Synspective SAR DATA PRODUCT FORMAT MANUAL

Version 15.0
June 25, 2025

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Revision History

Version	Date	Description
v1.0	Nov 17, 2022	Initial version
v2.0	Dec 15, 2022	1. BRS File name is changed to match with IMG File name (Table 1.1-1) 2. Scene ID and Product ID in VOL File and summary.txt are changed to match with IMG File name (No. 9 and 12 in Table 1.1-7/ No. 9 in Table 1.1-9/ No. 2 and 3 in Table 1.1-18) 3. The sign for left and right looking direction is fixed (No.39 in Table 1.1-9) 4. The description of Synspective products specific implementation in SICD product is added (Table 1.2-2) 5. Orbit state vectors are added in XML Metadata for GRD product (“stateVecFormat” ~ “velZ” in Table 2.1-2) 6. Section number for the reference in Calibration Factor's Description in XML metadata data for GRD is updated (“calibrationFactor” in Table 2.1-2) 7. StriX-1 is added for Radiometric Calibration (Section 4) 8. “Intensity conversion factor” is changed to “Calibration factor” (Table 4-1) 9. Calibration factor (CF) subscripts ($CF_{SLC\ CEOS}$ and CF_{GRD})are added (Section 4) 10. New product version is added in product version history (Table 5-1)
v3.0	Feb 27, 2023	1. Datetype for No. 90 (Bandwidth per look in the range direction) in Data Set Summary Records in CEOS is updated from F16.7 to F16.6 (Table 1.1-9) 2. New product version is added in product version history (Table 5-1)
v4.0	May 15, 2023	1. Updated description of GRD Product (Section 2) 2. Updated eop:referenceSystemIdentifier Description to “Projection coordinate system ID 3. (EPSG Geodetic Parameter Dataset)“ and changed its example to “epsg:32630 (UTM zone 30N)” (Table 2.1-2) 4. Updated eop:mapProjection Description to “Map projection” and changed its example to “UTM” (Table 2.1-2)

Version	Date	Description
		5. Updated GeoTIFF Tag GeoAsciiParamsTag Description/Example to: "Based on GeoTIFF standards: "WGS 84 / UTM zone 18S|WGS 84|" (Table 2.1-3) 6. Updated GeoTIFF Tag ModelPixelScaleTag Description/Example to: "Pixel spacing (meters)" (Table 2.1-3) 7. Updated GeoTIFF Tag GTCitationGeoKey Description/Example to: "WGS 84 / UTM zone 18S" (Table 2.1-3) 8. New product version is added in product version history (Table 5-1) 9. Fixed links to Reference
v5.0	June 5, 2023	1. Added the description of New Product SR-GRD (Section 3)
v6.0	Aug 1, 2023	1. Added NESZ information to GRD XML (Table 2.1-2) 2. Added Sliding Spotlight mode to SR-GRD product (Section 3) 3. Added NESZ information to SR-GRD XML (Table 3.1-2) 4. New product version is added in product version history (Table 5-1)
v7.0	Oct 2, 2023	1. Updated the description of Field No.25 Data Set summary Records to: "reference height above the ellipsoid" (Table 1.1-9) for CEOS products 2. New product version is added in product version history (Table 5-1)
v7.1	Oct 19, 2023	1. New product version is added in product version history (Table 5-1)
v7.2	Dec 6, 2023	1. Updated the remarks of Field No.24 Facility Related Data Record (Table 1.1-14) for CEOS products 2. New product version is added in product version history (Table 5-1)
v8.0	Jan 22, 2024	1. Updated the Description of Field No.22 and 23 Facility Related Data Record (Table 1.1-14) for CEOS products 2. Updated SICD format standards from NGA.STND.0024-1_1.2.1 to NGA.STND.0024-1_1.3.0 (Section 1.2) 3. Added SICD format standards reference, NGA.STND.0024-2_1.3.0 and NGA.STND.0024-3_1.3.0 (Section 1.2)

Version	Date	Description
		4. Changed eop:processorName from StrixProcessor to GrdProcessor in XML metadata for GRD (Table 2.1-2) and SR-GRD product (Table 3.1-2) 5. New product version is added in product version history (Table 5-1) 6. Updated reference for SICD formats ([2], [3] and [4] in Reference)
v8.1	Jan 23, 2024	1. New product version is added in product version history (Table 5-1)
v8.2	Mar 18, 2024	1. Corrected a reference number for radiometric calibration in SICD format (Section 4) 2. New product version is added in product version history (Table 5-1)
v8.3	Apr 10, 2024	1. New product version is added in product version history (Table 5-1)
v9.0	Apr 22, 2024	1. New product version is added in product version history (Table 5-1)
v9.1	May 15, 2024	1. Added Strix-3 for Satellite type 2. Consolidated GRD and SR-GRD sections (Section 2) 3. Updated radiometric calibration table (Table 3-1) 4. New product version is added in product version history (Table 4-1)
v10.0	Aug 1, 2024	1. Removed "Blank" in remarks of Field No. 17 and 18 Data Quality Summary Record (Table 1.1-13) 2. Added new fields No.6 and 7, Pds_SlantRangeResolution and Pds_AzimuthResolution, in Summary Information (Table 1.1-18) 3. Restructure XML metadata table (Table 2.1-2) 4. Added new fields about range and azimuth resolution in XML metadata in GRD and SR-GRD product (Table 2.1-2) 5. Changed the title of Section 4 to "Product Release History" from "Product Version History" 6. Added Table 4-2 Software version related fields 7. Added thumbnail image in SICD product format (Section 1.2.1 and 1.2.4) 8. Added thumbnail image in GRD and SR-GRD product format (Section 2.1.1 and 2.1.4)

Version	Date	Description
v10.1	Aug 22, 2024	1. New version is added to product release history (Table 4-1)
v10.2	Sept 4, 2024	1. New version is added to product release history (Table 4-1)
v10.3	Oct 2, 2024	1. Added Staring Spotlight 2. Added Note in Radiometric Calibration (Section 3) about Staring Spotlight. 3. New version is added to product release history (Table 4-1)
v11.0	Nov 12. 2024	1. Added StriX-4 2. Added Cloud Optimized GeoTIFF (COG) in GRD and SR-GRD product (Section 2) 3. Removed Note in Radiometric Calibration (Section 3) about Staring Spotlight. 4. New version is added to product release history (Table 4-1)
v12.0	Dec 3, 2024	1. Added note in Radiometric Calibration (Section 3) about SR-GRD. 2. New version is added to product release history (Table 4-1)
v13.0	Jan 14, 2025	1. New version is added to product release history (Table 4-1)
v14.0	Mar 25, 2025	1. Added StriX-2 2. New version is added to product release history (Table 4-1) 3. Changed the cover page and the colors of the tables
v14.1	Apr 2, 2025	1. New version is added to product release history (Table 4-1)
v15.0	June 25, 2025	1. New version is added to product release history (Table 4-1)

Table of contents

Revision History **1**
Introduction **7**
1. SLC Product **7**
1.1 CEOS Product Format 7
1.1.1 Product Composition 7
Table 1.1-1 SLC CEOS Product File Naming Convention 8
1.1.2 Product Record Description 9
Table 1.1-2 Record Structure SLC CEOS Format 9
1.1.3 Record Data Type 10
Table 1.1-3 Data Type 10
1.1.4 Record Type Code and Record Subtype Code 10
Table 1.1-4 Record Type of Each Record 10
1.1.5 Contents of Records in SLC CEOS Files 11
Table 1.1-5 Volume Descriptor Record 11
Table 1.1-6 File Pointer Record 14
Table 1.1-7 Text Record 16
Table 1.1-8 Leader File Descriptor Record 17
Table 1.1-9 Data Set Summary Records 21
Table 1.1-10 Platform Position Data Record 33
Table 1.1-11 Attitude Data Record 36
Table 1.1-12 Radiometric Data Records 37
Table 1.1-13 Data Quality Summary Record 38
Table 1.1-14 Facility Related Data Record 41
Table 1.1-15 Image File Descriptor Record 43
Table 1.1-16 Signal Data Records 48
Table 1.1-17 Trailer Descriptor Record 52
1.1.6 Summary Information 56
Table 1.1-18 Contents of Summary Information 56
1.1.7 Thumbnail Image 58
1.2 SICD Product Format 59
1.2.1 Product Composition 59
Table 1.2-1 SLC SICD product file naming convention 59
1.2.2 SICD XML Metadata 60
Table 1.2-2 XML Field for Synspective products specific implementation in SICD product 60

1.2.3 NITF Metadata 60
1.2.4 Thumbnail Image 60
2. GRD and SR-GRD Product 61
2.1 GeoTIFF + XML Product Format 61
2.1.1 Product Composition 61
Table 2.1-1 GRD Product File Naming Convention 62
2.1.2 XML Metadata 64
Table 2.1-2 XML Tag and Attribute Name 64
2.1.3 GeoTIFF Tag 79
Table 2.1-3 GeoTIFF Tag 79
2.1.4 Thumbnail Image 81
2.1.5 Quicklook raster data (Cloud Optimized GeoTIFF, COG) 81
3. Radiometric Calibration 82
Table 3-1 Radiometric Correction 82
4. Product Release History 83
Table 4-1 Product release history 83
Table 4-2 Software version related fields 87
Reference 88

Introduction

This document defines the format of Synspective SAR data products observed by StriX satellites (Synspective products). There are two types of Synspective products: Single Look Complex (SLC) and Ground Range Detected (GRD). SLC products are available in CEOS and SICD formats and GRD products are available in GeoTIFF + XML format.

1. SLC Product

The general specification of the SLC product:

- Single Look Complex (SLC) data after range and azimuth compression
- single look in azimuth and range
- provided in slant range geometry
- phase information is preserved
- pixel spacing is in slant geometry
- data type: 32 bit float (I) + 32 bit float (Q)
- mode of observation: Stripmap, Sliding Spotlight or Staring Spotlight
- single polarization: VV

1.1 CEOS Product Format

CEOS standard format was published in 1988 and does not specify the naming convention. In practice, Synspective's CEOS product format references the ALOS-2 PALSAR-2 CEOS format [1].

1.1.1 Product Composition

SLC CEOS format is a wrapper, which combines multiple files:

- volume directory file (VOL),
- SAR leader file (LED),
- SAR image data (IMG),
- SAR trailer file (TRL)

CEOS product includes the following files as well.

- Summary information
- Thumbnail image

The naming convention for SLC CEOS product files are described in the table below.

Table 1.1-1 SLC CEOS Product File Naming Convention

File Type	Number of Files	File Name	Record Name	Contents
Volume Directory File	1	VOL-<Scene ID> -<Product ID>	- Volume descriptor File Pointer	This stores the volume and file management information.
SAR Leader File	1	LED-<Scene ID> -<Product ID>	- File descriptor - Data set summary - Platform location data - Attitude data - Radiometric data - Data quality summary - Facility related data	This file stores information such as annotation data and ancillary data related to the image data.
SAR Image Data	1	IMG-<Polarization> -<Scene ID> -<Product ID>	- File descriptor - Signal data	This file stores image data.
SAR Trailer File	1	TRL-<Scene ID> -<Product ID>	- File descriptor	This file stores the final information about the image data.
Summary Information	1	summary.txt		
Thumbnail Image	1	BRS-<Polarization> -<Scene ID> -<Product ID>.png		

Where:

Scene ID = AAAAAA-YYYYMMDDThhmmssZ

AAAAAA : Satellite type

- STRIXA: StriX-α
- STRIXB: StriX-β
- STRIX1: StriX-1
- STRIX2: StriX-2
- STRIX3: StriX-3
- STRIX4: StriX-4

- : Separator

YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day)

hhmmss: Scene center observation time* (hh: hour, mm: minutes, ss: seconds)

*precise orbit is used when available

Product ID = DDEEE

DD: Observation mode

- SM: Stripmap mode
- SL: Sliding Spotlight mode
- ST: Staring Spotlight mode

EEE: Processing level (SLC: Single Look Complex)

1.1.2 Product Record Description

The table below shows SLC CEOS format record structure.

Table 1.1-2 Record Structure SLC CEOS Format

Record No.	Record Length [byte]	Number of Record	Record Name	File Name
1	360	1	Volume descriptor	Volume Directory File
3	360	3	File pointer	
4	360	1	Text	
1	720	1	SAR Leader file descriptor	SAR Leader File
2	4,096	1	Dataset summary	
3	4,680	1	Platform location data	
4	16,384	1	Attitude data	
5	9,860	1	Radiometric data	
6	1,620	1	Data quality summary	
7	5000	1	Facility related data	
1	720	1	SAR data file descriptor	SAR Image Data
2 to n+1	variable	n	Signal data	
1	720	1	SAR trailer file descriptor	SAR Trailer

1.1.3 Record Data Type

The definition of data type is shown in the table below.

Table 1.1-3 Data Type

Type (code)	Details
Am	ASCII character（Left fill if not specified）
Im	Integer number in ASCII form（Right fill）
Fm.n	Floating number in ASCII form（Right fill）
Em.n	Exponential number in ASCII form（Right fill）
Bm	Binary number（the first byte is the most significant, big endian）

Where:
m：Number of digits
n：Number of decimal places

1.1.4 Record Type Code and Record Subtype Code

Each record has record type code and record subtype code to distinguish each other.
Each record type is shown in the table below.

Table 1.1-4 Record Type of Each Record

Record Name	First Record Type	Record Type	Second Record Type	Third Record Type	Record Length [bytes]
Volume descriptor	192	192	18	18	360
File pointer	219	192	18	18	360
Text	18	192	18	18	360
SAR Leader file descriptor	11	192	18	18	720
Dataset summary	18	10	18	20	4096
Platform location data	18	30	18	20	4680

Record Name	First Record Type	Record Type	Second Record Type	Third Record Type	Record Length [bytes]
Attitude data	18	40	18	20	16384
Radiometric data	18	50	18	20	9860
Data quality summary	18	60	18	20	1620
Facility related data	18	200	18	70	5000
SAR data file descriptor	50	192	18	18	720
Signal data	50	10	18	20	Variable
SAR trailer file descriptor	63	192	18	18	720

1.1.5 Contents of Records in SLC CEOS Files

The record formats are shown in the tables below.

Table 1.1-5 Volume Descriptor Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 1	
2	5	B1	First subtype code = 192	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 360	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’ : ASCII	
8	15-16	A2	Blank	
9	17-28	A12	Format descriptor ID = 'CEOS-SARbbbb’	

Field No.	Byte No.	Type	Description	Remarks
10	29-30	A2	Revision level of the document = 'bA', 'bB', ...	
11	31-32	A2	Superstructure format revision level = 'bA', 'bB', ...	
12	33-44	A12	Software release and revision number = ‘'NNN.NNNbbbbb'	
13	45-60	A16	Physical Volume ID = 'SYNSbbbbbbbbbbbb'	
14	61-76	A16	Logical volume ID = ‘MMMMMNYYYYmmDD’ MMMMM = Mission name ('STRIX') N = Mission ID（Alpha='A', Beta='B', 1='1'） YYYY = Product creation year mm = Product creation month DD = Product creation day	
15	77-92	A16	Volume set ID = 'MMMMMMMbbbbbbbbb' MMMMMM = Mission name (‘Strix-A’, ‘Strix-B’, ‘Strix-1’)	
16	93-94	I2	Number of physical volumes in the logical volume = ‘b1’	
17	95-96	I2	First tape’s sequence number of the physical volume = ‘b1’	
18	97-98	I2	Last tape’s sequence number of the physical volume = ‘b1’	
19	99-100	I2	Current tape’s sequence number of the physical volume = ‘b1’	
20	101-104	I4	Number of files in the logical volume following the volume directory file = 'bbb3':	

Field No.	Byte No.	Type	Description	Remarks
21	104-108	I4	Number of logical volumes in the volume set = 'bbb1'	
22	109-112	I4	Number of logical volumes in a physical volume = 'bbb1'	
23	113-120	A8	Logical volume creation date ='YYYYMMDD' (without zero suppression) YYYY: Year ('0001'-'9999') MM: Month ('01'-'12') DD: Day ('01'-'31')	
24	121-128	A8	Logical volume creation time ='HHMMSSXX' (without zero suppression) HH: Hour ('00'-'23') MM: Minute ('00'-'59') SS: Second ('00'-'59') XX: 10 milliseconds ('00'-'99')	
25	129-140	A12	Logical volume creation country (Japan) ='JAPANbbbbbbb'	
26	141-148	A8	Logical volume creator = 'SYNSbbbb'	
27	149-160	A12	Logical volume creation facility = 'SYNSbbbbbbbb'	
28	161-164	I4	Number of file pointer records in the volume directory = 'bbb3'	
29	165-168	I4	Number of text records in the volume directory = 'bbb1'	
30	169-260	A92	Volume descriptor spare area = blank	
31	261-360	A100	Private fields = blank	

Table 1.1-6 File Pointer Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 1	
2	5	B1	First subtype code = 219	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 360	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’; ASCII	
8	15-16	A2	Blank	
9	17-20	I4	Reference file number Leader file ='bbb1' Image file ='bbb2' Trailer file ='bbb3'	
10	21-36	A16	Reference file ID ='MMMMMNbTFFFFbbbb' MMMMM: Mission name ('STRIX') N: Mission number (Alpha ='A', Beta='B', 1='1') T: Processing level code (* 1) FFFF: File type 'SARL': Leader file 'IMOP': Image file 'SART': Trailer file	(*1) 'B': SLC
11	37-64	A28	Reference file class ='SARLEADERbFILEbbbbbbbbbbbbbb': For leader file ='IMAGERYbOPTIONSbFILEbbbbbbbb': For image file ='SARTRAILERbFILEbbbbbbbbbbbbb': For trailer file	

Field No.	Byte No.	Type	Description	Remarks
12	65-68	A4	Reference file class code ='SARL': For leader files ='IMOP': For image files ='SART': For trailer files	
13	69-96	A28	Reference file data type ='MIXEDbBINARYbANDbASCIIbbbbbb’	
14	97-100	A4	Reference file data type code ='MBAA'	
15	101-108	I8	Number of records in the reference file (zero suppression) Leader file ='bbbbbbb7' (SLC) Image file = number of SAR data records + 1 Trailer file ='bbbbbbb1'	
16	109-116	I8	Length of the first record in reference file ='bbbbb720'	
17	117-124	I8	Maximum record length (byte length) of the reference file: 'bbbLLLL'	
18	125-136	A12	Reference file record length type ='VARIABLEbLEN': For leader files ='VARIABLEbLEN': For image files ='VARIABLEbLEN': For trailer files	
19	137-140	A4	Reference file record length type code ='VARE': For leader files ='VARE': For image files ='VARE': For trailer files	
20	141-142	I2	The number of the physical volume set containing the first record of the file ='b1'	
21	143-144	I2	The number of the physical volume set containing the last record of the file = 'b1'	
22	145-152	I8	Record number of the first record on this physical volume ='bbbbbbb1'	

Field No.	Byte No.	Type	Description	Remarks
23	153-160	I8	Record number of the last record on this physical volume Leader file ='bbbbbbb7' (SLC) Image file = number of lines + 1 Trailer file ='bbbbbbb1'	
24	161-260	A100	Blank	
25	261-360	A100	Private fields = blank	

Table 1.1-7 Text Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 5	
2	5	B1	First subtype code = 18	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 360	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’ In case of ASCII	
8	15-16	A2	Blank	
9	17-56	A40	Deliverable ID (Product ID) ='PRODUCT: DDEEEb ~ b' DD: Observation mode SL: Sliding Spotlight mode SM: Stripmap mode ST: Staring Spotlight mode EEE: Processing level SLC: Single Look Complex	

Field No.	Byte No.	Type	Description	Remarks
10	57-116	A60	Product creation location / date / time (without zero suppression) ='PROCESS: JAPAN-SYNS-STRIXNbYYYYMMDDbHHMMSSb ～ b' N: A, B, 1 YYYYMMDD: Creation date HHMMSS: Creation time (UTC)	
11	117-156	A40	Physical tape ID ='TAPEbID: b ～ b'	
12	157-196	A40	Scene ID ='ORBITb: AAAAAA-YYYYMMDDThhmmssZb ～ b' AAAAAA: Satellite type (='STRIXN') N: A, B or 1 YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day) hhmmss: Scene center observation time (hh: hour, mm: minutes, ss: seconds) -: Separator	
13	197-236	A40	Scene location ID (without zero suppression) ='FRAMEbCENTRE: b ～ b': SLC	
14	237-360	A124	Blank	

Table 1.1-8 Leader File Descriptor Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 1	
2	5	B1	First subtype code = 11	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	

Field No.	Byte No.	Type	Description	Remarks
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 720	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’: ASCII	
8	15-16	A2	Continue flag = ‘bb’	
9	17-28	A12	Format control document ID='CEOS-SARbbbb'	
10	29-30	A2	Format control document revision level ='bA'	
11	31-32	A2	Record format revision level ='bA'	
12	33-44	A12	Software Release & Revision Number ='NNN.NNNbbbbb'	
13	45-48	I4	Number of files = ‘bbb1’	
14	49-64	A16	File ID ='MMMMMNbTFFFFbbbb' MMMMM: Mission name ('STRIX') N: Mission ID (Alpha='A', Beta='B', 1='1') T: Processing level code SLC ='B' FFFF: File type Leader file ='SARL'	
15	65-68	A4	Record sequence and location type flag ='FSEQ'	
16	69-76	I8	Sequence number of location = 'bbbbbbb1'	
17	77-80	I4	Field length of sequence number = 'bbb4'	
18	81-84	A4	Record code and location type flag = 'FTYP'	
19	85-92	I8	Record code position ='bbbbbbb5'	

Field No.	Byte No.	Type	Description	Remarks
20	93-96	I4	Field length of record code ='bbb4'	
21	97-100	A4	Record length and location type flag = 'FLGT'	
22	101-108	I8	Location of record length ='bbbbbbb9'	
23	109-112	I4	Field length of record length ='bbb4'	
24	113-180	A68	Blank	
25	181-186	I6	Number of dataset summary records ='bbbbb1'	
26	187-192	I6	Dataset summary record length ='bb4096'	
27	193-198	I6	Number of map projection data records ='bbbbb0'	
28	199-204	I6	Map projection data record length ='bbbbb0'	
29	205-210	I6	Number of platform location data records ='bbbbb1'	
30	211-216	I6	Platform location data record length ='bb4680'	
31	217-222	I6	Number of attitude data records='bbbbb1'	
32	223-228	I6	Attitude data record length = 16384	
33	229-234	I6	Number of radiometric data records ='bbbbb1'	
34	235-240	I6	Radiometric record length ='bb9860'	
35	241-246	I6	Number of radiometric compensation records ='bbbbb0'	
36	247-252	I6	Radiometric compensation record length ='bbbbb0'	

Field No.	Byte No.	Type	Description	Remarks
37	253-258	I6	Number of data quality summary records='bbbbb1'	
38	259-264	I6	Data quality summary record length ='bb1620'	
39	265-270	I6	Number of data histogram records ='bbbbb0'	
40	271-276	I6	Data histogram record length ='bbbbb0'	
41	277-282	I6	Number of range spectra records ='bbbbb0'	
42	283-288	I6	Range spectra record length ='bbbbb0'	
43	289-294	I6	Number of DEM descriptor records ='bbbbb0'	
44	295-300	I6	DEM descriptor record length ='bbbbb0'	
45	301-306	I6	Number of radar parameter update records ='bbbbb0'	
46	307-312	I6	Radar parameter update record length ='bbbbb0'	
47	313-318	I6	Number of annotation data records ='bbbbb0'	
48	319-324	I6	Annotation data record length ='bbbbb0'	
49	325-330	I6	Number of detail processing records = 'bbbbb0'	
50	331-336	I6	Detail processing record length = 'bbbbb0'	
51	337-342	I6	Number of calibration records ='bbbbb0'	
52	343-348	I6	Calibration record length ='bbbbb0'	
53	349-354	I6	Number of GCP records ='bbbbb0'	

Field No.	Byte No.	Type	Description	Remarks
54	355-360	I6	GCP record length ='bbbbb0'	
55	361-420	A60	Blank	
56	421-426	I6	Number of facility data records = 'bbbbb1'	
57	427-432	I6	Facility data record length = 'bb5000'	
58	433-720	A288	Blank	

Table 1.1-9 Data Set Summary Records

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 2	
2	5	B1	First subtype code = 18	
3	6	B1	Record type code = 10	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 20	
6	9-12	B1	Record length = 4096	
7	13-16	I4	Dataset summary record sequence number = ‘bbb1’	
8	17-20	I4	SAR channel ID = blank	

Field No.	Byte No.	Type	Description	Remarks
9	21-52	A32	Scene ID ='AAAAAA-YYYYMMDDThhmmssZb ～ b' AAAAAA: Satellite type (='STRIXN') N: A, B or 1 YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day) hhmmss: Scene center observation time (hh: hour, mm: minutes, ss: seconds) -: Separator	
10	53-68	A16	Number of scene reference = 'bbbbbbbbbbbbbbbb'	
11	69-100	A32	Scene center time ='YYYYMMDDHHMMSSTTTbbbbbbbbbbbbbbbb' (No zero suppression) YYYYMMDD: YYYY: year, MM: month, DD: day HHMMSSTTT: Time (UTC)	
12	101-116	A16	Blank	
13	117-132	F16.7	Geodetic latitude (degrees) in the center of the processed scene = blank: SLC	
14	133-148	F16.7	Geodetic longitude (degrees) in the center of the processed scene = blank: SLC	
15	149-164	F16.7	Processed scene center true heading (degrees) = blank: SLC	
16	165-180	A16	Ellipsoidal model = 'WGS84b ～ b'	
17	181-196	F16.7	Semi-major axis of ellipsoid (km) = 6378.1370000	
18	197-212	F16.7	Semi-minor axis of ellipsoid (km) = 6356.7523142	

Field No.	Byte No.	Type	Description	Remarks
19	213-228	F16.7	Earth mass (10^{24} kg) = 5.9740000	
20	229-244	F16.7	Gravitational constant (10^{-14} m^3 / s^2 kg) = 3.9860050	
21	245-260	F16.7	Ellipsoid J2 parameter = $0.1082629*10^{-2}$	
22	261-276	F16.7	Ellipsoid J3 parameter = $-0.0000254*10^{-1}$	
23	277-292	F16.7	Oblong parameter (mechanical shape coefficient J4 term) (10 ^-1) = $-0.0000162*10^{-1}$	
24	293-308	A16	Blank	
25	309-324	F16.7	reference height above the ellipsoid	
26	325-332	I8	Scene center line No. (Including zero fill)	N/2 (N: number of lines)
27	333-340	I8	Scene center pixel No. (Including zero fill)	M/2 (M: number of pixels)
28	341-356	F16.7	Processing scene length (km) = blank	
29	357-372	F16.7	Processing scene width (km) = blank	
30	373-388	A16	Blank	
31	389-392	I4	Number of SAR channels ='bbb1	
32	393-396	A4	Blank	
33	397-412	A16	Sensor platform name (ID) StriX: 'STRIXbbbbbbbbbbb’	

Field No.	Byte No.	Type	Description	Remarks
34	413-444	A32	Sensor ID and operation mode ='AAAAAA-BB-CCbb-bbbbbbbbbbbbbbbb' AAAAAA: Satellite type (='STRIXN') N:A, B or 1 BB: SAR band ('Xb') CC: Operation mode '01': Stripmap mode '02': Sliding spotlight mode '03': Staring spotlight mode	
35	445-452	I8	Total satellite orbit number	
36	453-460	F8.3	Sensor platform geodetic latitude at nadir corresponding to scene center = blank: SLC	
37	461-468	F8.3	Sensor platform geodetic longitude at nadir corresponding to scene center = blank: SLC	
38	469-476	F8.3	Sensor platform heading at nadir corresponding to scene center = blank: SLC	
39	477-484	F8.3	Sensor angle (degrees) relative to the flight direction of the sensor platform = 'bb90.000' (-90.0: left side), (90.0: right side)	
40	485-492	F8.3	Incidence angle (degrees) at the scene center	
41	493-500	A8	Blank	
42	501-516	F16.7	Radar wavelength (m): Nominal value	f

Field No.	Byte No.	Type	Description	Remarks
43	517-518	A2	Motion compensation indicator = '00' fixed = '00': no compensation = '01': on board compensation = '10': in processor compensation = '11': both on board and in processor	
44	519-534	A16	Range pulse code ='LINEARbFMbCHIRPb'	
45	535-550	E16.7	Range pulse amplitude coefficient #1 = Nominal Value Center frequency ξ1 with respect to pulse width τ of linear FM modulation chirp (Constant term)	
46	551-566	E16.7	Range pulse amplitude coefficient #2 = Nominal value FM rate ξ2 for pulse width τ of linear FM modulation chirp (Linear coefficient term)	
47	567-582	E16.7	Range pulse amplitude coefficient #3 = Nominal value (= 0.0) FM rate ξ3 for pulse width τ of linearFMmodulationchirp (Quadratic coefficient terms)	
48	583-598	E16.7	Range pulse amplitude coefficient #4 = Nominal value (= 0.0) FM rate ξ4 for pulse width τ of linearFMmodulationchirp (Cubic coefficient terms)	
49	599-614	E16.7	Range pulse amplitude coefficient #5 = Nominal value (= 0.0) FM rate ξ5 for pulse width τ of linearFMmodulationchirp (Quartic term coefficient)	
50	615-630	E16.7	Range pulse phase coefficient #1 (constant term) = blank	

Field No.	Byte No.	Type	Description	Remarks
51	631-646	E16.7	Range pulse phase coefficient #2 (linear coefficient term) = blank	
52	647-662	E16.7	Range pulse phase coefficient #3 (secondary coefficient term) = blank	
53	663-678	E16.7	Range pulse phase coefficient #4 (third-order coefficient term) = blank	
54	679-694	E16.7	Range pulse phase coefficient #5 (quartic coefficient term) = blank	
55	695-702	I8	Down linked data chirp extraction index linear-up chirp ='bbbbbbb0' linear-down chirp ='bbbbbbb1' linear-up and -down chirp ='bbbbbbb2'	
56	703-710	A8	Blank	
57	711-726	F16.7	Sampling frequency (MHz) nominal value Set the observation auxiliary data value of the first record	
58	727-742	F16.7	Range gate (rise at the start of the image) (μsec) Set the observation auxiliary data value of the first record	
59	743-758	F16.7	Range pulse width (μsec) Set the observation auxiliary data value of the first record	
60	759-762	A4	Baseband conversion flag ='YESb' (fixed)	
61	763-766	A4	Range compression flag = 'YESb':	
62	767-782	F16.7	Receiver gain for like polarized (at the start of the image) Nominal value	
63	783-798	F16.7	Receiver gain for cross-polarized (at the start of the image) Nominal value	

Field No.	Byte No.	Type	Description	Remarks
64	799-806	I8	Quantization in bits per channel = 'bbbbbbbb'	
65	807-818	A12	Quantization descriptor ='UNIFORMbI, Qb’	
66	819-834	F16.7	DC bias nominal value of component I	
67	835-850	F16.7	DC bias nominal value of Q component	
68	851-866	F16.7	Gain imbalance for I & Q = Nominal value	
69	867-882	A16	Blank	
70	883-898	A16	Blank	
71	899-914	F16.7	Electronic boresight	
72	915-930	F16.7	Mechanical boresight	
73	931-934	A4	Echo tracker-on/off = 'OFFb' (fixed value)	
74	935-950	F16.7	Acquisition PRF (mHz)	
75	951-966	F16.7	Two-way antenna beam width [deg] (Elevation, Effective value) = Nominal value	
76	967-982	F16.7	Two-way antenna beam width [deg] (Azimuth, Effective value) = Nominal value	
77	983-998	I16	Satellite encoded binary time code: Standard satellite time counter of error time information = blank	
78	999-1030	A32	Satellite clock time: Standard ground time of error time information (Tgref) = blank	
79	1031-1046	I16	Satellite clock increment [nsec]: Error time information of calculation satellitecounter cycle (Psc) = blank	

Field No.	Byte No.	Type	Description	Remarks
80	1047-1062	A16	Processing equipment (ID) = 'SYNSbbbbbbbbbbbb'	
81	1063-1070	A8	Processing system name (ID) = 'SYNSbbbb'	
82	1071-1078	A8	Processing version ID Same as the first 8 characters of the volume descriptor software release & revision number	
83	1079-1094	A16	Process code of processing equipment = 'bbbbbbbbbbbbbbbb'	
84	1095-1110	A16	Product level code = 'SLCbbbbbbbbbbbbb' (SLC)	
85	1111-1142	A32	Product type specifier For SLC: ='BASICbIMAGEbb ～ b'	
86	1143-1174	A32	Processing algorithm ID = blank	
87	1175-1190	F16.7	Number of looks in the azimuth direction (nominal value) SLC = 1.0	
88	1191-1206	F16.7	Number of looks in the range direction (nominal value) = 1.0	
89	1207-1222	F16.7	Bandwidth per look in azimuth (Hz) Same as 1239-1254 bytes	
90	1223-1238	F16.6	Bandwidth per look in the range direction (Hz) (3dB down width of the power spectrum of the reference function for a sub aperture look)	
91	1239-1254	F16.7	Bandwidth in azimuth direction (Hz) (3dB down width of power spectrum of the reference function for full aperture)	
92	1255-1270	F16.7	Bandwidth in the range direction (kHz)	

Field No.	Byte No.	Type	Description	Remarks
93	1271-1302	A32	Window function in azimuth direction = 1: RECTANGLE	
94	1303-1334	A32	Window function in the range direction = 1: RECTANGLE	
95	1335-1350	A16	Data input source (eq. HDDT-ID, etc.) Online transmission ='ONLINEb ～ b'	
96	1351-1366	F16.7	Resolution in the ground range direction (nominal value) (m) = blank: For SLC	
97	1367-1382	F16.7	Resolution in azimuth direction (nominal value) (m) = blank: For SLC	
98	1383-1398	F16.7	Radiometric parameter (Bias) = blank	
99	1399-1414	F16.7	Radiometric parameter (Gain) = blank	
100	1415-1430	F16.7	Along track Doppler frequency (center) constant term at early edge of image (Hz)	
101	1431-1446	F16.7	Along track Doppler frequency (center) linear coefficient terms at early edge of image (Hz / pixel)	
102	1447-1462	F16.7	Along track Doppler frequency (center) quadratic coefficient terms at early edge of image (Hz / pixel / pixel)	
103	1463-1478	A16	Blank	
104	1479-1494	F16.7	Cross track Doppler frequency (center) constant term at early edge of image (Hz)	
105	1495-1510	F16.7	Cross track Doppler frequency (center) linear coefficient terms at early edge of image (Hz / pixel)	

Field No.	Byte No.	Type	Description	Remarks
106	1511-1526	F16.7	Cross track Doppler frequency (center) quadratic coefficient terms at early edge of image (Hz / pixel / pixel)	
107	1527-1534	A8	Time direction indicator along pixel direction= blank (fixed)	
108	1535-1542	A8	Time direction indicator along line direction Ascending ='ASCENDbb' Descending ='DESCENDb'	
109	1543-1558	F16.7	Along track Doppler frequency rate constant terms at early edge of the image (Hz / sec)	
110	1559-1574	F16.7	Along track Doppler frequency rate linear coefficient at early edge of the image (Hz / sec / pixel)	
111	1575-1590	F16.7	Along track Doppler frequency rate quadratic coefficient at early edge of the imagedata (Hz / sec / pixel / pixel)	
112	1591-1606	A16	Blank	
113	1607-1622	F16.7	Cross track Doppler frequency rate constant terms at early edge of the image (Hz / sec)	
114	1623-1638	F16.7	Cross track Doppler frequency rate linear coefficient at early edge of the image (Hz / sec / pixel)	
115	1639-1654	F16.7	Cross track Doppler frequency rate quadratic coefficient at early edge of the image (Hz / sec / pixel / pixel)	
116	1655-1670	A16	Blank	
117	1671-1678	A8	Line content indicator = SLC:'RANGEbbb'	

Field No.	Byte No.	Type	Description	Remarks
118	1679-1682	A4	Clutter lock applied flag ='NOTb' ='YESb','NOTb'	
119	1683-1686	A4	Auto-focusing applied flag ='NOTb' ='YESb','NOTb'	
120	1687-1702	F16.7	Line spacing (m) SLC: Calculated value of spacing in the azimuth direction	
121	1703-1718	F16.7	Pixel spacing (m) SLC: Calculated value of spacing in the range direction	
122	1719-1734	A16	Processor range compression designator = 'SYNTHETICbCHIRPb'	
123	1735-1750	F16.7	Doppler center frequency approximation coefficient constant term (a)	
124	1751-1766	F16.7	Doppler center frequency approximation coefficient Linear coefficient term (b) $fd = a + b \cdot R$ fd: Doppler center frequency (Hz) R: Slant range (km)	
125	1767-1770	I4	Calibration mode data position flag ='bbb0' No calibration mode data area ='bbb0' Observation start side ='bbb1' Observation end side ='bbb2' Observation start / end side ='bbb3'	
126	1771-1778	I8	Start line number of calibration at the side of start In case of calibration location flag is '0', always = 'bbbbbbb0'	

Field No.	Byte No.	Type	Description	Remarks
127	1779-1786	I8	End line number of calibration at the side of start In case of calibration location flag is '0', always = 'bbbbbbb0'	
128	1787-1794	I8	Start line number of calibration at the side of end In case of calibration location flag is '0', always = 'bbbbbbb0'	
129	1795-1802	I8	End line number of calibration at the side of end In case of calibration location flag is '0', always = 'bbbbbbb0'	
130	1803-1806	I4	PRF switching indicator = 'bbb0' If the PRF has not changed in one scene ='bbb0' When PRF changes in one scene ='bbb1'	
131	1807-1814	I8	Line number of PRF switching No change point:'bbbbbbb1'	
132	1815-1830	F16.7	Beam center direction (degrees) at the center of the scene	
133	1831-1834	I4	Yaw steering flag If not yaw steering ='bbb1' If yaw steering ='bbb0'	
134	1835-1838	I4	Blank	
135	1839-1854	F16.7	Off Nadir angle (degrees)	+: Left side observation,-: Right side observation
136	1855-1858	A4	Blank	
137	1859-1886	A28	Blank	
138	1887-1906	E20.13	Incidence angle constant term (a0)	$\Theta = a0 + a1*R + a2*R^2$ θ: Incident angle (rad) R: Slant range (km)

Field No.	Byte No.	Type	Description	Remarks
139	1907-1926	E20.13	Incidence angle linear coefficient term (a1)	
140	1927-1946	E20.13	Incidence angle quadratic coefficient term (a2)	
141	1947-1966	A20	Blank	
142	1967-1986	A20	Blank	
143	1987-2006	A20	Blank	
Image annotation				
144	2007-2014	I8	Number of annotation points (up to 64) ='bbbbbbb0'	
145	2015-2022	A8	Blank	
146	2023-2030	I8	Line number of 1st annotation start = blank	
147	2031-2038	I8	Pixel number of 1st annotation start = blank	
148	2039-2054	A16	1st annotation text = blank	
149-337	2055-4070	(I8 * 2, A * 16) * 63	2nd to 64th annotations	
338	4071-4096	A26	System reserved = blank	

Table 1.1-10 Platform Position Data Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 3	
2	5	B1	First subtype code = 18	
3	6	B1	Record type code = 30	

Field No.	Byte No.	Type	Description	Remarks
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 20	
6	9-12	B1	Record length = 4680	
7	13-44	A32	Orbital element type Onboard orbit = '1bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb' Precise orbit = '2bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb’	
8	45-60	F16.7	1st orbital element Position vector in the earth fixed coordinate system of the scene center (x) [m]	
9	61-76	F16.7	2nd orbital element Position vector in the earth fixed coordinate system of the scene center (y) [m]	
10	77-92	F16.7	3rd orbital element Position vector in the earth fixed coordinate system of the scene center (z) [m]	
11	93-108	F16.7	4th orbital element Velocity vector in the earth fixed coordinate system of the scene center (x') [m/sec]	
12	109-124	F16.7	5th orbital element Velocity vector in the earth fixed coordinate system of the scene center (y') [m/sec]	

Field No.	Byte No.	Type	Description	Remarks
13	125-140	F16.7	6th orbital element Velocity vector in the earth fixed coordinate system of the scene center (z') [m/sec]	
14	141-144	I4	Number of data points variable up to 28 Example: Onboard orbit ='bb28' Precise orbit ='bb28’	
15	145-148	I4	Year of first point ='YYYY'	
16	149-152	I4	Month of first point =’bbMM’	
17	153-156	I4	Day of first point = ‘bbDD’	
18	157-160	I4	Day in the year of first point (Example February 2:'bb33')	
19	161-182	E22.15	Seconds of the first point (Example, 0:51:30.23 = 3090.23)	
20	183-204	E22.15	Interval time between points (seconds) = ss	
21	205-268	A64	Reference Coordinate System (ECI, ECR) = 'ECRbb ～ b'	
22	269-290	E22.15	Greenwich mean hour angle (degrees) = blank	
23	291-306	F16.7	Along track position error (m) = blank	
24	307-322	F16.7	Across track position error (m) = blank	
25	323-338	F16.7	Radial position error (m/sec) = blank	
26	339-354	F16.7	Along track velocity error (m/sec) = blank	
27	355-370	F16.7	Across track velocity error (m / sec) = blank	
28	371-386	F16.7	Radial velocity error (m / sec) = blank	

Field No.	Byte No.	Type	Description	Remarks
FIRST POSITIONAL DATA POINT				
29	387-452	3E22.15	First data point position vector (x, y, z) (m)	
30	453-518	3E22.15	First data point velocity vector (x', y', z') (m / sec)	
	519-4082	27*6*E 22.15	Repeat 387-518 for up to 28 points	
35	4083-4199	A18	Blank	
36	4101	I1	Leap second flag 0: None 1: Leap second present	
37	4102-4680	A579	Blank	

Table 1.1-11 Attitude Data Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 4	
2	5	B1	First record subtype code = 18	
3	6	B1	Record type code = 40	
4	7	B1	Second record subtype code = 18	
5	8	B1	Third record subtype code = 20	
6	9-12	B4	Record length = 16384	
7	13-16	I4	Number of points = ‘nn’	
8	17-20	I4	Day of the year	
9	21-28	I8	Milli-second of the day	
10	29-32	I4	Pitch data quality flag = blank	

Field No.	Byte No.	Type	Description	Remarks
11	33-36	I4	Role data quality flag = blank	
12	37-40	I4	Yaw data quality flag = blank	
13	41-54	E14.6	Pitch [deg]	
14	55-68	E14.6	Roll [deg]	
15	69-82	E14.6	Yaw [deg]	
16	83-86	I4	Pitch rate quality flag = blank	
17	87-90	I4	Roll rate quality flag = blank	
18	91-94	I4	Yaw quality flag = blank	
19	95-108	E14.6	Pitch rate	
20	109-122	E14.6	Roll rate	
21	123-136	E14.6	Yaw rate	
	137-136+120*(n-1)	120*(n-1)	Repeat bytes 17-136 for the number of points (n)	
22	137+120*(n-1)-16384	A(16384-(136+120*(n-1)))	Blank	

Table 1.1-12 Radiometric Data Records

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 5	
2	5	B1	First record subtype code = 18	
3	6	B1	Record type code = 50	
4	7	B1	Second record subtype code = 18	
5	8	B1	Third record subtype code= 20	

Field No.	Byte No.	Type	Description	Remarks
6	9-12	B1	Record length = 9860	
7	13-16	I4	Radiometric data record sequence number ='bbb1’	
8	17-20	I4	Number of radiometric data fields ='bbb1’	
RADIOMETRIC DATA SET				
9	21-36	F16.7	Calibration factor (CF) SLC: $\beta_{0dB} = 10 * \log 10 <I^2 + Q^2> + CF$	The backscattering coefficient (beta-naught) of a pixel can be obtained by the ensemble averaging (<>), i.e., the spatial averaging of pixel values around the target. Here, I and Q in <> of the above formula are the pixel values.
10	37-9860	A9824	Blank	

Table 1.1-13 Data Quality Summary Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 6	
2	5	B1	First record subtype code = 18	
3	6	B1	Record type code = 60	
4	7	B1	Second record subtype code = 18	
5	8	B1	Third record subtype code= 20	
6	9-12	B4	Record length = 1620	
7	13-16	I4	Data quality record number ='bbb1’	

Field No.	Byte No.	Type	Description	Remarks
8	17-20	A4	SAR channel ID ='ABbb' A: Received polarization (V) B: Receiving antenna (S: Single beam)	
9	21-26	A6	Date of the last calibration update = 'YYMMDD' YY : lower 2 figures of the year MM : Month DD : Day	Blank: to be determined
10	27-30	I4	Number of channels (up to 8)	
ABSOLUTE RADIOMETRIC DATA QUALITY				
11	31-46	F16.7	ISLR (nominal value) [dB]	Blank
12	47-62	F16.7	PSLR (nominal value) [dB]	Blank
13	63-78	F16.7	Azimuth ambiguity rate (AAR) (Nominal value)	Blank
14	79-94	F16.7	Range ambiguity rate (RAR) (Nominal value)	Blank
15	95-110	F16.7	Estimate of SNR [dB]	Blank
16	111-126	F16.7	BER (Actual value)	Blank
17	127-142	F16.7	Slant range resolution (Nominal value) [m]	
18	143-158	F16.7	Azimuth resolution (Nominal value) [m]	
19	159-174	F16.7	Radiometric resolution (Nominal value) [dB]	Blank
20	175-190	F16.7	Instantaneous dynamic range [dB]	Blank
21	191-206	F16.7	Nominal absolute radiometric calibration magnitude uncertainty of SAR channel indicated in bytes 17-20 [dB]	Blank

Field No.	Byte No.	Type	Description	Remarks
22	207-222	F16.7	Nominal absolute radiometric calibration phase uncertainty of SAR channel indicated in bytes 17-20 [deg]	Blank
RELATIVE RADIOMETRIC QUALITY				
23	223-238	F16.7	Nominal relative radiometric calibration magnitude uncertainty of SAR channel indicated in bytes 17-20 [dB]	
24	239-254	F16.7	Nominal relative radiometric calibration magnitude uncertainty of SAR channel indicated in bytes 17-20 [dB]	
25	255 – (n-1)*32+254	(n-1)*2F16.7	Repetition of bytes 223 - 254 for the remaining channels (up to 8 channels)	
26	(n-1)*32+255 - 734	A(480-(n-1)*32)	Blank	
ABSOLUTE GEOMETRIC DATA QUALITY				
27	735-750	F16.7	Absolute location error along track (Nominal value) [m]	Blank
28	751-766	F16.7	Absolute location error cross track (Nominal value) [m]	Blank
29	767-782	F16.7	Geometric distortion scale in line direction (Nominal value)	Blank
30	783-798	F16.7	Geometric distortion scale in pixel direction (Nominal value)	Blank
31	799-814	F16.7	Geometric distortion skew	Blank
32	815-830	F16.7	Scene orientation error	Blank
RELATIVE GEOMETRIC DATA QUALITY				

Field No.	Byte No.	Type	Description	Remarks
33	831-846	F16.7	Along track relative misregistration error of other channels versus SAR channel (bytes 17-20) [meters]	Blank
34	847-862	F16.7	Cross track relative misregistration error of other channels versus SAR channel (bytes 17-20) [meters]	Blank
35	863-1086	(n-1)* 2F16.7	Repetition of bytes 831 - 862 for the other channels (up to 8 channels)	Blank
36	1087-1620	A532	Blank	

Table 1.1-14 Facility Related Data Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 7	
2	5	B1	First record subtype code = 18	
3	6	B1	Record type code = 200	
4	7	B1	Second record subtype code = 18	
5	8	B1	Third record subtype code= 18	
6	9-12	B1	Record length = 5000	
7	13-16	A4	Blank	
8	17-416	20E2 0.10	Twenty coefficients to convert from latitude and longitude to line(L) and pixel (P) position in the image. For SLC: blank	
9	417-420	A4	Blank	
10	421-428	A8	Blank	
11	429-436	A8	Blank	

Field No.	Byte No.	Type	Description	Remarks
12	437-444	A8	Blank	
13	445-452	A8	Blank	
14	453-456	I4	PRF switching flag No change in a scene = 'bbb0' (fixed value)	
15	457-464	I8	Start line number of PRF switching No change = 'bbbbbbb1' (fixed value)	
16	465-472	A8	Blank	
17	473-480	A8	Blank	
18	481-488	A8	Blank	
19	489-800	A312	Blank	
20	801-1024	A224	Blank	
21	1025-2024	50E20.10	Coefficients of the 8th polynomial expression to convert from pixel (P) and line (L) to latitude (φ) and longitude (λ), say (φ, λ) where: $\varphi = a_0 *L^4 *P^4 + a_1 *L^3 *P^4 + a_2 *L^2 *P^4 + a_3 *L*P^4 + a_4 *P^4 + a_5 *L^4 *P^3 + a_6 *L^3 *P^3 + a_7 *L^2 *P^3 + a_8 *L*P^3 + a_9 *P^3 + a_{10}*L^4 *P^2 + a_{11}*L^3 *P^2 + a_{12}*L^2 *P^2 + a_{13}*L*P^2 + a_{14}*P^2 + a_{15}*L^4 *P + a_{16}*L^3 *P + a_{17}*L^2 *P + a18*L*P + a_{19}*P + a_{20}*L^4 + a_{21}*L^3 + a_{22}*L^2 + a_{23}*L + a_{24}$ $\lambda = b_0 *L4 *P4 + b_1 *L3 *P4 + b_2 *L2 *P4 + b_3 *L*P4 + b_4 *P4 + b_5 *L4 *P3 + b_6 *L3 *P3 + b_7 *L2 *P3 + b_8 *L*P3 + b_9 *P3 + b_{10}*L4 *P2 + b_{11}*L3 *P2 + b_{12}*L2 *P2 + b_{13}*L*P2 + b_{14}*P 2 + b_{15}*L4 *P + b_{16}*L3 *P + b_{17}*L2 *P + b_{18}*L*P + b_{19}*P + b_{20}*L4 + b_{21}*L3 + b_{22}*L2 + b_{23}*L + b_{24}$ (The order of storing: $a_0, a_1, a_2, ..., a_{24}$ & $b_0, b_1, b_2, ..., b_{24}$)	(P, L) referred in the upper left pixel(p) and line (l) are substituted by the following expressions as P = p - Po, L = l - Lo, where (p, l) is an arbitrary coordinate address on the image. For the expressions above, the position defined as (p, l)=(0, 0) corresponds to the central point of the pixel at the upper left corner and (φ, λ) is measured in "degrees"
22	2025-2044	E20.10	Origin pixel (Po), 0.0 fixed	
23	2045-2064	E20.10	Origin Line (Lo), 0.0 fixed	

Field No.	Byte No.	Type	Description	Remarks
24	2065-3064	50E2 0.10	Coefficients of the 8th polynomial expression to convert from latitude (Φ) and longitude (Λ) to pixel (p) and line (l), say (p, l) where: $p = c_0 *\Lambda 4 *\Phi 4 + c_1 *\Lambda 3 *\Phi 4 + c_2 *\Lambda 2 *\Phi 4 + c_3 *\Lambda *\Phi 4 + c_4 *\Phi 4 + c_5 *\Lambda 4 *\Phi 3 + c_6 *\Lambda 3 *\Phi 3 + c_7 *\Lambda 2 *\Phi 3 + c_8 *\Lambda *\Phi 3 + c_9 *\Phi 3 + c_{10} *\Lambda 4 *\Phi 2 + c_{11} *\Lambda 3 *\Phi 2 + c_{12} *\Lambda 2 *\Phi 2 + c_{13} *\Lambda *\Phi 2 + c_{14} *\Phi 2 + c_{15} *\Lambda 4 *\Phi + c_{16} *\Lambda 3 *\Phi + c_{17} *\Lambda 2 *\Phi + c_{18} *\Lambda *\Phi + c_{19} *\Phi + c_{20} *\Lambda 4 + c_{21} *\Lambda 3 + c_{22} *\Lambda 2 + c_{23} *\Lambda + c_{24}$ $l = d_0 *\Lambda^4 *\Phi^4 + d_1 *\Lambda^3 *\Phi^4 + d_2 *\Lambda^2 *\Phi^4 + d_3 *\Lambda *\Phi^4 + d_4 *\Phi^4 + d_5 *\Lambda^4 *\Phi^3 + d_6 *\Lambda^3 *\Phi^3 + d_7 *\Lambda^2 *\Phi^3 + d_8 *\Lambda *\Phi^3 + d_9 *\Phi^3 + d_{10} *\Lambda^4 *\Phi^2 + d_{11} *\Lambda^3 *\Phi^2 + d_{12} *\Lambda^2 *\Phi^2 + d_{13} *\Lambda *\Phi^2 + d_{14} *\Phi^2 + d_{15} *\Lambda^4 *\Phi + d_{16} *\Lambda^3 *\Phi + d_{17} *\Lambda^2 *\Phi + d_{18} *\Lambda *\Phi + d_{19} *\Phi + d_{20} *\Lambda^4 + d_{21} *\Lambda^3 + d_{22} *\Lambda^2 + d_{23} *\Lambda + d_{24}$ (The order of storing: $c_0, c_1, c_2, \ldots, c_{24}$ & $d_0, d_1, d_2, \ldots, d_{24}$)	(Φ, Λ) referred in the upper left latitude(φ), longitude(λ) are substituted by the following expressions as $\Phi=\varphi-\Phi_0$ (degrees), $\Lambda=\lambda-\Lambda_0$ (degrees), where (φ, λ) is an arbitrary position on the image. For the expressions, the position defined as (p, l)=(0, 0) corresponds to the central point of the pixel at the upper left corner.
25	3065-3084	E20.1 0	Origin Latitude (Φ_0) scene center latitude	
26	3085-3104	E20.1 0	Origin Longitude (Λ_0) scene center longitude	
27	3105-5000	A189 6	Blank	

Table 1.1-15 Image File Descriptor Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 1	
2	5	B1	First subtype code = 50	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 720	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’ In case of ASCII	

Field No.	Byte No.	Type	Description	Remarks
8	15-16	A2	Blank	
9	17-28	A12	Format Manual ID ='CEOS-SARbbbb'	
10	29-30	A2	Format Manual Management Revision Number ='bA'	
11	31-32	A2	Record format revision level ='bA'	
12	33-44	A12	Software Release & Revision Number ='NNN.NNNbbbbb' 001.000, 001.001,... 002.000	
13	45-48	I4	File number = ‘bbb1’	
14	49-64	A16	File ID ='MMMMMNbTFFFFbbbb' MMMMM: Mission name ('STRIX') N: Mission ID (Alpha='A', Beta='B', 1='1') T: Processing level code SLC ='B' FFFF: File type Image file ='IMOP'	
15	65-68	A4	Record sequence and location type flag = 'FSEQ'	
16	69-76	I8	Sequence number of location = 'bbbbbbb1'	
17	77-80	I4	Field length of sequence number = 'bbb4'	
18	81-84	A4	Record code and location type flag = 'FTYP'	
19	85-92	I8	Record code position ='bbbbbbb5'	
20	93-96	I4	Record code field length ='bbb4'	
21	97-100	A4	Record length and position format flag ='FLGT'	
22	101-108	I8	Record length position ='bbbbbbb9'	

Field No.	Byte No.	Type	Description	Remarks
23	109-112	I4	Record length bytes ='bbb4'	
24	113-180	A68	Blank	
25	181-186	I6	Number of SAR data records Number of signal data records	1056
26	187-192	I6	Data set summary record length	
27	193-216	A24	Blank	
SAMPLE GROUP DATA				
28	217-220	I4	Bit length per sample = 'bb32': SLC	
29	221-224	I4	Number of samples per data group = 'bbb2': SLC	
30	225-228	I4	Number of bytes per data group='bbb8': SLC	
31	229-232	A4	Justification and order of samples within data group = blank (fixed value)	
SAR RELATED DATA IN THE RECORD				
32	233-236	I4	Number of SAR channels ='bbb1'	
33	237-244	I8	Number of lines per data set (one channel) (Excluding border lines)	
34	245-248	I4	Number of left border pixels per line = 'bbb0'	
35	249-256	I8	Number of data group (or pixels) per line	For level SLC products, each data record corresponds to 1 image range line. Each range line begins at the nearest-range pixel and ends at the farthest-range pixel.

Field No.	Byte No.	Type	Description	Remarks
36	257-260	I4	Number of right border pixels per line = 'bbb0'	
37	261-264	I4	Number of top border lines = 'bbb0'	
38	265-268	I4	Number of bottom border lines = 'bbb0'	
39	269-272	A4	Interleaving ID = 'BSQb' (fixed value)	
RECORD DATA IN THE FILE				
40	273-274	I2	Number of physical records per line = 'b1' (fixed value)	
41	275-276	I2	Number of physical records per multi-channel line in this file = 'b1' (fixed value)	
42	277-280	I4	Number of bytes of PREFIX DATA per record SLC = '1056'	
43	281-288	I8	Number of bytes of SAR data per record (zero suppression)	For SLC products, each data record corresponds to 1 image range line. Each range line begins at the nearest-range pixel and ends at the farthest-range pixel.
44	289-292	I4	Number of bytes of suffix data per record = 'bbb0' (fixed value)	
45	293-296	I4	Prefix/suffix repeat flag = 'bbbb' (fixed value)	
PREFIX / SUFFIX DATA LOCATORS				
46	297-304	A8	Sample data line number locator = 'bb13b4PB' 'P': Prefix, 'S': Suffix 'A': ASCII, 'B': Binary, 'N': Numeric	

Field No.	Byte No.	Type	Description	Remarks
47	305-312	A8	SAR channel number locator = 'bb49b2PB'	
48	313-320	A8	Time of SAR data line locator = 'bb45b4PB'	
49	321-328	A8	Left-fill count locator = 'bb21b4PB'	
50	329-336	A8	Right-fill count locator = 'bb29b4PB'	
51	337-340	A4	Pad pixels present indicator = 'bbbb'	
52	341-368	A28	Blank	
53	369-376	A8	SAR data line quality code locator = 'bb97b4PB'	
54	377-384	A8	Calibration information field locator = 'bbbbbbbb'	
55	385-392	A8	Gain values field locator = 'bbbbbbbb'	
56	393-400	A8	Bias values filed locator = 'bbbbbbbb'	
57	401-428	A28	SAR data format type indicator ='COMPLEX * 8bbbbbbbbbbbbbbbbb': SLC	
58	429-432	A4	SAR data format type code ='C * 8b': SLC 'COMPLEX * 8bbbbbbbbbbbbbbbbbb'''C * 8b'(8 byte wide) -The first half (4 bytes) in the 8-byte field is two's complement representation Including real number components in floating point format A complex representation in which the second half contains an imaginary component.	
59	433-436	I4	Pixel left justified bits ='bbb0'	
60	437-440	I4	Pixel right-justified bits ='bbb0'	

Field No.	Byte No.	Type	Description	Remarks
61	441-448	I8	Maximum pixel value (starting from 0) (zero suppression)= blank: SLC	
62	449-452	A4	Blank	
63	453-456	A4	Blank	
64	457-460	A4	Blank	
65	461-720	A260	Blank	

Table 1.1-16 Signal Data Records

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 2,3,..	
2	5	B1	First record subtype code = 50	
3	6	B1	Record type code = 10	
4	7	B1	Second record subtype code = 18	
5	8	B1	Third record subtype code= 20	
6	9-12	B4	Record length	
PREFIX DATA-GENERAL INFORMATION				
7	13-16	B4	SAR image data line number = 1, 2, 3 ...	
8	17-20	B4	SAR image data record index = 1 (fixed value) (indicates the record sequence number in the image line)	
9	21-24	B4	Actual count of left-fill pixels = 0 (fixed value)	

Field No.	Byte No.	Type	Description	Remarks
10	25-28	B4	Actual count of data pixels	For SLC products, actual count of data pixels corresponds to the number of 1 image range pixels. Each range line begins at the nearest-range pixel and ends at the farthest-range pixel.
11	29-32	B4	Actual count of right-fill pixels = 0	
PREFIX DATA-SENSOR PARAMETERS				
12	33-36	B4	Sensor parameters update flag = 0	
13	37-40	B4	Sensor acquisition year Scene start line year	
14	41-44	B4	Sensor acquisition day of year Scene start line day of year	
15	45-48	B4	Sensor acquisition milli-seconds of day	
16	49-50	B2	SAR channel ID Single polarization = 1	
17	51-52	B2	SAR channel code = 3 L = 0, S = 1, C = 2, X = 3, KU = 4, KA = 5	
18	53-54	B2	Transmit pulse polarization (0 = H, 1 = V)	
19	55-56	B2	Received pulse polarization (0 = H, 1 = V)	
20	57-60	B4	Processing PRF [mHz]	
21	61-64	B4	0 (fixed)	
22	65-66	B2	Onboard range compressed flag = 0 NO = 0, YES = 1	

Field No.	Byte No.	Type	Description	Remarks
23	67-68	B2	Chirp type designator LINEAR FM CHIRP = 0 PHASE MODULATORS = 1	
24	69-72	B4	Chirp length (pulse width) [nsec]	
25	73-76	B4	Chirp constant coefficient [Hz] = Nominal value	
26	77-80	B4	Chirp linear coefficient [Hz/µsec] = Nominal value	
27	81-84	B4	Chirp quadratic coefficient [Hz/µsec^2] = Nominal value	
28	85-92	B8	Sensor acquisition micro-seconds of day	
29	93-96	B4	Receiver gain [dB] = Nominal value	
30	97-100	B4	Invalid line flag NO. (Effective line) = 0 YES (Loss line) = 1	
31	101-104	B4	Electronic elevation angle at nadir of antenna [deg]	
32	105-108	B4	Mechanical elevation angle at nadir of antenna [deg]	
33	109-112	B4	Electronic antenna squint angle [deg]	
34	113-116	B4	Mechanical antenna squint angle [deg]	
35	117-120	B4	Slant range to 1st data sample [m]	
36	121-124	B4	Data record window position (SAMPLE DELAY [nsec])	
37	125-128	B4	Blank	
PREFIX DATA-PLATFORM REFERENCE INFORMATION				

Field No.	Byte No.	Type	Description	Remarks
38	129-132	B4	Platform position parameters update flag = 0 (fixed) Repeat = 0 Update = 1	
39	133-136	B4	Platform latitude [1/1,000,000 deg] = 0	
40	137-140	B4	Platform longitude [1/1,000,000 deg] = 0	
41	141-144	B4	Platform altitude [m] = 0	
42	145-148	B4	Platform ground speed [cm/sec] = 0	
43	148-160	3B4	Platform velocity X', Y', Z'[cm/sec] = 0	
44	161-172	3B4	Platform acceleration X”, Y”, Z”[cm/sec^2] = 0	
45	173-176	B4	Platform track angle [1/1,000,000 deg] = 0	
46	177-180	B4	Platform true track angle [1/1,000,000 deg] = 0	
47	181-184	B4	Platform pitch angle [1/1,000,000 deg] = 0	
48	185-188	B4	Platform roll angle [1/1,000,000 deg] = 0	
49	189-192	B4	Platform yaw angle [1/1,000,000 deg] = 0	
PREFIX DATA-SENSOR/FACILITY SPECIFIC AUXILIARY DATA				
50	193-196	B4	Latitude of 1 st pixel [1/1,000,000 deg]	
51	197-200	B4	Latitude of center-pixel [1/1,000,000 deg]	
52	201-204	B4	Latitude of last pixel [1/1,000,000 deg]	
53	205-208	B4	Longitude of 1st pixel [1/1,000,000 deg]	
54	209-212	B4	Longitude of center-pixel [1/1,000,000 deg]	

Field No.	Byte No.	Type	Description	Remarks
55	213-216	B4	Longitude of last pixel [1/1,000,000 deg]	
56	217-288	B72	Blank	
57	289-1056	B768	Observation auxiliary data = 0	
SAR RAW SIGNAL DATA				
	1057-i	jBk	SAR data i: Number of bytes of data + 1056 j: Number of pixels in this record k: Pixel size (byte)	Repeat by the number of pixels

Table 1.1-17 Trailer Descriptor Record

Field No.	Byte No.	Type	Description	Remarks
1	1-4	B4	Record Number = 1	
2	5	B1	First subtype code = 63	
3	6	B1	Record type code = 192	
4	7	B1	Second subtype code = 18	
5	8	B1	Third subtype code= 18	
6	9-12	B4	Record length = 720	
7	13-14	A2	ASCII/EBCDIC flag = ‘Ab’ In case of ASCII	
8	15-16	A2	Blank	
9	17-28	A12	Format Manual ID = 'CEOS-SARbbbb'	
10	29-30	A2	Format Manual Management Revision Number = 'bA'	
11	31-32	A2	Record format revision level = 'bA'	

Field No.	Byte No.	Type	Description	Remarks
12	33-44	A12	Software Release & Revision Number ='NNN.NNNbbbbb' 001.000, 001.001,... 002.000	
13	45-48	I4	Number of files = ‘bbb1’	
14	49-64	A16	File ID ='MMMMMNbTFFFFbbbb' MMMMM: Mission name ('STRIX') N: Mission ID (Alpha='A', Beta='B', 1='1') T: Processing level code SLC ='B' FFFF: File type Trailor file ='SART'	
15	65-68	A4	Command software v203 is used = 'FSEQ'	
16	69-76	I8	Sequence number position ='bbbbbbb1'	
17	77-80	I4	Sequence number field length = 'bbb4'	
18	81-84	A4	Record code and location type flag = 'FTYP'	
19	85-92	I8	Record code location = 'bbbbbbb5'	
20	93-96	I4	Record code field length ='bbb4'	
21	97-100	A4	Record length and location format flag ='FLGT'	
22	101-108	I8	Record length location ='bbbbbbb9'	
23	109-112	I4	Record length field length = 'bbb4'	
24	113-180	A68	Blank	
25	181-186	I6	Number of data set summary records = ‘bbbbb0’	
26	187-192	I6	Dataset Summary Record Length = ‘bbbbb0’	

Field No.	Byte No.	Type	Description	Remarks
27	193-198	I6	Number of map projection data records = ‘bbbbb0’	
28	199-204	I6	Map projection data record length ='bbbbb0'	
29	205-210	I6	Number of platform position data records ='bbbbb0'	
30	211-216	I6	Platform position data record length ='bbbbb0'	
31	217-222	I6	Number of attitude data records = 'bbbbb0'	
32	223-228	I6	Attitude data record length = 'bbbbb0'	
33	229-234	I6	Number of radiometric data records = 'bbbbb0'	
34	235-240	I6	Radiometric data record length = 'bbbbb0'	
35	241-246	I6	Number of radiometric compensation records = 'bbbbb0'	
36	247-252	I6	Radiometric Compensation Record Length = 'bbbbb0'	
37	253-258	I6	Number of data quality summary records ='bbbbb0'	
38	259-264	I6	Data Quality Summary Record Length = 'bbbbb0'	
39	265-270	I6	Number of data histograms records = 'bbbbb0'	
40	271-276	I6	Data Histogram Record Length ='bbbbb0'	
41	277-282	I6	Number of range spectra records ='bbbbb0'	

Field No.	Byte No.	Type	Description	Remarks
42	283-288	I6	Range spectrum record length ='bbbbb0'	
43	289-294	I6	Number of DEM descriptor records ='bbbbb0'	
44	295-300	I6	DEM Descriptor Record Length ='bbbbb0'	
45	301-306	I6	Number of radar parameter update records ='bbbbb0'	
46	307-312	I6	Radar parameter update record length ='bbbbb0'	
47	313-318	I6	Number of annotation data records ='bbbbb0'	
48	319-324	I6	Annotation data record length ='bbbbb0'	
49	325-330	I6	Number of detailed processing parameter records ='bbbbb0'	
50	331-336	I6	Detailed processing parameter record length ='bbbbb0'	
51	337-342	I6	Number of calibration records ='bbbbb0'	
52	343-348	I6	Calibration record length ='bbbbb0'	
53	349-354	I6	Number of GCP records ='bbbbb0'	
54	355-360	I6	GCP record length ='bbbbb0'	
55	361-420	A60	Blank	
56	421-426	I6	Number of facility data records ='bbbbb0'	
57	427-432	I6	Facility data (1) record length ='bbbbb0'	
58	433-720	A288	Blank	

1.1.6 Summary Information

The summary information file shows a snapshot of meta data for an SLC CEOS product and is included in the product. The table below shows the contents of the summary information.

Table 1.1-18 Contents of Summary Information

No.	Section	Item Name	Keyword	Value
1	Ordering information (Odi)	Processed Site/Date/ Time	Odi_SiteDateTime	'PROCESS:JAPAN-SYNS-STRIXAbYYYYMMDDbHHMMSS' YYYYMMDD : Processed date (YYYY: year, MM: month, DD: day) HHMMSS : Processed time (UTC)
2		Scene description ID	Scs_SceneID	'AAAAAA-YYYYMMDDThhmmssZ' AAAAAA : Satellite name (='STRIXN') N:A, B or 1 YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day) hhmmss: Scene center observation time (hh: hour, mm: minutes, ss: seconds) -: Separator
3	Product specification (Pds)	Product ID	Pds_ProductID	'DDEEE' DD: Observation mode SM: Stripmap mode SL: Sliding Spotlight mode ST: Staring Spotlight mode EEE: Processing level SLC: Single Look Complex
4		Precision of orbit data	Pds_OrbitDataPrecision	‘Precision’ / ‘Onboard’
5		Precision of attitude data	Pds_AttitudeDataPrecision	'Onboard'

No.	Section	Item Name	Keyword	Value
6		Nominal slant range resolution	Pds_SlantRangeResolution	
7		Nominal azimuth resolution	Pds_AzimuthResolution	
8	Image information (Img)	Date and time of scene center	Img_SceneCenterDateTime	'YYYYMMDDbhh:mm:ss.ttt'（UT） YYYY ：Year (A.D) MM：Month（01～12） DD：Day（01～31） hh：Hour（00～23） mm：Minute（00～59） ss：Second（00～60）（ss=60 is used only by a leap second） ttt：Milli-second（000～999）
9		Date and time of scene start	Img_SceneStartDateTime	
10		Date and time of scene end	Img_SceneEndDateTime	
11		Off-nadir angle	Img_OffNadirAngle	NN.N [degree] (Measured), +: left looking, -: right looking
12	Product information (Pdi)	Data size of product	Pdi_ProductDataSize	
13		Number of files in SLC product	Pdi_CntOfSLCProductFileName	
14		Filename of SLC product	Pdi_SLCProductFileNamennnn：01～99	
15		Number of pixels	Pdi_NoOfPixels	

No.	Section	Item Name	Keyword	Value
16		Number of lines	Pdi_NoOfLines	
17		Product format	Pdi_ProductFormat	
18	Label information (Lbi)	Satellite name	Lbi_Satellite	'StriX-N' N: A, B or 1
19		Sensor name	Lbi_Sensor	'SAR'
20		Processing level	Lbi_ProcessLevel	'SLC'
21		Processing facility	Lbi_ProcessFacility	'SYNS'
22		Observation date	Lbi_ObservationDate	'YYYYMMDD' YYYYMMDD : (YYYY: year, MM: month, DD: day)

1.1.7 Thumbnail Image

A thumbnail image is generated by transforming a processed data type to 8 bit integer and by averaging neighbored pixels. The image format is PNG and map projection is in slant range.

1.2 SICD Product Format

Sensor Independent Complex Data (SICD) product is contained in National Imagery Transmission Format (NITF) and is presented by single file (.nitf) [2], [3] , [4], [5] . The NITF file includes both image and metadata. The SICD format follows the standard, NGA.STND.0024-1_1.3.0, NGA.STND.0024-2_1.3.0 and NGA.STND.0024-3_1.3.0.

1.2.1 Product Composition

SLC SICD product includes:

- image raster data and metadata (nitf)
- thumbnail image (jpeg)

The naming convention for SLC SICD product files is described in the table below.

Table 1.2-1 SLC SICD product file naming convention

File Type	Number of Files	File Name	Type	Contents
Image File	1	IMG-<Polarization>-<Scene ID>-<Product ID>-SICD.nitf	NITF	This file stores raster image and metadata
Thumbnail Image	1	IMG-<Polarization>-<Scene ID>-<Product ID>-SICD.jpeg	JPEG	

Where:

Scene ID = AAAAAA-YYYYMMDDThhmmssZ

AAAAAA : Satellite type

- STRIXA: StriX-α
- STRIXB: StriX-β
- STRIX1: StriX-1
- STRIX2: StriX-2
- STRIX3: StriX-3
- STRIX4: StriX-4

- : Separator

YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day)

hhmmss: Scene center observation time* (hh: hour, mm: minutes, ss: seconds)

*precise orbit is used when available

Product ID = DDEEE

DD: Observation mode

- SM: Stripmap mode
- SL: Sliding Spotlight mode
- ST: Staring Spotlight mode

EEE: Processing level (SLC: Single Look Complex)

1.2.2 SICD XML Metadata

XML metadata of Synspective's SICD product are compliant with the table in Section 3.2 XML Metadata Parameter Lists in the SICD standard [2]. The field for Synspective products specific implementation is listed below.

Table 1.2-2 XML Field for Synspective products specific implementation in SICD product

Field Name	Type	Description	Example
ModeID	TXT	Radar imaging mode: AAB AA – Observation mode SM – Stripmap SL – Sliding Spotlight ST – Staring Spotlight B – Looking direction L – Left, R – Right	SMR

1.2.3 NITF Metadata

NITF metadata of Synspective's SICD product are compliant with the table in Section 3.3 NITF Header Parameters in the SICD standard [3].

1.2.4 Thumbnail Image

A thumbnail image is generated by transforming a processed data type to 8 bit integer and by averaging neighbored pixels. The image format is JPEG and map projection is slant range. The pixel value is in linear scale.

2. GRD and SR-GRD Product

GRD and SR-GRD products are offered with GeoTIFF + XML format

The general specification of the GRD and SR-GRD product:

- image projected to ellipsoid (WGS 84 / UTM)
- magnitude representation (DN: Digital Number)
- no phase information
- image is resampled
- mode of observation: Stripmap, Sliding Spotlight or Staring Spotlight
- single polarization: VV
- bit depth: 16 bit
- Coordinate reference system:
    - Universal Polar Stereographic Projection(UPS) :
      S 90 deg. <= phi < S 80 deg or N 84 deg. < phi <= N 90 deg
    - Universal Transverse Mercator(UTM): S 80 deg. <= phi <= N 84 deg.
    - phi : scene center latitude (deg.)

The specification of the SR-GRD product:

- Applied Spatially Variant Apodization (SVA) to produce Super-Resolution Ground Range Detected Images (SR-GRD)

2.1 GeoTIFF + XML Product Format

2.1.1 Product Composition

GRD product includes:

- image raster data (GeoTIFF)
- metadata (xml)
- thumbnail image (jpeg)
- Quicklook raster data (Cloud Optimized GeoTIFF, COG)

The naming convention for the product files is described in the table below.

Table 2.1-1 GRD Product File Naming Convention

File Type	Number of Files	File Name	Type	Contents
Image File	1	(GRD) IMG-<Polarization>-<Scene ID>-<Product ID>.tif (SR-GRD) IMG-<Polarization>-<Scene ID>-SR-<Product ID>.tif	GeoTIFF	This file stores a raster image
Metadata file	1	(GRD) PAR-<Scene ID>-<Product ID>.xml (SR-GRD) PAR-<Scene ID>-SR-<Product ID>.xml	xml	This file stores information about raster image and observation
Thumbnail Image	1	(GRD) IMG-<Scene ID>-<Product ID>.jpeg (SR-GRD) IMG-<Scene ID>-SR-<Product ID>.jpeg	JPEG	
Image File	1	(GRD) IMG-<Scene ID>-<Product ID>_cog.tif (SR-GRD) IMG-<Scene ID>-SR-<Product ID>_cog.tif	Cloud Optimized GeoTIFF	This file stores a raster image. It is in a Cloud Optimized GeoTIFF format.

Where:

Scene ID = AAAAAA-YYYYMMDDThhmmssZ

AAAAAA : Satellite type

- STRIXA: StriX-α
- STRIXB: StriX-β
- STRIX1: StriX-1
- STRIX3: StriX-3
- STRIX4: StriX-4

- : Separator

YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day)

hhmmss: Scene center observation time* (hh: hour, mm: minutes, ss: seconds)

*precise orbit is used when available

Product ID = DDEEE

DD: Observation mode

- SM: Stripmap mode
- SL: Sliding Spotlight mode
- ST: Staring Spotlight mode

EEE: Processing level (GRD: Ground Range Detected)

2.1.2 XML Metadata

The definition of data type is shown in the table below.

Table 2.1-2 XML Tag and Attribute Name

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
gml:metaDataProperty				
eop:EarthObservationMetaData				
eop:creationDate	datetime		Creation Date ISO8601format YYYY-MMDDThh:mm:ssZ	2021-12-14T18:29:37Z
eop:acquisitionType	string		Acquisition type NOMINAL CALIBRATION	
eop:acquisitionSubType	string		Acquisition mode Staring Spotlight	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
			Sliding Spotlight Stripmap	
eop:status	string		Product Status ARCHIVED	
eop:processing				
eop:ProcessingInformation				
eop:processingDate	datetime		Processing date (UTC) ISO8601 format YYYY-MMDDThh:mm:ssZ	2021-12-14T18:29:37Z
eop:method	string		GRD interpolation method NN: Nearest Neighbor BL: Bilinear	
eop:processorName	string		Processing software name: GrdProcessor	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:processorVersion	string		Software version Major version. Minor version v000.000	v003.005
eop:processingLevel	string		Processing level SLC | GRD	GRD
sar:sarProcessingParameter				
sar:rangePixelSpacing	double	m	Pixel spacing in range at the scene center	1.0
sar:azimuthPixelSpacing	double	m	Pixel spacing in azimuth at the scene center	1.0
sar:processingPRF	double	Hz	Pulse repetition frequency used for processing	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:nativeProductFormat	string		Data Format GRD: GeoTIFF	GeoTiff
eop:vendorSpecific				
eop:SpecificInformation				
offnadirAngle	double		Off-nadir angle	
calibrationFactor	double		CF (Calibration Factor) to convert DN (Digital Number) to σ0 $\sigma_0 = DN^2 / CF^2$ Refer to Section 3 for details.	
sceneCenterDateTime	datetime		Scene center time ISO8601 format (precise orbit is used when available)	2021-12-12T07:24:21Z

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
neszMaximumPower	double	dB	Maximum Noise Equivalent Sigma Zero value	-17.51555132633136
neszMinimumPower	double	dB	Minimum Noise Equivalent Sigma Zero value	-20.93269457914013
groundRangeResolution	double	m	Ground range resolution	
gml:target				
eop:Footprint				
gml:multiExtentOf				
gml:MultiSurface				
gml:Polygon				

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
gml:exterior				
gml:LinearRing				
gml:posList	string	deg	4 corners of the scene (latitude, longitude) Left top, latitude longitude Left bottom, latitude longitude Right bottom, latitude longitude Right top, latitude longitude Left top, latitude longitude Latitude is expressed as "SNN.NNNNNNNN N"、 Longitude is expressed as " SNN.NNNNNNNN N " “S” is for polarity. The plus sign would be omitted. Values are separated by space.	-1.896944000 42.996389000 -2.650000000 42.862778000 -2.861667000 43.381667000 -2.102500000 43.516667000 -1.896944000 42.996389000

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:orientation				
gml:centerOf				
gml:Point				
gml:pos	string	deg	scene center (latitude, longitude) Latitude is expressed as "SNN.NNNNNNNNNNNNN"、Longitude is expressed as "SNNN.NNNNNNNNNNNNN" “S” is for polarity. The plug sign would be omitted. Values are separated by space.	
gml:using				
eop:EarthObservationEquipment				

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:platform				
eop:shortName	string		Satellite name	StriX
eop:serialIdentifier	string		Satellite ID	alpha beta
eop:orbitType	string		Orbit category GEO : Geostationary Orbit LEO : Low earth orbit	LEO
orbit				
orbitHeader				
stateVecFormat	string		Format of orbit state vectors	pos(m),vel(m/s)
numStateVectors	integer		Number of data points of orbit state vectors	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
firstStateTime				
firstStateTimeUTC	datetime		UTC time of the first vector	
lastStateTime				
lastStateTimeUTC	datetime		UTC time of the last vector	
stateVec				
timeUTC	datetime		UTC time at Nth point	
posX	single	m	Satellite position (x) at Nth point in the earth fixed coordinate system	
posY	single	m	Satellite position (y) at Nth point in the earth fixed coordinate system	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
posZ	single	m	Satellite position (z) at Nth point in the earth fixed coordinate system	
velX	single	m/s	Satellite velocity (x) at Nth point in the earth fixed coordinate system	
velY	single	m/s	Satellite velocity (y) at Nth point in the earth fixed coordinate system	
velZ	single	m/s	Satellite velocity (z) at Nth point in the earth fixed coordinate system	
eop:instrument				
eop:shortName	string		Instrument name	SAR

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:sensor				
eop:sensorType	string		Sensor type OPTICAL RADAR ALTIMETRIC ATMOSPHERIC	RADAR
eop:operationalMode	string		StaringSpotlight, SlidingSpotlight or Stripmap	SlidingSpotlight
eop:slantRangeResolution	double	m	Nominal slant range resolution	
eop:azimuthResolution	double	m	Nominal azimuth resolution	
eop:acquisitionParameters				
sar:Acquisition				

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:orbitDirection	string		Orbit direction ASCENDING DESCENDING	ASCENDING
sar:polarisationMode	string		Polarization mode S:single: (Example: VV, HH) D:dual: (Example: HH+HV, VV+VH) Q:quad:(Example: HH+HV+VH+VV) UNDEFINED:	S
sar:polarisationChannels	string		Polarization channels	VV
sar:antennaLookDirection	string		Observation direction LEFT RIGHT	LEFT

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
sar:satelliteHeadingAngle	single	deg	Satellite heading angle North is set to 0 degree Counter clockwise ranged from (0 to 360)	
sar:minimumIncidenceAngle	single	deg	Minimum incidence angle "NN.NNN"	
sar:maximumIncidenceAngle	single	deg	Maximum incidence angle "NN.NNN"	
sar:incidenceAngleVariation	single	deg	Difference between minimum and maximum incidence angle "NN.NNN"	
sar:incidenceAngleConstant	single	deg	Incident angle constant terms	
sar:incidenceAngleLinearCoefficient	single	deg/pixel	Incident angle linear term	

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
sar:incidenceAngleQuadraticCoefficient	single	deg / pixel/ pixel	Incident angle quadratic term	
sar:acquisitionPRF	double	Hz	Pulse repetition frequency used for the data acquisition	
sar:carrierFrequency	single	Hz	Carrier frequency	9650000000
sar:rangeSamplingFrequency	single	Hz	Range sampling frequency	400000000
sar:chirpBandWidth	single	Hz	Frequency chirp bandwidth	300000000
gml:resultOf				
eop:EarthObservationResult				

Tag / Attribute Name	Type	Unit	Description	Example / Remarks
eop:referenceSystemIdentifier	single		Projection coordinate system ID (EPSG Geodetic Parameter Dataset)	epsg:32630 (WGS 84 / UTM zone 30N)
eop:mapProjection	string		Map projection	UTM
eop:size	int	byte	Raster file size	
eop:numberOfPixel	int		Number of pixels	
eop:numberOfLine	int		Number of lines	
eop:imageNumberOfBits	bit	bit	Number of bits of an image	16

2.1.3 GeoTIFF Tag

The definition of data type is shown in the table below.

Table 2.1-3 GeoTIFF Tag

Tag / Attribute Name	Key ID	Type	Count	Description/ Example
BitsPerSample	258	SHORT	-	16
Compression	259	SHORT	1	1: no compress
Copyright	33432	ASCII	-	“Copyright(c) 2020 Synspective Inc. All Right Reserved.”
ImageLength	257	LONG	-	number of lines
ImageWidth	256	LONG	-	number of pixels
PhotometricInterpretation	262	SHORT	1	1
PlanarConfiguration	284	SHORT	1	1
RowPerStrip	278	SHORT	1	1
SampleFormat	339	SHORT	SamplesPerPixel	1＝ unsigned integer 2＝ signed integer 3＝ float 4＝ undefined 5＝ complex integer 6＝ complex float
SamplePerPixel	277	SHORT	1	1
Software	305	ASCII	-	StrixProcessor
StripByteCounts	279	SHORT or LONG	When PlanarConfiguration=1, number of strips per image	Number of bytes for each strip

Tag / Attribute Name	Key ID	Type	Count	Description/ Example
StripOffsets	273	LONG	When PlanarConfiguration=1, number of strips per image	Byte offset for each strip
GeoKeyDirectoryTag	34735	SHORT	4	Based on GeoTIFF standards
GeoDoubleParamsTag	34736	DOUBLE	-	Based on GeoTIFF standards
GeoAsciiParamsTag	34737	ASCII	-	Based on GeoTIFF standards: “WGS 84 / UTM zone 18S|WGS 84|”
ModelTiepointTag	33922	DOUBLE	6*number of tie points	longitude and latitude of the left top corner
ModelPixelScaleTag	33550	DOUBLE	3	Pixel spacing (meters)
GTModelTypeGeoKey	1024	SHORT	2	1 = ModelTypeProjected 2 = ModelTypeGeographic 3 = ModelTypeGeocentric
GTRasterTypeGeoKey	1025	SHORT	1	1 = RasterPixelIsArea 2=RasterPixelIsPoint
GTCitationGeoKey	1026	ASCII	1	WGS 84 / UTM zone 18S
GeographicTypeGeoKey	2048	SHORT	1	Geographic coordinate system 4326=WGS84
GeogAngularUnitsGeoKey	2054	SHORT	1	9102=Angular_Degree [deg]

Tag / Attribute Name	Key ID	Type	Count	Description/ Example
GDALNoDataTag	42113	ASCII	1	0 Value for no data pixel. This tag is used by GDAL.

2.1.4 Thumbnail Image

A thumbnail image is generated by transforming a processed data type to 8 bit integer and by averaging neighbored pixels. The image format is JPEG and map projection is in north-up orientation. The pixel value is in dB scale.

2.1.5 Quicklook raster data (Cloud Optimized GeoTIFF, COG)

The COG file has a tiled format and resolution pyramid layer for speeding up the display on the web. Additionally, the COG file is generated by transforming the processed data type to 8bit integer with dB scaling and tone correction for better visibility for the human eye.

3. Radiometric Calibration

The following corrections are applied to the Synspective products.

Table 3-1 Radiometric Correction

Satellite	Mode	Antenna Pattern Correction	Range Spread Loss Correction	Incidence Angle Correction*	Calibration factor
StriX-α	Stripmap		√	√	√
StriX-β	Stripmap	√	√	√	√
StriX-β	Sliding Spotlight	√	√	√	√
StriX-1	Stripmap	√	√	√	√
StriX-1	Sliding Spotlight	√	√	√	√
StriX-2,3,4	Stripmap	√	√	√	√
StriX-2,3,4	Sliding Spotlight	√	√	√	√
StriX-2,3,4	Staring Spotlight	√	√	√	√

*GRD/ SR-GRD only

- SLC CEOS

The following equation will be applied to convert I and Q values to beta naught (β_{0dB}) ,

$$\text{SLC: } \beta_{0dB} = 10 * \log_{10} \langle I^2 + Q^2 \rangle + CF_{SLC\ CEOS}$$

To convert from β_0 to σ_0, the incident angle correction will be applied by

$$\sigma_0 = \beta_0 * \sin(\theta),$$

where θ is the incidence angle.

- SLC SICD

Follow the NITF format document in Section 4.10 [2] to perform radiometric calibration.

- GRD GeoTIFF

The following equation will be applied to convert Digital Number (DN) to sigma naught (σ_0) using Calibration Factor (CF_{GRD}) in XML metadata in GRD product ,

$$\sigma_0 = DN^2 / CF_{GRD}^{\ 2}$$
$$\sigma_{0dB} = 10\log_{10}(\sigma_0)$$

Note: To radiometrically calibrate GRD product, the standard GeoTIFF file should be used, not the COG files.

Note: SR-GRD product is not radiometrically calibrated. The above equation is not applied.

Note: For StriX-α Stripmap, antenna pattern correction is not applied. This results in 2~3dB uncertainty for the calibration factor when applying the above formula.

4. Product Release History

The product release history is shown in Table 4-1 with the software version used to create each SAR product..

Table 4-1 Product release history

Date	Version (SLC SICD)	Version (SLC CEOS, GRD/SR-GRD GeoTIFF+XML)	Description
May 24, 2022	v0.0.3	v003.009	- StriX-β is released
July 19, 2022	v0.0.4	v003.010	- Calibration factor is added for Stripmap StriX-β

Date	Version (SLC SICD)	Version (SLC CEOS, GRD/SR-GRD GeoTIFF+XML)	Description
Sept 7, 2022	v0.0.5	v004.000	- Calibration factor is added for Sliding Spotlight StriX-β - Calculation for doppler frequency (center) is updated in SLC product
Oct 24, 2022	v0.0.6	v005.000	- Heading angle and incidence angle polynomial is added in GRD product
Dec 15, 2022	v0.8.0	v006.000	- StriX-1 is released - Orbit state vectors are added in XML metadata in GRD product - Calculation for doppler frequency is updated in SLC product
Feb 27, 2023	v0.9.0	v007.000	- Geolocation algorithm is updated in SLC and GRD product - ImpRespWid in SICD is fixed to match with azimuth frequency bandwidth - StriX-1 for Stripmap range sampling frequency is reduced from 187.5 MHz to 100 MHz in SLC product - linear and quadratic coefficients are set for along track Doppler rate polynomial in CEOS
May 15, 2023	v0.10.0	v008.000	- Add resampling in the azimuth direction to reduce data size for the given resolution - Fix SFDRatePoly constant coefficient sign - UTM CRS for GRD products
Aug 1, 2023	v0.11.0	v009.000	- Noise Equivalent Sigma Zero metadata was added to GRD and SR-GRD XML Product

Date	Version (SLC SICD)	Version (SLC CEOS, GRD/SR-GRD GeoTIFF+XML)	Description
Oct 2, 2023	v0.12.0	v010.000	- Geolocation algorithm is updated in GRD product - Fixed an issue with the extent of GRD GeoTIFF raster
Oct 19, 2023	v0.12.2	v010.001	- Fixed a minor raster alignment issue with the GRD GeoTIFF raster in Ascending observations
Dec 6, 2023	v0.12.3	v010.002	- Fixed a bug in GRD geocoding algorithm
Jan 22, 2024	v0.13.0	v011.000	- Updated geocoding algorithm of GRD - Updated SICD format version from 1.2.1 to 1.3.0
Jan 23, 2024	v0.13.1	v011.000	- Fixed a bug in processing system
Mar 18, 2024	v0.13.2	v011.000	- Fixed a minor bug in an interface between processing library and platform pipeline
Apr 10, 2024	v0.13.3	v011.000	- Fixed a minor bug in an interface to precise orbit
Apr 22, 2024	v0.14.0	v012.000	- Fixed a minor bug that generated subpixel geolocation offset in GRD products
May 15, 2024	v0.14.1	v012.000	- Support StriX-3 observations

Date	Version (SLC SICD)	Version (SLC CEOS, GRD/SR-GRD GeoTIFF+XML)	Description
Aug 1, 2024	v0.15.0	v013.000	- Filled values for nominal slant range and azimuth resolutions in CEOS fields - Added fields nominal slant range and azimuth resolutions in Summary Information for CEOS product - Added metadata fields for image resolutions in XML file in GRD and SR-GRD product
Aug 22, 2024	v0.15.1	v013.000	- Fixed a bug in the processing management system (products are not affected)
Sept 4, 2024	v0.15.2	v013.000	- Fixed a bug in the processing management system (products are not affected)
Oct 2, 2024	v0.15.3	v013.000	- Support Staring Spotlight observations
Nov 12, 2024	v1.0.0	v014.000	- Support StriX-4 - Add Cloud Optimized GeoTIFF in GRD and SR-GRD product - Update focusing algorithm
Dec 3, 2024	v1.1.0	v014.000	- Support Staring Spotlight with 0.25m Azimuth resolution - Update processing kernel for Staring Spotlight
Jan 15, 2025	v1.2.0	v014.001	- Fixed a bug in Field No. 55 in Table 1.1-16 Signal Data Records in CEOS Product Format
Mar 25, 2025	v1.3.0	v015.000	- Support StriX-2 - Updated a reference chirp for focusing
Apr 2, 2025	v1.3.1	v015.000	- Fixed a bug in Staring Spotlight focusing

Date	Version (SLC SICD)	Version (SLC CEOS, GRD/SR-GRD GeoTIFF+XML)	Description
June 25, 2025	v1.4.0	v015.001	- Updated timing calculation for Staring Spotlight and Sliding Spotlight - Added overlap when processing subaperture for Staring Spotlight and Sliding Spotlight - Support longer observation durations for Stripmap

The above versions can be confirmed in each product metadata in Table 4-2.

Table 4-2 Software version related fields

Product type	File	Field
CEOS	VOL	Volume Descriptor Record, Field no. 12: Software release and revision number
SICD	nitf	SICD.ImageCreation.Application
GRD	XML	eop:processorVersion

Reference

[1] ALOS-2/PALSAR-2 Level 1.1/1.5/2.1/3.1 CEOS SAR Product Format Description Dec. 06, 2021.
https://www.eorc.jaxa.jp/ALOS/en/alos-2/pdf/product_format_description/PALSAR-2_xx_Format_CEOS_E_g.pdf

[2] Sensor Independent Complex Data (SICD), Volume 1, Design & Implementation Description Document, Version 1.3.0 2021-11-30.
https://nsgreg.nga.mil/doc/view?i=5381

[3] Sensor Independent Complex Data (SICD), Volume 2, File Format Description Document, Version 1.3.0 2021-11-30. https://nsgreg.nga.mil/doc/view?i=5382

[4] Sensor Independent Complex Data (SICD), Volume 3, Image Projections Description Document, Version 1.3.0 2021-11-30 .https://nsgreg.nga.mil/doc/view?i=5442

[5] National Imagery Transmission Format (Version 2.1) for the National Imagery Transmission Format Standard, 01 May 2006. https://nsgreg.nga.mil/doc/view?i=4324