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ERS Ground Stations
Products specification

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ERS Ground Stations
Products specification

Document overview

Document No.	ER-IS-EPO-GS-0201
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Summary	This document defines all outgoing products generated by the ERS-1 and ERS-2 Ground Stations at: Kiruna, Fucino, Maspalomas, Gatineau and Prince Albert. Products are defined in terms of their structure, content and format. Distribution media are defined in terms of their type and format.
Summary Contents	Product generation ERS Ground stations products Product distribution

Document change record

Issue/Rev	*Date*	*Page*	*Details*	*Editor*
3 / 0	94-04-15	All	ERS-1 applicable document converted to MS-Word 6.0. ERS-2 products included	Mats Önnestam
3 / 1	00-11-16	All	Document restructured into four parts: Introduction, Product generation, ERS Ground Station products and Product distribution. Product distribution part rewritten to present all available media formats including LRDTF and Low Rate copy utility formats. Error and format corrections in all parts.	Mats Önnestam

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Acronyms and Abbreviations

AGC	Automatic Gain Control
AMI	Active Microwave Instrumentation
ASCII	American National Standard Code for Information Interchange
ATSR	Along-Track Scanning Radiometer and Microwave Sounder
BER	Bit Error Rate
BPI	Bytes Per Inch
CCT	Computer-Compatible Tape
CEOS-WGD	Committee on Earth Observation Satellites - Working Group on Data
CFE	Customer Furnished Equipment
CN	Communications Node
CTRS	Conventional Terrestrial Reference System
CUS	Central User Service
DAF	Data Acquisition Facility
DEC	Digital Equipment Corporation
DECnet	DEC Computer Network Protocol
DPMC	Data Processing, Monitoring and Control Facility
DPS	Data Path Switcher
DRR	Data Recording and Reproduction
EECF	Earthnet ERS Central Facility
EGS	ESA ERS-2 Ground Stations
EOF	End Of File
EPO	Earthnet Program Office
ERS	European Remote Sensing Satellite(s)
ESA	European Space Agency
ESRIN	European Space Research Institute
FD	Fast Delivery
FDP	Fast Delivery Processor
FFT	Fast Fourier Transform
FS	Frame Synchronizer
FS	Fucino Station
FTP	File Transfer Protocol
FUC	Fucino Station
GS	Ground Segment
GS	Gatineau Station
GAP	Global Activity Plan
GAT	Gatineau Station
H/W	Hardware
HDDR	High Density Digital Recorder
HDDT	High Density Digital Tape
HR	High Rate
HSL	High Speed Link
ICU	Interface Control Unit
I/F	Interface
IDHT	Instrument Data Handling and Transmission
II16	Intermediate AMI SAR Image 16 bits product
IPS	Inches Per Second
IRG	Inter Record Gap
IRIG	Interrange Instrumentation Group
ISLR	Integrated Sidelobe Ratio
IWA	Intermediate Product: AMI Wave
KS	Kiruna Station
LR	Low Rate
LRDPF	Low Rate Data Processing Facility
LSB	Least Significant Bit
LUT	Look-Up Table
MAS	Maspalomas Station
MS	Maspalomas Station
MMCC	Mission Management and Control Center

MPH	Main Product Header
N/A	Not Applicable
OB	Output Buffer
OBC	On-Board Computer
OBRC	On Board Range Compressed
PA	Prince Albert Station
PAF	Processing and Archiving Facility
PB	Playback
PCD	Product Confidence Data
PF	Platform
PRN	Pseudo-Random Noise
PSDN	Packet Switching Data Network
RA	Radar Altimeter
RATSR	Raw ATSR Data Product
RAL	Rutherford Appleton Laboratories (UK)
RF	Radio Frequency
RH	Raw High rate data Product
RL	Raw Low rate data Product
RMS	Root Mean Square
RT	Real-Time
S/C	System-Corrected
S/	Subsystem
S/W	Software
SAR	Synthetic Aperture Radar
SAR FDP	Synthetic Aperture Radar Fast Delivery Processor
SWH	Significant Wave Height
SPH	Specific Product Header
TBC	To Be Confirmed
TBD	To Be Defined
TCG	Time Code Generator
TCR	Time Code Reader
TSU	Time Search Unit
TT&C	Tracking, Telecommand and Control
TTCDAF	TT&C and DAF facilities
UI16	Fast Delivery Product: AMI Image-16 bit
UI8	Fast Delivery Product: AMI Image-8 bit
URA	Fast Delivery Product: Radar Altimeter
UTC	Universal Time, Coordinated
UWA	Fast Delivery Product: AMI Wave
UWI	Fast Delivery Product: AMI W ind

Part 1

Introduction

Document overview

The ERS Ground Station Product Specification, the GS-201

This document defines all outgoing products generated by the following ERS Ground Stations:

- Kiruna Station (KS)
- Fucino Station (FS)
- Maspalomas Station (MS)
- Gatineau Station (GS)
- Prince Albert Station (PA)

Products are defined in terms of their structure, content, format and method of distribution.

The document serves as a specification document of products for the following four types of Primary Users:

- Mission Management and Control Center (MMCC)
- Esrin ERS Central Facility (EECF)
- Off-line Processing and Archiving Facilities (PAF's)
- National Nominated Centers (Centers nationally selected by ERS-1 Participating Member States, to receive ERS-1 Fast Delivery Products within three hours from sensing, for further distribution to national end-users).

This document, , provides the definition and format for all ERS Ground Stations data products, including those products that are for ESA internal use only.

The document consists of four parts:

1. This introduction.
2. A presentation of the product generation at the ERS Ground Stations and a summary of the product quality control aspects.
3. Specifications of all ERS Ground Station products.
4. Specifications of media types and formats used for product distribution.

Applicable Documents

A-1	ER-IS-ESA-GS-0002	ERS-2 Satellite to Ground Segment Interface Specification
A-2	ER-IS-EPO-GE-0103	EECF to Ground Stations Interface Specification
A-3		Not used
A-4	ER-ST-EPO-LB-0503	LBR Format CCT Standardization by CEOS-WGD
A-5	ER-PR-EPO-GS-2201	ERS Products Shipment Procedures
A-6	ER-IS-ESA-GS-0001	ERS-1 Satellite to Ground Segment Interface Specification

Reference Documents

R-1	ER-LI-EPO-GS-0101	ERS-1 Ground Segment Acronyms, Abbreviations and Glossary of Terminology
R-2	ER-SS-MDA-GS-6101	ERS-1 Kiruna Station High Density Digital Recorder.
R-3	ER-RS-MDA-GS-5001	Synthetic Aperture Radar Fast Delivery Processor Requirement Specification.
R-4	ER-RP-EPO-AM-0501	SAR Data products Format Standard Recommended by CEOS/WGD.
R-5	ER-IS-EPO-GS-0204	ERS-1 Ground Stations Products Specification to Users
R-6	ER-ST-EPO-GS-0202	ERS-1 LBR Raw Data Optical Disk File Structure Description
R-7	ER-ST-EPO-GS-0210	ERS-1 Raw Data on Exabyte Format Specification

Part 2

Product generation

Generation and quality control

The ERS Ground Stations

The ERS ground stations at Kiruna, Fucino, Maspalomas, Gatineau and Prince Albert acquire, process and distribut data from the two European Remote Sensing satellites ERS-1 and ERS-2.

The Kiruna Station, having also TTC capability for the ERS-2 satellite, is controlled by MMCC, Darmstadt. All parameters and commands to Kiruna Station will be originating from MMCC and will be processed in the Data Processing Monitoring and Control, DPMC, subsystem.

All other ERS Ground Stations will be controlled by EECF, Frascati. The processing parameters and commands will be processed by the Control and Monitor Subsystem, CMS, at the Ground Stations.

The ERS telemetry consists of two parts: High rate data and low rate data. Kiruna, Fucino and Maspalomas acquire high rate data. Kiruna, Maspalomas, Gatineau and Prince Albert acquire low rate data.

Due to its geographical position the Kiruna station acquires 10 out of 14 1/3 ERS-2 orbits per day. Fucino covers the southern Europe and Mediterranean area for 4-5 passes of real-time acquistion of high rate data per day. The acquistion of 3 orbits of low bit rate data are shared between Maspalomas and Gatineau. Prince Albert takes care of the acquisition of the 14th orbit of low bit rate data.

Figure 1 presents the block diagram for an ERS ground station and shows the mian product dataflow from the acquisition subsystem to the user.

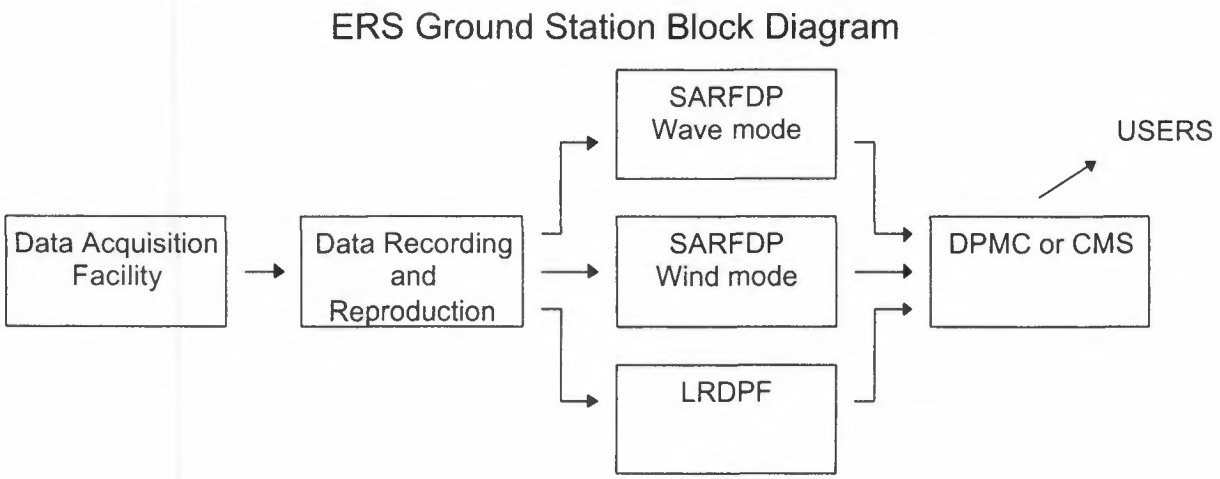

Figure 1 ERS Ground Station Block diagram

Product generation

Products are generated and distributed according to a schedule which is defined by the MMCC or the EECF and distributed to the station. This schedule contains separate commands to generate and disseminate the products. The parameters with which a product is generated, are product-dependent.

Products are generated by the three Fast Delivery Processors, FDP's, SARFDP 1, SARFDP 2 and LRDPF. Once completed, the products are outputted to the DPMC or the CMS, which provides temporary storage on disk until the products are distributed.

The two SARFDP, SAR fast deliver processor, processor produce AMI Image and AMI Wave products. All other products are produced by the LRDPF, Low Rate Data Processing Facility.

The ground station at Fucino has a LRDTF, Low Bit Rate Transcription Facility, for the transcription of ERS-1 low bit rate data from HDDT to Optical disk and Exabyte. This facility works off-line from the CMS.

The Low Bit Rate data for ERS-2 is transcribed to Exabyte directly at the receiving station by the s econd generation of the LRDPF system. These transcribed Exabytes can be copied in a Copy Utility runned on the same hardware as the LRDPF but off-line from the rest of the station.

Product types

This section gives a description of all products generated in the ESA ERS Ground Stations at Kiruna, Fucino, Maspalomas and Gatineau.

Table 1 lists the ERS ground station products and their sizes. The products fall into six categories:

- Raw data products, acronym starting with 'R'[1]
- Fast Delivery Products, acronym starting with 'U'
- Intemediate Products, acronym starting with 'I'
- Extracted Calibration products, acronym starting with 'E' and ending with 'C'[1]
- Extracted General and Instrument header products, acronym starting with 'E' and ending with 'I'[2]
- Text products, acronym starting with 'T'

Table 1 ERS Ground Station Product Sizes

Product		Data Set SPH Size in Bytes	Data Set Record Size in Bytes	Data Set Number of Records	Product Size in Bytes
EATC2	ATSR-2 Low rate Extracted Calibration data	282	6804	1	7262
EATC2	ATSR-2 High rate Extracted Calibration data	282	6804	2	14066
EATI1	ATSR-1 Instrument Headers	40	4004[3]	N[6]	1500000[5]
EATI2	ATSR-2 Instrument Headers	40	6804[3]	N[6]	1500000[5]
EEP	Ephemeris Data	N/A	388	1	564
EGH	General Headers	N/A	260	16	4336
EGOC	GOME Extracted Calibration data	303	8004	1	8483
EGOI	GOME Instrument Headers	40	8004[3]	N[6]	1500000[5]
EIC	AMI Image Extracted Calibration data Calibration Data	N/A	11466	1	11642
EII	AMI Image Instrument Headers	40	234[3]	N[4]	1500000[5]

[1] RATSR is a Extracted Calibration product although it has an acronym indicating a Raw data product.

[2] The General Header product has the acronym EGH.

[3] Maximum number of Bytes per record.

Table 1 ERS Ground Station Product Sizes

Product		Data Set SPH Size in Bytes	Data Set Record Size in Bytes	Data Set Number of Records	Product Size in Bytes
EMWC	Microwave Sounder Extracted Calibration data	315	900	1	1391
ERAC	Radar Altimeter Extracted Calibration Data	282	3136	1	3594
ERAI	Radar Altimeter Instrument Headers	40	3136[3]	N[6]	1500000[5]
EWAC	AMI Wave Extracted Calibration data Calibration Data	4480	4332	299	1299924
EWAI	AMI Wave Instrument Headers	40	108[3]	299	1500000[5]
EWIC	AMI Wind Extracted Calibration data Calibration Data	282	7864	1	8322
EWII	AMI Wind Instrument Headers	40	72[3]	N[6]	1500000[5]
II16	AMI Image Intermediate Products	600	10004	6300	63025976
IWA	AMI Wave Intermediate Products, OGRC	260	16004	17	272504
IWA	AMI Wave Intermediate Products, OBRC	260	24004	17	408504
RATSR[1]	ATSR-1 Extracted Calibration data	282	4004	1	4462
RH	High rate raw data on HDDT	N/A	N/A	N/A	N/A
RL	Low rate raw data on HDDT	N/A	N/A	N/A	N/A
TP	Text Product	N/A	84	1	260
UI16	AMI Image 16-bit Fast delivery	260	10004	6300	63025636
UI8	AMI Image 8-bit Fast delivery	260	5004	6300	31525636
UIC	AMI Image Chirp Replica	N/A	1540	2	3256
UIND	AMI Image Noise Statistics and Drift Calibration	28	1540	4	6364
URA	Radar Altimeter Fast delivery	56	88	77	7008
UWA	AMI Wave Fast delivery	260	148	1	584
UWAC	AMI Wave Chirp Replica	N/A	1540	1	1716
UWAND	AMI Wave Noise Statistics and Drift Calibration, OGRC	28	1540	4	6364
UWAND	AMI Wave Noise Statistics and Drift Calibration, OBRC	28	124	4	700
UWI	AMI Wind Fast delivery	166	46	361	16948

[4] Variable number of records.

[5] Maximum product size.

[6] Maximum variable number of Data set records is equal to number of source packets in 110 minutes worth of raw data. This applies to EWII, ERAI, EGOI, EATI1 and EATI2.

Product Format

Each product, with the exception of the raw data products stored on HDDT, has the same structure. This product structure consists of three parts. Figure 2 shows the product structure.

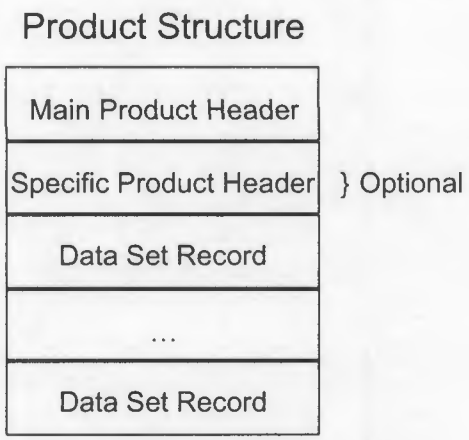

Figure 2 Product structure

The MPH has a single 176-byte record with an identical format for all products. The format of the Main Product Header record is given in Table 5. The Main Product Header contains information applicable to all processing chain products.

The specific product header is optional. The number and length of the record varies by product type.

All products have a product data set, consisting of one or more records. Length and number of records is determined by the product type and is given in the Main Product Header.

Data Types

Table 2 shows the simple common data types in the ERS Ground station products. There are two important complex data types as well: the prod_type_list and the utc_time_m. The first specifies a list of product types for a command, the second gives the time in two integers.

Table 2 Data types in the ERS Ground station products

Data Type	Meaning
I1	1-byte unsigned integer
I2	2-byte integer in DEC format
I4	4-byte integer in DEC format
A	ASCII
B	1 byte or bits (flags)
S	Special format, as defined in description field

Data type prod_type_list

The prod_type_list data type is an array of 50 Bytes. Each byte indicates one product type. Several product types can be indicated. Table 3 shows the indices for each product type. The processing subsystems read this list from the parameters in the commands and interprets which products they have to process, e.g., transcrib_list [15] = 0 in the C_Config_Trans command means that product type 15, ERAC, will be transcribed.

Table 3 Product types

Type	Product	
0	RATSR	ATSR-1 Extracted Calibration data
1	UI16	AMI Image 16-bit Fast delivery
2	UI8	AMI Image 8-bit Fast delivery
3	UIND	AMI Image Noise Statistics and Drift Calibration
4	UIC	AMI Image Chirp Replica
5	UWA	AMI Wave Fast delivery
6	UWAND	AMI Wave Noise Statistics and Drift Calibration
7	UWAC	AMI Wave Chirp Replica
8	UWI	AMI Wind Fast delivery
9	URA	Radar Altimeter Fast delivery
10	IWA	AMI Wave Intermediate Products
11	II16	AMI Image Intermediate Products
12	EIC	AMI Image Extracted Calibration data Calibration Data
13	EWAC	AMI Wave Extracted Calibration data Calibration Data
14	EWIC	AMI Wind Extracted Calibration data Calibration Data
15	ERAC	Radar Altimeter Extracted Calibration Data
16	EII	AMI Image Instrument Headers
17	EWAI	AMI Wave Instrument Headers
18	EWII	AMI Wind Instrument Headers
19	ERAI	Radar Altimeter Instrument Headers
20	EGH	General Headers
21	EEP	Ephemeris Data
22	TP	Text Product
23	UILR	User Image Low Resolution Image
30	VI	Verification Image
31	VIC	Verification Image Calibration
32	VWA	Verification Wave
33	VWAC	Verification Wave Calibration
34	EGOC	GOME Extracted Calibration data
35	EGOI	GOME Instrument Headers
36	EATI2	ATSR-2 Instrument Headers
37	EATI1	ATSR-1 Instrument Headers
38	EATC2	ATSR-2 Low rate Extracted Calibration data
39	EMWC	Microwave Sounder Extracted Calibration data
40	EICM	Multiple AMI Image Calibration Data

Data type utc_time_m

The data type utc_time_m contains the Julian day and time format in two four byte integers. The first integer gives the number of days since January 1, 1950. The second shows the number of milliseconds the actual day.

Nonvalid Fields

If a Ground Station does not have a value for a field, either because the field is not applicable or a value is unavailable the field is set according to the following:

Table 4 Fillers for nonvalid fields

Field value	Used for data type
0	for integer numbers
space	for ASCII
0	for bit fields within a byte
0	for special format. Note that there may also exist a 'non-value' definition by also exist a 'non-value' definition by special format itself.

If a value exceeds the range of a type, the positive or negative maximum is given.

Byte and Bit Order

Data which are stored in Digital Equipment Corporation (DEC) internal storage formats have the following layout:

16-bit or 32-bit integer numbers have the Least Significant Byte first; for example:

Byte		
1	Least significant byte	
2	.	Integer 1
3	.	(32 bits)
4	Most significant byte	
5	Least significant byte	
6	.	Integer 2
7	.	(32 bits)
8	Most significant byte	
9	Least significant byte	
10	.	Integer 3
11	.	(32 bits)
12	Most significant byte	
.	.	.
.	.	.

Data addressed on bit level; for example, Product Confidence Data (PCD), have the bit addresses start at the least significant bit of a byte and increase to the most significant bit in the byte, i.e. the data item with the following description:

Bit	**Meaning**
bit 1 - 3	PCD_A
bit 4	PCD_B
bit 5 - 7	PCD_C
bit 8 - 10	PCD_D
bit 11 - 16	PCD_E

These bits are stored in two bytes as follows:

	byte 1	byte 2
bit number:	8 7 6 5 4 3 2 1	16 15 14 13 12 11 10 9
bit position:	7 6 5 4 3 2 1 0	15 14 13 12 11 10 9 8
storage of PCD:	D C C C B A A A	E E E E E E D D

A bit is defined to be set if the bit has a value 1.

Main Product Headers

Table 5 MPH for all products, except HDDT products

Field	Bytes	Type	Description
1	17	A/I	Product identifier (for ESA internal operational use only), i.e. a set of characters and integers which form a unique identifier. The set of 17 Bytes is defined as follows: Byte 1: Originator of logical schedule (for ESA internal use only) e.g.: I: MMCC/EECF, Immediate Command M: MMCC/EECF, Logical Schedule J: Local operator, Immediate Command K: Local operator, Logical Schedule Byte 2-5: Sequential Counter of Logical Schedule Byte 6-9: Unique Identification or Schedule Offset Byte 10-13: Not used, set to 0 Byte 14-17: Sequential Number of Currently Generated Product
2	1	I1	Type of Product, see Table 3
3	1	I1	Spacecraft 1: ERS-1 2: ERS-2
4	24	A	UTC time[7] of subsatellite point at beginning of product. Format in ASCII: DD-MMM-YYYY hh:mm:ss.ttt For example: 30-JAN-1987 14:30:27.123
5	1	I1	Station ID, where data was processed 1: Kiruna Station (KS) 2: Fucino Station (FS) 3: Gatineau Station (GS) 4: Maspalomas Station (MS) 5: EECF Station (ES) 6: Prince Albert Station (PS)
6	2	B	Product Confidence Data bit 1 PCD Summary Flag 0: product correctly generated 1: at least one of the remaining 15 bits of the PCD in the MPH is set. In particular the specific header flags are not read when this bit is set. bit 2 - 3 spare bit 4 - 5 Downlink Performance and X-Band acquisition chain. This value summarizes the PCD snapshots rel. to the products. 0: performance better than MMCC/EECF-supplied minimum threshold 1: performance equal to or worse than threshold 2: performance unknown

- [7]UTC time at beginning of product, has the following meaning: for SAR it is the time of the first processed range line i.e. 0.4 to 0.48 sec before the zero doppler time of the first line of the product; for UWI it is the time of the first line of nodes; for URA it is the time of the first data set record.

Table 5 MPH for all products, except HDDT products

Field	Bytes	Type	Description
			bit 6 - 7 HDDT Summary. This value summarizes the PCD snapshots rel. to the product. 0: performance better than MMCC/EECF-supplied minimum threshold 1: performance equal to or worse than threshold 2: performance unknown bit 8 - 9 Frame Synchronizer. This value summarizes the PCD snapshots rel. to the product. 0: performance better than MMCC/EECF-supplied minimum threshold 1: performance equal to or worse than threshold 2: performance unknown bit 10 - 11 FS to Processor I/F The LRDPF and SARFDP reads the status of the FS interface. 0: no parity error detected 1: at least one parity error detected 2: performance unknown bit 12 - 13 Checksum Analysis on LR Frames. The percentage of source packets, featuring a checksum error, and used in the actual product is compared to a MMCC/EECF given threshold. 0: lower than threshold 1: greater than threshold 2: performance unknown bit 14 - 15 Quality of Downlinked Formats and Source Packets. The RA product is based on using 80 consecutive source packets. The percentage of erroneous ones is determined and compared to a MMCC/EECF given threshold. 1: greater than threshold 2: performance unknown bit 16 Existence of Auxiliary Data.[8] 0: auxiliary data and/or chirp correctly extracted 1: not all auxiliary data extracted
7	24	A	UTC time when MPH was generated; Format as in field 4.
8	4	I4	Size of Specific Product Header: Record in Bytes
9	4	I4	Number of Product Data Set Records
10	4	I4	Size of each Product Data Set Record in Bytes
11	1	B	Subsystem that generated the product. 0: SARFDP 1 1: SARFDP 2 2: LRDPF

[8]For the LRDPF it has the meaning that at least one auxiliary data field in a source packet header is corrupted and for the SARFDP it means that the chirp could not be extracted from the input raw data. For UWI and URA this flag is always set to zero.

Table 5 MPH for all products, except HDDT products

Field	Bytes	Type	Description
			3: VMP 4: LRDTF
12	1	B	OBRC flag used for SAR products only bit 1 - 2 0: not used 1: OGRC data 2: OBRC data
13	24	A	UTC reference time. Time relation used to convert from satellite to ground, used together with the next two fields.
14	4	I4	Reference binary time of satellite clock (32-bit unsigned integer)
15	4	I4	Step length of satellite clock in nanoseconds
16	8	I2	Processor software version used to generate product. Format as defined by MMCC/EECF. 8 bytes = 4 words of integer x 2
17	2	I2	Threshold table version number.
18	2	B	Spare
19	24	A	UTC time of ascending node state vector
20-25	24	6I4	Ascending node state vector[9] in earth-fixed reference system
20	4	I4	State vector; X in 10^{-2} m
21	4	I4	State vector; Y in 10^{-2} m
22	4	I4	State vector; Z in 10^{-2} m
23	4	I4	State vector; X velocity in 10^{-5} m/s
24	4	I4	State vector; Y velocity in 10^{-5} m/s
25	4	I4	State vector; Z velocity in 10^{-5} m/s

Product Quality Control

In case there is a loss of data between products, null products may be generated. The interval of null products is determined by the PCD update rate (nominally 2.5 seconds) during ingestion. In terms of satellite time, the interval of null products will be:

Low Rate Real-time data: 1.25 seconds
Low Rate Playback data: 17.1 seconds
High Rate data: 0.078 seconds
This variation is due to the difference between record speed and the speed of reproduction of data for ingestion.

SAR FDP Input Data Error Handling

The SAR FDP has two basic schemes for minimizing the effects of bit errors in the high-rate and low-rate data:

[9] Product types which don't need valid orbit state vectors, e.g., UWAND and extracted products, for production, may contain invalid state vectors since these are not verified during production.

- For extracted parameters which are relatively static (for example, PRF code, sampling window start time code, gain codes), the processor searches for the same value in two consecutive range lines or source packets;
- For dynamic extracted parameters (for example, range line number, satellite binary time code), the processor compares each value with previous and next values and thereby establishes the validity of each value based on acceptable ranges of change.

Missing or incomplete range lines of image mode data or source packets of wave mode data are replaced with zeroes. No parameters are extracted from the auxiliary data fields of these data sets. Missing data is indicated in the header of each affected product and summarized in the product confidence data field. Duplicate and obsolete wave mode source packets are detected by the SAR FDP on the basis of the satellite binary time code and are discarded.

If data are not received for the generation of a product, then no product is generated and the SAR FDP indicates so in its status report to the DPMC/CMS.

LRDPF Input Data Error Handling

Error handling within the LRDPF is performed on a product-type basis. The following subsections describe the error handling strategy for each product type.

Radar Altimeter Error Handling

A URA Fast Delivery product will always contain 77 data set records, equally spaced in time, by about one second.

Blank data records or, if necessary, blank products are generated, whenever no valid RA ocean tracking mode data are available at the beginning or between sets of valid data of the specified processing time interval. They are inserted as needed to ensure the above spacing as well as the right number of records per product.

A blank data record has the same structure as normal data record with only valid data for the UTC time, localization and the instrument mode identification byte. All other bytes of the blank data set record will be set to default values.

If a source packet is valid but not error-free, then calibration values contained in the auxiliary data of the packet will be ignored and the previous values, obtained from the last error-free source packet, will be used.

If at the end of a processing interval a product contains less than 77 data set records, then the whole product is discarded.

Wind Scatterometer Error Handling.

Wind Scatterometer Fast Delivery Products will always be generated for the complete specified processing time interval with reference to the mid-beam.

Each product will correspond to an array of 19 nodes across-track by 19 nodes along-track with a node spacing of about 25 km.

For each node within the processing interval, the processor will attempt to find and process the corresponding satellite telemeter data of each beam (fore, mid and aft). For each beam and each node, the processor will calculate the corresponding sigma-nought value only if sufficient valid data are available for this node calculation.

The wind extraction algorithm will not be attempted for nodes having less than 2-beam sigma-nought calculated values. For each of the records of the products generated within the processing time interval, the appropriate data fields will be filled or flagged according to the number of processed beams and the possibility of wind vector extraction.

If a source packet is valid but not error-free, then calibration values contained in the auxiliary data of the packet will be ignored and the previous values, obtained from the last error-free source packet, will be used.

If at the end of the processing time interval, the last product is incomplete, it will be completed either by processed data or by blank records to make a complete product.

Extracted Calibration Data Products

Extracted Calibration data products may be generated by the SAR FDP's and the LRDPF. The general error handling strategy is independent of the processor involved.

Extracted Calibration Data products will be generated for a specified time interval. The products will start with the first data which can be extracted for that time interval: as long as no data are available, no products will be generated.

When there is a gap in the source data the LRDPF generates zero filled data set records in null products with an update rate corresponding to the receipt of acquisition PCDs from the DPMC/CMS. A null product has a complete MPH, a complete SPH and a DSR padded with zeroes. The SPH is filled with the latest available general header.

An EATC2 null product will always look like a low rate ATSR-2 product.

The Wave Calibration Data Products (EWAC) products will be generated for all wave cells found within the specified time interval. In case of incomplete wave cells, the product EWAC will be completed by null records to generate complete products.

General Header and Ephemeris Data Products

These products may be generated by either the SAR FDP or the LRDPF. In both cases the error handling strategy is the same.

For EEP products, the input data are searched from the start time until a complete product is found, that is 16 contiguous packets forming a complete set of ephemeris data without error.

EGH products are generated within the time interval specified in the generation command. Products are generated within the interval corresponding to complete products; that is, sets of 16 contiguous error-free packets. Data which are not error-free are replaced by null data and flagged as erroneous. If no source packets are obtained in the interval then no product is generated.

Instrument Header Products

Instrument Header products may be generated by the SAR FDP's and the LRDPF. The general error handling strategy is independent of the processor involved.

Instrument Header products will be generated for a specified time interval. The products will start with the first data which can be extracted for that time interval: as long as no data are available, no products will be generated.

In case there is loss of data in bursts during the products generation interval, then null data set records will be generated within the product with an update rate corresponding to the receipt of acquisition PCDs from the DPMC/CMS. A null data set record is a data set record with a data set record number and all the selected windows padded with zeros.

For the Image Instrument Headers (EII) products will be generated for all formats (one range line per format) found in a specified time interval, products will be generated within the specified time interval.

The Wave Instrument Headers (EWAI) products will be generated for all wave cells found within the specified time interval. In case of incomplete wave cells, the product EWAI will be completed by null records to generate complete products.

Product Confidence Data

All products disseminated from ESA Ground Stations contain information on the quality of the content. This data is referred to as Product Confidence Data (PCD). Six areas are covered:

- Performance of downlink and X-Band acquisition chain;
- Checksum analysis on LR frames;

- Quality of downlinked formats and source packets;
- Quality of auxiliary data;
- Performance and status of processing chain equipment;
- Quality assessment performed during product generation.

Location of Product Confidence Data in Product Format

Product confidence data are stored in several places throughout a product. As a general rule, acquisition-related information is stored in the MPH, processing information covering the entire product is given in the SPH, and information affecting the quality of individual cells is recorded on a cell basis together with the other cell contents. The location of the PCD in a product is as follows:

- Main Product Header: Within the main product header (same format for all products), 16 bits provide a summary of all checks performed before product dissemination;
  PCD summary flag;
  performance of downlinked and X-Band acquisition chain;
  performance and status of processing chain;
  checksum analysis on LR frames;
  quality of downlinked formats and source packets;
  quality of auxiliary data;
- Specific Product Header (FD and intermediate products):
  product processor hardware equipment;
  quality of downlinked formats and source packets (image and wave products only);
  performance during product generation;
- Data Set Cell (RA and Wind products only):
  checksum analysis on LR frames;
  quality of downlinked formats and source packets;
  performance during product generation;
  quality assessment performed during product generation.

All PCD collected during acquisition and product generation are summarized in a single flag, product confidence factor. This flag is stored in the MPH of every product.

Performance of Downlink and X-Band Acquisition Chain

During acquisition, the following PCD is collected from the demodulator/bit synchronizer:

- Bit Error Rate (BER) estimate;
- Downlink channel signal strength (through the automatic gain control);
- I and Q bit synch lock status;
- Demodulator lock status.

These PCD, called PCD_DEMOD, are passed via the Time Code Generator (TCG) Interface to the TCG, to be embedded in the IRIG time code and passed on to the Data Path Switcher (DPS). The DPS outputs the down linked data in parallel with the time code for recording on HDDT. When data are read back from the HDDT for processing, the DPMC collects the PCD_DEMOD from the time code. It checks the PCD_DEMOD against limits, and passes the result as PCD flags (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and SAR FDP. The LRDPF and the SAR FDPs attach the PCD flags to all products which are generated from the downlinked data associated with the PCD_DEMOD.

Checksum Analysis on Low Rate Frames

The LR transfer frame checksums are analyzed by the Frame Synchronizer. Any detected errors are flagged by the Frame Synchronize r. The LRDPF takes action by replacing the noise and calibration pulse data with defaults, and by flagging the event in the MPH. In the SAR FDP (in Wave Mode), auxiliary data are checked for self consistency between consecutive source packets. A count of checksum errors is maintained and a flag in the MPH set if the ratio of erroneous frames to total frames exceeds a threshold.

Quality of Downlinked Formats and Source Packets

The performance of instrument formats and source packets is monitored by the SAR FDPs and the LRDPF through analysis of the data from the Frame Synchronizer. If a source packet (LR) or format (HR) cannot be reassembled; that is, it is too short or too long, all data are either replaced by ''0'' (AMI image or wave products) before processing, or totally disregarded (AMI wind and RA products). In addition, a flag is set accordingly in the MPH, the SPH (image and wave products), and in the PCD of the cell (RA and wind products).

Quality of Auxiliary Data

Auxiliary data in the header of the downlinked source packets are checked by the processors against predefined limits. If a processor is unable to extract the auxiliary data needed for product generation, a flag is set accordingly in the MPH or in the PCD of the cell (RA and wind products).

Performance and Status of Processing Chain Equipment

The following equipment is monitored during product generation:

- High Density Digital Recorders (HDDRs)
- Frame Synchronizers (FSs)
- Frame Synchronizer to product processor interfaces
- SAR FDP and LRDPF processor status

The HDDRs are monitored by the DPMC/CMS, which collects status information generated by the Tape Search Units (TSUs). The DPMC/CMS also collects Synch Lock status via the Tape Search Units every 2.5 seconds, checks the parameters against predefined limits, and passes the resulting flag (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and the SAR FDPs.

During the replay of the recorder, the Frame Synchronizers monitor the:

- BER, and
- Lock status

of the downlinked data. The DPMC/CMS samples the Frame Synchronizer status every 2.5 seconds, checks the parameters against predefined limits, and passes the resulting flag (correct, incorrect, unknown) every 2.5 seconds on to the LRDPF and the SAR FDPs. The Frame Synchronizers to processor interfaces are monitored in the SAR FDPs and the LRDPF. The processors check the parity bit in the incoming data from the Frame Synchronizer. Performance below a certain threshold is recorded in the MPH of the related products.

Generally, the processing hardware is checked out in the daily or in the prepass test. Each test usually produces a Pass or Fail result, which is reported to the MMCC/EECF in the relevant test report. In certain ambiguous cases, where processing is done with uncertain hardware conditions, a flag is set in the SPH of each product.

Performance during Product Generation

During product generation, algorithm-specific data for product confidence parameters are generated. Depending on whether a PCD applies to an entire product or a product cell, the PCD is stored in the SPH or in the cell PCD. Cell-dependent PCD exist for wind and RA products.

Part 3

ERS Ground Station Products

Products specifications

Raw data products

High rate data (RH)

Raw data products contain data as received from the ERS-2 satellite. No processing or reformatting of data has been performed. All raw data products are output on HDDT. The raw data are annotated with the time of data reception at the Ground Stations and an indication of the quality of reception.

Description:	This data is an exact copy of all data downlinked from ERS-2 on the X-Band High Rate Link.
Satellite Source:	X-Band, Link 1; that is, the AMI image mode data (and scrambled zero frames) and IDHT General Header.
Originating Subsystem:	DRR
Production Generation:	All data received in the Ground Stations
Command:	No specific product generation command
On-Line Storage Specification:	Recorded in parallel on two HDDTs, one HDDT is kept in the Ground Stations storage until the other HDDT has been accepted at the Processing and Archiving Facility.
Throughput:	All data of every pass.
Format and Media:	See Section 'High Bit Rate Data on HDDT' on page 87.
Comments on Product Confidence:	Product confidence data from the demodulators are stored in the time track, see Table 6.

Table 6 Organization of a Time Code Frame

Bit Number	Meaning 'Not Used' Bits shall be set to zero
0	PR (Position Identifier - Reference)
1	1 second
2	2 seconds
3	4 seconds
4	8 seconds
5	0 . not used
6	10 seconds
7	20 seconds
8	40 seconds
9	P1 (Position Identifier)
10	1 minute
11	2 minutes
12	4 minutes
13	8 minutes
14	0 . not used

Table 6 Organization of a Time Code Frame

Bit Number	Meaning 'Not Used' Bits shall be set to zero	
15	10 minutes	
16	20 minutes	
17	40 minutes	
18	0 . not used	
19	P2 (Position Identifier)	
20	1 hour	
21	2 hours	
22	4 hours	
23	8 hours	
24	0 . not used	
25	10 hours	
26	20 hours	
27	0 . not used	
28	0 . not used	
29	P3 (Position Identifier)	
30	1 day	
31	2 days	
32	4 days	
33	8 days	
34	0 . not used	
35	10 days	
36	20 days	
37	40 days	
38	80 days	
39	P4 (Position Identifier)	
40	100 days	
41	200 days	
42	0 . not used	
43	0 . not used	
44	0 . not used	
45	0.10 second	
46	0.20 second	
47	0.40 second	
48	0.80 second	
49	P5 (Position Identifier)	
50	PC0 1 HR BER estimate (LSB)	)
51	PC1 2 HR BER estimate	| Product
52	PC2 4 HR BER estimate	| Confidence
53	PC3 8 HR BER estimate (MSB)	| (definitions
54	PC4 1 HR AGC (LSB)	| given in
55	PC5 2 HR AGC	| Table 7 and
56	PC6 4 HR AGC	| Table 8.)
57	PC7 8 HR AGC	)
58	PC8 HR carrier lock (1=TRUE)	
59	P6 (Position Identifier)	
60	PC10 1 LR BER estimate (PB) (LSB)	)
61	PC11 2 LR BER estimate (PB)	| Product
62	PC12 4 LR BER estimate (PB)	| Confidence
63	PC13 8 LR BER estimate (PB) (MSB)	| (definitions
64	PC14 HR I bit clock lock (1=TRUE)	| given in
65	PC15 HR Q bit clock lock (1=TRUE)	| Table 7 and
66	PC16 LR I bit clock lock (1=TRUE)	| Table 8.)

Table 6 Organization of a Time Code Frame

Bit Number	Meaning 'Not Used' Bits shall be set to zero	
67	PC17 LR Q bit clock lock (1=TRUE)	see Note[10] below
68	PC18 PCD Source flag (1=chain 1, 0=chain 2)	
69	P7 (Position Identifier)	
70	PC20 1 LR BER (RT) (LSB)	Product Confidence (definitions given in Table 7 and Table 8.)
71	PC21 2 LR BER (RT)	
72	PC22 4 LR BER (RT)	
73	PC23 8 LR BER (RT) (MSB)	
74	PC24 1 LR AGC (LSB)	
75	PC25 2 LR AGC	
76	PC26 4 LR AGC	
77	PC27 8 LR AGC (MSB)	
78	PC28 LR carrier lock (1=TRUE)	
79	P8 (Position Identifier)	
80	SBS (LSB)	Straight Binary Seconds Time of Day
81	SBS	
82	SBS	
83	SBS	
84	SBS	
85	SBS	
86	SBS	
87	SBS	
88	SBS	
89	P9 (Position Identifier)	
90	SBS	
91	SBS	
92	SBS	
93	SBS	
94	SBS	
95	SBS	
96	SBS	
97	SBS	
98	SBS (MSB)	
99	P0 (Position Identifier)	

[10]Each HDDR label indicates which demodulator delivered the data. All PCD's associated with the time code are delivered by the demodulators; all PCD's are merged in one single time code data stream delivered to all HDDR's.

Bit number 68 (PC18 PCD source flag) changes value every second while the data is being recorded.

Chain 1 indicates demodulators 0 and 2 (HR demod 1 and LR demod 1) Chain 2 indicates demodulators 1 and 3 (HR demod 2 and LR demod 2)

Time Code PCD interpretation

The configuration, as illustrated in Figure 3, offers for both high rate (HR) and low rate (LR) redundancy paths.

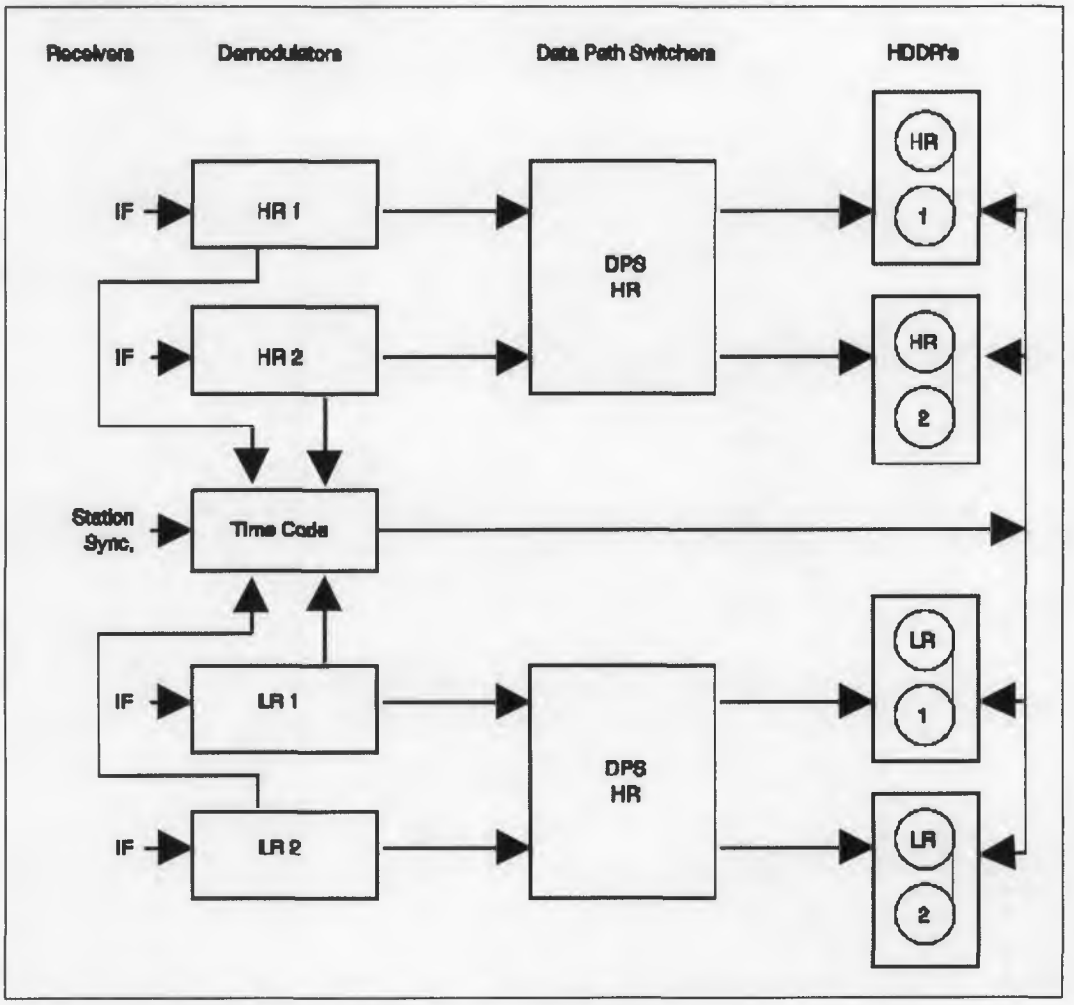

Figure 3 Receiving and recording configuration at EGS

Using the data path switcher, the receiving/recording subsystem can be configured such that one HR demodulator can be assigned to one HR HDDR or to the two HR HDDRs in parallel (nominally if no failure, one HR demodulator is assigned to one HR HDDT and both HR chains operate in parallel). Therefore each HDDR label indicates which of the two demodulators was delivering the data recorded (chain 1 or chain 2);

For the LR part (demodulators + HDDRs) the same applies as for the HR.

All PCDs associated with the time code are delivered by the demodulators; all PCDs are merged in one single time code data stream delivered to all HDDRs.

Each demodulator provides the following PCDs:

- Carrier lock 1 bit;
- Estimate 4 bits (also referred to as E/N_0 dB in Table 7 and Table 8);
- BER estimate 4 bits;
- I channel bit clock lock 1 bit;

- Q channel bit clock lock 1 bit.

Without carrier lock, there is no chance to demodulate the data. AGC and BER are very much correlated; AGC relates to signal strength and BER is associated to modulated signal energy (BER can be used as data quality threshold).

I/Q channel bit clock lock indicates locking of the demodulator clock recovery circuit. This lock is necessary to obtain valid data recording on the HDDTs.

Table 7 Product Confidence Data Definitions, page 1

	PC 3	PC 2	PC 1	PC 0	QPSK											
	PC 13	PC 12	PC 11	PC 10	UQPSK PB (15 Mbps)											
	PC 23	PC 22	PC 21	PC 20							UQPSK RT (1.1 Mbps)					
					E/N_0 dB		BER typ.		Output 0 - 10 V		E/N_0 dB		BER typ.		Output 0 - 10 V	
	MSB			LSB	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
15	1	1	1	1	0.00	2.77	$8x10^{-2}$	*	0	0.642	0.00	8.77	*	*	0	0.642
14	1	1	1	0	2.77	3.54	$4x10^{-2}$	*	0.642	1.283	8.77	9.54	*	*	0.642	1.283
13	1	1	0	1	3.54	4.30	$2.5x10^{-2}$	$8x10^{-2}$	1.283	1.916	9.54	10.30	*	*	1.283	1.916
12	1	1	0	0	4.30	5.07	$1.5x10^{-2}$	$5x10^{-2}$	1.916	2.556	10.30	11.07	$1x10^{-5}$	$3x10^{-4}$	1.916	2.556
11	1	0	1	1	5.07	5.84	$8x10^{-3}$	$3x10^{-2}$	2.556	3.199	11.07	11.84	$4.5x10^{-6}$	$8x10^{-5}$	2.556	3.199
10	1	0	1	0	5.84	6.60	$3.5x10^{-3}$	$1.5x10^{-2}$	3.199	3.833	11.84	12.60	$4x10^{-7}$	$2x10^{-5}$	3.199	3.833
9	1	0	0	1	6.60	7.38	$1.5x10^{-2}$	$8x10^{-3}$	3.833	4.483	12.60	13.38	$> 1x10^{-7}$	$3x10^{-6}$	3.833	4.483
8	1	0	0	0	7.38	8.14	$5x10^{-4}$	$3.5x10^{-3}$	4.483	5.116	13.38	14.14	$> 1x10^{-7}$	$4x10^{-7}$	4.483	5.116
7	0	1	1	1	8.14	8.91	$1.5x10^{-4}$	$1.5x10^{-3}$	5.116	5.758	14.14	14.91	$> 1x10^{-7}$	$> 1x10^{-7}$	5.166	5.758
6	0	1	1	0	8.91	9.68	$4x10^{-5}$	$5x10^{-4}$	5.758	6.399	14.91	15.68	$> 1x10^{-7}$	$> 1x10^{-7}$	5.758	6.399
5	0	1	0	1	9.68	10.45	$1x10^{-5}$	$1.5x10^{-4}$	6.399	7.041	15.68	16.45	$> 1x10^{-7}$	$> 1x10^{-7}$	6.399	7.041
4	0	1	0	0	10.45	11.22	$2x10^{-6}$	$4x10^{-5}$	7.041	7.683	16.45	17.22	$> 1x10^{-7}$	$> 1x10^{-7}$	7.041	7.683
3	0	0	1	1	11.22	11.98	$> 1x10^{-7}$	$1.5x10^{-6}$	7.683	8.316	17.22	17.98	$> 1x10^{-7}$	$> 1x10^{-7}$	7.683	8.316
2	0	0	1	0	11.98	12.75	$> 1x10^{-7}$	$> 1x10^{-7}$	8.316	8.957	17.98	18.75	$> 1x10^{-7}$	$> 1x10^{-7}$	8.316	8.957
1	0	0	0	1	12.75	13.52	$> 1x10^{-7}$	$> 1x10^{-7}$	8.957	9.607	18.75	19.52	$> 1x10^{-7}$	$> 1x10^{-7}$	8.957	9.607
0	0	0	0	0	13.52	*	$> 1x10^{-7}$	$> 1x10^{-7}$	9.607	10	19.52	*	$> 1x10^{-7}$	$> 1x10^{-7}$	9.607	10

*Legend: * Out of range*

Theoretical Limit for low-rate RT demodulator: $4x10^{-5}$

The absolute accuracy of E/N_0 measurement is: $\pm$ 1.0 dB

The E/N_0 quantification step size is: 0.77 dB

Table 8 Product Confidence Data Definitions, page 2

	PC7	PC6	PC5	PC4	QPSK			
	PC27	PC26	PC25	PC24	UQPSK (PB) (RT)			
					Input level (dBm)		Output (0 - 10 V)	
	MSB			LSB	Min	Max	Min	Max
15	1	1	1	1	**0	-47.44	0	0.625
14	1	1	1	0	-47.44	-44.88	0.625	1.280
13	1	1	0	1	-44.88	-42.32	1.280	1.925
12	1	1	0	0	-42.32	-39.76	1.925	2.562
11	1	0	1	1	-39.76	-37.20	2.562	3.200
10	1	0	1	0	-37.20	-34.64	3.200	3.837
9	1	0	0	1	-34.64	-32.08	3.837	4.475
8	1	0	0	0	-32.08	-29.52	4.475	5.125
7	0	1	1	1	-29.52	-26.96	5.125	5.762
6	0	1	1	0	-26.96	-24.40	5.762	6.400
5	0	1	0	1	-24.40	-21.84	6.400	7.050
4	0	1	0	0	-21.84	-19.28	7.050	7.675
3	0	0	1	1	-19.28	-16.72	7.675	8.385
2	0	0	1	0	-16.72	-14.16	8.385	8.962
1	0	0	0	1	-14.16	-11.60	8.962	9.600
0	0	0	0	0	-11.60	*	9.600	10

The absolute accuracy of Input level measurement is: ± 1.0 dB
The Input level quantification step size is: 2.56 dB

Eb/N_0 versus PCD value

The analogue monitoring voltage used for the frontpanel monitoring of E/N_0 on the (U)QPSK demodulators is also used for the product confidence data.

The same accuracy's as for the frontpanel E/N_0 monitoring are to be taken into account. The PCD interface however is digital 4-bit representation of the E/N_0 estimation. This introduces an extra quantisation uncertainty in the PCD data.

E/N_0 analogue voltage accuracy : absolute accuracy on E/N_0 estimation:
PCD data quantisation: step quantisation : 0.77 dB

Input level versus PCD value

The 4-bit PCD value is derived from the analogue AGC voltage of the QPSK demodulators. The accuracy of the PCD value is determined by the used quantisation step in combination with the accuracy of the analogue AGC voltage

AGC analogue voltage accuracy absolute accuracy on received input level ±1 dB:
PCD data quantisation step quantisation : 2.56 dB

Low rate data (RL)

Raw data products contain data as received from the ERS-2 satellite. No processing or reformatting of data has been performed. All raw data products at the Ground Station are output on tape, either HDDT or CCT. The raw data are annotated with the time of data reception at the Ground Stations and an indication of the quality of reception.

Description:	This data is an exact copy of all data downlinked from ERS-2 on the X-Band Low Rate Link.
Satellite Source:	X-Band, Link 2; that is, AMI wave mode, AMI wind mode, RA data (and scrambled zero data) and IDHT General Header.
Originating Subsystem:	DRR
Product Generation:	All data received in the Ground Stations
Command:	No specific product generation command
On-Line Storage Specification:	Recorded in parallel on two HDDTs. One HDDT is kept in the Ground Stations storage until the Optical Disk has been accepted at the Processing and Archiving Facility. Data of one pass is stored on one HDDT.
Throughput:	All data of every pass
Format and Media:	See Section 'Low Bit Rate Data on HDDT' on page 88.
Comments on Product Confidence:	See High Rate Data.

Fast Delivery Product Descriptions

Fast Delivery products include all products which are disseminated over an electronic telecommunication link from the Stations or from EECF. This includes the following products:

- AMI Image-16-bit (UI16)
- AMI Image-8-bit (UI8)
- AMI Image Noise Statistic and Drift Calibration (UIND)
- AMI Image Chirp Replica (UIC)
- AMI Wave (UWA)
- AMI Wave Noise Statistic and Drift Calibration (UWAND)
- AMI Wave Chirp Replica (UWAC)
- AMI Wind (UWI)
- Radar Altimeter (URA)

AMI Image-16-bit (UI16)

Description:	SAR processed image covering an area of about 100 x 100 km. This is equivalent to the full azimuth swath width (5000 pixels) and 6300 lines. Pixel size is 20 m (ground range) by approximately 16 m (azimuth). The pixel value, proportional to the square root of the image pixel power (magnitude) is represented by 16 bits. Input for this product is On-Ground Range Compressed (OGRC) data. These are data which have been acquired and digitized on the spacecraft prior to range compression and which undergo range compression in the SAR FDP.
Satellite Source:	AMI Image mode
Originating Subsystem:	SAR FDP
Production Generation:	MMCC defines the start time for each product.
Command:	C_GEN_UI
On-Line Storage Specification:	200 minutes
Throughput:	Three AMI Image products, either 8- or 16-bit output pixels, per orbit and per SAR FDP. If both SAR FDPs are in image mode, only 8-bit images can be produced. The throughput requirements are not applicable if the SAR FDP must produce one or more of the following products: Extracted Data Product Instrument Header Product
Format	One product includes: Main Product Header: See Table 5. Specific Product Header: See Table 9. 6300 Product Data Set Records: See Table 10. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 16 bits.
Media:	High-Speed Link

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
1	2	B	Product Confidence Data for Processing[11]. bit 1 - 2: Processing equipment status 0: equipment working 1: degraded mode due to: - product channel not accessible; - display device not accessible; - CCT drive not accessible 2: hardware problem in either the STAR array processor or the APTEC image disk. bit 3: PRF code change flag 0: same PRF code for entire image 1: PRF value changed at least once bit 4: Sampling window change flag 0: same sampling window for entire image 1: sampling window changed at least once bit 5: Calibration system and receiver gain change flag 0: same system and receiver gain for entire image 1: system or receiver gain changed at least once bit 6: Chirp replica quality flag[12] 0: cross-correlation pulse width, first side lobe and ISLR all less than MMCC/EECF-specified values. 1: the correctly extracted chirp quality exceeds specified values bit 7: Input data statistic flag[13]	N/A

[11]The Product Confidence Data for Processing bits do not cause the MPH summary bit to be set

[12]Chirp Replica Quality flag (field 1, bit 6): see fields: 1, 8, 9 and 10. These fields refer to chirp cross-correlation. This means cross-correlation with an MMCC/EECF-supplied nominal chirp. These fields are only valid if the chirp replica is successfully extracted and is used (i.e. field 27, bit = 0). When field 27, bit 1 = 1, meaning that the chirp replica is not extracted successfully, then the cross-correlation values. fields 8, 9 and 10 will be set to 0. Also, if field 1 (bit 6) is set (ie. chirp quality failed) then the values in fields 8, 9 and 10 have no significance. The values given in fields 8, 9 and 10 are calculated on the assumptions that the chirp baseband and the chirp extraction index are correct.

The chirp replica quality flag is raised for a correctly extracted chirp, when either of the chirp quality figures (3dB width, sidelobe or ISLR - respectively fields 8, 9 or 10) is greater then the threshold values set by MMCC/EECF.

[13]Input Data Statistic flag (field 1, bit 7): The dynamic range depending on the number of bits per samples, the following example is given for 5 bits. For 5 bits the values vary from 0 to 31, i.e. an expected mean value of 15.5. When MMCC/EECF gives a threshold of x\% of dynamic range centre, it is understood as specifying a range of: ± x/2 % around 15.5. The MMCC/EECF threshold of y % for the standard deviation is understood as y % of 31.

The input data statistics flag is set = 1 :

if ((abs(IN_MEAN_I - dynamic range/2) > mean I threshold % of dynamic range)

.or. (abs(IN_MEAN_Q - dynamic range/2) > mean Q threshold % of dynamic range)

.or. (IN_STDEV_I > std. dev. I threshold % of dynamic range)

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
			0: mean of I and Q input values are both within MMCC/EECF-specified percentage of dynamic range centre, and standard deviation values of I and Q input values are both greater than MMCC/EECF-given percentage of dynamic range 1: (flag is set) otherwise bit 8: Doppler centroid confidence measure flag 0: confidence measure ≤ MMCC/EECF-specified value 1: confidence measure > MMCC/EECF-specified value bit 9: Doppler centroid value flag 0: centroid absolute value ≤ PRF/2 1: centroid absolute value > PRF/2 bit 10: Doppler ambiguity confidence measure flag 0: confidence measure ≥ MMCC/EECF-specified value 1: confidence measure < MMCC/EECF-specified value bit 11 Output data mean flag[14]. 0: mean and standard deviation both greater than MMCC/EECF-specified percentage of dynamic range 1: otherwise bit 12 - 16: Spare	
2	4	I4	Subsatellite Track Heading (relative to North) at mid-azimuth position of product	10^{-3} deg

.or. (IN_STDEV_Q > std. dev. Q threshold % of dynamic range))

where:

IN_MEAN_I is SPH byte 37-40 + OGRC/OBRC I bias

IN_MEAN_Q is SPH byte 41-44 + OGRC/OBRC Q bias

IN_STDEV_I is SPH Byte 45-48

IN_STDEV_Q is SPH Byte 49-52

The dynamic range for image OBRC is 63, for image OGRC is 31, for wave OBRC is 15, and for wave OGRC is 3.

[14]Output Data Statistics flag (field 1, bit 11). The mean and standard deviation of the output intensity of part of a complete image (typically 1/15 th) are computed but not reported. The actual values are compared to MMCC/EECF given thresholds to set the bit 11 of field 1.

The bit is set = 1 :

if ((output mean < mean threshold % of dynamic range) .or.

(output std. dev. < std. dev. threshold % of dynamic range))

The output mean is given by SPH byte 241-244, the output standard deviation is given by byte 245-248. The dynamic range is 255 for UI8 and 65535 for UI16, IWA, and UWA.

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
3	2	I2	Number of PRF code changes for test. During an imaging sequence no PRF changes are to be expected	
4	2	I2	Number of sampling window time changes	
5	2	I2	Sum of number of calibration sub-system and receiver gain changes	
6	2	I2	Number of missing lines	
7	2	I2	Spare	
8	4	I4	3-dB pulse width of chirp replica cross-correlation function[12].	10^{-3}
9	4	I4	First side lobe level of pointchirp replica cross-correlation function[12].	10^{-3} dB
10	4	I4	ISLR of chirp replica cross-correlation function[12].	10^{-3} dB
11	4	I4	Doppler centroid confidence measure. This is the goodness of fit between the Doppler data and the beam replica. A value of zero results when there is a perfect match between the Doppler data and the replica. A value of one represents the worst possible fit.	10^{-3}
12	4	I4	Doppler ambiguity confidence measure[15]. This is a measure of the peak of the matched filter output for the predicted Doppler ambiguity offset. This value is normalized : 1: best case ; 0: worst case.	10^{-3}
13	4	I4	Unbiased Mean of uncorrected I data	10^{-3}
14	4	I4	Unbiased Mean of uncorrected Q data	10^{-3}
15	4	I4	Standard Deviation of I input data	10^{-3}
16	4	I4	Standard Deviation of Q input data	10^{-3}
17-26	40	I4	Scene Latitudes and Longitudes[16].	
17	4	I4	Geodetic latitude of the first pixel of the first line of the scene product. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
18	4	I4	East longitude (i.e. 360° from Greenwich to east) of the first pixel of the first line of the scene product.	10^{-3} deg
19	4	I4	Geodetic latitude of last pixel of the first line of the scene product	10^{-3} deg
20	4	I4	East longitude of the last pixel of the first line of the scene product	10^{-3} deg
21	4	I4	Geodetic latitude of last pixel of the last line of the scene product	10^{-3} deg
22	4	I4	East longitude of the last pixel of the last line of the scene	10^{-3} deg

[15]Field 12 is not used in wave mode products.

[16]Latitudes and Longitudes. The latitudes and longitudes always refer to the image frame (6300 by 5000 pixels) independent of the size of the actual data contained within the frame.

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
			product	
23	4	I4	Geodetic latitude of first pixel of the last line of the scene product	10^{-3} deg
24	4	I4	East longitude of the first pixel of the last line of the scene product	10^{-3} deg
25	4	I4	Geodetic latitude of center pixel of the scene product	10^{-3} deg
26	4	I4	East longitude of the center pixel of the scene product	10^{-3} deg
27	1	B	Origin of used chirp[17] (not applicable for OBRC) bit 1 means: 0: chirp replica used derived from data (field 28) 1: default chirp from MMCC/EECF (field 29-37)	
28	2	I2	Chirp extraction index	samples
29	4	I4	Chirp amplitude coefficient-constant	
30	4	I4	Chirp amplitude coefficient-linear	per sec
31	4	I4	Chirp amplitude coefficient-quadratic	10^{5} sec^{-2}
32	4	I4	Chirp amplitude coefficient-cubic	10^{10} sec^{-3}
33	4	I4	Chirp amplitude coefficient-quartic	10^{15} sec^{-4}
34	4	I4	Chirp phase coefficient[18]-constant a0	10^{-6} cycles
35	4	I4	Chirp phase coefficient- linear a1	Hz
36	4	I4	Chirp phase coefficient-quadratic a2	10^{-6} Hz/s
37	4	I4	Chirp phase coefficient-cubic a3	10^{-12} Hz/s^2
38	4	I4	I bias for raw data correction[19].	10^{-3}
39	4	I4	Q bias for raw data correction.	10^{-3}
40	4	I4	I/Q Standard Deviation Ratio for raw data correction	10^{-3}
41	4	I4	Output pixel bit length (8 or 16) applicable for UI16 and UI8 products only: 0: Wave Mode product	

[17]Origin of used chirp: In case of requested chirp from telemetry but extraction fails, the default chirp from MMCC/EECF is used instead.

[18]Chirp phase coefficient: The chirp phase is expressed in radians: $\exp\{\phi\} = \exp\{2\pi \times (a0 + a1 \times t + a2 \times t^2 + a3 \times \ldots)\}$. Since the unit of ϕ is radians, the expression (.....) is dimensionless. This implies that a1 must have the dimension of $1/t$, a2 that of $1/t^2$, etc. The corresponding units used are Hz, Hz/s, etc.

[19]Raw Data Correction (fields 38 to 40) indicate the values before correction of the raw data i.e. are still biased unsigned integers. They are the same as the biases provided by MMCC (in the EXT_SAR table) and they include the nominal encoding bias (Image OGRC=16; Image OBRC=32; Wave OGRC=2; Wave OBRC=8).

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
			8: UI8 product 16: UI16 and II16 product	
42	4	I4	16-to-8-bit conversion coefficient for output pixel-constant[20].	10^{-3}
43	4	I4	16-to-8-bit conversion coefficient - linear[20].	10^{-6}
44	4	I4	16-to-8-bit conversion coefficient - quadratic[20].	10^{-9}
45	4	I4	Calibration System Gain (telemetry value)	
46	4	I4	Receiver Gain (telemetry value)	
47	4	I4	Normalized clutter noise estimate[21] (UWA only).	10^{-3}
48	4	I4	For UWA only: max. of UWA spectrum components before normalization. For other products: Reserved for ESA usage.	
49	4	I4	Range pixel spacing. Slant range pixel spacing for II16. Ground range pixel spacing for UI16, UI8, and IWA.	10^{-3} m
50	4	I4	Azimuth pixel spacing	10^{-3} m
51	4	I4	Pulse Repetition Frequency	10^{-3} Hz
52	4	I4	2-way slant range time of the first processed range cell	nsec
53	4	I4	Doppler centroid value at near range	10^{-3} Hz
54	4	I4	Slope of Doppler centroid over 2-way slant range time	Hz/ sec
55	4	I4	Azimuth FM rate at near range	10^{-3} Hz/ sec
56	4	I4	Slope of azimuth FM rate over 2-way slant range time	10^{-3} Hz/s^2
57	2	I2	Doppler ambiguity number	--
58	4	I4	Calibration coefficient (antenna), constant term	10^{-3}
59	4	I4	Calibration coefficient (antenna), linear term	10^{-6}
60	4	I4	Calibration coefficient (antenna), quadratic term	10^{-9}
61	4	I4	Calibration coefficient, spare term	
62	4	I4	Calibration coefficient, spare term	
63	2	I2	EXT_SAR parameter table ID	
64	1	I1	Datation improvement (for UI16, UI8 and II16 only) 0: successfully performed 1: attempted but failed	
65	2	I2	SARFDP Static Transfer Function Table ID (UWA only)	
66	2	I2	SARFDP Parameter Database ID	

[20] Applicable for UI8 products only, the coefficients in fields 42, 43 and 44 are used to convert from 16-bit pixels to 8-bit pixels.

[21] Clutter Noise (fields 47 and 48): For the case of UWA the normalization equations are: clutter = clutter * 255 / max_of_spectrum and spectrum_component = spectrum_component * 255 / max_of_spectrum.

Table 9 Specific product header for UI16, UI8, UWA and IWA

Field	Bytes	Type	Description	Units
67	4	I4	Output image mean (Only valid for UI16, UI8, II16, IWA)	10^{-3}
68	4	I4	Output image standard deviation (Only valid for UI16, UI8, II16, IWA)	10^{-3}
69	4	I4	Range compression scalar gain	10^{-5}
70	4	I4	Azimuth FFT scalar gain	10^{-5}
71	4	I4	Azimuth compression scalar gain	10^{-5}
72	4	I4	Overall processing gain. Includes all the gains in fields 69, 70 and 71 and the scaling due to look summation. Only valid for 16 bit images (not valid for UI8).	10^{-5}

Table 10 Data Set Record for UI16

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	10,000	I2	Processed image mode data samples. There are 5000 samples per record. A sample is represented as a 16-bit integer. The most significant bit is not used and set to zero.	

AMI Image-8-bit (UI8)

Description:

SAR processed image covering an area of about 100 x 100 km. This is equivalent to the full azimuth swath width (5000 pixel) and 6300 lines. Pixel size is 20 m (ground range) by approximately 16 m (azimuth). The pixel value, proportional to the square root of the image pixel power (magnitude) is represented by 8 bits.

The data are processed with 16 bits per pixel and are reduced to 8 bits for dissemination. The reduction from 16 to 8 bits is done using coefficients defined by MMCC/EECF. Whether an image is to be produced in 8 or 16 bits is determined by the generation command prior to processing.

Input for this product is OGRC data.

All product parameters are the same as for AMI Image (16-bit) FD Product, except that one pixel is represented by 8 bits.

Format

Product Data Set: See Table 11. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 8 bits.

Table 11 Data Set Record for UI8

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1	
2	5000	I1	Processed image mode data samples. There are 5000 samples per record. A sample is represented as an 8-bit integer.	

AMI Image noise stat. & drift calibr. (UIND)

Description: The data for one single product can be extracted either at the beginning or at the end of a measurement sequence. The product contains mean magnitude and standard deviation of the extracted noise data, and four calibration pulses.

Satellite Source: AMI Image mode

Originating Subsystem: SAR FDP

Production Generation: Generated upon MMCC/EECF commands, which must specify from where the data shall be extracted. The UIND product can be generated either as a stand-alone command or together with a UI16 or UI8 command. In the latter case, the UIND product is done during azimuth processing of the image product.

Command: C_GEN_UIND, and C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: maximum two products per orbit

Format

One product includes:

Main Product Header: See Table 5.

Specific Product Header: See Table 12. The SPH contains the noise data statistics.

Four Product Data Set Records: One data set record contains one complete pulse and is described in Table 13. The records are stored in ascending time order. If a complete pulse cannot be extracted, zeroes are placed in the data set record.

Media: High-Speed Link to user community and MMCC/EECF Link

Table 12 Specific Product Header for UIND, UWAND

Field	Bytes	Type	Description	Units
1	4	I4	Mean of uncorrected I noise data	10^{-3}
2	4	I4	Mean of uncorrected Q noise data	10^{-3}
3	4	I4	Standard deviation of I noise data	10^{-3}
4	4	I4	Standard deviation of Q noise data	10^{-3}
5	4	I4	Number of noise lines extracted	--
6	4	I4	Calibration System Gain (telemetry value)	--
7	4	I4	Receiver Gain (telemetry value)	--

Table 13 Data Set Record for UIND

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	1536	I1	768 Calibration pulse samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers.	

AMI Image chirp replica (UIC)

Description: This product contains two chirps, i.e. two sets of samples of the transmitted pulse. For each image scene, one chirp is extracted from the beginning, and one at the end, of the auxiliary data to be processed.

Satellite Source: AMI Image mode

Originating Subsystem: SAR FDP

Production Generation: Automatically generated for every requested AMI Image User FD product; i.e. up to 3 per orbit.

Command: C_GEN_UI

On-Line Storage Specification: 200 minutes

Throughput: same as AMI Image User FD products

Format One product includes:

Main Product Header: See Table 5.

Two Product Data Set Records: One record contains one chirp. The first record is from the beginning and the second from the end of the image scene. The records are described in Table 14.

Media: MMCC Link or EECF Link.

Table 14 Data Set Record for UIC, UWAC

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	1536	I1	Chirp replica samples. There are 768 samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers.	

AMI Image PCD's and Product Annotations

As far as AMI IMAGE MODE Product Confidence Measures (PCD's) and product annotations are concerned there is no difference between

- UI16: image 16 bits per pixel and
- UI8 : image 8 bits per pixel.

In both products one record corresponds to one range line.

The SAR FD processor doesn't ingest 27,000 lines after t1, but converts the requested time interval (t1,t2) into a number of lines. The product format being fixed, the missing lines (when the actual number of ingested lines is less than 27,000) are filled with zeros. The product localization still corresponds to the 27,000 lines (4 corners).

PCD at Main Product Header level.

A summary of the PCD at main product header is given in the field 6 of the MPH.

- bit 1 : the product is considered as correctly generated when none of the bits 2 to 16 of the MPH field 6 has been raised.

PCD at Specific Product Header (SPH) level.

Most of the PCD measurements are reported at specific product header level, see See Table 9; additional explanations are hereafter included:

Processing equipment status flag (field 1, bits 1 + 2): the value 2 will never show in an actual product, because under such circumstances, no product is generated.

PRF code change flag (field 1, bit 3): the value of the PRF is read in the telemetry and checked for consistency (see paragraph : SAR FDP input error handling): the first line to be processed is the first line with satellite binary time (SBT, greater than or equal to the start time in the processing command.

Furthermore, the first two lines are ensured to have identical PRF code, sampling window start time code calibration system gain code, receiver gain code and satellite binary code.

The nominal situation is that no PRF change occurs during the processing of a given image. The code is considered to change if there are two consecutive valid lines with identical code which is different from the previous one. Should more than one PRF value be observed, the bit 3 of field number one shall be raised. The actual number of PRF changes within and image is reported in field 3.
Remark: The changes of this parameter value are observed, but the first value, accepted as valid (see error handling), is kept constant during the processing of a given product.

Sampling window change flag (field 1, bit 4): Exactly the same as for the PRF (see above). Actual number of changes is reported in field 4.
Remark: the changes of this parameter value are observed but the first value accepted as valid (see error handling) is kept constant during the processing of a given product.

Calibration system and receiver gain change flag (field 1, bit 5): Exactly the same as for the PRF (see above). Actual number of changes is reported in field 5.
Remark: the changes of this parameter value are observed but the first value accepted as valid (see error handling) is kept constant during the processing of a given product.

Number of missing lines: (field 6). See also paragraph on SAR FDP input data error handling.
The number corresponds either to the number of missing lines (image mode) or missing source packets (wave mode). The identified missing data are padded with zeroes before processing.

For image mode these lines of zeroes are inserted after range compression is completed, that is after the data is unpacked, range compressed and converted to 8 I, 8 Q signed data.

The SAR FDP uses the format counter to detect missing lines with proper account for format counter wrap around (16 bit counter).
The SAR always generates 6300 image records; if there is not enough input data to generate the full scene, the image is padded with zeroes up to 6300 records.

Doppler centroid confidence measure: (fields 1, 11, 12, 53, 54 and 57). Principle of the measurements: The across-track variation of the position of the centroid of the Doppler spectrum is approximated by a first order polynomial, as follows;

For a number M of contiguous azimuth lines, the Doppler centroid is estimated and the M estimates are averaged. This operation is repeated N times across swath. A first order polynomial is then fitted to the N estimates (straight line approximation). This straight line is described by two parameters:

- Doppler centroid value at near range in Hz
- Slope of Doppler centroid across track in Hz/sec.

The two values are reported in fields 53 and 54.

Doppler centroid confidence measure flag (field 1, bit 8): The actual value in field 11 is compared to a predicted maximum value.

Doppler centroid value flag (field 1, bit 9): The actual value in field 53 is compared to a predicted maximum value.

Doppler ambiguity confidence measure flag (field 1, bit 10): The actual value in field 12 is compared to a predicted maximum value.

Doppler centroid goodness of fit: The difference between the beam pattern and the actual Doppler spectrum (both supposed Gaussian), is expressed by calculating the chi-square value of these two distributions. The measure is normalized as follows: Therefore a perfect fit gives a value of zero. The misfit corresponding to a maximum distance (PRF/2) between the 2 Gaussian distribution is given a value of 1. The value is reported in field 11.

Doppler ambiguity confidence measure: To ensure a correct radiometric value of the output pixels, it is mandatory to process the spectrum corresponding to the area actually in the center of the beam illumination. The spectrum of a sampled signal being:

$$S(f \pm n \times PRF)$$

(PRF being the sampling frequency), the Doppler ambiguity removal unit determines the actual value of n, by measuring the misregistration of two looks, in range. The misregistrations corresponding to n = -1,0,1, the value of zero being the expected position, are calculated. The two highest values max1 and max2 are used to form a confidence measure:

(max1 - max2)/max1
where max1 < max2.

This value is reported in field 12. The value of n corresponding to the highest correlation peak is reported in field 57:

-1	centroid between	-3 × PRF/2 and -PRF/2
0		-PRF/2 and PRF/2
1		PRF/2 and 3 × PRF/2 etc.

Remark: the value is the offset to the expected value.

Input data statistics: (fields 1, 13, 14, 15, 16, 38 to 40). The I and Q parts of each sample, which may be positive or negative, are biased positive prior to Analog to Digital Conversion. As a result each complex sample after digitization is represented by two N-bit unsigned integers, where N has the following values;

OGRC wave mode echo and noise data	2
OBRC wave mode echo and noise data	4
OGRC image mode echo and noise data	5
All chirp replica and drift calibration pulse data	6

Since the real and imaginary parts are biased, the mean of all I and Q data sequences will be approximately $2^{N-1}/2$. The two (assumed) orthogonal channels are noted I and Q. For all samples of these channels, the following quantities are estimated:

Field 13 <I> (<> denotes the average)
Field 14 <Q>
Field 15 <I × I> - <I> × <I>
Field 16 <Q × Q> - <Q> × <Q>

Raw Data Correction (fields 38 to 40) indicate the values before correction of the raw data i.e. are still biased unsigned integers. They are the same as the biases provided by MMCC (in the EXT_SAR table) and they include the nominal encoding bias (Image OGRC=16; Image OBRC=32; Wave OGRC=2; Wave OBRC=8).

Field 38 mean of the I channel
Field 39 mean of the Q channel
Field 40 imbalance between I and Q channels, defined as ratio std(I)/std(Q).

To perform raw data correction, the processor subtracts the respective means from the I and Q parts of each data sample. It then multiplies the Q part of each sample by the I/Q standard deviation ratio value. (The SAR FDP performs no correction for non-orthogonality of the I and Q demodulation channels).

Actual chirp replica (fields 27-37): The range compression is performed using either a replica sent to the station (field 27) or a replica extracted from the raw data themselves (fields 28-37). The chirp replica is sent to the stations by means of nine coefficients (fields 29 to 37):

- chirp amplitude (5 coefficients of a fourth order polynomial representation)
- chirp phase (4 coefficients of a third order polynomial representation)

If the chirp replica is extracted from the raw data themselves the required chirp extraction index parameter is sent to the station.
The value of the extraction index parameter (field 28) is:

index = 1 + offset,

where index and offset are numbers of complex samples, and offset points to the position of the start of the chirp samples within the receiving window.
Remark: sample numbers start at 1.

Use of the chirp index

The chirp index parameter is part of the product generation command but it is only used if the range matched filter is to be generated using the extracted chirp.

The processor extracts 710 chirp elements out of the available 768 elements; the location of the extracted elements is determined by the index parameter. If the offset is zero, the processor extracts 710 elements starting from the first element.

A chirp is valid if it is extracted from 24 contiguous range lines. The bit which indicates the first four segments of the chirp replica (bit 3 of byte 23 in telemetry format) is ensured to be set in the first four of the 24 contiguous range lines.

The processor only uses the extracted chirp to generate the matched filter. It does not do any analysis to estimate the chirp coefficients. If the range matched filter is to be generated using MMCC/EECF parameter, the processor will use the MMCC/EECF supplied chirp coefficients: the index parameter is not used at all in this case.

The chirp replica is represented in 6-bit complex unsigned binary form (see input data statistics).

As mean values for correction are not delivered by the MMCC/EECF for the chirp, a value of 31 +j 31 is subtracted from each complex chirp sample to remove the A to D conversion bias. No gain mis match correction is performed.

The following measurements are performed, on the autocorrelation of the actual replica function, used for range compression (in FD processing, only one range replica function is used for the whole image):

- 3-dB pulse width:
  First side lobe: The left and right side lobes are measured and the highest value reported.
  Remark: the sidelobes of the autocorrelation function have to be symmetric.

- ISLR of the reference chirp, provided by MMCC/EECF, and the downlinked chirp cross-correlation function: The 1-D ISLR is computed as follows:
  The chirp peak is in the middle of 32 samples.
  The peak energy is obtained by summation within plus or minus 1.5 ± (3 dB Width). The ISLR is then: 2 ± sum from x to 16,
  where x = 1.5 ± (3 dB Width) samples.

PCD at Data Set Record level.

For both UI16 and UI8 there is no PCD value at record level.

AMI Wave (UWA)

Description: Power spectrum in polar coordinates. The power spectrum is based on a sample of data covering an area of at least 5 x 5 km. The instrument on the satellite collects data at intervals of approximately 200 to 300 km. The sample patch may be anywhere in the 100-km wide swath in the order of 2 km steps. Input for this product can be OBRC or OGRC data.

Satellite Source: AMI Wave mode

Originating Subsystem: SAR FDP

Production Generation: Products are generated for MMCC/EECF defined start and stop times.

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: 150 products per orbit.

The throughput requirements are not applicable if the SAR FDP must also produce one or more of the following products:

- Extracted Data Product
- Instrument Header Product
- General Header Product

Format One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 9.
- One product Data Set Record: For format see Table 15. The data set contains the mean square value of the intensity of all pixels in one sector. A sector is defined in Figure 4.

Media: MMCC Link or EECF Link.

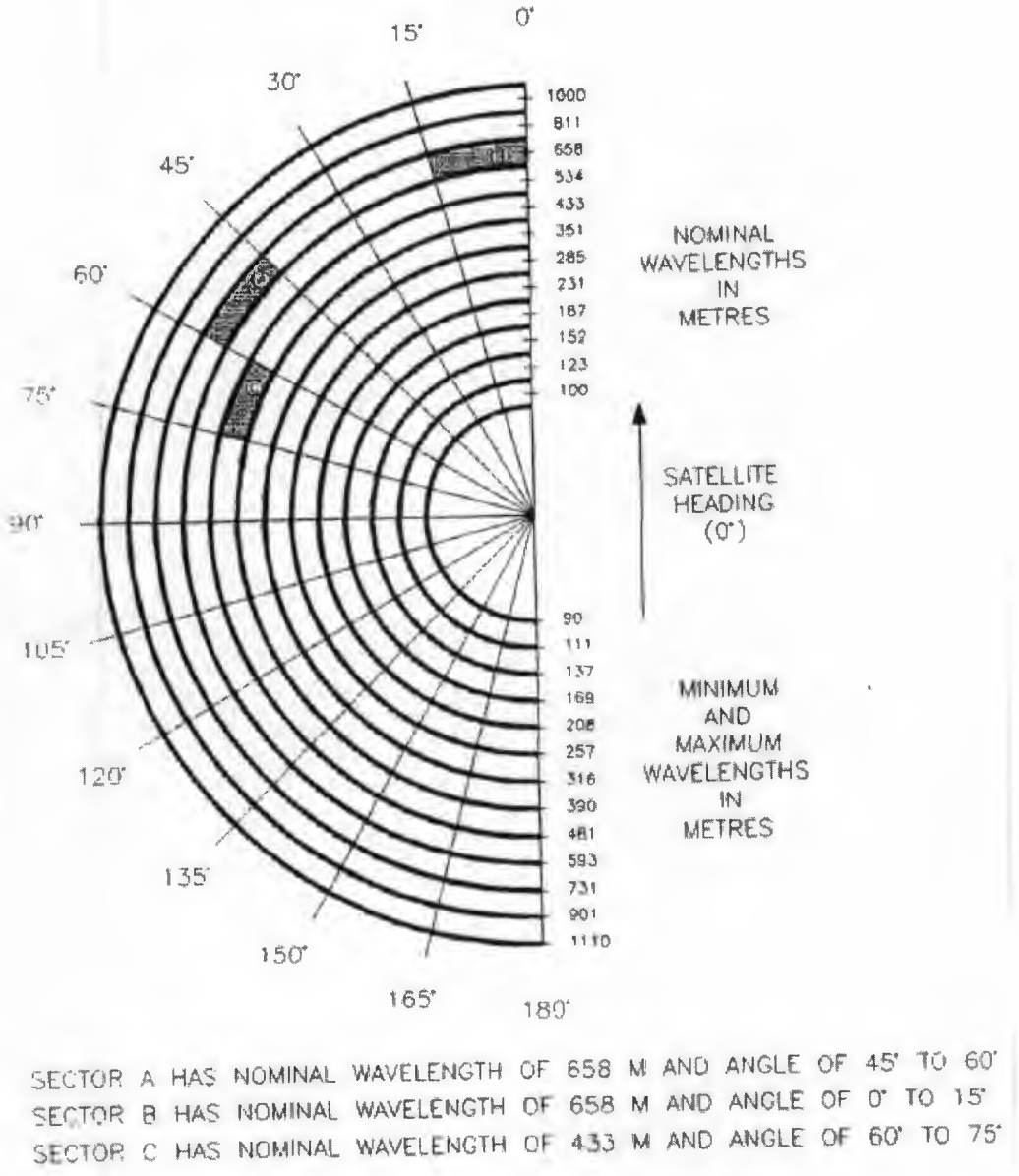

Figure 4 Wave Product Example

Table 15 Data Set Record for UWA

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, this number is always 1.	
2-13	12	I1	Intensity of sector 1 and Heading Range of 0° to 15°	
2	1	I1	Nominal wavelength 100 m Wavelength range 90 m - < 111 m	
3	1	I1	Nominal wavelength 123 m Wavelength range 111 m - < 137m	.
4	1	I1	Nominal wavelength 152 m Wavelength range 137 m - < 169 m	
5	1	I1	Nominal wavelength 187 m Wavelength range 169 m - < 208 m	
6	1	I1	Nominal wavelength 231 m Wavelength range 208 m - < 257 m	
7	1	I1	Nominal wavelength 285 m Wavelength range 257 m - < 316 m	
8	1	I1	Nominal wavelength 351 m Wavelength range 316 m - < 390 m	
9	1	I1	Nominal wavelength 433 m Wavelength range 390 m - < 481 m	
10	1	I1	Nominal wavelength 534 m Wavelength range 481 m - < 593 m	
11	1	I1	Nominal wavelength 658 m Wavelength range 593 m - < 731m	
12	1	I1	Nominal wavelength 811 m Wavelength range 731 m - < 901m	
13	1	I1	Nominal wavelength 1000 m Wavelength range 901 m-< 1110 m	
14-25	12	I1	Intensity of sector 2 and Heading Range of 15° to 30° Wavelengths as for sector 1.	
26-37	12	I1	Intensity of sector 3 and Heading Range of 30° to 45° Wavelengths as for sector 1.	
38-49	12	I1	Intensity of sector 4 and Heading Range of 45° to 60° Wavelengths as for sector 1.	
50-61	12	I1	Intensity of sector 5 and Heading Range of 60° to 75° Wavelengths as for sector 1.	
62-73	12	I1	Intensity of sector 6 and Heading Range of 75° to 90° Wavelengths as for sector 1.	
74-85	12	I1	Intensity of sector 7 and Heading Range of 90° to 105° Wavelengths as for sector 1.	
86-97	12	I1	Intensity of sector 8 and Heading Range of 105° to 120° Wavelengths as for sector 1.	
98-109	12	I1	Intensity of sector 9 and Heading Range of 120° to 135° Wavelengths as for sector 1.	

Table 15 Data Set Record for UWA

Field	Bytes	Type	Description	Units
110-121	12	I1	Intensity of sector 10 and Heading Range of 135° to 150° Wavelengths as for sector 1.	
122-133	12	I1	Intensity of sector 11 and Heading Range of 150° to 165° Wavelengths as for sector 1.	
134-145	12	I1	Intensity of sector 12 and Heading Range of 165° to 180° Wavelengths as for sector 1.	

AMI Wave noise stat. & drift calibr. (UWAND)

Description: Mean magnitude and standard deviation of the noise data, as well as four calibration pulses, extracted at the beginning of a measurement sequence (= scene). It should be mentioned that even when the orbit propagator returns an error code, the raw data are extracted. So within the product the orbit data may be wrong.

Satellite Source: AMI Wave mode

Originating Subsystem: SARFDP

Production Generation: Generated from data of every 15th scene, within each specified processing interval for AMI Wave FD Product generation, starting with the first scene of every processing interval.

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: Ten products per orbit

Format One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: Contains the noise data statistics. See Table 12.
- Four Product Data Set Records: One data set record contains one complete pulse and is described in Table 16. If a complete pulse cannot be extracted, zeroes are placed in the data set record.

Media: MMCC Link or EECF Link

Table 16 Data Set Record for UWAND

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2			Calibration pulse samples. Each sample is represented as 8-bit I, 8-bit Q. Values are unsigned integers.	
	OGRC: 1536	I1	768 samples	
	OBRC: 120	I1	60 samples	

AMI Wave chirp replica (UWAC)

Description:	This product contains one chirp as extracted from the auxiliary data at the beginning of the data to be processed.
Satellite Source:	AMI Wave Mode
Originating Subsystem:	SAR FDP
Production Generation:	Automatically generated for every AMI Wave FD Product
Command:	C_GEN_WA
On-Line Storage Specification:	200 minutes
Throughput:	150 products per orbit
Format	One product includes: • Main Product Header: See See Table 5. • One Product Data Set Record: The single data set record is described in Table 14.
Media:	MMCC Link or EECF Link

Product Confidence

There are no product confidence measures related to the image spectrum itself. However the specific product header is identical to the one of the image mode and therefore contains the same information (see above).

The SAR processor uses the data subset counter and the satellite binary counter (SBT) to check the packet continuity (data subset counter should increment by 1 and SBT by 1 or 2 between packets).

Duplicate packets are discarded and missing packets are replaced with zeroes: the zeroes are inserted before the data is processed, that is, the data is still in packet form.

In the wave mode case, the extracted chirp is valid if it is extracted from 22 contiguous valid packets.

AMI Wind (UWI)

Description:

This product includes the intermediate and final results of the wind product generation. It consists of an array of wind vectors expressed in wind speed and direction. The product corresponds to a 500 x 500-km area. This area is represented by a 19 x 19 array of cells, with nominal 25-km spacing.

The produced wind field corresponds to an equivalent neutral stability wind field, referenced to a height of 10 m. For each cell a wind vector is given together with latitude and longitude. The sigma nought and other information needed to convert these to wind fields are also provided for each cell.

Satellite Source:

AMI Wind Mode

Originating Subsystem:

LRDPF

Production Generation:

Products are generated for MMCC/EECF- defined start and stop times with reference to the midbeam.

Command:

C_GEN_WI

On-Line Storage Specification:

200 minutes

Throughput:

70 products per orbit

Format

Format: One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 17.
- 361 Product Data Set Records: One cell is stored in one record. See Table 18.

  Cells are stored in ascending time order within each cell line across-track; cells closer to the satellite track precede farther cells.

Media:

MMCC Link or EECF Link.

Comment on Product Confidence:

Product confidence is monitored on a product-wide and cell basis. Factors which apply to the entire product, are included in the SPH:

- Doppler Compensation accuracy (power spectrum monitoring) for each beam
- Mean power on I and Q Channel for each beam
- Internal Calibration level for each beam.

Table 17 Specific Product Header for UWI[22]

Field	Bytes	Type	Description	Units
1	2	B	Product Confidence Data for Processing bit 1 & 2: Processing equipment status 0: equipment working 1: some problems with equipment 2: equipment failed during product generation bit 3: Spare bit 4: I/Q Imbalance Flag 0: all beams better than MMCC/EECF-defined threshold 1: any beam above or equal to MMCC/EECF-defined threshold bit 5: Internal Calibration level flag 0: all beams within MMCC/EECF-defined level window 1: any beam out of MMCC/EECF-defined level window bit 6: Blank Product Flag 0: data available 1 no data available bit 7: Doppler Compensation: Center of Gravity flag 0: all beams below MMCC/EECF defined threshold 1: any beam above or equal to MMCC/EECF-defined threshold bit 8: Doppler Compensation: Standard Deviation flag 0: all beams below MMCC/EECF defined interval 1: any beam outside MMCC/EECF-defined interval bit 9 - 16: Spare	N/A
2	4	I4	Geodetic latitude of Product Center; A negative value denotes South latitude, and a positive value denotes North latitude.	
3	4	I4	East longitude (i.e. 0-360°) from Greenwich to East)	10^{-3} deg
4	4	I4	Subsatellite Track Heading w.r. to North, turning clockwise 0at time of product center	10^{-3} deg
5	2	I2	Mean distance between two successive along track nodes at product center	meter
6	2	I2	Center of Gravity of averaged power spectrum (forebeam)	2.344 Hz[23]
7	2	I2	''Standard Deviation'' of averaged power spectrum (forebeam)	2.344 Hz

[22]Refer to notes after Table 4-18 for parameter values in the case that these cannot be calculated.

[23]The units in fields 6 to 11 have units of 2.344 Hz, while 234.4 Hz represents the frequency discretisation.

Table 17 Specific Product Header for UWI[22]

Field	Bytes	Type	Description	Units
8	2	I2	Center of Gravity of averaged power spectrum (midbeam)	2.344 Hz
9	2	I2	''Standard Deviation'' of averaged power spectrum (midbeam)	2.344 Hz
10	2	I2	Center of Gravity of averaged power spectrum (aftbeam)	2.344 Hz
11	2	I2	''Standard Deviation'' of averaged power spectrum (aftbeam)	2.344 Hz
12	4	I4	I Mean Noise Power, forebeam	10^{-3} ADC units
13	4	I4	Q Mean Noise Power, forebeam	10^{-3} ADC units
14	4	I4	I Mean Noise Power, midbeam	10^{-3} ADC units
15	4	I4	Q Mean Noise Power, midbeam	10^{-3} ADC units
16	4	I4	I Mean Noise Power, aftbeam	10^{-3} ADC units
17	4	I4	Q Mean Noise Power, aftbeam	10^{-3} ADC units
18	4	I4	Internal Calibration level monitoring factor, forebeam	10^{-3} ADC units
19	4	I4	Internal Calibration level monitoring factor, midbeam	10^{-3} ADC units
20	4	I4	Internal Calibration level monitoring factor, aftbeam	10^{-3} ADC units
21	2	B	Mode of operation - set by the first midbeam source packet contributing to spatial filtering for the first node (near swath) in the center row of a product. bit 1 and 2: 0: windmode 1: wind/wave mode 2: no data found to identify mode	
22-71	82	I2	Parameter Table ID. Details as follows:	
22	2	I2	Global threshold Parameter Table ID	
23	2	I2	Static parameter Parameter Table ID	

Table 17 Specific Product Header for UWI[22]

Field	Bytes	Type	Description	Units
24	2	I2	Dynamic parameter Parameter Table ID	
25	2	I2	F $R_b(n)$ Parameter Table ID	
26	2	I2	$T_{orbit,ref,D}$ Parameter Table ID	
27	2	I2	ϕ_F Parameter Table ID	
28	2	I2	ϕ_M Parameter Table ID	
29	2	I2	ϕ_A Parameter Table ID	
30	2	I2	F $T_b(n)$ Parameter Table ID	
31	2	I2	$C_{ADC,b}(n)$ Parameter Table ID	
32	2	I2	$T_{orbit,ref,N}$ Parameter Table ID	
33	2	I2	$F_{N,F}$ Parameter Table ID	
34	2	I2	$F_{N,M}$ Parameter Table ID	
35	2	I2	$F_{N,F}$ Parameter Table ID	
36	2	I2	$\theta_{N,b}(j,k)$ Parameter Table ID	
37	2	I2	$\phi_{N,b}(j,k)$ Parameter Table ID	
38	2	I2	$M_{eff,b}(j,k)$ Parameter Table ID	
39	2	I2	N(j,k) Parameter Table ID	
40	2	I2	Wind extraction software configuration Table ID	
41	2	I2	$LA_b(i_r,i_c)$ Parameter Table ID	
42	2	I2	$LZ_b(i_r,i_c)$ Parameter Table ID	
43	2	I2	LN_b Parameter Table ID	
44	2	I2	MA_b Parameter Table ID	
45	2	I2	MS_b Parameter Table ID	
46	2	I2	$NA_F(\upsilon,i_c)$ fore Parameter Table ID	
47	2	I2	$NA_M(\upsilon,i_c)$ mid Parameter Table ID	
48	2	I2	$NA_A(\upsilon,i_c)$ aft Parameter Table ID	
49	2	I2	$NS_F(\upsilon,i_c)$ fore Parameter Table ID	
50	2	I2	$NS_M(\upsilon,i_c)$ mid Parameter Table ID	
51	2	I2	$NS_A(\upsilon,i_c)$ aft Parameter Table ID	
52	2	I2	$NN_F(\upsilon,i_c)$ fore Parameter Table ID	
53	2	I2	$NN_M(\upsilon,i_c)$ mid Parameter Table ID	
54	2	I2	$NN_A(\upsilon,i_c)$ aft Parameter Table ID	
55	2	I2	l_{ref} Parameter Table ID	
56	2	I2	$a_F(\mu,i_c)$ fore Parameter Table ID	
57	2	I2	$a_M(\mu,i_c)$ mid Parameter Table ID	

Table 17 Specific Product Header for UWI[22]

Field	Bytes	Type	Description	Units
58	2	I2	$a_A(\mu, i_c)$ aft Parameter Table ID	
59	2	I2	$av_F(k,i_r,i_c)$ fore Param. Table ID	
60	2	I2	$av_M(k,i_r,i_c)$ mid Parameter Table ID	
61	2	I2	$av_A(k,i_r,i_c)$ aft Parameter Table ID	
62	2	I2	i_b Parameter Table ID	
63	2	I2	Spare	
64	2	I2	Spare	
65	2	I2	Meteo Table ID (table type 83, Forecast F18)	
66	2	I2	Meteo Table ID (table type 84, Forecast F24)	
67	2	I2	Meteo Table ID (table type 85, Forecast F30)	
68	2	I2	Meteo Table ID (table type 86, Forecast F36)	
69	2	I2	Spare	
70	2	I2	Spare	
71	2	I2	Spare	

Table 18 Data Set Record for UWI

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	4	I4	Geodetic latitude of Node. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
3	4	I4	East longitude (i.e. 0-360° from Greenwich to east)	10^{-3} deg
4	4	I4	σ° of forebeam[24]	10^{-7} dB
5	2	I2	Incidence Angle for forebeam	0.1 deg
6	2	I2	Look Angle of forebeam[25] clock- wise w.r.t. North at grid point	0.1 deg
7	1	I1	Kp Value of forebeam, set to 255 if the calculation is not possible.	%
8	1	I1	Counter of forebeam corrupted or missing source packets[26]	

[24]It should be indicated that the σ° values, fields 4, 9 and 14, are derived from the linear values by using: $10\log_{10}(linearvalue)$. If beam is not available then the value of sigma_0 is set to -999 999 999.

[25]Look Angle for the three beams, Fields 6, 11 and 16: The beam look angle is defined as the angle between the unit vector tangential to the local meridian and pointing North and the projection of the vector from the centre of cell node to satellite onto the local tangential plane, counting clockwise.

[26]The counter of corrupted or missing source packets, fields 8, 13 and 18, is multiplied by -1 when in wind/wave mode to indicate wind/wave mode operation.
The absolute value of the counter, in wind/wave mode, is always greater than two because the wind/wave mode operation causes two FMA sequences to be lost.

Table 18 Data Set Record for UWI

Field	Bytes	Type	Description	Units
9	4	I4	σ^o of midbeam	10^{-7} dB
10	2	I2	Incidence Angle of midbeam	0.1 deg
11	2	I2	Look Angle of midbeam clock- wise w.r.t. North at grid point .	0.1 deg
12	1	I1	Kp Value of midbeam, set to 255 if the calculation is not possible.	%
13	1	I1	Counter of midbeam corrupted or missing source packets	
14	4	I4	σ^o of aftbeam	10^{-7} dB
15	2	I2	Incidence Angle of aftbeam	0.1 deg
16	2	I2	Look Angle of aftbeam clock- wise w.r.t. North at grid point.	0.1 deg
17	1	I1	Kp Value of aftbeam, set to 255 if the calculation is not possible.	%
18	1	I1	Counter of aftbeam corrupted or missing source packets	
19	1	I1	Wind speed (set to 255 if wind extraction is not possible)	0.2 m/s
20	1	I1	Wind direction[27] with respect to North turning clockwise at grid point (set to 255 if wind extraction is not possible)	
21	2	B	Product Confidence Data[28] bit 1 Summary PCD factor 0: processing of cell according to full specification 1: result to be viewed with limitation, i.e. one of the PCD flags listed below is not 0 (except bits 11-13). bit 2 Forebeam Flag 0: beam OK 1: no forebeam calculation bit 3 Midbeam Flag	N/A

[27]For version 2.502 and onward, starting on date 15 October 1991, the wind direction, field 20, is given in the meteorological sense. The definitions of the wind direction used for version 2.502 and onward and used for versions before 2.502 are shown in Figure 5.

[28]The schematic in Figure 6 is used to unambiguously interprete the Product Confidence Data flags of field 21 of the UWI DSR. It corresponds to one run of the ambiguity removal.

[29]Rank one solution flag,bit 10: The ambiguity removal unit may result or not in a solution. When no ambiguity removal is performed or ambiguity removal is not successful, the solution with the highest probability (rank 1) is given and this flag raised.

[30]Flag on ambiguity removal method, bit 11 - 12: The ambiguity removal unit may or may not make use of external meteorological data. This flag is raised when meteo data are used. This indicator is set independently of the success of the ambiguity removal indicated by bit 10.

[31]Rank 1 is solution of minimum residual. A high occurrence of the bit 13 flag set to 1 is related to a low quality of the model.
Remark: it is necessary to indicate when the ambiguity removal is not attempted. This occurs for instance when the distance (in a maximum likelihood sense) between the measurement and the model is too big or when the number NB of adjacent nodes in a closed area is too small (eg. < 100) to allow for continuity reasoning.

Table 18 Data Set Record for UWI

Field	Bytes	Type	Description	Units
			0: beam OK 1: no midbeam calculation bit 4 Aftbeam Flag 0: beam OK 1: no aftbeam calculation bit 5 Forebeam Arcing Flag 0: no arcing detected on forebeam 1: arcing detected on forebeam bit 6 Midbeam Arcing Flag 0: no arcing detected on midbeam 1: arcing detected on midbeam bit 7 Aftbeam Arcing Flag 0: no arcing detected on aftbeam 1: arcing detected on aftbeam bit 8 Limit of Kp value 0: all beams below MMCC/EECF-supplied threshold 1: any beam above or equal to MMCC/EECF-supplied threshold bit 9 Land-Sea Flag 0: Sea 1: Land bit 10 Rank one solution flag[29]. 0: Ambiguity removed 1: No ambiguity removal performed or ambiguity removal not successful See Note 6. bit 11-12 Ambiguity Removal Method[30] . 0: ambiguity removed autonomously 1: use of meteorological tables after failure of autonomous ambiguity removal 2: ambiguity removed using meteorological data only 3: no ambiguity removal attempted bit 13 Maximum likelihood distance flag[31]. 0: Maximum Likelihood Distance M of the rank 1 solution is less than or equal to a threshold. 1: Maximum Likelihood Distance M of the rank 1 solution (i.e. solution of minimum residual) is greater than a threshold (see note 9). bit 14 Frame Checksum Flag 0: Checksum correct 1: Checksum error detected, noise and calibration replaced with default bit 15 and 16 Spare	

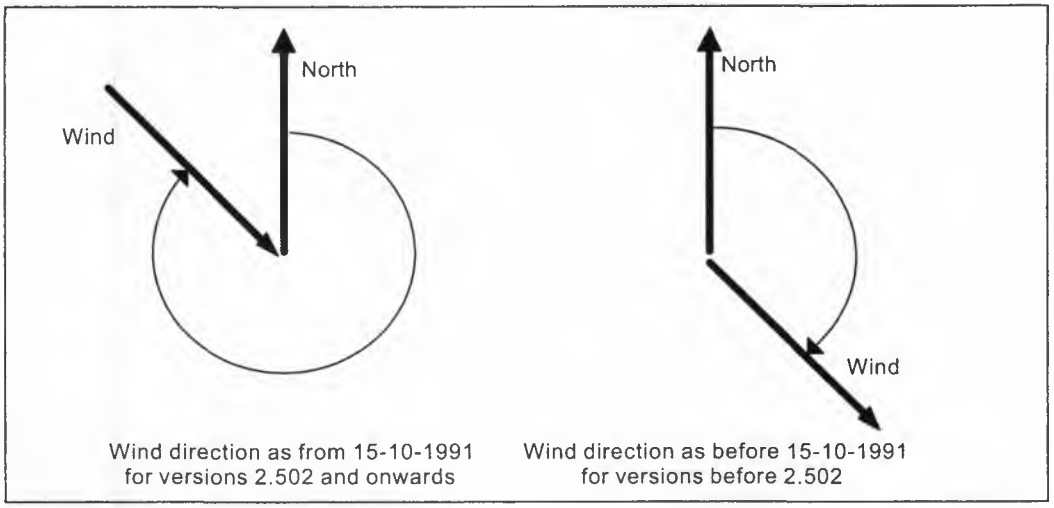

Figure 5 Wind Direction Definitions

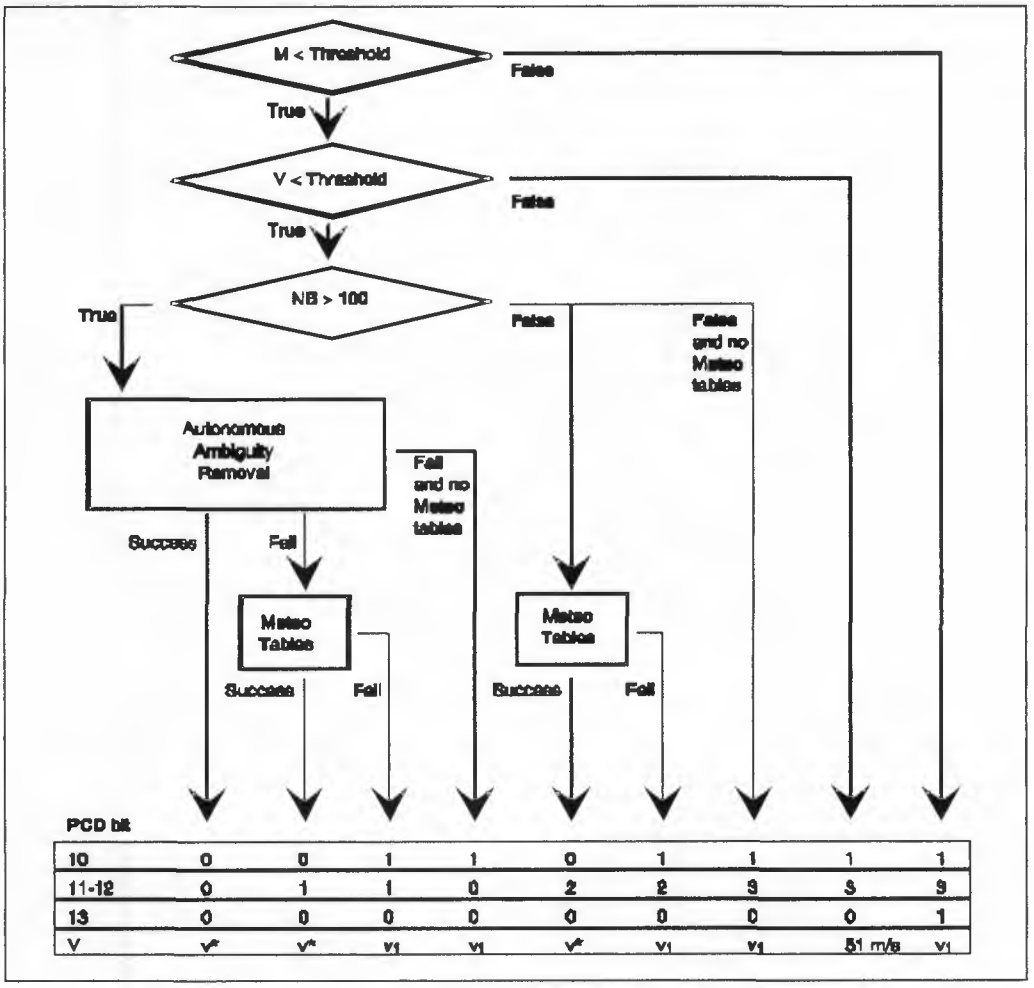

Figure 6 PCD flags for UWI relations with ambiguity removal[32]

[32] Legend: M: Maximum Likelihood Distance of rank 1 solution; V: Estimated Windspeed; NB: Number of adjacent nodes; v_1 := Windspeed of rank 1 solution; v* = Windspeed solution chosen by ambiguity removal;

Remark: the case bit 10 = 0, bit 11-12 = 3 and bit 13 = 0, with the given solution v* may occur in the following example. The ambiguity removal is attempted over 6 consecutive products with a displacement of 2 products. After the first 2 products with successful ambiguity removal the results are kept. In case of non-successful ambiguity removal on the next products, the old results (after ambiguity removal) are used, but the indicator of the method used is lost.

UWI Product Confidence Measures and Product Annotations.

Remark: The meaning of any LRDPF flag is as follows:

- 1: wrong (bit set)
- 0: nominal.

UWI PCD at Main Product Header summary is given in the field 6, bit 1 of the MPH, see Table 5: the product is considered as correctly generated when none of the bits 2 to 16 of the MPH field 6 has been raised.

UWI PCD's in Specific Product Header are presented in Table 17.

Equipment status flag (bits 1 and 2): This flag is always zero in the current implementation.

I/Q Imbalance flag (bit 4): Input statistics of noise channels, per beam: The I/Q imbalance monitoring factor is calculated by averaging the I and Q noise power, over a given number of consecutive F/M/A sequences. This number (nominally 8), is an external parameter. The respective quantities; I mean noise power and Q mean noise power for each beam are reported on fields 9 to 14. The given values are before unbiasing.

Flag on mean power on I and Q: For each beam the I/Q imbalance is estimated by forming the ratio: mean I power / mean Q power. However, these two values are separately checked against a threshold, without forming the ratio. Therefore $3 \times 2 = 6$ thresholds are used;

The flag is set when either the I or Q channels exceeds its threshold.

Internal Calibration level (bit 5): This calculation is performed for every beam, once per product.

Blank Product flag (bit 6): When no source packet, as necessary to generate a product in the time interval (t1,t2), is found, a dummy product is generated and this flag is set.

Remark: the above means that if at least one source packet has been found, this flag is not raised.

Doppler compensation flags (bits 7 and 8): The on-board Doppler compensation is refined on ground. The overall performance of the Doppler compensation scheme is measured by taking the resulting signal power spectrum, averaged over a number of L1 measurements blocks and comparing its Center of Gravity and 'Standard Deviation' with those of an externally specified reference spectrum corresponding to an ideal Doppler compensation. This is done for all beams and per product. When no beam and no estimate is available, the following default values below are used in the table. In case of lack of input data, the standard deviation fields should not be filled with the best case values.

Fields 6,8,10	Averaged power spectrum Center of Gravity	999
Fields 7,9,11	Averaged power spectrum Standard Deviation	-1
Fields 12-17	I/Q Mean Noise power	-1
Fields 18-20	Internal Calibration level	-1

UWI PCD's at Data Set Record level are presented in Table 18.

Wind speed (field 19) may lie in the range 0 to 50.8 m/s. The value of 51.0 m/s (field value of 255) is reserved to indicate that an invalid wind speed was determined. So, when no wind extraction is possible, the product is written with the following default values:

Wind speed	255
Wind direction	255

The product UWI contains various product confidence measures at node level, one record corresponding to one node, as indicated in field 21:

Forebeam, Midbeam and Aftbeam Flag (bits 2,3 and 4):
If a source packet is incomplete or too long, it is disregarded. During the calculations of the 3 σ^{o} values, the number of missing or erroneous packets is counted. This flag is set when no source packet contributing to a node has been found, for this beam.

Remark 1: the above means that when at least one source packet, out of a maximum number of 36, is found, the spatial filtering is performed.

Remark 2: This flag is not related to the arcing problem (see later). The wind extraction software looks at these flags to determine which branch of the algorithm to use:

3 Beam wind extraction

2 Beam wind extraction

In case of only one beam data is available, no wind extraction is attempted.

Forebeam, Midbeam and Aftbeam arcing flag (bits 5,6 and 7): A possible arcing of the transmitting tube (TWT) leads to an automatic switching off of the transmission. As a new transmission is not attempted before 15 sec, an arcing results in loss of data. These missing data are identified by looking at the statistics of the received data; as no transmission occurs, received data feature noise statistics. The corresponding beam data for a given node are flagged.
Remark: above information is not read and therefore not used by the wind extraction software.

Limit of Kp value (bit 8): Before the wind extraction, the Kp value for each beam, for a given node is estimated. For every beam the actual value is compared to a given limit (e.g. 20%), and this flag raised in case at least one exceeds this limit. In case this flag is raised no wind extraction is attempted.

Land/sea flag (bit 9): A high resolution grid (5' x 5') is used to determine the percentage of land contamination within an area surrounding the center of the node, given by its latitude and longitude. The larger zone extends (beyond the 5' x 5' area) outwards at least 25 km. A scatterometer point falling within a given 5' x 5' area, is processed only if no surrounding cell is indicated as land in the larger zone. The land/sea flag is therefore raised when the contamination is more than 0% of land.

Flag on frame checksum (bit 14): For every source packet contributing to a node (up to 36), there is an input flag set by the frame synchronizer. This flag is set whether at least one out of these 36 input flags has been set by the frame synchronizer. If a checksum error happens, the calibration and noise data are replaced with defaults.

Radar Altimeter (URA)

Description:	The product contains an averaged wind speed, wave height, and satellite altitude together with the standard deviations (one per quantity) for single cells along the satellite track. One cell is sampled every 6.725 km and there is a maximum of 20 values measured during 1 second. Seventy seven (77) cells are combined in one product and represent an area of approximately 500 km.
Satellite Source:	Radar Altimeter
Originating Subsystem:	LRDPF
Production Generation:	Products are generated for MMCC/EECF-defined start and stop times.
Command:	C_GEN_URA
On-Line Storage Specification:	200 minutes
Throughput:	80 products per orbit
Format	One product includes: Main Product Header: See See Table 5. Specific Product Header: See Table 19. 7 Product Data Set records: See Table 20.
Media:	MMCC Link or EECF Link. This product is also stored on CCT. For tape format and tape label annotation see 'Computer Compatible Tape Format (CCT)' on page 89.

Table 19 Specific Product Header for URA

Field	Bytes	Type	Description	Units
1	2	B	Product Confidence Data bit 1-2 Processing Equipment Status 0: equipment working 1: some problems with equipment 2: equipment failed during product generation bit 3 Product type 0: ocean mode 1: non-ocean mode or blank product bit 4 Corrupt Data 0: all processing nominal 1: details of data corruption in Data Set Record bit 5 arithmetic flag 0: no arithmetic fault 1: at least one DSR has a flag raised in byte 62 bit 6-16 Spare	
2	4	I4	Geodetic latitude of data set record 1. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
3	4	I4	East longitude (i.e. 0-360° from Greenwich to east) of data set record 1.	10^{-3} deg
4	4	I4	Subsatellite Track Heading at data set record 1.	
5	4	I4	USO offset frequency with respect to 5 MHz	10^{-3} Hz
6-23	36	I2	Identifier of external tables. Details as follows:	
6	2	I2	Global Threshold Parameter Table ID	
7	2	I2	Static Params Parameter Table ID	
8	2	I2	Dynamic Params Parameter Table ID	
9	2	I2	τ_{REF}^{G} Parameter Table ID	
10	2	I2	$TAB_{\tau 1}$ Parameter Table ID	
11	2	I2	$TAB_{\tau 2}$ Parameter Table ID	
12	2	I2	Reserved	
13	2	I2	$\sigma_{S,REF}^{G}$ Parameter Table ID	
14	2	I2	TAB_S Parameter Table ID	
15	2	I2	Reserved	
16	2	I2	A_{REF}^{G} Parameter Table ID	
17	2	I2	Reserved	
18	2	I2	TAB_{A2} Parameter Table ID	
19	2	I2	TAB_{LOC} Parameter Table ID	
20	2	I2	Spare	
21	2	I2	Pressure Table ID (table type 83, Forecast F18)	

Table 19 Specific Product Header for URA

Field	Bytes	Type	Description	Units
22	2	I2	Pressure Table ID (table type 84, Forecast F24)	
23	2	I2	Pressure Table ID (table type 85, Forecast F30)	
24	2	I2	Pressure Table ID (table type 86, Forecast F36)	

Table 20 Data Set Record for URA

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	24	A	UTC Time at middle of the source packet ($T_{H,LOC}$) in ASCII: ''dd-mmm-yyyy hh:mm:ss.ttt'' For example: ''30-JAN-1987 14:30:27.123''	
3	4	I4	Geodetic latitude. A negative value denotes South latitude, and a positive value denotes North latitude.	10^{-3} deg
4	4	I4	East longitude (i.e. 0-360° from Greenwich to east)	10^{-3} deg
5	2	I2	Average Wind Speed	10^{-2} m/s
6	2	I2	Standard Deviation of Wind Speed	10^{-4} m/s
7	2	I2	Average Significant Wave Height	10^{-2} m
8	2	I2	Standard Deviation of Significant Wave Height	10^{-4} m
9	4	I4	Average Altitude (Corrected)	10^{-2} m
10	4	I4	Standard Deviation of Altitude	10^{-4} m
11	2	I2	Number of blocks used for averaging	
12	1	B	Product Confidence Data bit 1 Summary PC factor 0: processing of all according to specification 1: at least one of the following bits is raised; result to be viewed with limitation. bit 2 Standard Deviation Wind Speed. The average value and the standard deviation are calculated for the N available blocks measurements (N given in field 11). 0: Standard Deviation Wind Speed within MMCC/EECF-supplied limits 1: Standard Deviation Wind Speed outside MMCC/EECF-supplied limits bit 3 Standard Deviation SWH Limit The average value and the standard deviation are calculated for the N available blocks measurements (N given in field 11). 0: Standard Deviation SWH within MMCC/EECF-supplied limits 1: Standard Deviation SWH outside MMCC/EECF-supplied limits bit 4 Standard Deviation Altitude Limit The average value and the standard deviation are calculated for the N available blocks measurements (N given in field 11).	

Table 20 Data Set Record for URA

Field	Bytes	Type	Description	Units
			0: Standard Deviation Altitude within MMCC/EECF-supplied limits 1: Standard Deviation Altitude outside MMCC/EECF-supplied limits bit 5 Mean Peakiness Limit 0: Mean peakiness within MMCC/EECF supplied limits 1: Mean peakiness outside MMCC/EECF supplied limits bit 6 Frame Checksum Flag 0: Checksum correct 1: Checksum error detected, no action taken bit 7 HTL time content correction (on product localization) 0: correction performed 1: when the search from the 2 input parameters to the time constant does not succeed; correction not performed bit 8 Enough Measurements 0: when N ≥ 10, enough measurements to process data 1: when N < 10, not enough measurements to process data	
13	2	I2	Average Peakiness	10^{-2}
14	2	I2	Averaged sigma_0	10^{-2} dB
15	2	I2	Integrated electron density [33]	
16	1	B	Open Loop Calibration Status: bit 1 Height Error Correction 0: from open loop calibration 1: default bit 2 Reserved bit 3 AGC output correction 0: from open loop calibration 1: default bit 4 Reserved bit 5 is 1 after a real arithmetic overflow or underflow during processing bit 6 is 1 after an integer arithmetic overflow during processing bit 7 is 1 after division by zero during processing	
17	1	B	Instrument Mode[34], i.e. byte 2 of packet ID in Primary Header (see Document R-1).	

[33]Integrated electron density: Units: number of electrons per squaremeter;
Scaling: written value is $1000log_{10}()$, so scaling is $10^{writtenvalue/1000}$

[34]Instrument mode: 0 = no, 1 = yes. Fields 5-15 of this record are only valid if bit 8 of Field 17 is set to '1'.

Table 20 Data Set Record for URA

Field	Bytes	Type	Description	Units
			bit 1 Blank data record bit 2 Test bit 3 Calibration (closed loop) bit 4 BITE bit 5 Acquisition on Ice bit 6 Acquisition on Ocean bit 7 Tracking on Ice bit 8 Tracking on Ocean	
18	1	B	Reserved (e.g. for ATSR PCD)	
19	4	I4	Altitude Correction, ionosphere	10^{-3} m
20	4	I4	Altitude Correction, wet troposphere	10^{-3} m
21	4	I4	Altitude Correction, dry troposphere	10^{-3} m
22	4	I4	Altitude Correction, calibration constant	10^{-3} m
23	4	I4	Smoothed Open Loop HTL calibration correction	10^{-3} m
24	4	I4	Smoothed Open Loop AGC calibration correction	10^{-3} dB

URA Product Confidence Measures and Product Annotations

Source Packet level errors:

Only ocean mode valid source packets are processed.

Too long or incomplete source packets are discarded.

Non-Ocean mode valid source packets are reported in a blank record (cell time longitude and latitude are calculated).

Time gaps, due to unavailability or nonvalid satellite source packets, are filled with blank records at about one second intervals.

Checksum errors on valid source packet are reported.

URA PCD at main product header (MPH) level summary is given in the field 6 of the MPH.

bit 1 : the product is considered as correctly generated when none of the bits 2 to 16 of the MPH field 6 has been raised.

URA PCD at Specific Header level is specified in see Table 19, field 1.

Processing equipment status flag (bits 1 and 2): This flag is always zero in the current implementation.

Product type flag (bit 3): This flag is zero (not-set) when at least one data record out of 77 is in ocean mode with $N \geq 10$ (see above).
Under all other circumstances this flag is set. When there is a missing source packet within the series of 77 forming a product, it is replaced with a blank one.

Corrupt data flag (bit 4): This flag is set when at least one data set record out of 77 features a set PCD summary flag. If there are not enough measurements as input in the averaging process, the contents of the wind speed, wave height and altitude fields are to be discarded.

URA PCD at Record Level is specified in see Table 20.

Number of blocks used for averaging (field 11): The field indicates the actual number of valid measurements blocks which can be used for calculating the various means and standard

deviations (field 12, bits 2, 3, 4 and field 13). As a minimu m of 10 is required, the actual written number is:

N if $N \geq 10$ and

0 if $N < 10$

Points to be confirmed:

- validity criteria
- as 0 means ''OK'', $N < 10$ should correspond to 1.
- Summary PC factor (field 12).

Frame checksum (bit 6): This flag is copied from the DPMC input.

HTL time constant (bit 7): The RA algorithm derives the height tracking loop time constant from a table; this table gives for a number of sets of parameter loop (parameters alpha and beta), the corresponding time constant. When the search from the 2 input parameters to the time constant does not succeed, bit 7 flag is raised.

Average peakiness (field 13). The peakiness factor is also calculated N times and averaged to detect sea ice.

Intermediate products

Intermediate products are derived during AMI wave FD product generation or as an alternative to the UI16, UI8 product generation. Upon request, products are either put on CCT, Exabyte, or sent to MMCC, EECF or user over high-speed link.

The intermediate products generated at The Ground Stations are:

- AMI Wave Intermediate (IWA)
- AMI Image Mode Intermediate (II16)

The RA FD products can also be stored on CCT and can be used like intermediate products.

AMI Wave Intermediate (IWA)

Description: This product consists of an intermediate wave image generated prior to conversion to a power spectrum, and the power spectrum, see UWA product.

The image contains:

- 320 in azimuth x 400 in range pixels for OGRC
- 320 in azimuth x 600 in range pixels for OBRC.

The intensity of each pixel is represented by 16 bits.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP

Production Generation: Products are automatically generated, when AMI Wave FD products are generated.

Command: C_GEN_WA

On-Line Storage Specification: 200 minutes

Throughput: Same as AMI Wave FD Product

Format One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: See Table 9.
- 17 Product Data Set Records: The data set records of this product are of two different types. The first 16 records contain 20 range lines each of the intermediate image, see Table 21. Within each range line, pixels closer to the satellite track precede farther range pixels. The 17^{th} data set record contains the power spectrum, see Table 22.

Media: Exabyte Tape, see Section 'The DPMC/CMS Exabyte Tape Format' on page 96.

Table 21 Data Set Record 1-16 for IWA

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2			Processed wave mode samples. Each sample is represented as a 16-bit integer. The Most Significant Bit is not used and set to zero.	
OGRC: 2	16,000	I1	8,000 samples	
OBRC: 2	24,000	I1	12,000 samples	

Table 22 Data Set Record 17 for IWA

Field	Bytes	Type	Description	Units
1-145	148		As for UWA data set record. See table 4-15.	
OGRC: 146	15,856	B	Spares	
OBRC: 146	23,856	B	Spares	

Product Confidence:

There are no product confidence measures related to the image spectrum itself.

However the specific product header is identical to the one of the image mode and therefore contains the same information, see section 'Product Confidence' on page 11.

The SAR processor uses the data subset counter and the satellite binary counter (SBT) to check the packet continuity (data subset counter should increment by 1 and SBT by 1 or 2 between packets).

Duplicate packets are discarded and missing packets are replaced with zeroes: the zeroes are inserted before the data is processed, that is, the data is still in packet form.

In the wave mode case, the extracted chirp is valid if it is extracted from 22 contiguous valid packets.

AMI Image Mode Intermediate (II16)

Description:	This product is similar to the UI16 product except that it has not undergone any Slant-Range-to-Ground-Range conversion. This product also contains additional information required for geocoding.
Satellite Source:	AMI Image mode
Originating Subsystem:	SAR FDP
Production Generation:	MMCC defines the start time for each product.
Command:	C_GEN_UI
On-Line Storage Specification:	200 minutes
Throughput:	Same as UI16 or UI8 FD Products. Note that the SARFDP produces a single UI16 or II16 product per C_GEN command (not both).
Format	One product includes: • Main Product Header: See See Table 5. • Specific Product Header: See Table 23. • 6300 Product Data Set Records: See Table 10. One record is one range line. Range lines are stored in ascending time order. Within each range line, pixels closer to the satellite track precede farther range pixels. The intensity of each pixel is represented by 16 bits.
Media:	High-Speed Link

Table 23 Specific Product Header for II16

Field	Bytes	Type	Description	Units
1-72	260		As for UI16, UI8 Specific Product Header. See Table 9 Specific product header for UI16, UI8, UWA and IWA.	
73	4	I4	Zero Doppler range time of the first range pixel	nsec
74	4	I4	Zero Doppler range time of the center range pixel	nsec
75	4	I4	Zero Doppler range time of the last range pixel	nsec
76	24	A	Zero Doppler azimuth time of the first azimuth pixel. ASCII format: ''dd-mmm-yyyy hh:mm:ss.ttt''	nsec
77	24	A	Zero Doppler azimuth time of the center azimuth pixel. Formats for field 76.	nsec
78	24	A	Zero Doppler azimuth time of the last azimuth pixel. Format as for field 76.	nsec
79-84	24	I4	First State Vector: (Earth- fixed reference system)	
79	4	I4	State vector; X	10^{-2} m
80	4	I4	State vector; Y	10^{-2} m
81	4	I4	State vector; Z	10^{-2} m
82	4	I4	State vector; X velocity	10^{-5} m/s
83	4	I4	State vector; Y velocity	10^{-5} m/s
84	4	I4	State vector; Z velocity	10^{-5} m/s
85-90	24	I4	Second State Vector. Format as for First State Vector	
91-96	24	I4	Third State Vector.Format as for First StateVector	
97-102	24	I4	Fourth State Vector.Format as for First StateVector	
103-108	24	I4	Fifth State Vector.Format as for First StateVector	
109	24	A	UTC time of the first StateVector. Format: ''dd-mmm-yyyy hh:mm:ss.ttt''	
110	4	I4	Delta time between each ofthe above state vectors	msec
111	108	B	Spare.	

Extracted calibration data products

Extracted data products represent raw data over specific areas and are used either for instrument calibration and monitoring, e.g. pass over an active transponder, or for archiving of extracted and transcribed raw data at the PAFs. The data is not processed in the Ground Stations, but passed on to the MMCC or EECF via dedicated link or to the PAFs on transcription Exabyte.

These products are for ESA internal use only. They are not intended to be distributed outside the ESA environment.

The following extracted data products are defined below:

- AMI Image Calibration Data (EIC)
- AMI Wave Calibration Data (EWAC)

- AMI Wind Calibration Data (EWIC)
- Radar Altimeter Calibration Data (ERAC)
- ATSR-1 Calibration Data (RATSR)
- ATSR-2 Calibration Data (EATC2)
- GOME Calibration Data (EGOC)
- Micro Wave Calibration Data (EMWC)

AMI Image Calibration Data (EIC)

Description: Calibration data for the AMI Image Mode consist of complete downlinked Formats, with the exception of the three Synch Bytes and three IDHT-ID Bytes which have been removed. In addition, all echo data samples are expanded from 5-bit I and Q to 8-bit I and Q.

Satellite Source: AMI Image Mode

Originating Subsystem: SAR FDP

Production Generation: Products are extracted for MMCC/ EECF defined start and stop times. Up to five commands defining different time intervals can be submitted by MMCC/ EECF per orbit.

Command: C_GEN_EIC

On-Line Storage Specification: One day

Throughput: Maximum storage of 130 Mbytes or 11,212 products per orbit and day provided on the DPMC/CMS. The SAR FDP storage capacity is 15,000 products. The SARFDP can ingest, process and store 15,000 products in an orbit (this excludes any Fast Delivery product generation).

Format One product includes:

- Main Product Header: See See Table 5.
- One Product Data Set Record: The product data set consists of one downlink format without IDHT-ID, as shown in Table 24.

Media: Exabyte tape, see Section 'The DPMC/CMS Exabyte Tape Format' on page 96.

Table 24 Data Set Record EIC

Field	Bytes	Type	Description	Units
1	4	I4	Data record number. This number is always 1.	
2	10	S	IDHT Header. This field is identical to ''IDHT GEN. HEADER'' in the HR format structure of Document A-1.	
3	220	S	Auxiliary Data and Replica/Calibration pulses. This field is identical to the ''Auxiliary Data Field'' in the HR format structure of Document A-1.	
4	11,232	I1	Noise and Echo data. This field contains 5,616 complex samples. Each complex data sample is unsigned extended from the downlink format to 8-bit I and 8-bit Q.	

AMI Wave Calibration data (EWAC)

Description: This product contains 16 General Header Source Packets comprising one complete OBC format and 299 wave source packets comprising one wave cell. The OBC format is the first complete one following the first frame of instrument data.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP

Production Generation: Products are extracted for MMCC/ EECF-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC/ EECF per orbit.

One product is generated for each wave cell lying within the specified time interval. If a start or stop time lies within a cell, all specified auxiliary data for that complete cell are extracted.

Command: C_GEN_EWAC

On-Line Storage Specification: One day

Throughput: Maximum 15 Mbytes of data per orbit and maximum 30 Mbytes per day. ⇒ 11 products per orbit and 22 products per day.

Format One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: The General Header is stored in the SPH as shown in Table 25.
- 299 Product Data Set Records: Each product data set record consists of one source packet. See Table 26.

Media: Exabyte tape, see Section 'The DPMC/CMS Exabyte Tape Format' on page 96.

Table 25 Specific Product Header for EWAC

Field	Bytes	Type	Description	Units
1	4096	S	PF Data. This field contains 16 frames each of 256 bytes of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1. The first 256 bytes correspond to the start of platform data, frame count of 0, and the last 256 bytes to the end of platform data, frame count of 15.	
2	384	S	Ephemeris Data. This field is identical to the sub-commutated, 24 bytes of Ephemeris Data of the ''Source Data Field'' of 16 General IDHT Header Source Packets, see Document A-1. The first 24 bytes correspond to the start of ephemeris data, ephemeris ID of 1, and the last 24 bytes to the end of ephemeris data, ephemeris ID of 16.	

Table 26 Data Set Record for EWAC (OBRC and OGRC)

Field	Bytes	Type	Description	Units
1	4	I4	Data record number. Data records are numbered 1-299.	
2	6	S	Primary Header. This is identical to the packet Primary Header as described in Document A-1.	
3	98	S	Secondary Header. This field is identical to the ''Secondary Header'' as described in Document A-1.	
4	4224	S	Source data. This field is identical to the ''Measurement Data Field'' as described in Document A-1.	

AMI Wind Calibration data (EWIC)

Description: This product contains one AMI wind scatterometer and one General Header Source Packet. The General Header is the one just preceding the first frame of Instrument Data.

Satellite Source: AMI Wind Mode

Originating Subsystem: LRDPF

Production Generation: Products are extracted for MMCC/ EECF-defined start and stop times. Up to five commands defining different time intervals can be submitted by MMCC/ EECF per orbit.

Command: C_GEN_EWIC

On-Line Storage Specification: One day

Throughput: Maximum 12 Mbytes of data per orbit and maximum 24 Mbytes per day. ⇒ 1450 products per orbit and 2900 products per day.

Format Format: One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: One General Header frame is stored in the SPH as shown in Table 27.

  If there is no General Header available the General Header portion of the SPH is padded with zeroes. Note that a General Header packet is received only for every third EWIC packet. The General Header packet is not available for the first EWIC product resulting from the C_GEN_EWIC command, unless the times of the General header and EWIC packets are identical.
- One Product Data Set Record: The product data set consists of one source packet. See Table 28.

Media: Transcription Exabyte, see Section 'The LRDPF Transcription Exabyte Format' on page 108.

Table 27 Specific Product Header for EWIC, ERAC

Field	Bytes	Type	Description	Units
1	256	S	PF Data. This field is identical to the first 256 bytes of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
2	1	S	Ephemeris ID. This field is identical to the Ephemeris ID byte field of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
3	1	B	Spare - binary zero	
4	24	S	Ephemeris data(sub-commutated). This field is identical to the sub-commutated, 24 bytes of Ephemeris Data of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	

Table 28 Data Set Record for EWIC

Field	Bytes	Type	Description	Units
1	4	I4	Data record number. This number is always 1.	
2	6	S	Primary Header. This is identical to the packet ''Primary Header'' as described in Document A-1.	
3	62	S	Secondary Header. This field includes the auxiliary data and is identical to the packet ''Secondary Header'' as described in Document A-1.	
4	7792	S	Source Data. This field includes calibration and echo data for either forebeam, midbeam or aftbeam. The format is identical to the one described in Document A-1.	

Radar Altimeter Calibration data (ERAC)

Description: This product contains one raw Radar Altimeter data and General Header Source Packet. The General Header is the one just preceding the first frame of instrument data.

Satellite Source: Radar Altimeter

Originating Subsystem: LRDPF

Production Generation: Products are extracted for MMCC/ EECF-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC/ EECF per orbit.

Command: C_GEN_ERAC

On-Line Storage Specification: One day

Throughput: Maximum 2 Mbytes of data per orbit and maximum 4 Mbytes per day. ⇒ 564 products per orbit and 1128 products per day.

Format One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: One General Header frame is stored in the SPH as shown in Table 27.

  The General Header packet is not available for the first ERAC product resulting from the C_GEN_ERAC command, unless the times of the General header and ERAC packets are identical.
- One Product Data Set Record: The product data set consists of one source packet. See Table 29.

Media: Transcription Exabyte, see Section 'The LRDPF Transcription Exabyte Format' on page 100.

Table 29 Data Set Record for ERAC

Field	Bytes	Type	Description	Units
1	4	I4	Data record number. This number is always 1.	
2	6	S	Primary Header. This field is identical to the ''Primary Header'' as described in Document A-1.	
3	6	S	Secondary Header. This field is identical to the packet ''Secondary Header'' as described in Document A-1.	
4	3120	S	Source Data. This field is identical to the ''Source Data Field'' as described in Document A-1.	

ATSR-1 Calibration Data (RATSR)

Description: This product contains one ATSR-1 and one General Header Source Packet.

Satellite Source: ATSR-1

Originating Subsystem: LRDTF

Production Generation: ATSR products are generated on request from Rutherford Appleton Laboratory for an MMCC/EECF specified start and stop time.

Command: C_GEN_RATSR

On-Line Storage Specification: None

Throughput: All data collected in one orbit, approximately 40k products, per orbit.

Format One product includes.:

- Main Product Header: See See Table 5.
- Specific Product Header: General Header information is stored in the SPH as shown in Table 30 if the datation (byte 12 to 15) falls within the interval of 0.15 seconds preceding the ATSR source packet contained in the DSR of the product.

  All ATSR products have the same size. If there is no General Header available, the General Header portion of the SPH is padded with zeroes. Note that a General Header packet is received only for every 6^{th} to 7^{th} RATSR product.

  The General Header packet is not available for the first RATSR product resulting from the C_GEN_RATSR command, unless the times of the General header and RATSR packets are identical.
- One Product Data Set Record: The product data set consists of one record with one ATSR source packet as specified in Table 31.

Media: Digital Cassette Exabyte format

Table 30 Specific Product Header for RATSR and EATC2

Field	Bytes	Type	Description	Units
1	256	S	PF Data. This field is identical to the first 256 bytes of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
2	1	S	Ephemeris ID. This field is identical to the Ephemeris ID byte field of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
3	1	B	Spare - binary zero	
4	24	S	Ephemeris data(sub-commutated). This field is identical to the sub-commutated, 24 bytes of Ephemeris Data of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	

Table 31 Data Set Record for RATSR

Field	Bytes	Type	Description	Units
1	4	I4	Data set record number. This number is always 1.	
2	4000	S	One Source Packet identical to the downlinked format, see Document A-6.	

ATSR-2 Calibration Data (EATC2)

Description: This product contains one low rate or two high rate ATSR-2 source packets and one General Header Source Packet.

Satellite Source: ATSR-2

Originating Subsystem: LRDPF

Production Generation: ATSR products are generated on request from Rutherford Appleton Laboratory for an MMCC/EECF specified start and stop time.

Command: C_GEN_EATC2

On-Line Storage Specification: None

Throughput: All data collected in one orbit, 320 Mbytes in low rate or 620 Mbytes in high rate per orbit.

Format One product includes.:

- Main Product Header: See See Table 5.
- Specific Product Header: General Header information is stored in the SPH as shown in Table 30 if the datation (byte 12 to 15) falls within the interval of 0.15 seconds preceding the ATSR source packet contained in the DSR of the product.

  All ATSR products have the same size. If there is no General Header available, the General Header portion of the SPH is padded with zeroes. Note that a General Header packet is received only for every 6^{th} to 7^{th} RATSR product.

  The General Header packet is not available for the first RATSR product resulting from the C_GEN_RATSR command, unless the times of the General header and RATSR packets are identical.
- One Product Data Set Record: The product data set consists of one record with one ATSR source packet as specified in Table 32.

Media: Transcription Exabyte, see Section 'The LRDPF Transcription Exabyte Format' on page 108.

Table 32 Data Set Record for EATC2

Field	Bytes	Type	Description	Units
1	4	I4	Data set record number. This number is always 1.	
2	6800	S	One complete ATSR-2 Source Packet identical to the downlinked format, see Document A-1.	

GOME Calibration Data (EGOC)

Description: This product contains one raw GOME source packet and one General Header source packet.

Satellite Source: GOME[35]

[35]The GOME instrument is available on ERS-2 only. One GOME source packet is multiplexed as ten GOME science packets interleaved in the ATSR-2 data stream.

Originating Subsystem:	LRDPF
Production Generation:	Products are extracted for MMCC/ EECF-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC/ EECF per orbit.
Command:	C_GEN_EGOC
On-Line Storage Specification:	One day
Throughput:	All data collected in one orbit, approximately 37 Mbytes per orbit.
Format	One product includes: • Main Product Header: See See Table 5. • Specific Product Header: One General Header frame is stored in the SPH as shown in Table 33. If there is no General Header available the General Header portion of the SPH is padded with zeroes. • One Product Data Set Record: The product data set consists of one source packet. See Table 34.
Media:	Transcription Exabyte, see Section 'The LRDPF Transcription Exabyte Format' on page 100.
Comment on Product Confidence:	Padding of the product data set record occurs in the event of missing frames containing GOME science data. The corresponding fields of the data set record will be padded with "BB" hexadecimal.

Table 33 Specific Product Header for EGOC and EMWC

Field	Bytes	Type	Description	Units
1	256	S	PF Data. This field is identical to the first 256 bytes of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
2	1	S	Ephemeris ID. This field is identical to the Ephemeris ID byte field of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
3	1	B	Spare - binary zero	
4	24	S	Ephemeris data(sub-commutated). This field is identical to the sub-commutated, 24 bytes of Ephemeris Data of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	
5	1	B	Product Confidence Data: Product padding flag. 0: Product data set record not padded 1: Product data set record padded	
6	EGOC: 20 EMWC: 32	B	Product Confidence Data: PCD reported at ATSR Source Packet level. One byte PCD for each GOME or MW frame. bit 1 - 2: The percentage of frames with checksum error compared to MMCC/EECF specified threshold. bit 3 - 4: Quality of downlinked formats and source packets compared to MMCC/EECF specified threshold. bit 5 - 8: Spare All analysis performed on GOME or on MW frames only. 0: Lower than threshold 1: Greater than threshold 2: Performance unknown	

Table 34 Data Set Record for EGOC

Field	Bytes	Type	Description	Units
1	4	I4	Data set record number. This number is always 1.	
2	8000	S	One complete GOME Source Packet identical to the downlinked format, see Document A-1.	

Microwave Calibration Data (EMWC)

Description:	This product contains Microwave data sub-commutaded over 32 ATSR source packets and one General Header source packet
Satellite Source:	Microwave Sounder
Originating Subsystem:	LRDPF
Production Generation:	Products are extracted for MMCC/ EECF-defined start and stop times. Up to five commands defining different time intervals can be submitted by the MMCC/ EECF per orbit.
Command:	C_GEN_EMWC
On-Line Storage Specification:	One day
Throughput:	All data collected in one orbit, approximately 2 Mbytes per orbit.
Format	One product includes: • Main Product Header: See See Table 5 on page 7. • Specific Product Header: One General Header frame is stored in the SPH as shown in Table 33. If there is no General Header available the General Header portion of the SPH is padded with zeroes. • One Product Data Set Record: The product data set consists of one source packet. See Table 35.
Media:	Transcription Exabyte, see Section 'The LRDPF Transcription Exabyte Format' on page 100.
Comment on Product Confidence:	Padding of the product data set record occurs in the event of missing frames containing MW science data. The corresponding fields of the data set record will be padded with "BB" hexadecimal.

Table 35 Data Set Record for EGOC

Field	Bytes	Type	Description	Units
1	4	I4	Data set record number. This number is always 1.	
2	896	S	One complete MW Science Packet consisting of: 12 bytes ATSR SP header 2 bytes H/L Rate Packet ID[36] 4 bytes Synch protocol[37] 2 bytes Previous Pkt Error Code[36] 8 bytes MW data sub-commutated over 32 ATSR source packets, see document A-1.	

[36]Zero fields for ERS-1

[37]Zero fields for ERS-2

Extracted General and Instrument Header products

Extracted General and Instrument Header products represent raw data over specific areas and are used either for instrument calibration and monitoring, e.g. pass over an active transponder, or for archiving of extracted and transcribed raw data at the PAFs. The data is not processed in the Ground Stations, but passed on to the MMCC or EECF via dedicated link.

These products are for ESA internal use only. They are not intended to be distributed outside the ESA environment.

The following extracted data products are defined below:

- AMI Image Instrument Headers (EII)
- AMI Wave Instrument Headers (EWAI)
- AMI Wind Instrument Headers (EWII)
- Radar Altimeter Instrument Headers (ERAI)
- ATSR-1 Instrument Headers (EATI1)
- ATSR-2 Instrument Headers (EATI2)
- GOME Instrument Headers (EGOI)
- General Headers (EGH)

AMI Image Instrument header (EII)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: AMI Image Mode

Originating Subsystem: SAR FDP

Production Generation: Auxiliary data are extracted for MMCC/ EECF- specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EII

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.

Format One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 36. SPH defines size and content of the data set records.
- Variable Number of Product Data Set Records: Each data set record corresponds to one source packet. The length of a data set record is variable, the format is defined in Table 37. All data of one selected time interval of one, command are combined in one product. Up to ten windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC or EECF

Table 36 Specific Product Header for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI

Field	Bytes	Type	Description	Units
2	2	I2	Starting byte position of window 1 in downlinked data	
3	2	I2	Length in bytes of window 1	
			⋮	
19	2	I2	Starting byte position of window 10 in downlinked data	
20	2	I2	Length in bytes of window 10	

Table 37 Data Set Record for EII, EWAI, EWII, ERAI, EATI1, EATI2, EGOI

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	(n-4)[38]	S	MMCC/EECF-selected windows: EII: from ''IDHT GEN.HEADER'' and ''Auxiliary Data Field''; EWAI, EWII: from ''Primary'' and ''Secondary'' Header; ERAI: from ''Primary Header'', ''Secondary Header'' and ''Source Data Field''. EATI1, EATI2, EGOI: from "Primary Header", "Secondary Header" and "Auxiliary Data Field". as in downlinked formats and source packets, see Document A-1.	

[38] n is variable from product to product and depends on sizes of selected windows, maximum value for: EII is 234, EWAI is 108, EWII is 72 and ERAI is 3136

AMI Wave Instrument header (EWAI)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: AMI Wave Mode

Originating Subsystem: SAR FDP

Production Generation: Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected.

One product is generated for each wave cell lying within the specified time interval. If a start or stop time lies within a cell, all specified auxiliary data for that complete cell is extracted.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EWAI

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.

Format One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 36.
- 299 Product Data Set Records: The length of a data set record is variable; the format is defined in Table 37. One product contains the auxiliary data extracted from each of 299 source packets comprising a wave cell. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC or EECF.

AMI Wind Instrument header (EWII)

Description:	This product contains selected windows or all auxilia ry data extracted over a specified time interval.
Satellite Source:	AMI Wind Mode
Originating Subsystem:	LRDPF
Production Generation:	Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF also define whether all auxiliary data or separate windows shall be collected. A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.
Command:	C_GEN_EWII
On-Line Storage Specification:	200 minutes
Throughput:	Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.
Format	One product includes: • Main Product Header: See Table 5. • Specific Product Header: See Table 36. • Variable Number of Product Data Set Records: The length of a data set record is variable, the format is defined in Table 37. All data of the selected time interval are, combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.
Media:	X.25 link to MMCC or EECF

Radar Altimeter Instrument Header (ERAI)

Description:	This product contains selected windows or all auxiliary data extracted over a specified time interval.
Satellite Source:	Radar Altimeter
Originating Subsystem:	LRDPF
Production Generation:	Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected. A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.
Command:	C_GEN_ERAI
On-Line Storage Specification:	200 minutes
Throughput:	Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.
Format	One product includes: • Main Product Header: See Table 5. • Specific Product Header: See Table 36. • Variable Number of Product Data Set Records: The length of a data set record is variable, the format is defined in Table 37. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.
Media:	X.25 link to MMCC or EECF.

ATSR-1 Instrument Header (EATI1)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: ATSR-1

Originating Subsystem: LRDPF

Production Generation: Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EATI1

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.

Format One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 36.
- Variable Number of Product Data Set Records: The length of a data set record is variable, the format is defined in Table 37. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC or EECF.

ATSR-2 Instrument Header (EATI2)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: ATSR-2

Originating Subsystem: LRDPF

Production Generation: Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EATI2

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.

Format One product includes:

- Main Product Header: See See Table 5.
- Specific Product Header: See Table 36.
- Variable Number of Product Data Set Records: The length of a data set record is variable, the format is defined in Table 37. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC or EECF.

GOME Instrument Header (EGOI)

Description: This product contains selected windows or all auxiliary data extracted over a specified time interval.

Satellite Source: GOME

Originating Subsystem: LRDPF

Production Generation: Auxiliary data are extracted for MMCC/EECF -specified start and stop times. MMCC/EECF can also define whether all auxiliary data or separate windows shall be collected.

A maximum of 10 commands can be submitted per orbit, defining start and stop time and the data extraction window(s) position(s) within the auxiliary data.

Command: C_GEN_EGOI

On-Line Storage Specification: 200 minutes

Throughput: Maximum 1.5 Mbytes per orbit and maximum 15 Mbytes per day.

Format One product includes:

- Main Product Header: See Table 5.
- Specific Product Header: See Table 36.
- Variable Number of Product Data Set Records: The length of a data set record is variable, the format is defined in Table 37. All data of the selected time interval are combined in one product. Up to 10 windows can be simultaneously extracted and included in one record.

Media: X.25 link to MMCC or EECF.

General Headers (EGH)

Description:	This product contains 16 sets of platform data included in the Source Data Field of the IDHT General Header Source Packet.
Satellite Source:	IDHT
Originating Subsystem:	LRDPF, SAR FDP (wave mode processing) as backup.
Production Generation:	Products are extracted for MMCC/EECF -defined start and stop times.
Command:	C_GEN_EGH
On-Line Storage Specification:	200 minutes
Throughput:	375 products per orbit
Format	One product includes.: • Main Product Header: See Table 5. • 16 Product Data Set Records: Each product data set record consists of byte 6 to 261 of the IDHT General Header Source Packet, as shown in Table 38. The first record corresponds with the start of the platform data, platform frame count of 0. The last record corresponds to platform frame count of 15.
Media:	X.25 link to MMCC or EECF.
Comment on Product Confidence:	In case there is a missing or corrupted Source Packet within a product, the platform data field in the corresponding record is set to 0. In addition, the ''Quality of Downlinked Formats and Source Packets'' flag in the MPH is set accordingly. In case there is a duplicated Source Packet, the second one is ignored. In case there is no data at all then no products are generated.

IDHT General Header packets are sub-commutated in segments of 8 bytes per transmitted format, and are located in the first frame of each format. However, it should be noted that the integrity of the General Header data in the HR telemetry is and will not verified. Therefore ESA discourages the extraction of the General Header Data from link 1.

Table 38 Data Set Record for EGH

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, starting with 1.	
2	256	S	Platform Data The format is identical to the first 256 bytes of the ''Source Data Field'' of the General IDHT Header Source Packet, see Document A-1.	

Text Products

Text Product (TP)

Description:	Text messages are generated by the MMCC/ EECF. They are output over the product distribution link at MMCC/EECF -specified times.
Satellite Source:	Not Applicable
Originating Subsystem:	MMCC/DPMC or EECF/CMS.

Production Generation:	Not Applicable.
Command:	C_USER_TEXT
On-Line Storage Specification:	200 minutes
Throughput:	Variable low
Format	One product includes.: • Main Product Header: See Table 5. • One Product Data Set Record: Each record consists of one 80-byte-long text message, see Table 39.
Media:	Product distribution links.

Table 39 Data Set Record for Text Product

Field	Bytes	Type	Description	Units
1	4	I4	Data record number, this number is always 1.	
2	80	A	Text message	

Part 4

Product distribution

Media and file formats

Product distribution media

The ERS ground stations use a number of different media to distribute their products. The products can either be distributed via telecommunication links or on some magnetic or optical media. This part of the document presents the magnetic and optical media and their data formats.

- ***The High Density Digital Tape, HDDT:*** The stations use HDDT to acquire and store the original telemetry from the satellite. The tapes contain the unprocessed datastream as it is received from the satellite. The stations distribute this 'raw data' to the PAF's for high rate data and to the raw data archive in Fucino for low rate data.
- ***The Computer Compatible Tape, CCT:*** The stations use the CCT to archive low rate fast delivery products. The tapes contain processed data. The stations distribute data on CCT on request when the normal telecommunications links are unavailable.
- ***The Exabyte, EXA:*** The stations use the Exabyte for several purposes:
  - To archive fast delivery and intermediate high rate and Wave products. The cassettes contain processed data. The station distribute them to the PAF's for archiving.
  - To transcribe low bit rate data from HDDT to Exabyte. The cassettes contain unprocessed annotated source packets in a computer readable format. The stations distribute these cassettes to the PAF's for low bit rate data processing and archiving.
  - To archive low bit rate fast delivery products. The cassettes contain processed data. These cassettes will not nominally be distributed outside the station.
- ***The Optical Disc, OD:*** The station at Fucino uses the OD to transcribe ERS-1 low bit rate data from HDDT. The discs contain unprocessed source packets in computer readable format. The station distributes the discs to the French PAF for low bit rate processing and archiving. This media will be replaced by the Exabyte when ERS-2 becomes the operational satellite.

Table 40 lists the nominal and alternative magnetic and optical media for the raw data, intermediate and fast delivery products. It should however be noted that any product can be put on CCT or Exabyte. Later sections in the document will present these possibilities.

Table 40 Product distribution media

Product		Link	HDDT	CCT	EXA	OD
EATC2	ATSR-2 Extracted Calibration				2	
EATI1	ATSR-1 Instrument Headers	N				
EATI2	ATSR-2 Instrument Headers	N				
EEP	Ephemeris data	N				
EGH	General Headers	N[39]				
EGOC	GOME Extracted Calibration				2	
EGOI	GOME Instrument Headers	N				
EIC	AMI Image Extracted Calibration				N	
EII	AMI Image Instrument Headers	N				
EMWC	Microwave Extracted Calibration				2	
ERAC	Radar Altimeter Extracted Calibration				2	1
ERAI	Radar Altimeter Instrument Headers	N				
EWAC	AMI Wave Extracted Calibration				N	
EWAI	AMI Wave Instrument Headers	N				
EWIC	AMI Wind Extracted Calibration				2	1
EWII	AMI Wind Instrument Headers	N				
II16	AMI Image Intermediate				N	
IWA	AMI Wave Intermediate				N	
RATSR	ATSR-1 Extracted Calibration					1[40]
RH	High bit rate raw data		N			
RL	Low bit rate raw data		N			
TP	Text product	N				
UI16	AMI Image 16-bit	N			A	
UI8	AMI Image 8-bit	N			A	
UIC	AMI Image Chirp Replica	N				
UIND	AMI Image Noise statistic and drift calibration	N				
URA	Radar Altimeter	N		A		
UWA	AMI Wave	N			A	
UWAC	AMI Wave Chirp Replica	N				
UWAND	AMI Wave Noise statistic and drift calibration	N				
UWI	AMI Wind	N		A		

Legend:

N: Nominal media for ERS-1 and ERS-2;

1: Nominal media for ERS-1;

2: Nominal media for ERS-2;

A: Alternative media for ERS-1 and ERS-2, to be used in case of link failure

[39] General headers can be systematically put on OD and Exabytes but the telecommunication links are always the nominal means of distribution.

[40] The RATSR product, Extracted ATSR source packets, is transcribed by the LRDTF to OD during the ERS-1 mission. The product is also systematically put on the Digital Cassette for ATSR-1.

High Density Digital Tape format (HDDT)

Used media

The ERS ground stations use one inch Sony V-1K-188M compatible video tapes to record the acquired high and low bit rate data. The tapes have a reel size of 14 inches and accommodate 9200 feet of tape.

Paper label

The sticker on the HDDT or tape label contains the necessary information concerning the content of the tape:

- MMCC/EECF-supplied medium ID
- Satellite ID
- Station ID
- Drive on which HDDT was generated
- Demodulator used for acquisition.
- Number of acquisitions on this tape
- Start time of HDDT recording
- Stop time of HDDT recording

Figure 7 Example of a HDDT paper label

The start and stop times mentioned on the tape label are the times of the beginning and the end of the recording. The satellite starts to send data some time after the start time on the label and stops some time before the stop time. The satellite sends PRN data circa 35 seconds before and 15 seconds after transmission of image data.

High Bit Rate Data on HDDT

Reader requirements

The ERS ground stations use the Thorn EMI[41] Datatech SE9000 Laboratory 28-Track Tape Recorder and the SE9500 3PM Digital Data Formatter configured for High Rate data for recording of High Bit Rate data. Thorn EMI[41] has modified these units to accept the Sony tapes. The reader of the High Bit Rate HDDT's should be of the same type. The document R-2 fully describes these units.

Media format

For High Rate data, each tape accommodates approximately 11 minutes recording time. Figure 8 presents the High Rate tape layout.

[41] Thorn EMI is now Penny & Giles.

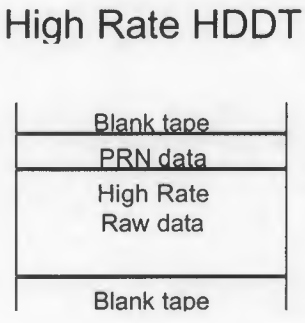

Figure 8 High rate HDDT layout

Each tape starts with some blank space, circa 100 m, followed by the PRN data used to verify proper performance of the recorder before the acquisition of data. The downlinked X-Band data then follows.

The high rate HDDR records the data on 27 tracks, 24 for data and 3 for parity, at 120 IPS. This gives a recording density of 39.06 kbpi. Possible play-back speeds range from 3-3/4 IPS to 120 IPS. The BER is 1 in 10^6. Table 41 shows the track allocation for the high rate HDDT.

One track on the HDDT contains an analogue time code in IRIG-A130[42] format, 10 kHz carrier. The time is Universal Time, Coordinated UTC. The IRIG format embeds product quality data.

Table 41 Tack allocation of High Rate HDDT

	Odd Headstack	Even Headstack
D R Channel, time code track	1,	
Formatter 1	7, 13, 19, 25	4, 10, 16, 22, 28
Formatter 2	5, 11, 17, 23	2, 8, 14, 20, 26
Formatter 3	3, 9, 15, 21, 27	6, 12, 18, 24

There may be two image sequences on the tape, either dictated by the Mission Operation Plan or because of occultation. The station fills the tape between the two images with PRN in the first case. The PCD in the Time Code track will show normal behavior. In the case of occultation the station can not receive the transmission. This results in the absence of PRN and abnormal behavior for the PCD in the Time Code.

Low Bit Rate Data on HDDT

Reader requirements

The ERS ground stations use the Thorn EMI[43] Datatech SE9000 Laboratory 14-Track Tape Recorder and the SE9500 3PM Digital Data Formatter configured for Low Rate data for recording of High Bit Rate data. Thorn EMI[43] has modified these units to accept the Sony tapes. The reader of the Low Bit Rate HDDT's should be of the same type. The document R-2 fully describes these units.

Media format

Each tape, recorded at the ERS ground stations, accommodates nominally one pass of approximately 13 minutes recording time. Figure 9 presents the Low rate HDDT layout.

[42] See Table 6 on page 15 for time code format.

[43] Thorn EMI is now Penny & Giles.

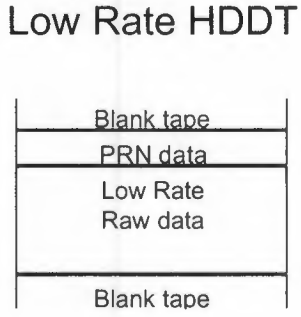

Figure 9 Low rate HDDT layout

Each tape starts with some blank space followed by the PRN data used to verify proper performance of the recorder before the acquisition of data. The downlinked X-band data then follows.

The low rate HDDR records the data on 13 of the available 14 tracks at the recording speed of 60 IPS. Table 42 shows the track allocation. The playback data is recorded on the tape in reverse direction from the real-time data. The BER is 1 in 10^6.

One track of the HDDT contains an analogue time code in IRIG-A130[44] format, 10-kHz carrier. The time is UTC. The IRIG format embeds product quality data.

Table 42 Track allocation for Low Rate HDDT

	Odd Headstack	Even Headstack	Playback speed	Packing density
Formatter 1: Playback	3, 5, 7, 11	2, 6, 8, 10, 12	15 - 60 IPS	33.48 kbpi
Formatter 2: Real-time	9 13 -	4	60 - 120 IPS	14.28 kbpi
D R Channel: Time code	1			

Computer Compatible Tape Format (CCT)

Used media

The ERS ground stations record CCT with 6250 bpi, using 9-track tapes, with 2400 feet of tape on 10-inch reels. The tape drives that generate these tapes have built-in error detection and correction.

Media format

The ERS ground stations store products on CCT after an archive command. All products addressed with the same command are put into one logical volume which contains of at least one physical reel.

There are two different formats for CCT's:

- Product-type-per-file
- Product-per-file

Table 43 defines the CCT formats for all ERS ground stations products.

Table 43 CCT format for ERS ground station products

	Product-type-per-file	Product-per-file

[44] See Table 6 on page 15 for time code format.

Table 43 CCT format for ERS ground station products

	Product-type-per-file	Product-per-file
EATC2	X	
EATI1		X
EATI2		X
EEP	X	
EGH	X	
EGOC	X	
EGOI		X
EIC	X	
EII		X
EMWC	X	
ERAC	X	
ERAI		X
EWAC		X
EWAI		X
EWIC	X	
EWII		X
II16		X
IWA		X
RATSR	X	
UI16		X
UI8		X
UIC	X	
UIND	X	
URA	X	
UWA	X	
UWAC	X	
UWAND	X	
UWI	X	

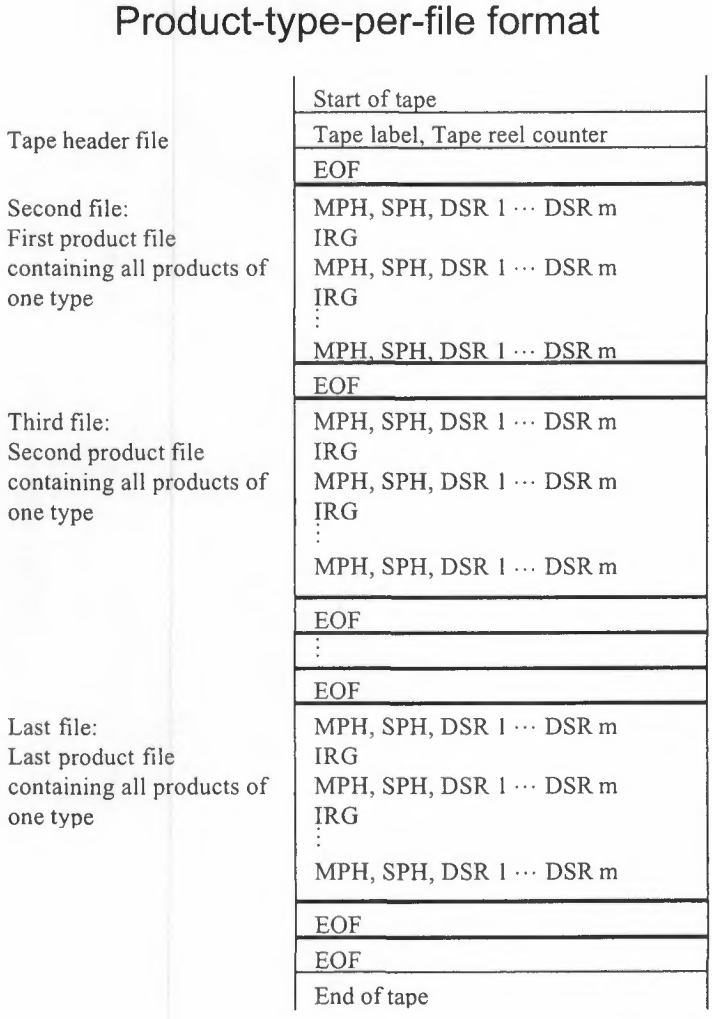

Figure 10 Product-type-per-file format for CCT

The product-type-per-file format means storing of all products of the same type in one file. Each product is one record on the tape. There is only one file per product type on each CCT. Figure 10 presents the format layout.

Product-per-file format

	Start of tape
Tape header file	Tape label, Tape reel counter
	EOF
Second file: First product file on the reel	MPH IRG SPH IRG DSR 1 IRG DSR 2 IRG ⋮ DSR m
	EOF
Third file: Second product file on the reel	MPH IRG SPH IRG DSR 1 IRG DSR 2 IRG ⋮ DSR m
	EOF
	⋮
	EOF
Last file: Last product file on the reel	MPH IRG SPH IRG DSR 1 IRG DSR 2 IRG ⋮ DSR m
The last reel in a multireel volume has three EOF markers. All other reels have two.	EOF
	EOF
	EOF (on the last reel only)
	End of tape

Figure 11 Product per file format for CCT

The product-per-file structure gives one product per file. The product record structure as written on the tape is the same as the original record structure. The format can give logical volumes with more than one physical reel. The last of these reels has three EOF marks. Figure 11 Product per file format for CCT presents this tape layout.

Tape header File

All CCT's generated at the ERS Ground Stations have a tape header file. Table 44 presents this file.

Table 44 CCT Header File Format

Field	Bytes	Type	Description
1	8	A	Tape Identifier The generating systems write the identifier to all tape reels generated with the same command. This identifier is also printed on the paper label.
2	2	I2	Reel counter The value is 1 for the first reel of a tape set.
3	4	I4	Spare

Paper Label

All CCT's have a paper label containing the following information:

- Medium ID
- Satellite ID
- Station ID
- Tape drive ID
- Tape reel counter
- Last reel counter
- Time interval for which products were taken and stored on tape
- List of product types (acronyms) stored on tape

```
Label: ES500022                                  Spacecraft:  1
Station:  5                  Drive:  1             Reel:  1/  1
Start/Stop:  6-MAY-1991 12:34:56.780   6-MAY-1991 12:45:00.000
UI16 UI8 UIND UIC II16
```

Figure 12 Example of a CCT paper label

Exabyte formats (EXA)

The stations can produce a number of different Exabyte formats by using a number of subsystems. These formats are similar but different in details. This section of the document presents the different Exabyte formats.

- ***The Exabyte Tape format:*** The DPMC and CMS subsystems produce this format to archive fast delivery and intermediate SAR and Wave products.
- ***The Transcription Exabyte format:*** The LRDPF subsystem produces this format when it transcribes low bit rate data from HDDT to Exabytes. This is the nominal format for low bit rate raw data distribution to the PAF's.
- ***The Transcription Exabyte Copy format:*** The Transcription Exabyte Copy utility produces this format when it copies one transcription Exabyte to one or many copies. These copies have the same format as the original transcription exabyte what regards number and order of fields. Some of the fields have a different content.
- ***The Low Rate Archive Exabyte format:*** The LRDPF subsystem produces this format when it archives a single product to exabyte. The stations will use this format for archiving of fast delivery low bit rate products. This format will not be used for any nominal distribution of data to the PAF's.
- ***The Digital Cassette Exabyte format:*** The LRDTF subsystem produces this format when it transcribes ATSR-1 low bit rate data to Exabyte. This format will be replaced by the Transcription Exabyte format when ERS-2 becomes the operational satellite.

The three formats: Transcription, transcription copy and low rate archive, are all of the same family and should be software compatible in a reading system. They all have the same media layout with a production information file at the beginning of the cassette and a directory file at the end.

Table 45 presents the nominal Exabyte formats for the products commonly put on Exabyte at the stations.

Table 45 Nominal Exabyte formats

Product: *N: Nominal Exabyte format for ERS-1 and ERS-2* *1: Nominal Exabyte format for ERS-1* *2: Nominal Exabyte format for ERS-2*		Exabyte tape by DPMC/ CMS	Tran-scription Exabyte by LRDPF	Digital Cassette by LRDTF
EATC2	ATSR-2 Extracted Calibration		2	
EGH	General Headers		2	
EGOC	GOME Extracted Calibration		2	
EIC	AMI Image Extracted Calibration	N		
EMWC	Microwave Extracted Calibration		2	
ERAC	Radar Altimeter Extracted Calibration		2	
EWAC	AMI Wave Extracted Calibration		2	
EWIC	AMI Wind Extracted Calibration		2	
II16	AMI Image Intermediate	N		
IWA	AMI Wave Intermediate	N		
RATSR	ATSR-1 Extracted Calibration			1
UI16	AMI Image 16-bit	N		
UI8	AMI Image 8-bit	N		
UWA	AMI Wave	N		

Used media

The Exabyte system uses 8 mm cartridge tapes. The capacity of these tapes depends on the tape length and the device drive. The ERS Ground Stations use tapes with five Gbytes storing capacity.

Exabyte paper labels

All Exabyte tapes have a paper label containing the same information as that provided on a CCT label.

- Medium ID
- Satellite ID

- Station ID
- Tape drive ID
- Tape reel counter
- Last reel counter
- Time interval for which products were taken and stored on tape
- List of product types (acronyms) stored on tape

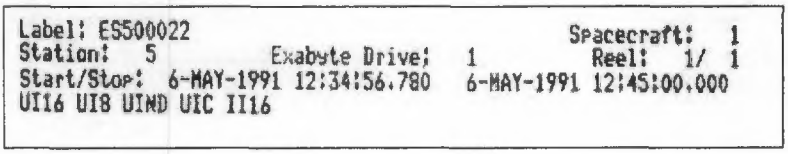

Figure 13 Example of an Exabyte paper label

The DPMC/CMS Exabyte Tape Format

The C_Exabyte command

The DPMC and CMS subsystems of the ERS ground stations store products on Exabyte after an C_Exabyte command. All products addressed with the same command are put into one logical volume which contains of one physical cassette.

The C_Exabyte command can be used to store products from the DPMC or CMS product databases to up to four Exabyte devices. Any number of product types may be selected for storage. However will the command only handle ERS-1 products, i.e., those listed in position 0 to 23 in the product type list.

The command contains among others four fields that control the contents of the produced Exabyte: prod_type_list, start_time, stop_time and mph_file. The second file of the Exabyte, the MPH file, contains the three of these four fields from the command. The last, mph_file, is reflected in another field in the MPH file. Table 46 presents the four fields.

Table 46 C_Exabyte fields

Field	Bytes	Type	Description
prod_type_list	50	prod_type_list[45]	The field lists the products to be stored on the Exabyte. The command can handle any number of products as among the ERS-1 subset, i.e., those products listed in position 0 to 23.
start_time	8	utc_time_m[46]	Start of product acquisition time window
stop_time	8	utc_time_m[46]	Stop of product acquisition time window
mph_file	1	B	The field controls the filling of the MPH file. The file can be filled with the MPH for each product. 0: Fill MPH file 1: Do not fill MPH file

Media format

The Exabyte produced by the DPMC or the CMS contains one tape header file, one MPH file and one ore more product files.

The first file on the cassette, the Tape Header file, contains the tape label and the tape cassette counter.

The second file, the MPH file, gives information about the cassette. It states the product list and the acquisition time window for the stored products in the directory record. The file could as well contain MPH's from the stored products if MPH filling is requested in the C_Exabyte command. This option is however nominally disabled by the mph_file flag in the C_Exabyte command.

Figure 14 defines the tape format for the Exabyte produced by the DPMC or CMS.

[45] See Section 'Data type utc_time_m' on page 5.

[46] See Section 'Data type utc_time_m' on page 5.

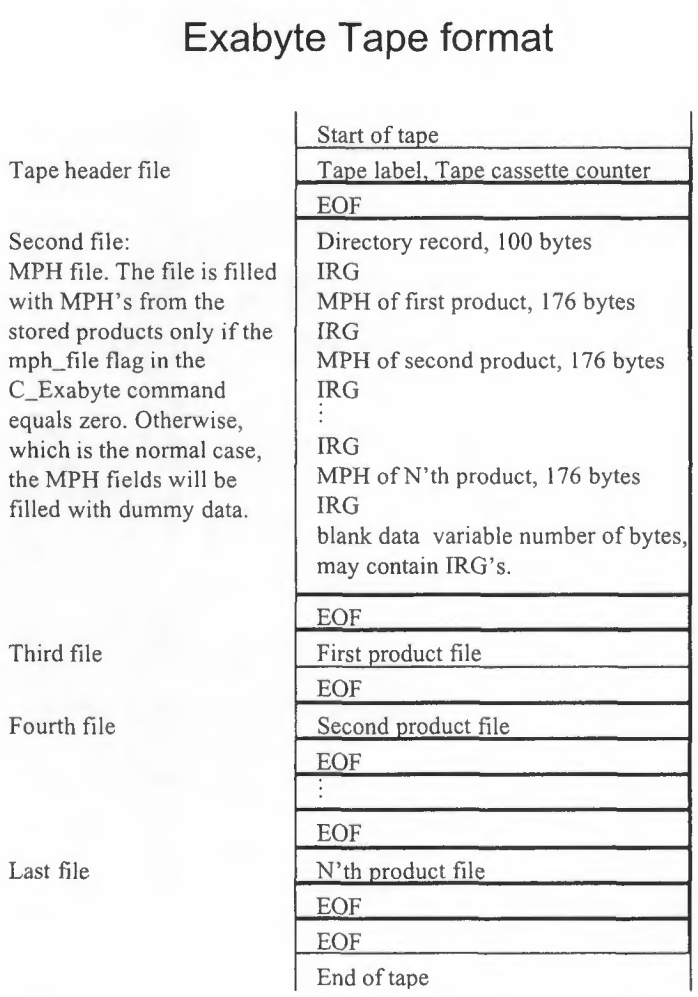

Figure 14 Exabyte tape format

Tape header File

All Exabytes generated by the DPMS and CMS systems have a tape header file. Table 47 presents this file.

Table 47 Exabyte Tape Header File Format

Field	Bytes	Type	Description
1	8	A	Cassette identifier
2	2	I2	Tape cassette counter
3	4	I4	Spare

MPH file

The second file, the MPH file, of the cassette gives a list of contents. It contains always:

- The product type list from the C_Exabyte command

- The start time of the product acquisition window
- The stop time of the product acquisition window

The MPH file can also contain a list of the MPH's of the stored products if the mph_file flag in the C_Exabyte command equals zero. The systems does this filling of MPH's after having written all other files on the cassette. This means that the drive rewinds the cassette and positions the cassette at the start of the second file before writing the file. This rewind and position procedure is not as accurate as it should and the writing of the MPH's might disturb the rest of the cassette. The MPH fields will due to this nominally be left blank.

Table 48 MPH File Directory format

Field	Bytes	Type	Description
1	4	I4	Number of MPH's stored in this file (N). The field equals zero if the mph_file flag selects no MPH filling. The maximum value is 550.
2	24	B	Product Type list copied from the C_Exabyte command.
3	24	A	Start time of product acquisition time window. Copied from the C_Exabyte command.
4	24	A	Stop time of product acquisition time window. Copied from the C_Exabyte command.
5	24	B	Spare
6	176	MPH[47]	First product MPH, blank data if the mph_file flags selects no MPH filling.
7	176	MPH[47]	Second product MPH, blank data if the mph_file flags selects no MPH filling.
⋮	⋮	⋮	
N+5	176	MPH[47]	The N'th product MPH

Product files

The products stored on the Exabytes produced by the two systems can have two different formats:

- Small product format for products with a size less than or equal to 32 Kbytes.
- Large product format for products with a size greater than 32 Kbytes.

Both formats can exist on the same Exabyte cassette. Table 49 defines the Exabytes formats for the products.

Table 49 Exabyte format for products produced by the DPMC or CMS

	Small product format	Large product format
EEP	X	
EGH	X	
EIC	X	
EII		X
ERAC	X	
ERAI		X

[47] See Table 5 on page 7.

Table 49 Exabyte format for products produced by the DPMC or CMS

	Small product format	Large product format
EWAC		X
EWAI		X
EWIC	X	
EWII		X
II16		X
IWA		X
RATSR	X	
UI16		X
UI8		X
UIC	X	
UIND	X	
URA	X	
UWA	X	
UWAC	X	
UWAND	X	
UWI	X	

The Small product format means one file per product containing the whole product with no inter record gaps.

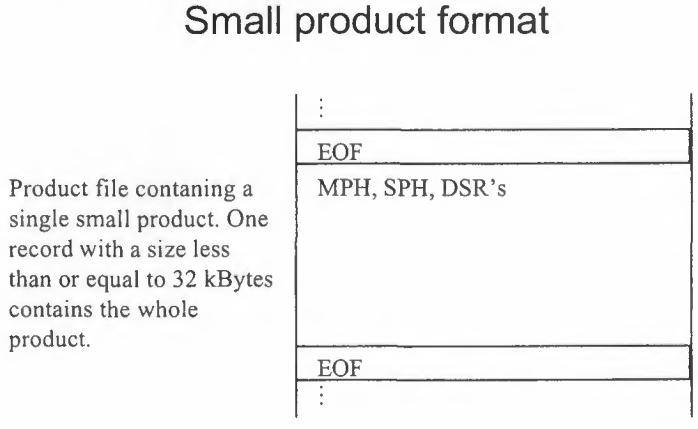

Figure 15 Small Product Format for the Exabyte tape

The Large product format means one file per product containing the whole product with inter record gaps at each 32 Kbytes.

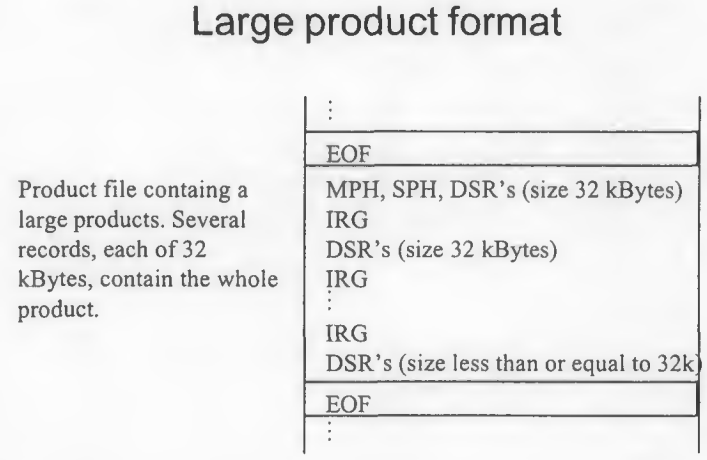

Figure 16 Large Product Format for the Exabyte tape

The LRDPF Transcription Exabyte Format

The Transcription commands

The Exabyte tape is the nominal physical medium for transcription of Low Bit Rate ERS-2 data at the ERS stations. There are several commands for the LRDPF that control the transcription process. Two of these control the contents of the produced media: C_Init_Trans and C_Config_Trans. The LRDPF writes these commands to a production information file on the Exabyte.

The C_Init_Trans command initializes the transcription process. The fields of the command specifies two time windows. The first gives the product acquisition time window. It starts with the start time of the first acquisition to be put on the cassette and ends with the stop time of the last acquisition. The second window gives the station time window; the time when the command is active. The LRDPF starts the transcription session and mounts the cassettes at the start of this window. The transcription session ends with the writing of the directory file and the dismount of the cassettes at the end of the station time window.

Table 50 C_Init_Trans command fields

Field	Bytes	Type	Description
fdp	1	B	Fast delivery processor: 2: LRDPF
acq_start_time	8	utc_time_m[48]	Acquisition start time. The start time of the first acquired product to be put on the cassette.
acq_stop_time	8	utc_time_m[48]	Acquisition stop time. The end time of the last acquired product to be put on the cassette.
stn_start_time	8	utc_time_m[48]	Station start time. The time when the transcription session starts and the LRDPF mount the cassettes.
stn_stop_time	8	utc_time_m[48]	Station stop time. The time when the transcription session ends, the LRDPF writes the directory file and dismount the cassettes.

[48] See Section 'Data type utc_time_m' on page 5.

The C_Config_Trans command configures the transcription session for each Exabyte device on the LRDPF. The command selects the products to be transcribed to one logical Exabyte device. The fields of the command specifies the logical device identifier, the products to be transcribed and the device label to be written in the tape header file.

Table 51 C_Config_Trans command fields

Field	Bytes	Type	Description
fdp	1	B	Fast delivery processor: 2: LRDPF
tape_drive	1	B	Logical device identifier. The LRDPF translates this field into a physical identifier by looking into a device table.
transcript_list	50	prod_type_list[49]	List of products to be transcribed. Only extracted calibration data products and general header products are valid.
device_label	16	A	Device label to be written in the tape header file and paper label to be printed.

Media format

The Transcription exabyte contains one tape header file, one production information file, one or many product files and one directory file. Figure 17 presents the tape layout.

The first file, the tape header file, contains the tape label, the tape cassette counter and a tape type identifier.

The second file the production information file contains the production date, the satellite identifier and the two commands: C_Init_Trans and C_Config_trans.

The directory file is the last file on the cassette. This file contains the transcribed volume and number of products, tape level quality assurance and product level volume and quality assurance.

[49] See Section 'Data type prod_type_list' on page 4.

Transcription exabyte format

	Start of tape
Tape header file	Tape label Tape cassette counter Tape type
	EOF
Second file: Production information file	Production date Satellite identifier C_Init_Trans command C_Config_Trans command
	EOF
Third file	First product file
	EOF
Fourth file	Second product file
	EOF
	⋮
	EOF
Last product file	N'th product file
	EOF
Last file: Directory file	Number of extracted product files Extracted product volume Tape record counter Station time Logical device id Device label Physical volume number Tape level QA summary Tape level QA Product file descriptors with: Number of non-zero products Number of products MPH of first product MPH of last product PCD monitors Product level QA
	EOF
	EOF
	EOF
	EOF (only on singel volume and on last cassette in a multi volume)
	End of tape

Figure 17 Transcription Exabyte tape format

Tape header File

The Exabytes produced by the LRDPF have a tape header file. It contains the tape label, tape type and the tape cassette counter. Table 52 presents this file.

Table 52 LRDPF Exabyte Tape Header File

Field Number	Number of Bytes	Data Type	Description
1	8	A	Tape Label: the LRDPF writes the label to all cassettes generated from the same command. It is also printed on the paper label.
2	2	I2	Tape cassette counter: First cassette = 1.
3	1	A	Tape type: A: Archive Exabyte T: Transcription Exabyte
4	3	B	Spare

Production information file

The production information file gives details about the transcription setup for the exabyte. The file contains the production time, the satellite identifier and the two commands that initialized the transcription session. These commands originate from the DPMC, the CMS or the local LRDPF operator. Table 53 presents the format of the Production Information File.

Table 53 Transcription Exabyte Production Information File

Field Number	Number of Bytes	Data Type	Description
1	8	utc_time_m[50]	Production time
2	4	I4	Satellite id: 1: ERS-1 2: ERS-2
3	33	C_Init_Trans	The command from the DPMC, CMS or the local operator that initialized the transcription session. The section 'The Transcription commands' on page 100 presents this command.
4	68	C_Config_Trans	The command from the DPMC, CMS or the local operator that initialized the transcription session to this Exabyte. The section 'The Transcription commands' on page 100 presents this command.
5	87	B	Spare

[50] See Section 'Data type utc_time_m' on page 5.

Product files

The transcription Exabytes may only contain extracted calibration data products and general header products.

The LRDPF store products in a one file per product type format. The system writes in two different file formats: one format for extracted wave data, the EWAC product, and instrument header products and another format for all other products.

The LRDPF writes all products to one file per product type with an inter record gap between each product. The EWAC and the instrument header products get inter record gaps between the MPH, the SPH and the DSR's as well. Figure 18 and Figure 19 present the two formats.

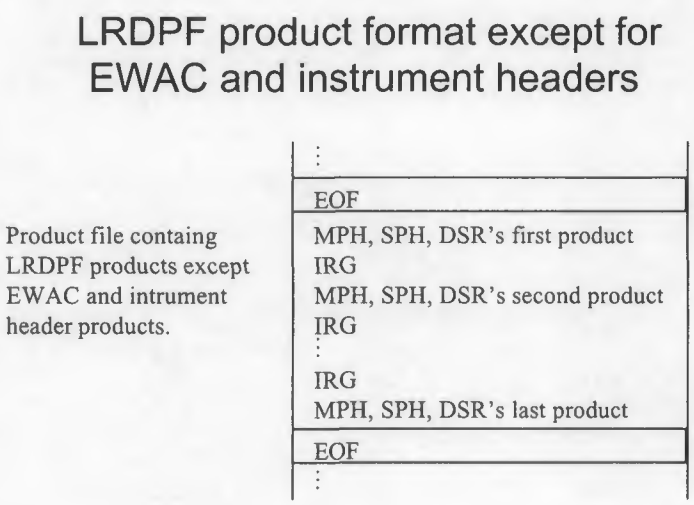

Figure 18 LRDPF product format except for EWAC and Instrument Headers

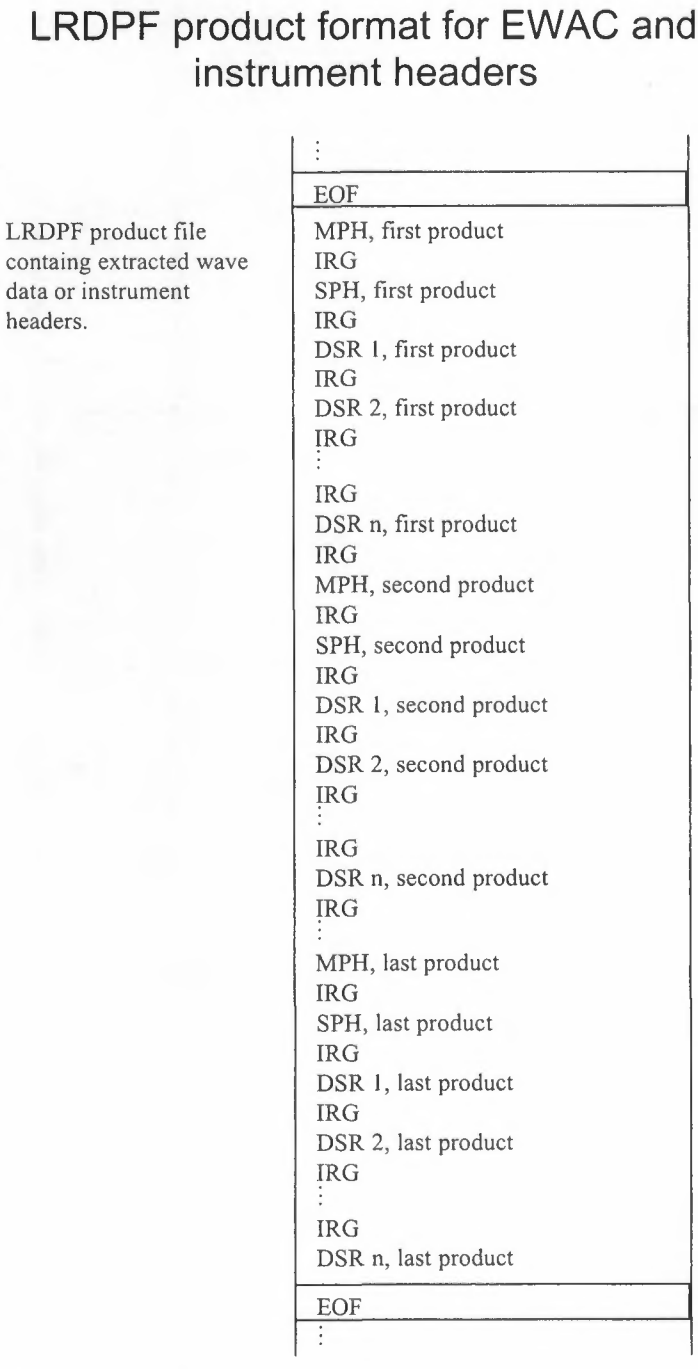

Figure 19 LRDPF product format for EWAC and instrument headers

Directory file

The directory file is always the last file on every transcription Exabyte. Even cassettes in a multi cassette volume have the directory of their contents. The file contains the transcribed volume and number of products, tape level quality assurance and product level volume and quality assurance.

The LRDPF creates the information while writing to the Exabyte. The directory file is not complete until all other files are written. This makes it impossible for the system to write the file in another place than at the end of the cassette.

Table 54 presents the Directory File.

Table 54 Transcription Exabyte Directory File

Field	Bytes	Type	Description
1	4	I4	Number of extracted product files
2	4	I4	Total product data volume
3	4	I4	Transcription tape record counter
4	8	utc_time_m[51]	Station time of tape record.
5	1	B	Logical device id
6	16	A	Device label
7	4	I4	Physical volume number
8	1	B	Tape level QA summary. The field is a logicalsum of the tape QA analysis and of all the product QA analysis on the tape. 0: Overall tape QA pass 1: Overall tape QA fail
9	1	B	Tape level QA analysis: 0: Pass, the number of files read from tape match the directory file value. 1: File fail, the number of files read from tape do not match the directory file value. 2: Volume fail, not used 3: Media fail, LRDPF could not read from tape.
10	4	I4	Number of product files as read from tape.
11	4	I4	Number of product files as in directory file.
12	4	I4	Spare (Reserved for product volume as read from tape)
13	4	I4	Product volume as in directory file
14	6	I2	Spare
15	435	B	Spare
16	4	I4	Product File 1: Number of non-zero products, the LRDPF sets this field to 0.

[51] See Section 'Data type utc_time_m' on page 5.

Table 54 Transcription Exabyte Directory File

Field	Bytes	Type	Description
17	4	I4	Product File 1: Total number of products
18	176	MPH[52]	Product File 1: Main Product Header of First Product
19	176	MPH[52]	Product File 1: Main Product Header of Last Product
20	4	I4	Product File 1: Spare (Reserved for Raw data availability)
21	4	I4	Product File 1: Spare (Reserved for Acquisition PCD monitor)
22	4	I4	Product File 1: Spare (Reserved for Ingestion PCD monitor)
23	1	B	Product File 1: Product identifier 0: RATSR 13: EWAC 14: EWIC 15: ERAC 20: EGH 34: EGOC 38: EATC2 39: EMWC
24	1	B	Product File 1: Product QA: 0: Pass, MPH read from tape match directory file values. 1: Product fail, MPH read from tape do not match directory file values. 2: Media fail, LRDPF could not read from tape.
25	6	B	Product file 1: Spare
26	120	B	Product File 1: Spare
27 - 37	500	--	Product File 2: As fields 16 - 26.
⋮	⋮	⋮	
--	500	--	Product file N As fields 16 - 26.

[52] See Table 5 on page 7.

The LRDPF Archive Exabyte Format

The C_Archive command

The C_Archive command archives products to an archiving media, in this case to an Exabyte. One command can archive several product types. The LRDPF archives all products of the same type in one product type file on the Exabyte.

The command contains several fields that control the contents of the Exabyte: One product list, one acquisition time window and one tape label. The LRDPF writes the complete command in the production information file at the start of the tape.

Table 55 C_Archive command fields

Field	Bytes	Type	Description
fdp	1	B	Fast delivery processor: 0: SARFDP 1 1: SARFDP 2 2: LRDPF The Archive Exabytes from the LRDPF will always show the value 2 in this field.
delete_flag	1	B	Delete product from database: the LRDPF ignores this flag.
archive_list	50	prod_type_list[53]	List of products to be archived. The LRDPF can archive any low rate product.
start_time	8	utc_time_m[54]	Start time of acquisition time window.
stop_time	8	utc_time_m[54]	Stop time of acquisition time window.
device_label	16	A	Device label to identify the cassette and to be printed on the paper label.
device_type	1	B	Device type: 1: CCT 2: Exabyte 3: DAT 4: Optical Disc The Archive Exabytes from the LRDPF will always show the value 2 in this field.

Media format

The LRDPF Archive Exabyte contains of one tape header file, one production information file, one or several product files and one directory file. Figure 20 presents the Archive exabyte layout.

The first file, the tape header file, contains the tape label, the cassette counter and the tape type.

The second file, the production information file, contains the production time, the satellite identifier and the C_Archive command.

[53] See Section 'Data type prod_type_list' on page 4.

[54] See Section 'Data type utc_time_m' on page 5.

The last file on the cassette, the directory file, contains the number of archived products and the MPH's of the first and last product of each type.

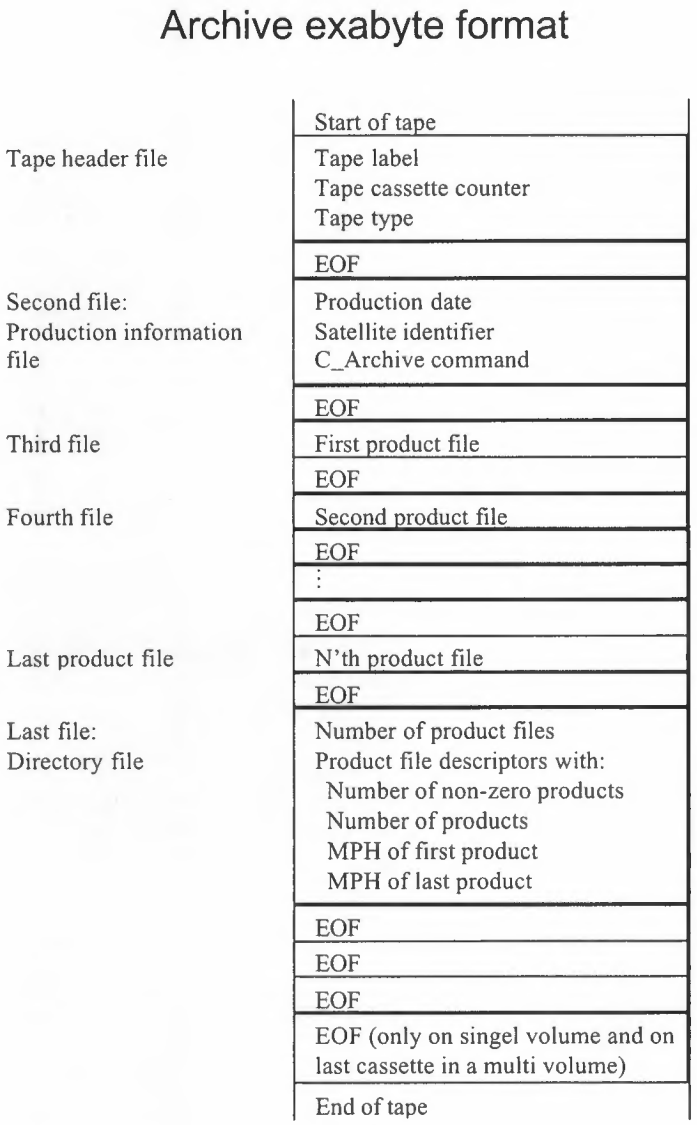

Figure 20 LRDPF Archive Exabyte format

Tape Header file

The archive Exabytes have the same tape header file as the transcription Exabytes. Table 52 presents this file.

Production information file

The production information file gives details about the system setup at the time for the archive command. The file contains the production time, the satellite identifier and the C_Archive command. This command can originate from the DPMC, the CMS or the local LRDPF operator.

Table 56 Archive Exabyte Production Information File

Field Number	Number of Bytes	Data Type	Description
1	8	utc_time_m[55]	Production time
2	4	I4	Satellite id: 1: ERS-1 2: ERS-2
3	85	C_Archive	The command from the DPMC, CMS or the local operator that initialized the product archiving. The section 'The C_Archive command' on page 108 presents this command.
4	103	B	Spare

Product files

The LRDPF Archive Exabyte contains product files with the same formats as the formats for transcription Exabytes. The section 'Product files' on page 110 presents the product file formats.

Directory file

The directory file is always the last file on every Archive Exabyte. The file contains the number of product files, the total archive volume, number of archived products for each product file and the first and last MPH's for each product type. Table 57 presents the Archive Exabyte Directory file.

[55] See Table 5 on page 7.

Table 57 Archive Exabyte Directory File

Field	Bytes	Type	Description
1	4	I4	Number of archived product files
2	4	I4	Total product data volume
3	492	B	Spare
4	4	I4	Product File 1: Number of non-zero products, the LRDPF sets this field to 0.
5	4	I4	Product File 1: Total number of products
6	176	MPH[56]	Product File 1: Main Product Header of First Product
7	176	MPH[56]	Product File 1: Main Product Header of Last Product
8	140	B	Product File 1: Spare
9 - 14	500	--	Product File 2: As fields 4 - 8
⋮	⋮	⋮	
--	500	--	Product file N As fields 4 - 8

[56] See Table 5 on page 7.

The Low Bit Rate Copy Utility Exabyte Format

The Low Bit Rate Copy Utility can accept any LRDPF transcription or any copy of these and produce one or many copies. The utility produces identical Exabyte formats and product files but modifies the tape header file, the production information file and the directory file. This section only specifies the modifications in the original file formats.

Tape Header file

The copy utility uses the spare field, field 4, to mark the cassette as a copy.

Table 58 Low Bit Rate Copy utility modifications to the tape header file

Field Number	Number of Bytes	Data Type	Description
4	3	B	Spare, filled with binary zeros on the original.
			Modifications:
		A	Byte 1: 'X' indicates a copy
		B	Byte 2: Logical device drive identifier
		B	Byte 3: Copy station identifier
			1: Kiruna station
			2: Fucino station
			3: Gatineau station
			4: Maspalomas station
			5: Esrin ERS central facility
			6: Prince Albert station

Production information file

The copy utility records the date and time for the copying in the spare field, field 5.

Table 59 Low Bit Rate Copy utility modifications to the Production Information File

Field Number	Number of Bytes	Data Type	Description
5	87	B	Spare, filled with binary zeroes on the original.
			Modifications:
		utc_time_m[57]	Bytes 1 - 8: copy time
			Bytes 9 - 87: spare

Directory file

The copy utility modifies the Directory file to show what the utility has read on the original and what is has written on the copy. The utility also makes a quality analysis on the copy.

[57] See Section 'Data type utc_time_m' on page 5.

Table 60 Low Bit Rate Copy utility modifications to the Directory File

Field	Bytes	Type	Description
1	4	I4	Number of extracted product files Modified to show the number of copied products written to this Exabyte.
2	4	I4	Total product data volume Modified to show the total data volume written to this Exabyte.
8	1	B	Tape level QA summary. The field is a logical sum of the tape QA analysis and of all the product QA analysis on the tape. 0: Overall tape QA pass 1: Overall tape QA fail Modified to show the QA summary on the copy and not on the original.
9	1	B	Tape level QA analysis: 0: Pass, the number of files read from tape match the directory file value. 1: File fail, the number of files read from tape do not match the directory file value. 2: Volume fail, not used 3: Media fail, LRDPF could not read from tape. Modified to show the QA analysis on the copy and not on the original.
10	4	I4	Number of product files as read from tape. Modified to show the number of files as read from copy.
11	4	I4	Number of product files as in directory file. Modified to show the number of files as read from original directory file.
13	4	I4	Product volume as in directory file. Modified to show the product volume as read from original directory file.
18	176	MPH[58]	Product File 1: Main Product Header of First Product Modified to show the MPH of the first product as read from copy.
19	176	MPH[58]	Product File 1: Main Product Header of Last Product Modified to show the MPH of the last product as read from copy.

[58] See Table 5 on page 7.

Table 60 Low Bit Rate Copy utility modifications to the Directory File

Field	Bytes	Type	Description
26	120	B	Product File 1: Spare, filled with binary zeroes on the original. Modified to show the record error conditions encountered during the copy process: Byte 1: File Copy QA index 0: Original value 1: File copied OK 2: File copied; First and last MPH times are not the same as in the source directory file.
		B	Byte 2 - 120: Spare

The LRDTF Digital Cassette Exabyte format

The LRDTF produces the Digital Cassette format, as specified in document R-7, for distribution of Extracted Low Bit Rate data during the ERS-1 mission. This format will not be used for any products from ERS-2.

The LRDTF produces Exabytes off-line. This means that the MPH's for the products miss some information. This section describes the media format and defines the differences in the MPH's.

Media format

One Digital cassette contains one cassette header file, one cassette directory file and a number of product files. The LRDTF writes the Tape Header File and the Cassette Directory File when the cassette is rewound. To allow harmless overwriting, the system leaves sufficient space at the beginning of the tape. This initial space has a size equivalent to a file of 30 Mbytes.

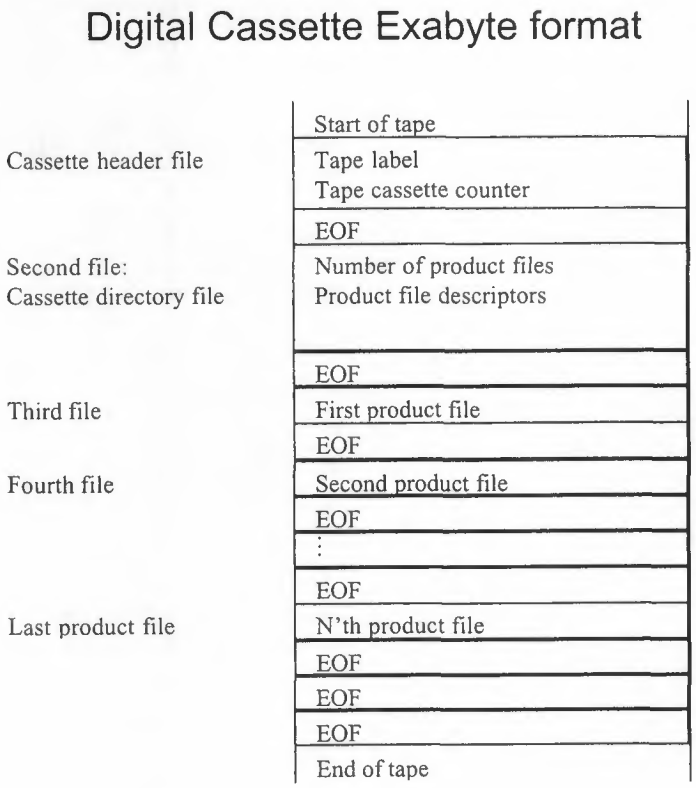

Figure 21 Digital Cassette Exabyte format

Cassette header file

The Digital Cassettes from the LRDTF have the same cassette header file format as the Exabyte tapes coming from the DPMC or CMS. Table 47 presents this file.

Cassette directory file

The LRDTF writes a directory file at the beginning of the tape. The file contains the number of product files and a product file descriptor for each file. This descriptor states the acquisition time window and the satellite binary time window for each product file. Table 61 presents the directory file format.

Table 61 Cassette Directory File Format

Field	Bytes	Type	Description
1	2	I2	Number of product files on the cassette
2	8	utc_time_m[59]	Product file descriptor for first product file: Start time of acquisition time window.
3	8	utc_time_m[59]	Product file descriptor for first product file: Stop time of acquisition time window.
4	4	I4	Product file descriptor for first product file: Satellite Binary Time of first source packet in the product[60].
5	4	I4	Product file descriptor for first product file: Satellite Binary Time of last source packet in the product[60].
6 - 9	24		Product file descriptor for second product file
⋮	⋮	⋮	
2+(n-1)×4 to 2+n×4	24		Product file descriptor for last product file

Product files

The Digital cassette can contain a number of product files. Each file contains all products from one acquisition. Each product forms one record in the product file. This product file format is the same as the product file format for extracted products on the transcription Exabyte. Figure 18 presents this product file format.

Main Product Headers

The Low Rate Transcription Facility, the LRDTF, produces the Digital Cassette format off-line. The system has no connection to the CMS or the DPMS. It has to generate all data for the main product headers from its own databases. This means that the MPH's will show differences in some fields. Table 62 shows the differences in the Main Product Headers as compared to the general format in Table 5.

[59] See Section 'Data type utc_time_m' on page 5.

[60] Field 4 and 5: The satellite binary time is extracted from bytes 6 - 9 of the last ATSR source packet of the pass.

Table 62 MPH for the Digital Cassette format

Field	Bytes	Type	Description
4	24	A	UTC time of subsatellite point at beginning of product. This information is not available in the LRDTF database. The field is filled with blanks (20H).
6	2	B	Product Confidence Data, PCD Bits 4 to 13 of the PCD field involves comparing the actually observed performance against certain thresholds read from externally provided look-up tables (LUT's). This document assumes that the LUT forming part of the LRDTF is identical to the data structure EXT_PCD_TRESH complemented by the table header PARAM_TBL_HEAD, as defined by EECF.
6			PCD Bit 4 - 5: Downlink performance. The field indicates the downlink performance by taking the maximum out of four checks against the LUT thresholds for: BER estimate, AGC value, I or Q lock and Carrier lock. The LRDTF reads the acquisition PCD from the time code track and compares it with the LUT thresholds, warning and error, for BER estimate and AGC value. For the binary indications, I or Q lock and Carrier lock, the LRDTF checks the number of consecutive samples in a given state against the thresholds. The filed shows the result in two bits: 00: observed value < warning threshold 01: warning threshold ≤≤ observed value < error threshold 10: error threshold ≤≤ observed value 11: PCD cannot be extracted from HDDT PCD, bit 6 - 7: HDDT summary The LRDTF monitors the formatters' lock status of the HDDR during playback. The field indicates the lock status as the binary values in bit 4 - 5. PCD, bit 8 - 9: Frame synchronizer The field indicates the frame synchronizer performance by taking the maximum out of two checks against the LUT thresholds for: Frame Synchronizer BER estimate Frame Synchronizer lock status The field indicates the result as bit 4 - 5 does.

Table 62 MPH for the Digital Cassette format

Field	Bytes	Type	Description
			PCD, bit 12 - 13: Checksum analysis on low rate frames The LRDTF calculates the percentage of low rate frames in the low rate products that have checksum errors. Bit 13 shows the result. Bit 12 is always 0. 0: Percentage of checksum errors < threshold 1: Threshold ≤≤ percentage of checksum errors
7	24	A	UTC time when MPH was generated; format 'dd-mmm-yyyy hh:mm:ss.ttt' for example: 023-Nov-04 09:33:27.123 The LRDTF generates this time stamp from its own real time clock. It is manually adjusted to UTC and is not synchronized to a station clock
13	24	A	UTC reference time The LRDTF database defines this field. It will nominally be set to blank (20H). Since the Time Correlation Element is not available in the LRDTF the field will be left blank. It may be inputted manually by the operator for exceptional operations.
14	4	I4	Reference binary time of satellite clock The LRDTF database defines this field. It will nominally be set to zero. Since the Time Correlation Element is not available in the LRDTF the field will be left blank. It may be inputted manually by the operator for exceptional operations.
15	4	I4	Step length of satellite clock in nanoseconds The LRDTF database defines this field. It will nominally be set to zero. Since the Time Correlation Element is not available in the LRDTF the field will be left blank. It may be inputted manually by the operator for exceptional operations.
17	2	I2	Threshold table version This field indicates the version number of the threshold table which was used to determine the MPH PCD.

Optical Disk Format (OD)

Media type

The Low Rate Transcription Facility transcribes raw data from HDDT's to 12 inch optical dis cs during the ERS-1 mission. Document R-6 specifies the Optical Disk format and disk type.

Media format

One optical disc contains normally of low bit rate data from 3 HDDT's. The data files consists of:

AMI Wave mode data file,

AMI Wind mode data file,

Radar altimeter data file,

ATSR data file,

General header data file,

CON file for ESA use,

PCD file for ESA use and

LAB file for ESA use.

The LRDTF adds Product Confidence data to every source packet. The label files provide low bit rate information for the relevant HDDT transcription and the previous ones.

Paper label

The paper label on the disk contains information concerning the contents of the disk:

OD-ID: ID unique throughout the ERS ground segment

OD drive ID: unique ID per station of drive to write the OD

Station ID

Satellite ID

HDDR ID used to playback the HDDT

For each pass transcribed to the OD[61]:

HDDT ID from which the data is transcribed. The ID includes Station id where the HDDT was written.

HDDR ID at Ground Station where data was recorded

Demodulator ID used during acquisition

HDDT recording start time in UTC[62]

HDDT recording stop time in UTC[62]

```
Volume id: FT000283 Drive id:0 Station id:FT
Satellite:ERS-1 HDDR PB:9
HDDT label: fs400110 HDDR rec:1 Demod id:1
Start/Stop:15-OCT-1990 11:35:42.000 / 15-OCT-1990 11:44:25.000
HDDT label: fs400111 HDDR rec:1 Demod id:1
Start/Stop:15-OCT-1990 11:35:42.000 / 15-OCT-1990 11:44:25.000
HDDT label: fs400112 HDDR rec:1 Demod id:1
Start/Stop:15-OCT-1990 11:35:42.000 / 15-OCT-1990 11:44:25.000
```

Figure 22 Example of an OD paper label

Transcription quality report

The transcription quality report is a print-out done by the Optical Disk Quality control after the quality check procedure of every optical disk before packing for shipment, The report contains:

OD-ID: ID unique throughout the ERS ground segment

Directory listing of side 1

Directory listing of side 2

[61] The pass is defined as the total data set that was telemetred from the satellite to the ERS ground station originating from the on-board recorder dump and the real-time acquisition.

[62] The time on the paper label is expressed in UTC time represented as 24 characters ASCII string: dd-mmm-yyy hh:mm:ss.ttt as defined in ER-TN-ESA-GS-0017, Time Handling and Processing.

Print-out of every label file of side 1 and 2
Remarks done by operator for anomalies