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D4

RADARSAT-1

Data Products Specifications

Revision Number	Release Date	Summary of Changes
3/0	May 8, 2000	Document Administration
3/0	January 15, 2004	Updated Appendix D; added PAP 24, 25, 26, 27, 28 and 29
3/0	August 19, 2004	Updated Appendix D; added PAP 29

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LIST OF FIGURES AND TABLES

Document Revision History

Revision Number	Release Date	Summary of Changes
2/0	7-Nov-1997	Initial document release; supersedes former document numbers RZ-MA-50-5309 2/1 and RZ-SP-50-5313 5/1
2/1	02-Feb-1998	*Change notice issued only; RSI-GS-026-2/0-CHG01.* Tape ID fields must be changed to only 8 characters in length. Exceeding this causes CDPF ingest problems. Under "Content" column all incidences of "xxxxxxxxxxxxxxxx" are changed to "xxxxxxxx$$$$$$$$" on: • App. B-1 "Volume Description Record Contents" row #13 ("phyvol_id") • App. B-5 "Text Record Contents" row #11 ("phyvol_id") • App. B-22 "Null Volume Descriptor Record" row #13 ("tape_id")
3/0	08-May-2000	• Section 3.4.3: definition added for Multilook Processing • Added Section 4.2: RAW Data Structure • Section 4.4.1: enhanced product label descriptions • Section 5.3: updated and integrated newest info on calibration and extraction of beta nought & sigma nought • Section 5.3.3: (formerly App. D1) incidence angle calculation updated; e.g. corrections to "eph_orb_data" value and orbit altitude formula • Separate Appendix A (product descriptions) and B (CEOS definitions); enhancements to both • Appendix D: Updated "Changes of Payload Parameter files" • Other updates to structure and wording throughout document for clarity only; no impact on content
3/0	10-May-2006	▪ Appendix A-6: updated Nominal Product Volume from 2800 MB to 866 MB

Acronyms and Abbreviations

bpi	Bytes per inch
CCT	Computer Compatible Tape
CDPF	Canadian Data Processing Facility
CEOS	Committee on Earth Observation Satellites
CDHS	Canadian Data Handling System
CSA	Canadian Space Agency
dB	Decibel
DEM	Digital Elevation Model
GB	Gigabyte
GCP	Ground Control Point
GICS	Geocoded Image Correction System
HDDT	High Density Digital Tape
IDCS	Image Data Calibration System
IRW	Impulse Response Width
ISLR	Integrated Side Lobe Ratio
LAN	Local Area Network
LUT	Look-Up Table
MCS	Mission Control System
MB	Megabyte
N/A	Not Applicable
NSP	National System Projection
PSLR	Peak Side Lobe Ratio
RAW	Raw Signal Data
RCONTROL	RADARSAT Control
RCS	Radar Cross Section
RSARP	RADARSAT SAR Processor
RSI	RADARSAT International
SAR	Synthetic Aperture Radar
SCN	ScanSAR Narrow
SCW	ScanSAR Wide
SGF	SAR Georeferenced Fine
SGX	SAR Extra-Fine Resolution
SLC	Single Look Complex
SPG	SAR Precision Geocoded
SSG	SAR Systematically Geocoded
TT&C	Telemetry, Tracking and Command
UTM	Universal Transverse Mercator

Purpose

The RADARSAT Data Product Specifications provides an overview of the endorsed products generated by the RADARSAT program. These products may be produced at the CDPF or at any of the RADARSAT Network Stations.

Scope of Document

This document outlines the suite of available RADARSAT products, the product delivery options, and product attributes such as image quality, resolution and size. The CEOS format for RADARSAT data is also defined for each record in structure and contents.

Intended Audience

The RADARSAT Data Product Specification is designed both to answer the questions of the novice user, and to inform the experienced user of key characteristics of RADARSAT products. It is intended for:

- system operators of RADARSAT Network Stations;
- users of RADARSAT data; and
- developers of RADARSAT related systems and software, including processors.

1. Structure of Document

The remaining sections in this RADARSAT Data Product Specification are summarized as follows.

Section 2: lists the applicable and reference documents

Section 3: gives an overview of RADARSAT products and describes how they are defined

Section 4: describes the data product structure

Section 5: describes extraction of calibrated radiometric data

Appendix A: provides detailed product descriptions and specifications

Appendix B: details the CEOS record structure and contents

Appendix C: describes map projection records

Appendix D: describes changes to Payload Parameter files that affect processing

2. Reference Documents

Reference documents are equal or lower-level documents provided for reference only. They do not take precedence over this document. The issue/revision numbers of these reference documents are provided for information only. Changes to the issue/revision numbers do not make this document out of date. For the most current versions and release dates of these documents please contact RSI.

D6 RADARSAT Spacecraft to Data Acquisition Network (X-Band) Interface Control Document, RSCSA-IC0009, Rev H (formerly Spar Doc 815650).

3. RADARSAT Product Overview

This section introduces the products produced within the RADARSAT program. It provides a high-level description of the products and describes the methods used to classify them.

3.1 RADARSAT Products

A RADARSAT product consists of a SAR image or signal data stored on magnetic, optical or electronic media. Products are characterized by the beam mode and position used by the satellite, and the level of processing that has been applied to the data. A summary of the various products generated is given in Table 1.

Table 1 - List of RADARSAT Products in Various Terminology

Processing Level	Product Type in RADARSAT Mnemonics	Product Type in RSI Terminology	Product Level in Network Station Certification
RAW (signal data)	RAW	RAW signal data	Level 0
Georeferenced data (Satellite path oriented)	SLC	Single Look Complex	Level 1
	SGF	Path Image	
	SGX	Path Image Plus	
	SCN	ScanSAR Narrow	
	SCW	ScanSAR Wide	
Geocoded data (Map oriented)	SSG	Map Image	Level 2
	SPG	Precision Map Image	

SAR processing facilities use the “RADARSAT Mnemonics” terms in the second column. The end user group uses the “RSI Terminology” names in the third column. All these names may be found in various RADARSAT documents.

Descriptions of the beam modes, processing levels and product definition terms are given in Sections 3.2, 3.3 and 3.4 respectively. Detailed descriptions of the individual products are found in Appendix A of this document.

SAR image data can be used to generate further RADARSAT products such as:

- film transparencies and photographic prints
- value-added products
- electronic data transmissions

3.1.1 Format

All RADARSAT products are produced in the CEOS format as described in Appendix A (product definitions) and Appendix B (CEOS content descriptions).

3.1.2 Output Media

Products can be output to 8mm data cartridge (normally Exabyte), CD-ROM or to electronic media. Products output to CD-ROM and Exabyte tapes are delivered to a general user. Products output to electronic media are delivered to a Product Server from which the product can be retrieved by a direct user.

3.2 Beam Modes

The RADARSAT SAR instrument consists of a radar transmitter, a radar receiver and a data downlink transmitter. The radar transmitter and receiver operate through an electrically steerable antenna that directs the transmitted energy in a narrow beam normal to the satellite track. The elevation angle and the elevation profile of the beam (beam positions) can be adjusted so that the beam intercepts the earth's surface over the desired range of incidence angles. The ability to choose the beam and position is important since image characteristics vary with the incidence angle associated with each beam. In addition, by varying the characteristics of the transmitted pulses and the receiver timing, different resolution and coverage can be achieved. The beam modes are each characterized by a specific beam elevation angle and profile, as shown in Figure 1.

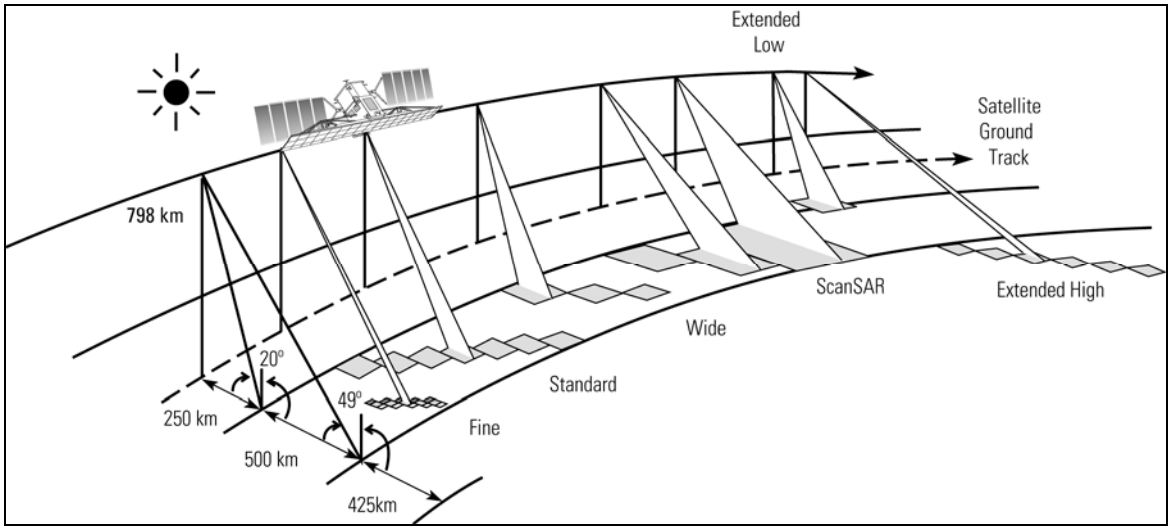

Figure 1 - RADARSAT SAR Beam Modes

For any given beam mode, the same beam angle and profile is used for both transmit and receive. The receiver detects the echo resulting from backscatter of the transmitted signal from the earth's surface. The detected signal is then digitized and encoded prior to transmission to

the on-ground data reception facility. Data transmission may occur in real time as the data is collected, or the data may be stored on the on-board tape recorders (OBR) for later transmission.

Subsequent processing of the signal allows the formation of high-resolution radar images of the earth's surface. Further processing of this data permits extraction of a variety of geophysical data.

The SAR instrument may be operated in one of two modes:

- Single Beam; and
- ScanSAR.

Figure 2 shows the relationships between the beam modes and the individual beams used within each mode. The nominal beam characteristics are listed in Table 2. The following sections describe the different beam modes.

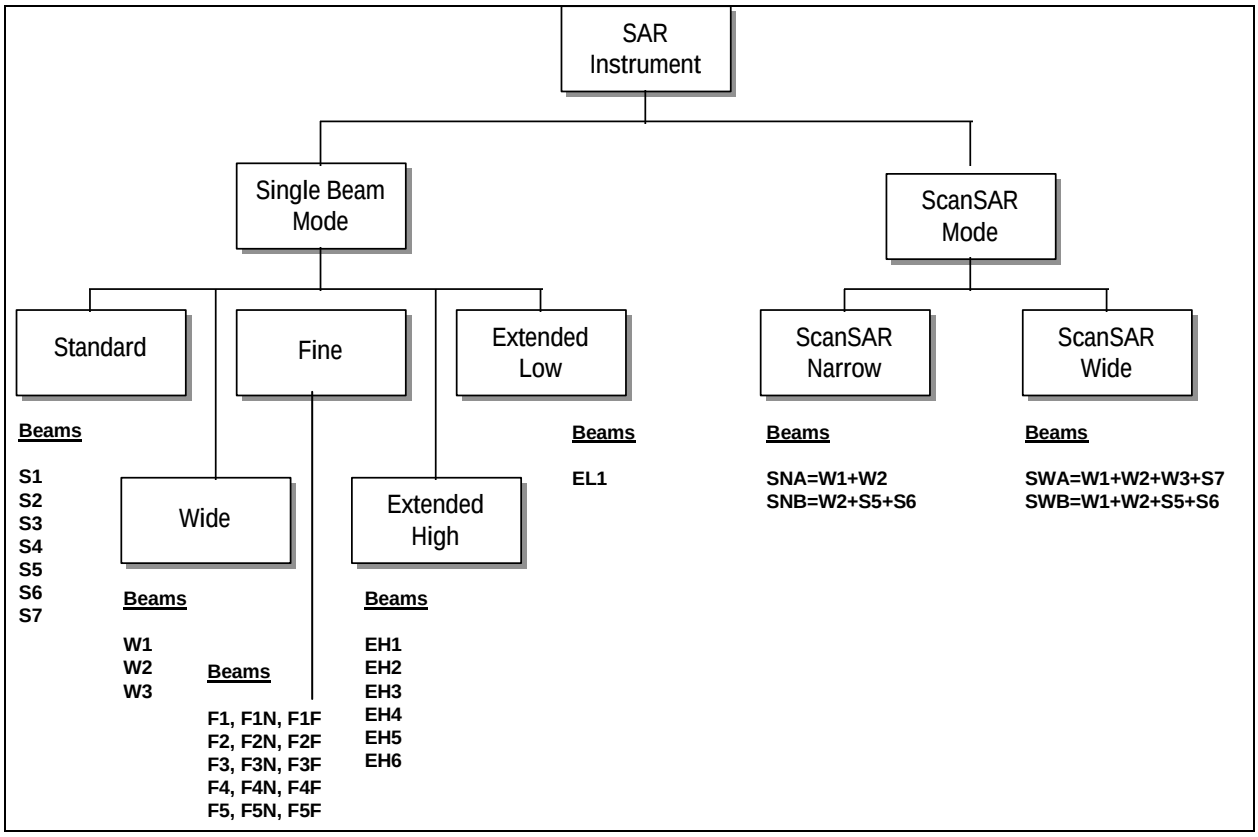

Figure 2 - RADARSAT SAR Instrument Modes

The nominal characteristics of all single beam and ScanSAR modes are outlined in Table 2.

Table 2 - Nominal Beam Characteristics

Beam Mode	Beam Position	Incidence Angle (degrees)	Resolution Range x Azimuth (m)	Real Time swath* (km)
Standard:	S1	24-31	24 x 27	100
	S2	30-37	20 x 27	
	S3	34-40	25 x 27	
	S4	36-42	23 x 27	
	S5	41-46	22 x 27	
	S6	45-49	20 x 27	
	S7	39-42	19 x 27	
Fine:	F1	37-41	8.3 x 8.4	50
	F2	39-42	7.9 x 8.4	
	F3	41-44	7.6 x 8.4	
	F4	43-46	7.3 x 8.4	
	F5	45-47	7.1 x 8.4	
Wide:	W1	20-31	33 x 27	150
	W2	31-39	25 x 27	
	W3	39-45	21 x 27	
Extended Low:	EL1	10-23	39 x 27	170
Extended High:	EH1	49-52	18-27	75
	EH2	50-53	18 x 27	
	EH3	52-55	17 x 27	
	EH4	54-57	17 x 27	
	EH5	56-58	16 x 27	
	EH6	57-60	16 x 27	
ScanSAR Narrow :	SNA	20-39	50 x 50	300
	SNB	31-46	50 x 50	
ScanSAR Wide:	SWA	20-49	100 x 100	500
	SWB	20-46	100 x 100	450

*** NOTE**: Exact swath varies with incidence angle and the latitude of the image footprint.

3.2.1 Single Beam Mode

In Single Beam Mode operation, the beam elevation and profile are maintained constant throughout the data collection period. A beam is characterized by its:

- nominal incidence angle;
- nominal swath width; and
- nominal spatial resolution.

The following Single Beam operational modes are available:

3.2.1.1 Standard Beam

Standard beam mode operates with any one of seven beam positions, referred to as S1 to S7. The nominal incidence angle range covered by the full set of Standard beams is from 20 degrees (at the inner edge of S1) to 49 degrees (at the outer edge of S7). The nominal spatial resolution is 27 metres in azimuth and 26m (near) to 20m (far) in range direction. Each individual beam covers a minimum ground swath of 100km within the total 500-km accessibility swath of the full set of Standard beams. The nominal spatial resolution in the range direction is 26m for S1 at near range to 20m for S7 at far range. The nominal azimuth resolution is the same, 27m, for all beam positions.

Standard beam modes allow imaging over a wide range of incidence angles with optimum system image quality.

3.2.1.2 Wide Beam

Wide beams are similar to the Standard beams except that the swath width achieved by this beam is 150km rather than 100km. As a result, only three Wide beams, W1, W2 and W3 are necessary to provide coverage of almost all of the 500-km swath range. They provide comparable resolution to the standard beam mode, though the increased ground swath coverage is obtained at the expense of a slight reduction in overall image quality. W1 and W2 are available for single beam products. W3 is used as one of the beams to form SWA products, but is not recommended for individual images as it contains a nadir ambiguity (narrow white vertical strip in the image).

3.2.1.3 Fine Beam

Fine beam mode is intended for applications that require the best spatial resolution available from the RADARSAT system. Nominal azimuth resolution is 8.4m, with range resolution 9.1m to 7.8m from F1 to F5. Since the radar operates with a higher sampling rate in this mode than in any of the other beam modes, the ground swath coverage has to be reduced to approximately 50km in order to keep the downlink signal within its allocated bandwidth. Originally, five Fine beam positions, F1 to F5, were available to cover the far range of the swath with an incidence angle range from 37 to 47 degrees. By modifying timing parameters, 10 new positions have been added with offset ground coverage. Each original Fine beam position can either be shifted closer to or further away from Nadir. The resulting positions are now denoted by either an N (Near) or F (Far). For example, F1 is complemented by F1N and F1F. The shift in any fine beam's coverage does not affect image quality.

3.2.1.4 Extended High Beam

Six Extended High beam positions, EH1 to EH6, are available for collection of data in the 49 to 60 degree incidence angle range. Since this beam mode operates outside the optimum scan angle range of the SAR antenna, some minor degradation of image quality can be expected when compared with the Standard beam mode. Swath widths are restricted to a nominal 80km for the inner three positions, and 70km for the outer three positions. The operational beam positions on satellite are EH1, EH3, EH4 and EH6, which can cover the complete Extended High beam swath.

3.2.1.5 Extended Low Beam

A single Extended Low beam position, EL1, is provided for imaging in the incidence angle range 10 to 23 degrees with nominal ground swath coverage of 170km. As with the Extended High beam mode, some minor degradation of image quality can be expected due to operation of the antenna beyond its optimum elevation angle range.

3.2.2 ScanSAR Mode

In ScanSAR operation, combinations of two, three or four single beams are used during data collection. Each beam is selected sequentially so that data is collected from a wider swath than possible with a single beam. The beam switching rates are chosen to ensure at least one "look" at the earth's surface for each beam within the along track illumination time or dwell time of the antenna beam. In practice, the radar beam switching is adjusted to provide two looks per beam. The beam multiplexing inherent in ScanSAR operation reduces the effective sampling rate within each of the component beams; hence the increased swath coverage is obtained at the expense of spatial resolution. The following ScanSAR operational modes are available.

3.2.2.1 ScanSAR Narrow

The ScanSAR Narrow mode (SCN) provides coverage of a nominal 300-km ground swath, with spatial resolution of 50m in general. Two combinations of single beams (SNA and SNB) can be used:

- SNA: W1 + W2
- SNB: W2 + S5 + S6

The first combination SNA provides coverage over the incidence angle range of 20 to 39 degrees. The second combination SNB provides coverage over the incidence angle range 31 to 46 degrees.

3.2.2.2 ScanSAR Wide

The ScanSAR Wide mode (SCW) provides coverage of either 500-km (for SWA) or 450-km (for SWB) nominal ground swaths, with spatial resolution 100m in general. Two combinations of single beams can be used:

- SWA: W1 + W2 + W3 + S7
- SWB: W1 + W2 + S5 + S6

The first combination SWA covers the full 500-km swath incidence angle range of 20 to 49 degrees. The second combination SWB provides 450km of coverage over the incidence angle range 20 to 46 degrees.

3.2.3 Notes about On-board Recorded Data

Use of the On-Board Recorder (OBR) imposes some limitations on the use of some beam modes. ScanSAR Wide A (SWA) is restricted to direct data downlink operation and only SWB is available for recording. Also, swath coverage is reduced for fine beams when the OBR is used.

3.3 Processing Levels

RADARSAT products are available at three processing levels:

I. RAW Signal Data (Level 0)

- RAW- RAW Signal Data product in CEOS format

II. Georeferenced Data (Level 1)

- SLC - Single Look Complex product;
- SGF - SAR Georeferenced Fine Resolution product (Path Image);
- SGX - SAR Georeferenced Extra Fine Resolution product (Path Image Plus);
- SCN - ScanSAR Narrow beam product;
- SCW- ScanSAR Wide beam product

III. Geocoded Data (Level 2)

- SSG - SAR Systematically Geocoded product (Map Image);
- SPG - SAR Precision Geocoded product (Precision Map Image).

The main characteristics of the products are given in Table 3, and details in Appendix A.

Table 3 - Product Characteristics

	S1-S7	F1N-F5F	W1-W3	EH1-EH6	EL1
RAW (CEOS formatted RAW signal data) All single beams and ScanSAR combinations					
Pixel Size (m)	Not applicable				
Number of samples	~9500 samples per record x length of swath				
Volume (16-bit) MB	~200 MB per 100 km in azimuth direction				
SLC (Single Look Complex)					
N-Looks	1 x 1	1 x 1	1 x 1	1 x 1	1 x 1
Pixel Size (m)	11.6 x 5.1	4.6 x 5.1	11.6 x 5.1	11.6 x 5.1	8.1 x 5.1
Number of pixels/lines	8620 x 19610	10870 x 9805	12930 x 29410	6465 x 14705	20990 x 33330
Volume (16-bit) MB	676	426	1521	380	2800
SGF (Path Image)					
N-Looks	1 x 4	1 x 1	1 x 4	1 x 4	1 x 4
Pixel Size (m)	12.5 x 12.5	6.25 x 6.25	12.5 x 12.5	12.5 x 12.5	12.5 x 12.5
Number of pixels/lines	8000 x 8000	8000 x 8000	12000 x 12000	6000 x 6000	13600 x 13600
Volume (16-bit) MB	128	128	288	72	370
SGX (Path Image Plus)					
N-Looks	1 x 4	1 x 1	1 x 4	1 x 4	1 x 4
Pixel Size (m)	8 x 8	3.125 x 3.125	10 x 10	8 x 8	10 x 10
Number of pixels/lines	12500 x 12500	16000 x 16000	14400 x 14400	9375 x 9375	17000 x 17000
Volume (16-bit) MB	312.5	512	415	176	578
SSG / SPG (Map Image and Precision Map Image)					
N-Looks	1 x 4	1 x 1	1 x 4	1 x 4	1 x 4
Pixel Size (m)	12.5 x 12.5	6.25 x 6.25	12.5 x 12.5	12.5 x 12.5	12.5 x 12.5
Number of pixels/lines	10400 x 10400	10400 x 10400	16000 x 16000	8000 x 8000	17600 x 17600
Volume (8-bit) MB	102	102	256	64	310
SCN (ScanSAR Narrow) (SNA=W1+W2; SNB=W2+S5+S6)					
N-Looks	2 x 2				
Pixel Size (m)	25 x 25				
Number of pixels/lines	12000 x (4000 lines per 100 km in azimuth)				
Volume (8-bit) MB	48 MB per 100 km in azimuth direction				
SCW (ScanSAR Wide) (SWA=W1+W2+W3+S7; SWB=W1+W2+S5+S6)					
N-Looks	4 x 2				
Pixel Size (m)	50 x 50				
Number of pixels/lines	10000 x (2000 lines per 100 km of azimuth)				
Volume (8-bit) MB	20 MB per 100 km in azimuth direction				

Notes:
1. *Number* x *Number* represents numbers in Range x Azimuth.
2. Image volume depends on the actual image size (pixels x lines) and the pixel representation either in 8-bit or 16-bit for ScanSAR and SSG/SPG.
3. SSG and SPG covers the same data as for the SGF product, but the image size is larger due to re-orientation of the image when registering to a map projection. The no-data areas are filled with zero.

The principal features of the different processing levels are outlined below.

3.3.1 RAW Signal Data (RAW)

A RAW Signal Data product contains raw or unprocessed radar video baseband data in complex in-phase and quadrature signal (I and Q) format as they are recorded by the spacecraft. The only processing performed to the downlink X-band raw signal data is the frame synchronization, meaning re-assembly of the data into contiguous radar range lines in matrix form, and the CEOS formatting. Each range line of data is represented by one Signal Data Record in the RAW CEOS product.

As described in Appendix A, the RAW product can contain any single beam mode, or for ScanSAR any combination of different beam modes, depending on the operation of the SAR instrument during the data reception or recording period. A RAW product cannot, however, combine data from more than one beam mode, i.e. data from two different beam modes are always packaged as two separate products. A RAW product must be SAR processed before it can be displayed as imagery. RAW products are typically produced on 8mm (Exabyte) tapes. This is the standard medium for exchanging data between Network Stations.

3.3.2 Georeferenced Data (SLC, SGF, SGX, SCN, SCW)

The processed image is georeferenced using orbit and attitude data from the satellite. This allows latitude and longitude information to be calculated for each pixel in the image. The earth geometry is assumed to be a standard ellipsoid. Each output image line contains auxiliary information that includes the latitude and longitude of the first, middle and last pixels of the line. It may also be referred to as "Path Image" due to the orientation of the image in the satellite path direction.

The raw radar signal data is processed to provide SAR image data pixels. The image pixel data is represented by a series of CEOS processed data records, each record containing one complete line of pixels lying in the range dimension of the image. All georeferenced products except SLC have range lines produced in "Zero Doppler Coordinates."

Processing data acquired in Single Beam Mode (SLC, SGF, SGX)

The single beams (Standard, Fine, Wide, Extended Low and Extended High) can be georeferenced into products SLC, SGF and SGX. Signal data for the region of interest is transferred to the processor. If any range lines are missing or invalid, and the number of contiguous missing lines is less than 100, the missing range lines are filled in by replicating the data from the last good range line. If the number of contiguous missing lines exceeds 100, but is less than 200, then the missing lines are zero filled. If the number of contiguous missing lines exceeds 200, processing is terminated and no product is generated.

Replicated range lines in Single Beam Mode will cause blurring in the output imagery. Zero filled lines will cause the radiometry of the image to be reduced in the affected region. Since the

beam width is approximately one half of a second (or 660 range lines) this will not be very noticeable.

Processing Data acquired in ScanSAR Mode (SCN, SCW)

For ScanSAR processing, signal data for the region of interest is transferred to the processor. If any range lines are missing or invalid in a ScanSAR burst (a group of transmitted pulses), and there is at least one good range line in the burst, then the data in the range line is replicated to fill the burst. If there are no valid range lines in the burst, then the burst is zero filled. If the number of contiguous missing lines exceeds 2 seconds (approximately 2600 lines) then processing is terminated. If there is sufficient data at this point to form an image, typically about 23 seconds of input data is required), then the image data is delivered. If there is less data than this, product generation may fail.

Replicated lines in ScanSAR Mode will cause some slight blurring in the image.
If one burst is zero filled, the area of the product associated with this burst will have half the radiometry compared to adjacent pixels. If two or more contiguous bursts are missing, the output product will be black in this region. This will appear in the image as a zero radiometry band extending across the range dimension. The azimuth extent will be governed by the number of contiguous missing bursts.

Each product is further described below:

3.3.2.1 SLC Product (Single Look Complex)

The Single Look Complex (SLC) product differs from the SGF and SGX products in that interpolation of the slant range coordinates is not performed into ground range coordinates, and each image pixel is represented by complex I and Q numbers to preserve the magnitude and phase information. SLC images can be generated from any single beam mode. SLC image data is georeferenced as for SGF or SGX data, but the range coordinate is in radar slant range rather than ground range. Pixel sizes are variable and governed by the radar range and azimuth sampling rates. All processing is single look; hence SLC products always provide imagery which utilises the full available radar resolution, regardless of beam mode.
Since SLC products retain the phase information in the image data, they are useful in applications such as pass-to-pass SAR interferometry.

3.3.2.2 SGF Product (Path Image)

The SAR Georeferenced Fine Resolution (SGF) product is generated with standard ground coordinate pixel dimensions of either 12.5m (for beams of Standard, Wide, Extended Low and Extended High) or 6.25m (for Fine beam).

With pixel size 12.5m, Standard beams cover a nominal image dimension 100km square, and Wide beams cover 150km. For Extended Low product, image dimensions are nominally 170km cross track by 100 to 170km along track. For Extended High the image dimension is 75km square. All 12.5m pixel products are the result of processing four independent azimuth samples, or four looks, in the along track antenna beam dwell time, and then non-coherently summing the four looks prior to forming the final image. This process results in smoothing of the coherent speckle noise in the image to provide improved radiometric resolution for distributed or homogeneous target areas. Typical spatial resolutions of these beams are in the order of 25m, i.e. twice the pixel size.

For Fine beam mode, the SGF pixel size is 6.25m and the nominal image dimension is 50km square. The 6.25m pixel products are generated using the full available radar resolution, or one look, in the along track antenna beam dwell time, to give spatial resolution of the order of 8m. These products provide increased discrimination for discrete or point targets at the expense of increased background speckle noise.

3.3.2.3 SGX Product (Path Image Plus)

The SAR Georeferenced Extra-Fine Resolution (SGX) products are generated by denser sampling than the SGF products, in order to more fully utilize the resolution capabilities of the SAR instrument.

The pixel sizes differ according to the beam mode:

- 8m pixel size for Standard and Extended High beam mode (4 looks);
- 10m pixel size for Wide and Extended Low beam mode (4 looks) and
- 3.125m pixel size for Fine beam mode (1 look).

The use of the smaller pixel dimensions compared with the SGF products ensures that the image pixel dimensions do not exceed one half of the radar resolution for all regions of the image. This is of significance in some applications where the best possible image resolution is required, and where processing speed and volume of data product are secondary considerations. Overall image scene dimensions for SGX products are the same as for the corresponding SGF products.

As an example, the basic radar ground range resolution for Fine beam mode is of the order of 8m in both range and azimuth. In generating the 6.25m SGF product, the data is undersampled relative to the usual Nyquist sampling criteria, leading to a potential loss of information. The equivalent SGX product, with 3.125m sampling, retains all of the input image information at the expense of a quadrupling of the volume of data.

3.3.2.4 SCN Product (Path Image)

The ScanSAR Narrow (SCN) product is a georeferenced ground coordinate multi-look image produced by multiplexing either two (SNA) or three (SNB) single beams. Image pixels are 25m square and scenes are nominally 300km in the cross track (range) dimension. The along track (azimuth) scene dimension is user selectable.

SCN products are generated using two looks in range and two looks in azimuth for a nominal total of four looks.

3.3.2.5 SCW Product (Path Image)

The ScanSAR Wide (SCW) product is a georeferenced ground coordinate multi-look image produced by multiplexing four single beams for both SWA and SWB. Image pixels are 50m square and scenes are nominally 450 km for SWB and 500 km for SWA in the cross track (range) dimension. The along track (azimuth) scene dimension is user selectable.

SCW products are generated using four looks in range and two looks in azimuth for a nominal total of eight looks.

3.3.3 Geocoded Data (SSG, SPG)

The geocoded products are from the highest processing level. Using different geocoding methods, the products can be systematically geocoded (SSG) or geocoded with the precise ground control points (SPG).

3.3.3.1 SSG Product (Map Image)

A Systematically Geocoded image is also known as “Map Image.” Systematically Geocoded data product is further processed from SGF products. The image coordinates are converted to a map projection using the orbital information of the spacecraft. Any recognized map projection can be created, depending on the capability of the particular processing station.

For Universal Transverse Mercator (UTM) projection products, the Processed Data Record now includes the Northings and Eastings of the first and last pixel in each line. A CEOS Map Projection Data Record included with the product provides Northings and Eastings as well as latitude and longitude for the top left and bottom right corners of the complete image. Map origin Northings and Eastings are also provided. For projections other than UTM the projection centre latitude and longitude and National Systems Projection (NSP) standard parallels are also included in the Map Projection Data Record.

The SAR Systematically Geocoded (SSG) Product can be generated from any Single beam SGF product. Geocoding of four look SGF data from Standard, Wide, Extended High or Extended Low beam modes generates a normal SSG product. Geocoding of SGF Fine beam mode data generates a Fine SSG product. Pixel spacing remains as for the original data so that normal SSG products have 12.5m pixel size and Fine SSG products have 6.25m pixel size. SSG product coverage depends on the SGF input data. The SSG product has a wider dimension and the larger volume than the input SGF data, due to the rotated orientation with respect to the map projection. The blank corners of the SSG products are filled with zero.

3.3.3.2 SPG Product (Precision Map Image)

A Precision Geocoded image is also known as "Precision Map Image." The geographic positional corrections for SPG products are performed with operator assistance using either a number of precisely surveyed ground control points within the imaged area, or with the assistance of an accurate topographic map. The SAR Precision Geocoded (SPG) product bears the same relationship to the input SGF data as the SSG product described above. Data format and available map projections are the same as for SSG products. Standard SPG products with 12.5m pixels, and Fine SPG products with 6.25m pixels are available.

Geographic positioning of the data may be further refined as Orthorectified Images (ORI) by using a digital elevation model (DEM). Such services are available at RSI.

3.4 Product Definition Terms

This section explains the terms used in Appendix A "Detailed Product Descriptions."

3.4.1 Product Terms

Coordinate System

Georeferenced products can be in one of two coordinate systems: slant range or ground range. Slant range coordinates maintain the natural pixel spacing of the signal data; this spacing is not uniform across the image. In other words, the pixels representing the side of the image closest to the satellite cover a larger ground area than those representing the far side of the image. The pixel spacing for an image in ground range coordinates is normalized to a uniform pixel size. Geocoded products can be represented by any one of the 23 types of map projections shown in Appendix C. Additional map projections can be supported as required.

Nominal Image Coverage

The image coverage is the ground area within that image. It is nominal in that the width is chosen such that all range data is processed and included in the image. The exact width will therefore vary from image to image. For products generated in single beam mode, the length of the image is defined so that it approximates the width, although the two will not likely be exactly equal. For products generated in ScanSAR mode, the length is variable and may be specified by the user.

Pixel Spacing

Pixel spacing is the distance between adjacent pixels and is measured in metres. This is the same as the pixel size. The pixel spacing may be different for range and azimuth.

Pixel Data Representation

A pixel can be represented by either a complex number or an unsigned integer. If represented by a complex number, each pixel is represented by two integers (one each for the real I and imaginary Q parts) that are either 8 or 16 bits each (depending on product type).

A pixel can also be represented by a single integer (8 or 16 bits) using the magnitude of the complex number:

$$Magnitude = \sqrt{I^2 + Q^2}$$

Nominal Image Size

The nominal image size is the number of pixels per line multiplied by the number of lines, where the number of pixels per line can be calculated using:

$$PixelsPerLine = \frac{ImageRange}{RangePixelSpacing}$$

Similarly the number of lines in an image is given by:

$$Lines = \frac{ImageAzimuth}{AzimuthPixelSpacing}$$

Nominal Product Volume

The nominal product volume is calculated as follows:

$$Volume = PixelsPerLine * Lines * BytesPerPixel$$

3.4.2 Image Quality Terms

Nominal Incidence Angle

Nominal incidence angles are incidence angles specified at the near and far edge of each beam, using an elliptical model for the Earth's surface. The incidence angle at any point on the Earth's surface is the angle between a vector directed toward the satellite position from the point, and the normal vector away from the Earth's surface at that point.

Nominal Range Resolution

For ground range products, the nominal range resolution is specified at the near and far edge of each beam. The nominal range resolution is specified in terms of the 3dB Impulse Response Width in the range direction where:

Impulse Response Function is the two-dimensional signal appearing in a processed image as a result of the compression of returned energy from a point target.

Impulse Response Width is defined as the width of the impulse response function at a power level 3 dB below the peak of the function.

Nominal Azimuth Resolution

Nominal azimuth resolution is specified in terms of the 3 dB Impulse Response Width in the azimuth direction. The nominal azimuth resolution is constant within each beam.

Peak Side Lobe Ratio (PSLR)

A side lobe of the impulse response function is any local maximum other than those within the contour around the peak, which passes through points 3 dB below the main lobe peak. Side

lobes are measured relative to the main lobe peak. The peak side lobe ratio (PSLR) is defined to be the ratio of the maximum side lobe level and the main lobe level.

Integrated Side Lobe Ratio (ISLR)

The integrated side lobe ratio (ISLR) is defined to be the ratio of the integrated energy in the side lobe region of the two dimensional (range and azimuth) impulse response function relative to the integrated energy in the main lobe region. For purposes of ISLR definition only, the region of the main lobe is considered to extend +/- 1.5 impulse response widths in the range and azimuth directions, forming a parallelogram centred on the impulse response peak.

Radiometric Error

Radiometric error is the measured difference in mean energy between any two areas in an image, when imaging a scene of uniformly distributed scatterers.

Radiometric Linearity

The radiometric linearity is expressed as a minimum permitted coefficient of correlation of the linear regression of imaged signal power on input power for point targets covering the dynamic range of the processor.

Absolute Location Error

The absolute location error is specified as the distance along the ground between the measured and known position of point targets within a processed image.

Geometric Distortion

The geometric distortion is specified as a maximum error in relative distance between points within a square image, when comparing pairs of points with known locations.

Relative Phase Error

The relative phase error is only applicable to the SLC product because it is the only processed product for which the data is left in complex (I and Q) form.
The phase error is the deviation between the measured and predicted phase difference of two point targets within a complex image. The point targets chosen for the measurement must be within a 100km by 100km region of the processed image.

3.4.3 Processing Terms

Number of Azimuth Looks

The number of azimuth looks is the number of overlapping processed looks in the azimuth direction.

Number of Range Looks (for SCN and SCW)

The number of range looks is the number of overlapping processed looks in the range direction. All single beam mode products have one range look.

Azimuth Look Bandwidth

The azimuth look bandwidth is the processed Doppler bandwidth for each individual azimuth look.

Effective Number of Looks

The effective number of looks represents the number of statistically independent looks in the product. The effective number of looks is less than the total number of looks because of the partial overlapping of the looks.

Range and Azimuth Spectral Weighting

The Kaiser weighting function is used for both range and azimuth spectral weighting. The Kaiser weighting coefficients are specified in the Detailed Product Descriptions sheets in Appendix A.

Number of Samples in Matched Filter (for SCN and SCW)

The number of samples in the matched filter is the number of azimuth samples processed in each ScanSAR burst.

Azimuth FM Rate (for SCN and SCW)

The azimuth FM rate is the nominal rate of change of the azimuth phase history in each ScanSAR mode and position.

Multilook Processing

Multilook processing refers to the process of partitioning the available range and/or azimuth signal spectra into smaller portions, and the subsequent formation of “smoothed” lower resolution imagery with less radiometric variability or “speckle noise” than would otherwise have been possible at full resolution. The number of looks is the number of spectral partitions used. Processed data from each partition are non-coherently summed to smooth the final image. The partitioned spectra partially overlap, reducing the independence of each look.

4. CEOS DATA PRODUCT STRUCTURE

This section details the content and structure of RADARSAT CEOS products. General users may receive their products on Exabyte or CD-ROM, or by electronic delivery.

4.1 CEOS Contents

A CEOS product consists of five files containing various descriptive records. The files are as follows:

- Volume Directory file;
- SAR Leader file;
- SAR Data file;
- SAR Trailer file;
- Null Volume Directory file.

Table 4 shows the general organization of the various CEOS files for RADARSAT products. Note that Data Set Summary, Data Quality Summary, Signal Data Histogram, Processed Data Histogram, Processing Parameters, Attitude Data, Radiometric Data, and Radiometric Compensation Data records may be placed in the SAR Trailer file for ScanSAR products (SCN and SCW).

Detailed information about the RADARSAT scene and the processing parameters used to create that scene is contained in the various records of the CEOS files. Detailed information about the contents and structure of those records is provided in Appendix B; a guide to this appendix is given in Table 5.

Table 4 - RADARSAT CEOS Products and CEOS Format

CEOS FORMAT FILES / RECORDS	RADARSAT CEOS PRODUCTS							
	RAW	SCN	SCW	SGF	SGX	SLC	SPG	SSG
VOLUME DIRECTORY FILE								
• VOLUME DESCRIPTOR	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
• FILE POINTER RECORD	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
• TEXT RECORD	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
SAR LEADER FILE								
• DESCRIPTOR RECORD	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
• DATA SET SUMMARY	🗐	*	*	🗐	🗐	🗐		
• DATA QUALITY SUMMARY		*	*	🗐	🗐	🗐		
• SIGNAL DATA HISTOGRAM		*	*	🗐	🗐	🗐		
• PROCESSED DATA (16-bit) HISTOGRAM		*	*	🗐	🗐	🗐		
• PROCESSING PARAMETERS		*	*	🗐	🗐	🗐		
• MAP PROJECTION DATA							🗐	🗐
• PLATFORM POSITION DATA	🗐	🗐	🗐	🗐	🗐	🗐		
• ATTITUDE DATA		*	*	🗐	🗐	🗐		
• RADIOMETRIC DATA		*	*	🗐	🗐	🗐	🗐	🗐
• RADIOMETRIC COMPENSATION DATA		*	*	🗐	🗐	🗐	🗐	🗐
SAR DATA FILE								
• DESCRIPTOR RECORD	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
• SIGNAL DATA	🗐							
• PROCESSED DATA		🗐	🗐	🗐	🗐	🗐	🗐	🗐
SAR TRAILER FILE								
• DESCRIPTOR RECORD	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐
• DATA SET SUMMARY		*	*				🗐	🗐
• DATA QUALITY SUMMARY		*	*				🗐	🗐
• SIGNAL DATA HISTOGRAM		*	*				🗐	🗐
• PROCESSED DATA (8-bit) HISTOGRAM		*	*				🗐	🗐
• PROCESSING PARAMETERS		*	*					
• ATTITUDE DATA		*	*					
• RADIOMETRIC DATA		*	*					
• RADIOMETRIC COMPENSATION DATA		*	*					
NULL VOLUME DIRECTORY FILE								
• NULL VOLUME DESCRIPTOR	🗐	🗐	🗐	🗐	🗐	🗐	🗐	🗐

NOTES: 🗐 - Record used in this product.
* - These records may appear in either the Leader file or the Trailer file. Regardless of which file location is chosen, all records indicated with an asterisk (*) must appear there.

Table 5 - Guide for RADARSAT CEOS products format

File Name	Record Name	Mnemonic	Appendix Index	On page
Volume Directory File	**Volume descriptor record** **File pointer records** **Text record**	**vol_desc_rec** **file_pntr_rec** **text_rec**	**Appendix B-1** **Appendix B-2/-3/-4** **Appendix B-5**	**78** **79/80/81** **82**
SAR Leader File	**SAR leader file descriptor record** **Data set summary record** **Data quality summary record** **Signal data histogram record** **Processed data 16-bit histogram record** **Processing parameters record** **Map projection data record** **Platform position data record** **Attitude data record** **Radiometric data record** **Radiometric compensation data record**	**sar_desc_rec** **dataset_sum_rec** **qual_sum_rec** **sdr_hist_rec** **pdr16_hist_rec** **proc_parm_rec** **map_proj_rec** **pos_data_rec** **att_data_rec** **radi_data_rec** **radi_comp_rec**	**Appendix B-6** **Appendix B-7** **Appendix B-8** **Appendix B-9** **Appendix B-10** **Appendix B-11** **Appendix B-12** **Appendix B-13** **Appendix B-14** **Appendix B-15** **Appendix B-16**	**83** **85** **88** **90** **91** **93** **96** **98** **99** **100** **101**
SAR Data File	**Image options file descriptor record** **Signal data records** **Processed data records**	**imop_desc_rec** **sdr_data_rec** **pdr_data_rec**	**Appendix B-17** **Appendix B-18** **Appendix B-19**	**102** **104** **106**
SAR Trailer File	**SAR trailer file descriptor record** **Data set summary record** **Data quality summary record** **Signal data histograms record** **Processed data (8-bit) histogram record** **Processing parameters record** **Attitude data record** **Radiometric data record** **Radiometric compensation data record**	**sar_desc_rec** **dataset_sum_rec** **qual_sum_rec** **sdr_hist_rec** **pdr8_hist_rec** **proc_parm_rec** **att_data_rec** **radi_data_rec** **radi_comp_rec**	**Appendix B-20** **Appendix B-7** **Appendix B-8** **Appendix B-9** **Appendix B-21** **Appendix B-11** **Appendix B-14** **Appendix B-15** **Appendix B-16**	**108** **85** **88** **90** **110** **93** **99** **100** **101**
Null Volume Directory File	**Null volume descriptor record**	**null_vol_rec**	**Appendix B-22**	**111**

NOTE: Some records are optional for some products. See Table 4 for details.

4.2 RAW Data Structure

4.2.1 CDPF Signal Data Record Size

4.2.1.1 Introduction

Appendix B-18 indicates that the Signal Data Record has a variable length depending on the size of the SAR Signal Data field, *sdr_data*. The first 50 fields of each Signal Data Record (SDR) are fixed, and occupy 192 bytes. These are the CEOS header (preamble), which contains various information about the raw product, including the overall length of the Signal Data Record - "*length*" - in field 6, and the number of complex echo data samples (i.e. 2 bytes each) - "*n_data_pixel*" - in field 10. A complex echo sample is two bytes, consisting of an I and a Q sample of 1 byte each.

SAR Signal Data - "*sdr_data*" - is contained in field 51, and contains a variable number of samples depending on the number of samples digitized, on the presence or absence of a pulse replica, and on the amount of zero fill included.

The following section provides expressions for the length of Signal Data Record, and to determine the number of zero fill bytes included, if any.

4.2.1.2 Ingested Raw Data Range Line Frames

Reference Document D6, the RADARSAT X-Band ICD [RSCSA-IC0009], describes the frame structure for raw data ingested by the processor, forming the basis for the Signal Data Record. While many of the radar parameters that are transcribed to the CEOS Level 0 product, are described in D6, it does not describe the CEOS Level 0 range line structure.

The ingested frame length is a constant 323 bytes (2584 bits), of which 12 bytes are housekeeping data and 311 are application data. Level 0 product range lines are constructed from multiple frames. The first frame in a range line contains 50 bytes of Auxiliary data, and either pulse replica data or received echo data, depending on the presence or absence of the pulse replica in any particular line. All subsequent application data fields contain either echo data, or replica and echo data, or echo and zero fill data.

The CDPF transcribes complete application data fields to the SAR Signal Data Field of the SDR, including any zero fill that may be present. In performing this transcription, all signal data components - replica, echo and fill - are augmented from 4 bits to 8 bits by prepending a zero to each 4 bit sample. The Auxiliary data component of the application data field is unmodified.

4.2.1.3 SDR Length – General

The length of the CDPF raw product Signal Data Record is:

$$length = 142 + 622*Nf \quad \text{bytes} \qquad (1)$$

where *Nf* is the number of frames spanning all of the auxiliary, replica, and echo data in each range line. The basis for this formula is the conversion that framed application data undertakes in being written to the SDR. The first 50 bytes, the AUX data *(Naux)*, are transcribed directly. The remaining 311 – 50 = 261 bytes of the first frame and all subsequent frames in each range line contain signal data of one form or another, and are expanded by two from 4 to 8 bits. Since each application data segment in a frame is 311 bytes, and complete frames are transformed, the *sdr_data* field then occupies:

50+2((311-50)+(Nf-1)*311) bytes*

Adding 192 bytes for the CEOS header to the transcribed application data results in formula (1).

4.2.1.4 Determination of Number of Frames Used

The number of frames *(Nf)* comprising a range line can be determined from the receive window duration (*Trx)*, the ADC sample interval *(SI)*, and the replica length (*Rep)*. These can be obtained from nominal published values, or with more precision can be obtained directly from the AUX data segment in each range line and by calculation from the formulas given in the X-Band ICD (reference document D6). The method for determination of these values is outlined briefly in Section 4.2.1.5.

With either method,

$$length = Nheader + Naux + Nrep + Necho + Nzero \quad (2)$$

where:

$$Nheader = 192 \quad (3)$$
$$Naux = 50 \quad (4)$$
$$Necho = 2*fix(Trx/Si) \quad (5)$$
$$Nrep = 0 \text{ or } Rep \quad (6)$$

Here *Necho* is the length in bytes of the digitized complex signal samples in the receive window, and *Nrep* is the replica length in bytes. Each complex sample occupies 2 bytes. The *fix( )* function in equation 5 rounds its argument to the nearest lower integer.

Then the number of range line samples, *LenX*, excluding any zero filling and header, in bytes is:

$$LenX = Naux + Nrep + Necho \quad (7)$$

The number of frames, *Nf* , used is then the integer part of *LenX* divided by the application data field length in each frame. The *ceil( )* function indicates a rounding operation of its argument to the next higher integer.

$$Nf = ceil(LenX/622) \quad (8)$$

Since each last frame in a range line is padded with zeros to completely fill it, then the expected number of zeros is:

$$Nzero = length-LenX - Nheader \quad (9)$$

Finally, the number of valid signal samples per line, including radar echo, replica samples and zero fill is:

$$Nsig = Necho + Nrep + Nzero \quad (10a)$$
$$= length - Naux - Nheader \quad (10b)$$

4.2.1.5 Determination of Receive Window Duration from AUX Data

For simplicity, some key relations from Reference Document D6 are extracted in the following. These relations are believed stable, but in principle are subject to change in future revisions of D6, and should be confirmed, if possible, from the latest released document. The *Int( )* function rounds down its argument to the nearest lower integer. It is equivalent to the *fix( )* function, and is retained here for compatibility with D6.

The receive window (opening) duration is:

$$Trx = 8*Int\ [\ ((Rx\_Dur\_Code+1)\ *6 - 2)\ /\ 8]\ *\ TimeUnit\ /\ 6\ \ sec$$

where:

ADC_Code	TimeUnit (nsec)	SI (nsec)	Replica Length (bytes)	Beams
00	185.66	30.94	2880	F1-F5
01	324.91	54.15	1644	S1,S2, EL1
10	464.15	77.36	1152	S3-S7, W1-W3, EH1-EH6, all ScanSAR

The *Rx_Dur_Code* and *ADC_Code* are contained in the 400 bit (50 byte) AUX at bit numbers 232-244 and at bit numbers 179-180 respectively. A simpler approach for the *TimeUnit* is to select it from the above table based on beam used. The Sample Interval *(SI)* and *Replica Length* are similarly obtained.

The accuracy of the above numbers is sufficient to determine the Receive Window Duration *(Trx)* to typically within a few echo samples. Using the detailed values calculated through use of additional formulas in Reference Document D6 provides added precision.

4.2.1.6 Examples

Raw products for a number of scenes have been examined to verify the above formulas. Results are summarized in the following table. The first part of the table, "*Data from the SDR*," are actual numbers from CDPF CEOS products. These are followed by numbers calculated using Equations 1-10.

Beams	W1	S1	S1	S2	EH1
Data from the SDR					

length	15070	15070	13204	16936	14448
n_data_pixel	7414	7414	6481	8347	7103
Replica present	No	Yes	No	Yes	No
ADC_Code	10	01	01	01	10
Rx_Dur_Code	1208	1058	1058	1215	1178
Calculated from Equations 1-10					
length	15070	15070	13204	16936	14448
Necho	14496	12704	12704	14576	14144
Nsig	14828	14828	12962	16694	14206
Nrep	0	1644	0	1644	0
Nzero	332	480	258	474	62
Nf	24	24	21	27	23

NOTES:

1. Accuracy improves slightly when computing *Necho* and *Nzero* if the *RxDuration* formula given in the current version of Reference Document D6 is used.

2. Compatibility with CDPF requirements means that SDR record lengths must correspond to Equation 1. This means that range line lengths will vary in each product due to the fact that every eighth line contains a pulse replica, while others do not.

3. Equation 1 can be used to generate a table of legitimate SDR record lengths versus number of frames ingested. This could be used in raw product validation.

4.3 Product Processing Reports

A processing report of the product accompanying the data product is delivered to the user giving the summary of the processing parameters. Table 6 and Table 7 are examples of the printed processing reports by the CDPF at RSI.

Table 6 - Contents of Processing Report for RADARSAT CEOS Products by CDPF (For RAW, SGF, SGX, SLC, SCN and SCW products)

Terms	Contents
Satellite	RADARSAT-1
orbit number	Absolute orbit number
product identifier	Reference to work order or product order
product type	RAW, SCN, SCW, SGF, SGX or SLC
processing start date/time	Spacecraft time
processing end date/time	Spacecraft time
Product Specification:	
product generation date/time	Current time
output media type	Exabyte, CD, electronic delivery
destination pathname	for electronic delivery products
representative latitude/longitude (not for RAW)	
scene centre latitude	From CEOS
scene centre longitude	From CEOS
Data source specification:	
Sensor orientation	Normal (right-looking) or left-looking
Sensor configuration	Ascending/Descending
Beam(s)	Single or multiple for ScanSAR
Ingest start time	Spacecraft time
Ingest stop time	Spacecraft time
Processing specification (not for RAW):	
Pixel data type	8 bit, 16 bit, 16 bit complex
Coordinate system	Slant or ground range
Number of image lines	From CEOS
number of pixels per line	From CEOS
nominal scene dimensions	
range (km)	Sensor specification
azimuth (km)	Sensor specification
nominal pixel dimensions	
range (m)	Data product specification
pixel (m)	Data product specification
orbit data source	Orbit data or Ephemeris
number of azimuth looks	Data product specification
number of range looks	Data product specification

Table 7 - Additional Information Report for Geocoded CEOS Products by CDPF
(For products SSG and SPG)

Additional map projection and ellipsoid

Application LUT applied	
Map projection	
Map system	
Scene centre coordinates	
Scene Corners:	
UL coordinates	
UR coordinates	
LL coordinates	
LR coordinates	

4.4 Distribution Media

4.4.1 8mm Data Cartridge (Exabyte)

The 8 mm data cartridge (usually Exabyte tapes) is industry standard with 2.5 GB and 5 GB capacities. A RADARSAT product on Exabyte will not occupy more than one Exabyte tape and there is never more than one product on an Exabyte tape.

A printed report (Table 6 and Table 7) accompanies each Exabyte containing a product.

The information to be included on the label affixed to any Exabyte product is shown below:

Station RADARSAT-1 CEOS DATA PRODUCT
Product ID: *C0006411* Ref No.: *97-00587*
Beam: *F2N* Product: *SGF* Orbit: *1749 Asc.*
Image Times: *1997-Jul-10 22:21:14.558* to *22:21:21.000*
Scene Centre: *N 53:22:15 W105:36:25*
Processed: *1999-Apr-25* Tape Density: *5 GB*

Processed by *Station, Country*, distributed under license from RADARSAT International
Copyright Canadian Space Agency/Agence spatiale canadienne *yyyy*

NOTE: - By contract the two-line License and copyright statements, shown at the bottom of this example, must appear on all RADARSAT products. In case of space limitation, it may be shortened as such:

"Processed and dist'd under RSI license,
Copyright CSA/ASC yyyy"

The values for items indicated in *Underlined Italics* will be extracted from CEOS records as:

- *Station* - Volume Descriptor record: logical generation facility ID
- *Country* - Volume Description Record: logical facility and country

- *yyyy* - copyright year of data acquisition
- *Product ID* - Null Volume Descriptor Record: physical Tape ID
- *Ref. No.* - Reference number (such as processing work order or client order number)
- *Beam* - Radiometric Compensation Data Record: beam type
- *Product* - Text Record or Dataset Summary Record: product type
- *Orbit* - Data Set Summary Record: orbit number
- *Image times* - Detailed Processing Parameters Record: processing start and stop times (for RAW: use times in the processing work order)
- *Scene centre* - Text Record: scene location (for RAW: can be left blank)
- *Processed* - Date of processing
- *Tape density* - Medium-dependent value

4.4.2 CD-ROM

The format and structure of the CEOS records will be the same as for Exabyte products. Additional information may be conveyed on the CD-ROM to fully exploit the advantages of this medium. Files are named and organized as follows.

readme.txt	Text file containing general user information (optional)
scene01.lbl	ASCII label file for scene 1 (optional)
scene01	Sub Directory
vdf_dat.001	Volume Directory File
lea_01.001	SAR Leader File
dat_01.001	SAR Data File
tra_01.001	SAR Trailer File
nul_vdf.001	Null Volume Directory File

CD-ROMs are produced using the ISO-9660 standard.

The label for the CD-ROM will contain at least the same information as for Exabyte tapes, and may include more detailed information and graphic design (such as company logos and a quick look image).

A printed report is available in a format similar to those provided with Exabyte products. The CD cover insert provides more details of the products.

4.4.3 Electronic Delivery Products

The format of the CEOS records and the order they are transferred will be the same as for Exabyte products. The method used to put a product into files that are transferred to a destination disk file is shown below. The SAR Data File can be partitioned, upon request, into many files due to the large size of some products (SCN and SCW):

Volume Directory File
SAR Leader File
SAR Data File 1
SAR Data File 2
.....
SAR Data File n
SAR Trailer File
Null Volume Directory File

A printed report is available in a format similar to the report for the product on Exabyte. The printed report will be distributed manually, not via electronic means.

5. Calibration of RADARSAT Products

All CDPF data products, with the exception of Signal Data (RAW) products[1], are calibrated during processing to provide both geometric and radiometric corrections to the image data.

5.1 Geometric Calibration

Geometric calibration requires an initial knowledge of the satellite position, as well as knowledge of the antenna beam pointing direction with respect to the satellite track. Satellite positional information is calculated during processing using either:

- orbit ephemeris data (predicted orbit); or
- restituted orbit data (definitive orbit).

Orbit ephemeris data is embedded as auxiliary data in the satellite data downlink signal and allows the processor to calculate the predicted position of the satellite for the relevant image epoch. Since the ephemeris data used in the prediction may have been uploaded to the satellite up to 24 hours previously, the predicted position is subject to some error. The RADARSAT System Specification defines a geometric positioning error that allows for this prediction error, hence products processed using ephemeris data will always meet the overall system requirements for geometric calibration.

Restituted orbit data provides improved knowledge of the satellite position since it is based on actual orbit measurements performed during transits of the satellite over the ground Telemetry, Tracking and Command (TT&C) stations. Since this information is often available for periods that span the current image epoch, the derived positional data is highly accurate. Restituted orbit data is passed directly by landline telemetry from the MCS and is applicable to the satellite time for which image processing is required.

Geometric positioning computation also requires knowledge of the slant range between the target and the radar sensor, and the azimuthal pointing direction of the antenna with respect to the satellite track. Slant range computation is based on the two way transit time of the radar signal, and is measured by precision on-board reference clock signals. Antenna pointing is estimated by analysis of the Doppler frequency spectrum of the received signal during on-ground processing. Errors in antenna beam pointing in the elevation direction do not affect geometric position estimation, but are of significance in radiometric calibration.

System geometric calibration can be checked, and corrections applied if necessary, using images of accurately surveyed point targets in conjunction with processed georeferenced and system geocoded imagery.

5.2 Radiometric Calibration

[1] As of this document's release date, products of the Extended High beams (EH1-EH6) are not calibrated.

Radiometric calibration of the data is required so that information on the magnitude of the radar backscatter coefficient of the imaged terrain can be extracted from the processed image data. There are two fundamental requirements for radiometric calibration:

- relative radiometric calibration stability; and
- absolute radiometric calibration knowledge.

Relative radiometric calibration stability relates primarily to the electrical stability of the radar sensor and its ability to provide repeatable measurements over periods of time. The ground processor itself is not subject to temporal stability or gain changes, but incorporates several autonomous measures designed to compensate for such variations in the radar sensor. The following relative calibration measures are adopted in the RADARSAT System:

- raw signal I and Q channel imbalance correction;
- replica gain correction to compensate for radar transmitter & receiver gain fluctuations; and
- antenna elevation beam pointing estimation and pattern correction to reduce errors due to variations in satellite roll angle.

Absolute radiometric calibration is required so that the magnitudes of the digital pixel data in the processed image data product can be related to specific values of radar backscatter coefficient. Absolute radiometric calibration is achieved by imaging scenes containing various types of calibrated reference targets:

- precision active transponders set to a known Radar Cross Section (RCS);
- passive corner reflectors of known RCS; and
- areas of known distributed target backscatter coefficient previously measured independently by other SAR sensors, scatterometers, etc.

The image data is analyzed off line using the Image Data Calibration System (IDCS) Image Analysis and Calibration Workstations. Differences between the predicted and measured RCS and/or backscatter coefficients are corrected by adjusting the gain of the processor using an externally controlled gain correction parameter. The validity of the resulting calibration depends on the long-term relative radiometric calibration stability of the system. Absolute calibration measurements are performed at regular intervals to ensure compliance with overall system radiometric calibration requirements.

Output scaling of the processor

The final step in producing a radiometrically calibrated output product is adjustment of the output scaling of the processor to ensure optimum use of its 8- or 16-bit output dynamic range for different applications. For this purpose several output scaling Look-Up Tables (LUTs) are available and are used to apply a fixed offset and a range dependent gain function to the processed data prior to generation of the final image output. The same offset and LUT data is provided in the CEOS Radiometric Data Record which is included with each product (except RAW), hence the user has all the information necessary to extract radiometrically calibrated data from the imagery.

5.3 Extraction of Beta Nought and Sigma Nought from Calibrated Data

Extraction of calibrated data from the pixel data in the image requires reversal of an output scaling operation, which was performed on the data during processing. Each pixel in the output data is represented by one (or two) digital numbers (DN) which represent the magnitude of the detected pixel data (or the value of each I and Q component for SLC data). The scaling that was applied to the product during processing is described in the CEOS Radiometric Data Record.

The following describes how the pixel DNs can be converted to beta nought (ß^o) or radar brightness values by extraction and application of the scaling information. Conversion of DNs to radar backscatter coefficient (sigma nought), σ^o, additionally requires knowledge of the incidence angles over the image swath. The conversion from beta nought to sigma nought as a function of pixel incidence angle is described.

5.3.1 Extraction of Beta Nought

The scaling LUT values in the Radiometric Data Record:

Fields 12 to 531 of the CEOS Radiometric Data Record provide information on the range dependent scaling gain and fixed offset terms applied during product generation. The Radiometric Data Record is a component of the SAR Leader File for single beam products and of the SAR Trailer File for ScanSAR products. Principal field attributes are:

Field	Mnemonic	Bytes	Format	Description
12	table_des	37-60	A24	Designator "OUTPUT$SCALING$$.."
13	n_samp	61-68	I8	Number of look up table samples, generally = 512
14	samp_type	69-84	A16	Designator "GAIN$$$$$$$…."
15	samp_inc	85-88	I4	Increment between table entries in range pixels
16-527	lookup_tab	89-8265	512E16.7	Output scaling LUT values A_i - linear values
529	noise_scale	8285-8300	F16.7	Thermal noise reference level (dB)
531	offset	8317-8332	E16.7	Scaling offset A3 - linear, set to 0 for SLC products

The first sample in field 16 (bytes 89 to 104) gives the scaling look up table (LUT) value, A_0, for the nearest range pixel. The next sample in bytes 105 to 120 gives the scaling LUT value, A_1, for the pixel at the next sample increment in range. This sample point is positioned at *N* pixels from the near range pixel, where *N* = *samp_inc* as given by the integer value in field 15. The third table value gives the scaling at 2**N* pixels from the nearest range pixel and so on.

The number of scaling table values is fixed at 512. The table pixel spacing, *samp_inc*, is selected to the nearest integer value which allows the samples to span the maximum possible range in the processed image.

5.3.1.1 Beta Nought Extraction for Detected Products

The following procedures are used to extract the value of the radar brightness for pixels in the processed image for detected products (SGF, SGX, SGC, SCN, SCW).
If DN_j is the digital number that represents the magnitude of the j^{th} pixel from the start of a range line in the detected image data, then the corresponding value of radar brightness, $ß^o_j$, for the pixel is given by:

$$ß^o_j = 10*\log_{10}[(DN_j^2 + A3)/A2_j] \text{ dB} \quad (1)$$

where $A2_j$ is the scaling gain value for the j^{th} pixel, and *A3* is the fixed offset. *A3* is obtained directly from field 531 (offset) in the Radiometric Data Record. $A2_j$ is obtained by linear interpolation of the gain values (lookup_tab) given in fields 16-527 of the Radiometric Data Record, as described below.

Interpolation of LUT Values to find $A2_i$

With the present CDPF configuration LUT data are always provided in ascending range order, deviating from the CDPF Product Specification Section 5.1.5 which requires LUTs to be output in ascending pixel order. [NOTE: *This deviation may be removed as part of continuing CDPF upgrades, and users will be notified appropriately of changes.]* For single beam products, the range lines are always output in West - East order. Consequently, for ascending pass right looking and descending pass left looking products, the image range pixel indexes and LUT indexes both increment in order of increasing range. The first LUT entry corresponds to the scaling gain for the first, nearest range, image pixel. ScanSAR products also follow this convention regardless of left or right looking data acquisition mode since ScanSAR products are always generated in natural - or ascending range - order.

For descending pass right looking, and ascending pass left looking, single beam products, the image range line pixels are arranged far range first. The first LUT entry therefore corresponds to the scaling gain for the last pixel in the range line.

In the following the LUT table values are denoted by A_i , where *i* has the range 0 to (*n_samp - 1*). For all current CDPF products *n_samp* is set to 512, hence *i* = 0..511. The image pixel index is denoted by *j* where *j* represents the j^{th} pixel from the start of the range line. The range of *j* is 0 to (*n_data_pixel - 1*), where *n_data_pixel* is the number of data pixels in the range line as given in field 10 of the CEOS Processed Data Record. The scaling gain, $A2_j$, for an image pixel is found by linear interpolation between the two values for LUT scaling gain, A_i , which bracket the range of the image pixel. In some instances pixels near to the maximum range of a range line will lie at ranges beyond the range covered by the LUT. In such cases, $A2_j$ is found by linear extrapolation from the last two LUT values, A_{510} and A_{511} .

Near Range First:

For products generated with near range pixels first, including all ScanSAR products, find the LUT sample indices, i_L and i_U, (lower and upper) corresponding to the j^{th} image pixel from:

$$i_L = \text{floor}(j/\text{samp\_inc})$$
$$i_U = \text{ceil}(j/\text{samp\_inc})$$

where *samp_inc* is the increment between LUT table entries, obtained from field 15 of the CEOS Radiometric Data Record. From the LUT extract the gain values Ai_L and Ai_U corresponding to these indices. The required interpolated value of $A2_j$ is then given by:

$$A2_j = Ai_L + [(Ai_U - Ai_L) * ((j/\text{samp\_inc}) - i_L)] \quad (2)$$

Equation 2 is valid for all pixel indexes up to and including $j = samp\_inc*(n\_samp-1)$.
To find $A2_j$ for pixels for which $j > samp\_inc*(n\_samp-1)$, it is necessary to extrapolate the LUT values based on the last available LUT values, namely A_{510} and A_{511}. The extrapolated value of $A2_j$ for these pixels is given by:

$$A2_j = A_{511} + [(A_{511} - A_{510}) * ((j/\text{samp\_inc}) - 511)] \quad (3)$$

Far Range First:
For products in which the *j=0* pixel is the farthest range pixel in the range line, the lower and upper LUT sample indices for the j^{th} image pixel are given by:

$$i_L = \text{floor}[(n\_data\_pixel - j - 1)/\text{samp\_inc}]$$
$$i_U = \text{ceil}[(n\_data\_pixel - j - 1)/\text{samp\_inc}]$$

where *samp_inc* is the increment between LUT table entries, obtained from field 15 of the CEOS Radiometric Data Record.

From the LUT extract the gain values Ai_L and Ai_U corresponding to these indices. The required value of $A2_j$ is then given by:

$$A2_j = Ai_L + [(Ai_U - Ai_L) * \{((n\_data\_pixel - 1 - j)/\text{samp\_inc}) - i_L\}] \quad (4)$$

Equation 4 is valid for all pixel indexes down to and including:

$$j = n\_data\_pixel - samp\_inc*(n\_samp - 1) - 1$$

To find $A2_j$ for pixels for which $j < n\_data\_pixel - samp\_inc*(n\_samp - 1) - 1$, it is necessary to extrapolate the LUT values based on the last available LUT values, namely A_{510} and A_{511}. The extrapolated vale for $A2_j$ for these pixels is given by:

$$A2_j = A_{511} + [(A_{511} - A_{510}) * (((n\_data\_pixel - 1 - j)/\text{samp\_inc}) - 511)] \quad (5)$$

5.3.1.2 Beta Nought Extraction for SLC Products

For complex (SLC) single beam products, the pixel number, *j* , is related to the LUT index, *i* , using the same procedure as for detected products. The radar brightness for the j^{th} range pixel is then given by:

$$ß^o_j = 10*\log_{10}[(DNI_j/A2_j)^2 + (DNQ_j/A2_j)^2] \text{ dB} \quad (6)$$

or:

$$ß^o_j = 20*\log_{10}(DN_j/A2_j) \text{ dB} \quad (7)$$

where DNI_j and DNQ_j are the digital values of the I and Q components of the j^{th} pixel from the start of the range line, $A2_j$ is the corresponding range dependent gain and $DN_j^2 = DNI_j^2 + DNQ_j^2$. The offset is not used in SLC product generation.

5.3.1.3 System Beta Nought Calibration Updates

RADARSAT System calibration is maintained by regular maintenance operations, which may result in re-assessment of the system gains and required antenna beam shape corrections which are embodied in the payload parameter files. In some cases, products may have been generated by the CDPF before the relevant beam profiles were completely established, and such data may benefit from calibration if radiometric fidelity is critical to the application.

Calibration of the product requires that the raw data be re-processed at the CDPF using the correctly calibrated payload parameter file. The user may estimate the magnitude of the radiometric error in the original product by reference to beta nought correction data published by CSA. These data are provided for each beam in terms of the beta nought correction in dB over the range of beam elevation angles. The next section includes a description of a method of calculating the incidence angles for the image pixels. The corresponding beam elevation angles are then derived from the incidence angles.

5.3.2 Conversion from Beta Nought to Sigma Nought

The relationship between radar brightness ($ß^o$) and radar backscatter coefficient (σ^o) is:

$$\sigma^o_j = ß^o_j + 10*\log_{10}(\sin I_j) \text{ dB} \quad (8)$$

where I_j is the incidence angle at the j^{th} range pixel. This formula assumes that the earth is a smooth ellipsoid at sea level.

5.3.3 Incidence Angle Calculation

5.3.3.1 Data Required in Calculation of the Incidence Angle

Data required for calculating the incidence angle for any given pixel in the image range line are available in the CEOS record. Given these data, a relatively straightforward approximation to the incidence angle can be performed. For scene products the resulting error in conversion from beta nought to sigma nought resulting from the approximation should be less than 0.4 dB.

Before starting the calculation, the following data are required from the CEOS record.

From the Dataset Summary Record:

Field	Mnemonic	Bytes	Format	Description
17	ellip_major	181-196	F16.7	Ellipsoid semi-major axis (km)
18	ellip_minor	197-212	F16.7	Ellipsoid semi-minor axis (km
36	plat_lat	453-460	F8.3	Platform geodetic latitude (deg.)
122	pix_spacing	1703-1718	F16.7	Pixel spacing (m)

From the Detailed Processing Parameters Record:

Field	Mnemonic	Bytes	Format	Description
411	eph_orb_data	4649-4664	E16.7	First element of equinoctial orbit elements = orbit semi-major axis (km)
426-431	srgr_coef	4908-5003	6 x E16.7	Set of six slant to ground range coefficients repeated up to 19 times for swath products.

From the Processed Data Record:

Field	Mnemonic	Bytes	Format	Description
10	n_data_pixel	25-28	B4	Data pixel count

5.3.3.2 Calculation of the Incidence Angle

Using the procedures described below, find the following:

- Earth radius, r , and the orbit altitude, h , for the image.
- Ground range increment, dRg = *pix_spacing* , between pixels.
- Slant range, RS_j , for each pixel.
- Incidence angle, I_j , for each pixel.

Notes: 1) The pixel index, j , assumes a range of *0..n_data_pixel-1*.

2) For scene products the platform latitude and SRGR coefficients used in the following calculation apply to the scene centre. Some numerical values are included from a typical beam S1 SGF scene product at mid latitude.

3) For SLC products the procedure is similar, however, the conversion from ground to slant range is not required and the slant range RS_j for each pixel is calculated directly from the pixel spacing.

1. Calculate earth radius (r) and satellite altitude (h)

From the CEOS Data Set Summary Record:

ellipsoid semi-major axis: ellip_maj = 6378.14 km

ellipsoid semi-minor axis: ellip_min = 6356.755 km

platform geodetic latitude: plat_lat = 45.901 deg

From the CEOS Detailed Processing Parameters Record:

eph_orb_data(1) $\alpha = 7.167055 \cdot 10^6$ m

Calculate earth radius, *r* , at image centre position (start of image for swath products):

$$r = ellipmin \cdot \frac{\sqrt{1 + \tan^2(platlat \cdot \frac{\pi}{180})}}{\sqrt{\frac{ellipmin^2}{ellipmaj^2} + \tan^2(platlat \cdot \frac{\pi}{180})}} \cdot 10^3$$

i.e. $r = 6.367 \cdot 10^6$ m

Calculate orbit altitude, *h* : $h = \alpha - r$

i.e. $h = 8 \cdot 10^5$ m

2. Calculate the slant range for each ground range increment of the output scaling LUT:

From the Detailed Processing Parameters Record: 6 values of SRGR coefficients [srgr_coef(1-6)]:

1st SRGR coeff = a	$a = 8.4087600 \cdot 10^5$
2nd SRGR coeff = b	$b = 3.3333325 \cdot 10^{-1}$
3rd SRGR coeff = c	$c = 6.0235465 \cdot 10^{-7}$
4th SRGR coeff = d	$d = -2.4054597 \cdot 10^{-13}$
5th SRGR coeff = e	$e = -1.1672899 \cdot 10^{-19}$
6th SRGR coeff = f	$f = 1.9135056 \cdot 10^{-25}$

From the CEOS Data Set Summary Record:

pixel spacing: pix_spacing = 12.5 m

For detected products, let: dRg = pix_spacing = 12.5 m in this example.

For SLC products, the slant range pixel spacing, dRs = pix_spacing

For all products, let the pixels be denoted by *j*, where *j* is counted from the start of the range line and has a range: < j = 0 .. (n_data_pixel -1)>

For detected products arranged near range pixels first, find the slant range for the j^{th} pixel from:

$$RS_j = a + j.dRg \cdot b + (j \cdot dRg)^2 .c + (j \cdot dRg)^3 .d + (j \cdot dRg)^4 .e + (j \cdot dRg)^5 \cdot f$$

For SLC products arranged near range first: $RS_j = a + dRs \cdot j$

For detected products having far range pixels first, calculate the slant range for the j^{th} pixel from:

$$RS_j = a + k \cdot dRg \cdot b + (k \cdot dRg)^2 \cdot c + (k \cdot dRg)^3 \cdot d + (k \cdot dRg)^4 \cdot e + (k \cdot dRg)^5 \cdot f$$

For SLC products arranged far range first: $RS_j = a + dRs \cdot k$

Where $k = n\_data\_pixel - j$

3. Calculate the incidence angle at each pixel:

The incidence angle for the j^{th} pixel is given by:

$$I_j = \arccos\left[\frac{(h^2 - (RS_j)^2 + 2 \cdot r \cdot h)}{2 \cdot RS_j \cdot r}\right]$$

4. Calculate the corresponding beam elevation angles:

The elevation angle, θ_j, for the j^{th} pixel is given by:

$$\theta_j = \arcsin\left[\sin(I_j) \cdot \frac{r}{r + h}\right]$$

where I_j is the incidence angle calculated in part 3 above, *r* is the earth radius, and *h* is the orbit altitude. θ_j is the beam elevation angle measured with respect to the nadir direction.

The conversion from incidence angle to elevation is required in order to estimate the differences in beta nought values between calibrated and uncalibrated products. CSA publishes separately a document containing tables and plots which show the beta nought differences as a function of beam elevation angle. For this purpose it is sufficiently accurate to take *r* as a mean earth radius of 6367 km, and *h* as the mean orbit altitude of 800 km.

5.3.3.3 Special Considerations for ScanSAR Products

In the case of ScanSAR products, the platform latitude given in the Dataset Summary Record applies at the start of the swath. SRGR coefficients should be taken from the processing block appropriate for the portion of the image under consideration. For incidence angle calculations at intermediate points along the swath, it is therefore necessary to estimate the platform geodetic latitude for the part of the swath of interest. An approximation can be calculated as follows:

1) From the Processed Data Record, field 40 (*lat_mid*), find the mid pixel latitude of a range line near the centre of the region of interest.

2) From the Data Set Summary Record, fields 13 (pro_lat) and 36 (*plat_lat*), find the latitude of the centre of the first processed image range line and the platform latitude at the start of the image respectively.

3) Find the difference (*pro_lat* - *lat_mid*).

4) Calculate the new platform latitude equal to: *plat-lat* + (*pro_lat* - *lat_mid*).

To find the corresponding set of SRGR coefficients proceed as follows:

5) From the Processed Data Record for the range line selected in (a), find the acquisition time from fields 13, 14 and 15 (*acq_year*, *acq_day*, *acq_msec*).

6) From field 425 (*srgr_update*) of the Detailed Processing Parameters Record, find the closest time for SRGR update to the time obtained from step (e).

Use the SRGR coefficients from the block having the update time identified in (6).

Note that the timing selection steps in (5) and (6) above could lead to a timing error of up to one half of the ScanSAR processing block duration, plus some allowance for throwaway at the start of the image. The resulting effect on the beta to sigma nought conversion accuracy has not been fully evaluated.

APPENDIX A - DETAILED PRODUCT DESCRIPTIONS

(For explanation of Product Definition Terms, please see text in Section 3.4)

Appendix A-1: RAW Product

RAW Product	
Format	CEOS
Output Media	Exabyte Tape, CD-ROM, Image LAN
Product Characteristics	
Coordinate System	Slant Range
Nominal Image Coverage	50 - 500 km
Spacing	natural spacing of signal data
Sample Representation	8-bit unsigned integer for I and 8-bit unsigned integer for Q
Nominal Image Size	9500 pixels per line x length of swath
Nominal Product Volume	~ 200 MB per 100 km (azimuth direction)
Image Quality Characteristics	
Beams (1)	S1 to S7, W1 to W3, F1 to F5 , EH1 to EH6, EL1, W1+W2, W2+S5+S6, W1+W2+W3+S7, or W1+W2+S5+S6.
Nominal Incidence Angles	10 - 60 degrees
Nominal Range Resolution	N/A
Nominal Azimuth Resolution	N/A
Nominal PSLR	N/A
Nominal ISLR	N/A
Radiometric Error	N/A
Radiometric Linearity	N/A
Absolute Location Error	N/A
Geometric Distortion	N/A
Relative Phase Error	N/A
Processing Parameters	
Number of Azimuth Looks	N/A
Azimuth Look Bandwidth	N/A
Effective Number of Looks	N/A
Range Spectral Weighting	N/A
Azimuth Spectral Weighting	N/A
Notes	
(1)	A RAW Product will be ONE of beams S1 to S7, W1 to W3, F1 to F5, EH1 to EH6, EL1, W1+W2, W2+S5+S6, W1+W2+W3+S7, or W1+W2+S5+S6.

Appendix A-2: SLC, Single Look Complex, Standard Beam

SLC Product from Standard Beam							
Format	CEOS						
Output Media	Exabyte tape, CD-ROM, Image LAN						
Product Characteristics							
Coordinate System	Slant Range						
Nominal Image Coverage	100 km (range) x 100 km (azimuth)						
Pixel Spacing	11.6 m (range) x 5.1 m (azimuth)						
Pixel Data Representation	16-bit unsigned integer for I and 16-bit unsigned integer for Q						
Nominal Image Size	8620 pixels x 19610 lines						
Nominal Product Volume	676 MB						
Image Quality Characteristics							
Beams (1)	S1	S2	S3	S4	S5	S6	S7
Nominal Incidence Angles (°)	20-27	24-31	30-37	34-40	36-42	41-46	45-49
Nominal Range Resolution (2)	10.5 m	10.5 m	15.7 m	15.7 m	15.7 m	15.7 m	15.7 m
Nominal Azimuth Resolution (2)	8.9 m						
Nominal PSLR (2)	<-20 dB						
Nominal ISLR (2)	-11.2 dB						
Radiometric Error	< 3 dB						
Radiometric Linearity (2)	> 0.97						
Absolute Location Error	< 750 m						
Geometric Distortion	< 40 m						
Relative Phase Error (2)	10 degrees						
Processing Parameters							
Number of Azimuth Looks	1						
Azimuth Look Bandwidth	900 Hz						
Effective Number of Looks	1						
Range Spectral Weighting	Kaiser window (coefficient 2.4)						
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)						
Notes							
(1)	A Standard SLC Product will be ONE of beams S1 to S7.						
(2)	SAR Processor specification. Excludes contribution from other sources of error.						

Appendix A-3: SLC, Single Look Complex, Fine Beam

SLC Product from Fine Beam					
Format	CEOS				
Output Media	Exabyte tape, CD-ROM, Image LAN				
Product Characteristics					
Coordinate System	Slant Range				
Nominal Image Coverage	50 km (range) x 50 km (azimuth)				
Pixel Spacing	4.6 m (range) x 5.1 m (azimuth)				
Pixel Data Representation	16-bit unsigned integer for I and 16-bit unsigned integer for Q				
Nominal Image Size	10870 pixels x 9805 lines				
Nominal Product Volume	426 MB				
Image Quality Characteristics					
Beams (1)	F1	F2	F3	F4	F5
Nominal Incidence Angles (°)	37-40	39-42	41-44	43-46	45-48
Nominal Range Resolution (2)	6.0 m	6.0 m	6.0 m	6.0 m	6.0 m
Nominal Azimuth Resolution 2)	8.9 m				
Nominal PSLR (2)	<-20 dB				
Nominal ISLR (2)	-11.2 dB				
Radiometric Error	< 3 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	< 750 m				
Geometric Distortion	< 40 m				
Relative Phase Error (2)	10 degrees				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
Effective Number of Looks	1				
Range Spectral Weighting	Kaiser window (coefficient 2.4)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)				
Notes					
(1)	A Fine Resolution SLC Product will be ONE of beams F1 to F5.				
(2)	SAR Processor specification. Excludes contribution from other sources of error.				

Appendix A-4: SLC, Single Look Complex, Wide Beam

SLC Product from Wide Beam			
Format	CEOS		
Output Media	Exabyte tape, CD-ROM, Image LAN		
Product Characteristics			
Coordinate System	Slant Range		
Nominal Image Coverage	150 km (range) x 150 km (azimuth)		
Pixel Spacing	11.6 m (range) x 5.1 m (azimuth)		
Pixel Data Representation	16-bit unsigned integer for I and 16-bit unsigned integer for Q		
Nominal Image Size	12930 pixels x 29410 lines		
Nominal Product Volume	1521 MB		
Image Quality Characteristics			
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolution (2)	15.7 m	15.7 m	15.7 m
Nominal Azimuth Resolution (2)	8.9 m		
Nominal PSLR (2)	<-20 dB		
Nominal ISLR (2)	-11.2 dB		
Radiometric Error	< 3dB		
Radiometric Linearity (2)	> 0.97		
Absolute Location Error	< 750 m		
Geometric Distortion	< 40 m		
Relative Phase Error (2)	10 degrees		
Processing Parameters			
Number of Azimuth Looks	1		
Azimuth Look Bandwidth	900 Hz		
Effective Number of Looks	1		
Range Spectral Weighting	Kaiser window (coefficient 2.4)		
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)		
Notes			
(1)	A Wide Swath SLC Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

Appendix A-5: SLC, Single Look Complex, Extended High Beam

SLC Product from Extended High Beam						
Format	CEOS					
Output Media	Exabyte tape, CD-ROM, Image LAN					
Product Characteristics						
Coordinate System	Slant Range					
Nominal Image Coverage	75 km (range) x 75 km (azimuth)					
Pixel Spacing	11.6 m (range) x 5.1 m (azimuth)					
Pixel Data Representation	16-bit unsigned integer for I and 16-bit unsigned integer for Q					
Nominal Image Size	6465 pixels x 14705 lines					
Nominal Product Volume	380 MB					
Image Quality Characteristics						
Beams (1)	EH1	EH2	EH3	EH4	EH5	EH6
Nominal Incidence Angles (°)	49-52	50-53	52-55	54-57	56-58	57-60
Nominal Range Resolution (2)	15.7 m	15.7 m	15.7 m	15.7 m	15.7 m	15.7 m
Nominal Azimuth Resolution (2)	8.9 m					
Nominal PSLR (2)	<-20 dB					
Nominal ISLR (2)	-11.2 dB					
Radiometric Error	< 3 dB					
Radiometric Linearity (2)	> 0.97					
Absolute Location Error	< 750 m					
Geometric Distortion	< 40 m					
Relative Phase Error (2)	10 degrees					
Processing Parameters						
Number of Azimuth Looks	1					
Azimuth Look Bandwidth	900 Hz					
Effective Number of Looks	1					
Range Spectral Weighting	Kaiser window (coefficient 2.4)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)					
Notes						
(1)	A High Incidence SLC Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

Appendix A-6: SLC, Single Look Complex, Extended Low Beam

SLC Product from Extended Low Beam	
Format	CEOS
Output Media	Exabyte tape, CD-ROM, Image LAN
Product Characteristics	
Coordinate System	Slant Range
Nominal Image Coverage	170 km (range) x 170 km (azimuth)
Pixel Spacing	8.1 m (range) x 5.1 m (azimuth)
Pixel Data Representation	16-bit unsigned integer for I and 16-bit unsigned integer for Q
Nominal Image Size	20990 pixels x 33330 lines
Nominal Product Volume	866 MB
Image Quality Characteristics	
Beams (1)	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution (2)	10.5 m
Nominal Azimuth Resolution (2)	8.9 m
Nominal PSLR (2)	<-20 dB
Nominal ISLR (2)	-11.2 dB
Radiometric Error	< 3 dB
Radiometric Linearity (2)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error (2)	10 degrees
Processing Parameters	
Number of Azimuth Looks	1
Azimuth Look Bandwidth	900 Hz
Effective Number of Looks	1
Range Spectral Weighting	Kaiser window (coefficient 2.4)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)
Notes	
(1)	A Low Incidence SLC Product will be beam EL1.
(2)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A-7: SGF, Path Image, Standard Beam

SGF Product from Standard Beam							
Format	CEOS						
Output Media	Exabyte tape, CD-ROM, Image LAN						
Product Characteristics							
Coordinate System	Ground Range						
Nominal Image Coverage	100 km (range) x 100 km (azimuth)						
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)						
Pixel Data Representation	16-bit unsigned integer (magnitude detected)						
Nominal Image Size	8000 pixels x 8000 lines						
Nominal Product Volume	128 MB						
Image Quality Characteristics							
Beams (1)	S1	S2	S3	S4	S5	S6	S7
Nominal Incidence Angles (°)	20-27	24-31	30-37	34-40	36-42	41-46	45-49
Nominal Range Resolution (2) (m)	27.9 - 20.5	22.8 - 18.0	27.5 - 23.2	25.1 - 21.8	23.6 - 20.7	21.5 - 19.2	19.8 - 18.4
Nominal Azimuth Resolution (2)	27.0 m						
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)						
Nominal ISLR (2)	-13.6 dB						
Radiometric Error	< 3 dB						
Radiometric Linearity (2)	> 0.97						
Absolute Location Error	< 750 m						
Geometric Distortion	< 40 m						
Relative Phase Error	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
Effective Number of Looks	3.1						
Range Spectral Weighting	Kaiser window (coefficient 2.8)						
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)						
Notes							
(1)	A Standard SGF Product will be ONE of beams S1 to S7.						
(2)	SAR Processor specification. Excludes contribution from other sources of error.						

Appendix A-8: SGF, Path Image, Fine Beam

SGF Product from Fine Beam					
Format	CEOS				
Output Media	Exabyte tape, CD-ROM, Image LAN				
Product Characteristics					
Coordinate System	Ground Range				
Nominal Image Coverage	50 km (range) x 50 km (azimuth)				
Pixel Spacing	6.25 m (range) x 6.25 m (azimuth)				
Pixel Data Representation	16-bit unsigned integer (magnitude detected)				
Nominal Image Size	8000 pixels x 8000 lines				
Nominal Product Volume	128 MB				
Image Quality Characteristics					
Beams (1)	F1	F2	F3	F4	F5
Nominal Incidence Angles (°)	37-40	39-42	41-44	43-46	45-47
Nominal Range Resolution (2) (m)	8.6 - 8.0	8.2 - 7.7	7.8 - 7.4	7.5 - 7.2	7.3 - 7.0
Nominal Azimuth Resolution (2)	8.4 m				
Nominal PSLR (2)	<-20 dB				
Nominal ISLR (2)	-11.2 dB				
Radiometric Error	< 3 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	< 750 m				
Geometric Distortion	< 40 m				
Relative Phase Error	N/A				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
Effective Number of Looks	1				
Range Spectral Weighting	Kaiser window (coefficient 2.4)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)				
Notes					
(1)	A Fine Resolution SGF Product will be ONE of beams F1 to F5.				
(2)	SAR Processor specification. Excludes contribution from other sources of error.				

Appendix A-9: SGF, Path Image, Wide Beam

SGF Product from Wide Beam			
Format	CEOS		
Output Media	Exabyte tape, CD-ROM, Image LAN		
Product Characteristics			
Coordinate System	Ground Range		
Nominal Image Coverage	150 km (range) x 150 km (azimuth)		
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)		
Pixel Data Representation	16-bit unsigned integer (magnitude detected)		
Nominal Image Size	12000 pixels x 12000 lines		
Nominal Product Volume	288 MB		
Image Quality Characteristics			
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolution (2) (m)	40.8 - 26.9	27.2 - 22.0	22.0 - 19.7
Nominal Azimuth Resolution (2)	27.0 m		
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)		
Nominal ISLR (2)	- 13.6 dB		
Radiometric Error	< 3 dB		
Radiometric Linearity (2)	> 0.97		
Absolute Location Error	< 750 m		
Geometric Distortion	< 40 m		
Relative Phase Error	N/A		
Processing Parameters			
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
Effective Number of Looks	3.1		
Range Spectral Weighting	Kaiser window (coefficient 2.8)		
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)		
Notes			
(1)	A Wide Swath SGF Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

Appendix A-10: SGF, Path Image, Extended High Beam

SGF Product from Extended High Beam						
Format	CEOS					
Output Media	Exabyte tape, CD-ROM, Image LAN					
Product Characteristics						
Coordinate System	Ground Range					
Nominal Image Coverage	75 km (range) x 75 km (azimuth)					
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)					
Pixel Data Representation	16-bit unsigned integer (magnitude detected)					
Nominal Image Size	6000 pixels x 6000 lines					
Nominal Product Volume	72 MB					
Image Quality Characteristics						
Beams (1)	EH1	EH2	EH3	EH4	EH5	EH6
Nominal Incidence Angles (°)	49-52	50-53	52-55	54-57	56-58	57-60
Nominal Range Resolution (2) (m)	18.8 - 17.6	18.1 -17.3	17.7 - 17.0	17.1 - 16.6	16.8 - 16.4	16.6 - 16.2
Nominal Azimuth Resolution (2)	27.0 m					
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)					
Nominal ISLR (2)	- 13.6 dB					
Radiometric Error	< 3 dB					
Radiometric Linearity (2)	> 0.97					
Absolute Location Error	< 750 m					
Geometric Distortion	< 40 m					
Relative Phase Error	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Effective Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	An Extended High SGF Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

Appendix A-11: SGF, Path Image, Extended Low Beam

SGF Product from Extended Low Beam	
Format	CEOS
Output Media	Exabyte tape, CD-ROM, Image LAN
Product Characteristics	
Coordinate System	Ground Range
Nominal Image Coverage	170 km (range) x 170 km (azimuth)
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)
Pixel Data Representation	16-bit unsigned integer (magnitude detected)
Nominal Image Size	13600 pixels x 13600 lines
Nominal Product Volume	370 MB
Image Quality Characteristics	
Beams (1)	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution (2) (m)	54.1-24.1
Nominal Azimuth Resolution (2)	27.0 m
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)
Nominal ISLR (2)	- 13.6 dB
Radiometric Error	< 3 dB
Radiometric Linearity (2)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
Effective Number of Looks	3.1
Range Spectral Weighting	Kaiser window (coefficient 2.8)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)
Notes	
(1)	An Extended Low SGF Product will be beam EL1.
(2)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A-12: SGX, Path Image Plus, Standard Beam

SGX Product from Standard Beam							
Format	CEOS						
Output Media	Exabyte tape, CD-ROM, Image LAN						
Product Characteristics							
Coordinate System	Ground Range						
Nominal Image Coverage	100 km (range) x 100 km (azimuth)						
Pixel Spacing	8.0 m (range) x 8.0 m (azimuth)						
Pixel Data Representation	16-bit unsigned integer (magnitude detected)						
Nominal Image Size	12500 pixels x 12500 lines						
Nominal Product Volume	312.5 MB						
Image Quality Characteristics							
Beams (1)	S1	S2	S3	S4	S5	S6	S7
Nominal Incidence Angles (°)	20-27	24-31	30-37	34-40	36-42	41-46	45-49
Nominal Range Resolution (2) (m)	27.9 - 20.5	22.8 - 18.0	27.5 - 23.2	25.1 - 21.8	23.6 - 20.7	21.5 - 19.2	19.8 - 18.4
Nominal Azimuth Resolution (2)	27.0 m						
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)						
Nominal ISLR (2)	- 13.6 dB						
Radiometric Error	< 3 dB						
Radiometric Linearity (2)	> 0.97						
Absolute Location Error	< 750 m						
Geometric Distortion	< 40 m						
Relative Phase Error	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
Effective Number of Looks	3.1						
Range Spectral Weighting	Kaiser window (coefficient 2.8)						
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)						
Notes							
(1)	A Standard SGX Product will be ONE of beams S1 to S7.						
(2)	SAR Processor specification. Excludes contribution from other sources of error.						

Appendix A-13: SGX, Path Image Plus, Fine Beam

SGX Product from Fine Beam					
Format	CEOS				
Output Media	Exabyte tape, CD-ROM, Image LAN				
Product Characteristics					
Coordinate System	Ground Range				
Nominal Image Coverage	50 km (range) x 50 km (azimuth)				
Pixel Spacing	3.125 m (range) x 3.125 m (azimuth)				
Pixel Data Representation	16-bit unsigned integer (magnitude detected)				
Nominal Image Size	16000 pixels x 16000 lines				
Nominal Product Volume	512 MB				
Image Quality Characteristics					
Beams (1)	F1	F2	F3	F4	F5
Nominal Incidence Angles (°)	37-40	39-42	41-44	43-46	45-47
Nominal Range Resolution (2) (m)	8.6 - 8.0	8.2 - 7.7	7.8 - 7.4	7.5 - 7.2	7.3 - 7.0
Nominal Azimuth Resolution (2)	8.4 m				
Nominal PSLR (2)	<-20 dB				
Nominal ISLR (2)	-11.2 dB				
Radiometric Error	< 3 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	< 750 m				
Geometric Distortion	< 40 m				
Relative Phase Error	N/A				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
Effective Number of Looks	1				
Range Spectral Weighting	Kaiser window (coefficient 2.4)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)				
Notes					
(1)	A Fine Resolution SGF Product will be ONE of beams F1 to F5.				
(2)	SAR Processor specification. Excludes contribution from other sources of error.				

Appendix A-14: SGX, Path Image Plus, Wide Beam

SGX Product from Wide Beam			
Format	CEOS		
Output Media	Exabyte tape, CD-ROM, Image LAN		
Product Characteristics			
Coordinate System	Ground Range		
Nominal Image Coverage	150 km (range) x 150 km (azimuth)		
Pixel Spacing	10.0 m (range) x 10.0 m (azimuth)		
Pixel Data Representation	16-bit unsigned integer (magnitude detected)		
Nominal Image Size	14400 pixels x 14400 lines		
Nominal Product Volume	415 MB		
Image Quality Characteristics			
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolution (2) (m)	40.8 - 26.9	27.2 - 22.0	22.0 - 19.7
Nominal Azimuth Resolution (2)	27.0 m		
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)		
Nominal ISLR (2)	- 13.6 dB		
Radiometric Error	< 3 dB		
Radiometric Linearity (2)	> 0.97		
Absolute Location Error	< 750 m		
Geometric Distortion	< 40 m		
Relative Phase Error	N/A		
Processing Parameters			
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
Effective Number of Looks	3.1		
Range Spectral Weighting	Kaiser window (coefficient 2.8)		
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)		
Notes			
(1)	A Wide SGF Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

Appendix A-15: SGX, Path Image Plus, Extended High Beam

SGX Product from Extended High Beam						
Format	CEOS					
Output Media	Exabyte tape, CD-ROM, Image LAN					
Product Characteristics						
Coordinate System	Ground Range					
Nominal Image Coverage	75 km (range) x 75 km (azimuth)					
Pixel Spacing	8.0 m (range) x 8.0 m (azimuth)					
Pixel Data Representation	16-bit unsigned integer (magnitude detected)					
Nominal Image Size	9375 pixels x 9375 lines					
Nominal Product Volume	176 MB					
Image Quality Characteristics						
Beams (1)	EH1	EH2	EH3	EH4	EH5	EH6
Nominal Incidence Angles (°)	49-52	50-53	52-55	54-57	56-58	57-60
Nominal Range Resolution (2) (m)	18.5 - 17.6	18.1 - 17.3	17.7 - 17.0	17.1 - 16.6	16.8 - 16.4	16.6 - 16.2
Nominal Azimuth Resolution (2)	27.0 m					
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)					
Nominal ISLR (2)	- 13.6 dB					
Radiometric Error	< 3 dB					
Radiometric Linearity (2)	> 0.97					
Absolute Location Error	< 750 m					
Geometric Distortion	< 40 m					
Relative Phase Error	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Effective Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	An Extended High SGF Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

Appendix A-16: SGX, Path Image Plus, Extended Low Beam

SGX Product from Extended Low Beam	
Format	CEOS
Output Media	Exabyte tape, CD-ROM, Image LAN
Product Characteristics	
Coordinate System	Ground Range
Nominal Image Coverage	170 km (range) x 170 km (azimuth)
Pixel Spacing	10.0 m (range) x 10.0 m (azimuth)
Pixel Data Representation	16-bit unsigned integer (magnitude detected)
Nominal Image Size	17000 pixels x 17000 lines
Nominal Product Volume	578 MB
Image Quality Characteristics	
Beams (1)	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution (2) (m)	54.1 - 24.1
Nominal Azimuth Resolution (2)	27.0 m
Nominal PSLR (2)	-20.2 dB (range), -20.7 dB (azimuth)
Nominal ISLR (2)	- 13.6 dB
Radiometric Error	< 3 dB
Radiometric Linearity (2)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
Effective Number of Looks	3.1
Range Spectral Weighting	Kaiser window (coefficient 2.8)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)
Notes	
(1)	A Low Incidence SGF Product will be beam EL1.
(2)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A-17: SSG, Map Image, Standard Beam

SSG Product from Standard Beam Beam							
Format	CEOS						
Output Media	Exabyte Tape, CD-ROM, Image LAN						
	Product Characteristics						
Coordinate System	See Appendix C.						
Nominal Image Coverage	100 km (range) x 100 km (azimuth)						
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)						
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)						
Nominal Image Size	10400 pixels x 10400 lines						
Nominal Product Volume	102 MB in 8 bit, 204 MB in 16 bit						
	Image Quality Characteristics						
Beams (1)	S1	S2	S3	S4	S5	S6	S7
Nominal Incidence Angles (°)	20-27	24-31	30-37	34-40	36-42	41-46	45-49
Nominal Range Resolution	N/A						
Nominal Azimuth Resolution	N/A						
Nominal PSL	N/A						
Nominal ISL	N/A						
Radiometric Error	< 3 dB						
Radiometric Linearity (2)	> 0.97						
Absolute Location Error	<750 m						
Geometric Distortion	<40 m						
Relative Phase Error	N/A						
	Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
Effective Number of Looks	3.1						
Range Spectral Weighting	Kaiser window (coefficient 2.8)						
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)						
	Notes						
(1)	A Standard SSG Product will be ONE of beams S1 to S7.						
(2)	SAR Processor specification. Excludes contribution from other sources of error.						

Appendix A-18: SSG, Map Image, Fine Beam

SSG Product from Fine Beam					
Format	CEOS				
Output Media	Exabyte Tape, CD-ROM, Image LAN				
	Product Characteristics				
Coordinate System	See Appendix C.				
Nominal Image Coverage	50 km (range) x 50 km (azimuth)				
Pixel Spacing	6.25 m (range) x 6.25 m (azimuth)				
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)				
Nominal Image Size	10400 pixels x 10400 lines				
Nominal Product Volume	102 MB in 8 bit, 204MB in 16 bit				
	Image Quality Characteristics				
Beams (1)	F1	F2	F3	F4	F5
Nominal Incidence Angles (°)	37-40	39-42	41-44	43-46	45-47
Nominal Range Resolution	N/A				
Nominal Azimuth Resolution	N/A				
Nominal PSL	N/A				
Nominal ISL	N/A				
Radiometric Error	< 3 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	<750 m				
Geometric Distortion	<40 m				
Relative Phase Error	N/A				
	Processing Parameters				
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
Effective Number of Looks	1				
Range Spectral Weighting	Kaiser window (coefficient 2.4)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)				
	Notes				
(1)	A Fine Resolution SSG Product will be ONE of beams F1 to F5.				
(2)	SAR Processor specification. Excludes contribution from other sources of error.				

Appendix A-19: SSG, Map Image, Wide Beam

SSG Product from Wide Beam			
Format	CEOS		
Output Media	Exabyte Tape, CD-ROM, Image LAN		
	Product Characteristics		
Coordinate System	See Appendix C.		
Nominal Image Coverage	150 km (range) x 150 km (azimuth)		
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)		
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)		
Nominal Image Size	16000 pixels x 16000 lines		
Nominal Product Volume	256 MB in 8 bit, 512 MB in 16 bit		
	Image Quality Characteristics		
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolution	N/A		
Nominal Azimuth Resolution	N/A		
Nominal PSL	N/A		
Nominal ISL	N/A		
Radiometric Error	< 3 dB		
Radiometric Linearity (2)	> 0.97		
Absolute Location Error	<750 m		
Geometric Distortion	<40 m		
Relative Phase Error	N/A		
	Processing Parameters		
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
Effective Number of Looks	3.1		
Range Spectral Weighting	Kaiser window (coefficient 2.8)		
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)		
	Notes		
(1)	A Wide SSG Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

Appendix A-20: SSG, Map Image, Extended High Beam

SSG Product from Extended High Beam						
Format	CEOS					
Output Media	Exabyte Tape, CD-ROM, Image LAN					
Product Characteristics						
Coordinate System	See Appendix C.					
Nominal Image Coverage	75 km (range) x 75 km (azimuth)					
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)					
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)					
Nominal Image Size	8000 pixels x 8000 lines					
Nominal Product Volume	64 MB in 8 bit, 128 MB in 16 bit					
Image Quality Characteristics						
Beams (1)	EH1	EH2	EH3	EH4	EH5	EH6
Nominal Incidence Angles (°)	49-52	50-53	52-55	54-57	56-58	57-60
Nominal Range Resolution	N/A					
Nominal Azimuth Resolution	N/A					
Nominal PSL	N/A					
Nominal ISL	N/A					
Radiometric Error	< 3 dB					
Radiometric Linearity (2)	> 0.97					
Absolute Location Error	< 750 m					
Geometric Distortion	< 40 m					
Relative Phase Error	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Effective Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	An Extended High SSG Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

Appendix A-21: SSG, Map Image, Extended Low Beam

SSG Product from Extended Low Beam	
Format	CEOS
Output Media	Exabyte Tape, CD-ROM, Image LAN
	Product Characteristics
Coordinate System	See Appendix C.
Nominal Image Coverage	170 km x 170 km
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)
Pixel Data Representation	8 bit unsigned integer (magnitude detected)
Nominal Image Size	17600 pixels x 17600 lines
Nominal Product Volume	310 MB in 8 bit, 620 MB in 16 bit
	Image Quality Characteristics
Beams (1)	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution	N/A
Nominal Azimuth Resolution	N/A
Nominal PSLR	N/A
Nominal ISLR	N/A
Radiometric Error	< 3 dB
Radiometric Linearity (2)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error	N/A
	Processing Parameters
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
Effective Number of Looks	3.1
Range Spectral Weighting	Kaiser window (coefficient 2.8)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)
	Notes
(1)	An Extended Low SSG Product will be beam EL1.
(2)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A-22: SPG, Precision Map Image, Standard Beam

SPG Product from Standard Beam							
Format	CEOS						
Output Media	Exabyte Tape, CD-ROM, Image LAN						
Product Characteristics							
Coordinate System	See Appendix C.						
Nominal Image Coverage	100 km (range) x 100 km (azimuth)						
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)						
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)						
Nominal Image Size	10400 pixels x 10400 lines						
Nominal Product Volume	102 MB in 8 bit, 204 MB in 16 bit						
Image Quality Characteristics							
Beams (1)	S1	S2	S3	S4	S5	S6	S7
Nominal Incidence Angles (°)	20-27	24-31	30-37	34-40	36-42	41-46	45-49
Nominal Range Resolution	N/A						
Nominal Azimuth Resolution	N/A						
Nominal PSLR	N/A						
Nominal ISLR	N/A						
Radiometric Error	< 3 dB						
Radiometric Linearity (2)	> 0.97						
Absolute Location Error	<750 m						
Geometric Distortion	<40 m						
Relative Phase Error	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
Effective Number of Looks	3.1						
Range Spectral Weighting	Kaiser window (coefficient 2.8)						
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)						
Notes							
(1)	A Standard SPG Product will be ONE of beams S1 to S7.						
(2)	SAR Processor specification. Excludes contribution from other sources of error.						

Appendix A-23: SPG, Precision Map Image, Fine Beam

SPG Product from Fine Beam					
Format	CEOS				
Output Media	Exabyte Tape, CD-ROM, Image LAN				
	Product Characteristics				
Coordinate System	See Appendix C.				
Nominal Image Coverage	50 km (range) x 50 km (azimuth)				
Pixel Spacing	6.25 m (range) x 6.25 m (azimuth)				
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)				
Nominal Image Size	10400 pixels x 10400 lines				
Nominal Product Volume	102 MB in 8 bit, 204 MB in 16 bit				
	Image Quality Characteristics				
Beams (1)	F1	F2	F3	F4	F5
Nominal Incidence Angles (°)	37-40	39-42	41-44	43-46	45-47
Nominal Range Resolution	N/A				
Nominal Azimuth Resolution	N/A				
Nominal PSLR	N/A				
Nominal ISLR	N/A				
Radiometric Error	< 1 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	<750 m				
Geometric Distortion	<40 m				
Relative Phase Error	N/A				
	Processing Parameters				
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
Effective Number of Looks	1				
Range Spectral Weighting	Kaiser window (coefficient 2.4)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)				
	Notes				
(1)	A Fine Resolution SPG Product will be ONE of beams F1 to F5.				
(2)	SAR Processor specification. Excludes contribution from other sources of error.				

Appendix A-24: SPG, Precision Map Image, Wide Beam

SPG Product from Wide Beam			
Format	CEOS		
Output Media	Exabyte Tape, CD-ROM, Image LAN		
Product Characteristics			
Coordinate System	See Appendix C.		
Nominal Image Coverage	150 km (range) x 150 km (azimuth)		
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)		
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)		
Nominal Image Size	16000 pixels x 16000 lines		
Nominal Product Volume	256 MB in 8 bit, 512 MB in 16 bit		
Image Quality Characteristics			
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolution	N/A		
Nominal Azimuth Resolution	N/A		
Nominal PSLR	N/A		
Nominal ISLR	N/A		
Radiometric Error	< 1 dB		
Radiometric Linearity (2)	> 0.97		
Absolute Location Error	<750 m		
Geometric Distortion	<40 m		
Relative Phase Error	N/A		
Processing Parameters			
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
Effective Number of Looks	3.1		
Range Spectral Weighting	Kaiser window (coefficient 2.8)		
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)		
Notes			
(1)	A Wide SPG Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

Appendix A-25: SPG, Precision Map Image, Extended High Beam

SPG Product from Extended High Beam						
Format	CEOS					
Output Media	Exabyte Tape, CD-ROM, Image LAN					
	Product Characteristics					
Coordinate System	See Appendix C.					
Nominal Image Coverage	75 km (range) x 75 km (azimuth)					
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)					
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)					
Nominal Image Size	8000 pixels x 8000 lines					
Nominal Product Volume	64 MB in 8 bit, 128 MB in 16 bit					
	Image Quality Characteristics					
Beams (1)	EH1	EH2	EH3	EH4	EH5	EH6
Nominal Incidence Angles (°)	49-52	50-53	52-55	54-57	56-58	57-60
Nominal Range Resolution	N/A					
Nominal Azimuth Resolution	N/A					
Nominal PSLR	N/A					
Nominal ISLR	N/A					
Radiometric Error	< 3 dB					
Radiometric Linearity (2)	> 0.97					
Absolute Location Error (2)	<750 m					
Geometric Distortion (2)	<40 m					
Relative Phase Error	N/A					
	Processing Parameters					
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Effective Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
	Notes					
(1)	An Extended High SPG Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

Appendix A-26: SPG, Precision Map Image, Extended Low Beam

SPG Product from Extended Low Beam	
Format	CEOS
Output Media	Exabyte Tape, CD-ROM, Image LAN
Product Characteristics	
Coordinate System	See Appendix C.
Nominal Image Coverage	170 km x 170 km
Pixel Spacing	12.5 m (range) x 12.5 m (azimuth)
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)
Nominal Image Size	17600 pixels x 17600 lines
Nominal Product Volume	310 MB in 8 bit, 620 MB in 16 bit
Image Quality Characteristics	
Beams (1)	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution	N/A
Nominal Azimuth Resolution	N/A
Nominal PSLR	N/A
Nominal ISLR	N/A
Radiometric Error	< 3 dB
Radiometric Linearity (2)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
Effective Number of Looks	3.1
Range Spectral Weighting	Kaiser window (coefficient 2.8)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)
Notes	
(1)	An Extended Low SPG Product will be beam EL1.
(2)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A-27: SCN, ScanSAR Narrow, ScanSAR Narrow Beam

SCN Product from ScanSAR Narrow Beam

Format	CEOS				
Output Media	Exabyte tape, CD-ROM, Image LAN				
Product Characteristics					
Coordinate System	Ground Range				
Nominal Image Coverage	300 km (range) x (user specified azimuth)				
Pixel Spacing	25 m (range) x 25 m (azimuth)				
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)				
Nominal Image Size	12000 pixels x (4000 lines per 100 km of azimuth)				
Nominal Product Volume	48 MB in 8 bit, 96 MB in 16 bit per 100 km of azimuth				
Image Quality Characteristics					
Beam Combinations (1)	SNA		SNB		
	W1	W2	W2	S5	S6
Nominal Incidence Angles (°)	20-31	31-39	31-39	36-42	41-46
Nominal Range Resolution (2) (m)	81.5-53.7	54.4-43.8	54.4-43.8	46.8-41.4	42.1-38.4
Nominal Azimuth Resolution (2)	47.8 m	53.8 m	71.1 m	71.9 m	78.8 m
Nominal PSLR (2)	-20.2 dB (range), -20.6 dB (azimuth)				
Nominal ISLR (2)	-13.6 dB				
Radiometric Error	< 3 dB				
Radiometric Linearity (2)	> 0.97				
Absolute Location Error	< 750 m				
Geometric Distortion	< 40 m				
Relative Phase Error	N/A				
Processing Parameters					
Number of Azimuth Looks	2				
Nominal Number of Range Looks	2				
Effective Number of Looks	3.5				
Number of Samples in Matched Filter	111		84		
Azimuth FM Rate	2008 Hz/s	1846 Hz/s	1846 Hz/s	1763 Hz/s	1662 Hz/s
Effective Range Spectral Weighting (3)	Kaiser window (coefficient 2.8)				
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)				

Notes	
(1)	A ScanSAR Narrow SCN product will be ONE of beam combinations W1 + W2 or W2 + S5 + S6.
(2)	SAR Processor specification. Excludes contribution from other sources of error.
(3)	Range Spectral Weighting results from range look extraction.

Appendix A-28: SCW, ScanSAR Wide, ScanSAR Wide Beam

SCW Product from ScanSAR Wide Beam

Format	CEOS							
Output Media	Exabyte tape, CD-ROM, Image LAN							
Product Characteristics								
Coordinate System	Ground Range							
Nominal Image Coverage	500 km (range) x (user specified azimuth)							
Pixel Spacing	50 m (range) x 50 m (azimuth)							
Pixel Data Representation	8 or 16 bit unsigned integer (magnitude detected)							
Nominal Image Size	10000 pixels x (2000 lines per 100 km of azimuth)							
Nominal Product Volume	20 MB in 8 bit, 40 MB in 16 bit per 100 km of azimuth							
Image Quality Characteristics								
Beam Combinations (1)	SWA				SWB			
	W1	W2	W3	S7	W1	W2	S5	S6
Nominal Incidence Angles (°)	20-31	31-39	39-45	45-49	20-31	31-39	36-42	41-46
Nominal Range Resolution (m) (2)	162.7-107.3	108.7-87.4	88.0-78.5	78.9-73.3	162.8-107.3	108.7-87.4	93.5-82.8	84.0-76.6
Nominal Azimuth Resolution (m) (2)	93.1	104.7	117.3	117.5	93.1	104.7	106.0	117.6
Nominal PSLR (2)	-20.2 dB (range), -20.6 dB (azimuth)							
Nominal ISLR (2)	-13.6 dB							
Radiometric Error	< 3 dB							
Radiometric Linearity (2)	> 0.97							
Absolute Location Error	< 750 m							
Geometric Distortion	< 120 m							
Relative Phase Error	N/A							
Processing Parameters								
Number of Azimuth Looks	2							
Nominal Number of Range Looks	4							
Effective Number of Looks	7							
Number of Samples in Matched Filter	57							
Azimuth FM Rate (Hz/s)	2008	1846	1703	1590	2008	1846	1763	1662
Effective Range Spectral Weighting (3)	Kaiser window (coefficient 2.8)							
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)							

Notes	
(1)	A Wide ScanSAR SCN Product will be ONE of beam combinations W1+W2+W3+S7 or W1+W2+S5+S6.
(2)	SAR Processor specification. Excludes contribution from other sources of error.
(3)	Range Spectral Weighting results from range look extraction.

APPENDIX B - CEOS RECORD STRUCTURE AND CONTENTS

Explanation for the following Appendix B tables:

In the Format column:

There are two types of data representation used, i.e. binary number (B) and ASCII character string (A, I, F, D and E) with field width in bytes (w) and digits after the decimal point (d), where

Bw	=	binary data,
Aw	=	ASCII character data,
Iw	=	integer number in textual form,
Fw.d	=	floating point number in textual form,
Dw.d	=	double precision number in textual form,
Ew.dEe	=	exponential number in textual form, and
e	=	exponent.

Example: "E16.7" means the format of the content of this field is defined as exponential number in text format, width 16 bytes, with 7 digits after the decimal point.

In the Content column:

Number	=	a constant value (e.g. 192),
"*"	=	a calculated or assigned value,
"$"	=	a space between characters,
"– "	=	repeat the previous field
"x "	=	Alphanumerical text
"---"	=	defining the meaning of the previous term

Appendix B-1: Volume Descriptor Record Contents

(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	1	Record sequence number
2	rec_sub1	5	B1	192	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	format_doc	17-28	A12	CCB-CCT-0002	Format control documentation
10	format_ver	29-30	A2	$E	Format doc version
11	format_rev	31-32	A2	$A	Format doc revision
12	software_id	33-44	A12	* <n>.<m> where <n>.<m> is the version number	Software identifier
13	phyvol_id	45-60	A16	xxxxxxxx$$$$$$$$ (where $ is space - not to be used)	Physical volume identifier
14	logvol_id	61-76	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX = RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Logical volume identifier
15	volset_id	77-92	A16	*	Volume set identifier
16	phyvol_cnt	93-94	I2	*	Total physical volume count
17	first_phyvol	95-96	I2	$1	Physical volume of first tape
18	last_phyvol	97-98	I2	*	Physical volume of last tape
19	curr_phyvol	99-100	I2	*	Physical volume of current tape
20	first_file	101-104	I4	*	First file number in physical volume
21	volset_log	105-108	I4	$$$1	Logical volume within set
22	phyvol_log	109-112	I4	$$$1	Logical volume within phyvol
23	logvol_date	113-120	A8	*	Logvol creation date
24	logvol_time	121-128	A8	*	Logvol creation time
25	logvol_country	129-140	A12	*	Logvol generation country
26	logvol_agency	141-148	A8	*	Logvol generation agency
27	logvol_facility	149-160	A12	*	Logvol generation facility
28	n_filepoint	161-164	I4	$$$3	Number of file pointer records
29	n_voldir	165-168	I4	$$$5	Number of records in volume directory file
30	spare2	169-260	A92	blanks	Unused
31	product_id	261-268	A8	*	Product identifier
32	spare3	269-360	A92	blanks	Local use segment

Appendix B-2: SAR Leader File Pointer Record

(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	2	Record sequence number
2	rec_sub1	5	B1	219	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	file_num	17-20	I4	$$$1	Referenced file number
10	file_name	21-36	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Referenced file name
11	file_class	37-64	A28	SARLEADER$FILE$$$$$$$$$$$$$$	Referenced file class
12	file_code	65-68	A4	SARL	Referenced file class code
13	data_type	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	Referenced file data type
14	data_code	97-100	A4	MBAA	Referenced file data type code
15	nrec	101-108	I8	RAW=$$$$$$$3 SCN=$$$$$$$2 SCW=$$$$$$$2 SGF=$$$$$$$9/$$$$$$10[a] SGX=$$$$$$$9/$$$$$$10[a] SLC=$$$$$$$9/$$$$$$10[a] SPG=$$$$$$$3/$$$$$$$4[b] SSG=$$$$$$$3/$$$$$$$4[b]	Referenced file record count
16	first_len	109-116	I8	$$$$$720	First record length, bytes
17	max_len	117-124	I8	*	Maximum record length, bytes
18	len_type	125-136	A12	VARIABLE$LEN	Record length type
19	len_code	137-140	A4	VARE	Record length type code
20	first_phyvol	141-142	I2	$1	First physical volume
21	last_phyvol	143-144	I2	$1	Last physical volume
22	first_rec	145-152	I8	$$$$$$$1	First physical volume record
23	last_rec	153-160	I8	*	Last physical volume record
24	spare2	161-260	A100	blanks	Unused
25	spare3	261-360	A100	blanks	Unused

a. 10 if elevation gain profile applied, 9 otherwise.
b. 4 if elevation gain profile applied, 3 otherwise.

Appendix B-3: Image Options File Pointer Record Contents
(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	3	Record sequence number
2	rec_sub1	5	B1	219	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record, bytes
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	file_num	17-20	I4	$$$2	Referenced file number
10	file_name	21-36	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Referenced file name
11	file_class	37-64	A28	IMAGERY$OPTIONS$FILE$$$$$$$$	Referenced file class
12	file_code	65-68	A4	IMOP	Referenced file class code
13	data_type	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	Referenced file data type
14	data_code	97-100	A4	MBAA	Referenced file data type code
15	nrec	101-108	I8	* (blank for SCN, SCW)	Referenced file record count
16	first_len	109-116	I8	$$$16252	First record length, bytes
17	max_len	117-124	I8	* (blank for SCN, SCW)	Maximum record length, bytes
18	len_type	125-136	A12	VARIABLE$LEN (for RAW) FIXED$LENGTH (for others)	Record length type
19	len_code	137-140	A4	VARE (for RAW) FIXD (for others)	Record length type code
20	first_phyvol	141-142	I2	$1	First physical volume
21	last_phyvol	143-144	I2	* (blank for SCN, SCW)	Last physical volume
22	first_rec	145-152	I8	*	First phyvol record
23	last_rec	153-160	I8	*(blank for SCN, SCW)	Last phyvol record
24	spare2	161-260	A100	blanks	Unused
25	spare3	261-360	A100	blanks	Unused

Appendix B-4: SAR Trailer File Pointer Record Contents
(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	4	Record sequence number
2	rec_sub1	5	B1	219	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	file_num	17-20	I4	$$$3	Referenced file number
10	file_name	21-36	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Referenced file name
11	file_class	37-64	A28	SARTRAILER$FILE$$$$$$$$$$$$	Referenced file class
12	file_code	65-68	A4	SART	Referenced file class code
13	data_type	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	Referenced file data type
14	data_code	97-100	A4	MBAA	Referenced file data type code
15	nrec	101-108	I8	RAW=$$$$$$$1 SCN=$$$$$$$8/$$$$$$$9[a] SCW=$$$$$$$8/$$$$$$$9[a] SGF=$$$$$$$1 SGX=$$$$$$$1 SLC=$$$$$$$1 SPG=$$$$$$$5 SSG=$$$$$$$5	Referenced file record count
16	first_len	109-116	I8	$$$$$720	First record length, bytes
17	max_len	117-124	I8	*	Maximum record length, bytes
18	len_type	125-136	A12	VARIABLE$LEN	Record length type
19	len_code	137-140	A4	VARE	Record length type code
20	first_phyvol	141-142	I2	*	First physical volume
21	last_phyvol	143-144	I2	*	Last physical volume
22	first_rec	145-152	I8	*	First physical volume record
23	last_rec	153-160	I8	*	Last physical volume record
24	spare2	161-260	A100	blanks	Unused
25	spare3	261-360	A100	blanks	Unused

a. 9 if elevation gain profile applied, 8 otherwise.

Appendix B-5: Text Record Contents

(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	5	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	63	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	cont_flag	15-16	A2	$$	Continuation flag
9	product_type	17-56	A40	RAW=PRODUCT:$RSAT-1-SAR-UNPROCESSED$SIGNAL$ SCN=PRODUCT:$RSAT-1-SAR-SCN$BULK$IMAGE$DATA$ SCW=PRODUCT:$RSAT-1-SAR-SCW$BULK$IMAGE$DATA$ SGF=PRODUCT:$RSAT-1-SAR-SGF$SPECIAL$PRODUCT$ SGX=PRODUCT:$RSAT-1-SAR-SGX$SPECIAL$PRODUCT$ SLC=PRODUCT:$RSAT-1-SAR-SLC$SPECIAL$PRODUCT$ SPG=PRODUCT:$RSAT-1-SAR-SPG$x$PREC$GEOCODED$ SSG=PRODUCT:$RSAT-1-SAR-SSG$x$SYSM$GEOCODED$ where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Product type specifier
10	product_create	57-116	A60	PROCESS:$ccccccccccc$aaaaaaaa$fffffffffff$YYYYMMDD$$$$$$$$$ (where: ccccccccccc --- creating country; aaaaaaaa --- creating agency; fffffffffff --- creating facility)	Product creation info
11	phyvol_id	117-156	A40	TAPE$ID:xxxxxxxx$$$$$$$$,$TAPE$nn$$$$$$$ (for SCN, SCW) TAPE$ID:xxxxxxxx$$$$$$$$,$TAPE$nnOFnn$ (for others) (where: xxxxxxxx$$$$$$$$ --- physical tape id)	Physical volume identifier; **Tape ID must be unique number for each tape**, same as for “Tape ID” in Null Volume Description Record
12	scene_id	157-196	A40	ORBIT$:nnnnnnn$DYYYYMMDD-Thhmmssttt$$$$$ (where: nnnnnnn --- orbit number (currently, it is spaces for SSG and SPG); DYY...ttt --frame centre acquisition date and time [acquisition date/time of first image line for SCN and SCW])	Scene identifier
13	scene_loc	197-236	A40	blank (for RAW, SCN, SCW) FRAME$CENTRE:$pXnnn.nn$$qXnnn.nn$$$$$$$$ (for SGF, SGX, SLC) (where: p --- N or S latitude; q --- E or W longitude; X --- + or -; nnn.nn --- degrees) * (for SPG, SSG)	Scene location
14	copyright_info	237-256	A20	Copyright CSA (yyyy) where yyyy is the year of acquisition	Copyright
15	spare2	257-360	A104	blanks	Unused

Appendix B-6: SAR Leader File - File Descriptor Record Contents
(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	1	Record sequence number
2	rec_sub1	5	B1	63	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	720	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	*<n>.<m> where <n>.<m> is the version number	Software identifier
13	file_num	45-48	I4	$$$1	File number
14	file_name	49-64	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	File name
15	rec_seq	65-68	A4	FSEQ	Record sequence/location flag
16	seq_loc	69-76	I8	$$$$$$$1	Sequence number location
17	seq_len	77-80	I4	$$$4	Sequence number length
18	rec_code	81-84	A4	FTYP	Record code/location flag
19	code_loc	85-92	I8	$$$$$$$5	Record code location
20	code_len	93-96	I4	$$$4	Record code length
21	rec_len	97-100	A4	FLGT	Record length/location flag
22	rlen_loc	101-108	I8	$$$$$$$9	Record length location
23	rlen_len	109-112	I4	$$$4	Record length, bytes
24-27	spare2	113-116	4A1	Blanks	Reserved
28	spare3	117-180	A64	Blanks	Reserved segment
29	n_dataset	181-186	I6	$$$$$0 (for SCN, SCW, SPG, SSG) $$$$$1 (for others)	Number of dataset summary records
30	l_dataset	187-192	I6	$$$$$0 (for SCN, SCW, SPG, SSG) $$4096 (for others)	Data set summary record length, bytes
31	n_map_proj	193-198	I6	$$$$$1 (for SSG, SPG) $$$$$0 (for others)	Number of map proj records
32	l_map_proj	199-204	I6	$$1620 (for SSG, SPG) $$$$$0 (for others)	Map projection record length, bytes
33	n_plat_pos	205-210	I6	$$$$$1 $$$$$0 (for SPG, SSG)	Number of platform position records

Number	Mnemonic	Bytes	Format	Content	Description
34	l_plat_pos	211-216	I6	$$8960 $$$$$0 (for SPG, SSG)	Platform position record length, bytes
35	n_att_data	217-222	I6	$$$$$1 (SGF, SGX, SLC) $$$$$0 (for others)	Number of attitude data records
36	l_att_data	223-228	I6	$$8960 (SGF, SGX, SLC) $$$$$0 (for others)	Attitude data record length, bytes
37	n_radi_data	229-234	I6	$$$$$0 (RAW, SCN, SCW) $$$$$1 (for others)	Number of radiometric data records
38	l_radi_data	235-240	I6	$$$$$0 (RAW, SCN, SCW) $$9860 (for others)	Radiometric data record length, bytes
39	n_radi_comp	241-246	I6	$$$$$0 (RAW, SCN, SCW) $$$$$1 (for others)[a]	Number of radiometric compensation records
40	l_radi_comp	247-252	I6	$$$$$0 (RAW, SCN, SCW) $16836 (for others)[a]	Radiometric compensation record length, bytes
41	n_qual_sum	253-258	I6	$$$$$0 (for SCN, SCW, SPG, SSG, RAW) $$$$$1 (for others)	Number of data quality summary records
42	l_qual_sum	259-264	I6	$$$$$0 (SCN, SCW, SPG, SSG, RAW) $$1620 (for others)	Data quality summary record length, bytes
43	n_data_hist	265-270	I6	$$$$$0 (for RAW, SCN, SCW, SSG, SPG) $$$$$2 (for others)	Number of data histogram records
44	l_data_hist	271-276	I6	$$$$$0 (RAW, SCN, SCW, SSG, SPG) $16920 (for others)	Data histogram record length, bytes
45	n_rang_spec	277-282	I6	$$$$$0	Number of range spectra records
46	l_rang_spec	283-288	I6	$$$$$0	Range spectra record length, bytes
47	n_dem_desc	289-294	I6	$$$$$0	Number of DEM descriptor records
48	l_dem_desc	295-300	I6	$$$$$0	DEM description record length, bytes
49	n_radar_par	301-306	I6	$$$$$0	Number of RADAR parameter records
50	l_radar_par	307-312	I6	$$$$$0	RADAR parameter record length, bytes
51	n_anno_data	313-318	I6	$$$$$0	Number of annotation data records
52	l_anno_data	319-324	I6	$$$$$0	Annotation data record length, bytes
53	n_det_proc	325-330	I6	$$$$$1 (for SGF, SGX, SLC) $$$$$0 (for others)	Number of detailed processing parameter records
54	l_det_proc	331-336	I6	$$7726 (for SGF, SGX, SLC) $$$$$0 (for others)	Detailed processing parameter record length, bytes
55	n_cal	337-342	I6	$$$$$0	Number of calibration records
56	l_cal	343-348	I6	$$$$$0	Calibration record length, bytes
57	n_gcp	349-354	I6	$$$$$0	Number of GCP records
58	l_gcp	355-360	I6	$$$$$0	GCP record length, bytes
59-68	spare4	361-420	10I6	$$$$$0	Unused
69	n_fac_data	421-426	I6	$$$$$0	Number of facility data records
70	l_fac_data	427-432	I6	$$$$$0	Facility data record length, bytes
71	spare5	433-720	A288	Blanks	Unused

a. These are 0 if elevation beam profile not applied.

Appendix B-7: Data Set Summary Record Contents
(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Note: in SAR Leader for RAW, SGF, SGX, SLC; in SAR Trailer for SCN, SCW, SPG and SSG

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	2	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	10	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	Length	9-12	B4	4096	Length of this record
7	seq_num	13-16	I4	1	Sequence number
8	sar_chn	17-20	I4	1	SAR channel indicator
9	scene_id	21-36	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$$ SSG=RSAT-1-SAR-SSG$$	Scene identifier
10	scene_des	37-68	A32	blank	Scene designator
11	inp_sctim	69-100	A32	*	Input swath start time for SCN, SCW. Input scene centre time for others.
12	asc-des	101-116	A16	ASCENDING or DESCENDING	Ascending/Descending flag
13	pro_lat	117-132	F16.7	blank (for RAW) * (for others)	Processed scene centre latitude (note: latitude of mid-point of the first line for SCN, SCW). Output coordinates at zero doppler
14	pro_long	133-148	F16.7	blank (for RAW) * (for others)	Processed scene centre longitude (note: longitude of mid-point of the first line for SCN, SCW). Output coordinates at zero doppler
15	pro_head	149-164	F16.7	blank (for RAW, SSG, SPG) * (for others)	Processed scene centre heading (middle pixel heading of first line for SCN, SCW). Output coordinates at zero doppler
16	ellip_des	165-180	A16	WGS-84$$$$$$$$$$	Ellipsoid designator
17	ellip_maj	181-196	F16.7	6378.140	Ellipsoid semi-major axis, km
18	ellip_min	197-212	F16.7	6356.755	Ellipsoid semi_minor axis, km
19	earth_mass	213-228	E16.7	*	Earth's mass (kg)
20	grav_const	229-244	E16.7	*	Gravitational constant ($m^{3/(kg.s2))}$
21-23	ellip_j	245-292	3E16.7	*	Ellipsoid J2-4 parameters
24	spare2	293-308	A16	Blank	Unused
25	terrain_h	309-324	F16.7	Blank	Average terrain height, km
26	sc_lin	325-332	I8	blank (for RAW) * (1/2 max no. lines for others)	Scene centre line number (rounded down)
27	sc_pix	333-340	I8	blank (for RAW) * (1/2 max no. pixels for others)	Scene centre pixel number (rounded down)

Number	Mnemonic	Bytes	Format	Content	Description
28	scene_len	341-356	F16.7	blank (for RAW) * (for others)	Scene length, km
29	scene_wid	357-372	F16.7	blank (for RAW) * (for others)	Scene width, km
30	spare3	373-388	A16	Blank	Unused
31	nchn	389-392	I4	1	Number of SAR channels
32	spare5	393-396	A4	Blank	Unused
33	mission_id	397-412	A16	RSAT-1$$$$$$$$$$	Mission identifier
34	sensor_id	413-444	A32	RSAT-1-C$-$$$$-HH$$$$$$$$$$$$$$$$	Sensor identifier
35	orbit_num	445-452	A8	* (blanks for SSG, SPG)	Orbit number
36	plat_lat	453-460	F8.3	* (blanks for SSG, SPG, RAW)	Platform geodetic latitude for scene centre (note: first line for SCN, SCW)
37	plat_long	461-468	F8.3	* (blanks for SSG, SPG, RAW)	Platform geodetic longitude for scene centre (note: first line for SCN, SCW)
38	plat_head	469-476	F8.3	* (blanks for SSG, SPG, RAW)	Platform heading (note: first line for SCN, SCW)
39	clock_ang	477-484	F8.3	* (-90.0 or +90.0)	Sensor clock angle
40	incident_ang	485-492	F8.3	*(blank for RAW)	Incidence angle
41	spare15	493-500	A8	Blank	Unused
42	wave_length	501-516	F16.7	0.05656	Radar wave length
43	motion_comp	517-518	A2	00	Motion compensation indicator
44	pulse_code	519-534	A16	LINEARFMCHIRP$	Range pulse code specifier
45 - 49	ampl_coef	535-614	5E16.7	blank (for RAW) * (for others)	Range chirp coefficients (from X-Band downlink)
50 - 54	phas_coef	615-694	5E16.7	blank (for RAW) * (for others)	Range phase coefficients (from X-Band downlink)
55	chirp_ext_ind	695-702	I8	blank (for RAW) * (for others)	Chirp extraction index
56	spare6	703-710	A8	Blank	Unused
57	fr	711-726	F16.7	*(blank for RAW)	Range sampling rate
58	rng_gate	727-742	F16.7	*(blank for RAW)	Range gate start time
59	rng_length	743-758	F16.7	* (42 microseconds nominal)	Range pulse length
60	baseband_f	759-762	A4	YES$	Baseband conversion flag
61	rngcmp_f	763-766	A4	NOT$	Range compressed flag
62	gn_polar	767-782	F16.7	Blank	Like polarized gain
63	gn_cross	783-798	F16.7	Blank	Cross polarized gain
64	chn_bits	799-806	I8	4	Number of bits per channel
65	quant_desc	807-818	A12	UNIFORMI,Q	Quantization descriptor
66	i_bias	819-834	F16.7	blank (for RAW) * (for others)	I channel DC bias
67	q_bias	835-850	F16.7	blank (for RAW)* (for others)	Q channel DC bias
68	iq_ratio	851-866	F16.7	blank (for RAW)* (for others)	I/Q channel ratio
69	spare7	867-882	F16.7	Blank	Unused
70	spare8	883-898	F16.7	Blank	Unused
71	ele_sight	899-914	F16.7	blank (for SSG, SPG, RAW) * (nominal values)	Electronic boresight
72	mech_sight	915-930	F16.7	Blank	Mechanical boresight

Number	Mnemonic	Bytes	Format	Content	Description
73	echo_track	931-934	A4	ON$$or OFF$ (blank for SSG, SPG, RAW)	Echo tracker on/off flag
74	fa	935-950	F16.7	blank (for SCN, SCW, SSG, SPG, RAW) * (for others)	Nominal PRF, Hz
75	elev_beam	951-966	F16.7	blank	Elevation beamwidth
76	azim_beam	967-982	F16.7	blank	Azimuth beamwidth
77	sat_bintim	983-998	I16	blank	Satellite binary time
78	sat_clktim	999-1030	I32	blank	Satellite clock time
79	sat_clkinc	1031-1038	I8	blank	Satellite clock increment
80	spare9	1039-1046	A8	blank	Unused
81	fac_id	1047-1062	A16	*	Processing facility identifier
82	sys_id	1063-1070	A8	*	Processing system identifier
83	ver_id	1071-1078	A8	VER$<n>.<m> (where <n>.<m> is the version number)	Processing version identifier
84	fac_code	1079-1094	A16	*	Facility process code
85	lev_code	1095-1110	A16	blank	Product level code
86	prod_type	1111-1142	A32	RAW=UNPROCESSED$SIGNAL$DATA$$$$$$$$ SCN=SCANSAR$NARROW$$$$$$$$$$$$$$$$$$ SCW=SCANSAR$WIDE$$$$$$$$$$$$$$$$$$$$ SGF=SAR$GEOREF$FINE$$$$$$$$$$$$$$$$ SGX=SAR$GEOREF$EXTRA$FINE$$$$$$$$$$ SLC=SPECIAL$PRODUCT(SINGL-LOOK$COMP) SPG=PRECISION$$GEOCODED$<mmmm>$$$$$$$$ SSG=SYSTEMATICS$GEOCODED$<mmmm>$$$$$$$$ (where <mmmm> is map projection)	Product type specifier
87	algor_id	1143-1174	A32	blank (for RAW) SPECAN $$$$$$$$$$$$$$$$$$$$$$$$ (for SCN, SCW) RANGE$DOPPLER$$$$$$$$$$$$$$$$$$ (for others)	Processing algorithm identifier
88	n_azilok	1175-1190	F16.7	RAW=blank SCN and SCW =2 SGF and SGX =* SLC=1 SPG and SSG =blank	Number of azimuth looks
89	n_rnglok	1191-1206	F16.7	RAW=blank SCN and SCW =* SGF and SGX =1 SLC=1 SPG and SSG =1	Number of range looks
90	bnd_azilok	1207-1222	F16.7	blank (RAW) * (others)	Azimuth look bandwidth
91	bnd_rnglok	1223-1238	F16.7	blank (RAW) * (others)	Range look bandwidth
92	bnd_azi	1239-1254	F16.7	blank (RAW) * (others)	Total azimuth look bandwidth
93	bnd_rng	1255-1270	F16.7	blank (RAW) * (others)	Total range look bandwidth
94	azi_weight	1271-1302	A32	* Kaiser (weighting = *) (blank for RAW)	Azimuth weighting designator
95	rng_weight	1303-1334	A32	* Kaiser (weighting = *) (blank for RAW)	Range weighting designator

Number	Mnemonic	Bytes	Format	Content	Description
96	data_inpsrc	1335-1350	A16	*	Data input source
97	rng_res	1351-1366	F16.7	blank (RAW) * (others)	Nominal resolution in range (meter)
98	azi_res	1367-1382	F16.7	blank (RAW) * (others)	Nominal resolution in azimuth (meter)
99 - 100	radi_stretch	1383-1414	2F16.7	blank	Constant radiometric parameter (Bias) Linear radiometric parameter (Gain)
101 - 103	alt_dopcen	1415-1462	3E16.7	* (for SCN, SCW) blank (for others)	Along track Doppler frequency constant term at early edge of image (HZ) Along track Doppler frequency linear term at early edge of the image (Hz/pixel) Along track Doppler frequency quadratic term at early edge of the image (Hz/pixel/pixel)
104	spare10	1463-1478	A16	blank	Unused
105 - 107	crt_dopcen	1479-1526	3E16.7	blank (for RAW,SSG,SPG) * (for others)	Cross track Doppler freq term at early edge of image (HZ) Cross track Doppler frequency linear term at early edge of the image (Hz/pixel) Cross track Doppler frequency quadratic term at early edge of the image (Hz/pixel/pixel)
108	time_dir_pix	1527-1534	A8	RAW=INCREASE SCN=INCREASE SCW=INCREASE SGF, SGX and SLC =* SPG and SSG =blank	Pixel time direction indicator
109	time_dir_lin	1535-1542	A8	RAW=INCREASE SCN=INCREASE SCW=INCREASE SGF, SGX and SLC =* SPG and SSG =blank	Line time direction indicator
110 - 112	alt_rate	1543-1590	3E16.7	blank	Along track Doppler rate term
113	spare12	1591-1606	A16	blank	Unused
114 - 116	crt_rate	1607-1654	3E16.7	* (blank for RAW, SSG, SPG)	Cross track Doppler rate term
117	spare13	1655-1670	A16	blank	Unused
118	line_cont	1671-1678	A8	OTHER$$$ (for SPG, SSG) RANGE$$$ (for others)	Line content indicator
119	clutter_lock	1679-1682	A4	NOT$	Clutter lock applied flag
120	auto_focus	1683-1686	A4	NOT$	Auto-focus applied flag
121	line_spacing	1687-1702	F16.7	blank (RAW) * (others)	Line spacing (m)
122	pix_spacing	1703-1718	F16.7	blank (RAW) * (others)	Pixel spacing (m)
123	rngcmp_desg	1719-1734	A16	blank (RAW) * (others)	Range compression designator
124	spare14	1735-4096	A2362	blanks	Unused

Appendix B-8: Data Quality Summary Record Contents
(for SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Note: in SAR Leader for SGF, SGX, SLC; in SAR Trailer for SCN, SCW, SPG and SSG

Number	Mnemonic	Bytes	Format	Comment	Description
1	rec_seq	1-4	B4	3	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	60	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	1620	Length of this record
7	rec_seq	13-16	I4	1	Record sequence number
8	sar_chn	17-20	A4	1	SAR channel indicator
9	cali_date	21-26	A6	blank	Calibration update date
10	nchn	27-30	I4	1	Number of channels
11	islr	31-46	F16.7	*	Nominal Integrated side lobe ratio, dB
12	pslr	47-62	F16.7	*	Nominal Peak side lobe ratio, dB
13	azi_ambig	63-78	F16.7	-25 (blank for SSG, SPG)	Nominal Azimuth ambiguity
14	rng_ambig	79-94	F16.7	-25 (blank for SSG, SPG)	Nominal Range ambiguity
15	snr	95-110	F16.7	blank	Nominal Signal to noise ratio
16	ber	111-126	F16.7	blank	Nominal Bit error rate
17	rng_res	127-142	F16.7	25.0	Nominal slant range resolution, meters
18	azi_res	143-158	F16.7	25.0	Nominal Azimuth resolution, meters
19	rad_res	159-174	F16.7	blank	Nominal radiometric resolution, dB
20	dyn_rng	175-190	F16.7	30 (blank for SSG, SPG)	Instantaneous dynamic range
21	rad_unc_db	191-206	F16.7	1 (blank for SSG, SPG)	Nominal Radiometric uncertainty, dB
22	rad_unc_deg	207-222	F16.7	blank	Radiometric uncertainty, deg
23	db	223-238	F16.7	blank	Units of db
24	deg	239-254	F16.7	blank	Units of deg
25-52	-	255-734	-	-	Repeat fields 23 to 24, 15 times
53	alt_locerr	735-750	F16.7	600 (blank for SSG/SPG)	Nominal Along track location error, meters
54	crt_locerr	751-766	F16.7	40 (blank for SSG/SPG)	Nominal Cross track location error, meters
55	alt_scale	767-782	F16.7	30 (blank for SSG/SPG)	Nominal geometric distortion scale in line direction
56	crt_scale	783-798	F16.7	30 (blank for SSG/SPG)	Nominal geometric distortion scale in pixel direction
57	dis_skew	799-814	F16.7	blank	Nominal Distortion skew
58	ori_err	815-830	F16.7	blank	Nominal Scene orientation error
59	alt_m	831-846	F16.7	blank	Nominal Along track misregistration
60	crt_m	847-862	F16.7	blank	Nominal Cross track misregistration
61-75	-	863-1342	-	-	Repeat fields 59 to 60, 15 times
76	nesz	1343-1358	F16.7	-22	Nominal noise equivalent sigma zero
77	enl	1359-1374	F16.7	*	Nominal equivalent Effective Number of Looks
78	tb_update	1375-1382	A8	YYYY-DDD	Default parameters table update date
79	spare	1383-1620	A238	blank	Unused

Appendix B-9: Data Histogram Record - Signal Data
(for SCN, SCW, SGF, SGX, SLC, SSG, SPG products)

Note: in SAR Leader for SGF, SGX, SLC; in SAR Trailer for SCN, SCW, SPG and SSG

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	4	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	70	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	16920	Length of this record
7	rec_seq	13-16	I4	1	Record sequence number
8	sar_chn	17-20	I4	1	SAR channel number
9	ntab	21-28	I8	1	Number of histogram table data sets in this record
10	ltab	29-36	I8	$$$$2296	Histogram table data set size (bytes)
11	hist_desc	37-68	A32	JOINTIQ$$$$$$$$$$$$$$$$$$$$$$$$	Histogram descriptor; first 4 bit for coded I and the second 4 bit for coded Q in each bin.
12	nrec	69-72	I4	1	Records per table
13	tab_seq	73-76	I4	1	Table sequence number
14	nbin	77-84	I8	256	Total number of histogram bins. Refer to text description of sampling methodology
15	ns_lin	85-92	I8	*	Number of lines sampled
16	ns_pix	93-100	I8	*	Number of pixels sampled
17	ngrp_lin	101-108	I8	*	Group size in line
18	ngrp_pix	109-116	I8	*	Groups size across line
19	nsamp_lin	117-124	I8	*	Samples in line group
20	nsamp_pix	125-132	I8	*	Samples across line group
21	min_smp	133-148	E16.7	0	Minimum first bin
22	max_smp	149-164	E16.7	255	Maximum last bin
23	mean_smp	165-180	E16.7	*	Mean sample value
24	std_smp	181-196	E16.7	*	Sample standard deviation
25	smp_inc	197-212	E16.7	1	Sample value increment
26	min_hist	213-228	E16.7	*	Minimum histogram value
27	max_hist	229-244	E16.7	*	Maximum histogram value
28	mean_hist	245-260	E16.7	*	Histogram mean value
29	std_hist	261-276	E16.7	*	Histogram standard deviation
30	nhist	277-284	I8	256	Histogram table size
31-286	hist	285-2332	256I8	*	256 Histogram table values of 16 bins for I x 16 bins for Q
287	spare	2333-16920	A14588	blanks	Unused

Appendix B-10: Data Histogram Record - Processed Data (16-bit)

(for SGF, SGX, SLC products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	5	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	70	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	16920	Length of this record
7	rec_seq	13-16	I4	1	Record sequence number
8	sar_chn	17-20	I4	1	SAR channel number
9	ntab	21-28	I8	SGF=1 SGX=1 SLC=2	Number of histogram table data sets in this records
10	ltab	29-36	I8	8440	Histogram table data set size
11	hist_desc	37-68	A32	DETECTED$DATA$$$$$$$$$$$$$$$$$$$$ (for SGF, SGX, SCN, SCW, SSG and SPG) I$COMPONENT$$$$$$$$$$$$$$$$$$$$ (for SLC)	Histogram descriptor. There are two histogram tables for SLC, one for I, the other for Q.
12	nrec	69-72	I4	1	Records per table
13	tab_seq	73-76	I4	1	Table sequence number
14	nbin	77-84	I8	1024	Total number of table bins. Refer to text description of sampling method.
15	ns_lin	85-92	I8	*	Number of lines sampled
16	ns_pix	93-100	I8	*	Number of pixels sampled
17	ngrp_lin	101-108	I8	*	Group size in line
18	ngrp_pix	109-116	I8	*	Groups size across line
19	nsamp_lin	117-124	I8	*	Samples in line group
20	nsamp_pix	125-132	I8	*	Samples across line group
21	min_smp	133-148	E16.7	0 (SGF, SGX) -32768 (SLC)	Minimum first bin
22	max_smp	149-164	E16.7	65535 (SGF, SGX) +32767 (SLC)	Maximum last bin
23	mean_smp	165-180	E16.7	*	Mean sample value
24	std_smp	181-196	E16.7	*	Sample standard deviation
25	smp_inc	197-212	E16.7	64	Sample value increment
26	min_hist	213-228	E16.7	*	Minimum histogram value
27	max_hist	229-244	E16.7	*	Maximum histogram value
28	mean_hist	245-260	E16.7	*	Histogram mean value
29	std_hist	261-276	E16.7	*	Histogram standard deviation
30	nhist	277-284	I8	1024	Histogram table size
31-1054	hist	285-8476	1024I8	*	Histogram table values for 1024 bins
1055	hist_desc	8477-8508	A32	SLC= Q$COMPONENT$$$$$$$$$$$$$$$$$$$$	Histogram descriptor. For SGF and SGX fields 1055 to 2098 are blank.
1056	nrec	8509-8512	I4	SLC=1	Records per table
1057	tab_seq	8513-8516	I4	SLC=2	Table sequence number
1058	nbin	8517-8524	I8	SLC=1024	Total number of table bins

Number	Mnemonic	Bytes	Format	Content	Description
1059	ns_lin	8525-8532	I8	SLC=*	Number of lines sampled
1060	ns_pix	8533-8540	I8	SLC=*	Number of pixels sampled
1061	ngrp_lin	8541-8548	I8	SLC=*	Group size in line
1062	ngrp_pix	8549-8556	I8	SLC=*	Groups size across line
1063	nsamp_lin	8557-8564	I8	SLC=*	Samples in line group
1064	nsamp_pix	8565-8572	I8	SLC=*	Samples across line group
1065	min_smp	8573-8588	E16.7	SLC=-32768	Minimum first bin
1066	max_smp	8589-8604	E16.7	SLC=+32767	Maximum last bin
1067	mean_smp	8605-8620	E16.7	SLC=*	Mean sample value
1068	std_smp	8621-8636	E16.7	SLC=*	Sample standard deviation
1069	smp_inc	8637-8652	E16.7	SLC=64	Sample value increment
1070	min_hist	8653-8668	E16.7	SLC=*	Minimum histogram value
1071	max_hist	8669-8684	E16.7	SLC=*	Maximum histogram value
1072	mean_hist	8685-8700	E16.7	SLC=*	Histogram mean value
1073	std_hist	8701-8716	E16.7	SLC=*	Histogram standard deviation
1074	nhist	8717-8724	I8	SLC=1024	Histogram table size
1075-2098	hist	8725-16916	1024I8	SLC=*	Histogram table
2099	spare	16917-16920	A3	blanks	Unused

Appendix B-11: Detailed Processing Parameters Record Contents
(for SGF, SGX, SLC, SCN, SCW products)

Note: in SAR Leader for SGF, SGX, SLC; in SAR Trailer for SCN and SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	6	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	120	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	7726	Length of this record
7	rec-seq	13-16	I4	1	Record sequence number
8	spare1	17-20	A4	blank	Unused
9	inp_media	21-23	A3	CCT/EXA/FS$/DLT/DSK	Input media; DSK=Disk
10	n_tape_id	24-27	I4	*	Number of input tape identifiers
11	tape_id	28-107	10A8	*	Tape identifiers
12	exp_ing_start	108-128	A21	YYYY-DDD-HH:MM:SS.SSS	Expected ingest start time; satellite time code
13	exp_ing_stop	129-149	A21	YYYY-DDD-HH:MM:SS.SSS	Expected ingest stop time; satellite time code
14	act_ing_start	150-170	A21	YYYY-DDD-HH:MM:SS.SSS	Actual ingest start time; satellite time code
15	act_ing_stop	171-191	A21	YYYY-DDD-HH:MM:SS.SSS	Actual ingest stop time; satellite time code
16	proc_start	192-212	A21	YYYY-DDD-HH:MM:SS.SSS	Processing start time; satellite time code
17	proc_stop	213-233	A21	YYYY-DDD-HH:MM:SS.SSS	Processing stop time; satellite time code
18-27	mn_sig_lev	234-393	10F16.7	*	Mean signal levels across range
28	src_data_ind	394-397	I4	*	Source data quality indicator
29	miss_ln	398-405	I8	*	Number of missing lines
30	rej_ln	406-413	I8	*	Number of rejected lines
31	large_gap	414-421	I8	*	Number of time inconsistencies (large gaps)
32	bit_err_rate	422-437	E16.7	*	Measured bit error rate
33	fm_crc_err	438-453	E16.7	*	Percent of frames with CRC errors
34	date_incons	454-461	I8	*	Number of date inconsistencies
35	prf_changes	462-469	I8	*	Number of unexpected PRF changes
36	delay_changes	470-477	I8	*	Number of delay changes
37	skipd_frams	478-485	I8	*	Number of skipped frames
38	rej_bf_start	486-493	I8	*	Range lines rejected before start time
39	rej_few_fram	494-501	I8	*	Range lines rejected due to too few frames
40	rej_many_fram	502-509	I8	*	Range lines rejected due to too many frames
41	rej_mchn_err	510-517	I8	*	Frames rejected due to master channel error
42	rej_vchn_err	518-525	I8	*	Frames rejected due to virtual channel error
43	rej_rec_type	526-533	I8	*	Frames rejected due to incorrect recording type
44	sens_config	534-543	A10	ASCENDING/DESCENDING	Sensor configuration (ascending/descending)
45	sens_orient	544-552	A9	NORMAL/ANTARCTIC	Sensor orientation (right/left looking)
46	sych_marker	553-560	A8	*	Frame synch marker
47	rng_ref_src	561-572	A12	PARAMETERS/REPLICA$DATA	Range reference function source
48-51	rng_amp_coef	573-636	4E16.7	*	Range reference amplitude coefficients
52-55	rng_phas_coef	637-700	4E16.7	*	Range reference phase coefficients
56-59	err_amp_coef	701-764	4E16.7	*	Error function amplitude coefficients
60-63	err_phas_coef	765-828	4E16.7	*	Error function phase coefficients
64	pulse_bandw	829-832	I4	1173/1748/3030	Pulse bandwidth x 10^{-2} MHz
65	adc_samp_rate	833-837	A5	12920/18460/32320	ADC sampling rate (x 10^{-3} Msamp/s)

Number	Mnemonic	Bytes	Format	Content	Description
66	rep_agc_attn	838-853	F16.7	*	Replica AGC attenuation
67	gn_corctn_fctr	854-869	F16.7	*	Gain correction factor (dB)
68	rep_energy_gn	870-885	F16.7	*	Replica energy gain correction
69	orb_data_src	886-896	A11	SIGNAL$DATA/ORBIT$FILE	Orbit data source; specifies whether the orbit file or Signal Data Ephemeris was used
70	pulse_cnt_1	897-900	I4	*	Pulse count 1
71	pulse_cnt_2	901-904	I4	*	Pulse count 2
72	beam_edge_rqd	905-907	A3	YES/NO$	Beam edge detection requested
73	beam_edge_conf	908-923	F16.7	*	Beam edge confidence measure
74	pix_overlap	924-927	I4	*	Number of pixels in beam overlap
75	n_beams	928-931	I4	*	Number of beams
76	beam_type	932-934	A3	*	Beam type
77	beam_look_src	935-943	A9	NOMINAL/AUX$DATA/BEAM$EDGE	Elevation beam look angle source
78	beam_look_ang	944-959	F16.7	*	Applied elevation beam look angle (deg)
79	prf	960-975	F16.7	*	Actual PRF (Hz)
80-91	-	976-1107	-	-	Repeat fields 76 to 79 another 3 times
92	n_pix_updates	1108-1111	I4	*	Number of pixel count updates
93	pix_update	1112-1132	A21	YYYY-DDD-HH:MM:SS.SSS	Pixel count update date/time
94-97	n_pix	1133-1164	4I8	*	Count of image pixels in beams
98-192	-	1165-2171	-	-	Repeat fields 93 to 97 another 19 times
193	pwin_start	2172-2187	F16.7	*	Processing window start time (sec)
194	pwin_end	2188-2203	F16.7	*	Processing window end time (sec)
195	recd_type	2204-2212	A9	REAL$TIME/PLAYBACK	Recording type
196	temp_set_inc	2213-2228	F16.7	*	Time increment between temperature settings (sec)
197	n_temp_set	2229-2232	I4	*	Number of temperature settings
198-201	temp_set	2233-2248	4I4	*	Temperature settings
202-277	-	2249-2552	-	-	Repeat fields 198 to 201 another 19 times
278	n_image_pix	2553-2560	I8	*	Number of image pixels sampled
279	prc_zero_pix	2561-2576	F16.7	*	Per cent zero pixels
280	prc_satur_pix	2577-2592	F16.7	*	Per cent saturated pixels
281	img_hist_mean	2593-2608	F16.7	*	Image histogram mean intensity
282-284	img_cumu_dist	2609-2656	3F16.7	*	Image cumulative distribution
285	pre_img_gn	2657-2672	F16.7	200.00	Pre-image calibration gain factor
286	post_img_gn	2673-2688	F16.7	200.00	Post-image calibration gain factor
287	dopcen_inc	2689-2704	F16.7	*	Time increment between Dopcen estimates (sec)
288	n_dopcen	2705-2708	I4	*	Number of Doppler centroid estimates
289	dopcen_conf	2709-2724	F16.7	*	Doppler centroid confidence measure
290	dopcen_ref_tim	2725-2740	F16.7	*	Doppler centroid reference time (sec)
291-294	dopcen_coef	2741-2804	4F16.7	*	Doppler centroid coefficients
295-408	-	2805-4628	-	-	Repeat fields 289 to 294 another 19 times
409	dopamb_err	4629-4632	I4	*	Doppler ambiguity error
410	dopamb_conf	4633-4648	F16.7	*	Doppler ambiguity confidence measure
411-417	eph_orb_data	4649-4760	7E16.7	*	Ephemeris orbit data
418	appl_type	4761-4772	A12	*	Application type
419-423	slow_time_coef	4773-4882	5D22.15	*	Slow time coefficients

Number	Mnemonic	Bytes	Format	Content	Description
424	n_srgr	4883-4886	I4	*	Number of SRGR coefficient sets
425	srgr_update	4887-4907	A21	YYYY-DDD-HH:MM:SS.SSS	SRGR update date/time
426-431	srgr_coef	4908-5003	6E16.7	*	SRGR coefficients
432-564	-	5004-7226	-	-	Repeat fields 425 to 431 another 19 times
565	pixel_spacing	7227-7242	F16.7	*	SGF product pixel spacing
566	gics_reqd	7243-7245	A3	YES/NO$	GICS product required. When this field is set to "NO" then fields 567-584 will be blank
567	wo_number	7246-7253	A8	*	Work order identifier
568	wo_date	7254-7273	A20	DD-MMM-YYYY$HH:MM:SS	Work order entry date
569	satellite_id	7274-7283	A10	RSAT-1$$$$	Satellite identifer
570	user_id	7284-7303	A20	*	User id
571	complete_msg	7304-7306	A3	YES/NO$	Completion message required flag
572	scene_id	7307-7321	A15	*	SGF product scene identifier
573	density_in	7322-7325	A4	*	Density of SGF product media
574	media_id	7326-7333	A8	*	SGF product identifier
575	angle_first	7334-7349	F16.7	*	Incidence angle of first pixel in a line of the SGF product
576	angle_last	7350-7365	F16.7	*	Incidence angle of last pixel in a line of the SGF product
577	prod_type	7366-7368	A3	SSG/SPG	Geocoded output product type
578	map_system	7369-7384	A16	*	Map system identifier
579	centre_lat	7385-7406	D22.15	*	Geocoded output product scene centre latitude
580	centre_long	7407-7428	D22.15	*	Geocoded output product scene centre longitude
581	span_x	7429-7450	D22.15	*	Geocoded output product size - map eastings (km)
582	span_y	7451-7472	D22.15	*	Geocoded output product size - map northings (km)
583	apply_dtm	7473-7475	A3	YES/NO$	DTM correction to be applied flag
584	density_out	7476-7479	A4	*	Geocoded output product density
585	state_time	7480-7500	A21	YYYY-DDD-HH:MM:SS.ccc	Time of the first state vector
586	num_state_ vectors	7501-7504	I4	*	Number of state vectors
587	state_time_inc	7505-7520	F16.7	*	Time increment between state vectors
588	Coord_sys	7521-7532	A12	ZERO_DOPPLER	Scene output coordinate system
589	Spare2	7533-7726	A194	blank	Unused

Appendix B-12: Map Projection Data Record Contents

(for SSG, SPG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	2	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	20	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	1620	Length of this record
7	spare1	13-28	A16	blanks	Unused
8	map_desc	29-60	A32	*	Map projection descriptor
9	n_pixel	61-76	I16	*	Number of pixels per line
10	n_line	77-92	I16	*	Number of lines per processed band
11	pixel_spacing	93-108	F16.7	12.5	Nominal inter-pixel distance, meters
12	line_spacing	109-124	F16.7	12.5	Nominal inter-line distance,meters
13	osc_orient	125-140	F16.7	0.0	Output scene centre orientation, degrees
14	orb_incl	141-156	F16.7	*	Actual platform orbital inclination, degrees
15	asc_node	157-172	F16.7	blank	Actual ascending node, degrees
16	isc_dist	173-188	F16.7	*	Distance of platform at input scene centre from the geocentre, metres
17	geo_alt	189-204	F16.7	*	Geodetic platform altitude, metres
18	isc_vel	205-220	F16.7	*	Actual ground speed at nadir at input scene centre time, metres/sec
19	plat_head	221-236	F16.7	*	Platform heading, degrees
20	ref_ellip	237-268	A32	*	Reference ellipsoid name
21	semi_major	269-284	F16.7	*	Ellipsoid semi-major axis, metres
22	semi_minor	285-300	F16.7	*	Ellipsoid semi-minor axis, metres
23 24 25	datum_shift	301-348	3F16.7	*	Datum shift parameter referenced to Greenwich: dx (metres) Datum shift parameter perpendicular to Greenwich: dy (metres) Datum shift parameter direction of the rotation axis: dz (metres)
26 27 28	aux_datum_shift	349-396	3F16.7	-9999.99	Additional datum shift parameter 1st rotation angle Additional datsum shift parameter 2nd rotation angle Additional datum shift parameter 3rd rotation angle
29	scal_ellip	397-412	F16.7	blank	Reference ellisoid scale factor
30	proj_desc	413-444	A32	*	Map projection alphanumeric description
31	utm_desc	445-476	A32	UNIVERSAL$TRANSVERSE$MERCATOR$$$	UTM descriptor
32	utm_zone_sig	477-480	A4	*	UTM zone signature
33	utm_east_orig	481-496	F16.7	*	Map origin, false easting
34	utm_north_orig	497-512	F16.7	*	Map origin, false northing
35	utm_cent_long	513-528	F16.7	blank	Projection centre longitude, deg
36	utm_cent_lat	529-544	F16.7	blank	Projection centre latitude, deg
37-38	utm_stand_par	545-576	2F16.7	blank	1st and 2nd standard parallels, deg
39	utm_scale	577-592	F16.7	0.9996	Scale factor

Number	Mnemonic	Bytes	Format	Content	Description
40	ups_desc	593-624	A32	blank	UPS descriptor
41	ups_cent_long	625-640	F16.7	blank	Projection centre longitude, deg
42	ups_cent_lat	641-656	F16.7	blank	Projection centre latitude, deg
43	ups_scale	657-672	F16.7	blank	Scale factor
44	nsp_desc	673-704	A32	*	NSP descriptor (44-59 blank if in UTM)
45	nsp_east_orig	705-720	F16.7	*	Map origin, false easting
46	nsp_north_orig	721-736	F16.7	*	Map origin, false northing
47	nsp_cent_long	737-752	F16.7	*	Projection centre longitude, deg
48	nsp_cent_lat	753-768	F16.7	*	Projection centre latitude, deg
49	nsp_stand_par1	769-784	F16.7	*	Standard parallels, deg
50	nsp_stand_par2	785-800	F16.7	*	Standard parallels, deg
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels, deg
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels, deg
53	nsp_stand_mer1	833-848	F16.7	*	Central meridian, deg
54	nsp_stand_mer2	849-864	F16.7	*	Central meridian, deg
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian, deg
56	nsp_spare1	881-896	A16	*	Projection dependent
57	nsp_spare2	897-912	A16	*	Projection dependent
58	nsp_spare3	913-928	A16	blanks	Unused
59	nsp_spare4	929-944	A16	blanks	Unused
60	corner_ne	945-1072	8F16.7	*	Top left corner northing, meters;
61					Top left corner easting, meters;
62					Top right corner northing, meters;
63					Top right corner easting, meters;
64					Bottom right corner northing, meters;
65					Bottom right corner easting, meters;
66					Bottom left corner northing, meters;
67					Bottom left corner easting, meters;
68	corner_ll	1073-1200	8F16.7	*	Top left corner latitude, deg;
69					Top left corner longitude, deg;
70					Top right corner latitude, deg;
71					Top right corner longitude, deg;
72					Bottom right corner latitude, deg;
73					Bottom right corner longitude, deg;
74					Bottom left corner latitude, deg;
75					Bottom left corner longitude, deg;
76	terr_height	1201-1264	4F16.7	*	Top left corner terrain height relative to
77					ellipsoid, meters;
78					Top right corner terrain height, meters;
79					Bottom right corner height, meters;
					Bottom left corner height, meters
80-87	lp_conv_coef	1265-1424	8E20.10	blanks	8 coefficients to convert a line and pixel position to the map projection frame of reference
88-95	mp_conv_coef	1425-1584	8E20.10	blanks	8 coefficients to convert from the map projection to line and pixel position in the image
96	dem_type	1585-1588	A4	NONE or DTED	DEM type
97	spare3	1589-1620	A32	blanks	Unused

Appendix B-13: Platform Position Data Record Contents

(for RAW, SCN, SCW, SGF, SGX, SLC products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	3 (RAW) 2 (SCN, SCW) 7 (SGF, SGX, SLC)	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	30	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	8960	Length of this record, bytes
7	orbit_ele_desg	13-44	A32	blank	Orbital elements designator
8 9 10 11 12 13	orbit_ele	45-140	6F16.7	a = semi major axis (km) i = inclination (radians) e = eccentricity (unitless) ω = argument of pericenter (radians) = longitude of the node (radians) M = Mean anomaly (radians)	Orbital elements
14	ndata	141-144	I4	*	Number of data points
15	year	145-148	I4	*	Year of first data point
16	month	149-152	I4	*	Month of first data point
17	day	153-156	I4	*	Day of first data point
18	gmt_day	157-160	I4	*	Day of year of first data point
19	gmt_sec	161-182	D22.15	*	Seconds of day of first data point
20	data_int	183-204	D22.15	*	Data sampling interval (sec)
21	ref_coord	205-268	A64	INERTIAL$...$	Reference coordinate system
22	hr_angle	269-290	D22.15	*	Greenwich mean hour angle (deg)
23	alt_poserr	291-306	F16.7	blank	Along track position error
24	crt_poserr	307-322	F16.7	blank	Cross track position error
25	rad_poserr	323-338	F16.7	blank	Radial position error
26	alt_velerr	339-354	F16.7	blank	Along track velocity error
27	crt_velerr	355-370	F16.7	blank	Cross track velocity error
28	rad_velerr	371-386	F16.7	blank	Radial velocity error
29	pos	387-452	3D22.15	*	Data point position (m). Values taken directly from orbit files and are spaced at 8 minute intervals (need 15 sets)
30	vel	453-518	3D22.15	*	Data point velocity (mm/s). Values taken directly from orbit files and are spaced at 8 minute intervals (need 15 sets)
31 -156	-	519-8834	-	-	Repeat fields 29 to 30, 14 times
157	spare	8835-8960	A126	blanks	Unused

Appendix B-14: Attitude Data Record

(for SCN, SCW, SGF, SGX, SLC products)

Note: in SAR Leader for SGF, SGX, SLC; in SAR Trailer for SCN and SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	7 (SCN, SCW) 8 (SGF, SGX, SLC)	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	40	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	8960	Length of this record, bytes
7	npoint	13-16	I4	1 (SGF, SGX, SLC) * (SCN, SCW)	Number of data points
8	gmt_day	17-20	I4	*	Day of the year, GMT
9	gmt_sec	21-28	I8	*	Milliseconds of day, GMT
10	pitch_flag	29-32	I4	*	Pitch data quality flag
11	roll_flag	33-36	I4	*	Roll data quality flag
12	yaw_flag	37-40	I4	*	Yaw data quality flag
13	pitch	41-54	E14.6	*	Pitch error, degrees
14	roll	55-68	E14.6	*	Roll error, degrees
15	yaw	69-82	E14.6	*	Yaw error, degrees
16	pitch_rate_flag	83-86	I4	*	Pitch rate data quality flag
17	roll_rate_flag	87-90	I4	*	Roll rate data quality flag
18	yaw_rate_flag	91-94	I4	*	Yaw rate data quality flag
19	pitch_rate	95-108	E14.6	*	Pitch rate, degrees/sec
20	roll_rate	109-122	E14.6	*	Roll rate, degrees/sec
21	yaw_rate	123-136	E14.6	*	Yaw rate, degrees/sec
22	-	137-2416	-	-	Repeat fields 8 to 21, 19 times
23	pitch_bias	2417-2430	E14.6	*	Pitch bias, degrees. Reference values only – Does not include attitude offset.
24	roll_bias	2431-2444	E14.6	*	Roll bias, degrees. Reference values only – Does not include attitude offset.
25	yaw_bias	2445-2458	E14.6	*	Yaw bias, degrees. Reference values only – Does not include attitude offset.
26	spare	2459-8960	A6502	blank	Unused

Appendix B-15: Radiometric Data Record Contents
(for SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Note: in SAR Leader for SGF, SGX, SLC, SPG and SSG; in SAR Trailer for SCN and SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	8 (SCN, SCW) 9 (SGF, SGX, SLC) 3 (SPG, SSG)	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	50	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	9860	Length of this record
7	seq_num	13-16	I4	1	Record sequence number
8	n_data	17-20	I4	1	Number of data sets
9	field_size	21-28	I8	9840	Data set size in bytes
10	chan_ind	29-32	A4	1	SAR channel indicator
11	spare1	33-36	A4	blank	Unused
12	table_desig	37-60	A24	OUTPUT$SCALING$$$$$$$$$$	Table designator
13	n_samp	61-68	I8	*	Number of lookup table samples
14	samp_type	69-84	A16	GAIN$$$$$$$$$$$$	Sample type designator
15	samp_inc	85-88	I4	*	Increment between table entries, range samples
16 - 527	lookup_tab	89-8280	512E16.7	*	Output scaling gain table
528	spare2	8281-8284	A4	blank	Unused
529	noise_scale	8285-8300	F16.7	*	Thermal noise reference level (db)
530	spare3	8301-8316	F16.7	blank	Unused
531	offset	8317-8332	E16.7	*	Scaling offset
532	calib_const	8333-8348	E16.7	blank	Calibration constant
533	spare4	8349-9860	A1512	blank	Unused

Appendix B-16: Radiometric Compensation Data Record
(for SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Note: in SAR Leader for SGF, SGX, SLC, SPG and SSG; in SAR Trailer for SCN and SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	9 (SCN, SCW) 10 (SGF, SGX, SLC) 4 (SPG, SSG)	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	51	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	16836	Length of this record
7	seq_num	13-16	I4	1	Record sequence number
8	chan_ind	17-20	I4	1	SAR channel indicator
9	n_dset	21-28	I8	* for SCN, SCW 1 for other product type	Number of data sets in record
10	dset_size	29-36	I8	4200	Compensation data set size
11	comp_desig	37-44	A8	RANGE$$$	Compensation data designator
12	comp_descr	45-76	A32	ELEVATION$ANTENNA$PATTERN$$$$$$$	Compensation data descriptor
13	n_comp_rec	77-80	I4	1	Number of compensation records
14	comp_seq_no	81-84	I4	1	Record sequence number
15	beam_tab_size	85-92	I8	*	Number of beam table entries
16	beam_tab	93-4188	256F16.7	*	Elevation gain beam profile
17	beam_type	4189-4204	A16	*	Beam type
18	look_angle	4205-4220	F16.7	*	Look angle of beam table centre
19	beam_tab_inc	4221-4236	F16.7	*	Increment between beam table entries
20	-	4237-16836	-	repeat for ScanSAR blank for other beams	Repeat fields 11 to 19, another 1 to 3 times for ScanSAR to include all beans used, blank for unused beams

Appendix B-17: Image Options File Descriptor Record

(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	1	Record sequence number
2	rec_sub1	5	B1	63	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	16252	Length of this record
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	* <n>.<m> (where <n>.<m> is the version number)	Software identifier
13	file_num	45-48	I4	$$$2	File number
14	file_name	49-64	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	File name
15	rec_seq	65-68	A4	FSEQ	Record sequence/location flag
16	seq_loc	69-76	I8	$$$$$$$1	Sequence number location
17	seq_len	77-80	I4	$$$4	Sequence number length
18	rec_code	81-84	A4	FTYP	Record code/location flag
19	code_loc	85-92	I8	$$$$$$$5	Record code location
20	code_len	93-96	I4	$$$4	Record code length
21	rec_len	97-100	A4	FLGT	Record length/location flag
22	rlen_loc	101-108	I8	$$$$$$$9	Record length location
23	rlen_len	109-112	I4	$$$4	Record length, bytes
24-27	spare2	113-116	4A1	blank	Reserved
28	spare3	117-180	A64	blank	Reserved segment
29	n_dataset	181-186	I6	* (blank for SCN, SCW)	Number of SAR data records
30	l_dataset	187-192	I6	*	SAR data record length, bytes
31	spare4	193-216	A24	blanks	Unused
32	nbit	217-220	I4	$$$8 (RAW, SCN, SCW, SPG, SSG) $$16 (SGF, SGX, SLC)	Number of bits per sample
33	nsamp	221-224	I4	$$$2 (RAW, SLC) $$$1 (others)	Samples per data group
34	nbyte	225-228	I4	$$$1 (SCN, SCW, SPG, SSG) $$$2 (RAW, SGF, SGX) $$$4 (SLC)	Bytes per data group or per pixel

Number	Mnemonic	Bytes	Format	Content	Description
35	justify	229-232	A4	$$$$	Sample justification and order
36	nchn	233-236	I4	$$$1	Number of SAR channels
37	nlin	237-244	I8	* (may be blank for SCN, SCW)	Lines per data set
38	nleft	245-248	I4	$$$0	Left border pixels per line
39	ngrp	249-256	I8	*(blank for RAW)	Groups per line per channel
40	nright	257-260	I4	$$$0	Right border pixels per line
41	ntop	261-264	I4	$$$0	Top border lines
42	nbott	265-268	I4	$$$0	Bottom border lines
43	intleav	269-272	A4	BSQ$	Interleave indicator
44	nrec_lin	273-274	I2	$1	Records per line
45	nrec_chn	275-276	I2	$1	Records per channel
46	n_prefix	277-280	I4	$180	Prefix data per record
47	n_sar	281-288	I8	*	SAR data byte count
48	n_suffix	289-292	I4	0	Suffix data per record
49	spare5	293-296	A4	$$$$	Unused
50	lin_loc	297-304	A8	$$13$4PB	Line number locator
51	chn_loc	305-312	A8	$$49$2PB	Channel number locator
52	tim_loc	313-320	A8	$$45$4PB	Time locator
53	left_loc	321-328	A8	$$21$4PB	Left fill locator
54	right_loc	329-336	A8	$$29$4PB	Right fill locator
55	pad_ind	337-340	A4	blank	Pad pixel indicator
56	spare6	341-368	A28	blanks	Unused
57	qual_loc	369-376	A8	blank	Quality code locator
58	cali_loc	377-384	A8	blank	Calibration info locator
59	gain_loc	385-392	A8	blank	Gain value locator
60	bias_loc	393-400	A8	blank	Bias value locator
61	type_id	401-428	A28	RAW=COMPLEX$INTEGER*2$$$$$$$$$$ SCN=UNSIGNED$INTEGER*1$$$$$$$$$$ SCW=UNSIGNED$INTEGER*1$$$$$$$$$$ SGF=UNSIGNED$INTEGER*2$$$$$$$$$$ SGX=UNSIGNED$INTEGER*2$$$$$$$$$$ SLC=COMPLEX$INTEGER*4$$$$$$$$$$ SPG=UNSIGNED$INTEGER*1$$$$$$$$$$ SSG=UNSIGNED$INTEGER*1$$$$$$$$$$	Data type identifier
62	type_code	429-432	A4	RAW=CI*2 SCN and SCW =IU1$ SGF and SGX =IU2$ SLC=CI*4 SPG and SSG =IU1$	Data type code
63	left_fill	433-436	I4	$$$0 (RAW=$$$4)	Number left fill bits
64	right_fill	437-440	I4	$$$0	Number right fill bits
65	pix_rng	441-448	I8	RAW=$$$$$15 SCN and SCW =$$$$255 SGF and SGX =$$$65535 SLC=$$$32767 SPG and SSG =$$$$255	Pixel data range
66	spare7	449-16252	A15804	blanks	Unused

Appendix B-18: Signal Data Record Contents
(for RAW products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	*	Record sequence number. There will be one or more signal data records
2	rec_sub1	5	B1	50	First record sub-type code
3	rec_type	6	B1	10	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	*	Length of this record
7	line_num	13-16	B4	*	Signal data line number
8	rec_num	17-20	B4	1	Signal data record index
9	n_left_pixel	21-24	B4	0	Left fill pixel count
10	n_data_pixel	25-28	B4	*	Data pixel count
11	n_right_pixel	29-32	B4	0	Right fill pixel count.
12	sensor_updf	33-36	B4	1	Sensor parameter update flag
13	acq_year	37-40	B4	*	Acquisition year
14	acq_day	41-44	B4	*	Acquisition day of year
15	acq_msec	45-48	B4	*	Acquisition msecs of day
16	sar_chan_ind	49-50	B2	1	SAR channel indicator
17	sar_chan_code	51-52	B2	2	SAR channel code
18	tran_polar	53-54	B2	0	Transmitted polarization
19	recv_polar	55-56	B2	0	Received polarization
20	prf	57-60	B4	0	Pulse repetition frequency, Hz
21	spare1	61-64	B4	0	Unused
22	obrc	65-66	B2	0	On-board range compressed flag
23	pulse_type	67-68	B2	0	Pulse type designator
24	chp_len	69-72	B4	* (nominal value 42000)	Chirp length, ns
25	chp_coef1	73-76	B4	0	Chirp constant coefficients (Hz)
26	chp_coef2	77-80	B4	0	Chirp linear coefficients (Hz/usec)
27	chp_coef3	81-84	B4	0	Chirp quadratic coefficients (Hz/usec**2)
28	spare2	85-88	B4	0	Spare
29	spare2	89-92	B4	0	Spare
30	recv_gain	93-96	B4	0	Receiver gain
31	nt_line	97-100	B4	0	Nought line flag
32	ele_nadir	101-104	B4	* (nominal value)	Elec. nadir angle, 10**-6 deg
33	mec_nadir	105-108	B4	* (nominal value)	Mech. nadir angle, 10**-6 deg
34	ele_squint	109-112	B4	* (nominal value)	Elec. squint angle, 10**-6 deg
35	mec_squint	113-116	B4	* (nominal value)	Mech. squint angle, 10**-6 deg
36	sr_first	117-120	B4	0	First sample slant range, m
37	dr_window	121-124	B4	0	Data record window time, ns
38	spare3	125-128	B4	0	Spare
39	plat_updf	129-132	B4	0	Platform position update flag
40	plat_lat	133-136	B4	0	Platform latitude, 10**-6 deg
41	plat_long	137-140	B4	0	Platform longitude, 10**-6 deg
42	plat_alt	141-144	B4	0	Platform altitude, m
43	plat_speed	145-148	B4	0	Platform speed, cm/s

Number	Mnemonic	Bytes	Format	Content	Description
44	plat_vel	149-160	3B4	0	Platform velocity, cm/s
45	plat_acc	161-172	3B4	0	Platform acceleration, cm/s
46	plat_track	173-176	B4	0	Platform track, 10**-6 deg
47	plat_head	177-180	B4	0	Platform heading, 10**-6 deg
48	plat_pitch	181-184	B4	0	Platform pitch, 10**-6 deg
49	plat_roll	185-188	B4	0	Platform roll, 10**-6 deg
50	plat_yaw	189-192	B4	0	Platform yaw, 10**-6 deg
51	sdr_data	193-i	jB1	* where: i = number of bytes (i = 192 + j) j = number of bytes in range line	SAR signal data. Refer to Section 4.2 of this document.

Appendix B-19: Processed Data Record

(for SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	*	Record sequence number. There may be one or more than one processed data record
2	rec_sub1	5	B1	50	First record sub-type code
3	rec_type	6	B1	11	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	*	Length of this record
7	line_num	13-16	B4	*	Image data line number. There may be one or more than one processed data record
8	rec_num	17-20	B4	1	Image data record index
9	n_left_pixel	21-24	B4	0	Left fill pixel count
10	n_data_pixel	25-28	B4	*	Data pixel count
11	n_right_pixel	29-32	B4	0	Right fill pixel count
12	sensor_updf	33-36	B4	0 (SPG, SSG) 1 (others)	Sensor parameter update flag
13	acq_year	37-40	B4	0 (SPG, SSG) * (others)	Acquisition year, Time of Zero Doppler image line
14	acq_day	41-44	B4	0 (SPG, SSG) * (others)	Acquisition day of year, Time of Zero Doppler image line
15	acq_msec	45-48	B4	0 (SPG, SSG) * (others)	Acquisition msecs of day, Time of Zero Doppler image line
16	sar_chan_ind	49-50	B2	1 (0 for SSG,SPG)	SAR channel indicator
17	sar_chan_code	51-52	B2	2 (0 for SSG,SPG)	SAR channel code
18	tran_polar	53-54	B2	0	Transmitted polarization
19	recv_polar	55-56	B2	0	Received polarization
20	prf	57-60	B4	* (0 for SCN, SCW,SSG,SPG)	Pulse repetition frequency, Hz
21	spare	61-64	B4	blank	Unused
22	sr_first	65-68	B4	0 (SPG, SSG) * (others)	Slant range to first pixel, m
23	sr_mid	69-72	B4	0	Slant range to mid-pixel, m
24	sr_last	73-76	B4	0 (SPG, SSG) * (others)	Slant range to last pixel, m
25	fdc_first	77-80	B4	0	First pixel Doppler centroid, Hz
26	fdc_mid	81-84	B4	0	Mid-pixel Doppler centroid, Hz
27	fdc_last	85-88	B4	0	Last pixel Doppler centroid, Hz
28	ka_first	89-92	B4	0	First pixel azimuth FM rate, Hz
29	ka_mid	93-96	B4	0	Mid-pixel azimuth FM rate, Hz
30	ka_last	97-100	B4	0	Last pixel azimuth FM rate, Hz
31	nadir_ang	101-104	B4	0	Nadir look angle, 10**-6 deg
32	squint_ang	105-108	B4	0	Azimuth squint angle, 10**-6 deg
33	null_f	109-112	B4	0	Null line flag
34-37	spare2	113-128	4B4	0	Unused
38	geo_updf	129-132	B4	1	Geographic ref. parameter update flag (1=data in this section is an update 0=data is a repeat)

Number	Mnemonic	Bytes	Format	Content	Description
39	lat_first	133-136	B4	* (blank for SSG,SPG)	First pixel latitude (millionths of deg)
40	lat_mid	137-140	B4	*	Mid-pixel latitude (millionths of deg)
41	lat_last	141-144	B4	* (blank for SSG,SPG)	Last pixel latitude (millionths of deg)
42	long_first	145-148	B4	*(blank for SSG,SPG)	First pixel longitude (millionths of deg)
43	long_mid	149-152	B4	*	Mid pixel longitude (millionths of deg)
44	long_last	153-156	B4	*(blank for SSG,SPG)	Last pixel longitude. (millionths of deg)
45	north_first	157-160	B4	* (SPG, SSG - for UTM Products only, else zero) 0 (others)	Northing of first pixel, m
46	spare3	161-164	B4	0	Unused
47	north_last	165-168	B4	* (SSG, SPG - for UTM Products only, else zero) 0 (others)	Northing of last pixel, m
48	east_first	169-172	B4	* (SSG, SPG - for UTM Products only, else zero) 0 (others)	Easting of first pixel, m
49	spare4	173-176	B4	0	Spare
50	east_last	177-180	B4	* (SSG, SPG - for UTM Products only, else zero) 0 (others)	Easting of last pixel, m
51	heading	181-184	B4	blank (for SPG,SSG) * (compute from lst\last pixels)	Line heading, (millionths of deg)
52	spare5	185-192	B8	0	Spare
53	pdr_data	193-i	jBk	* where: i = number of bytes (i = 192 +j*k) j = number of pixels on this record k = 1 (for SCN, SCW,SSG, SPG) = 2 (for SGF, SGX) = 4 (for SLC)	SAR processed data

Appendix B-20: SAR Trailer File - File Descriptor Record Contents
(for RAW, SCN, SCW, SGF, SGX, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	1	Record sequence number. There may be one or more than one processed data record
2	rec_sub1	5	B1	63	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	720	Length of this record, bytes
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	*<n>.<m> (where <n>.<m> is the version number)	Software identifier
13	file_num	45-48	I4	$$$3	File number
14	file_name	49-64	A16	RAW=RSAT-1-SAR-RAW$$ SCN=RSAT-1-SAR-SCN$$ SCW=RSAT-1-SAR-SCW$$ SGF=RSAT-1-SAR-SGF$$ SGX=RSAT-1-SAR-SGX$$ SLC=RSAT-1-SAR-SLC$$ SPG=RSAT-1-SAR-SPG$x SSG=RSAT-1-SAR-SSG$x where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	File name
15	rec_seq	65-68	A4	FSEQ	Record sequence/location flag
16	seq_loc	69-76	I8	$$$$$$$1	Sequence number location
17	seq_len	77-80	I4	$$$4	Sequence number length
18	rec_code	81-84	A4	FTYP	Record code/location flag
19	code_loc	85-92	I8	$$$$$$$5	Record code location
20	code_len	93-96	I4	$$$4	Record code length
21	rec_len	97-100	A4	FLGT	Record length/location flag
22	rlen_loc	101-108	I8	$$$$$$$9	Record length location
23	rlen_len	109-112	I4	$$$4	Record length
24-27	spare2	113-116	4A1	blanks	Reserved
28	spare3	117-180	A64	blanks	Reserved Segment
29	n_dataset	181-186	I6	$$$$$0 (RAW, SGF,SGX, SLC) $$$$$1 (SCN,SCW,SPG,SSG)	Number of dataset summary records
30	l_dataset	187-192	I6	$$$$$0 (RAW, SGF,SGX, SLC) $$4096 (SCN,SCW,SPG,SSG)	Data set summary record length, bytes
31	n_map_proj	193-198	I6	$$$$$0	Number of map projection records
32	l_map_proj	199-204	I6	$$$$$0	Map projection record length, bytes
33	n_plat_pos	205-210	I6	$$$$$0	Number of platform position records

Number	Mnemonic	Bytes	Format	Content	Description
34	l_plat_pos	211-216	I6	$$$$$0	Platform position record length, bytes
35	n_att_data	217-222	I6	$$$$$1 (SCN, SCW) $$$$$0 (for others)	Number of attitude data records
36	l_att_data	223-228	I6	$$8960(SCN, SCW) $$$$$0 (for others)	Attitude data record length, bytes
37	n_radi_data	229-234	I6	$$$$$1 (SCN, SCW) $$$$$0 (for others)	Number of radiometric data records
38	l_radi_data	235-240	I6	$$9860(SCN, SCW) $$$$$0 (for others)	Radiometric data record length, bytes
39	n_radi_comp	241-246	I6	$$$$$1 (SCN, SCW)[a] $$$$$0 (for others)	Number of radiometric compensation records
40	l_radi_comp	247-252	I6	$16836 (SCN, SCW)[a] $$$$$0 (for others)	Radiometric compensation record length, bytes
41	n_qual_sum	253-258	I6	$$$$$0 (RAW, SGF,SGX, SLC) $$$$$1 (SCN,SCW,SPG,SSG)	Number of data quality summary records
42	l_qual_sum	259-264	I6	$$$$$0 (RAW, SGF, SGX, SLC) $$1620 (SCN, SCW, SPG, SSG)	Data quality summary record length, bytes
43	n_data_hist	265-270	I6	$$$$$0 (RAW, SGF, SGX, SLC) $$$$$2 (SCN,SCW,SPG,SSG)	Number of data histogram records
44	l_data_hist	271-276	I6	$$$$$0 (RAW, SGF, SGX, SLC) $16920 (SCN, SCW, SPG, SSG)	Data histogram record length, bytes
45	n_rang_spec	277-282	I6	$$$$$0	Number of range spectra records
46	l_rang_spec	283-288	I6	$$$$$0	Range spectra record length, bytes
47	n_dem_desc	289-294	I6	$$$$$0	Number of DEM descriptor records
48	l_dem_desc	295-300	I6	$$$$$0	DEM description record length, bytes
49	n_radar_par	301-306	I6	$$$$$0	Number of RADAR parameter records
50	l_radar_par	307-312	I6	$$$$$0	RADAR parameter record length, bytes
51	n_anno_data	313-318	I6	$$$$$0	Number of annotation data records
52	l_anno_data	319-324	I6	$$$$$0	Annotation data record length, bytes
53	n_det_proc	325-330	I6	$$$$$1 (for SCN,SCW) $$$$$0 (for others)	Number of detailed processing parameter records
54	l_det_proc	331-336	I6	$$7726 (SCN, SCW) $$$$$0 (for others)	Detailed processing parameter record length, bytes
55	n_cal	337-342	I6	$$$$$0	Number of calibration records
56	l_cal	343-348	I6	$$$$$0	Calibration record length, bytes
57	n_gcp	349-354	I6	$$$$$0	Number of GCP records
58	l_gcp	355-360	I6	$$$$$0	GCP record length, bytes
59-68	spare4	361-420	10I6	$$$$$0	Unused
69	n_fac_data	421-426	I6	$$$$$0	Number of facility data records
70	l_fac_data	427-432	I6	$$$$$0	Facility data record length, bytes
71	spare5	433-720	A288	blanks	Unused

a. These are 0 if elevation beam profile not applied.

Appendix B-21: Data Histogram Record - Processed Data (8-bit)
(for SCN, SCW, SSG, SPG products)

Note: in SAR Trailer

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	5	Record sequence number
2	rec_sub1	5	B1	18	First record sub-type code
3	rec_type	6	B1	70	Record type code
4	rec_sub2	7	B1	18	Second record sub-type code
5	rec_sub3	8	B1	20	Third record sub-type code
6	length	9-12	B4	16920	Length of this record
7	rec_seq	13-16	I4	1	Record sequence number
8	sar_chn	17-20	I4	1	SAR channel number
9	ntab	21-28	I8	1	Number of histogram tables sets in this record
10	ltab	29-36	I8	2296	Histogram table data set size
11	hist_desc	37-68	A32	DETECTED$DATA$$$$$$$$$$$$$$$$$$	Histogram descriptor
12	nrec	69-72	I4	1	Records per table
13	tab_seq	73-76	I4	1	Table sequence number
14	nbin	77-84	I8	256	Total number of table bins
15	ns_lin	85-92	I8	*	Number of line sampled
16	ns_pix	93-100	I8	*	Number of pixels sampled
17	ngrp_lin	101-108	I8	*	Group size in line
18	ngrp_pix	109-116	I8	*	Groups size across line
19	nsamp_lin	117-124	I8	*	Samples in line group
20	nsamp_pix	125-132	I8	*	Samples across line group
21	min_smp	133-148	E16.7	0	Minimum first bin
22	max_smp	149-164	E16.7	255	Maximum last bin
23	mean_smp	165-180	E16.7	*	Mean sample value
24	std_smp	181-196	E16.7	*	Sample standard deviation
25	smp_inc	197-212	E16.7	1	Sample value increment
26	min_hist	213-228	E16.7	*	Minimum histogram value
27	max_hist	229-244	E16.7	*	Maximum histogram value
28	mean_hist	245-260	E16.7	*	Histogram mean value
29	std_hist	261-276	E16.7	*	Histogram standard deviation
30	nhist	277-284	I8	256	Histogram table size
31-286	hist	285-2332	256I8	*	256 Histogram table values for 256 bins
287	spare	2333-16920	A14588	blanks	Unused

Appendix B-22: Null Volume Descriptor Record Contents

(for RAW, SCN, SCW, SGX, SGF, SLC, SPG, SSG products)

Number	Mnemonic	Bytes	Format	Content	Description
1	rec_seq	1-4	B4	1	Record sequence number
2	rec_sub1	5	B1	192	First record sub-type code
3	rec_type	6	B1	192	Record type code
4	rec_sub2	7	B1	63	Second record sub-type code
5	rec_sub3	8	B1	18	Third record sub-type code
6	length	9-12	B4	360	Length of this record, bytes
7	ascii_flag	13-14	A2	A$	ASCII flag
8	spare1	15-16	A2	$$	Unused
9	format_doc	17-28	A12	CCB-CCT-0002	Format control doc
10	format_ver	29-30	A2	$E	Format doc version
11	format_rev	31-32	A2	$A	Format doc revision
12	software_id	33-44	A12	*<n>.<m> (where <n>.<m> is the version number)	Software identifier
13	tape_id	45-60	A16	xxxxxxxx$$$$$$$$ (where $ is space - not to be used)	Physical tape id
14	logvol_id	61-76	A16	blank	Logical volume id
15	phyvol_id	77-92	A16	blank	Physical volume id
16	n_phyvol	93-94	I2	*	Number of physical volumes
17	first_phyvol	95-96	I2	$1	First physical volume
18	last_phyvol	97-98	I2	*	Last physical volume
19	curr_phyvol	99-100	I2	*	Current physical volume
20	first_file	101-104	I4	blank	First file in volume
21	volset_log	105-108	I4	$$$2	Logical volume within set
22	logvol_vol	109-112	I4	$$$2	Logical volume within physical volume
23	spare2	113-360	A248	blanks	Unused

APPENDIX C - MAP PROECTION DATA RECORDS

Appendix C-1: Albers Conical Equal Area

Number	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	ALBERS$CONICAL$ EQUAL-AREA$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of first standard parallel (deg)
50	nsp_stand_par2	785-800	F16.7	*	Latitude of second standard parallel (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-2: Azimuthal Equidistant

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	AZIMUTHAL$ EQUIDISTANT$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-3: Equidistant Conic Type A

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	EQUIDISTANT$CONIC$ TYPE$A$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of Standard parallel (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-4: Equidistant Conic Type B

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	EQUIDISTANT$CONIC$ TYPE$B$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	First Standard parallel (deg)
50	nsp_stand_par2	785-800	F16.7	*	Second Standard parallel (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-5: Equirectangular

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	EQUIRECTANGULAR$$$$$$$ $$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of true scale (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	Spares

Appendix C-6: General Vertical Near-Side Perspective

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	GENERAL$ VERTICAL$NEAR$SIDE$ PERSP	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	F16.7	*	height of perspective point above surface (m)
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-7: Gnomonic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	GNOMONIC$$$$$$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-8: Lambert Azimuthal Equal Area

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	“LAMBERT$ AZIMUTHAL$EQUAL-AREA$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-9: Lambert Conformal Conic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	LAMBERT$ CONFORMAL$$$$$$$$$$$$ $$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of first standard parallel (deg)
50	nsp_stand_par2	785-800	F16.7	*	Latitude of second standard parallel (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-10: Hotine Oblique Mercator Type A

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	HOTINE$OBLIQUE$ MERCATOR$ TYPE$A$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	-9999.99	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of first point on central line (deg)
50	nsp_stand_par2	785-800	F16.7	*	Latitude of second point on central line (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	*	Longitude of first point on central line (deg)
54	nsp_stand_mer2	849-864	F16.7	*	Longitude of second point on central line (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	F16.7	*	Scale factor at the center of the projection
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-11: Hotine Oblique Mercator Type B

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	HOTINE$OBLIQUE$ MERCATOR$ TYPE$B$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	-9999.99	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	*	Longitude of point on central line where azimuth is measured (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	F16.7	*	Scale factor at the center of the projection
57	nsp_spare2	897-912	F16.7	*	Azimuth angle east of north of central line (deg)
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-12: Mercator

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	MERCATOR$$$$$$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of true scale (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer 1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer 2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer 3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-13: Miller Cylindrical

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	MILLAR$ CYLINDRICAL$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-14: Orthographic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	ORTHOGRAPHIC$$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-15: Polar Stereographic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	POLAR$ STEREOGRAPHIC$$$$$$$$ $$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	-9999.99	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude deg)
49	nsp_stand_par1	769-784	F16.7	*	Latitude of true scale (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	*	Longitude straight down from North Pole or up from South Pole (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-16: Polyconic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	POLYCONIC$$$$$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	Spares

Appendix C-17: Sinusoidal

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	SINUSOIDAL$$$$$$$$$$ $$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-18: State Plane Coordinate System

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	STATE$PLANE$$$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	-9999.99	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	-9999.99	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	-9999.99	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	F16.7	*	state plane zone code
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-19: Stereographic

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	STEREOGRAPHIC$$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.9	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

Appendix C-20: Transverse Mercator

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	TRANSVERSE$MERCATOR $$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	*	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	F16.7	*	Scale factor at the Central meridian
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	Spares

Appendix C-21: Van der Grinten I

Field	Mnemonic	Bytes	Format	Contents	Description
44	nsp_desc	673-704	A32	VANDERGRINTEN$ $$$$$$$$$$$$$$$$	NSP descriptor
45	nsp_east_orig	705-720	F16.7	*	Map Origin (false easting) (m)
46	nsp_north_orig	721-736	F16.7	*	Map Origin (false northing) (m)
47	nsp_cent_long	737-752	F16.7	*	Center of projection longitude (deg)
48	nsp_cent_long	753-768	F16.7	-9999.99	Center of projection latitude (deg)
49	nsp_stand_par1	769-784	F16.7	-9999.99	Standard parallels (deg)
50	nsp_stand_par2	785-800	F16.7	-9999.99	Standard parallels (deg)
51	nsp_stand_par3	801-816	F16.7	-9999.99	Standard parallels (deg)
52	nsp_stand_par4	817-832	F16.7	-9999.99	Standard parallels (deg)
53	nsp_stand_mer1	833-848	F16.7	-9999.99	Central meridian (deg)
54	nsp_stand_mer2	849-864	F16.7	-9999.99	Central meridian (deg)
55	nsp_stand_mer3	865-880	F16.7	-9999.99	Central meridian (deg)
56	nsp_spare1	881-896	A16	blanks	spares
57	nsp_spare2	897-912	A16	blanks	spares
58	nsp_spare3	913-928	A16	blanks	spares
59	nsp_spare4	929-944	A16	blanks	spares

APPENDIX D - CHANGES OF PAYLOAD PARAMETER FILES

The following table lists changes made to values in the Payload Parameter File, from launch to the date of this document's issuance. For the latest status of Payload Parameter Files please contact RSI or CSA.

Note: Only Payload File numbers 16 and up are applicable for data processing.

Payload File #	Update	Effective Start Time (UTC)	Nature of Change
5	28-Dec-95	23:24:28	Nominal Antenna Patterns
6	28-Feb-96	21:03:41	Update to replica phase coefficients
8	14-Jun-96	15:34:53	Refinement to beams S1-S7, W1-W3, F1-F5 and Azimuth Pattern
9	23-Jul-96	20:06:25	Refinements to beams S1-S7, W1-W3, F1-F5
11	27-Nov-96	19:39:39	Beams S1-S4 declared calibrated
13	14-Feb-97	17:12:08	Beams S5-S7 and W1-W3 declared calibrated. Beams S1, S2 and S4 calibration updated
14	02-Jun-97	16:39:46	Beams F1N-F5F declared calibrated
15	12-Aug-97	15:35:51	Refinement of beam EL1
16	17-Sep-97	18:56:54	Beam EL1 declared calibrated, GCFs and TNRLs updated, Relative Beam Gains adjusted
17	09-Sept-97	07:00:00	Valid for AMM period. Only Beam S4 calibrated for left-looking mode.
18	20-Oct-97	19:00:00	Valid for post-AMM period. Copy of #16 with TNRL values updated for the three chirps.
19	21-Apr-98	21:12:32	Beams F4 and W1 re-calibrated
20	13-Oct-98	20:57:17	Beams S3 and S6 re-calibrated
21	10-Dec-98	20:57:17	Beam S1 antenna elevation pattern changed
22	25-Oct-99	22:00:00	Beam EL1 re-calibrated
23	15-Nov-99	10:00:17	Beam S7 re-calibrated
24	17-Apr-00	22:00:17	Beams W2 recalibrated and TNRL updated
25	18-Apr-00	23:00:17	Beams S4 recalibrated and TNRL updated
26	09-Feb-01	23:00:17	ScanSAR relative beam gain adjustment and W1 recalibration
27	27-Aug-01	23:00:17	Recalibration of Beams S2 and EL1 with saturation correction
28	02-Nov-01	23:00:17	Beam F4 recalibrated
29	07-Jun-02	00:00:00	Beam S3 and S7 recalibrated
30	16-Aug-04	00:00:00	Beam EH3, EH4 and EH6 recalibrated