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ER-IS-EPO-GS-5902

ERS SAR Products Computer Compatible Tape Format Specifications

Document: ER-IS-EPO-GS-5902
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1. INTRODUCTION

1.1 DOCUMENTATION CONVENTIONS

This CCT format specification follows the format coding conventions defined in the document " SAR DATA PRODUCTS FORMAT STANDARD Rev 2.0 10-March-1989 by CEOS SAR Data Standards Subgroup".To improve compatibility between different installations, certain conventions have been used for the specification of the data formats on the CCT.The conventions apply to the definitions of the field formats and are described below.

The basic unit of storage on a SST is defined as an 8-bit byte. All other fields are built up using this basic unit. Alphanumeric fields are defined as textual strings containing either textual or numeric information to be interpreted as textual information. The fields are defined as multiples of 8-bit byte fields which contain either the ASCII or EBCDIC binary value of the alphanumeric character. The 8-bit byte fields are stored sequentially on the CCT in that the first byte contains the first character, the second the second character, and so on. In this document, these fields are identified with the "Aw" character where the"A" indicates textual data and the "w" specifies the field width in bytes.For example the definition "A32" is used to specify a text string of 32 characters.

Numeric fields are used to define numerical data in textual form. They are defined to be multiples of 8-bit bytes and are stored on the CCT in a fashion that is similar to that one used for textual data . The fields are denoted by "Iw" for Integer, "Fw.d" for Floating point decimal and "Ew.dEe" for Exponential representations. Where "w" specifies the field width, "d" specifies the digits after the decimal point and "e" specifies the exponent. Specifically, "F16.7" specifies a 16-byte field with the sign in 4he first byte, the non fractional component in the next 7 bytes and the fractional component in the 7 bytes following the decimal point (e.g. +1234567.1234567). Similarly, "E20.10" is a 20-byte field with a sign in the first byte, a decimal value in bytes 2-5, a decimal point in the 6-th byte, fractional part in bytes 7-16 and the last 4 bytes used for the exponent (e.g. -1234.1234567890E+04).

Binary fields are used to define binary data values. The basic element of storage for binary values are also defined in multiples of 8-bit bytes. For binary data, the order of each byte on the CCT is such that the most significant bytes appear before the least significant bytes. Unlike for the alphanumeric definitions above, binary data need not be encoded as integral multiples of 8-bits. In this type of usage encoding may be used and generally the encoding will be data dependent. The field definitions cannot be generalized and are addressed at the data file specification level. Nevertheless, the basic element of storage on the CCT is the 8-bit byte and binary fields are designated in this document as "Bw", where the "B" specifies binary data and the "w" the field width in bytes. For the cases where the unit of binary data width is not an integral multiple of 8-bits, the field size may be specified as an acceptable common multiple of 8-bit bytes.

For example if the signal data is quantized to 5-bit unsigned integer valued pixels,one method of storing this data is to use the low order 5-bits of a byte for data and zero fill the high order bits of the byte. Another more efficient method is to define a field as 5 bytes wide in which 8 pixels of data are stored from higher order bits downwords.

In addition to the above format specification conventions, additional notation conventions have been adopted to further assist with the clarity in this document. These notation conventions are:

$ - the use of the "$" (dollar sign) in the documentation denotes a requirement for the blank character (ie. the ASCII or EBCDIC space character).

(TBC) - "TO BE CONFIRMED", a value has been supplied by the format definition document pending approval by the committee on CCT standard formats.

(TBD) - "TO BE DEFINED", a value for this field has not been assinged by the CEOS-WGD subgroup on SAR data and is still to be defined by the group.

<tbd> - "to be determined", this expression is used to flag a field or its contents which will vary depending on the product type or data origin and will have to be defined and/or supplied on the, CCT by the facility generating the CCT.

(n) - this expression is used to denote the contents of an integer binary field which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

<xxxx> - this expression is used to denote the contents of an alphanumeric text field, in this case 4-bytes wide, which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

<nnnn> - this expression is used to denote the contents of an integer numeric field, in this case 4-bytes wide, which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

1.2 FILE TYPE CONVENTIONS

Special mention should be made of the "referenced file data type" field of the file pointer records. The standard format family definitions for types of file data has limitations. On the CCT these are expressed as a description field, A28 (field 13) and as an abbreviation field, A4 (field 14) in the file pointer record. The data types currently defined are.

"8BITASCII$ONLY$$$$$$$$$$$$"	"ASCO"	ASCII only data
"EBCDIC$ONLY$$$$$$$$$$$$$$$$$$"	"EBCO"	EBCDIC only
"BCD$ONLY$$$$$$$$$$$$$$$$$$$$$$"	"BCDO"	BCD only
"BINARY$ONLY$$$$$$$$$$$$$$$$$$"	"BINO"	binary only data
"MIXED$BINARY$AND$ASCII$$$$$$"	"MBAA"	binary & ASCII
"MIXED$BINARY$AND$EBCDIC$$$$$"	"MBAE"	binary & EBCDIC
"MIXED$BINARY$AND$BCD$$$$$$$$"	"MBAB"	binary & BCD
"UNDEFINED,$ETC.$$$$$$$$$$$$$$"	"UNDF"	undefined
"COMPLEX$$$$$$$$$$$$$$$$$$$$$$$$"	"COMP"	complex
"REAL$$$$$$$$$$$$$$$$$$$$$$$$$$"	"REAL"	floating point

Problems arise because there are two main types of binary representations (ie. signed binary and two"s complement) and two main types of floating point representations (binary exponent and hexadecimal exponent).These definitions above are not explicit enough to uniquely specify the representation used to interpret the data. Furthermore, historically the data format was tied to the sensor and product type. For SAR data the format in most cases is not dependent on either the sensor or the product type. For example, SAR image data type can be detected or undetected (complex) and may be expressed as either REAL numbers or INTEGER numbers independently from the data obtained from the sensor.
For consistency with past standard format family usage, in this document the term "BINARY" is all inclusive and will be interpreted to mean any binary bit pattern which may follow any interpretation convention (ie. two"s complement variable width integer, combined pixels, status bits, etc.).Historically the use of this term was closely tied to data source and usage of the description field. In one such implementation, the term "COMPLEX" was used to denote a complex 4 byte pair with each real and imaginary components stored as a pair of 2 byte two"s complement signed integer values (ie: 16-bits real and 16-bits imaginary).In this document the file data type is not used to specify the data format. For the SAR data, the actual format of the SAR data is specified in the file descriptor record.

1.3 SAR DATA TYPE SPECIFICATION CONVENTIONS

For this format specification, the "referenced file data type" field definition is "MIXED BINARY AND ASCII" and abbreviated to "MBAA" in the file pointer record. However to adequately distinguish between the different formats of SAR data, two fields have been added to the variable segment of the SAR data file descriptor record, these are the "data format type indicator" (field 61) and the "data format type code (field 62). These fields are used to specify the format used to store the SAR data. To allow for a more unique specification of the data formats, Fortran like conventions have been adopted. The conventions used are illustrated by the following examples.

"INTEGER*1$$$$$$$$$$$$$$$$$$$$"	"I*1$"(1 byte wide)
"INTEGER*2$$$$$$$$$$$$$$$$$$$$"	"I*2$"(2 byte wide)
"INTEGER*4$$$$$$$$$$$$$$$$$$$$"	"I*4$"(4 byte wide)

- one, two and four byte two"s complement integer representation

"SIGNED$INTEGER*1$$$$$$$$$$$$"	"IS1$"(1 byte wide)
"SIGNED$INTEGER*2$$$$$$$$$$$$"	"IS2$" (2 byte wide)
"SIGNED$INTEGER*4$$$$$$$$$$$$"	"IS4$" (4 byte wide)

- one, two and four byte signed integer with the most significant bit used to denote sign

"UNSIGNED$INTEGER*1$$$$$$$$$$"	"IU1$" (1 byte wide)
"UNSIGNED$INTEGER*2$$$$$$$$$$"	"IU2$" (2 byte wide)
"UNSIGNED$INTEGER*4$$$$$$$$$$"	"IU4$" (4 byte wide)

- one, two and four byte un-signed integer with the most significant bit used as part of the pixel value, the pixel is always positive.

"REAL*2$$$$$$$$$$$$$$$$$$$$$$$$"	"R*2$" (2 byte wide)
"REAL*4$$$$$$$$$$$$$$$$$$$$$$$$"	"R*4$" (4 byte wide)
"REAL*8$$$$$$$$$$$$$$$$$$$$$$$$"	"R*8$" (8 byte wide)

- two, four and eight byte two's complement floating point representation with the exponent denoted two's complement binary.(note that the REAL*8 representation is the same as double precision.)

"REAL*2$HEXADECIMAL$$$$$$$$$$"	"R*2H" (2 byte wide)
"REAL*4$HEXADECIMAL$$$$$$$$$$"	"R*4H" (4 byte wide)
"REAL*8$HEXADECIMAL$$$$$$$$$$"	"R*8H" (8 byte wide)

- two, four eight byte hexadecimal floating point representation with the exponent denoted as a hexadecimal exponent. (note that the REAL*8... representation is the same as double precision.)

"COMPLEX*4$$$$$$$$$$$$$$$$$$$$"	"C*4$" (4 byte wide)
"COMPLEX*8$$$$$$$$$$$$$$$$$$$$"	"C*8$" (8 byte wide)

- four byte field with the first half (two bytes) containing the two's complement floating point representation value of the real component and the second half containing the imaginary component.

Similarly for the eight byte type,with each half of the field containing the real and imaginary pairs.

"COMPLEX$INTEGER*2$$$$$$$$$$$$"	"CI*2" (2 byte wide)
"COMPLEX$INTEGER*4$$$$$$$$$$$$"	"CI*4" (4 byte wide)
"COMPLEX$INTEGER*8$$$$$$$$$$$$~	"CI*8" (8 byte wide)

- similar to the complex floating point representation above except that each component is stored as a two's complement integer.

"COMPLEX$SIGNED$INTEGER*2$$$$"	"CIS2" (2 byte wide)
"COMPLEX$SIGNED$INTEGER*4$$$$"	"CIS4" (4 byte wide)
"COMPLEX$SIGNED$INTEGER*8$$$$"	"CIS8" (8 byte wide)

- similar to the complex floating point representation above except that each component is stored as a signed integer.

"COMPLEX*4$HEXADECIMAL$$$$$$$"	"C*4H" (4 byte wide)
"COMPLEX*8$HEXADECIMAL$$$$$$$"	"C*8H" (8 byte wide)

- same as the floating point complex notation above except that the representation follows the hexadecimal conventions.

1.4 Note:

Fields not provided are treated as follows:(for a case of a field 8 bytes long)

Field type	Format	Filler
alphanumeric	A8	8 blanks
numeric integer	Iw	-9999999
numeric floating point	F8.2	-9999.99
numeric exponential	E8.2	-9999.99E-99

2. STANDARD FORMAT FAMILY CONVENTIONS

Inorder for a specific CCT format implementation be a member of the standard format family of tape formats,a few rules governing the logical organization of files,and records within files,must be followed. Initially the format designer selects the group of data files which will embody the data set to be supplied on the CCT.The group of data files is called a logical volume. An envelope of superstructure records,defined by the standard format family with formats rigidly enforced by the controlling organization,is then appended to this data set.This envelope,which completely defines the logical and physical organization of the data set,can be described in the following way.

The first requirement of the superstructure is to add a file called the " VOLUME DIRECTORY FILE ". This is the first file in the logical volume and contains only fixed-format records and consists of a Volume Descriptor Record,a group of File Pointer Records (one for each data file contained in the logical volume),and one or more Text Records. The length of each of the records in this file is defined to be 360 bytes. Since this file describes not only the logical organization of the data set,but also the physical organization on one or more individual tapes,it is repeated at the start of each tape with certain fields updated to indicate the new physical volume sequence number,and,assuming that a data file spans over several physical volumes,to indicate the precise location within the data file where the split has occurred. (Figures 2.0.1). The first record of the volume directory file,the VOLUME DESCRIPTOR RECORD,is employed to define in general terms the logical and physical construction of the data set.The record describes the volume and contains a count of the total number,of records in the volume directory file.This is followed by one or more FILE POINTER RECORDs and TEXT RECORDs. Each file pointer record contains sufficient introductory information to locate the file in the logical volume and permits the reading of the data file to which it points. The information contained in this record consists of the record count,maximum record length and the generic class name assigned to the data file.The text records generally contain an alphanumeric string of characters which describes the data set in the logical volume. After the volume directory file,the subsequent files are data files.

The second requirement for the superstructure is to supply an additional record, called the FILE DESCRIPTOR RECORD, at the start of each data file.The purpose of this record is to provide details on the format used to store the data in the file. It is supplied once only,at the start of the file,and is not repeated if the file is split over one or more tapes. The file descriptor record may be considered as consisting of two portions,the fixed segment and the variable segment. The format of the fixed segment is common to all file descriptor records and provides more information on how to read the referenced data file. The format of the variable segment is defined once only,when the file class is initially assigned. In general terms,it may be considered as providing much more specific information pertaining to the detailed layout of information within the data records (for example,pixel grouping information for imagery data),and hence,is described in detail at the start of subsequent chapters in this document which describe the content of individual data files.In the standard family,all records are uniquely identified regardless of whether the data in the record is formatted or binary, each record has a 12 byte binary header attached to it which gives the record count in the file,the record type identification and the record length in bytes.

FIRST LOGICAL VOLUME → EOV END VOL → SECOND LOGICAL VOLUME → EOS

PHYSICAL VOLUME 1	PHYSICAL VOLUME 2
VOLUME DIRECTORY FILE FIRST LOGICAL VOL	VOLUME DIRECTORY FILE FIRST LOGICAL VOL
SARLEADER FILE DATA SET TYPE -1	IMAGERY OPTIONS DATA SET TYPE -N RECORDS
IMAGERY OPTIONS DATA SET TYPE -1 RECORDS	EOF
SARLEADER FILE DATA SET TYPE -2	VOLUME DIRECTORY FILE SECOND LOGICAL VOL
.	SARLEADER FILE DATA SET TYPE -1
. .	IMAGERY OPTIONS DATA SET TYPE -1 RECORDS
SARLEADER FILE DATA SET TYPE -N	. . .
IMAGERY OPTIONS DATA SET TYPE -N RECORDS	SARLEADER FILE DATA SET TYPE -M
EOF EOF	
	SARTRAILER FILE DATA SET TYPE -M
	EOF
	NULL VOLUME DESCRIPTOR
	EOF EOF EOF

Figure 2.0.1 CCT FAMILY LAYOUT EXAMPLE:
TWO LOGICAL VOLUME DATA SETS ON TWO PHYSICAL VOLUME SETS

3. SAR CCT PHYSICAL VOLUME ORGANIZATION

SAR CCT data products are organized into logical volumes,which can span one or more physical volumes, Computer Compatible Tapes (CCTs).The simplest products will be those that occupy only one physical volume.The superstructure concepts used in the standard format family,adhered to by this format, conveniently handle multiple physical volumes and permit the SAR logical volume data to be split across physical volumes between data files or even between data records within the files.

4. SAR LOGICAL VOLUME

The "SAR Logical Volume" as defined in this document, encompasses all SAR data modes.This includes signal data obtained directly from the sensor (RAW), image data (processed into imagery), enhanced SAR data (ie. higher level products derived from SAR image data), synchronized information from the sensor platform, downstream telemetry with associated georeferencing data and facility related parameters, such as correction tables or matrices.This logical volume is structured using the following classes of files:

VOLUME DIRECTORY FILE
SARLEADER FILE
IMAGERY OPTIONS FILE
NULL VOLUME DIRECTORY FILE

The SARLEADER FILE contains auxiliary information pertaining to the data, such as platform geometry, data quality, etc.
The IMAGERY OPTIONS FILE contains the SAR data. This format specification supports all of the SAR data product types:

SAR Signal Data (unprocessed or partially processed)
SAR Image Data (fully processed)

Figures 4.0.1 and 4.0.2 show the organization of the files in the logical volume for Band Sequential (BSQ) and Band Interleaved by Line (BIL) or by Pixel data respectively (BIP).

VOLUME DIRECTORY FILE

SARLEADER FILE
DATA SET TYPE -1

IMAGERY OPTIONS
DATA SET TYPE -1

SARLEADER FILE
DATA SET TYPE-2

.
.
.

SARLEADER FILE
DATA SET TYPE-N

NULL VOLUME

FIGURE 4.0.1 BAND SEQUENTIAL ORGANIZATION

VOLUME DIRECTORY FILE

SARLEADER FILE

IMAGERY OPTIONS FILE
DATA SET TYPES 1 TO N

NULL VOLUME

FIGURE 4.0.2 BAND-INTERLEAVED BY LINE OR BY PIXEL ORGANIZATION

5. SAR CCT Structure Overview

5.1 VOLUME DIRECTORY FILE

The volume directory file is the first file of the SAR logical volume and consists of a volume descriptor record, file pointer records (one for each of the files that follow) and text records. The purpose of this file is to identify the logical volume and to specify its structure as it relates to the physical volume. Although the standard definitions allow for EBCDIC text, in this definition, these records are written in ASCII except for the first 12 bytes which are in binary. The length of each of the records in the file is 360 bytes.

5.1.1 VOLUME DESCRIPTOR RECORD

The volume descriptor record is the first record in the volume directory file. Its purpose is to identify the logical volume and indicate its size by specifying the number of data files contained within it. It also contains the relationship of this particular physical volume to the logical volume.

5.1.2 FILE POINTER RECORDS

The file pointer records are the second record types in the, volume directory file. They are the pointers to the files and contain information required to access the data files in the logical volume. There are two pointer records, one for each file in the SAR logical volume. Each pointer record indicates the file type, file size and position in the SAR logical volume.

5.1.3 TEXT RECORD(S)

The text record(s) contain information identifying the CCT product and a brief textual summary of its contents. The information contained is constructed in plain English so that it can be readily displayed at a terminal upon reading the CCT.

Table 1 *VOLUME DESCRIPTOR RECORD*

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record Sequence Number
2	5-5	B1	1st record sub-type code
3	6-6	B1	Record type code
4	7-7	B1	2nd record sub-type code
5	8-8	B1	3rd record sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC Flag
8	15-16	A2	Blanks
9	17-28	A12	Format control document
10	29-30	A2	Superstructure format control document revision number
11	31-32	A2	Superstructure record format revision
12	33-44	A12	Logical volume generating facility software release and revision level
13	45-60	A16	ID of physical volume containing this volume descriptor
14	61-76	A16	Logical volume identifier
15	77-92	A16	Volume set ID
16	93-94	I2	Total number of physical volumes in the logical volume
17	95-96	I2	Physical volume number, start of logical volume
18	97-98	I2	Physical volume number, end of logical volume <$N> .
19	99-100	I2	Physical volume sequence number (i.e. of current tape) <$N>
20	101-104	I4	First referenced file number in this physical volume
21	105-108	I4	Logical volume number within volume set
22	109-112	I4	Logical volume number within physical volume
23	113-120	A8	Logical volume creation date <YYYYMMDD>
24	121-128	A8	Logical volume creation time <HHMMSSDD>
25	129-140	A12	Logical volume generating country
26	141-148	A8	Logical volume generating agency
27	149-160	A12	Logical volume generating facility
28	161-164	I4	Number of pointer records in volume directory
29	165-168	I4	Number of records in volume directory
30	169-172	I4	Total number of logical volumes in the set
31	173-260	A88	Volume descriptor spare segment
32	261-360	A100	Local use segment

Table 2

FILE POINTER RECORD

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5-5	B1	1st record sub-type code
3	6-6	B1	Record type code
4	7-7	B1	2nd record sub-type code
5	8-8	B1	3rd record sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC Flag
8	15-16	A2	Blanks
9	17-20	I4	Referenced file number
10	21-36	A16	Referenced file name
11	37-64	A28	Referenced file class
12	65-68	A4	Referenced file class code
13	69-96	A28	Referenced file data type
14	97-100	A4	Referenced file data type code
15	101-108	I8	Number of records in referenced file
16	109-116	I8	Referenced file - descriptor record length
17	117-124	I8	Referenced file maximum record length
18	125-136	A12	Referenced file record length type
19	137-140	A4	Referenced file record length type code
20	141-142	I2	Referenced file physical volume number, start of file
21	143-144	I2	Referenced file physical volume number, end of file
22	145-152	I8	Referenced file portion, 1st record number for this physical volume
23	153-160	I8	Referenced file portion, last record number for this physical volume
24	161-260	A100	Pointer spare segment
25	261-360	A100	Local use segment

Table 3 **TEXT RECORD**

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5-5	B1	1st record sub-type code
3	6-6	B1	Record type code
4	7-7	B1	2nd record sub-type code
5	8-8	B1	3rd record sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC Flag
8	15-16	A2	Continuation flag.This field contains two blanks unless the information of this record is continued on a following record,in which case, the field is coded C$.
9	17-56	A40	Product type specifier
10	57-116	A60	Location and date/time of product creation
11	117-156	A40	Physical volume identification
12	157-196	A40	Scene identification
13	197-236	A40	Scene location
14	237-256	A20	*Spares*
15	257-360	A104	*Spares*

5.2 SARLEADER FILE

The SARLEADER file contains auxiliary information corresponding to the SAR data contained in the data file. The SAR leader file contains a file descriptor record followed by one or more auxiliary information packet. Each packet is organised into one or more records. The SAR leader file supports the following record types:

1. One file descriptor record
2. Any or all of the following record types; (Record-Type)

DATA SET SUMMARY RECORD	(10, 10,31,20)
MAP PROJECTION DATA RECORD	(10, 20,31,20)
PLATFORM POSITION DATA RECORD	(10, 30,31,20)
RADIOMETRIC COMPENSATION RECORD	(10, 51,31,20)
DIGITAL ELEVATION MODEL DESCRIPTOR RECORD	(10, 90,31,20)
RADAR PARAMETER DATA UPDATE RECORD	(10,100,31,20)
GROUND CONTROL POINTS DESCRIPTOR RECORD	(18,140,31,20)
FACILITY RELATED DATA RECORD GENERAL TYPE	(10,200,31,50)
FACILITY RELATED DATA RECORD MPH+SPH TYPE	(10,200,31,50)
FACILITY RELATED DATA RECORD GEO-CODE TYPE	(10,200,31,50)
FACILITY RELATED DATA RECORD PCS QUALITY TYPE	(10,200,31,50)
FACILITY RELATED DATA RECORD GEOCODED TYPE	(10,200,31,50)

Although all of the possible ERS-2 auxiliary record types are defined, not all of these records may appear on a particular CCT. Since the data may be both sensor and product related, all of the records may not be appropriate for some CCT products. The exact contents of the SAR leader file are determined by the product type and sensor type combination. For example, the map projection data is not relevant to unprocessed SAR signal data and therefore will not appear on the signal CCT products. In the cases where the auxiliary data is inappropriate or the data is not available, the corresponding field of the descriptor record has a zero record count and the records are not written to the SAR leader file.

The SAR auxiliary data records are recorded as numeric or alphanumeric text strings. The length of the records varies depending on the type of ancillary data contained in it. For the facility defined records, the record length is defined by the CCT generating facility. In instances where the information is less than the defined record length, the remaining part of the record is filled with blanks.

5.2.1 SARLEADER FILE DESCRIPTOR RECORD

The SAR leader file descriptor record is subdivided into two major segments, namely, the descriptor record fixed segment and the descriptor record variable segment. The SAR leader file descriptor record fixed segment, as the name implies, is fixed in length and its definition is common to all file descriptor records. It contains information on how to read the file. The SAR leader file descriptor record variable segment is SAR leader file data specific and provides information on the presence or absence of the SAR auxiliary data records, the length of each of the different types of records and the number of each type of record in the SAR leader file.

5.2.2 DATA SET SUMMARY RECORD

The data set summary record contains information about the mission, data acquisition, the sensor parameters and the processing parameters used to generate the SAR data on this logical volume.

5.2.3 MAP PROJECTION DATA RECORD

The map projection data record provides information about the geometric characteristics of the input (raw) and processed imagery data.

5.2.4 PLATFORM POSITION DATA RECORD

The platform position data record provides position/orbit information for the aircraft/spacecraft. Although the format is not dependent on the platform type, the content of the record differs for airborne and spaceborne sensors.

5.2.5 RADIOMETRIC COMPENSATION RECORD

The radiometric compensation record contains information about the range and azimuth radiometric correction applied to the data including compensation for the antenna illumination pattern in the range direction and/or illumination variations in azimuth due to aircraft roll.

5.2.6 DIGITAL ELEVATION MODEL DESCRIPTOR RECORD

The Digital Elevation Model (DEM) descriptor record is variable length since the number of DEM descriptor data sets and the size of the data sets are product and facility related. Each record consists of 12 bytes of record identifier, DEM general information and a number of DEM descriptor data sets.

5.2.7 RADAR PARAMETER DATA UPDATE RECORD

The Radar parameter data update record contains the radar parameters as they are updated.

5.2.8 GROUND CONTROL POINTS DESCRIPTOR RECORD

The Ground Control Points (GCP) descriptor record is variable length since the number of GCP descriptor data sets and the size of the data sets are product and facility related.
Each record consists of 12 bytes of record identifier, GCP general information and a number of GCP descriptor data sets.

5.2.9 FACILITY RELATED DATA RECORD GENERAL TYPE

This record contains in a free format all information which is strictly facility related. The record type codes are used to indicate the type and source of this data. It is anticipated that each facility will use the record type codes to specify their own unique processing parameters record format for this data.

5.2.10 FACILITY RELATED DATA RECORD MPH-SPH TYPE

This record contains in a free format all information which is strictly facility related and applicable to all ERS-2 fast delivery processing chain products.

5.2.11 FACILITY RELATED DATA RECORD GEOCODED TYPE

This record contains in a free format all information which is strictly facility related and applicable to ERS-2 SAR geocoded products.

5.2.12 FACILITY RELATED DATA RECORD PCS QUALITY TYPE

This record contains in a free format information which is strictly ESA reserved and used by the Product Control Service at Earthnet.

Table 4 ***SARLEADER FILE - FILE DESCRIPTOR RECORD FIXED SEGMENT***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record Sequence Number
2	5-5	B1	1st record sub-type code
3	6-6	B1	Record type code
4	7-7	B1	2nd record sub-type code
5	8-8	B1	3rd record sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC Flag
8	15-16	A2	Blanks
9	17-28	A12	Control document number for this data file format
10	29-30	A2	Format control document revision level
11	31-32	A2	File design descriptor revision letter
12	33-44	A12	Generating software release and revision level
13	45-48	I4	File number .
14	49-64	A16	File name
15	65-68	A4	Record requence and location type flag
16	69-76	I8	Sequence number location
17	77-80	I4	Sequence number field length
18	81-84	A4	Record Ccde and location type flag
19	85-92	I8	Record code location
20	93-96	I4	Record code field length
21	97-100	A4	Record length and location type flag
22	101-108	I8	Record length location
23	109-112	I4	Record length field length
24	113-113	A1	*Reserved*
25	114-114	A1	*Reserved*
26	115-115	A1	*Reserved*
27	116-116	A1	*Reserved*
28	117-180	A64	Reserved segment

SARLEADER FILE - FILE DESCRIPTOR RECORD VARIABLE SEGMENT

29	181-186	I6	Number of data set summary records
30	187-192	I6	Data set summary record length
31	193-198	I6	Number of map projection data records
32	199-204	I6	Map projection record length

33	205-210	I6	Number of platform pos. data records
34	211-216	I6	Platform position record length
35	217-222	I6	Number of attitude data records
36	223-228	I6	Attitude data record length
37	229-234	I6	Number of radiometric data records
38	235-240	I6	Radiometric record length
39	241-246	I6	Number of rad. compensation records
40	247-252	I6	Radiometric compensation rec. length
41	253-258	I6	Number of data quality summary records
42	259-264	I6	Data quality summary record length
43	265-270	I6	Number of data histograms records
44	271-276	I6	Data histogram record length
45	277-282	I6	Number of range spectra records
46	283-288	I6	Range spectra record length
47	289-294	I6	Number of DEM descriptor records
48	295-300	I6	DEM descriptor record length
49	301-306	I6	Number of radar par. update records
50	307-312	I6	Radar par. update record length
51	313-318	I6	Number of annotation data records
52	319-324	I6	Annotation data record length
53	325-330	I6	Number of det.processing records
54	331-336	I6	Det.processing record length
55	337-342	I6	Number of calibration records
56	343-348	I6	Calibration record length
57	349-354	I6	Number of GCP records
58	355-360	I6	GCP record length
59	361-366	I6	*Spare*
60	367-372	I6	*Spare*
61	373-378	I6	*Spare*
62	379-384	I6	*Spare*
63	385-390	I6	*Spare*
64	391-396	I6	*Spare*
65	397-402	I6	*Spare*
66	403-408	I6	*Spare*
67	409-414	I6	*Spare*
68	415-420	I6	*Spare*
69	421-426	I6	Number of facility data records
70	427-432	I6	Facility data record maximum length
71	433-720	A2	Blanks

Table 5 **DATA SET SUMMARY RECORD DEFINITION**

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5-5	B1	1st record sub-type code
3	6-6	B1	Record type code
4	7-7	B1	2nd record sub-type code
5	8-8	B1	3rd record sub-type code
6	9-12	B4	Length of this record
7	13-16	I4	Data Set Summary Record sequence number (starts at 1)
8	17-20	I4	SAR channel indicator (1)

SCENE PARAMETERS

9	21-36	A16	Scene identifier
10	37-68	A32	Scene reference number (ORBIT=....-FRAME=.....)
11	69-100	A32	Input scene centre time (UTC) <YYYYMMDDhhmmssttt$$$$$$$$$$$$$>where : YYYY = year ; MM = month ; DD =day; hh = hours ; mm = minutes ; ss = seconds ; ttt = milliseconds
12	101-116	A16	*Spare*
13	117-132	F16.7	Processed scene centre geodetic latitude defined as positive to the north of the equator and negative to the south (deg)
14	133-148	F16.7	Processed scene centre geodetic longitude defined as positive to the east of the prime meridian and negative to the west. (deg.)
15	149-164	F16.7	Processed scene centre true heading as calculated relative to North (deg)
16	165-180	A16	Ellipsoid designator
17	181-196	F16	Ellipsoid semimajor axis (km) - (R)
18	197-212	F16	Ellipsoid semiminor axis (km)
19	213-228	F16.7	Earth"s mass times Gravitational constant - (M*G)
20	229-244	A16	*Spare*
21	245-260	F16.7	Ellipsoid J2 parameter
22	261-276	F16.7	Ellipsoid J3 parameter
23	277-292	F16.7	Ellipsoid J4 parameter
24	293-308	A16	*Spare*
25	309-324	F16.7	Average terrain height above Ellipsoid at scene centre

26	325-332	I8	Scene centre line number (the line number at the scene centre including zero fill)
27	333-340	I8	Scene centre pixel number (the pixel number to the scene centre including zero fill)
28	341-356	F16.7	Processed scene length including zero fill
29	357-372	F16.7	Processed scene width (km) including zero fill
30	373-388	A16	*Spare*
31	389-392	I4	Number of SAR channels
32	393-396	A4	*Spare*
33	397-412	A16	Sensor platform mission identifier
34	413-444	A32	Sensor ID: and mode of operation for this channel <AAAAAA-BB-CC-DD-EF> where: AAAAAA = sensor identifier; BB = SAR band; CC = resolution mode code; DD = imaging mode code; E = transmit polarization; F = receiver polarization
35	445-452	A8	Orbit number
36	453-460	F8.3	Sensor Platform geodetic Latitude at nadir (positive to north) corresponding to Scene Center (deg)
37	461-468	F8.3	Sensor Platform geodetic Longitude at nadir (positive to east) corresponding to Scene Center (deg)
38	469-476	F8.3	Sensor Platform Heading at nadir corresponding to Scene Center(deg)
39	477-484	F8.3	Sensor clock angle as measured relative to sensor platform flight direction
40	485-492	F8.3	Incidence angle at scene centre as derived from sesor platform orientation
41	493-500	F8.3	Radar frequency (GHz)
42	501-516	F16.7	Radar wavelength (meters)
43	517-518	A2	Motion compensation indicator "00" = no compensation, "01" = on board compensation "10" = in processor compensation, "11" = both on board and in processor
44	519-534	A16	Range pulse code specifier
45	535-550	E16.7	Range pulse (chirp) amplitude coefficient, Constant term (offset from DC) (Hz) nominal value
46	551-566	E16.7	Range pulse (chirp)amplitude coefficient, Linear term (sec^{-1}) nominal value
47	567-582	E16.7	Range pulse (chirp) amplitude coefficient, Quadratic term (sec^{-2}) nominal value
48	583-598	E16.7	Range pulse (chirp) amplitude coefficient, Cubic term (sec^{-3}) nominal value
49	599-614	E16.7	Range pulse (chirp)amplitude coefficient, Quartic term (sec^{-4}) nominal value
50	615-630	E16.7	Range pulse (chirp) phase coefficient, Constant term (offset in cycles)
51	631-646	E16.7	Range pulse (chirp) phase coefficient, Linear term (Hz) nominal value
52	647-662	E16.7	Range pulse (chirp) phase coefficient, Quadratic term (Hz/sec) nominal value
53	663-678	E16.7	Range pulse (chirp) phase coefficient, Cubic term (Hz/sec^{-2}) nominal value
54	679-694	E16.7	Range pulse (chirp) phase coefficient, Quartic term (Hz/sec^{-3}) nominal value
55	695-702	I8	Down linked data chirp extraction index (in samples)
56	703-710	A8	*Spare*
57	711-726	F16.7	Sampling rate (MHz)
58	727-742	F16.7	Range gate delay at early edge (in time) at the start of the image (μsec)

59	743-758	F16.7	Range pulse length (μsec)
60	759-762	A4	*Reserved*
61	763-766	A4	Range compressed flag (yes = range compressed data)
62	767-782	F16.7	*Reserved*
63	782-798	F16.7	*Reserved*
64	799-806	I8	Quantization in bits per channel (5I 5Q/6I 6Q for OGRC/OBRC)
65	807-818	A12	Quantizer descriptor (eg:"UNIFORMI,Q")
66	819-834	F16.7	DC Bias for I-component
67	835-850	F16.7	DC Bias for Q-component
68	851-866	F16.7	Gain imbalance for I & Q
69	867-898	A32	*Spare*
71	899-914	F16.7	*Reserved*
72	915-930	F16.7	Antenna mechanical boresight relative to platform vertical axis at the start of the image positive to the right negative to the left.(deg)
73	931-934	A4	*Reserved*
74	935-950	F16.7	Nominal PRF (Hz)
75	951-966	F16.7	*Reserved*
76	967-982	F16.7	*Reserved*

SENSOR SPECIFIC PARAMETERS

77	983-998	I16	Satellite encoded binary time code
78	999-1030	A32	Satellite clock time <YYYYMMDDhhmmssttt$$$...$>
79	1031-1038	I8	Satellite clock increment (nano-secs)
80	1039-1046	A8	*Spare*
81	1047-1062	A16	Processing facility identifier
82	1063-1070	A8	Processing system identifier
83	1071-1078	A8	Processing version identifier
84	1079-1094	A16	*Reserved*
85	1095-1110	A16	*Reserved*
86	1111-1142	A32	Product type specifier
87	1143-1174	A32	Processing algorithm identifier (e.g. Range-Doppler)
88	1175-1190	F16.7	Nominal number of looks processed in Azimuth
89	1191-1206	F16.7	Nominal effective number of looks processed in Range
90	1207-1222	F16.7	Bandwidth per look in Azimuth (Hz)
91	1223-1238	F16.7	Bandwidth per look in Range (MHz)
92	1239-1254	F16.7	Total processor bandwidth in Azimuth (Hz)
93	1255-1270	F16.7	Total processor bandwidth in Range (MHz)
94	1271-1302	A32	Weighing function designator in Azimuth

95	1303-1334	A32	Weighing function designator in Range
96	1335-1350	A16	Data input source (eg:HDDT identifier)
97	1351-1366	F16.7	Nominal resolution equal to 3dB points in ground range (meter)
98	1367-1382	F16.7	Nominal resolution in Azimuth (meter)
99-100	1383-1414	A32	*Reserved*
101	1415-1430	F16.7	Along track Doppler frequency Constant term at early edge of image (Hz)
102	1431-1446	F16.7	Along track Doppler frequency Linear term at early edge of the image (Hz/sec)
103	1447-1462	F16.7	Along track Doppler frequency Quadratic term at early edge of the image (Hz/sec/sec)
104	1463-1478	A16	*Spare*
105	1479-1494	F16.7	Cross track Doppler frequency Constant term at early edge of the image (Hz)
106	1495-1510	F16.7	Cross track Doppler frequency Linear term at early edge of the image (Hz/sec)
107	1511-1526	F16.7	Cross track Doppler frequency Quadratic term at early edge of the image (Hz/pixel/sec)
108	1527-1534	A8	Time direction indicator along pixedl direction (ie:"INCREASE"- ing or "DECREASE"- ing")
109	1535-1542	A8	Time direction indicator along line direction (ie:"INCREASE"-ing or "DECREASE"-ing")
110	1543-1558	F16.7	Along track Doppler frequency rate Constant term at early edge of the image (Hz/sec)
111	1559-1574	F16.7	Along track Doppler frequency rate Linear term at early edge of the image (Hz/sec/sec)
112	1575-1590	F16.7	Along track Doppler frequency rate Quadratic term at early edge of the image (Hz/sec/sec/sec)
113	1591-1606	A16	*Spare*
114	1607-1622	F16.7	Cross track Doppler frequency rate Constant term at near edge of the image (Hz/sec)
115	1623-1638	F16.7	Cross track Doppler frequency rate Linear term relative to near edge of the image (Hz/sec/sec)
116	1639-1654	F16.4	Cross track Doppler frequency rate Quadratic term relative to near edge of the image (Hz/sec/sec/sec)
117	1655-1670	A16	*Spare*
118	1671-1678	A8	Line content indicator
119	1679-1682	A4	Clutter lock applied flag
120	1683-1686	A4	Autofocussing applied flag
121	1687-1702	F16.7	Line spacing (meters)
122	1703-1718	F16.7	Pixel spacing (in range) (meters)
123	1719-1734	A16	Processor range compression designator
124-125	1735-1766	2A16	*Spare*

SENSOR SPECIFIC LOCAL USE SEGMENT

126	1767-1814	3F16.7	Zero-doppler range time of first range pixel (msec) Zero-doppler range time of centre range pixel(msec) Zero-doppler range time of last range pixel (msec)

127	1815-1886	3A24	Zero-doppler azimuth time of first azimuth pixel (UTC) Zero-doppler azimuth time of centre azimuth pixel(UTC) Zero-doppler azimuth time of last azimuth pixel (UTC) as : dd-MMM-YYYY hh:mm:ss.ttt where dd = day MMM = month (e.g. JAN) YYYY = year hh = hour mm = minuts ss = seconds ttt = milliseconds

PROCESSOR SPECIFIC LOCAL USE SEGMENT

128	1887-2006	A120	*Spare*
129	2007-2014	I8	Number of annotation points (up to 64)
130	2015-2022	A8	*Spare*
131	2023-2030	I8	Line no of 1st annotation start
132	2031-2038	I8	Pixel no of 1st annotation start
133	2039-2054	A16	1st annotation text
134	2055-2062	I8	Line no of 2nd annotation start
135	2063-2070	I8	Pixel no of 2nd annotation start
136	2071-2086	A16	2nd annotation text
.....	.....	.....	.....
.....	.....	.....	.....
163	2375-2382	I8	Line no of 12th annotation start
164	2383-2390	I8	Pixel no of 12th annotation start
165	2391-2406	A16	12th annotation text
166	2407-2432	A26	*Spare*

The frame annotation points are max 3 points for each of the four edges of the image.The annotation text is "NnnnnnnnEeeeeeee"; where nnnnnnn denotes the northing in integer meters and eeeeeee denotes the easting in integer meters of this point. The locations are selected in a way that the upper and lower frame marks are positioned to full 50000 m eastings (i.e. 3450000 next will be 3500000). The locations at the right and left image border are selected that the frame marks are positioned to full 50000 m northings.If more than two marks for one of the three borders will not fit within the image frame, the annotation line, column and text of the remaining mark is set to zero.

Table 6 **MAP PROJECTION DATA RECORD DEFINITION**

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-28	A16	*Spare*

MAP PROJECTION GENERAL INFORMATION

8	29-60	A32	Map projection descriptor (eg: slant range,.. geocoded)
9	61-76	I16	Number of pixels per line of image
10	77-92	I16	Number of lines
11	93-108	F16.7	Nominal inter-pixel distance in output scene (meters)
12	109-124	F16.7	Nominal inter-line distance in output scene (meters)
13	125-140	F16.7	Orientation at output scene centre for geocoded products this is simply the convergence of the meridians, ie: the angle between geographic north and map grid north (degrees) (Angle of projection axis from true North)
14	141-156	F16.7	Actual platform orbital inclination (deg)
15	157-172	F16.7	Actual ascending node (longitude at equator) (deg)
16	173-188	F16.7	Distance of platform at input scene centre from the geocentre (meters)
17	189-204	F16.7	Geodetic altitude of the platform relative to ellipsoid of the projection (meters)
18	205-220	F16.7	Actual ground speed at nadir at input scene centre (meters/sec)
19	221-236	F16.7	Platform heading at centre : effective subplatform track direction (degrees)
20	237-268	A32	Name of reference ellipsoid
21	269-284	F16.7	Semimajor axis of ref.ellipsoid (m)
22	285-300	F16.7	Semiminor axis of ref.ellipsoid (m)
23	301-316	F16.7	Datum shift parameter ref. to Greenwich: dx (m)
24	317-332	F16.7	Datum shift param. perp. to Greenwich: dy (m)
25	333-348	F16.7	Datum shift param. direct. of rotation axis: dz (m)
26	349-364	F16.7	Additional datum shift param. first rotation angle
27	365-380	F16.7	Additional datum shift param. second rotation angle
28	381-396	F16.7	Additional datum shift param. third rotation angle
29	397-412	F16.7	Scale factor of reference ellipsoid
30	413-444	A32	Alphanumeric description of map projection

*UTM-PROJECTION (first default projection) ****

31	445-476	A32	UTM descriptor (only UTM)"Universal transversal Mercator"
32	477-480	A4	Signature of the UTM zone
33	481-496	F16.7	Map origin (false easting)
34	497-512	F16.7	Map origin (false northing)
35	513-528	F16.7	Center of projection longitude (de)
36	529-544	F16.7	Center of projection latitude (deg)
37	555-560	F16.7	Cirst standard parallel (deg)
38	561-576	F16.7	Second standard parallel (deg)
39	577-592	F16.7	Scale factor

*UPS-PROJECTON (second default projection) ****

40	593-608	A32	UPS descriptor (only UPS)"Universal Polar stereographic"
41	609-640	F16.7	Center of projection longitude (deg)
42	641-656	F16.7	Center of projection latitude (deg)
43	657-672	F16.7	Scale factor

*NATIONAL SYSTEMS (any other projection) ****

44	673-704	A32	Projection descriptor
45	705-720	F16.7	Map origin (false easting)
46	721-736	F16.7	Map origin (false northing)
47	737-752	F16.7	Center of projection longitude (deg)
48	753-768	F16.7	Center of projection latitude (deg)
49	769-784	F16.7	Standard parallels (deg, default:-9999.99)

MAP PROJECTION DATA RECORD - MPD

50	785-800	F16.7	Standard parallels (deg, default:-9999.99)
51	801-816	F16.7	Standard parallels (deg, default:-9999.99)
52	817-832	F16.7	Standard parallels (deg, default:-9999.99)
53	833-848	F16.7	Central meridian (deg, default:-9999.99)
54	849-864	F16.7	Central meridian (deg, default:-9999.99)
55	865-880	F16.7	Central meridian (deg, default:-9999.99)
56	881-944	A64	*Spare*

COORDINATES OF CORNER POINTS

57	945-960	F16.7	Top left corner northing (meters)
58	961-976	F16.7	Top left corner easting (meters)
59	977-992	F16.7	Top right corner northing (meters)
60	993-1008	F16.7	Top right corner easting (meters)
61	1009-1024	F16.7	Bottom right corner northing (meters)
62	1025-1040	F16.7	Bottom right corner easting (meters)
63	1041-1056	F16.7	Bottom left corner northing (meters)
64	1057-1072	F16.7	Bottom left corner easting (meters)
65	1073-1088	F16.7	Top left corner latitude (deg)
66	1089-1104	F16.7	Top left corner longitude (deg)
67	1105-1120	F16.7	Top right corner latitude (deg)
68	1121-1136	F16.7	Top right corner longitude (deg)
69	1137-1152	F16.7	Bottom right corner latitude (deg)
70	1153-1168	F16.7	Bottom right corner longitude (deg)
71	1169-1184	F16.7	Bottom left corner latitude (deg)
72	1185-1200	F16.7	Bottom left corner longitude (deg)
73	1201-1216	F16.7	Top left corner terrain height relative to ellipsoid (m)
74	1217-1232	F16.7	Top right corner terrain height relative to ellipsoid (m)
75	1233-1248	F16.7	Bottom right corner terrain height relative to ellipsoid (m)
76	1249-1264	F16.7	Bottom left corner terrain height relative to ellipsoid (m)

COEFFICIENTS FOR IMAGE TO MAP TO IMAGE CONVERSION

77	1265-1284	E20.10	Coefficient A11 to convert a line (L) and pixel (P) position to the map projection frame (E,N)
78	1285-1304	E20.10	Coefficient A12 to convert a line (L) and pixel (P) position to the map projection frame (E,N)
79	1305-1324	E20.10	Coefficient A13 to convert a line (L) and pixel (P) position to the map projection frame (E,N)
80	1325-1344	E20.10	Coefficient A14 to convert a line (L) and pixel (P) position to the map projection frame (E,N)
81	1345-1364	E20.10	Coefficient A21 to convert a line (L) and pixel(P) position to the map projection frame (E,N)
82	1365-1384	E20.10	Coefficient A22 to convert a line (L) and pixel(P) position to the map projection frame (E,N)
83	1385-1404	E20.10	Coefficient A23 to convert a line (L) and pixel(P) position to the map projection frame (E,N)
84	1405-1424	E20.10	Coefficient A24 to convert a line (L) and pixel(P) position to the map projection frame (E,N)
85	1425-1444	E20.10	Coefficient B11 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
86	1445-1464	E20.10	Coefficient B12 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
87	1465-1484	E20.10	Coefficient B13 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
88	1485-1504	E20.10	Coefficient B14 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
89	1505-1524	E20.10	Coefficient B21 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
90	1525-1544	E20.10	Coefficient B22 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)

91	1545-1564	E20.10	Coefficient B23 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
92	1565-1584	E20.10	Coefficient B24 to convert a map projection frame(E,N) to line and pixel position in the image (L,P)
93	1585-1620	A36	*Spares*

**** comment to field no 78 -93: The coefficients are derived from the following formulas:

Easting = A11 + A12 * line + A13 * column + A14 * line * column
Northing = A21 + A22 * line + A23 * column + A24 * line * column

The inverse is computed by:

Line = B11 + B12 * East + B13 * North + B14 * North * East
Column = B21 + B22 * East + B23 * North +B24 * North * East

Table 7 ***PLATFORM POSITION DATA RECORD***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-44	A32	Orbital elements designator
8	45-60	F16.7	1-st orbital element
9	61-76	F16.7	2-nd orbital element
10	77-92	F16.7	3-rd orbital element
11	93-108	F16.7	4-th orbital element
12	109-124	F16.7	5-th orbital element
13	125-140	F16.7	6-th orbital element
14	141-144	I4	Number of data points (up to 64)
15	145-148	I4	Year of data point. (YYYY)
16	149-152	I4	Month of data point. ($$MM)
17	153-156	I4	Day of data point. ($$DD)
18	157-160	I4	Day in the year (GMT) (1st January = day 1)
19	161-182	D22.15	Seconds of day (GMT) of data
20	183-204	D22.15	Time interval between DATA points (sec)
21	205-268	A64	Reference coordinate system
22	269-290	D22.15	Greenwich mean hour angle (degrees)
23	291-306	F16.7	Along track position error (meters)
24	307-322	F16.7	Across track position error (meters)
25	323-338	F16.7	Radial position error (meters)
26	339-354	F16.7	Along track velocity error (m/s)
27	355-370	F16.7	Across track velocity error (m/s)
28	371-386	F16.7	Radial velocity error

FIRST POSITIONAL DATA POINT

29	387-452	3D22.15	l-st data point position vector as latitude, longitude and altitude for airborne sensor platform, and as (X,Y,Z)coordinates for spaceborne sensor platforin a reference system such as CTS (**meters**)
30	453-518	3D22.15	1st data point velocity vector in airborne coordinates (**meters/second & degrees/second** for airborne sensor platform or (X',Y',Z') in a reference system such as CTS for spaceborne sensor platforms

31-....	519-...	6D22.15	2nd, 3rd, ... data point position & velocity vectors (repetition of fields 29-30 as specified by the number of points in field #14)
<tbd>	<tbd>-EOR	A<tbd>	Blanks

Table 8 ***RADIOMETRIC COMPENSATION DATA RECORD***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-16	I4	Rad.compensation record Sequence number
8	17-20	I4	SAR channel indicator
9	21-28	I8	Number of radiometric compensation data sets in the record
10	29-36	I8	Compensation data set size (bytes)
11	37-44	A8	Compensation data type designator (eg: "RANGE" "AZIMUTH' "PIXEL","LINE"
12	45-76	A32	Compensation data descriptor (eg:"elevation antenna pattern", "range attenuation","resolution cell size", "azimuth attenuation", etc.)
13	77-80	I4	Number of compensation records
14	81-84	I4	Sequence number in the full compensation table of the table contained in this record
15	85-92	I8	Total number of compensation pairs in the full compensation table
16	93-100	I8	Data pixel number corresponding to first correction value in compensation table
17	101-108	I8	Data pixel number corresponding to last correction value in compensation table
18	109-116	I8	Compensation pixel group size (pixels)
19	117-132	F16.7	Min. table Offset value (dB)
20	133-148	F16.7	Min. table Gain value (dB)
21	149-164	F16.7	Max. table Offset value (dB)
22	165-180	F16.7	Max. table Gain value (dB)
23	181-196	A16	*Spare*

RADIOMETRIC COMPENSATION TABLE VALUES

24	197-204	I8	Number of compensation table entries (up to 256 samples/record in example)
25	205-220	F16.7	1-st compensation sample Offset (dB)
26	221-236	F16.7	1-st compensation sample Gain (dB)
27	237-252	F16.7	2-nd compensation sample Offset (dB)
28	253-268	F16.7	2-nd compensation sample Gain (dB)
			. . . .
			. . up to .

535	8365-8380	F16.7	256-th compensation sample Offset (dB)
536	8381-8396	F16.7	256-th compensation sample Gain (dB)

Table 9 **DIGITAL ELEVATION MODEL (DEM) DESCRIPTOR RECORD DEFINITION**

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code = 18
3	6	Bl	Record type code = 90
4	7	Bl	2-nd record sub-type code = 18
5	8	Bl	3-rd record sub-type code = 20
6	9-12	B4	Length of this record =<tbd>
7	13-16	I4	Digital elevation model descriptor record sequence number
8	17-20	I4	Spare
9	21-28	I8	Number of DEM data descriptor a sets in this record. (DEM coverage must be described the corner points of a set of polygons.)
10	29-60	A32	Original source of DEM (Copyright info)
11	61-92	A32	Height datum reference name
12	93-124	A32	DEM generation method (map, satellite stereo,..etc.)
13	125-136	A12	Original raster spacing unit (meters,degrees,arcsec, etc.)
14	137-168	A32	Original DEM presentation projection
15	169-184	F16.7	Original DEM raster spacing north-south in unit as per field 13.
16	185-200	F16.7	Original DEM raster spacing north-south in unit as per field 13.
17	201-232	A32	Applied resampling method (bilinear,spline, etc.)
18	233-248	F16.7	RMS height error (meters)
19	249-264	F16.7	RMS location error north-south in unit as per field 13.
20	265-280	F16.7	RMS location error east-west in unit as per field 13.
21	281-296	F16.7	Maximum height in DEM (meters)
22	297-312	F16.7	Minimum height in DEM (meters)
23	313-328	F16.7	Mean height value in DEM (meters). (Value computed by using the number of DEM points in original presentation
24	329-344	F16.7	Standard deviation of heights in DEM (meters).(value computed by using the number of DEM points in original presentation)
25	345-348	I4	Number of polygons described in this record

1-ST DEM DATA DESCRIPTOR DATA SET

26	349-352	I4	Polygon sequence number
27	353-356	I4	Number of corner-points for current polygon
28	357-364	I8	*Spare*
29	365-380	F16.7	Ist corner point Latitude

30	381-396	F16.7	lst corner point Longitude
31	397-412	F16.7	2nd corner point Latitude
32	413-428	F16.7	2nd corner point Longitude
33	429-444	F16.7	3rd corner point Latitude
34	445-460	F16 7	3rd corner oint Longitude
<tbd>	<tbd>-<tbd>	F16.7	Last corner point Latitude
<tbd>	<tbd>-<tbd>	F16.7	Last corner point Longitude

2-ND,... DEM DATA DESCRIPTOR DATA SETS

<tbd>	<tbd>-<tbd>	...	Repetition of the DEM descriptor data sets (from field 26 onwards) as indicated by number of polygons (in field 25).
<tbd>	<tbd>-EOR	A<tbd>	*Spares*

Table 10 ***RADAR PARAMETER UPDATE DATA RECORD DEFINITION***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-16	I4	Radar parameter record sequence number
8	17-20	A4	*Spare*
9	21-28	I8	Number of radar parameter update data sets in the record
10	29-36	I8	Radar parameter update data set size (bytes)

1-ST RADAR PARAMETER UPDATE DATA SET

11	37-56	A20	GMT of Change (YYYYMMDD-hhmmssttt$$)
12	57-60	A4	SAR channel indicator
13	61-68	I8	Radar data line number where this update takes effect
14	69-76	I8	Radar data sample number where this update takes effect
15	77-108	A32	Parameter descriptor field, one of: "RECEIVER GAIN (dB) =" "RECORD WINDOW POSITION (µsec) =" "ELECTRONIC BORESIGHT (degrees) =" "PRF (Hz) =" "PULSE BANDWIDTH (Hz) =" "PULSE DURATION (µsec) =" "QUANTIZATION (bits) etc.
16	109-124	E16.7	Parameter value

2-ND RADAR PARAMETER UPDATE DATA SET

20	125-...	...	The radar parameter update data set (fields 11-16) are repeated as many times as indicated by the data set counter (fie1d# 9)
<tbd>	tbd>-EOR	<A<tbd>	*Spares*

Table 11 ***GROUND CONTROL POINTS DESCRIPTOR RECORD DEFINITION***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code = 18
3	6	Bl	Record type code = 140
4	7	Bl	2-nd record sub-type code = 18
5	8	Bl	3-rd record sub-type code = 20
6	9-12	B4	Length of this record = <tbd>
7	13-16	I4	Ground control points descriptor record sequence number
8	17-20	I4	*Spare*
9	21-24	I4	Number of GCPs in this record
10	25-28	I4	Number of GCPs for geometric adjustment
11	29-32	I4	Number of GCPs for quality test
12	33-96	A64	*Spare* (for comments)

1-ST GCP DESCRIPTOR

13	97-100	I4	GCP sequence number
14	101-106	A6	Adjustment or test ("ADJUST"/"TEST$$")
15	107-138	A32	GCP generation method (map, DEM simulated SAR, geocoded THEMATIC MAPPER,..etc.)
16	139-154	A16	Matching method (automatic correlation,visual match, etc.)
17	155-170	A16	Method applied to (Slant/Ground range or Geocoded Image)
18	171-186	F16.7	Geographic latitude of GCP
19	187-202	F16.7	Geographic longitude of GCP
20	203-218	F16.7	GCP height above the reference ellipsoid
21	219-234	F16.7	Pixel first coordinate in image which matches GCP. (Pixel range line, pixel northing)
22	235-250	F16.7	Pixel second coordinate in image which matches GCP. (Pixel azimuth line,pixel easting)
23	251-266	F16.7	Pixel first coordinate in image which corresponds to transformed GCP coordinate/algorithmic geolocation.(Pixel range line, pixel northing)
24	267-282	F16.7	Pixel second coordinate in image which corresponds to transformed GCP coordinate/algorithmic geolocation.(Pixel azimuth line, pixel easting)
25	283-298	F16.7	Difference of (pixel) first coordinates on ground (meters)
26	299-314	F16.7	Difference of (pixel) second coordinates on ground (meters)
27	315-330	F16.7	Correlation coefficient for automatic matching
28	331-346	F16.7	Reliability measure or second correlation coefficient (site and software specific)

29	347-360	A14	*Spare*

2-ND, 3-RD,... GCP DESCRIPTORS

30	361-<tbd>	...	Repetition of the GCP descriptor fields (from field 13 through 29) as indicated by the number of GCPs (in field #9).
<tbd>	<tbd>-EOR	A<tbd>	*Spares*

Table 12 ***FACILITY RELATED DATA RECORD GENERAL TYPE DEFINITON***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-76	A64	Name of this facility related data record
8	77-82	A6	Date of the last release of QC software as YYMMDD, where: YY = last two digits of year; MM = month of the year; DD = day of the month
9	83-84	A2	*Spare*
10	85-90	A6	Date of the last calibration update as YYMMDD

SAR QA SUMMARY FLAGS

11	91-94	I4	Overall QA summary flag (0/1)
12	95-98	I4	PRF code change flag (0/1)
13	99-102	I4	Sampling window change flag (0/1)
14	103-106	I4	Cal system & receiver gain change flag (0/1)
15	107-110	I4	Chirp replica quality flag (0/1)
16	111-114	I4	Input data statistic flag (0/1)
17	115-118	I4	Doppler centroid confidence measure flag (0/1)
18	119-122	I4	Doppler centroid value flag (0 or 1)
19	123-126	I4	Doppler ambiguity confidence measure flag (0/1)
20	127-130	I4	Output data Mean flag

SAR QA PARAMETERS

21	131-134	I4	OGRC/OBRC flag (0/1)
22	135-138	I4	Number of PRF code changes
23	139-142	I4	Number of sampling window time changes
24	143-146	I4	Number of calibration subsystems gain changes
25	147-150	I4	Number of missing lines
26	151-154	I4	Number of receiver gain changes
27	155-170	F16.7	3-dB pulse width of (first) Chirp Replica Autocorrelation Function (ACF)

28	171-186	F16.7	First side-lobe level of chirp ACF
29	187-202	F16.7	ISLR of chirp ACF function
30	203-218	F16.7	Doppler centroid confidence measure (processor specific)
31	219-234	F16.7	Doppler ambiguity confidence measure (processor specific)
32	235-250	F16.7	Estimated mean of I input data
33	251-266	F16.7	Estimated mean of Q input data
34	267-282	F16.7	Estimated standard deviation of I input data
35	283-298	F16.7	Estimated standard deviation of Q input data
36	299-314	F16.7	Calibration system gain
37	315-330	F16.7	First receiver gain read
38	331-346	F16.7	Doppler ambiguity number
39	347-362	A16	*Spare*

INTERNAL CALIBRATION

40	363-378	F16.7	Bias correction applied to I channel
41	379-394	F16.7	Bias correction applied to Q channel
42	395-410	F16.7	Gain imbalance correction applied to I channel
43	411-426	F16.7	Gain imbalance correction applied to Q channel
44	427-442	F16.7	I/Q Non-orthogonality correction applied to Q channel
45	443-458	A16	*Spare*
46	459-474	F16.7	Estimated noise power
47	475-490	I16	Internal cal data time tag (UTC)
48	491-494	I4	Number of valid calibration pulses
49	495-498	I4	Number of valid noise pulses
50	499-502	I4	Number of valid replicas (set to 1)
51	503-518	F16.7	first sample in replica (CEI)
52	519-534	F16.7	Mean Cal pulse power
53	535-550	F16.7	Mean noise power
54	551-566	F16.7	Range compression normalisation factor
55	567-582	F16.7	Replica power
56	583-598	F16.7	Incidence angle at first range pixel (at mid-azimuth)
57	599-614	F16.7	Incidence angle at centre range pixel (at mid-azimuth)
58	615-630	F16.7	Incidence angle at last range pixel (at mid-azimuth)
59	631-646	F16.7	Normalisation reference range Ro (in Km) (set to 0 for ERS.SAR.SLC)
60	647-658	A12	*Spare*
61	659-662	I4	Antenna elevation gain pattern flag (0 or 1)
62	663-678	F16.7	Absolute calibration constant K (scalar)
63	679-694	F16.7	Upper bound K (+3 std dev)

64	695-710	F16.7	Lower bound K (-3 std dev)
65	711-726	F16.7	Processor noise scaling factor
66	727-732	A6	Date on which K was generated as YYMMDD
67	733-736	A4	K version number as XXYY where XX refers to a K update implemented at ERS-2 ground segmentYY refers to an upgrade only at the PAF (as may arise in case of local software updates)
68	737-740	I4	Number of duplicated input lines
69	741-756	F16.7	Estimated bit error rate
70	757-768	A12	*Spare*
71	769-784	F16.7	Output image mean
72	785-800	F16.7	Output image standard deviation
73	801-816	F16.7	Output image maximum value
74	817-840	A24	Time of raw data first input range line (UTC) <dd-MMM-yyy hh:mm:ss.ttt>
75	841-864	A24	Time of ascending node state vectors (UTC) (same format as field 74)
76	865-886	D22.15	Ascending node position vector X component (m)
77	887-908	D22.15	Ascending node position vector Y component (m)
78	909-930	D22.15	Ascending node position vector Z component (m)
79	931-952	D22.15	Ascending node velocity vector V_X component (m/s)
80	953-974	D22.15	Ascending node velocity vector V_Y component (m/s)
81	975-996	D22.15	Ascending node velocity vector V_Z component (m/s)
82	997-1000	I4	Output pixel bit length (bits)
83	1001-1016	F16.7	Processor gain parameter 1
84	1017-1032	F16.7	Processor gain parameter 2
85	1033-1048	F16.7	Processor gain parameter 3
86	1049-1052	I4	Peak location of cross correlation function between first extracted chirp and nominal chirp (samples)
87	1053-1068	F16.7	3-dB width of CCF between last extracted chirp and nominal chirp (samples)
88	1069-1084	F16.7	First side lobe level of chirp (CCF) between last extracted chirp and nominal chirp (dB)
89	1085-1100	F16.7	ISLR of CCF between last extracted chirp and nominal chirp (dB)
90	1101-1104	I4	Peak location of CCF betwee last extracted chirp and nominal chirp (samples)
91	1105-1108	I4	Roll tilt mode flag (0 = not in roll tilt mode)
92	1109-1112	I4	Raw data correction flag (0 = correction with default (0 = not correction with default parameters)
93	1113-1116	I4	Look detection flag (1 = power detected and summed)
94	1117-1120	I4	Doppler ambiguity estimation flag (0 = no estimation done)
95	1121-1124	I4	Azimuth baseband conversion flag (0 = no conversion done)
96	1125-1128	I4	Samples per line used for the raw data analysis
97	1129-1132	I4	Range lines skip factor for raw data analysis
98	1133-1156	A24	Time of input state vectors (UTC) used to process the image (same format as field 74)
99	1157-1178	D22.15	Input state vector position X component (m)
100	1179-1200	D22.15	Input state vector position Y component (m)
101	1201-1222	D22.15	Input state vector position Z component (m)

102	1223-1244	D22.15	Input state vector velocity V_X component (m/s)
103	1245-1266	D22.15	Input state vector velocity V_Y component (m/s)
104	1267-1288	D22.15	Input state vector velocity V_Z component (m/s)
105	1289-1292	I4	Input state vector type flag (0 = ascending node state vectors,predicted orbit; 1 = near scene state vectors,restituted orbit)
106	1293-1308	F16.7	Window coefficient for range-matched filter
107	1309-1324	F16.7	Window coefficient for azimuth-matched filter
108	1325-1328	I4	Update period of range-matched filter (chirps)
109	1329-1456	8F16.7	Look scalar gains (up to 8 looks)
110	1457-1460	I4	Sampling window start time bias (nanoseconds)
111	1461-1482	D22.15	Doppler centroid cubic coefficient(Hz/sec^3)
112	1483-1486	I4	PRF code of first range line (telemetry value)
113	1487-1490	I4	PRF code of last range line (telemetry value)
114	1491-1494	I4	Sampling window start time code of first range line (telemetry value)
115	1495-1498	I4	Sampling window start time code of last range line
116	1499-1502	I4	Calibration system gain of last processed line (telemetry value)
117	1503-1506	I4	Receiver gain of last processed line (telemetry value)
118	1507-1510	I4	First processed range sample
119	1511-1514	I4	Azimuth FFT/IFFT ratio
120	1515-1518	I4	Number of azimuth blocks processed
121	1519-1526	I8	Number of input raw data lines
122	1527-1530	I4	Initial doppler ambiguity number
123	1531-1578	3F16.7	Chirp quality thresholds -Pulse width of the chirp CCF (10^{-3} pixels) -First sidelobe of the chirp CCF (10^{-3} dB) -ISLR of the chirp CCF (10^{-3} dB)
	1579-1642	4F16.7	Input data statistic thresholds -mean of input I data in fraction of maximum absolute of input data (10^{-3}) -mean of input Q data in fraction of maximum absolute of input data (10^{-3}) -standard deviation of input I data in fraction of maximum absolute of input data (10^{-3}) -standard deviation of input Q data in fraction of maximum absolute of input data (10^{-3})
	1643-1674	2F16.7	Doppler ambiguity confidence thresholds (10^{-3})
	1675-1706	2F16.7	Output data statistic thresholds -mean of outout data (10^{-3}) -standard deviation of output data (10^{-3})

124	1707-1722	I16	Satellite binary time of first range line (telemetry value)
125	1723-1726	I4	Number of valid pixels per range line (the remaining pixels are zero padded)
126	1727-1730	I4	Number of range samples discarded during processing interpolations
127	1731-1746	F16.7	I/Q gain imbalance lower bound
128	1747-1762	F16.7	I/Q gain imbalance upper bound
129	1763-1778	F16.7	I/Q quadrature departure lower bound (degrees)
130	1779-1794	F16.7	I/Q quadrature departure upper bound (degrees)
131	1795-1810	F16.7	3-dB look bandwidth (Hz)
132	1811-1826	F16.7	3-dB processed doppler bandwidth (Hz)
133	1827-1830	I4	Range spreading loss compensation flag (0 = no compensation)
134	1831-1831	I1	Datation flag (1 = azimuth timing improved based on timing information of range line specified in field 136)
135	1832-1838	I7	Maximum error of range line timing (nanoseconds)
136	1839-1845	I7	Format number of range line used to synchronize azimuth timing
137	1846-1846	I1	Automatic look scal gain flag (1 = automatically calculated)
138	1847-1850	I4	Maximum value of look scalar gain before the look scalar gains are normalised
139	1851-1854	I4	Replica normalisation method flag (0 = normalised by replica power,i.e. $Z' = Z*(c/A_r)$ where A_r is the replica power and c is specified in field 54; 1 = normalised by the square root of replica power, $Z' = Z/A_r$)
140	1855-1934	4E20.10	4 coefficients of the ground range to slant range conversion polynamial
141	1935-2034	5E20.10	5 coefficients of the antenna elevation pattern polynomial
142	2035-2050	E16.7	Range time of origin of antenna elevation (sec) pattern polynomial
143	2051-12288	A10238	*Spare*

Table 13 ***FACILITY RELATED DATA RECORD MPH-SPH Type***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Sequence number
2	5	B	1st record sub-type code
3	6	B	Record type code
4	7	B	2nd record sub-type code
5	8	B	3rd record sub-type code
6	9-12	B4	Record length
7	13-76	A64	Name of this facility related data record
8	77-93	17B1	Product identifier
9	94-105	I12	Type of product
10	106-117	I12	Spacecraft
11	118-141	A24	UTC of subsatellite point at beginning of product
12	142-153	I12	Station identifier
13	154-165	I12	Product confidence data
14	166-189	A24	UTC time when MPH was generated;
15	190-201	I12	Size of specific product header in bytes
16	202-213	I12	Number of product data set records
17	214-225	I12	Size of each product date set record in bytes
18	226-237	I12	Subsystem that generated the product
19	238-249	I12	OBRC flag used for SAR products only
20	250-273	A24	UTC reference time
21	274-285	I12	Reference binary time of satellite clock
22	286-297	I12	Step length of satellite clock in nanoseconds
23	298-305	A8	Software version used to generate product
24	306-317	I12	Threshold table version number.
25	318-329	I12	*Spare*
26	330-353	A24	UTC time of ascending node

ASCENDING NODE STATE VECTOR IN EARTH FIXED REFERENCE SYSTEM

27	354-365	I12	State vector; X 10-2m
28	366-377	I12	State vector; Y 10-2m
29	378-389	I12	State vector; Z 10-2m
30	390-401	I12	State vector; X velocity 10-5m/s
31	402-413	I12	State vector; Y velocity 10-5m/s
32	414-425	I12	State vector; Z velocity 10-5m/s

33	426-437	I12	Product confidence data
34	438-449	I12	Subsatellite Track Heading, relative to North,mid-azimuth position of product (10 deg)
35	450-461	I12	Number of PRF code changes for test
36	462-473	I12	Number of sampling window time changes
37	474-485	I12	Sum of number of calibration sub-system and receiver gain changes
38	486-497	I12	Number of missing lines
39	498-509	I12	*Spare*
40	510-521	I12	3-dB pulse width of chirp replica cross-correlation pixels function (10 pixels)
41	522-533	I12	First side lobe level of point chirp replica cross-correlation function (10 dB)
42	534-545	I12	ISLR of chirp replica cross-correlation function (10 dB)
43	546-557	I12	Doppler centroid confidence measure.(10)
44	558-569	I12	Doppler ambiguity confidence measure.(10)
45	570-581	I12	Mean of I input data (10)
46	582-593	I12	Mean of Q input data (10)
47	594-605	I12	Standard deviation of I input data (10)
48	606-617	I12	Standard deviation of Q input data (10)
49	618-629	I12	Geodetic latitude of the first pixel of the first line of the scene product.(10 deg)
50	630-641	I12	East longitude of the first pixel of the first of the first line of the scene product (10 deg)
51	642-653	I12	Geodetic latitude of the last pixel of the first line of the scene product (10 deg)
52	654-665	I12	East longitude of the last pixel of the first pixel of the first line of the scene product (10 deg)
53	666-677	I12	Geodetic latitude of the last pixel of the last line of the sceneproduct (10 deg)
54	678-689	I12	East longitude of the last pixel of the last line of the scene product (10 deg)
55	690-701	I12	Geodetic latitude of the first pixel of the last line of the scene product (10 deg)
56	702-713	I12	East longitude of the first pixel of the lastline of the scene product (10 deg)
57	714-725	I12	Geodetic latitude of the centre pixel of the scene product (10 deg)
58	726-737	I12	East longitude of the centre pixel of the scene product (10 deg)
59	738-749	I12	Origin of used chirp
60	750-761	I12	Chirp extraction index (samples)
61	762-773	I12	Chirp amplitude coefficient-Constant (10 deg)
62	774-785	I12	Chirp amplitude coefficient-Linear (sec)
63	786-797	I12	Chirp amplitude coefficient-Quadratic (10/sec)
64	798-809	I12	Chirp amplitude coefficient-Cubic (10/sec)
65	810-821	I12	Chirp amplitude coefficient-Quartic(10/sec)
66	822-833	I12	Chirp phase coefficient-Constant(10 cycles)
67	834-845	I12	Chirp phase coefficient-Linear (Hz)
68	846-857	I12	Chirp phase coefficient-Quadratic (10 Hz/sec)
69	858-869	I12	Chirp phase coefficient-Cubic (10 Hz/sec)
70	870-881	I12	I mean for raw data correction
71	882-893	I12	Q mean for raw data correction

72	894-905	I12	I/Q Std ratio for raw data correction
73	906-917	I12	Output pixel bit length
74	918-929	I12	16- to 8-bit conversion coefficient-Constant
75	930-941	I12	16- to 8-bit conversion coefficient-Linear
76	942-953	I12	16- to 8-bit conversion coefficient-Quadratic
77	954-965	I12	Calibration system gain of the first processed line
78	966-977	I12	Receiver gain
79	978-989	I12	Clutter noise estimate
80	990-1001	I12	*Spare*
81	1002-1013	I12	Range pixel spacing (10 m)
82	1014-1025	I12	Azimuth pixel spacing (10 m)
83	1026-1037	I12	Pulse Repetition Frequency (10 Hz)
84	1038-1049	I12	2-way slant range time of the first processed cell (μsec)
85	1050-1061	I12	Doppler centroid value at near range (10 Hz)
86	1062-1073	I12	Doppler centroid slope (2-way slant range time) (Hz/sec)
87	1074-1085	I12	Azimuth FM rate at near range (10 Hz/sec)
88	1086-1097	I12	Azimuth FM rate slope (2-way slant range time)(10 Hz/sec)
89	1098-1109	I12	Doppler ambiguity number
90	1110-1121	I12	Calibration coefficient (antenna) Constant term
91	1122-1133	I12	Calibration coefficient (antenna) Linear term
92	1134-1145	I12	Calibration coefficient (antenna) Quadratic term
93	1146-1157	I12	Calibration coefficient (antenna) Spare term
94	1158-1169	I12	Calibration coefficient (antenna) Spare term
95	1170-1181	I12	EXT SAR parameter table identifier
96	1182-1193	I12	Datation inprovement
97	1194-1205	I12	SARFDP Static transfer function table identifier
98	1206-1217	I12	SARFDP Parameter database identifier
99	1218-1229	I12	Output image mean (10)
100	1230-1241	I12	Output image standard deviation (10)
101	1242-1253	I12	Range compression scalar gain (10)
102	1254-1265	I12	Azimuth FFT scalar gain (10)
103	1266-1277	I12	Azimuth compression scalar gain (10)
104	1278-1289	I12	Overall processing gain
105	1290-2048	A759	*Spare* blanks

Table 14 ***FACILITY DATA RECORD GEOCODED TYPE DEFINITION***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Sequence number
2	5	B	1st record sub-type code
3	6	B	Record type code
4	7	B	2nd record sub-type code
5	8	B	3rd record sub-type code
6	9-12	B4	Record length
7	13-76	A64	Name of this facility related data record

Table 15 ***FACILITY RELATED DATA RECORD PCS TYPE DEFINITION***

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-76	A64	Name of this facility related data record
8	77-12288	B	ESA reserved

5.3 SAR DATA FILE

The SAR data is classed as a class "IMAGERY OPTIONS" file, or "IMOP", under the LGSOWG file type descriptions. The IMOP class was adopted because it offered the most flexibility for storing the large variety of data types and formats available from current and anticipated SAR sensors. In addition, this class also provides the capability for storing SAR data as either unprocessed (raw) signal data, processed image data or enhanced SAR data. In all of the cases the "product type" fields (field 86 of the data summary record) are used to indicate the type of SAR data and the "data type" fields (fields 61 & 62 of file descriptor record) are used to indicate the data format. The file contents are basically.

1. one file descriptor record
2. SAR data records

All imagery options file records are fixed length in the logical volume for a given sensor.and product combination. The record sizes may vary from one logical volume to another. Each record contains the standard twelve bytes of record introductory data (namely, record number, record type and sub-types, and record length). The remainder of the file descriptor record contains the file structure information. The remainder of the SAR data records contain the SAR data related information. The SAR data records contain not only the SAR data, but also support data, ie. ancillary data, such as line count, sensor time, geographic location and data quality codes. This support data is physically separated in the record into the prefix data which precede the SAR data and suffix data which follows it.

The organization of the imagery file may be "Band Sequential" (BSQ), where the file contains image data for one SAR sensor channel only, "Band Interleaved by Line" (BIL) or band interleaved by pixel (BIP), where the file contains data for one or more channels. The contents of the descriptor record are coded in ASCII where as the contents of the SAR data record are binary. Any binary fields occupying more than one byte are stored with the bytes in descending order of significance with the most significant being stored first on the tape.

5.3.1 SAR DATA FILE DESCRIPTOR RECORD

The SAR data file descriptor record is the same length as the SAR data record and is subdivided into two major segments, namely, the descriptor record fixed segment and the descriptor record variable segment. The SAR data file descriptor record definition follows the "IMOP" class definition.

As the name implies, the fixed segment is fixed in length and its definition is common to all file descriptor records of the Standard CCT Family of Tape Formats. This segment identifies the organization of the file in the logical volume and the 12 bytes of standard record introductory data.

The SAR data file descriptor record variable segment is "IMOP" definition dependent and defines the format of the SAR data in the file. It gives the number and the length of the SAR data records contained in the file. The remainder of the variable segment contains detailed information on the method used to pack the SAR data samples in the SAR data record within the-data fields, each of which may consist of a group of bytes. In addition, the data dynamic range, the encoding of individual samples, the size (if any) of left ,right, top and bottom borders, the size of the prefix and suffix data, byte pointers to key SAR parameters and finally the nature of the packing of multichannel lines are also supplied. (Additional information on data packing appear in section 1.4)

5.3.2 SIGNAL DATA RECORD

The definition of the SAR signal data record is a record containing the following groups of data:

1. The twelve bytes of standard record introductory data (namely,record number, record type and sub-types, and record length)
2. Prefix data
3. One line of signal data
4. Suffix data

5.3.3 PROCESSED DATA RECORD

The definition of the SAR processed data record is a record containing the following groups of data:

1. The twelve bytes of standard record introductory data (namely, record number, record type and sub-types, and record length)
2. Prefix data
3. One line of processed data, including left fillers and right fillers, where necessary
4. Suffix data

Table 16 *SAR DATA IMAGERY OPTIONS FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT) DEFINITION*

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC flag
8	15-16	A2	Blanks
9	17-28	A12	Format control document ID for this data file format
10	29-30	A2	Format control document revision level
11	31-32	A2	File design descriptor revision letter
12	33-44	A12	Generating software release and revision level
13	45-48	I4	File number
14	49-64	A16	File name
15	65-68	A4	Record sequence and location type flag
16	69-76	I8	Sequence number location
17	77-80	I4	Sequence number field length
18	81-84	A4	Record code and location type flag
19	85-92	I8	Record code location
20	93-96	I4	Record code field length
21	97-100	A4	Record length and location type flag
22	101-108	I8	Record length location
23	109-112	I4	Record length field length
24	113	Al	*Reserved*
25	114	Al	*Reserved*
26	115	Al	*Reserved*
27	116	Al	*Reserved*
28	117-180	A64	Reserved segment

SAR DATA IMAGERY OPTIONS FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT)DEFINITION

29	181-186	I6	Number of SAR DATA records
30	187-192	I6	SAR DATA record length (bytes)
31	193-216	A24	*Reserved* (blanks)

SAMPLE GROUP DATA

32	217-220	I4	Number of bits per sample
33	221-224	I4	Number of samples per data group (or pixel)
34	225-228	I4	Number of bytes per data group (or pixel)
35	229-232	A4	Justification and order of samples within data group (or pixel)

SAR RELATED DATA IN THE RECORD

36	233-236	I4	Number of SAR channels in this file (I and Q values as two channels)
37	237-244	I8	Number of lines per data set (one channel) in this file (excluding border lines)
38	245-248	I4	Number of left border pixels per line
39	249-256	I8	Total number of data groups (or pixels) per line per SAR channel
40	257-260	I4	Number of right border pixels per line
41	261-264	I4	Number of top border lines
42	265-268	I4	Number of bottom border lines
43	269-272	A4	Interleaving indicator "BIL$", "BSQ$", "BIP$"

RECORD DATA IN THE FILE

44	273-274	I2	Number of physical records per line
45	275-276	I2	Number of physical records per multi-channel line in this file
46	277-280	I4	Number of bytes of prefix data per record
47	281-288	I8	Number of bytes of SAR data (or pixel data) per record
48	289-292	I4	Number of bytes of suffix data per record
49	293-296	A4	Prefix/suffix repeat flag

PREFIX/SUFFIX DATA LOCATORS (*)

50	297-304	A8	Sample data line number locator
51	305-312	A8	SAR channel number locator
52	313-320	A8	Time of SAR data line locator
53	321-328	A8	Left-fill count locator
54	329-336	A8	Right-fill count locator
55	337-340	A4	Pad pixels present indicator ("$$$$","0000" if present, "1111" if not present)
56	341-368	A28	Blanks
57	369-376	A8	SAR data line quality code locator
58	377-384	A8	Calibration information field locator
59	385-392	A8	Gain values field locator

60	393-400	A8	Bias values field locator

SAR DATA PIXEL DESCRIPTION

61	401-428	A28	SAR Data format type identifier
62	429-432	A4	SAR Data format type code
63	433-436	I4	Number of left fill bits within pixel
64	437-440	I4	Number of right fill bits within pixel
65	441-448	I8	Maximum data range of pixel (starting from 0)
66	449-640	A192	*Reserved*
67	641-EOR	(A9n-641)	Blanks
	Note.	(*)	The form at for an 8- byte ASCII as follows.
			Bytes 1-4 = start byte number of within prefix/suffix.
			Bytes 5-6 = length in bytes of the field to be located.
			Byte 7 = letter "P" or "S" indicating the location of the field is in prefix or suffix.
			Byte 8 = type of data format.
			A = ASCII
			B = Binary
			N = Numeric ASCII

Table 17 *IMAGERY OPTIONS FILE - SIGNAL DATA RECORD DEFINITION*

FIELD	BYTES	FORMAT	DESCRIPTION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd record sub-type code
5	8	Bl	3-rd record sub-type code
6	9-12	B4	Length of this record

PREFIX DATA - GENERAL INFORMATION

7	13-16	B4	SAR image data line number
8	17-20	B4	SAR image data record index (indicates the record sequence number of the image line)
9	21-24	B4	Actual count of left-fill pixels
10	25-28	B4	Actual count of data pixels
11	29-32	B4	Actual count of right-fill pixels

PREFIX DATA - SENSOR PARAMETERS

12	33-36	B4	*Reserved*
.	.	.	.
.	.	.	.
28	85-88	B4	*Spare*
29	89-92	B4	*Spare*
30	93-96	B4	*Reserved*
.	.	.	.
.	.	.	.
37	121-124	B4	*Reserved*
38	125-128	B4	*Spare*

PREFIX DATA PLATFORM REFERENCE INFORMATION

39	129-132	B4	*Reserved*
.	.	.	.
.	.	.	.
50	189-192	B4	*Reserved*

PREFIX DATA- SENSOR/FACILITY SPECIFIC, AUXILIARY DATA

51	193-412	B220	Sensor/Facility specific auxiliary information such as down linked auxiliary data (i.e. pulse replicas, etc.) and data quality information

SAR RAW SIGNAL DATA

52	413-(i)	(j)B(k)	SAR Signal data consisting of Noise and echo data, where: (i)-number of prefix + data bytes (j)-number of pixels on this record (k)-size of pixel in bytes

SUFFIX DATA

53	<tbd>-	<tbd>B4	Processing Facility specific details (quality information, frame errors, sync loss,parity, etc.)
54	<tbd>-EOR	<tbd>B4	*Spares*

Table 18 *IMAGERY OPTIONS FILE - PROCESSED DATA RECORD DESCRIPTION*

FIELD	BYTES	FORMAT	DEFINITION
1	1-4	B4	Record sequence number =
2	5	Bl	1-st record sub-type code =
3	6	Bl	Record type code =
4	7	Bl	2-nd record sub-type code =
5	8	Bl	3-rd record sub-type code =
6	9-12	B4	Length of this record = (n)

PREFIX DATA - GENERAL INFORMATION,

7	13-16	B4	Processed data line number
8	17-20	B4	Processed data record index
9	21-24	B4	Actual count of left-fill pixels
10	25-28	B4	Actual count of data pixels
11	29-32	B4	Actual count of right-fill pixels

PREFIX DATA - SENSOR/PROCESSING PARAMETERS,

12	33-36	B4	Sensor parameters update flag
13	37-40	B4	Sensor acquisition year
14	41-44	B4	Sensor acquisition day of year
15	45-48	B4	Sensor acquisition msecs of day
16	49-50	B2	SAR channel indicator (sequence number in multichannel SAR data)
17	51-52	B2	SAR channel code
18	53-54	B2	Transmitted polarization
19	55-56	B2	Received polarization
20	57-60	B4	PRF
21	61-64	B4	*Spare*
22	65-68	B4	Slant/range to first data sample in meters
23	69-72	B4	Slant/range to mid data sample in meters
24	73-76	B4	Slant/range to last data sample in meters
25	77-80	B4	Doppler centroid value at first data sample in Hz
26	81-84	B4	Doppler centroid value at mid data sample in Hz
27	85-88	B4	Doppler centroid value at last data sample in Hz
28	89-92	B4	Azimuth FM rate of the first data sample
29	93-96	B4	Azimuth FM rate of the mid data sample

30	97-100	B4	Azimuth FM rate of the last data sample
31	101-104	B4	Radar look angle of nadir (10^{-6}deg)
32	105-108	B4	Radar azimuth/squint angle (10^{-6}deg)
33	109-112	B4	*Spare*
34	113-116	B4	*Spare*
35	117-120	B4	*Spare*
36	121-124	B4	*Spare*
37	125-128	B4	*Spare*

PREFIX DATA - GEOGRAPHIC REFERENCE INFO.

38	129-136	B4	Geographic ref. parameter update flag
39	133-136	B4	Latitude of first pixel (10^{-6}deg)
40	137-140	B4	Latitude of mid-pixel(10^{-6}deg)
41	141-144	B4	Latitude of last pixel(10^{-6}deg)
42	145-148	B4	Longitude of first pixel (10^{-6}deg)
43	149-152	B4	Longitude of mid-pixel(10^{-6}deg)
44	153-156	B4	Longitude of last pixel(10^{-6}deg)
45	157-160	B4	Northing of 1-st pixel (m)
46	161-164	B4	*Spare*
47	165-168	B4	Northing of last pixel (m)
48	169-172	B4	Easting of 1-st pixel (m)
49	173-176	B4	*Spare*
50	177-180	B4	Easting of last pixel (m)
51	181-184	B4	Orientation of image line (10^{-6}deg)
52	185-188	B4	*Spare*
53	189-192	B4	*Spare*

SAR PROCESSED DATA

54	193-196	B2	First sample of first image line
..		..	.....
(n)	.. EOR	B2	Last sample of last image line

5.4 NULL VOLUME DIRECTORY FILE

The logical volume set is terminated with a null volume directory file. The null volume directory contains only one record, namely, the null volume descriptor record.

5.4.1 NULL VOLUME DESCRIPTOR RECORD

The null volume descriptor record indicates the end of the logical volume. Its definition is identical to the volume descriptor record (defined in Table 5.1.1) and the data contained indicate the end of the volume.

Table 19 *VOLUME DESCRIPTOR RECORD DEFINITION*

FIELD	BYTES	FORMAT	DEFINITION
1	1-4	B4	Record sequence number
2	5	Bl	1-st record sub-type code
3	6	Bl	Record type code
4	7	Bl	2-nd sub-type code
5	8	Bl	3-rd sub-type code
6	9-12	B4	Length of this record
7	13-14	A2	ASCII/EBCDIC flag
8	15-16	A2	Blanks
9	17-28	A12	Superstructure format control document (CCB document)
10	29-30	A2	Superstructure format control document revision level ("$E")
11	31-32	A2	Superstructure record format revision level ("$A")
12	33-44	A12	Logical volume generating facility software release and revision level
13	45-60	A16	ID of physical volume containing this volume descriptor
14	61-76	A16	Logical volume identifier (scene related information)
15	77-92	A16	Volume set identifier (i.e. scene date and time as YYYYMMDDhhmmssdd where dd=deci-secs)
16	93-94	I2	Total number of physical volumes in the logical volume
17	95-96	I2	Physical volume sequence number of the first tape within the logical volume
18	97-98	I2	Physical volume sequence number of the last tape within the logical volume
19	99-100	I2	Physical volume sequence number of the current tape within the logical volume
20	101-101	I4	First referenced file number in this physical volume within the logical volume.
21	105-108	I4	Logical volume within a volume set
22	109-112	I4	Logical volume number within physical volume
23	113-120	A8	Logical volume creation date (YYYYMMDD)
24	121-128	A8	Logical volume creation time (hhmmssdd, dd=deci-seconds)
25	129-140	A12	Logical volume generation country
26	141-148	A8	Logical volume generating agency
27	149-160	A12	Logical volume generating facility
28	161-164	I4	Number of file pointer records in volume directory
29	165-168	I4	Number of records in volume directory
30	169-260	A92	Volume descriptor spare segment (always blank filled)
31	261-360	Al00	Local use segment