 product's header or datablock, specific auxiliary data product, etc.)
- Adaptation of tables to XML standards for clarification purposes. That is, tables follow the hierarchical tagging based in the format of an XML file.
- As L1PP products examples & schemas and the L1PP format documents do not fit in some aspects, work has been done to detect the differences between them and to take decisions on which of them prevail when inspiring the L1OP Specifications.
- Define a convention on the C format and precision used to print the fields, and apply it to each of the fields in the L1OP Specifications, based on what has been defined in L1PP documents. Whenever there is a doubt, the policy followed has been being conservative and forcing more precision than the one specified in the L1PP Specifications.
- Adaptation to "variable array of variable array" concept from L1PP to L1OP Products, as explained in [RD.9].
- Refinement and proposal of several new fields in Products' headers regarding what is needed to fit the Products in an automated operational environment that shall be using the header information as metadata to be stored in databases for consultancy.

- Calculation of data set record sizes, and estimation of operational Products sizes, based on assumptions on the number of data set records in each of the datasets of Products.
- Generation of the corresponding operational Products schemas and some product examples, which scientific contents are fully based on what is contained in the L1PP products examples.
- Generation of new L1A products to support consolidation of calibration sequences in the operational timeline (synthetic curve of correlated noise injection measurements; averaged uncorrelated noise injection; individual FWF containing calibrated correlations instead of FWF shape estimation; and averaged FWF shape estimation).
- Removal of one L1A product: individual correlated noise injection (MIR_CORN1A), as its measurements are already contained in the synthetic curve product. In this way, this intermediate processing step is saved simplifying the processing model and reducing the storage needs.
- Harmonisation of specifications with L0 and L2.
    - MPH has been set common to all SMOS products resulting from MIRAS measurements, and has been removed from all auxiliary data products.
    - SPH contains more fields that have been removed from MPH.
    - AUX_SGLINT product has been removed while waiting a definitive decision on the processing level in which it is to be used (L1B or L2). Currently it is specified in L2 document.
- Addition of VTEC product specification in operational EEF format, as proposed by ESA in [RD.16].
- Removal of IGRF data product specification. From now on it is to be considered a configuration file part of the IGRF model software distribution, and data product is not to be considered as an ADF that can be updated independently.
- Naming convention changed to have different product names for different nominal/external attitudes.
- Merging of all antenna pattern products in only one containing all the information.
- Updating Galactic Maps specification, as proposed by ESA in [RD.15].
- The endianness of the products has been defined:
    - L0 products are all big-endian. This is due to the fact that the L0P simply gathers the packets as they come out from Front-End Processor, applying no change on their structure. As the packets are available from FEP as big-endian, so they are the L0 products.
    - L1 products are defined all as little-endian, and will always be distributed as such –i.e. DPGS will not perform the byte swapping at User's demand-. This is due to the fact that the most widely available computer processor vendors, Intel and AMD, both use little endian. Other platforms, such as Apple, will have to apply byte swapping when reading the L1 products, using the functionality that the DPGS XML R/W API provides to the SMOS products Users.

2.1.1 Conventions

This section contains lists of conventions used in these specifications:

- The tables for headers start and end with a ***Fixed_Header***, ***Main_Product_Header*** and ***Specific_Product_Header*** tags to make clear which are the fields enclosed within. The same applies for datablocks, which are enclosed within ***Data_Block*** tags.
- Binary data blocks are specified following the XML syntax, although obviously they are not in XML format. The Field#, Type, Unit, Precision, C format and Origin columns for the pseudo-XML tags are in gray colour, so as to make clear that they are not fields contained in the product. A note has been added in any case in the Comments column highlighting this issue.
- A wider line specifies which is the beginning and the end of a dataset. Adjacent datasets are then separated by this wider line, but this also applies to Header/DataBlock tags that are separated from datasets by this wider line.

The tables have the following columns:

- Field #: numbering applied to each field appearing in the table.
- Field Name: tag used in the schemas to identify the field
- Type: variable type, this is the concept of the variable instead of its actual implementation in the product. It can be either Tag (enclosing XML structures), string, integer, identifier, real value, matrix of complex values, etc.
- Unit: specification of the unit type according to EEF convention. N/A is applied to unitless fields.
- The following column is different for binary and ASCII XML structures:
    - Element Precision: this column specifies the implementation of an element of the field, in C-like specification (float, unsigned integer, etc.), specifying also the element's size in bytes.
    - String Length (ASCII XML): number of bytes in which the field value is written
- The following column is different for binary and ASCII XML structures:
    - C Format (ASCII XML): specifies in C language fwrite function the format in which field is written to a file. Note that %+08.3f means that the number has always 8 digits, one of which is the sign, another is the dot and 3 of them are decimals, being the remaining digits at the left of the dot.
    - Variable Format (Binary): specifies the format of the variable from the elements defined in the previous column (number of elements, sorting, etc.).
- Comments: clarifications on the meaning of the product's field.
- Origin: this column specifies which is the origin of the information filling the product field
    - [ICNF]: L1OP internal configuration file (CNF_L1OP__, see specification in [RD.18])

- [INT]: L1OP internal processing
- [AUX_XXXXXX]: data coming from auxiliary data files
- [MIR]: data coming from a lower level CORR-TM input product
- [TLM]: data coming from a lower level HKTM input product

2.2 L1 FILE STRUCTURE

2.2.1 Logical File vs Physical File

A SMOS Level 1 Product Logical File is compliant with [AD.3] and [AD.4]; its structure, shown in Figure 2-1, comprises

→ An ASCII XML Fixed Header, whose structure is identical for all file types.

→ An ASCII XML Variable Header, which allows to define and structure different information for each file type, and is split into:

- a Main Product Header (MPH)
- a Specific Product Header (SPH).

It must be noticed that SMOS measurements products' headers (i.e. those specified in Chapter 4 of this document) follow the structure described above, while the auxiliary data products (specified in Chapter 5) do not have MPH, as most of that information does not make sense in these products. Whenever a field is still needed, it has been moved to the SPH.

→ A Data Block, containing one or more Data Sets. Each Data Set contains a number of identical Data Set Records.

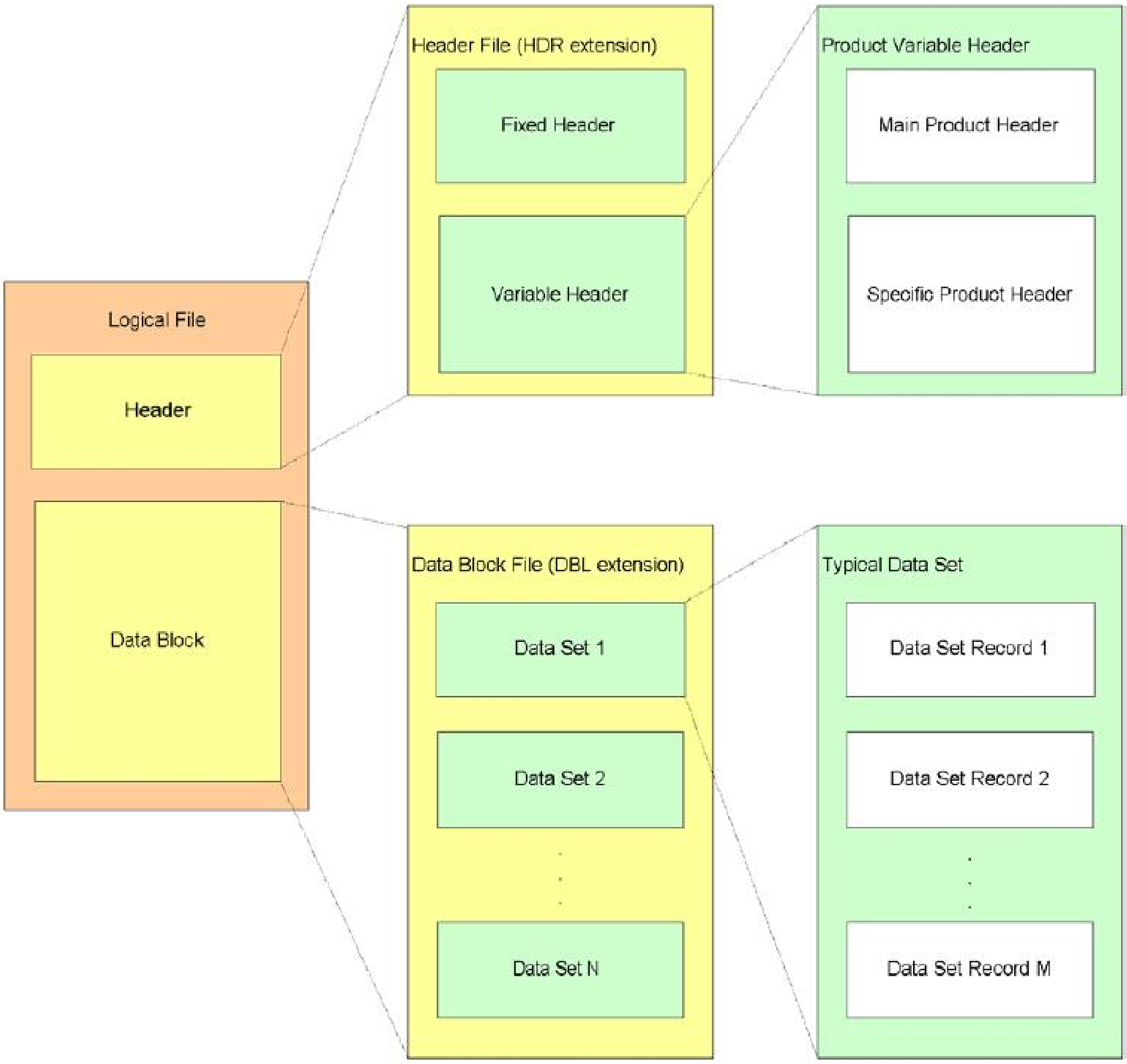

Figure 2-1. Level 1 Product Structure (taken from Deimos Eng., L1PP Product format)

In terms of computer 'Physical Files', the L1 Logical File can be structured in one of the following two ways:

- o when Data Block is binary, it is structured as two separate Physical Files:
  - → a Header file (XML ASCII), with .HDR extension
  - → a Data Block file (binary), with .DBL extension
- o when Data Block is XML, it is structured as one unique Physical File, all in XML ASCII format following EEF convention, with .EEF extension.

The L1 Physical files related to the same Logical File shall share the file name, only differentiating each Physical File using a different extension, as specified above.

The high level file syntax for these files is as defined in [AD.3], i.e.

```
Header File (file_name.HDR):
<?xml version="1.0" ?>
<Earth_Explorer_Header Validation-Schema-Reference>
     <Fixed_Header>
          Fixed Header contents
     </Fixed_Header>
     <Variable_Header>
          Variable Header contents
     </Variable_Header>
</Earth_Explorer_Header>

Data Block File (file_name.DBL): ad-hoc ASCII syntax
```

Table 2-1. Non-XML ASCII File Syntax

The packaging mechanism for users external to the DPGS is the .ZIP one, as described in [RD.9]. For internal users, it is as described in [RD.17].

The "Validation-Schema-Reference field is to be filled as specified in [RD.9] section 3.2.1. In the operational processor, this field is filled by the XML R/W library.

2.2.2 L1 File Names

The Logical File Name of the SMOS L1 Product consists of 60 characters, with the following layout:

MM_CCCC_TTTTTTTTTT_<instance_ID>

Where each field of the filename is as follows:

→ ***MM***: is the Mission identifier, for the SMOS case it shall be always **SM**

→ *CCCC*: is the File Class, which has three alternatives:

- **TEST** : for internal testing purposes only (e.g. products generated as input to or output from acceptance testing, GSOV, etc.)
- **OPER** : for all files generated in automated processing during mission operation phases
- **REPR**: for all the reprocessed files.

→ ***TTTTTTTTTT***: is the File Type, consisting of two sub-fields:

TTTTTTTTTT=FFFFDDDDDD

Where:

- ***FFFF*** : is the File Category.
    - For the L1 HKTM product, this shall be always **TLM_**.
    - For all other MIRAS measurement product, this shall be always **MIR_**.

- For auxiliary data products, this shall be always `AUX_`.

- *DDDDDD*: is the Semantic Descriptor, described in Table 4-5 for L1 measurements products and auxiliary data products.

→ *<instance_ID>* : the instance ID for the L1 product matches Shape 1 defined in [AD.4]:

<instance_ID>= *yyyymmddThhmmss_YYYYMMDDTHHMMSS_vvv_ccc_s*

- *yyyymmddThhmmss* :
  - in case of MIRAS measurements products (including calibration ones) it is the SMOS sensing start time of the data contained in the product, in CCSDS compact format. As SMOS sensing time values will typically have greater precision than a second, the sensing start time shall be rounded up (this way the period specified in the filename is completely covered by the time period of the data actually contained in it). The origin for this time is the Precise_Validity_Stop_time specified in the Specific Product Header.
  - in case of auxiliary data products it is the start time of the period in which the product is valid –i.e. it can be used as supporting product in the processing of a SMOS measurement product to an upper level-. As possibly the values will typically have greater precision than a second, the start time shall be rounded up (this way the period specified in the filename is completely covered by the time period of the data actually contained in it)

- *YYYYMMDDTHHMMSS* :
  - in case of MIRAS measurements products (including calibration ones) it is the SMOS sensing stop time of the data contained in the product, in CCSDS compact format. As SMOS sensing time values will typically have greater precision than a second, the sensing stop time shall be rounded down (this way the period specified in the filename is completely covered by the time period of the data actually contained in it). The origin for this time is the Precise_Validity_Stop_time specified in the Specific Product Header.
  - in case of auxiliary data products it is the stop time of the period in which the product is valid –i.e. it can be used as supporting product in the processing of a SMOS measurement product to an upper level-. As possibly the values will typically have greater precision han a second, the stop time shall be rounded down (this way the period specified in the filename is completely covered by the time period of the data actually contained in it).

- *vvv* : is the version number of the processor generating the product.

- *ccc* : is the file counter (used to make distinction among products having all other filename identifiers identical). The counter shall start at `001` and not `000`.

- `s` : is the site instance ID, where
  - `0`: test data generated outside the SMOS operational ground segment (e.g. test data)
  - `1`: SMOS DPGS Fast Processing Centre
  - `2`: SMOS DPGS Reprocessing Centre
  - `3`: SMOS DPGS Reference Processing Centre
  - `4`: SMOS Near Real Time Processing Centre

2.2.3 L1 XML Schemas Guidelines

L1 XML schema Guidelines will follow the conventions and format indicated in [RD.9].

The schemas of the L1 products specified in this document can be found in URL:

ftp://193.146.123.163/smos/schemas/

The XML Rear/Write API tool implemented by DPGS Prime to read, write and modify the SMOS products, using the BinX recommendation to deal with binary data, is available in URL:

ftp://193.146.123.163/smos/software/XML_RW_API/

The L1OP Product Format Specifications document release that describes the products received by the user is identified by reading the ***Ref_Doc*** field in SMOS products headers.

3. LEVEL 1 PRODUCTS GENERIC STRUCTURE

3.1 LEVEL 1 HEADERS

The Level 1 Headers will be an XML file and as any other Earth Explorer File will have a common structure divided in two main parts:

- a Fixed Header (FH), with identical structure for all files
- a Variable Header (VH), which allows to define and structure different information for each file type.

Further information about Headers is specified in the following sections.

3.1.1 Level 1 Earth Explorer Fixed Header

The ***Fixed Header*** is common to all Earth Explorer Mission products, therefore it is compliant with [AD.3] and [AD.4].

The following table specifies the fields in the Fixed Header.

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Fixed_Header***	Tag				Tag starting the Fixed Header of all SMOS products.	
02	***File_Name***	String	N/A	60 bytes	%60s	It is a repetition of the Logical File Name, i.e. the File Names excluding the extension.	INT (except for file counter, provided by Job Order)
03	***File_Description***	String	N/A	Variable (limited to 300 bytes)	%s	A 1-line description of the File Type. Each Mission shall define the list of official file descriptions (per File Type). See text below the tables to find a complete list of the descriptions.	Hard-coded value in the Processor
04	***Notes***	String	N/A	Variable (limited to 300 bytes)	%s	Multi-lines free text. This can be used for any type of comment, relevant that instance of the file. The Operational Processor generates no notes and this field remains always empty.	Generated by User
05	***Mission***	String	N/A	4 bytes	%4s	A 1-word description of the Mission, coherent with the Mission element in the File Name. For this Mission, this string shall be always “SMOS” in upper case letters.	Hard-coded
06	***File_Class***	String	N/A	4 bytes	%4s	A 1-line description of the file class, coherent with the File Class element in the File Name. Each Mission shall define the list of official file classes. For the SMOS Mission, this string shall be “TEST” for testing purposes, “OPER” for products generated during Satellite orbiting and “REPR” for all products reprocessed, all in upper case letters.	ICNF
07	***File_Type***	String	N/A	Variable	%10s	It is a repetition of the File Type element in the File Name, including File Category and Semantic Descriptor.	INT
08	***Validity_Period***	Tag				Tag starting a structure to specify the period of time during which the file contents are valid	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
09	***Validity_Start***	String	N/A	23 bytes	%23s	This is the UTC Validity Start Time, coherent with the Validity Start Time in the File Name, but in CCSDS ASCII format with time reference. Note that this can have the special value indicating "beginning of mission" (without an absolute time specified) as defined in Tailoring of EEFF Standard for SMOS GS [AD.4]. "UTC=yyyy-mm-ddThh:mm:ss" The Validity Start Time shall be the start time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	INT
10	***Validity_Stop***	String	N/A	23 bytes	%23s	This is the UTC Validity Stop Time, coherent with the Validity Stop Time in the File Name, but in CCSDS ASCII format with time reference. Note that this can have the special value indicating "end of mission" (without an absolute time specified) as defined in Tailoring of EEFF Standard for SMOS GS [AD.4]. "UTC=yyyy-mm-ddThh:mm:ss" The Validity Stop Time shall be the stop time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	INT
11	***Validity_Period***	Tag				Tag starting a structure to specify the period of time during which the file contents are valid	
12	***File_Version***	Integer	N/A	4 bytes	%04d	It is a repetition of the File Counter element in the File Name instance ID, plus 1 additional digit (most significant, always set to 0 to be the same as file counter in filename; it appears here as 4 digits for compliancy with EEFF convention –see [AD.3]-). Must start at 0001 (not 0000), only digits allowed.	Job Order for products (CEC for ADF)
13	***Source***	Tag				Tag starting a structure to specify the GS element that has created the product	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
14	***System***	String	N/A	4 bytes	%s	Name of the Ground Segment element creating the file. For the Data Processing Ground Segment, this string shall be "DPGS"	ICNF
15	***Creator***	String	N/A	4 bytes	%s	Name of the tool, within the Ground Segment element, creating the file . For L1 Operational Processor measurements product (File Class = MIR), this string shall be "L1OP". For the auxiliary data products, this string can be "RPC" for Reference Processing Centre, "CEC" for Calibration & Expertise Centre, "L1PP" for L1P Prototype Development Team, "L2PP" for L2P Prototypes Development Teams.	ICNF
16	***Creator_Version***	Integer	N/A	3 bytes	%03d	Version of the tool. This shall be the same as version number in Filename's instance ID "vvv". Only digits allowed	ICNF
17	***Creation_Date***	String	N/A	23 bytes	%23s	This is the UTC Creation Date, in CCSDS ASCII format with time reference, as defined in Mission Conventions Document [AD.2]. "UTC=yyyy-mm-ddThh:mm:ss."	INT from machine's clock
18	***Source***	Tag				Tag ending the structure to specify the GS element that has created the product	
19	***Fixed_Header***	Tag				Tag ending the Fixed Header of all SMOS products.	

Table 3-1. Fixed Header particularized for L1OP

The following table contains a list of the strings to be used for the ***File_Description*** field, for each product type.

Product Type	File_Description
TLM_MIRA1A	Level 1A Housekeeping Telemetry product
MIR_CRSU1A	Level 1A containing N Correlated Noise Injection sequences distributed in different orbit latitudes generated with the instrument pointing to the Sky
MIR_CRSD1A	Level 1A containing N Correlated Noise Injection sequences distributed in different orbit latitudes generated with the instrument pointing to the Earth
MIR_AFWU1A	Level 1A calibration containing the average of all Fringe Washing Function estimates in one or more MIR_FWAS1A products generated with the instrument pointing to the Sky
MIR_AFWD1A	Level 1A calibration containing the average of all Fringe Washing Function estimates in one or more MIR_FWAS1A products generated with the instrument pointing to the Earth
MIR_ANIR1A	Level 1A Noise Injection Radiometer consolidated calibration product
MIR_UAVU1A	Level 1A Uncorrelated Noise Injection product containing an average of all individual uncorrelated noise injection measurements in a calibration campaign. Consolidation is the whole campaing, no matter if they are in the same semi-orbit or not generated with the instrument pointing to the Sky
MIR_UAVD1A	Level 1A Uncorrelated Noise Injection product containing an average of all individual uncorrelated noise injection measurements in a calibration campaign. Consolidation is the whole campaing, no matter if they are in the same semi-orbit or not generated with the instrument pointing to the Earth
MIR_GMATU_	G Matrix (MIRAS' System Response Function) used in image reconstruction generated with the instrument pointing to the Sky
MIR_GMATD_	G Matrix (MIRAS' System Response Function) used in image reconstruction generated with the instrument pointing to the Earth
MIR_JMATU_	Inverted J Matrix used in image reconstruction generated with the instrument pointing to the Sky
MIR_JMATD_	Inverted J Matrix used in image reconstruction generated with the instrument pointing to the Earth
MIR_TARD1A	Level 1A Dual Polarization External Target measurements product
MIR_TARF1A	Level 1A Full Polarization External Target measurements product
MIR_SC_D1A	Level 1A Dual Polarization Science (Earth observation) measurements product
MIR_SC_F1A	Level 1A Full Polarization Science (Earth observation) measurements product

Product Type	File_Description
MIR_TARD1B	Level 1B Dual Polarization External Target measurements product
MIR_TARF1B	Level 1B Full Polarization External Target measurements product
MIR_SC_D1B	Level 1B Dual Polarization Science (Earth observation) measurements product
MIR_SC_F1B	Level 1B Full Polarization Science (Earth observation) measurements product
MIR_FTTD__	Level 1B Flat Target Transformation product in dual polarization
MIR_FTTF__	Level 1B Flat Target Transformation product in full polarization
MIR_SCSD1C	Level 1C Dual Polarization Sea Science measurements product
MIR_SCSF1C	Level 1C Full Polarization Sea Science measurements product
MIR_SCLD1C	Level 1C Dual Polarization Land Science measurements product
MIR_SCLF1C	Level 1C Full Polarization Land Science measurements product
MIR_BWSD1C	Level 1C Browse Dual Polarization Sea Science measurements product
MIR_BWLD1C	Level 1C Browse Full Polarization Sea Science measurements product
MIR_BWSF1C	Level 1C Browse Dual Polarization Land Science measurements product
MIR_BWLF1C	Level 1C Browse Full Polarization Land Science measurements product
AUX_PMS___	PMS Characterisation Table
AUX_NIR___	Noise Injection Radiometer (NIR) Characterisation parameters
AUX_PLM___	MIRAS Payload configuration parameters
AUX_SPAR__	MIRAS Switches' and Noise Distribution Network's S-parameters
AUX_LCF___	MIRAS LICEFs Characterisation parameters
AUX_PATT__	Antenna pattern of all LICEF in amplitude and phase in different MIRAS pass band frequencies, plus the coordinates and the patterns' average

Product Type	File_Description
AUX_FAIL__	MIRAS elements in failure status
AUX_BWGHT_	Weight vector to be multiplied element by element with the calibrated visibilitie
AUX_BFP___	Best Fit Plane used in geolocation
AUX_MISP__	Mispointing angles between the Body Frame referenced in the Proteus quaternions and the Antenna Plane defined by the MIRAS instrument
AUX_DGG___	ISEA4-9 Discrete Global Grid used in geolocation
AUX_LSMASK	Land/Sea mask of pixels in the DGG
AUX_MASK__	Mask with flagging of pixels for use in L1c land or sea products
AUX_GALAXY	L-Band Galactic Brightness Temperature Map
AUX_GALNIR	L-Band Galactic Brightness Temperature Map Convoluted with the NIR Antenna Pattern
AUX_SUNT__	Measured Sun Brightness Temperatures
AUX_MOONT_	Measured Moon Brightness Temperatures
AUX_ERTHT_	Constant Earth Brightness Temperatures Model
AUX_VTEC_P	Predicted Vertical Total Electron Content used in ionospheric effects correction (created from data retrieved from the COPG file)
AUX_VTEC_C	Consolidated Vertical Total Electron Content used in ionospheric effects correction (created from data retrieved from the IGSG file)
AUX_APDL__, AUX_APDS__	Apodisation Window used in gelocation, both for Land and Sea.
AUX_RFI___	Radio Frequency Interference in MIRAS bandwidth on the Discrete Global Grid
AUX_SGLINT	Bistatic Scattering Coefficients Look Up Table used in Sun glint correction
AUX_CNFL1P	Processor Algorithm Configuration Parameters and Constants for L1OP

Table 3-2. File Description field depending on the Product Type, for L1OP

3.1.2 Level 1 Earth Explorer Variable Header

The Variable Header is specific to each File Type. It is written in XML ASCII format and it is constituted by two structures, Main Product Header (MPH) and a Specific Product Header (SPH). Further information will be handled in next chapters.

3.2 LEVEL 1 DATA BLOCK

The Data Block content for L1 products consist of one or several Measurement Data Sets. However, the possible several Reference Data Sets are not included in the Data_Block but instead their filenames and dataset names are referenced in the header.

Each Measurement Data Set should contain a number of Data set Records, preferably of identical structure. However, variable arrays are contemplated for L1 C Products (i.e. level 1c).

4. LEVEL 1 PRODUCT TYPES SPECIFICATIONS

4.1 LEVEL 1 PRODUCTS COMMON HEADER

Different Level 1 Products share common information for the Header. This common information will be presented in the following sections and reference from the different sections in the document.

4.1.1 Main Product Header:

The Main Product Header of any SMOS Product Level 1 will be written in XML ASCII. It contains the information about:

- Product and Creator identification
- Orbit information
- Product Confidence Data (PCD)

The Main Product Header is defined as in [RD.12] Chapter 3.2.1, although some fields redundant with Fixed Header have been suppressed. The following table shows the specification of the Main Product Header.

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Main_Product_Header***	Tag				Tag starting the Main Product Header structure	
02	***Ref_Doc***	string	N/A	17 bytes	%17s	Name of the document containing the specifications for the current product (this document for L1 products): SO-TN-IDR-GS-0005	ICNF
03	***Acquisition_Station***	string	N/A	4 bytes	%4s	Acquisition Station ID. Left justified with trailing blanks. Currently, the possible values are: • " VFR": acquisition station for SMOS at ESAC • “ SGS”: acquisition station for SMOS at Svalbard • Others TBD In L1OP processing, the value in this field shall be obtained from the lower level input product (the origin for L1 being the L0 products).	MIR / TLM
04	***Processing_Centre***	string	N/A	4 bytes	%4s	ID code of the Processing Centre that has generated the product {ESAC, others TBD –e.g. LTA location-}. This is the physical location where the product is generated.	ICNF
05	***Logical_Proc_Centre***	string	N/A	3 bytes	%3s	ID code of the Logical Processing Centre that has generated the product. The Logical Processing Centre is the group of subsystems within the Processing Centre working co-ordinately to generate the product. Possible values are: {FPC}: SMOS DPGS Fast Processing Centre @ ESAC; {LTA}: SMOS DPGS LTA @ Kiruna; {CEC}: SMOS DPGS Calibration & Expertise Centre @ESAC; {IDR}: Indra ; {GMV}: GMV; {INS}: INSA	ICNF

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
06	***Orbit_Information***	Tag				Tag starting an Orbit Information structure.	
07	***Phase***	integer	N/A	4 byte	%+04d	Phase number, at sensing start time of the first packet in the corresponding Level 0 product. If not used set to +000	MIR / TLM
08	***Cycle***	Integer	N/A	4 bytes	%+04d	Cycle number, at sensing start time of the first packet in the corresponding Level 0 product. If not used set to +000	MIR / TLM
09	***Rel_Orbit***	Integer	N/A	6 bytes	%+06d	Relative orbit, at sensing start time of the first packet in the corresponding Level 0 product. If not used set to +00000	MIR / TLM
10	***Abs_Orbit***	Integer	N/A	6 bytes	%+06d	Absolute orbit, at sensing start time of the first packet in the corresponding Level 0 product. If not used set to +00000. First crossing of ascending node after launch determines the beginning of absolute orbit 1.	MIR / TLM
11	***OSV_TAI***	string	Tag TAI	30 bytes	%30s	TAI date and time of vector from field 15 to 20 TAI=yyyy-mm-ddThh:mm:ss.uuuuuu	MIR / TLM
12	***OSV_UTC***	string	Tag UTC	30 bytes	%30s	UTC date and time of vector from field 15 to 20 UTC=yyyy-mm-ddThh:mm:ss.uuuuuu	MIR / TLM
13	***OSV_UT1***	string	Tag (UT1)	30 bytes	%30s	UT1 date and time of vector from field 15 to 20 UT1=yyyy-mm-ddThh:mm:ss.uuuuuu	MIR / TLM
14	***Leap_Second***	string	Tag (s)	30	%30s	UTC time of the occurrence of the leap second. If the leap second occurred in the corresponding L0 product window, the field is set. Otherwise it is set to 30 blanks. It corresponds to the time of the Leap Second occurrence (i.e. midnight of the day after the leap second) UTC=yyyy-mm-ddThh:mm:ss.uuuuuu	MIR / TLM

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
15	***X_Position***	Real	m	12 bytes	%+012.3f	X Position in Earth Fixed Reference corresponding to the last vector in the POF before the sensing start time in L0.	MIR / TLM
16	***Y_Position***	Real	m	12 bytes	%+012.3f	Y Position in Earth Fixed Reference corresponding to the last vector in the POF before the sensing start time in L0.	MIR / TLM
17	***Z_Position***	Real	m	12 bytes	%+012.3f	Z Position in Earth Fixed Reference corresponding to the last vector in the POF before the sensing start time in L0.	MIR / TLM
18	***X_Velocity***	Real	m/s	12 bytes	%+012.6f	X Velocity in Earth Fixed Reference	MIR / TLM
19	***Y_Velocity***	Real	m/s	12 bytes	%+012.6f	Y Velocity in Earth Fixed Reference	MIR / TLM
20	***Z_Velocity***	Real	m/s	12 bytes	%+012.6f	Z Velocity in Earth Fixed Reference	MIR / TLM
21	***Vector_Source***	string	N/A	2 bytes	%2s	Source of the Orbit State Vector record: FP = FOS predicted	MIR / TLM
22	***Orbit_Information***	Tag				Tag ending an Orbit Information structure	
23	***Product_Confidence***	string	N/A	Variable (limited to 200 bytes)	%s	Product confidence value. Enumerated: • NOMINAL: SPH's Overall_Quality flag set to 1 • DEGRADED: SPH's Overall_Quality flag set to>1	INT
24	***Main_Product_Header***	Tag				Tag ending a Main Product Header structure	

Table 4-1. Specification of the Main Product Header

4.1.2 Specific Product Header:

The Specific Product Header of any SMOS Product Level 1 will be written in XML ASCII. The SPH is composed of several structures depending on the product type. The following two sub-elements are common to all Level 1 Measurement products:

- XML Specific Product Header Product Main Info
- XML Specific Product Header Data Sets

While the SPH Product Main Info contains generic information about the Product, the SPH Data Sets contains the list of names of Data Sets either of Reference or of Measurement.

The Reference Data Sets contain the reference to any file containing relevant information for the Product. The Measurement Data Sets contain relevant information about the binary information linked directly to the product.

In all cases, the SPH will be enclosed between the ***Specific_Product_Header*** Tag.

Amongst the fields in the Specific Product Header Main Info section, its second Field, the ***SPH_Descriptor*** will be different for every type of Level 1 Products. All the accepted types and names are presented in the following table:

Accepted Name	Description
TLM_MIR1A_SPH	Calibrated L1 product generated from MIRAS and Proteus ancillary data output
MIR_UAVU1A_SPH **MIR_UAVD1A_SPH**	Calibration L1 product generated from averaging the MIRAS uncorrelated Noise injection individual measurements in different semi-orbits (respectively, when pointing to the Sky and to the Earth)
MIR_CRSU1A_SPH **MIR_CRSD1A_SPH**	Calibration L1 product generated from gathering MIRAS correlated noise injection calibration individual measurements in a synthetic curve with measurements at different latitudes (respectively, when pointing to the Sky and to the Earth)
MIR_AFWU1A_SPH **MIR_AFWD1A_SPH**	Calibration L1 product generated from averaging the MIRAS FWF individual measurements in different semi-orbits (respectively, when pointing to the Sky and to the Earth)
MIR_GMATU__SPH **MIR_GMATD__SPH**	G Matrix (MIRAS' System Response Function) generated from MIR_AFWU1A and MIR_AFWD1A (respectively, when pointing to the Sky and to the Earth)
MIR_JMATU__SPH **MIR_JMATD__SPH**	Inverted J Matrix used in image reconstruction generated from MIR_GMATD_ and MIR_GMATU_ (respectively, when pointing to the Sky and to the Earth)
MIR_ANIR1A_SPH	Consolidated Calibration L1 product generated from MIRAS output during an external target calibration pertaining NIR calibration parameters
MIR_SC_D1A_SPH	Nominal L1a product generated from MIRAS output in Dual polarisation mode and combined with relevant Calibration L1 data, in nominal Earth observation pointing

Accepted Name	Description
MIR_SC_F1A_SPH	Nominal L1a product generated from MIRAS output in Full polarisation mode and combined with relevant Calibration L1 data, in nominal Earth observation pointing
MIR_TARD1A_SPH	Nominal L1a product generated from MIRAS output in Dual polarisation mode and combined with relevant Calibration L1 data when performing external target observation
MIR_TARF1A_SPH	Nominal L1a product generated from MIRAS output in Full polarisation mode and combined with relevant Calibration L1 data when performing external target observation
MIR_SC_D1B_SPH	Nominal L1b product generated from MIRAS output in Dual polarisation mode, in nominal Earth observation pointing
MIR_SC_F1B_SPH	Nominal L1b product generated from MIRAS output in Full polarisation mode, in nominal Earth observation pointing
MIR_TARD1B_SPH	Nominal L1b product generated from MIRAS output in Dual polarisation mode when performing external target observation
MIR_TARF1B_SPH	Nominal L1b product generated from MIRAS output in Full polarisation mode when performing external target observation
MIR_FTTD___SPH	Flat Target Transformation product generated from MIRAS output mode when pointing to a flat external target (Deep Sky), in dual polarisation mode
MIR_FTTF___SPH	Flat Target Transformation product generated from MIRAS output mode when pointing to a flat external target (Deep Sky), in full polarisation mode
MIR_SCLD1C_SPH	Nominal L1c product generated from MIRAS output in Dual polarisation mode and apodised for Soil Moisture applications
MIR_SCLF1C_SPH	Nominal L1c product generated from MIRAS output in Full polarisation mode and apodised for Soil Moisture applications
MIR_SCSD1C_SPH	Nominal L1c product generated from MIRAS output in Dual polarisation mode and apodised for Ocean Salinity applications
MIR_SCSF1C_SPH	Nominal L1c product generated from MIRAS output in Full polarisation mode and apodised for Ocean Salinity applications
MIR_BWLD1C_SPH	Browse L1c product generated from MIRAS output in Dual polarisation mode and apodised for Soil Moisture applications
MIR_BWLF1C_SPH	Browse L1c product generated from MIRAS output in Full polarisation mode and apodised for Soil Moisture applications
MIR_BWSD1C_SPH	Browse L1c product generated from MIRAS output in Dual polarisation mode and apodised for Ocean Salinity applications
MIR_BWSF1C_SPH	Browse L1c product generated from MIRAS output in Full polarisation mode and apodised for Ocean Salinity applications

Table 4-2. Level 1 SPH Accepted Names

Additionally, there shall be other structures specific for each data product type, informing about algorithms used, main statistics, etc. See SPH description in each product type's SPH specification section.

4.1.2.1 SPH Product Info

The XML SPH Product Main Info described in the following table contains the information about:

- Product Description and Identification Information
- Product Time Information
- Schema, Size and Checksum information
- Identifier of HW generating the product

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
02	***Main_Info***	Starting Tag				Tag starting a Main_Info structure	
03	***SPH_Descriptor***	String	N/A	14 bytes	%14uc	Name describing SPH, as per Table 4-2.	Hard-coded
04	***Time_Info***	Starting Tag				Tag starting a Time_Information structure	
05	***Precise_Validity_Start***	String	N/A	Variable	%30s	This is the UTC Validity Start Time, coherent with the Validity Start Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. It is a repetition of the time of the first DSR. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu"	INT
06	***Precise_Validity_Stop***	String	N/A	Variable	%30s	This is the UTC Validity Stop Time, coherent with the Validity Stop Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. It is a repetition of the time of the last DSR. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu"	INT
07	***Abs_Orbit_Start***	Integer	N/A	6 bytes	%+06d	Absolute orbit of the Precise_Validity_Start. Output of xo_time_to_orbit using orbit_id and field #5.	INT
08	***Start_Time_ANX_T***	Real	s	11 bytes	%011.6f	Time in seconds between Precise_Validity_Start and closest previous crossing of the ascending node. Output of xo_time_to_orbit using orbit_id and field #5.	INT
09	***Abs_Orbit_Stop***	Integer	N/A	6 bytes	%+06d	Absolute orbit of the Precise_Validity_Stop. Output of xo_time_to_orbit using orbit_id and field #6.	INT
10	***Stop_Time_ANX_T***	Real	s	11	%011.6f	Time in seconds between Precise_Validity_Stop and closest previous	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
				bytes		crossing of the ascending node from the Precise_Validity_Start. Output of xo_time_to_orbit using orbit_id and field #6.	
11	***UTC_at_ANX***	string	N/A	30 bytes	%30s	UTC time of the ascending node of the orbit containing the Precise_Validity_Start. Output of xo_orbit_info using orbit_id and field #5. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu"	INT
12	***Long_at_ANX***	real	deg	12 bytes	%+012.6f	Longitude of the ascending node of the orbit containing the Precise_Validity_Start (positive if east of Greenwich). Output of xo_orbit_info using orbit_id and field #5.	INT
13	***Ascending_Flag***	String	N/A	1 byte	%c	Orbit orientation along product. A for ascending, D for descending	MIR/TLM
14	***Semiorbit_Start***	Date	N/A	Variable	%30s	This is the UTC Start Time of the semiorbit in which the product is contained, in CCSDS ASCII format with time reference and microseconds. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu"	MIR/TLM
15	***Semiorbit_Stop***	Date	N/A	Variable	%30s	This is the UTC Stop Time of the semiorbit in which the product is contained, in CCSDS ASCII format with time reference and microseconds. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu"	MIR/TLM
16	***Time_Info***	Closing Tag				Tag closing Time_Info structure	
17	***Correlator_Layer***	Identifier	N/A	1 byte	%01c	Field reporting the layer of correlators used in the averages, taken from the first DSR with valid Correlator_Layer value. It shall be N for Nominal, R for Redundant.	INT
18	***Checksum***	Integer	N/A	10	%010d	Checksum of the datablock, obtained from the algorithm in the IEEE Std	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
				bytes		1003.1.2004, using function ***cksum*** in POSIX.	
19	***Header_Schema***	string	N/A	31 bytes	%31s	Name of the XSD to be used for the validation of the product header. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
20	***Datablock_Schema***	string	N/A	42 bytes	%42s	Name of the validation xml schema for the binary product's datablock Name of the binX schema for the validation of the product datablock. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
21	***Header_Size***	Integer	bytes	6 bytes	%06d	Size of the Header of the product	INT
22	***Datablock_Size***	Integer	Bytes	11 bytes	%011d	Size of the product Datablock	INT
23	***HW_Identifier***	String	N/A	4 bytes	%4s	Unique identifier of the hardware involved in the processing. "nnnn" where n are digits or characters	ICNF
24	***Main_Info***	Closing Tag				Tag closing a Main_Info structure	

Table 4-3. Level 1 Main Info SPH

4.1.2.2 SPH Quality Information structure

This structure contains the statistics on the quality checks performed during processing on the generated L1 data. Following table specifies the contents for this structure, which is common to all MIRAS products.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
M+01	***Quality_Information***	structure	N/A	N/A	N/A	Tag starting of a ***Quality_Information*** structure	
M+02	***Overall_Quality***	Integer	N/A	1 byte	%1d	1 is NOMINAL 2 is DEGRADED by SW error: any error reported by the algorithms such as no convergence or division by zero will raise this flag 3 is DEGRADED by Instrument error 4 is DEGRADED by corrupted/missing ADF	INT
M+03	***L1_Quality***	Real	10^{-2} %	5 bytes	%05d	NOT USED Percentage of quality checks successfully passed during Level 1 processing, rounded up. Checks are defined in “Error Handling” subsections of DPM documents ([RD.3], [RD.4] and[RD.5]). Value is -1 if value is not computed	INT
M+04	***N_Discarded_Scenes***	Integer	scenes	4 bytes	%04d	Number of scenes discarded from the corresponding L0 up to this product.	INT +input product
M+05	***N_Invalid_Blocks***	Integer	blocks	6 bytes	%06d	Copied from the SPH of the corresponding input product. Number of blocks in the L0 product with at least 1 missing packet	MIR / TLM
M+06	***N_Missing_Packets***	Integer	packets	6 bytes	%06d	Copied from the SPH of the corresponding input product. Number of missing packets inserted in the L0 product (not including 24-packet blocks missing in the pass).	MIR / TLM

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
M+07	***Quality_Information***	Closing Tag					

Table 4-4. Level 1 Quality Information structure in SPH

4.1.2.3 SPH Data Sets

The fields in the SPH Data Sets table are present in all Level 1 products. They present the data sets that are related to the content of the product, either they are physically contained in it or they are referenced from other product used as input to the generation of this product.

Some other fields are included before the SPH Data Sets fields, i.e. the SPH Data Sets structures shall be the last ones in the product's header.

The Data Block content for L1 Products consists of a Measurement Data Sets (containing binary contents as described in its associated XML schema) and a Reference Data Set (containing filename linking the product to a reference supporting file used as input to generate this product).

The following table presents the XML specification of the Data Sets:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
N+01	***List_of_Data_Sets***	Starting Tag		2	%02d	List containing the number of ***Data_Set*** structures, with "count" field as attribute. It is an XML structure containing a number of the Data_Set structures	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
N+02	***Data_Set***	Start of block				Tag starting a ***Data_Set*** structure	
N+03	***DS_Name***	String	N/A	30 bytes	%30s	Name describing the Data Set	INT
N+04	***DS_Type***	Char	N/A	1	%c	Type of Data Set: M for measurement R for reference	INT
N+05	***DS_Size***	Integer	N/A	10 bytes	%010d	Size in bytes of the Data Set. Filled with zeroes for Reference Data Sets	INT
N+06	***DS_Offset***	Integer	N/A	10 bytes	%010d	Offset in bytes since the beginning of Data Block file until the beginning of the data set. Filled with zeroes for Reference Data Sets	INT
N+07	***Ref_Filename***	String	N/A	60 bytes	%60s	Name of reference file if Data_Set_Type is R. Otherwise blanks	Job Order + INT
N+08	***Num_DSR***	Integer	N/A	10	%010d	Number of measurement records in the Data Set (filled only for Measurement Data Sets). Filled with zeroes for Reference Data Sets	INT
N+09	***DSR_Size***	Integer	N/A	8	%08d	Size in bytes of each binary measurement data set record. For variable size DSR, the value is -1. Filled with zeroes for Reference Data Sets	INT
N+10	***Byte_Order***	String	N/A	4	%4s	Type of ordering of the binary data. • For Data Sets contained in the product's datablock, the Order will be "0123" (little-endian) • For referenced data Sets, the order will be "0000"	INT
N+11	***Data_Set***	Ending Tag				Tag ending a ***Data_Set*** structure	
N+12	***List_of_Data_Sets***	Ending Tag				End of list containing the number of ***Data_Set*** structures	

Table 4-5. Level 1 SPH Data Set List

As seen above, there may be more than one file of each type in the Reference Data Set structure, depending for example on how many files of that type are needed to cover the sensing period of the current product. The following table provides a summary of the possible References used in Level 1.

Reference Data Set Name	File Type (File Category + Semantic Descriptor)	Description
L0_CORRELATIONS_FILE	`MIR_SC_D0_,MIR_SC_F0_, MIR_TARD0_, MIR_TARF0_, MIR_UNCD0_, MIR_CORD0_, MIR_UNCU0_, MIR_CORU0_`	L0 Product filename from which the current L1a was created
L0_HKTM_FILE	`TLM_MIRA0_`	L0 HKTM Product filename from which the current L1a HKTM was created
L1A_AVER_OFFSET_FILE	`MIR_UAVD1A, MIR_UAVU1A`	L1A offset filename containing the average of the uncorrelated noise injection measurements used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different names)
L1A_ORBIT_AMPL_PHASE_FILE	`MIR_CRSD1A, MIR_CRSU1A`	L1a Calibration filename containing several sets of parameters obtained during short calibration at different latitudes, used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different names)
L1A_AVER_NIR_CAL_FILE	`MIR_ANIR1A`	Averaged NIR calibrated parameters filename used to calibrate L1a visibilities
L1A_HKTM_FILE	`TLM_MIRA1A`	HKTM filename containing the S/C position and attitude for the snapshots in the current product
L1A_AVER_FWF_CAL_FILE	`MIR_AFWD1A, MIR_AFWU1A`	L1a Calibration filename of the file containing the average Fringe Washing Function estimated coefficients used in the computation of the reconstruction G Matrix (different products for nominal and external attitudes, with different names)
L1A_G_MATRIX_FILE	`MIR_GMATU_, MIR_GMATD_`	G Matrix filename used in the Image reconstruction process of the current L1b product. Different names for products in nominal and external attitude
L1A_J_MATRIX_FILE	`MIR_JMATU_, MIR_JMATD_`	Matrix filename used in the Image reconstruction process of the current L1b product. Different names for products in nominal and external attitude
L1A_FLAT_TARGET _FILE	`MIR_FTTD__, MIR_FTTF__`	L1a Calibrated Visibilities filename obtained during external target observation of the Deep Sky, to be used in the Flat Target Response (TBC), in dual and full polarization
L1A_FILE	`MIR_SC_D1A, MIR_SC_F1A, MIR_TARD1A, MIR_TARF1A`	L1a Calibrated Visibilities filename used to create the current L1b product
L1B_FILE	`MIR_SC_D1B, MIR_SC_F1B, MIR_TARD1B, MIR_TARFF1B`	L1b Product filename used to create the current L1c product

Reference Data Set Name	File Type (File Category + Semantic Descriptor)	Description
APODIDSATION_FILE	AUX_APDL__, AUX_APDS__	Apodisation window definition filename used in the current L1c product
DGG_FILE	AUX_DGG___	Fixed Earth Grid filename used in the current L1c product
TEC_FILE	AUX_VTEC_P , AUX_VTEC_C	TEC filename used in the current L1c products
GALAXY_FILE	AUX_GALAXY	Original Galaxy Map
GALAXY_NIR_FILE	AUX_GALNIR	Galaxy Map used for reconstruction and NIR calibration
PMS_FILE	AUX_PMS___	Auxiliary file with PMS characterisation used for L1a calibration
NIR_FILE	AUX_NIR___	Auxiliary file with NIR characterisation used for L1a calibration (defined externally)
PLM_FILE	AUX_PLM____	Auxiliary file with PLM characterisation, defining time lags and intermediate frequency
S_PARAM_FILE	AUX_SPAR__	Auxiliary file with S-parameters characterisation used for L1a calibration
LICEF_FILE	AUX_LCF___	Auxiliary file with receivers' characterisation (ohmic efficiency and absolute antenna phase) used for L1a calibration
ANTENNA_PATTERNS_FILE	AUX_PATT__	Auxiliary file with receivers' amplitude and phase pattern characterisation used for generation of the G reconstruction matrix, their coordinates and average as well.
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
BEST_FIT_PLANE_FILE	AUX_BFP___	Auxiliary file with definition of Best Fit Plane to be used during geolocation in L1c
L1C_PIXEL_MASK_FILE	AUX_MASK__	Auxiliary file with the flagging of pixels for use in L1c land or sea products
LAND_SEA_MASK_FILE	AUX_LSMASK	Auxiliary file containing the Land/Sea mask of pixels in the DGG
RFI_FILE	AUX_RFI___	Auxiliary file with RFI flagged pixels in the same grid as the DGG
SUN_BT_FILE	AUX_SUNT__	Auxiliary file with definition of Sun Brightness Temperatures used for correction before L1b processing
MOON_BT_FILE	AUX_MOONT_	Auxiliary file with definition of Moon Brightness Temperatures used for correction before L1b processing
EARTH _BT_FILE	AUX_ERTHT_	Auxiliary file with definition of Earth Brightness Temperatures used for correction before L1b processing
BISTATIC_SCAT_FILE	AUX_SGLINT	Auxiliary file with Bistatic Scattering Coefficients
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP
MISPOINTING_ANGLES_FILE	AUX_MISP__	Auxiliary product containing the mispointing angles between the Body Frame referenced in the Proteus quaternions and the Antenna Plane defined by the MIRAS instrument

Reference Data Set Name	File Type (File Category + Semantic Descriptor)	Description
WEIGHT_VECTOR_FILE	AUX_BWGHT_	Auxiliary product containing the weight vector to be multiplied element by element with the calibrated visibilities

Table 4-6. L1 Data Set Reference List

4.2 LEVEL 1 DATA TYPES SPECIFICATIONS

4.2.1 HKTM Data Specification (TLM_MIRA1A)

The TLM_MIRA1A data is generated from the data contained in the ancillary packets of the TLM_MIRA0_ product. A dataset record is generated for each integration time (every 1.2 seconds). The TLM_MIRA1A product acts as a supporting product presenting a single source for the instrument status monitoring measurements and spacecraft position and attitude data, so that it is not replicated in all products. This product does not contain information extracted from the PUS HKTM X-Band packets or PUS S-band packets.

The measurements in this product are obtained in parallel with MIRAS correlation measurements, i.e. there shall be one data set record of TLM_MIRA1A for each integration time, captured in parallel with correlation measurements whichever the type (correlated noise injection, uncorrelated noise injection, dual polarization and full polarization measurements).

4.2.1.1 Specific Product Header

The Specific Product Header Format for TLM_MIRA1A products follows the format described in section 4.1.2, including:

- Level 1 SPH Main Info (see Table 4-3)
- Quality Information structure (see Table 4-4)
- Level 1 SPH Data Sets (see Table 4-5)

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Starting Tag				Tag starting the Specific Product Header structure	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
02-19	*Main_Info*	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in in Table 4-3	
20-26	*Quality_Information*	structure	N/A	N/A	N/A	Quality_Information structure's fields as defined in Table 4-4	
27	*Time_Delay_Flag*	flag	N/A	1 byte	%01d	Flag warning about the existence of DSR that are suitable to be used for FWF shape estimation: • 1 when at least one DSR in the file contains FWF_Step field with value 1 or 2 • 0 otherwise	Internal processing
28	*NIR_Calibration_Flag*	flag	N/A	1 byte	%01d	Flag informing about the existence in product of any type of NIR Calibration	Internal processing
29-40	*Data_Sets*	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-5	
41	*Specific_Product_Header*	Closing Tag				Tag ending the Specific Product Header structure	

Table 4-7. Level 1A HTKM SPH

The specific valid Reference Data Sets for Level1A HKTM Products are:

Reference Data Set Name	Product Type	Description
L0_HKTM_FILE	`TLM_MIRA0_`	L0 Ancillary data Product filename from which the current HKTM L1a was created
PLM_FILE	`AUX_PLM___`	Auxiliary file with PLM characterisation, defining thermistor ground calibrated coefficients

Reference Data Set Name	Product Type	Description
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-8. Level 1A HKTM Reference Data Sets

4.2.1.2 Data Block

The TLM_MIRA1A binary Data Block consists of one Measurement dataset with specific information on the HousekeepingTelemetry. The dataset consists of a unique type of data set record repeated for each integration time of 1.2 seconds, preceded by a counter of dataset records actually contained in the product.

The Snapshot is identified by means of the Snapshot_OBET. The OBET Format, defined by the Agency, is as follows:

SMOS OBET TIME FORMAT									
P-FIELD								T-FIELD	
Extension Flag	Time Code Identification			Details Bits for the information on the code				Coarse Time	Fine Time Note
0 (MSB)	1	2	3	4	5	6	7(LSB)	32 bits	24 bits
1 Bit	3 bits			4 bits					
0	1	1	0	0	1	1	0	Seconds from epoch	2^{-24} seconds
1 byte								4 bytes	3 bytes

Table 4-9. OBET Time Format

Note: 3 bytes are sent for fine time, which means a resolution of about 60 nanoseconds, but the real resolution is 2^{-16} seconds. Therefore, this last byte will not have meaning information. It is sent due to alignment matters.

The following table describes the XML schema used to decode the binary contents of this type of record. The first field in the datablock is the counter of the dataset records contained in the dataset. The tag element used to describe the DSR structure name in the XML schema shall be ***HKTM_Data***. The size of each DSR is fixed and equal to 1657 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	HKTM_Data					Init of binary Data Set containing the ***HKTM_Data*** records.	
01	***HKTM_Sample_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***HKTM_Sample*** data set record structures.	Generated by L1A Processor
	List_of_HKTM_Samples					Init of list of ***HKTM_Sample*** data set record structures, repeated ***Counter*** times. There are as many DSR as integration periods in the product.	
	HKTM_Sample					Init of ***HKTM_Sample*** data set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and	UTC Time at which the scene was taken. Start of integration time period, and also start of validity for HKTM measurements. Expressed in EE CFI transport time format	Based in L0 ancillary packet UTC at PPS, corrected with PPS information to get the time in UTC format

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					microseconds) are unsigned		
03	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Based in L0 ancillary packet,'s secondary header
04	***OBET_PPS***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element	OBET measured value at PPS as extracted from L0 ancillary packet. Time in PLM format	Based in L0 ancillary packet, first 8-byte field in source data
05	***UTC_PPS***	Date	N/A	signed/unsigned integer (4 bytes)	Vector array of 3 elements First element (weeks) is signed integer, remaining two (seconds and fractions of seconds) are unsigned	UTC measured value at PPS as extracted from L0 ancillary packet. Time in Proteus platform. Expressed in EE CFI transport time format	Copied from L0 ancillary packet
06	***X_Position***	Real number	m	Double (8 bytes)	1 element	Orbit State Vector X Position in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packetpropagated with CFI to the Snapshot_time
07	***Y_Position***	Real number	m	Double (8 bytes)	1 element	Orbit State Vector Y Position in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packetpropagated

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							with CFI to the Snapshot_time
08	***Z_Position***	Real number	m	Double (8 bytes)	1 element	Orbit State Vector Z Position in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packetpropagated with CFI to the Snapshot_time
09	***X_Velocity***	Real number	m/s	Double (8 bytes)	1 element	Orbit State Vector X Velocity in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packetpropagated with CFI to the Snapshot_time
10	***Y_Velocity***	Real number	m/s	Double (8 bytes)	1 element	Orbit State Vector Y Velocity in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packet, propagated with CFI to the Snapshot_time
11	***Z_Velocity***	Real number	m/s	Double (8 bytes)	1 element	Orbit State Vector Z Velocity in Earth Fixed Reference at corresponding UTC SNAPSHOT_TIME	Based in PVT data from L0 ancillary packetpropagated with CFI to the Snapshot_time
12	***Nadir_Latitude***	Real number	Deg	Float (4 bytes)	1 element	Latitude of the satellite nadir point at corresponding UTC SNAPSHOT_TIME	Internal processing
13	***Nadir_Longitude***	Real number	deg	Float (4 bytes)	1 element	Longitude of the satellite nadir point at corresponding UTC SNAPSHOT_TIME	Internal processing
14	***Vector_Solution***	Identifier	N/A	Char (1	1 element	Source of the Orbit State Vector	Internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				byte)		record: • SOLUTION_NULL = 0 • SOLUTION_INITIALISATION = 1 • SOLUTION_PVT_FROZEN = 2 • SOLUTION_NKF_SOLUTION = 3 • SOLUTION_SPS_SOLUTION = 4 • SOLUTION_PREDICTED = 5 (not used) • SOLUTION_RESTITUTED = 6 (not used)	
15	***Q0***	Real number	N/A	Double (8 bytes)	1 element	Quaternion real element at corresponding UTC SNAPSHOT_TIME. Measured from J2000 inertial reference frame to body frame	Based in AOCS data from L0 ancillary packet propagated with CFI to the Snapshot_time
16	***Q1***	Real number	N/A	Double (8 bytes)	1 element	Quaternion first imaginary element at corresponding UTC SNAPSHOT_TIME. Measured from J2000 inertial reference frame to body frame	Based in AOCS data from L0 ancillary packet propagated with CFI to the Snapshot_time
17	***Q2***	Real number	N/A	Double (8 bytes)	1 element	Quaternion second imaginary element at corresponding UTC SNAPSHOT_TIME. Measured from J2000 inertial reference frame to body	Based in AOCS data from L0 ancillary packet propagated with CFI to the

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						frame	Snapshot_time
18	*Q3*	Real number	N/A	Double (8 bytes)	1 element	Quaternion third imaginary element at corresponding UTC SNAPSHOT_TIME. Measured from J2000 inertial reference frame to body frame	Based in AOCS data from L0 ancillary packet propagated with CFI to the Snapshot_time
19	*X_Ang_Velocity*	Real number	Rad/s	Double (8 bytes)	1 element	X Angular Velocity in Body Frame Reference	Format-converted from L0 ancillary packet value
20	*Y_Ang_Velocity*	Real number	Rad/s	Double (8 bytes)	1 element	Y Angular Velocity in Body Frame Reference	Format-converted from L0 ancillary packet value
21	*Z_Ang_Velocity*	Real number	Rad/s	Double (8 bytes)	1 element	Z Angular Velocity in Body Frame Reference	Format-converted from L0 ancillary packet value
22	*PMS_Voltages*	Array of real numbers	mV	double (8 bytes)	Vector array of 72 elements, following the same order as the signals for correlations, beginning with arm A and ending in arm C	PMS Voltages measured for each of the CMNs.	Based in PMS_YYY_XX_## fields in the L0 ancillary packet, where YYY is NIR or LCF, XX is the arm/s to which it belongs and ## is the number of the NIR/LICEF to which it is associated
23	*NIR_Mode*	Array of identifiers	N/A	byte-8	Vector array of 3 elements, following order AB, BC, CA	NIR modes in operation.	Based in L0 ancillary packet, Op-Mode fields in NIR_XY_01

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							sections, where XY identifies the arms around NIR unit.
24	***NIR_Avg_Samples***	counter	N/A	byte-8	Vector array of 3 elements, following order AB, BC, CA	NIR number of averaged samples in last cycle.	Based in L0ancillary packet, their byte positions are 290, 302, 315
25	***NIR_Error***	Array of flags	N/A	byte-8	3 elements, following order AB, BC, CA	NIR measurement error indicator. If set to 1, values measured in that NIR are not suitable for reconstruction.	Based in L0ancillary packet, their byte positions are 282, 294, 306.
26	***NIR_Pulse_Length***	Array of real values	N/A	double (8 bytes)	6 elements, order followed is AB-H, AB-V, BC- H, BC-V, CA-H and CA-V.	NIR measurements in operation. Normalised pulse length value, between [0,1].	Based in L0 ancilary packet in NIR_XY_01 sections, where XY identifies the arms around NIR unit
27	***Physical_Temperatures***	Matrix of real numbers	K	float (4 bytes)	Matrix array of [12][14] elements	Thermistor temperatures received for each CMN and consolidated for all receiving thermistor channels, leading to a 12*14 matrix. 24 new values are received in each ancillary packet, calibrated and converted to K here.	Coming from the characterisation of the thermistors, and the calibration parameters computed from two references loads on each CMN unit (ref_temps). Values are based in L0 ancillary packet's TEMP1 and TEMP2 in each CMN_X_# section, where X is the arm and # is the

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							number of CMN.
28	***M_Fly***	Array of real values	V/K	float (4 bytes)	Vector array of 12 elements	Thermistor calibration coefficient recovered from voltages on two reference channels. Recovered independently for each CMN, it must be combined with Mcal value measured on ground to calibrate the thermistors voltage outputs.	Based in L0 ancillary packet, fields TEMP1 and TEMP2, and field Pair_Temp_ID in each CMN section
29	***Q_Fly***	Array of real values	V	float (4 bytes)	Vector array of 12 elements	Thermistor calibration coefficient recovered from voltages on two reference channels. Recovered independently for each CMN, it must be combined with Qcal value measured on ground to calibrate the thermistors voltage outputs.	Based in L0 ancillary packet, fields TEMP1 and TEMP2, and field Pair_Temp_ID in each CMN section
30	***LICEF_Status***	Array of flags	N/A	byte-8 (8 flags contained)	2 arrays, one for each polarisation (H and V), of 9 elements each, with totally 72 bit-flags in each array. Field size is then 18 bytes	Status of each LICEF by polarisation H, V (0=No error, 1=Error). Obtained from single failure and correlator failure identification.	Value taken from Elements Failure Computation
31	***CMN_NIR_Status***	Array of flags	N/A	Unsigned short (2 bytes)	Array of 12+3 status bit-flags contained in 2 bytes. Order is first CMN status,	Status of each CMN and NIR (0=No error, 1=Error). Obtained from single failure identification. • Bit 0 (LSB): CMN H1	Value taken from Elements Failure Computation

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					then NIR status	• Bit 1: CMN H2 • Bit 2: CMN H3 • Bit 3: CMN A1 • Bit 4: CMN A2 • Bit 5: CMN A3 • Bit 6: CMN B1 • Bit 7: CMN B2 • Bit 8: CMN B3 • Bit 9: CMN C1 • Bit 10: CMN C2 • Bit 11: CMN C3 • Bit 12: NIR AB • Bit 13: NIR BC • Bit 14: NIR CA	
32	***NS_Status***	Array of flags	N/A	Unsigned short (2 bytes)	Array of 10 bit-flags	Status of each Noise Source (0=No error, 1=Error). Obtained from single failure identification. • Bit 0 (LSB): NS H • Bit 1: NS A1 • Bit 2: NS A2 • Bit 3: NS A3	Value taken from Elements Failure Computation

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						• Bit 4: NS B1 • Bit 5: NS B2 • Bit 6: NS B3 • Bit 7: NS C1 • Bit 8: NS C2 • Bit 9: NS C3	
33	***TSYNC_Error***	Flag	N/A	unsigned byte	1 element	Status of Tsync signal information (0=No error, 1=Error). Obtained from single failure identification	Based in L0ancillary packet, field starting in byte position 318 of source data.
34	***Arm_Pol_Mode***	Array of flags	N/A	unsigned byte	Vector array of 3 elements. Order followed is A, B and C	Polarisation mode in each arm (HHH=000, HVV=011, VHV=101, VVH=110, VVV=111, VHH=100, HVH=010, HHV=001).	Based in the processing the TSYNC shape data and return each arm polarisation mode.
35	***Arm_Redundancy_Config***	Array of flags	N/A	unsigned byte	Vector array of 3 elements. Order followed is A, B and C	Redundancy configuration in each arm for the noise source and thermistors (0 NOMINAL, 1 REDUNDANT)	Based in L0 ancillary packet ARM_RED_CONF starting in byte 17
36	***ASIC_Mode***	Array of identifiers	N/A	unsigned byte	Vector array of 9 elements. Order followed is ASIC0, ASIC1… ASIC8 (nominal layer), or ASIC9, ASIC10… ASIC17 (redundant layer)	• ASIC operation mode. The list of possibles values is: • READOUT (0x0C): nominal • IDLE (0x00): instrument active but no correlations are being read • MAX_COUNT (0x0D): produced	Based in L0 ancillary packet fields ASIC# starting in byte 405 and ending in byte 413

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						only during correlator test mode • LFSR (0x0F): linear feedback shift register. Produced only during correlator test mode • OCTG (0x0E): on chip test generator. Produced only during correlator test mode	
37	***CCU_Error***	Flag	N/A	unsigned byte	1 element	Status of CCU information (0=No error, 1=Error). Obtained from single failure identification	Based in L0 ancillary packet, byte position 402
38	***PPS_Error***	Flag	N/A	unsigned byte	1 element	Status of PPS information (0=No error, 1=Error). Obtained from single failure identification	Based in L0 ancillary packet, byte position 16
39	***XBAND_Error***	Flag	N/A	unsigned byte	1 element	Status of XBAND information (0=No error, 1=Error). Obtained from single failure identification	Based in L0 ancillary packet, byte position 395. The X-band data is coded as 8-bit 2´s complement in the ancillary source packets, so it must be transformed into engineering units.
40	***Correlators_Op_Mode***	Identifier	N/A	unsigned byte	1 element	Operating mode of ALL correlators (0=STOP,1=DUAL, 2=FULL)	Based in L0 ancillary packet, byte position 403
41	***Correlators_Redunda***	Identifier	N/A	unsigned	1 element	Redundancy configuration of	Based in L0 ancillary

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	ncy_Config			byte		correlators layer (0=NONE, 1=NOMINAL, 2=REDUNDANT, 3=BOTH)	packet, byte position 418
42	***Memory_Redundancy_Config***	Identifier	N/A	unsigned byte	1 element	Redundancy configuration of mass memory unit (0=NOMINAL, 2=REDUNDANT)	Based in L0 ancillary packet, byte position 419
43	***Instrument_Mode***	Identifier	N/A	unsigned byte	1 element	Instrument mode as reported by ancillary packet (see section 2.2.8 of [RD.19]) • ASW_INIT = 0 • INSTRUMENT_INIT= 1 • DUAL_POLARISATION = 2 • FULL_POLARISATION = 3 • CALIBRATION = 4 • TEST = 5	Based in L0 ancillary packet, byte position 420
44	***Correlated_Noise_Mode***	Identifier	N/A	unsigned byte	1 element	Correlated Noise Injection operation mode, computed from CMN executed commands combination (codes available at DPM L1A, table 16 [RD.3])	Based in L0 ancillary packet, the fields called LAST_EXECUTED_COMMAND in the different sections are considered together to detect C.N.I mode
45	***FWF_Step***	Identifier	N/A	unsigned byte	1 element	Time lag of FWF (0=NO_LAG, 1=-T, 2=+T)	Based in L0 ancillary packet, byte position

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							404
46	***Corrupted_Data***	Flag	N/A	unsigned byte	1 element	Indicator of snapshot validity for reconstruction. If set to 1, some operation was performed that invalidates the correlators accumulation or NIR measurements	Based in L0 ancillary packet, byte position 421
47	***TSYNC_CMN_Error***	Array of flags	N/A	unsigned byte	Vector array of 12 elements	Status of TSYNC signal at each CMN (0=No error, 1=Error). Obtained from single failure identification.	Based in L0 ancillary packet, bit 15 for field TSYNC_HEALTH in each CMN HOUSEKEEPING section
48	***Heater_Status***	Array of flags	N/A	unsigned byte	Vector array of 12 elements	Status of heater at each CMN (0=OFF, 1=ON).	Based in L0 ancillary packet, bit 1 for field HEATER_SWITCH in each CMN HOUSEKEEPING section
49	***Last_Executed_Command***	Identifier	N/A	unsigned short (2 bytes)	Vector array of 12 elements	Command executed on each CMN.	Based in L0 ancillary packet, the fields called LAST_EXECUTED_COMMAND in the different sections
50	***Last_Executed_Command_Error***	Array of flags	N/A	unsigned byte	Vector array of 12 elements	Status flag of the last executed command on each CMN (0=No error, 1=Error). Obtained from single failure identification.	Based in L0 ancillary packet, the fields called LAST_CMD_OK in the different sections

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
51	***Last_APID***	Identifier	N/A	unsigned short (2 bytes)	1 element	Last APID received by the correlators	Based in L0 ancillary packet, byte position 414
52	***XBAND_Status***	Flag	N/A	unsigned byte	1 element	Status flag for Xband system (nominal or redundant)	Based in L0 ancillary packet, byte position 396
53	***RF_Level***	Real value	mV	Float (4 bytes)	1 element	Power RF Signal Level	Based in L0 ancillary packet, byte position 397
54	***VCO_TM***	Real value	mV	Float (4 bytes)	1 element	DC Level of the VCO	Based in L0 ancillary packet, byte position 398
55	***Num_Alim_TM***	Real value	mV	Float (4 bytes)	1 element	Voltage of the digital parts supply	Based in L0 ancillary packet, byte position 399
56	***SSPA_Alim_TM***	Real value	mV	Float (4 bytes)	1 element	Voltage of the solid state RF power amplifier	Based in L0 ancillary packet, byte position 400
57	***Temp_TM***	Real value	K	Float (4 bytes)	1 element	Xband System temperature	Based in L0 ancillary packet, byte position 401
58	***PM_Nominal***	Flag	N/A	unsigned byte	1 element	Processing Module Nominal or Redundant mode (0= NOMINAL, 1=REDUNDANT)	Based in L0 ancillary packet, byte position 416 bit 0
59	***EEPROM_Selected***	Flag	N/A	unsigned byte	1 element	EEPROM Bank selected (0=Bank #0, 1=Bank #1)	Based in L0 ancillary packet, byte position

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							416 bit 2
60	***Reset_Source***	Flag	N/A	unsigned byte	1 element	(0=Reset Source SW, 1=Reset Source Power-on)	Based in L0 ancillary packet, byte position 416 bit 4
61	***EEPROM_Write***	Flag	N/A	unsigned byte	1 element	EEPROM Write status (0=ENABLED, 1=DISABLED)	Based in L0 ancillary packet, byte position 416 bit 6
	HKTM_Sample					End of ***HKTM_Sample*** data set record structure.	
	List_of_HKTM_Samples					End of list of ***HKTM_Sample*** data set record structures.	
	HKTM_Data					End of binary Data Set containing the ***Grid_Points*** records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-10. Level 1A Housekeeping Telemetry Product Data Block

The following table shows the contents of the physical temperatures data. CMN ordering is as usual: H1, H2, H3, A1, A2, A3, B1, B2, B3, C1, C2 and C3. Temperature ordering is shown in the table.

	CMN H1	CMN H2	CMN H3	CMN X 1/2/3 (X=A,B or C)
Ch. 1	LICEF_AB_03	LICEF_BC_03	LICEF_CA_03	LICEF_X_04/10/16
Ch. 2	LICEF_NIR_AB_01_H	LICEF_NIR_BC_01_H	LICEF_NIR_CA_01_H	LICEF_X_05/11/17
Ch. 3	LICEF_NIR_AB_01_V	LICEF_NIR_BC_01_V	LICEF_NIR_CA_01_V	LICEF_X_06/12/18
Ch. 4	LICEF_A_01	LICEF_B_01	LICEF_C_01	LICEF_X_07/13/19
Ch. 5	LICEF_A_02	LICEF_B_02	LICEF_C_02	LICEF_X_08/14/20
Ch. 6	LICEF_A_03	LICEF_B_03	LICEF_C_03	LICEF_X_09/15/21
Ch. 7	NIR_A_T3 (NS_1H)	NIR_A_T3 (NS_2H)	NIR_A_T3 (NS_3H)	NS_X_1/2/3
Ch. 8	NIR_A_T5 (Lref_1H)	NIR_A_T5 (Lref_2H)	NIR_A_T5 (Lref_3H)	Hinge_n
Ch. 9	NIR_A_T7 (AntennaPatch_1H)	NIR_A_T7 (AntennaPatch_2H)	NIR_A_T7 (AntennaPatch_3H)	Not used
Ch. 10	NIR_A_T11 (NS_1V)	NIR_A_T11 (NS_2V)	NIR_A_T11 (NS_3V)	Not used
Ch. 11	NIR_A_T13 (Lref_1V)	NIR_A_T13 (Lref_2V)	NIR_A_T13 (Lref_3V)	Not used
Ch. 12	NIR_A_T15 (AntennaInterm_1H)	NIR_A_T15 (AntennaInterm_2H)	NIR_A_T15 (AntennaInterm_3H)	Not used
Ch. 13	NS_H_Internal	Not used	Not used	Not used
Ch. 14	PD_H1_n	PD_H2_n	PD_H3_n	PD_X_1/2/3

Table 4-11. Physical Temperatures Data Fomat

4.2.2 L1A Calibration Data Specification

L1a Calibration Data shall be formed by the calibration parameters and offsets extracted after noise injection, and the estimated coefficients of the Fringe Washing function.

The Specific Product Header Format for all Level 1A Calibration products follows the format described in section 4.1.2, including:

- Level 1 Main Info SPH (see Table 4-3)
- Level 1 Quality Information (see Table 4-4)
- Level1 SPH Data Sets (see Table 4-5)

4.2.2.1 Average Uncorrelated Noise Injection Data Type (MIR_UAVD1A / MIR_UAVU1A)

The uncorrelated noise injection measurements are MIRAS correlation measurements obtained when the input ports of the LICEFs are switched to their internal reference loads, allowing the estimation of visibility offsets after the conversion of raw correlations into visibilities and the corresponding calibration.

This product is the actual uncorrelated input to L1A Visibilities processing, as it contains only the average of all uncorrelated noise injection measurements made during a given time period, i.e. it is made by averaging the individual measurements for each epoch contained in the Uncorrelated Noise Injection data type. This period needs not to be obtained from a pole-to-pole segment, but it can be several semi-orbits long. The product contains only one average, corresponding to a whole calibration campaign (which extent is decided backwards and onwards by checking if the gaps between uncorrelated noise measurements are larger than a defined threshold).

The average shall be performed by combining the previously existing MIR_UAVD1A / MIR_UAVU1A consolidated product (if any) with the result of processing the half-orbit MIR_UNCD0_/ MIR_UNCU0_ product containing additional individual measurements. The distance in time from the previous MIR_UAVD/U1A stop time and the new MIR_UNCD0_/U0_ start time shall be smaller than a configured maximum acceptable gap. The average values shall be presented along with the number of measurements used and the time period where the samples were gathered. This time shall be used to further consolidate additional data in an existing average, or to discard the previous average and recompute a new one.

This product type contains the average of the uncorrelated noise injection measurements of a calibration campaign obtained either when the instrument is pointing in nominal attitude (from MIR_UNCD0_ products) or when the instrument is pointing with external attitude (from MIR_UNCU0_ products), but never both of them in the same product. The resulting products shall be named respectively MIR_UAVD1A and MIR_UAVU1A. The naming difference allows performing the distinction, although they share the same format specification and schemas. MIR_UAVD1A is the uncorrelated noise injection product to be used in MIR_SC_D1A and MIR_SC_F1A error correction, while MIR_UAVU1A is the one to be used in MIR_TARD1A and MIR_TARF1A corrections.

4.2.2.1.1 Specific Product Header

The Specific Product Header Format for MIR_UAVD1A/MIR_UAVU1A products follows the format described in table below:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Starting Tag				Tag starting the Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in Table 4-3	
20	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure's fields as defined in Table 4-4.	
21	***Uncorrelated_Quality_Information***	Starting Tag				Tag starting of an ***Uncorrelated_Quality_Information*** structure	
22	***N_Averaged_Measurements***	Integer	N/A	4 bytes	%04s	Number of averaged uncorrelated noise injection measurements	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
23	***Unc_Averaged_Measurements_Threshold***	Integer	N/A	4 bytes	%04s	Field indicating the threshold for the acceptable minimum number of averaged individual uncorrelated measurements, set as configuration value during the generation of this product	CNF
24	***Uncorrelated_ Quality***	Flag	N/A	1 byte	%01d	Flag indicating that the average contained in the product as used less epochs than the number specified as threshold in the configuration file. The possible values are: • 1 if number of averaged measurements is under the threshold • 0 if it is greater	INT
25	***Uncorrelated_Quality_Information***	Closing Tag				Tag closing an ***Uncorrelated_Quality_Information*** structure	
25-36	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	
37	***Specific_Product_Header***	Closing Tag				Tag closing the Specific Product Header structure	

Table 4-12. Level 1A MIR_UAVD1A / MIR_UAVU1A SPH

The reference data sets for MIR_UAVD1A/MIR_UAVU1A Data Type are:

Reference Data Set Name	Product Type	Description
L0_CORRELATIONS_FILE	`MIR_UNCD0_,` `MIR_UNCU0_`	L0 Product filename from which the current L1a Aux file was created
L1A_ORBIT_AMPL_PHASE_FILE	`MIR_CRSD1A,`	L1a Calibration filename containing several sets of parameters obtained during short calibration at

Reference Data Set Name	Product Type	Description
	MIR_CRSU1A	different latitudes, used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different names)
L1A_AVER_OFFSET_FILE	MIR_UAVD1A MIR_UAVU1A	L1a Offset filename containing individual measurements of uncorrelated noise injection
L1A_HKTM_FILE	TLM_MIRA1A	HKTM filename containing the physical temperatures for the snapshots in the current product
PMS_FILE	AUX_PMS___	Auxiliary file with external PMS characterisation
FAILURES_FILE	AUX_FAIL_	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-13. Level 1A Uncorrelated Noise Injection Reference Data Sets

4.2.2.1.2 Data Block

The binary Data Block of the MIR_UAVD1A/MIR_UAVU1A data product consists of one dataset giving the mean average of all the individual measurements obtained by processing the contents of the MIR_UNCD0_/MIR_UNCU0_ product. The sequence in which the data is presented is the same as for nominal L1A Products, and can be seen in Figure 4-1.

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 DS structure name in the XML schema shall be ***Mean_Offset***.

- The ***Mean_Offset*** dataset shall contain a list of ***Mean_Offsets_Data*** Data Set Record (with 1 DSR being the baseline), spanning all continuous or semi-continuous integration times spent in Uncorrelated Noise Injection during the consolidation period. This data record shall contain the complete set of averaged offsets for every pair of receivers, expressed as a visibility offset, together with the number of samples used for the average. Total amount of offsets is then 72*71/2, as the LICEF_NIR are correlated in both polarisations during the integration time. The origin of the offset is presented (Nominal or Redundant) layer, in case they were to be applied to measurements from the opposite layer. The size of each DSR is fixed and equal to 41213 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Mean_Offset					Init of binary Data Set containing the list of ***Mean_Offset_Data***records.	
01	***Mean_Offset_Data_Counter***	Integer	N/A	Unsigned integer (4 bytes)	1 element	Number of Mean_Offset_Data data set record structure in the following list.	Internal processing
	List_of_Mean_Offset_Datas					Tag starting a list of Mean_Offset_Data	
	Mean_Offset_Data					Init of ***Mean_Offset_Data*** record structure.	
02	***Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the Uncorrelated Noise Injection calibration campaign was started. Expressed in EE CFI transport time format	Internal processing
03	***Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two	UTC Time at which the Uncorrelated Noise Injection calibration campaign was finished. Expressed in EE CFI transport time format	Internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					(seconds and microseconds) are unsigned		
04	***Correlator_Layer***	Character	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Internal processing
05	***Samples***	Integer Value	N/A	Unsigned integer (4 bytes)	1 element	Number of samples taken to perform the average. Typically it shall be the number of U-noise epochs used.	Internal processing
06	***Offset***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	71*36 elements. Order followed s depicted in Figure 4-1	Complex mean offset values (for real and imaginary term of *Vkj*) in all baselines.	Internal processing
07	***Receiver_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (order followed is described in last paragraph of 4.2.3.1)	Average physical temperature of receivers in Kelvin, during uncorrelated noise injection. One value per receiver.	Internal processing
	List_of_Mean_Offset_Datas					Tag ending the list of Mean_Offset_Data	
	Mean_Offset					End of binary Data Set containing the list of ***Mean_Offset_Data*** records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-14. Level 1A Average Uncorrelated Noise Injection Product Data Block

4.2.2.2 Synthetic Curve of Correlated Noise Injection (MIR_CRSD1A / MIR_CRSU1A)

The correlated noise injection measurements are MIRAS correlation measurements obtained when the input ports of the LICEFs are switched to the C-ports (measuring first from odd noise sources and then from even noise sources), transformed to raw correlations, allowing the estimation of the Fringe Washing Function at the origin and the calibration of PMS.

The correlated noise injection measurements used by the L1OP to calibrate the visibilities are not based in only one L0 product but in the measurements obtained from several MIR_CORD0 / MIR_CORU0, i.e. they are not consolidated in a pole-to-pole basis. The individual measurements performed in each semi-orbit are processed to L1A and directly included in the Synthetic Curve of Correlated Noise Injection products MIR_CRSD1A or MIR_CRSU1A (containing measurements processed from MIR_CORD0 or MIR_CORU0 respectively, but never from both of them). The number of past orbits –along with the new measurement- to be included in the MIR_CRSD1A/MIR_CRSU1A product is a configurable parameter.

The objective is to populate a series of “bins” along the orbit with applicable calibration values (FWF at the origin and PMS Gain and Offset) that will be used to calibrate science data measured in those parts of the orbit. Correlated noise injection (combined in odd and even sources) produces the calibration parameters (complex value of the FWF at the origin, representing the correction factors in amplitude and phase) that need to be applied to calibrate the instrument measurements, as well as the calibrated coefficients for the PMS.

When using this product, spline interpolation must be used between the correlated noise injection individual measurements to retrieve the calibration parameters that are to be applied in correction of the visibilities in observation or external target modes. A MIR_CRSD1A product is to be applied to nominal observation mode visibilities calibration, while for external target measurements calibration the MIR_CRSU1A must be used.

4.2.2.2.1 Specific Product Header

The Specific Product Header Format for Level 1 Correlated Noise Injection Short Calibration Curve products follows the format described in table below.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Starting Tag				Tag starting the Specific Product Header structure	
02-19	***Main_Info***	structure				Main Product Info structure's fields as defined in Table 4-3	
20-26	***Quality_Information***	structure				Quality_Information structure's fields as defined in Table 4-4	
27	***N_Bins_Updated***	integer	N/A	1 byte	%01d	Number of bins that have been included in the file resulting from the calibration sequences in the input L0 product.	INT
28	***N_Bins_Removed***	Integer	N/A	1 byte	%01d	Number of bins from the input MIR_CRSD/U1A that have been removed for obsolescence.	ADF
29-30	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-5	
31	***Specific_Product_Header***	Closing Tag				Tag closing the Specific Product Header structure	

Table 4-15. Level 1A Synthetic Curve of Correlated Noise Injection SPH

The reference data sets for MIR_CRSD1A/MIR_CRSU1A Data Type are:

Reference Data Set Name	Product Type	Description
L0_CORRELATIONS_FILE	`MIR_CORD0_, MIR_CORU0_`	L0 Product filename from which the current L1a was created
L1A_ORBIT_AMPL_PHASE_FILE	`MIR_CRSD1A, MIR_CRSU1A`	L1a Calibration filename containing several sets of parameters obtained

Reference Data Set Name	Product Type	Description
		during correlated noise injection calibration at different latitudes, used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different names)
L1A_HKTM_FILE	TLM_MIRA1A	HKTM filename containing thermistors temperature information for the snapshots in the current product
L1A_AVER_NIR_CAL_FILE	MIR_ANIR1A	Average NIR calibrated parameters filename used to calibrate L1a visibilities
NIR_FILE	AUX_NIR___	Auxiliary file with NIR characterisation used for L1a calibration (defined externally)
PMS_FILE	AUX_PMS___	Auxiliary file with PMS characterisation used for L1a calibration
S_PARAM_FILE	AUX_SPAR__	Auxiliary file with S-parameters characterisation used for L1a calibration
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-16. Level 1A Synthetic Curve of Correlated Noise Injection Reference Data Sets

4.2.2.2.2 Data Block

The binary Data Block consists of five Measurement datasets

The following table describes the XML schema used to decode the binary contents of these type of datasets.

- The ***Cons_Ampl_Phase_Correction*** structure consist of a number of data records representing the orbit “bins”. These data records shall contain the complete set of calibration parameters for every pair of receivers, expressed as a complex value (amplitude and phase), that are applicable to any measurement within the “bin”. The sequence in which the data is presented is the same as for nominal L1a Products, and can be seen in Figure 11. Total amount of calibration parameters is then 72*71/2, as the LICEF_NIR are correlated in both polarisations during the integration time. The size of each DSR is fixed and equal to 43773 bytes.

- the ***Cons_PMS_Coefficients*** structure shall consist also of a number of data records representing the same orbit "bins". Each of this data records shall contain the PMS coefficients (gain and offset), needed for computation of the System Temperatures with the PMS output voltages. The size of each DSR is fixed and equal to 2744 bytes.
- The ***Cons_Long_PMS_Coefficients*** structure consists of a number of data records representing all the Long PMS calibration sequences available that have not been declared obsolete. Each of this data records shall contain the PMS coefficients (gain and offset), needed for computation of the PMS Sensitivities.. The size of each structure is fixed and equal to 2744 bytes.
- The ***PMS_Sensitivities*** structure consists of a unique data record with the PMS temperature Sensitivities applicable to all PMS. The size of each structure is fixed and equal to 3029 bytes.
- The ***FWF_Origin_Sensitivities*** structure consists a unique data record with the FWF at the origin temperature Sensitivities applicable to all baselines. The size of each structure is fixed and equal to 41214 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Cons_Ampl_Phase_Correction					Init of Cons_Ampl_Phase_Correction binary Data Set	
01	***Cons_Ampl_Phase_Correction_Counter***	Counter	N/A	Unsigned integer (4 bytes)	1 Element	Number of Cons_Ampl_Phase_Correction_Data DSRs.	Internal processing
	List_of_Cons_Ampl_Phase_Correction_Datas					Init of List_of_ Cons_Ampl_Phase_Correction Datas structures.	
	Cons_Ampl_Phase_Correction_Data					Init of Cons_Ampl_Phase_Correction _Data structure repeated Cons_Ampl_Phase_Correction _Counter times.	
02	***Sequence_Start_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element	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	Internal processing

					(days) is signed integer, remaining two unsigned integer.	transport time format.	
03	***Sequence_Stop_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	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	Internal processing
04	***Correlator_Layer***	string	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Internal processing
05	***Samples***	Real value	N/A	Float (4 bytes)	1 element	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	Internal processing
06	***Time_From_ANX***	Date	s	Float (4 bytes)	1 element	Relative time within orbit since Ascending Node. Crossing computed by using the orbit scenario file, output of xo_time_to_orbit using orbit_id and field #02 . Used to determine to which bin is the measurement applicable.	Internal processing
07	***FWF_Origin***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	71*36 elements. Order followed is depicted in Figure 4-1	Complex values (amplitude and phase) in all baselines (including redundant). It is the Fringe Washing Function at the origin for port C	Internal processing

08	***FWF_Origin_Quality***	integer	N/A	Unsigned byte	71*36 elements. Order followed is depicted in Figure 4-1	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).	Internal processing
09	***Receiver_Temp***	real value	K	Float (4 bytes)	72 elements	Physical temperature of receivers in Kelvin. Ordering has been described previously	Internal processing
	Cons_Ampl_Phase_Correction_Data					End of Cons_Ampl_Phase_Correction _Data structure repeated Cons_Ampl_Phase_Correction _Counter times.	
	List_of_Cons_Ampl_Phase_Correction_Datas					End of List_of_ Cons_Ampl_Phase_Correction Datas structures.	
	Cons_Ampl_Phase_Correction					End of Cons_Ampl_Phase_Correction binary Data Set	
	Cons_PMS_Coefficients					Init of Cons_PMS_Coefficients binary Data set	
10	***Cons_PMS_Coefficients_Counter***	Counter	N/A	Unsigned integer (4 bytes)	1 element	Number of Cons_PMS_Coefficients_Data DSR structures	Internal processing
	List_of_Cons_PMS_Coefficients_Datas					Init of List of Cons_PMS_Coefficients_Datas structures	
	Cons_PMS_Coefficients_Data					Init of Cons_PMS_Coefficients_Data DSR structure.	
11	***Sequence_Start_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed	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	Internal processing

					integer, remaining two unsigned integer.	calibration matrices. Expressed in EE CFI transport time format.	
12	***Sequence_Stop_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	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	Internal processing
13	***Samples***	Real value	N/A	Float (4 bytes)	1 element	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	Internal processing
14	***Time_From_ANX***	Date	s	Float (4 bytes)	1 element	Relative time within orbit since Ascending Node Crossing. Crossing computed by using the orbit scenario file, output of xo_time_to_orbit using orbit_id and field #11. Used to determine to which bin is the measurement applicable	Internal processing
15	***PMS_ID***	Identifier	N/A	Unsigned byte	72 elements	PMS Unique identifier. The equivalence with PMS_ID in AUX_PMS is as follows: • 1 to 24 for arm A (AB_03, ABH_01, ABV_01, A__01, A__02.... A__21) • to to 48 for arm B (BC_03, BCH_01, BCV_01, B__01, B__02.... B__21) • 49 to 72 for arm C (CA_03, CAH_01, CAV_01, C__01, C__02.... C__21)	Internal processing
16	***Temperature***	Real	K	Float (4 bytes)	72 elements	Temperature at which the PMS coefficients were	Internal

		value				obtained.	processing
17	***Gain***	Real value	mV/K	Double (8 bytes)	72 elements	Gain coefficient for PMS identified before and at previous temperature.	Internal processing
18	***Offset***	Real value	mV	Double (8 bytes)	72 elements	Offset coefficient for PMS identified before and at previous temperature.	Internal processing
19	***T_Rec_Ref_H***	Real value	K	Double (8 bytes)	3 elements	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	Internal processing
20	***T_Rec_Ref_V***	Real value	K	Double (8 bytes)	3 elements	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	Internal processing
21	***T_Rec_Ref_LICEF_H***	Real value	K	Double (8 bytes)	72 elements	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	Internal processing
22	***T_Rec_Ref_LICEF_V***	Real value	K	Double (8 bytes)	72 elements	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.	Internal processing

	Cons_PMS_Coefficients_Data					End of Cons_PMS_Coefficients_Data DSR structure.	
	List_of_Cons_PMS_Coefficients_Datas					End of List of Cons_PMS_Coefficients_Datas structures	
	Cons_PMS_Coefficients					Endof Cons_PMS_Coefficients binary Data set	
	Cons_Long_PMS_Coefficients					Init of Cons_Long_PMS_Coefficients binary Data set	
23	***Cons_Long_PMS_Coefficients_Counter***	Counter	N/A	Unsigned integer (4 bytes)	1 element	Number of Cons_Long_PMS_Coefficients_Data DSR structures.	Internal processing
	List_of_Cons_Long_PMS_Coefficients_Datas					Init of List of Cons_Long_PMS_Coefficients_Datas	
	Cons_Long_PMS_Coefficients_Data					Init of Cons_Long_PMS_Coefficients_Data structure	
24	***Sequence_Start_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	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	Internal processing
25	***Sequence_Stop_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned	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	Internal processing

					integer.		
26	***Samples***	Real value	N/A	float (4 bytes)	1 element	Number of epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	Internal processing
27	***Time_From_ANX***	Real value	N/A	float (4 bytes)	1 element	Relative time within orbit since Ascending Node Crossing. Crossing computed by using the orbit scenario file, output of xo_time_to_orbit using orbit_id and field #24. Used to determine to which bin is the measurement applicable	Internal processing
28	***PMS_ID***	Identifie r	N/A	Unsigned byte	72 elements	PMS Unique identifier.	Internal processing
29	***Temperature***	Real Value	K	Float (4 bytes)	72 elements	Temperature at which the PMS coefficients were obtained.	Internal processing
30	***Gain***	Real Value	mV/K	Double (8 bytes)	72 elements	Gain coefficient for PMS identified before and at previous temperature.	Internal processing
31	***Offset***	Real Value	mV	Double (8 bytes)	72 elements	Offset coefficient for PMS identified before and at previous temperature.	Internal processing
32	***T_Rec_Ref_H***	Real Value	K	Double (8 bytes)	3 elements	Reference NIR Receiver Temperature $T_{rec_k}^{LH-CIP}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
33	***T_Rec_Ref_V***	Real Value	K	Double (8 bytes)	3 elements	Reference NIR Receiver Temperature $T_{rec_k}^{LV-CIP}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing

34	***T_Rec_Ref_LICEF_H***	Real Value	K	Double (8 bytes)	72 elements	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.	Internal processing
35	***T_Rec_Ref_LICEF_V***	Real Value	K	Double (8 bytes)	72 elements	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.	Internal processing
	Cons_Long_PMS_Coefficients_Data					End of Cons_Long_PMS_Coefficients_Data structure	
	List_of_Cons_Long_PMS_Coefficients_Datas					End of List of Cons_Long_PMS_Coefficients_Datas	
	Cons_Long_PMS_Coefficients					End of Cons_Long_PMS_Coefficients binary Data set	
	PMS_Sensitivities					Init of PMS_Sensitivities binary Data set	
36	***PMS_Sensitivities_Counter***	Counter	N/A	Unsigned integer (4 bytes)	1 element	Number of PMS_Sensitivities_Data DSR structures.	Internal processing
	List_of_PMS_Sensitivities_Datas					Init of list of PMS_Sensitivities_Datas structures	
	PMS_Sensitivities_Data					Init of PMS_Sensitivities_Data structure.	
37	***Sequence_Start_Time***	Date	N/A	signed/unsigned integer (4	array of 3 elements	UTC Time at which the PMS Sensitivity calibration sequence was started. Start of first sequence	Internal

				bytes)	First element (days) is signed integer, remaining two unsigned integer.	consolidated, and also start of validity for data. Expressed in EE CFI transport time format	processing
38	***Sequence_Stop_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	UTC Time at which the PMS Sensitivity calibration sequence was closed. Stop time for last event in the sequence. Expressed in EE CFI transport time format	Internal processing
39	***Samples***	Real value	N/A	float (4 bytes)	1 element	Number of PMS Calibration events used in the computation of PMS Sensitivities	Internal processing
40	***Quality_Flag***	Integer value	N/A	Unsigned char	1 element	NOT USED for DPGS-V2 (filled with 0) Indicator of confidence level in the estimated sensitivities to be computed through a TBD method. (0 if OK, >0 if not OK)	Internal processing
41	***PMS_ID***	Identifier value	N/A	Unsigned byte	72 elements	PMS Unique identifier.	Internal processing
42	***PMS_Gain_Sensitivity***	Real Value	mV/K2	Double (8 bytes)	72 elements	PMS Gain Sensitivity to physical temperature $S_{T_{ph}}^{G_0}$	Internal processing
43	***PMS_Averaged_Gain***	Real Value	mV/K	Double (8 bytes)	72 elements	Averaged PMS Gain coefficient for PMS identified before	Internal processing
44	***PMS_Offset_Sensitivity***	Real Value	mV/K	Double (8 bytes)	72 elements	PMS Offset Sensitivity to physical temperature	Internal processing

						$S_{T_{ph}}^{V_{off\,0}}$.	
45	***T_Rec_Ref_H_Sensitivity***	Real Value	K/K	Double (8 bytes)	3 elements	Reference NIR Receiver Temperature Sensitivity $\frac{T_{rec_k}^{LH-CIP}}{\Delta T_{ph}}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
46	***T_Rec_Ref_V_Sensitivity***	Real Value	K/K	Double (8 bytes)	3 elements	Reference NIR Receiver Temperature Sensitivity $\frac{T_{rec_k}^{LV-CIP}}{\Delta T_{ph}}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
47	***T_Rec_Ref_LICEF_H_Sensitivity***	Real Value	K/K	Double (8 bytes)	72 elements	LICEF Receiver Noise Temperature at HAP Sensitivity. 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.	Internal processing
48	***T_Rec_Ref_LICEF_V_Sensitivity***	Real Value	K/K	Double (8 bytes)	72 elements	LICEF Receiver Noise Temperature at VAP Sensitivity. 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.	Internal processing
	PMS_Sensitivities_Data					End of PMS_Sensitivities_Data structure.	

	List_of_ PMS_Sensitivities_Datas					End of list of PMS_Sensitivities_Datas structures	
	PMS_Sensitivities					Endof PMS_Sensitivities binary Data set	
	FWF_Origin_Sensitivities					Init of FWF_Origin_Sensitivities binary Data set.	
49	***FWF_Origin_Sensitivities_Counter***	Counter	N/A	Unsigned integer (4 bytes)	Element	Number of FWF_Origin_Sensitivities_Data DSR structures	Internal processing
	List_of_ FWF_Origin_Sensitivities_Datas					Init of List of FWF_Origin_Sensitivities_Data structures.	
	FWF_Origin_Sensitivities_Data					Init of FWF_Origin_Sensitivities structure.	
50	***Sequence_Start_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	UTC Time at which the FWF0 Sensitivity calibration sequence was started. Start of first sequence consolidated, and also start of validity for data. Expressed in EE CFI transport time format	Internal processing
51	***Sequence_Stop_Time***	Date	N/A	signed/unsigned integer (4 bytes)	array of 3 elements First element (days) is signed integer, remaining two unsigned integer.	UTC Time at which the FWF0 Sensitivity calibration sequence was closed. Stop time for last event in the sequence. Expressed in EE CFI transport time format	Internal processing

52	***Correlator_Layer***	string	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Internal processing
53	***Samples***	Real value	N/A	float (4 bytes)	1 element	Number of FWF0 Calibration events used in the computation of PMS Sensitivities	Internal processing
54	***Quality_Flag***	Flag	N/A	Unsigned char	1 element	NOT USED for DPGS-V2 (filled with 0) Indicator of confidence level in the estimated sensitivities to be computed through a TBD method. (0 if OK, >0 if not OK)	Internal processing
55	***FWF_Origin_Amplitude _Sensitivity***	Real	N/A	Double (8 bytes)	71*36 elements	FWF at the origin Modulus Sensitivity to physical temperature $S_{T_{ph}}^{\lvert g_{kj} \rvert}$ It is the Fringe Washing Function at the origin for port C, Same distribution followed as the one depicted in Figure 4-1.	Internal processing
56	***FWF_Origin_Phase_Se nsitivity***	Real	N/A	Double (8 bytes)	71*36 elements	FWF at the origin Phase Sensitivity to physical temperature $S_{T_{ph}}^{\overline{g}_{kj}}$ It is the Fringe Washing Function at the origin for port C, Same distribution followed as the one depicted in Figure 4-1.	Internal processing
57	***Receiver_Temp***	Real	K	Float (4 bytes)	72 elements	Physical temperature of receivers in Kelvin. Ordering has been described previously.	Internal processing
	FWF_Origin_Sensitiviti es_Data					End of FWF_Origin_Sensitivities structure.	
	List_of_ FWF_Origin_Sensitiviti es_Datas					End of List of FWF_Origin_Sensitivities_Data structures.	

	FWF_Origin_Senstiivities					End of FWF_Origin_Sensitivities binary Data set.	
	Data_Block					End of binary Data Block in the product.	

Table 4-17. Level 1A Synthetic Curve of Correlated Noise Injection Product Data Block

4.2.2.3 Average Fringe Wash Function Data Type (MIR_AFWD1A / MIR_AFWU1A)

This product allows using an averaged version of the FWF shape estimated along several semi-orbits (typically 2, which may not necessarily be contained in 2 products as they can be started at the middle of an orbit). The algorithm shall be gathering all consecutive individual FWF from MIR_CORD0_ -obtained either when the instrument is pointing in nominal attitude- or from MIR_CORU0_ – the instrument is pointing with external attitude-, but never both of them together. Then the average of the calibrated correlations contained in them is performed, and the coefficients of the fringe-washing function in each antenna polarization plane from the resulting averaged calibrated correlations is computed.

The product contains only one set of FWF coefficients at different time delays, corresponding to a whole calibration campaign (which extent is decided backwards and onwards by checking if the gaps between FWF estimations are larger than a defined threshold). Knowing those three values for every pair of receivers, the FWF of each baseline may be approximated by any known function, so that a refined estimate is obtained. This estimate should be in turn used in the reconstruction process for computing the system response. This product contains the FWF measurements for every baseline (including redundant ones), so that the choice for the function for approximation may still be done outside of L1 automated processing. The product shall contain the FWF shape coefficients computed accordingly to the baseline shown in the In-Orbit Calibration Plan.

This product type contains the FWF coefficients of the average of the calibrated correlations obtained in correlated noise injection measurements of a calibration campaign, obtained either when the instrument is pointing in nominal attitude (from MIR_CORD0_ products) or when the instrument is pointing with external attitude (from MIR_CORU0_ products), but never both of them in the same product. The resulting products shall be named respectively MIR_AFWD1A and MIR_AFWU1A. The naming difference allows performing the distinction, although they share the same format specification and schemas. MIR_AFWD1A is the average FWF product to be used to create the AUX_GMATD_ product (which in turn will be used in MIR_SC_D1B and MIR_SC_F1B generation), while MIR_AFWU1A is the one to be used to create the AUX_GMATU_ product (which in turn will be used in MIR_TARD1B and MIR_TARF1B generation).

4.2.2.3.1 Specific Product Header

The Specific Product Header Format for Level MIR_AFWD1A/MIR_AFWU1A products follows the format described in table below:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
02	***Specific_Product_Header***	Starting Tag				Tag starting the Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in in Table 4-3	
20-26	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure's fields as defined in Table 4-4	INT
27	***FWF_Quality_Information***	Starting Tag				Tag starting of an ***FWF_Quality_Information*** structure	
28	***FWF_Averaged_Measurements_Threshold***	Integer	N/A	4 bytes	%04s	Field indicating the threshold for the acceptable minimum number of averaged individual FWF measurements, set as configuration value during the generation of this product	CNF
29	***N_Averaged_Measurements***	Real	N/A	1 byte	%uc	Number of averaged FWF measurements	INT
30	***FWF_ Quality***	Flag	N/A	1 byte	%+01d	Flag indicating that the average contained in the product as used less epochs than the number	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified as threshold in the configuration file. The possible values are: • 1 if number of averaged measurements is under the threshold • 0 if it is greater	
31	*FWF_Quality Information*	Closing Tag				Tag ending an ***Uncorrelated_Quality_Information*** structure	
36-47	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-5	
48	***Specific_Product_Header***	Closing Tag				Tag ending the Specific Product Header structure	

Table 4-18. Level 1A Average FWF Shape product SPH

The SPH Data Sets structures are also needed. The reference data sets for MIR_AFWD1A/MIR_AFWU1A Data Type are:

Reference Data Set Name	Product Type	Description
L0_CORRELATIONS_FILE	`MIR_CORD0_, MIR_CORU0_`	L0 Product filename from which the current L1a was created
L1A_FWF_CAL_FILE	`MIR_AFWD1A, MIR_AFWU1A`	Previous consolidated MIR_AFWD1A/MIRA_AFWU1A calibration product
L1A_HKTM_FILE	`TLM_MIRA1A`	HKTM filename containing the S/Cposition and attitude for the snapshots in the current product
S_PARAM_FILE	`AUX_SPAR__`	Auxiliary file with S-parameters characterisation used for L1a calibration
LICEF_FILE	`AUX_LCF___`	Auxiliary file with receivers' ohmic efficiency and absolute phase characterisation used for L1a calibration
PLM_FILE	`AUX_PLM___`	Auxiliary file with PLM characterisation, defining time lags and intermediate frequency

Reference Data Set Name	Product Type	Description
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-19. Level 1A Averaged FWF Reference Data Sets

4.2.2.3.2 Data Block

The binary Data Block of the MIR_AFWD1A/MIR_AFWU1A products consists of two Measurement datasets.

The following table describes the XML schema used to decode the binary contents of this type of dataset.

- The ***Cons_FWF_Measurements*** data set shall consist of the averaged FWF values for the three delays, for every pair of receivers (72x71/2 elements, as contained in nominal L1a products). There shall be then only three DSR. The size of each DSR is fixed and equal to 40929 bytes.
- The ***Cons_FWF_Coefficients*** data set shall consist of the FWF Shape coefficients derived from those previous averaged measurements. This shall be the FWF Shape used in the G Matrix computation. The FWF shape coefficients are obtained by approximating its amplitude by a sinc function, and its phase by a quadratic function.

$$\hat{\hat{r}}_{kj}(\tau) \approx A \cdot \mathrm{sinc}\left(B \cdot (\tau - C)\right) \cdot e^{i\left(D\tau^2 + E\tau + F\right)}$$

The size of each DSR is fixed and equal to 104825 bytes.

Field #	Field Name	Type	Uni t	Element Precision	Variable Format	Comment	Origin

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Cons_FWF_Measurements					Init of binary Data Set containing the list of ***FWF_Measurements_Delay*** records.	
01	***FWF_Measurements_Delay_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***FWF_Measurements_Delay*** data set record structures.	Generated by L1A Processor
	List_of_FWF_Measurements_Delay					Init of list of ***FWF_Measurements_Delay*** data set record structures, repeated ***FW_Cofficients_Delay_Counter*** times.	
	FWF_Measurements_Delay					Init of ***FWF_Measurements_Delay*** data set record structure.	
02	***Sequence_Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	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)	Generated by L1A Processor
03	***Sequence_Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	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)	Generated by L1A Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
04	***Correlator_Layer***	Character	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Copied from L1A HKTM
05	***Samples***	Real value	N/A	Float (4 bytes)	1 element	Number of total epochs averaged to perform each calibration step. Typically it shall be the average of all calibration steps.	Generated by L1A Processor
06	***Time_Delay***	Real value	N/A	Float (4 bytes)	1 element	Time delay applied for measuring FWF in this integration time. Accepted values shall be: 0, 1/55.84MHz and –1/55.84MHz.	Read from PLM ADF
07	***FWF_Measurements***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	71*36 elements. Order followed s depicted in Figure 4-1	FWF measured values at C port at time delay expressed in field #06 in all baselines (including redundant). FWF measured values at C port at time delay expressed in field #5 in all baselines (including redundant).	Generated by L1A Processor
	FWF_Measurements_Delay					End of ***FWF_Measurements_Delay*** data set record structure.	
	List_of_FWF_Measurements_Delay					End of list of ***FWF_Measurements_Delay*** data set record structures	
	Cons_FWF_Measurements					End of binary Data Set containing the list of ***FWF_Measurements_Delay*** records.	
	Cons_FWF_Coefficients					Init of binary Data Set containing the list of ***FWF_Coefficients_Data*** records.	
08	***FWF_Coefficients_Datas_ Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***FWF_Coefficients_Data*** data set record structures.	Generated by L1A Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_FWF_Coefficients_Datas					Init of list of ***FWF_Coefficients_Data*** data set record structures, repeated ***FW_Coefficients _Counter*** times.	
	FWF_Coefficients_Data					Init of ***FWF_Coefficients*** *data* set record structure.	
09	***Sequence_Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	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).	Generated by L1A Processor
10	***Sequence_Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	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)	Generated by L1A Processor
11	***Correlator_Layer***	Character	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Generated by L1A Processor
12	***Samples***	Real value	N/A	Float (4	1 element	Number of total epochs averaged to perform each calibration step. Typically it shall be the	Generated by L1A

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				bytes)		average of all calibration steps.	Processor
13	***A***	Array of real values	N/A	Double (8 bytes)	71*36 elements. Order followeds depicted in Figure 4-1	FWF Shape A coefficient for amplitude sinc approximation.	Generated by L1A Processor
14	***B***	Array of real values	N/A	Double (8 bytes)	71*36 elements. Order followeds depicted in Figure 4-1	FWF Shape B coefficient for amplitude sinc approximation.	Generated by L1A Processor
15	***C***	Array of real values	N/A	Double (8 bytes)	71*36 elements. Order followeds depicted in Figure 4-1	FWF Shape C coefficient for amplitude sinc approximation.	Generated by L1A Processor
16	***D***	Array of real values	N/A	Double (8 bytes)	71*36 elements. Order followeds depicted in Figure 4-1	FWF Shape D coefficient for phase quadratic approximation.	Generated by L1A Processor
17	***E***	Array of real values	N/A	Double (8 bytes)	71*36 elements. Order followeds depicted in Figure 4-1	FWF Shape E coefficient for phase quadratic approximation.	Generated by L1A Processor
18	***FWF_Shape_Quality***	Array of integer	N/A	Unsigned integer (1	71*36 elements.	One value per baseline (including redundant). It indicates if the FWF shape was measured during	Generated by L1A

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		values		byte)	Order followed s depicted in Figure 4-1	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).	Processor
	FWF_Coefficients_Data					End of ***FWF_Coefficients_Data*** data set record structure.	
	List_of_FWF_Coefficients_Datas					End of list of ***FWF_Coefficients_Data*** data set record structures	
	Cons_FWF_Coefficients					End of binary Data Set containing the list of ***FWF_Coefficients*** records.	
	FWF_Coefficients_Data					Init of ***FWF_Coefficients*** *data* set record structure.	

Table 4-20. Level 1A Fringe Wash Function Product Data Block

4.2.2.4 Averaged NIR Calibration Data Type (MIR_ANIR1A)

Consolidated NIR Calibration data is by combining the new NIR calibration measurements obtained from TLM and external targets observations with a previously existing (if any) consolidation product. The objective is to consolidate all NIR calibration data which is not older than a configurable time into a unique product file.

NIR Calibration data is produced several times during the orbit, whenever the NIR elements are working in other modes different than NIR-A (nominal measurement). These calibrations may usually require a S/C manoeuvre in order to point to the sky.

4.2.2.4.1 Specific Product Header

The Specific Product Header Format for MIR_ANIR1A products follows the format described in table below.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Starting Tag				Tag starting the SPH structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in fields #01 to #16 in Table 4-3	
20-26	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure defined as specified in Table 4-4	
27-38	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	
39	***Specific_Product_Header***	Closing Tag				Tag ending the SPH structure	

Table 4-21. Level 1A Averaged NIR Measurements product SPH

The reference data sets MIR_ANIR1A Data Type are:

Reference Data Set Name	Product Type	Description
L0_CORRELATIONS_FILE	`MIR_TARD0_, MIR_TARF0_`	L0 filename for science data in external target

Reference Data Set Name	Product Type	Description
L1A_HKTM_FILE	TLM_MIRA1A	HKTM filename containing the S/C position and attitude for the snapshots in the current product
L1A_NIR_FILE	MIR_ANIR1A	Previously consolidated NIR in-orbit calibration file
NIR_FILE	AUX_NIR___	Auxiliary file with external NIR characterisation
AUX_GALAXY_FILE	AUX_GALAXY	Original galaxy map
ANTENNA_PATTERNS_FILE	AUX_PATT__	Auxiliary file with receivers' amplitude and phase pattern characterisation used for generation of the G reconstruction matrix
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-22. Level 1A Averaged NIR Reference Data Sets

4.2.2.4.2 Data Block

As it is written in section 4.6.8.3 in [RD.1], the binary Data Block of the MIR_ANIR1A_ product consists of two Measurement datasets, containing different NIR Reference values along the orbit.Each of the data sets consists of a number of data set records, measuring different NIR reference values along the orbit.

The following table describes the XML schema used to decode the binary contents of this type of datasets.

- The ***Cons_NIR_A_External*** data set consists of on the calibrated NIR system, which shall be used as input in the NIR BT computation. There shall be as many Data Set Records for each product as complete sequences spent in NIR-A and NIR-LA mode, whose validity period has not expired. The size of each data set record is fixed and equal to 461 bytes.
- The ***Cons_NIR_R_External*** data set consists of on the calibrated CAS system, which shall be used as input in the NIR-R calibration while processing Correlated Noise Injection data. There shall be as many Data Set Records for each product as complete sequences spent in NIR-A and NIR-AR mode, whose validity period has not expired. The size of each DSR is fixed and equal to 316 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Cons_NIR_A_External					Init of binary Data Set containing the list of NIR_A_External_Sample records.	
01	***Cons_NIR_A_External_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of NIR_A_External data set record structures.	Generated by L1A Processor
	List_of_Cons_NIR_A_External_Datas					Init of list of List_of_Cons_NIR_A_External_Datas data set record structures, repeated Counter times.	
	Cons_NIR_A_External_Data					Init of NIR_A_External_Data data set record structure.	
02	***Sequence_Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence. Expressed in EE CFI transport time format (Array of 3 integer elements)	Copied from L1A HKTM
03	***Sequence_Stop_Time***	Date	N/A	signed /unsigned integer (4	Vector array of 3 elements First element (days) is signed	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	Copied from L1A HKTM

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				bytes)	integer, remaining two (seconds and microseconds) are unsigned	integer elements)	
04	***Correlator_Layer***	Identifier	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Internal processing
05	***Samples***	Real value	N/A	Float (4 bytes)	1 element	Number of epochs averaged to perform the calibration.	Internal processing
06	***NIR_Expected_BT_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	NIR Expected Brightness Temperature in H polarisation $T'_{A0,h}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
07	***NIR_Expected_BT_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	NIR Expected Brightness Temperature in V polarisation $T'_{A0,v}$ One measurement per NIR. Order followed is AB, BC, CA	Internal processing
08	***NIR_Observed_Antenna_BT_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	NIR Observed Brightness Temperature in H polarisation $T'''_{A0,h}$ at antenna plane during calibration One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
09	***NIR_Observed_Antenna_BT_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	NIR Observed Brightness Temperature in V	Internal process

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						polarisation $T'''_{A0,v}$ at antenna plane during calibration One measurement per NIR. Order followed is AB, BC, CA.	ing
10	***T_Noise_Cal_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Calibrated NIR Noise Source Temperature $T_{NA0,h}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
11	***T_Noise_Cal_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Calibrated NIR Noise Source Temperature $T_{NA0,v}$ One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
12	***T_Phys_Tpu_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of NIR_LICEF_H (Tpu). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
13	***T_Phys_Tpu_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of NIR_LICEF_V (Tpu). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
14	***T_Phys_Tp6***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the antenna intermediate layer (Tp6). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
15	***T_Phys_Tp7***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the antenna patch (Tp7). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
16	***T_Phys_Tp3_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the reference attenuator (Tp3h). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA	Internal processing
17	***T_Phys_Tp3_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the reference attenuator (Tp3v). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
18	***T_Phys_Tp1_H***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the NIR diode (Tp1h). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed	Internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						is AB, BC, CA.	
19	***T_Phys_Tp1_V***	Real value	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the NIR diode (Tp1v). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA	Internal processing
20	***Cross_Coupling_Factor***	Real value	N/A	Double (8 bytes)	Vector array of 3x2 elements.	Cross-coupling factor (χ). One value for II correlations, and another for QI correlations per NIR (for Redundant Correlator layer, it is QQ and IQ).	Internal processing
21	***Leakage_Factor***	Real value	N/A	Double (8 bytes)	Vector array of 3x2 elements.	Leakage factor (Θ). One value for II correlations, and another for QI correlations per NIR (for Redundant Correlator layer, it is QQ and IQ).	Internal processing
	Cons_NIR_A_External_Data					End of Cons_NIR_A_External_Data data set record structure.	
	List_of_Cons_ NIR_A_External_Datas					End of list of Cons_NIR_A_External_Data data set record structures.	
	Cons_NIR_A_External					End of binary Data Set containing the list of Cons_NIR_A_External_Sample records.	
	Cons_NIR_R_External					Init of binary Data Set containing the list of NIR_External_Sample records.	
22	***Cons _NIR_R_External_Counter***	Counter	N/A	unsigned integer (4	1 element	Number of Cons_NIR_R_External data set record structures.	Generated by

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				bytes)			L1A Proces sor
	List_of_Cons_NIR_R_External_Datas					Init of list of Cons_NIR_R_External_Datas data set record structures, repeated Counter times. The list contains as many DSR as integration times spent in NIR-R mode in the product.	
	Cons_NIR_R_External_Data					Init of Cons_NIR_R_External_Data data set record structure.	
23	***Sequence_Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the calibration sequence was started. Start of integration time period for the first event in the sequence. Expressed in EE CFI transport time format	Copied from L1A HKTM
24	***Sequence_Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	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)	Copied from L1A HKTM
25	***Samples***	Real value	N/A	Float (4 bytes)	1 element	Number of epochs averaged to perform the calibration.	Based on L1 HKTM

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
26	***NIR_Observed_BT_H***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	NIR Observed Brightness Temperature in H polarisation $T_{A\_ON0,h}^{CIP}$ during calibration One measurement per NIR. Order followed is AB, BC, CA.	Based on L1 HKTM
27	***NIR_Observed_BT_V***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	NIR Observed Brightness Temperature in V Polarisation $T_{A\_ON0,v}^{CIP}$ during calibration One measurement per NIR. Order followed is AB, BC, CA.	Based on L1 HKTM
28	***T_Noise_Cal_Ref_H***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Calibrated NIR Noise Source Temperature $T_{NR0,h}$ in the reference branch One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
29	***T_Noise_Cal_Ref_V***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Calibrated NIR Noise Source Temperature $T_{NR0,v}$ in the reference branch One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
30	***T_Phys_Tpu_H***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of NIR_LICEF_H (Tpu). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
31	***T_Phys_Tpu_V***	Real	K	Double (8	Vector array of 3	Reference Physical Temperature of NIR_LICEF_V (Tpu). Obtained as an	Internal

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		values		bytes)	elements.	average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	processing
32	***T_Phys_Tp6***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the antenna intermediate layer (Tp6). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
33	***T_Phys_Tp7***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the antenna patch (Tp7). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
34	***T_Phys_Tp3_H***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the reference attenuator (Tp3h). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
35	***T_Phys_Tp3_V***	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the reference attenuator (Tp3v). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA	Internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
36	*T_Phys_Tp1_H*	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the NIR diode (Tp1h). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
37	*T_Phys_Tp1_V*	Real values	K	Double (8 bytes)	Vector array of 3 elements.	Reference Physical Temperature of the NIR diode (Tp1v). Obtained as an average during the whole calibration sequence. One measurement per NIR. Order followed is AB, BC, CA.	Internal processing
	Cons_NIR_R_External_Data					End of Cons_NIR_R_External_Data data set record structure.	
	List_of_Cons_NIR_R_External_Samples					End of list of Cons_NIR_R_External_Sample data set record structures, repeated Counter times. The list contains as many DSR as integration times spent in NIR-R mode in the product.	
	Cons_NIR_R_External					End of binary Data Set containing the list of Cons_NIR_R_External_Sample records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-23. Level 1A NIR Calibration Product Data Block

4.2.3 L1A Data Specification

L1A Data are the products obtained in science measurement mode (either pointing to the earth –nominal- or to external sources - i.e. deep Sky, Moon…-) in both dual and full polarisation, converted to raw correlations and calibrated using MIRAS calibration data (see section 4.2).

There is a unique type of product, as it contains the calibrated visibilities between receivers, before any reconstruction is applied. These products present these calibrated visibilities in a known array, detailed in Figure 4-1, so that the reconstruction process may re-order and apply the reconstruction algorithm as needed.

4.2.3.1 Dual Polarization Calibrated Visibilities (MIR_SC_D1A / MIR_TARD1A)

The dual polarization calibrated visibilities are obtained after converting the dual polarization L0 science packets into raw correlations and calibrating them.

MIR_SC_D1A products contain reformatted, unpacked and calibrated complex correlations coming from L0 data, combined per integration time and including all redundant visibilities. The basic distribution of calibrated visibilities within the binary structure shall be the one shown in Figure 4-1, based on the same distribution found in the ASICs correlations matrix. This time, the data being provided is complex calibrated visibilities, so only the elements above the diagonal are needed. The reconstruction module shall extrapolate elements below the diagonal, by simply doing the complex conjugate, or any other approach. The elements in the diagonal (zero baseline) shall be the cross-correlation of the I and Q channels of the same LICEF, and provided in a separate structure.

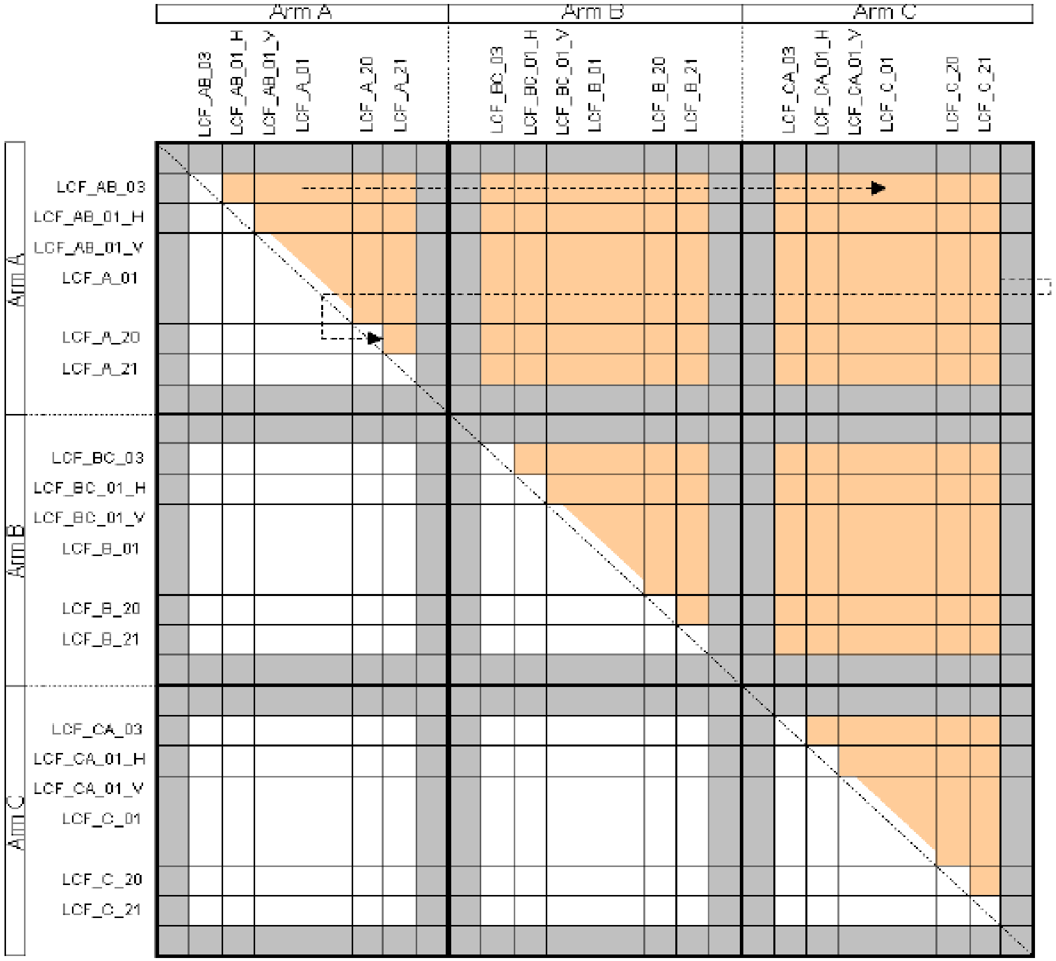

Figure 4-1. Visibilities array order (taken from Deimos Eng., L1PP Product format)

Depending on the polarisation mode, correlation from the baselines with a LICEF_NIR shall be chosen by the reconstruction module, as both H and V signals are correlated simultaneously. In case of dual polarisation, cross-correlations shall be mostly unused, but for full polarisation they may be needed as they provide additional baselines.

Additionally, whenever temperature measurements are given for all 69 receivers, the ordering of those values shall follow the standard baseline, using the 72 signals i.e. LCF_AB_03, LCF_AB_01_H (NIR), LCF_AB_01_V (NIR), LCF_A_01, LCF_A_02…LCF_A_21, LCF_BC_03, LCF_BC_01_H (NIR), LCF_BC_01_V (NIR), LCF_B_01…LCF_B_21, LCF_CA_03, LCF_CA_01_H (NIR), LCF_CA_01_V (NIR), LCF_C_01…LCF_C_21.

4.2.3.1.1 Specific Product Header

The Specific Product Header for MIR_SC_D1A product shall follow the format described in table below:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
03	***Specific_Product_Header***	Starting Tag				Tag starting the Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in in Table 4-3	
20-26	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure's fields as defined in Table 4-4	
27	***U_Correction_Applied***	Flag	N/A	1 byte	%d	Flag indicating if the U_Correction has been applied on the calibrated visibilities. ▪ 1=correction applied ▪ 0=not applied	ADF

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
28-39	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-5	
40	***Specific_Product_Header***	Closing Tag				Tag ending the Specific Product Header structure	

Table 4-24. Level 1A MIR_SC_D1A/MIR_TARD1A SPH

The reference data sets for L1 A Products are:

Reference Data Set Name	Product Type	Description
L0_CORRELATIONS_FILE	`MIR_SC_D0_,MIR_SC_F0_, MIR_TARD0_, MIR_TARF0_`	L0 Product filename from which the current L1a was created
L1A_AVER_OFFSET_FILE	`MIR_UAVU1A MIR_UAVD1A`	L1A offset filename containing the average of the uncorrelated noise injection measurements used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different name)
L1A_ORBIT_AMPL_PHASE_FILE	`MIR_CRSU1A MIR_CRSD1A`	L1a Calibration filename containing several sets of parameters obtained during short calibration at different latitudes, used to calibrate the L1a visibilities (different products for nominal and external attitudes, with different name)
L1A_AVER_NIR_CAL_FILE	`MIR_ANIR1A`	Consolidated NIR calibrated parameters filename used to calibrate L1A visibilities
L1A_HKTM_FILE	`TLM_MIRA1A`	HKTM filename containing the S/C position and attitude for the snapshots in the current product
PMS_FILE	`AUX_PMS___`	Auxiliary file with external PMS characterisation
NIR_FILE	`AUX_NIR___`	Auxiliary file with external NIR characterisation
S_PARAM_FILE	`AUX_SPAR__`	Auxiliary file with S-parameters characterisation used for plane translation of calibration data
LICEF_FILE	`AUX_LCF___`	Auxiliary file with absolute phase characterisation used for plane translation of L1A calibration data

Reference Data Set Name	Product Type	Description
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-25. Level 1A Calibrated Visibilites Reference Data Sets

4.2.3.1.2 Data Block

The binary Data Block of the MIR_SC_D1A product consists of one Measurement datasets, containing the calibrated visibilities and other supporting parameters. There is one DSR for each integration time, either in HHH or VVV polarization modes. This Data Set will contain as many Data Set Records as snapshots measured by the instrument in [RD.1] for more specific details on this data block. .

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 ***Calibrated_Visib_Dual.***

- The ***Calibrated_Visib_Dual*** data set consists of the complete set of calibrated visibilities obtained by processing Level 0 dual polarization products. There shall be as many Data Set Records for each product as integration times spent in dual polarization measurement mode pointing in the same direction during the half orbit (i.e. dual-pol measurements shall be separated in different products if they are observing the earth suface –nominal- or external sources –Moon, deep sky, etc.-). The first field in the dataset, ***Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Calib_Data*** dataset record structure. The size of each DSR is fixed and equal to 41891 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Calibrated_Visib_Dual					Init of binary Data Set containing the list of	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						Calib_data records.	
01	***Calib_Data_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Calib_data*** data set record structures.	Generated by L1A Processor
	List_of_Calib_Datas					Init of list of ***Calib_data*** data set record structures, repeated ***Counter*** times. There are as many DSR as integration times spent in the product.	
	Calib_Data					Init of ***Calib_Data data*** set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Middle of integration time period, propagated from UTC at start of integration provided in ancillary packet. Expressed in EE CFI transport time format.	Copied from L1A HKTM product
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Internal processing
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from secondary header in scene packets
05	***Correlator_Layer***	Character	N/A	char (1 byte)	1 element	Correlator layer from which the data was	Copied from L1A HKTM

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						taken (NOMINAL='N' or REDUNDANT='R')	product
06	***Snapshot_Order***	Identifier	N/A	char (1 byte)	1 element	Order within the same integration time (OBET) in which this scene was taken ('0' for HHH or VVV, '1', '2', or '3' for the combined polarisations). Set always to '0' for DSR ***Calib_Visib_Dual***	Internal processing
07	***Receiver_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (order followed is described in last paragraph of 4.2.3.1)	Physical temperature of receivers in Kelvin. One value per receiver.	Copied from L1A HKTM product
08	***Sys_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (order followed is described in last paragraph of 4.2.3.1)	System temperature of receivers in respective polarisation (field #09), used for de-normalisation of visibilities, expressed in Kelvin. One value per receiver.	Generated by L1A Processor
09	***Receiver_Noise_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (one value per receiver, order followed is described in last paragraph of 4.2.3.1)	LICEF Noise Temperature in respective polarisation (field #11),expressed in Kelvin.	Generated by L1A Processor
10	***NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 12 elements.Four values (H, V, T3 and T4) per receiver.. Order followed is AB-H, AB-V, AB-T3, ABT4, BC-H, BC-V, BC-T3, BC-T4, CAH, CA-V, CA-T3 and CA-T4.	Brightness temperatures measured at NIR elements in Kelvin. To be used as "zero baseline" for reconstruction process.	Generated by L1A Processor
11	***Pol_Mode***	Set of flags	N/A	unsigned byte	1 element (3 bits are used)	Polarisation mode in receivers (HHH or VVV).	Based on L1A HKTM

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							product
12	***Calib_Visib***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	71*36 elements. Order followed s depicted in Figure 4-1	Complex calibrated visibilities in all measured baselines (including redundant).	Generated by L1A Processor from L0 product
13	***Antenna_Boresight***	Array of real values	deg	Float (4bytes)	2 elements	In case of MIR_SC_D1A: • First element is Latitude of Earth surface point in the snapshot's boresight direction. • Second element is Longitude of Earth surface point in the snapshot's boresight direction. In case of MIR_TARD1A: • First element is Right Ascension in the snapshot's boresight direction (coordinates reference system is B1950). • Second element is Declination in the snapshot's boresight direction (coordinates reference system is B1950).	Generated by L1A Processor
	Calib_Data					End of ***Calib_Data data*** set record structure.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_Calib_datas					End of list of ***Calib_data*** data set record structures.	
	Calibrated_Visib_Dual					End of binary Data Set containing the list of ***Calib_data*** records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-26. Level 1A Dual Polarization Calibrated Visibilities Product Data Block

4.2.3.2 Full Polarization Calibrated Visibilities (MIR_SC_F1A / MIR_TARF1A)

The full polarization calibrated visibilities are obtained after converting the full polarization L0 science packets into raw correlations and calibrating them.

Full polarisation products contain one set of complete visibilities for each snapshot.

4.2.3.2.1 Specific Product Header

The Specific Product Header for MIR_SC_F1A products are identical to the MIR_SC_D1A products (section 4.2.3.1.1).

4.2.3.2.2 Data Block

The binary Data Block of the MIR_SC_F1A product consists of one Measurement datasets, containing the calibrated visibilities and other supporting parameters. There is one DSR for the first integration time, either in HHH or VVV polarization modes; and three more

DSR dedicated to the measurements obtained during second integration time (HVV, VHV and VVH; or VHH, HVH and HHV). This structure is applicable to any scene produced in [RD.1]full-polarisation, the only difference with regard to the dual-polarisation structure is that it includes a byte to determine the order of the scenes captured in the same integration time. It includes the System Temperatures for all receivers in the appropriate polarisations, as they all are used for de-normalisation.

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 ***Calibrated_Visib_Full.***

- The ***Calibrated_Visib_Full*** data set consists of the complete set of calibrated visibilities obtained by processing Level 0 full polarization products. There shall be a complete Data Set Record for each complete snapshot, i.e. one per integration time for the pure polarisation acquisition and three per integration time for the combined polarisation acquisition, when pointing in the same direction during the half orbit (i.e. dual-pol measurements shall be separated in different products if they are observing the earth suface –nominal- or external sources –Moon, deep sky, etc.-). The first field in the dataset, ***Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Calib_Data*** dataset record structure. The size of each DSR is fixed and equal to 41891 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Calibrated_Visib_Full					Init of binary Data Set containing the list of ***Calib_data*** records.	
01	***Calib_Data_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Calib_data*** data set record structures.	Generated by L1A Processor
	List_of_Calib_Datas					Init of list of ***Calib_data*** data set record structures, repeated ***Counter*** times. The number of DSR is twice the number of integration periods (one DSR for the first integration period, three DSR for the second	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						integration period; all four DSR can be gathered in a full polarization scene).	
	Calib_Data					Init of ***Calib_Data data*** set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Middle of integration time period, propagated from UTC at start of integration provided in ancillary packet. Expressed in EE CFI transport time format.	Copied from L1A HKTM product
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Internal processing
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from secondary header in input scene
05	***Correlator_Layer***	Character	N/A	char (1 byte)	1 element	Correlator layer from which the data was taken (NOMINAL='N' or REDUNDANT='R')	Copied from L1A HKTM product
06	***Snapshot_Order***	Identifier	N/A	Char (1 byte)	1 element	Order within the same integration time (OBET) in which this scene was taken ('0' for HHH or VVV, '1', '2', or '3' for the combined polarisations).	internal processing

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
07	***Receiver_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (order followed is described in last paragraph of 4.2.3.1)	Physical temperature of receivers in Kelvin. One value per receiver.	Based on L1A HKTM product
08	***Sys_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (order followed is described in last paragraph of 4.2.3.1)	System temperature of receivers in respective polarisation (field #11), used for de-normalisation of visibilities, expressed in Kelvin. One value per receiver.	Generated by L1A Processor
09	***Receiver_Noise_Temp***	Array of real values	K	Float (4 bytes)	Vector array of 72 elements (one value per receiver, order followed is described in last paragraph of 4.2.3.1)	LICEF Noise Temperature in respective polarisation (field #11),expressed in Kelvin.	Generated by L1A Processor
10	***NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 12 elements.Four values (H, V, T3 and T4) per receiver.. Order followed is AB-H, AB-V, AB-T3, ABT4, BC-H, BC-V, BC-T3, BC-T4, CAH, CA-V, CA-T3 and CA-T4.	Brightness temperatures measured at NIR elements in mKelvin. To be used as “zero baseline” for reconstruction process.	Generated by L1A Processor
11	***Pol_Mode***	Set of flags	N/A	unsigned byte	1 element (3 bits are used)	Polarisation mode in receivers, as described in field #11 of CALIBRATED_VISIB_DUAL (HHH=000, HVV=011, VHV=101, VVH=110, VVV=111, VHH=100, HVH=010, HHV=001)	Based on L1A HKTM product
12	***Calib_Visib***	Array of complex	N/A	Double (real part) + double	71*36 elements. Order followed s	Complex calibrated visibilities in all	Generated by L1A Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		values		(imag part), totally 16 bytes	depicted in Figure 4-1	measured baselines (including redundant).	from L0 product
13	***Antenna_Boresight***	Array of real values	deg	Float (4bytes)	2 elements	In case of MIR_SC_F1A: • First element is Latitude of Earth surface point in the snapshot's boresight direction. • Second element is Longitude of Earth surface point in the snapshot's boresight direction. In case of MIR_TARF1A: • First element is Right Ascension in the snapshot's boresight direction (coordinates reference system is B1950). • Second element is Declination in the snapshot's boresight direction (coordinates reference system is B1950).	Generated by L1A Processor
	Calib_Data					End of ***Calib_Data data*** set record structure.	
	List_of_Calib_Datas					End of list of ***Calib_data*** data set record structures.	
	Calibrated_Visib_Full					End of binary Data Set containing the list of ***Calib_data*** records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-27. Level 1A Full Polarization Calibrated Visibilities Product Data Block

4.2.4 L1B Data Specification

L1B Data are the products obtained in science measurement mode (either pointing to the earth –nominal- or to external sources), starting from L1A calibrated visibilities and performing a correction for contamination sources and an image reconstruction.

To perform the corrections and reconstruction, the L1B processors need supporting calibration data derived from MIRAS measurements (presented in section 4.2.4.1): the G Matrix or Instrument System Response, its mathematical reduction the J+ Matrix, and the Flat Target Transformation product.

4.2.4.1 L1B Calibration products

4.2.4.1.1 Specific Product Header

The Specific Product Header for Level 1B Calibration products shall follow the format described in section 4.1.2 and shall include the following information:

- Level 1 Main Info SPH
- Level1 SPH Data Sets

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Starting				Tag starting the Specific Product Header structure	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
		Tag					
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in fields 01 to 16 in Table 4-3	
20-31	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	N/A
32	***Specific_Product_Header***	Closing Tag				Tag ending the Specific Product Header structure	

Table 4-28. Level 1B Calibration Products SPH

4.2.4.1.2 G Matrix (MIR_GMATD_ / MIR_GMATU_)

The MIR_GMATD_/ MIR_GMATU_ product consists of 1 dataset containing the instrument's system response values, with 15996 data set record (the rows of the G Matrix), each DSR with 65536 values. The binary format of the matrix is specified in 4.20 in [RD.2].

Initially the ***G-matrix*** shall be defined as the mathematical operator required to transform the complex calibrated visibilities plus the zero frequency value measured through the NIR elements, into reconstructed Brightness Temperature values.

The complete system can be described by a unique G matrix, which takes as input the data produced in all polarisations (H, V and HV). This unique G matrix includes the effect of cross-polarisation antenna patterns into the reconstruction. This G matrix format is the same for all reconstruction methods; the only difference between reconstruction approaches lies in the external elements used to construc it.

If the level of cross-polarisation contamination can be disregarded, because its effect is negligible (there shall be a conclusive study on this matter TBC), this unique G matrix could be split into three separate and smaller G matrices, one for each polarisation.

The purpose of this matrix (or matrices) is to be used for computation of the J+ matrix operator, which is described in the next chapter.

The matrix shall be consistent in attitude with the measurement product to which processing it is applied. MIR_GMATU_ is generated from MIR_AFWU1A and is to be used for MIR_JMATU_ generation only. Equivalently, MIR_GMATD_ is generated from MIR_AFWD1A and is to be used for MIR_JMATD_ generation only.

4.2.4.1.2.1 Specific Product Header

The header of the MIR_GMATD_/ MIR_GMATU_ product contains the FH, MPH and the SPH as defined in Table 4-34.

The reference data sets for MIR_GMATD_/ MIR_GMATU_ Data Type are:

Reference Data Set Name	Product Type	Description
L1A_AVER_FWF_CAL_FILE	`MIR_AFWU1A` `MIR_AFWD1A`	L1a Average Fringe Washing Function estimated coefficients used in the computation of the reconstruction G Matrix
PLM_FILE	`AUX_PLM___`	Auxiliary file with PLM characterisation, defining receiver's physical coordinates
ANTENNA_PATTERNS_FILE	`AUX_PATT__`	Auxiliary file with receivers' amplitude and phase pattern characterisation used for generation of the G reconstruction matrix
ALGORITHM_CONFIG_FILE	`AUX_CNFL1P`	Processor Configuration Parameters and Constants for L1OP

Table 4-29. G Matrix Reference Data Sets

4.2.4.1.2.2 Data Block

As written in in 4.22 in [RD.2], the MIR_GMATD_/ MIR_GMATU_ product consists of 1 dataset containing the instrument's system response values, with 15996 data set record (the rows of the G Matrix), each DSR with 65536 values.

The binary format of the matrix is specified following. Rows in the G matrix shall be ordered as follows:

- The first 2346*2+3 rows shall correspond to H polarisation calibrated visibilities
- The next 2346*2+3 rows shall correspond to V polarisation calibrated visibilities
- The final 3303*2 rows shall correspond to HV polarisation calibrated visibilities

Going into further detail:

- The first 3 rows shall correspond to the zero baselines as measured from the NIR for H polarisation. Order shall be first NIR_AB, then NIR_BC and last NIR_CA
- The next 2346 rows shall correspond to the real values of the H polarisation calibrated visibilities as received from the L1a products, and ordered in the same approach as shown in Figure 4-1, i.e. first element shall be calibrated visibility of LICEF_AB_03 against LICEF_AB_01_H, next shall be LICEF_AB_03 against LICEF_A_01, etc… until the sixty ninth element LICEF_AB_03 against LICEF_C_21. The next element shall then be LICEF_AB_01_H against LICEF_A_01, and so on until LICEF_AB_01 against LICEF_C_21. The next shall be LICEF_A_01 against LICEF_A_02, etc. until LICEF_A_02 against LICEF_C_21. This ordering shall continue until all LICEF correlations have been inserted, and not including correlations with LICEF_NIR in V polarisation (i.e. correlations with receivers LICEF_AB_01_V, LICEF_BC_01_V and LICEF_CA_01_V).
- The next 2346 rows shall correspond to the imaginary values of the H polarisation calibrated visibilities, following the same order as above.
- The next 3 rows shall correspond to the zero baselines as measured from the NIR for V polarisation. Order shall be first NIR_AB, then NIR_BC and last NIR_CA
- The next 2346 rows shall correspond to the real values of the V polarisation calibrated visibilities as received from the L1a products, and ordered in the same approach as shown in Figure 4-1, i.e. first element shall be calibrated visibility of LICEF_AB_03 against LICEF_AB_01_V, next shall be LICEF_AB_03 against LICEF_A_01, etc… until the sixty ninth element LICEF_AB_03 against LICEF_C_21. The next element shall then be LICEF_AB_01_V against LICEF_A_01, and so on until LICEF_AB_01 against LICEF_C_21. The next shall be LICEF_A_01 against LICEF_A_02, etc. until LICEF_A_02 against LICEF_C_21. This ordering shall continue until all LICEF correlations have been inserted, and not including correlations with LICEF_NIR in H polarisation (i.e. correlations with receivers LICEF_AB_01_H, LICEF_BC_01_H and LICEF_CA_01_H). Please refer to Figure 4-1 for a visual representation of the order followed.
- The next 2346 rows shall correspond to the imaginary values of the V polarisation calibrated visibilities, following the same order as above.
- The next 3303 rows shall correspond to the real values of the HV polarisation calibrated visibilities as received from the L1a products, and ordered in the following approach. Please refer to Figures 10 and 11 of [RD.13] (orange cells) for a visual representation of the description:

- First 528 rows with calibrated visibilities of elements in Arm A in H polarisation against elements in Arm B in V polarisation. I.e. first LICEF_AB_03 against LICEF_BC_03, then LICEF_AB_03 against LICEF_BC_01_V, then LICEF_AB_03 against LICEF_B_01, until the 23rd element LICEF_AB_03 against LICEF_B_21. Next is LICEF_AB_01_H against LICEF_BC_03, then LICEF_AB_01_H against LICEF_B_01, and so on until all elements in arm B are correlated with LICEF_AB_01_H (please note that this row does not include the correlation against LICEF_BC_01_V). This ordering continues until the last element correlated is LICEF_A_21 against LICEF_B_21.
- Next 528 rows with calibrated visibilities of elements in arm A in H polarisation against elements in arm C in V polarisation. Same order as above, i.e. first LICEF_AB_03 against LICEF_CA_03, then LICEF_AB_03 against LICEF_CA_01_V, then LICEF_AB_03 against LICEF_C_01, until the 23rd element LICEF_AB_03 against LICEF_C_21. Next is LICEF_AB_01_H against LICEF_CA_03, then LICEF_AB_01_H against LICEF_C_01, and so on until all elements in arm C are correlated with LICEF_AB_01_H (please note that this row does not include the correlation against LICEF_CA_01_V). This ordering continues until the last element correlated is LICEF_A_21 against LICEF_C_21.
- Next 528 rows with calibrated visibilities of elements in arm B in H polarisation against elements in arm A in V polarisation. Same order as above, i.e. first LICEF_BC_03 against LICEF_AB_03, then LICEF_BC_03 against LICEF_AB_01_V, then LICEF_BC_03 against LICEF_A_01, until the 23rd element LICEF_BC_03 against LICEF_A_21. Next is LICEF_BC_01_H against LICEF_AB_03, then LICEF_BC_01_H against LICEF_A_01, and so on until all elements in arm A are correlated with LICEF_BC_01_H (please note that this row does not include the correlation against LICEF_AB_01_V). This ordering continues until the last element correlated is LICEF_B_21 against LICEF_A_21.
- Next 528 rows with calibrated visibilities of elements in arm B in H polarisation against elements in arm C in V polarisation. Same order as above, i.e. first LICEF_BC_03 against LICEF_CA_03, then LICEF_BC_03 against LICEF_CA_01_V, then LICEF_BC_03 against LICEF_C_01, until the 23rd element LICEF_BC_03 against LICEF_C_21. Next is LICEF_BC_01_H against LICEF_CA_03, then LICEF_BC_01_H against LICEF_C_01, and so on until all elements in arm C are correlated with LICEF_BC_01_H (please note that this row does not include the correlation against LICEF_CA_01_V). This ordering continues until the last element correlated is LICEF_B_21 against LICEF_C_21.
- Next 528 rows with calibrated visibilities of elements in arm C in H polarisation against elements in arm A in V polarisation. Same order as above, i.e. first LICEF_CA_03 against LICEF_AB_03, then LICEF_CA_03 against

LICEF_AB_01_V, then LICEF_CA_03 against LICEF_A_01, until the 23rd element LICEF_CA_03 against LICEF_A_21. Next is LICEF_CA_01_H against LICEF_AB_03, then LICEF_CA_01_H against LICEF_A_01, and so on until all elements in arm A are correlated with LICEF_CA_01_H (please note that this row does not include the correlation against LICEF_AB_01_V). This ordering continues until the last element correlated is LICEF_C_21 against LICEF_A_21.

- Next 528 rows with calibrated visibilities of elements in Arm C in H polarisation against elements in Arm B in V polarisation. Same order as above, i.e. first LICEF_CA_03 against LICEF_BC_03, then LICEF_CA_03 against LICEF_BC_01_V, then LICEF_CA_03 against LICEF_B_01, until the 23rd element LICEF_CA_03 against LICEF_B_21. Next is LICEF_CA_01_H against LICEF_BC_03, then LICEF_CA_01_H against LICEF_B_01, and so on until all elements in arm B are correlated with LICEF_CA_01_H (please note that this row does not include the correlation against LICEF_BC_01_V). This ordering continues until the last element correlated is LICEF_C_21 against LICEF_B_21.
- Next 23 rows with calibrated visibilities of LICEF_AB_01_H against all other receivers in arm A in V polarisation. I.e. LICEF_AB_01_H against LICEF_AB_03, LICEF_AB_01_H against LICEF_AB_01_V, LICEF_AB_01_H against LICEF_A_01, etc… until LICEF_AB_01_H against LICEF_A_21
- Next 22 rows with calibrated visibilities of all receivers in arm A in H polarisation against LICEF_AB_01_V, excluding LICEF_AB_01_H against LICEF_AB_01_V, whose equation is presented in the point above. I.e. LICEF_AB_03 against LICEF_AB_01_V, LICEF_A_01 against LICEF_AB_01_V, etc… until LICEF_A_21 against LICEF_AB_01_V
- Next 23 rows with calibrated visibilities of LICEF_BC_01_H against all other receivers in arm B in V polarisation. I.e. LICEF_BC_01_H against LICEF_BC_03, LICEF_BC_01_H against LICEF_BC_01_V, LICEF_BC_01_H against LICEF_B_01, etc… until LICEF_BC_01_H against LICEF_B_21
- Next 22 rows with calibrated visibilities of all receivers in arm B in H polarisation against LICEF_BC_01_V, excluding LICEF_BC_01_H against LICEF_BC_01_V, whose equation is presented in the point above. I.e. LICEF_BC_03 against LICEF_BC_01_V, LICEF_B_01 against LICEF_BC_01_V, etc… until LICEF_B_21 against LICEF_BC_01_V
- Next 23 rows with calibrated visibilities of LICEF_CA_01_H against all other receivers in arm C in V polarisation. I.e. LICEF_CA_01_H against LICEF_CA_03, LICEF_CA_01_H against LICEF_CA_01_V, LICEF_CA_01_H against LICEF_C_01, etc… until LICEF_CA_01_H against LICEF_C_21

  - o Next 22 rows with calibrated visibilities of all receivers in arm C in H polarisation against LICEF_CA_01_V, excluding LICEF_CA_01_H against LICEF_CA_01_V, whose equation is presented in the point above. I.e. LICEF_CA_03 against LICEF_CA_01_V, LICEF_C_01 against LICEF_CA_01_V, etc… until LICEF_C_21 against LICEF_CA_01_V

- The following and last 3303 rows shall correspond to the imaginary values of the HV polarisation calibrated visibilities as received from the L1a products, and ordered in the approach that has been just described.

Columns in the G matrix shall be ordered in the following way:

- The first 128x128 columns shall correspond to H polarisation Brightness Temperatures
- The next 128x128 columns shall correspond to V polarisation Brightness Temperatures
- The next 128x128 columns shall correspond to the real components of the HV polarisation Brightness Temperatures
- The final 128x128 columns shall correspond to the imaginary components of the HV polarisation Brightness Temperatures

Going into more detail, each distribution of 128x128 elements shall correspond to the SMOS natural hexagonal grid represented in a rectangular matrix. The centre (0,0) shall be the first element of the distribution. The following figures show the resulting xi-eta distribution of values for a 128x128 Brightness Temperature scene using steering 30º of MIRAS instrument:

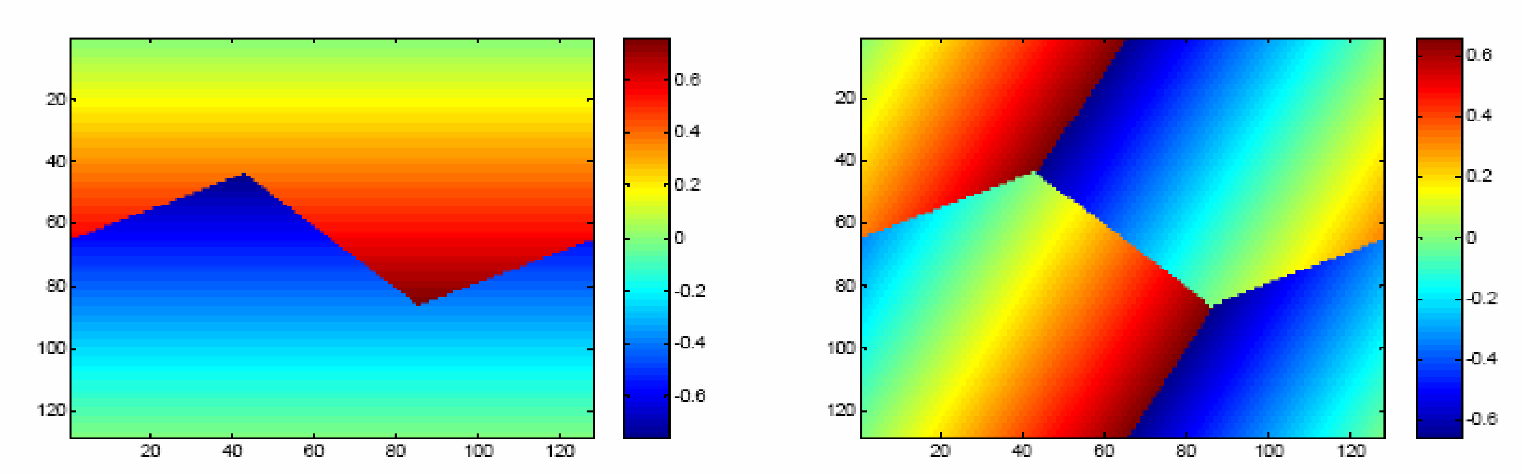

Figure 4-2. XI (left image) and ETA (right image) coordinates proposed for the G Matrix format (taken from Deimos Eng., L1PP ADF format)

The distribution of 128x128 elements shall be arranged in a vector form of 16384 elements, placing elements row after row, as opposed to Matlab that represents them column after column.

The size of the ***MIR_GMATD_/ MIR_GMATU_*** product data block is then 15996x65536x8 = 8386510848, about 7,81 GB. The following table describes the binary format of the ***MIR_GMATD_/ MIR_GMATU_*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	G_Matrix					Init of binary Data Set containing the G-Matrix elements.	
	List_of_GMatrix_Rows					Init of list of ***GMatrix_Row*** structures. There shall be 15996 DSR.	
	GMatrix_Row					Init of ***GMatrix_Row*** DSR structure.	
01	***G_Coefficients***	Array of real values	N/A	Double (8 bytes)	65536 elements	Individual coefficients for the G Matrix row contained in a 65536 real valued vector.	Generated by G Matrix Processor
	GMatrix_Row					End of ***GMatrix_Row*** DSR structure.	
	List_of_GMatrix_Rows					End of list of ***GMatrix_Row*** structures.	
	G_Matrix					End of binary Data Set containing the G-Matrix elements.	
	Data_Block					End of binary Data Block in the product.	

Table 4-30. G Matrix Product Data Block

4.2.4.1.3 J+ Matrix (MIR_JMATD_ / MIR_JMATU_)

As is written in section 4.23 in [RD.2], this matrix shall represent the mathematical reduction of the previous G matrix in order to obtain Brightness Temperatures frequencies. It represents the System Response Function of the instrument transforming Calibrated Visibilities plus the zero frequency value measured through the NIR elements into Brightness Temperature Frequencies.

This is the matrix that shall be inverted to complete the Image Reconstruction process. Regardless of how the G matrix is built, the size of the Brightness Temperature grid, or what modelling it has used, its reduction into the J matrix shall always have the same format and size.

The data that shall be stored in this product format shall be the inverted J, which is called J+.

However, the number of columns is now dependant on the u,v frequency domain, and is restricted to the number of non-redundant correlations that the instrument shall be measuring. For MIRAS, the number of nonredundant visibilities is 2791, forming a star shape in the u,v plane, and is only dependant on the number of receivers per arm and the Y shape of the instrument.

Thus, the number of columns for this matrix shall be 11164. This number comes from 1395 complex elements plus one real element that is measured for H or V polarisation, plus 2791 complex elements measured for HV polarisation. Again, the total size of the matrix is dependant on the level of coupling between polarisations through the cross-polarisation antenna patterns. If they can be considered negligible, the J matrix can be split into three separate and independent matrices, one for each polarisation.

The matrix shall be consistent in attitude with the measurement product to which processing it is applied. MIR_JMATU_ is generated from MIR_GMATU_ and is to be applied to MIR_TARD1B or MIR_TARF1B products only. Equivalently, MIR_JMATD_ is generated from MIR_GMATD_ and is to be applied to MIR_SC_D1B or MIR_SC_F1B products only.

4.2.4.1.3.1 Specific Product Header

The header of the MIR_JMATD_/MIR_JMATU_ product contains the FH, MPH and the SPH as defined in Table 4-34.

The reference data sets for MIR_JMATD_/MIR_JMATU_ Data Type are:

Reference Data Set Name	Product Type	Description
L1A_G_MATRIX_FILE	MIR_GMATU MIR_GMATD_	G Matrix filename used in the J Matrix generation
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-31. J Matrix Reference Data Sets

4.2.4.1.3.2 Data Block

The ***MIR_JMATD_/MIR_JMATU_*** product co nsists of 1 dataset ***J_Matrix*** containing the mathematical reduction of the G matrix, with 11164 data set record (the rows of the J+ Matrix), each DSR with 15996 values.

Therefore the total size of the ***MIR_JMATD_/MIR_JMATU_*** product is 11164x15996x8= 1428634752, about 1.33 GB. The following table describes the binary format of the ***MIR_JMATD_/MIR_JMATU_*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	J_Matrix					Init of binary Data Set containing the J-Matrix elements.	
	List_of_JMatrix_Rows					Init of list of ***JMatrix_Row*** structures. There shall be 15996 DSR.	
	JMatrix_Row					Init of J***Matrix_Row*** DSR structure.	
01	***J_Coefficients***	Array of real values	N/A	Double (8 bytes)	11164 elements	Individual coefficients for the J^+ Matrix row, contained in a 11164 real valued vector.	Generated by J+ Matrix Processor
	JMatrix_Row					End of ***JMatrix_Row*** DSR structure.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_JMatrix_Rows					End of list of ***JMatrix_Row*** structures.	
	J_Matrix					End of binary Data Set containing the J-Matrix elements.	
	Data_Block					End of binary Data Block in the product.	

Table 4-32. J Matrix Product Data Block

4.2.4.1.4 Flat Target Transformation in Dual Polarization (MIR_FTTD__)

As is written in section 4.26 of [RD.2], this product simply contains the averaged correlations measured for H and V polarisations during deep sky observation. These correlations shall be subtracted from any L1a measurement product in order to apply the Flat Target Transformation before Image Reconstruction.

4.2.4.1.4.1 Specific Product Header

The header of the MIR_FTTD__ product contains the FH, MPH and the SPH as defined in Table 4-34.

The specific reference data sets for MIR_FTTD__ Data Type are:

Reference Data Set Name	Product Type	Description
L1A_HKTM_FILE	`TLM_MIRA1A`	HKTM filename containing the S/C position and attitude for the snapshots
L1A_FILE	`MIR_TARD1A`	L1a Calibrated Visibilities filename obtained in External Target Observation
GALAXY_FILE	`AUX_GALAXY`	Original Galaxy Map used for generation of the Ideal Sky visibilities

Reference Data Set Name	Product Type	Description
GALAXY_NIR_FILE	AUX_GALNIR	Galaxy Map convoluted with NIR used for generation of the Ideal Sky visibilities
L1A_G_MATRIX_FILE	MIR_GMATU_	G Matrix filename used in the Ideal visibilities generation
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-33. Flat Target Transformation Reference Data Sets

4.2.4.1.4.2 Data Block

This MIR_FTTD__ product's binary datablock shall contain a unique data set ***Flat_Target_Transformation*** with several data set records. The information in these DSR shall be defined as the complete set of correlation values averaged in the external target observation interval. The order of the visibilities vectors presented above shall be the same as the one presented for the rows of the G matrix in section 4.2.4.1.2.2.

The size of a DSR is 225388 bytes. There may be several DSR in the dataset, and here we assume 10 in order to make size calculations, so the datablock would have 2,15 MB. The ***MIR_FTTD__*** product's data block specification is as follows.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Flat_Target_Transformation					Init of binary Data Set containing the Flat Target Transformation data.	
01	***FTT_Data_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***FTT_Data*** data set record structures.	Generated by L1B Processor
	List_of_FTT_Datas					Start of list of ***FTT_Data*** structures.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	FTT_Data					Start of ***FTT_Data*** structure.	
02	***Start_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the Sky Observation sequence was started. Expressed in EE CFI transport time format	Copied from L1A product Snapshot_time field for first DSR used in the generation of FTT product
03	***Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the Sky Observation sequence was finished. Expressed in EE CFI transport time format	Copied from L1A product Snapshot_time field for last DSR used in the generation of FTT product
04	***Averaged_Receiver_Temp***	Real value	K	Float (4 bytes)	1 element	Averaged physical temperature of receivers during whole period, expressed in Kelvin.	Averaging of physical temperatures matrix obtained from L1 HKTM
05	***Averaged_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements ordered like [NIR_AB_H, NIR_AB_V, NIR_BC_H, NIR_BC_V,	Averaged Brightness Temperatures measured at each NIR element, expressed in Kelvin. Two values (H and V) per receiver. Averaging is performed only over each NIR element.	Generated by L1B Processor, by averaging the NIR brightness temperatures

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					NIR_CA_H, NIR_CAV]		obtained from the L1 HKTM
06	***Averaged_FTT_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Averaged complex calibrated correlations in H polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	Generated by L1B Processor, by averaging the L1A product H-pol Calibrated Visibilities
07	***Averaged_FTT_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Averaged complex calibrated correlations in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	Generated by L1B Processor, by averaging the L1A product V-pol Calibrated Visibilities
08	***Ideal_Sky_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements (ordered like [NIR_AB_H, NIR_AB_V, NIR_BC_H, NIR_BC_V, NIR_CA_H, NIR_CAV])	Brightness temperatures measured at each NIR element for an ideal Sky scene, expressed in Kelvin. Two values (H and V) per receiver.	ADF
09	***Ideal_Sky_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of the Sky in H polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
10	***Ideal_Sky_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of the Sky in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT
11	***Ideal_Uniform_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements (ordered like [NIR_AB_H, IR_AB_V, NIR_BC_H, NIR_BC_V, NIR_CA_H, NIR_CAV])	Brightness temperatures measured at each NIR element for a uniform 1K scene, expressed in Kelvin. Two values (H and V) per receiver.	INT
12	***Ideal_Uniform_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of a uniform 1Kelvin scene in H polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT
13	***Ideal_Uniform_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of a uniform 1Kelvin scene in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT
	FTT_Data					End of ***FTT_Data*** structure.	
	List_of_FTT_Datas					End of list of ***FTT_Data*** structures.	
	Flat_Target_Transformation					End of binary Data Set containing the Flat Target Transformation data.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	/Data_Block					End of binary Data Block in the product.	

Table 4-34. Flat Target Transformation Dual Polarization Product Data Block

4.2.4.1.5 Flat Target Transformation in Full Polarization (MIR_FTTF__)

As is written in section 4.26 of [RD.2], this product simply contains the averaged correlations measured for all polarisations during deep sky observation. These correlations shall be subtracted from any L1a measurement product in order to apply the Flat Target Transformation before Image Reconstruction.

4.2.4.1.5.1 Specific Product Header

The header of the MIR_FTTF__ product contains the FH, MPH and the SPH as defined in Table 4-34.

The specific reference data sets for MIR_FTTF_ Data Type are:

Reference Data Set Name	Product Type	Description
L1A_HKTM_FILE	TLM_MIRA1A	HKTM filename containing the S/C position and attitude for the snapshots
L1A_FILE	MIR_TARF1A	L1a Calibrated Visibilities filename obtained in External Target Observation
GALAXY_FILE	AUX_GALAXY	Original Galaxy Map used for generation of the Ideal Sky visibilities
GALAXY_NIR_FILE	AUX_GALNIR	Galaxy Map convoluted with NIR used for generation of the Ideal Sky visibilities
L1A_G_MATRIX_FILE	MIR_GMATU_	G Matrix filename used in the Ideal visibilities generation
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.

Reference Data Set Name	Product Type	Description
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-35. Flat Target Transformation Reference Data Sets

4.2.4.1.5.2 Data Block

This MIR_FTTF_ product's binary datablock shall contain a unique data set ***Flat_Target_Transformation*** with several data set records. The information in these DSR shall be defined as the complete set of correlation values averaged in the external target observation interval.

The size of a DSR is 383932 bytes. There may be several DSR in the dataset, and here we assume 10 in order to make size calculations, so the datablock would have 3,66 MB. The ***MIR_FTTF_*** product's data block specification is as follows.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Flat_Target_Transformation					Init of binary Data Set containing the Flat Target Transformation data.	
01	***FTT_Data_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***FTT_Data*** data set record structures.	Generated by L1B Processor
	List_of_FTT_Datas					Start of list of ***FTT_Data*** structures.	
	FTT_Data					Start of ***FTT_Data*** structure.	
02	***Start_Time***	Date	N/A	signed /unsigned	Vector array of 3 elements First element	UTC Time at which the Sky Observation sequence was started. Expressed in EE	Copied from L1A product Snapshot_time

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				integer (4 bytes)	(days) is signed integer, remaining two (seconds and microseconds) are unsigned	CFI transport time format	field for first DSR used in the generation of FTT product
03	***Stop_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the Sky Observation sequence was finished. Expressed in EE CFI transport time format	Copied from L1A product Snapshot_time field for last DSR used in the generation of FTT product
04	***Averaged_Receiver_Temp***	Real value	K	Float (4 bytes)	1 element	Averaged physical temperature of receivers during whole period, expressed in Kelvin.	Averaging of physical temperatures matrix obtained from L1 HKTM
05	***Averaged_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements ordered like [NIR_AB_H, NIR_AB_V, NIR_BC_H, NIR_BC_V, NIR_CA_H, NIR_CAV]	Averaged Brightness Temperatures measured at each NIR element, expressed in Kelvin. Two values (H and V) per receiver. Averaging is performed only over each NIR element.	Generated by L1B Processor, by averaging the NIR brightness temperatures obtained from the L1 HKTM
06	***Averaged_FTT_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16	Vector array of 69*34 elements	Averaged complex calibrated correlations in H polarisation for all baselines (including redundant, but	Generated by L1B Processor, by averaging the

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				bytes		excluding LICEF-NIR correlations in cross-polarisation).	L1A product H-pol Calibrated Visibilities
07	***Averaged_FTT_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Averaged complex calibrated correlations in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	Generated by L1B Processor, by averaging the L1A product V-pol Calibrated Visibilities
08	***Averaged_FTT_Visib_HV***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 3303 elements	Averaged complex calibrated correlations in HV polarisation for all baselines (including redundant).	Generated by L1B Processor, by averaging the L1A product HV-pol Calibrated Visibilities
09	***Ideal_Sky_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements (ordered like [NIR_AB_H, IR_AB_V, NIR_BC_H, NIR_BC_V, NIR_CA_H, NIR_CAV])	Brightness temperatures measured at each NIR element for an ideal Sky scene, expressed in Kelvin. Two values (H and V) per receiver.	ADF
10	***Ideal_Sky_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16	Vector array of 69*34 elements	Ideal Instrument visibilities of the Sky in H polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				bytes			
11	***Ideal_Sky_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of the Sky in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT
12	***Ideal_Sky_Visib_HV***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 3303 elements	Ideal Instrument visibilities of the Sky in HV polarisation for all baselines (including redundant).	INT
13	***Ideal_Uniform_NIR_Brightness_Temp***	Real value	K	Double (8 bytes)	Vector array of 6 elements (ordered like [NIR_AB_H, IR_AB_V, NIR_BC_H, NIR_BC_V, NIR_CA_H, NIR_CAV])	Brightness temperatures measured at each NIR element for a uniform 1K scene, expressed in Kelvin. Two values (H and V) per receiver.	INT
14	***Ideal_Uniform_Visib_H***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of a uniform 1Kelvin scene in H polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT
15	***Ideal_Uniform_Visib_V***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 69*34 elements	Ideal Instrument visibilities of a uniform 1Kelvin scene in V polarisation for all baselines (including redundant, but excluding LICEF-NIR correlations in cross-polarisation).	INT

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
16	***Ideal_Uniform_Visib_HV***	Array of complex values	N/A	Double (real part) + double (imag part), totally 16 bytes	Vector array of 3303 elements	Ideal Instrument visibilities of a uniform 1Kelvin scene in HV polarisation for all baselines (including redundant).	INT
	FTT_Data					End of ***FTT_Data*** structure.	
	List_of_FTT_Datas					End of list of ***FTT_Data*** structures.	
	Flat_Target_Transformation					End of binary Data Set containing the Flat Target Transformation data.	
	Data_Block					End of binary Data Block in the product.	

Table 4-36. Flat Target Transformation Full Polarization Product Data Block

4.2.4.2 L1B Measurement Products

The L1B measurements products values are the Fourier Components of the resulting Brightness Temperature scenes, which shall be the ones used for L1c processing, with no apodisation applied at this level. This information is presented on a snapshot basis, ordered by time stamp.

The format structure proposed for these L1b products is presented in [RD.1].the following figure:

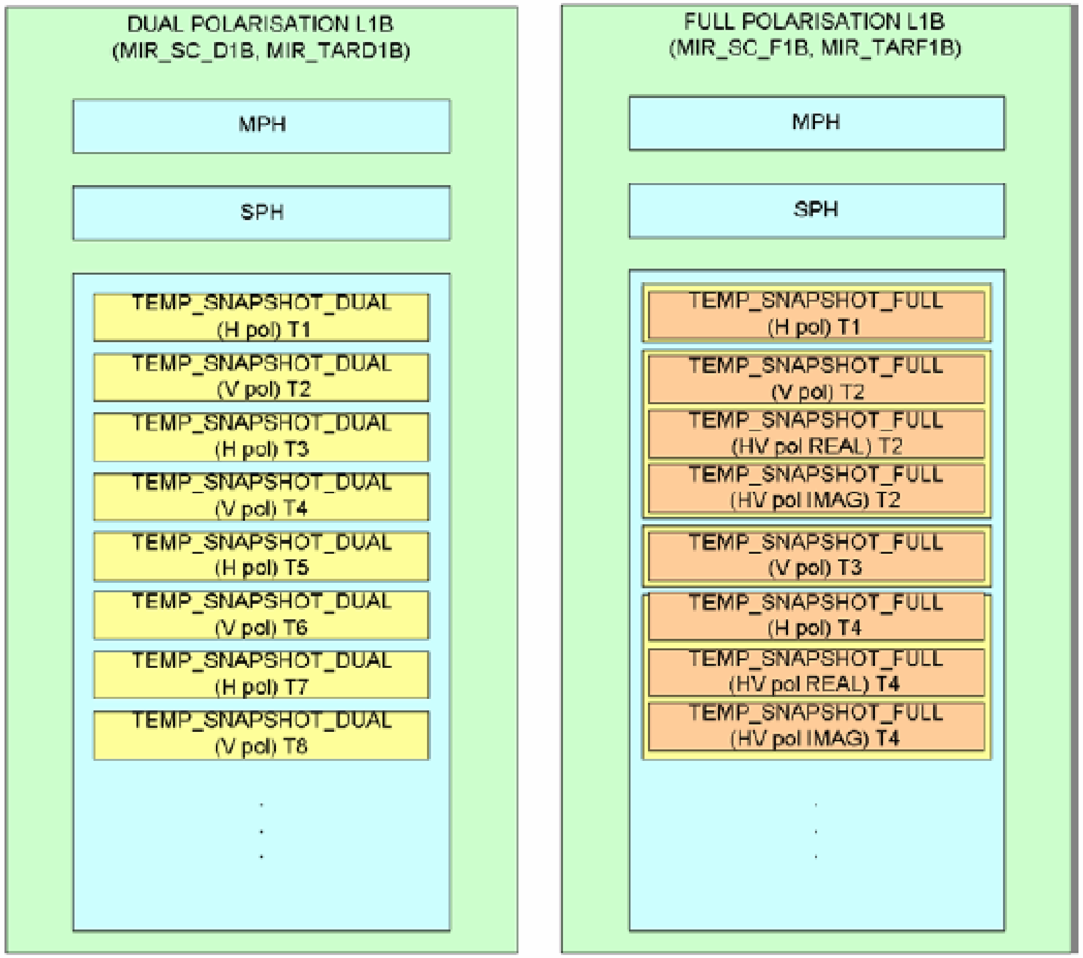

Figure 4-3. SMOS L1B product structure (taken from Deimos Eng., L1PP Product format)

Different L1b products are generated depending on the polarisation mode of the instrument (dual or full polarimetric), and their contents change from mode to mode. In dual-pol, one data set record is generated per integration time (1.2s), containing H or V polarisation measurements. In full-pol every alternate integration time generates a data set record (H or V), and the next one generates two data set records (HV and V or HV and H).

Also, different products are generated when the satellite has nominal attitude, i.e. MIRAS is pointing towards Earth surface (hence the products shall be named MIR_SC_D1B in case of dual polarization and MIR_SC_F1B in case of full polarization), and when the satellite is pointing with external attitude to other targets than Earth (hence the products names are MIR_TARD1B in case of dual polarization and MIR_TARF1B in case of full polarization).

Products are arranged on a pole-to-pole time interval according to ascending and descending passes and grouped according to multiples of the integration time (time sorted and arranged with respect to the originating L1A product).

The Scene Brightness Temperature frequencies are complex numbers ordered according to the diagram shown in the following figure. In H or V polarisation, only the baselines shaded in blue in the figure mentioned shall be represented. If values are applicable to cross-polarisation scene (HV_real or HV_imag) as in full polarization mode, they are real values representing real or imaginary components in the complete star domain.

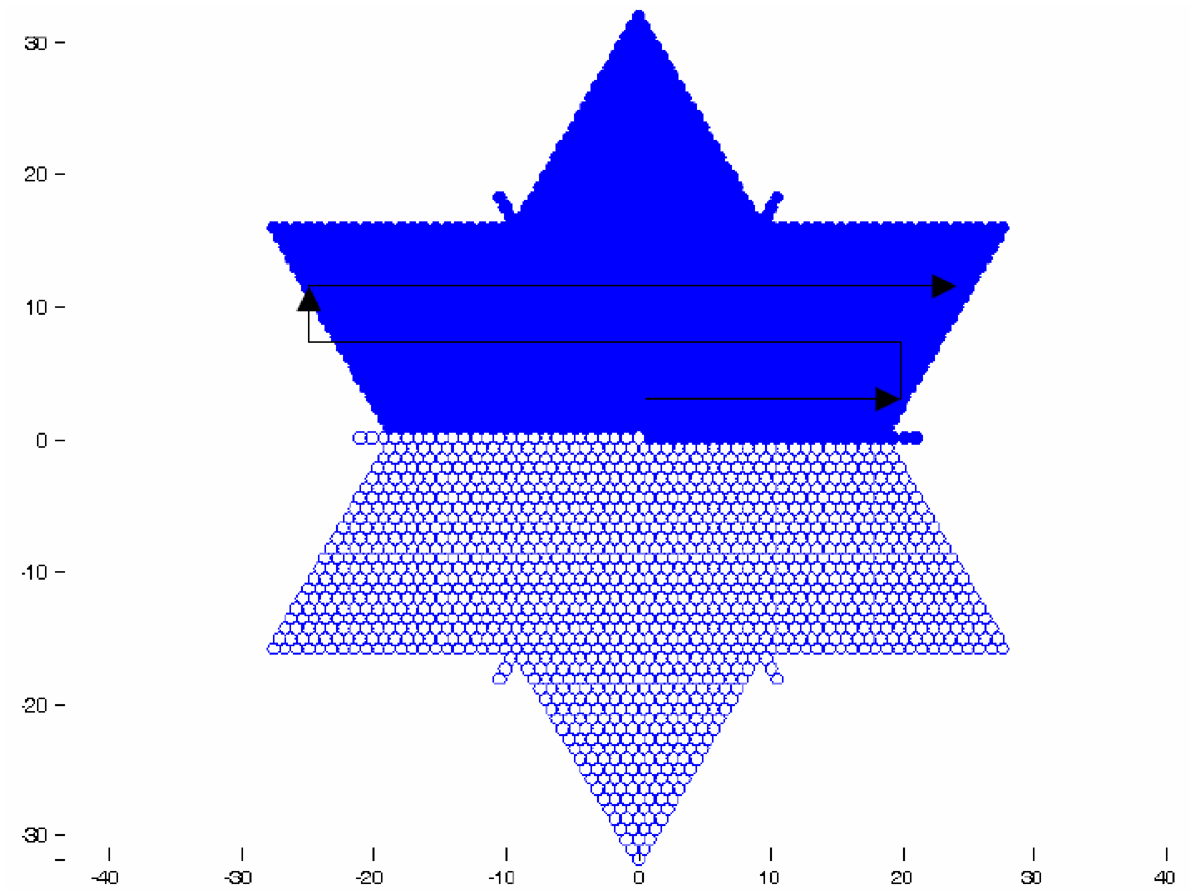

Figure 4-4. Brightness Temperatures Scene Fourier Components sorting (taken from Deimos Eng., L1PP ATBD)

4.2.4.2.1 Dual Polarization Reconstructed $\check{T}_B$ Fourier Components (MIR_SC_D1B / MIR_TARD1B)

The dual polarization reconstructed brightness temperature Fourier components are obtained by correcting and reconstructing the L1A calibrated visibilities in dual polarization.

4.2.4.2.1.1 Specific Product Header

The Specific Product Header for MIR_SC_D1B / MIR_TARD1B shall follow the format described in section 4.1.2 and shall include the following information:

- Level 1 Main Info SPH (see Table 4-3 for description)
- Quality Information (see Table 4-4 for description)
- Image_Retrieval_Algorithm (see Table below for description)
- Foreign_Source_Correction structure (see Table below for description)
- Level1 SPH Data Sets (see Table 4-5 for description)

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***					Init of Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in fields 01 to 16 in Table 4-3	
20-26	***Quality_Information***	structure				Quality_Information structure defined as specified in Table 4-4	
27	***Reconstruction_Image_Algorithm***	Integer	N/A	1 byte	%01d	This field can have one of the following values: • 1 for "Theoretical G-Matrix" • 2 for "Parametric G-Matrix"	Processor SW Configuration
28	***Foreign_Sources_Correction***	Starting Tag				Tag starting a structure specifying details on methods for correcting the contributions of non-desired sources of radiation	
29	***Flat_Correction_Type***	Integer	N/A	1 byte	%01d	Method used to correct the contribution from flat target. This field can have one of the following values: • 0 for "FTT Not Applied" • 1 for "FTT Applied"	ICNF
30	***Direct_Sun_Correction_Type***	Integer	N/A	2 bytes	%+02d	Method used to correct the contribution from direct Sun into the snapshot. This field can have one of the following values: • 0 for "Correction by Measurements Self-estimation Technique" • 1 for "Correction Based on Sun Auxiliary Data"	ICNF

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						• -1 for not applied	
31	***Reflected_Sun_Correction_Type***	Integer	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for "Reflected Sun BT forward model" • -1 for not applied	ICNF
32	***Direct_Moon_Correction_Type***	Integer	N/A	2 bytes	%+02d	This field can have one of the following values: • 0 for "Correction by Default Moon BT Value (250K)" • 1 for "Correction Based on Moon Auxiliary Data" • -1 for not applied	ICNF
33	***Earth_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied • -1 for not applicable (if Flat_Correction_Type is 1).	ADF
34	***Sky_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied • -1 for not applicable (if Flat_Correction_Type is 1).	ADF
35	***Backlobe_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
36	***Foreign_Sources_Correction***	Closing Tag				Tag closing the structure specifying details on methods for correcting the contributions of non-desired sources of radiation	
37-48	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	
49	***Specific_Product_Header***					End of Specific Product Header structure	

Table 4-37. Level 1 B SPH

The specific valid Reference Data Sets for MIR_SC_D1B Products are:

Reference Data Set Name	Product Type	Description
L1A_HKTM_FILE	`TLM_MIRA1A`	HKTM filename containing the S/C position and attitude for the snapshots in the current product
L1A_FILE	`MIR_SC_D1A,` `MIR_TARD1A`	L1a Dual Polarization Calibrated Visibilities filename used to create the current L1b product
L1A_G_MATRIX_FILE	`MIR_GMATU_,` `MIR_GMATD_`	G Matrix filename used in the Image reconstruction process of the current L1b product
L1A_J_MATRIX_FILE	`MIR_JMATU_,` `MIR_JMATD_`	J Matrix filename used in the purely mathematical Image reconstruction process of the current L1b product
L1A_FLAT_TARGET_FILE	`MIR_FTTD__`	Flat Target Transformation file obtained in Dual Polarization mode
AUX_GALAXY_FILE	`AUX_GALAXY`	Original Galaxy Map
FAILURES_FILE	`AUX_FAIL__`	Auxiliary file with failure of components to be taken into account during L1 processing
SUN_BT_FILE	`AUX_SUNT__`	Auxiliary file with definition of Sun Brightness Temperatures used for correction before L1b processing
MOON_BT_FILE	`AUX_MOONT_`	Auxiliary file with definition of Moon Brightness Temperatures used for correction before L1b processing

Reference Data Set Name	Product Type	Description
EARTH_BT_FILE	AUX_ERTHT_	Auxiliary file with definition of Earth Brightness Temperatures used for correction before L1b processing
WEIGHT_VECTOR_FILE	AUX_BWGHT_	Auxiliary product containing the weight vector to be multiplied element by element with the calibrated visibilities
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-38. Level 1 B Dual Polarization Reconstructed Brightness Temperatures Fourier Components Reference Data Sets

4.2.4.2.1.2 Data Block

The binary Data Block of the MIR_SC_D1B product consists of one Measurement datasets, containing the components of the FFT of the reconstructed image. There is one DSR for the first integration time, in HHH polarization mode, and one DSR for the second integration time, in VVV polarization mode.

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 ***Temp_Snapshot_Dual.***

- The ***Temp_Snapshot_Dual*** data set consists of the complete set of brightness temperatures Fourier components obtained by processing MIR_SC_D1A products. All data is referenced to the time described in the field ***Snapshot_Time*** expressed in UTC format. ***Snapshot_OBET*** is still referred to the start of the integration time, but it is kept as it provides an extra unique reference to the snapshot. There shall be a complete Data Set Record for each integration time, when pointing in the same direction during the half orbit (i.e. dual-pol measurements shall appear in separate products if they are observing the earth surface –nominal- or external sources –Moon, deep sky, etc.-). The first field in the dataset, ***Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Reconstructed_BT_Snapshot*** dataset record structure. The size of each DSR is fixed and equal to 22515 bytes.
- The ***Scene_Bias_Correction*** data set contains specific data computed during Image Reconstruction, which must be added later during geolocation in order to obtain the complete Brightness Temperature distribution. The data computed is used to correct for the Scene Dependent Bias detected in simulation tests. There shall be a complete Data Set Record for each

integration time. All data is referenced to the time described in the field Snapshot_Time expressed in UTC format. Snapshot_OBET is still referred to the start of the integration time, but it is kept as it provides an extra unique reference to the snapshot available in other Data Sets. The first field in the dataset, ***Scene_Bias_Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Scene_Bias*** dataset record structure. The size of each DSR is fixed and equal to 64 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Temp_Snapshot_Dual					Init of binary Data Set containing the ***Reconstructed_BT_Snapshot*** data set records.	
01	***Reconstructed_BT_Snapshot_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Reconstructed_BT_Snapshot*** data set record structures.	
	List_of_Reconstructed_BT_Snapshots					Init of list of ***Reconstructed_BT_Snapshot*** data set record structures, repeated ***Counter*** times. The list contains as many DSR as integration times are contained in the product.	
	Reconstructed_BT_Snapshot					Init of ***Reconstructed_BT_Snapshot*** data set record structure.	
02	***Snapshot_Time***	Date	N/A	signed	Vector array of 3 elements	UTC Time at which the scene was taken. Start of integration time period. Expressed in EE CFI transport time	Copied from L1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				/unsigned integer (4 bytes)	First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	format.	
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1A product
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1A product
05	***X_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector X Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
06	***Y_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Y Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
07	***Z_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Z Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
08	***X_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector X Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
09	*Y_Velocity*	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Y Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
10	*Z_Velocity*	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Z Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
11	*Vector_Source*	Identifier	N/A	unsigned byte	1 element	Source of the Orbit State Vector record: • SOLUTION_NULL = 0 • SOLUTION_INITIALISATION = 1 • SOLUTION_PVT_FROZEN = 2 • SOLUTION_NKF_SOLUTION = 3 • SOLUTION_SPS_SOLUTION = 4 • SOLUTION_PREDICTED = 5 (not used) • SOLUTION_RESTITUTED = 6 (not used)	Copied from TLM_MIRA1A product
12	*Q0*	Real value	N/A	Double (8 bytes)	1 element	Real number component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
13	*Q1*	Real value	N/A	Double (8 bytes)	1 element	First component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
14	*Q2*	Real value	N/A	Double (8 bytes)	1 element	Second component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body	Copied from TLM_MIRA1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						frame	
15	***Q3***	Real value	N/A	Double (8 bytes)	1 element	Third component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
16	***Flags***	Set of flags	N/A	unsigned byte	1 element	L1b flags applicable to the scene for this particular integration time. The complete flags are specified below this table.	L1B Processor Internal generation
17	***Antenna_Boresight***	Array of real values	deg	Float (4bytes)	2 elements	In case of MIR_SC_D1B: • First element is Latitude of Earth surface point in the snapshot's boresight direction. • Second element is Longitude of Earth surface point in the snapshot's boresight direction. In case of MIR_TARD1B: • First element is Right Ascension in the snapshot's boresight direction (coordinates reference system is B1950). • Second element is Declination in the snapshot's boresight direction (coordinates reference system is B1950).	Copied from L1A product
18	***Scene_BT_Fourier***	Array of comple	N/A	Double (8 bytes).	Vector array of 2791 values (see order in	Complex Fourier Domain components of the reconstructed scene	Generated by L1B Processor after

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		x values		Element is only real or imaginary part	Figure 4-3; first one double for the zero baseline, then 1395 doubles for the real parts of the upper baselines of the star domain, then 1395 doubles for the imaginary parts of the same baselines)		reconstruction of calibrated visibilities
19	***Accuracy***	Real value	K	Float (4 bytes)	1 element	Snapshot overall accuracy measurement, based on Corbella equation and computed as the difference of the mean snapshot Brightness Temperature and the averaged physical temperature of the LICEF receivers	Generated by L1B Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
20	***Physical_Temperatures_STD***	Real value	K	Float (4 bytes)	1 element	Standard deviation of the physical temperature of the LICEF receivers at the integration time	Generated by L1B Processor , based in physical temperature matrix in L1A HKTM
21	***Average_System_Temperatures***	Real value	K	Float (4 bytes)	1 element	Average of the system temperatures computed in the L1A product for the corresponding integration time	Based on L1A product + internal processing
22	***LICEF_Status***	Array of flags	N/A	byte-8 (8 flags contained)	2 arrays, one for each polarisation (H and V), of 9 elements each, with totally 72 bit-flags in each array, Field size is then 18 bytes	Status of each LICEF by polarisation H, V (0=No error, 1=Error). Obtained from single failure and correlator failure identification.	Value taken from L1A HKTM
23	***CMN_NIR_Status***	Array of flags	N/A	Unsigned short (2 bytes)	Array of 12+3 status bit-flags contained in 2 bytes. Order is first CMN status, then NIR status	Status of each CMN and NIR (0=No error, 1=Error). Obtained from single failure identification.	Value taken from L1A HKTM
24	***Foreign_Sources_Flags***	Flags	N/A	Byte-8	1 element	Characteristics of the Foreign Sources involved in each integration time (Sun eclipsed, in the front/back of the instrument,…). The complete flags are specified below this table.	Internal processing
25	***Direct_Sun_Pos***	Vector of real values	N/A	Float (4 bytes)	Vector array of 2 elements (first xi, then eta)	Position in antenna reference frame of Sun position (xi-eta coordinates).	Generated by L1B Processor
26	***Reflected_Sun_Pos***	Real	N/A	Float (4 bytes)	Vector array of 2 elements (fist xi, then	Position in antenna reference frame of reflected Sun position (xi-eta	Generated by L1B Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		value			eta)	coordinates). Set to (-1,-1) no reflection is possible. Reflected Sun is always out of Extended alias-free FOV, but as complete unit circle is represented, it is significative.	
27	***Direct_Moon_Pos***	Real value	N/A	Float (4 bytes)	Vector array of 2 elements (first xi, then eta)	Position in antenna reference frame of Moon position (xi-eta coordinates).	Generated by L1B Processor
28	***Direct_Sun_BT***	Real value	K	Double (8 bytes)	1 element	Magnitude of Direct Sun Brightness Temperature as derived during reconstruction process and subtracted.	Generated by L1B Processor
29	***Constant_Earth_BT***	Real value	K	Double (8 bytes)	1 element	Magnitude of Constant Earth Brightness Temperature as derived during reconstruction process and subtracted, if FTT was not applied.	Generated by L1B Processor
	Reconstructed_BT_Snapshot					End of ***Reconstructed_BT_Snapshot*** data set record structure	
	List_of_Reconstructed_BT_Snapshots					End of list of ***Reconstructed_BT_Snapshot*** data set record structures.	
	Temp_Snapshot_Dual					End of binary Data Set containing the ***Reconstructed_BT_Snapshot*** data set records.	
	Scene_Bias_Correction					Init of binary Data Set containing the ***Scene_Bias*** data set records.	
30	***Scene_Bias_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Reconstructed_BT_Snapshot*** data set record structures.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_Scene_Bias					Init of list of ***List_of_Scene_Bias*** data set record structures	
	Scene_Bias					Init of ***Scene_Bias*** data set record structure	
31	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Start of integration time period. Expressed in EE CFI transport time format.	Copied from L1A product
32	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1A product
33	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1A product
34	***Constant_Sky_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Sky Brightness Temperature as derived during reconstruction process (scene bias correction) and subtracted from the L1b	TBD

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						output data.	
35	***Constant_Land_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Land Brightness Temperature as derive during reconstruction process (scene bias correction) and subtracted from the L1b output data.	TBD
36	***Constant_Sea_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Sea Brightness Temperature as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	TBD
37	***Derivative_Land_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of First Derivative of Land Brightness Temperature against incidence angle, as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	TBD
38	***Derivative_Sea_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of First Derivative of Sea Brightness Temperature against incidence angle, as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	TBD

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Scene_Bias					End of ***Scene_Bias*** data set record structure	
	List_of_Scene_Bias					End of list of ***List_of_Scene_Bias*** data set record structures	
	Scene_Bias_Correction					End of binary Data Set containing the ***Scene_Bias*** data set records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-39. Level 1 B Dual Polarization Reconstructed Brightness Temperatures Fourier Components Product Data Block

The Flags field #16 shall be used to report polarisation of the data inside the data set record, as well as corrections performed on the reconstructed scene by the Image Reconstruction Algorithms. The flags are contained in an 8-bit counter, each bit representing a status, and they shall be described using the following order convention:

[MSB:X X X X:X X X X:LSB]

This fields contains the following flags:

- Polarisation flags:
  - [X X X X:X X 0 0] represents HH polarisation
  - [X X X X:X X 0 1] represents VV polarisation
  - [X X X X:X X 1 0] represents HV polarisation real valued components
  - [X X X X:X X 1 1] represents HV polarisation imaginary valued components
- SUN FOV flag:
  - [X X X X:X 0 X X] means that no Direct Sun correction has been performed during image reconstruction

  - [X X X X:X 1 X X] means that Direct Sun correction has been performed during image reconstruction
- SUN GLINT_FOV flag:
  - [X X X X:0 X X X] means that no Reflected Sun correction has been performed during image reconstruction
  - [X X X X:1 X X X] means that Reflected Sun correction has been performed during image reconstruction
- MOON FOV flag:
  - [X X X 0:X X X X] means that no Direct Moon correction has been performed during image reconstruction
  - [X X X 1:X X X X] means that Direct Moon correction has been performed during image reconstruction
- SINGLE_SNAPSHOT flag:
  - [X X 0 X:X X X X] means that this scene has been combined with an adjacent scene in opposite polarisation during image reconstruction to account for cross-polarisation leakage
  - [X X 1 X:X X X X] means that this scene has not been combined with an adjacent scene in opposite polarisation during image reconstruction to account for cross-polarisation leakage (it has been processed with only co-polar antenna patterns information)
- FTT flag:
  - [X 0 X X:X X X X] means that **no** Flat Target Transformation has been performed during image reconstruction (instead, the Corbella Term has been corrected using G matrix, and a constant Earth term has been removed from the image)
  - [X 1 X X:X X X X] means that Flat Target Transformation has been performed during image reconstruction

The Flags field #22 shall be used to report specific situations of the Foreign Sources Data inside the data set record. The flags are contained in an 8-bit counter, each bit representing a status, and they shall be described using the following order convention:

[MSB:X X X X:X X X X:LSB]

This fields contains the following flags:

- SUN Position flag:

  - [X X X X:X X X 0] means that the Sun is situated in front of the instrument array.
  - [X X X X:X X X 1] means that the Sun is situated in the back of the instrument array.
- SUN Eclipsed flag:
  - [X X X X:X X 0 X] means that the Sun is not eclipsed
  - [X X X X:X X 1 X] means that the Sun is eclipsed and not visible from the instrument array
- MOON Position flag:
  - [X X X X:X 0 X X] means that the Moon is situated in front of the instrument array.
  - [X X X X:X 1 X X] means that the Moon is situated in the back of the instrument array.
- MOON Eclipsed flag:
  - [X X X X:0 X X X] means that the Moon is not eclipsed
  - [X X X X:1 X X X] means that the Moon is eclipsed and not visible from the instrument array

4.2.4.2.2 Full Polarization Reconstructed $\check{T}_B$ Fourier Components (MIR_SC_F1B / MIR_TARF1B)

The full polarization reconstructed brightness temperature Fourier components are obtained by correcting and reconstructing the L1A calibrated visibilities in full polarization.

4.2.4.2.2.1 Specific Product Header

The Specific Product Header for MIR_SC_F1B / MIR_TARF1B products shall be identical to the one described for MIR_SC_D1B / MIR_TARD1B products.

The specific valid Reference Data Sets for Level 1B Full Polarization Reconstructed Brightness Temperatures Fourier Components Products are:

Reference Data Set Name	Product Type	Description
L1A_HKTM_FILE	TLM_MIRA1A	HKTM filename containing the S/C position and attitude for the snapshots in the current product
L1A_FILE	MIR_SC_F1A, MIR_TARF1A	L1a Full Polarization Calibrated Visibilities filename used to create the current L1b product
L1A_G_MATRIX_FILE	MIR_GMATU_, MIR_GMATD_	G Matrix filename used in the Image reconstruction process of the current L1b product
L1A_J_MATRIX_FILE	MIR_JMATU_, MIR_JMATD_	J Matrix filename used in the purely mathematical Image reconstruction process of the current L1b product
L1A_FLAT_TARGET_FILE	MIR_FTTF__	Flat Target Transformation file obtained in Full Polarization mode
GALAXY_FILE	AUX_GALAXY	Original Galaxy Map
AUX_FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
SUN_BT_FILE	AUX_SUNT__	Auxiliary file with definition of Sun Brightness Temperatures used for correction before L1b processing
MOON_BT_FILE	AUX_MOONT_	Auxiliary file with definition of Moon Brightness Temperatures used for correction before L1b processing
EARTH_BT_FILE	AUX_ERTHT_	Auxiliary file with definition of Earth Brightness Temperatures used for correction before L1b processing
WEIGHT_VECTOR_FILE	AUX_BWGHT_	Auxiliary product containing the weight vector to be multiplied element by element with the calibrated visibilities
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-40. Level 1 B Full Polarization Reconstructed Brightness Temperatures Fourier Components Reference Data Sets

4.2.4.2.2.2 Data Block

The binary Data Block of the MIR_SC_F1B / MIR_TARF1B product consists of two Measurement datasets, containing the components of the FFT of the reconstructed image. There is one DSR for the first integration time, in HHH or VVV polarization mode, and three DSR for the second integration time (HVV, VHV and VVH; or VHH, HVH and HHV).

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 ***Temp_Snapshot_Full.***

- The ***Temp_Snapshot_Full*** data set consists of the complete set of brightness temperatures Fourier components obtained by processing Level 1A full polarization products. There shall be a complete Data Set Record for each complete scene, i.e. one DSR per integration time for the pure polarisation acquisition and three DSR per integration time for the combined polarisation acquisition. The first field in the dataset, ***Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Reconstructed_BT_Snapshot*** dataset record structure. The size of each DSR is fixed and equal to 22515 bytes.
- The ***Scene_Bias_Correction*** data set contains specific data computed during Image Reconstruction, which must be added later during geolocation in order to obtain the complete Brightness Temperature distribution. The data computed is used to correct for the Scene Dependent Bias detected in simulation tests. There shall be a complete Data Set Record for each integration time. All data is referenced to the time described in the field Snapshot_Time expressed in UTC format. Snapshot_OBET is still referred to the start of the integration time, but it is kept as it provides an extra unique reference to the snapshot available in other Data Sets. The first field in the dataset, ***Scene_Bias_Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Scene_Bias*** dataset record structure. The size of each DSR is fixed and equal to 64 bytes.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Temp_Snapshot_Full					Init of binary Data Set containing the ***Reconstructed_BT_Snapshot*** data set records.	
01	***Reconstructed_BT_Snapshot_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Reconstructed_BT_Snapshot*** data set record structures.	Generated by L1B Processor
	List_of_Reconstructed_BT_Snapshots					Init of list of ***Reconstructed_BT_Snapshot*** data set record structures, repeated ***Counter***	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						times. The number of DSR is twice the number of integration times.	
	Reconstructed_BT_Snapshot					Init of ***Reconstructed_BT_Snapshot*** data set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Start of integration time period. Expressed in EE CFI transport time format.	Copied from L1A product
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element snapshot within orbit)	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1A product
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1A product
05	***X_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector X Position in Earth Fixed Reference at snapshot_Time (field	Copied from TLM_MIRA1A

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						02)	product
06	***Y_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Y Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
07	***Z_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Z Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
08	***X_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector X Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
09	***Y_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Y Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
10	***Z_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Z Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from TLM_MIRA1A product
11	***Vector_Source***	Identifier	N/A	unsigned byte	1 element	Source of the Orbit State Vector record: • SOLUTION_NULL = 0 • SOLUTION_INITIALISATION = 1 • SOLUTION_PVT_FROZEN = 2 • SOLUTION_NKF_SOLUTION = 3 • SOLUTION_SPS_SOLUTION = 4 • SOLUTION_PREDICTED = 5 (not	Copied from TLM_MIRA1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						used) • SOLUTION_RESTITUTED = 6 (not used)	
12	***Q0***	Real value	N/A	Double (8 bytes)	1 element	Real number component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
13	***Q1***	Real value	N/A	Double (8 bytes)	1 element	First component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
14	***Q2***	Real value	N/A	Double (8 bytes)	1 element	Second component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
15	***Q3***	Real value	N/A	Double (8 bytes)	1 element	Third component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from TLM_MIRA1A product
16	***Flags***	Set of flags	N/A	unsigned byte	1 element	L1b flags applicable to the scene for this particular integration time. The complete set of flags are specified in section 4.2.4.2.1.2.	L1B Processor Internal generation
17	***Antenna_Boresight***	Array of real values	deg	Float (4bytes)	2 elements	In case of MIR_SC_D1B: • First element is Latitude of Earth surface point in the snapshot's boresight direction.	Copied from L1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						• Second element is Longitude of Earth surface point in the snapshot's boresight direction. In case of MIR_TARD1B: • First element is Right Ascension in the snapshot's boresight direction (coordinates reference system is B1950). • Second element is Declination in the snapshot's boresight direction (coordinates reference system is B1950).	
18	***Scene_BT_Fourier***	Array of components of complex values	N/A	Double (8 bytes). Element is only real or imaginary part	Vector array of 2791 values. If pure polarization (HH or VV) scene, see order in Figure 4-3; first one double for the zero baseline, then 1395 doubles for the real parts of the upper baselines of the star domain, then 1395 doubles for the imaginary parts of the same baselines) If cross-polarisation	Complex Fourier Domain components of the reconstructed scene. If FTT is not applied, the scene does not contain a constant Earth bias over the Earth within unit circle.	Generated by L1B Processor after reconstruction of calibrated visibilities

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					(HV_real or HV_imag) scene they represent real or imaginary components, respectively, in the complete star domain. Order is described in Figure 4-3, for the complete star domain.		
19	***Accuracy***	Real value	K	Float (4 bytes)	1 element	Snapshot overall accuracy measurement, based on Corbella equation and computed as the difference of the mean snapshot Brightness Temperature and the averaged physical temperature of the LICEF receivers	Generated by L1B Processor
20	***Physical_Temperatures_STD***	Real value	K	Float (4 bytes)	1 element	Standard deviation of the physical temperature of the LICEF receivers at the integration time	Generated by L1B Processor , based in physical temperature matrix in L1A HKTM
21	***Average_System_Temperatures***	Real value	K	Float (4 bytes)	1 element	Average of the system temperatures measured by the PMS and included in the L1A product's field Sys_Temp	Based on L1A product + internal processing
22	***LICEF_Status***	Array of flags	N/A	byte-8 (8 flags contained)	2 arrays, one for each polarisation (H and V), of 9 elements each, with totally 72 bit-flags in each array. Field size is then 18 bytes	Status of each LICEF by polarisation H, V (0=No error, 1=Error). Obtained from single failure and correlator failure identification.	Copied from L1A HKTM

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
23	***CMN_NIR_Status***	Array of flags	N/A	Unsigned short (2 bytes)	Array of 12+3 status bit-flags contained in 2 bytes. Order is first CMN status, then NIR status	Status of each CMN and NIR (0=No error, 1=Error). Obtained from single failure identification.	Copied from L1A HKTM
24	***Foreign_Sources_Flags***	Flags	N/A	Byte-8	1 element	Characteristics of the Foreign Sources involved in each integration time (Sun eclipsed, in the front/back of the instrument,…) (see section 4.2.4.2.1.2)	Generated by L1B Processor
25	***Direct_Sun_Pos***	Real value	N/A	Float (4 bytes)	Vector array of 2 elements (first xi, then eta)	Position in antenna reference frame of Sun position (xi-eta coordinates). Vector array of [2] float elements	Generated by L1B Processor
26	***Reflected_Sun_Pos***	Real value	N/A	Float (4 bytes)	Vector array of 2 elements (fist xi, then eta)	Position in antenna reference frame of reflected Sun position (xi-eta coordinates). Reflected Sun is always out of Extended alias-free FOV, but as complete unit circle is represented, it is significative.	Generated by L1B Processor
27	***Direct_Moon_Pos***	Real value	N/A	Float (4 bytes)	Vector array of 2 elements (first xi, then eta)	Position in antenna reference frame of Moon position (xi-eta coordinates).	Generated by L1B Processor
28	***Direct_Sun_BT***	Real value	K	Double (8 bytes)	1 element	Magnitude of Direct Sun Brightness Temperature as derived during reconstruction process and subtracted.	Generated by L1B Processor
29	***Constant_Earth_BT***	Real value	K	Double (8 bytes)	1 element	Magnitude of Constant Earth Brightness Temperature as derived during reconstruction process and subtracted, if	Generated by L1B Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						FTT was not applied.	
	Reconstructed_BT_Snapshot					End of ***Reconstructed_BT_Snapshot*** data set record structure.	
	List_of_Reconstructed_BT_Snapshots					End of list of ***Reconstructed_BT_Snapshot*** data set record structures.	
	Temp_Snapshot_Full					End of binary Data Set containing the ***Reconstructed_BT_Snapshot*** data set records.	
	Scena_Bias_Correction					Init of binary Data Set containing the ***Scene_Bias*** data set records.	
30	***Scene_Bias_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Reconstructed_BT_Snapshot*** data set record structures.	
	List_of_Scene_Bias					Init of list of ***List_of_Scene_Bias*** data set record structures	
	Scene_Bias					Init of ***Scene_Bias*** data set record structure	
31	***Snapshot_Time***	Date	N/A	signed /unsigned integer	Vector array of 3 elements First element (days) is signed integer, remaining two	UTC Time at which the scene was taken. Start of integration time period. Expressed in EE CFI transport time format.	Copied from L1A product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
				(4 bytes)	(seconds and microseconds) are unsigned		
32	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1A product
33	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1A product
34	***Constant_Sky_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Sky Brightness Temperature as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	
35	***Constant_Land_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Land Brightness Temperature as derive during reconstruction process (scene bias correction) and subtracted from the L1b	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						output data.	
36	***Constant_Sea_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of Constant Sea Brightness Temperature as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	
37	***Derivative_Land_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of First Derivative of Land Brightness Temperature against incidence angle, as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	
38	***Derivative_Sea_BT***	Real Value	K	Double (8 bytes)	1 element	NOT USED for DPGS-V2 (filled with 0) Magnitude of First Derivative of Sea Brightness Temperature against incidence angle, as derived during reconstruction process (scene bias correction) and subtracted from the L1b output data.	
	Scene_Bias					End of ***Scene_Bias*** data set record structure	
	List_of_Scene_Bias					End of list of ***List_of_Scene_Bias*** data	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						set record structures	
	Scena_Bias_Correction					End of binary Data Set containing the ***Scene_Bias*** data set records.	
	Data_Block					End of binary Data Block in the product.	

Table 4-41. Level 1 B Full Polarization Reconstructed Brightness Temperatures Fourier Components Product Data Block

4.2.5 L1C Data Specification

L1C Data are the products obtained in science measurement mode when pointing to the earth in nominal mode, starting from L1B brightness temperatures Fourier components, peforming an inverse FFT and geolocating them in pole-to-pole swaths according to ascending and descending passes. The products include values for geophysical corrections, although they are not applied at this level.

As written in section 4.5 in [RD.1], L1c products are reprocessed L1b products that have been geographically sorted into swath-based brightness temperature maps. One overlapped L1B product at ground level is needed for the generation of one L1c product. If there was no overlap in L1B, in order to properly process the data near both orbit ends two L1B products would be needed to generalte one L1C product. The format shall be similar to the one depicted in the following figure:

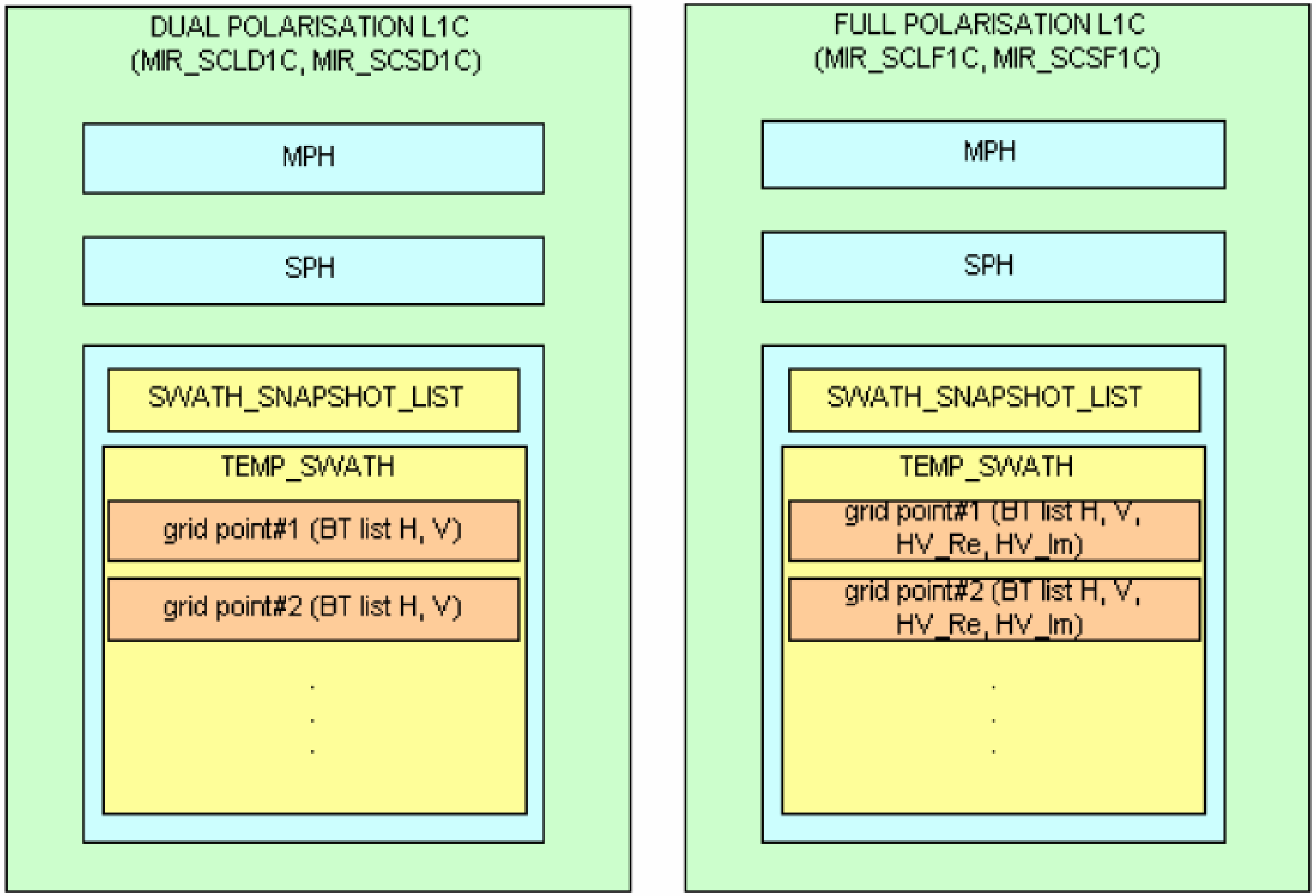

Figure 4-5. SMOS L1C product structure (taken from Deimos Eng., L1PP Product format)

Following the SAG suggestion, it has been decided, that the OS L1c product will contain 200 Km of land, and the SM L1c product will contain 200 Km of sea.

4.2.5.1 Dual Polarization Reconstructed $\check{T}_B$ Swath (MIR_SCSD1C / MIR_SCLD1C)

The dual polarization reconstructed brightness temperature swath are L1C products obtained from MIR_SC_D1B products when pointing to the earth. It is organized in grid points (these belonging to the Digital Global Grid DGG, organized in equal-area cells corresponding to $2.7 \cdot 10^6$ points), each point containing several brightness temperature samples TOA (on top of the atmosphere, at the antenna reference frame), and also a number of geophysical parameters allowing geophysical corrections in upper processing levels.

4.2.5.1.1 Specific Product Header

The Specific Product Header for Level 1C MIR_SCLD1C/MIR_SCSD1C Products shall follow the format described in table below.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***					Init of Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in fields 01 to 16 in Table 4-3	
20-26	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure defined as specified in Table 4-4	
27	***Product_Location***	Starting Tag					
28	***Start_Lat***	real	deg	11 bytes	%+011.6f	WGS84 geodetic latitude of the subsatellite point of the	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						first snapshot in the product (positive to North)	
29	***Start_Lon***	real	deg	11 bytes	%+011.6f	WGS84 longitude of the subsatellite point of the first snapshot in the product (positive to East, from Greenwich)	INT
30	***Stop_Lat***	real	deg	11 bytes	%+011.6f	WGS84 geodetic latitude of the subsatellite point of the last snapshot in the product (positive to North)	INT
31	***Stop_Lon***	real	deg	11 bytes	%+011.6f	WGS84 longitude of the subsatellite point of the last snapshot in the product (positive to East, from Greenwich)	INT
32	***Mid_Lat***	real	deg	11 bytes	%+011.6f	Geodetic latitude of satellite nadir point of the snapshot in the middle (rounded down) of the list used in the generation of the product .	INT
33	***Mid_Lon***	real	deg	11 bytes	%+011.6f	Longitude of satellite nadir point of the snapshot in the middle (rounded down) of the list used in the generation of the product	INT
34	***Product_Location***	Closing Tag					
35	***Radiometric_Accuracy_Scale***	Integer	K	3 bytes	%03d	Scale used in the normalisation to 2s complement of the Pixel Radiometric Accuracy (default 50K)	AUX_CNFL1P
36	***Pixel_Footprint_Scale***	Integer	km	3 bytes	%03d	Scale used in the normalisation to 2s complement of the Pixel Footprint size (default 100km)	AUX_CNFL1P
37	***Geolocation_Information***	Starting tag				Tag starting a structure specifying information on the geolocation input parameters and the results statistics as well	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
38	***Percentage_of_Mixed_Pixels***	Real	N/A	7 bytes	%07.3f	Percentage of mixed pixels within product (defined as mixed in the L1C Pixel Mask)	INT
39	***Geometric_Correction_Type***	Integer	N/A	1 byte	%01d	This field specifies the method used to geolocate the pixels: • 1 for "S/C Atittude Only" • 2 for "Best Fit Plane Correction Applied"	ADF
40	***Apodisation_Window***	integer	N/A	3 bytes	%03d	Constant Apodisattion function used to generate the product. Numerical value representing the apodisation function applied (coherent with the filename Reference Data Set) 000=Rectangular window 001=Blackman window 002=Barlett window 003=Hamming window 004=Hanning window … 100=Kaiser window with alpha 1.20 101=Kaiser window with alpha 1.21 … (user defined and agreed windows) 999=Strip Adaptive window	ADF
41	***Total_Num_Grid_Points***	integer	N/A	6 bytes	%06d	Total number of grid points covered by L1C product	INT
42	***Geolocation_Information***	Closing Tag				Tag ending the structure specifying information on the geolocation input parameters and the results statistics as well	
43-54	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	
56	***Specific_Product_Header***					End of Specific Product Header structure	

Table 4-42. Level 1C SPH

The specific valid Reference Data Sets for MIR_SCLD1C/MIR_SCSD1C products are:

Reference Data Set Name	Product Type	Description
L1B_FILE	`MIR_SC_D1B`	L1b Product filename used to create the current L1c product
DGG_FILE	`AUX_DGG___`	Fixed Earth Grid filename used in the current L1c product
TEC_FILE	`AUX_VTEC_P,AUX_VTEC_C`	TEC filename used in the current L1b and L1c products
RFI_FILE	`AUX_RFI___`	Auxiliary file with RFI flagged pixels in the same grid as DGG
FAILURES_FILE	`AUX_FAIL__`	Auxiliary file with failure of components to be taken into account during L1 processing
BEST_FIT_PLANE_FILE	`AUX_BFP__`	Auxiliary file with definition of Best Fit Plane to be used during geolocation in L1c
L1C_PIXEL_MASK_FILE	`AUX_MASK__`	Auxiliary file with the flagging of pixels for use in L1c land or sea products
LAND_SEA_MASK_FILE	`AUX_LSMASK`	Auxiliary file containing the Land/Sea mask of pixels in the DGG
APODISATION_FILE	`AUX_APDL__,` `AUX_APDS__`	Auxiliary file with definition and coefficients of the apodisation applied from L1b to L1c
ORBIT_SCENARIO_FILE	`MPL_ORBSCT`	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	`AUX_CNFL1P`	Processor Configuration Parameters and Constants for L1OP

Table 4-43. Level 1 C Dual Polarization Reconstructed Brightness Temperatures Swath Reference Data Sets

4.2.5.1.2 Data Block

The binary Data Block of the MIR_SCLD1C/MIR_SCSD1C product consists of two Measurement datasets, the first one containing the list of snapshots and associated information in the swath, and the second one containing the list of brightness temperature samples and associated geophysical information for each grid points sensed by the MIRAS instrument.

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 first DSR structure name in the XML schema shall be ***Swath_Snapshot_List***, and the second one is ***Temp_Swath_Dual***.

- The ***Swath_Snapshot_List*** data set consists of a list of the snapshots along with the parameters that characterise them. All data is referenced to the time described in the field ***Snapshot_Time*** expressed in UTC format. ***Snapshot_OBET*** is still referred to the start of the integration time, but it is kept as it provides an extra unique reference to the snapshot. There shall be a complete Data Set Record for each integration time. The first field in the dataset, Counter, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Snapshot_Information*** dataset record structure. The size of each DSR is fixed and equal to 161 bytes.

- The ***Temp_Swath_Dual*** data set shall contain a list of Brightness Temperatures and their incidence angles for every point in the Earth Fixed grid covered by the product. There shall be a complete Data Set Record for each grid point within the product. The first field in the dataset, ***Counter***, specifies the number of pixels structures ***Grid_Point_Data*** contained in it. This dataset differs with the rest of the datasets in L1 in that it contains an intermediate hierarchical level, consisting ***Grid_Point_Data*** in a variable list of brightness temperature samples ***BT_Data***, falling over the same DGG pixel. The size of each ***BT_Data*** is fixed and equal to 24 bytes, while the size of ***Grid_Point_Data*** is variable and depends on the number of ***BT_Data*** actually contained in it (18+Nx24 bytes; where N is the number of ***BT_Data*** over that grid point, specified by field #30 ***BT_Data_Counter***). This concept is referred to as <u>*variable array of variable array*</u>.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Swath_Snapshot_List					Init of binary Data Set containing a number of ***Snapshot_Information*** data set records.	
01	***Snapshot_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Snapshot_Information*** data set record structures.	Generated by L1C Processor
	List_of_Snapshot_Informations					Init of list of ***Snapshot_Information*** data set record structures, repeated ***Counter*** times.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						There are as many DSR as snapshots are present in the product.	
	Snapshot_Information					Init of ***Snapshot_Information*** data set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Start of integration time period. This reference time is applicable to all PVT and AOCS data contained in the "Auxiliary data" part. Expressed in EE CFI transport time format.	Copied from L1B product
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1B product
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1B product
05	***X_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector X Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product
06	***Y_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Y Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
07	***Z_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Z Position in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product
08	***X_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector X Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product
09	***Y_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Y Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product
10	***Z_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Z Velocity in Earth Fixed Reference at snapshot_Time (field 02)	Copied from L1B product
11	***Vector_Source***	Identifier	N/A	Unsigned 1 byte	1 element	Source of the Orbit State Vector record: • SOLUTION_NULL = 0 • SOLUTION_INITIALISATION = 1 • SOLUTION_PVT_FROZEN = 2 • SOLUTION_NKF_SOLUTION = 3 • SOLUTION_SPS_SOLUTION = 4 • SOLUTION_PREDICTED = 5 (not used) • SOLUTION_RESTITUTED = 6 (not used)	Copied from L1B product
12	***Q0***	Real value	N/A	Double (8 bytes)	1 element	Real number component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
13	***Q1***	Real value	N/A	Double (8 bytes)	1 element	First component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
14	***Q2***	Real value	N/A	Double (8 bytes)	1 element	Second component of quaternion obtained rotating from the J2000 inertial reference frame	Copied from L1B product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						to the satellite body frame	
15	*Q3*	Real value	N/A	Double (8 bytes)	1 element	Third component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
16	*TEC*	Real value	TECU (10^{16} Electron/m^2)	Double (8 bytes)	1 element	Total Electron Count content applicable to snapshot data.	AUX_VTEC_P/C + internal processing, or IRI-95/2000 model
17	*Geomag_F*	Real value	nT	Double (8 bytes)	1 element	Full or Total Intensity (F) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model	Generated by L1C Processor, using IGRF model
18	*Geomag_D*	Real value	Deg	Double (8 bytes)	1 element	Declination (D) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model. Magnetic declination is the angle between magnetic north and true north. D is considered positive when the angle measured is east of true north and negative when west. Positive in eastward direction	Generated by L1C Processor, using IGRF model
19	*Geomag_I*	Real value	Deg	Double (8 bytes)	1 element	Inclination (I) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model. Magnetic inclination is the angle between the horizontal plane and the total field vector, measured positive into Earth. Positive in downward (towards Earth Surface) direction.	Generated by L1C Processor, using IGRF model
20	*Sun_RA*	Real value	deg	Float (4 bytes)	1 element	Right Ascension of Sun illumination direction in Earth Fixed Reference	L1C Processor generated from Sun-related fields in L1B product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
21	***Sun_DEC***	Real value	deg	Float (4 bytes)	1 element	Declination of Sun illumination direction in Earth Fixed Reference	L1C Processor generated from Sun-related fields in L1B product
22	***Sun_BT***	Real value	K	Float (4 bytes)	1 element	Direct Sun estimated Brightness Temperature that has been removed from snapshot	L1C Processor generated from Sun-related fields in L1B product
23	***Accuracy***	Real value	K	Float (4 bytes)	1 element	Snapshot overall accuracy measurement, based on Corbella equation and computed as the difference of the mean snapshot Brightness Temperature and the averaged physical temperature of the LICEF receivers	L1C Processor generated, starting from L1B product
24	***Radiometric_Accuracy***	Array of real values	K	Float (4 bytes)	2 elements	Error accuracy measurement in the Brightness Temperature value at boresight: • First one is the pure polarisation • Second one is the cross-polarization The second element is only used to store the boresight accuracy for full pol snapshots, set to 0 in all other cases.	L1C Processor generated
	Snapshot_Information					End of ***Snapshot_Information*** data set record structure.	
	List_of_Snapshot_Informations					End of list of ***Snapshot_Information*** data set record structures.	
	Swath_Snapshot_List					End of ***Swath_Snapshot_List*** binary Data Set.	
	Temp_Swath_Dual					Init of ***Temp_Swath_Dual*** binary Data Set.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
25	***Grid_Point_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Grid_Point_Data*** data set record structures.	Generated by L1C Processor
	List_of_Grid_Point_Datas					Init of list of ***Grid_Point_Data*** data set record structures, repeated ***Counter*** times. There are as many DSR as pixels are present in the product. The order in the product is according to Grid_Point_Latitude.	
	Grid_Point_Data					Init of ***Grid_Point_Data*** data set record structure.	
26	***Grid_Point_ID***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point, linking it to Auxiliary Earth Grid file. For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
27	***Grid_Point_Latitude***	Real value	deg	Float (4 bytes)	1 element	Latitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG
28	***Grid_Point_Longitude***	Real value	deg	Float (4 bytes)	1 element	Longitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG
	Grid_Point_Altitude	Real value	m	Float (4 bytes)	1 element	Altitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG
29	***Grid_Point_Mask***	Set of flags	N/A	unsigned byte	1 element	Flag indicating land/sea USGS content, coastline distance, and Ice content.	Copied from AUX_LSMASK
30	***BT_Data_Counter***	Counter	N/A	unsigned byte	1 element	Counter of Brightness Temperature Data values for current point (variable number depending on point across track position). Size of array to be read with data (maximum value of 255).	Generated by L1C Processor
	List_of_BT_Datas					Init of list of ***BT_Datas*** data structures	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						repeated ***Counter*** times.	
	BT_Data					Init of ***BT_Data*** data set record structure.	
31	***Flags***	Set of flags	N/A	unsigned short integer (2 bytes)	1 element	L1c flags applicable to the pixel for this particular integration time. Flags identified below this table.	Generated by L1C Processor
32	***BT_Value***	Real value	K	Float (4 bytes)	1 element	Brightness temperature value over current Earth fixed grid point, obtained by DFT interpolation from L1b data.	Generated by L1C Processor, starting from L1B product
33	***Pixel_Radiometric_Accuracy***	Real value (coded as integer)	K	unsigned short (2 bytes)	1 element	Error accuracy measurement in the Brightness Temperature presented in the previous field, extracted in the direction of the pixel. Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$K, where X is ***Radiometric_Accuracy_Scale*** given in SPH	Generated by L1C Processor, starting from L1B product
34	***Incidence_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Incidence angle value corresponding to the measured BT value over current Earth fixed grid point. Measured as angle from pixel to S/C with respect to the pixel local normal (0° if vertical) Coded in 2's complement. LSB=$90/2^{16}$. Meaning that value=(unsigned short)*$90/2^{16}$degrees	L1C Processor generated, from satellite's position and attitutde in L1B, DGG point location.
35	***Azimuth_Angle***	Real value (code as	deg	unsigned short (2 bytes)	1 element	Azimuth angle value corresponding to the measured BT value over current Earth fixed grid point. Measured as angle in pixel local	L1C Processor generated, from satellite's position

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		integer)				tangent plane from projected pixel to S/C direction with respect to the local North (0º if local North) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	and attitutde in L1B, DGG point location.
36	***Faraday_Rotation_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Faraday rotation angle value corresponding to the measured BT value over current Earth fixed grid point. It is computed as the rotation from antenna to surface (i.e. inverse angle) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	L1C Processor generated, using TEC value as input
37	***Geometric_Rotation_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Geometric rotation angle value corresponding to the measured BT value over current Earth fixed grid point. It is computed as the rotation from surface to antenna (i.e. direct angle) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	L1C Processor generated, using geomagnetic IGRF-2005 model
38	***Snapshot_ID_of_Pixel***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1B
39	***Footprint_Axis1***	Real value (code as integer)	km	unsigned short (2 bytes)	1 element	Elliptical footprint major semi-axis value. Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$ km, where X is ***Pixel_Footprint_Scale*** given in SPH	L1C Processor generated, using satellite's position and attitude in L1B
40	***Footprint_Axis2***	Real	km	unsigned	1 element	Elliptical footprint minor semi-axis value.	L1C Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		value (code as integer)		short (2 bytes)		Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$ km, where X is ***Pixel_Footprint_Scale*** given in SPH	generated, using satellite's position and attitude in L1B
	BT_Data					End of ***BT_Data*** data set record structure.	
	List_of_BT_Datas					End of list of ***BT_Datas*** data structures, repeated ***Counter*** times.	
	Grid_Point_Data					End of ***Grid_Point_Data*** data set record structure.	
	List_of_Grid_Point_Datas					End of list of ***Grid_Point_Data*** data set record structures.	
	Temp_Swath_Dual					End of ***Temp_Swath_Dual*** binary Data Set.	
	Data_Block					End of binary Data Block in the product.	

Table 4-44. Level 1 C Dual Polarization Reconstructed Brightness Temperatures Swath Product Data Block

The Flags field #31 shall be used to report polarisation of the pixel measurement data, as well as quality values applicable to the measurement. The flags are contained in an 16-bit counter, each bit representing a status, and they shall be described using the following order convention:

[MSB:X X X X:X X X X:X X X X:X X X X:LSB]

This fields contains the following flags:

- Polarisation flags:
    - [X X X X:X X X X:X X X X:X X 0 0] represents HH polarisation

- [X X X X:X X X X:X X X X:X X 0 1] represents VV polarisation

- SUN FOV flag:
  - [X X X X:X X X X:X X X X:X 0 X X] means that no Direct Sun correction has been performed during image reconstruction of this pixel
  - [X X X X:X X X X:X X X X:X 1 X X] means that Direct Sun correction has been performed during image reconstruction of this pixel
- SUN GLINT_FOV flag:
  - [X X X X:X X X X:X X X X:0 X X X] means that no Reflected Sun correction has been performed during image reconstruction of this pixel
  - [X X X X:X X X X:X X X X:1 X X X] means that Reflected Sun correction has been performed during image reconstruction of this pixel
- MOON FOV flag:
  - [X X X X:X X X X:X X X 0:X X X X] means that no Direct Moon correction has been performed during image reconstruction of this pixel
  - [X X X X:X X X X:X X X 1:X X X X] means that Direct Moon correction has been performed during image reconstruction of this pixel
- SINGLE_SNAPSHOT flag:
  - [X X X X:X X X X:X X 0 X:X X X X] means that this scene has been combined with an adjacent scene in opposite polarisation during image reconstruction to account for crosspolarisation leakage
  - [X X X X:X X X X:X X 1 X:X X X X] means that this scene has not been combined with an adjacent scene in opposite polarisation during image reconstruction to account for crosspolarisation leakage (it has been processed with only co-polar antenna patterns information)
- FTT flag:

  - [X X X X:X X X X:X 0 X X:X X X X] means that **no** Flat Target Transformation has been performed during image reconstruction of this pixel (instead, the Corbella Term has been corrected using G matrix, and a constant Earth term has been removed from the image)
  - [X X X X:X X X X:X 1 X X:X X X X] means that Flat Target Transformation has been performed during image reconstruction of this pixel
- SUN POINT flag:
  - [X X X X:X X X X:0 X X X:X X X X] means that this pixel is located in a zone where no Sun alias was reconstructed
  - [X X X X:X X X X:1 X X X:X X X X] means that this pixel is located in a zone where a Sun alias was reconstructed (after Sun removal, measurement may be degraded)
- SUN GLINT_AREA flag:
  - [X X X X:X X X 0:X X X X:X X X X] means that this pixel is located in a zone where no Sun reflection has been detected
  - [X X X X:X X X 1:X X X X:X X X X] means that this pixel is located in a zone where Sun reflection has been detected
- MOON POINT flag:
  - [X X X X:X X 0 X:X X X X:X X X X] means that this pixel is located in a zone where no Moon alias was reconstructed
  - [X X X X:X X 1 X:X X X X:X X X X] means that this pixel is located in a zone where a Moon alias was reconstructed (after Moon removal, measurement may be degraded)
- AF FOV flag:
  - [X X X X:X 0 X X:X X X X:X X X X] means that the pixel is not inside the exclusive zone of Alias free (delimited by the six aliased unit circles)
  - [X X X X:X 1 X X:X X X X:X X X X] means that the pixel is inside the exclusive zone of Alias free (delimited by the six aliased unit circles)
- EAF FOV flag:
  - [X X X X:0 X X X:X X X X:X X X X] means that the pixel is not inside the Extended Alias free zone (obtained after removing sky aliases)

    - [X X X X:1 X X X:X X X X:X X X X] means that the pixel is inside the Extended Alias free zone (obtained after removing sky aliases)
- BORDER FOV flag:
    - [X X X 0:X X X X:X X X X:X X X X] means that the pixel is far from the border delimiting the Extended Alias free zone
    - [X X X 1:X X X X:X X X X:X X X X] means that the pixel is close to the border delimiting the Extended Alias free zone
- SUN TAILS flag:
    - [X X 0 X:X X X X:X X X X:X X X X] means that this pixel is located in a zone with no potential problems with Sun aliases
    - [X X 1 X:X X X X:X X X X:X X X X] means that this pixel is located in the hexagonal alias directions centred on a Sun alias (if Sun is not removed, measurement may be degraded in these directions)
- RFI flag:
    - [X 0 X X:X X X X:X X X X:X X X X] means that this pixel is not affected by RFI effects
    - [X 1 X X:X X X X:X X X X:X X X X] means that this pixel is affected by RFI effects (as identified in static ADF file)

4.2.5.2 Full Polarization Reconstructed $\check{T}_B$ Swath (MIR_SCSF1C / MIR_SCLF1C)

The MIR_SCLF1C/MIR_SCSF1C products obtained from MIR_SC_F1B products when pointing to the earth. It is organized in grid points (these belonging to the Digital Global Grid DGG, organized in equal-area cells corresponding to $2.7\cdot10^6$ points), each point containing several brightness temperature samples TOA (on top of the atmosphere, at the antenna reference frame), and also a number of geophysical parameters allowing geophysical corrections in upper processing levels.

As is specified for the dual polarization mode, the MIR_SCSF1C product will contain 200km of land, and the MIR_SCLF1C with contain 200km of sea.

4.2.5.2.1 Specific Product Header

The Specific Product Header for MIR_SCLF1C/ MIR_SCSF1C Products shall follow the format described in section 4.2.5.1.1.

The specific valid Reference Data Sets for MIR_SCLF1C/ MIR_SCSF1C Products are:

Reference Data Set Name	Product Type	Description
L1B_FILE	MIR_SC_F1B	L1b Product filename used to create the current L1c product
DGG_FILE	AUX_DGG___	Fixed Earth Grid filename used in the current L1c product
TEC_FILE	AUX_VTEC_P,AUX_VTEC_C	TEC filename used in the current L1b and L1c products
RFI_FILE	AUX_RFI___	Auxiliary file with RFI flagged pixels in the same grid as DGG
FAILURES_FILE	AUX_FAIL__	Auxiliary file with failure of components to be taken into account during L1 processing
BEST_FIT_PLANE_FILE	AUX_BFP__	Auxiliary file with definition of Best Fit Plane to be used during geolocation in L1c
L1C_PIXEL_MASK_FILE	AUX_MASK__	Auxiliary file with the flagging of pixels for use in L1c land or sea products
LAND_SEA_MASK_FILE	AUX_LSMASK	Auxiliary file containing the Land/Sea mask of pixels in the DGG
APODISATION_FILE	AUX_APDL__, AUX_APDS__	Auxiliary file with definition and coefficients of the apodisation applied from L1b to L1c
ORBIT_SCENARIO_FILE	MPL_ORBSCT	Mission planning file used to initialise the EE CFI orbit_id and/or time_id. It is read and used by the EE CFI.
ALGORITHM_CONFIG_FILE	AUX_CNFL1P	Processor Configuration Parameters and Constants for L1OP

Table 4-45. Level 1 C Full Polarization Reconstructed Brightness Temperatures Swath Reference Data Sets

4.2.5.2.2 Data Block

The binary Data Block of the MIR_SCLF1C/ MIR_SCSF1C product consists of two Measurement datasets, the first one containing the list of snapshots and associated information in the swath, and the second one containing the list of brightness temperature samples and associated geophysical information for each grid points sensed by the MIRAS instrument.

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 first DSR structure name in the XML schema shall be ***Swath_Snapshot_List***, and the second one is ***Temp_Swath_Full.***

- The ***Swath_Snapshot_List*** data set consists of a list of the snapshots along with the parameters that characterise them. All data is referenced to the time described in the field ***Snapshot_Time*** expressed in UTC format. ***Snapshot_OBET*** is still referred to the start of the integration time, but it is kept as it provides an extra unique reference to the snapshot. There shall be a complete Data Set Record for each integration time. The first field in the dataset, ***Counter***, specifies the number of DSR contained in it, while the following fields are ***Counter*** repetitions of the ***Snapshot_Information*** dataset record structure. The size of each DSR is fixed and equal to 161 bytes.
- The ***Temp_Swath_Full*** data set shall contain a list of Brightness Temperatures and their incidence angles for every point in the Earth Fixed grid covered by the product. There shall be a complete Data Set Record for each grid point within the product. The first field in the dataset, ***Counter***, specifies the number of pixels structures ***Grid_Point_Data*** contained in it. This dataset differs with the rest of the datasets in L1 in that it contains an intermediate hierarchical level, consisting ***Grid_Point_Data*** in a variable list of brightness temperature samples ***BT_Data***, falling over the same DGG pixel. The size of each ***BT_Data*** is fixed and equal to 28 bytes, while the size of ***Grid_Point_Data*** is variable and depends on the number of ***BT_Data*** actually contained in it (18+Nx28 bytes; where N is the number of ***BT_Data*** over that grid point, specified by field #30 ***Counter***). This concept is referred to as <u>*variable array of variable array*</u>.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Swath_Snapshot_List					Init of binary Data Set containing a number of ***Snapshot_Information*** data set records.	
01	***Snapshot_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Snapshot_Information*** data set record structures.	Generated by L1C Processor
	List_of_Snapshot_Infor					Init of list of ***Snapshot_Information*** data set record structures, repeated ***Counter***	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	mations					times. There are as many DSR as snapshots are present in the product	
	Snapshot_Information					Init of ***Snapshot_Information*** data set record structure.	
02	***Snapshot_Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC Time at which the scene was taken. Start of integration time period. This reference time is applicable to all PVT and AOCS data contained in the "Auxiliary data" part. Expressed in EE CFI transport time format.	Copied from L1B product
03	***Snapshot_ID***	Identifier	N/A	unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 + Seconds_from_ANX	Copied from L1B product
04	***Snapshot_OBET***	Time counter	N/A	bit stream (8 bytes) declared as unsigned long	1 element (OBET Format is specified in section 4.2.1.2)	Unique identifier for the snapshot. Formed by the OBET at T_SYNC extracted from L0. Represents start of integration time in OBET format.	Copied from L1B product
05	***X_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector X Position in Earth Fixed Reference at snapshot_Time (field 1)	Copied from L1B product
06	***Y_Position***	Real	m	Double (8	1 element	Orbit State Vector Y Position in Earth Fixed	Copied from L1B

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		value		bytes)		Reference at snapshot_Time (field 1)	product
07	***Z_Position***	Real value	m	Double (8 bytes)	1 element	Orbit State Vector Z Position in Earth Fixed Reference at snapshot_Time (field 1)	Copied from L1B product
08	***X_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector X Velocity in Earth Fixed Reference at snapshot_Time (field 1)	Copied from L1B product
09	***Y_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Y Velocity in Earth Fixed Reference at snapshot_Time (field 1)	Copied from L1B product
10	***Z_Velocity***	Real value	m/s	Double (8 bytes)	1 element	Orbit State Vector Z Velocity in Earth Fixed Reference at snapshot_Time (field 1)	Copied from L1B product
11	***Vector_Source***	Identifier	N/A	Unsigned 1 byte	1 element	Source of the Orbit State Vector record: • SOLUTION_NULL = 0 • SOLUTION_INITIALISATION = 1 • SOLUTION_PVT_FROZEN = 2 • SOLUTION_NKF_SOLUTION = 3 • SOLUTION_SPS_SOLUTION = 4 • SOLUTION_PREDICTED = 5 (not used) • SOLUTION_RESTITUTED = 6 (not used)	Copied from L1B product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
12	*Q0*	Real value	N/A	Double (8 bytes)	1 element	Real number component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
13	*Q1*	Real value	N/A	Double (8 bytes)	1 element	First component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
14	*Q2*	Real value	N/A	Double (8 bytes)	1 element	Second component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
15	*Q3*	Real value	N/A	Double (8 bytes)	1 element	Third component of quaternion obtained rotating from the J2000 inertial reference frame to the satellite body frame	Copied from L1B product
16	*TEC*	Real value	TECU (10^{16} Electron /m^2)	Double (8 bytes)	1 element	Total Electron Count content applicable to snapshot data.	AUX_VTEC_P/C + internal processing, or IRI-95/2000 model
17	*Geomag_F*	Real value	nT	Double (8 bytes)	1 element	Full or Total Intensity (F) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model	L1C Processor generated, using IGRF model
18	*Geomag_D*	Real value	Deg	Double (8 bytes)	1 element	Declination (D) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model. Magnetic declination is the angle between magnetic north and true north. D is considered positive when the angle measured is east of true north and negative when west. Positive in eastward direction	L1C Processor generated, using IGRF model

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
19	***Geomag_I***	Real value	Deg	Double (8 bytes)	1 element	Inclination (I) of Geomagnetic field vector applicable to snapshot data, obtained mixing PVT and IGRF model. Magnetic inclination is the angle between the horizontal plane and the total field vector, measured positive into Earth. Positive in downward (towards Earth Surface) direction.	L1C Processor generated, using IGRF model
20	***Sun_RA***	Real value	deg	Float (4 bytes)	1 element	Right Ascension of Sun illumination direction in Earth Fixed Reference	L1C Processor generated from Sun-related fields in L1B product
21	***Sun_DEC***	Real value	deg	Float (4 bytes)	1 element	Declination of Sun illumination direction in Earth Fixed Reference	L1C Processor generated from Sun-related fields in L1B product
22	***Sun_BT***	Real value	K	Float (4 bytes)	1 element	Direct Sun estimated Brightness Temperature that has been removed from snapshot	L1C Processor generated from Sun-related fields in L1B product
23	***Accuracy***	Real value	K	Float (4 bytes)	1 element	Snapshot overall accuracy measurement, based on Corbella equation and computed as the difference of the mean snapshot Brightness Temperature and the averaged physical temperature of the LICEF receivers	L1C Processor generated, starting from L1B product
24	***Radiometric_Accuracy***	Array of real values	K	Float (4 bytes)	2 elements	Error accuracy measurement in the Brightness Temperature value at boresight: • First one is the pure polarisation • Second one is the cross-polarization The second element is only used to store	L1C Processor generated

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						the boresight accuracy for full pol snapshots, set to 0 in all other cases.	
	Snapshot_Information					End of ***Snapshot_Information*** data set record structure.	
	List_of_Snapshot_Informations					End of list of ***Snapshot_Information*** data set record structures.	
	Swath_Snapshot_List					End of ***Swath_Snapshot_List*** binary Data Set.	
	Temp_Swath_Full					Init of ***Temp_Swath_Full*** binary Data Set.	
25	***Grid_Point_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Grid_Point_Data*** data set record structures.	
	List_of_Grid_Point_Datas					Init of list of ***Grid_Point_Data*** data set record structures, repeated ***Counter*** times. There are as many DSR as pixels are present in the product. The order in the product is according to Grid_Point_Latitude.	
	Grid_Point_Data					Init of ***Grid_Point_Data*** data set record structure.	
26	***Grid_Point_ID***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point, linking it to Auxiliary Earth Grid file. For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
27	***Grid_Point_Latitude***	Real value	deg	Float (4 bytes)	1 element	Latitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
28	***Grid_Point_Longitude***	Real value	deg	Float (4 bytes)	1 element	Longitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG
29	***Grid_Point_Altitude***	Real value	m	Float (4 bytes)	1 element	Altitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from AUX_DGG
30	***Grid_Point_Mask***	Set of flags	N/A	unsigned byte	1 element	Flag indicating land/sea USGS content, coastline distance, and Ice content.	Copied from AUX_LSMASK
31	***BT_Data_Counter***	Counter	N/A	unsigned byte	1 element	Counter of Brightness Temperature Data values for current point (variable number depending on point across track position). Size of array to be read with data (maximum value of 255).	L1C Processor generated
	List_of_BT_Datas					Init of list of ***BT_Datas*** data structures, repeated ***Counter*** times.	
	BT_Data					Init of ***BT_Data*** data set record structure.	
32	***Flags***	Set of flags	N/A	unsigned short integer (2 bytes)	1 element	L1c flags applicable to the pixel for this particular integration time. Flags identified are the same as in section 4.2.5.1.2, with the exception coming following this table.	L1C Processor generated
33	**BT_Value_Real**	Real	K	Float (4 bytes)	1 element	Brightness temperature value over Earth fixed grid point, obtained by interpolation from L1b data. Contains real	L1C Processor generated, starting from L1B

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		value				components of HH, HV or VV polarisation measurements.	product
34	**BT_Value_Imag**	Real value	K	Float (4 bytes)	1 element	Brightnesstemperature value over current Earth fixed grid point, obtained by interpolation from L1b data. Contains imaginary components of HH, HV or VV polarisation measurements. For the pure polarizations the imaginary part should be always 0.	L1C Processor generated, starting from L1B product
35	***Pixel_Radiometric_Accuracy***	Real value (coded as integer)	K	unsigned short (2 bytes)	1 element	Error accuracy measurement in the Brightness Temperature presented in the previous field, extracted in the direction of the pixel. Coded in 2's complement.LSB=X/2^{16}. Meaning that value=(unsigned short)*X/2^{16}K where X is ***Radiometric_Accuracy_Scale*** given in SPH	L1C Processor generated, starting from L1B product
36	***Incidence_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Incidence angle value corresponding to the measured BT value over current Earth fixed grid point. Measured as angle from pixel to S/C with respect to the pixel local normal (0º if vertical) Coded in 2's complement. LSB=90/2^{16}. Meaning that value=(unsigned short)*90/2^{16}degrees	L1C Processor generated, from satellite's position and attitutde in L1B, DGG point location.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
37	***Azimuth_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Azimuth angle value corresponding to the measured BT value over current Earth fixed grid point. Measured as angle in pixel local tangent plane from projected pixel to S/C direction with respect to the local North (0º if local North) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	L1C Processor generated, from satellite's position and attitutde in L1B, DGG point location.
38	***Faraday_Rotation_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Faraday rotation angle value corresponding to the measured BT value over current Earth fixed grid point. It is computed as the rotation from antenna to surface (i.e. inverse angle) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	L1C Processor generated, using TEC value as input
39	***Geometric_Rotation_Angle***	Real value (code as integer)	deg	unsigned short (2 bytes)	1 element	Geometric rotation angle value corresponding to the measured BT value over current Earth fixed grid point. It is computed as the rotation from surface to antenna (i.e. direct angle) Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	L1C Processor generated, using geomagnetic IGRF-2005 model
40	***Snapshot_ID_of_Pixel***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for the snapshot. Formed by aggregation of orbit and time within orbit. Contents of this field are formed by: Absolute_orbit_number*10000 +	Copied from L1B product

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						Seconds_from_ANX	
41	***Footprint_Axis1***	Real value (code as integer)	km	unsigned short (2 bytes)	1 element	Elliptical footprint major semi-axis value. Coded in 2's complement. LSB=X/2^{16}. Meaning that value=(unsigned short)*X/2^{16} km, where X is ***Pixel_Footprint_Scale*** given in SPH	L1C Processor generated, using satellite's position and attitude in L1B
42	***Footprint_Axis2***	Real value (code as integer)	km	unsigned short (2 bytes)	1 element	Elliptical footprint minor semi-axis value. Coded in 2's complement. LSB=X/2^{16}. Meaning that value=(unsigned short)*X/2^{16} km, where X is ***Pixel_Footprint_Scale*** given in SPH	L1C Processor generated, using satellite's position and attitude in L1B
	BT_Data					End of ***BT_Data*** data set record structure.	
	List_of_BT_Datas					End of list of ***BT_Datas*** data structures, repeated ***Counter*** times.	
	Grid_Point_Data					End of ***Grid_Point_Data*** data set record structure.	
	List_of_Grid_Point_Datas					End of list of ***Grid_Point_Data*** data set record structures.	
	Temp_Swath_Dual					End of ***Temp_Swath_Dual*** binary Data Set.	
	Data_Block					End of binary Data Block in the product.	

Table 4-46. Level 1 C Full Polarization Reconstructed Brightness Temperatures Swath Product Data Block

The Flags field #31 shall be used to report polarisation of the pixel measurement data, as well as quality values applicable to the measurement. The flags are contained in an 16-bit counter, each bit representing a status, and they shall be described using the following order convention:

[MSB:X X X X:X X X X:X X X X:X X X X:LSB]

This fields contains the flags as specified in section 4.2.5.1.2, except for the polarisation flags that in this case shall be:

- Polarisation flags:
  - [X X X X:X X X X:X X X X:X X 0 0] represents HH polarisation (the BT_Value_Imag in the corresponding DSR should be equal to 0)
  - [X X X X:X X X X:X X X X:X X 0 1] represents VV polarisation (the BT_Value_Imag in the corresponding DSR should be equal to 0)
  - [X X X X:X X X X:X X X X:X X 1 0] represents HV polarisation real valued components.
  - [X X X X:X X X X:X X X X:X X 1 1] represents HV polarisation imaginary valued components.

4.2.5.3 Browse $\check{T}_B$ in Dual and Full Polarization (MIR_BWSD1C / MIR_BWLD1C / MIR_BWSF1C / MIR_BWLF1C)

The Browse Brightness Temperature L1 data products are arranged in pole-to-pole swaths according to ascending and descending passes. Each grid point contains a brightness temperature sample interpolated from MIRAS measurements at an incidence angle of 42.5º as default (configurable value).

Products are arranged in swaths on a pole-to-pole time interval according to ascending and descending passes. The format shall be similar to the one depicted in the following figure:

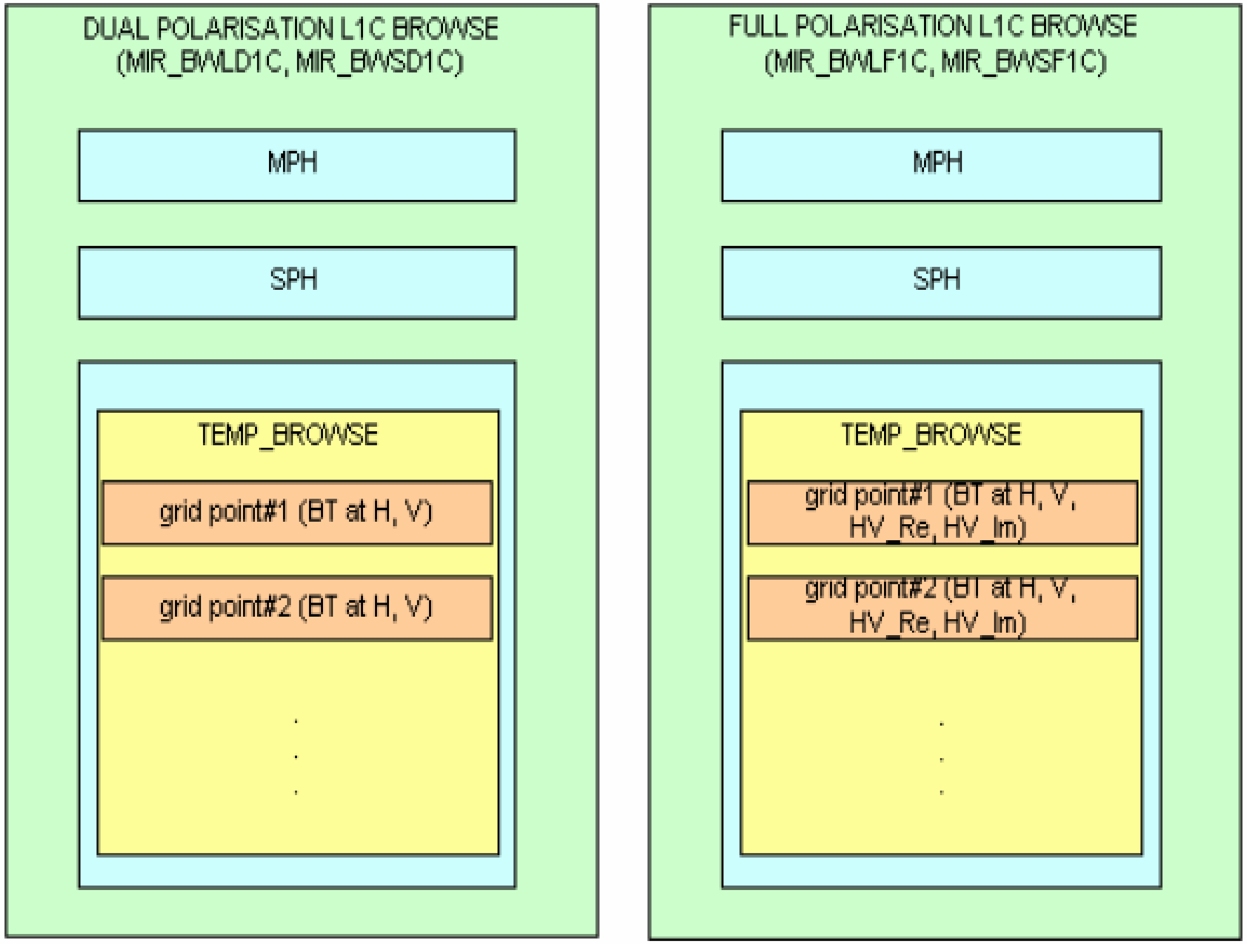

Figure 4-6. SMOS Browse Swath product structure (taken from Deimos Eng., L1PP Product format)

4.2.5.3.1 Specific Product Header

The Specific Product Header for Level 1C Browse Brightness Temperatures products shall follow the format described in table below:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***					Init of Specific Product Header structure	
02-19	***Main_Info***	structure	N/A	N/A	N/A	Main Product Info structure's fields as defined in fields 01 to 16 in Table 4-3	
20-26	***Quality_Information***	structure	N/A	N/A	N/A	Quality_Information structure defined as specified in Table 4-4	
27	***Product_Location***	Starting Tag					
28	***Start_Lat***	real	deg	11 bytes	%+011.6f	WGS84 geodetic latitude of the subsatellite point of the first snapshot in the product (positive to North)	INT
29	***Start_Lon***	real	deg	11 bytes	%+011.6f	WGS84 longitude of the subsatellite point of the first snapshot in the product (positive to East, from Greenwich)	INT
30	***Stop_Lat***	real	deg	11 bytes	%+011.6f	WGS84 geodetic latitude of the subsatellite point of the last snapshot in the product (positive to North)	INT
31	***Stop_Lon***	real	deg	11 bytes	%+011.6f	WGS84 longitude of the subsatellite point of the last snapshot in the product (positive to East, from Greenwich)	INT
32	***Mid_Lat***	real	deg	11 bytes	%+011.6f	Geodetic latitude of satellite nadir point of the snapshot in the middle (rounded down) of the list used in the generation of the product .	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
33	***Mid_Lon***	real	deg	11 bytes	%+011.6f	Longitude of satellite nadir point of the snapshot in the middle (rounded down) of the list used in the generation of the product	INT
34	***Product_Location***	Closing Tag					
35	***Incidence_Angle***	real	deg	7 bytes	%+07.3f	Incidence angle of Brightness Temperature measurements presented in Browse product. Set to 42.500	ADF
36	***Radiometric_Accuracy_Scale***	Integer	K	3 bytes	%03d	Scale used in the normalisation to 2s complement of the Pixel Radiometric Accuracy (default 50K)	ADF
37	***Pixel_Footprint_Scale***	Integer	km	3 bytes	%03d	Scale used in the normalisation to 2s complement of the Pixel Footprint size (100km)	ADF
38	***Geolocation_Information***	Starting tag				Tag starting a structure specifying information on the geolocation input parameters and the results statistics as well	
39	***Percentage_of_Mixed_Pixels***	Real	N/A	7 bytes	%07.3f	Percentage of mixed pixels within product (defined as mixed in the L1C Pixel Mask)	INT
40	***Geometric_Correction_Type***	Integer	N/A	1 byte	%01d	This field specifies the method used to geolocate the pixels: • 1 for "S/C Atittude Only" • 2 for "Best Fit Plane Correction Applied"	ADF
41	***Apodisation_Window***	integer	N/A	3 bytes	%03d	Constant Apodisattion function used to generate the product. Numerical value representing the apodisation function applied (coherent with the filename Reference Data Set) 000=Rectangular window 001=Blackman window 002=Barlett window 003=Hamming window	ADF

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						004=Hanning window … 100=Kaiser window with alpha 1.20 101=Kaiser window with alpha 1.21 … (user defined and agreed windows) 999=Strip Adaptive window	
42	***Geolocation_Information***	Closing Tag				Tag ending the structure specifying information on the geolocation input parameters and the results statistics as well	
44-55	***Data_Sets***	structure	N/A	N/A	N/A	Data Sets structure's fields as defined in Table 4-4	
56	***Specific_Product_Header***					End of Specific Product Header structure	

Table 4-47. Level 1 C Browse Brightness Temperatures SPH

The specific valid Reference Data Sets for Level 1 C Browse Brightness Temperatures Products are:

Reference Data Set Name	Product Type	Description
L1C_FILE	`MIR_SCSD1C, MIR_SCLD1C, MIR_SCSF1C, MIR_SCLF1C`	L1C Product filename corresponding to the browse product
ALGORITHM_CONFIG_FILE	`AUX_CNFL1P`	Processor Configuration Parameters and Constants for L1OP

Table 4-48. Level 1 C Browse Brightness Temperatures Reference Data Sets

4.2.5.3.2 Data Block

The binary Data Block of the L1C Browse Brightness Temperatures data product consists of one Measurement dataset, containing the list of points with the associated brightness temperature sample at each polarization (2 in dual polarization products, 4 in full polarization products) at one single incidence angle (42.5º), and associated information for each grid point sensed by the MIRAS instrument.

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 ***Temp_Browse.***

- The ***Temp_Browse*** data set shall contain a fixed number of brightness temperatures samples in different polarizations (2 or 4 depending on the product being dual or full polarisation) for every point in the Earth Fixed grid covered by the product. There shall be a complete Data Set Record for each grid point within the product. The first field in the dataset, ***Counter***, specifies the number of pixels structures ***Grid_Point_Data*** contained in it. This dataset differs with the rest of the L1C datasets in that it contains a fixed number of ***BT_Data*** structures for each ***Grid_Point_Data*** DSR. The size of each ***BT_Data*** is fixed and equal to 14 bytes, while the size of ***Grid_Point_Data*** depends on the polarisation mode (14+2x14= 42 bytes for dual polarisation; 14+4x14= 70 bytes for full polarisation). Field #06 specifies the number of ***BT_Data*** in each ***Grid_Point_Data***.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Temp_Browse					Init of ***Temp_Browse*** binary Data Set.	
01	***Grid_Point_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Grid_Point_Data*** data set record structures.	Generated by L1C Processor
	List_of_Grid_Point_Datas					Init of list of ***Grid_Point_Data*** data set record structures, repeated ***Counter*** times. There are as many DSR as pixels are present in the product. The order in the product is according to	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						Grid_Point_Latitude.	
	Grid_Point_Data					Init of ***Grid_Point_Data*** data set record structure.	
02	***Grid_Point_ID***	Identifier	N/A	Unsigned integer (4 bytes)	4 bytes (for ISEA 4-9, maximum of 2.7M pixels)	Unique identifier for Earth fixed grid point, linking it to Auxiliary Earth Grid file	Copied from L1C product
03	***Grid_Point_Latitude***	Real value	deg	Float (4 bytes)	1 element	Latitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from L1C product
04	***Grid_Point_Longitude***	Real value	deg	Float (4 bytes)	1 element	Longitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from L1C product
05	***Grid_Point_Altitude***	Real value	m	Float (4 bytes)	1 element	Altitude of the DGG cell's center identified by ***Grid_Point_ID***	Copied from L1C product
06	***Grid_Point_Mask***	Set of flags	N/A	unsigned byte	1 element	Flag indicating land/sea USGS content, coastline distance, and Ice content.	Copied from L1C product
07	***BT_Data_Counter***	Counter	N/A	unsigned byte	1 element	Counter of Brightness Temperature Data values for current point (fixed number in Browse products, 2 for dual polarisation products, 4 for full polarisation products)	Generated by L1C Processor
	List_of_BT_Datas					Init of list of ***BT_Datas*** data structures repeated ***Counter*** times.	
	BT_Data					Init of ***BT_Data*** data set record structure.	
08	***Flags***	Set of flags		unsigned short integer (2 bytes)	1 element	Following flags identified in section 4.2.5.1.2.	Generated by L1C Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
			N/A				
09	***BT_Value***	Real value	K	Float (4 bytes)	1 element	Brightness temperature value over current Earth fixed grid point, obtained by interpolation from L1c data over the grid point.	Generated by L1C Processor
10	***Radiometric_Accuracy_of_Pixel***	Real value (coded as integer)	K	unsigned short (2 bytes)	1 element	Error accuracy measurement in the Brightness Temperature presented in the previous field, extracted in the direction of the pixel. Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$ K, where X is ***Radiometric_Accuracy_Scale*** given in SPH	Generated by L1C Processor
11	***Azimuth_Angle***	Real value (coded as integer)	deg	unsigned short (2 bytes)	1 element	Elliptical footprint angle between major semi-axis direction and North direction, obtained by interpolation from L1c data over the grid point. Coded in 2's complement. LSB=$360/2^{16}$. Meaning that value=(unsigned short)*$360/2^{16}$ degrees	Generated by L1C Processor
12	***Footprint_Axis1***	Real value (coded as integer)	km	unsigned short (2 bytes)	1 element	Elliptical footprint major semi-axis value, obtained by interpolation from L1c data over the grid point. Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$ km where X is ***Pixel_Footprint_Scale*** given in SPH	Generated by L1C Processor
13	***Footprint_Axis2***	Real value (coded as integer)	km	unsigned short (2 bytes)	1 element	Elliptical footprint minor semi-axis value, obtained by interpolation from L1c data over the grid point. Coded in 2's complement. LSB=$X/2^{16}$. Meaning that value=(unsigned short)*$X/2^{16}$ km where X is ***Pixel_Footprint_Scale*** given in SPH	Generated by L1C Processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	BT_Data					End of ***BT_Data*** data set record structure	
	List_of_BT_Datas					End of list of ***BT_Datas*** data structures, repeated ***Counter*** times.	
	Grid_Point_Data					End of ***Grid_Point_Data*** data set record structure.	
	List_of_Grid_Point_Datas					End of list of ***Grid_Point_Data*** data set record structures.	
	Temp_Browse					End of ***Temp_Browse*** binary Data Set.	
	Data_Block					End of binary Data Block in the product.	

Table 4-49. Level 1 C Browse Brightness Temperatures Product Data Block

5. LEVEL 1 AUXILIARY DATA PRODUCT TYPES SPECIFICATIONS

5.1 AUXILIARY DATA PRODUCTS COMMON HEADER

5.1.1 Main Product Header:

ADF only have Fixed Header and Specific Product Header.

Only the MPH fields Ref_Doc and Total_Size are needed in ADF, so they are moved to the ADF's Specific Product Header.

5.1.2 Specific Product Header:

The Specific Product Header for ADF with binary data blocks has the following structure:

- Main_SPH as defined in Table 5-1
- ADF particular SPH (optionally defined for each product, see the corresponding section for each ADF)
- Data_Sets as defined in Table 4-5

The Reference Data Sets contain the reference to any file containing relevant information for the Product. The Measurement Data Sets contain relevant information about the information linked directly to the product (Binary or XML).

Amongst the fields in the Specific Product Header Main Info section, its second Field, the *SPH_Descriptor* will be different for every type of Level 1 Auxiliary Products. All the accepted types and names are presented in the following table:

Accepted Name	Description
AUX_PMS____SPH	SPH for Auxiliary product containing on-ground characterisation of PMS, including sensitivity of parameters to physical temperature
AUX_NIR_____SPH	SPH for Auxiliary product generated from on-ground (initially) and external (in-flight) characterization of the NIR, using MIRAS output during an external target calibration (Not part of L1 Processing, this type of calibration is to be performed out of PLPC)
AUX_PLM____SPH	SPH for Auxiliary product generated from on-ground characterisation of the PLM, including thermistor parameters, receiver's exact position, Xband parameters, etc.
AUX_SPAR___SPH	SPH for Auxiliary product containing on-ground characterisation of the S-parameters
AUX_LCF____SPH	SPH for Auxiliary product containing on-ground characterisation of receivers' efficiencies
AUX_PATT___SPH	SPH for Auxiliary product containing on-ground characterisation of receivers' amplitude and phase patterns and maximum directivity
AUX_FAIL___SPH	SPH for Auxiliary product containing default failures to be taken into account on nominal L1 processing
AUX_BWGHT_SPH	SPH for Auxiliary product containing the weight vector to be multiplied element by element with the calibrated visibilities
AUX_BFP____SPH	SPH for Auxiliary product containing receivers' derived Best Fit Plane
AUX_MISP___SPH	SPH for Auxiliary product containing the mispointing angles between the Body Frame referenced in the Proteus quaternions and the Antenna Plane defined by the MIRAS instrument
AUX_DGG____SPH	SPH for Auxiliary product containing the Earth Fixed Grid on which L1c products shall be expressed
AUX_VTEC_P_SPH	SPH for Auxiliary product containing Predicted Total Electron Content values to compute Faraday rotation angle
AUX_VTEC_C_SPH	SPH for Auxiliary product containing Consolidated Total Electron Content values to compute Faraday rotation angle
AUX_GALAXY_SPH	SPH for Auxiliary product containing the L-band measurements of the Sky
AUX_GALNIR_SPH	SPH for Auxiliary product containing the L-band measurements of the Sky convoluted with the NIR pattern
AUX_MASK___SPH	SPH for Auxiliary product containing the flagging of pixels for use in L1c land or sea products
AUX_LSMASK_SPH	SPH for Auxiliary product containing the Land/Sea mask of pixels in the DGG
AUX_SUNT___SPH	SPH for Auxiliary products containing the measured evolution of Sun Brightness Temperature along time
AUX_MOONT_SPH	SPH for Auxiliary products containing the measured evolution of Moon Brightness Temperature along time
AUX_ERTHT__SPH	SPH for Auxiliary products containing a simple modelling of Earth Brightness Temperature
AUX_RFI____SPH	SPH for Auxiliary products containing known sources of Radio Frequency Interference in MIRAS bandwidth, in the same grid as the auxiliary grid being used
AUX_SGLINT_SPH	SPH for Auxiliary product containing the look-up tables needed to apply the sung glint correction algorithm
AUX_APDL___SPH, AUX_APDS___SPH	SPH for Auxiliary products containing the element-by- element definition of the Apodisation Window for Land or Sea in the u,v plane.
AUX_CNFL1P_SPH	SPH for Auxiliary product containing configuration values and constant s to be used during L1 processing

Table 5-1. Level 1 Auxiliary SPH Accepted Names

The Specific Product Header for ADF with XML ASCII data blocks has the following structure:

- Main_SPH_for_XML as defined in Table 5-2
- ADF particular SPH (optionally defined for each product, see the corresponding section for each ADF)

5.1.2.1 XML Specific Product Header

The following table presents the parameters for the Specific Product Header Main_SPH structure, to be used for all ADFs with binary datablock.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Main_SPH***	Tag				Init of Main_SPH structure	
02	***SPH_Descriptor***	string		14 bytes	%14s	Name describing SPH.	Hard-coded
03	***Ref_Doc***	string	N/A	17 bytes	%17s	Name of the document containing the specifications for the current product (this document) , with the shape: SO-TN-ID-IDR-GS-0005	ICNF
04	***Precise_Validity_Start***	String	N/A	30 bytes	%30s	This is the UTC Validity Start Time, coherent with the Validity Start Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. Note that this can have the special value indicating “beginning of mission” (without an absolute time specified) as defined in Tailoring of EEFF Standard for SMOS GS [AD.4]. “UTC=yyyy-mm-ddThh:mm:ss.uuuuuu”	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						The Precise_Validity_Start Time shall be the start time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	
05	***Precise_Validity_Stop***	String	N/A	30 bytes	%30s	This is the UTC Validity Stop Time, coherent with the Validity Stop Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. Note that this can have the special value indicating "end of mission" (without an absolute time specified) as defined in Tailoring of EEFF Standard for SMOS GS [AD.4]. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu" The Precise_Validity_Stop Time shall be the stop time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	INT
06	***Checksum***	Integer	N/A	10 bytes	10*uc	Checksum of the datablock, obtained from the algorithm in the IEEE Std 1003.1.2004 , using function ***cksum*** in POSIX.	INT
07	***Header_Schema***	string	N/A	31 bytes	%31s	Name of the XSD to be used for the validation of the product header. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
08	***Datablock_Schema***	string	N/A	42 bytes	%42s	Name of the validation xml schema for the product's datablock Name of the binX schema for the validation of the product datablock. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
09	***Header_Size***	Integer	bytes	6 bytes	%06d	Size of the Header of the product	INT
10	***Datablock_Size***	Integer	Bytes	11 bytes	%011d	Size of the product Datablock	INT
11	***HW_Identifier***	String	N/A	4 bytes	%4s	Identifier of the machine that has generated this ADF.	ICNF
23	***Main_SPH***	Tag				End of Specific Product Header structure	

Table 5-2. Level 1 Auxiliary Data Main_SPH for products with Binary Datablock

The ADFs with binary data block will contain also, at the end of the SPH, the list of data sets as defined in Table 4-5.

For the pure XML ASCII ADFs, the following Main_SPH_for_XML structure will be used (note that these files do not contain the list of data sets):

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Main_SPH_for_XML***	Tag				Init of ***Main_SPH_for_XML*** structure	
02	***SPH_Descriptor***	string		14 bytes	%14s	Name describing SPH.	L1OP SW
03	***Ref_Doc***	string	N/A	17 bytes	%17s	Name of the document containing the specifications for the current product (this document) , with the shape: SO-TN-ID-IDR-GS-0005	Processor SW configuration
04	***Precise_Validity_Start***	String	N/A	30 bytes	%30s	This is the UTC Validity Start Time, coherent with the Validity Start Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. Note that this can have the special value indicating "beginning of mission" (without an absolute time specified) as defined in Tailoring of EEFF Standard for SMOS GS [AD.4]. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu" The Precise_Validity_Start Time shall be the start time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	INT
05	***Precise_Validity_Stop***	String	N/A	30 bytes	%30s	This is the UTC Validity Stop Time, coherent with the Validity Stop Time in the File Name, but in CCSDS ASCII format with time reference and microseconds. Note that this can have the special value indicating "end of mission" (without an absolute time specified) as defined in	INT

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						Tailoring of EEFF Standard for SMOS GS [AD.4]. "UTC=yyyy-mm-ddThh:mm:ss.uuuuuu" The Precise_Validity_Stop Time shall be the stop time of the period in which the product is valid –i.e. can be used as supporting input to the processing- in case the product is an auxiliary file.	
06	***Header_Schema***	string	N/A	31 bytes	%31s	Name of the XSD to be used for the validation of the product header. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
07	***Datablock_Schema***	string	N/A	31 bytes	%31s	Name of the validation xml schema for the product's datablock Name of the XSD schema for the validation of the product datablock. The format is as specified in [RD.9]. In the operational processor, the value will be provided by an XML R/W API method.	CNF
08	***Header_Size***	Integer	bytes	6 bytes	%06d	NOT USED for DPGS-V2 (filled with 0) Size of the Header of the product	INT
09	***Datablock_Size***	Integer	Bytes	11 bytes	%011d	Size of the physical file (including header and datablock)	INT
10	***HW_Identifier***	String	N/A	4 bytes	%4s	Identifier of the machine that has generated this ADF.	ICNF
10	***Main_SPH_for_XML***	Tag				End of ***Main_SPH_for_XML*** structure	

Table 5-3. Level 1 Auxiliary Data Main SPH for XML for products with XML ASCII Datablock

5.2 AUXILIARY DATA TYPES BLOCKS SPECIFICATIONS

5.2.1 PMS Characterisation Table (AUX_PMS___)

As is written in section 4.3 in [RD.2], conversion tables are used to convert PMS voltage telemetry values into power units. These shall be the measured System Temperatures used to normalise the calibrated visibilities. There is one of such voltage measurements per LICEF, which needs to be converted appropriately.

During MIRAS operation, it is possible to characterise again the PMS response, using correlated Noise Injection. This calibration produces as intermediate output the calibrated measurements of gain and offset of each PMS, to be used for System Temperature computation. This data shall be consolidated into the MIR_CRSD1A / MIR_CRSU1A product containing the PMS calibration coefficients.

This file contains a unique data set that shall contain the gain and offset information for all PMS, under different thermal conditions. Its contents shall be referred in ASCII XML format. The data set is formed by 1 Data Set Record with all the information.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the AUX_PMS___ Auxiliary Data Product is in XML ASCII format, and contains each PMS gains and offsets measured at different physical temperatures, the sensitivity of offsets and gains to temperature drifts and the PMS linearity. There is 1 dataset ***PMS_Characterisation*** consisting of 1 data set record. The total size of the ***PMS_Characterisation_Table*** product is 57 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***PMS Characterisation Table*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
02	***PMS_Characterisation***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***List_of_PMS_Datas***	Starting Tag	N/A	2 bytes		Tag starting a list of identical ***PMS_Data*** structures. Tag contains an attribute "*count*" which is always "72"	Attribute "*count*" is fixed
04	***PMS_Data***	Starting Tag				Tag starting a structure with all variables needed to identify a PMS device and characterise it at different physical temperatures	
05	***PMS_ID***	String	N/A	5 bytes	%5c	PMS unique identifier Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_, BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or _) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	Fixed identifiers (Pre-processor SW)
06	***List_of_PMS_Characterisation_Datas***	Starting Tag	N/A	2 bytes		Tag starting a list of identical ***PMS_Characterisation_Data*** structures. Tag contains an attribute "*count*" which is always "03" (TBC), the number of on-ground characterisations at different physical temperatures	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
07	***PMS_Characterisation_Data***	Starting Tag				Tag starting a ***PMS_Characterisation_Data*** structure	
08	***Temperature***	String	K	6 bytes	%06.3f	Temperature at which the PMS coefficients were obtained. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
09	***Gain***	String	mV/K	10 bytes	%+010.4f	Gain coefficient for PMS identified before and at previous temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
10	***Offset***	String	mV	10 bytes	%+010.4f	Offset coefficient for PMS identified before and at previous temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
11	***PMS_Characterisation_Data***	Closing Tag				End of ***PMS_Characterisation_Data*** structure	
12	***List_of_PMS_Characterisation_Datas***	Closing Tag				End of list of ***PMS_Characterisation_Data*** structures	
13	***Gain_Sensitivity***	String	mV/K^2	11 bytes	%+011.3e	Gain sensitivity coefficient for PMS gain against PMS physical temperature drifts. Tag contains attribute "*unit*" always set to the string "*mV/K^2*".	Measured on-ground Attribute "*unit*" is fixed
14	***Offset_Sensitivity***	String	mV/K	9 bytes	%+09.5f	Offset sensitivity coefficient for PMS offset against PMS physical temperature drifts. Tag contains attribute "*unit*" always set to the string	Measured on-ground Attribute "*unit*" is

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified in **Unit** column.	fixed
15	***PMS_Linearity***	String	mV/K^2	11 bytes	%+011.3e	Term used to correct 2nd order response of each PMS (Flink). Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground. Attribute "*unit*" is fixed
16	***PMS_Data***	Closing Tag				End of ***PMS_Data*** structure	
17	***List_of_PMS_Datas***	Closing Tag				End of list of ***PMS_Data*** structures	
18	***PMS_Characterisation***	Closing Tag				End of Data Set structure	
19	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-4. PMS Characterisation Table Product Data Block

5.2.2 NIR Characterisation Table (AUX_NIR___)

As is written in section 4.4 in [RD.2], conversion tables are used to convert NIR pulse length telemetry values into Brightness Temperature units and noise temperature whenever the LICEF-NIRs are operating like a nominal LICEF and providing correlations.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the NIR Characterisation auxiliary data product is in XML ASCII format, with 1 dataset ***NIR_Characterisation*** containing 1 single dataset record. The product data block contains the attenuations of all 3 NIR devices measured at different physical temperatures, the noise temperatures, the corrections to NIR response and to sensitivity. The total size of the ***AUX_NIR___*** product is 14 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_NIR___*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***NIR_Characterisation***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***List_of_NIR_Datas***	Starting Tag	N/A	2 bytes		Tag starting a list of identical ***NIR_Data*** structures. Tag contains an attribute "*count*" which is always "03" (the number of NIR devices in the MIRAS instrument)	Attribute "*count*" is fixed
04	***NIR_Data***	Starting Tag				Tag starting a structure with all variables needed to identify a NIR device and characterise it at different physical temperatures	
05	***NIR_ID***	String	N/A	2 bytes	%2s	NIR unique identifier. It shall follow the format XY X=First arm identifier {A,B,C} Y=Second arm identifier {A,B,C} Possible values = {AB, BC, CA}	Fixed identifiers (Pre-processor SW)
06	***L_1_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between VAP and VAP2 (radiator of the antenna) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
07	***L_2_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between VAP2 and VIP (feed network of the antenna) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
08	***L_NC_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between VIP and V- OPV (output connector) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
09	***L_A_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between V-OPV and LV-VIP (input connector) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
10	***L_DA_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between LV-VIP and LV-LCIP (switch output) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
11	***L_DR_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between LV-RIP and LV-LCIP (switch attenuation between reference channel at switch plane and common input plane) at specified temperature Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
12	***L_DC_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between LV-CIP and LV-LCIP (switch attenuation between calibration channel at switch plane and common input plane) at specified temperature. Tag contains attribute "unit" always set to the string	Measured on-ground Attribute "*unit*" is fixed

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified in Unit column.	
13	***L_R_V***	String	dB	4 bytes	%04.2f	Attenuation (losses) between V-OPR and LV-RIP (input connector) at specified temperature. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
14	***L_1_H***	String	dB	4 bytes	%04.2f	Attenuation (losses) between HAP and HAP2 (radiator of the antenna) at specified temperature. Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
15	***L_2_H***	String	dB	4 bytes	%04.2f	Attenuation (losses) between HAP2 and HIP (feed network of the antenna) at specified temperature. Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
16	***L_NC_H***	String	dB	4 bytes	%04.2f	Attenuation (losses) between HIP and H-OPV (output connector) at specified temperature. Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
17	***L_A_H***	String	dB	4 bytes	%04.2f	Attenuation (losses) between H-OPV and LH-VIP (input connector) at specified temperature Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
18	***L_DA_H***	String	dB	4 bytes	%04.2f	Attenuation (losses) between H-OPV and LH-VIP (input connector) at specified temperature. Tag contains attribute "unit" always set to the string	Measured on-ground Attribute "*unit*"

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified in Unit column.	is fixed
19	*L_DR_H*	String	dB	4 bytes	%04.2f	Attenuation (losses) between LV-RIP and LV-LCIP (switch attenuation between reference channel at switch plane and Tag contains attribute "unit" always set to the string specified in Unit column.common input plane) at specified temperature	Measured on-ground Attribute "*unit*" is fixed
20	*L_DC_H*	String	dB	4 bytes	%04.2f	Attenuation (losses) between LV-CIP and LV-LCIP (switch attenuation between calibration channel at switch plane and common input plane) at specified temperature Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
21	*L_R_H*	String	dB	4 bytes	%04.2f	Attenuation (losses) between H-OPR and LH-RIP (input connector) at specified temperature. Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
22	*C_A_V*		K/K	10 bytes	%+010.2e	Correction to NIR response (in mode A). First order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	
23	*D_A_V*		K	10 bytes	%+010.2e	Correction to NIR response (in mode A). Second order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	
24	*U_A_V*		K/K	10 bytes	%+010.2e	Correction to temperature sensitivity (in mode A). Tag contains attribute "unit" always set to the string	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified in Unit column.	
25	***A_V***		K/K	10 bytes	%+010.2e	Temperature sensitivity correction (in mode A). First order correction. Tag contains attribute “unit” always set to the string specified in Unit column.	
26	***B_V***		K/K	10 bytes	%+010.2e	Temperature sensitivity correction (in mode A). Second order correction. Tag contains attribute “unit” always set to the string specified in Unit column.	
27	***C_R_V***		K/K	10 bytes	%+010.2e	Correction to NIR response (in mode R). First order correction. Tag contains attribute “unit” always set to the string specified in Unit column.	
28	***D_R_V***		K	10 bytes	%+010.2e	Correction to NIR response (in mode R) Second order correction. Tag contains attribute “unit” always set to the string specified in Unit column.	
29	***U_R_V***		K/K	10 bytes	%+010.2e	Correction to NIR response (in mode A). First order correction. Tag contains attribute “unit” always set to the string specified in Unit column.	
30	***C_A_H***		K/K	10 bytes	%+010.2e	Correction to NIR response (in mode A). Second order correction. Tag contains attribute “unit” always set to the string	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						specified in Unit column.	
31	***D_A_H***		K	10 bytes	%+010.2e	Correction to NIR response (in mode A). Tag contains attribute "unit" always set to the string specified in Unit column.	
32	***U_A_H***		K/K	10 bytes	%+010.2e	Correction to temperature sensitivity (in mode A) Tag contains attribute "unit" always set to the string specified in Unit column.	
33	***A_H***		K/K	10 bytes	%+010.2e	Temperature sensitivity correction (in mode A). First order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	
34	***B_H***		K/K	10 bytes	%+010.2e	Temperature sensitivity correction (in mode A). Second order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	
35	***C_R_H***		K/K	10 bytes	%+010.2e	Correction to NIR response (in mode R). First order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	
36	***D_R_H***		K	10 bytes	%+010.2e	Correction to NIR response (in mode R). Second order correction. Tag contains attribute "unit" always set to the string specified in Unit column.	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
37	***U_R_H***		K/K	10 bytes	%+010.2e	Correction to temperature sensitivity (in mode R). Tag contains attribute "unit" always set to the string specified in Unit column.	
38	***List_of_Dicke_Switch_Values_Datas***	Starting Tag				Tag starting a List containing the Dicke Switch data structures, with "count" field (count=3)	Attribute "*count*" is fixed
39	***Dicke_Switch_Values_Data***	Starting Tag				Tag starting the structure containing the Dicke Switch Values.	
40	***Temperature***	String	K	7 bytes	%07.3f	Temperature at which the Dicke Switch values were obtained Tag contains attribute "unit" always set to the string specified in Unit column.	Measured on-ground Attribute "*unit*" is fixed
41	***Amplitude_Dicke_Switch_V***	String	dB	5 bytes	%05.2f	Dicke Switch Isolation Module for V polarisation	
42	***Phase_Dicke_Switch_V***	String	Deg	8 bytes	%+08.3f	Dicke Switch Isolation Phase for V polarisation	
43	***Amplitude_Dicke_Switch_H***	String	dB	5 bytes	%05.2f	Dicke Switch Isolation Module for H polarisation	
44	***Phase_Dicke_Switch_H***	String	Deg	8 bytes	%+08.3f	Dicke Switch Isolation Phase for H polarisation	
45	***Dicke_Switch_Values_Data***	Ending Tag				Tag endng the structure containing the Dicke Switch Values.	
46	***List_of_Dicke_Switch_Values_Datas***	Ending Tag				Tag ending a List containing the Dicke Switch data structures, with "count" field (count=3)	
47	***NIR_Data***	Ending Tag				Tag ending a structure with all variables needed to identify a NIR device and characterise it at different physical	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						temperatures	
48	***List_of_NIR_Datas***	Ending Tag	N/A			Tag ending a list of identical NIR_Data structures.	
49	***List_of_NIR_Default_Datas***	Starting Tag				Tag starting the List containing the NIR default data structures, with "count" field (count=3)	Attribute "*count*" is fixed
50	***NIR_Default_Data***	Starting Tag				Tag starting the NIR Default Data structure	
51	***NIR_ID***	String	N/A	2 bytes	%2s	NIR unique identifier. It shall follow the format XY X=First arm identifier {A,B,C} Y=Second arm identifier {A,B,C} Possible values = {AB, BC, CA}	Fixed identifiers (Pre-processor SW)
52	***NIR_Expected_BT_H***		K	12 bytes	%+012.6f	NIR-A Expected Brightness Temperature in H polarisation $T_{A0,h}$	
53	***NIR_Expected_BT_V***		K	12 bytes	%+012.6f	NIR-A Expected Brightness Temperature in V polarisation $T_{A0,v}$	
54	***T_Noise_Cal_H***		K	12 bytes	%+012.6f	NIR-A antenna noise injection temperature during calibration $T_{NA0,h}$	
55	***T_Noise_Cal_V***			12 bytes			

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
			K		%+012.6f	NIR-A antenna noise injection temperature during calibration $T_{NA0,v}$	
56	***NIR_Observed_BT_H***		K	12 bytes	%+012.6f	NIR-R observed brightness temperature + injected temperature in H polarization at LH-HIP $T_{A\_ON0,h}$	
57	***NIR_Observed_BT_V***		K	12 bytes	%+012.6f	NIR-R observed brightness temperature + injected temperature in V polarization at LH-VIP $T_{A\_ON0,v}$	
58	***T_Noise_Cal_Ref_H***		K	12 bytes	%+012.6f	NIR-R noise injection temperature in the reference branch during calibration $T_{NR0,h}$	
59	***T_Noise_Cal_Ref_V***		K	12 bytes	%+012.6f	NIR-R noise injection temperature in the reference branch during calibration $T_{NR0,v}$	
60	***T_Phys_Tp6***		K	12 bytes	%+012.6f	Reference Physical Temperature of the antenna intermediate layer (Tp6).	
61	***T_Phys_Tp7***		K	12 bytes	%+012.6f	Reference Physical Temperature of the antenna patch (Tp7).	
62	***T_Phys_Tp1_H***		K	12 bytes	%+012.6f		

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						Reference Physical Temperature of the NIR diode (Tp1h).	
63	***T_Phys_Tp1_V***		K	12 bytes	%+012.6f	Reference Physical Temperature of the NIR diode (Tp1v).	
64	***NIR_Default_Data***	Ending Tag				Tag ending the NIR Default Data structure	
65	***List_of_NIR_Default_Datas***	Ending Tag				Tag ending the List containing the NIR default data structures, with "count" field (count=3)	Attribute "*count*" is fixed
66	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-5. NIR Characterisation Table Product Data Block

5.2.3 PLM Characterisation Table (AUX_PLM___)

As is written in section 4.5 in [RD.2], this product contains all parameters calibrated on-ground referent to elements of the PLM, as well as operational parameters like the intermediate frequency where the instrument is operating.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the PLM Characterisation auxiliary data product is in XML ASCII format, with 1 dataset ***PLM_Parameters*** containing 1 single dataset record. The product data block contains the thermistor on-ground calibrated parameters, per each CMN unit. The total size of the ***AUX_PLM___*** product is 22 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_PLM___*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***PLM_Parameters***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***Intermediate_Frequency_Nominal***		MHz	12 bytes	%+012.6f	Central frequency of operation in L-band, at which the instrument operates in the nominal correlator layer (1413.5 MHz)	
04	***Intermediate_Frequency_Redundant***		MHz	12 bytes	%+012.6f	Central frequency of operation in L-band, at which the instrument operates in the redundant correlator layer (1413.5 MHz)	
05	***Low_Frequency***		MHz	12 bytes	%+012.6f	Lower end of bandwidth frequency in L-band at which the instrument operates (1403.5 MHz)	
06	***Local_Oscillator_Frequency***		MHz	12 bytes	%+012.6f	Local Oscillator Frequency, used in the computation of phase parameters in the FWF shape (1396.0 MHz)	
07	***Time_Delay_Minus_T***		μs	12 bytes	%+012.6f	Time delay applied for measuring FWF at –t. Shall be constant and set to -1/55.84MHz.	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
08	***Time_Delay_Plus_T***		µs	12 bytes	%+012.6f	Time delay applied for measuring FWF at +t. Shall be constant and set to +1/55.84MHz.	
09	***DICOS_Sampling***		N/A	5 bytes	%05d	Normalisation value for DICOS correlations. It represents the sampling length of each sample interval Default value is 65438	
10	***NIR_Sampling***		N/A	5 bytes	%05d	Normalisation value for NIR pulse length ancillary measurements. It represents the sampling length of each sample interval Default value is 65535	
11	***LICEF_Directivity_H***		N/A	8 bytes	%+08.5f	Averaged directivity value to be used in radiometric accuracy computation for H polarisation. Default value is 8.5	
12	***LICEF_Directivity_V***		N/A	8 bytes	%+08.5f	Averaged directivity value to be used in radiometric accuracy computation for V polarisation. Default value is 8.5	
13	***Xband_Range***	Real	mV	8 bytes	%+08.4f	Linear conversion range for X-band telemetry voltages used in conversion from 2's complement. Default value is 39.0625mV. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Fixed value Attribute "*unit*" is fixed

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
14	***Xband_Ref_Temp***	Real	K	8 bytes	%+08.3f	Reference temperature for X-band temperature telemetry voltages conversion to Kelvin. Default value is 293K. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Fixed value Attribute "*unit*" is fixed
15	***Xband_Ref_Resist***	Real	Ohm	8 bytes	%+08.1f	Reference resistance for X-band temperature telemetry voltages conversion to Kelvin. Default value is 15 KOhm. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Fixed value Attribute "*unit*" is fixed
16	***Xband_Ref_B***	Real	K	8 bytes	%+08.2f	Reference B parameter for X-band telemetry voltages used in conversion from 2's complement. Default value is 4150K. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Fixed value Attribute "*unit*" is fixed
17	***List_of_CMN_Units***	Starting Tag	N/A	2 bytes		Tag starting a list of identical ***CMN_Unit*** structures. It contains an attribute "*count*" which is always "12", the number of CMN units in the instrument	Attribute "*count*" is fixed
18	***CMN_Unit***	Starting Tag				Tag starting a ***CMN_Unit*** structure	
19	***CMN_ID***	string	N/A	2 bytes	%2s	Unique ID defining correlator unit to which the parameters are applicable: H1-H3, A1-A3, B1-B3, C1-C3	Fixed identifiers
20	***M_Cal_Nom***		V/K	8 bytes	%+08.5f	Calibration coefficient relating dV/dT for nominal layer thermistors	
21	***Q_Cal_Nom***		V	8 bytes	%+08.5f	Calibration coefficient relating dV for nominal layer thermistors	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
22	***M_Cal_Red***		V/K	8 bytes	%+08.5f	Calibration coefficient relating dV/dT for redundant layer thermistors	
23	***Q_Cal_Red***		V/K	8 bytes	%+08.5f	Calibration coefficient relating dV for redundant layer thermistors	
24	***T_Low***	Real	ºC	9 bytes	%+09.5f	Lowest reference temperature (constant in time) . Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
25	***T_High***	Real	ºC	9 bytes	%+09.5f	Highest reference temperature (constant in time). Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
26	***G1G2VC***	Real	V	18 bytes	%+018.14f	Term in the Resistance computation equation. Default value is -19.68503937007874. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
27	***G2VC***	Real	V	18 bytes	%+018.14f	Term in the Resistance computation equation. Default value is –15.15748031496063. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
28	***R1***	Real	Ohm	18 bytes	%+018.14f	Term in the Resistance computation equation. Default value is 3010. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
29	***A***	Real	K^{-1}	12 bytes	%+012.9f	Steinhart and Hart equation term characterising the thermistor in the current CMN. Default value is 0.001400531.	Measured on-ground

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Attribute "*unit*" is fixed
30	***B***	Real	K^{-1}	12 bytes	%+012.9f	Steinhart and Hart equation term characterising the thermistor in the current CMN. Default value is 0.000237737. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
31	***C***	Real	K^{-1}	12 bytes	%+012.9f	Steinhart and Hart equation term characterising the thermistor in the current CMN. Default value is 0.000000098. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
32	***PMS_Range***	inte ger	V	2 bytes	%02d	Linear conversion range for PMS voltages used in conversion from 2's complement. Default value is 5V. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
33	***CMN_Unit***	Closin g Tag				End of ***CMN_Unit*** structure	
34	***List_of_CMN_Units***	Closin g Tag				End of list of ***CMN_Unit*** structures	
35	***List_of_LICEF_Positi ons***	Startin g Tag	N/A	2 bytes		Tag starting a list of identical ***LICEF_Position*** structures. It contains an attribute "*count*" which is always "69" (TBC), the number of LICEF devices	Attribute "*count*" is fixed
36	***LICEF_Position***	Startin g Tag				Tag starting a ***LICEF_Position*** structure	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
37	***LICEF_ID***	String	N/A	5 bytes	%5c	Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_, BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or _) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	Fixed identifiers (Pre-processor SW)
38	***X***	Real	mm	10 bytes	%+010.5f	X horizontal position of the LICEF on a reference frame centred on the Hub and positive in the direction LICEF NIR BC 03 to LICEF BC 01. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
39	***Y***	Real	mm	10 bytes	%+010.5f	Y vertical position of the LICEF on a reference frame centred on the Hub and positive in the direction of the axis contained between arms A and B. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
40	***Z***	Real	mm	10 bytes	%+010.5f	Z off-plane position of the LICEF on a reference frame centred on the Hub and positive in the direction formed by the natural normal vector to the XY plane. Tag contains attribute "*unit*" always set to the string specified in **Unit** column.	Measured on-ground Attribute "*unit*" is fixed
41	***LICEF_Position***	Closing Tag				End of ***LICEF_Position*** structure	
42	***List_of_LICEF_Positions***	Closing Tag				End of list of ***LICEF_Position*** structures	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
43	*PLM_Parameters*	Closing Tag				End of Data Set structure	
44	*Data_Block*	Closing Tag				End of Data Block in the product	

Table 5-6. PLM Characterisation Table Product Data Block

5.2.4 S-Parameters of MIRAS (AUX_SPAR__)

As is written in section 4.6 in [RD.2], for calibration purposes, all S-parameters of the connections inside MIRAS shall be measured by the manufacturer of MIRAS in its full implementation, and provided as an initial auxiliary file.

The Scattering Parameters from the noise source to the j and k receivers relevant at this stage are:

- Transfer parameters S_{jk} and S_{kj}, a measure of the complex insertion gain;
- Driving point parameters S_{jj} and S_{kk}, a measure of the input and output mismatch loss

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the S-Parameters auxiliary data product is in XML ASCII format, with 2 datasets ***NDN_S_Parameters*** and ***Switch_S_Parameters*** containing 1 single dataset record each. The first data set gives the S-parameters of the Noise Distribution Network measured at different physical temperatures for each noise source, and also with values for the power dividers and cables. The second data set contains the S-parameters of the switches in all receivers in all instrument sections.

The total size of the ***AUX_SPAR__*** product is 551 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_SPAR__*** product's data block, with the ***NDN_S_Parameters*** dataset and the ***Switch_S_Parameters*** dataset.

- The ***NDN_S_Parameters*** dataset contains the S-parameters for the NDN, in the hub and all arm sections. Its contents shall be referred in ASCII XML format. This data set is formed by 1 Data Set Record with all the information.
- The ***Switch_S_Parameters*** dataset contains the S-parameters for the switches, in all receivers in all sections. Its contents shall be referred in ASCII XML format. Each data set is formed by 1 Data Set Record with all the information. It is not known currently whether information on switch U shall be measured or not, as well as the number of characterisations needed for the LICEF-NIR elements.

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***NDN_S_Parameters***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***Hub_NS***	Starting Tag				Tag starting a ***Hub_NS*** structure	
04	***Hub_NS_ID***	String	N/A	4 bytes	%4s	Unique ID defining Noise Source unit to which the parameters are applicable: "NS_H"	Fixed identifier
05	***List_of_ Hub_NS_Values***	Starting Tag		2 bytes		Tag starting a list of identical **S-parameters values** structures. It contains an attribute "*count*" which is by default 5 (TBC)	Attribute "*count*" is fixed
06	***Hub_NS_Value***	Starting Tag				Tag starting a ***Value*** structure	
07	***Temperature***	real	deg	7 bytes	%+07.3f	Temperature at which the S-parameters were obtained, in Celsius.	Measured on-ground

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Attribute "*unit*" is fixed
08	***S_jk_Magnitude*** ***(where j and k range from 1 to 5)***	real	dB	11 bytes	%+011.8f	S parameter relating connection between the 5 port networks in the hub Noise Source. Forms a matrix of 5x5 values defining amplitude. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
09	***S_kj_Phase*** ***(where j and k range from 1 to 5)***	real	deg	10 bytes	%+010.5f	S parameter relating connection between the 5 port networks in the hub Noise Source. Forms a matrix of 5x5 values defining phase. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
10	***Hub_NS_Value***	Closing Tag				End of ***Value*** structure	
11	***List_of_Hub_NS_Values***	Closing Tag				End of list of ***Value*** structures	
12	***Hub_NS***	Closing Tag				End of ***Hub_NS*** structures	
13	***List_of_Arm_NSs***	Starting Tag		2 bytes		Tag starting a list of identical ***Arm_NS*** (Arm Noise Sources) data structures structures. It contains an attribute "*count*" which is always "09"	Attribute "*count*" is fixed
14	***Arm_NS***	Starting Tag				Tag starting an ***Arm_NS*** structure	

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
15	***Arm_ID***	String	N/A	5 bytes	5 bytes	Unique ID defining Noise Source unit to which the parameters are applicable: NS_A1, NS_A2, NS_A3, NS_B1, NS_B2, NS_B3, NS_C1, NS_C2, NS_C3	Fixed string
16	***List_of_ Arm_NS_Values***	Starting Tag		2 bytes		Tag starting a list of identical **S-parameters values** structures. It contains an attribute "*count*" which is by default 5	Attribute "*count*" is fixed
17	***Arm_NS_Value***	Starting Tag				Tag starting a ***Value*** structure	
18	***Temperature***	Tag	C	7 bytes	%+07.3f	Temperature at which the S-parameters were obtained. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
19	***S_jk_Magnitude*** ***(where j and k range from 1 to 4)***	Real	dB	11 bytes	%+011.8f	S parameter relating connection between the 4 port networks in each of the arms Noise Sources. Forms a matrix of 4x4 values defining amplitude. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
20	***S_kj_Phase*** ***(where j and k range from 1 to 4)***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the 4 port networks in each of the arms Noise Sources. Forms a matrix of 4x4 values defining phase. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
21	***Arm_NS_Value***	Closing Tag				End of ***Value*** structure	
22	***List_of_***	Closing				End of list of ***Value*** structures	

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
	Arm_NS_Values	Tag					
23	***Arm_NS***	Closing Tag				End of ***Arm_NS*** structure	
24	***List_of_Arm_NSs***	Closing Tag				End of list of ***Arm_NS*** structures	
25	***List_of_Power_Dividers***	Starting Tag		2 bytes		Tag starting a list of identical ***Power_Divider*** data structures. It contains an attribute "*count*" which is always "12"	Attribute "*count*" is fixed
26	***Power_Divider***	Starting Tag				Tag starting a ***Power_Divider*** structure	
27	***Power_Divider_ID***	String	N/A	5 bytes	%5s	Unique ID defining Power Divider unit to which the parameters are applicable: PD_H1, PD_H2, PD_H3, PD_A1, PD_A2, PD_A3, PD_B1, PD_B2, PD_B3, PD_C1, PD_C2, PD_C3	Fixed identifier (Pre-processor SW)
28	***List_of_ Power_Divider Values***	Starting Tag		2 bytes		Tag starting a list of identical **S-parameters values** structures. It contains an attribute "*count*" which is by default 5.	Attribute "*count*" is fixed
29	***Power_Divider Value***	Starting Tag				Tag starting a ***Value*** structure	
30	***Temperature***	Real	deg	7 bytes	%+07.3f	Temperature at which the S-parameters were obtained, in Celsius. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
31	***S_jk_Magnitude***	Real	dB	11	%+011.8f	S parameter relating connection between the 8 port networks in	Measured on-

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
	(where j and k range from 1 to 8)			bytes		each of the Power Dividers. Forms a matrix of 8x8 values defining amplitude. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	ground Attribute "*unit*" is fixed
32	***S_kj_Phase*** ***(where j and k range from 1 to 8)***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the 8 port networks in each of the Power Dividers. Forms a matrix of 8x8 values defining phase. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
33	***Power_Divider_Value***	Closing Tag				End of ***Value*** structure	
34	***List_of_Power_Divider_Values***	Closing Tag				End of list of ***Value*** structures	
35	***Power_Divider***	Closing Tag				End of ***Power_Divider*** structure	
36	***List_of_Power_Dividers***	Closing Tag				End of list of ***Power_Divider*** structures	
37	***List_of_Cables***	Starting Tag				Tag starting a list of identical ***Cable*** data structures. It contains an attribute "*count*" which is always "96"	Attribute "*count*" is fixed
38	***Cable***	Starting Tag				Tag starting a ***Cable*** structure	

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
39	***Cable_ID***	string	N/A	6 bytes	%6s	Unique ID defining Cable unit to which the parameters are applicable. There are 8 cables per arm or hub section, naming convention is C_"*section_name*"_"*cable_number*": Where *section_name* can be H1, H2, H3, A1, A2, A3, B1, B2, B3, C1, C2 or C3, and *cable_number* goes from 1 to 8. (e.g. C_C1_3)	Fixed string
40	***List_of_Cable_Values***	Starting Tag		2 bytes		Tag starting a list of identical **S-parameters values** structures. It contains an attribute "*count*" which is by default 10	Attribute "*count*" is fixed
41	***Cable_Value***	Starting Tag				Tag starting a ***Value*** structure	
42	***Temperature***	Real	deg	7 bytes	%+07.3f	Temperature at which the S-parameters were obtained, in Celsius. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
43	***S_jk_Magnitude*** ***(where j and k range from 1 to 2)***	Real	dB	11 bytes	%+011.8f	S parameter relating connection between the 2 port networks in each of the cables. Forms a matrix of 2x2 values defining amplitude. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
44	***S_kj_Phase*** ***(where j and k range from 1 to 2)***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the 2 port networks in each of the cables. Forms a matrix of 2x2 values defining phase. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
45	***Cable_Value***	Closing Tag				End of ***Value*** structure	

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
46	***List_of_Cable_Values***	Closing Tag				End of list of ***Value*** structures	
47	***Cable***	Closing Tag				End of ***Cable*** structure	
48	***List_of_Cables***	Closing Tag				End of list of ***Cable*** structures	
49	***NDN_S_Parameters***	Closing Tag				End of ***NDN_S_Parameters*** Data Set structure	
50	***Switch_S_Parameters***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set structure containing the variables described below	
51	***List_of_Switchs***	Starting Tag				Tag starting a list of identical ***Switch*** data structures. It contains an attribute "*count*" which is always "72"	Attribute "*count*" is fixed
52	***Switch***	Starting Tag				Tag starting a ***Switch*** structure	
53	***Switch_ID***	String	N/A	5 bytes	%5c	Unique ID defining LICEF or NIR-LICEF to which the measurements are applicable (from 1 to 69) Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_, BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or	

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						_) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	
54	***List_of_Switch_Values***	Tag				Tag starting a list of identical Switch **S-parameters values** structures. It contains an attribute "*count*" which is by default 10.	Attribute "*count*" is fixed
55	***Switch_Value***	Starting Tag				Tag starting a ***Value*** structure	
56	***Temperature***	Real	deg	7 bytes	%07.3f	Temperature at which the S-parameters were measured, in Kelvin. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
57	***S_LH_Magnitude***	Real	dB	10 bytes	%+010.7f	S parameter relating connection between the antenna H-pol Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
58	***S_LH_Phase***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the antenna H-pol Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
59	***S_LV_Magnitude***	Real	dB	10	%+010.	S parameter relating connection between the antenna V-pol	Measured on-

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
				bytes	7f	Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane Tag contains attribute "*unit*" always set to the string specified in **Unit** column	ground Attribute "*unit*" is fixed
60	***S_LV_Phase***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the antenna V-pol Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
61	***S_LC_Magnitude***	Real	dB	10 bytes	%+010.7f	S parameter relating connection between the Calibration Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane The switch in U position is not measured. Losses between CIP and U are assumed negligible, so it is assumed to be 1.Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
62	***S_LC_Phase***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the Calibration Input plane and TRF Output plane normalized with the S parameter relating connection between the Calibration Input plane and TRF Output plane The switch in U position is not measured. Losses between CIP and U are assumed negligible, so it is assumed to be 1.Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground Attribute "*unit*" is fixed
63	***S_LU_Magnitude***	Real	dB	10 bytes	%+010.7f	S parameter relating connection between the Unoise Input plane and TRF Output plane. The switch in U position is not measured. Losses between CIP	Measured on-ground Attribute "*unit*" is

Field	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						and U are assumed negligible, so this value is assumed to be 1. Tag contains attribute "*unit*" always set to the string specified in Unit column	fixed
64	***S_LU_Phase***	Real	deg	10 bytes	%+010.5f	S parameter relating connection between the Unoise Input plane and TRF Output plane. The switch in U position is not measured. Losses between CIP and U are assumed negligible, so this value is assumed to be 1. Tag contains attribute "*unit*" always set to the string specified in Unit column	Measured on-ground Attribute "*unit*" is fixed
65	***Switch_Value***	Closing Tag				End of ***Value*** structure	
66	***List_of_Switch_Values***	Closing Tag				End of list of ***Value*** structures	
67	***Switch***	Closing Tag				End of ***Switch*** structure	
68	***List_of_Switchs***	Closing Tag				End of list of ***Switch*** structures	
69	***Switch_S_Parameters***	Closing Tag				End of ***Switch_S_Parameters*** Data Set structure	
70	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-7. S-Parameters of MIRAS Product Data Block

5.2.5 Receivers Characterisation (AUX_LCF___)

This ADF is aimed to contain the Antenna Ohmic Efficiency (η) for each LICEF, and the receivers' pattern absolute phase to translate the phase of calibrated visibilities from the input planes to the antenna planes.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the ***AUX_LCF___*** auxiliary data product is in XML ASCII format, with 1 dataset ***LICEF_Characterisation*** containing 1 single dataset record. The data set provides the LICEF ohmic efficiency and the receiver's absolute phase, for each LICEF in the instrument. The total size of the ***AUX_LCF___*** product is 74 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_LCF___*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***LICEF_Characterisation***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***List_of_LICEF_Datas***	Starting Tag	N/A	2 bytes		Tag starting a list of identical ***LICEF_Data*** structures. Tag contains an attribute "*count*" which is always "72"	Attribute "*count*" is fixed
04	***LICEF_Data***	Starting Tag				Tag starting a ***LICEF_Data*** structure	
05	***LICEF_ID***	String	N/A	5 bytes	%5c	Unique ID defining LICEF or NIR-LICEF to which the measurements are applicable (from 1 to 69). Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_,	Fixed identifiers (Pre-processor SW)

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or _) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	
06	***List_of_Efficiency_Datas***	Starting Tag		2 bytes		Tag starting a list of identical ***Efficiency_Data*** structures. Tag contains an attribute "*count*" which is always "2"	
07	***Efficiency_Data***	Starting Tag				Tag starting a ***Efficiency_Data*** structure	
08	***Polarisation***	Flag	N/A	1 byte	%1d	H or V polarisation value where the Efficiency was measured	Fixed identifiers (Pre-processor SW)
09	***Mean_Efficiency***	Real	N/A	10 bytes	+010.7f	Mean ohmic efficiency value for LICEF and polarisation	Measured on-ground
10	***STD_Efficiency***	Real	N/A	10 bytes	+010.7f	Standard deviation of ohmic efficiency value for LICEF and polarisation	Measured on-ground
11	***Efficiency_Data***	Closing Tag				End of ***Efficiency_Data*** structure	
12	***List_of_Efficiency_Datas***	Closing Tag				End of list of ***Efficiency_Data*** structures	
13	***List_of_Abs_Phase_Datas***	Starting Tag		2 bytes		Tag starting a list of identical ***Abs_Phase_Data*** structures. Tag contains an attribute "*count*" which is always "2"	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
14	***Abs_Phase_Data***	Starting Tag				Tag starting a ***Abs_Phase_Data*** structure	
15	***Polarisation***	Flag	N/A	1 byte	%1d	H or V polarisation value where the Absolute Phase was measured	Fixed identifiers (Pre-processor SW)
16	***Mean_Abs_Phase***	Real	deg	10 bytes	+010.5f	Mean absolute antenna pattern phase value for LICEF and polarisation. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground. Attribute "*unit*" is fixed
17	***Std_Abs_Phase***	Real	deg	10 bytes	+010.5f	Standard deviation of absolute antenna pattern phase value for LICEF and polarisation. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	Measured on-ground. Attribute "*unit*" is fixed.
18	***Abs_Phase_Data***	Closing Tag				End of ***Abs_Phase_Data*** structure	
19	***List_of_Abs_Phase_Datas***	Closing Tag				End of list of ***Abs_Phase_Data*** structures	
20	***LICEF_Data***	Closing Tag				End of ***LICEF_Data*** structure	
21	***List_of_LICEF_Datas***	Closing Tag				End of list of ***LICEF_Data*** structures	
22	***LICEF_Characterisation***	Closing Tag				End of Data Set structure	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
23	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-8. Receivers Characterisation Product Data Block

5.2.6 Normalised amplitude and phase patterns of all antennas (AUX_PATT__)

This product contains the LICEFs antenna patterns information needed during the characterisation of the instrument to be used in the inversion process to generate the MIRAS brightness temperature images.

The SPH contains the Main_SPH structure as defined in Table 5-1, plus the list of Data Sets as defined in Table 4-5.

The Data Block ***AUX_PATT__*** product consists of 3 datasets:

- ***Antenna_Pattern_Coordinates*** containing two 2D arrays with the (ξ,η) values in which the antenna patterns are given. The dataset shall consist of 1 single data set record, and shall have a size of 524.176 bytes (512 KB).
- ***Average_Antenna_Pattern*** containing the average of all antenna pattern's amplitude and phase for co-polar and cross-polar patterns for each polarisation (H and V). The dataset shall consist of 8 data set records, and shall have a size of 4193416 bytes (4 MB).
- ***Antenna_Pattern*** consists of the antenna pattern's amplitude and phase for co-polar and cross-polar patterns for each polarisation (H and V) of each antenna, in the (ξ,η) cosines domain coordinates specified by dataset *Antenna_Pattern_Coordinates*. Each of these dataset records products contains the values at lowest, centre and highest frequency in the L-band pass frequency of the instrument, at one of the 4 polarisations. The dataset consists of with 72 antennas x 4 data set records each, one per each type of polarisation combination, and shall have a size of 452895552 bytes (432 MB).

The following table describes the binary format of the ***AUX_PATT___*** product's data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Antenna_Pattern_Coordinates					Init of binary Data Set containing the ***Antenna_Pattern_Coordinates***.	
01	***XI_Value***	Real value	N/A	Double (8 bytes)	Matrix array of 181x181 elements	Xi axis coordinate matrices (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
02	***ETA_Value***	Real value	N/A	Double (8 bytes)	Matrix array of 181x181 elements	Eta axis coordinate matrices (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
	Antenna_Pattern_Coordinates					End of binary Data Set containing the ***Antenna_Pattern_Coordinates***.	
	Average_Antenna_Pattern					Init of binary Data Set containing the ***Average_Antenna_Pattern***.	
	List_of_Average_Pattern_Records					Start of list of 8 ***Average_Pattern_Record*** structures.	
	Average_Pattern_Record					Start of ***Average_Pattern_Record*** structure.	
03	***Average_Measurement***	Identifier	N/A	unsigned byte	1 element	Enumerated value for Horizontal co-polar and cross-polar, or Vertical polarisation co-polar and cross-polar, and front or back patterns. (X_COPL='1', X_CRPL='2', Y_COPL='3', Y_CRPL='4', X_COPL_BACK='5', X_CRPL_BACK='6', Y_COPL_BACK='7',	MIRAS manufacturer / ESL

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						Y_CRPL_BACK='8').	
04	***Average_Pattern_Amplitude***	Matrix of real values	linear	Double (8 bytes)	Matrix array of 181x181 elements	Average ntenna pattern amplitude in linear units, measured in known points of the cosines domain plane at the centre frequency (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
05	***Average_Pattern_Phase***	Matrix of real values	deg	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern phase in known points of the cosines domain plane measured at the centre frequency (Minimum sampling space to be 181x181, the more samples the better).	MIRAS manufacturer / ESL
	Average_Pattern_Record					End of ***Average_Pattern_Record*** structure.	
	List_of_Average_Pattern_Records					End of list ***Average_Pattern_Record*** structures.	
	Average_Antenna_Pattern					End of binary Data Set containing the ***Average_Antenna_Pattern***.	
	Antenna_Patterns					Init of binary Data Set containing the list of ***Antenna_Pattern_Records***.	
	List_of_Antenna_Pattern_Records					Start of list of 72x4 ***Antenna_Pattern_Record*** structures.	
	Antenna_Pattern_Record					Start of ***Antenna_Pattern_Record*** structure.	
06	***Antenna_ID***	Identifier	N/A	Unsigned byte	1 element	Identifier of the antenna characterized by this DSR patterns	
07	***Measurement***	Identifier	N/A	unsigned byte	1 element	Enumerated value for Horizontal co-polar and cross-polar, or Vertical polarisation co-polar and cross-polar. (X_COPL='1', X_CRPL='2', Y_COPL='3',	MIRAS manufacturer / ESL

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						Y_CRPL='4').	
08	***Frequency_Low***	Real value	MHz	Double (8 bytes)	1 element	Lowest frequency value at which the pattern was measured (1404MHz).	MIRAS manufacturer / ESL
09	***Frequency_Centre***	Real value	MHz	Double (8 bytes)	1 element	Centre frequency value at which the pattern was measured (1413MHz).	MIRAS manufacturer / ESL
10	***Frequency_High***	Real value	MHz	Double (8 bytes)	1 element	Highest frequency value at which the pattern was measured (1423MHz).	MIRAS manufacturer / ESL
11	***Pattern_Low_Amplitude***	Matrix of real values	linear	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern amplitude in linear units, measured in known points of the cosines domain plane at the highest frequency (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
12	***Pattern_Low_Phase***	Matrix of real values	deg	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern phase in known points of the cosines domain plane measured at the lowest frequency (Minimum sampling space to be 181x181, the more samples the better).	MIRAS manufacturer / ESL
13	***Pattern_Centre_Amplitude***	Matrix of real values	linear	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern amplitude in linear units, measured in known points of the cosines domain plane at the highest frequency (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
14	***Pattern_Centre_Phase***	Matrix of real values	deg	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern phase in known points of the cosines domain plane measured at the centre frequency (Minimum sampling space to be on 181x181, the more samples the better).	MIRAS manufacturer / ESL
15	***Pattern_High_Amplitude***	Matrix of real	linear	Double (8	Matrix array of	Antenna pattern amplitude in linear units, measured in known points of the cosines domain plane at the	MIRAS manufacturer

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
		values		bytes)	181x181 elements	highest frequency (Minimum sampling space to be 181x181, the more samples the better)	/ ESL
16	***Pattern_High_Phase***	Matrix of real values	deg	Double (8 bytes)	Matrix array of 181x181 elements	Antenna pattern phase in known points of the cosines domain plane measured at the highest frequency (Minimum sampling space to be 181x181, the more samples the better)	MIRAS manufacturer / ESL
	Antenna_Pattern_Record					End of ***Antenna_Pattern_Record*** structure.	
	List_of_Antenna_Pattern_Records					End of list of ***Antenna_Pattern_Record*** structures.	
	Antenna_Pattern					End of binary Data Set containing the ***Antenna_Pattern*** measurements records.	
	Data_Block					End of binary Data Block in the product.	

Table 5-9. Normalised Amplitude and Phase Pattern of Antennas Product Data Block

5.2.7 Failing Components (AUX_FAIL__)

As is written in section 4.10 in [RD.2] this file contains the failure status for all LICEF receivers, in the hub and all arm sections, correlator units and NIR units.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the ***AUX_FAIL__*** auxiliary data product is in XML ASCII format, with 1 dataset ***Failing_Components*** containing 1 single dataset record. The data set provides the failure status of each LICEF, correlator and NIR units. The total size of the ***AUX_FAIL__*** product is 43 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_FAIL__*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***Failing_Components***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***List_of_LICEF_Datas***	Starting Tag		2 bytes		List containing the LICEF_Data structures for LICEF status information. Tag contains an attribute "*count*" which is always "72"	Attribute "*count*" is fixed
04	***LICEF_Data***	Starting Tag				Tag starting a ***LICEF_Data*** structure	
05	***LICEF_ID***	String	N/A	5	%5c	Unique ID defining LICEF or NIR-LICEF to which the measurements are applicable (from 1 to 72 considering that the LICEF_NIR are composed by two LICEF) Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_, BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or _) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	
06	***H_Failure***	Integer flag	N/A	1 byte	%1c	If set to TRUE, the signal provided by the LICEF in H polarisation is incorrect. To be taken into account with correlations performed with this LICEF.	Value generated at CEC

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
07	***V_Failure***	Integer flag	N/A	1 byte	%1c	If set to TRUE, the signal provided by the LICEF in V polarisation is incorrect. To be taken into account with correlations performed with this LICEF.	Value generated at CEC
08	***LICEF_Data***	Closing Tag				End of ***LICEF_Data*** structure	
09	***List_of_LICEF_Datas***	Closing Tag				End of list of ***LICEF_Data*** structures	
10	***List_of_CMN_Units***	Starting Tag		2 bytes		Tag starting a list of identical ***CMN_Unit*** structures. Tag contains an attribute "*count*" which is always "12"	Attribute "*count*" is fixed
11	***CMN_Unit***	Starting Tag				Tag starting a ***CMN_Unit*** structure	
12	***CMN_ID***	string	N/A	2 bytes	%2s	Unique ID defining correlator unit to which the parameters are applicable: H1-H3, A1-A3, B1-B3, C1-C3	Fixed identifiers (L1OP SW)
13	***Failure***	Integer flag	N/A	1 byte	%1c	Correlations performed for those receivers contained within the CMN shall be ignored if set to TRUE	Value generated at CEC
14	***List_of_Thermistor_Datas***	Tag		2 bytes		List containing the Thermistor status data. Tag contains an attribute "*count*" which is always "16"	Attribute "*count*" is fixed
15	***Thermistor_Data***	Starting Tag				Tag starting a ***Thermistor_Data*** structure	
16	***Thermistor_ID***	string	N/A	4 bytes	%04s	Unique ID defining the thermistor unit to which the failures are applicable (TH01 to TH14, RE01 and RE02)	Fixed identifiers (L1OP SW)

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
17	***Failure***	Integer flag	N/A	1 byte	%1c	Physical temperature measurements performed with this thermistor shall be disregarded if set to TRUE	Value generated at CEC
18	***Thermistor_Data***	Closing Tag				End of ***Thermistor_Data*** structure	
19	***List_of_Thermistor_Datas***	Closing Tag				End of list of ***Thermistor_Data*** structures	
20	***CMN_Unit***	Closing Tag				End of ***CMN_Unit*** structure	
21	***List_of_CMN_Units***	Closing Tag				End of list of ***CMN_Unit*** structures	
22	***List_of_NIR_Datas***	Tag		2 bytes		List containing the NIR status data Tag contains an attribute "*count*" which is always "3"	Attribute "*count*" is fixed
23	***NIR_data***	Starting Tag				Tag starting a ***NIR_data*** structure	
24	***NIR_ID***	String	N/A	2 bytes	%2s	Unique ID defining NIR unit to which the failures are applicable. Valid values are AB, BC and CA. It shall follow the format XY X=First arm identifier {A,B,C} Y=Second arm identifier {A,B,C} Possible values = {AB, BC, CA}	Fixed identifiers (L1OP SW)

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
25	***H_Failure***	Integer flag	N/A	1 byte	%1c	Brightness temperature measurements in H polarisation performed for the current NIR shall be ignored if set to TRUE	Value generated at CEC
26	***V_Failure***	Integer flag	N/A	1 byte	%1c	Brightness temperature measurements in V polarisation performed for the current NIR shall be ignored if set to TRUE	Value generated at CEC
27	***NIR_Data***	Closing Tag				End of ***NIR_Data*** structure	
28	***List_of_NIR_Datas***	Closing Tag				End of list of ***NIR_Data*** structures	
29	***List_of_PMS_Datas***	Tag		2 bytes		List containing the ***PMS*** status data Tag contains an attribute "*count*" which is always "72"	Attribute "*count*" is fixed
30	***PMS_Data***	Starting Tag				Tag starting a ***PMS_data*** structure	
31	***PMS_ID***	String	N/A	5 bytes	%5c	Unique ID defining PMS to which the measurements are applicable (from 1 to 72) Format is XXYZZ, where: • XX indicates the arm location (A_, AB, B_, BC, C_ or CA) • Y indicates polarisation for NIR elements (H, V or _) • ZZ indicates LICEF number in arm location (01, 02, 03,… 21) For example AB_03, CAH01, B__18	Fixed identifiers (L1OP SW)
32	***Failure***	integer	N/A	1 byte	%1d	System Temperatures computed with this PMS shall be discarded if set to TRUE	Value generated at CEC

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
33	***PMS_Data***	Closing Tag				End of ***PMS_Data*** structure	
34	***List_of_PMS_Datas***	Closing Tag				End of list of ***PMS_Data*** structures	
35	***Failing_Components***	Closing Tag				End of ***Failing_Components*** Data Set structure	
36	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-10. Failing Components Product Data Block

5.2.8 Baseline Weights (AUX_BWGHT_)

This file contains a unique data set that contains the weights for all 2556 baselines. Parameters defined in this auxiliary file shall be used to establish a weight vector to be multiplied element by element with the calibrated visibilities, prior to the Image Reconstruction process (i.e. multiplication with J+ matrix).

The data set is formed by 1 Data Set Record with all the information. Its contents shall be referred in ASCII XML format. The following table describes the content of AUX_BWGHT_ Data block:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***Baseline_Weights***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***List_of_Baseline_Datas***	Starting Tag				List containing the Baseline data structures, with “count” field (count=2556)	
04	***Baseline_Data***	Starting Tag				Init of Baseline_ Data structure	
05	***Baseline_ID***	string	N/A	11 bytes	%011s	Unique ID defining the baseline to which the measurements are applicable Format is XX_YYxZZ_WW, where: XX and ZZ indicate the arm location (A_, AB, B_, BC, C_ or CA) YY and WW indicate LICEF number in arm location (01, 02, 03,… 21) For example AB_03xCAH01, B__18xC__05	
	Weight	Integer	N/A	5 bytes	%05.3d	Decimal weight to be applied to each baseline. Default value should be 1 for all baselines.	

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
06	***Baseline_Data***	Closing Tag				End of Baseline_ Data structure	
07	***List_of_Baseline_Datas***	Closing Tag				End of list of Baseline Data structures	
08	***Baseline_Weights***	Tag				End of Data Set structure	
09	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-11. Baseline Weight Product Data Block

5.2.9 Best Fit Plane (AUX_BFP___)

As is written in section 4.12 in [RD.2], the Best Fit Plane describes the ideal antenna plane over which the visibilities are assumed to have been measured. Any deviation of the antenna positions from it translates into an error in the visibilities. The Best Fit Plane is the plane that best describes, in a least-square sense, the estimated position of the antenna phase geometrical centres.

The Best Fit Plane shall be described by the Euler angles (in sequence 321) from the Antenna Plane pointing direction.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The Data Block of the ***AUX_BFP___*** auxiliary data product is in XML ASCII format, with 1 dataset ***Best_Fit_Plane*** containing 1 single dataset record. It contains the ideal antenna plane over which the visibilities are assumed to have been measured. The total size of the ***AUX_BFP___*** product is 4 KB (measured as the size in hard disk of one sample of the product containing both header and datablock). The following table describes the XML format of the ***AUX_BFP___*** product's data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***Best_Fit_Plane***	Starting Tag				Initial Data Set definition tag. **Start of** Data Set XML structure containing the variables described below	
03	***Yaw_Angle***	Real	deg	10 bytes	%+010.5f	Angle to be rotated centred on Z axis of Antenna Plane (pointing direction). Tag contains attribute "*unit*" always set to the string specified in **Unit** column	CEC or ESL Attribute "*unit*" is fixed
04	***Pitch_Angle***	Real	deg	10 bytes	%+010.5f	Angle to be rotated centred on Y axis. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	CEC or ESL Attribute "*unit*" is fixed
05	***Roll_Angle***	Real	deg	10 bytes	%+010.5f	Angle to be rotated centred on X axis. Tag contains attribute "*unit*" always set to the string specified in **Unit** column	CEC or ESL Attribute "*unit*" is fixed
06	***Best_Fit_Plane***	Closing Tag				End of Data Set structure	
07	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-12. Best Fit Plane Product Data Block

5.2.10 Mispointing Angles (AUX_MISP__)

The current ADF describes the mispointing angles between the Body Frame referenced in the Proteus quaternions and the Antenna Plane defined by the MIRAS instrument. The information from the mispointing shall be used as an addition to the Best Fit Plane and nominal attitude to obtain the real instrument attitude, needed to project onto the Earth surface with the minimum geolocation error the image reconstructed in the antenna plane. The mispointing shall be described by the Euler angles (in sequence 321) from the nominal Body Frame instrument pointing direction.

This file contains a unique data set that contains the Euler angles that define the instrument mispointing, expressed in the instrument reference frame. Its contents shall be referred in ASCII XML format. The data set is formed by 1 Data Set Record with all the information.

The table attached below defines the content of the AUX_MISP__ Data block:

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***Mispointing***	Starting Tag				Initial Data Set definition tag. Start of Data Set XML structure containing the variables described below	
03	***Yaw_Angle***		deg	10	%+010.5f	Angle to be rotated centred on Z axis of Body Frame (pointing direction)	
04	***Pitch_Angle***		deg	10	%+010.5f	Angle to be rotated centred on Y axis	
05	***Roll_Angle***						

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
			deg	10	%+010.5f	Angle to be rotated centred on X axis	
06	***Mispointing***	Ending Tag				End of Mispointing Data set structure.	
07	***Data_Block***	Closing Tag				End of Data Block in the product	

Table 5-13. Mispointing Angles Product Data Block

5.2.11 Discrete Global Grid (AUX_DGG___)

The AUX_DGG___ product consists of a unique data set ***Discrete_Global_Grid*** that contains the Fixed Earth Grid coordinates of the ISEA 4-9 hexagonal grid centres.The data set is formed by 10 Data Set Records each one corresponding to an ISEA 4-9 zones.
The DSRs are ordered by increasing zone ID. Within a DSR appears a list of points ordered by increasing grid ID. These zones are used to allow a fast indexing of the data for search algorithms.

The SPH contains only the Main_SPH structure as defined in Table 5-1, and the List of Data Sets as defined in Table 4-5.

The total size of the ***AUX_DGG___*** product Data Block is about 40 MB (assuming no dummy grid points, the exact size would be 41.943.192 bytes). The following table describes the binary format of the ***AUX_DGG___*** product's data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Discrete_Global_Grid					Init of binary Data Set containing the ***Grid_Points*** records organized in zones.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_Zones					Start of list of 10 ***Zones*** structures in which the DGG is subdivided.	
	Zone					Start of ***Zone*** structure.	
01	***Zone_ID***	Identifier	N/A	Unsigned long integer (8 bytes)	1 element	Unique ID defining the zone where the points are contained. An initial approach has 10 zones formed by two adjacent triangles of the main ISEA decomposition	Auxiliary Data Provider ESL (DGG generation code available)
02	***Grid_Point _Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of points contained within the zone (if not used, refer to whole file). (For ISEA 4-9, maximum of 2.7M pixels)	Auxiliary Data Provider ESL (DGG generation code available)
	List_of_Grid_Point_Datas					Start of list of Num_Points ***Grid_Point_Data*** structures.	
	Grid_Point_Data					Start of ***Grid_Point_Data*** structure.	
03	***Grid_Point_ID***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point. For ISEA 4-9, maximum of 2.7M pixels	Auxiliary Data Provider ESL (DGG generation code available)

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
04	***Latitude***	Real value	deg	Float (4 bytes)	1 element	Latitude value of grid point over the ellipsoid. Positive above equator (North) Range [-90, 90]	Auxiliary Data Provider ESL (DGG generation code available)
05	***Longitude***	Real value	deg	Float (4 bytes)	1 element	Longitude value of grid point over the ellipsoid. Positive west of Greenwich meridian. Range [-180, 180]	Auxiliary Data Provider ESL (DGG generation code available)
06	***Altitude***	Real value	m	Float (4 bytes)	1 element	Local altitude of grid point taken from GETASSE30. (http://www.brockmann-consult.de/beam/doc/help/visat/GETASSE30ElevationModel.html)Range goes from [-407, 8752] m	Auxiliary Data Provider ESL (DGG generation code available), possibly combined with a DEM
	Grid_Point_Data					End of ***Grid_Point_Data*** structure..	
	List_of_Grid_Point_Datas					End of list of ***Grid_Point_Data*** structures.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Zone					End of ***Zone*** structure.	
	List_of_Zones					End of list of ***Zones*** structures.	
	Discrete_Global_Grid					End of binary Data Set containing the ***Grid_Points*** records.	
	Data_Block					End of binary Data Block in the product.	

Table 5-14. Discrete Global Grid Product Data Block

5.2.12 Land/Sea Mask (AUX_LSMASK)

Due to the much different requirements for Soil Moisture and Ocean Salinity not only different apodisation windows are needed to separately process the two products, but also a land-sea mask to differentiate the areas of the globe to be processed with each one of them.

This Land/Sea Mask ADF shall be a static file, from which the L1c Pixel Mask ADF will be extracted initially. The purpose of the Land/Sea Mask ADF is to contain the different flags and water content percentage of the DGG pixels, as a fixed reference never to be changed. It shall not be used in the L1 Processors. The auxiliary data shall be extracted from the USGS Land-Sea mask (10/05/96). In this file, each cell is assigned to either land, water or interrupted area based on the dominant area of a cell, according to the following nomenclature:

- 0=Land
- 1=Water
- 2=Interrupted area (meaning black zones in Figure 5-1)

Its contents and projection type are shown in the following image:

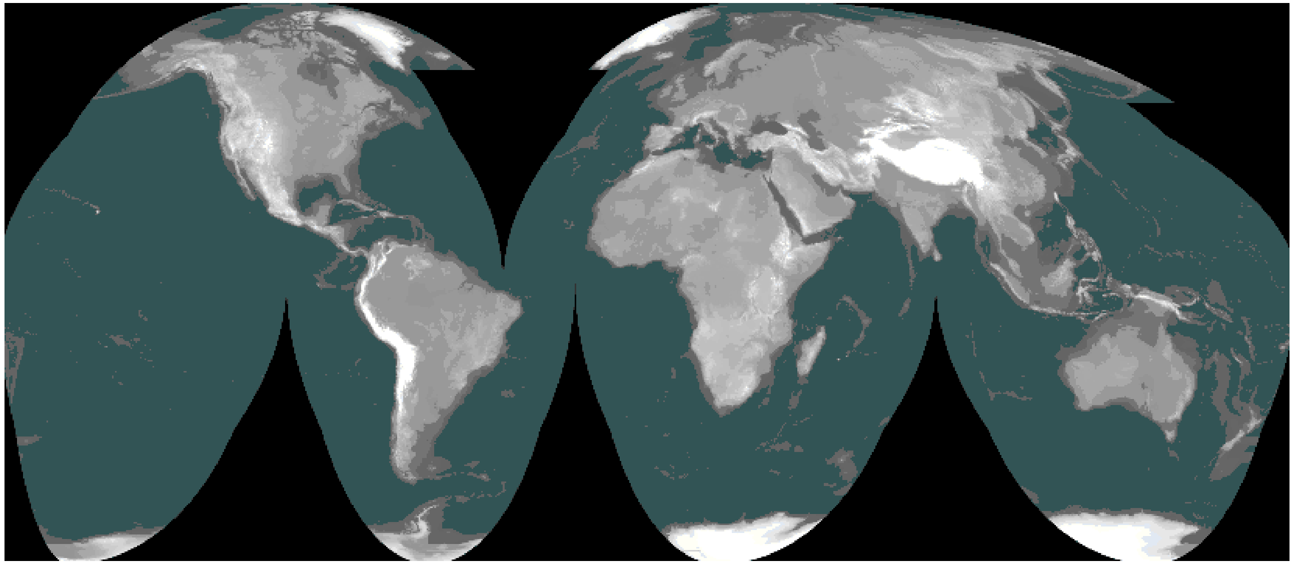

Figure 5-1. USGS Land-Sea mask (taken from Deimos Eng., L1PP Product format)

The USGS Land/Sea mask is a Binary Data Set representing a 1-km grid cell in an 8-bit raster image in the interrupted Goodes homolosine map projection. The image, as shown above, is comprised of 17347 lines by 40031 samples with 662Mb in size.

The Interrupted Goode Homolosine projection, developed by J.P. Goode in 1923, is an equal-area pseudo-cylindrical composite map projection which is interrupted to reduce distortion in the major land masses. This projection merges the Mollweide projection for higher latitudes (also called the Homolographic projection) and the Sinusoidal projection for lower latitudes (Goode 1925). The two projections join at 40 44'11.8" North and South; this is where the linear scale of the two projections match. All the major continents, with the exception of Antarctica, are intact. The projection is often presented with repeated sections so that Greenland and the eastern tip of Siberia are not interrupted.

There are C libraries available in order to search for the line and sample in the projection corresponding to a given latitude and longitude. Within each sample, the value for Land or Water can be obtained immediately. The ISEA grid proposed in the previous section has been used to perform a binning of the USGS land/sea mask, in order to compute the water fraction of each ISEA cell. The result has been used to define the flags presented below.

Additionally, the coastline map used in MERIS processing (MERIS uncertainty map for Envisat) and the SW associated to its handling was provided by Brockmann Consult, in order to compute the sea pixels beyond the expanded coastlines (40, 100 and 200km).

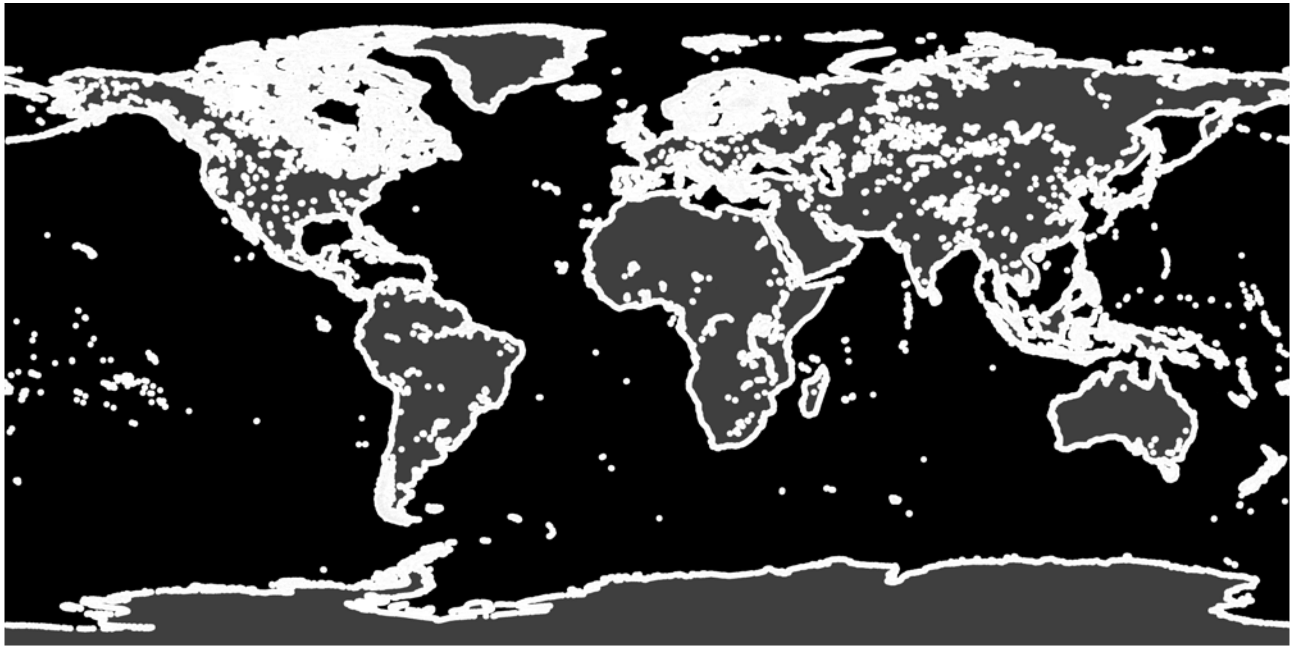

Figure 5-2. MERIS Uncertainty map for 100km (taken from Deimos Eng., L1PP Product format)

The AUX_LSMASK auxiliary data product consists of 1 dataset with $2.7 \cdot 10^6$ data set records, one for each pixel. The product consists of a set of flags for each pixel in the grid, the format of which is described in section 4.12 of [RD.2].

The SPH contains only the Main_SPH structure as defined in Table 5-1, and the List of Data Sets as defined in Table 4-5.

The AUX_LSMASK product Data Block contains a unique data set ***Land_Sea_Mask*** with $2.7 \cdot 10^6$ data set records, one for each pixel. In the same approach as in the DGG, the data set shall be formed by 10 Data Set Records corresponding to the same number of zones, each one with a list of grid points. Each grid point infor consists of a set of masking flags. A default pixel water content percentage is also computed by taking into account the shape of the ISEA pixels and the number of land/sea pixels from USGS that fall inside each cell.

The total size of the ***AUX_LSMASK*** product is about 15 MB (assuming no dummy points included, the exact size is 15728652 bytes). The following table describes the binary format of the ***AUX_LSMASK*** product's data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Land_Sea_Mask					Init of binary Data Set containing the mask identifying land and sea grid points, organized in zones.	
	List_of_Zones					Start of list of 10 ***Zones*** structures in which the DGG is subdivided.	
	Zone					Start of ***Zone*** structure.	
01	***Zone_ID***	Identifier	N/A	Unsigned long integer (8 bytes)	1 element	Unique ID defining the zone where the points are contained. Same as the one proposed for ISEA grid.	Copied from AUX_DGG
02	***Grid_Point _Mask_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of points contained within the zone (if not used, refer to whole file). For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
	List_of_Grid_Point_Mask_Datas					Start of list of Num_Points ***Grid_Point_Mask_Data*** structures.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Grid_Point_Mask_Data					Start of ***Grid_Point_Mask_Data*** structure.	
03	***Grid_Point_ID***	Identifer	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point. For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
04	***Mask***	Set of flags	N/A	unsigned byte	1 element	Flag indicating land/sea USGS content, coastline distance, and Ice content. The flags definition is attached below this table.	USGS combined with ISEA4H9
05	***Water_Fraction***	Percentage	N/A	unsigned byte	1 element	Percentage of Water content in the DGG cell, expressed in 0,5% units. Range is [0 to 200]	USGS combined with ISEA4H9
	Grid_Point_Mask_Data					End of ***Grid_Point_Mask_Data*** structure.	
	List_of_Grid_Point_Mask_Datas					End of list of ***Grid_Point_Mask_Data*** structures.	
	Zone					End of ***Zone*** structure.	
	List_of_Zones					End of list of ***Zones*** structures.	
	Land_Sea_Mask					End of binary Data Set containing mask identifying the land an sea grid points.	
	Data_Block					End of binary Data Block in the product.	

Table 5-15. Land/Sea Mask Product Data Block

The Mask flag is contained in an 8-bit counter, each bit representing a particular condition for that pixel, and they shall be described using the following convention: [MSB:X X X X:X X X X:LSB]

- USGS Sea Flag:
    - [X X X X:X X X 0] means that the pixel is not considered Sea in the USGS Land-Sea mask (water fraction below 95%)
    - [X X X X:X X X 1] means that the pixel is considered Sea in the USGS Land-Sea mask (water fraction above 95%)
- USGS Land Flag:
    - [X X X X:X X 0 X] means that the pixel is not considered Land in the USGS Land-Sea mask (water fraction above 10%)
    - [X X X X:X X 1 X] means that the pixel is considered Land in the USGS Land-Sea mask (water fraction below 10%)
- USGS Mixed Flag:
    - [X X X X:X 0 X X] means that the pixel is not considered Mixed in the USGS Land-Sea mask (water fraction below 10% OR above 95%)
    - [X X X X:X 1 X X] means that the pixel is considered Mixed in the USGS Land-Sea mask (water fraction above 10% AND below 95%)
- 200km Coastal flag:
    - [X X X X:0 X X X] means that the pixel has a distance from the coast of more than 200 Km (using the MERIS uncertainty map with its coasts extended to 200km)
    - [X X X X:1 X X X] means that the pixel has a distance from the coast of less than 200 Km (using the MERIS uncertainty map with its coasts extended to 200km)
- 100km Coastal flag:
    - [X X X 0:X X X X] means that the pixel has a distance from the coast of more than 100 Km (using the MERIS uncertainty map with its coasts extended to 100km) e.g. black and grey areas in figure 4
    - [X X X 1:X X X X] means that the pixel has a distance from the coast of less than 100 Km (using the MERIS uncertainty map with its coasts extended to 100km) e.g. white area in figure 4
- 40km Coastal flag:

  - [X X 0 X:X X X X] means that the pixel has a distance from the coast of more than 40 Km (using the MERIS uncertainty map with its coasts extended to 40km)
  - [X X 1 X:X X X X] means that the pixel has a distance from the coast of less than 40 Km (using the MERIS uncertainty map with its coasts extended to 40km)
- Min Sea-Ice flag:
  - [X 0 X X:X X X X] means that the pixel is not contained within the Minimum Sea-Ice zone defined for Cryosat
  - [X 1 X X:X X X X] means that the pixel is contained within the Minimum Sea-Ice zone defined for Cryosat
- Max Sea-Ice flag:
  - [0 X X X:X X X X] means that the pixel is not contained within the Maximum Sea-Ice zone defined for Cryosat
  - [1 X X X:X X X X] means that the pixel is contained within the Maximum Sea-Ice zone defined for Cryosat

5.2.13 L1c Pixel Mask (AUX_MASK___)

This ADF shall be used for configuring the L1 Processor about the DGG pixels that will be computed for Land or Sea products

The data set shall assign to each pixel in the DGG grid a flag marking it as “to be processed as land” and/or “to be processed as sea”. Both values are cumulative, meaning that the pixel will be processed for land and sea. The only categories that will be available now will be land or sea.

This file contains a unique data set with the pixel information. In the same approach as in the DGG, the data set shall be formed by 10 Data Set Records.

The Mask flag is contained in an 8-bit counter, each bit representing a particular condition for that pixel, and they shall be described using the following convention: [MSB:X X X X:X X X X:LSB]

- L1c Land Flag:
  - [X X X X:X X X 0] means that the pixel shall not be processed in the L1c Land products
  - [X X X X:X X X 1] means that the pixel shall be processed in the L1c Land products

- L1c Sea flag:
  - [X X X X:X X 0 X] means that the pixel shall not be processed in the L1c Sea products
  - [X X X X:X X 1 X] means that the pixel shall be processed in the L1c Sea products

The following table describes the binary content of the AUX_MASK__:

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	L1C_Pixel_Mask					Name describing the Data Set. XML structure containing the variables described below	
	List_of_Zones					Start of list of 10 ***Zones*** structures in which the DGG is subdivided.	
	Zone					Start of ***Zone*** structure.	
01	***Zone_ID***	Identifier	N/A	Unsigned long integer (8 bytes)	1 element	Unique ID defining the zone where the points are contained. Same as the one proposed for ISEA grid.	Copied from AUX_DGG
02	***Num_Points***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of points contained within the zone (if not used, refer to whole file). For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
	List_of_Grid_Point_Datas					Start of list of Num_Points ***Grid_Point_Data*** structures.	
	Grid_Point_Data					Start of ***Grid_Point_Data*** structure.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
03	*Grid_Point_ID*	Identifer	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point. For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
04	*Mask*		N/A	1	1 byte	Flag indicating whether pixel is to be processed as land and/or sea.	
	Grid_Point_Data					End of ***Grid_Point_Data*** structure.	
	List_of_Grid_Point_Datas					End of list of Num_Points ***Grid_Point_Data*** structures.	
	Zone					End of ***Zone*** structure.	
	List_of_Zones					End of list of ***Zones*** structures.	
	L1C_Pixel_Mask					Name describing the Data Set. XML structure containing the variables described above.	
	Data_Block					End of binary Data Block in the product.	

Table 5-16. L1cPixel Mask Product Data Block

5.2.14 Original L-Band Galaxy Map (AUX_GALAXY)

As is written in section 4.17 in [RD.2], for correcting the Sky contribution to the reconstruction process, the emission line of the neutral interstellar hydrogen at 1420 MHz should be computed as auxiliary data, as it can reach values over 50 K. The effects can be predicted with a considerable accuracy by calculating the noise temperature arriving to each radiometer´s diagram pixel using available maps of the galactic emission at 1420 MHz.

As written in [RD.15], the Galaxy Map specified in this section is the original map generated by N. Floury. It is the reference to derive the L1 and L2 OS and SM galaxy radiation maps, obtained after applying a different weighting function to the original map. It is composed of the three following components:

- Hydrogen HI line: this strong emitting line at 1420.4058 MHz (+/- additional Doppler) is usually rejected by a band-stop filter in surveys of the continuum and must be reintroduced,
- Continuum (~1.4 GHz with a rejection of the HI line when required): combination of a variety of emission mechanisms (other lines, synchrotron, free-free, thermal, blended emission of discrete radio sources ….)
- Cosmic background (quasi constant value of 2.725 K)

The equatorial system of coordinates (right ascension, declination) is used here to define the domain covered by existing surveys. The reference system used here is B1950.

At present, only I Stoke component is computed (the other elements may be updated during the mission to reflect polarimetric measurements) and it is a sum of the following elements:

- Reich & Testori continuum
- Effelsberg survey for Cassiopeia region
- HI (K)

The precision of the map is set at 0.5 K.

5.2.14.1.1 Specific Product Header

The AUX_GALAXY Product Specific Product Header includes the following fields:

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Tag				Init of Specific Product Header for L-Band Galaxy Map auxiliary data product	
02	***Main_SPH***	structure	N/A	N/A	N/A	Main_SPH for binary products structure, as specified in fields 02 to 09 in Table 5-1 .	
03	***Coordinates_Info***	Starting Tag				Init of SPH in the product.	
04	***Min_RA***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Minimum Right Ascension of Sky contribution direction in Earth Fixed Reference	INT
05	***Max_RA***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Maximum Right Ascension of Sky contribution direction in Earth Fixed Reference	INT
06	***Min_DEC***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Minimum Declination of Sky contribution direction in Earth Fixed Reference	INT
07	***Max_DEC***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Maximum Declination of Sky contribution direction in Earth Fixed Reference	INT
08	***Delta_RA***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Difference between Maximum and Minimum Declination of Sky contribution direction in Earth Fixed Reference	INT

09	***Delta_DEC***	Real	deg	8 bytes	%+08.3f	NOT USED for DPGS-V2 (filled with 0) Difference Maximum Declination of Sky contribution direction in Earth Fixed Reference	INT
10	***Cordinates_Info***	Ending Tag				End of Coordinates_Info structure	
11	***Reference_Epoch***	Starting Tag				Init of Reference_Epoch structure	
12	***Epoch***	String	N/A	5 bytes	%5s	Reference system used to compute the sky map	INT
13	***Reference_Epoch***	Closing Tag				End of Reference_Epoch structure	
14-25	***Data_Sets***	structure				Data Sets structure's fields as defined in Table 4-4	
26	***Specific_Product_Header***	Tag				End of Specific Product Header for L-Band Galaxy Map auxiliary data product	

Table 5-17. L-band Galaxy Map Auxiliary Data Product SPH

5.2.14.1.2 Data Block

The ***AUX_GALAXY*** auxiliary data product consists of 1 dataset ***Original_Galaxy_Map*** with values of galactic noise for each element of a Right Ascension and Declination equally spaced grid. Its contents shall be in binary format, and will consist on discrete measurements of Sky brightness temperature in a Right Ascension and Declination grid. This is a rectangular grid spaced 0.25º in each direction. The data set shall be formed by several fields, each one of them representing a matrix of values in the Galaxy map grid. Each row in the matrix will correspond to a fixed Declination (starting at +90º for the first row and ending at –90º for the last row). In turn, every row will be formed by 1441 individual elements, each of them corresponding to one Right Ascension coordinate, starting at 360º and ending at 0º.

The size of the L-Band Galaxy Map is 16.623.376 bytes, about 15,85 MB. The following table describes the binary format of the ***AUX_GALAXY*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Original_Galaxy_Map					Init of binary Data Set containing the L-Band galactic noise values for each cell of Right Ascension and Declination.	
01	***I***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Total Intensity (first Stokes parameter).	Values from external ADP's original file pre-processed at CEC
02	***Q***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Phase difference (second Stokes parameter).	Values from external ADP's original file pre-processed at CEC
03	***U***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Polarisation semi-major axis (third Stokes parameter).	Values from external ADP's original file pre-processed at CEC
04	***Error***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Total Error in the measurements.	Values from external ADP's original file pre-processed at CEC
	Original_Galaxy_Map					End of binary Data Set containing galactic noise matrix.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					End of binary Data Block in the product.	

Table 5-18. Original L-Band Galaxy Map Product Data Block

5.2.15 L1 L-Band Galaxy Map (AUX_GALNIR)

The Galaxy Map ***AUX_GALNIR*** specified in this section is the actual one used by L1OP. It is based on the ***AUX_GALAXY*** map defined in previous section, but as written in [RD.15] the expected NIR Brightness Temperatures are obtained by convoluting the Galactic Map in the respective polarizations with the averaged NIR antenna radiation pattern. The antenna boresight is pointed in each of the grid coordinates directions, and the result of the integral is assigned to that coordinate. EADS CASA Espacio has computed an initial version of the values.

The RMS value is computed in a similar manner to the NIR BT, except that the Galactic Map is convoluted with a –3dB beam. The antenna boresight is pointed in each of the grid coordinates directions, and only the pixels within the 3dB cone around boresight are considered. Pixels are first filtered down to the resolution of the PLM, using an ISEA grid to achieve a constant resolution for the entire sphere. EADS CASA Espacio has also computed an initial version of the values.

5.2.15.1.1 Specific Product Header

See SPH specified in section 5.2.11.1.1.

The Reference Data Sets in the AUX_GALNIR product are specified in table below:

Reference Data Set Name	Product Type	Description

Reference Data Set Name	Product Type	Description
GALAXY_FILE	AUX_GALAXY	Original Galaxy Map
ANTENNA_PATTERNS_FILE	AUX_PATT__	Auxiliary data file containing the NIR antenna patterns to be used for convolution with the original galaxy map

Table 5-19. Galactic Map Convoluted with NIR Pattern Reference Data Sets

5.2.15.1.2 Data Block

The ***AUX_GALNIR*** auxiliary data product consists of 1 dataset ***NIR_BT_Galaxy_Map*** with values of galactic noise convoluted with the NIR antenna radiation pattern for each element of a Right Ascension and Declination equally spaced grid. Its contents shall be in binary format, and will consist on discrete measurements of Sky brightness temperature in a Right Ascension and Declination grid. This is a rectangular grid spaced 0.25º in each direction. The data set shall be formed by several fields, each one of them representing a matrix of values in the Galaxy map grid. Each row in the matrix will correspond to a fixed Declination (starting at +90º for the first row and ending at –90º for the last row). In turn, every row will be formed by 1441 individual elements, each of them corresponding to one Right Ascension coordinate, starting at 360º and ending at 0º.

The size of the L-Band Galaxy Map is 8311688 bytes, about 7.93 MB. The following table describes the binary format of the ***AUX_GALNIR*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	NIR_BT_Galaxy_Map					Init of binary Data Set containing the L-Band galactic noise values for each cell of Right Ascension and Declination.	
01	***Expected NIR_BT***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Average NIR polarisation Brightness Temperature expected from the instrument when it is pointing in the coordinates of	Values from external ADP's original file pre-processed at CEC

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
						each matrix element.	
02	***RMS***	Matrix of real values	K	Float (4 bytes)	Matrix of 721x1441 elements	Flatness of the Galaxy map, expressed as the RMS at –3dB in all points in the grid. It shall be used as an index of the suitability of the instrument pointing for FTT or G matrix calibration.	Values from external ADP's original file pre-processed at CEC
	NIR_BT_Galaxy_Map					End of binary Data Set containing galactic noise matrix.	
	Data_Block					End of binary Data Block in the product.	

Table 5-20. L1 L-Band Galaxy Map Product Data Block

5.2.16 Sun Auxiliary Brightness Temperature Maps (AUX_SUNT__)

A typical value for the **Sun**'s brightness temperature (T_{SUN}) at L-Band would be 218,000 K, but this value can vary considerably with the solar cycles, making it very difficult to perform an absolute calibration.. As is written in section 4.14 in [RD.2], this file contains brightness temperature model for the Sun which shall be used in the Foreign Sources correction if they are available at the time of processing. The changes in brightness temperature of the sun can be quite big and can be taken into account either through radio telescope measurements or through analytical estimation. UPC has developed a technique to derive the sun's brightness temperature at a given point in time through the data itself. This approach is the one adopted in SEPS and is explained in its Architectural and Detailed Design Document [RD.01] in pages 162-164 of version 4.1.The AUX_SUNT__ map auxiliary data product consists of 1 dataset with a number of data set records containing discrete measurements of Sun brightness temperature against time. This data set contains the Brightness Temperature values for Sun for the validity period defined in the SPH. In the near future this external source shall be modelled as a set of coefficients, expressing the BT value as a function of time. These models are still TBD, so the initial definition is done providing discrete measurements.

The SPH contains only the Main_SPH structure as defined in Table 5-1, and the List of Data Sets as defined in Table 4-5.

The size of the ***AUX_SUNT__*** product Data Block is depending on the number of measurements included. The samples are assumed to be provided inhomogenously in time. The following table describes the binary format of the ***AUX_SUNT__*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Sun_Measured_Temperatures					Init of binary Data Set containing the L-Band Sun emission values and the time at which they were measured.	
01	***Sun_BT_Measurement_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Sun_BT_Measurement_Data*** data set record structures.	Set by SUNT pre-processor, counting #DSR
	List_of_Sun_BT_Measurement_Datas					Init of list of ***Sun_BT_Measurement_Data*** data set record structures, repeated ***Counter*** times.	
	Sun_BT_Measurement_Data					Tag starting a ***Sun_BT_Measurement_Data*** data set record structure.	
02	***Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two	UTC time of Brightness Temperature measurement. Expressed in EE CFI transport time format	Value obtained from external ADP's original file

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					(seconds and microseconds) are unsigned		
03	***Sun_BT_H***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Sun in H polarisation	Value obtained from external ADP's original file
04	***Sun_BT_V***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Sun in V polarisation	Value obtained from external ADP's original file
05	***Sun_BT_HV_real***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Sun in HV polarisation (real part)	Value obtained from external ADP's original file
06	***Sun_BT_HV_imag***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Sun in HV polarisation (imaginary part)	Value obtained from external ADP's original file
	Sun_BT_Measurement_Data					End of ***Sun_BT_Measurement_Data*** data set record structure.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_Sun_BT_Measurement_Datas					End of list of ***Sun_BT_Measurement_Data*** data set record structures.	
	Sun_Measured_Temperatures					End of binary Data Set containing the L-Band Sun emission temperatures.	
	Data_Block					End of binary Data Block in the product.	

Table 5-21. Sun Brightness Temperatures Product Data Block

5.2.17 Moon Auxiliary Brightness Temperature Maps (AUX_MOONT_)

The **Moon**'s solid angle is approximately the same as the Sun, but its brightness temperature is much lower than that of the Sun, estimated in around 250 Kelvin at L-band. The measured visibility samples when pointing to the Moon will produce an increase of the brightness temperature of just 0.01 K.

This Auxiliary File shall contain a model for the Moon as well as empirical measurements, if possible. It shall be used to compute contributions to be removed at L1. Applicability shall be nominally during reprocessing, as this auxiliary information shall not be available in real time. Its contents shall be in binary format, and will consist on discrete measurements of brightness temperature against time.

The AUX_MOONT_ Map auxiliary data product consists of 1 dataset with a number of data set records containing discrete measurements of Moon brightness temperature against . In the near future this external source shall be modelled as a set of coefficients, expressing the BT value as a function of time. These models are still, so the initial definition is done providing discrete measurements.

The SPH contains only the Main_SPH structure as defined in Table 5-1, and the List of Data Sets as defined in Table 4-5.The size of the ***AUX_MOONT_*** product Data Block is depending on the number of measurements included. The samples are assumed to be provided inhomogenously in time. The following table describes the binary format of the ***AUX_MOONT_*** data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Moon_Measured_Temperatures					Init of binary Data Set containing the L-Band Moon emission values and the time at which they were measured.	
01	***Moon_BT_Measurement_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Moon_BT_Measurement_Data*** data set record structures.	Set by MOONT pre-processor, counting #DSR
	List_of_Moon_BT_Measurement_Datas					Init of list of ***Moon_BT_Measurement_Data*** data set record structures, repeated ***Counter*** times.	
	Moon_BT_Measurement_Data					Tag starting a ***Moon_BT_Measurement_Data*** data set record structure.	
02	***Time***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are unsigned	UTC time of Brightness Temperature measurement. Expressed in EE CFI transport time format	Value obtained from external ADP's original file
03	***Moon_BT_H***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Moon in H polarisation	Value obtained from external

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
							ADP's original file
04	***Moon_BT_V***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Moon in V polarisation	Value obtained from external ADP's original file
05	***Moon_BT_HV_real***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Moon in HV polarisation (real part)	Value obtained from external ADP's original file
06	***Moon_BT_HV_imag***	Real value	K	Float (4 bytes)	1 element	Brightness Temperature of the Moon in HV polarisation (imaginary part)	Value obtained from external ADP's original file
	Moon_BT_Measurement_Data					End of ***Moon_BT_Measurement_Data*** data set record structure.	
	List_of_Moon_BT_Measurement_Datas					End of list of ***Moon_BT_Measurement_Data*** data set record structures.	
	Moon_Measured_Tempertures					End of binary Data Set containing the L-Band Moon emission temperatures.	
	Data_Block					End of binary Data Block in the product.	

Table 5-22. Moon Brightness Temperatures Product Data Block

5.2.18 Earth Auxiliary Brightness Temperature Map (AUX_ERTHT_)

The source of data to build the Earth Auxiliary Brightness Temperature Map, and the SMOS DPGS Earth Explorer format as well, are yet to be defined.

As is written in section 4.18 in [RD.2], the contribution of the Earth must be taken into account whenever the instrument is pointing to the Deep Sky, as the Earth shall be entering the back lobes of the antennas, and may influence the calibration results. The model shall be very simple, considering a constant temperature for land sources and a different one for sea sources. This model is still TBD.

5.2.19 VTEC Maps (AUX_VTEC_C / AUX_VTEC_P)

As is written in section 4.19 in [RD.2], the VTEC (Vertical Total Electron Content) is the content of electrons in a vertical column of 1 m^2 and is expressed in TEC units (1 TECU = 1e+16 e-/m^2).

As written in [RD.16], in the SMOS DPGS two VTEC ADF will be available: one for the forecast (AUX_VTEC_P) and other for the consolidated analysis (AUX_VTEC_C). They both share the same ADF specification. Each ADF is applicable for one IONEX map and shall contain a Header file, consisting in FH and the SPH specified in Table 5-18, in XML, and a Data Block file (see Table 5-19) in binary.

5.2.19.1.1 Specific Product Header

The Specific Product Header for both AUX_VTEC_P and AUX_VTEC_C includes the following fields:

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Specific_Product_Header***	Tag				Init of Specific Product Header for L-Band Galaxy Map auxiliary data product	
02	***Main_SPH***	structure	N/A	N/A	N/A	Main_SPH structure as defined in Table 5-1.	
03	***IONEX_Descriptor***	Starting Tag				Structure containing information on the Native IONEX format	
04	***IONEX_version***	string	n/a	8 bytes	%8c	Format version of the IONEX data	IONEX data
05	***Type***	string		1 bytes	%c	Type of maps 'I' for Ionosphere maps	IONEX data
06	***Source***	string		3 bytes	%3c	Satellite system or theoretical model used to derive the map	IONEX data
07	***SW_Version***	string		20 bytes	%20c	Name of the program creating the current Maps	IONEX data
08	***Institute***	string		20 bytes	%20c	Name of the Agency/Institute creating the Maps	IONEX data
09	***Creation_Date***	string		30 bytes	%30c	Date and time of Maps creation UTC=Yyyy-mm-ddThh:mm:ss.uuuuuu	IONEX data
10	***Epoch_First_Map***	string		30 bytes	%30c	Epoch of first TEC Map UTC=Yyyy-mm-ddThh:mm:ss.uuuuuu	IONEX data
11	***Epoch_Last_Map***	string		30 bytes	%30c	Epoch of first TEC Map UTC=Yyyy-mm-ddThh:mm:ss.uuuuuu	IONEX data
12	***Interval***	integer	sec	5 Bytes	%05d	Time interval between TEC Maps. If '0' interval may be	IONEX data

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
						variable	
13	***Number_of_Maps***	integer		3 bytes	%03d	Total number of maps in the current file	IONEX data
14	***Mapping_Function***	string		4 bytes	%4c	Mapping function adopted for TEC determination	IONEX data
15	***Elevation_Cutoff***	Real	deg	8 bytes	%+08.3f	Minimum elevation angle	IONEX data
16	***Observables_Used***	string		60 bytes	%60c	Specification of the observable used in TEC computation (or blank line for theoretical model)	IONEX data
17	***Number_of_Station***	integer		4 bytes	%04d	Number of contributing stations. Set to -1 if missing	IONEX data (option)
18	***Number_of_Satellite***	integer		2 bytes	%02d	Number of contributing satellites. Set to -1 if missing	IONEX data (option)
19	***Base_Radius***	Real	Km	12 Bytes	%012.6f	Mean Earth radius or bottom of height grid	IONEX data
20	***Map_Dimension***	Integer		2 bytes	%02d	Dimension of TEC maps	IONEX data
21	***Height_Vector***	Starting Tag				Tag starting the Height_Vector defining the equidistant grid in height	
22	***Height_Vector_1st***	Real	Km	8 bytes	%08.3f	First element to define the equidistant grid in height	IONEX data
23	***Height_Vector_2nd***	Real	Km	8 bytes	%08.3f	Second element to define the equidistant grid in height	IONEX data
24	***Height_Vector_Increment***	Real	Km	8 bytes	%08.3f	Increment to define the equidistant grid in height	IONEX data

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
25	***Height_Vector***	Closing Tag				Tag closing the Height_Vector defining the equidistant grid in height	
26	***Latitude_Vector***	Starting Tag				Tag starting the Latitude_Vector defining the equidistant grid in height	
27	***Latitude_Vector_1st***	Real	deg	7 bytes	%+07.3f	First element to define the equidistant grid in latitude	IONEX data
28	***Latitude_Vector_2nd***	Real	deg	7 bytes	%+07.3f	Second element to define the equidistant grid in latitude	IONEX data
29	***Latitude_Vector_Increment***	Real	deg	7 bytes	%+07.3f	Increment to define the equidistant grid in latitude	IONEX data
30	***Latitude_Vector***	Closing Tag				Tag closing the Latitude_Vector defining the equidistant grid in height	
31	***Longitude_Vector***	Starting Tag				Tag starting the Longitude_Vector defining the equidistant grid in height	
32	***Longitude_Vector_1st***	Real	deg	8 bytes	%+08.3f	First element to define the equidistant grid in Longitude	IONEX data
33	***Longitude_Vector_2nd***	Real	deg	8 bytes	%+08.3f	Second element to define the equidistant grid in Longitude	IONEX data
34	***Longitude_Vector_Increment***	Real	deg	8 bytes	%+08.3f	Increment to define the equidistant grid in Longitude	IONEX data
35	***Longitude_Vector***	Closing Tag				Tag closing the Longitude_Vector defining the equidistant grid in Longitude	
36	***Scale_Factor***	integer	N/A	3 Bytes	%+03d	Exponent defining the unit of the VTEC values in the Maps. Default value is -1 which correspond to a scale factor of 10^{-1}.	IONEX data (option)

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
						Set to -1 if missing.	
37	***IONEX_Descriptor***	StopTag				End of the structure containing information on the Native IONEX format	
38	***AUX_VTEC_Descriptor***	Starting Tag					
39	***FTP_Server***	string	N/A	60 bytes	%60uc	FTP server used to download the data in native format	INT
40	***AUX_VTEC_Descriptor***	Stop Tag					
41	***List_of_QC_Data_Sets***	Starting Tag				List containing QC information on VTEC maps	
42	***QC_Data_Set***	Starting Tag				Tag starting QC information	
43	***Mean_TEC***	integer	0.1 TECU	3 Bytes	%03d	Map average VTEC value	INT
44	***STD_TEC***	integer	0.1 TECU	3 Bytes	%03d	Map std VTEC value	INT
45	***Max_TEC***	integer	0.1 TECU	3 Bytes	%03d	Maximum value in VTEC map	INT
46	***Min_TEC***	integer	0.1 TECU	3 Bytes	%03d	Minimum value in VTEC map	INT

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
47	***VTEC_PCD***	Set of flags	N/A	5 Bytes	%05d	Quality control flags (values allowed for each digit are 0 and 1) Digit 1 (right) mean value below conf. threshold Digit 2 mean value above conf. threshold Digit 3 std value above conf. threshold Digit 4 Maximum value above conf. threshold Digit 5 (left) Minimum value above conf. threshold	INT
48	***QC_Data_Set***	StopTag					
49	***List_of_QC_Data_Sets***	Closing Tag				List containing QC information on VTEC maps	
50-61	***Data_Sets***	structure				Data Sets structure's fields as defined in Table 4-4	
62	***Specific_Product_Header***	Tag				End of Specific Product Header for L-Band Galaxy Map auxiliary data product	

Table 5-23. VTEC Auxiliary Data Products SPH

5.2.19.1.2 Data Block

The ***AUX_VTEC_P*** and ***AUX_VTEC_C*** auxiliary data products both consist of 1 dataset ***VTEC_Info*** with values of Vertical Total Electron Content, respectively forecasts and consolidated analysis.

The Data Block is organised as a 3D multidimensional variable array, where the first dimension is the number of maps (1 in the current baseline), the second dimension is the definition of grid according to the delta Latitude quantization of the IAAC files (current baseline in the IAAC products is delta latitude of 2.5 deg) and the Longitude quantization of the IACC files (the current baseline is a delta longitude of 5.0 deg. and therefore a vector of 73 elements -Longitude ranges between -180 and 180 deg-). The third dimension is the list of VTEC values for the specified grid. The current baseline in the IAAC data is 13 maps per day centered at 00H, 02H, ….. 22H, 00H so 13 files has to be generated from one input IONEX file.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	VTEC_Info					Init of binary Data Set containing the list of VTEC maps for different time of one day.	
01	***VTEC_Maps_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***VTEC_Maps_Measurement_Data*** data set record structures.	Set by TEC pre-processor, counting #DSR
	List_of_VTEC_Maps					Init of list of ***VTEC_Map*** data set record structures, repeated ***VTEC_Maps_Counter*** times.	
	VTEC_Map					Tag starting a ***VTEC_Map*** data set record structure.	
02	***Map_Number***	Identifier	N/A	Short integer (2 bytes)	1 element	Internal number of current Map. '1' for the first Map	IONEX data
03	***Epoch_Current_Map***	Date	N/A	signed /unsigned integer (4 bytes)	Vector array of 3 elements First element (days) is signed integer, remaining two (seconds and microseconds) are	Epoch of current Map in EE CFI transport time format	IONEX data and ADF pre-processor

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
					unsigned		
04	***VTEC_Record_Counter***	Counter	N/A	Short integer (2 bytes)	1 element	Number of data set record contained in the Map	IONEX data and ADF pre-processor
	List_of_VTEC_Records					Init of list of ***VTEC_Record*** structures, repeated ***VTEC_Record_Counter*** times.	
	VTEC_Record					Tag starting a ***VTEC_Record*** structure.	
05	***Latitude***	Real value	Deg	Float (4 bytes)	1 element	Data set record for "latitude"	IONEX data
06	***Longitude_start***	Real value	Deg	Float (4 bytes)	1 element	Start Longitude for the Data set record	IONEX data
07	***Longitude_stop***	Real value	deg	Float (4 bytes)	1 element	Stop Longitude for the Data set record	IONEX data
08	***Delta_Longitude***	Real value	Deg	Float (4 bytes)	1 element	Increment in Longitude	IONEX data
09	***Height***	Real value	Km	Float (4 bytes)	1 element	Data set record for 'height'	IONEX data
10	***VTEC_Record_Elements***	Counter	N/A	Short integer (2 bytes)	1 element	Number of elements contained in this data set record	IONEX data and ADF pre-processor
	List_of_VTEC_Datas					Init of list of ***VTEC_Data*** structures, repeated ***VTEC_Record_Elemennts*** times.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	VTEC_Data					Tag starting a ***VTEC_Data*** structure.	
11	***VTEC_value***	Integer value	TECU	Short integer (2 bytes)	1 element	VTEC values for 'Latitude' and 'Heigh' from 'Longitude_start' to 'Longitude_stop' with increment 'Delta_longitude'. Scale factor defined in Field#42 in table 5-18 If value not available set to 9999	IONEX data
	VTEC_Data					Tag ending a ***VTEC_Data*** structure.	
	List_of_VTEC_Datas					End of list of ***VTEC_Data*** structures	
	VTEC_Record					Tag ending a ***VTEC_Record*** structure.	
	List_of_VTEC_Records					End of list of ***VTEC_Record*** structures.	
	VTEC_Map					Tag ending a ***VTEC_Map*** data set record structure.	
	List_of_VTEC_Maps					End of list of ***VTEC_Map*** data set record structures.	
	VTEC_Info					End of binary Data Set containing the list of VTEC maps for different time of one day.	
	Data_Block					End of binary Data Block in the product.	

Table 5-24. VTEC Products Data Block

5.2.20 Apodisation Function (AUX_APDS__ / AUX_APDL__)

As written in section 4.21 in [RD.2], the auxiliary file defining the apodisation function applied contains the discretisation of the apodisation values over the frequency domain coordinates. In this way any apodisation can be expressed as a function of U and V values.

There will be 2 apodisation functions, one for Land (AUX_APDL__) and another for Sea (AUX_APDS__). The following fields in the header allow identifying the type and definition of the apodisation window contained in the product.

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
18	***Specific_Product_Header_***	Starting Tag				Init of Specific Product Header for Apodisation Window auxiliary data product	
19	***Main_SPH_for_XML***	Structure	N/A	N/A	N/A	***Main_SPH_for_XML*** structure as specified in Table 5-2	
20	***Apodisation_Window***	Integer	N/A	3 bytes	%03d	Constant Apodisattion function used to generate the product. Numerical value representing the apodisation function applied (coherent with the filename Reference Data Set) 000=Rectangular window 001=Blackman window 002=Barlett window 003=Hamming window 004=Hanning window … 100=Kaiser window with alpha 1.20 101=Kaiser window with alpha 1.21 … (user defined and agreed windows) 999=Strip Adaptive window	Generated at CEC
21	***Specific_Product_Header***	Closing Tag				End of Specific Product Header for Apodisation Window auxiliary data product	

Table 5-25. Apodisation Window specific fields in SPH

The AUX_APDL__/AUX_APDS__auxiliary data product consists of 1 dataset with 1 data set record. This data set contains the expression of the apodisation function, and its values for each pair of (u,v) coordinates. Its contents shall be referred in ASCII XML format.

The size of the Apodisation Function product is about 275 KB. The following table describes the binary format of the ***AUX_APDL__/AUX_APDS__*** data block.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Starting Tag				Init of Data Block in the product.	
02	***Apodisation_Function***	Starting Tag				Initial Data Set definition tag. Start of Data Set XML structure containing the variables described below	
03	***Expression***	String	N/A	256 bytes	256 chars	ASCII representation of the formula used to compute the apodisation coefficients as a function of u,v values. Shall be useful for simple apodisation windows.	Generated at CEC
04	***Contour_Radius_3dB***	Real	N/A	12 bytes	%012.8f	Radius of the -3dB contour of the main lobe in the antenna plane (range from 0 to 1 in the unit circle)	Generated at CEC
05	***List_of_Apodisation_ Coefficients***	Starting Tag				Init of list of 1396 ***Apodisation_Coefficient*** structures.	
06	***Apodisation_Coefficie nt***	Starting Tag				Tag starting a ***Apodisation_Coefficient*** structure.	
07	***U***	Real	N/A	10 bytes	%+010.5f	U baseline coordinate value	Obtained from LICEF positions measured on-ground
08	***V***	Real	N/A	10 bytes	%+010.5f	V baseline coordinate value	Obtained from LICEF positions measured on-ground
09	***W***	Real	N/A	10 bytes	%+010.7f	Apodisation coefficient obtained for the previous baseline	Generated at

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
						coordinates	CEC
10	***Apodisation_Coefficient***	Closing Tag				End of ***Apodisation_Coefficient*** structure.	
11	***List_of_Apodisation_Coefficients***	Closing Tag				End of list of ***Apodisation_Coefficient*** structures.	
12	***Apodisation_Function***	Closing Tag				End of ***Apodisation_Function*** Data Set structure.	
13	***Data_Block***	Closing Tag				End of Data Block in the product.	

Table 5-26. Apodisation Function Product Data Block

For the Strip Adaptive apodisation, a second table must be used, as it is not possible to express it as a function of only U and V coordinates. This second table will present the coefficients for two cubic equations, which relate the parameters of the 2D Kaiser apodisation window used in Strip Adaptive (α_1, α_2) with the elliptical footprint semi-axes they produce in the antenna frame (w_1, w_2). This relationship is performed in terms of:

$$\log(\alpha_1 \cdot \alpha_2) = A_1 \left(\log(w_1 \cdot w_2)\right)^3 + B_1 \left(\log(w_1 \cdot w_2)\right)^2 + C_1 \log(w_1 \cdot w_2) + D_1$$

$$\log\left(\frac{\alpha_1}{\alpha_2}\right) = A_2 \left(\log\left(\frac{w_1}{w_2}\right)\right)^3 + B_2 \left(\log\left(\frac{w_1}{w_2}\right)\right)^2 + C_2 \log\left(\frac{w_1}{w_2}\right) + D_2$$

The next table represents the specific contents for the Strip Adaptive apodisation, which contains the cubic coefficients determining the 2D Kaiser parameters as a function of the ellipse desired in the antenna frame.

Field #	Tag Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Apodisation_Coefficients***	Starting Tag				Tag starting a ***Apodisation_Coefficients*** structure.	
02	***Expression1***	string	N/A	256	256 chars	ASCII representation of the formula used to compute log((α1*α2) as a function of log(w1*w2).	Generated at CEC
03	***A1***	real	N/A	10	%+010.7f	Coefficient for log(w1*w2)3	Generated at CEC
04	***B1***	real	N/A	10	%+010.7f	Coefficient for log(w1*w2)2	Generated at CEC
05	***C1***	real	N/A	10	%+010.7f	Coefficient for log(w1*w2)	Generated at CEC
06	***D1***	real	N/A	10	%+010.7f	Constant value	Generated at CEC
07	***Expression2***	string	N/A	256	256 chars	ASCII representation of the formula used to compute log((α1/α2) as a function of log(w1/w2).	Generated at CEC
08	***A2***	real	N/A	10	%+010.7f	Coefficient for log(w1/w2)3	Generated at CEC
09	***B2***	real	N/A	10	%+010.7f	Coefficient for log(w1/w2)2	Generated at CEC
10	***C2***	real	N/A	10	%+010.7f	Coefficient for log(w1/w2)	Generated at CEC
11	***D2***	real	N/A	10	%+010.7f	Constant value	Generated at CEC
12	***Apodisation_Coefficient***	Closing Tag				End of ***Apodisation_Coefficient*** structure.	

Table 5-27. Apodisation Coefficientes in the Strip Adaptive Case

5.2.21 RFI Mask (AUX_RFI___)

As is written in section 4.24 of [RD.2], this auxiliary product shall be based on a mask containing TRUE values for those pixels that are expected to be affected by RFI. It is also possible that this file may be generated as a by-product of the L1c SMOS product files, after analysing the RFI flag in those files. This file shall be used to fill the information referring to the RFI flag in the L1c products. The mask shall be expressed in the same Earth Fixed grid as the one used for L1c products, identifying the pixels by their unique identifier. All pixels shall be represented within the mask, even those ones not affected by RFI. This file shall be a binary file.

The SPH contains only the Main_SPH structure as defined in Table 5-1, and the List of Data Sets as defined in Table 4-5.

The AUX_RFI___ auxiliary data product Data Block consists of 1 dataset with information for about $2.7 \cdot 10^6$ pixels organised in 10 DSR. The product consists of a flag for each pixel in the grid indicating where radio frequency interference exists. In the same style as the AUX_DGG___, this file shall consist of a unique Data Set containing 10 Data Set Records, each one containing a list of points within a zone. These zones are used to allow a fast indexing of the data for search algorithms. They come from the natural decomposition of the icosahedron used in the ISEA projection.

The total size of the ***AUX_RFI___*** product is about 12.5 MB (assuming no dummy grid points, the exact size would be 13.107.330 bytes). The following table describes the binary format of the ***AUX_RFI___*** product's data block.

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	RFI_Mask					Init of binary Data Set containing the mask identifying grid points affected by RF interference, organized in zones.	
	List_of_Zones					Start of list of 10 ***Zones*** structures in which the DGG is subdivided.	
	Zone					Start of ***Zone*** structure.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
01	***Zone_ID***	Identifier	N/A	Unsigned long integer (8 bytes)	1 element	Unique ID defining the zone where the points are contained. An initial approach has 10 zones formed by two adjacent triangles of the main ISEA decomposition. Same as the one proposed for ISEA grid.	AUX_DGG
02	***Grid_Point_RFI_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of points contained within the zone (if not used, refer to whole file). For ISEA 4-9, maximum of 2.7M pixels	AUX_DGG
	List_of_Grid_Point_RFI_Mask_Datas					Start of list of Num_Points ***Grid_Point_RIF_Mask_Data*** structures.	
	Grid_Point_RFI_Mask_Data					Start of ***Grid_Point_RFI_Mask_Data*** structure.	
03	***Grid_Point_ID***	Identifier	N/A	Unsigned integer (4 bytes)	1 element	Unique identifier for Earth fixed grid point. For ISEA 4-9, maximum of 2.7M pixels	Copied from AUX_DGG
04	***RFI_Flag***	Flag	N/A	unsigned byte	1 element	RFI value of grid point over the ellipsoid. 0 for “No RFI”, 1 for “RFI detected”	TBD (Possibly generated at CEC)
	Grid_Point_RFI_Mask_Data					End of ***Grid_Point_RFI_Mask_Data*** structure.	
	List_of_Grid_Point_RFI_Mask_Datas					End of list of ***Grid_Point_RIF_Mask_Data*** structures.	
	Zone					End of ***Zone*** structure.	
	List_of_Zones					End of list of ***Zones*** structures.	
	RFI_Mask					End of binary Data Set containing mask identifying the grid points affected by RF interference.	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					End of binary Data Block in the product.	

Table 5-28. RFI Mask Product Data Block

5.2.22 Bistatic Scattering Coefficients (AUX_SGLINT)

As is written in section 4.27 of [RD.2], the auxiliary file used to correct Sun glint effect consists of a look-up table for the bistatic scattering coefficients as a function of incoming radiation incidence angle (θo, theta_o), relative azimuth between incoming radiation and radiometer look direction (φs, phi_s), radiometer incidence angle (θs, theta_s), and wind speed (W).

The LUT is only function of the input parameters as given in the following table:

Input parameter	Range	Increment
Sun incidence angle θ_o [deg, 0=nadir]	0°->90°	5°
Relative azimuth angle between sun and MIRAS observation angle ϕ_s [deg]. This is defined as: phi_radiometer - phi_incoming_sunradiation + 180	0°->360°	5°
MIRAS observation incidence angle θ_s [deg, 0=nadir]	0°->90°	5°
Wind speed [m/s]	7	N/A

Wind speed is currently considered as 7m/s and not supposed to change, although the LUT can be expanded to contain different values for different wind speed values.

This data set shall be comprised of a number of Data Set Records, each one of them containing the Bistatic Scattering Coefficients against a fixed polarisation, wind speed and radiometer incidence angle (θ_s theta_s).

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	Data_Block					Init of binary Data Block in the product.	
	Bistatic_Scattering_Coefficients					Init of binary Data Set containing the bistatic scattering coefficients to be used for Sun Glint correction	
01	***Wind_Speeds_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Wind_Speed_Data*** contained within the product	ESL
	List_of_Wind_Speed_Datas					Start of list of ***Wind_Speed_Data*** structures	
	Wind_Speed_Data					Start of ***Wind_Speed_Data*** structure	
02	***Wind_Speed_Value***	Real value	m/s	Unsigned short (2 bytes)	1 element	Wind speed value of the Bistatic Scattering Coefficients for the MDR	ESL
03	***Incidence_Angles_Counter***	Counter	N/A	unsigned integer (4 bytes)	1 element	Number of ***Incidence_Angle_Data*** contained within the product	ESL
	List_of_Incidence_Angle_Datas					Start of list of ***Incidence_Angle_Data*** structures	
	Incidence_Angle_Data					Start of ***Incidence_Angle_Data*** structure	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
04	***MIRAS_Incidence_Angle***	Real value	deg	Float (4 bytes)	1 element	Radiometer incidence angle (θ_s theta_s) value of the Bistatic Scattering Coefficients for the MDR	ESL
	List_of_Biscattering_Coefficients_Datas					Start of list of ***Biscattering_Coefficients_Data*** structures, with fixed length of 4 DSR	
	Biscattering_Coefficients_Data					Start of ***Biscattering_Coefficients_Data*** structure	
05	***Polarisation***	Identifier	N/A	Unsigned short (2 bytes)	1 element	Polarisation value of the Bistatic Scattering Coefficients for the MDR: 0=HH, 1=VV, 2=HV, 3=VH	ESL
06	***Scattering_Coefficients***	Real value	N/A	Double (8 bytes)	72 elements	Bistatic Scattering Coefficients array for a fixed set of θ_o and ϕ_s angles. Vector of 72 values	ESL
	Bistatic_Coefficients_Data					End of ***Bistatic_Coefficients_Data*** structure	
	List_of_Bistatic_Coefficients_Datas					End of list of ***Bistatic_Coefficients_Data*** structures	
	Incidence_Angle_Data					End of ***Incidence_Angle_Data*** structure	
	List_of_Incidence_Angle_Datas					End of list of ***Incidence_Angle_Data*** structures	
	Wind_Speed_Data					End of ***Wind_Speed_Data*** structure	

Field #	Field Name	Type	Unit	Element Precision	Variable Format	Comment	Origin
	List_of_Wind_Speed_Datas					End of list of ***Wind_Speed_Data*** structures	
	Bistatic_Scattering_Coefficients					End of dataset	
	Data_Block					End of binary Data Block in the product.	

Table 5-29. Sunglint Product Data Block

5.2.23 L1 Configuration Parameters (AUX_CNFL1P)

The AUX_CNFL1P ADF contains a list of parameters needed to specify the values of the configurable algorithms. This ADF is updated manually by the DPGS operators.

The SPH contains only the Main_SPH_for_XML structure as defined in Table 5-2.

The product Data Block contains two data sets, ***Algorithm_Configuration*** and ***L1_Constants***, with one DSR each. The ADF is specified in XML ASCII. The ADF header is formed by the Fixed Header and the Specific Product Header as specified in Table 5-2.

The AUX_CNFL1P data block specification is as follows:

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
01	***Data_Block***	Tag				Tag starting the datablock of the product.	
02	***Algorithm_Configuration***	Starting				Tag starting the **Algorithm_Parameters** dataset	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
		Tag					
03	***Default_TIME_TAI***	Real	Days	18 bytes	+019.16f	Default time correlation data used when AUX_TIME Auxiliary Data File is not available: [0] = -.1000000000000000	Set by Operator (default from L1OP Installation)
04	***Default_TIME_UTC***	Real	Days	18 bytes	+019.16f	Default time correlation data used when AUX_TIME Auxiliary Data File is not available: [1] = -.0995949074074074 (UTC time)	Set by Operator (default from L1OP Installation)
05	***Default_TIME_UT1***	Real	Days	18 bytes	+019.16f	Default time correlation data used when AUX_TIME Auxiliary Data File is not available: [2] = -.0995879629629630 (UT1 time)	Set by Operator (default from L1OP Installation)
06	***Default_TIME_GPS***	Real	Days	18 bytes	+019.16f	Default time correlation data used when AUX_TIME Auxiliary Data File is not available: [3] = -.0997800925925926 (GPS time).	Set by Operator (default from L1OP Installation)
07	***L1A_Parameters***					Tag starting the **L1A_Parameters** structure	
08	***Backwards_Overlap_APID_FULL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
09	***Backwards_Overlap_APID_DUAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
10	***Backwards_Overlap_APID_EXC_FULL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
11	***Backwards_Overlap_APID_EXC_DUAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
12	***Backwards_Overlap_APID_U_CAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
13	***Backwards_Overlap_APID_C_CAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
14	***Backwards_Overlap_APID_EXT_U_CAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
15	***Backwards_Overlap_APID_EXT_C_CAL***	Integer	s	4bytes	%4d	Number of seconds for product (backwards) overlap in APID_FULL.	Set by Operator (default from L1OP Installation)
16	***Raw_Number_of_Iterations***	Integer	N/A	4 bytes	%04d	Maximum number of iterations in the raw correlation convergence criteria	
17	***Raw_Thresholds_Residue_Limit***	Real	N/A	10 bytes	%010.8g	Threshold residue limit for the solution using the Newton-Raphson method	Set by Operator (default from L1OP

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
							Installation)
18	***UNCN_Correction***	Flag	N/A	1 byte	%01d	Optional flag to perform offset correction: 0 means No offset correction to be applied 1 means Offset correction to ALL baselines applied 2 means Offset correction ONLY to baselines fed by the same local oscillator	Set by Operator (default from L1OP Installation)
19	***L1A_Parameters***	Closing Tag				Tag closing the ***L1A_Parameters*** structure	
20	***L1B_Parameters***	Starting Tag				Tag starting the ***L1B_Parameters*** structure	
21	***Reconstruction_Image_Algorithm***	Integer	N/A	1 byte	%01d	This field can have one of the following values: • 1 for "Theoretical G-Matrix" • 2 for "Parametric G-Matrix"	
22	***Flat_Correction_Type***	Integer	N/A	1 byte	%01d	Method used to correct the contribution from flat target. This field can have one of the following values: • 0 for "FTT Not Applied" • 1 for "FTT Applied"	
23	***Direct_Sun_Correction_Type***	Integer	N/A	2 bytes	%+02d	Method used to correct the contribution from direct Sun into the snapshot. This field can have one of the following values:	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
						• 0 for "Correction by Measurements Self-estimation Technique" • 1 for "Correction Based on Sun Auxiliary Data" • -1 for not applied	
24	***Reflected_Sun_Correction_Type***	Integer	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for "Reflected Sun BT forward model" • -1 for not applied	
25	***Direct_Moon_Correction_Type***	Integer	N/A	2 bytes	%+02d	This field can have one of the following values: • 0 for "Correction by Default Moon BT Value (250K)" • 1 for "Correction Based on Moon Auxiliary Data" • -1 for not applied	
26	***Earth_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied • -1 for not applicable (if Flat_Correction_Type is 1).	
27	***Sky_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied • -1 for not applicable (if Flat_Correction_Type is	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
						1).	
28	***Backlobe_Contribution_Removed***	Flag	N/A	2 bytes	%+02d	This field can have one of the following values: • 1 for correction applied • 0 for correction not applied	
29	***Crosspolar_Contribution_Flag***	Flag	N/A	1 byte	%01d	Flag for activating/deactivating the contribution of the cross-polar antenna patterns.	Set by operator (default from l1op installation)
30	***Backlobes_Earth_Temperature***	Real	degrees	6 bytes	%6.2f	Constant Earth temperature used in the computation of backlobes contribution.	Set by operator (default from l1op installation)
31	***Backlobes_Sky_Temperature***	Real	degrees	6 bytes	%6.2f	Constant Sky temperature used in the computation of backlobes contribution.	Set by operator (default from l1op installation)
32	***L1B_Parameters***	Closing Tag				Tag closing the **L1B_Parameters** structure	
33	***L1C_Parameters***	Starting Tag				Tag starting the **L1C_Parameters** structure	
34	***Geometric_Correction_Type***	Integer	N/A	1 byte	%01d	This field specifies the method used to geolocate the pixels: • 1 for "S/C Atittude Only" • 2 for "Best Fit Plane Correction Applied"	
35	***Radiometric_Accuracy_S***	Integer	K	3 bytes	%03d	Scale used in the normalisation to 2s complement of the	Set by Operator

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
	cale					Pixel Radiometric Accuracy (default 50K)	(default from L1OP Installation)
36	***Pixel_Footprint_Scale***	Integer	Km	3 bytes	%03d	Scale used in the normalisation to 2s complement of the Pixel Footprint size (100km)	Set by Operator (default from L1OP Installation)
37	***Browse_Incidence_Angle***	Real	degrees	5 bytes	%+05.1f	Incidence angle selected to compute browse products	Set by Operator (default from L1OP Installation)
38	***Browse_Higher_Angle***	Real	degrees	5 bytes	%+05.1f	Higher angle useful for interpolation of browse values	Set by Operator (default from L1OP Installation)
39	***Browse_Lower_Angle***	Real	degrees	5 bytes	%+05.1f	Lower angle useful for interpolation of browse values	Set by Operator (default from L1OP Installation)
40	***Border_FOV_Flag_Distance***	Real	km	6 bytes	%06.1f	Maximum distance in Km from a DGG point to the projected EAF-FOV contour in order to raise the BORDER FOV flag.	Set by Operator (default from L1OP Installation)
41	***L1C_Parameters***	Closing Tag				Tag closing the **L1C_Parameters** structure	
42	***Algorithm_Configuration***	Closing Tag				Tag closing the **Algorithm_Parameters** dataset	
43	***Quality_Parameters***	Starting Tag				Tag starting the Quality_Parameters structure	

Field #	Field Name	Type	Unit	String Length	C Format	Comment	Origin
44	***RMS_Threshold_for_FTT***	Real	(10-2 %)	6 bytes	%06d	Maximum RMS for a scene to be useful in FTT generation.	Set by Operator (default from L1OP Installation)
45	***Quality_Parameters***	Closing Tag				Tag closing the **Quality_Parameters** structure	
46	***Data_Block***	Tag				Tag ending the datablock of the product.	

Table 5-30. L1 Configuration File Product Data Block

6. PRODUCTS SIZES ESTIMATIONS

The following is a list of the size of each of the products specified in this document. The headers sizes can be approximated by 4 KB each, considering borh FH and VH. For the data blocks, their sizes have been obtained following two procedures:

→ The binary products are obtained after counting the size of each DataSet Record and assuming a certain typical number of data set records, including the overlap as defined in [RD.6] (assumed to consist of 100 scenes).

→ The XML ASCII products sizes have been obtained after creating examples of each product and looking at its size in the disk.

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
TLM_MIRA1A	HKTM_Data	4 bytes	1681 bytes	2700	4538704 ≈4,33 MB
MIR_UAVD1A / MIR_UAVU1A	Mean_Offset	4 bytes	41213 bytes	1	40,25 kB
MIR_CRSD1A / MIR_CRSU1A	Cons_Ampl_Phase_Correction	4 bytes	43773 bytes	4	235799 ≈230 kB
	Cons_PMS_Coefficients	4 bytes	2744 bytes	4	

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
	Cons_Long_PMS_Coefficients	4 bytes	2744 bytes	2	
	PMS_Sensitivities	4 bytes	3029 bytes	1	
	FWF_Origin_Sensitivities	4 bytes	41214 bytes	1	
MIR_AFWD1A / MIR_AFWU1A	Cons_FWF_Measurements	4 bytes	40929 bytes	3	227612 ≈0.217 MB
	Cons_FWF_Cofficients	4 bytes	104825 bytes	1	
MIR_ANIR1A	NIR_External	4 bytes	461 bytes	1	785 bytes
	NIR_LICEF	4 bytes	316 bytes	1	
MIR_SC_D1A / MIR_TARD1A	Calibrated_Visib_Dual	4 bytes	41891 bytes	2x1350	113105704≈107.866 MB
MIR_SC_F1A / MIR_TARF1A	Calibrated_Visib_Full	4 bytes	41891 bytes	4x1350	226211404 ≈215.75 MB

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
MIR_GMATD_ / MIR_GMATU_	G_Matrix				8386510848 bytes ≈ 7.81 GB
MIR_JMATD_ / MIR_JMATU_	J_Matrix				1428634752 bytes ≈ 1.33 GB
MIR_FTTD__	Flat_Target_Transformation	4 bytes	225388	10	2253884 bytes ≈2,15 MB
MIR_FTTF__	Flat_Target_Transformation	4 bytes	383932	10	3839324 bytes ≈3,66 MB
MIR_SC_D1B / MIR_TARF1B	Temp_Snapshot_Dual	4 bytes	22515 bytes	2x1350	60790508 ≈57.97 MB
	Scene_Bias_Correction	4 bytes	64 bytes	0	
MIR_SC_F1B / MIR_TARF1B	Temp_Snapshot_Full	4 bytes	22515 bytes	4x1350	121581008 ≈115.95 MB
	Scene_Bias_Correction	4 bytes	64 bytes	0	
MIR_SCLD1C /	Swath_Snapshot_List	4 bytes	161 bytes	2700	313274700 ≈298.76 MB

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
MIR_SCSD1C	Temp_Swath_Dual	18 bytes	24 bytes	2x1350x4800	
MIR_SCLF1C / MIR_SCSF1C	Swath_Snapshot_List	4 bytes	161 bytes	2700	546554700 ≈521.23 MB
	Temp_Swath_Full	18 bytes	28 bytes	3x1350x4800	
MIR_BWLD1C / MIR_BWSD1C	Temp_Browse	4 bytes	46 bytes	100000	4600004 ≈4.38 MB
MIR_BWLD1C / MIR_BWSD1C	Temp_Browse	4 bytes	74 bytes	100000	7400004 ≈7.06 MB
AUX_PMS___	PMS_Characterisation				57 KB
AUX_NIR___	NIR_Characterisation				14 KB
AUX_PLM___	PLM_Parameters				22 KB
AUX_SPAR__	NDN_S_Parameters Switch_S_Parameters				551 KB
AUX_LCF___	LICEF_Characterisation				74 KB
AUX_PATT__	Antenna_Pattern_Coordinates	0	524176	1	457613144 bytes

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
		bytes			= 436.4 MB
	Average_Antenna_Patterns	0 bytes	524177 bytes	8	
	Antenna_Patterns	0 bytes	1572554 bytes	72x4	
AUX_FAIL__	Failing_Components				450 KB
AUX_BWGHT	Baseline_Weights				50 kB
AUX_BFP___	Best_Fit_Plane				4KB
AUX_MISP__	Mispointing				50 kB
AUX_DGG___	Discrete_Global_Grid	0 bytes	12+ 2621422/10x16 bytes	10	41942872 ≈40 MB
AUX_LSMASK	Land_Sea_Mask	0 bytes	12+ 2621422/10x6 bytes	10	15728652 ≈15 MB
AUX_MASK__	L1C_Pixel_Mask	0 bytes	12+ 2621422/10x5	10	13107230 ≈12.5 MB

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
			bytes		
AUX_GALAXY	Original_Galaxy_Map	0 bytes	16x721x1441	1	16623376 bytes ≈ 15.85 MB
AUX_GALNIR	NIR_BT_Galaxy_Map	0 bytes	8x721x1441	1	8311688bytes ≈ 7.93 MB
AUX_SUNT__	Sun_Measured_Temperatures	4 bytes	28 bytes	100?	2804? Bytes
AUX_MOONT_	Moon_Measured_Temperatures	4 bytes	28 bytes	100?	2804? bytes
AUX_ERTHT_					
AUX_VTEC_P AUX_VTEC_C	VTEC_Info	4	1x16+73x[20+2 x73]= 12134 bytes	1	12 kB
AUX_APDS__ / AUX_APDL__	Apodisation_Function				275 kB
AUX_RFI___	RFI_Mask	120 bytes	12+ 2621422/10x5 bytes	10	13107230 ≈12,5 MB

PRODUCT SIZE ESTIMATIONS					
Type of Data		Fixed fields	Size of data set record (DSR)	Typical number of DSR in a product	Total size of product
Product	Data Set				
AUX_SGLINT	**Bistatic_Scattering_Coefficients**	4 bytes	2+4+19x(4+4x(72*8+2))	1	44014 bytes
AUX_CNFL1P	**Algorithm_Configuration_L1_Constants**				

Table 6-1. Products sizes