Extracted from JPL D-11427 rev. L, June 27, 1994

Tape Hdr Format

See: sarhport.jpl.nasa.gov/sampledata/Readme.ceosdesc

APPENDIX-A SIR-C CEOS Exabyte Tape Layout /Readme.dataformat

Each SIR-C CEOS Exabyte tape contains five type of files: The Volume Directory File (VDF), SAR Leader File (ldr), SAR Data File (img), SAR Trailer File (tlr) and Null Volume Directory File (NVDF). Each Exabyte tape contains one Volume Directory File at the beginning of the tape, then three SAR files : ldr, img and tlr for each product. Finally is the Null Volume Directory File at the end of the tape.

The Volume Directory File contains one Volume Descriptor Record and three File Pointer Records (LDR, IMG, TLR) for each product. Finally is the text record of each product. Figure B below shows the table of tape layout and Volume Directory File layout.

Tape Layout

Volume Directory File (VDF)
Leader File #1 (ldr)
Data File #1 (img)
Trailer File #1 (tlr)
Leader File #2 (ldr)
Data File #2 (img)
Trailer File #2 (tlr)
. . .
Leader File #n (ldr)
Data File #n (img)
Trailer File #n (tlr)
Null Volume Directory File (NVDF)

Volume Directory File (VDF) layout

Volume Descriptor Record
File Pointer Record of ldr #1
File Pointer Record of img #1
File Pointer Record of tlr #1
File Pointer Record of ldr #2
File Pointer Record of img #2
File Pointer Record of tlr #21
. . .
File Pointer Record of ldr #n
File Pointer Record of img #n
File Pointer Record of tlr #n
Text Record #1
Text Record #2
. . .
Text Record #n

Figure B : SIR-C CEOS Tape Layout and Volume Directory File (VDF) layout




APPENDIX-B Description of SIR-C CEOS Files and Output Files

The description of SIR-C CEOS files:

1. Volume Directory File: This is the first file of data volume and consists of a volume descriptor record, file pointer records and text records. This file is to identify and specify the structure related to the data volume.

2. SAR Leader File: This file contains auxiliary information corresponding to the SAR data contained in the data file.

3. SAR Data File: This file contains the SAR data. It consists of one file descriptor record and either Image data records or Reformatted Signal data records.

4. SAR Trailer File: For SIR-C, this file contains simply the file descriptor record because all the information are stored in SAR Leader file.

5. Null Volume Directory File: This file contains only the null volume descriptor record to indicate the end of the data volume.

Below is the description of SIR-C CEOS output files in ASCII format and plot data files:

1. SAR Leader File_ascii: This file contains the text format of File Descriptor Record, Data Set Summary Record, Map Projection Data Record, Platform Position Record, Attitude Data Record, Radiometric Data Record, Radiometric Compensation Record, Data Quality Summary Record, Data Histograms Record, Range Spectra Record, Radar Parameter Update Data Record, Detailed Processing Parameter Record, and Calibration Data Record of SAR Leader File.

2. SAR Imagery Options Record_ascii: This file contains the text format of file descriptor record of SAR Data File.

3. SAR Data File_image: This file contains compressed Image data OR
SAR Data File_HH/_HV/_VV/_VH: These four files contains raw data of Reformatted Signal Data Records

4. SAR Trailer File_ascii: This file contains the text format of file descriptor record of SAR Trailer File.

56. Radiometric Compensation plot data files (prXXXXX_radioplot_ZWW) : These files contain data of Radiometric Compensation record in (x,y) format. The (x,y) pairs are tab-delimited

6. Data Histogram plot data files (prXXXXX_histoplot_YYY_ZWW) : These files contain data of Data Histogram record in (x,y) format. The (x,y) pairs are tab-delimited

7. Range Spectra plot data files (prXXXXX_spectraplot_ZWW) : These files contain data of Range Spectra record in (x,y) format. The (x,y) pairs are tab-delimited

(Where XXXXX : Processing run number
YYY : Image or Raw (IMA or RAW)
Z : L or C band
WW : HH, HV, VH, or/and VV polarization)

List of CEOS Files used by SIR-C:

Volume Directory File
- Volume Descriptor Record
- File Pointer Record -SAR Leader File
- File Pointer Record - Imagery Options File
- File Pointer Record - SAR Trailer File
- Text Record

SAR Leader File
- File Descriptor Record
- Data Set Summary Record
- Map Projection Data Record
- Platform Position Record
- Attitude Data Record
- Radiometric Data Record
- Radiometric Compensation Record
- Data Quality Summary Record
- Data Histograms Record
- Range Spectra Record
- Radar Parameter Update Data Record
- Detailed Processing Parameter Data Record
- Calibration Data Record

Imagery Options File
- File Descriptor Record
- Imagery Options File (Image Data Records or Reformatted Signal Data Records)

SAR Trailer File
- File Descriptor Record

Null Volume Directory File
- Null Volume Descriptor Record

nyms:

BFPQ	Block Floating Point Quantizer
BIL	Band Interleaved by Line tape organizational method: Volume Directory File SAR Leader File Imagery Options File Data Set 1 Data Set 2 Data Set n SAR Trailer File Null Volume Directory File
BIP	Band Interleaved by Pixel tape organizational method: same as BIL
BSQ	Band Sequential tape organizational method: Volume Directory File SAR Leader File 1 Imagery Options File 1 SAR Trailer File 1 SAR Leader File 2 Imagery Options File2 SAR Trailer File 2 Null Volume Directory File BSQ is the organization SIR-C will use.
FIXD	Fixed length record
IMOP	Imagery Options: Class of file in SAR logical volume
MBAA	Mixed Binary And Ascii
MLC	Multi-Look Complex Image
MLD	Multi-Look Detected Image
RSD	Reformated Signal Data
SARL	SAR Leader file: Class of file in SAR logical volume
SART	SAR Trailer file: Class of file in SAR logical volume
SLC	Single-Look Complex Image
VARE	Variable record length
$	space character

Data File Preamble:

Every data record begins with a 12-byte preamble which contains general information describing the data file including record type, subtype, and record length. The preamble is included in the definition of each record below.

Volume Directory File:
Volume Descriptor Record

For SIR-C, each logical volume is one physical volume. Logical volumes do not span multiple physical volumes.

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number (1)
2	5	B1	RDC	---	1st record subtype code (192)
3	6	B1	RDC	---	Record type code (192)
4	7	B1	RDC	---	2nd record subtype code (18)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B4	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag ("A$")
8	15-16	A2	---	---	Blanks
9	17-28	A12	RDC	---	Format control document ("CCB-CCT-0002")
10	29-30	A2	RDC	---	Format control document version (for original: "A$", next: "B$", etc.)
11	31-32	A2	RDC	---	Record format revision level (for original: "A$", next: "B$", etc.)
12	33-44	A12	RDC	---	CEOS Software release and revision level
13	45-60	A16	RDC	---	Physical tape id
14	61-76	A16	RDC	---	Logical volume id
15	77-92	A16	RDC	---	Volume set id ("SITE$ID$$$$$$$$")
16	93-94	I2	RDC	---	Total number of physical volumes in logical volume(1)
17	95-96	I2	RDC	---	1st physical volume sequence number (1)
18	97-98	I2	RDC	---	Last physical volume sequence number (1)
19	99-100	I2	RDC	---	This physical volume sequence number (1)
20	101-104	I4	RDC	---	1st reference file in volume (1)
21	105-108	I4	RDC	---	Logical volume in set (1)
22	109-112	I4	RDC	---	Logical volume number in physical volume (1)
23	113-120	A8	RDC	---	Tape creation date (YYYYMMDD)
24	121-128	A8	RDC	---	Tape creation time (hhmmssdd)
25	129-140	A12	RDC	---	Creating country ("USA$$$$$$$$$")
26	141-148	A8	RDC	---	Creating agency ("NASA$$$$")
27	149-160	A12	RDC	---	Creating facility ("JPL$$$$$$$$$")
28	161-164	I4	RDC	---	Number of pointer records
29	165-168	I4	RDC	---	Number of records
30	169-260	A92	---	---	Spare
31	261-360	A100	---	---	Spare

Volume Directory File:
File Pointer Record - SAR Leader File

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number (2)
2	5	B1	RDC	---	1st record subtype code (219)
3	6	B1	RDC	---	Record type code (192)
4	7	B1	RDC	---	2nd record subtype code (18)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B4	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag ("A5")
8	15-16	A2	---	---	Blank
9	17-20	I4	RDC	---	File number (1)
10	21-36	A16	RDC	---	File name
11	37-64	A28	RDC	---	File class ("SARLEADER$FILE$$$$$$$$$$$$$")
12	65-68	A4	RDC	---	File class code ("SARL")
13	69-96	A28	RDC	---	Data type ("MIXED$BINARY$AND$ASCII$$$$$")
14	97-100	A4	RDC	---	Data type code ("MBAA")
15	101-108	I8	RDC	---	Number of records
16	109-116	I8	RDC	---	1st record length
17	117-124	I8	RDC	---	Max record length
18	125-136	A12	RDC	---	Record type ("VARIABLE$LEN")
19	137-140	A4	RDC	---	Record type code ("VARE")
20	141-142	I2	RDC	---	Start file volume number
21	143-144	I2	RDC	---	End file volume number
22	145-152	I8	RDC	---	First record number on tape
23	153-160	I8	RDC	---	Last record number on tape
24	161-260	A100	---	---	Blank
25	261-360	A100	---	---	Blank

Volume D[redacted]ry File:
File Pointer Record - Imagery Options

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number (3)
2	5	B1	RDC	---	1st record subtype code (219)
3	6	B1	RDC	---	Record type code (192)
4	7	B1	RDC	---	2nd record subtype code (18)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B1	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag ("A$")
8	15-16	A2	---	---	Blank
9	17-20	I4	RDC	---	File number (2)
10	21-36	A16	RDC	---	File name
11	37-64	A28	RDC	---	File class ("IMAGERY$OPTIONS$FILE$$$$$$$$")
12	65-68	A4	RDC	---	File class code ("IMOP")
13	69-96	A28	RDC	---	Data type ("MIXED$BINARY$AND$ASCII$$$$$$")
14	97-100	A4	RDC	---	Data type code ("MBAA")
15	101-108	I8	RDC	---	Number of records
16	109-116	I8	RDC	---	1st record length
17	117-124	I8	RDC	---	Max record length
18	125-136	A12	RDC	---	Record type ("FIXED$LENGTH)
19	137-140	A4	RDC	---	Record type code ("FIXD")
20	141-142	I2	RDC	---	Start file volume number
21	143-144	I2	RDC	---	End file volume number
22	145-152	I8	RDC	---	First record number on tape
23	153-160	I8	RDC	---	Last record number on tape
24	161-260	A100	---	---	Blank
25	261-360	A100	---	---	Blank

Volume Directory File:
File Pointer Record - SAR Trailer File

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number (4)
2	5	B1	RDC	---	1st record subtype code (219)
3	6	B1	RDC	---	Record type code (192)
4	7	B1	RDC	---	2nd record subtype code (18)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B4	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag ("AS")
8	15-16	A2	---	---	Blank
9	17-20	I4	RDC	---	File number (3)
10	21-36	A16	RDC	---	File name
11	37-64	A28	RDC	---	File class ("SARTRAILER$FILE$$$$$$$$$$$$")
12	65-68	A4	RDC	---	File class code ("SART")
13	69-96	A28	RDC	---	Data type ("MIXED$BINARY$AND$ASCII$$$$$")
14	97-100	A4	RDC	---	Data type code ("MBAA")
15	101-108	I8	RDC	---	Number of records
16	109-116	I8	RDC	---	1st record length
17	117-124	I8	RDC	---	Max record length
18	125-136	A12	RDC	---	Record type ("VARIABLE$LEN")
19	137-140	A4	RDC	---	Record type code ("VARE")
20	141-142	I2	RDC	---	Start file volume number
21	143-144	I2	RDC	---	End file volume number
22	145-152	I8	RDC	---	First record number on tape
23	153-160	I8	RDC	---	Last record number on tape
24	161-260	A100	---	---	Blanks
25	261-360	A100	---	---	Blanks

Volume D[illegible]ry File:
Text Record:

The purpose of this record is to allow the reader of the CEOS tape to simply print out a short description of the data

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number
2	5	B1	RDC	---	1st record subtype code (18)
3	6	B1	RDC	---	Record type code (63)
4	7	B1	RDC	---	2nd record subtype code (18)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B4	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag ("A$")
8	15-16	A2	---	---	Continuation flag ("$$") for "not continued"
9	17-56	A40	PF/RDC	pdata_product	Product type specifier ("MULTI-LOOK DETETCTED",etc.)
10	57-116	A60	RDC	---	Location, date/time of CEOS product creation ("PRODUCED AT JPL/NASA/USA ON 1994/01/16 11:45:00"
11	117-156	A40	RDC	---	Physical volumes identification ("TAPE$ID:$xxxxxxxxxxxxxxxx,$TAPES1$OF$1") where xxx...x is the tape ID
12	157-196	A40	PF/RDC	pdatatake_id	Site identification ("DTxxx.yy$YYYY/MM/DD hh:mm:ss.ttt") where xxx.yy is the datatake ID and YY::tt - frame center, acquisition date and time
13	197-236	A40	PF/RDC	pcenter_lat pcenter_long	Site location ("FRAME$CENTER: nnndegnn.n'P nnndegnn.n'Q") where P = N or S latitude, Q = E or W longitude
14	237-256	A20	---	---	Spares
15	257-360	A104	---	---	Spares

SAR Leader File:
File Descriptor Record

The File Descriptor Record is defined below.

Field	Bytes	Format	Source	Parameter	Description
				FIXED LENGTH RECORD SEGMENT	
1	1-4	B4	OPS	---	Record sequence number (1)
2	5	B1	OPS	---	1st rec.subtype code (63)
3	6	B1	OPS	---	Record type code (192)
4	7	B1	OPS	---	2nd rec.subtype code (18)
5	8	B1	OPS	---	3rd rec.subtype code (18)
6	9-12	B4	OPS	---	Record length (720)
7	13-14	A2	OPS	---	ASCII flag("A$")
8	15-16	A2	---	---	Blank
9	17-28	A12	OPS	---	Format control document ("CEOS-SAR-CCT")
10	29-30	A2	OPS	---	Format control document version ("A$")
11	31-32	A2	OPS	---	Record format rev.level ("A$")
12	33-44	A12	OPS	---	Software id
13	45-48	I4	RDC	---	File number (1)
14	49-64	A16	OPS	---	File name (same as field 10 of file pointer record)
15	65-68	A4	OPS	---	Record sequence and location type flag ("FSEQ")
16	69-76	I8	OPS	---	Sequence number location (1)
17	77-80	I4	OPS	---	Sequence number field length (4)
18	81-84	A4	OPS	---	Record code and location type flag ("FTYP")
19	85-92	I8	OPS	---	Record code location (5)
20	93-96	I4	OPS	---	Record code field length (4)
21	97-100	A4	OPS	---	Record length and location type flag ("FLGT")
22	101-108	I8	OPS	---	Record length location (9)
23	109-112	I4	OPS	---	Record length field length (4)
24	113	A1	---	---	Blank
25	114	A1	---	---	Blank
26	115	A1	---	---	Blank
27	116	A1	---	---	Blank
28	117-180	A64	---	---	Blanks

29	181-186	I6	OPS	---	Number of data set summary records (1)
30	187-192	I6	OPS	---	Record length (2016)
31	193-198	I6	OPS	---	Number of map projection data records (1)
32	199-204	I6	OPS	---	Record length (1604)
33	205-210	I6	OPS	---	Number of platform position data records (1)
34	211-216	I6	OPS	---	Record length (variable)
35	217-222	I6	OPS	---	Number of attitude data records (1)
36	223-228	I6	OPS	---	Record length (variable)
37	229-234	I6	OPS	---	Number of radiometric data records (one per polarization channel)
38	235-240	I6	OPS	---	Record length (variable)
39	241-246	I6	OPS	---	Number of radiometric compensation records (one per polarization channel)
40	247-252	I6	OPS	---	Record length (variable)
41	253-258	I6	OPS	---	Number of data quality summary records (one per polarization channel)
42	259-264	I6	OPS	---	Record length (464)
43	265-270	I6	OPS	---	Number of data histogram records (one per polarization channel)
44	271-276	I6	OPS	---	Record length (variable)
45	277-282	I6	OPS	---	Number of range spectra records (one per polarization channel)
46	283-288	I6	OPS	---	Record length (variable)
47	289-294	I6	OPS	---	Number of digital elevation model descriptor records (0)
48	295-300	I6	OPS	---	Record length (0)
49	301-306	I6	OPS	---	Number of radar parameter update records (variable: one for DWP and one per polarization for receiver gain)
50	307-312	I6	OPS	---	Record length (variable)
51	313-318	I6	OPS	---	Number of annotation data records (0)
52	319-324	I6	OPS	---	Record length (0)
53	325-330	I6	OPS	---	Number of detailed processing records (1)
54	331-336	I6	OPS	---	Record length (1312)
55	337-342	I6	OPS	---	Number of calibration data records (1)
56	343-348	I6	OPS	---	Record length (772)
57	349-354	I6	OPS	---	Number of ground control points descriptor records (0)
58	355-360	I6	OPS	---	Record length (0)
59	361-366	I6	---	---	Blanks
60	367-372	I6	---	---	Blanks
61	373-378	I6	---	---	Blanks
62	379-384	I6	---	---	Blanks
63	385-390	I6	---	---	Blanks
64	391-396	I6	---	---	Blanks
65	397-402	I6	---	---	Blanks
66	403-408	I6	---	---	Blanks
67	409-414	I6	---	---	Blanks
68	415-420	I6	---	---	Blanks
69	421-426	I6	OPS	---	Number of facility data records (0)
70	427-432	I6	OPS	---	Record length (0)
71	433-720	A288	COMM	---	Comments from Q/A operator

SAR Leader File:
Data Set Summary Record

The Data Set Summary Record is defined as follows:

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Record Sequence Number (2)
2	5	BI	OPS	---	1st record subtype code (10)
3	6	BI	OPS	---	Record type code (10)
4	7	BI	OPS	---	2nd record subtype code (50)
5	8	BI	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record = 2016 (2014 + 2 for word boundary padding)
7	13-16	I4	OPS	---	Data set Summary Record sequence number (1)
8	17-20	I4	PF/OPS	ppolarization pfrequency	SAR channel indicator(XVV: 00, LHH: 11, LHV: 12, LVV: 13, LVH: 14, Lquad: 15, LHH&LHV: 16, LVV&LVH: 17, LHH&LVV: 18, CHH: 21, CHV: 22, CVV: 23, CVH: 24, Cquad: 25, CHH&CHV: 26, CVV&CVH: 27, CHH&CVV: 28)
					SCENE PARAMETERS
9	21-36	A16	PF	psite_id	Site identifier (3-letter ID)
10	37-68	A32	PF	psite_name	Site name (English name)
11	69-100	A32	PF/OPS	pmet_image_start pgmt_0met pimage_duration	Scene GMT center time (YYYY/MM/DD hh:mm:ss.tti) where: YYYY = year MM = month DD = day hh = hours (00 to 23) mm = minutes (00 to 59) ss = seconds (00 to 59) tti = milliseconds (000 to 999)
12	101-116	A16	PF/OPS	pmet_image_start pimage_duration	Scene MET center time (DD hh:mm:ss.tti)
13	117-132	F16.7	PF	pcenter_lat	Processed scene center geodetic latitude defined as positive to the north of the equator and negative to the south (degrees)
14	133-148	F16.7	PF	pcenter_long	Processed scene center geodetic longitude defined as positive to the east of the prime meridian and negative to the west.(degrees)
15	149-164	F16.7	PF	ptrack_angle	Processed Scene Center true heading as calculated relative to true North (degrees): Track angle at scene center
16	165-180	A16	CONST	pearth_model	Ellipsoid designator
17	181-196	F16.7	CONST	pmajor_earth_radius	Ellipsoid semimajor axis (km)
18	197-212	F16.7	CONST	pminor_earth_radius	Ellipsoid semiminor axis (km)
19	213-228	F16.7	---		Gravitational parameter
20	229-244	A16	---		Spare
21	245-260	F16.7	---		Ellipsoid J2 parameter
22	261-276	F16.7	---		Ellipsoid J3 parameter
23	277-292	F16.7	---		Ellipsoid J4 parameter
24	293-308	F16.7	PF	pterrain_height	Average terrain height above Ellipsoid at scene center (meters)
25	309-324	F16.7	PF/OPS	pdigital_lines ptotal_rg_lines	Scene center line number (the line number at the scene center including zero fill)
26	325-340	F16.7	PF/OPS	pdigital_pixels ppric_samp	Scene center pixel number (the pixel number at the scene center including zero fill)

27	341-356	F16.7	PF	pimage_size	Processed scene length (km) including zero fill
28	357-372	F16.7	PF	pswath_width	Processed scene width (km) including zero fill
29	373-380	A8	---		Spare
30	381-388	A8	---		Spare
31	389-392	I4	PF/OPS	ppolarization	Number of SAR polarization channels
32	393-396	A4	---		Spare
33	397-412	A16	PF/OPS	pspacecraft_id	Sensor platform mission identifier (this field identifies the platform for the sensor that transmitted the SAR data: "STS-059$$$$$$$$" for SIR-C)
34	413-444	A32	PF/OPS	psar_system, pfrequency, ppulse_bandwidth, pradar_mode, ppolarization	Sensor ID: and mode of operation for this channel: (this field specifies the sensor and its mode of operation in the form of: <AAAAAA-BB-CCDD-EEFF$$$$$$$$$$$$$>, where: AAAAAA= six character sensor ID (SIR-C, X-SAR) BB = SAR band (X$, L$, C$) CC = code for resolution mode (HIgh = 20 MHz, LOw = 10 MHz) ~~DD = SIR-C data acquisition mode ID (eg: mode 0 to 23)~~ unreliable. EE = transmit polarization (H$, V$, or HV) FF = receive polarization (H$, V$, or HV)
35	445-452	A8	PF	pdatatake_id	Data take ID
36	453-460	F8.3	PF	pnadir_lat_scene_ctr	Sensor Platform geodetic Latitude at nadir corresponding to Scene Center (degrees)
37	461-468	F8.3	PF	pnadir_long_scene_ctr	Sensor Platform geodetic Longitude at nadir corresponding to Scene Center (degrees)
38	469-476	F8.3	PF	pnadir_trk_ang_scene_ctr	Sensor Platform Heading at nadir corresponding to Scene Center (degrees)
39	477-484	F8.3	PF/OPS	pleft_right_looking	Left/Right looking flag (Left Looking: -90, Right Looking: +90)
40	485-492	F8.3	PF	pincidence_angle	Incidence angle at scene center as derived from sensor platform orientation, electronic boresight and Earth geometry (degrees)
41	493-500	F8.3	PF/OPS	pcarrier_freq	Radar Frequency (GHz)
42	501-516	F16.7	PF	pwavelength	Radar wavelength (meters)
43	517-518	A2	OPS	---	Motion compensation indicator 00 = no compensation
44	519-534	A16	PF/OPS	pchirp_type	Range pulse code specifier ("DIGITALSCHIRP")
45	535-550	F16.7	---	---	Range pulse amplitude coefficient #1 (Chirp =range chirp constant term (offset from DC))
46	551-566	F16.7	---	---	Range pulse amplitude coefficient #2 (Chirp =range chirp linear term)
47	567-582	F16.7	---	---	Range pulse amplitude coefficient #3 (quadratic term)
48	583-598	F16.7	---	---	Range pulse amplitude coefficient #4 (cubic term)
49	599-614	F16.7	---	---	Range pulse amplitude coefficient #5 (quartic term)
50	615-630	F16.7	---	---	Range pulse phase coefficient #1 (offset in radians)
51	631-646	F16.7	PF	prg_chirp_start_freq	Range chirp start frequency (MHz)
52	647-662	F16.7	PF	prg_chirp_rate	Range chirp rate (MHz/µsec)
53	663-678	F16.7	---	---	Range pulse phase coefficient #4 (cubic term)
54	679-694	F16.7	---	---	Range pulse phase coefficient #5 (quadratic term)
55	695-702	I8	---	---	Down linked data chirp extraction index (in samples)
56	703-710	A8	---	---	Spare
57	711-726	F16.7	PF	pcmplx_samp_rate	Range complex sampling rate (MHz)
58	727-742	F16.7	PF	pecho_delay_time	Range gate at near edge at the start of the image (one-way echo delay time)(µsec)
59	743-758	F16.7	PF	ppulse_duration	Range pulse length (µsec)
60	759-762	A4	OPS	---	Base band conversion flag (YES$)
61	763-766	A4	PF/OPS	pdata_product	Range compressed flag (YES$/NO$$) (NO for reformatted signal data, YES = for all others)

62	767-782	F16.7	PF/OPS	phh_receiver_gain, pvv_receiver_gain, ppolarization	Receiver gain for like polarized at early edge at the start of the image (dB)
63	783-798	F16.7	PF/OPS	phv_receiver_gain, pvh_receiver_gain, ppolarization	Receiver gain for cross polarized at early edge at the start of the image(dB)
64	799-806	I8	PF	pbits_per_sample	Quantization in bits per channel (4-bit: 4, 8-bit: 8, BFPQ: 8)
65	807-818	A12	PF/OPS	pquantization	Quantizer descriptor (BFPQ: "(8,4)BFPQ$$$", if 4-bit or 8-bit "UNIFORM$$$$$")
66	819-834	F16.7	---	---	DC Bias for I-component
67	835-850	F16.7	---	---	DC Bias for Q-component
68	851-866	F16.7	---	---	Gain imbalance for I & Q
69	867-882	F16.7	---	---	Spare
70	883-898	F16.7	---	---	Spare
71	899-914	F16.7	PF	plook_angle	Antenna electronic boresight relative to platform vertical axis at the scene center (degrees) (positive to the right; negative to the left)
72	915-930	F16.7	PF	pmech_ant_boresight	Antenna mechanical boresight relative to platform vertical axis at the start of the image, positive to the right, negative to the left (degrees)
73	931-934	A4	PF/OPS	pmtil_line	Echo tracker-on/off designator ("ON$$" or "OFF$")
74	935-950	F16.7	PF	pprfc	Nominal PRF (Hz)
75	951-966	F16.7	PF	prange_beamwidth	Effective two-way antenna elevation 6 dB beam width at boresight (degrees)
76	967-982	F16.7	PF	paz_beamwidth	Effective two-way antenna azimuth 6 dB beam width at electronic boresight (degrees)
				SENSOR SPECIFIC PARAMETERS	
77	983-998	I16	---	---	(Satellite encoded binary time code)
78	999-1030	A32	---	---	(Satellite clock time, (YYYYMMDDhhmmssut$$$...)
79	1031-1038	I8	---	---	Satellite clock increment (nano-secs))
80	1039-1046	A8	---	---	Spare
				GENERAL PROCESSING PARAMETERS	
81	1047-1062	A16	OPS	---	Processing facility identifier ("JPL$$$$$$$$$$$$")
82	1063-1070	A8	PF	phw_version	Processing system identifier (hardware configuration)
83	1071-1078	A8	PF	psw_version	Processing version identifier (software version)
84	1079-1094	A16	---	---	Processing facility process code
85	1095-1110	A16	PF/OPS	pdata_product	Product level code (Reformatted Signal Data: "0.0$$$...",, SLC: "1.0$$$...", MLD, MLC: "1.5$$$...", Geocoded data products: "1.7$$$...",)
86	1111-1142	A32	PF/OPS	pdata_product	Product type specifier ("MULTI-LOOK$DETECTED$$$...", "MULTI-LOOK$COMPLEX$$$...", "SINGLE-LOOK$COMPLEX$$$...", or "REFORMATTED$SIGNAL$DATA$$$...")
87	1143-1174	A32	PF/OPS	pdata_product	Processing algorithm identifier (MLD, MLC, SLC:"FREQUENCY$DOMAIN$CONVOLUTION", RSD: "NONE")
88	1175-1190	F16.7	PF	pnum_looks	Total number of looks
89	1191-1206	F16.7	---	---	Nominal effective number of Range looks
90	1207-1222	F16.7	---	---	Bandwidth per look in Azimuth (Hz)
91	1223-1238	F16.7	---	---	Bandwidth per look in Range (Hz)
92	1239-1254	F16.7	PF	ppbw	Total processor bandwidth in Azimuth (Hz)
93	1255-1270	F16.7	PF	ppulse_bandwidth	Total processor bandwidth in Range (MHz)
94	1271-1302	A32	PF/OPS	paz_data_weighting	Weighting function designator in Azimuth (if weighting flag is on: "COS$SQUARE$PLUS$n.nn$PEDESTAL$HT", else: "NONE$$$..."
95	1303-1334	A32	PF/OPS	prg_data_weighting	Weighting function designator in Range (if weighting flag is on: COS$SQUARE$PLUS$n.nn$PEDESTAL$HT", else: "NONE$$$..."
96	1335-1350	A16	PF	phddc_id	HDDC identifier
97	1351-1366	F16.7	PF	ML : ppost_rg_res	

				SLC: ppre_rg_res RDC: none	Nominal resolution equal to 3dB points in ground range (m)
98	1367-1382	F16.7	PF	ML : ppost_az_res SLC: ppre_az_res RDC: none	Nominal resolution equal to 3dB in Azimuth (m)
99	1383-1398	F16.7	PF	pnoise_gain	Processor gain for noise data
100	1399-1414	F16.7	OPS	---	Linear radiometric conversion factor (1)
101	1415-1430	F16.7	---	---	Along track Doppler frequency constant term at early edge of image (Hz)
102	1431-1446	F16.7	---	---	Along track Doppler frequency linear term relative to early edge of the image (Hz/pixel)
103	1447-1462	F16.7	---	---	Along track Doppler frequency quadratic term relative to early edge of the image (Hz/pixel/pixel)
104	1463-1478	A16	---	---	Spare
105	1479-1494	F16.7	---	---	Cross track Doppler frequency constant term at near edge of the image (Hz)
106	1495-1510	F16.7	---	---	Cross track Doppler frequency linear term relative to near edge of the image (Hz/pixel)
107	1511-1526	F16.7	---	---	Cross track Doppler frequency quadratic term relative to near edge of the image (Hz/pixel/pixel)
108	1527-1534	A8	OPS	---	Time direction indicator along pixel direction ("INCREASE"-ing)
109	1535-1542	A8	OPS	---	Time direction indicator along line direction ("INCREASE"-ing)
110	1543-1558	F16.7	---	---	Along track Doppler frequency rate constant term at early edge of the image (Hz/sec)
111	1559-1574	F16.7	---	---	Along track Doppler frequency rate linear term relative to early edge of the image (Hz/sec/pixel)
112	1575-1590	F16.7	---	---	Along track Doppler frequency rate quadratic term relative to early edge of the image (Hz/sec/pixel/pixel)
113	1591-1606	A16	---	---	Spare
114	1607-1622	F16.7	---	---	Cross track Doppler frequency rate constant term at near edge of the image (Hz/sec)
115	1623-1638	F16.7	---	---	Cross track Doppler frequency rate linear term relative to near edge of the image (Hz/sec/pixel)
116	1639-1654	F16.7	---	---	Cross track Doppler frequency rate quadratic term relative to near edge of the image (Hz/sec/pixel/pixel)
117	1655-1670	F16.7	PF	phh_delay	HH channel electronic delay time (RSD product only) (micro seconds)
118	1671-1678	A8	OPS	---	Line content indicator ("RANGE$$$")
119	1679-1682	A4	PF/OPS	pdata_product	Clutter lock applied flag (MLD, MLC, SLC: "YES$", RSD: "NONE")
120	1683-1686	A4	PF/OPS	pdata_product	Autofocussing applied flag (MLD, MLC, SLC: "YES$", RSD: "NONE")
121	1687-1702	F16.7	PF	paz_spacing	Line spacing (m)
122	1703-1718	F16.7	PF	prg_spacing	Pixel spacing (m)
123	1719-1734	A16	PF/OPS	pchirp_type	Processor range compression designator("DIGITAL$CHIRP", "ANALYTIC$CHIRP", or "MEASURED$CHIRP")
124	1735-1750	A16	PF/OPS	ptrack_angle	Orbit direction at image center ("ASCENDING$$$$$$$" OR "DESCENDING$$$$$$")
125	1751-1766	A16	---	---	Spare
				SENSOR SPECIFIC LOCAL USE SEGMENT	
126	1767-1886	A120	---	---	Spares
				PROCESSOR SPECIFIC LOCAL USE SEGMENT	
127	1887-2006	A120	---	---	Spares
				IMAGE ANNOTATION FIELDS	
128	2007-2014	I8	OPS	---	Number of Annotation Points (0)
129	2015-2016	A2	---	---	Spare

SAR Leader File:
Map Projection Data Record

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (3)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (20)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (1604)
7	13-28	A16	---	---	Spare
8	29-60	A32	PF/OPS	pdata_product	Map projection descriptor (MLD, MLC: "GROUND$RANGE$$$...", SLC, RSD: "SLANT$RANGE$$$...")
9	61-76	I16	PF	pdigital_pixels pprfc_samp	Number of pixels per line of image
10	77-92	I16	PF	pdigital_lines ptotal_rg_lines	Number of lines
11	93-108	F16.7	PF	prg_spacing	Nominal inter-pixel distance in output scene (meters)
12	109-124	F16.7	PF	paz_spacing	Nominal inter-line distance in output scene (meters)
13	125-140	F16.7	---	---	Orientation at output scene center, for geocoded products this is simply the convergence of the meridians, ie. the angle between geographic north and map grid north (degrees) (Angle of projection axis from true North)
14	141-156	F16.7	---	---	Actual platform orbital inclination (degrees)
15	157-172	F16.7	---	---	Actual ascending node (longitude at equator) (degrees)
16	173-188	F16.7	PF	pdistance_scene_ctr	Distance of platform at input scene center from the geocenter (km)
17	189-204	F16.7	PF	paltitude_geodetic	Geodedic altitude of the platform relative to the ellipsoid (km)
18	205-220	F16.7	PF	pnadir_spd_scene_ctr	Actual ground speed at nadir at input scene center time (km/sec)
19	221-236	F16.7	PF	pnadir_trk_ang_scene_ctr	Platform heading (degrees): effective subplatform track direction angle relative to true north, including the effects of orbital inclination and skew due to earth rotation.
				PROJECTION ELLIPSOID PARAMETERS	
20	237-268	A32	CONST	pearth_model	Name of reference ellipsoid (GEM 10B)
21	269-284	F16.7	CONST	pmajor_earth_radius	Semimajor axis of ref. ellipsoid (km)
22	285-300	F16.7	CONST	pminor_earth_radius	Semiminor axis of ref. ellipsoid (km)
23	301-316	F16.7	---	---	Datum shift parameter referenced to Greenwich, dx (meters)
24	317-332	F16.7	---	---	Datum shift parameter perpendicular to Greenwich, dy (meters)
25	333-348	F16.7	---	---	Datum shift parameter direction of the rotation axis, dz (meters)
26	349-364	F16.7	---	---	Additional datum shift parameter 1st rotation angle
27	365-380	F16.7	---	---	Additional datum shift parameter 2nd rotation angle
28	381-396	F16.7	---	---	Additional datum shift parameter 3rd rotation angle
29	397-412	F16.7	---	---	Scale factor of reference ellipsoid
				MAP PROJECTION DESIGNATOR	
30	413-444	A32	---	---	Alphanumeric description of map projection
				UTM-PROJECTION (1ST DEFAULT)	
31	445-476	A32	---	---	UTM descriptor
32	477-480	A4	---	---	Signature of the UTM zone
33	481-496	F16.7	---	---	Map origin (false easting)
34	497-512	F16.7	---	---	Map origin (false northing)
35	513-528	F16.7	---	---	Center of projection longitude (degrees)

36	529-544	F16.7	---	---	r of projection latitude (degrees)
37	545-560	F16.7	---	---	1st standard parallel (degrees)
38	561-576	F16.7	---	---	2nd standard parallel (degrees)
39	577-592	F16.7	---	---	Scale factor
				UPS-PROJECTION (2ND DEFAULT)	
40	593-624	A32	---	---	UPS descriptor
41	625-640	F16.7	---	---	Center of projection longitude (degrees)
42	641-656	F16.7	---	---	Center of projection latitude (degrees)
43	657-672	F16.7	---	---	Scale factor
				NATIONAL SYSTEMS PROJECTION (any others)	
44	673-704	A32	---	---	Projection descriptor
45	705-720	F16.7	---	---	Map origin (false easting)
46	721-736	F16.7	---	---	Map origin (false northing)
47	737-752	F16.7	---	---	Center of projection longitude (degrees)
48	753-768	F16.7	---	---	Center of projection latitude (degrees)
49	769-784	F16.7	---	---	Standard parallels (deg, default: -9999.99)
50	785-800	F16.7	---	---	Standard parallels (deg, default: -9999.99)
51	801-816	F16.7	---	---	Standard parallels (deg, default: -9999.99)
52	817-832	F16.7	---	---	Standard parallels (deg, default: -9999.99)
53	833-848	F16.7	---	---	Central meridian (deg, default: -9999.99)
54	849-864	F16.7	---	---	Central meridian (deg, default: -9999.99)
55	865-880	F16.7	---	---	Central meridian (deg, default: -9999.99)
56	881-896	A16	---	---	Spares
57	897-912	A16	---	---	Spares
58	913-928	A16	---	---	Spares
59	929-944	A16	---	---	Spares
				COORDINATES OF FOUR CORNER POINTS	
60	945-960	F16.7	---	---	Top left corner northing (meters)
61	961-976	F16.7	---	---	Top left corner easting (meters)
62	977-992	F16.7	---	---	Top right corner northing (meters)
63	993-1008	F16.7	---	---	Top right corner easting (meters)
64	1009-1024	F16.7	---	---	Bottom right corner northing (meters)
65	1025-1040	F16.7	---	---	Bottom right corner easting (meters)
66	1041-1056	F16.7	---	---	Bottom left corner northing (meters)
67	1057-1072	F16.7	---	---	Bottom left corner easting (meters)
68	1073-1088	F16.7	PF	pnear_early_lat	Near range early time latitude (degrees)
69	1089-1104	F16.7	PF	pnear_early_long	Near range early time longitude (degrees)
70	1105-1120	F16.7	PF	pfar_early_lat	Far range early time latitude (degrees)
71	1121-1136	F16.7	PF	pfar_early_long	Far range early time longitude (degrees)
72	1137-1152	F16.7	PF	pfar_late_lat	Far range late time latitude (degrees)
73	1153-1168	F16.7	PF	pfar_late_long	Far range late time longitude (degrees)
74	1169-1184	F16.7	PF	pnear_late_lat	Near range late time latitude (degrees)
75	1185-1200	F16.7	PF	pnear_late_long	Near range late time longitude (degrees)
76	1201-1216	F16.7	---	---	Top left corner terrain height relative to ellipsoid (meters)
77	1217-1232	F16.7	---	---	Top right corner terrain height (meters)
78	1233-1248	F16.7	---	---	Bottom right corner height (meters)
79	1249-1264	F16.7	---	---	Bottom left corner height (meters)
				COEFFS. FOR IMAGE TO MAP TO IMAGE CONVERSION	

80-87	1265-1424	8E20.10	---	---	Eight coefficients (A11, A12,...,A24) to convert a line (L) and pixel (P) position to the map projection frame of reference, say (E,N) where:
				---	E = A11 + A12+ A13 + A14TL
				---	N = A21 + A22 + A23 + A24nP
88-95	1425-1584	8E20.10	---	---	Eight coefficients (B11, B12,...,B24) to convert from the map projection (E,N) to line (I) and pixel (P) position in the image, say (L,P) where:
				---	L = B11 + B12 + B13 + B144ETN
				---	P = B21 + B22TE + B23TN
96	1585-1620	A36	---	---	Spares

The format of the record is defined below. (One record with a variable number of data sets.)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (4)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (30)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-44	A32	---	---	Orbital elements designator
8	45-60	F16.7	---	---	1st orbital element
9	61-76	F16.7	---	---	2nd orbital element
10	77-92	F16.7	---	---	3rd orbital element
11	93-108	F16.7	---	---	4th orbital element
12	109-124	F16.7	---	---	5th orbital element
13	125-140	F16.7	---	---	6th orbital element
14	141-144	I4	EPH/OPS	---	Number of data sets
15	145-148	I4	EPH/OPS	---	Year of data point (YYYY) for first point
16	149-152	I4	EPH/OPS	---	Month of data point (MM) for first point
17	153-156	I4	EPH/OPS	---	Day of data point (DD) for first point
18	157-160	I4	EPH/OPS	---	Days of the year (GMT) for first point
19	161-182	D22.15	EPH/OPS	---	Seconds of day (GMT) for first point
20	183-204	D22.15	EPH/OPS	---	Time interval between data sets (data points) (sec)
21	205-268	A64	PF/OPS	pcoordinate_state	Reference coordinate system for state vector and attitude vector ("GREENWHICH$TRUE$OF$DATE")
22	269-290	D22.15	CONST	paries_hour_angle	Angle between +x-axis of coordinate system and the Prime Meridian (degrees)
23	291-306	F16.7	---	---	Along track position error (meters)
24	307-322	F16.7	---	---	Across track position error (meters)
25	323-338	F16.7	---	---	Radial position error (meters/sec)
26	339-354	F16.7	---	---	Along track velocity error (meters/sec)
27	355-370	F16.7	---	---	Across track velocity error (meters/sec)
28	371-386	F16.7	---	---	Radial velocity error (meters/sec)
29	387-388	A2	---	---	Spare
					PLATFORM POSITION DATA SET
30	389-454	3D22.15	EPH	---	1st data point (X,Y,Z) position vector (km)
31	455-520	3D22.15	EPH	---	1st data point (X,Y,Z) velocity vector (km/sec)

Repeat fields 29-30 for each record in the ephemeris file.

SAR Leader File:
Attitude Data Record

The Attitude Data Record is defined as follows. (One record with a variable number of data sets.)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (5)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (40)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-16	I4	OPS	---	Number of attitude data points
					ATTITUDE DATA SET
8	17-20	I4	EPH	---	Days of the year (GMT)
9	21-28	I8	EPH	---	Millisecond of day (GMT)
10	29-32	I4	---	---	Pitch data quality flag
11	33-36	I4	---	---	Roll data quality flag
12	37-40	I4	---	---	Yaw data quality flag
13	41-56	F16.7	EPH	---	Pitch from PATH tape(degrees)
14	57-72	F16.7	EPH	---	Roll angle from PATH tape (degrees)
15	73-88	F16.7	EPH	---	Yaw from PATH tape (degrees)
16	89-92	I4	---	---	Pitch rate data quality flag
17	93-96	I4	---	---	Roll rate data quality flag
18	97-100	I4	---	---	Yaw rate data quality flag
19	101-116	F16.7	---	---	Pitch rate (degrees/sec)
20	117-132	F16.7	---	---	Roll rate (degrees/sec)
21	133-148	F16.7	---	---	Yaw rate (degrees/sec)

Repeat fields 8-21 for each record in the roll angle file.

The radiometric data record is defined below. (One record per polarization channel. For SIR-C implementation, one data set per record.)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (6)
2	5	B1	OPS	---	Record subtype code (10)
3	6	B1	OPS	---	Record type code (50)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (136)
7	13-16	I4	OPS	---	Radiometric data record sequence number (1, 2, ...)
8	17-20	I4	OPS	---	Number of radiometric data sets in the record (1)
					RADIOMETRIC DATA SET
9	21-28	I8	OPS	---	Radiometric data set size in bytes
10	29-32	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator ("XVV$","LHH$", "LHV$", "LVV$", "LVH$", "CHH$", "CHV$", "CVV$", "CVH$")
11	33-36	A4	---	---	Spare
12	37-60	A24	CAL_QA	qcal_date	Date of nearest calibration update (yymmdd)
13	61-68	I8	OPS	---	Number of samples in the look up table (0)
14	69-84	A16	PF/OPS	pdata_product	Sample type designator (MLD, MLC: "CROSS$PRODUCTS"; SLC: "SCATTERING$MATRIX"; RSD: "NONE")
					Calibration Equation: $\langle I \rangle = K \cdot \sigma^0 + K_N(R) \cdot \langle N \rangle$ where <I> : expectation value of image pixel power; K : absolute calibration constant; $K_N(R)$: noise gain of processor as a function of range R; <N> : raw data noise power per sample
15	85-100	F16.7	PF	phh_noise_power phv_noise_power pvv_noise_power pvh_noise_power	Raw data noise power estimate (<N>) (data number units)
16	101-116	F16.7	OPS	---	Linear conversion factor (backscatter coefficient to image power conversion factor) (K) (1)
17	117-132	F16.7	PF	pnoise_gain	Processor gain for noise data before radiometric correction is applied. ($K_{N,0}$)
18	133-136	A4	---	---	Spare

The CEOS file definition for the Radiometric Data Record includes a variable length look up table following field 18. Since the SIR-C implementation does not include the look up table, there is only one data set in each Radiometric Data Record and each record is of fixed length.

SAR Leader File:
Radiometric Compensation Record

The radiometric compensation record is defined as follows: (One record per polarization channel)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (7)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (51)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-16	I4	OPS	---	Radiometric compensation record sequence number (1)
8	17-20	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator("XVV$", "LHH$", "LHV$", "LVV$", "LVH$", "CHH$", "CHV$, "CVV$", "CVH$")
9	21-28	I8	OPS	---	Number of radiometric compensation data sets in the record (1)
10	29-36	I8	OPS	---	Compensation data set size (in bytes)
					RADIOMETRIC COMPENSATION DATA SET
11	37-44	A8	OPS	---	Compensation data type designator ("RANGE")
12	45-76	A32	OPS	---	Compensation data descriptor (processed image: "rg radiometric correction vector", raw data: "elevation antenna pattern")
13	77-80	I4	OPS	---	Number of compensation records required to compensate table (1)
14	81-84	I4	OPS	---	Sequence number in the full compensation table of the table contained in this record (1)
15	85-92	I8	---	---	Total number of compensation pairs in the full compensation table
16	93-100	I8	OPS	---	Slant range sample index corresponding to first correction value in compensation table (1)
17	101-108	I8	PF	pradio_comp_length	Slant range sample index corresponding to last correction value in compensation table
18	109-116	I8	OPS	---	Compensation pixel group size (m pixels). This is the number of pixels for which each of the compensation samples is applicable (1)
19	117-132	F16.7	OPS	---	Min. sample index (1)
20	133-148	F16.7	RCF/OPS	---	Min. radiometric compensation value (dB)
21	149-164	F16.7	PF	pradio_comp_length	Max. sample index
22	165-180	F16.7	RCF/OPS	---	Max. radiometric compensation value (dB)
23	181-196	A16	---	---	Spare
24	197-204	I8	PF	pradio_comp_length	Number of compensation table entries (n)
					RADIOMETRIC COMPENSATION TABLE
25	205-220	F16.7	OPS	---	1st compensation sample index (increment by 1)
26	221-236	F16.7	RCF	---	1st compensation sample value (linear scale)

Repeat fields 25-26 for each sample value in the Radiometric Compensation File.
Repeat fields 11-26+ for each data set. (SIR-C has only one data set per record.)

SAR Leader File:
Data Quality Summary Record

The data quality summary record is defined as follows: (One record per polarization channel)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (8)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (60)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record = 464 (462 + 2 for word boundary padding)
7	13-16	I4	OPS	---	Data summary quality record sequence number
8	17-20	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator("XVV$", "LHH$", "LHV$", "LVV$", "LVH$", "CHH$", "CHV$", "CVV$", "CVH$")
9	21-26	A6	CAL_QA	qcal_date	Date of the nearest calibration update as YYMMDD, where: YY = last two digits of year MM = month of the year DD = day of the month
10	27-30	I4	OPS	---	Number of channels (1)
				ABSOLUTE RADIOMETRIC DATA QUALITY	
11	31-46	F16.7	CAL_QA/OPS	qaz_islr, qrng_islr	2-D Nominal Integrated Side Lobe Ratio (ISLR) (dB)
12	47-62	F16.7	CAL_QA/OPS	qaz_pslr, qrng_pslr	2-D Nominal Peak Side Lobe to main lobe Ratio (PSLR) (dB)
13	63-78	F16.7	CAL_QA	qaz_amb	Nominal azimuth ambiguity (dB)
14	79-94	F16.7	CAL_QA	qrng_amb	Nominal range ambiguity (dB)
15	95-110	F16.7	QA_PARM	qsnr_mean	Estimate of SNR (from range spectra) (dB)
16	111-126	F16.7	QA_PARM	qber_prfc	Bit Error Rate estimate (BER)
17	127-142	F16.7	CAL_QA	qrng_3dbres	Nominal slant range resolution (meters)
18	143-158	F16.7	CAL_QA	qaz_3dbres	Nominal azimuth resolution (meters)
19	159-174	F16.7	CAL_QA	qradio_res	Nominal radiometric resolution (dB)
20	175-190	F16.7	CAL_QA	qinst_dynrng	Instantaneous dynamic range (dB)
21	191-206	F16.7	CAL_QA	qabs_radio_unc	Nominal absolute radiometric calibration uncertainty of SAR frequency band indicated in field 8 (dB)
22	207-222	F16.7	---	---	Nominal absolute phase calibration uncertainty of SAR frequency band indicated in field 8 (deg)

				RELATIVE RADIOMETRIC DATA QUALITY	
23	223-238	F16.7	CAL_QA	qshort_rel_radio_unc	Nominal short-term relative radiometric calibration uncertainty of SAR polarization channel (field 8) versus HH channel on a multi-channel volume (dB)
24	239-254	F16.7	CAL_QA	qrel_phase_unc	Nominal relative phase calibration uncertainty of SAR polarization channel (field 8) versus HH channel on a multi-channel volume (deg)
25	255-270	F16.7	CAL_QA	qlong_rel_radio_unc	Nominal long-term relative radiometric calibration uncertainty of SAR polarization channel (field 8) versus HH channel on multi-channel volume (dB)
26	271-286	F16.7	CAL_QA	qshort_freq_radio_unc	Nominal short-term frequency-to-frequency radiometric calibration uncertainty (CHH/LHH) (dB)
27	287-302	F16.7	CAL_QA	qlong_freq_radio_unc	Nominal long-term frequency-to-frequency radiometric calibration uncertainty (CHH/LHH) (dB)
				ABSOLUTE GEOMETRIC DATA QUALITY	
28	303-318	F16.7	CAL_QA	qatrack_abs_loc_err	Nominal absolute location error along track (meters)
29	319-334	F16.7	CAL_QA	qxtrack_abs_loc_err	Nominal absolute location error cross track (meters)
30	335-350	F16.7	CAL_QA	qatrack_scale_err	Nominal geometric scale error in along track direction
31	351-366	F16.7	CAL_QA	qxtrack_scale_err	Nominal geometric scale error in cross track direction
32	367-382	F16.7	CAL_QA	qskew_err	Nominal geometric skew error
33	383-398	F16.7	CAL_QA	qorient_err	Scene orientation error (degrees)
				RELATIVE GEOMETRIC DATA QUALITY	
34	399-414	F16.7	CAL_QA	qatrack_polreg_err	Along track relative registration error of SAR polarization channel (field 8) versus the HH channel (meters)
35	415-430	F16.7	CAL_QA	qxtrack_polreg_err	Cross track relative registration error of polarization channel (field 8) versus the HH channels(meters)
36	431-446	F16.7	CAL_QA	qatrack_freqreg_err	Along track relative registration error between LHH and CHH (meters)
37	447-462	F16.7	CAL_QA	qxtrack_freqreg_err	Cross track relative registration error between LHH and CHH (meters)
38	463-464	A2	---	---	Spare

Histograms shall be generated for image and signal data files. One histogram record is generated per polarization. Two data sets are included in each record: one for raw data and one for image data. When working with a Reformatted Signal Data data product, no image histogram is provided.

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (9)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (70)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable, depends on whether image histogram data set is provided)
7	13-16	I4	OPS	---	Data histograms record sequence number
8	17-20	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator("XVV$", "LHH$", "LHV$", "LVV$", "LVH$", "CHH$", "CHV$", "CVV$", "CVH$")
9	21-28	I8	PF/OPS	pdata_product	Number of histogram table data sets in this record (2: one raw data histogram and one image data histogram, except RSD product)
10	29-36	I8	OPS	---	Histogram table data set size in bytes
				HISTOGRAM DATA SET	
11	37-68	A32	OPS	---	Histogram descriptor ("RAW$DATA$$$$$..."or "IMAGE$DATA$$$$$...")
12	69-72	I4	OPS	---	Number of histogram records needed to reconstitute the full histogram table (1)
13	73-76	I4	OPS	---	Sequence number in the full histogram table of the table contained in this record (1)
14	77-84	I8	QA_PARM/OPS	qraw_hist_size, qimg_hist_size	Histogram table size, in bytes
15	85-92	I8	PF	pprfc_samp, pdigital_pixels	Total number of samples/pixels per line
16	93-100	I8	PF	ptotal_rg_lines, pdigital_lines	Total number of image lines
17	101-108	I8	QA_PARM	qraw_samp_per_group, qimg_samp_per_group	Data samples/pixels per group in cross track
18	109-116	I8	QA_PARM	qraw_lines_per_group, qimg_lines_per_group	Data lines per group in along track
19	117-124	I8	QA_PARM	qraw_xtrack_num_groups, qimg_xtrack_num_groups	Number of groups cross track
20	125-132	I8	QA_PARM	qraw_atrack_num_groups, qimg_atrack_num_groups	Number of groups along track
				DATA STATISTICS	
21	132-148	F16.7	QA_PARM/OPS	qimg_hist_minval	Minimum sample value corresponding to first histogram table bin
22	149-164	F16.7	QA_PARM/OPS	pbits_per_sample, qimg_hist_maxval	Maximum sample value corresponding to last histogram table bin
23	165-180	F16.7	QA_PARM	qraw_hist_mean_global, qimg_hist_mean_global	Mean sample value
24	181-196	F16.7	QA_PARM	qraw_hist_sd_global, qimg_hist_sd_global	Standard deviation of sample value

25	197-212	F16.7	OPS	---	Sample value increment
				DATA HISTOGRAM STATISTICS	
26	213-228	F16.7	OPS	---	Minimum histogram table value
27	229-244	F16.7	OPS	---	Maximum histogram table value
28	245-260	F16.7	---	---	Mean histogram table value
29	261-276	F16.7	---	---	Standard deviation of histogram table
30	277-284	I8	QA_PARM	qraw_hist_size, qimg_hist_size	Number of bins
31	285-292	F16.7	QA_PLOT	qraw_hist_data qimg_hist_data	1st histogram table value
32	293-300	F16.7	QA_PLOT	qraw_hist_data qimg_hist_data	2nd histogram table value
33-n	2329-m	F16.7	QA_PLOT	qraw_hist_data qimg_hist_data	3rd to nth histogram table value

Repeat fields11-nnn for the second data set (unless working with a Reformatted Signal Data data product.)

The range spectra record is defined as follows: (One record per polarization channel)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (10)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (80)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-16	I4	OPS	---	Range spectra record sequence number (1, 2, ...)
8	17-20	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator("XVV$", "LHH$", "LHV$", "LVV$", "LVH$, "CHH$, "CHV$", "CVV$", "CVH$")
9	21-28	I8	OPS	---	Number of spectra table data sets in this record (1)
10	29-36	I8	OPS	---	Spectra table data set size in bytes
				RANGE SPECTRA DATA	
11	37-40	I4	OPS	---	Number of range spectra data records required to reconstitute the full spectra table (1)
12	41-44	I4	OPS	---	Sequence number in the full spectra table of the table contained in this record (1)
13	45-52	I8	PF	pprfc_sample	Total number of samples in range direction
14	53-60	I8	QA_PARM	qrngspec_offset	Number of samples offset from first sample in range line
15	61-68	I8	QA_PARM	qrngspec_num_lines	Number of range lines integrated for spectra
16	69-84	F16.7	QA_PLOT/OPS	pcmplx_samp_rate, qrngspec_num_bins	Center frequency of first spectra bin (MHz)
17	85-100	F16.7	QA_PLOT/OPS	pcmplx_samp_rate, qrngspec_num_bins	Center frequency of last spectra bin (MHz)
18	101-116	F16.7	QA_PLOT/OPS	qrngspec_data	Minimum spectral power (dB)
19	117-132	F16.7	QA_PLOT/OPS	qrngspec_data	Maximum spectral power (dB)
20	133-148	A16	---	---	Spare
21	149-164	A16	---	---	Spare
				SPECTRAL DATA TABLE VALUES	
22	165-172	I8	QA_PARM	qrngspec_num_bins	Number of frequency bins in table
23	173-188	F16.7	QA_PLOT	qrngspec_data	1st spectral data value (dB)
24	189-204	F16.7	QA_PLOT	qrngspec_data	2nd spectral data value (dB)
	...				
		F16.7	QA_PLOT	qrngspec_data	nth spectral data value (dB)

SAR Leader File:
Radar Parameter Update Data Record

(One DWP change record shared by all polarizations. One receiver gain change record per polarization channel.)

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (11)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (100)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-16	I4	OPS	---	Radar parameter record sequence number (1)
8	17-20	A4	---	---	Number of radar parameter update data sets in the record (one record for DWP and one record for Receiver Gain per polarization)
9	21-28	I8	OPS	---	Number of data sets
10	29-36	I8	OPS	---	Radar parameter update data set size (variable)
				RADAR PARAMETER UPDATE DATA SET	
11	37-56	A20	PF/DWP/RGF	pprfc, pgmt_0met, pmet_request,	GMT of Change ("YYYYMMDD hhmm:ss.tt")
12	57-60	A4	PF/OPS	pfrequency, ppolarization	SAR channel indicator ("LHH$", "LHV$", "LVV$", "LVH$", "CHH$", "CHV$", "CVV$", "CVH$")
13	61-68	I8	DWP/RGF	---	Radar data line number where this update takes effect
14	69-76	I8	OPS	---	Radar data sample number where this update takes effect (1)
15	77-108	A32	OPS	---	Parameter descriptor field, one of: "RECEIVER$GAIN$$$..." "DATA$WINDOW$POSITION$$$..."
16	109-124	F16.7	PF/DWP/RGF	pdwp_step	Parameter value, gain (dB), DWP (usec)

Repeat fields 11-16 for each record in the respective file.

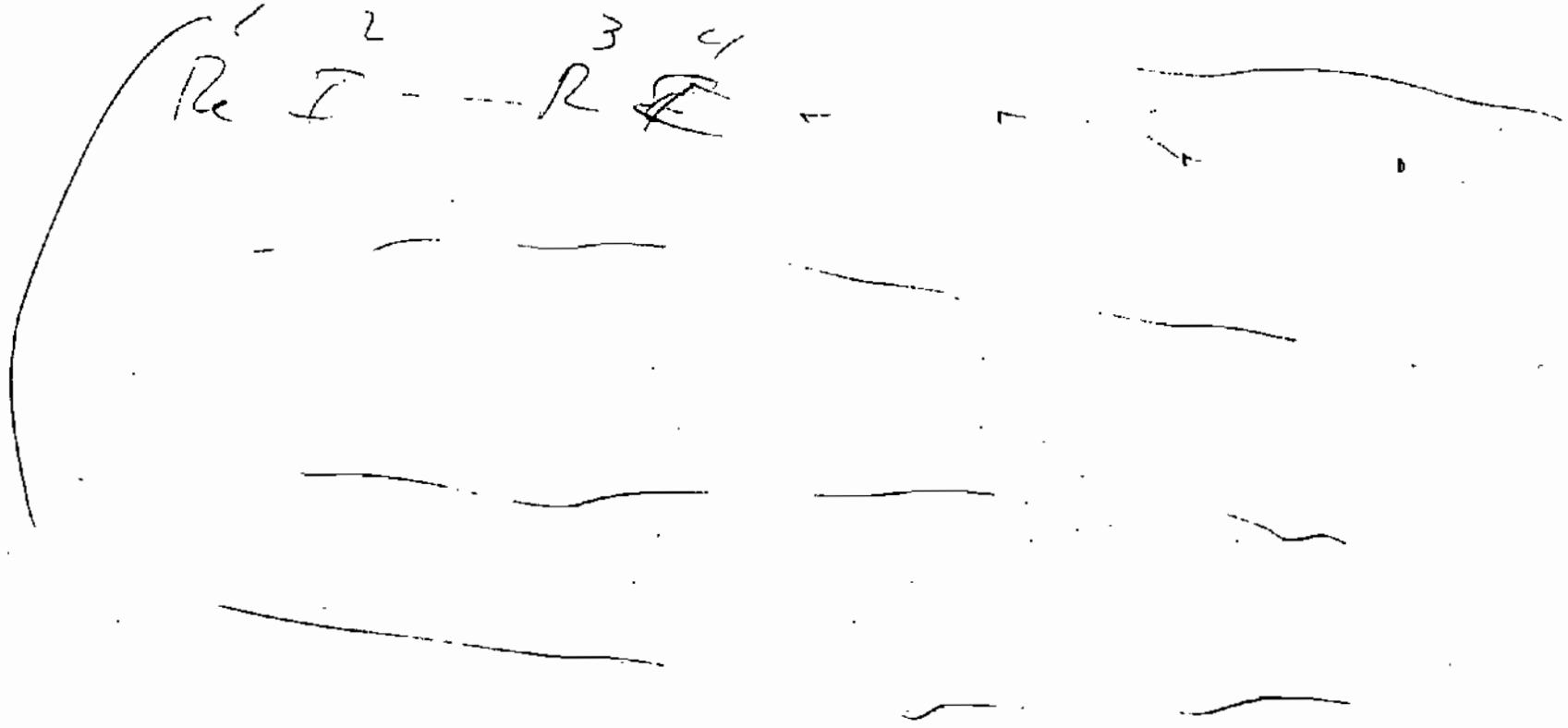
The detailed processing parameters record length, format, and data content are completely facility defined with the exception of the 12 byte preamble.

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (12)
2	5	BI	OPS	---	Ist record subtype code (10)
3	6	BI	OPS	---	Record type code (120)
4	7	BI	OPS	---	2nd record subtype code (50)
5	8	BI	OPS	---	3rd record subtype code (eg. CEOS=20, CCRS=36, ESA=50, NASA=60, NASA-JPL=61, NASDA=70, DFVLR=80, RAE=90, TELESPAZIO=100, UNSPECIFIED = 18, etc.)
6	9-12	B4	OPS	---	Length of this record = 1312 (includes word boundary padding)
7	13-16	I4	OPS	---	Detailed processing parameters record sequence number (1)
8	17-20	A4	---	---	Blanks
9	21-28	I8	QA_PARM	qnum_flywheels	Number of flywheels
10	29-108	10I8	QA_PARM	qmissing_line_chan1	Locations of missing line segments in Channel 1 (5 location pairs: start frame count, end frame count)
11	109	I1	QA_PARM	qexcess_line_chan1	Flag indicating more than 5 missing line segments in Channel 1
12	110-189	10I8	QA_PARM	qmissing_line_chan2	Locations of missing line segments in Channel 2 (5 location pairs: start frame count, end frame count)
13	190	I1	QA_PARM	qexcess_line_chan2	Flag indicating more than 5 missing line segments in Channel 2
14	191-270	10I8	QA_PARM	qmissing_line_chan3	Locations of missing line segments in Channel 3 (5 location pairs: start frame count, end frame count)
15	271	I1	QA_PARM	qexcess_line_chan3	Flag indicating more than 5 missing line segments in Channel 3
16	272-351	10I8	QA_PARM	qmissing_line_chan4	Locations of missing line segments in Channel 4 (5 location pairs: start frame count, end frame count)
17	352	I1	QA_PARM	qexcess_line_chan4	Flag indicating more than 5 missing line segments in Channel 4
18	353-368	F16.7	QA_PARM	qref_cal_gain	Reference caltone gain setting (dBmW) HH
19	369-384	F16.7	QA_PARM		HV
20	385-400	F16.7	QA_PARM		VV
21	401-416	F16.7	QA_PARM		VH
22	417-432	F16.7	QA_PARM	qcal_gain_mean	Mean of caltone gain estimates (dBmW) HH
23	433-448	F16.7	QA_PARM		HV
24	449-464	F16.7	QA_PARM		VV
25	465-480	F16.7	QA_PARM		VH
26	481-496	F16.7	QA_PARM	qcal_gain_sd	Standard deviation of caltone gain estimates (dBmW) HH
27	497-512	F16.7	QA_PARM		HV
28	513-528	F16.7	QA_PARM		VV
29	529-544	F16.7	QA_PARM		VH
30	545-560	F16.7	QA_PARM	qraw_hist_oversat_mean	Average percent of over saturation in raw data histogram HH
31	561-576	F16.7	QA_PARM		HV
32	577-592	F16.7	QA_PARM		VV
33	593-608	F16.7	QA_PARM		VH
34	609-624	F16.7	QA_PARM	qraw_hist_undersat_mean	Average percent of under saturation in raw data histogram HH
35	625-640	F16.7	QA_PARM		HV
36	641-656	F16.7	QA_PARM		VV
37	657-672	F16.7	QA_PARM		VH

38	673-680	I8	PF	pproc_run_num	Processing run number
39	681-688	A8	PF	pmission_id	Mission ID (flight number)
40	689	I1	PF	pbeam_spoiling_mode	Antenna beam spoiling mode (0-7)
41	690-713	A24	PF/OPS	pgmt_0met, pmet_image_start	GMT of image start (YYYY/MM/DD hh:mm:ss.ttt)
42	714-729	F16.7	PF	pgmt_0met, pmet_image_start	GMT of image start in seconds (.ccc)
43	730-745	F16.7	PF	pimage_duration	Image duration (s)
44	746-761	F16.7	PF	pnear_rg_slant_rg	Near slant range (km)
45	762-777	F16.7	PF	pearth_rad_ctr	Radius of the earth at image center (km)
46	778-793	F16.7	PF	pearth_rad_nadir	Radius of the earth at nadir (km)
47	794-801	I8	PF	pgmt_0met	GMT of 0 MET: year
48	802-809	I8	PF	pgmt_0met	GMT of 0 MET: days
49	810-817	I8	PF	pgmt_0met	GMT of 0 MET: hours
50	818-825	I8	PF	pgmt_0met	GMT of 0 MET: minutes
51	826-833	F8.3	PF	pgmt_0met	GMT of 0 MET: seconds (Units: ss.ccc)
52	834-849	F16.7	PF	ptime_drift	MET drift time (Units 10**-6)
53	850-865	F16.7	PF	pfd0_constant	Fd0 constant term (Hz)
54	866-881	F16.7	PF	pfd0_linear	Fd0 linear term (10**-3 Hz)
55	882-897	F16.7	PF	pfd0_quadratic	Fd0 quadratic term (10**-7 Hz)
56	898-913	F16.7	PF	pfd1_constant	Fd1 constant term (10**-3 Hz)
57	914-929	F16.7	PF	pfd1_linear	Fd1 linear term (10**-6 Hz)
58	930-945	F16.7	PF	pfd1_quadratic	Fd1 quadratic term (10**-10 Hz)
59	946-961	F16.7	PF	pfd2_constant	Fd2 constant term (10**-6 Hz)
60	962-977	F16.7	PF	pfd2_linear	Fd2 linear term (10**-9 Hz)
61	978-993	F16.7	PF	pfd2_quadratic	Fd2 quadratic term (10**-14 Hz)
62	994-1009	F16.7	PF	pfr0_constant	Fr0 constant term (Hz/sec)
63	1010-1025	F16.7	PF	pfr0_linear	Fr0 linear term (10**-3 Hz/sec)
64	1026-1041	F16.7	PF	pfr0_quadratic	Fr0 quadratic term (10**-7 Hz/sec)
65	1042-1057	F16.7	PF	pfr1_constant	Fr1 constant term (10**-3 Hz/sec)
66	1058-1073	F16.7	PF	pfr1_linear	Fr1 linear term (10**-6 Hz/sec)
67	1074-1089	F16.7	PF	pfr1_quadratic	Fr1 quadratic term (10**-10 Hz/sec)
68	1090-1105	F16.7	PF	pfr2_constant	Fr2 constant term (10**-7 Hz/sec)
69	1106-1121	F16.7	PF	pfr2_linear	Fr2 linear term (10**-10 Hz/sec)
70	1122-1137	F16.7	PF	pfr2_quadratic	Fr2 quadratic term (10**-14 Hz/sec)
71	1138-1148	A11	PF	pprocessing_date	Processing date (MM-DD-YYYY)
72	1149-1164	F16.7	PF	pavg_roll	Average roll angle estimates from null-line processing (deg)
73	1165-1180	F16.7	PF	pnear_incidence_angle	Near range incidence angle (deg)
74	1181-1196	F16.7	PF	pfar_incidence_angle	Far range incidence angle (deg)
75	1197-1212	I8	PF	paz_ref_length	Azimuth reference function length at mid-swath (samples)
76	1213-1220	F16.7	PF	psignal_gain	Signal processing gain
77	1221-1236	F16.7	PF	phh_caltone_phase	HH Caltone Phase Estimate (deg)
78	1237-1252	F16.7	PF	phv_caltone_phase	HV Caltone Phase Estimate (deg)
79	1253-1268	F16.7	PF	pvv_caltone_phase	VV Caltone Phase Estimate (deg)
80	1269-1284	F16.7	PF	pvh_caltone_phase	VH Caltone Phase Estimate (deg)
81	1285-1286	I2	PF	ppolarization	Internal SIR-C Polarization Index (0:HH, 1:HV, 2:VV, 3:VH, 4:QUADPOL, 5:HHHV, 6:VVVH, 7:HHVV, 8:HHVH, 9:VVHV, 10:HVVH)
82	1287-1294	I8	PF	psample_offset	Offset to first processing range sample
83	1295-1310	F16.7	PF	prange_str_angle	Range electronic steering angle
84	1311-1312	A2	---	---	Spare

This record stores the 4x4 polarimetric calibration matrix and the absolute calibration coefficient.. The functions include channel balancing, phase calibration, and cross-talk removal. Whenever the polarimetric calibration function has not been performed, as in the case of single pol data, the calibration matrix is the identity matrix.

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Sequence number (13)
2	5	B1	OPS	---	1st record subtype code (10)
3	6	B1	OPS	---	Record type code (130)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (772)
7	13-16	I4	OPS	---	Calibration record sequence number (1)
8	17-20	A4	---	---	Blanks
9	21-36	F16.7	PF	pabs_cal_coeff	Absolute calibration coefficient
10	37-52	F16.7	PF	pchannel_imbalance	Channel imbalance between HH and VV channels (dB)
11	53-68	F16.7	PF	pphase_error	Phase error between HH and VV channels (deg)
12	69-772	32D22.15	POLCAL	pcalibration_process	4x4 polarimetric calibration (complex) matrix



Imagery Options File:
File Descriptor Record -Fixed Segment Contents

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Record sequence number (1)
2	5	B1	OPS	---	1st record subtype code (63)
3	6	B1	OPS	---	Record type code (192)
4	7	B1	OPS	---	2nd record subtype code (18)
5	8	B1	OPS	---	3rd record subtype code (18)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-14	A2	OPS	---	ASCII flag ("A$")
8	15-16	A2	---	---	Blanks
9	17-28	A12	OPS	---	Control Document Number for this file ("CEOSSARCCT")
10	29-30	A2	OPS	---	Control Document revision number ("A$", then "B$",... and so on)
11	31-32	A2	OPS	---	File design descriptor revision number ("A$", then "B$",... and so on)
12	33-44	A12	PF	psw_version	Software ID (same as field 12 of the volume descriptor record)
13	45-48	I4	RDC	---	File number (2)
14	49-64	A16	OPS	---	File name
15	65-68	A4	OPS	---	Record sequence and location type flag (FSEQ)
16	69-76	I8	OPS	---	Sequence number location ($$$$$$$1)
17	77-80	I4	OPS	---	Sequence number field length ($$$4)
18	81-84	A4	OPS	---	Record code and location type flag (FTYP)
19	85-92	I8	OPS	---	Record code location ($$$$$$$5)
20	93-96	I4	OPS	---	Record code field length ($$$4)
21	97-100	A4	OPS	---	Record length and location type flag (FLGT)
22	101-108	I8	OPS	---	Record length location ($$$$$$$9)
23	109-112	I4	OPS	---	Record length field length ($$$4)
24-27	113-120	I8	PF	pheader_size	Number of bytes of header data at the beginning of each signal data file (RSD data product only)
28	121-180	A60	---	---	Reserved

The SAR Data File will contain either signal data or processed image data.

29	181-186	I6	PF/OPS	pdigital_lines ptotal_rg_lines	SAR DATA records count (number of lines in image/data file)
30	187-192	I6	PF	pdigital_pixels ppfrc_samp	SAR DATA record length in bytes (number of pixels/samples per line * number of bytes per pixel/sample)
31	193-216	A24	PF/OPS	ppolarization	Polarization strings (e.g. "HH HV VV VH")
				SAMPLE GROUP DATA	
32	217-220	I4	PF/OPS	pdata_product	Number of bits per sample/pixel RSD: 8 MLD: 16 MLC, SLC: blanks
33	221-224	I4	PF/OPS	pdata_product	Number pixels per data group MLD: 1 MLC: dual pol: 2, quad pol: 3 SLC: single pol: 1, dual pol: 2, quad pol: 4 RSD: 1
34	225-228	I4	PF/OPS	pbytes_per_pixel	Number of bytes per data group MLD: 2 MLC: dual pol: 5, quad pol: 10 SLC: single pol: 4, dual pol: 6, quad pol: 10 RSD: 1
35	229-232	A4	---	---	Justification and order of samples/pixels within data group (blank)
				SAR DATA	
36	233-236	I4	PF/OPS	ppolarization	Number of SAR polarization channels
37	237-244	I8	PF	pdigital_lines ptotal_rg_lines	Number of image/data lines per polarization channel
38	245-248	I4	OPS	---	Number of left border pixels per line (0)
39	249-256	I8	PF	pdigital_pixels ppfrc_samp	Total number of samples/pixels/data groups allocated per line per SAR channel
40	257-260	I4	OPS	---	Right border pixels per line (0)
41	261-264	I4	OPS	---	Number of top border scan lines (0)
42	265-268	I4	OPS	---	Number of bottom border scan lines (0)
43	269-272	A4	OPS	---	Interleaving indicator "BSQ$" ? TRASH

RECORD DATA

44	273-274	I2	OPS	---	Number of physical records per line (1)
45	275-276	I2	OPS	---	Number of physical records per multichannel line in this file (1)
46	277-280	I4	OPS	---	Length of prefix data per line (0)
47	281-288	I8	PF	pdigital_pixels pprfc_samp	Number of bytes of sample/image data per line (including fill) (same as 30 above)
48	289-292	I4	OPS	---	Length of suffix data per line (0)
49	293-296	A4	---	---	Prefix/suffix repeat flag

PREFIX/SUFFIX DATA LOCATORS

50	297-304	A8	---	---	Sample data line number locater
51	305-312	A8	---	---	SAR channel number locator
52	313-320	A8	---	---	Time of SAR data locator
53	321-328	A8	---	---	Left-filled count locater
54	329-336	A8	---	---	Right-filled count locater
55	337-340	A4	---	---	Pad pixels present indicator: "YES$" or "NO$$" (always "$$$$" for SAR data)
56	341-368	A28	---	---	Blanks
57	369-376	A8	---	---	SAR data line quality code locater
58	377-384	A8	---	---	Calibration information field locater
59	385-392	A8	---	---	Gain values field locater A8
60	393-400	A8	---	---	Bias values field locater A8

PIXEL DATA DESCRIPTION

61	401-428	A28	PF/OPS	pdata_product	SAR data format type identifier: MLD: "POWER DETECTED$$$$$$$$$$" MLC: "COMPRESSED CROSS-PRODUCTS$$$$" SLC: "COMPRESSED SCATTERING MATRIX" RSD: "REAL BYTE$$$$$$$$$$$$$$$$$$$$$$"
62	429-432	A4	---	---	SAR data format type code
63	433-436	I4	OPS	---	Number of left fill bits within pixel (0)
64	437-440	I4	OPS	---	Number of right fill bits within pixel (0)
65	441-448	I8	---	---	Maximum data range of pixel
64	449-n	A<N>	---	---	Blanks (Pad record with blanks such that this record is the same length as the Image Data Record (or Reformatted Signal Data Record))

Imagery Options File:
Reformatted Signal Data Records (RSD)

One record per polarization channel.

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Record sequence number (2, 3, 4...)
2	5	B1	OPS	---	1st record subtype code (50)
3	6	B1	OPS	---	Record type code (10)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-n	B2	One line of raw data		Real byte format

Imagery Options File:
Image Data Records

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	OPS	---	Record sequence number (2, 3, 4...)
2	5	B1	OPS	---	1st record subtype code (50)
3	6	B1	OPS	---	Record type code (11)
4	7	B1	OPS	---	2nd record subtype code (50)
5	8	B1	OPS	---	3rd record subtype code (20)
6	9-12	B4	OPS	---	Length of this record (variable)
7	13-n		One line of image		MLD: 2 bytes/pixel MLC: dual pol: 5, quad pol: 10 SLC: single pol: 4, dual pol: 6, quad pol: 10

deal with somehow

SAR Trailer File

The SAR Leader and SAR Trailer files serve the same purpose. Since the SIR-C implementation of CEOS puts all data in the Leader file; the Trailer file simply contains the File Descriptor Record.

Field	Bytes	Format	Source	Parameter	Description
			FIXED LENGTH RECORD SEGMENT		
1	1-4	B4	OPS	---	Record sequence number (1)
2	5	B1	OPS	---	1st rec.subtype code (63)
3	6	B1	OPS	---	Record type code (192)
4	7	B1	OPS	---	2nd rec.subtype code (18)
5	8	B1	OPS	---	3rd rec.subtype code (18)
6	9-12	B4	OPS	---	Record length (720)
7	13-14	A2	OPS	---	ASCII flag("A$")
8	15-16	A2	---	---	Blank
9	17-28	A12	OPS	---	Format control document ("CEOS-SAR-CCT")
10	29-30	A2	OPS	---	Format control document version ("A$")
11	31-32	A2	OPS	---	Record format rev.level ("A$")
12	33-44	A12	OPS	---	Software id
13	45-48	I4	RDC	---	File number (3)
14	49-64	A16	OPS	---	File name (same as field 10 of file pointer record)
15	65-68	A4	OPS	---	Record sequence and location type flag ("FSEQ")
16	69-76	I8	OPS	---	Sequence number location (1)
17	77-80	I4	OPS	---	Sequence number field length (4)
18	81-84	A4	OPS	---	Record code and location type flag ("FTYP")
19	85-92	I8	OPS	---	Record code location (5)
20	93-96	I4	OPS	---	Record code field length (4)
21	97-100	A4	OPS	---	Record length and location type flag ("FLGT")
22	101-108	I8	OPS	---	Record length location (9)
23	109-112	I4	OPS	---	Record length field length (4)
24	113	A1	---	---	Blank
25	114	A1	---	---	Blank
26	115	A1	---	---	Blank
28	117-180	A64	---	---	Blanks

29	181-186	I6	OPS	---	Number of data set summary records (0)
30	187-192	I6	OPS	---	Record length (0)
31	193-198	I6	OPS	---	Number of map projection data records (0)
32	199-204	I6	OPS	---	Record length (0)
33	205-210	I6	OPS	---	Number of platform position data records (0)
34	211-216	I6	OPS	---	Record length (0)
35	217-222	I6	OPS	---	Number of attitude data records (0)
36	223-228	I6	OPS	---	Record length (0)
37	229-234	I6	OPS	---	Number of radiometric data records (0)
38	235-240	I6	OPS	---	Record length (0)
39	241-246	I6	OPS	---	Number of radiometric compensation records (0)
40	247-252	I6	OPS	---	Record length (0)
41	253-258	I6	OPS	---	Number of data quality summary records (0)
42	259-264	I6	OPS	---	Record length (0)
43	265-270	I6	OPS	---	Number of data histogram records (0)
44	271-276	I6	OPS	---	Record length (0)
45	277-282	I6	OPS	---	Number of range spectra records (0)
46	283-288	I6	OPS	---	Record length (0)
47	289-294	I6	OPS	---	Number of digital elevation model descriptor records (0)
48	295-300	I6	OPS	---	Record length (0)
49	301-306	I6	OPS	---	Number of radar parameter update records (0)
50	307-312	I6	OPS	---	Record length (0)
51	313-318	I6	OPS	---	Number of annotation data records (0)
52	319-324	I6	OPS	---	Record length (0)
53	324-330	I6	OPS	---	Number of detailed processing records (0)
54	331-336	I6	OPS	---	Record length (0)
55	337-342	I6	OPS	---	Number of calibration data records (0)
56	343-348	I6	OPS	---	Record length (0)
57	349-354	I6	OPS	---	Number of ground control points descriptor records (0)
58	355-360	I6	OPS	---	Record length (0)
59	361-366	I6	---	---	Blanks
60	367-372	I6	---	---	Blanks
61	373-378	I6	---	---	Blanks
62	379-384	I6	---	---	Blanks
63	385-390	I6	---	---	Blanks
64	391-396	I6	---	---	Blanks
65	397-402	I6	---	---	Blanks
66	403-408	I6	---	---	Blanks
67	409-414	I6	---	---	Blanks
68	415-420	I6	---	---	Blanks
69	421-426	I6	OPS	---	Number of facility data records (0)
70	427-432	I6	OPS	---	Record length (0)
71	433-720	A288	---	---	Blanks

Null Volume Descriptor Record

Field	Bytes	Format	Source	Parameter	Description
1	1-4	B4	RDC	---	Record sequence number (1)
2	5	B1	RDC	---	1st record subtype code (192)
3	6	B1	RDC	---	Record type code (192)
4	7	B1	RDC	---	2nd record subtype code (63)
5	8	B1	RDC	---	3rd record subtype code (18)
6	9-12	B4	RDC	---	Record length (360)
7	13-14	A2	RDC	---	ASCII flag (A$)
8	15-16	A2	---	---	Blanks ($$)
9	17-28	A12	RDC	---	Format control doc (CEOS -SAR-CCT)
10	29-30	A2	RDC	---	Format control version (A$)
11	31-32	A2	RDC	---	Format control document version (A$)
12	33-44	A12	RDC	---	Software id
13	45-60	A16	RDC	---	Physical tape id
14	61-76	A16	RDC	---	Logical set id
15	77-92	A16	RDC	---	Volume set id
16	93-94	I2	RDC	---	Total number of physical volumes
17	95-96	I2	RDC	---	1st physical volume sequence number (1$)
18	97-98	I2	RDC	---	Last physical volume sequence number (1$)
19	99-100	I2	RDC	---	This physical volume sequence number (1$)
20	101-104	I4	RDC	---	1st reference file in volume ($$$$)
21	105-108	I4	RDC	---	Logical volume in set (2$$$)
22	109-112	I4	RDC	---	Logical volume number in physical volume (2$$$)
23	113-120	A8	—	---	Blanks
24	121-128	A8	---	---	Blanks
25	129-140	A12	---	---	Blanks
26	141-148	A8	---	---	Blanks
27	149-160	A12	---	---	Blanks
28	161-164	I4	---	---	Blanks
29	165-168	I4	---	---	Blanks
30	169-260	A92	---	---	Spare
31	261-360	A100	---	---	Spare

Extracted from JPL D-11427 rev 2.0, 6-94

Data Compression Formats

7. Miscellaneous Software

There are a few programs included here for relatively rare .specialized applications:

Cornerturn (transpose) any format data.

Convert compressed format data to floating point files, and floating point files to cmpressed files.

Convert dual pol SLC data to quad pol SLC data by either assuming that HV=VH and HH=VV, or that the HV=VH=HH-6dB (depending on mode).

Convert quad pol SLC data to dual pol SLC data by eliminating two polarizations.

All of these programs are included here for testing purposes only. In the future, a software package will be released that includes these and other funtions.

8. Data Compression Formats

For SIR-C there are three possible data formats:

1) compressed cross-products data (MLC) (Multilook data)
   quad-pol, 10 bytes per pixel
   dual-pol 5 bytes per pixel

2) compressed detected data (MLD) (Multilook data)
   single-pol, 2 bytes per pixel

3) compressed scattering matrix data (SLC) (Singlelook data)
   quad-pol, 10 bytes per pixel
   dual-pol, 6 bytes per pixel
   single-pol, 4 bytes per pixel

In the following descriptions:

sign( ) will return the sign of the argument ($\pm$ 1)

nint( ) will indicate that the nearest integer value is calculated of its argument.

int( ) will indicate that the truncation of the floating point value to integer is calculated of its argument, and that, if the floating point value is less than zero, subtraction by 1.0 is additionally required. Note that this is <u>not</u> the same as FORTRAN int( ).

SIR-C

8.1 Single Look Complex data

There are three data products for complex scattering matrix data, depending of polarization mode.

SIR-C "SLC" quad-pol data - 10 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will not have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be single look complex scattering matrix data. This is the only format that is supported by the SIR-C calibration processor during phase 1. There is no symmetrization of the data. There is no general scale factor.

° 10 bytes per pixel - quad-pol data, with:

° Byte(1) : $\mathrm{int}\{\log_2 (S_{HH}S_{HH}^* + S_{HV}S_{HV}^* + S_{VH}S_{VH}^* + S_{VV}S_{VV}^*)\}$

° Byte(2) : $\mathrm{nint}\{254|\mathrm{Mantissa} - 1.5|\}$

$$\mathrm{Mantissa} = (S_{HH}S_{HH}^* + S_{HV}S_{HV}^* + S_{VH}S_{VH}^* + S_{VV}S_{VV}^*) / 2^{\mathrm{Byte}(1)}$$

$$\mathrm{qsca} = \mathrm{sqrt}\{ [(\mathrm{Byte}(2) / 254) + 1.5] 2^{\mathrm{Byte}(1)} \}$$

° Byte(3) : $\mathrm{nint}\{127\ \mathrm{Re}(S_{HH})/\mathrm{qsca}\}$

° Byte(4) : $\mathrm{nint}\{127\ \mathrm{Im}(S_{HH})/\mathrm{qsca}\}$

° Byte(5) : $\mathrm{nint}\{127\ \mathrm{Re}(S_{HV})/\mathrm{qsca}\}$

° Byte(6) : $\mathrm{nint}\{127\ \mathrm{Im}(S_{HV})/\mathrm{qsca}\}$

° Byte(7) : $\mathrm{nint}\{127\ \mathrm{Re}(S_{VH})/\mathrm{qsca}\}$

° Byte(8) : $\mathrm{nint}\{127\ \mathrm{Im}(S_{VH})/\mathrm{qsca}\}$

° Byte(9) : $\mathrm{nint}\{127\ \mathrm{Re}(S_{VV})/\mathrm{qsca}\}$

° Byte(10) : $\mathrm{nint}\{127\ \mathrm{Im}(S_{VV})/\mathrm{qsca}\}$

The total power (when decompressing) is :

$$TP = \mathbf{0.25}\ (\ byte(2) / 254 + 1.5)\ 2^{Byte(1)}$$

and the remaining terms are given by :

$$ysca = sqrt[\ [\ (Byte(2) / 254\ ) + 1.5]\ 2^{Byte(1)}\ ]$$

$Re(S_{HH}) = byte(3)\ ysca/127$
$Im(S_{HH}) = byte(4)\ ysca/127$
$Re(S_{HV}) = byte(5)\ ysca/127$
$Im(S_{HV}) = byte(6)\ ysca/127$
$Re(S_{VH}) = byte(7)\ ysca/127$
$Im(S_{VH}) = byte(8)\ ysca/127$
$Re(S_{VV}) = byte(9)\ ysca/127$
$Im(S_{VV}) = byte(10)\ ysca/127$

SIR-C "SLC" dual-pol data - 6 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will not have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be single look complex scattering matrix data. The compression format is the same as for the quad-pol data format, except that not all 10 bytes are present. The bytes present depend on the polarization mode.

HH and VV polarizations : bytes 1,2,3,4,9,10
HH and HV polarizations : bytes 1,2,3,4,5,6
VH and VV polarizations : bytes 1,2,7,8,9,10

SIR-C "SLC" single-pol data - 4 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be single look complex scattering matrix data. The compression format is the same as for the quad-pol data format, except that not all 10 bytes are present. The bytes present depend on the polarization mode.

HH polarization : bytes 1,2,3,4
VV polarization : bytes 1,2,9,10

8.2 Multi Look Complex data

There are **two** possible data formats for Cross-products data, depending on polarization mode.

SIR-C "MLC" quad-pol data - 10 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will not have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be multi look complex cross-product data. The bytes present depend on the polarization mode. The data has been symmetrized such that $S_{HV} = 0.5\ (S_{HV} + S_{VH})$.

° 10 bytes per pixel - quad-pol data, with:

° Byte(1) : $\text{int}\{\log_2(S_{HH}S_{HH}^* + 2S_{HV}S_{HV}^* + S_{VV}S_{VV}^*)\}$

° Byte(2) : $\text{nint}\{254[\text{Mantissa} - 1.5]\}$

$$\text{Mantissa} = (S_{HH}S_{HH}^* + 2S_{HV}S_{HV}^* + S_{VV}S_{VV}^*) / 2^{\text{Byte}(1)}$$

$$\text{qsca} = [\ (\text{Byte}(2) / 254\ ) + 1.5]\ 2^{\text{Byte}(1)}$$

° Byte(3) : $\text{nint}\{255\ \text{sqrt}(S_{HV}S_{HV}^* / \text{qsca})\} - 127$

° Byte(4) : $\text{nint}\{255\ (S_{VV}S_{VV}^* / \text{qsca})\} - 127$

° Byte(5) : $\text{nint}\{\text{sign}[\text{Re}(S_{HH}S_{HV}^*)]$
$127\text{sqrt}(2|\text{Re}(S_{HH}S_{HV}^*)| / \text{qsca})\}$

° Byte(6) : $\text{nint}\{\text{sign}[\text{Im}(S_{HH}S_{HV}^*)]$
$127\text{sqrt}(2|\text{Im}(S_{HH}S_{HV}^*)| / \text{qsca})\}$

° Byte(7) : $\text{nint}\{127\ (2\text{Re}(S_{HH}S_{VV}^*)\ / \text{qsca})\}$

° Byte(8) : $\text{nint}\{127\ (2\text{Im}(S_{HH}S_{VV}^*)\ / \text{qsca})\}$

° Byte(9) : $\text{nint}\{\text{sign}[\text{Re}(S_{HV}S_{VV}^*)]$
$127\text{sqrt}(2|\text{Re}(S_{HV}S_{VV}^*)| / \text{qsca})\}$

° Byte(10) : $\text{nint}\{\text{sign}[\text{Im}(S_{HV}S_{VV}^*)]$
$127\text{sqrt}(2|\text{Im}(S_{HV}S_{VV}^*)| / \text{qsca})\}$

The total power is :

$$TP = 0.25\ (\ \text{byte}(2) / 254 + 1.5)\ 2^{\text{Byte}(1)}$$

The remaining terms are given by :

$$2\ S_{HV}S_{HV}^{*} = qsca[\ (byte(3) + 127)/255]^2$$

$$3\ S_{VV}S_{VV}^{*} = qsca[\ (byte(4) + 127)/255]^2$$

$$1\ S_{HH}S_{HH}^{*} = qsca - S_{VV}S_{VV}^{*} - 2\ S_{HV}S_{HV}^{*}$$

$$4\begin{cases} Re(S_{HH}S_{HV}^{*}) = 0.5\ qsca\ \{sign(byte(5))\ [byte(5)/127]^2\} \\ Im(S_{HH}S_{HV}^{*}) = 0.5\ qsca\ \{sign(byte(6))\ [byte(6)/127]^2\} \end{cases}$$

$$5\begin{cases} Re(S_{HH}S_{VV}^{*}) = \ qsca\ [byte(7)/254] \\ Im(S_{HH}S_{VV}^{*}) = \ qsca\ [byte(8)/254] \end{cases}$$

$$6\begin{cases} Re(S_{HV}S_{VV}^{*}) = 0.5\ qsca\ \{sign(byte(9))\ [byte(9)/127]^2\} \\ Im(S_{HV}S_{VV}^{*}) = 0.5\ qsca\ \{sign(byte(10))\ [byte(10)/127]^2\} \end{cases}$$

SIR-C "MLC" dual-pol data - 5 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be multi look complex cross-product data. The compression format is the same as for the quad-pol data format, except that not all 10 bytes are present. The bytes present depend on the polarization mode.

HH and VV polarizations : bytes 1,2,4,7,8

→ HH and HV polarizations : bytes 1,2,3,5,6

VH and VV polarizations : bytes 1,2,3,9,10

8.3 Multi Look Detected data

There is one Multilook detected data product :

SIR-C "MLD" single pol data - 2 bytes per pixel. Consists of one file for each scene, per frequency. Each line of the file consists of TBD range samples, in which range increases with sample number. There are a TBD number of lines per file, in which each line corresponds to different azimuth or along track locations. There are no header lines after the file has been stripped for the header by the CEOS reader. The standard output product by the GDPS will not have 12 bytes of file information at the beginning of each line. There will be separate header files. This data will be multi look detected power values. The polarization will be either HH , HV, VH, or VV, depending on mode.

° 2 bytes per pixel - single-pol data, with:

° Byte(1) : $\mathrm{int}\{\log_2(S_{XY}S_{XY}^*)\}$

° Byte(2) : $\mathrm{nint}\{254[S_{XY}S_{XY}^*/2^{\mathrm{Byte}(1)} - 1.5]\}$

To decompress the power,

$$TP = (\mathrm{byte}(2) / 254 + 1.5)\, 2^{\mathrm{Byte}(1)}$$

Appendix A: AIRSAR format data

For AIRSAR data, there are four possible formats :

1) compressed stokes matrix data
   (multilook,quad-pol, low-res, 10 bytes/pixel)
2) compressed scattering matrix (730 processor) data
   (single look,quad-pol,10 bytes/pixel)
3) compressed scattering matrix (3.5 processor) data
   (single look,quad-pol, low-res, 10 bytes/pixel)
4) uncompressed synoptic amplitude data
   (vax real*4, single pol, low-res, 4 bytes/pixel)

In the following descriptions:

sign( ) will return the sign of the argument (± 1)

nint( ) will indicate that the nearest integer value is calculated of its argument.

int( ) will indicate that the truncation of the floating point value to integer is calculated of its argument, and that, if the floating point value is less than zero, subtraction by 1.0 is additionally required. Note that this is not the same as FORTRAN int( ).

gen_fac is the AIRSAR general scale factor whose value is recorded in the header of the oldheader, field 133.

A.1 Complex scattering matrix data

AIRSAR 730 processor "hi-res" quad-pol data - 10 bytes per pixel. Consists of four files for each scene, per frequency. Each line of each file consists of 1024 azimuth samples. There are 750 lines, each corresponding to progressively greater range from the radar. The azimuth pixel spacing is 3.33 meters. The range pixel spacing is 6.66 meters (assumes 20 MHz data). The four files are exactly adjacent to each other in azimuth. Generally, the first two lines of the file are header lines. There is no symmetrization of the data.

° 10 bytes per pixel - quad-pol data, with:

° Byte(1) : $\mathrm{int}\{\log_2(0.25\,(S_{HH}M_{HH}^{*} + S_{HV}S_{HV}^{*} + S_{VH}S_{VH}^{*} + S_{VV}S_{VV}^{*}))\}$

° Byte(2) : $\mathrm{nint}\{254[\mathrm{Mantissa} - 1.5]\}$

$$\mathrm{Mantissa} = 0.25\,(S_{HH}S_{HH}^{*} + S_{HV}S_{HV}^{*} + S_{VH}S_{VH}^{*} + S_{VV}S_{VV}^{*}) / 2^{\mathrm{Byte}(1)}$$

$$\mathrm{qsca} = 2\,\mathrm{sqrt}\{\ \mathrm{gen\_fac}\,[\,(\mathrm{Byte}(2) / 254) + 1.5]\,2^{\mathrm{Byte}(1)}\ \}$$

° Byte(3) : $\mathrm{nint}\{127\,\mathrm{Re}(S_{HH})/\mathrm{qsca}\}$

° Byte(4) : $\mathrm{nint}\{127\,\mathrm{Im}(S_{HH})/\mathrm{qsca}\}$

° Byte(5) : $\mathrm{nint}\{127\,\mathrm{Re}(S_{HV})/\mathrm{qsca}\}$

° Byte(6) : $\mathrm{nint}\{127\,\mathrm{Im}(S_{HV})/\mathrm{qsca}\}$

° Byte(7) : $\mathrm{nint}\{127\,\mathrm{Re}(S_{VH})/\mathrm{qsca}\}$

° Byte(8) : $\mathrm{nint}\{127\,\mathrm{Im}(S_{VH})/\mathrm{qsca}\}$

° Byte(9) : $\mathrm{nint}\{127\,\mathrm{Re}(S_{VV})/\mathrm{qsca}\}$

° Byte(10) : $\mathrm{nint}\{127\,\mathrm{Im}(S_{VV})/\mathrm{qsca}\}$

The total power (when decompressing) is :

$$\mathrm{TP} = \mathrm{gen\_fac}\,(\,\mathrm{byte}(2) / 254 + 1.5)\,2^{\mathrm{Byte}(1)}$$

and the remaining terms are given by :

$$\mathrm{ysca} = 2\,\mathrm{sqrt}\{\ \mathrm{gen\_fac}\,[\,(\mathrm{Byte}(2) / 254) + 1.5]\,2^{\mathrm{Byte}(1)}\ \}$$

$$\mathrm{Re}(S_{HH}) = \mathrm{byte}(3)\,\mathrm{ysca}/127$$

$$\mathrm{Im}(S_{HH}) = \mathrm{byte}(4)\,\mathrm{ysca}/127$$

$Re(S_{HV})$ = byte(5) ysca/127
$Im(S_{HV})$ = byte(6) ysca/127
$Re(S_{VH})$ = byte(7) ysca/127
$Im(S_{VH})$ = byte(8) ysca/127
$Re(S_{VV})$ = byte(9) ysca/127
$Im(S_{VV})$ = byte(10) ysca/127

AIRSAR 3.5 processor "complex" quad-pol data - 10 bytes per pixel. Consists of four files for each scene, per frequency. Each line of each file consists of 1024 azimuth samples. There are 1282 lines, each corresponding to progressively greater range from the radar. For 20 MHz bandwidth data, the azimuth pixel spacing is 12.2 meters (1993 and after, the prf was increased, such that the azimuth pixel spacing was decreased to 8 meters). The range pixel spacing is 6.66 meters (again assuming 20 MHz data). The first 2 lines of each file are header lines. The four files correspond to the center four looks of 16 processed looks. There is no symmetrization of the data. The compression is identical to the AIRSAR 730 processor "hi-res" quad-pol data.

The differences between AIRSAR and SIR-C data, is that the first two bytes are defined differently, and that the scale factor is defined differently. The value stored in the first two bytes by AIRSAR is the total power, while the value stored in the first two bytes by SIR-C is **four times** the total power. The scale factor for AIRSAR is **two times** larger than the scale factor used by SIR-C. In addition, there is no general scale factor for SIR-C.

Because of round off errors for some of the cross-product terms that are small, AIRSAR data converted to the SIR-C format, and then compared with the original AIRSAR compressed scattering matrix data, or with the AIRSAR Stokes data derived from the scattering matrix data, might not be in exact agreement.

A.2 Stokes matrix data

AIRSAR compressed Stokes matrix "CM" quad-pol data - 10 bytes per pixel. Consists of one file for each scene, per frequency. Each line of each file consists of 1024 azimuth samples. There are 750 or 1282 lines depending on the processor, each corresponding to progressively greater range from the radar. The azimuth pixel spacing is 12.1 meters for the pre-1993 prf, and 8 meters for the 1993 and later prf. The range pixel spacing is 6.66 meters (assumes 20 MHz data). The first two or three lines in the file are header lines. The data has been symmetrized such that $S_{HV} = 0.5\ (S_{HV} + S_{VH})$, and is usually calibrated. For the "730 processor", the data has been multilooked by 4, while for the "3.5 processor", the data has been multilooked by 16.

° 10 bytes per pixel - quad-pol data, with:

- ° Byte(1) : int{log2(M_{11})}
- ° Byte(2) : nint{254[Mantissa - 1.5|}

  Mantissa = (M_{11}) / $2^{Byte(1)}$

  qsca = gen_fac [(Byte(2) / 254) + 1.5| $2^{Byte(1)}$
- ° Byte(3) : nint{127 M_{12}/qsca}
- ° Byte(4) : nint{127 sign(M_{13}/qsca) sqrt(M_{13}/qsca)}
- ° Byte(5) : nint{127 sign(M_{14}/qsca) sqrt(M_{14}/qsca)}
- ° Byte(6) : nint{127 sign(M_{23}/qsca) sqrt(M_{23}/qsca)}
- ° Byte(7) : nint{127 sign(M_{24}/qsca) sqrt(M_{24}/qsca)}
- ° Byte(8) : nint{127 M_{33}/qsca}
- ° Byte(9) : nint{127 M_{34}/qsca}
- ° Byte(10) : nint{127 M_{44}/qsca}

The total power is :

TP = M_{11} = gen_fac (byte(2) / 254 + 1.5) $2^{Byte(1)}$)

The remaining terms are given by :

M_{12} = M_{11} byte(3) /127

M_{13} = sign(byte(4)) M_{11} (byte(4) /127)**2

M_{14} = sign(byte(5)) M_{11} (byte(5) /127)**2

M_{23} = sign(byte(6)) M_{11} (byte(6) /127)**2

M_{24} = sign(byte(7)) M_{11} (byte(7) /127)**2

M_{33} = M_{11} byte(8) /127

M_{34} = M_{11} byte(9) /127

$$M_{44} = M_{11} \text{ byte}(10) / 127$$
$$M_{22} = M_{11} - M_{33} - M_{44}$$

The difference between the AIRSAR 'CM' data and SIR-C MLC data is chiefly that, for AIRSAR, the elements of the Stokes Matrix are stored directly to each compressed byte; while for SIR-C, the cross-products (that when combined appropriately comprise the Stokes matrix) are stored. In addition, the AIRSAR data employs a general scale factor, while SIR-C does not. And finally, the value stored in the first two bytes by AIRSAR is the total power divided by the general scale factor, while the value stored in the first two bytes by SIR-C is **four times** the total power.

A.3 Detected data products

AIRSAR synoptic amplitude data - 4 bytes per pixel. This data is not compressed. Consists of one file for each scene, per channel processed (usually three). Each line of the file consists of 1279 range samples, in which range increases with sample number. There are 5090 lines per file, in which each line corresponds to different azimuth or along track locations. The azimuth pixel spacing is 12.1 meters for the pre-1993 prf, and 8 meters for the 1993 and later prf. The range pixel spacing is 6.66 meters (assumes 20 MHz data). The first two lines in the file are header lines. The data has been multilooked by 16, and the pixels are amplitude rather than power values. The format is that each pixel is a four byte DEC VAX floating point number. There is no general scale factor that is used.

Appendix B: Parameter description

The following defined parameters may be determined and written to a file by running the program CREATE_IN. CREATE_IN determines these parameters by reading the ASCII CEOS headers that are created by the CEOS_READER software. This appendix describes how they are defined. Input parameters may be determined from the CEOS headers. In the SAR Leader File, Data Set Summary Record, field 86 is the data type (MLC,SLC, or MLD), while field 8 of the same record is the frequency and polarization (i.e. CHH and CVV , or Lquad). From these you may determine the numerical representation of datatype and datamode by the following:

datatype	field 86	Field 8
1	MLD	single pol
2	MLC	quad pol
3	MLC	dual pol
4	SLC	quad pol
5	SLC	dual pol
6	SLC	single pol

(datatype 7 is AIRSAR CM data, while datatype 8 is AIRSAR scattering matrix data)

datamode	field 8
0	Lquad,Cquad
1	LHH and LVV, or CHH and CVV
2	LHH and LHV, or CHH and CHV
3	LVH and LVV, or CVH and CVV
4	LHH or CHH
5	LVV or CVV
6	other single pol data (i.e. MLD HV)

The number of bytes per sample may be found in the Imagery Options File, file descriptor record, field 34. The number of samples nsamp is in the Imagery Options File, file descriptor record, field 39, while the number of lines is in the Imagery Options File, file descriptor record, field 29.

The record length in the Imagery Options File, file descriptor record, field 30. **If this software is running on a DEC computer, the record length from the above field might have to be divided by 4. Check your FORTRAN reference guide.**

For AIRSAR data, the ASCII common block header file is more simply determined. The program CREATE_IN_AIRSAR reads the newheader to produce the ASCII common block header file. Alternatively, the file may be created manually. Both the CM format data and the scattering matrix format data are only available as quad pol, the record length is always 10240 bytes, the number of samples is always 1024, the number of bytes per sample is always 10 , and the number of lines is usually either 750 or 1280.

The data type for AIRSAR CM data is '7', while the data type for AIRSAR scattering matrix data is '8'.

For AIRSAR CM data, the ASCII file will be :

7,0,10240(non-DEC computer) or 2560(DEC), 1024,750 or 1280, 10

For AIRSAR scattering matrix data, the ASCII file will be:

8,0,10240(non-DEC computer) or 2560(DEC), 1024,750 or 1280, 10

Appendix C: The Stokes matrix and Cross-Products

The symmetrized Stokes matrix may be formed from the cross-products of the scattering matrix that are stored by SIR-C in the MLC format as follows:

m(1,1) = (ShhShh* + SvvSvv* + 2ShvShv*) / 4.0
m(1,2) = (ShhShh* - SvvSvv*) / 4.0
m(1,3) = (Re(ShhShv*) + Re(ShvSvv*)) / 2.0
m(1,4) = (-Im(ShhShv*) - Im(ShvSvv*)) / 2.0
m(2,1) = m(1,2)
m(2,2) = (ShhShh* +SvvSvv* - 2ShvShv*) / 4.0
m(2,3) = (Re(ShhShv*) - Re(ShvSvv*)) / 2.0
m(2,4) = (-Im(ShhShv*) + Im(ShvSvv*))/ 2.0
m(3,1) = m(1,3)
m(3,2) = m(2,3)
m(3,3) = (ShvShv* + Re(ShhSvv*) / 2.0
m(3,4) = -Im(ShhSvv*) / 2.0
m(4,1) = m(1,4)
m(4,2) = m(2,4)
m(4,3) = m(3,4)
m(4,4) = (ShvShv* - Re(ShhSvv*))/ 2.0

The cross-products in terms of the symmetrized Stokes matrix elements are :

ShhShh* = 2m(1,2) + 2m(1,1) - m(3,3) - m(4,4)
ShvShv* = m(3,3) + m(4,4)
SvvSvv* = 2m(1,1) - 2m(1,2) - m(3,3) - m(4,4)
ShhShv* = complex(m(1,3) + m(2,3), -m(1,4) - m(2, 4))
ShhSvv* = complex(m(3,3) - m(4,4), -2m(3,4))
ShvSvv* = complex(m(1,3) - m(2,3), -m(1,4) + m(2,4))

For SLC data, the Stokes matrix will not be symmetrized. The unsymmetrized Stokes Matrix is given by:

m(1,1) = (ShhShh* + ShvShv* + SvhSvh* + SvvSvv*) / 4.0
m(1,2) = (ShhShh* - ShvShv* + SvhSvh* - SvvSvv*) / 4.0
m(1,3) = (Re(ShhShv*) + Re(SvhSvv*)) / 2.0
m(1,4) = (-Im(ShhShv*) - Im(SvhSvv*)) / 2.0
m(2,1) = (ShhShh* + ShvShv* - SvhSvh* - SvvSvv*) / 4.0
m(2,2) = (ShhShh* + SvvSvv* - ShvShv* - SvhSvh*) / 4.0
m(2,3) = (Re(ShhShv*) - Re(SvhSvv*)) / 2.0
m(2,4) = (-Im(ShhShv*) + Im(SvhSvv*))/ 2.0
m(3,1) = (Re(ShhSvh*) + Re(ShvSvv*)) / 2.0
m(3,2) = (Re(ShhSvh*) - Re(ShvSvv*)) / 2.0
m(3,3) = (ShvShv* + Re(ShhSvv*) / 2.0
m(3,4) = (-Im(ShhSvv*+Im(ShvSvh*) / 2.0
m(4,1) = (-Im(ShhSvh*) - Im(ShvSvv*)) / 2.0
m(4,2) = (-Im(ShhSvh*) + Im(ShvSvv*))/ 2.0
m(4,3) = (-Im(ShhSvv* - Im(ShvSvh*) / 2.0
m(4,4) = (Re(ShvSvh*) - Re(ShhSvv*))/ 2.0