CRYOSAT Ground Segment

Instrument Processing Facility L1B

Products Specification Format

[PROD-FMT]

CS-RS-ACS-GS-5106

Issue: 6.4

Date: 30/04/2015

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Document Change Record

Issue/Rev.	Class (R=Review /A=Approval)	Date	Reason for Change	Changed Pages/Paragraphs
Cryosat 1				
1	R	10/04/2002	Initial Issue for SRR	All
1.8	R	17/05/2002	Update for Co-location Meeting	See side bars
1.9	R	12/07/2002	Comments following Co-Location Meeting Delivery for ADR	See side bars
2.0	R	20/12/2002	Outcomes of Actions issued in the ADR Meeting.	See side bars
2.1	R	25/02/2003	Alignment of document for Va 2.0 SW re-delivery. The following items are covered in this update: SPR93 Definition of Start and Stop Time in product filenames and product MPH as for CS-MN-ACS-GS-5217 Correction of Percentage fields from 10-3 to 10-2 in Product Headers NOTE THAT THIS IS AN INTERIM VERSION OF THE PROD_FMT: FURTHER CHANGES ALREADY DISCUSSED DURING FAT-VA WILL BE INCLUDED AFTER VA 2.0 REDELIVERY TO ALLOW CORRECT DEVELOPMENT OF VB SW PROCESSORS.	See side bars

Issue /Rev.	Class (R=Review /A=Approval)	Date	Reason for Change	Changed Pages/Paragraphs
2.2	A	25/04/2003	Global Revision of Product Headers and Update of Records Structure	
2.3	A	13/06/2003	Includes updates of MCD fields and CAL1 / CAL2 product layouts as per agreements in MoM CS-MS-ACS-GS-5219	
2.4	A	20/10/2003	Update of CAL3 L1B and SARIN L1B Product Layouts as for agreements with MSSL Inclusion of NPM quality flag in FBR and L1B MCD Modification of CAL1-SARIN MCD definition to separate quality information of Rx1 and Rx2 channels. Inclusion of Platform Attitude Control flag in MODE_ID field Inclusion of SAR/SARIN processing specific flags in MCD for L1B product Revision of Product Header.	
2.5	A	30/11/2003	Inclusion of statement about the exotic units in products Inclusion of scaling factors in Monitoring Products	
2.6	A	31/01/2004	Inclusion of scaling factors in CAL1 Products + XML DSD definition + typographical	
2.7	A	26/11/2004	Inclusion of Exotic CAL1 Product + corrections	
2.8	A	16/05/2005	XML and ASCII SPH modified to introduce Surface Id Statistics fields (Task#6 IPF1-CCN6) List of DS_NAME for Measurement DSD updated to account for Fast Delivery Ocean Processing Chain. FBR and L1B MCD updated: obsolete External COM Correction bit field removed; flags to trace exotic CAL1 file have been introduced IPF1 Products List updated with FDM products	
2.9	A	02/08/2005	Inclusion of fields descriptions	

3.0	A	09/09/2005	Typo errors corrections	See Sidebars
3.1	A	24/06/2006	Inclusion of new DS Name for new geocorrections files	See Sidebars
3.2	A	10/07/2007	Definition of 'Flags' field in SAR Average Waveform Group added	See Sidebars
Cryosat 2				
4.0	R	12/12/2007	Vh 1.0 delivery (SIRAL redundancy)	See Sidebars
4.1	R	16/06/2008	Two Beam Behaviour parameters added	See sidebars
4.2	R	15/11/2008	Added new applicables to trace the CCN#1 requirements	Sec. 1.3.1
4.3	R	27/02/2009	Updated note on phase slope (field 33)	Table 2.3.4-1: phase slope correction in L1B MDS record
			Updated note on internal phase correction (field 30)	Table 2.3.4-1: internal phase correction in L1B MDS record
			Updated note on external phase correction (field 31)	Table 2.3.4-1: external phase correction in L1B MDS record
			Updated note on internal phase correction (field 30)	Table 2.3.3-1: internal phase correction in FBR MDS record
			Updated note on external phase correction (field 31)	Table 2.3.3-1: external phase correction in FBR MDS record
			Added Correction Error Flag for new DAC geocorrection, as for CCN#2	Sec. 2.3.3, table 2.3.3-6
			Added Correction Status Flag for new DAC geocorrection, as for CCN#2	Sec. 2.3.3, table 2.3.3-5
			Added new DAC geocorrection and a spare byte in the Correction Group of MDS record, as for CCN#2	Sec. 2.3.3, table 2.3.3-1: FBR MDS Records Sec. 2.3.4-1, table 2.3.3-5: L1B MDS records
			Reference to DORIS ionospheric correction has been replaced with GIM, because DORIS ionospheric correction data have been removed by PDGS.	Sec. 2.3.3, table 2.3.3-1: FBR MDS Records Sec. 2.3.4-1, table 2.3.3-5: L1B MDS records
			Removed reference to DRYTRP file Added reference to MOG_2D file	Table 2.3.2-5 DS Names for Reference DSDs
			ESA request	LRM FBR Product Format description has been moved from this document to the Annex 7 in the DPM
4.4	R	07/04/2009	Modifications agreed at VH1.2 QR	Sec.2.3.4: MCD field "Phase Perturbation Correction Mode" moved to last bit (#0) in table 2.3.4-2
				Sec.2.3.6.3: Added note to clarify storing of PTRs to fields #12 and #23 of the CAL1SARin type1 MDS

				in table 2.3.6.3-1 Sec.2.3.6.4: updated description of fields #21, #24, #25, #26 and #27 in table 2.3.6.4-1 Sec. 2.3.6.4: updated description of MCD fields #7, #8 and #9 in table 2.3.6.3-2
4.5	R	20/04/2009	New issue after RIDs	Section 1.3: list of reference updated Section 2: page 14: reference to Cal3 removed, added bullet for CAL products and L1b product tree Section 2.3: references to CAL3 removed from SPH Section 2.3, Table 2.3.4-2: bitfield Orbit Propagation Error is changed to bold type face because is used to set the BlockDegraded bitfield. Section 2.2.2.1: REF DOC example updated Section 3.1: setting of Valididty start and stop time updated as for relevant CR
4.6	R	15/09/2009	MCD field table for FBR product changed	Table 2.3.4-2: removed unused fields.
4.7	R	30/09/2011	Definition of field#2 changed as per [CRYO-IDE-71] Definition of the Beam behaviour stack amplitude updated as per [CRYO-IDE-1], [CRYO-IDE-27] Definition of field #75 (LRM Waveform Group Flags) fixed following [CRYO-IDE-74]	Sec. 2.3.3, 2.3.4, 2.3.6, 2.3.7: Definition of Field#2 (Uso Correction Factor in units 10^-9) changed into [Uso Correction Factor -1] in units 10^-15. Table 2.3.4-5 updated: the stack scaled amplitude is now described in units of db/100 Sec. 2.3.4: definition of Field#75 updated; Table 2.3.4-4b renamed as 3b; the string PL (pulse limited) replaced with LRM as suggested in [CRYO-IDE-74]; description of Field#70 and #80 corrected as 16 bit flags instead of 15 bits
4.8	R	20/10/2011	Definition of field#70 fixed [CRYO-IDE-74]	Field#70 refer to Table 2.3.4-3b; the caption of this table has been updated in order to specify its applicability to both SAR and SARin cases.
4.9	A	14/11/2011	New Release to take into account ESA's comments after delivery of IPF1 Vk1.0	Approval Table changed Distribution List changed Applicable and reference document list was modified List of Acronyms was updated

				Typo errors were corrected in Section 2 and subsections In table 2.2.2.2.1 description of fields: 16,17,19,23,24,25,26 was changed. Section 2.3.4: added table 2.3.4-4a for Field#75. Table 2.3.4-4 renamed as 2.3.4-4b and moved to pag. 74 after the description of field#80 Tables 2.3.4-3a/3b: description of bit 15 improved and caption fixed Description of Field#70 fixed pointing to table 2.3.4-3b (instead of 2.3.4-4) Table 2.3.4-5: unit for Standard deviation corrected Description of fields #86, 87, 89 fixed Section 2.3.5.1: added the unit dB/100 for Noise Measurement fields Sec. 2.3.5.3: added the unit dB/100 for Noise Measurement fields; Description of field#24, 25 fixed Sec. 2.3.6.3: Unit for field#35 fixed; table 2.3.6.3-2, bit 3 fixed (it refers to Rx 2) The term "Fast Delivery Ocean Mode" has been replaced with "Fast Delivery Marine Mode" everywhere Sec. 2.3.6.4 unit provided for Fields #16, #17 and #28
4.10 draft	A	05/10/2012	New Release to take in to account the modifications asked for the delivery of the FDM code	Approval Table and Distribution List: System Engineer changed from M. Antonacci to D. De Candia In section 2.2.2.1 the description of field #11 of the XML MPH changed because the Delta UT1 field is now computed In section 2.3.1 the description of

				field #18 of the MPH changed because the Delta UT1 field is now computed
4.10	A	15/02/2013	Release for IPF1 Vk2.0 AR	Same modifications as version 4.10draft
5.0	R	02/08/2013	Release for the specification of IPF Baseline C	Several typographical errors and changes in the text have been implemented and not traced in order to keep the readability of the document at an acceptable level. **Section 2.3.2:** List of Reference DSD Names updated to include forecast files and auxiliary file for bending Correction. **Section 2.3.3:** Description of FBR SAR/SARin MDS Record has been improved **Section 2.3.4:** Description of L1B Data Product MDS Record has been improved Waveform size of SAR/SARin MDS' is doubled to include trailing edge STR_ID, Roll, Pitch and Yaw angles added to LRM/SAR and SARin products LRM/SAR/SARin MCD modified to flag whether the Cal1 correction is applied by using the Peak or Integrated Power. LRM/SAR/SARin MCD modified to flag whether the time-varying antenna bending correction is applied. Table 2.3.4-5 modified to document the new setting of the Beam Behaviour Parameters. **Section 2.3.6:** Description of many fields of the CAL1 Product has been improved. CAL1 Product is modified to include integrated power field

5.1	A	10/12/2013	Implementation of ESA's comments to issue 5.0 Refinement of the FBR Measurement Confidence Data structure	All modifications to issue 5.0 are still visible by track change bars Section 2.3.4 : description of LRM(FDM)/SAR/SARin MDS, field 86 (Beam Behaviour Parameter). The following description: [32-33] Number of contributing beams in the stack before weighting annotated for monitoring purposes. Has been turned into : [32-33] Number of contributing beams in the stack before weighting, provided for monitoring purpose. Section 2.3.3, Table 2.3.3-4 Field 23 turned into CAL1 Type Correction (1-bit) , field 24 added as spare.
6.0	R	01/09/2014	Management of new file type STR_ATTREF added Default value for Noise Power Measurement.	Table 2.3.2-5 DS_NAME for Reference DSD: STAR_TRACKER_ATTREF_FILE added to the list Table 2.3.3-3 Instrument Configuration Field modified to add management of STR_ATTREF file Section 2.3.3, description of field 32 Section 2.3.4, description of field 37
6.1	A	30/09/2014	Possible invalid 1Hz waveform at the end of L1b product Star Tracker usage revised Measurement Confidence Data revised	Same changes as version 6.0 (still visible in track changes mode) Section 2.3.4: description of field 60 and field 71 has been updated Table 2.3.3-3 : removed reference to Star Tracker 1, 2 and 3 from the Instrument Configuration Table 2.3.4-1 : name and description of Field#14 updated Table 2.3.4-2 : "Antenna Bending Correction" field (field#22) of the

				L1b Measurement Confidence data has been turned to "Reserved" because not computed by IPF1
6.2	A	13/10/2014		Same changes as version 6.1 (still visible in track changes mode)
			Description of FBR MDS refined	The description of the following fields has been refined: field 41 (Total Geocentric Ocean Tide) field 42 (Long-Period Equilibrium Ocean Tide) field 43 (Ocean Loading Tide)
			Description of L1b MDS refined	The description of the following fields has been refined: field 46 (Total Geocentric Ocean Tide) field 47 (Long-Period Equilibrium Ocean Tide) field 48 (Ocean Loading Tide)
6.3	A	10/02/2015	Description of FBR MDS corrected	The description of the following fields has been reviewed: field 41 (Total Geocentric Ocean Tide) field 42 (Long-Period Equilibrium Ocean Tide) field 43 (Ocean Loading Tide) Fields names have been harmonised across the document
			Description of L1b MDS corrected	The description of the following fields has been reviewed: field 46 (Total Geocentric Ocean Tide) field 47 (Long-Period Equilibrium Ocean Tide) field 48 (Ocean Loading Tide) Fields names have been harmonised across the document
			Reference to DPM sections corrected	In the description of the some fields of the correction group the links to DPM section where the computation of the correction is explained was wrong
6.4	R	30/04/2015	Replacement of STR_ATTREF data usage with Level 0 Star Tracker Data for FDM processing only.	Field 14 of the MDS description (section 2.3.4) has been updated with the valid and mode dependent values for the STR ID

TABLE OF CONTENTS

1 INTRODUCTION

This document contains the description of the format of all the Level-1 products generated inside the PDS for the CryoSat mission.

1.1 PURPOSE AND SCOPE

The purpose of the document is to define the product structure and the content of each Level-1 file generated in the PDS identifying for each data section and field the meaning and the format to be used for its representation.

1.2 DOCUMENT STRUCTURE

The document includes the following sections:

Section 1 - Introduction	The present section.
Section 2 - Level-1 General Format Description	This section gives the general description of the Level-1 products in terms of common organisation and format and the detailed description of the format for each file type.
Section 3 - CryoSat Level-1 Products	This section contains the product file name and the composition rules of the file name.

1.3 APPLICABLE & REFERENCE DOCUMENTS

1.3.1 Applicable Documents

Document Title	**Identifier**	**Reference**
Earth Explorer Ground Segment File Format Standard Issue 1.4 , 13 June 2003	CS-TN-ESA-GS-0154	[FMT-GUIDE]
Cryosat Ground Segment Master ICD	CS-ID-ESA-GS-0147	[MASTER-ICD]
CCN #1: Upgrades of IPF1 [IPF1-CCN1] Issue 1.0	C2-CN-ACS-GS-5224	[CCN1-TN]
Minute of CCN#1 negotiation meeting	C2-MN-ACS-GS-5225	[CCN1-NM]
CCN #2: Upgrades of IPF1 [IPF1-CCN2] Issue 1.0	C2-CN-ACS-GS-5229	[CCN2-TN]
Minute of CCN#2 negotiation meeting	C2-MN-ACS-GS-5231	[CCN2-NM]
Minute of IPF1 Vh1.2 QR meeting	C2-MN-ACS_GS-5236	[MOM-QR]
Minutes of the Colocation meeting on 21-22 July 2014	C2-MN-ACS_ESL_5332	[MOM-CO]
Minutes of the IPF VM1.0 Acceptance Review meeting	C2-MN-ACS_ESL_5334	[MOM-AR]
Explorer Orbit SW User Manual	CS-MA-DMS-GS-0004	[EXPL_ORB-SUM]

1.3.2 Reference Documents

Document Title	**Identifier**	**Reference**
IPF1 Detailed Processing Model Issue 4.0	CS-TN-ACS-GS-5105	[IPF1-DPM]
Level 0 Products Specification Format Issue 3.3	CS-ID-ACS-GS-0119	[L0-FMT]
IEEE Standard for Binary Floating-Point Arithmetic. ANSI/IEEE Std 754-1985 Institute of Electrical and Electronics Engineers Issued 1985	IEEE-754	[IEEE]
Extensible Markup Language (XML) 1.0 (Second Edition) W3C Recommendation 6 October 2000	http://www.w3.org/TR/2000/REC-xml-20001006	[XML-GUIDE]

XML Schema Definition Language: W3C XML Schema Working Group and Schema Specifications	http://www.oasis-open.org/cover/schemas.html#W3CWorkingGroup	[XML-SCHEMA]
CCSDS Recommendation Time Code Formats Blue Book Issue 2.0, April 1990	CCSDS 301.0-B-2	[CCSDS-TIMEGUIDE]
CCSDS Recommendation Advanced Orbiting System, Networks and Data Links Architectural Specification Blue Book Issue 3.0, June 2001	CCSDS 701.0-B-3	[CCSDS-AOS]
CryoSat Master Interface Control Document	CS-ID-ESA-GS-0147	[CS-ICD]
SIRAL User Manual Issue 10.0	SIRA-ASPI-MA-0228	[SIR-US]

1.4 ACRONYMS AND ABBREVIATIONS

ACS	Advanced Computer Systems S.p.A.
ADC	Analogue to Digital Converter
AGC	Automatic Gain Control
AIR	Azimuth Impulse Response
AISP	Annotated Instrument Source Packet
APID	Application Process IDentifier
BER	Bit Error Rate
BLOB	Binary Large Object
CADU	Channel Access Data Unit
CAL	Calibration
CCSDS	Consultative Committee for Space Data Systems
CID	Content IDentifier
CVCDU	Coded Virtual Channel Data Unit
DFCB	Data Format Control Book
DSR	Data Set Record
EO	Earth Observation
ESA	European Space Agency
FOS	Flight Operations Segment
FBR	Full Bit Rate
GS	Ground Segment
HK/TM	Housekeeping/Telemetry data
ID	IDentifier
I/O	Input/Output
ISP	Instrument Source Packet
L1B	Level 1B
LRM	Low Rate Mode
MDS	Measurement Data Set
MJD	Modified Julian Day
MON	Monitoring
MPH	Main Product Header
NPM	Noise Power Measurement
PDS	Payload Data System
PSLR	Peak to Side Lobe Ratio
PSS-05	ESA Software Engineering Standard
PTR	Point Target Response
RC	Radar Cycle
RIR	Range Impulse Response
SIRAL	Synthetic Interferometric Radar ALtimeter
SOW	Statement Of Work
SPH	Specific Product Header
TAI	International Atomic Time Reference
TBC	To Be Clarified
TBD	To Be Defined
TRK	TRaKing
TT&C	Tracking, Telemetry and Command
UTC	Universal Time Co-ordinates
VCID	Virtual Channel IDentifier
VCDU	Virtual Channel Data Unit
WGS84	World Geodetic System 1984
XML	eXtensible Markup Language

2 LEVEL-1 GENERAL FORMAT DESCRIPTION

The Level-1 products are derived from the SIRAL instrument Level 0 data, applying the IPF1 processing algorithms defined in the IPF1 system of PDS.

IPF1 processing chains provide four types of Level1 products:

❒ **Level 1B**

The L1B data is the main product output from the IPF1. In the case of SAR and SARIN modes of SIRAL, the L1B data are strongly compressed in size following the application of SAR/SARIN algorithms and multilook for speckle reduction.

❒ **Level 1B CAL products**

CAL1 and CAL2 products also belong to the L1B class. CAL1 data are available for LRM/SAR/SARIN modes, while CAL2 data are available only for SAR/SARIN modes.

❒ **FBR**

The Full Bit Rate (FBR) product is output at an intermediate stage before the L1B processing is complete. This is the highest processing stage reached before information compression occurs. In particular the FBR data for SAR and SARIn modes still contain the echo data as complex numbers.

❒ **Monitoring**

Monitoring data is a systematic product aimed to provide timely information on the health of the instrument. It consists of a set of instrument parameters which may be produced rapidly and routinely starting from LRM/TRK SIRAL data, SAR or SARIN data.

The IPF1 has as output the following products :

- **Level 1B Science Data**
  - LRM Level 1B
  - SAR Level 1B
  - SARIn Level 1B
- **FBR Science Data**
  - SAR FBR
  - SARIn FBR
  - LRM FBR
- **Auxiliary Calibration Data**
  - CAL1 LRM
  - CAL1 SAR

- CAL1 SARIn
- CAL2 SAR
- CAL2 SARIn
- CCAL1 SARIn (Autocal Complex CAL1 data)

- **Monitoring Products**
  - MON LRM/TRK
  - MON SAR
  - MON SARin

2.1 FILE STRUCTURE

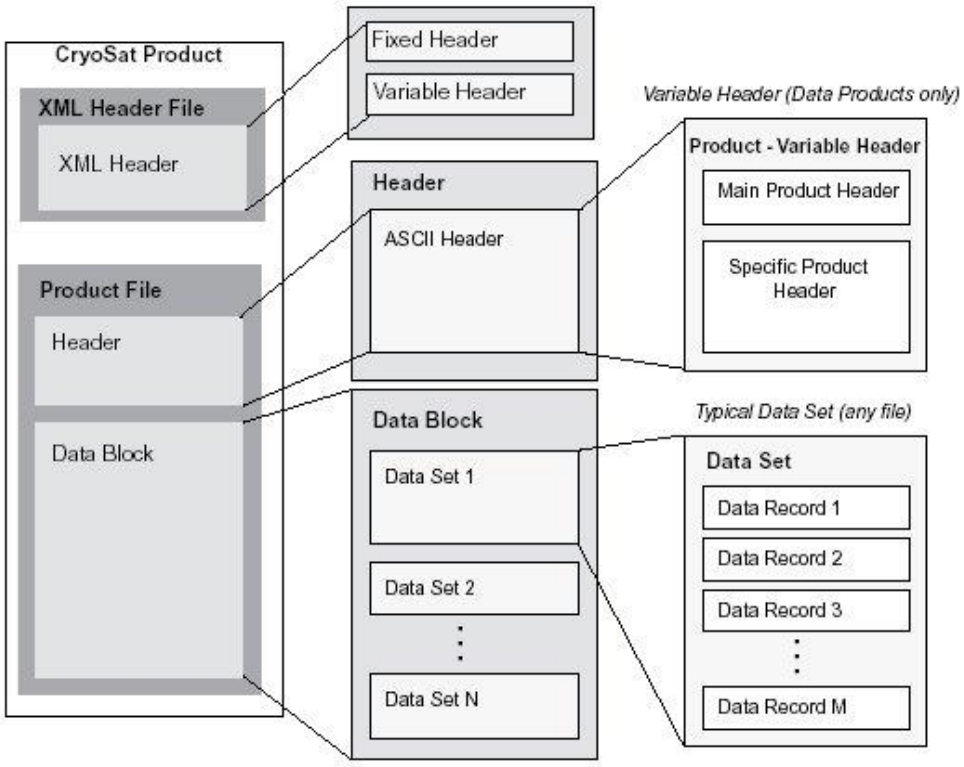
The file structure of any file produced by the IPF1 system must follow the requirements of the [FMT-GUIDE] .

Each level-1 product is composed by two files:

- XML Header File
- Binary Product File

The XML Header file is an auxiliary ASCII file that users can easily access for identifying the product without looking inside the Product File.

The Product File is the real product containing meaningful instrument's data and ASCII header used by ad hoc developed standard tools for inspecting the product's content. In order to use tools already developed for the ENVISAT mission, the product structure for CryoSat follows the correspondent one of the ENVISAT products as far as possible.



2.2 XML HEADER FILE

The XML Header file contains information identifying the product and easy to read as based on a standard syntax accessed by common tools available for visualising its content. The XML syntax has been chosen for the scope of the PDS.

The XML Header file is composed by:

- a Fixed Header
- a Variable Header

The Fixed Header (hereafter called Standard CryoSat Header) is the common header for all files managed into the PDS. That means it is applied to all files flowing amongst the sub-systems composing the PDS.

The Variable Header (hereafter called Product Header) is the header with format and content depending on the file type and kind of product.

2.2.1 Fixed Header (CryoSat Header)

The Standard CryoSat Header is completely ASCII and based on XML syntax and conventions proposed in [FMT-GUIDE].

The format and content of the Standard CryoSat Header is under ESA responsibility and it is specified in [FMT-GUIDE].

2.2.2 Variable Header (Product Header)

The Variable Header (hereafter called Product Header) for the Level-1 product is composed of:

- a XML Main Product Header (XML MPH)
- a XML Specific Product Header (XML SPH) which includes Reference Data Set Descriptors for external input files and one or more XML Specific Measurement Data Header (XML MDH) for the Data Sets of the Product

The XML MPH and XML SPH are derived from the correspondent headers (MPH and SPH) of the Product File, removing the unused fields and fields already reported in the Standard CryoSat Header.

Each header is completely ASCII and based on XML syntax and conventions proposed in the [FMT-GUIDE].

The following paragraphs describe the format and content of the XML MPH and XML SPH without overload of the XML format description.

2.2.2.1 XML Main Product Header (XML MPH)

Field #	Description	Units	Bytes	Format
	MPH	Tag		
	Product Identification Information			
#01	Product	Tag		
	Product File Name without extension		62	See Section 3
#02	Proc_Stage_Code	Tag		
	Processing stage code identifier: RPRO = Reprocessing OFFL = Routine Operation NRT_ = Near Real Time TEST = Test LTA_ = Long Term Archive		4	4*uc
#03	Ref_Doc	Tag		
	Reference DFCB Document describing the product		23	CS-RS-ACS-GS-5106 04.90
	Data Processing Information			
#04	Proc_Time	Tag		

Field #	Description	Units	Bytes	Format
	Processing Time (Product Generation Time)		30	UTC=yyyy-mm-ddThh:mm:ss.uuuuuu
#05	Software_Version	Tag		
	Processor Name and software version number		14	ProcessorName/VV.rr
	Orbit Information			
#06	Phase	Tag		
	Phase Code (set to X if not used)		1	uc
#07	Cycle	Tag		
	Cycle Number (set to +000 if not used)		4	%+04d
#08	Rel_Orbit	Tag		
	Relative Orbit Number at sensing start time (set to +00000 if not used)		6	%+06d
#09	Abs_Orbit	Tag		
	Absolute Orbit Number at sensing start time (set to +00000 if not used)		6	%+06d
#10	State_Vector_Time	Tag		
	UTC state vector time		30	UTC=yyyy-mm-ddThh:mm:ss.uuuuuu
#11	Delta_UT1	Tag		
	Universal Time Correction: DUT1 = UT1 – UTC	s	8	%+08.6f
#12	X_Position	Tag		
	X position in Earth Fixed Reference If not used set to +0000000.000	m	12	%+012.3f
#13	Y_Position	Tag		
	Y position in Earth Fixed Reference If not used set to +0000000.000	m	12	%+012.3f
#14	Z_Position	Tag		
	Z position in Earth Fixed Reference If not used set to +0000000.000	m	12	%+012.3f
#15	X_Velocity	Tag		
	X velocity in Earth Fixed Reference If not used set to +0000.000000	m/s	12	%+012.6f
#16	Y_Velocity	Tag		
	Y velocity in Earth Fixed Reference If not used set to +0000.000000	m/s	12	%+012.6f

Field #	Description	Units	Bytes	Format
#17	Z_Velocity	Tag		
	Z velocity in Earth Fixed Reference If not used set to +0000.000000	m/s	12	%+012.6f
#18	State_Vector_Source	Tag		
	Source of Orbit State Vector Record FP = FOS predicted DN = DORIS Level 0 navigator DP = DORIS precise orbit FR= FOS restituted DI = DORIS preliminary		2	2*uc
	Product Confidence Data Information			
#19	Product_Err	Tag		
	Product Error Flag 1 errors have been reported in the Product 0 no errors		1	uc
	Product Size Information			
#20	Tot_Size	Tag		
	Total Size of the Data Product	bytes	21	%021d

Table 2.2.2.1-1: XML Main Product Header Description

2.2.2.2 XML Specific Product Header (XML SPH)

Field #	Description	Units	Bytes	FORMAT
	SPH	tag		
Product description and identification				
#1	SPH_Descriptor	tag		
	Name describing the Specific Product Header		28	*ProductID SPECIFIC HEADER See Table 3-1*
Product Time information				
	Time_Information	tag		
#2	Start_Record_Time	tag		
	TAI of the first record in the Main MDS of this product		30	TAI=yyyy-mm-ddThh:mm:ss.uuuuuu
#3	Stop_Record_Time	tag		
	TAI of the last record in the Main MDS of this product		30	TAI=yyyy-mm-ddThh:mm:ss.uuuuuu
Product Orbit information				
	Orbit_Information	Tag		
#4	ABS_Orbit_Start	Tag		
	Absolute Orbit Number at sensing start time.		6	%06d
#5	Rel_Time_ASC_Node_Start	Tag		
	Relative time since crossing ascending node time relative to start time of data sensing.	s	11	%011.6f
#6	ABS_Orbit_Stop	Tag		

Field #	Description	Units	Bytes	FORMAT
	Absolute Orbit Number at sensing stop time.		6	%06d
#7	Rel_Time_ASC_Node_Stop	Tag		
	Relative time since crossing ascending node time relative to stop time of data sensing.	s	11	%011.6f
#8	Equator_Cross_Time	Tag		
	Time of equator crossing at the ascending node relative to the sensing start time.		30	UTC=yyyy-mm-ddThh:mm:ss.uuuuuu
#9	Equator_Cross_Long	Tag		
	Longitude of equator crossing at the ascending node relative to the sensing start time (positive East, 0 = Greenwich) referred to WGS84.	10-6 deg	11	%+011d
#10	Ascending_Flag	Tag		
	Orbit Orientation at the sensing start time A=Ascending D=Descending		1	uc
Product Location Information				
	Product_Location	tag		
#11	Start_Lat	tag		
	WGS84 latitude of the first record in the Main MDS (positive north)	10-6 deg	11	%+011d
#12	Start_Long	tag		
	WGS84 longitude of the first record in the Main MDS (positive East, 0 = Greenwich)	10-6 deg	11	%+011d

Field #	Description	Units	Bytes	FORMAT
#13	Stop_Lat	tag		
	WGS84 latitude of the last record in the Main MDS (positive north)	10-6 deg	11	%+011d
#14	Stop_Long	tag		
	WGS84 longitude of the last record in the Main MDS (positive East, 0 = Greenwich)	10-6 deg	11	%+011d
SIRAL Level 0 Quality information				
	Level_0_Confidence_Data	tag		
#15	L0_Proc_Flag	tag		
	Processing errors significance flag 1 errors (percentage of errors greater than threshold) 0 no errors		1	uc
#16	L0_Processing_Quality	tag		
	Percentage of quality checks successfully passed during ISP processing (max allowed +10000)	10-2 %	6	%+06d
#17	L0_Proc_Thresh	tag		
	Minimum acceptable percentage of quality threshold that must be passed during ISP processing (max allowed +10000)	10-2 %	6	%+06d
#18	L0_Gaps_Flag	tag		
	Flag to indicate gaps in input data • 1 gaps • 0 no gaps		1	uc
#19	L0_Gaps_Num	tag		
	Number of gaps detected during ISP processing		7	%07d
SIRAL Instrument Configuration				
	SIR_Instrument_Configuration	tag		
#20	Instrument_Identifier	tag	1	1*uc A (SIRAL Nominal) B (SIRAL Redundant)
#21	SIR_Op_Mode	tag		

Field #	Description	Units	Bytes	FORMAT
	SIRAL Operative Mode		10	10*uc LRM_____ SAR_____ SARIN____ CAL1_LRM__ CAL1_SAR__ CAL1_SARIN CAL2_SAR__ CAL2_SARIN ACQ_____ TRK_SARIN_ TRK_SAR___ CAL4_____
#22	SIR_Configuration	tag		
	SIRAL Rx Configuration		7	7*uc RX_1___ RX_2___ BOTH___ UNKNOWN
Level 1 Surface Statistics				
	Surface_Statistics	tag		
#23	Open_Ocean_Percent	tag		
	Percentage of output L1B records detected on open ocean or semi-enclosed seas	10-2 %	6	%+06d
#24	Close_Sea_Percent	tag		
	Percentage of output L1B records detected on close seas or lakes	10-2 %	6	%+06d
#25	Continent_Ice_Percent	tag		
	Percentage of output L1B records detected on continental ice	10-2 %	6	%+06d
#26	Land_Percent	tag		
	Percentage of output L1B records detected on land	10-2 %	6	%+06d
SIRAL Level 1 Processing information				
	Level_1_Confidence_Data	tag		

Field #	Description	Units	Bytes	FORMAT
#27	L1B_Prod_Status	tag		
	Complete/Incomplete Product Completion Flag (0 or 1). 1 if the product has a duration shorter than the input Level 0		1	uc
#28	L1B_Proc_Flag	tag		
	Processing errors significance flag 1 errors (percentage of errors greater than threshold) 0 no errors		1	uc
#29	L1B_Processing_Quality	tag		
	Percentage of quality checks successfully passed during Level 1B processing (max allowed +10000)	10-2 %	6	%+06d
#30	L1B_Proc_Thresh	tag		
	Minimum acceptable percentage of quality threshold that must be passed during Level 1B processing (max allowed +10000)	10-2 %	6	%+06d
Data Set Descriptors				
	DSDs	tag		
	List_of_DSDs	tag		
	Data_Set_Descriptor	tag		
#31	Data_Set_Name	tag		
	Name of the Data Set		28	uc
#32	Data_Set_Type	tag		
	M for Measurement – R for Reference		1	uc
#33	File_Name	tag		
	Name of the reference file. Field is left empty for Measurement DSD		62	uc
#34	Data_Set_Offset	tag		
	Offset in bytes from the beginning of the DBL file. For reference DSDs the field is set to 0.	bytes	21	%+021d
#35	Data_Set_Size	tag		

Field #	Description	Units	Bytes	FORMAT
	Size in bytes of the Measurement Data Set Record. For reference DSDs the field is set to 0.	bytes	21	%+021d
#36	Num_of_Records	tag		
	Number of Data Set Records. For reference DSDs the field is set to 0.		11	%+011d
#37	Record_Size	tag		
	Record size in bytes. For reference DSDs the field is set to 0.	bytes	11	%+011d
#38	Byte_Order	tag		
	It describes the endianess of the data set 3210 → Big-endian 0123 → Little-endian For Reference DSDs the field is left empty		4	%4c 3210 for CryoSat

Table 2.2.2.2-1: XML Specific Product Header description

2.3 PRODUCT FILES

The Product File structure follows the one defined for the ENVISAT level-0 products as much as possible.

As shown in figure 2.3-1, each product file is composed by:

- Main Product Header (MPH)
- Specific Product Header (SPH)
- Data Sets

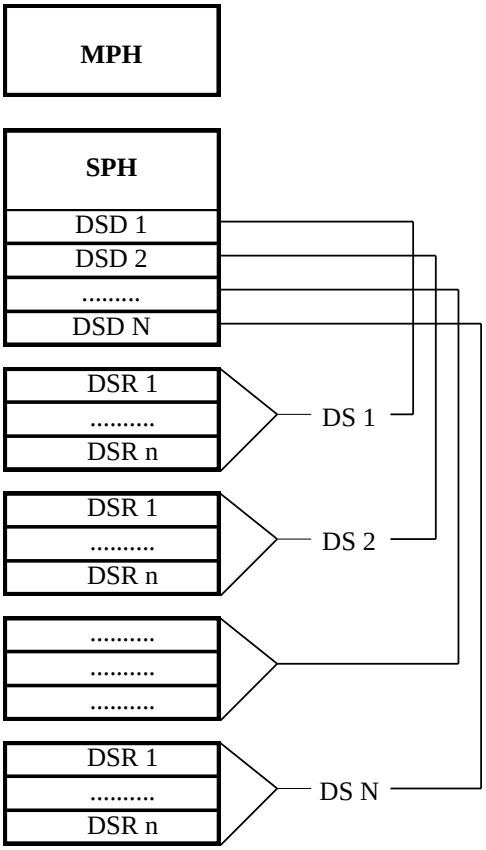


Figure 2.3-1: Generalised Product Structure

The MPH and SPH blocks are ASCII and following the current syntax for any composing field:

FieldName=*value***<units>**

The Data Sets are completely binary and contains one or more Data Set Records each.

All CryoSat Products contain one DS except for CAL1 products that may contain up to two DS (see section 2.3.6).

2.3.1 Main Product Header (MPH)

Field #	Description	Units	Bytes	Format
	Product Identification Info			
#01	**PRODUCT**=	keyword	8	
	quotation mark (")		1	uc
	Product File Name It is left justified with trailer blanks		62	See 3.1
	quotation mark (")		1	uc
	newline character	terminator	1	
#02	**PROC_STAGE**=	keyword	11	11*uc
	Processing stage code: N = Near-Real Time T = Test O = Off Line (Systematic) R = Reprocessing L = Long Term Archive		1	
	newline character	terminator	1	
#03	**REF_DOC**=	keyword	8	8*uc
	quotation mark (")		1	uc
	Reference DFCB Document describing the product		23	23*uc
	quotation mark (")		1	uc
	newline character	terminator	1	
#04	**Spare** (blank characters)		40	40*uc
	newline character	terminator	1	uc
	Data Processing Information			
#05	**ACQUISITION_STATION**=	keyword	20	20*uc
	quotation mark (")		1	uc
	Acquisition Station Name Filled by blanks		20	Kiruna
	quotation mark (")		1	uc
	newline character	terminator	1	
#06	**PROC_CENTER**=	keyword	12	12*uc
	quotation mark (")		1	uc
	Processing Centre		6	PDS or LTA
	quotation mark (")		1	uc
	newline character	terminator	1	

Field #	Description	Units	Bytes	Format
#07	**PROC_TIME**=	keyword	10	10*uc
	quotation mark (")		1	uc
	Processing Time (Product Generation Time)	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	
#08	**SOFTWARE_VER**=	keyword	13	13*uc
	quotation mark (")		1	uc
	Processor name, up to 8 characters, and software version number followed by trailer blanks if any. If not used set to blanks		14	14*uc ProcessorName/VV.rr
	quotation mark (")		1	uc
	newline character	terminator	1	
#09	**Spare** (blank characters)		40	40*uc
	newline character	terminator	1	uc
Information on Time of Data				
#10	**SENSING_START**=	keyword	14	14*uc
	quotation mark (")		1	uc
	UTC start time of data sensing. This is the UTC start time of the Input Level 0 Product. If not used set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	
#11	**SENSING_STOP**=	keyword	13	13*uc
	quotation mark (")		1	uc
	UTC stop time of data sensing. This is the UTC stop time of the Input Level 0 Product. If not used set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	
#12	**Spare** (blank characters)		40	40*uc
	newline character	terminator	1	uc
Orbit Information				
#13	**PHASE**=	keyword	6	6*uc
	Phase Code:		1	

Field #	Description	Units	Bytes	Format
	phase letter or number If not used set to X			
	newline character	terminator	1	uc
#14	**CYCLE**=	keyword	6	6*uc
	Cycle Number (set to +000 if not used)		4	%+04d
	newline character	terminator	1	uc
#15	**REL_ORBIT**=	keyword	10	10*uc
	Relative Orbit Number at sensing start time. If not used set to +00000		6	%+06d
	newline character	terminator	1	uc
#16	**ABS_ORBIT**=	keyword	10	10*uc
	Absolute Orbit Number at sensing start time. If not used set to +00000		6	%+06d
	newline character	terminator	1	uc
#17	**STATE_VECTOR_TIME**=	keyword	18	18*uc
	quotation mark (")		1	uc
	UTC state vector time It is filled properly in case of usage of FOS Predicted Orbit information otherwise it shall be set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	
#18	**DELTA_UT1**=	keyword	10	10*uc
	Universal Time Correction: DUT1 = UT1 – UTC	s	8	%+08.6f
	<s>	units	3	3*uc
	newline character	terminator	1	
#19	**X_POSITION**=	keyword	11	11*uc
	X position in Earth Fixed Reference. If not used set to +0000000.000	m	12	%+012.3f
	<m>	units	3	3*uc
	newline character	terminator	1	
#20	**Y_POSITION**=	keyword	11	11*uc
	Y position in Earth Fixed Reference.	m	12	%+012.3f

Field #	Description	Units	Bytes	Format
	If not used set to +0000000.000			
	<m>	units	3	3*uc
	newline character	terminator	1	
#21	**Z_POSITION**=	keyword	11	11*uc
	Z position in Earth Fixed Reference. If not used set to +0000000.000	m	12	%+012.3f
	<m>	units	3	3*uc
	newline character	terminator	1	
#22	**X_VELOCITY**=	keyword	11	11*uc
	X velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	
#23	**Y_VELOCITY**=	keyword	11	11*uc
	Y velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	
#24	**Z_VELOCITY**=	keyword	11	11*uc
	Z velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	
#25	**VECTOR_SOURCE**=	keyword	14	14*uc
	quotation mark (")		1	uc
	Source of Orbit State Vector Record FP = FOS predicted DN = DORIS Level 0 navigator DP = DORIS precise orbit FR = FOS restituted DI = DORIS preliminary		2	2*uc
	quotation mark (")		1	uc
	newline character	terminator	1	
#26	**Spare** (blank characters)		40	40*uc
	newline character	terminator	1	uc
SBT to UTC conversion Information				

Field #	Description	Units	Bytes	Format
#27	**UTC_SBT_TIME**=	keyword	13	13*uc
	quotation mark (")		1	uc
	Not used and set to 27 blanks		27	$$$$$$$$$$$$$$$$$$$$$$$$$$$
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#28	**SAT_BINARY_TIME**=	keyword	16	16*uc
	Satellite Binary Time Not used for CryoSat and set to zeros		11	+0000000000
	newline character	terminator	1	uc
#29	**CLOCK_STEP** =	keyword	11	11*uc
	Clock Step Not used for CryoSat and set to zeros		11	+0000000000
	<ps>	units	4	4*uc
	newline character	terminator	1	uc
#30	**Spare** (blank characters)		32	32*uc
	newline character	terminator	1	uc
Leap Second Information				
#31	**LEAP_UTC**=	keyword	9	9*uc
	quotation mark (")		1	uc
	UTC Time of the occurrence of the leap second. If a leap second occurred in the product window the field is set by a devoted function in the CFI EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is set to 27 blanks. It corresponds to the time after the Leap Second occurrence (i.e. midnight of the day after the leap second)		27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#32	**LEAP_SIGN**=	keyword	10	10*uc
	Leap second sign If a leap second occurred in the product window the field is set to the expected value by a devoted function in the CFI	s	4	%+04d

Field #	Description	Units	Bytes	Format
	EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is set to +000.			
	newline character	terminator	1	uc
#33	**LEAP_ERR**=	keyword	9	9*uc
	Leap second error flag. This field is always set to 0 considering that CRYOSAT products have true UTC times		1	uc
	newline character	terminator	1	uc
#34	**Spare** (blank characters)		40	40*uc
	newline character	terminator	1	uc
Product Confidence Data Information				
#35	**PRODUCT_ERR**=	keyword	12	12*uc
	Product Error Flag set to 1 if errors have been reported in the product		1	uc
	newline character	terminator	1	uc
Product Size Information				
#36	**TOT_SIZE**=	keyword	9	9*uc
	Total size of the product	bytes	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	Uc
#37	**SPH_SIZE**=	keyword	9	9*uc
	Length of the SPH	bytes	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	Uc
#38	**NUM_DSD**=	keyword	8	8*uc
	Number of Data Set Descriptors, including spares and all other types of DSDs		11	%+011d
	newline character	terminator	1	Uc
#39	**DSD_SIZE**=	keyword	9	9*uc
	Length of each DSD	bytes	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	Uc
#40	**NUM_DATA_SETS**=	keyword	14	14*uc
	Number of attached Data Sets (note that not all the DSDs have a DS attached)		11	%+011d
	newline character	terminator	1	Uc

Field #	Description	Units	Bytes	Format
#41	**CRC**=	keyword	4	4*uc
	Cyclic Redundancy Code computed as overall value of all records of the Measurement Data Set. If not computed it shall be set to -00001		6	%+06d
	newline character	terminator	1	Uc
#42	**Spare** (blank characters)		29	29*uc
	newline character	terminator	1	uc
	TOTAL		**1247**	

Table 2.3.1-1 Product MPH Description

2.3.2 Specific Product Header (SPH)

The Specific Product Header is an ASCII header. A general structure valid for all SIRAL IPF1 products is proposed. The proposed SPH structure is as follows.

Field #	Description	Units	Bytes	Data Type
Product description and identification				
#1	**SPH_DESCRIPTOR=**	keyword	15	15*uc
	quotation mark (")		1	uc
	ASCII string describing the product		28	28*uc Product ID SPECIFIC HEADER See Product ID in table 3-1
	quotation mark (")		1	uc
	newline character	terminator	1	uc
Product Time information				
#2	**START_RECORD_TAI_TIME=**	keyword	22	22*uc
	quotation mark (")		1	uc
	TAI of the first record in the Main MDS of this product	TAI	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#3	**STOP_RECORD_TAI_TIME=**	keyword	21	21*uc
	quotation mark (")		1	uc
	TAI of the last record in the Main MDS of this product	TAI	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
Product Orbit Information				
#4	**ABS_ORBIT_START**=	Keyword	16	16*uc
	Absolute Orbit Number at Product Start Time		6	%06d

Field #	Description	Units	Bytes	Data Type
	Newline character	terminator	1	uc
#5	**REL_TIME_ASC_NODE_START**=	Keyword	24	24*uc
	Relative time since crossing ascending node time relative to start time of data sensing	s	11	%011.6f
	<s>	units	3	3*uc
	Newline character	terminator	1	Uc
#6	**ABS_ORBIT_STOP**=	Keyword	15	15*uc
	Absolute Orbit Number at Product Stop Time		6	%06d
	Newline character	terminator	1	uc
#7	**REL_TIME_ASC_NODE_STOP**=	Keyword	23	23*uc
	Relative time since crossing ascending node time relative to stop time of data sensing	s	11	%011.6f
	<s>	units	3	3*uc
	Newline character	terminator	1	uc
#8	**EQUATOR_CROSS_TIME_UTC**=	Keyword	23	23*uc
	Quotation mark(")		1	uc
	Time of Equator crossing at the ascending node of the sensing start time	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	Quotation mark (")		1	uc
	Newline character	terminator	1	uc
#9	**EQUATOR_CROSS_LONG**=	Keyword	19	19*uc
	Longitude of Equator Crossing at the ascending node of the sensing start time (positive East, 0 = Greenwich) referred to WGS84	s	11	%+011d
	<10-6degE>	units	10	10*uc
	Newline character	terminator	1	uc
#10	**ASCENDING_FLAG**=	Keyword	15	15*uc
	Orbit Orientation at the sensing start time A= Ascending D= Descending		1	uc
	Newline character	terminator	1	uc
Product Location Information				

Field #	Description	Units	Bytes	Data Type
#11	**START_LAT=**	keyword	10	10*uc
	WGS84 latitude of the first record in the Main MDS (positive north)	[10-6 deg]	11	%+011d
	<10-6degN>	units	10	10*uc
	newline character	terminator	1	uc
#12	**START_LONG=**	keyword	11	11*uc
	WGS84 longitude of the first record in the Main MDS (positive East, 0 = Greenwich)	[10-6 deg]	11	%+011d
	<10-6degE>	units	10	10*uc
	newline character	terminator	1	uc
#13	**STOP_LAT=**	keyword	9	9*uc
	WGS84 latitude of the last record in the Main MDS (positive north)	[10-6 deg]	11	%+011d
	<10-6degN>	units	10	10*uc
	newline character	terminator	1	uc
#14	**STOP_LONG=**	keyword	10	10*uc
	WGS84 longitude of the last record in the Main MDS (positive East, 0 = Greenwich)	[10-6 deg]	11	%+011d
	<10-6degE>	units	10	10*uc
	newline character	terminator	1	uc
#15	**Spare (blank characters)**	ascii	50	50*uc
	newline character	terminator	1	uc
Level 0 Quality information				
#16	**L0_PROC_FLAG=**	keyword	13	13*uc
	Processing errors significance flag (1 or 0). 1 if the percentage of SIRAL packets free of processing errors is less than the acceptable threshold		1	uc
	newline character	terminator	1	uc
#17	**L0_PROCESSING_QUALITY=**	keyword	22	22*uc
	Percentage of quality checks successfully passed during the SP processing (max allowed +10000)	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc

Field #	Description	Units	Bytes	Data Type
	newline character	terminator	1	uc
#18	**L0_PROC_THRESH=**	keyword	15	15*uc
	Minimum acceptable percentage of quality threshold that must be passed during SP processing (max allowed +10000)	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#19	**L0_GAPS_FLAG=**	keyword	13	13*uc
	Gaps significance flag (1 or 0). 1 if gaps (either caused by extraction or alignment failures) were detected during the SP processing		1	uc
	newline character	terminator	1	uc
#20	**L0_GAPS_NUM=**	keyword	12	12*uc
	Number of gaps detected during the SP processing (no gaps indicated as +0000000)		8	%+08d
	newline character	terminator	1	uc
#21	**Spare (blank characters)**	ascii	37	37*uc
	newline character	terminator	1	uc

SIRAL Instrument Configuration				
#22	**INSTR_ID=**	keyword	9	9*uc
	quotation mark (")		1	uc
	Instrument identifier		1	1*uc A = SIRAL Nominal B = SIRAL Redundant
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#23	**SIR_OP_MODE=**	keyword	12	12*uc
	quotation mark (")		1	uc

	SIRAL Operative Mode: LRM$$$$$$ SAR$$$$$$ SARIN$$$$$ CAL1_LRM$$ CAL1_SAR$$ CAL1_SARIN CAL2_SAR$$ CAL2_SARIN ACQ$$$$$$$ TRK_SAR$$$ TRK_SARIN$ CAL4$$$$$$ (strings shorter than 10 are filled in with blanks $)		10	10*uc
	quotation mark (")		1	uc
	Newline character	terminator	1	uc
#24	**SIR_CONFIGURATION=**	keyword	18	17*uc
	quotation mark (")		1	uc
	SIRAL Configuration: RX_1$$$ RX_2$$$ BOTH$$$ UNKNOWN (strings shorter than 7 are filled in with blanks)		7	7*uc
	quotation mark (")		1	uc
	Newline character	terminator	1	uc
	Surface ID Statistics			
#25	**OPEN_OCEAN_PERCENT=**	keyword	19	19*uc
	Percentage of records detected on open ocean or semi-enclosed seas	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	Newline character	terminator	1	uc
#26	**CLOSE_SEA_PERCENT=**	keyword	18	18*uc
	Percentage of records detected on close seas or lakes	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	Newline character	terminator	1	Uc
#27	**CONTINENT_ICE_PERCENT=**	keyword	22	22*uc

	Percentage of records detected on continental ice	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	Newline character	terminator	1	Uc
#28	**LAND_PERCENT=**	keyword	13	13*uc
	Percentage of records detected on land	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	Newline character	terminator	1	Uc
#29	**Spare (blank characters)**	ascii	50	50*uc
	newline character	terminator	1	uc
Level 1 Processing information				
#30	**L1B_PROD_STATUS=**	keyword	16	16*uc
	Complete/Incomplete Product Completion Flag (0 or 1). 1 if the Product has a duration shorter than the input Level 0		1	uc
	newline character	terminator	1	uc
#31	**L1B_PROC_FLAG=**	keyword	14	14*uc
	Processing errors significance flag (1 or 0). 1 if the percentage of DSR free of processing errors is less than the acceptable threshold		1	uc
	newline character	terminator	1	uc
#32	**L1B_PROCESSING_QUALITY=**	keyword	23	23*uc
	Percentage of quality checks successfully passed during Level 1B processing (max allowed +10000)	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#33	**L1B_PROC_THRESH=**	keyword	16	16*uc
	Minimum acceptable percentage of quality threshold that must be passed during Level 1B processing (max allowed +10000)	[10-2 %]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#34	**Spare (blank characters)**	ascii	50	50*uc
	newline character	terminator	1	uc
	TOTAL		**1112**	
DSD Section				

Table 2.3.2-1 Product SPH Description

The DSD Section shall actually be divided in two principal sections, Measurement DSD, indicated as DSD (M) and Reference DSD, indicated as DSD (R). The general structure of a DSD is shown in table 2.3.2-2. The size of a DSD is 280 bytes.

#N	*DSD*			
#N.1	**DS_NAME=**	keyword	8	8*uc
	quotation mark		1	uc
	Name describing the Data Set		28	28*uc
	quotation mark		1	uc
	newline character	terminator	1	uc
#N.2	**DS_TYPE=**	keyword	8	8*uc
	Type of Data Set. It can be: M = Measurement R = Reference		1	uc
	newline character	terminator	1	uc
External product reference				
#N.3	**FILENAME=**	keyword	9	9*uc
	quotation mark		1	uc
	Name of the Reference File. Used if DS_TYPE is set to R. It is left justified with trailer blanks. The file name includes the extension. If not used it is set to 62 blanks.		62	62*uc
	quotation mark		1	uc
	newline character	terminator	1	uc
Position and size of DS				
#N.4	**DS_OFFSET=**	keyword	10	10*uc
	Length in bytes of MPH + SPH (including DSDs) + DS size of previous Data Set (if any).	byte	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#N.5	**DS_SIZE=**	keyword	8	8*uc

	Length in bytes of the attached Data Set Used if DS_TYPE is set to M If not used set to 0	byte	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
Number and length of DSRs				
#N.6	**NUM_DSR=**	keyword	8	8*uc
	Number of Data Set Records		11	%+011d
	newline character	terminator	1	uc
#N.7	**DSR_SIZE=**	keyword	9	9*uc
	Length in bytes of the Data Set Record If not used set to +0 If variable set to -1	byte	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#N.8	**Spare**	ascii	32	32*uc
	newline character	terminator	1	uc

Table 2.3.2-2 Generic DSD Description

A variable number of DSDs composes the SPH. Variability in fact depends on the number of auxiliary files and input Level 0 files effectively used to generate the product.

For convenience Measurement DSDs (1 or more) should appear first in the list, followed by all the needed Reference DSDs.

The effective size of the SPH in number of bytes is defined in field #37 SPH_SIZE of the MPH.

The total number of DSDs is defined in field #38 of the MPH.

The number of Measurement DSDs is defined in field #40 of the MPH.

For the Measurement Data Sets the DSD 1 (M) may have the following options for the DS_NAME:

DS_NAME for DSD 1 (M)
SIR_FBR_SAR
SIR_FBR_SARIN
SIR_L1B_SAR
SIR_L1B_SARIN
SIR_L1B_LRM
SIR_L1B_FDM
SIR_CAL1_LRM
SIR_CAL1_SAR
SIR_CAL1_SARIN
SIR_COMPLEX_CAL1_SARIN
SIR_CAL2_SAR
SIR_CAL2_SARIN
SIR_LRM_0M
SIR_SAR_0M
SIR_SIN_0M
SIR_CAL4_0M

Table 2.3.2-3 DS Names for Measurement Data Sets DSD 1

The DSD 2 (M) may have the following options for the DS_NAME:

DS_NAME for DSD 2 (M)
SIR_CAL1_LRM_INTERP_COR
SIR_CAL1_SAR_INTERP_COR
SIR_CAL1_SIN_INTERP_COR

Table 2.3.2-4 DS Names for Measurement Data Sets DSD 2

For the Reference DSDs the possible DS_NAME are hereafter listed. For a given DS_NAME one or more Reference DSDs may be in the final layout of the DSD if more than one file was used to generate the product. Identification of the specific file is possible through the field #N.3 FILENAME.

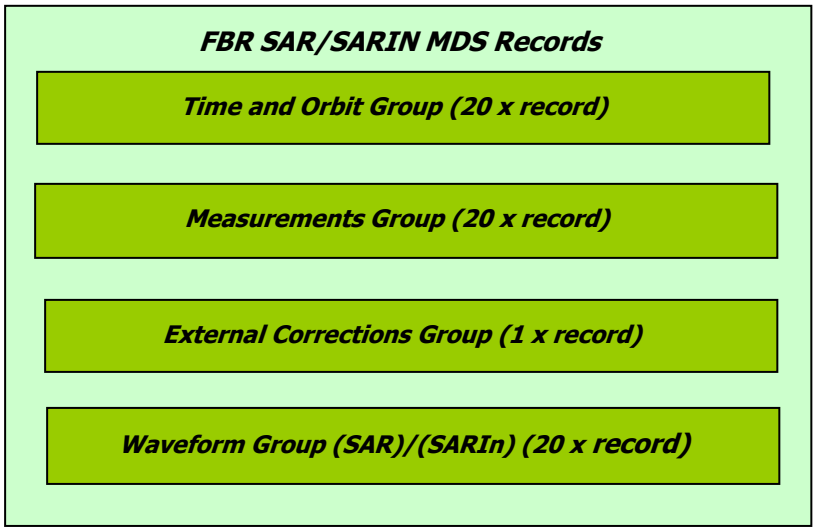
DS_NAME for DSD (R)	
CONSTANTS_FILE	Constants File
PROC_CONFIG_PARAMS_FILE	Processor Configuration Parameters File
SIRAL_LEVEL_0_FILE	SIRAL LEVEL 0 File from which the product was created
SCENARIO_FILE	Orbit Scenario File
ORBIT_FILE	Orbit Data File
STAR_TRACKER_LEVEL_0_FILE	Star Tracker Level 0 File
STAR_TRACKER_ATTREF_FILE	Star Tracker Level 1b File
DORIS_USO_DRIFT_FILE	DORIS USO Drift File
FOS_PLATFORM_DATA_FILE	FOS Platform Data File
FOS_HK_TM_FILE	FOS Sorted HouseKeeping Telemetries File
IPF_RA_DATABASE_FILE	Instrument Characterisation Data File
CALIBRATION_TYPE_1_FILE	File Product containing CAL_1 corrections
CALIBRATION_TYPE_2_FILE	File Product containing CAL_2 corrections
SIR_COMPLEX_CAL1_SARIN	File Product containing Complex CAL1 SARIN corrections
OCEAN_TIDE_FILE	File for Ocean Tide
TIDAL_LOADING_FILE	File for Tidal Loading
EARTH_TIDE_FILE	CartWright File
POLE_TIDE_FILE	Pole Location Data File
SURFACE_TYPE_FILE	Surface Type Map File
S1S2_PRESSURE_00H_MAP	Climatology Pressure Grids for each month at 00 hh.
S1S2_PRESSURE_06H_MAP	Climatology Pressure Grids for each month at 06 hh.
S1S2_PRESSURE_12H_MAP	Climatology Pressure Grids for each month at 12 hh.
S1S2_PRESSURE_18H_MAP	Climatology Pressure Grids for each month at 18 hh.
S1_TIDE_AMPLITUDE_MAP	S1 tide grid of monthly mean of global amplitude
S2_TIDE_AMPLITUDE_MAP	S2 tide grid of monthly mean of global amplitude
S1_TIDE_PHASE_MAP	S1 tide grid of monthly mean of global phase
S2_TIDE_PHASE_MAP	S2 tide grid of monthly mean of global phase
MODIFIED_DIP_MAP_FILE	Modified Dip Map File used for Bent Ionospheric Correction
IONO_COEFFICENTS_FILE	Ionospheric Coefficients file used for Bent Ionospheric Correction
SAI_FILE	Solar Activity Index File used for Bent Ionospheric Correction
GPS_IONO_MAP	GPS Ionospheric Map Data generated by using analysis data
GPS_IONO_MAP_FORECAST	GPS Ionospheric Map Data generated by using forecast data
SURFACE_PRESSURE_FILE	Surface Pressure File for Meteo Correction generated by using analysis data
SURFACE_PRESSURE_FORECAST	Surface Pressure File for Meteo Correction generated by using forecast data
MEAN_PRESSURE_FILE	Mean Pressure File for Meteo Correction generated by using analysis data
MEAN_PRESSURE_FORECAST	Mean Pressure File for Meteo Correction generated by using forecast data
WET_TROPOSHERE_FILE	Wet Troposphere File for Meteo Correction generated by using analysis data
WET_TROPOSHERE_FORECAST	Wet Troposphere File for Meteo Correction generated by using forecast data
AUX_MOG_2D	2D Gravity Wave model for Dynamic Atmospheric Correction generated by using analysis data
AUX_MOG_2D PRELIMINARY	2D Gravity Wave model for Dynamic Atmospheric Correction generated by using forecast data
U_WIND_FILE	U Wind component File for Meteo Correction generated by using

	analysis data
U_WIND_FORECAST	U Wind component File for Meteo Correction generated by using forecast data
V_WIND_FILE	V Wind component File for Meteo Correction generated by using analysis data
V_WIND_FORECAST	V Wind component File for Meteo Correction generated by using forecast data
METEO_GRID_DEF_FILE	Meteo Grid Definition File
BENDING_CORRECTION_FILE	Auxiliary File used to remove the time-varying bias of the mispointing angles

Table 2.3.2-5 DS Names for Reference DSDs

2.3.3 FBR SAR/SARin MDS Record Structure

The structure of this MDS is as follows:



The (SAR) and (SARIn) waveform groups are exclusive one of the other while all the previous groups are in common.

Field	Description	Units	Bytes	Format
Mode - Time and Orbit Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us (see table 2.3.3-2)
4	Source Sequence Counter		2	us (see note 6)
5	Instrument Configuration		4	ul (see table 2.3.3-3)
6	Burst counter (always starts from 1 and incremented at group rate)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	Mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/s	4	sl
11	Satellite velocity vector[3] (in ITRF)	mm/s	3*4	sl
12	Real beam direction vector[3] (in CRF)	μm	3*4	sl
13	Interferometer baseline vector[3] (in CRF)	μm	3*4	sl
14	FBR Measurement Confidence Data (flag word)		4	ul (see table 2.3.3-4)
Measurements Group				
15	Window Delay (2way) uncorrected for instrument delays	10-12 s	8	sll
16	H0 Initial Height Word	48.8 ps	4	sl (see note 2)
17	COR2 Height Rate	3.05 ps/rc	4	sl (see note 2)
18	Coarse Range Word LAI	12.5 ns	4	sl (see note 2)
19	Fine Range Word FAI	12.5/256 ns	4	sl (see note 2)
20	AGC_1 (not corrected)	dB/100	4	sl (see note 3)
21	AGC_2 (not corrected)	dB/100	4	sl (see note 3)
22	Total Fixed Gain Rx 1	dB/100	4	sl (see note 3)
23	Total Fixed Gain Rx 2	dB/100	4	sl (see note 3)
24	Transmit Power	Micro-Watts	4	sl
25	Doppler range correction (Radial component)	Mm	4	sl
26	Instrument Range Correction tx-rx antenna (from CAL1)	Mm	4	sl
27	Instrument Range Correction	Mm	4	sl

Field	Description	Units	Bytes	Format
	rx only antenna (from CAL1)			
28	Instrument Gain correction, tx-rx antenna (from CAL1)	dB/100	4	sl (see note 3)
29	Instrument Gain correction rx only antenna (from CAL1)	dB/100	4	sl (see note 3)
30	Internal Phase Correction	Microradians	4	sl
31	External Phase Correction	Microradians	4	sl
32	Noise power measurement	dB/100	4	sl (see note 3)
33	Phase Slope Correction	Microradians	4	sl
34	Spares		4*1	uc
Corrections Group				
35	Dry Tropospheric Correction	Mm	4	sl
36	Wet Tropospheric Correction	Mm	4	sl
37	Inverse Barometric Correction	Mm	4	sl
38	Dynamic Atmospheric Correction	Mm	4	sl
39	GIM Ionospheric Correction	Mm	4	sl
40	Model Ionospheric Correction	Mm	4	sl
41	Elastic Ocean Tide	Mm	4	sl
42	Long Period Ocean Tide	Mm	4	sl
43	Ocean Loading Tide	Mm	4	sl
44	Solid Earth Tide	Mm	4	sl
45	Geocentric Polar Tide	Mm	4	sl
46	Surface type flag	-	4	ul
47	Spare	-	4*1	uc
48	Correction status flags		4	ul (see table 2.3.3-5)
49	Correction error flags		4	ul (see table 2.3.3-6)
50	Spare		4*1	uc
		Sub-Total Size	3424 bytes	

Waveform group (SAR)				
51	Complex Echo Waveform[64,128,2]		64*128*2	sc (see note 5)
52	Number of pulses in burst		2	us
53	Flag		2	us
	Sub-Total Size		327760 bytes	
	Total Record Size		331184 bytes	

Waveform group (SARin)				
54	Complex Echo Waveform[64,512,2] antenna 1 (Tx-Rx)		64*512*2	sc (see note 5)
55	Complex Echo Waveform[64,512,2] antenna 2 (Rx only)		64*512*2	sc (see note 5)
56	Number of pulses in burst		2	us
57	Flag		2	us
	Sub-Total Size		2621520 bytes	
	Total Record Size		2624944 bytes	

Table2.3.3-1: FBR MDS Records

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) These are exotic units specific of SIRAL instrument.

3) This is an exotic unit used for db-units related fields.

5) Complex echo samples are packed in bytes for both SAR and SARIN, The "Q" byte is followed by the "I" byte.

6) The field Source Sequence Counter is copied in from the telemetry stream (ECHO-SAR L0 telemetry stream for the FBR SAR product; ECHO-SARIN L0 telemetry stream for the FBR SARIN). This field of the product contains the Source Sequence Counter value of the first AISP of a group.

– Fields Descriptions:

Field 1) MDSR Time Stamp - corresponding to ground bounce time of the individual pulse.

Field 2) this field is computed as [USO Correction factor -1]
being the USO correction factor defined as the ratio between the nominal and the modelled value:
USO_Corr_Factor = USO_freq_nominal / (USO_freq_nominal + model_freq_deviation)
where USO_freq_nominal is the nominal frequency provided in the IPF database , and
model_freq_deviation is the modelled frequency deviation provided by the DORIS USO drift file.
The user can apply it to the window delay as follows :
*L1B_window_delay_corrected = L1B_window_delay * (field#2*10^-15 + 1)*
.

Field 3) Mode ID - (us giving 16 bits) Identifies the SIRAL instrument measurement mode. See Table 2.3.3-2:

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Instrument Operative Mode	15-10	0-5	1 = LRM 2 = SAR 3 = SARIN 11 = CAL1-LRM 12 = CAL1-SAR 13 = CAL1-SARIN 22 = CAL2-SAR 23 = CAL2-SARIN
2.	SARIn Degraded Case	9	6	0 : Nominal SARIN Scenario 1: Contingency SARIN Scenario (1 Rx chain missing)
3.	Reserved	8	7	Set to zero
4.	CAL4 Flag	7	8	1 if CAL4 packets detected
5	Platform Attitude Control	6-5	9-10	0 = Unknown 1 = Local Normal Pointing 2 = Yaw Steering
6.	Reserved	4-0	11-15	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.3-2: Mode_ID

Field 4) Source Sequence Counter - read from the L0 echo telemetry packet (of the master channel in the case of SARin). This is a 16384 cyclic modulo counter, starting from 0, incrementing by 1. A separate counter is maintained for each instrument mode.

Field 5) Instrument Configuration flag - this is derived from flags in the L0 packets for tracking and the echo telemetry. See Table **2.3.3-3**:

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Rx chain in use	31-30	0-1	1 = Rx1 2 = Rx2 3 = Both 0 = Unknown
2.	SIRAL_Identifier	29	2	0 = Nominal 1 = Redundant
3.	Reserved	28	3	Set to zero
4.	Bandwidth	27-26	4-5	1 = 320 Mhz 2 = 40 Mhz 0 = Unknown
5.	Reserved	25-24	6-7	Set to zero
6.	Tracking Mode	23-22	8-9	1 = LRM 2 = SAR 3 = SARIN 0 = Unknown
7.	External Calibration	21	10	0 = no 1 = External Calibration
8.	Reserved	20	11	Set to zero
9.	Loop Status	19	12	0 = closed loop 1 = open loop
10.	Loss of Echo (from Cycle Report)	18	13	0 = OK 1 = Loss of Echo
11.	Real Time Error (from Cycle Report)	17	14	0 = OK 1 = Real Time Computation Error
12.	Echo Saturation Error (from Cycle Report)	16	15	0 = OK 1 = Echo Saturation Error
13.	Rx Band Attenuation	15	16	0 = not applied 1 = applied
14.	Cycle Report General Error	14	17	0 = Cycle Report is 0 1 = Cycle Report is not 0

ID	Definition	Bit (*)	Bit (**)	Setting
15.	Reserved	13	18	Set to 0
16.	Reserved	12	19	Set to 0
17.	Reserved	11	20	Set to 0
18	STR_ATTREF Star Tracker data used	10	21	Set to 1 if STR_ATTREF is used
19.	Reserved	9-0	22-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]

(**) Space Segment bit numbering standard

Table 2.3.3-3: Instrument Configuration

Field 6) High-rate block counter - increment from 1 for each data block. Hence the first full MDS record contain the numbers 1-20, the second 21-40, etc.

Field 7) Latitude of measurement - corresponding to the MDSR Time Stamp.

Field 8) Longitude of measurement - corresponding to the MDSR Time Stamp.

Field 9) Altitude - altitude of the satellite CoM above reference ellipsoid corresponding to the MDSR Time Stamp.

Field 10) Altitude rate - corresponding to the MDSR Time Stamp.

Field 11) Satellite velocity vector described in the International Terrestrial Reference Frame in the International Earth Fixed System. From Orbit CFI call. This is not a unit vector as the velocity magnitude is also required.

Field 12) Real beam direction vector described in the CryoSat Reference Frame. This is a unit vector and units are micro-metres.

Field 13. Interferometric baseline vector described in the CryoSat Reference Frame. This is a unit vector and units are micro-metres.

Field 14. FBR MCD - Measurement confidence flags. Generally the MCD flags indicate problems when set. If the whole MCD is 0 then no problems or non-nominal conditions were detected. Serious errors (highlighted in the table) are indicated by setting bit 31 (SS bit 0). In which case the block must not be processed. Other error settings can be regarded as warnings. See table 2.3.3-4:

ID	Definition	Bit (*)	Bit (**)	Setting
1.	**Block Degraded**	31	0	0 = OK 1 = Degraded (set if the block should not be processed – indicated by **bold** typeface)
2.	**Blank Block**	30	1	0 = OK 1 = Blank Block inserted for record padding
3.	**Datation Degraded**	29	2	0 = OK 1 = Datation is bad or not set
4.	Orbit Propagation Error	28	3	0 = OK 1 = Error (returned by CFI or independent check)
5.	Orbit File Change	27	4	0 = OK 1 = Orbit file has changed wrt previous record
6.	Orbit Discontinuity	26	5	0 = OK 1 = discontinuity (e.g. gap)
7.	Echo Saturation (from Cycle Report)	25	6	0 = OK 1 = Saturated
8.	Other Echo Error	24	7	0 = OK 1 = Echo Error (bit fields Tracking Echo Error or Echo Rx1 Error or Echo Rx2 Error set to 1)
9.	Rx 1 Channel Error for SARIN	23	8	0 = OK 1 = degraded or missing
10.	Rx 2 Channel error for SARIN	22	9	0 = OK 1 = degraded or missing
11.	**Window Delay Inconsistency**	21	10	0 = OK (value is in range) 1 = value out of range or computation error
12.	**AGC Inconsistency**	20	11	0 = OK (value is in range) 1 = value out of range or computation error
13.	CAL1 Correction Missing	19	12	0 = correction applied 1 = correction not applied
14.	CAL1 Correction from IPF DB	18	13	0 = correction from CAL1 Product used 1 = correction from IPF DB used
15.	DORIS USO Correction	17	14	0 = USO Correction Factor is

ID	Definition	Bit (*)	Bit (**)	Setting
				available 1 = USO Correction Factor is not available
16.	Complex CAL1 Correction from IPF DB	16	15	0 = correction from Complex CAL1 Product used 1 = correction from IPF DB used
17.	TRK Echo Error	15	16	0 = OK 1 = empty (or null) tracking echo
18.	Echo Rx 1 Error	14	17	0 = OK 1 = empty (or null) raw echo
19.	Echo Rx2 Error	13	18	0 = OK 1 = empty (or null) raw echo
20.	NPM Inconsistency	12	19	0 = OK 1 = value out of range or computation error
21	Reserved	11-4	20-27	Set to zero
22.	Attitude Correction Missing	3	28	0 = OK, attitude correction applied 1 = missing, correction not applied.
23.	CAL 1 Correction Type	2	29	0 = Peak Power used for CAL 1 correction 1= Integrated Power used for CAL1 correction
24	Reserved	1-0	30-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]

(**) Space Segment bit numbering standard

Table 2.3.3-4: FBR Measurement Confidence Data

Field 15) Window delay from the telemetry converted to physical units. This is a 2-way measurement: the time taken for the radar pulse to travel to the surface and back.

Field 16) H0 - from telemetry

Field 17) COR2 - on-board tracker height rate over the radar cycle

Field 18) Coarse range word LAI - derived from telemetry

Field 19) Fine range word FAI - derived from telemetry

Field 20) AGC1 - First AGC stage setting (applies to both receive channels) from telemetry. The value is commanded on board, from the tracker loop in normal operation. Gain calibration corrections are not applied. Note: the value is always an integer number of dB but units of dB/100 are used to be consistent.

Field 21) AGC2 - Second AGC stage setting (applies to both receive channels) from telemetry

Field 22) Total Fixed Gain On Channel 1 - total fixed instrument gain applied on chain 1, this is the gain applied by the RF unit. See [R21] for details.

Field 23) Total Fixed Gain On Channel 2 - instrument fixed gain on receive chain 2 (as for chain 1)

Field 24) Transmit power in micro Watts.

Field 25) Doppler range correction computed for the component of satellite velocity in the nadir direction.

Field 26) Instrument Range Correction (Tx-Rx chain) - Calibration correction to range on channel 1 computed from CAL1. (CAL1-LRM, CAL1-SAR and CAL1-SARin)

Field 27) Instrument Range Correction (Rx only chain) - Calibration correction to range on channel 2 computed from CAL1. (CAL1-LRM, CAL1-SAR and CAL1-SARin)

Field 28) Instrument Gain Correction (Tx-Rx chain) - Calibration correction to gain on channel 1 computed from CAL1. (Sometimes referred to as 'Sigma0 correction')

Field 29) Instrument Gain Correction (Rx only chain) - Calibration correction to gain on channel 2 computed from CAL1.

Field 30) Internal phase correction. - set to zero due to no availability of correction until specialized FBR-L1B processing

Field 31) External phase correction. - set to zero since correction has no meaning at FBR level

Field 32) Noise power measurement - converted from telemetry units to be the noise floor of FBR measurement echoes. This field is set to the default value equal to -9999.99 when the telemetry contains zero.

Field 33) Phase Slope Correction – set to zero since correction has no meaning at FBR level

Field 34) measurement spares - reserved for future use.

Field 35) Dry Tropospheric Correction - added to range measurement to correct for the propagation delay to the radar pulse, caused by the dry-gas component of the Earth's atmosphere.

Field 36) Wet Tropospheric Correction - added to range measurement to correct for the propagation delay to the radar pulse, caused by the H2O component of the Earth's atmosphere.

Field 37) Inverse Barometric Correction - added to range measurement to correct for the depression of the ocean surface caused by the local barometric pressure.

Field 38) Dynamic Atmospheric Correction (DAC, from MOG2D model) added to the range measurement to correct both the Inverse Barometric effect and the high-frequency ocean response to wind forcing. Only one of inverse barometric correction and DAC are used, as they are alternatives.

Field 39) GIM Ionospheric Correction - added to range measurement to correct for the delay to the Radar pulse caused by free electrons in the ionosphere. Computed from GPS ionospheric data.

Field 40) Model Ionospheric Correction - added to range measurement to correct for the delay to the Radar pulse caused by free electrons in the ionosphere. Computed from an ionospheric model.

Field 41) Elastic Ocean Tide - to be added to the range to remove the total effect of ocean tides. Set to 32767 in case of error.

Field 42) Long Period Ocean Tide - to be added to range measurement in order to remove the effect of the oceanic response to the single tidal forcing. Set to 32767 in case of error.

Field 43) Ocean Loading Tide – to be added to be added to the range measurement in order to remove the effect of local distortion to the Earth crust caused by increasing weight of ocean as local water tide rises. Set to 32767 in case of error.

Field 44) Solid Earth Tide - added to the range to remove the effect of local tidal distortion in the Earth's crust.

Field 45) Geocentric Polar Tide - added to the range to remove the effect of movement of the Earth's rotational axis w.r.t. geographic location.

Field 46) Surface type flag - enumerated key to classify surface at nadir:

0 = Open Ocean
1 = Closed Sea
2 = Continental Ice
3 = Land

Field 47) Correction spares - reserved for future use.

Field 48) Correction status flag - used to show which correction algorithms have been called, see Table 2.3.3-5.

Field 49) Correction error flag - used to show if a correction algorithms returned an error when called, see Table 2.3.3-6.

Field 50) Correction spares - reserved for future use.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Dry Tropospheric Correction Called	31	0	0 = no, 1 = yes
2.	Wet Tropospheric Correction Called	30	1	0 = no, 1 = yes
3.	Inverse Barometric Correction Called	29	2	0 = no, 1 = yes
4.	Dynamic Atmospheric Correction Called	28	3	0 = no, 1 = yes
5.	GIM Ionospheric Correction Called	27	4	0 = no, 1 = yes
6.	Model Ionospheric Correction Called	26	5	0 = no, 1 = yes
7.	Ocean Equilibrium Tide Called	25	6	0 = no, 1 = yes
8.	Ocean Long Period Tide Called	24	7	0 = no, 1 = yes
9.	Ocean Loading Tide Called	23	8	0 = no, 1 = yes
10.	Solid Earth Tide Called	22	9	0 = no, 1 = yes
11.	Geocentric Polar Tide Called	21	10	0 = no, 1 = yes
12.	Surface type flag Called	20	11	0 = no, 1 = yes
13.	reserved	19-0	10-31	set to 0

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.3-5: Correction status flags

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Dry Tropospheric Correction Error	31	0	0 = OK, 1 = error
2.	Wet Tropospheric Correction Error	30	1	0 = OK, 1 = error
3.	Inverse Barometric Correction Error	29	2	0 = OK, 1 = error
4.	Dynamic Atmospheric Correction Error	28	3	0 = OK, 1 = error
5.	GIM Ionospheric Correction Error	27	4	0 = OK, 1 = error
6.	Model Ionospheric Correction Error	26	5	0 = OK, 1 = error
7.	Ocean Equilibrium Tide Error	25	6	0 = OK, 1 = error
8.	Ocean Long Period Tide Error	24	7	0 = OK, 1 = error
9.	Ocean Loading Tide Error	23	8	0 = OK, 1 = error
10.	Solid Earth Tide Error	22	9	0 = OK, 1 = error
11.	Geocentric Polar Tide Error	21	10	0 = OK, 1 = error
12.	Surface type flag Error	20	11	0 = OK, 1 = error
13.	reserved	19-0	12-31	set to 0

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.3-6: Correction error flags

- Waveform Group for SAR Mode

Field 51) Complex Echo Waveform - Array of 64 echoes * 128 bins * 2 for I & Q samples. These are stored as signed characters, as they are in the telemetry.

Field 52) Number of echoes in burst - normally 64. If lower some of the echoes in field 51 are filled with zeroes.

Field 53) Flags for errors or information about echoes. Currently not used – Reserved for future use.

- Waveform Group for SARin Mode

Field 54) Complex Echo Waveform antenna 1- Array of 64 echoes * 512 bins * 2 for I & Q samples. These are stored as signed characters, as they are in the telemetry.

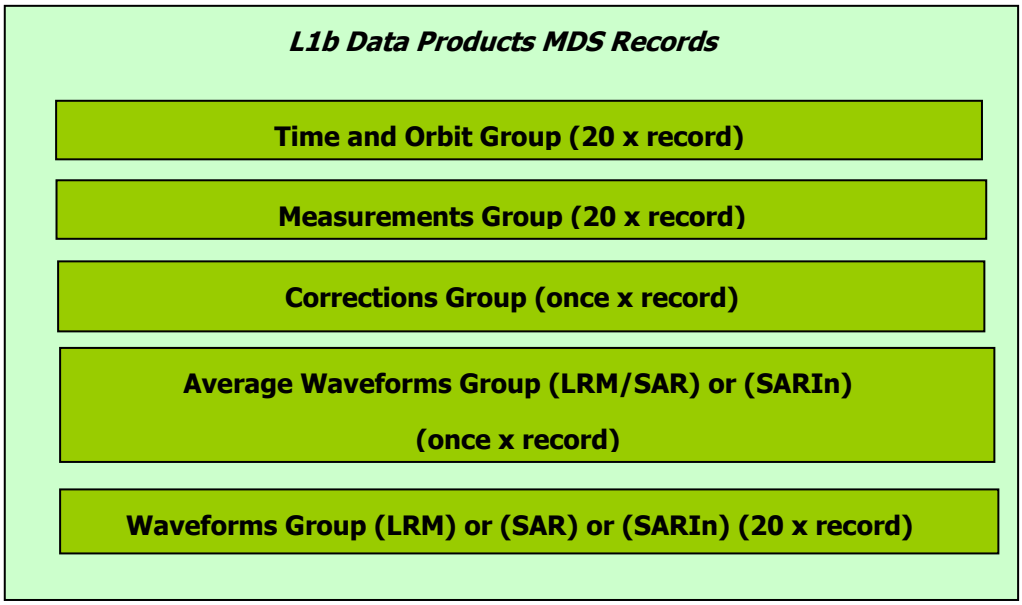
Field 55) Complex Echo Waveform antenna 2- Array of 64 echoes * 512 bins * 2 for I & Q samples. These are stored as signed characters, as they are in the telemetry.

Field 56) Number of echoes in burst - normally 64. If less some of the echoes in fields 54 and 55 are filled with zeroes.

Field 57) Flags for errors or information about echoes. Currently not used – Reserved for future use.

2.3.4 L1B LRM(FDM[1])/SAR/SARin Data Products MDS Record Structure

This MDS is composed of:



The L1B MDS has actually three variations depending on the Mode. The data record is arranged so that the first part is common to all modes. Time and Orbit Group and Measurements Group are in blocks of 20 per record. Corrections are made available once per record. The common part is then followed by:

- a 1 Hz averaged waveform
- a set of 20 Waveforms

Waveforms are mode dependent and thus specific layouts are defined.

[1] Fast Delivery Marine Mode (FDM) product is produced from LRM mode data only and is processed as soon as possible after acquisition. The FBR and L1B FDM products have the same record structure as LRM.

Field	Description	Units	Bytes	Format
Time and Orbit Group (structure repeated 20 times per record)				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID	-	2	us (see table 2.3.3-2)
4	Source Sequence Counter (only for LRM – Spare in SAR & SARIN)		2	us
5	Instrument Configuration		4	ul (see table 2.3.3-3)
6	Burst counter (surface sample counter) (always starts from 1 and incremented at group rate)	-	4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	Satellite velocity vector[3] (in ITRF)	mm/s	3*4	sl
12	Real beam direction vector[3] (in CRF)	μm	3*4	sl
13	Interferometer baseline vector[3] (in CRF)	μm	3*4	sl
14	Star Tracker Usage	–	2	us
15	Antenna Bench Roll Angle	10^{-1} μdeg	4	sl (see note 4)
16	Antenna Bench Pitch Angle	10^{-1} μdeg	4	sl (see note 4)
17	Antenna Bench Yaw Angle	10^{-1} μdeg	4	sl (see note 4)
18	Level 1b Measurement Confidence Data (flag word)	-	4	ul (see table 2.3.4-2)
19	Spares	-	4*1	uc
Measurements Group (structure repeated 20 times per record)				
20	Window Delay (2way) corrected for instrument delays	10-12 s	8	sll
21	H0 Initial Height Word	48.8 ps	4	sl (see note 2)
22	COR2 Height Rate	3.05 ps/rc	4	sl (see note 2)
23	Coarse Range word LAI	12.5 ns	4	sl (see note 2)
24	Fine Range word FAI	12.5/256 ns	4	sl (see note 2)
25	AGC Channel 1 (corrected)	dB/100	4	sl (see note 3)
26	AGC Channel 2 (corrected)	dB/100	4	sl (see note 3)
27	Total Fixed Gain Rx 1	dB/100	4	sl (see note 3)
28	Total Fixed Gain Rx 2	dB/100	4	sl (see note 3)
29	Transmit Power	Micro-Watts	4	sl
30	Doppler range correction (Radial	mm	4	sl

Field	Description	Units	Bytes	Format
	component)			
31	Instrument Range Correction tx-rx antenna	mm	4	sl
23	Instrument Range Correction rx only antenna	mm	4	sl
33	Instrument Gain correction tx-rx antenna	dB/100	4	sl (see note 3)
34	Instrument Gain correction rx only antenna	dB/100	4	sl (see note 3)
35	Internal Phase Correction	Microradians	4	sl
36	External Phase Correction	Microradians	4	sl
37	Noise power measurement	dB/100	4	sl (see note 3)
38	Phase Slope Correction	Microradians	4	sl
39	Spares		4*1	uc
Corrections Group (once per record)				
40	Dry Tropospheric Correction	mm	4	sl
41	Wet Tropospheric Correction	mm	4	sl
42	Inverse Barometric Correction	mm	4	sl
43	Dynamic Atmospheric Correction	mm	4	sl
44	GIM Ionospheric Correction	mm	4	sl
45	Model Ionospheric Correction	mm	4	sl
46	Elastic Ocean Tide	mm	4	sl
47	Long Period Ocean Tide	mm	4	sl
48	Ocean Loading Tide	mm	4	sl
49	Solid Earth Tide	mm	4	sl
50	Geocentric Polar Tide	mm	4	sl
51	Surface type flag	-	4	ul
52	Spare	-	4*1	uc
53	Correction status flags	-	4	ul (see Table 2.3.3-5)
54	Correction error flags	-	4	ul (see Table 2.3.3-6)
55	Spare		4*1	uc
	Sub-Total Size		3784 bytes	

Field	Descriptor	Unit	Bytes	Format
Average Waveform group: LRM/SAR (once per record)				
56	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
57	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
58	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
59	Altitude of COG above reference ellipsoid	mm	4	sl

Field	Descriptor	Unit	Bytes	Format
	(interpolated value)			
60	Window Delay (2way) corrected for instrument delays	10-12 s	8	sll
61	1 Hz Averaged Power Echo Waveform[128]	Scaled	128*2	us
62	Echo Scale Factor (to scale echo to watts)	-	4	sl
63	Echo Scale Power (a power of 2)		4	sl
64	Number of echoes averaged	-	2	us
65	Flags	-	2	us (see Table 2.3.4-3a for LRM and Table 2.3.4-3b for SAR)
	Sub-Total Size		300 bytes	

Field	Descriptor	Unit	Bytes	Format
Average Waveform group: SARIN (once per record)				
66	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
67	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
68	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
69	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
70	Window Delay (2way) corrected for instrument delays	10-12 s	8	sll
71	1 Hz Averaged Power Echo Waveform[512]	Scaled	512*2	us
72	Echo Scale Factor (to scale echo to watts)	-	4	sl
73	Echo Scale Power (a power of 2)		4	sl
74	Number of echoes averaged	-	2	us
75	Flags	-	2	us (see Table 2.3.4-3b)
	Sub-Total Size		1068 bytes	

Field	Descriptor	Unit	Bytes	Format
Waveform group: LRM (structure repeated 20 times per record)				
76	Averaged Power Echo Waveform [128]	Scaled	128*2	us
77	Echo Scale Factor (to scale echo to watts)	-	4	sl
78	Echo Scale Power (a power of 2)		4	sl

Field	Descriptor	Unit	Bytes	Format
79	Number of echoes averaged	-	2	us
80	Flags	-	2	us (see table 2.3.4-4a)
	Sub-Total Size		5360 bytes	
	Total Record Size		**9444bytes**	

Field	Descriptor	Unit	Bytes	Format
Waveform group: SAR (structure repeated 20 times per record)				
81	Averaged Power Echo Waveform [256]	Scaled	256*2	us
82	Echo Scale Factor (to scale echo to watts)	-	4	sl
83	Echo Scale Power (a power of 2)		4	sl
84	Number of echoes averaged	-	2	us
85	Flags	-	2	us (see Table 2.3.4-4b)
86	Beam behaviour parameter	-	100	(see table 2.3.4-5)
	Sub-Total Size		12480 bytes	
	Total Record Size		**16564 bytes**	

Field	Descriptor	Unit	Bytes	Format
Waveform group (SARin) (Structure repeated 20 times per record)				
87	Averaged Power Echo Waveform [1024]	Scaled	1024*2	us
88	Echo Scale Factor (to scale echo to watts)	-	4	sl
89	Echo Scale Power (a power of 2)		4	sl
90	Number of echoes averaged	-	2	us
91	Flags	-	2	us (see Table 2.3.4-4b)
92	Beam behaviour parameter		100	(see table 2.3.4-5)
93	Coherence [1024]	1/1000	1024*2	us
94	Phase difference [1024]	microrad	1024*4	sl

Field	Descriptor	Unit	Bytes	Format
	Sub-Total Size		166080 bytes	
	Total Record Size		**170932 bytes**	

Table 2.3.4-1: L1B Data Products MDS Records

Notes:

Note 1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

Note 2) These are exotic units specific of SIRAL instrument.

Note 3) This is an exotic unit used for dB-units related fields.

Note 4) this is an exotic unit exclusively used at binary record level to improve resolution of these angles

Field 1) MDSR Time Stamp - corresponding to ground bounce time of the individual pulse, or middle of group of pulses for LRM.

Field 2) this field is defined as [USO Correction factor -1]
being the USO correction factor defined as the ratio between the nominal and the modelled value:
USO_Corr_Factor = USO_freq_nominal / (USO_freq_nominal + model_freq_deviation)
where USO_freq_nominal is the nominal frequency provided in the IPF database , and
model_freq_deviation is the modelled frequency deviation provided by the DORIS USO drift file.
The user can apply it to the window delay as follows :
*L1B_window_delay_corrected = L1B_window_delay * (field#2*10^-15 + 1)*

Field 3) Mode ID - Identifies the SIRAL instrument measurement mode. See table 2.3.3-2

Field 4) Source Sequence Counter read from the L0 echo telemetry packet (of the master channel in the case of SARin). This is a 16384 cyclic modulo counter, starting from 0, incrementing by 1. A separate counter is maintained for each instrument mode.

Field 5) Instrument Configuration flag - This is derived from flags in the L0 packets for tracking and the echo. See table 2.3.3-3.

Field 6) Record counter – progressive counter incremented by 1 for each data block. Hence the first full MDS record contains the numbers 1-20, the second 21-40, etc.

Field 7) Latitude of measurement corresponding to the MDSR Time Stamp.

Field 8) Longitude of measurement corresponding to the MDSR Time Stamp.

Field 9) Altitude of the Satellite CoM above reference ellipsoid corresponding to the MDSR Time Stamp.

Field 10) Altitude rate corresponding to the MDSR Time Stamp.

Field 11) Satellite velocity vector in International Terrestrial Reference Frame in the International Earth Fixed System.

Field 12) Real beam direction vector described in the CryoSat Reference Frame. Unit vector in micro-metres.

Field 13) Interferometric baseline vector in CryoSat Reference Frame. Unit vector in micro-metres.

Field 14) The following mode dependent values are valid Star Tracker Usage:

- LRM/SAR/SARin
  - 0 : No Star Tracker data used for product generation and attitude initialisation done by using default values from the IPFDB
  - 4: Star Tracker data used for product generation and these data are the same used by the satellite through its AOCS (Attitude Orbit Control System).
- FDM
  - 0 : No Star Tracker data used for product generation and attitude initialisation done by using default values from the IPFDB
  - 1 : Data of Star Tracker 1 used for product generation
  - 2 : Data of Star Tracker 2 used for product generation
  - 3 : Data of Star Tracker 3 used for product generation

Field 15) Antenna Bench Roll Angle corresponding to the MDSR Time Stamp.

Field 16) Antenna Bench Pitch Angle corresponding to the MDSR Time Stamp

Field 17) Antenna Bench Yaw Angle corresponding to the MDSR Time Stamp

Field 18) L1B MCD - Measurement confidence flags. Generally the MCD flags indicate problems when set. If the whole MCD is 0 then no problems or non-nominal conditions were detected. Serious errors are indicated by setting bit 31 (SS bit 0), in which case the block must not be processed. Other error settings can be regarded as warnings. See table 2.3.4-2:

•

ID	Definition	Bit (*)	Bit (**)	Setting
1.	**Block Degraded**	31	0	0 = OK 1 = Degraded (set if the block should not be processed – indicated by **bold** typeface)
2.	**Blank Block**	30	1	0 = OK 1 = Blank Block inserted for record padding
3.	**Datation Degraded**	29	2	0 = OK 1 = Datation is bad or not set
4.	**Orbit Propagation Error**	28	3	0 = OK 1 = Error (returned by CFI or independent check)
5.	Orbit File Change	27	4	0 = OK 1 = Orbit file has changed wrt previous record
6.	Orbit Discontinuity	26	5	0 = OK 1 = discontinuity (e.g. gap)
7.	Echo Saturation (from Cycle Report)	25	6	0 = OK 1 = Saturated
8.	Other Echo Error	24	7	0 = OK 1 = Echo Error (bit fields Tracking Echo Error or Echo Rx1 Error or Echo Rx2 Error set to 1)
9.	Rx 1 Channel Error for SARIN	23	8	0 = OK 1 = degraded or missing
10.	Rx 2 Channel error for SARIN	22	9	0 = OK 1 = degraded or missing
11.	**Window Delay Inconsistency**	21	10	0 = OK (value is in range) 1 = value out of range or computation error
12.	**AGC Inconsistency**	20	11	0 = OK (value is in range) 1 = value out of range or computation error
13.	CAL1 Correction Missing	19	12	0 = correction applied 1 = correction not applied
14.	CAL1 Correction from IPF DB	18	13	0 = correction from CAL1 product used 1 = correction from IPF DB used
15.	DORIS USO Correction	17	14	0 = USO Correction Factor is available 1 = USO Correction Factor is not available
16.	complex CAL1 Correction from IPF DB	16	15	0 = correction from Complex CAL1

ID	Definition	Bit (*)	Bit (**)	Setting
				Product used 1 = correction from IPF DB used
17.	TRK Echo Error	15	16	0 = OK 1 = empty (or null) tracking echo
18.	Echo Rx 1 Error	14	17	0 = OK 1 = empty (or null) raw echo
19.	Echo Rx2 Error	13	18	0 = OK 1 = empty (or null) raw echo
20.	NPM Inconsistency	12	19	0 = OK 1 = value out of range or computation error
21	CAL 1 Correction Type	11	20	0 = Peak Power used for CAL 1 correction 1= Integrated Power used for CAL1 correction
22	Reserved	10	21	Set to 0
23	Reserved	9	22	Set to 0
24	Reserved	8	23	Set to 0
25.	Phase Perturbation Correction application	7	24	0 = applied 1 = not applied
26.	CAL2 Correction Missing	6	25	0 = correction applied 1 = correction not applied
27.	CAL2 Correction from IPF DB	5	26	0 = correction from CAL2 product used 1 = correction from IPF DB used
28.	**Power Scaling Error (for LRM/FDM only)**	4	27	0 = OK (echo has been power scaled) 1 = Error in scaling (L1B waveform is null) Used only for LRM L1B and FDM L1B
29.	Attitude Correction Missing	3	28	0 = OK, Correction Applied 1 = Not Corrected
30.	Reserved	2	29	Set to 0
31.	reserved	1	30	Set to 0
32.	Phase Perturbation Correction mode	0	31	0 = computed by CCAL1 1 = default from IPF DB used (applicable only to SARin data)

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.4-2: L1B Measurement Confidence Data

Field 19) Correction spares - reserved for future use.

Field 20) Window delay from the telemetry converted to physical units. Note that this is still a 2-way time, and so 2-way corrections are applied. COM offset is applied and Calibration correction from CAL1 is applied. Units are pico seconds.

Field 21) H0 - from telemetry

Field 22) COR2 - on-board tracker height rate over the radar cycle

Field 23) Coarse range word LAI - derived from telemetry

Field 24) Fine range word FAI - derived from telemetry

Field 25) AGC ch 1 - AGC gain applied on Rx channel 1. Gain calibration corrections are applied. (Sum of AGC stages 1 and 2 plus the corresponding corrections)

Field 26) AGC ch 2 - AGC gain applied on Rx channel 2. Gain calibration corrections are applied.

Field 27) Total Fixed Gain On Channel 1 - total fixed instrument gain applied on chain 1, this is the gain applied by the RF unit.

Field 28) Total Fixed Gain On Channel 2 - instrument fixed gain on receive chain 2 (as for chain 1)

Field 29) Transmit power in micro Watts.

Field 30) Doppler range correction computed for the component of satellite velocity in the nadir direction.

Field 31) Instrument Range Correction (Tx-Rx chain) - Calibration correction to range on channel 1 computed from CAL1.

Field 32) Instrument Range Correction (Rx only chain) - Calibration correction to range on channel 2 computed from CAL1.

Field 33) Instrument Gain Correction (Tx-Rx chain) - Calibration correction to gain on channel 1 computed from CAL1.

Field 34) Instrument Gain Correction (Rx only chain) - Calibration correction to gain on channel 2 computed from CAL1.

Field 35) Internal phase correction computed from the CAL-4 packets during the azimuth impulse response amplitude (SARIN only). It is set from the latest available CAL-4 packet.

Field 36) External phase correction taken from the IPFDB file (SARIN only) to be added to the internal phase correction term. The external phase correction is the temperature-averaged component of external inter-channel phase difference derived from phase difference sensitive antenna subsystem, waveguides and instrument waveguide switches. The external phase correction doesn't contain internal instrument temperature dependent effects of calibration coupler and duplexer which are dealt with by the CAL-4 signal. These CAL-4 data are processed to compute the internal phase correction parameter.

Field 37) Noise power measurement converted from telemetry units to be the noise floor of FBR measurement echoes. This field is set to the default value equal to -9999.99 when the telemetry contains zero.

Field 38) Phase Slope Correction - Differential group delay phase difference slope correction (across the whole bandwidth): fixed and variable group delays introduce a phase difference slope across the instrument bandwidth. Fixed elements of differential group delay have been determined during ground testing and characterisation and cover the elements of antenna, calibration coupler, Louis waveguide.
These fixed elements can be retrieved from the IPFDB.
Variable elements cover differences between the CAL-1 and CAL-4 paths and can be computed by processing the CAL-1 and CAL-4 data
SIR_SAR_1B and SIR_LRM_1B products contain this parameter but is set to zero because meaningless for these data.
Since the correction can only be made at the rate of the CAL-4 which is 1 Hz and the measurement group high rate blocks are provided at 20 Hz the product provides the closest in time to FBR value of slope correction.

Field 39) measurement spares - reserved for future use.

Field 40) Dry Tropospheric Correction – to be added to range measurement to correct for the propagation delay to the radar pulse, caused by the dry-gas component of the Earth's atmosphere (see sec. 6.2.3.3.1 in [DPM]).

Field 41) Wet Tropospheric Correction - to be added to range measurement to correct for the propagation delay to the radar pulse, caused by the H20 component of the Earth's atmosphere (see sec. 6.2.3.3.1 in [DPM]).

Field 42) Inverse Barometric Correction - to be added to range measurement to correct for the depression of the ocean surface caused by the local barometric pressure.

Field 43) Dynamic Atmospheric Correction (DAC, from MOG2D model) to be added to the range measurement to correct both the Inverse Barometric effect and the high-frequency ocean response to wind forcing. Only one of inverse barometric correction and DAC have to be used, as they are alternatives (see sec. 6.2.3.3.7 in [DPM]).

Field 44) GIM Ionospheric Correction - to be added to range measurement to correct for the delay to the Radar pulse caused by free electrons in the ionosphere. Computed from GPS ionospheric data (see sec. 6.2.3.3.2 in [DPM]).

Field 45) Model Ionospheric Correction - to be added to range measurement to correct for the delay to the Radar pulse caused by free electrons in the ionosphere. Computed from an ionospheric model (see sec. 6.2.3.3.2 in [DPM]).

Field 46) Elastic Ocean Tide - to be added to the range measurement in order to remove the total effects of ocean tides. Set to 32767 in case of error. (see sec. 6.2.3.3.3 in [DPM]).

Field 47) Long Period Ocean Tide - to be added to the range measurement in order to remove the effect of the oceanic response to the single tidal forcing. Set to 32767 in case of error (see sec. 6.2.3.3.3 in [DPM]).

Field 48) Ocean Loading Tide - to be added to the range measurement in order to remove the effect of local distortion to the Earth crust caused by increasing weight of ocean as local water tide rises. Set to 32767 in case of error (see sec. 6.2.3.3.3 in [DPM]).

Field 49) Solid Earth Tide - to be added to the range to remove the effect of local tidal distortion in the Earth's crust (see sec. 6.2.3.3.4 in [DPM]).

Field 50) Geocentric Polar Tide - to be added to the range to remove the effect of movement of the Earth's rotational axis w.r.t. geographic location (see sec. 6.2.3.3.5 in [DPM]).

Field 51) Surface type flag - enumerated key to classify surface at nadir:

0 = Open Ocean
1 = Closed Sea
2 = Continental Ice
3 = Land

Field 52) Correction spares - reserved for future use.

Field 53) Correction status flag - showing which correction algorithms have been called, see Table 2.3.3-5.

Field 54) Correction error flag - showing if a correction algorithm returned an error when called, see Table 2.3.3-6.

Field 55) Correction spares - reserved for future use.

- **Averaged Waveform Group for Low Rate Mode (LRM mode) and SAR mode. (Once per L1B record)**

Field 56) MDSR Time Stamp - corresponding to ground bounce time of the individual pulse, or middle of group of pulses for LRM.

Field 57) Latitude of measurement - corresponding to the MDSR Time Stamp.

Field 58) Longitude of measurement - corresponding to the MDSR Time Stamp.

Field 59) Altitude of the Satellite CoM above reference ellipsoid - corresponding to the MDSR Time Stamp.Field 60) Window delay from the telemetry converted to physical units. (2-way time)

Field 60) Window delay from the telemetry converted to physical units. (2-way time)

Field 61) Averaged Power Echo - Array of 128 bins. Averaged from all individual L0 echoes in approx 1 second (20 for LRM, 5120 for SAR). Units are counts scaled to fit in the range 0-65535 and are converted to Watts by using the scaling parameters in the following 2 fields. **WARNING** : In SAR mode the last 1Hz average waveform of the product is meaningless in most of the cases because there are

not enough FBR samples to be used in the averaging operation. When this happens the waveform is flagged as invalid (see description of field 65)

Field 62) Echo Scale factor 'A' (to scale echo to Watts)

Field 63) Echo Scale power 'B' (power of 2 to scale echo to Watts); the formula for converting the echo to Watts is: **Power in Watts = counts *(A*10^{-9}) *2^{B}**

Field 64) Number of echoes averaged - normally 1820 for LRM (=91 averaged on-board *20) or 5120 for SAR, but may be lower if some individual echoes are missing or rejected.

Field 65) Flags - for errors or information about echoes (LRM – Table 2.3.4-3a ; SAR - Table 2.3.4-3b).

ID	Definition	Bit (*)	Bit (**)	Setting
1.	1 Hz Echo Error	15	0	0 = 1Hz echo Computed 1 = 1Hz echo Not Computed
2.	Reserved	14-0	1-15	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]

(**) Space Segment bit numbering standard

Table 2.3.4-3a: Flags bits in LRM Average Waveform Group

ID	Definition	Bit (*)	Bit (**)	Setting
1.	1 Hz Echo Error	15	0	0 = 1Hz Echo Computed 1 = 1Hz Echo Not Computed
2.	Reserved	14-1	1-14	Set to zero
3.	Mispointing error	0	15	1=bad angles 0=no error

(*) Ground Segment bit numbering standard [FMT-Guide]

(**) Space Segment bit numbering standard

Table 2.3.4-3b: Flags bits in SAR/SARin Average Waveform Group

- **Averaged Waveform Group for SARin mode (Once per L1B record)**

This is the same as the above group but the waveform array is 512 bins instead of 128 and the number of echoes averaged is different.

Field 66) MDSR Time Stamp - corresponding to ground bounce time of the individual pulse, or middle of group of pulses for LRM.

Field 67) Latitude of measurement - corresponding to the MDSR Time Stamp.

Field 68) Longitude of measurement - corresponding to the MDSR Time Stamp.

Field 69) Altitude of the Satellite CoM above reference ellipsoid - corresponding to the MDSR Time Stamp.

Field 70) Window delay from the telemetry converted to physical units. (2-way time)

Field 71) Averaged Power Echo - Array of 512 bins. Averaged from 1280 individual L0 echoes in SARin mode. Units are counts scaled to fit in the range 0-65535 and are converted to Watts by using the scaling parameters in the following 2 fields. **WARNING** : In SARin mode the last 1Hz average waveform of the product is meaningless in most of the cases because there are not enough FBR samples to be used in the averaging operation. When this happens the waveform is flagged as invalid (see description of field 75)

Field 72) Echo Scale factor 'A' (to scale echo to Watts)

Field 73) Echo Scale power 'B' (power of 2 to scale echo to Watts); the formula for converting the echo to Watts is: **Power in Watts = counts *(A*10-9) *2B**

Field 74) Number of echoes averaged - normally 1280 but may be lower if some individual echoes are missing or rejected.

Field 75. Flags for errors or information about echoes (16 bit flag). See table 2.3.4-3b

- **Waveform Group for LRM mode (20x per L1B record)**

Field 76) Averaged Power Echo - Array of 128 bins. Averaged (on-board) from 91 individual echoes in pulse limited mode (LRM). Units are counts scaled to fit in the range 0-65535 and are converted to Watts by using the scaling parameters in the following 2 fields.

Field 77) Echo Scale factor 'A' (to scale echo to Watts)

Field 78) Echo Scale power 'B' (power of 2 to scale echo to Watts); the formula for converting the echo to Watts is: **Power in Watts = counts *(A*10^{-9}) *2^{B}**

Field 79) Number of echoes averaged - normally 91.

Field 80) Flags - TRK cycle report (as extracted from the L0):

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Reserved	3-15	0-12	Set to 0
2	TRK Cycle Report	0-2	13-15	0: no errors 1: Loss of Echo 2: Run Time Error 3: Echo Saturation Error 7: Unknown Error

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.4-4a: LRM 20Hz Waveform Flags

- **Waveform group: SAR (structure repeated 20 times per record)**

Field 81) Averaged Power Echo - Array of 256 bins. Averaged from a set of Doppler beam echoes formed at a common surface location. Units are counts scaled to fit in the range 0-65535 and are converted to Watts by using the scaling parameters in the following 2 fields.

Field 82) Echo Scale factor 'A' (to scale echo to Watts)

Field 83) Echo Scale power 'B' (power of 2 to scale echo to Watts); the formula for converting the echo to Watts is: **Power in Watts = counts *(A*10-9) *2B**

Field 94) Number of echoes averaged – variable, typically 280.

Field 85) Flags for errors or information about echoes (16 bit flag). See table 2.3.4-4b.

ID	Definition	PDS Bit	Setting
1	Approximate beam steering	15	0 = no, 1 = approximate steering used
2	Exact beam steering	14	0 = no, 1 = exact steering used
3	Doppler weighting computed	13	0 = not computed, 1 = computed
4	Doppler weighting applied before stack	12	0 = not applied, 1 = applied
5	Multi look incomplete	11	0 = no (i.e. complete), 1 = incomplete
6	Beam angle steering error	10	0 = OK, 1 = error
7	Anti aliased power echoes	9	0 = no, 1 = anti aliased

ID	Definition	PDS Bit	Setting
8	Auto beam steering	8	0 = no, 1 = auto beam steering used. Beam steering method is chosen based on the on-board tracker height variation.
9	reserved	7-0	set to 0

Table 2.3.4-4b: SAR/SARIN 20Hz Waveform Flags

Field 86) Beam Behaviour parameter (SAR mode) – 100-byte deep buffer containing information about the shape of the set of Doppler echoes from a common surface location that are averaged to generate the corresponding Level 1B multilooked waveform. If stack weighting is applied, which avoids considering in the multilooking the Doppler echoes coming from the furthest burst according to the look angle, then all the beam behaviour parameters but the one with ID=13 in table 2.3.4-5 are referred to the stack of Doppler echoes after weighting. The beam behaviour parameters contain the information related to the Doppler echoes that effectively contribute to the multilooked Level 1B waveform.. The format of each parameter is variable. Currently the usage of the first 34 bytes is defined as in table 2.3.4-5, while the rest is reserved for future use.

Description:

[0-1] Standard Deviation of Gaussian fit to range integrated stack power.
[2-3] Stack Centre - Mean of Gaussian fit to range integrated stack power.
[4-5] Stack Scaled - Stack amplitude parameter scaled in dB/100.
[6-7] Stack Skewness - 3rd moment providing the degree of asymmetry of the range integrated stack power distribution.
[8-9] Stack Kurtosis - 4th moment. Measure of peakiness of range integrated stack power distribution.
[10-11] Standard deviation (as a function of boresight angle, <microradians>) -
[12-13] Stack Centre angle (as a function of boresight angle, <microradians>)
[14-17] Doppler Angle Start- Doppler Angle of the first contributing beam to a surface sample. The Doppler angle is the angle at which the surface sample is seen with respect to the normal to the velocity vector.
[18-21] Doppler Angle Stop- Doppler Angle of the last contributing beam to a surface sample. The Doppler angle is the angle at which the surface sample is seen with respect to the normal to the velocity vector.
[22-25] Look Angle Start- Look Angle of the first contributing beam to a surface sample. The Look angle is the angle at which the surface sample is seen with respect to the nadir direction of the altimeter.
[26-29] Look Angle Stop- Look Angle of the last contributing beam to a surface sample. The Look angle is the angle at which the surface sample is seen with respect to the nadir direction of the altimeter.
[30-31] Number of contributing beams in the stack after weighting. In case of SAR, the user can generally assume regular angular steps between beams. In case of SARIN, the user can generally assume regular angular steps between beams with the exception of one double step every one second due to the interleaved CAL4 bursts. This field is the same as "Number of echoes averaged" present in the waveform group for SAR (field 84 of L1B) and SARin (field 90 of L1B).
[32-33] Number of contributing beams in the stack before weighting provided for monitoring purposes.

Beam Behaviour ID	Byte Index	Definition	Type	Setting
1	[0-1]	Standard Deviation	us	Unitless Stack beam/100
2	[2-3]	Stack Centre (Beam in stack at maximum of the fitted gaussian)	us	Unitless Stack beam/100
3	[4-5]	Stack Scaled Amplitude	ss	<dB/100>
4	[6-7]	Stack Skewness	ss	Unitless Value/100 or -99900 if cannot be computed
5	[8-9]	Stack Kurtosis	ss	Unitless Value/100 or -99900 if cannot be computed
6	[10-11]	Standard deviation (as a function of boresight angle)	us	<microradians> Range 0 to 0.065525 radians (0 – 3.755º)
7	[12-13]	Stack Centre angle (as a function of boresight angle)	ss	<microradians> Range -0.032767 to 0.032768 radians (-1.87741º – 1.87741º)
8	[14-17]	Doppler Angle Start	sl	<10^{-1} microradians>
9	[18-21]	Doppler Angle Stop	sl	<10^{-1} microradians>
10	[22-25]	Look Angle Start	sl	<10^{-1} microradians>
11	[26-29]	Look Angle Stop	sl	<10^{-1} microradians>
12	[30-31]	Number of contributing beams in the stack after weighting	us	Unitless
13	[32-33]	Number of contributing beams in the stack before weighting	us	Unitless
14	[34-99]	reserved		Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.4-5: Flags Beam Behaviour Parameters

- **Waveform Group for SARin mode (20x per L1B record)**

Field 87) Averaged Power Echo - Array of 1024 bins. Averaged from 2 sets of Doppler beam echoes formed (on 2 receive channels) at a common surface location. Units are counts scaled to fit in the range 0-65535 and are converted to Watts by using the scaling parameters in the following 2 fields.

Field 88) Echo Scale factor 'A' (to scale echo to Watts)

Field 89) Echo Scale power 'B' (power of 2 to scale echo to Watts); the formula for converting the echo to Watts is: **Power in Watts = counts *(A*10^{-9}) *2^{B}**

Field 90) Number of echoes averaged - variable, typically 70.

Field 91) Flags for errors or information about echoes (16 bit flag). See table 2.3.4-4b

Field 92) Beam Behaviour parameter (SARIN mode) – Same description as field 86.

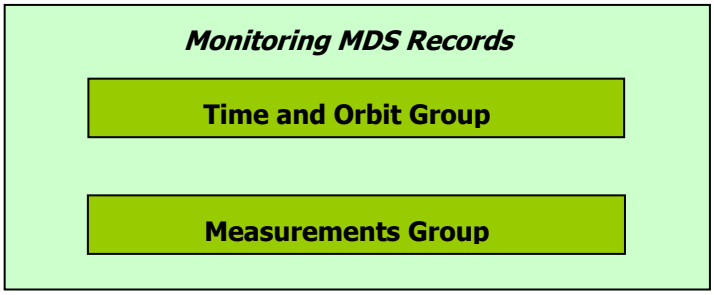
Field 93) Coherence - Array of 1024 bins, computed from the complex echoes on the 2 Rx channels

Field 94. Phase difference - Array of 1024 bins, computed from the complex echoes on the 2 Rx channels. Values are between -pi and +pi radians, units are micro radians.

2.3.5 Monitoring MDS Record Structure

Monitoring Products are generated from LRM/TRK – SAR – SARIn and CAL4 (which are included in SARIN) Level 0 data.

All the types of MDS records defined hereafter are provided with the following basic structure:



2.3.5.1 LRM/TRK Monitoring MDS Record Structure

For this type of product, one type of MDS is defined. The MDS envelopes all the tracking information extracted from TM-LRM or TM-TRK telemetries and copied without conversions or corrections applied in the record structure . The decoded information is geolocated and time tagged.

Field	Description	Units	Bytes	Format
Time and Orbit Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	Record counter (always starting from 1)		4	ul
3	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
4	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
5	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
6	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
7	Spare	-	10*1	uc
8	Monitoring Measurement Confidence Data (flag word)		4	ul (see table 2.3.5.1-2)

Field	Description	Units	Bytes	Format
Measurements Group				
9	Source Sequence Count	-	2	us
10	Mode_ID (see Table 2.3.5.1-3)		1	uc
11	Chirp Bandwidth		1	uc
12	Rx Band Attenuation Flag		1	uc
13	Rx Channel Selected		1	uc
14	Loop Command		1	uc
15	Cycle Report		1	uc
16	AGC1	dB	1	uc
17	AGC2	dB	1	uc
18	Altitude command H0	48.8 ps	4	sl (see note 2)
19	Vertical speed second order COR2	3.05 ps/rc	2	ss (see note 2)
20	Noise Measurement	dB/100	2	us
21	Tracker Waveform (128 samples)	FFT Power Units	128*2	us
22	Number of TRK Echoes Accumulated		2	us
23	Spare		1	uc
24	CID TRK Packet		1	uc
25	SIRAL_Identifier (0 = Nominal 1 = Redundant)		1	uc
26	Spare		15*1	uc
		Total Record Size	**340 bytes**	

Table 2.3.5.1-1: LRM/TRK Monitoring Data Product MDS Records

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) These are exotic units specific of SIRAL instrument.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	Block Degraded	31	0	0 = OK 1 = Degraded
2.	Blank Block	30	1	0 = OK 1 = Blank Block inserted for record padding
3.	Datation Degraded	29	2	0 = OK

ID	Definition	Bit (*)	Bit (**)	Setting
				1 = Datation is bad or not set
4.	Orbit Propagation Error	28	3	0 = OK 1 = Error (returned by CFI or independent check)
5.	Orbit File Change	27	4	0 = OK 1 = Orbit file has changed wrt previous record
6.	Orbit Discontinuity	26	5	0 = OK 1 = discontinuity (e.g. gap)
7.	Echo Saturation (from Cycle Report)	25	6	0 = OK 1 = Saturated
8.	Other Echo Error	24	7	0 = OK 1 = Echo Error (bit fields Tracking Echo Error or Echo Rx1 Error or Echo Rx2 Error set to 1)
9.	Rx 1 Channel Error for SARIN	23	8	0 = OK 1 = degraded or missing
10.	Rx 2 Channel error for SARIN	22	9	0 = OK 1 = degraded or missing
11.	Reserved	21-16	10-15	Set to zero
12.	TRK Echo Error	15	16	0 = OK 1 = empty (or null) tracking echo
13.	Echo Rx 1 Error	14	17	0 = OK 1 = empty (or null) raw echo
14.	Echo Rx2 Error	13	18	0 = OK 1 = empty (or null) raw echo
15.	Reserved	12-0	19-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.5.1-2: Monitoring Data Product MCD

Field Name	Setting
Mode_ID	1 = LRM 2 = SAR 3 = SARIN

Table 2.3.5.1-3: Monitoring Data Product Mode_ID Field Definition

2.3.5.2 SAR Monitoring MDS Record Structure

For this type of product, one type of MDS is defined. The MDS envelopes all the tracking information extracted from TM-TRK telemetries plus the waveform reconstructed from the 2D FFT processing of the raw echoes contained in the first packet of TM-ECHO-SAR type out of the four that the instrument produces within a tracking cycle. Conversions and instrument corrections are not applied. The decoded information is geolocated and time tagged.

Field	Description	Units	Bytes	Format
Time and Orbit Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	Record counter (always starting from 1)		4	ul
3	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
4	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
5	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
6	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
7	Spare	-	10*1	uc
8	Monitoring Measurement Confidence Data (flag word)		4	ul (see table 2.3.5.1-2)
Measurements Group				
9	Source Sequence Count (from TM-ECHO-SAR)		2	us
10	Mode_ID (see Table 2.3.5.1-3)		1	uc
11	Chirp Bandwidth		1	uc
12	Rx Band Attenuation Flag		1	uc
13	Rx Channel Selected		1	uc
14	Loop Command		1	uc
15	Cycle Report		1	uc
16	AGC1	dB	1	uc
17	AGC2	dB	1	uc
18	Altitude command H0	48.8 ps	4	sl (see note 2)
19	Vertical speed second order HPR	3.05 ps/rc	2	ss (see note 2)
20	Noise Measurement	dB/100	2	us
21	Tracker Waveform (128 samples)	FFT Power Units	128*2	us
22	Number of TRK Echoes Accumulated		2	us

Field	Description	Units	Bytes	Format
23	Decimation Factor		2	us
24	Normalised 2D Processed Echo SAR (power detected samples stored by doppler beam. 64 doppler beams in total. Each doppler beam contains 64 power detected samples)	FFT Power Units	64 x 64 x 2	us
25	CID SAR Packet		1	uc
26	CID TRK Packet		1	uc
27	FFT2D Scale Factor	-	4	sl
28	FFT2D Scale Power	-	4	sl
29	SIRAL_Identifier (0 = Nominal 1 = Redundant)		1	uc
30	Spare		9*1	uc
	Total Record Size		**8536 bytes**	

Table 2.3.5.2-1: SAR Monitoring Data Product MDS Records

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) These are exotic units specific of SIRAL instrument.

2.3.5.3 SARIN Monitoring MDS Record Structure

For this type of product, one type of MDS is presently defined. The MDS envelopes all the tracking information extracted from TM-TRK telemetries plus the waveform reconstructed from a simple 2D FFT processing of the raw echoes contained in the first packet of TM-ECHO-SARIN type out of the four that the instrument produces within a tracking cycle. Conversions or instrument corrections are not applied. The decoded information is geolocated and time tagged.

Field	Description	Units	Bytes	Format
Time and Orbit Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	Record counter (always starting from 1)		4	ul
3	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
4	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
5	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
6	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
7	Spare		10*1	uc
8	Monitoring Measurement Confidence Data (flag word)		4	ul (see table 2.3.5.1-2)
Measurements Group				
9	Source Sequence Count (From TM-ECHO-SARIN Master Channel)		2	us
10	Mode_ID (see Table 2.3.5.1-3)		1	uc
11	Chirp Bandwidth		1	uc
12	Rx Band Attenuation Flag		1	uc
13	Rx Channel Selected		1	uc
14	Loop Command		1	uc
15	Cycle Report		1	uc
16	AGC1	dB	1	uc
17	AGC2	dB	1	uc
18	Altitude command H0	48.8 ps	4	sl (see note 2)
19	Vertical speed second order HPR	3.05 ps/rc	2	ss (see note 2)
20	Noise Measurement	dB/100	2	us
21	Tracker Waveform (128 samples)	FFT Power Units	128*2	us

Field	Description	Units	Bytes	Format
22	Number of TRK Echoes Accumulated		2	us
23	Decimation Factor		2	us
24	Normalised 2D Processed Echo SARIN from Rx 1 Channel (power detected samples stored by doppler beam. 64 doppler beams in total. Each doppler beam contains 64 power detected samples)	FFT Power Units	64 x 64 x 2	us
25	Normalised 2D Processed Echo SARIN from Rx 2 Channel (power detected samples stored by doppler beam. 64 doppler beams in total. Each doppler beam contains 64 power detected samples)	FFT Power Units	64 x 64 x 2	us
26	CID SARIN Packet Rx1 Channel		1	uc
27	CID SARIN Packet Rx 2 Channel		1	uc
28	SIRAL_Identifier (0 = Nominal 1 = Redundant)		1	uc
29	CID TRK Packet		1	uc
30	FFT2D Scale Factor for Rx1 Channel	-	4	sl
31	FFT2D Scale Power for Rx1 Channel	-	4	sl
32	FFT2D Scale Factor for Rx2 Channel	-	4	sl
33	FFT2D Scale Power for Rx2 Channel	-	4	sl
		Total Record Size	**16728 bytes**	

Table 2.3.5.3-1: SARIN Monitoring Data Product MDS Record

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) These are exotic units specific of SIRAL instrument.

2.3.5.4 CAL4 Monitoring MDS Record Structure

An objective of the Monitoring applied to SARIn data is to provide information extracted from CAL4 packets. CAL 4 information is provided every second (~ 20 tracking cycles). This product is then suited to exclusively collect the CAL 4 data found in the input Level 0 data stream. CAL4 data are maintained in their raw format, i.e. specific processing is not applied.

The decoded information is geolocated and time tagged.

Field	Description	Units	Bytes	Format
		Time and Orbit Group		
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	Record counter (always starting from 1)		4	ul
3	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
4	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
5	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	ul
6	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
7	Spare		10*1	uc
8	Monitoring Measurement Confidence Data (flag word)		4	ul (see table 2.3.5.1-2)
		Measurements Group		
9	Source Sequence Count (from TM-ECHO-SARIN Master channel)		2	us
10	Mode_ID (see Table 2.3.5.1-3)		1	uc
11	Chirp Bandwidth		1	uc
12	Rx Band Attenuation Flag		1	uc
13	Rx Channel Selected		1	uc
14	Loop Command		1	uc
15	Cycle Report		1	uc
16	AGC1	dB	1	uc
17	AGC2	dB	1	uc
18	Altitude command H0	48.8 ps	4	sl (see note 2)
19	Vertical speed second order HPR	3.05 ps/rc	2	ss (see note 2)
20	Noise Measurement	dB/100	2	us
21	CAL4 complex data from Rx 1	-	64*512*2	sc

Field	Description	Units	Bytes	Format
	Channel [64, 512, 2]			
22	CAL4 complex data from Rx 2 Channel [64, 512, 2]	-	64*512*2	sc
23	CID SARIN Packet Rx1 Channel		1	uc
24	CID SARIN Packet Rx 2 Channel		1	uc
25	Spare		1	uc
26	CID TRK Packet		1	uc
27	SIRAL_Identifier (0 = Nominal 1 = Redundant)		1	uc
28	Spare		15*1	uc
	Total Record Size		**131156 bytes**	

Table 2.3.5.3-1: CAL4 Monitoring Data Product MDS Record

Notes:

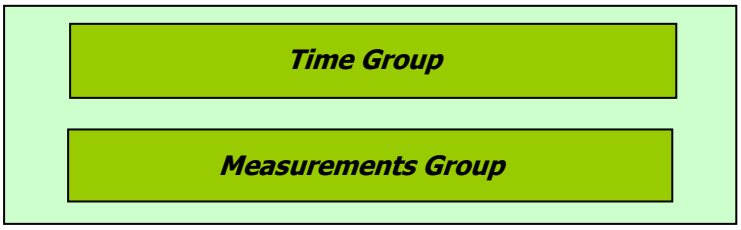
1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) These are exotic units specific of SIRAL instrument.

2.3.6 CAL1 MDS Record Structures

CAL1 nominal products are characterised by multiple record types (types 1 and 2) which are specific for the three possible calibration types in CAL1 Mode: LRM – SAR – SARIn.

All the types of MDS records defined hereafter are provided with the following basic structure:



As minimum a product is constituted by one MDS of the first type (described in the following sections) which contains the whole bunch of results of the calibration processing applied to an individual CAL1 level 0 file supplied in input and one MDS of the second type containing the calibration corrections (i.e. range and gain) and the associated MDSR time stamp.

Actually CAL 1 products may be generated starting from more than one Level 0 product. This possibility implies that in the product there are as many MDS of the first type for as many CAL 1 Level 0 files supplied in input and a set of MDS of the second type containing interpolated calibration corrections with their associated time stamp.

There is actually a fourth type of calibration product which is generated from the special processing of the CAL1-SARIN exotic data (i.e. with AGC and Frequency Synthesiser Stepping Command). This product is still characterised by a single MDS.

2.3.6.1 CAL1 LRM MDS Record Structures

The first type of MDS contains the reconstructed PTR measurements and the results of the processing applied to the reconstructed PTR.

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us
4	Spare		2*1	uc
5	Instrument Configuration		4	ul

Field	Description	Units	Bytes	Format
6	Record Counter (always starting from 1)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	CAL1 Measurement Confidence Data (flag word)		4	ul see table 2.3.6.1-2
Measurements Group				
12	Normalised Point Target Response Samples (P*128) (P in range 1..64) (max 8192 samples)	-	8192*2	us
13	AGC (AGC_1 + AGC_2) Corrected	dB/100	4	sl (see note 3)
14	Tx-Rx Peak Power*Gain Variation	dB/100	4	sl (see note 3)
15	Tx-Rx Local Oscillator Differential Path Delay (one way delay)	ps	4	sl
16	PSLR	dB/100	4	sl (see note 3)
17	3 dB Width	ps	4	sl
18	AGC_1 Command	dB/100	4	sl (see note 3)
19	AGC_2 Command	dB/100	4	sl (see note 3)
20	PTR Scale Factor	-	4	sl
21	PTR Scale Power	-	4	sl
22	Tx-Rx Integrated Power*Gain Variation	dB/100	4	sl (see note 3)
	Total Record Size		16472 bytes	

Table 2.3.6.1-1: CAL1 LRM MDS Records (Type 1)

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

3) This is an exotic unit used for dB-units related fields.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	CAL Error	31	0	0 = Valid Record 1 = Invalid Record
2.	Reserved	30-28	1-3	Set to zero
3	CAL1 Correction Missing	27	4	0 = correction applied 1 = correction not applied
4	Complex CAL1 Correction from IPF DB	26	5	0 = correction from Complex CAL1 Product used 1 = correction from IPF DB used
5.	AGC Inconsistency	25	6	0 = OK (AGC is static) 1 = AGC Stepping detected
6.	Reserved	24	7	Set to zero
7.	PTR Computation Error	23	8	0 = Average PTR computed 1 = Error (not available)
8.	CAL2 Correction Missing	22	9	0 = correction applied to PTR 1 = correction not applied
9.	CAL2 Correction from IPF DB	21	10	0 = correction from CAL1 Product used 1 = correction from IPF DB used
10.	DORIS USO Correction	20	11	0 = USO Correction Factor is available 1 = USO Correction Factor is not available
11.	PTR Analysis Method	19	12	0 = Gauss Fitting 1 = Search for Maximum
12.	PTR Width Error	18	13	0 = OK 1 = Error (width is out of range)
13.	PTR PSLR Error	17	14	0 = OK 1 = Error (PSLR is out of range)
14.	Gain Correction Error	16	15	0 = OK 1 = Error (value out of range)

ID	Definition	Bit (*)	Bit (**)	Setting
15.	Delay Correction Error	15	16	0 = OK 1 = Error (value out of range)
16	Reserved	14	17-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.6.1-2: CAL1-LRM MCD

The second type of MDS contains the interpolated corrections derived from the individual measurements:

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time	TAI	12	sl+2*ul
2	Error Flag 0 = Valid Measurement 1 = Not Valid Measurement		4	ul
3	Record Counter (always starting from 1)		4	ul
4	Spares		4*1	uc
Measurements Group				
5	Tx-Rx Peak Power*Gain Variation (interpolated value)	dB/100	4	sl (see note 3)
6	Tx-Rx Local Oscillator Differential Path Delay (interpolated value – for one way delay)	ps	4	sl
7	Tx-Rx Integrated Power*Gain Variation (interpolated value)	dB/100	4	sl (see note 3)
8	Spare		8*1	uc
	Total Record Size		**44 bytes**	

Table 2.3.6.1-3: CAL1 LRM MDS Records (Type 2)

Notes:

3) This is an exotic unit used for dB-units related fields.

2.3.6.2 CAL1 SAR MDS Record Structures

The first type of MDS record contains the results of the elaborations required to provide the average RiR (Range Impulse Response) and the average AiR (Azimuth Impulse Response), both zero padded by a factor of 64, as well as auxiliary information like the average phase correction, the range and gain corrections and quality parameters.

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us
4	Spare		2*1	uc
5	Instrument Configuration		4	ul
6	Record counter (always starting from 1)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	CAL1 Measurement Confidence Data (flag word)		4	ul see table 2.3.6.1-2
Measurements Group				
12	Normalised Power Detected PTR (8192 samples: zero padded by factor of 64)	-	8192*2	us
13	AGC (AGC_1+AGC_2) Corrected	dB/100	4	sl (see note 3)
14	Tx-Rx Peak Power*Gain Variation	dB/100	4	sl (see note 3)
15	Tx-Rx Local Oscillator Differential Path Delay (one way delay)	ps	4	sl
16	RiR PSLR	dB/100	4	sl (see note 3)
17	RiR 3dB Width	ps	4	sl
18	Pulse to Pulse Phase Correction Curve (64 samples)	micro-radians	64*4	sl
19	Pulse to Pulse Amplitude Correction Curve (64 samples)	10^-6	64*4	sl
20	AGC_1 Command	dB/100	4	sl (see note 3)
21	AGC_2 Command	dB/100	4	sl (see note 3)

Field	Description	Units	Bytes	Format
22	PTR Scale Factor	-	4	sl
23	PTR Scale Power	-	4	sl
24	Tx-Rx Integrated Power*Gain Variation	dB/100	4	sl (see note 3)
25	Spares		8*1	uc
	Total Record Size		**16992 bytes**	

Table 2.3.6.2-1 : CAL1 SAR MDS Record (Type 1)

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

3) This is an exotic unit used for dB-units related fields.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	CAL Error	31	0	0 = Valid Record 1 = Invalid Record
2.	Reserved	30-28	1-3	Set to zero
3	CAL1 Correction Missing	27	4	0 = correction applied 1 = correction not applied
4	AUTO CAL1 Correction from IPF DB	26	5	0 = correction from Complex CAL1 Product used 1 = correction from IPF DB used
5.	AGC Inconsistency	25	6	0 = OK (AGC is static) 1 = AGC Stepping detected
6.	Frequency Synthesiser Inconsistency	24	7	0 = OK (Freq. Synth Command is static) 1 = Freq. Synth. Comd. Stepping detected
7.	PTR Computation Error	23	8	0 = Average PTR computed 1 = Error (not available)
8.	CAL2 Correction Missing	22	9	0 = correction applied to PTR 1 = correction not applied
9.	CAL2 Correction from IPF DB	21	10	0 = correction from CAL1 Product used 1 = correction from IPF DB used
10.	DORIS USO Correction	20	11	0 = USO Correction Factor is available 1 = USO Correction Factor is not

ID	Definition	Bit (*)	Bit (**)	Setting
				available
11.	PTR Analysis Method	19	12	0 = Gauss Fitting 1 = Search for Maximum
12.	PTR Width Error	18	13	0 = OK 1 = Error (width is out of range)
13.	PTR PSLR Error	17	14	0 = OK 1 = Error (PSLR is out of range)
14.	Gain Correction Error	16	15	0 = OK 1 = Error (value out of range)
15.	Delay Correction Error	15	16	0 = OK 1 = Error (value out of range)
16.	Burst Correction Error	14	17	0 = OK 1 = Error (not computed)
17.	Reserved	13-0	18-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.6.1-2: CAL1-SAR MCD

The second type of MDS contains the interpolated corrections derived from the individual measurements:

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time	TAI	12	sl+2*ul
2	Error Flag 0 = Valid Measurement 1 = Not Valid Measurement		4	ul
3	Record Counter (always starting from 1)		4	ul
4	Spares		4*1	uc
Measurements Group				
5	Tx-Rx Peak Power*Gain Variation (interpolated value)	dB/100	4	sl (see note 3)
6	Tx-Rx Local Oscillator Differential Path Delay (interpolated value – for one way delay)	ps	4	sl

Field	Description	Units	Bytes	Format
7	Pulse to Pulse Phase Correction Curve (64 samples: interpolated values)	micro-radians	64*4	sl
8	Pulse to Pulse Amplitude Correction Curve (64 samples: interpolated values)	10^-6	64*4	sl
9	Tx-Rx Integrated Power*Gain Variation (interpolated value)	dB/100	4	sl (see note 3)
10	Spare		8*1	uc
	Total Record Size		**556 bytes**	

Table 2.3.6.2-3 : CAL1 SAR MDS Record (Type 2)

Notes:

3) This is an exotic unit used for dB-units related fields.

2.3.6.3 CAL1 SARIn MDS Record Structures

The first type of MDS record contains the results of the elaborations required to provide a set of 64 RiRs (Range Impulse Response) and the average AiR (Azimuth Impulse Response), both zero padded by a factor of 64, for each Rx channel as well as auxiliary information like the average phase correction, the range and gain corrections and quality parameters.

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us
4	Spare		2*1	uc
5	Instrument Configuration		4	ul
6	Record counter (always starting from 1)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	CAL1 Measurement Confidence Data (flag word)		4	ul see table 2.3.6.3-2
Measurements Group				
Rx 1 Channel: Retrieved Parameters				
12	Normalised Power Detected PTR of Rx1 Channel (8192 samples: zero padded by factor of 16)	-	8192*2	us (see note 3)
13	AGC (AGC_1 + AGC_2) Corrected of Rx1 Channel	dB/100	4	sl (see note 2)
14	Tx-Rx Peak Power*Gain Variation of Rx1 Channel	dB/100	4	sl (see note 2)
15	Tx-Rx Local Oscillator Differential Path Delay of Rx1 Channel (one way delay)	ps	4	sl
16	PTR PSLR	dB/100	4	sl (see note 2)
17	PTR 3 dB Width	ps	4	sl
18	Pulse to Pulse Phase Correction Curve (64 samples) of Rx 1 Channel	Micro-radians	64*4	sl
19	Pulse to Pulse Amplitude Correction Curve (64 samples) of Rx 1 Channel	10^-6	64*4	sl

Field	Description	Units	Bytes	Format
20	Rx1 PTR Scale Factor	-	4	sl
21	Rx1 PTR Scale Power	-	4	sl
22	Tx-Rx Integrated Power*Gain Variation of Rx1 Channel	dB/100	4	sl (see note 2)
23	Spare		8*1	uc
Rx 2 Channel: Retrieved Parameters				
24	Normalised Power Detected PTR of Rx2 channel (8192 samples: zero padded by factor of 16)	-	8192*2	us (see note 3)
25	AGC (AGC_1 + AGC_2) Corrected of Rx2 Channel	dB/100	4	sl (see note 2)
26	Tx-Rx Power*Gain Variation of Rx2 Channel	dB/100	4	sl (see note 2)
27	Tx-Rx Local Oscillator Differential Path Delay of Rx2 Channel (one way delay)	ps	4	sl
28	RiR PSLR	dB/100	4	sl (see note 2)
29	RiR 3 dB Width	ps	4	sl
30	Pulse to Pulse Phase Correction Curve (64 samples) of Rx 2 Channel	Micro-radians	64*4	sl
31	Pulse to Pulse Amplitude Correction Curve (64 samples) of Rx 2 Channel	10^-6	64*4	sl
32	Rx2 PTR Scale Factor	-	4	sl
33	Rx2 PTR Scale Power	-	4	sl
34	Tx-Rx Integrated Power*Gain Variation of Rx2 Channel	dB/100	4	sl (see note 2)
35	Spare		8*1	uc
Phase and Amplitude of Rx1 and Rx2 (extracted from RiR peaks)				
36	Phase PTR Peak Rx 1	Micro-radians	4	sl
37	Amplitude PTR Peak Rx 1	10^-6	4	sl
38	Phase RiR Peak Rx 2	Micro-radians	4	sl
39	Amplitude RiR Peak Rx 2	10^-6	4	sl
Common Rx1 and Rx2 Instrument Commands				
40	AGC_1 Command	dB/100	4	sl
41	AGC_2 Command	dB/100	4	sl
42	Frequency Synthesiser Command	-	2	us
43	Spares		10*1	uc
		Total Record Size	**33956 bytes**	

Table 2.3.6.3-1 : CAL1 SARIn MDS Record (Type 1)

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) This is an exotic unit used for dB-units related fields.

3) The PTR computed by CAL1SARin processor is 32768 samples long. The central portion [12289,20480] is stored in L1B product.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	CAL Error	31	0	0 = Valid Record 1 = Invalid Record (logical AND between CAL_Rx1_error and CAL_Rx2_error)
2.	CAL Rx 1 Error	30	1	0 = Rx1 related corrections valid 1 = Rx1 related corrections not valid
3.	CAL Rx 2 Error	29	2	0 = Rx2 related corrections valid 1 = Rx2 related corrections not valid
4.	Reserved	28	3	Set to zero
5	CAL1 Correction Missing	27	4	0 = correction applied 1 = correction not applied
6	Complex CAL1 Correction from IPF DB	26	5	0 = correction from Complex CAL1 Product used 1 = correction from IPF DB used
7.	AGC Inconsistency	25	6	0 = OK (AGC is static) 1 = AGC Stepping detected
8.	Frequency Synthesiser Inconsistency	24	7	0 = OK (Freq. Synth Command is static) 1 = Freq. Synth. Comd. Stepping detected
9.	PTR Computation Rx1 Error	23	8	0 = Average PTR from Rx1 computed 1 = Error (not available)
10.	PTR Computation Rx2 Error	22	9	0 = Average PTR from Rx2 computed 1 = Error (not available)
11.	CAL2 Correction Missing	21	10	0 = correction applied to PTR 1 = correction not applied
12.	CAL2 Rx 1 Correction from IPF DB	20	11	0 = correction from CAL1 Rx1 Product used 1 = correction from IPF DB used
13.	CAL2 Rx 2 Correction from IPF DB	19	12	0 = correction from CAL1 Rx2 Product used 1 = correction from IPF DB used
14.	DORIS USO Correction	18	13	0 = USO Correction Factor is available 1 = USO Correction Factor is not

ID	Definition	Bit (*)	Bit (**)	Setting
				available
15.	PTR Analysis Method	17	14	0 = Gauss Fitting 1 = Search for Maximum
16.	PTR Width Rx1 Error	16	15	0 = OK 1 = Error (width is out of range)
17.	PTR Width Rx2 Error	15	16	0 = OK 1 = Error (width is out of range)
18.	PTR PSLR Rx1 Error	14	17	0 = OK 1 = Error (PSLR is out of range)
19.	PTR PSLR Rx2 Error	13	18	0 = OK 1 = Error (PSLR is out of range)
20.	Gain Correction Rx1 Error	12	19	0 = OK 1 = Error (value out of range)
21.	Delay Correction Rx1 Error	11	20	0 = OK 1 = Error (value out of range)
22.	Gain Correction Rx2 Error	10	21	0 = OK 1 = Error (value out of range)
23.	Delay Correction Rx2 Error	9	22	0 = OK 1 = Error (value out of range)
24.	Burst Rx1 Correction Error	8	23	0 = OK 1 = Error (not computed)
25.	Burst Rx2 Correction Error	7	24	0 = OK 1 = Error (not computed)
26.	Reserved	6-0	25-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.6.3-2: CAL1-SARIN MCD

The second type of MDS contains the interpolated corrections derived from the individual measurements:

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time	TAI	12	sl+2*ul
2	Error Flag 0 = Valid Measurement 1 = Not Valid Measurement		4	ul
3	Record Counter (always starting from 1)		4	ul
4	Spares		4*1	uc
Measurements Group				
5	Tx-Rx Peak Power*Gain Variation (interpolated value) of Rx 1 Channel	dB/100	4	sl (see note 3)
6	Tx-Rx Local Oscillator Differential Path Delay (interpolated value – for one way delay) of Rx 1 Channel	ps	4	sl
7	Pulse to Pulse Phase Correction Curve (64 samples: interpolated values) of Rx 1 Channel	Micro-radians	64*4	sl
8	Pulse to Pulse Amplitude Correction Curve (64 samples: interpolated values) of Rx 1 Channel	10^-6	64*4	sl
9	Tx-Rx Peak Power*Gain Variation (interpolated value) of Rx 2 Channel	dB/100	4	sl (see note 3)
10	Tx-Rx Local Oscillator Differential Path Delay (interpolated value – for one way delay) of Rx 2 Channel	ps	4	sl
11	Pulse to Pulse Phase Correction Curve (64 samples: interpolated values) of Rx 2 Channel	Micro-radians	64*4	sl
12	Pulse to Pulse Amplitude Correction Curve (64 samples: interpolated values) of Rx 2 Channel	10^-6	64*4	sl
13	Phase RiR Peak Rx 1 (interpolated value)	Micro-radians	4	sl
14	Amplitude RiR Peak Rx 1 (interpolated value)	10^-6	4	sl
15	Phase RiR Peak Rx 2 (interpolated value)	Micro-radians	4	sl
16	Amplitude RiR Peak Rx 2 (interpolated value)	10^-6	4	sl
17	Tx-Rx Integrated Power*Gain Variation (interpolated value) of Rx 1 Channel	dB/100	4	sl (see note 3)
18	Tx-Rx Integrated Power*Gain Variation (interpolated value) of Rx 2 Channel	dB/100	4	sl (see note 3)
19	Spare		4*1	uc
	Total Record Size		1092 bytes	

Table 2.3.6.3-3 : CAL1 SARIn MDS Record (Type 2)

Notes:

3) This is an exotic unit used for dB-units related fields.

2.3.6.4 AUTO CAL1-SARIN MDS Record

Field	Description	Units	Size (Bytes)	Format
Time Group				
1	Data record time	TAI	12	sl+2*ul
2	USO correction	10^-15	4	sl
3	Mode ID		2	us
4	spare		2	us
5	Instrument configuration		4	ul
6	Record count		4	sl
7	latitude	10^-7 Deg	4	sl (see note 1)
8	longitude	10^-7 Deg	4	sl (see note 1)
Measurement Group				
9	Calibrated AGC1 chain 1 (32 combinations)	dB/100	128	sl (see note 3)
10	Calibrated AGC1 chain 2 (32 combinations)	dB/100	128	sl (see note 3)
11	Calibrated AGC2 chain 1 (32 combinations)	dB/100	128	sl (see note 3)
12	Calibrated AGC2 chain 2 (32 combinations)	dB/100	128	sl (see note 3)
13	Average Gain Calibration Component	dB/100	4	sl
14	Calibrated AGC command table (63 Commands) chain 1	dB/100	252	sl (see note 3)
15	Calibrated AGC measurement command table chain 2	dB/100	252	sl (see note 3)
16	Inversion quality chain 1 (AGC cal)	10^-2	4	sl
17	Inversion quality chain 2 (AGC cal)	10^-2	4	sl
18	Phase difference curves 32*11 AGC 1 settings	10^-6 Rad	1408	sl
19	Phase difference curves 32*11 AGC 2 settings	10^-6 Rad	1408	sl
20	11 Frequency averaged components used to reconstruct AGC phase tables	10^-6 Rad	44	sl
21	Frequency interpolated (512 points) phase difference correction curves 63*512 for all AGC measurement command table settings	10^-6 Rad	129024	sl
22	Phase difference curve at AGC setting CAL4_AGC1, CAL4_AGC2 with attenuator OFF		44	sl
23	Phase difference curve at AGC setting CAL4_AGC1, CAL4_AGC2 with attenuator ON		44	sl
24	Measurements of attenuator calibration curve (11 frequencies)	10^-6 Rad	44	sl

Field	Description	Units	Size (Bytes)	Format
25	Attenuator calibration correction curve interpolated over 512 range samples	10^-6 Rad	2048	sl
26	Measurements of calibration curves at 8 ADC power level (-30dBm to -16dBm) in steps of 2dB, at 11 frequencies	10^-6 Rad	352	sl
27	8 ADC power level (-30dBm to -16dBm) calibration correction curves in steps of 2dB interpolated over 512 range bins	10^-6 Rad	16384	sl
28	Inversion quality at 11 frequencies (phase difference cal)	10^-2	44	sl
29	MCD (see table 2.3.6.4-2)	-	4	ul
		TOTAL	151912	

Table 2.3.6.4-1 : CAL1 SARIn Exotic MDS Record

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

3) This is an exotic unit used for dB-units related fields.

ID	Definition	Bit(*)	Bit(**)	Setting
1.	CAL Error	31	0	0 = Valid Record 1 = Invalid Record
2.	Reserved	30-13	1-18	Set to zero
3.-4.	AGC results from SICCFR or SICC1B or IPFDB	12-11	19-20	0 = SICCFR, 1 = SICC1B, 2 = IPFDB
5.-6.	ADC results from SICCFR or SICC1B or IPFDB	10-9	21-22	0 = SICCFR, 1 = SICC1B, 2 = IPFDB
7.	AGC calibration computed	8	23	0 = computed, 1 = not computed
8.	ADC calibration computed	7	24	0 = computed, 1 = not computed
9	Auto CAL-1 Attenuator calibrated	6	25	0= computed 1=not computed
10	Gain inversion matrix condition greater than threshold	5	26	0 = OK 1=threshold exceeded
11	Phase difference matrix condition greater then threshold	4	27	0 = OK 1=threshold exceeded

ID	Definition	Bit(*)	Bit(**)	Setting
12	reserved	3-0	28-31	Set to zero

Table 2.3.6.3-2: CAL1-SARIN Exotic MCD

2.3.7 CAL2 MDS Record Structure

CAL2 Products are characterised by multiple record types which are specific for the two possible calibration types in CAL2 Mode: SAR – SARIn.

The MDS structures are based on the [MSL-PS] documents with amendments and corrections as identified at present.

2.3.7.1 CAL2 SAR MDS Record Structure

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us
4	Spare		2*1	uc
5	Instrument Configuration		4	ul
6	Record counter (fixed to 1)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	CAL2 Measurement Confidence Data (flag word)		4	ul (see table 2.3.7.1-2)
Measurements Group				
12	LPF Filter Shape Correction Mask(128 power samples)	10^-6	128*4	sl
13	Number of Noise Spectra averaged		4	ul
14	AGC (AGC_1 + AGC_2) Corrected	dB/100	4	sl (see note 2)
15	AGC_1 Command	dB/100	4	sl (see note 2)
16	AGC_2 Command	dB/100	4	sl (see note 2)
17	Number of Spikes from AUX_SIRDBF	-	2	us
18	Number of Spikes autodetected	-	2	us
19	Spare		16*1	uc

Field	Description	Units	Bytes	Format
	Total Size		**596 bytes**	

Table 2.3.7.1-1: CAL2 SAR MDS Record Structure

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields

2) This is an exotic unit used for dB-units related fields.

ID	Definition	Bit (*)	Bit (**)	Setting
1.	CAL Error	31	0	0 = Valid Record 1 = Invalid Record
2.	Reserved	30-28	1-3	Set to zero
3	CAL1 Correction Missing	27	4	0 = correction applied 1 = correction not applied
4	Complex CAL1 Correction from IPF DB	26	5	0 = correction from Complex CAL1 Product used 1 = correction from IPF DB used
5.	AGC Inconsistency	25	6	0 = OK (AGC is static) 1 = AGC Stepping detected
6.	Noise Spectra Computation Error	24	7	0 = OK 1 = Error (some spectra were not computed)
7.	Noise Power Error	23	8	0 = OK 1 = Mean Noise Power out of Range
8.	Reserved	22-0	9-31	Set to zero

(*) Ground Segment bit numbering standard [FMT-Guide]
(**) Space Segment bit numbering standard

Table 2.3.7.1-2: CAL2 MCD

2.3.7.2 CAL2 SARIn MDS Record Structure

Field	Description	Units	Bytes	Format
Time Group				
1	Data Record Time (MDSR Time Stamp)	TAI	12	sl+2*ul
2	USO Correction	10^{-15}	4	sl
3	Mode ID		2	us
4	Spare		2*1	uc
5	Instrument Configuration		4	ul
6	Record counter (fixed to 1)		4	ul
7	Latitude of measurement	10^{-1} μdeg	4	sl (see note 1)
8	Longitude of measurement	10^{-1} μdeg	4	sl (see note 1)
9	Altitude of COG above reference ellipsoid (interpolated value)	mm	4	sl
10	Instantaneous altitude rate derived from orbit	mm/sec	4	sl
11	CAL2 Measurement Confidence Data (flag word)		4	ul (see Table 2.3.7.1-2)
Measurements Group				
12	LPF Filter Shape Correction Mask(512 power samples)	10^-6	512*4	sl
13	Number of Noise Spectra averaged		4	ul
14	AGC (AGC_1 + AGC_2) Corrected	dB/100	4	sl (see note 3)
15	AGC_1 Command	dB/100	4	sl (see note 3)
16	AGC_2 Command	dB/100	4	sl (see note 3)
17	Number of Spikes from AUX_SIRDBF	-	2	us
18	Number of Spikes autodetected	-	2	us
17	Spare		16*1	uc
		Total Size	**2132 bytes**	

Table 2.3.7.2-1: CAL2 SARIn MDS Record Structure

Notes:

1) this is an exotic unit exclusively used at binary record level to improve resolution of the lat and long fields
3) This is an exotic unit used for dB-units related fields.

3 CRYOSAT LEVEL-1 PRODUCTS

The following table provides the Product Identification for each product generated by the IPF1.

Product Identification	Description
SIR1SAR_FR	Level 1 FBR SAR Mode (Rx1 Channel)
SIR2SAR_FR	Level 1 FBR SAR Mode (Rx2 Channel)
SIR_SIN_FR	Level 1 FBR SARin Mode
SIR_LRM_1B	Level-1 Product Low Rate Mode
SIR_FDM_1B	Level-1 Product Fast Delivery Marine Mode
SIR_SAR_1B	Level-1 SAR Mode
SIR_SIN_1B	Level-1 SARin Mode
SIR1LRC11B	Level-1 CAL1 Low Rate Mode (Rx1 Channel)
SIR2LRC11B	Level-1 CAL1 Low Rate Mode (Rx2 Channel)
SIR1SAC11B	Level-1 CAL1 SAR Mode (Rx1 Channel)
SIR2SAC11B	Level-1 CAL1 SAR Mode (Rx2 Channel)
SIR_SIC11B	Level-1 CAL1 SARin Mode
SIR_SICC1B	Level-1 CAL1 SARIN Exotic Data
SIR1SAC21B	Level-1 CAL2 SAR Mode (Rx1 Channel)
SIR2SAC21B	Level-1 CAL2 SAR Mode (Rx2 Channel)
SIR1SIC21B	Level-1 CAL2 SARin Mode (Rx1 Channel)
SIR2SIC21B	Level-1 CAL2 SARin Mode (Rx1 Channel)
SIR1LRM_0M	LRM and TRK Monitoring Data from Rx 1 Channel
SIR2LRM_0M	LRM and TRK Monitoring Data from Rx 2 Channel
SIR1SAR_0M	SAR Monitoring Data from Rx 1 Channel
SIR2SAR_0M	SAR Monitoring Data from Rx 1 Channel
SIR_SIN_0M	SARIN Monitoring Data
SIR_SIC40M	CAL4 Monitoring Data

Table 3-1: Level-1 products list

3.1 FILE NAMES

The file name of each Level-1 product follows what specified in [MASTER-ICD], i.e.:

MM_CCCC_TTTTTTTTT_yyyymmddThhmmss_YYYYMMDDTHHMMSS_bvvv.HDR
MM_CCCC_TTTTTTTTT_yyyymmddThhmmss_YYYYMMDDTHHMMSS_bvvv.DBL

where

MM is the mission identifier **CS** for CryoSat

CCCC is the file class (i.e.: OPER for routine operation, NRT_ for Near Real Time, RPRO for Reprocessing, TEST for Testing or TIxx for stand alone IPF1 testing associated to Test Data Sets tagged as Tixx, LTA_ for products generated in the Long Term Archive).

TTTTTTTTT is the file type and corresponds to the Product ID of the Table 3-1

yyyymmddThhmmss is the validity start time and correspond to the time of the first valid record stored in the Interim FBR.

YYYYMMDDTHHMMSS is the validity stop time and correspond to time of the last valid record stored in the Interim FBR.

b is the baseline identifier as read-in from the PCONF

vvv is the version number

For example in case of an operational Level-1 product of the SIRAL instrument in Low Rate Mode in baseline number A and version 1 the name could be:

CS_OPER_ SIR_LRM1B_20030624T075728_20030624T080231_A001.HDR
CS_OPER_ SIR_LRM1B_20030624T075728_20030624T080231_A001.DBL

The file with extension ***.HDR*** is the xml Header and the file with the extension ***.DBL*** is the Level 1b Product file.

END OF DOCUMENT