

# Synspective SAR DATA PRODUCT FORMAT MANUAL

Version 14.1  
Apr 2, 2025

© 2022 - 2025 Synspective Inc



## Revision History

| Version | Date         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| v1.0    | Nov 17, 2022 | Initial version                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| v2.0    | Dec 15, 2022 | <ol style="list-style-type: none"> <li>1. BRS File name is changed to match with IMG File name (<a href="#">Table 1.1-1</a>)</li> <li>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 <a href="#">Table 1.1-7</a>/ No. 9 in <a href="#">Table 1.1-9</a>/ No. 2 and 3 in <a href="#">Table 1.1-18</a>)</li> <li>3. The sign for left and right looking direction is fixed (No.39 in <a href="#">Table 1.1-9</a>)</li> <li>4. The description of Synspective products specific implementation in SICD product is added (<a href="#">Table 1.2-2</a>)</li> <li>5. Orbit state vectors are added in XML Metadata for GRD product (“stateVecFormat” ~ “velZ” in <a href="#">Table 2.1-2</a>)</li> <li>6. Section number for the reference in Calibration Factor's Description in XML metadata data for GRD is updated (“calibrationFactor” in <a href="#">Table 2.1-2</a>)</li> <li>7. StriX-1 is added for Radiometric Calibration (<a href="#">Section 4</a>)</li> <li>8. “Intensity conversion factor” is changed to “Calibration factor” (<a href="#">Table 4-1</a>)</li> <li>9. Calibration factor (CF) subscripts (CF<sub>SLC CEOS</sub> and CF<sub>GRD</sub>) are added (<a href="#">Section 4</a>)</li> <li>10. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol> |
| v3.0    | Feb 27, 2023 | <ol style="list-style-type: none"> <li>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 (<a href="#">Table 1.1-9</a>)</li> <li>2. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| v4.0    | May 15, 2023 | <ol style="list-style-type: none"> <li>1. Updated description of GRD Product (<a href="#">Section 2</a>)</li> <li>2. Updated eop:referenceSystemIdentifier Description to “Projection coordinate system ID</li> <li>3. (EPSG Geodetic Parameter Dataset)” and changed its example to “epsg:32630 (UTM zone 30N)” (<a href="#">Table 2.1-2</a>)</li> <li>4. Updated eop:mapProjection Description to “Map projection” and changed its example to “UTM” (<a href="#">Table 2.1-2</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| Version | Date         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         |              | <ol style="list-style-type: none"> <li>Updated GeoTIFF Tag GeoAsciiParamsTag<br/>Description/Example to: "Based on GeoTIFF standards: "WGS 84 / UTM zone 18S WGS 84 " (<a href="#">Table 2.1-3</a>)</li> <li>Updated GeoTIFF Tag ModelPixelScaleTag<br/>Description/Example to: "Pixel spacing (meters)" (<a href="#">Table 2.1-3</a>)</li> <li>Updated GeoTIFF Tag GTCitationGeoKey<br/>Description/Example to: "WGS 84 / UTM zone 18S" (<a href="#">Table 2.1-3</a>)</li> <li>New product version is added in product version history (<a href="#">Table 5-1</a>)</li> <li>Fixed links to <a href="#">Reference</a></li> </ol> |
| v5.0    | June 5, 2023 | <ol style="list-style-type: none"> <li>Added the description of New Product SR-GRD (<a href="#">Section 3</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| v6.0    | Aug 1, 2023  | <ol style="list-style-type: none"> <li>Added NESZ information to GRD XML (<a href="#">Table 2.1-2</a>)</li> <li>Added Sliding Spotlight mode to SR-GRD product (<a href="#">Section 3</a>)</li> <li>Added NESZ information to SR-GRD XML (<a href="#">Table 3.1-2</a>)</li> <li>New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                   |
| v7.0    | Oct 2, 2023  | <ol style="list-style-type: none"> <li>Updated the description of Field No.25 Data Set summary Records to: "reference height above the ellipsoid" (<a href="#">Table 1.1-9</a>) for CEOS products</li> <li>New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                        |
| v7.1    | Oct 19, 2023 | <ol style="list-style-type: none"> <li>New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| v7.2    | Dec 6, 2023  | <ol style="list-style-type: none"> <li>Updated the remarks of Field No.24 Facility Related Data Record (<a href="#">Table 1.1-14</a>) for CEOS products</li> <li>New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                  |
| v8.0    | Jan 22, 2024 | <ol style="list-style-type: none"> <li>Updated the Description of Field No.22 and 23 Facility Related Data Record (<a href="#">Table 1.1-14</a>) for CEOS products</li> <li>Updated SICD format standards from NGA.STND.0024-1_1.2.1 to NGA.STND.0024-1_1.3.0 (<a href="#">Section 1.2</a>)</li> <li>Added SICD format standards reference, NGA.STND.0024-2_1.3.0 and NGA.STND.0024-3_1.3.0 (<a href="#">Section 1.2</a>)</li> </ol>                                                                                                                                                                                             |

| Version | Date         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         |              | <ol style="list-style-type: none"> <li>4. Changed eop:processorName from StrixProcessor to GrdProcessor in XML metadata for GRD (<a href="#">Table 2.1-2</a>) and SR-GRD product (<a href="#">Table 3.1-2</a>)</li> <li>5. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> <li>6. Updated reference for SICD formats ([2], [3] and [4] in <a href="#">Reference</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| v8.1    | Jan 23, 2024 | <ol style="list-style-type: none"> <li>1. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| v8.2    | Mar 18, 2024 | <ol style="list-style-type: none"> <li>1. Corrected a reference number for radiometric calibration in SICD format (<a href="#">Section 4</a>)</li> <li>2. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| v8.3    | Apr 10, 2024 | <ol style="list-style-type: none"> <li>1. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| v9.0    | Apr 22, 2024 | <ol style="list-style-type: none"> <li>1. New product version is added in product version history (<a href="#">Table 5-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| v9.1    | May 15, 2024 | <ol style="list-style-type: none"> <li>1. Added Strix-3 for Satellite type</li> <li>2. Consolidated GRD and SR-GRD sections (<a href="#">Section 2</a>)</li> <li>3. Updated radiometric calibration table (<a href="#">Table 3-1</a>)</li> <li>4. New product version is added in product version history (<a href="#">Table 4-1</a>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| v10.0   | Aug 1, 2024  | <ol style="list-style-type: none"> <li>1. Removed "Blank" in remarks of Field No. 17 and 18 Data Quality Summary Record (<a href="#">Table 1.1-13</a>)</li> <li>2. Added new fields No.6 and 7, Pds_SlantRangeResolution and Pds_AzimuthResolution, in Summary Information (<a href="#">Table 1.1-18</a>)</li> <li>3. Restructure XML metadata table (<a href="#">Table 2.1-2</a>)</li> <li>4. Added new fields about range and azimuth resolution in XML metadata in GRD and SR-GRD product (<a href="#">Table 2.1-2</a>)</li> <li>5. Changed the title of <a href="#">Section 4</a> to "Product Release History" from "Product Version History"</li> <li>6. Added <a href="#">Table 4-2</a> Software version related fields</li> <li>7. Added thumbnail image in SICD product format (<a href="#">Section 1.2.1</a> and <a href="#">1.2.4</a>)</li> <li>8. Added thumbnail image in GRD and SR-GRD product format (<a href="#">Section 2.1.1</a> and <a href="#">2.1.4</a>)</li> </ol> |

| Version | Date         | Description                                                                                                                                                                                                                                                                                                 |
|---------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| v10.1   | Aug 22, 2024 | 1. New version is added to product release history ( <a href="#">Table 4-1</a> )                                                                                                                                                                                                                            |
| v10.2   | Sept 4, 2024 | 1. New version is added to product release history ( <a href="#">Table 4-1</a> )                                                                                                                                                                                                                            |
| v10.3   | Oct 2, 2024  | 1. Added Staring Spotlight<br>2. Added Note in Radiometric Calibration ( <a href="#">Section 3</a> ) about Staring Spotlight.<br>3. New version is added to product release history ( <a href="#">Table 4-1</a> )                                                                                           |
| v11.0   | Nov 12, 2024 | 1. Added StriX-4<br>2. Added Cloud Optimized GeoTIFF (COG) in GRD and SR-GRD product ( <a href="#">Section 2</a> )<br>3. Removed Note in Radiometric Calibration ( <a href="#">Section 3</a> ) about Staring Spotlight.<br>4. New version is added to product release history ( <a href="#">Table 4-1</a> ) |
| v12.0   | Dec 3, 2024  | 1. Added note in Radiometric Calibration ( <a href="#">Section 3</a> ) about SR-GRD.<br>2. New version is added to product release history ( <a href="#">Table 4-1</a> )                                                                                                                                    |
| v13.0   | Jan 14, 2025 | 1. New version is added to product release history ( <a href="#">Table 4-1</a> )                                                                                                                                                                                                                            |
| v14.0   | Mar 25, 2025 | 1. Added StriX-2<br>2. New version is added to product release history ( <a href="#">Table 4-1</a> )<br>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 ( <a href="#">Table 4-1</a> )                                                                                                                                                                                                                            |

# Table of contents

|                                                                                        |          |
|----------------------------------------------------------------------------------------|----------|
| <b>Revision History</b>                                                                | <b>1</b> |
| <b>Introduction</b>                                                                    | <b>7</b> |
| <b>1. SLC Product</b>                                                                  | <b>7</b> |
| 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        |
| <b>2. GRD and SR-GRD Product</b>                           | <b>61</b> |
| 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        |
| <b>3. Radiometric Calibration</b>                          | <b>82</b> |
| Table 3-1 Radiometric Correction                           | 82        |
| <b>4. Product Release History</b>                          | <b>83</b> |
| Table 4-1 Product release history                          | 83        |
| Table 4-2 Software version related fields                  | 87        |
| <b>Reference</b>                                           | <b>88</b> |



# 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><br>-<Product ID>                        | - Volume descriptor<br>File Pointer                                                                                                                               | This stores the volume and file management information.                                            |
| SAR Leader File       | 1               | LED-<Scene ID><br>-<Product ID>                        | - File descriptor<br>- Data set summary<br>- Platform location data<br>- Attitude data<br>- Radiometric data<br>- Data quality summary<br>- 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><br>-<Scene ID><br>-<Product ID>     | - File descriptor<br>- Signal data                                                                                                                                | This file stores image data.                                                                       |
| SAR Trailer File      | 1               | TRL-<Scene ID><br>-<Product ID>                        | - File descriptor                                                                                                                                                 | This file stores the final information about the image data.                                       |
| Summary Information   | 1               | summary.txt                                            |                                                                                                                                                                   |                                                                                                    |
| Thumbnail Image       | 1               | BRS-<Polarization><br>-<Scene ID><br>-<Product ID>.png |                                                                                                                                                                   |                                                                                                    |

Where:

Scene ID = AAAAAA-YYYYMMDDThhmmssZ

AAAAAA : Satellite type

- STRIXA: StriX- $\alpha$
- STRIXB: StriX- $\beta$
- 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.NNNbbbbbb'                                                                                                                                                              |         |
| 13        | 45-60    | A16  | Physical Volume ID = 'SYNSbbbbbbbbbbbb'                                                                                                                                                                             |         |
| 14        | 61-76    | A16  | Logical volume ID = 'MMMMMMNYYYYmmDD'<br>MMMMMM = Mission name ('STRIX')<br>N = Mission ID (Alpha='A', Beta='B', 1='1')<br>YYYY = Product creation year<br>mm = Product creation month<br>DD = Product creation day |         |
| 15        | 77-92    | A16  | Volume set ID = 'MMMMMMMMbbbbbbbbbb'<br>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<br>='YYYYMMDD' (without zero suppression)<br>YYYY: Year ('0001'-'9999')<br>MM: Month ('01'-'12')<br>DD: Day ('01'-'31')                                  |         |
| 24        | 121-128  | A8   | Logical volume creation time<br>='HHMMSSXX' (without zero suppression)<br>HH: Hour ('00'-'23')<br>MM: Minute ('00'-'59')<br>SS: Second ('00'-'59')<br>XX: 10 milliseconds ('00'-'99') |         |
| 25        | 129-140  | A12  | Logical volume creation country (Japan)<br>='JAPANbbbbbbb'                                                                                                                            |         |
| 26        | 141-148  | A8   | Logical volume creator = 'SYNSbbbb'                                                                                                                                                   |         |
| 27        | 149-160  | A12  | Logical volume creation facility =<br>'SYNSbbbbbbb'                                                                                                                                   |         |
| 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<br>Leader file = 'bbb1'<br>Image file = 'bbb2'<br>Trailer file = 'bbb3'                                                                                                                                                              |                  |
| 10        | 21-36    | A16  | Reference file ID<br>='MMMMNbTFFFb'bbb'<br>MMMMM: Mission name ('STRIX')<br>N: Mission number (Alpha = 'A', Beta = 'B', 1 = '1')<br>T: Processing level code (* 1)<br>FFFF: File type<br>'SARL': Leader file<br>'IMOP': Image file<br>'SART': Trailer file | (*1)<br>'B': SLC |
| 11        | 37-64    | A28  | Reference file class<br>='SARLEADERbFILEbbbbbbbbbbbbbb':<br>For leader file<br>='IMAGERYbOPTIONSbFILEbbbbbbbbbb':<br>For image file<br>='SARTRAILERbFILEbbbbbbbbbbbbbb':<br>For trailer file                                                               |                  |



| Field No. | Byte No. | Type | Description                                                                                                                                                                | Remarks |
|-----------|----------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 12        | 65-68    | A4   | Reference file class code<br>='SARL': For leader files<br>='IMOP': For image files<br>='SART': For trailer files                                                           |         |
| 13        | 69-96    | A28  | Reference file data type<br>='MIXEDbBINARYbANDBASCIIbBBBBB'                                                                                                                |         |
| 14        | 97-100   | A4   | Reference file data type code ='MBAA'                                                                                                                                      |         |
| 15        | 101-108  | I8   | Number of records in the reference file<br>(zero suppression)<br>Leader file ='BBBBBB7' (SLC)<br>Image file = number of SAR data records<br>+ 1<br>Trailer file ='BBBBBB1' |         |
| 16        | 109-116  | I8   | Length of the first record in reference file<br>='BBBBB720'                                                                                                                |         |
| 17        | 117-124  | I8   | Maximum record length (byte length) of<br>the reference file: 'bbbLLLL'                                                                                                    |         |
| 18        | 125-136  | A12  | Reference file record length type<br>='VARIABLEbLEN': For leader files<br>='VARIABLEbLEN': For image files<br>='VARIABLEbLEN': For trailer files                           |         |
| 19        | 137-140  | A4   | Reference file record length type code<br>='VARE': For leader files<br>='VARE': For image files<br>='VARE': For trailer files                                              |         |
| 20        | 141-142  | I2   | The number of the physical volume set<br>containing the first record of the file ='b1'                                                                                     |         |
| 21        | 143-144  | I2   | The number of the physical volume set<br>containing the last record of the file = 'b1'                                                                                     |         |
| 22        | 145-152  | I8   | Record number of the first record on this<br>physical volume ='BBBBBB1'                                                                                                    |         |

| Field No. | Byte No. | Type | Description                                                                                                                                               | Remarks |
|-----------|----------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 23        | 153-160  | I8   | Record number of the last record on this physical volume<br>Leader file ='bbbbbbb7' (SLC)<br>Image file = number of lines + 1<br>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:<br>DDEEEb ~ b'<br>DD: Observation mode<br>SL: Sliding Spotlight mode<br>SM: Stripmap mode<br>ST: Staring Spotlight mode<br>EEE: Processing level<br>SLC: Single Look Complex |         |

| Field No. | Byte No. | Type | Description                                                                                                                                                                                                                                                                     | Remarks |
|-----------|----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 10        | 57-116   | A60  | Product creation location / date / time (without zero suppression)<br>='PROCESS:<br>JAPAN-SYNS-STRIXNbYYYYMMDDbHHMMSSb ~ b'<br>N: A, B, 1<br>YYYYMMDD: Creation date<br>HHMMSS: Creation time (UTC)                                                                             |         |
| 11        | 117-156  | A40  | Physical tape ID ='TAPEbID: b ~ b'                                                                                                                                                                                                                                              |         |
| 12        | 157-196  | A40  | Scene ID ='ORBITb:<br>AAAAAA-YYYYMMDDThhmmssZb ~ b'<br>AAAAAA: Satellite type ('STRIXN') N: A, B or 1<br>YYYYMMDD: Scene center observation date (YYYY: year, MM: month, DD: day)<br>hhmmss: Scene center observation time (hh: hour, mm: minutes, ss: seconds)<br>-: Separator |         |
| 13        | 197-236  | A40  | Scene location ID (without zero suppression)<br>='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<br>ID='CEOS-SARbbbb'                                                                                                                                                       |         |
| 10        | 29-30    | A2   | Format control document revision level<br>='bA'                                                                                                                                                    |         |
| 11        | 31-32    | A2   | Record format revision level = 'bA'                                                                                                                                                                |         |
| 12        | 33-44    | A12  | Software Release & Revision Number<br>='NNN.NNNbbbb'                                                                                                                                               |         |
| 13        | 45-48    | I4   | Number of files = 'bbb1'                                                                                                                                                                           |         |
| 14        | 49-64    | A16  | File ID = 'MMMMMNbTFFFFbbbb'<br>MMMMM: Mission name ('STRIX')<br>N: Mission ID (Alpha='A', Beta='B',<br>1='1')<br>T: Processing level code<br>SLC = 'B'<br>FFFF: File type<br>Leader file = 'SARL' |         |
| 15        | 65-68    | A4   | Record sequence and location type flag<br>='FSEQ'                                                                                                                                                  |         |
| 16        | 69-76    | I8   | Sequence number of location =<br>'bbbbbbb1'                                                                                                                                                        |         |
| 17        | 77-80    | I4   | Field length of sequence number = 'bbb4'                                                                                                                                                           |         |
| 18        | 81-84    | A4   | Record code and location type flag =<br>'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 ='bbbbbb1'          |         |
| 26        | 187-192  | I6   | Dataset summary record length ='bb4096'               |         |
| 27        | 193-198  | I6   | Number of map projection data records ='bbbbbb0'      |         |
| 28        | 199-204  | I6   | Map projection data record length ='bbbbbb0'          |         |
| 29        | 205-210  | I6   | Number of platform location data records ='bbbbbb1'   |         |
| 30        | 211-216  | I6   | Platform location data record length ='bb4680'        |         |
| 31        | 217-222  | I6   | Number of attitude data records='bbbbbb1'             |         |
| 32        | 223-228  | I6   | Attitude data record length = 16384                   |         |
| 33        | 229-234  | I6   | Number of radiometric data records ='bbbbbb1'         |         |
| 34        | 235-240  | I6   | Radiometric record length ='bb9860'                   |         |
| 35        | 241-246  | I6   | Number of radiometric compensation records ='bbbbbb0' |         |
| 36        | 247-252  | I6   | Radiometric compensation record length ='bbbbbb0'     |         |

| Field No. | Byte No. | Type | Description                                         | Remarks |
|-----------|----------|------|-----------------------------------------------------|---------|
| 37        | 253-258  | I6   | Number of data quality summary records='bbbbbb1'    |         |
| 38        | 259-264  | I6   | Data quality summary record length ='bb1620'        |         |
| 39        | 265-270  | I6   | Number of data histogram records ='bbbbbb0'         |         |
| 40        | 271-276  | I6   | Data histogram record length ='bbbbbb0'             |         |
| 41        | 277-282  | I6   | Number of range spectra records ='bbbbbb0'          |         |
| 42        | 283-288  | I6   | Range spectra record length ='bbbbbb0'              |         |
| 43        | 289-294  | I6   | Number of DEM descriptor records ='bbbbbb0'         |         |
| 44        | 295-300  | I6   | DEM descriptor record length ='bbbbbb0'             |         |
| 45        | 301-306  | I6   | Number of radar parameter update records ='bbbbbb0' |         |
| 46        | 307-312  | I6   | Radar parameter update record length ='bbbbbb0'     |         |
| 47        | 313-318  | I6   | Number of annotation data records ='bbbbbb0'        |         |
| 48        | 319-324  | I6   | Annotation data record length ='bbbbbb0'            |         |
| 49        | 325-330  | I6   | Number of detail processing records ='bbbbbb0'      |         |
| 50        | 331-336  | I6   | Detail processing record length ='bbbbbb0'          |         |
| 51        | 337-342  | I6   | Number of calibration records ='bbbbbb0'            |         |
| 52        | 343-348  | I6   | Calibration record length ='bbbbbb0'                |         |
| 53        | 349-354  | I6   | Number of GCP records ='bbbbbb0'                    |         |

| Field No. | Byte No. | Type | Description                                 | Remarks |
|-----------|----------|------|---------------------------------------------|---------|
| 54        | 355-360  | I6   | GCP record length ='bbbbbb0'                |         |
| 55        | 361-420  | A60  | Blank                                       |         |
| 56        | 421-426  | I6   | Number of facility data records = 'bbbbbb1' |         |
| 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<br>='AAAAAA-YYYYMMDDThhmmssZb ~ b'<br>AAAAAA: Satellite type ('STRIXN') N:<br>A, B or 1<br>YYYYMMDD: Scene center observation<br>date (YYYY: year, MM: month, DD: day)<br>hhmmss: Scene center observation<br>time (hh: hour, mm: minutes, ss:<br>seconds)<br>-: Separator |         |
| 10        | 53-68    | A16   | Number of scene reference =<br>'bbbbbbbbbbbbbbbb'                                                                                                                                                                                                                                   |         |
| 11        | 69-100   | A32   | Scene center time<br>='YYYYMMDDHHMMSSTTTbbbbbbbbbb<br>bbbb'<br>(No zero suppression)<br>YYYYMMDD: YYYY: year, MM: month, DD:<br>day<br>HHMMSSTTT: Time (UTC)                                                                                                                        |         |
| 12        | 101-116  | A16   | Blank                                                                                                                                                                                                                                                                               |         |
| 13        | 117-132  | F16.7 | Geodetic latitude (degrees) in the center<br>of the processed scene<br>= blank: SLC                                                                                                                                                                                                 |         |
| 14        | 133-148  | F16.7 | Geodetic longitude (degrees) in the<br>center of the processed scene<br>= blank: SLC                                                                                                                                                                                                |         |
| 15        | 149-164  | F16.7 | Processed scene center true heading<br>(degrees) = blank: SLC                                                                                                                                                                                                                       |         |
| 16        | 165-180  | A16   | Ellipsoidal model = 'WGS84b ~ b'                                                                                                                                                                                                                                                    |         |
| 17        | 181-196  | F16.7 | Semi-major axis of ellipsoid (km) =<br>6378.1370000                                                                                                                                                                                                                                 |         |
| 18        | 197-212  | F16.7 | Semi-minor axis of ellipsoid (km) =<br>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 <sup>3</sup> / s <sup>2</sup> kg) = 3.9860050                 |                           |
| 21        | 245-260  | F16.7 | Ellipsoid J2 parameter = $0.1082629 \times 10^{-2}$                                                 |                           |
| 22        | 261-276  | F16.7 | Ellipsoid J3 parameter = $-0.0000254 \times 10^{-1}$                                                |                           |
| 23        | 277-292  | F16.7 | Oblong parameter (mechanical shape coefficient J4 term) ( $10^{-1}$ ) = $-0.0000162 \times 10^{-1}$ |                           |
| 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: 'STRIXbbbbbbbbbbbb'                                                |                           |

| Field No. | Byte No. | Type  | Description                                                                                                                                                                                                                                                        | Remarks |
|-----------|----------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 34        | 413-444  | A32   | Sensor ID and operation mode<br>='AAAAAA-BB-CCbb-bbbbbbbbbbbbbbbb<br>bb'<br>AAAAAA: Satellite type (= 'STRIXN') N:A,<br>B or 1<br>BB: SAR band ('Xb')<br>CC: Operation mode<br>'01': Stripmap mode<br>'02': Sliding spotlight mode<br>'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<br>= '00': no compensation<br>= '01': on board compensation<br>= '10': in processor compensation<br>= '11': both on board and in processor |         |
| 44        | 519-534  | A16   | Range pulse code<br>='LINEARbFMbCHIRPb'                                                                                                                                               |         |
| 45        | 535-550  | E16.7 | Range pulse amplitude coefficient #1 = Nominal Value<br>Center frequency $\xi_1$ with respect to pulse width $\tau$ of linear FM modulation chirp (Constant term)                     |         |
| 46        | 551-566  | E16.7 | Range pulse amplitude coefficient #2 = Nominal value<br>FM rate $\xi_2$ for pulse width $\tau$ of linear FM modulation chirp (Linear coefficient term)                                |         |
| 47        | 567-582  | E16.7 | Range pulse amplitude coefficient #3 = Nominal value (= 0.0)<br>FM rate $\xi_3$ for pulse width $\tau$ of linear FM modulation chirp (Quadratic coefficient terms)                    |         |
| 48        | 583-598  | E16.7 | Range pulse amplitude coefficient #4 = Nominal value (= 0.0)<br>FM rate $\xi_4$ for pulse width $\tau$ of linear FM modulation chirp (Cubic coefficient terms)                        |         |
| 49        | 599-614  | E16.7 | Range pulse amplitude coefficient #5 = Nominal value (= 0.0)<br>FM rate $\xi_5$ for pulse width $\tau$ of linear FM modulation chirp (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<br>linear-up chirp = 'bbbbbbb0'<br>linear-down chirp = 'bbbbbbb1'<br>linear-up and -down chirp = 'bbbbbbb2' |         |
| 56        | 703-710  | A8    | Blank                                                                                                                                               |         |
| 57        | 711-726  | F16.7 | Sampling frequency (MHz) nominal value<br>Set the observation auxiliary data value of the first record                                              |         |
| 58        | 727-742  | F16.7 | Range gate (rise at the start of the image) ( $\mu$ sec)<br>Set the observation auxiliary data value of the first record                            |         |
| 59        | 743-758  | F16.7 | Range pulse width ( $\mu$ sec)<br>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 = 'bbbbbbbbb'                                                               |         |
| 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<br>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 = 'SLCbbbbbbbbbbbb' (SLC)                                                                                               |         |
| 85        | 1111-1142 | A32   | Product type specifier<br>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)<br>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)<br>Same as 1239-1254 bytes                                                                              |         |
| 90        | 1223-1238 | F16.6 | Bandwidth per look in the range direction (Hz)<br>(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)<br>(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.)<br>Online transmission ='ONLINEb ~ b'                                    |         |
| 96        | 1351-1366 | F16.7 | Resolution in the ground range direction (nominal value) (m)<br>= blank: For SLC                               |         |
| 97        | 1367-1382 | F16.7 | Resolution in azimuth direction (nominal value) (m)<br>= 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<br>Ascending ='ASCENDbb'<br>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<br>= SLC:'RANGEbbb'                                                                         |         |



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

| Field No. | Byte No.  | Type       | Description                                                                                                                    | Remarks                                                                                                |
|-----------|-----------|------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 127       | 1779-1786 | I8         | End line number of calibration at the side of start<br>In case of calibration location flag is '0', always = 'bbbbbbb0'        |                                                                                                        |
| 128       | 1787-1794 | I8         | Start line number of calibration at the side of end<br>In case of calibration location flag is '0', always = 'bbbbbbb0'        |                                                                                                        |
| 129       | 1795-1802 | I8         | End line number of calibration at the side of end<br>In case of calibration location flag is '0', always = 'bbbbbbb0'          |                                                                                                        |
| 130       | 1803-1806 | I4         | PRF switching indicator = 'bbb0'<br>If the PRF has not changed in one scene = 'bbb0'<br>When PRF changes in one scene = 'bbb1' |                                                                                                        |
| 131       | 1807-1814 | I8         | Line number of PRF switching<br>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<br>If not yaw steering = 'bbb1'<br>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 | E20.1<br>3 | Incidence angle constant term (a0)                                                                                             | $\Theta = a_0 + a_1 \cdot R + a_2 \cdot R^2$<br>$\Theta$ : Incident angle (rad)<br>R: Slant range (km) |

| Field No.        | Byte No.  | Type                  | Description                                         | Remarks |
|------------------|-----------|-----------------------|-----------------------------------------------------|---------|
| 139              | 1907-1926 | E20.1<br>3            | Incidence angle linear coefficient term (a1)        |         |
| 140              | 1927-1946 | E20.1<br>3            | 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<br>Onboard orbit =<br>'1bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb'<br>Precise orbit =<br>'2bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb' |         |
| 8         | 45-60    | F16.7 | 1st orbital element<br>Position vector in the earth fixed coordinate system of the scene center (x) [m]                                    |         |
| 9         | 61-76    | F16.7 | 2nd orbital element<br>Position vector in the earth fixed coordinate system of the scene center (y) [m]                                    |         |
| 10        | 77-92    | F16.7 | 3rd orbital element<br>Position vector in the earth fixed coordinate system of the scene center (z) [m]                                    |         |
| 11        | 93-108   | F16.7 | 4th orbital element<br>Velocity vector in the earth fixed coordinate system of the scene center (x') [m/sec]                               |         |
| 12        | 109-124  | F16.7 | 5th orbital element<br>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<br>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<br>Example:<br>Onboard orbit ='bb28'<br>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  | E22.1<br>5 | Seconds of the first point (Example, 0:51:30.23 = 3090.23)                                                   |         |
| 20        | 183-204  | E22.1<br>5 | Interval time between points (seconds) = ss                                                                  |         |
| 21        | 205-268  | A64        | Reference Coordinate System (ECI, ECR) = 'ECRbb ~ b'                                                         |         |
| 22        | 269-290  | E22.1<br>5 | 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<br>22.15 | Repeat 387-518 for up to 28 points                      |         |
| 35                          | 4083-4199 | A18             | Blank                                                   |         |
| 36                          | 4101      | I1              | Leap second flag<br>0: None<br>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+1<br>20*(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)<br>SLC: $\beta_{\text{dB}} = 10 * \log 10 \langle I^2 + Q^2 \rangle + \text{CF}$ | The backscattering coefficient (beta-naught) of a pixel can be obtained by the ensemble averaging ( $\langle \rangle$ ), i.e., the spatial averaging of pixel values around the target. Here, I and Q in $\langle \rangle$ 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'<br>A: Received polarization (V)<br>B: Receiving antenna (S: Single beam)                 |                         |
| 9                                 | 21-26    | A6    | Date of the last calibration update =<br>'YYMMDD'<br>YY : lower 2 figures of the year<br>MM : Month<br>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 –<br>(n-1)*32+2<br>54 | (n-1)*<br>2F16.7        | Repetition of bytes 223 - 254 for the remaining channels (up to 8 channels)                                 |         |
| 26                              | (n-1)*32+2<br>55 - 734    | A(480<br>-(n-1)*<br>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)*<br>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<br>0.10 | Twenty coefficients to convert from latitude and longitude to line(L) and pixel (P) position in the image.<br>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 | 50E2<br>0.10 | <p>Coefficients of the 8th polynomial expression to convert from pixel (P) and line (L) to latitude (<math>\varphi</math>) and longitude (<math>\lambda</math>), say (<math>\varphi</math>, <math>\lambda</math>) where:</p> $\varphi = a_0 * L^4 * P^4 + a_1 * L^3 * P^4 + a_2 * L^2 * P^4 + a_3 * L * P^4 + a_4 * P^4 + a_5 * L^4 * P^3 + a_6 * L^3 * P^3 + a_7 * L^2 * P^3 + a_8 * L * P^3 + a_9 * P^3 + a_{10} * L^4 * P^2 + a_{11} * L^3 * P^2 + a_{12} * L^2 * P^2 + a_{13} * L * P^2 + a_{14} * P^2 + a_{15} * L^4 * P + a_{16} * L^3 * P + a_{17} * L^2 * P + a_{18} * L * P + a_{19} * P + a_{20} * L^4 + a_{21} * L^3 + a_{22} * L^2 + a_{23} * L + a_{24}$ $\lambda = b_0 * L^4 * P^4 + b_1 * L^3 * P^4 + b_2 * L^2 * P^4 + b_3 * L * P^4 + b_4 * P^4 + b_5 * L^4 * P^3 + b_6 * L^3 * P^3 + b_7 * L^2 * P^3 + b_8 * L * P^3 + b_9 * P^3 + b_{10} * L^4 * P^2 + b_{11} * L^3 * P^2 + b_{12} * L^2 * P^2 + b_{13} * L * P^2 + b_{14} * P^2 + b_{15} * L^4 * P + b_{16} * L^3 * P + b_{17} * L^2 * P + b_{18} * L * P + b_{19} * P + b_{20} * L^4 + b_{21} * L^3 + b_{22} * L^2 + b_{23} * L + b_{24}$ <p>(The order of storing: <math>a_0, a_1, a_2, \dots, a_{24}</math> &amp; <math>b_0, b_1, b_2, \dots, b_{24}</math>)</p> | <p>(P, L) referred in the upper left pixel(p) and line (l) are substituted by the following expressions as <math>P = p - P_0</math>, <math>L = l - L_0</math>, 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 (<math>\varphi</math>, <math>\lambda</math>) is measured in "degrees"</p> |
| 22        | 2025-2044 | E20.1<br>0   | Origin pixel ( $P_0$ ), 0.0 fixed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 23        | 2045-2064 | E20.1<br>0   | Origin Line ( $L_0$ ), 0.0 fixed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| Field No. | Byte No.  | Type         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------|-----------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24        | 2065-3064 | 50E2<br>0.10 | Coefficients of the 8th polynomial expression to convert from latitude ( $\Phi$ ) and longitude ( $\Lambda$ ) to pixel (p) and line (l), say (p, l) where:<br>$p = c_0 * \Lambda^4 * \Phi^4 + c_1 * \Lambda^3 * \Phi^4 + c_2 * \Lambda^2 * \Phi^4 + c_3 * \Lambda * \Phi^4 + c_4 * \Phi^4 + c_5 * \Lambda^4 * \Phi^3 + c_6 * \Lambda^3 * \Phi^3 + c_7 * \Lambda^2 * \Phi^3 + c_8 * \Lambda * \Phi^3 + c_9 * \Phi^3 + c_{10} * \Lambda^4 * \Phi^2 + c_{11} * \Lambda^3 * \Phi^2 + c_{12} * \Lambda^2 * \Phi^2 + c_{13} * \Lambda * \Phi^2 + c_{14} * \Phi^2 + c_{15} * \Lambda^4 * \Phi + c_{16} * \Lambda^3 * \Phi + c_{17} * \Lambda^2 * \Phi + c_{18} * \Lambda * \Phi + c_{19} * \Phi + c_{20} * \Lambda^4 + c_{21} * \Lambda^3 + c_{22} * \Lambda^2 + c_{23} * \Lambda + c_{24}$ $l = d_0 * \Lambda^4 * \Phi^4 + d_1 * \Lambda^3 * \Phi^4 + d_2 * \Lambda^2 * \Phi^4 + d_3 * \Lambda * \Phi^4 + d_4 * \Phi^4 + d_5 * \Lambda^4 * \Phi^3 + d_6 * \Lambda^3 * \Phi^3 + d_7 * \Lambda^2 * \Phi^3 + d_8 * \Lambda * \Phi^3 + d_9 * \Phi^3 + d_{10} * \Lambda^4 * \Phi^2 + d_{11} * \Lambda^3 * \Phi^2 + d_{12} * \Lambda^2 * \Phi^2 + d_{13} * \Lambda * \Phi^2 + d_{14} * \Phi^2 + d_{15} * \Lambda^4 * \Phi + d_{16} * \Lambda^3 * \Phi + d_{17} * \Lambda^2 * \Phi + d_{18} * \Lambda * \Phi + d_{19} * \Phi + d_{20} * \Lambda^4 + d_{21} * \Lambda^3 + d_{22} * \Lambda^2 + d_{23} * \Lambda + d_{24}$ (The order of storing: $c_0, c_1, c_2, \dots, c_{24}$ & $d_0, d_1, d_2, \dots, d_{24}$ ) | ( $\Phi, \Lambda$ ) referred in the upper left latitude( $\varphi$ ), longitude( $\lambda$ ) are substituted by the following expressions as $\Phi = \varphi - \Phi_0$ (degrees), $\Lambda = \lambda - \Lambda_0$ (degrees), where ( $\varphi, \lambda$ ) 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<br>0   | Origin Latitude ( $\Phi_0$ ) scene center latitude                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 26        | 3085-3104 | E20.1<br>0   | Origin Longitude ( $\Lambda_0$ ) scene center longitude                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 27        | 3105-5000 | A189<br>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<br>='NNN.NNNbbbb'<br>001.000, 001.001,... 002.000                                                                                                        |         |
| 13        | 45-48    | I4   | File number = 'bbb1'                                                                                                                                                                        |         |
| 14        | 49-64    | A16  | File ID ='MMMMMNbTFFFFbbbb'<br>MMMMM: Mission name ('STRIX')<br>N: Mission ID (Alpha='A', Beta='B', 1='1')<br>T: Processing level code<br>SLC ='B'<br>FFFF: File type<br>Image file ='IMOP' |         |
| 15        | 65-68    | A4   | Record sequence and location type flag =<br>'FSEQ'                                                                                                                                          |         |
| 16        | 69-76    | I8   | Sequence number of location =<br>'bbbbbbb1'                                                                                                                                                 |         |
| 17        | 77-80    | I4   | Field length of sequence number = 'bbb4'                                                                                                                                                    |         |
| 18        | 81-84    | A4   | Record code and location type flag =<br>'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<br>='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<br>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<br>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 field locator = 'bbbbbbbb'                                                                                                                                                                                                                                                                                                                        |         |
| 57        | 401-428  | A28  | SAR data format type indicator = 'COMPLEX * 8bbbbbbbbbbbbbbbb': SLC                                                                                                                                                                                                                                                                                           |         |
| 58        | 429-432  | A4   | <p>SAR data format type code = 'C * 8b': SLC</p> <p>'COMPLEX * 8bbbbbbbbbbbbbbbb'"C * 8b'(8 byte wide)</p> <p>-The first half (4 bytes) in the 8-byte field is two's complement representation</p> <p>Including real number components in floating point format</p> <p>A complex representation in which the second half contains an imaginary component.</p> |         |
| 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<br>Scene start line year                   |                                                                                                                                                                                          |
| 14                            | 41-44    | B4   | Sensor acquisition day of year<br>Scene start line day of year     |                                                                                                                                                                                          |
| 15                            | 45-48    | B4   | Sensor acquisition milli-seconds of day                            |                                                                                                                                                                                          |
| 16                            | 49-50    | B2   | SAR channel ID<br>Single polarization = 1                          |                                                                                                                                                                                          |
| 17                            | 51-52    | B2   | SAR channel code = 3<br>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<br>NO = 0, YES = 1               |                                                                                                                                                                                          |

| Field No.                                  | Byte No. | Type | Description                                                          | Remarks |
|--------------------------------------------|----------|------|----------------------------------------------------------------------|---------|
| 23                                         | 67-68    | B2   | Chirp type designator<br>LINEAR FM CHIRP = 0<br>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 <sup>2</sup> ] = 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<br>NO. (Effective line) = 0<br>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<br>= 0 (fixed)<br>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 <sup>2</sup> ]<br>= 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<br>i: Number of bytes of data + 1056<br>j: Number of pixels in this record<br>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<br>='NNN.NNNbbbb'<br>001.000, 001.001,... 002.000                                                                                                             |         |
| 13        | 45-48    | I4   | Number of files = 'bbb1'                                                                                                                                                                         |         |
| 14        | 49-64    | A16  | File ID ='MMMMMNbTFFFFbbbb'<br>MMMMM: Mission name ('STRIX')<br>N: Mission ID (Alpha='A', Beta='B',<br>1='1')<br>T: Processing level code<br>SLC ='B'<br>FFFF: File type<br>Trailer file ='SART' |         |
| 15        | 65-68    | A4   | Command software v203 is used =<br>'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 =<br>'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<br>='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 =<br>'bbbbbb0'                                                                                                                                                |         |
| 26        | 187-192  | I6   | Dataset Summary Record Length =<br>'bbbbbb0'                                                                                                                                                     |         |

| Field No. | Byte No. | Type | Description                                            | Remarks |
|-----------|----------|------|--------------------------------------------------------|---------|
| 27        | 193-198  | I6   | Number of map projection data records = 'bbbbbb0'      |         |
| 28        | 199-204  | I6   | Map projection data record length = 'bbbbbb0'          |         |
| 29        | 205-210  | I6   | Number of platform position data records = 'bbbbbb0'   |         |
| 30        | 211-216  | I6   | Platform position data record length = 'bbbbbb0'       |         |
| 31        | 217-222  | I6   | Number of attitude data records = 'bbbbbb0'            |         |
| 32        | 223-228  | I6   | Attitude data record length = 'bbbbbb0'                |         |
| 33        | 229-234  | I6   | Number of radiometric data records = 'bbbbbb0'         |         |
| 34        | 235-240  | I6   | Radiometric data record length = 'bbbbbb0'             |         |
| 35        | 241-246  | I6   | Number of radiometric compensation records = 'bbbbbb0' |         |
| 36        | 247-252  | I6   | Radiometric Compensation Record Length = 'bbbbbb0'     |         |
| 37        | 253-258  | I6   | Number of data quality summary records = 'bbbbbb0'     |         |
| 38        | 259-264  | I6   | Data Quality Summary Record Length = 'bbbbbb0'         |         |
| 39        | 265-270  | I6   | Number of data histograms records = 'bbbbbb0'          |         |
| 40        | 271-276  | I6   | Data Histogram Record Length = 'bbbbbb0'               |         |
| 41        | 277-282  | I6   | Number of range spectra records = 'bbbbbb0'            |         |



| Field No. | Byte No. | Type | Description                                                | Remarks |
|-----------|----------|------|------------------------------------------------------------|---------|
| 42        | 283-288  | I6   | Range spectrum record length ='bbbbbb0'                    |         |
| 43        | 289-294  | I6   | Number of DEM descriptor records ='bbbbbb0'                |         |
| 44        | 295-300  | I6   | DEM Descriptor Record Length ='bbbbbb0'                    |         |
| 45        | 301-306  | I6   | Number of radar parameter update records ='bbbbbb0'        |         |
| 46        | 307-312  | I6   | Radar parameter update record length ='bbbbbb0'            |         |
| 47        | 313-318  | I6   | Number of annotation data records ='bbbbbb0'               |         |
| 48        | 319-324  | I6   | Annotation data record length ='bbbbbb0'                   |         |
| 49        | 325-330  | I6   | Number of detailed processing parameter records ='bbbbbb0' |         |
| 50        | 331-336  | I6   | Detailed processing parameter record length ='bbbbbb0'     |         |
| 51        | 337-342  | I6   | Number of calibration records ='bbbbbb0'                   |         |
| 52        | 343-348  | I6   | Calibration record length ='bbbbbb0'                       |         |
| 53        | 349-354  | I6   | Number of GCP records ='bbbbbb0'                           |         |
| 54        | 355-360  | I6   | GCP record length ='bbbbbb0'                               |         |
| 55        | 361-420  | A60  | Blank                                                      |         |
| 56        | 421-426  | I6   | Number of facility data records ='bbbbbb0'                 |         |
| 57        | 427-432  | I6   | Facility data (1) record length ='bbbbbb0'                 |         |
| 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_SiteDateT<br>ime          | 'PROCESS:JAPAN-SYNS-STRIXAbYYYYMMDDb<br>HHMMSS'<br>YYYYMMDD: Processed date (YYYY: year, MM:<br>month, DD: day)<br>HHMMSS : Processed time (UTC)                                                                                                               |
| 2   |                                    | Scene<br>descriptio<br>n ID      | Scs_SceneID                   | 'AAAAAA-YYYYMMDDThhmmssZ'<br>AAAAAA: Satellite name (='STRIXN') N:A, B or<br>1<br>YYYYMMDD: Scene center observation date<br>(YYYY: year, MM: month, DD: day)<br>hhmmss: Scene center observation time (hh:<br>hour, mm: minutes, ss: seconds)<br>-: Separator |
| 3   | Product<br>specificatio<br>n (Pds) | Product<br>ID                    | Pds_ProductI<br>D             | 'DDEEE'<br>DD: Observation mode<br>SM: Stripmap mode<br>SL: Sliding Spotlight mode<br>ST: Staring Spotlight mode<br>EEE: Processing level<br>SLC: Single Look Complex                                                                                          |
| 4   |                                    | Precision<br>of orbit<br>data    | Pds_OrbitDat<br>aPrecision    | 'Precision' / 'Onboard'                                                                                                                                                                                                                                        |
| 5   |                                    | Precision<br>of attitude<br>data | Pds_Attitude<br>DataPrecision | '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)<br>YYYY : Year (A.D)<br>MM : Month (01~12)<br>DD : Day (01~31)<br>hh : Hour (00~23)<br>mm : Minute (00~59)<br>ss : Second (00~60) (ss=60 is used only by a leap second)<br>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_SLCProductFileName<br>nn : 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'<br>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- $\alpha$
- STRIXB: StriX- $\beta$
- 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<br>AA – Observation mode<br>SM – Stripmap<br>SL – Sliding Spotlight<br>ST – Staring Spotlight<br><br>B – Looking direction<br>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.  $\leq \phi < \text{S } 80 \text{ deg}$  or N 84 deg.  $< \phi \leq \text{N } 90 \text{ deg}$
  - Universal Transverse Mercator(UTM): S 80 deg.  $\leq \phi \leq \text{N } 84 \text{ deg}$ .
  - $\phi$  : 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)<br>IMG-<Polarization>-<Scene ID>-<Product ID>.tif<br>(SR-GRD)<br>IMG-<Polarization>-<Scene ID>-SR-<Product ID>.tif | GeoTIFF                 | This file stores a raster image                                             |
| Metadata file   | 1               | (GRD)<br>PAR-<Scene ID>-<Product ID>.xml<br>(SR-GRD) PAR-<Scene ID>-SR-<Product ID>.xml                                  | xml                     | This file stores information about raster image and observation             |
| Thumbnail Image | 1               | (GRD)<br>IMG-<Scene ID>-<Product ID>.jpeg<br>(SR-GRD) IMG-<Scene ID>-SR-<Product ID>.jpeg                                | JPEG                    |                                                                             |
| Image File      | 1               | (GRD)<br>IMG-<Scene ID>-<Product ID>_cog.tif<br>(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- $\alpha$
- STRIXB: StriX- $\beta$
- 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<br>ISO8601format<br>YYYY-MMDDThh:mm:ssZ | 2021-12-14T18:29:37Z |
|                      | eop:acquisitionType          | string   |      | Acquisition type<br>NOMINAL<br>CALIBRATION            |                      |
|                      | eop:acquisitionSubType       | string   |      | Acquisition mode<br>Staring Spotlight                 |                      |

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

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

| Tag / Attribute Name |                         | Type     | Unit | Description                                                                                                                                          | Example / Remarks        |
|----------------------|-------------------------|----------|------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|                      | eop:nativeProductFormat | string   |      | Data Format<br>GRD: GeoTIFF                                                                                                                          | GeoTiff                  |
|                      | eop:vendorSpecific      |          |      |                                                                                                                                                      |                          |
|                      | eop:SpecificInformation |          |      |                                                                                                                                                      |                          |
|                      | offnadirAngle           | double   |      | Off-nadir angle                                                                                                                                      |                          |
|                      | calibrationFactor       | double   |      | CF (Calibration Factor) to convert<br>DN (Digital Number) to $\sigma_0$<br>$\sigma_0 = \text{DN}^2 / \text{CF}^2$<br>Refer to Section 3 for details. |                          |
|                      | sceneCenterDateTime     | datetime |      | Scene center time<br>ISO8601 format<br>(precise orbit is used when<br>available)                                                                     | 2021-12-12T07:24:<br>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)<br>Left top, latitude longitude<br>Left bottom, latitude longitude<br>Right bottom, latitude longitude<br>Right top, latitude longitude<br>Left top, latitude longitude<br><br>Latitude is expressed as "SNN.NNNNNNNN N",<br>Longitude is expressed as " SNN.NNNNNNNN N "<br><br>“S” is for polarity. The plus sign would be omitted.<br>Values are separated by space. | -1.896944000<br>42.996389000<br>-2.650000000<br>42.862778000<br>-2.861667000<br>43.381667000<br>-2.102500000<br>43.516667000<br>-1.896944000<br>42.996389000 |

| Tag / Attribute Name |                               | Type   | Unit | Description                                                                                                                                                                                                                                          | Example / Remarks |
|----------------------|-------------------------------|--------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
|                      | eop:orientation               |        |      |                                                                                                                                                                                                                                                      |                   |
|                      | gml:centerOf                  |        |      |                                                                                                                                                                                                                                                      |                   |
|                      | gml:Point                     |        |      |                                                                                                                                                                                                                                                      |                   |
|                      | gml:pos                       | string | deg  | <p>scene center (latitude, longitude)</p> <p>Latitude is expressed as "SNN.NNNNNNNNNNNNNNN",<br/>Longitude is expressed as "SNNN.NNNNNNNNNNNNNNN"</p> <p>"S" is for polarity. The plus sign would be omitted.<br/>Values are separated by space.</p> |                   |
|                      | 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<br>beta                                |                 |
|                      |  | eop:orbitType        |             | string          |             | Orbit category<br>GEO : Geostationary Orbit<br>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<br>OPTICAL<br>RADAR<br>ALTIMETRIC<br>ATMOSPHERIC | RADAR                          |
|                      |                           | eop:operationalMode      | string | StaringSpotlight, SlidingSpotlight<br>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<br>ASCENDING<br>DESCENDING                                                                                                | ASCENDING         |
|                      |  |  |  |  | sar:polarisationMode     | string | Polarization mode<br>S:single: (Example: VV, HH)<br>D:dual: (Example: HH+HV,<br>VV+VH)<br>Q:quad:( Example:<br>HH+HV+VH+VV)<br>UNDEFINED: | S                 |
|                      |  |  |  |  | sar:polarisationChannels | string | Polarization channels                                                                                                                     | VV                |
|                      |  |  |  |  | sar:antennaLookDirection | string | Observation direction<br>LEFT<br>RIGHT                                                                                                    | LEFT              |

| Tag / Attribute Name |  |  |  |                                     | Type   | Unit          | Description                                                                                        | Example / Remarks |
|----------------------|--|--|--|-------------------------------------|--------|---------------|----------------------------------------------------------------------------------------------------|-------------------|
|                      |  |  |  | sar:satelliteHeadingAngle           | single | deg           | Satellite heading angle<br>North is set to 0 degree<br>Counter clockwise ranged from<br>(0 to 360) |                   |
|                      |  |  |  | sar:minimumIncidenceAngle           | single | deg           | Minimum incidence angle<br>"NN.NNN"                                                                |                   |
|                      |  |  |  | sar:maximumIncidenceAngle           | single | deg           | Maximum incidence angle<br>"NN.NNN"                                                                |                   |
|                      |  |  |  | sar:incidenceAngleVariation         | single | deg           | Difference between minimum<br>and maximum incidence angle<br>"NN.NNN"                              |                   |
|                      |  |  |  | sar:incidenceAngleConstant          | single | deg           | Incident angle constant terms                                                                      |                   |
|                      |  |  |  | sar:incidenceAngleLinearCoefficient | single | deg/pi<br>xel | 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<br>Synspective<br>Inc. All Right<br>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<br>2= signed integer<br>3= float<br>4= undefined<br>5= complex integer<br>6= complex float |
| SamplePerPixel            | 277    | SHORT               | 1                                                               | 1                                                                                                              |
| Software                  | 305    | ASCII               | -                                                               | StrixProcessor                                                                                                 |
| StripByteCounts           | 279    | SHORT<br>or<br>LONG | When<br>PlanarConfiguration=1,<br>number of strips per<br>image | Number of bytes for<br>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:<br>"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<br>2 = ModelTypeGeographic<br>3 = ModelTypeGeocentric |
| GTRasterTypeGeoKey     | 1025   | SHORT  | 1                                                      | 1 = RasterPixelIsArea<br>2=RasterPixelIsPoint                                |
| GTCitationGeoKey       | 1026   | ASCII  | 1                                                      | WGS 84 / UTM zone 18S                                                        |
| GeographicTypeGeoKey   | 2048   | SHORT  | 1                                                      | Geographic coordinate system<br>4326=WGS84                                   |
| GeogAngularUnitsGeoKey | 2054   | SHORT  | 1                                                      | 9102=Angular_Degree [deg]                                                    |

| Tag / Attribute Name | Key ID | Type  | Count | Description/ Example                                    |
|----------------------|--------|-------|-------|---------------------------------------------------------|
| GDALNoDataTag        | 42113  | ASCII | 1     | 0<br>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 ( $\beta_{\text{dB}}$ ) ,

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

To convert from  $\beta_0$  to  $\sigma_0$ , the incident angle correction will be applied by

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

where  $\theta$  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 ( $\sigma_0$ ) 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- $\alpha$  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- $\beta$ is released                              |
| July 19, 2022 | v0.0.4             | v003.010                                   | - Calibration factor is added for Stripmap StriX- $\beta$ |

| Date         | Version<br>(SLC SICD) | Version<br>(SLC CEOS,<br>GRD/SR-GRD<br>GeoTIFF+XML) | Description                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------|-----------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sept 7, 2022 | v0.0.5                | v004.000                                            | <ul style="list-style-type: none"> <li>- Calibration factor is added for Sliding Spotlight StriX-<math>\beta</math></li> <li>- Calculation for doppler frequency (center) is updated in SLC product</li> </ul>                                                                                                                                                                                                 |
| Oct 24, 2022 | v0.0.6                | v005.000                                            | <ul style="list-style-type: none"> <li>- Heading angle and incidence angle polynomial is added in GRD product</li> </ul>                                                                                                                                                                                                                                                                                       |
| Dec 15, 2022 | v0.8.0                | v006.000                                            | <ul style="list-style-type: none"> <li>- StriX-1 is released</li> <li>- Orbit state vectors are added in XML metadata in GRD product</li> <li>- Calculation for doppler frequency is updated in SLC product</li> </ul>                                                                                                                                                                                         |
| Feb 27, 2023 | v0.9.0                | v007.000                                            | <ul style="list-style-type: none"> <li>- Geolocation algorithm is updated in SLC and GRD product</li> <li>- ImpRespWid in SICD is fixed to match with azimuth frequency bandwidth</li> <li>- StriX-1 for Stripmap range sampling frequency is reduced from 187.5 MHz to 100 MHz in SLC product</li> <li>- linear and quadratic coefficients are set for along track Doppler rate polynomial in CEOS</li> </ul> |
| May 15, 2023 | v0.10.0               | v008.000                                            | <ul style="list-style-type: none"> <li>- Add resampling in the azimuth direction to reduce data size for the given resolution</li> <li>- Fix SFDRatePoly constant coefficient sign</li> <li>- UTM CRS for GRD products</li> </ul>                                                                                                                                                                              |
| Aug 1, 2023  | v0.11.0               | v009.000                                            | <ul style="list-style-type: none"> <li>- Noise Equivalent Sigma Zero metadata was added to GRD and SR-GRD XML Product</li> </ul>                                                                                                                                                                                                                                                                               |

| Date         | Version<br>(SLC SICD) | Version<br>(SLC CEOS,<br>GRD/SR-GRD<br>GeoTIFF+XML) | Description                                                                                                                                                         |
|--------------|-----------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Oct 2, 2023  | v0.12.0               | v010.000                                            | <ul style="list-style-type: none"> <li>- Geolocation algorithm is updated in GRD product</li> <li>- Fixed an issue with the extent of GRD GeoTIFF raster</li> </ul> |
| Oct 19, 2023 | v0.12.2               | v010.001                                            | <ul style="list-style-type: none"> <li>- Fixed a minor raster alignment issue with the GRD GeoTIFF raster in Ascending observations</li> </ul>                      |
| Dec 6, 2023  | v0.12.3               | v010.002                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in GRD geocoding algorithm</li> </ul>                                                                          |
| Jan 22, 2024 | v0.13.0               | v011.000                                            | <ul style="list-style-type: none"> <li>- Updated geocoding algorithm of GRD</li> <li>- Updated SICD format version from 1.2.1 to 1.3.0</li> </ul>                   |
| Jan 23, 2024 | v0.13.1               | v011.000                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in processing system</li> </ul>                                                                                |
| Mar 18, 2024 | v0.13.2               | v011.000                                            | <ul style="list-style-type: none"> <li>- Fixed a minor bug in an interface between processing library and platform pipeline</li> </ul>                              |
| Apr 10, 2024 | v0.13.3               | v011.000                                            | <ul style="list-style-type: none"> <li>- Fixed a minor bug in an interface to precise orbit</li> </ul>                                                              |
| Apr 22, 2024 | v0.14.0               | v012.000                                            | <ul style="list-style-type: none"> <li>- Fixed a minor bug that generated subpixel geolocation offset in GRD products</li> </ul>                                    |
| May 15, 2024 | v0.14.1               | v012.000                                            | <ul style="list-style-type: none"> <li>- Support StriX-3 observations</li> </ul>                                                                                    |

| Date         | Version<br>(SLC SICD) | Version<br>(SLC CEOS,<br>GRD/SR-GRD<br>GeoTIFF+XML) | Description                                                                                                                                                                                                                                                                                                                               |
|--------------|-----------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aug 1, 2024  | v0.15.0               | v013.000                                            | <ul style="list-style-type: none"> <li>- Filled values for nominal slant range and azimuth resolutions in CEOS fields</li> <li>- Added fields nominal slant range and azimuth resolutions in Summary Information for CEOS product</li> <li>- Added metadata fields for image resolutions in XML file in GRD and SR-GRD product</li> </ul> |
| Aug 22, 2024 | v0.15.1               | v013.000                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in the processing management system (products are not affected)</li> </ul>                                                                                                                                                                                                           |
| Sept 4, 2024 | v0.15.2               | v013.000                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in the processing management system (products are not affected)</li> </ul>                                                                                                                                                                                                           |
| Oct 2, 2024  | v0.15.3               | v013.000                                            | <ul style="list-style-type: none"> <li>- Support Staring Spotlight observations</li> </ul>                                                                                                                                                                                                                                                |
| Nov 12, 2024 | v1.0.0                | v014.000                                            | <ul style="list-style-type: none"> <li>- Support StriX-4</li> <li>- Add Cloud Optimized GeoTIFF in GRD and SR-GRD product</li> <li>- Update focusing algorithm</li> </ul>                                                                                                                                                                 |
| Dec 3, 2024  | v1.1.0                | v014.000                                            | <ul style="list-style-type: none"> <li>- Support Staring Spotlight with 0.25m Azimuth resolution</li> <li>- Update processing kernel for Staring Spotlight</li> </ul>                                                                                                                                                                     |
| Jan 15, 2025 | v1.2.0                | v014.001                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in Field No. 55 in Table 1.1-16 Signal Data Records in CEOS Product Format</li> </ul>                                                                                                                                                                                                |
| Mar 25, 2025 | v1.3.0                | v015.000                                            | <ul style="list-style-type: none"> <li>- Support StriX-2</li> <li>- Updated a reference chirp for focusing</li> </ul>                                                                                                                                                                                                                     |
| Apr 2, 2025  | v1.3.1                | v015.000                                            | <ul style="list-style-type: none"> <li>- Fixed a bug in Staring Spotlight focusing</li> </ul>                                                                                                                                                                                                                                             |



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:<br>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](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>