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RADARSAT

Data Products Specifications

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RADARSAT INTERNATIONAL

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CHANGE NOTICE

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RSI-GS-026-2/0-CHG01	February 2, 1998

Item Affected:

Number	**Title**	**Revision**
RSI-GS-026	RADARSAT Data Products Specifications	2/0, Nov. 7/97

Reason for Change:

Fields which represent the tape ID must be specified as 8 characters in length throughout document. Any Tape ID exceeding 8 characters in length causes problems in ingestion of level 0 data at CDPF.

Description of Change:

To be changed as per the attached sheets:

Page 65 *Appendix B-1, Volume Description Record Contents*
Note changes to number 13 ("phyvol_id") under "Content" column,
where "**xxxxxxxxxxxxxxxx**" is changed to "**xxxxxxxx$$$$$$$$"**

Page 71 *Appendix B-5, Text Record Contents*
Note changes to number 11 ("phyvol_id") under "Content" column,
where all incidences of "**xxxxxxxxxxxxxxxx**" are changed to "**xxxxxxxx$$$$$$$$"**

Page 100 *Appendix B-22, Null Volume Descriptor Record*
Note changes to number 13 ("tape_id") under "Content" column
where "**xxxxxxxxxxxxxxxx**" is changed to "**xxxxxxxx$$$$$$$$"**

RADARSAT INTERNATIONAL

Network Stations Approval	Production Approval
Jörg Germann - Manager, International Network Stations	William Jefferies - Manager, Operations

CHANGE RECORD

FOR RADARSAT Data Products Specification

RSI-GS-026

ISSUE	DATE	PAGE(S)	DESCRIPTION	RELEASE
2/0	November 7 1997	126	Document formerly numbered as RZ-MA-50-5309 2/1 and RZ-SP-50-5313 5/1	

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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 Processor
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

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TT&C	Telemetry, Tracking and Command
UTM	Universal Transverse Mercator

1. INTRODUCTION

1.1 Purpose of Document

The DARARSAT Data Products 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.

1.2 Scope of Document

The RADARSAT Data Products Specifications outlines the suite of available RADARSAT products, the product delivery options, product attributes (such as image quality, resolution and sizes) and describes the printed report and output product.

1.3 Intended Audience

The RADARSAT Data Products Specification is intended for operators of network processing stations, for users of RADARSAT data and for developers of RADARSAT related software (including processors). It is designed both to answer the questions of the novice user and to inform the experienced user of the key characteristics of RADARSAT products.

1.4 Structure of Document

The remaining sections in this Data Products Specifications document 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 details incidence angle calculation for Sigma Nought extraction and the payload file changes since launch of the RADARSAT-1 satellite.

2. REFERENCE DOCUMENT

Reference documents are equal or lower-level documents provided for reference or information only. They do not take precedence over this document. The issue/revision number for reference documents is provided for information only. Changes to the issue/revision numbers do not make this document out of date.

R-1	RSI-GS-020	RADARSAT CEOS Product Specification. Issue/Revision 5/1A.
R-2	CEOS-SAR-CCT	Synthetic Aperture Radar Computer Compatible Tape Format Specifications. Issue/Revision 2/1. CEOS WED on SAR Data Standards (March 1989). January 1, 1992.
R-3	RSI-GS-004	RADARSAT Film Product Specification. RADARSAT International.
R-4	RSI-GS-024	CDPF Data Products Manual.

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
Signal data	RAW	Signal data	Level 0
Georeferenced	SLC	Single Look Complex	Level 1
	SGF	Path Image	Level 1
	SGX	Path Image Plus	Level 1
	SCN	ScanSAR Narrow	Level 1
	SCW	ScanSAR Wide	Level 1
Geocoded	SSG	Map Image	Level 2
	SPG	Precision Map Image	Level 2

The RADARSAT mnemonics is used by the SAR processing facilities. The RSI terminology is used by the user group. All the 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 contained in the Detailed Product Descriptions in Appendix A.

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

- film transparencies and photographic prints

- value-added products
- electronic data transmissions

Format

All RADARSAT products are produced in the CEOS format as described in Appendix B and Documents R-1 and R-2. Film Products are defined in Document R-3 and are not described further herein.

Output Media

Products can be output to 8 mm data cartridge (normally Exabyte), CD ROM or 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 which 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 because 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.

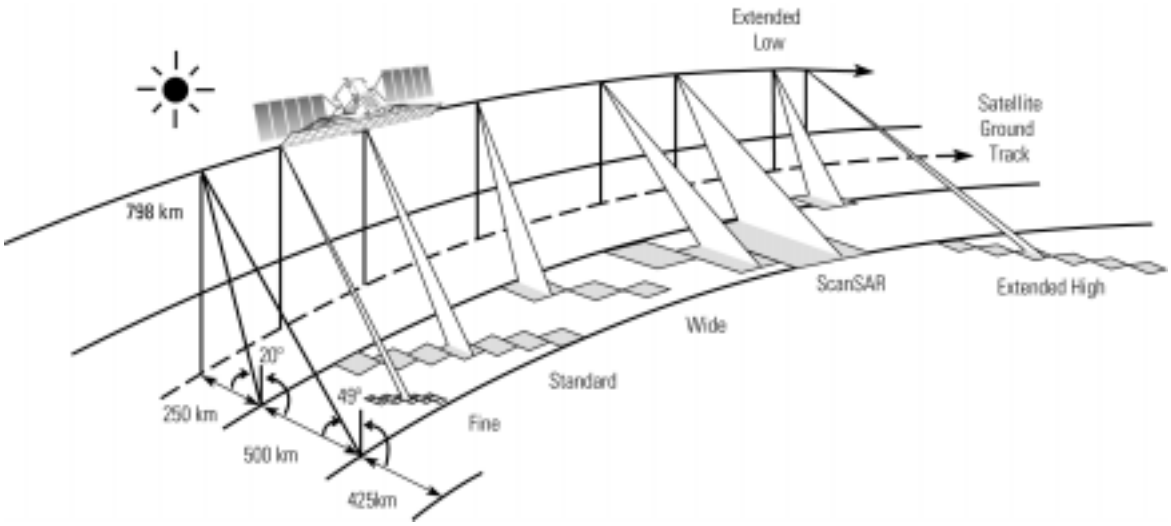

Figure 1 RADARSAT SAR Beam Modes

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 backscattering 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 1. The following sections describe the different beam modes.

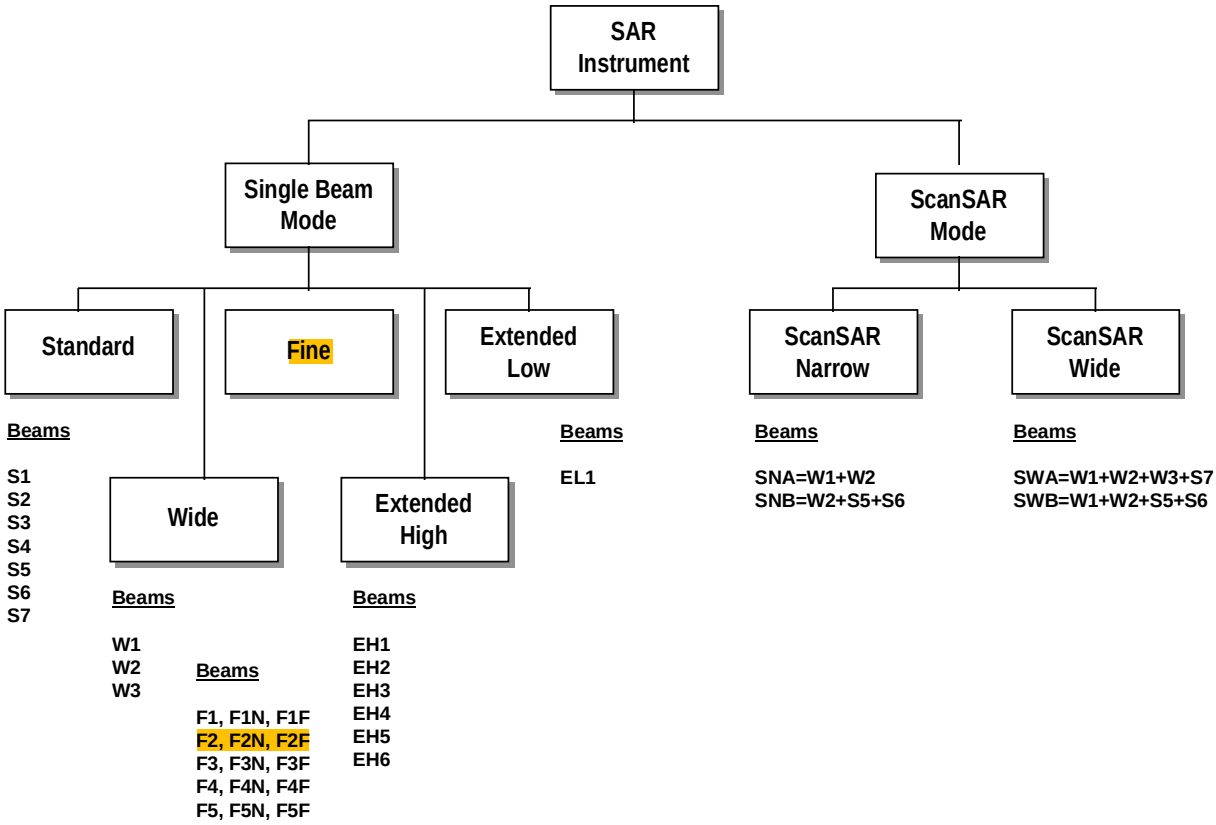

Figure 2 RADARSAT SAR Instrument Modes

The nominal characteristics of all single beam mode and ScanSAR mode is outlined in Table 2.

Table 2 Nominal Beam Characteristics

Beam Mode/ Position	Incidence Angle dg.	Resolution Rg x Az (m)	Real Time swath (km)
Standard: S1	20-27	24 x 27	100
S2	24-31	20 x 27	
S3	30-37	25 x 27	
S4	34-40	23 x 27	
S5	36-42	22 x 27	
S6	41-46	20 x 27	
S7	45-49	19 x 27	

Fine:			
F1	37-41	8.3 x 8.4	
F2	39-42	7.9 x 8.4	
F3	41-44	7.6 x 8.4	50
F4	43-46	7.3 x 8.4	
F5	45-47	7.1 x 8.4	
Wide:			
W1	20-31	33 x 27	
W2	31-39	25 x 27	150
W3	39-45	21 x 27	
Extended Low:			
EL1	10-23	39 x 27	170
Extended High:			
EH1	49-52	18 x 27	
EH2	50-53	18 x 27	
EH3	52-55	17 x 27	75
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: See Appendix A for exact figures of each beam position.

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:

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 beam is from 20 degrees (at the inner edge of S1) to 49 degrees (at the outer edge of S7). The spatial resolution is 27 m in azimuth and 26 m (near) to 20 m (far) in range direction. Each individual beam covers a minimum ground swath of 100 km within the total 500 km accessibility swath of the full set of Standard beams. The nominal spatial resolution in the range direction is 26 m for S1 at near range to 20 m for S7 at far range. The azimuth resolution is the same, 27 m, for all beam positions.

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

Wide Beam

Wide beams are similar to the Standard beams except that the swath width achieved by this beam is 150 km rather than 100 km. 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 the comparable resolution as the standard beam mode although 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 product but not recommended for individual image because it contains a nadir ambiguity (narrow white vertical strip in the image).

Fine Beam

The Fine beam mode is intended for applications which require the best spatial resolution available from the RADARSAT system. The azimuth resolution is 8.4 m, with range resolution 9.1 m to 7.8 m 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 a nominal 50 km 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, the 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 denoted by either an N (Near) or F (Far). For example, F1 is now complemented by F1N and F1F.

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 80 km for the inner three positions, and 70 km 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.

Extended Low Beam

A single Extended Low beam position, EL1, is provided for imaging in the incidence angle range 10 to 23 degrees with a nominal ground swath coverage of 170 km. 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 either 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 is 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:

ScanSAR Narrow

The ScanSAR Narrow mode (SCN) provides coverage of a nominal 300 km ground swath, with spatial resolution of 50 m 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 47 degrees.

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 100 m in general. Two combinations of single beams (SWA and SWB) 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 450 km of coverage over the incidence angle range 20 to 46 degrees.

On-board Recorded Data

When the On-board Recorder (OBR) is used to store data when the real time data acquisition is not possible with a network Station, some beam products will have reduced swath coverage than direct downlink data because of bandwidth limitations of the On-board Recorder. The ScanSAR Wide A is restricted to direct data downlink operation. Tape recorder data rate restrictions dictate the use of the SWB when on-board data storage is necessary.

3.3 Processing Levels

RADARSAT products are available at three main processing levels:

- Raw signal data
- Georeferenced data
- Geocoded data

Raw data products have had no SAR processing applied to them and consist of frame synchronized signal data as recorded by the spacecraft. Georeferenced data has been processed by a SAR processor, but may be in a variety of formats. Geocoded data has been processed and then transformed to a true map projection. Specific data products and their RADARSAT mnemonics are as follows:

Raw Signal Data
RAW- Signal Data product
Georeferenced Data
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

Geocoded Data

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

Table 3 Products Characteristics

	S1-S7	F1N-F5F	W1-W3	EH1-6	EL1
RAW (signal Data)	(all single beams and ScanSAR combinations)				
Pixel Size (m)	Natural spacing of signal data				
Number of pixels/lines	9500 pixels per line x length of swath				
Volume (16-bit) MB	~200 MB per 100 km in azimuth direction				
SLC (Single Look Complex)					
N-Look	1	1	1	1	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-Look	4 x 1	1 x 1	4 x 1	4 x 1	4 x 1
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 pixel	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-Look	4 x 1	1 x 1	4 x 1	4 x 1	4 x 1
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
SSP/SPG (Map Image and Precision Map Image)					
N-Look	4 x 1	1 x 1	4 x 1	4 x 1	4 x 1
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	11200 x 11200	11200 x 11200	16000 x 16000	8000 x 8000	16000 x 16000
Volume (8-bit) MB	64	64	144	36	185
SCN (ScanSAR Narrow) (SNA=W1+W2; SNB=W2+S5+S6)					
N-Look	2 x 2				
Pixel Size (m)	25 x 25				
Number of pixels/lines	12000 x (400 lines per 100 km of 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-Look	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				

Note:

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 8-bit or 16-bit for ScanSAR and SSG/SPG.
3. SSG and SPG contain same data as the input SGF image, but the image size will be larger because of the rotation of orientation with respect to the map projection.

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

3.3.1 Raw Signal Data (RAW)

A Signal Data product contains raw or unprocessed radar video baseband data in complex in-phase and quadrature signal (I and Q) format. The only processing performed on the data is the stripping of the downlink frame format and re-assembly of the data into contiguous radar range lines. Each range line of data is represented by one Signal Data Record in the RAW CEOS product. A Signal Data product may contain any combination of different beam modes depending on the operation of the SAR instrument during the data reception or recording period.

One type, RAW product, is produced within the Signal Data processing level. As described in Appendix A, the RAW product can contain any one beam mode (or beam combination if in ScanSAR mode). A RAW product cannot, however, combine data from more than one beam mode, i.e., data from two different beam modes is always packaged as two separate products. A RAW product must be processed before it can be displayed as imagery.

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

The image is georeferenced using orbit and attitude data from the satellite. This allows latitude and longitude information to be calculated for each line in the image. The earth geometry is assumed to be the standard ellipsoid. Each image line contains auxiliary information which includes the latitude and longitude of the first, mid and last pixels of the line. 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.

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

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.

The image is georeferenced using orbit and attitude data from the satellite. This allows latitude and longitude information to be calculated for each line in the image.

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 12.5 m (for beams of Standard, Wide, Extended Low and Extended High) or 6.25 m (for Fine beam).

With pixel size 12.5 m, Standard beams cover a nominal image dimension 100 km square, and Wide beams cover 150 km.
For Extended Low product, image dimensions are nominally 170 km cross track by 100 to 170 km along track. For Extended High the image dimension is 75 km square.

All 12.5 m 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 are of the order of 25 m, i.e., twice the pixel size.

For Fine beam mode, the SGF pixel size is 6.25 m and the nominal image dimension is 50 km square. The 6.25 m 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 8 m. 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 size are different according to the beam mode:

- 8 m pixel size for Standard and Extended High beam mode (4 look);
- 10 m pixel size for Wide and Extended Low beam mode (4 look) and
- 3.125 m 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 8 m in both range and azimuth. In generating the 6.25 m 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 3.125 m 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

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 25 m square and scenes are nominally 300 km 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

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 50 m 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 (SSG, SPG)

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

3.3.3.1 SSG Product (Map Image)

Systematically Geocoded image is also known as Map Image.

Systematically Geocoded data products 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 12.5 m pixel size and Fine SSG products have 6.25 m pixel size.

SSG product dimensions depend on the SGF input data dimensions. The 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 corners of the SSG products are filled with zero.

3.3.3.2 SPG Product (Precision Map Image)

Precision Geocoded image is also known as Precision Map Image in RSI terminology.

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 the Systematically Geocoded product. Standard SPG products with 12.5 m pixels, and Fine SPG products with 6.25 m pixels are available.

Geographic positioning of the data may be further refined by the use of a digital elevation model (DEM) as Orthorectified Image (ORI). Such service is available at RSI.

3.4 Product Definition Terms

This section explains the terms used in previous sections for RADARSAT beam modes and the data products. It also provides definition terms for Appendix A: Detailed Product Descriptions.

3.4.1 Product Characteristics

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. For example, 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 equals the width. For products generated in ScanSAR mode, the length is variable and may be specified by the user. Image coverage is in terms of range and azimuth.

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) which 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 Angles

Nominal incidence angle is specified at the near and far edge of each beam. The incidence angle is the angle between the satellite SAR beam and the axis perpendicular to the ground surface.

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 3 dB 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.

Radiometric Error

The radiometric error is the deviation in the integrated energy between two areas of an image consisting of random noise.

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 predicted 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 100 km by 100 km region of the processed image. The range distance measurement will be in terms of slant range or ground range depending on the image type.

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 100 km by 100 km 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

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

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

Azimuth FM Rate

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

4. CEOS DATA PRODUCT STRUCTURE

This section details the contents and structure of RADARSAT CEOS products. General users may receive their products on Exabyte, CD ROM or 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 are 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 Appendix B is given in Tables 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	✔	✔	✔	✔	✔	✔	✔	✔

NOTE: ✔ - record used in this product. * - these records may appear in either the Leader file or the Trailer file.

Regardless of which file is chosen, all records with '*' must appear there.

Table 5 Guide for RADARSAT CEOS products format

File Name	Record Name	Mnemonic	Appendix Index
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, B-3,B-4 Appendix B-5
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
SAR Data File	Image options file descriptor record[1] Signal data records Processed data records	imop_desc_rec sdr_data_rec pdr_data_rec	Appendix B-17 Appendix B-18 Appendix B-19
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
Null Volume Directory File	Null volume descriptor record	null_vol_rec	Appendix B-22

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

[1]. There is only one such record even though the file may consist of several partitions.

Table 6 and table 7 are the printed report accompanying each product to be send to the user.

Table 6 Printed Report Contents for CEOS Products
(For products RAW, SLC, SCN, SCW, SGF and SGX)

Title Page • CDPF RADARSAT logo • product identifier • satellite identifier • orbit identifier • product type (RAW, SCN, SCW, SGF, SGX or SLC) • processing start date/time (for SGF, SGX or SLC) • processing end date/time (for SGF, SGX or SLC)

Product Specification
• product generation date/time
• output media type (Exabyte, electronic delivery)
• output tape density (2.5/5 for Exabyte)
• output tape identifiers (Exabyte)
• destination pathname (for electronic delivery products)
• representative latitude/longitude (not for RAW)
  • scene centre (for SGF, SGX, SLC)
  • mid-point of first and last image lines (for SCN and SCW)

Data Source Specification • sensor configuration (ascending/descending) • sensor orientation • beam(s) (not for RAW) • start time of signal data to ingest (spacecraft time) • stop time of signal data to ingest (spacecraft time)

Processing Specification (not for RAW)
• pixel data type (8 bit, 16 bit, 16 bit complex)
• coordinate system (slant range or ground range)
• number of image lines
• number of pixels per image line
• nominal scene dimensions
  • range (km)
  • azimuth (km)
• nominal pixel dimensions
  • range (m)
  • azimuth (m)
• orbit data source
• image statistics
  • number of image pixels
  • percentage zero pixels
  • image histogram mean intensity
  • image cumulative distribution (at 90%, 95%, and 98% levels)
• nominal number of azimuth looks
• nominal number of range looks

Quality Assessment (QA) Report (not for RAW) • product quality index • QC rating • QC comment

Table 7 Additional Information of Geocoded CEOS Products
(For products SSG and SPG)

Processing Information
• product scene centre time
• product scene centre latitude
• product scene centre longitude
• map projection
• map system identifier
• pixel height
• pixel width
• geometric correction options:
  • correction type (Systematic Geocoded or Precision Geocoded)
  • resampling kernel
  • elevation correction (printed only if applied)
  • DEM correction (printed only if applied)

Output Data Specification • scene identifier • product identifier • correction type • tape agency identifier • tape organization • interleaving • tape density • product scene centre time • product scene centre latitude • product scene centre longitude • product dimensions • map projection • map system • product identifier(s) • output device identifier(s)
Quality Assessment (QA) Report • geometric quality assessment (if geometric QA requested) • radiometric quality assessment which consists of histogram statistics

4.2 Distribution Media

4.2.1 8 mm Data Cartridge (Exabyte)

The 8 mm data cartridge (usually Exabyte tapes) are 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 the Exabyte for a given product is shown below:

RADARSAT-1 CEOS DATA PRODUCT
Product ID: C0006411 Ref No.: 97-00587
Beam: F2N Product: Path Image (SGF) Orbit: 1749 Asc.
Image Time: 1997-Jul-10 22:21:14.558 to 22:21:21.000
Scene Centre: N 53:22:15 W105:36:25
Location: Prince Albert, Canada Tape Density: 2 GB
Processed by xxxxx, distributed under licence from RADARSAT International*
Copyright Canadian Space Agency/Agence spatiale canadienne 1997

* Change to the actual processing facilities: CDPF, TSS, DRA, CRISP, RSGS, NRCT, etc.

4.2.2 CD ROM

The format and structure of the CEOS records will be as for Exabyte products described in section 4.2.1. 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)
SCENE01.LBL	(ASCII Label file for Scene 1)
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.

A printed report is available and is in a format similar to Exabyte products.

4.2.3 Electronic Delivery Products

The format of the CEOS records and the order they are transferred will be as for Exabyte products as described in section 4.2.1. The method used to put a product into files which are

transferred to a destination disk file is shown in Table 8. The SAR Data File can be partitioned, upon request, into many files due to the large size of some products (SCN and SCW).

Table 8 Physical Layout for LAN Products

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 and is in a format similar to 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[2], 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

[2] As of the day of document release, the ScanSAR products are not calibrated.

- 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 which 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 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 which 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 target in conjunction with processed georeferenced and system geocoded imagery.

5.2 Radiometric Calibration

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 and 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.

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 any 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 which 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 (β^o) or radar brightness values by extraction and application of the scaling information. Conversion of DNs to radar backscatter coefficient, i.e., sigma nought (σ°), additionally requires knowledge of the incidence angles over the image swath. A method for extracting incidence angle data, and hence sigma nought, is also described in Appendix D.

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 (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.

5.4 Beta Nought Calibration 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, SCN, SCW).

If DN_j is the digital number which 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:

Let the LUT table values be denoted by A_i where i has the range 0 to (n_samp - 1). In general n_samp is set to 512, hence i = 0..511. The range of j for any given range line in the image is 0 to (n_data_pixel - 1), where n_data_pixel is the number of data pixels in the line and is provided in field 10 of the CEOS Processed Data Record.

For single beam ascending pass products and 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 value of $A2_j$ is then given by:

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

With the present CDPF configuration LUT data is always given in ascending range order, deviating from the CDPF Product Specification section 5.1.5 (R-1), which requires LUTs to be output in ascending pixel order. Note that this deviation will be removed during 1997, and users will be notified appropriately of changes. For single beam products, the range lines are always output in West - East order. For single beam products in descending pass/right looking for normal satellite configuration or ascending pass/ left looking for Antarctic Mapping configuration this means that the range line pixels are arranged far range first. The lower and upper LUT sample indices for the j th. image pixel are then given by:

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

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:

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

Values of j within the last few pixels of a range line for ascending pass single beam and ScanSAR products, or the first few pixels for descending pass single beam products, may give a value for i_U which is greater than (n_samp - 1), so that there is no corresponding value for A_U present in the LUT. In this case a value for Ai_U is generated by linear extrapolation from the last two LUT values (A_{510} and A_{511}), i.e.:

$$Ai_U = A_{511} + (A_{511} - A_{510})$$

Calibration Equation for SLC Products:

For single complex beam products (SLC), 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:

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

or:
$$ß^o_j = 20*\log_{10}(DN_j/A2_j) \text{ dB} \quad (3)$$

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.

Conversion to Sigma Nought

Radar brightness ($ß^o$) data may be converted to radar backscatter coefficient (σ^o) using the following:

$$\sigma^o_j = ß^o_j + 10*\log_{10}(\sin I_j) \text{ dB} \quad (4)$$

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.

From the CEOS product, extract the following data to compute the incidence angle, I_i, for each range increment of the output scaling LUT:

From the Dataset Summary Record:

Field	Mnemonic	Bytes	Format	Description
17	ellip_major	181-196	F16.7	Ellipsoid semi-major axis (km)
28	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_coeff	4908-5003	E16.7 x 6	Set of 6 slant to ground range coefficients repeated up to 19 times for swath products

From the Radiometric Data Record

Field	Mnemonic	Bytes	Format	Description
13	n_samp	61-68	I8	Number of LUT samples
15	samp_inc	85-88	I4	Increment between table entries, (range pixels)

For detected products, follow the procedure described in Appendix D to find the following:

- Earth radius, r, and the orbit altitude, h, for the image.
- Ground range increment, dRG, between scaling LUT sample increments.
- Slant range, RS_i, corresponding to each of the ground range sample increments in the output scaling LUT.
- Incidence angle, I_i, for each ground range sample increment.

We require the incidence angle, I_j, for the j th. image pixel. To a reasonable approximation:

$$I_j = I_i$$

where: i = integer[j/samp_inc] for ascending pass single beam and ScanSAR products,
i = integer[(n_data_pixel - 1 - j)/samp_inc] for descending pass single beam products.

For scene products the platform latitude and SRGR coefficients used in the calculation described in Appendix D apply to the scene centre. Numerical values are from a typical S1 SGF scene product at mid latitude.

For SLC products the procedure is similar, however, the conversion from ground to slant range is not required. The slant range of the first image pixel is given in field 22 (sr_first) of the Processed Data Record. The slant ranges, RS_i, at each LUT increment are then obtained directly from:

$$RS_i = sr\_first + i.samp\_inc$$

Special Considerations for ScanSAR Products

In the case of ScanSAR products, the platform latitude given in the Data Set Summary Record applies at the start of the swath; however, 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. A reasonable approximation can be calculated as follows:

a) 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.

b) From the Dataset 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.

c) Find the difference (pro_lat - lat_mid).

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

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

e) From the Processed Data Record for the range line selected in (a), find the acquisition time from fields 12, 13 and 14 (acq_year, acq_day, acq_msec).

f) 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 (f).

APPENDIX A

DETAILED PRODUCT DESCRIPTIONS

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
Pixel Spacing	natural spacing of signal data
Pixel Data 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, F1N to F5F , 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
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						
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.						

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

SLC 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				
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.				

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

SLC 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) (2)	W1	W2	W3
Nominal Incidence Angles (2) (°)	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		
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 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					
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 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	2800 MB
Image Quality Characteristics	
Beams	EL1
Nominal Incidence Angles (°)	10-23
Nominal Range Resolution (1)	10.5 m
Nominal Azimuth Resolution (1)	8.9 m
Nominal PSLR (1)	<-20 dB
Nominal ISLR (1)	-11.2 dB
Radiometric Error	< 3 dB
Radiometric Linearity (1)	> 0.97
Absolute Location Error	< 750 m
Geometric Distortion	< 40 m
Relative Phase Error (1)	10 degrees
Processing Parameters	
Number of Azimuth Looks	1
Azimuth Look Bandwidth	900 Hz
Number of Looks	1
Range Spectral Weighting	Kaiser window (coefficient 2.4)
Azimuth Spectral Weighting	Kaiser window (coefficient 2.4)
Notes	
(1)	SAR Processor specification. Excludes contribution from other sources of error.

Appendix A- 7 SGF, Path Image, Standard Beam

SGF 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 Er	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
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 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 Erro	N/A				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
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 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 Erro	N/A		
	Processing Parameters		
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
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.		

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

SGF 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 Er	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	A High Incidence 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 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 Err	N/A
	Processing Parameters
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
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- 12 SGX, Path Image Plus, Standard Beam

SGX 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 Erro	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
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.						

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

SGX 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 Erro	N/A				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
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.				

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

SGX 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 Erro	N/A		
Processing Parameters			
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
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.		

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

SGX 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 Err	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	A High Incidence 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 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 Erro	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
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 from Standard Beam Beam							
Format	CEOS						
Output Media	Exabyte Tape						
	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	8000 pixels x 8000 lines						
Nominal Product Volume	64 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 Resolutio	N/A						
Nominal Azimuth Resolutio	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 Erro	N/A						
	Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
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 from Fine Beam					
Format	CEOS				
Output Media	Exabyte Tape				
	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	8000 pixels x 8000 lines				
Nominal Product Volume	64 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 Resolutio	N/A				
Nominal Azimuth Resolutio	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 Err	N/A				
	Processing Parameters				
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
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.				

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Appendix A- 19 SSG, Map Image, Wide Beam

SSG from Wide Beam			
Format	CEOS		
Output Media	Exabyte Tape		
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	12000 pixels x 12000 lines		
Nominal Product Volume	144 MB		
Image Quality Characteristics			
Beams (1)	W1	W2	W3
Nominal Incidence Angles (°)	20-31	31-39	39-45
Nominal Range Resolutio	N/A		
Nominal Azimuth Resolutio	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 Erro	N/A		
Processing Parameters			
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
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 SSG Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

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

SSG from Extended High Beam						
Format	CEOS					
Output Media	Exabyte Tape					
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	6000 pixels x 6000 lines					
Nominal Product Volume	36 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 Resolutio	N/A					
Nominal Azimuth Resolutio	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 Erro	N/A					
Processing Parameters						
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
Notes						
(1)	A High Incidence 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, Extendedn Low Beam

SSG from Extended Low Beam	
Format	CEOS
Output Media	Exabyte Tape
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	13600 pixels x 13600 lines
Nominal Product Volume	185 MB
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 Erro	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
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 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 from Standard Beam							
Format	CEOS						
Output Media	Exabyte Tape						
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	8000 pixels x 8000 lines						
Nominal Product Volume	64 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	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 Erro	N/A						
Processing Parameters							
Number of Azimuth Looks	4 with 39% overlap						
Azimuth Look Bandwidth	293 Hz						
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 from Fine Beam					
Format	CEOS				
Output Media	Exabyte Tape				
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	8000 pixels x 8000 lines				
Nominal Product Volume	64 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	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 Erro	N/A				
Processing Parameters					
Number of Azimuth Looks	1				
Azimuth Look Bandwidth	900 Hz				
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.				

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

SPG from Wide Beam			
Format	CEOS		
Output Media	Exabyte Tape		
	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	12000 pixels x 12000 lines		
Nominal Product Volume	144 MB		
	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 Erro	N/A		
	Processing Parameters		
Number of Azimuth Looks	4 with 39% overlap		
Azimuth Look Bandwidth	293 Hz		
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 SPG Product will be ONE of beams W1 to W3.		
(2)	SAR Processor specification. Excludes contribution from other sources of error.		

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

SPG from Extended High Beam						
Format	CEOS					
Output Media	Exabyte Tape					
	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	6000 pixels x 6000 lines					
Nominal Product Volume	36 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	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 Erro	N/A					
	Processing Parameters					
Number of Azimuth Looks	4 with 39% overlap					
Azimuth Look Bandwidth	293 Hz					
Number of Looks	3.1					
Range Spectral Weighting	Kaiser window (coefficient 2.8)					
Azimuth Spectral Weighting	Kaiser window (coefficient 2.9)					
	Notes					
(1)	A High Incidence SPG Product will be ONE of beams EH1 to EH6.					
(2)	SAR Processor specification. Excludes contribution from other sources of error.					

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

SPG from Extended Low Beam	
Format	CEOS
Output Media	Exabyte Tape
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	13600 pixels x 13600 lines
Nominal Product Volume	185 MB
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 Err	N/A
Processing Parameters	
Number of Azimuth Looks	4 with 39% overlap
Azimuth Look Bandwidth	293 Hz
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 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 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 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 Err	N/A				
Processing Parameters					
Number of Azimuth Looks	2				
Nominal Number of Range Looks	2				
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 Narrow ScanSAR 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 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 or 40 MB 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 Err	N/A							
Processing Parameters								
Number of Azimuth Looks	2							
Nominal Number of Range Looks	4							
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								

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(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

B= binary data,
A=character data,
I=integer number in textual form,
F=floating point number in textual form,
D=double precision number in textual form,
E=exponential number in textual form, and
e=exponent.

In the Content column, the number (e.g. 192) is a constant value, " * " is a calculated value, and $ represents a space.

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**	**$$**	**Unused**
9	**format_doc**	**17-28**	**A12**	**CCB-CCT-0002**	**Format control documentation**
10	**format_ver**	**29-30**	**A2**	**$E**	**Format doc version**
11	**format_rev**	**31-32**	**A2**	**$A**	**Format doc revision**
12	**software_id**	**33-44**	**A12**	**CE$RSARP$<n>.<m> (for RAW, SCN, SCW, SGF, SGX, SLC) GICSVER<n>.<m> (forSSG, SPG) (where <n>.<m> is the version number)**	**Software identifier**
13	**phyvol_id**	**45-60**	**A16**	**xxxxxxxx$$$$$$$$ (where $ is space - not to be used)**	**Physical volume identifier**
14	**logvol_id**	**61-76**	**A16**	**RAW=RSAT-1-SAR-RAW$$ 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**

Appendix B-1 (cont'd): Volume Descriptor Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
25	**logvol_country**	**129-140**	**A12**	**CANADA$$$$$$**	**Logvol generation country**
26	**logvol_agency**	**141-148**	**A8**	*****	**Logvol generation agency**
27	**logvol_facility**	**149-160**	**A12**	**CDPF-RSAT$$$**	**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$$$$$$$$$$$$$$**	**Referenced file class**
12	**file_code**	**65-68**	**A4**	**SARL**	**Referenced file class code**
13	**data_type**	**69-96**	**A28**	**MIXED$BINARY$AND$ASCII$$$$$$**	**Referenced file data type**
14	**data_code**	**97-100**	**A4**	**MBAA**	**Referenced file data type code**
15	**nrec**	**101-108**	**I8**	**RAW=$$$$$$$3** **SCN=$$$$$$$2** **SCW=$$$$$$$2** **SGF=$$$$$$$9/$$$$$$10**[a] **SGX=$$$$$$$9/$$$$$$10**[a] **SLC=$$$$$$$9/$$$$$$10**[a] **SPG=$$$$$$$3/$$$$$$$4**[3] **SSG=$$$$$$$3/$$$$$$$4**[b]	**Referenced file record count**

[3]. 4 if elevation gain profile applied, 3 otherwise.

Appendix B-2 (cont'd): SAR Leader File Pointer Record

Number	Mnemonic	Bytes	Format	Content	Description
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**

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$$$$$$$$$$$$$**	**Referenced file class**
12	**file_code**	**65-68**	**A4**	**SART**	**Referenced file class code**
13	**data_type**	**69-96**	**A28**	**MIXED$BINARY$AND$ASCII$$$$$$**	**Referenced file data type**
14	**data_code**	**97-100**	**A4**	**MBAA**	**Referenced file data type code**
15	**nrec**	**101-108**	**I8**	**RAW=$$$$$$$1 SCN=$$$$$$$8/$$$$$$$9[4] SCW=$$$$$$$8/$$$$$$$9[a] SGF=$$$$$$$1 SGX=$$$$$$$1 SLC=$$$$$$$1 SPG=$$$$$$$5 SSG=$$$$$$$5**	**Referenced file record count**
16	**first_len**	**109-116**	**I8**	**$$$$$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**

[4]. 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	$$	Continuation flag
9	product_type	17-56	A40	RAW=PRODUCT:$RSAT-1-SAR-UNPROCESSED$SIGNAL$ SCN=PRODUCT:$RSAT-1-SAR-SCN$BULK$IMAGE$DATA$ SCW=PRODUCT:$RSAT-1-SAR-SCW$BULK$IMAGE$DATA$ SGF=PRODUCT:$RSAT-1-SAR-SGF$SPECIAL$PRODUCT$ SGX=PRODUCT:$RSAT-1-SAR-SGX$SPECIAL$PRODUCT$ SLC=PRODUCT:$RSAT-1-SAR-SLC$SPECIAL$PRODUCT$ SPG=PRODUCT:$RSAT-1-SAR-SPG$x$PREC$GEOCODED$ SSG=PRODUCT:$RSAT-1-SAR-SSG$x$SYSM$GEOCODED$ where: x = U - UTM L - Lambert Conformal P - Polar Stereographic, etc.	Product type specifier
10	product_create	57-116	A60	PROCESS:$ccccccccccc$aaaaaaaa$fffffffffff$YYYYMMDD$$$$$$$$$ (where: ccccccccccc --- creating country; aaaaaaaa --- creating agency; fffffffffff --- creating facility)	Product creation info
11	phyvol_id	117-156	A40	TAPE$ID:xxxxxxxx$$$$$$$$,$TAPE$nn$$$$$$$ (for SCN, SCW) TAPE$ID:xxxxxxxx$$$$$$$$,$TAPE$nnOFnn$ (for others) (where: xxxxxxxx$$$$$$$$ --- physical tape id)	Physical volume identifier
12	scene_id	157-196	A40	ORBIT$:nnnnnnn$DYYYYMMDD-Thhmmssttt$$$$$ (where: nnnnnnn --- orbit number (currently, it is spaces for SSG and SPG); DYY...ttt...frame centre acquisition date and time [acquisition date/time of first image line for SCN and SCW])	Scene identifier
13	scene_loc	197-236	A40	blank (for RAW, SCN, SCW) FRAME$CENTRE:$pXnnn.nn$$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
15	spare2	257-360	A104	blanks	Unused

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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	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	CE$RSARP$<n>.<m> (for RAW, SCN, SCW, SGF, SGX, SLC) GICVER<n>.<m> (for SSG, SPG) (where <n>.<m> is the version number)	Software identifier
13	file_num	45-48	I4	$$$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 summ records

Number	Mnemonic	Bytes	Format	Content	Description
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) $$$$$0 (for others)**	**Map projection record length, bytes**
33	**n_plat_pos**	**205-210**	**I6**	**$$$$$1 $$$$$0 (for SPG, SSG)**	**Number of platform position records**
34	**l_plat_pos**	**211-216**	**I6**	**$$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**

Number	Mnemonic	Bytes	Format	Content	Description
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)**
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)**
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)**
16	**ellip_des**	**165-180**	**A16**	*** (for SSG, SPG) INTERNATIONAL$$$ (for others)**	**Ellipsoid designator**
17	**ellip_maj**	**181-196**	**F16.7**	*** (for SPG, SSG) 6378.140 (for others)**	**Ellipsoid semi-major axis, km**
18	**ellip_min**	**197-212**	**F16.7**	*** (for SPG, SSG) 6356.755 (for others)**	**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 22 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**

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27	**sc_pix**	**333-340**	**I8**	**blank (for RAW) * (1/2 max no. pixels for others)**	**Scene centre pixel number**
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)**	
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 (note: first line for SCN, SCW)**
37	**plat_long**	**461-468**	**F8.3**	*** (blanks for SSG, SPG, RAW)**	**Platform geodetic longitude (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**

Appendix B-7 (cont'd): Data Set Summary Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
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 46 47 48 49	ampl_coef	535-614	5E16.7	blank (for RAW) * (for others)	coefficients
50 51 52 53 54	phas_coef	615-694	5E16.7	blank (for RAW) * (for others)	coefficients
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 [5]
72	mech_sight	915-930	F16.7	blank	Mechanical boresight
73	echo_track	931-934	A4	ON$$or OFF$ (blank for SSG, SPG, RAW)	Echo tracker on/off flag
74	fa	935-950	F16.7	blank (for SCN, SCW, SSG, SPG, RAW) * (for others)	Nominal PRF, Hz
75	elev_beam	951-966	F16.7	blank	Elevation beamwidth
76	azim_beam	967-982	F16.7	blank	Azimuth beamwidth
77	sat_bintim	983-998	I16	blank	Satellite binary time
78	sat_clktim	999-1030	I32	blank	Satellite clock time
79	sat_clkinc	1031-1038	I8	blank	Satellite clock increment
80	spare9	1039-1046	A8	blank	Unused
81	fac_id	1047-1062	A16	CDPF-RSAT$$$$$$$	Processing facility identifier
82	sys_id	1063-1070	A8	GICS$$$$ (for SSG, SPG) RSARPS/S (for others)	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

[5]. Electronic boresight is the same as elevation beam angle.

Appendix B-7 (cont'd): Data Set Summary Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
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)	algorithm identifier
88	n_azilok	1175-1190	F16.7	RAW=blank SCN=2 SCW=2 SGF=* SGX=* SLC=1 SPG=blank SSG=blank	
89	n_rnglok	1191-1206	F16.7	RAW=blank SCN=* SCW=* SGF=1 SGX=1 SLC=1 SPG=1 SSG=1	
90	bnd_azilok	1207-1222	F16.7	blank (RAW) * (others)	
91	bnd_rnglok	1223-1238	F16.7	blank (RAW) * (others)	
92	bnd_azi	1239-1254	F16.7	blank (RAW) * (others)	
93	bnd_rng	1255-1270	F16.7	blank (RAW) * (others)	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
96	data_inpsrc	1335-1350	A16	*	Data input source
97	rng_res	1351-1366	F16.7	blank (RAW) * (others)	
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)
101 102 103	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

105 106 107	**crt_dopcen**	**1479-1526**	**3E16.7**	**blank (for RAW,SSG,SPG) * (for others)**	**Cross track Doppler freq term**

Appendix B-7 (cont'd) Data Set Summary Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
108	**time_dir_pix**	**1527-1534**	**A8**	**RAW=INCREASE SCN=INCREASE SCW=INCREASE SGF=* SGX=* SLC= * SPG=blank SSG=blank**	**Pixel time direction indicator**
109	**time_dir_lin**	**1535-1542**	**A8**	**RAW=INCREASE SCN=INCREASE SCW=INCREASE SGF=* SGX=* SLC=* SPG=blank SSG=blank**	**Line time direction indicator**
110 111 112	**alt_rate**	**1543-1590**	**3E16.7**	**blank**	**Along track Doppler rate term**
113	**spare12**	**1591-1606**	**A16**	**blank**	**Unused**
114 115 116	**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)**	
122	**pix_spacing**	**1703-1718**	**F16.7**	**blank (RAW) * (others)**	
123	**rngcmp_desg**	**1719-1734**	**A16**	**blank (RAW) * (others)**	
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 File for SGF, SGX, SLC: in SAR Trailer File for SCN, SCW, SPG, 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	* (blank for SSG, SPG)	Nominal Azimuth ambiguity
14	rng_ambig	79-94	F16.7	* (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	*	Nominal slant range resolution, meters
18	azi_res	143-158	F16.7	*	Nominal Azimuth resolution, meters
19	rad_res	159-174	F16.7	blank	Nominal radiometric resolution, dB
20	dyn_rng	175-190	F16.7	* (blank for SSG, SPG)	Instantaneous dynamic range
21	rad_unc_db	191-206	F16.7	* (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	*	Nominal Along track location error, meters
54	crt_locerr	751-766	F16.7	*	Nominal Cross track location error, meters
55	alt_scale	767-782	F16.7	* (blank for SSG/SPG)	Nominal geometric distortion scale in line direction
56	crt_scale	783-798	F16.7	* (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	*	Nominal noise equivalent sigma zero
77	enl	1359-1374	F16.7	*	Nominal equivalent number of looks
78	tb_update	1375-1382	A8	YYYY-DDD	Default parameters table update date
79	spare	1383-1620	A238	blank	Unused

a. For SSG and SPG products, fields 53 and 54 will be filled in if this information is provided by the GICS operator or left

blank if it is not.

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, SSG and SPG

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 [6]**
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**
15	**ns_lin**	**85-92**	**I8**	*****	**Data samples in line**
16	**ns_pix**	**93-100**	**I8**	*****	**Data samples across line**
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**

[6]. first 4 bit for coded I and the second 4 bit for coded Q in each bin.

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$$$$$$$$$$$$$$$$$$$$ (for SGF, SGX) I$COMPONENT$$$$$$$$$$$$$$$$$$$$ (for SLC)**	**Histogram descriptor[7]**
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**
15	**ns_lin**	**85-92**	**I8**	*****	**Data samples in line**
16	**ns_pix**	**93-100**	**I8**	*****	**Data samples across line**
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**

[7]. There are two histogram tables for SLC, one for I, the other for Q.

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

Number	Mnemonic	Bytes	Format	Content	Description
31-1054	**hist**	**285-8476**	**1024I8**	*****	**Histogram table values for 1024 bins**
1055	**hist_desc**	**8477-8508**	**A32**	**SLC= Q$COMPONENT$$$$$$$$$$$$$$$$$$$$**	**Histogram descriptor[8]**
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**
1059	**ns_lin**	**8525-8532**	**I8**	**SLC=***	**Data samples in line**
1060	**ns_pix**	**8533-8540**	**I8**	**SLC=***	**Data samples across line**
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**

[8]. For SGC, SGF and SGX fields 1055 to 2098 are blank.

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, 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$	Input media
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
13	exp_ing_stop	129-149	A21	YYYY-DDD-HH:MM:SS.SSS	Expected ingest stop time
14	act_ing_start	150-170	A21	YYYY-DDD-HH:MM:SS.SSS	Actual ingest start time
15	act_ing_stop	171-191	A21	YYYY-DDD-HH:MM:SS.SSS	Actual ingest stop time
16	proc_start	192-212	A21	YYYY-DDD-HH:MM:SS.SSS	Processing start time
17	proc_stop	213-233	A21	YYYY-DDD-HH:MM:SS.SSS	Processing stop time
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	*	Per cent 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$DATA	Range reference function source
48-51	rng_amp_coef	573-636	4E16.7	*	Range reference amplitude coefficients
52-55	rng_phas_coef	637-700	4E16.7	*	Range reference phase coefficients
56-59	err_amp_coef	701-764	4E16.7	*	Error function amplitude coefficients
60-63	err_phas_coef	765-828	4E16.7	*	Error function phase coefficients
64	pulse_bandw	829-832	I4	*	Pulse bandwidth code
65	adc_samp_rate	833-837	A5	*	ADC sampling rate
66	rep_agc_attn	838-853	F16.7	*	Replica AGC attenuation
67	gn_corctn_fctr	854-869	F16.7	*	Gain correction factor (dB)
68	rep_energy_gn	870-885	F16.7	*	Replica energy gain correction (dB)
69	orb_data_src	886-896	A11	SIGNAL$DATA/ORBIT$FILE	Orbit data source
70	pulse_cnt_1	897-900	I4	*	Pulse count 1
71	pulse_cnt_2	901-904	I4	*	Pulse count 2
72	beam_edge_rqd	905-907	A3	YES/NO$	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**

Appendix B-11 (cont'd): Detailed Processing Parameters Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
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**	*****	**Pre-image calibration gain factor**
286	**post_img_gn**	**2673-2688**	**F16.7**	*****	**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**
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[a]**
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$**	**Completion message required flag**
572	**scene_id**	**7307-7321**	**A15**	*****	**SGF product scene identifier**
573	**density_in**	**7322-7325**	**A4**	*****	**Density of SGF product media**
574	**media_id**	**7326-7333**	**A8**	*****	**SGF product identifier**
575	**angle_first**	**7334-7349**	**F16.7**	*****	**Incidence angle of first pixel in a line of the SGF product**
576	**angle_last**	**7350-7365**	**F16.7**	*****	**Incidence angle of last pixel in a line of the SGF product**
577	**prod_type**	**7366-7368**	**A3**	**SSG/SPG**	**GICS output product type**
578	**map_system**	**7369-7384**	**A16**	*****	**Map system identifier**
579	**centre_lat**	**7385-7406**	**D22.15**	*****	**GICS output product scene centre latitude**
580	**centre_long**	**7407-7428**	**D22.15**	*****	**GICS output product scene centre longitude**
581	**span_x**	**7429-7450**	**D22.15**	*****	**GICS output product size - map eastings (km)**
582	**span_y**	**7451-7472**	**D22.15**	*****	**GICS output product size - map northings (km)**
583	**apply_dtm**	**7473-7475**	**A3**	**YES/NO$**	**DTM correction to be applied flag**
584	**density_out**	**7476-7479**	**A4**	*****	**GICS output product density**
585	**state_time**	**7480-7500**	**A21**	**YYYY-DDD-HH:MM:SS.ccc**	**Time of the first state vector**
586	**num_state_**	**7501-7504**	**I4**	*****	**Number of state vectors**

	vectors				
587	**state_time_inc**	**7505-7520**	**F16.7**	*****	**Time increment between state vectors**
588	**spare2**	**7521-7726**	**A206**	**blank**	**Unused**

a. When this field is set to "NO" then fields 567-584 will be blank.

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**

Appendix B-12 (cont'd): Map Projection Data Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
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
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
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 61 62 63 64 65 66 67	corner_ne	945-1072	8F16.7	*	Top left corner northing, meters; Top left corner easting, meters; Top right corner northing, meters; Top right corner easting, meters; Bottom right corner northing, meters; Bottom right corner easting, meters; Bottom left corner northing, meters; Bottom left corner easting, meters;
68 69 70 71 72 73 74 75	corner_ll	1073-1200	8F16.7	*	Top left corner latitude, deg; Top left corner longitude, deg; Top right corner latitude, deg; Top right corner longitude, deg; Bottom right corner latitude, deg; Bottom right corner longitude, deg; Bottom left corner latitude, deg; Bottom left corner longitude, deg;
76 77 78 79	terr_height	1201-1264	4F16.7	*	Top left corner terrain height relative to ellipsoid, meters; Top right corner terrain height, meters;

					Bottom right corner height, meters; Bottom left corner height, meters

Appendix B-12 (cont'd): Map Projection Data Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
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**	**blanks**	**Orbital elements**[9]
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)**
30	**vel**	**453-518**	**3D22.15**	*****	**Data point velocity (mm/s)**
31 -156	**-**	**519-8834**	**-**	**-**	**Repeat fields 29 to 30, 63 times**
157	**spare**	**8835-8960**	**A126**	**blanks**	**Unused**

[9]. Equinoctial elements are in Table 4-13.

Appendix B- 14 Attitude Data Record

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

Note: in SAR Leaser for SGF, SGX. SLC, in SAR Trailer for SCN, 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**
24	**roll_bias**	**2431-2444**	**E14.6**	*****	**Roll bias, degrees**
25	**yaw_bias**	**2445-2458**	**E14.6**	*****	**Yaw bias, degrees**
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, SSG; in SAR Trailer for SCN, SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	**rec_seq**	**1-4**	**B4**	**see footnote a**	**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**
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**

a. SCN=8, SCW=8, SGF=9, SGX=9, SLC=9, SPG=3, SSG=3
b. see Subsection 5.1.5

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, SSG; in SAR Trailer for SCN, SCW

Number	Mnemonic	Bytes	Format	Content	Description
1	**rec_seq**	**1-4**	**B4**	**see footnote a**	**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**	**see footnote b**	**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**	**-**	**see footnote c**	**Repeat fields 11 to 19, another 3 times**

a. SCN=9, SCW=9, SGF=10, SGX=10, SLC=10, SPG=4, SSG=4
b. SCN=*, SCW=*, SGF=1, SGX=1, SLC=1, SPG=1, SSG=1
c. fields 11 to 19 will be repeated for SCN/SCW to include all beams used, blank for unused beams
d. See Subsection 5.1.4.

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	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	GICSVER<n>.<m> (SPG, SSG) CE$RSARP$<n>.<m> (others) (where <n>.<m> is the version number)	Software identifier
13	file_num	45-48	I4	$$$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) $$$4 (SLC)	Bytes per data group or per pixel
35	justify	229-232	A4	$$$$	Sample justification and order
36	nchn	233-236	I4	$$$1	Number of SAR channels
37	nlin	237-244	I8	* (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

Appendix B-17 (cont'd): Image Options File Descriptor Record

Number	Mnemonic	Bytes	Format	Content	Description
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$$$$$$$$$$$ SCN=UNSIGNED$INTEGER*1$$$$$$$$$$ SCW=UNSIGNED$INTEGER*1$$$$$$$$$$ SGF=UNSIGNED$INTEGER*2$$$$$$$$$$ SGX=UNSIGNED$INTEGER*2$$$$$$$$$$ SLC=COMPLEX$INTEGER*4$$$$$$$$$$ SPG=UNSIGNED$INTEGER*1$$$$$$$$$$ SSG=UNSIGNED$INTEGER*1$$$$$$$$$$**	**Data type identifier**
62	**type_code**	**429-432**	**A4**	**RAW=CI*2 SCN=IU1$ SCW=IU1$ SGF=IU2$ SGX=IU2$ SLC=CI*4 SPG=IU1$ SSG=IU1$**	**Data type code**
63	**left_fill**	**433-436**	**I4**	**$$$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=$$$$$$15 SCN=$$$$$255 SCW=$$$$$255 SGF=$$$65535 SGX=$$$65535 SLC=$$$32767 SPG=$$$$$255 SSG=$$$$$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 numbera**
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 numbera**
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**

Appendix B-18 (cont'd): Signal Data Record Contents

Number	Mnemonic	Bytes	Format	Content	Description
42	plat_alt	141-144	B4	0	Platform altitude, m
43	plat_speed	145-148	B4	0	Platform speed, cm/s
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[b]

a. There may be one or more signal data records, see Subsection 5.1.8.

b. Also see Subsection 5.1.2.

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[a]**
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[10]**	*****	**Image data line number**
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[11]**
14	**acq_day**	**41-44**	**B4**	**0 (SPG, SSG) * (others)**	**Acquisition day of year**
15	**acq_msec**	**45-48**	**B4**	**0 (SPG, SSG) * (others)**	**Acquisition msecs of day**
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**

[10]. There may be one or more than one processed data record.

[11]. Zero Doppler time of the image line.

33	**null_f**	**109-112**	**B4**	**0**	**Null line flag**

Appendix B-19 (cont'd): Processed Data Record

Number	Mnemonic	Bytes	Format	Content	Description
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)**
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
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	$$	Unused
9	format_doc	17-28	A12	CEOS-SAR-CCT	Format control document
10	format_rev	29-30	A2	$B	Format document revision
11	design_rev	31-32	A2	$B	File design revision
12	software_id	33-44	A12	GICSVER<n>.<m> (SPG, SSG) CE$RSARP$<n>.<m> (others) (where <n>.<m> is the version number)	Software identifier
13	file_num	45-48	I4	$$$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)	Data set summary record length, bytes

				$$4096 (SCN,SCW,SPG,SSG)	
31	**n_map_proj**	**193-198**	**I6**	**$$$$$0**	**Number of map projection records**
32	**l_map_proj**	**199-204**	**I6**	**$$$$$0**	**Map projection record length, bytes**
33	**n_plat_pos**	**205-210**	**I6**	**$$$$$0**	**Number of platform position records**

Appendix B-20 (cont'd): SAR Trailer File - File Descriptor Record Contents

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**	*****	**Data samples in line**
16	**ns_pix**	**93-100**	**I8**	*****	**Data samples across line**
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**	**$$**	**Unused**
9	**format_doc**	**17-28**	**A12**	**CCB-CCT-0002**	**Format control doc**
10	**format_ver**	**29-30**	**A2**	**$E**	**Format doc version**
11	**format_rev**	**31-32**	**A2**	**$A**	**Format doc revision**
12	**software_id**	**33-44**	**A12**	**CE$RSARP$<n>.<m> (for RAW, SCN, SCW, SGF, SGX, SLC) GICSVER<n>.<m> (for SSG, SPG) (where <n>.<m> is the version number)**	**Software identifier**
13	**tape_id**	**45-60**	**A16**	**xxxxxxxx$$$$$$$$ (where $ is space - not to be used)**	**Physical tape id**
14	**logvol_id**	**61-76**	**A16**	**blank**	**Logical volume id**
15	**phyvol_id**	**77-92**	**A16**	**blank**	**Physical volume id**
16	**n_phyvol**	**93-94**	**I2**	*****	**Number of physical volumes**
17	**first_phyvol**	**95-96**	**I2**	**$1**	**First physical volume**
18	**last_phyvol**	**97-98**	**I2**	*****	**Last physical volume**
19	**curr_phyvol**	**99-100**	**I2**	*****	**Current physical volume**
20	**first_file**	**101-104**	**I4**	**blank**	**First file in volume**
21	**volset_log**	**105-108**	**I4**	**$$$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_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- 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_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- 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_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- 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_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- 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_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- 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_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	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_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- 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_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- 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_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- 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_mer 1	833-848	F16.7	*	Longitude of first point on central line (deg)
54	nsp_stand_mer 2	849-864	F16.7	*	Longitude of second point on central line (deg)
55	nsp_stand_mer 3	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_mer 1	833-848	F16.7	*	Longitude of point on central line where azimuth is measured (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	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_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- 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_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- 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_mer 1	833-848	F16.7	*	Longitude straight down from North Pole or up from South Pole (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- 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_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- 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_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- 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_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	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_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- 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_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	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_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 D

Incidence Angle Calculation

Appendix D- 1 Incidence Angle Calculation

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)	$\alpha = 7.167055\ 10^6$	m

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

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

i.e r = $6.367.10^6$ m

Calculate orbit altitude, h:

$$h = \alpha - r$$

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

2) Caluculate the slant range for each ground range increment of the output scaling LUT:

From the CEOS Radiometric Data Record:

number of LUT samples	n_samp = 512
pixels between table entries	samp_inc = 20 pixels

From the CEOS Detailed Processing Parameters Record:

6 values of SRGR coefficients [srgr_coef(1-6)]

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

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From the CEOS Data Set Summary Record:

pixel spacing pix_spacing = 12.5 m

Calculate the ground range increment, dRg, between each LUT sample:

dRg = samp_inc . Pix_spacing

dRg = 250 m

Calculate the slant range, RS, corresponding to each LUT sample:

i = 0 .. (n_samp -1)

$RS_i = a + i \,.\, dRg \,.b + (i.\, dRg)^2 \,.\, c + (i.\, dRg)^3 \,.\, d + (i.\, dRg)^4 \,.\, e + (i.\, dRg)^5 \,.\, f$

3) Calculate the incidence angle at each LUT sample increment:

$$I_i = \arccos[\frac{(h^2 - (RS_i)^2 + 2.r.h}{2.RS_i.r}].\frac{180}{\pi}$$

Appendix D- 2 Changes of Payload Parameter Files

The following table lists the changes made to values in the Payload Parameter file, from launch to date:

Update	Effective Start Time	Nature of Change	Payload File #
28-Dec-95	23:24:28	Nominal Antenna Patterns	5
28-Feb-96	21:03:41	Update to replica phase coefficients	6
14-Jun-96	15:34:53	Refinement to beams S1-S7, W1-W3, F1-F5 and Azimuth Pattern	8
23-Jul-96	20:06:25	Refinements to beams S1-S7, W1-W3, F1-F5	9
27-Nov-96	19:39:39	Beams S1-S4 declared calibrated	11
14-Feb-97	17:12:08	Beams S5-S7 and W1-W3 declared calibrated. Beams S1, S2 and S4 calibration updated	13
02-Jun-97	16:39:46	Beams F1N-F5F declared calibrated	14
12-Aug-97	15:35:51	Refinement of beam EL1	15
17-Sep-97	18:56:54	Beam EL1 declared calibrated, GCFs and TNRLs updated, Relative Beam	16