

**GPM/GMI
Level-1B Product Format**

Version 1.0

September 2nd, 2014

Japan Aerospace Exploration Agency

Revision history

revision	date	section	content, reason
Version 1.0	Sept. 2 nd 2014	ALL	New

Reference

- (1) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT “File Specification for GPM Products”, Version 1.07 TKIO 3.60.4, August 1, 2014
- (2) PRECIPITATION PROCESSING SYSTEM GLOBAL PRECIPITATION MEASUREMENT “Metadata for GPM Products”, Version 1.00 February 27, 2014

Contents

1. 1BGMI – GMI Brightness Temperatures.....	1
1.1. Data Format Structure	2
1.1.1. Dimension definition.....	2
1.1.2. Data Format Structure for 1BGMI – GMI Brightness Temperatures	3
1.1.3. Data Format Structure for each Group	4
1.1.3.1 Data Format Structure for S1 Group	4
1.1.3.2 Data Format Structure for S2 Group	8
1.2. Contents of objects in each Group	12
1.2.1. Metadata	12
1.2.1.1 FileHeader	12
1.2.1.2 InputRecord.....	13
1.2.1.3 NavigationRecord.....	13
1.2.1.4 FileInfo	14
1.2.2. Data Group	15
1.2.2.1 S1 (Swath).....	15
1.2.2.2 S2 (Swath).....	30
Index.....	44

1. 1BGMI – GMI Brightness Temperatures

1.1. Data Format Structure

1.1.1. Dimension definition

Dimension definitions:

- nscan
 - var Number of scans in the granule.
- nchan1
 - 9 Number of channels in Swath 1.
- nchan2
 - 4 Number of channels in Swath 2.
- nfreq1
 - 5 Number of frequencies in Swath 1.
- nfreq2
 - 2 Number of frequencies in Swath 2.
- npix11
 - 221 Number of pixels in Swath 1.
- npix12
 - 221 Number of pixels in Swath 2.
- ncolds1
 - 85 Maximum number of cold samples in Swath 1.
- ncolds2
 - 85 Maximum number of cold samples in Swath 2.
- nhots1
 - 65 Maximum number of hot samples in Swath 1.
- nhots2
 - 65 Maximum number of hot samples in Swath 2.
- ntherm
 - 11 Number of hot load thermisters.
- LNL
 - 2 Linear and non-linear.
- nsamt
 - 4 Number of sample types.
The types are : total science GSDR, earthview, hot load, cold sky.
- ntach
 - 32 Number of tachometer readings.
- GMlxyz
 - 3 x, y, z components in GMI instrument coordinate system.

1.1.2. Data Format Structure for 1BGMI – GMI Brightness Temperatures

The Level-1B GMI Product, 1BGMI, "GMI Brightness Temperatures," is written as a multi-Swath Structure. Swath S1 has channels 1-9: 10V 10H 19V 19H 23V 37V 37H 89V 89H. Swath S2 has channels 10-13: 165V 165H 183+/-3V 183+/-8V. The following sections describe the structure and contents of the format.

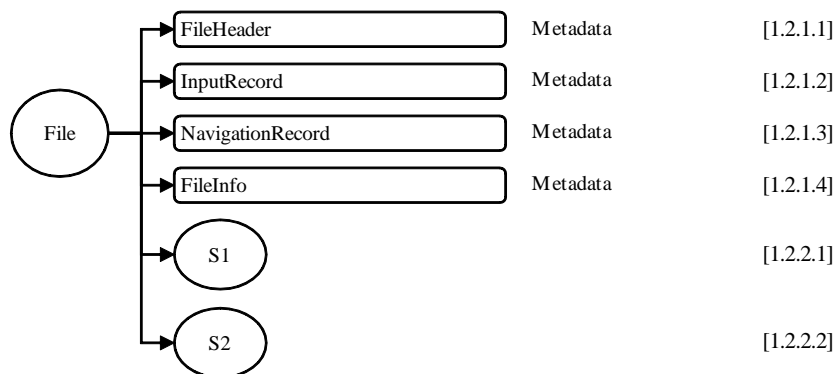


Figure 1.1-1 Data Format Structure for 1BGMI – GMI Brightness Temperatures

1.1.3. Data Format Structure for each Group

1.1.3.1 Data Format Structure for S1 Group

S1 Group's structure is shown in this section.

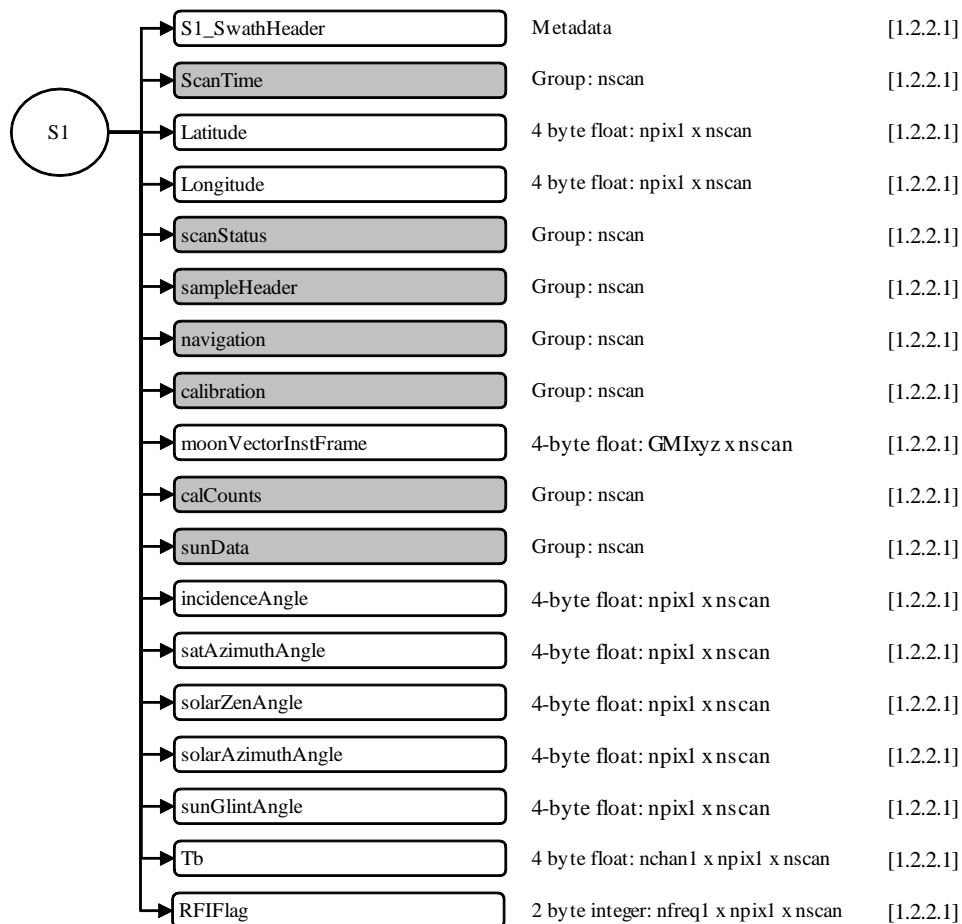


Figure 1.1-2 Data Format Structure for 1BGMI, S1

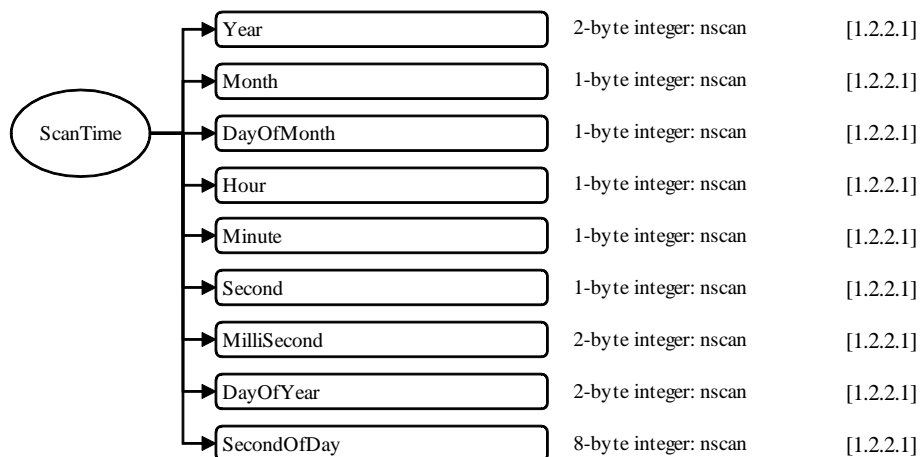


Figure 1.1-3 Data Format Structure for 1BGMI, S1, ScanTime

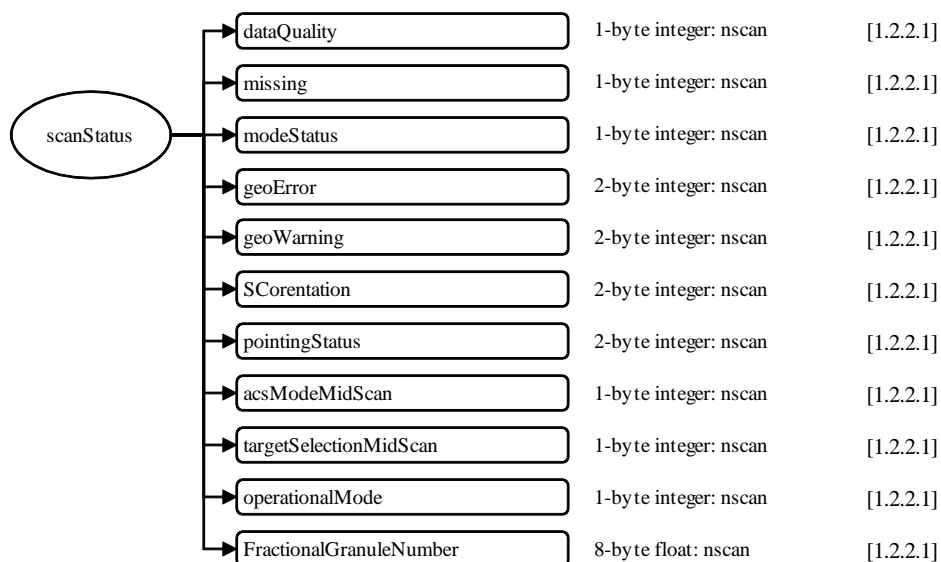


Figure 1.1-4 Data Format Structure for 1BGMI, S1, scanStatus

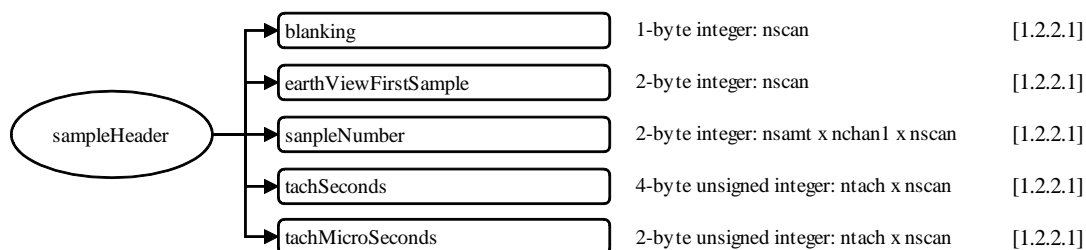


Figure 1.1-5 Data Format Structure for 1BGMI, S1, sampleHeader

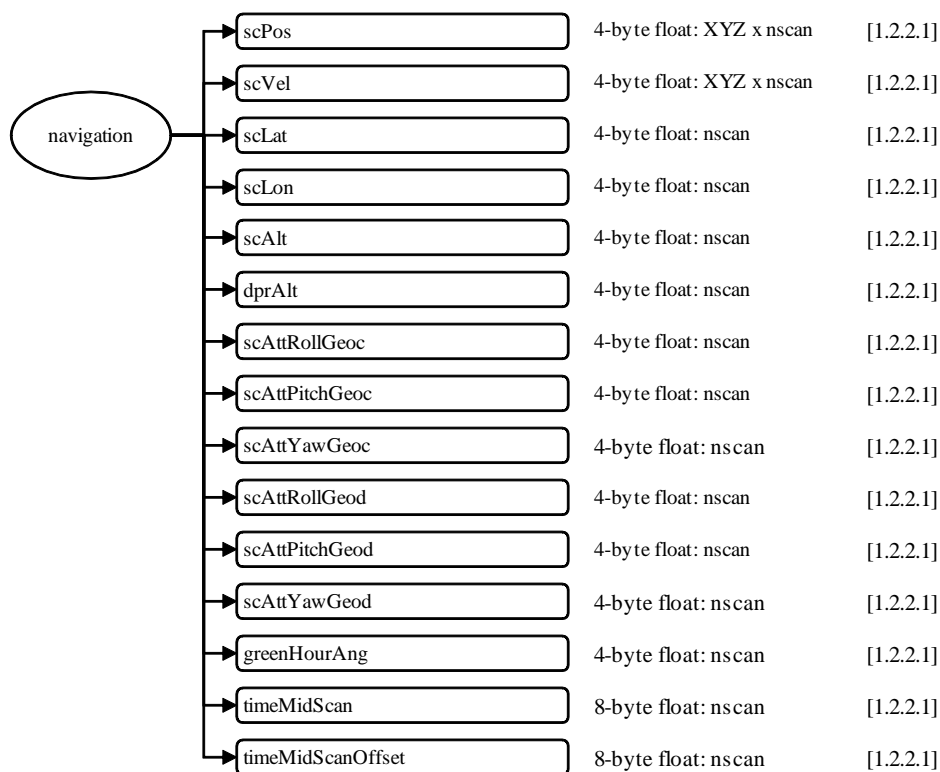


Figure 1.1-6 Data Format Structure for 1BGMI, S1, navigation

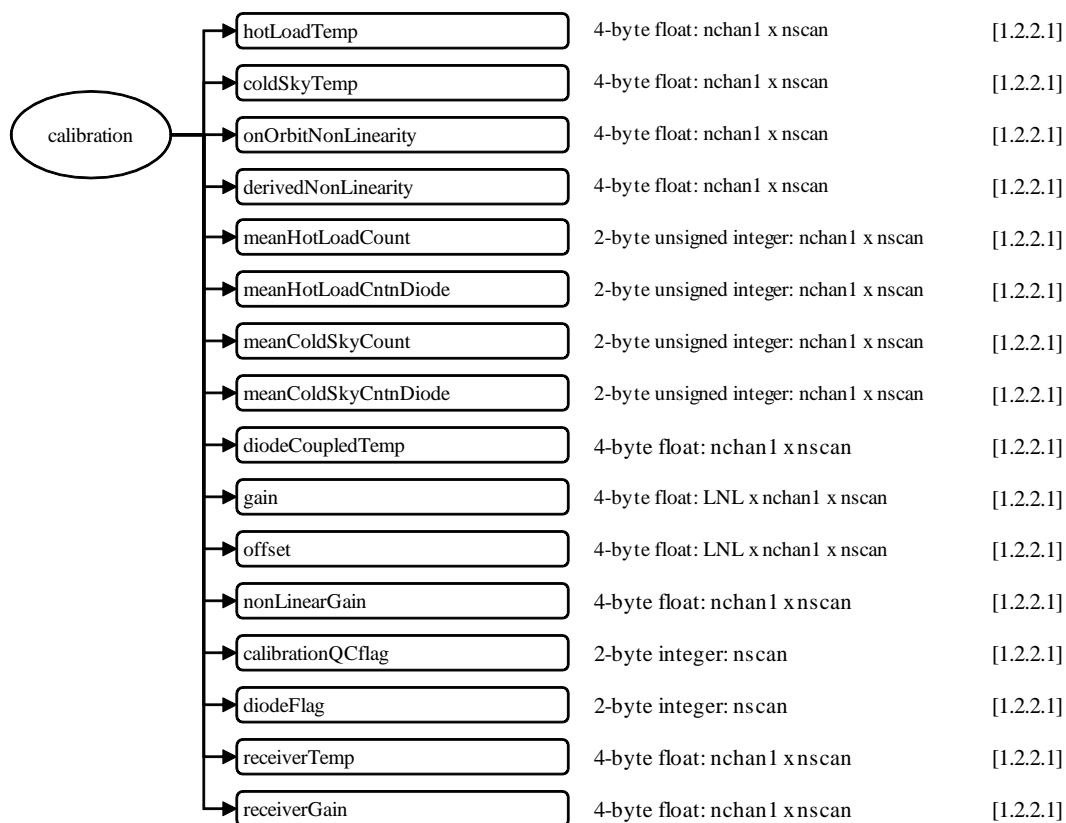


Figure 1.1-7 Data Format Structure for 1BGMI, S1, calibration

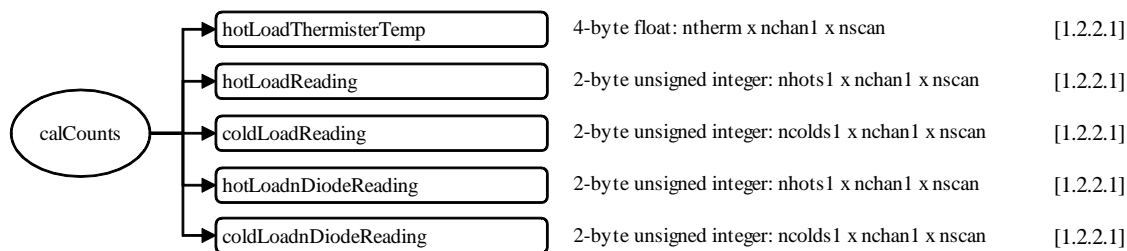


Figure 1.1-8 Data Format Structure for 1BGMI, S1, calCounts



Figure 1.1-9 Data Format Structure for 1BGMI, S1, sunData

1.1.3.2 Data Format Structure for S2 Group

S2 Group's structure is shown in this section.

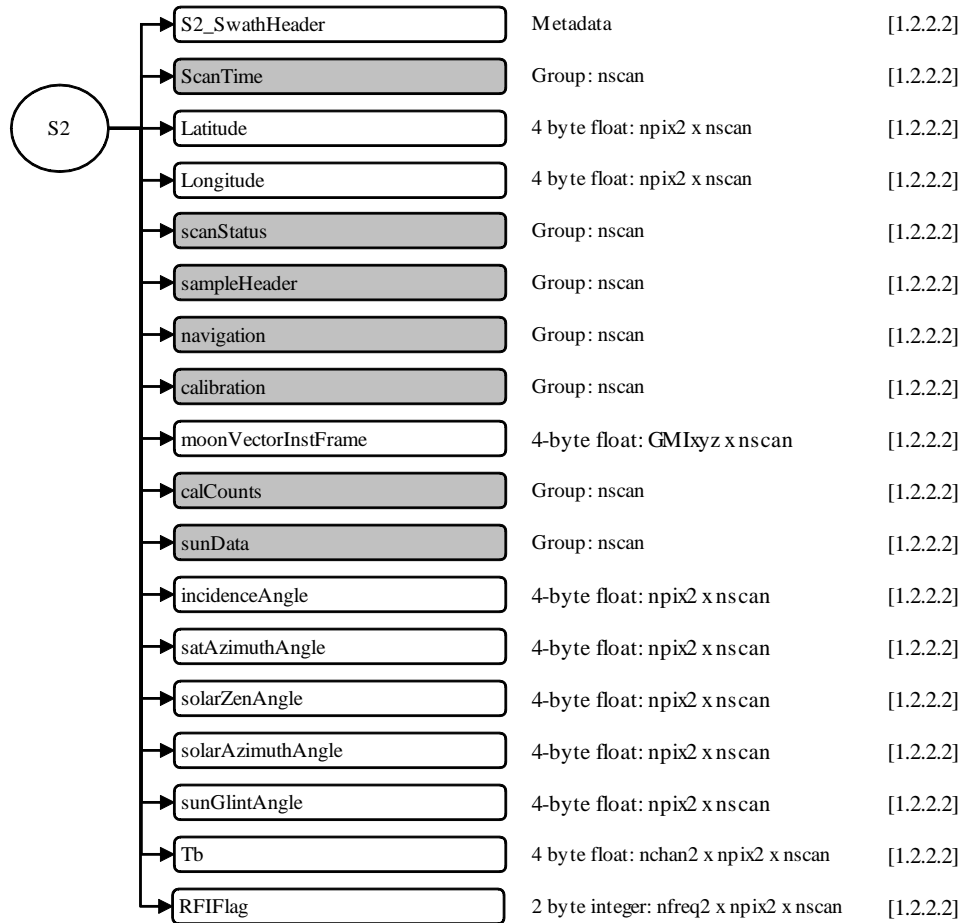


Figure 1.1-10 Data Format Structure for 1BGMI, S2

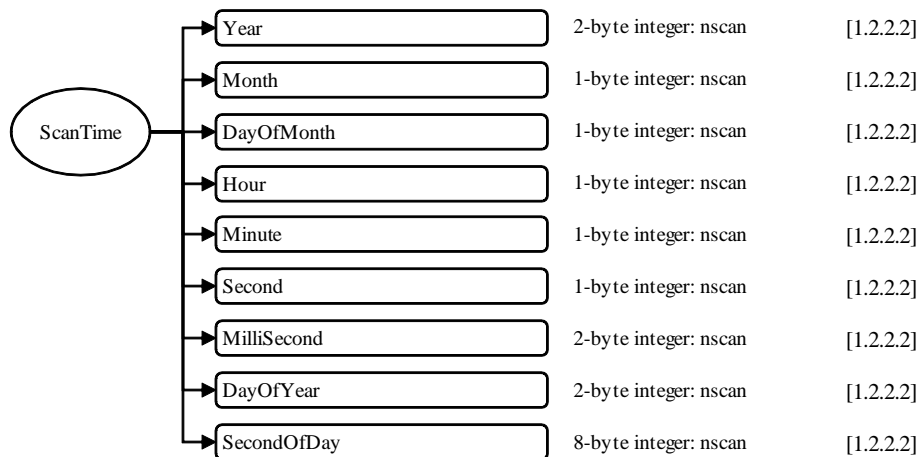


Figure 1.1-11 Data Format Structure for 1BGMI, S2, ScanTime

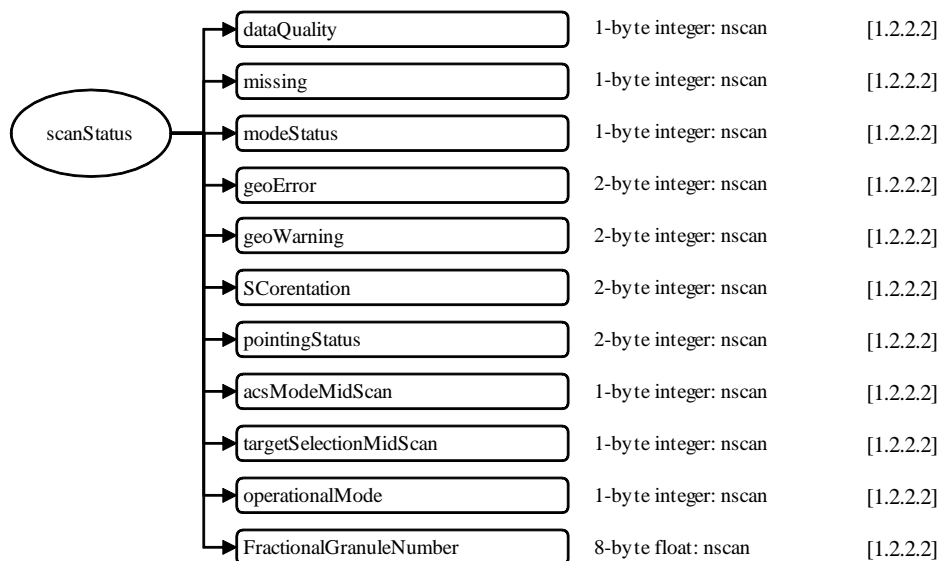


Figure 1.1-12 Data Format Structure for 1BGMI, S2, scanStatus

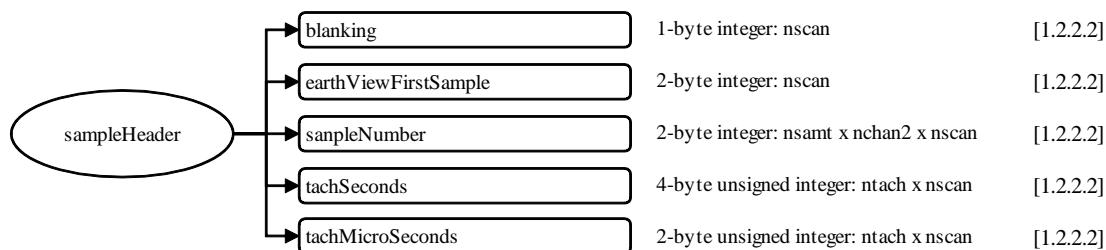


Figure 1.1-13 Data Format Structure for 1BGMI, S2, sampleHeader

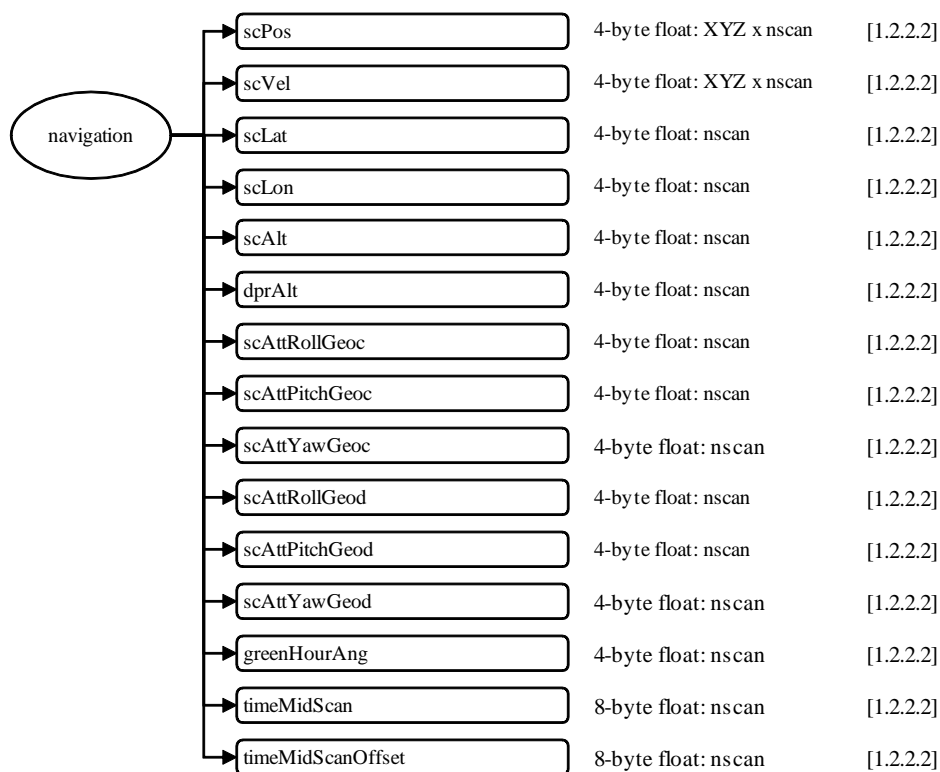


Figure 1.1-14 Data Format Structure for 1BGMI, S2, navigation

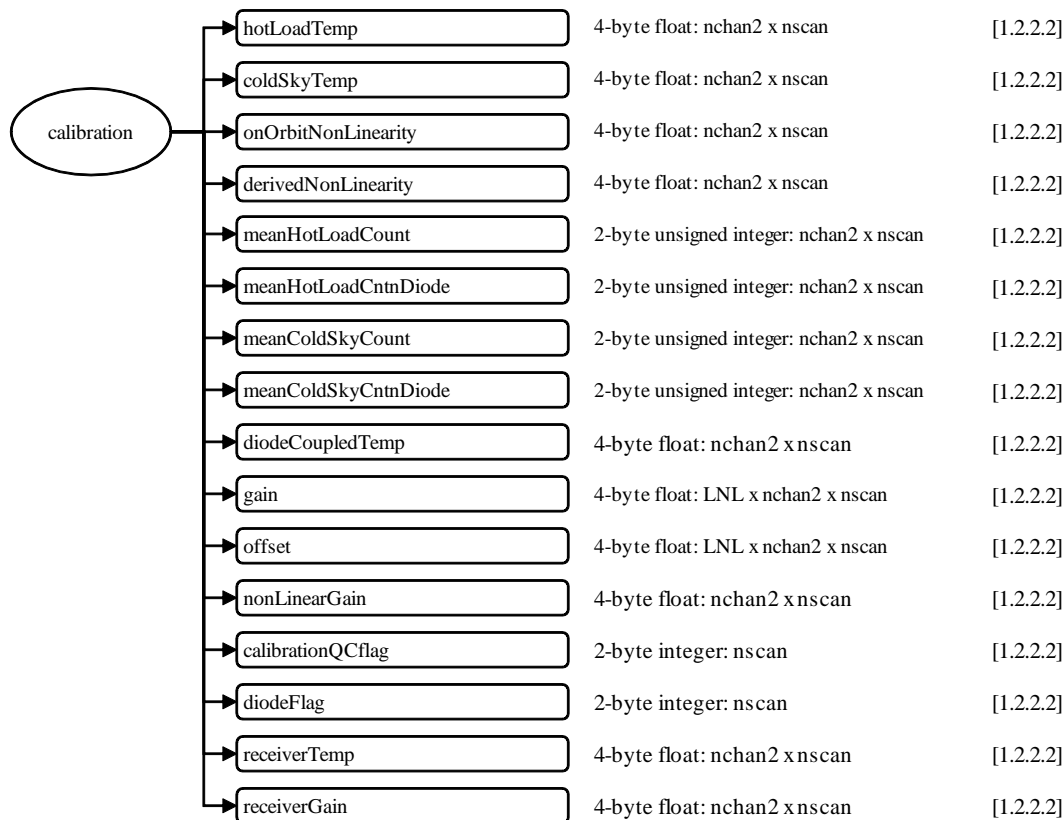


Figure 1.1-15 Data Format Structure for 1BGMI, S2, calibration

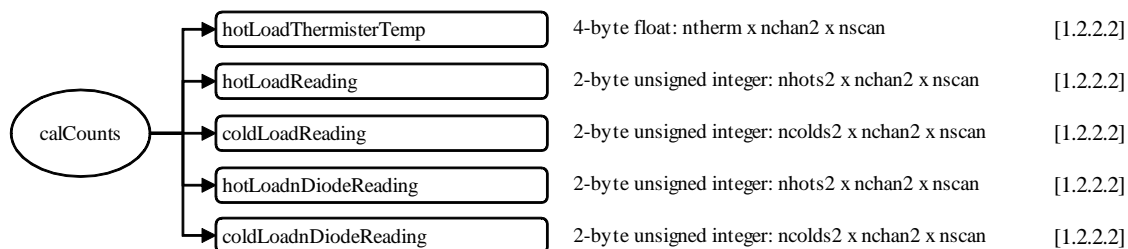


Figure 1.1-16 Data Format Structure for 1BGMI, S2, calCounts

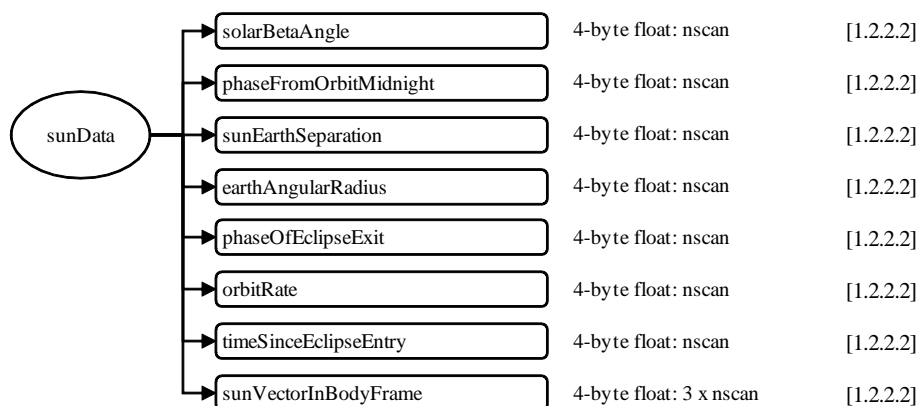


Figure 1.1-17 Data Format Structure for 1BGMI, S2, sunData

1.2. Contents of objects in each Group

1.2.1. Metadata

1.2.1.1 FileHeader

FileHeader contains metadata of general interest. Table 1.2-1 shows each metadata elements in FileHeader.

Table 1.2-1 FileHeader Group

Metadata Element	Estimated Size (bytes)	Description
DOI	256	Digital Object Identifier.
AlgorithmID	50	The algorithm that generated this product, e.g., 2A12.
AlgorithmVersion	50	The version of the algorithm that generated this product.
FileName	50	The file name of this granule.
SatelliteName	10	Values are: TRMM GPM MULTI F10 ... F18 AQUA GCOMW1 CORIOLIS MT1 NOAA15 ... NOAA19 METOPANPP. More values will be added as they are known.
InstrumentName	10	Values are: PR TMI VIRS PRTMI KU KA DPR GMI DPRGMI MERGED SSMI SSMIS AMSRE AMSR2 WIND-SAT MADRAS AMSUA AMSUB SAPHIR MHS ATMS. More values will be added as they are known.
GenerationDateTime	50	The date and time this granule was generated. The format is YYYY-MM-DDTHH:MM:SS.sssZ, where YYYY is 4-digit year, MM is month number, DD is day of month, T is "T", HH is hour, MM is minute, SS is second, sss is millisecond, and Z is "Z". All fields are zero-filled. The missing value is constructed by replacing all digits with 9, i.e., 9999-99-99T99:99:99.999Z
StartGranuleDateTime	50	The start time defining this granule. The format is the same as GenerationDateTime. DETAILS: An orbital granule starts when the satellite is at the position defined by GranuleStart. Thus the start time is not the first scan time. Some algorithms have overlap scans in the file before the start time as defined in SwathHeader. A monthly granule starts on the first ms of the month, for example March 1998 would be 1998-03-01T00:00:00.000Z
StopGranuleDateTime	50	The stop time defining this granule. The format is the same as GenerationDateTime. DETAILS: An orbital granule stops when the satellite is at the position defined by GranuleStart. Thus the stop time is not the last scan time. Some algorithms have overlap scans in the file after the stop time as defined in SwathHeader. A monthly granule stops on the last ms of the month, for example March 1998 would be 1998-03-31T23:59:59.999Z
GranuleNumber	50	The number of this granule, which starts as in GranuleStart. If the GranuleStart is identical to the orbit start, then the GranuleNumber will be the same as the orbit number. The GranuleNumber will have 6 digits, including leading zeroes, for example 001234.
NumberOfSwaths	50	The number of swaths in this granule.
NumberOfGrids	50	The number of grid structures in this granule.
GranuleStart	50	The starting place in the orbit of this granule. Currently defined values are "SOUTHERNMOST LATITUDE" and "NORTHBOUND EQUATOR CROSSING".
TimeInterval	50	The time interval covered by this granule. Values are "ORBIT", "HALF ORBIT", "HALF HOUR", "HOUR", "3 HOUR", "DAY", "MONTH", "CONTACT".
ProcessingSystem	50	The name of the processing system, e.g., "PPS", "JAXA".
ProductVersion	50	The data version assigned by the processing system.
EmptyGranule	50	Whether a granule is empty. Values are "EMPTY" or

1.2. Contents of objects in each Group

1.2.1. Metadata

1.2.1.2. InputRecord

Metadata Element	Estimated Size (bytes)	Description
		"NOT EMPTY".
MissingData	50	The number of missing scans.

1.2.1.2 InputRecord

InputRecord contains a record of input files for this granule. Table 1.2-2 shows each metadata elements in InputRecord.

Table 1.2-2 InputRecord Group

Metadata Element	Estimated Size (bytes)	Description
InputFileName	1000	A list of input file names for this granule.
InputAlgorithmVersions	1000	A list of algorithm versions of the input files for this granule.
InputGenerationDateTimes	1000	A list of generation date times of the input files for this granule. The format is the same as GenerationDateTime.

1.2.1.3 NavigationRecord

NavigationRecord contains navigation metadata for this granule. Table 1.2-3 shows each metadata elements in NavigationRecord.

Table 1.2-3 NavigationRecord Group

Metadata Element	Estimated Size (bytes)	Description
LongitudeOnEquator	50	The longitude where the satellite crosses the equator going from south to north.
UTCDateTimeOnEquator	50	The UTC time when the satellite crosses the equator going from south to north. The format is the same as GenerationDate Time.
MeanSolarBetaAngle	50	The average solar beta angle in this granule.
EphemerisFileName	50	Name of the ephemeris file input for processing.
AttitudeFileName	50	Name of the attitude file input for processing.
GeoControlFileName	50	Name of the GeoTK Control Parameters File input for processing.
EphemerisSource	50	Values are "0 CONSTANT INPUT TEST VALUE", "1 GROUND ESTIMATED STATE (GES)", "2 GPS FILTERED SOLUTION (GEONS)", "3 GPS POINT SOLUTION (PVT)", "4 ON BOARD PROPAGATED (OBP)", "5 OEM GROUND EPHEMERIS FILE", "6 GEONS WITH FALLBACK AS FLAGGED", "7 PVT WITH FALLBACK AS FLAGGED", "8 OBP WITH FALLBACK AS FLAGGED", "9 GES WITH FALLBACK AS FLAGGED"
AttitudeSource	50	Values are "0 CONSTANT INPUTS FOR TESTING", "1 ON BOARD CALCULATED PITCH ROLL YAW"
GeoToolkitVersion	50	Version of the GeoToolkit
SensorAlignmentFirstRotationAngle	50	Alignment angle, first rotation, in degrees. Rotation adjustment from sensor coordinates to the Attitude Control System Flight Coordinates.
SensorAlignmentSecondRotationAngle	50	Alignment angle, second rotation, in degrees.
SensorAlignmentThirdRotationAngle	50	Alignment angle, third rotation, in degrees.

Metadata Element	Estimated Size (bytes)	Description
SensorAlignmentFirstRotationAxis	50	Euler rotation sequence, first rotation axis. Values are "1", "2", "3" (representing X, Y, Z).
SensorAlignmentSecondRotationAxis	50	Euler rotation sequence, second rotation axis. Values are "1", "2", "3" (representing X, Y, Z).
SensorAlignmentThirdRotationAxis	50	Euler rotation sequence, third rotation axis. Values are "1", "2", "3" (representing X, Y, Z).

1.2.1.4 FileInfo

FileInfo contains metadata used by the PPS I/O Toolkit. Table 1.2-4 shows each metadata elements in FileInfo.

Table 1.2-4 FileInfo Group

Metadata Element	Estimated Size (bytes)	Description
DataFormatVersion	50	The version of the data format used to write this file. This version is separate for each AlgorithmID. The order is: "a" "b" ... "z" "aa" "ab" ... "az" "ba" "bb" ...
TKCodeBuildVersion	50	Usually TK CodeBuildVersion is "1". If the I/O routines built by TKIO change even though the DataFormatVersion is unchanged, then TK CodeBuildVersion increments to "2", "3", ... If subsequently DataFormatVersion changes, TKCodeBuildVersion becomes "1" again.
MetadataVersion	50	The version of metadata used to write this file. This version is separate for each AlgorithmID. The order is: "a" "b" ... "z" "aa" "ab" ... "az" "ba" "bb" ...
FormatPackage	50	The underlying format of this granule. Values are "HDF4", "HDF5", "NETCDF", "TKBINARY"
BlueprintFilename	50	The filename of the primary blueprint file that defined the format used to write this file.
BlueprintVersion	10	The BlueprintVersion of the format definition
TKIOVersion	50	The version of TKIO used to create I/O routines to write this file. TKIOVersion does not define the format used to write this file.
MetadataStyle	50	The style in which the metadata was written, e.g., "PVL". "PVL" means < parameter >=< value >;
EndianType	50	The endian type of the system that wrote this file. Values are "BIG ENDIAN" and "LITTLE ENDIAN".

1.2.2. Data Group

Elements of data group are explained in detail in this section.

1.2.2.1 S1 (Swath)

(1) S1_SwathHeader (Metadata)

S1_SwathHeader contains metadata for swaths.

Table 1.2-5 S1_SwathHeader Group

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	The scans read by TKreadScan are a "set". For single swath data, one scan is read so NumberScansInSet=1. For multiple swath data, one TKreadScan may read more than one scan. For example, for SSM/I data one TKreadScan reads one low frequency scan and two high frequency scans. Therefore NumberScansInSet=1 for the low frequency swath and NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in S1)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime_sec is expressed as the UTC seconds of the day.

Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Table 1.2-6 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOfMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecoundOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude (4-byte float, array size: npix1 x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsoid. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-7 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(4) Longitude (4-byte float, array size: npix1 x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsoid. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-8 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(5) scanStatus (Group in S1)

dataQuality (1-byte integer, array size: nscan)

A summary of data quality in the scan. Unless this is 0 (normal), the scan data is meaningless to higher precipitation processing. Bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0, the unsigned integer value is 2^{**i}).

Bit Meaning if bit = 1

- 0 missing
- 5 geoError is not zero
- 6 modeStatus is not zero

missing (1-byte integer, array size: nscan)

Indicates whether information is contained in the scan data. The values are:

Bit Meaning if bit = 1

- 0 Scan is missing
- 1 Science telemetry packet missing
- 2 Science telemetry segment withing packet missing
- 3 Science telemetry other missing
- 4 Housekeeping (HK) telemetry packet missing
- 5 Spare (always 0)
- 6 Spare (always 0)
- 7 Spare (always 0)

modeStatus (1-byte integer, array size: nscan)

A summary of status modes. If all status modes are routine, all bits in modeStatus = 0. Routine means that scan data has been measured in the normal operational situation as far as the status modes are concerned. modeStatus does not assess geolocation quality. modeStatus is broken into 8 bit flags. Each bit = 0 if the status is routine but the bit = 1 if the status is not routine. Bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0, the unsigned integer value is 2^{**i}). The non-routine situations follow:

Bit Meaning if bit = 1

- 0 Spare (always 0)
- 1 SCorientation not 0 or 180
- 2 pointingStatus not 0
- 3 Spare (always 0)
- 4 Non-routine operationalMode
- 5 Spare (always 0)
- 6 Spare (always 0)
- 7 Spare (always 0)

geoError (2-byte integer, array size: nscan)

A summary of geolocation errors in the scan. geoError is used to set a bit in dataQuality. A zero integer value of geoError indicates 'good' geolocation. A non-zero value broken down into the bit flags below indicates the specified reason, where bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0 the unsigned integer value is 2^{**i}).

Bits 0, 4, 5, 8 and 9 are per pixel error flags. If the number of bad pixels (for any of the reasons specified by these flags) is greater than the threshold then bit 7 = 1 and each of these flags is set to 1 if any pixel is bad for that reason. At launch this threshold is zero, so data is flagged if any pixel is bad. If the number of bad pixels is less than or equal to the threshold then bit 7 = 0 and all of these flags are also 0.

Bit Meaning if bit = 1

- 0 Latitude limit exceeded for viewed pixel locations
- 1 Negative scan time, invalid input
- 2 Error getting spacecraft attitude at scan mid-time

- 3 Error getting spacecraft ephemeris at scan mid-time
- 4 Invalid input non-unit ray vector for any pixel
- 5 Ray misses Earth for any pixel with normal pointing
- 6 Nadir calculation error for subsatellite position
- 7 Pixel count with geolocation error over threshold
- 8 Error in getting spacecraft attitude for any pixel
- 9 Error in getting spacecraft ephemeris for any pixel
- 10 Spare (always 0)
- 11 Spare (always 0)
- 12 Spare (always 0)
- 13 Spare (always 0)
- 14 Spare (always 0)
- 15 Spare (always 0)

geoWarning (2-byte integer, array size: nscan)

A summary of geolocation warnings in the scan. geoWarning does not set a bit in dataQuality. Warnings indicate unusual conditions. These conditions do not indicate bad geolocation but are flagged as a warning that further review of the data may be useful. A zero integer value indicates usual geolocation. A non-zero value broken down into the following bit flags indicates the following, where bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0 the unsigned integer value is 2^{*i}):

Bit Meaning if bit = 1

- 0 Ephemeris Gap Interpolated
- 1 Attitude Gap Interpolated
- 2 Attitude jump/discontinuity
- 3 Attitude out of range
- 4 Anomalous Time Step
- 5 GHA not calculated due to error
- 6 SunData (Group) not calculated due to error
- 7 Failure to calculate Sun in inertial coordinates
- 8 Fallback to GES ephemeris
- 9 Fallback to GEONS ephemeris
- 10 Fallback to PVT ephemeris
- 11 Fallback to OBP ephemeris
- 12 Spare (always 0)
- 13 Spare (always 0)
- 14 Spare (always 0)
- 15 Spare (always 0)

SCorientation (2-byte integer, array size: nscan)

The positive angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. We define v in the same direction as the spacecraft axis +X, which is also the center of the GMI scan. If SCorientation is not 0 or 180, a bit is set to 1 in modeStatus.

Value Meaning

- 0 +X forward (yaw 0)
- 180 -X forward (yaw 180)
- 8000 Non-nominal pointing
- 9999 Missing

pointingStatus (2-byte integer, array size: nscan)

pointingStatus is provided by the geo Toolkit. A value of zero means the pointing is good. Non-zero values indicate non-nominal pointing. If pointingStatus is non-zero, a bit in modeStatus is set to 1.

Value Meaning

- 0 Nominal pointing in Mission Science Mode
- 1 GPS point solution stale and PVT ephemeris used
- 2 GEONS solution stale and GEONS ephemeris used
- 8000 Non-nominal mission science orientation
- 9999 Missing

acsModeMidScan (1-byte integer, array size: nscan)

acsModeMidScan is provided by the geo Toolkit as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

- 0 LAUNCH
- 1 RATENULL
- 2 SUNPOINT
- 3 GSPM (Gyro-less Sun Point)
- 4 MSM (Mission Science Mode)
- 5 SLEW
- 6 DELTAH
- 7 DELTAV
- 99 UNKNOWN -- ACS mode unavailable

targetSelectionMidScan (1-byte integer, array size: nscan)

targetSelectionMidScan is provided by the geo Toolkit as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

- 0 S/C Z axis nadir, +X in flight direction
- 1 Flight Z axis nadir, +X in flight direction
- 2 S/C Z axis nadir, -X in flight direction
- 3 Flight Z axis nadir, -X in flight direction
- 4 +90 yaw for DPR antenna pattern calibration
- 5 -90 yaw for DPR antenna pattern calibration
- 99 Missing

operationalMode (1-byte integer, array size: nscan)

Status of the GMI instrument.

Bit Meaning if bit = 1

- 0 Receiver status (0=ON, 1=OFF)
- 1 Spinup Status (0=ON, 1=OFF)

FractionalGranuleNumber (8-byte float, array size: nscan)

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

- 9999.9 Missing value

Table 1.2-9 scanStatus Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	dataQuality	0	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
2	missing	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
3	modeSatus	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
4	geoError	-	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
5	geoWarning	-	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.1. S1 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
6	SCorientation	-9999	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
7	pointingStatus	-9999	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
8	acsModeMidScan	-99	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
9	targetSelectionMidScan	-99	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
10	operationalMode	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
11	FractionalGranuleNumber	-9999.9	-	-	-	8-byte float	8 x nscan	8	nscan	1	1

(6) sampleHeader (Group in S1)

blanking (1-byte integer, array size: nscan)

Value of 0 = Table 0 used for hot and cold samples,

No blanking

Value of 1 = Table 1 used for hot and cold samples,

Blanking on both sides

Value of 2 = Table 2 used for hot and cold samples,

Blanking on begin side

Value of 3 = Table 3 used for hot and cold samples,

Blanking on end side

earthViewFirstSample (2-byte integer, array size: nscan)

Sample number of the first earth view. Values range from 0 to 512. Special values are defined as:

-9999 Missing value

sampleNumber (2-byte integer, array size: nsamt x nchan1 x nscan)

Number of valid samples in scan. Values range from 0 to 512. Special values are defined as:

-9999 Missing value

tachSeconds (4-byte unsigned integer, array size: ntach x nscan)

Tachometer seconds. Special values are defined as:

0 Missing value

tachMicroSeconds (2-byte unsigned integer, array size: ntach x nscan)

Tachometer microseconds. Special values are defined as:

0 Missing value

Table 1.2-10 sampleHeader Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	blanking	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
2	earthViewFirstSample	-9999	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
3	sampleNumber	-9999	-	-	-	2-byte integer	2 x 4 x 9 x nscan	2	nsamt	nchan1	nscan
4	tachSeconds	0	-	-	-	4-byte unsigned int	4 x 32 x nscan	4	ntach	nscan	1
5	tachMicroSeconds	0	-	-	-	2-byte unsigned int	4 x 32 x nscan	2	ntach	nscan	1

(7) navigation (Group in S1)

scPos (4-byte float, array size: XYZ x nscan)

The position vector(m) of the spacecraft in Earth-Centered Earth Fixed (ECEF) Coordinates at the Scan mid-Time (i.e., time at the middle pixel/IFOV of the active scan period). Values range from -10000000 to 10000000 m. Special values are defined as:

-9999.9 Missing value

scVel (4-byte float, array size: XYZ x nscan)

The velocity vector (ms⁻¹) of the spacecraft in ECEF Coordinates at the Scan mid-Time. Values range from -10000000 to 10000000 m/s. Special values are defined as:

-9999.9 Missing value

scLat (4-byte float, array size: nscan)

The geodetic latitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -70 to 70 degrees. Special values are defined as:

-9999.9 Missing value

scLon (4-byte float, array size: nscan)

The geodetic longitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAlt (4-byte float, array size: nscan)

The altitude (m) of the spacecraft above the Earth Ellipsoid at the Scan mid-Time. Values range from 350000 to 500000 m. Special values are defined as:

-9999.9 Missing value

dprAlt (4-byte float, array size: nscan)

The altitude (m) of the spacecraft above the Earth Ellipsoid at the Scan mid-Time from DPR science telemetry. This is empty in non-DPR products. Values range from 350000 to 500000 m. Special values are defined as:

-9999.9 Missing value

scAttRollGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Orbital Coordinates to the spacecraft body coordinates. Orbital Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geocentric nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Note this is geocentric, not geodetic, referenced, so that pitch and roll will have twice orbital frequency components due to the onboard control system following the oblate geodetic Earth horizon. Note also that the yaw value will show an orbital frequency component relative to the Earth fixed ground track due to the Earth rotation relative to inertial coordinates. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttPitchGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler pitch angle (degrees) at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttYawGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees. Special values are defined as:

-9999.9 Missing value

scAttRollGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Geodetic Coordinates to the spacecraft body coordinates. Geodetic Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geodetic nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttPitchGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler pitch angle (degrees) at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttYawGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees. Special values are defined as:

-9999.9 Missing value

greenHourAng (4-byte float, array size: nscan)

The rotation angle (degrees) from Geocentric Inertial Coordinates to Earth Fixed Coordinates. Values range from 0 to 360 degrees. Special values are defined as:

-9999.9 Missing value

timeMidScan (8-byte float, array size: nscan)

The Scan mid-Time in GPS Atomic time, namely the seconds since 0000 UTC, 6 Jan 1980. timeMidScan is used as the reference time for the scPos and scVel values. Values range from 0 to 10000000000 s. Special values are defined as:

-9999.9 Missing value

timeMidScanOffset (8-byte float, array size: nscan)

Offset from the secondary header packet time to the timeMidScan. Values range from 0 to 100 s. Special values are defined as:

-9999.9 Missing value

Table 1.2-11 navigation Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	scPos	-9999.9	-10000000	10000000	[m]	4-byte float	4 x 3 x nscan	4	XYZ	nscan	1
2	scVel	-9999.9	-10000000	10000000	[ms ⁻¹]	4-byte float	4 x 3 x nscan	4	XYZ	nscan	1
3	scLat	-9999.9	-70	70	[decimal degree]	4-byte float	4 x nscan	4	nacan	1	1
4	scLon	-9999.9	-180	180	[decimal degree]	4-byte float	4 x nscan	4	nacan	1	1
5	scAlt	-9999.9	350000	500000	[m]	4-byte float	4 x nscan	4	nacan	1	1
6	dprAlt	-9999.9	350000	500000	[m]	4-byte float	4 x nscan	4	nacan	1	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.1. S1 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
7	scAttRollGeoc	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
8	scAttPitchGeoc	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
9	scAttYawGeoc	-9999.9	-135	225	[degree]	4-byte float	4 x nscan	4	nacan	1	1
10	scAttRollGeod	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
11	scAttPitchGeod	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
12	scAttYawGeod	-9999.9	-135	225	[degree]	4-byte float	4 x nscan	4	nacan	1	1
13	greenHourAng	-9999.9	0	360	[degree]	4-byte float	4 x nscan	4	nacan	1	1
14	timeMidScan	-9999.9	0	10000000000	-	8-byte float	8 x nscan	8	nacan	1	1
15	timeMidScanOffset	-9999.9	0	100	-	8-byte float	8 x nscan	8	nacan	1	1

(8) calibration (Group in S1)

hotLoadTemp (4-byte float, array size: nchan1 x nscan)

The mean physical temperature for the temperature sensors attached to the hot load. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

coldSkyTemp (4-byte float, array size: nchan1 x nscan)

The mean cold sky temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

onOrbitNonLinearity (4-byte float, array size: nchan1 x nscan)

The on Orbit Non-Linearity. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

derivedNonLinearity (4-byte float, array size: nchan1 x nscan)

The derived Non-Linearity. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

meanHotLoadCount (2-byte unsigned integer, array size: nchan1 x nscan)

The mean Hot Load Count. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanHotLoadCntnDiode (2-byte unsigned integer, array size: nchan1 x nscan)

The mean Hot Load Count Plus Noise Diode. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanColdSkyCount (2-byte unsigned integer, array size: nchan1 x nscan)

The mean Cold Sky Count. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanColdSkyCntnDiode (2-byte unsigned integer, array size: nchan1 x nscan)

The mean Cold Sky Count Plus Noise Diode. Values range from 0 to 15. Special values are defined as:

65535 Missing value

diodeCoupledTemp (4-byte float, array size: nchan1 x nscan)

The diode Coupled Temp. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

gain (4-byte float, array size: LNL x nchan1 x nscan)

Automatic gain control. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

offset (4-byte float, array size: LNL x nchan1 x nscan)

Offset. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

nonLinearGain (4-byte float, array size: nchan1 x nscan)

The nonlinear gain. Special values are defined as:

-9999.9 Missing value

calibrationQCflag (2-byte integer, array size: nscan)

calibrationQCflag. Values range from 0 to 15. Special values are defined as:

-9999 Missing value

diodeFlag (2-byte integer, array size: nscan)

Diode flag. If diodeFlag = 1, use LoadPlusDiodeReading If diodeFlag = 0, use LoadReading Values range from 0 to 1 counts. Special values are defined as:

-9999 Missing value

receiverTemp (4-byte float, array size: nchan1 x nscan)

The receiver temperature. Special values are defined as:

-9999.9 Missing value

receiverGain (4-byte float, array size: nchan1 x nscan)

The receiver gain. Special values are defined as:

-9999.9 Missing value

Table 1.2-12 calibraion Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	hotLoadTep	-9999.9	0	400	[K]	4-byte float	4 x 9 x nscan	4	ncahn1	nscan	1
2	coldSkytemp	-9999.9	0	400	[K]	4-byte float	4 x 9 x nscan	4	ncahn1	nscan	1
3	onOrbitNonLinearty	-9999.9	0	400	[K]	4-byte float	4 x 9 x nscan	4	ncahn1	nscan	1
4	derivedNonLinearity	-9999.9	0	400	[K]	4-byte float	4 x 9 x nscan	4	ncahn1	nscan	1
5	meanHotLoatCount	65535	0	15		2-byte unsigned int	2 x 9 x nscan	2	ncahn1	nscan	1
6	meanHotLoadCntnDiode	65535	0	15		2-byte unsigned int	2 x 9 x nscan	2	ncahn1	nscan	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.1. S1 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
7	meanColdSkyCount	65535	0	15		2-byte unsigned int	2 x 9 x nscan	2	nchan1	nscan	1
8	diodeCoupledTemp	-9999.9	0	400	[K]	4-byte float	4 x 9 x nscan	4	nchan1	nscan	1
9	Gain	-9999.9	0	400	[K]	4-byte float	4 x 2 x 9 x nscan	4	LNL	nchan1	nscan
10	offset	-9999.9	0	400	[K]	4-byte float	4 x 2 x 9 x nscan	4	LNL	nchan1	nscan
11	nonLinearGain	-9999.9	-	-	-	4-byte float	4 x 9 x nscan	4	nchan1	nscan	1
12	calibrationQCflag	-9999	0	15	-	2-byte integer	2 x nscan	2	nscan	1	1
13	diodeFlag	-9999	0	1	-	2-byte integer	2 x nscan	2	nscan	1	1
14	receiverTemp	-9999.9	-	-	-	4-byte float	4 x 9 x nscan	4	nchan1	nscan	1
15	receiverGain	-9999.9	-	-	-	4-byte float	4 x 9 x nscan	4	nchan1	nscan	1

(9) moonVectorInstFrame (4-byte float, array size: GMlxyz x nscan)

The x, y, z components of the moon vector in the GMI instrument coordinate system. Values are in counts. Special values are defined as:

-9999.9 Missing value

Table 1.2-13 moonVectorInstFrame Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	moonVectorInstFrame	-9999.9	-	-	-	4-byte float	4 x 3 x nscan	4	GMlxyz	nscan	1

(10) calCounts (Group in S1)

hotLoadThermisterTemp (4-byte float, array size: ntherm x nchan1 x nscan)

Hot Load Thermister Temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

hotLoadReading (2-byte unsigned integer, array size: nhots1 x nchan1 x nscan)

Hot Load Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

coldLoadReading (2-byte unsigned integer, array size: ncolds1 x nchan1 x nscan)

Cold Load Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

hotLoadnDiodeReading (2-byte unsigned integer, array size: nhots1 x nchan1 x nscan)

Hot Load Plus Diode Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

coldLoadnDiodeReading (2-byte unsigned integer, array size: ncolds1 x nchan1 x nscan)

Cold Load Plus Diode Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

Table 1.2-14 calCounts Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	hotLoadThemisterTep	-9999.9	0	400	[K]	4-byte float	4 x 11 x 9 x nscan	4	ntherm	nchan1	nscan
2	hotLoadReading	0	0	15	-	2-byte unsigned int	4 x 65 x 9 x nscan	2	nhots1	nchan1	nscan
3	coldLoadReading	0	0	15	-	2-byte unsigned int	4 x 85 x 9 x nscan	2	ncolds1	nchan1	nscan
4	hotloadnDiodeReading	0	0	15	-	2-byte unsigned int	4 x 65 x 9 x nscan	2	nhots1	nchan1	nscan
5	coldLoadnDiodeReading	0	0	15	-	2-byte unsigned int	4 x 85 x 9 x nscan	2	ncolds1	nchan1	nscan

(11) sunData (Group in S1)

solarBetaAngle (4-byte float, array size: nscan)

Sun direction elevation from the orbit plane, positive toward orbit normal which is given by the cross product of the spacecraft position and velocity vectors. Values range from -89.0 to 89.0 degrees. Special values are defined as:

-9999.9 Missing value

phaseFromOrbitMidnight (4-byte float, array size: nscan)

Phase angle of the Sun direction around the orbit plane, with zero phase in the direction of the Earth center from the spacecraft and positive toward the spacecraft velocity direction so the phase increases with time. Zero phase occurs at local orbit midnight, 90 degrees occurs with the spacecraft over the Earth's dawn terminator, 180 degrees occurs at local orbit noon, and -90 degrees occurs with the spacecraft over the Earth's dusk terminator. Values range from -180.0 to 180.0 degrees. Special values are defined as:

-9999.9 Missing value

sunEarthSeparation (4-byte float, array size: nscan)

The separation angle between the Sun and Earth directions from the spacecraft. Values range from 0 to 180.0 degrees. Special values are defined as:

-9999.9 Missing value

earthAngularRadius (4-byte float, array size: nscan)

The angle between the center of the Earth and the horizon edge. The sun is above the Earth horizon when the sunEarthSeparation is greater than the earthAngularRadius. Values range from 69.0 to 80.0 degrees. Special values are defined as:

-9999.9 Missing value

phaseOfEclipseExit (4-byte float, array size: nscan)

The estimated phaseFromOrbitMidnight where the spacecraft leaves the Earth shadow, based on the instantaneous solarBetaAngle and earthAngularRadius. Values range from 0.0 to 80.0 degrees. Special values are defined as:

-9999.9 Missing value

orbitRate (4-byte float, array size: nscan)

The instantaneous angular rate of the spacecraft around the orbit. Values range from 0.064 to 0.07 degrees/s. Special values are defined as:

-9999.9 Missing value

timeSinceEclipseEntry (4-byte float, array size: nscan)

The estimated duration in seconds since the last entry into the Earth's shadow. Values range from 0 to 5600.0 s. Special values are defined as:

-9999.9 Missing value

sunVectorInBodyFrame (4-byte float, array size: 3 x nscan)

The unit sun vector direction in the TMI instrument body coordinate frame, defined such that +Z is nominally toward the Earth and gives the instrument spin axis, and data is collected nominally centered about the +X direction. Values range from 0 to 1.0. Special values are defined as:

-9999.9 Missing value

Table 1.2-15 sunData Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarBetaAngle	-9999.9	-89.0	89.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
2	phaseFromOrbitMidnight	-9999.9	-180.0	180.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
3	sunEarthSeparation	-9999.9	0	180.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
4	earthAngularRadius	-9999.9	69.0	80.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
5	phaseOfEclipseExit	-9999.9	0.0	80.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
6	orbitRate	-9999.9	0.064	0.07	[degree/s]	4-byte float	4 x nscan	4	nscan	1	1
7	timeSinceEclipseEntry	-9999.9	0	5600.0	[s]	4-byte float	4 x nscan	4	nscan	1	1
8	sunVectorInBodyFrame	-9999.9	0	1.0	-	4-byte float	4 x nscan	4	3	nscan	1

(12) incidenceAngle (4-byte float, array size: npix1 x nscan)

The angle at the center of the IFOV between the antenna boresight vector and the zenith vector normal to the Earth Ellipsoid. Also known as Satellite Zenith Angle. Values range from 0 to 90 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-16incidenceAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	incidenceAngle	-9999.9	0	90	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(13) satAzimuthAngle (4-byte float, array size: npix1 x nscan)

The angle clockwise looking down between the local pixel geodetic north and the direction to the satellite. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-17 satAzimuthAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	satAzimuthAngle	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(14) solarZenAngle (4-byte float, array size: npix1 x nscan)

The angle between the local pixel geodetic zenith and the direction to the sun. Values range from 0 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-18 solarZenAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarZenAngle	-9999.9	0	180	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(15) solarAzimuthAngle (4-byte float, array size: npix1 x nscan)

The angle clockwise looking down between the local pixel geodetic north and the direction to the sun.

Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-19 solarAzimuthAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarAzimuthAngle	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(16) sunGlintAngle (4-byte float, array size: npix1 x nscan)

Conceptually, the angle between the sun and the instrument view direction as reflected off the Earth's surface. More specifically, define a Sun Vector from the viewed pixel location on the earth ellipsoid-model surface to the sun. Also define an Inverse Satellite Vector from the pixel to the satellite. Then reflect the Inverse Satellite Vector off the earth's surface at the pixel location to form the Reflected Satellite View Vector. sunGlintAngle is the angular separation between the Reflected Satellite View Vector and the Sun Vector. When sunGlintAngle is zero, the instrument views the center of the specular (mirror-like) sun reflection. Values range from 0 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-20 sunGlintAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	sunGlintAngle	-9999.9	0	180	[degree]	4-byte float	4 x 221 x nscan	4	npix1	nscan	1

(17) Tb (4-byte float, array size: nchan1 x npix1 x nscan)

Earth view brightness temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

Table 1.2-21 Tb Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Tb	-9999.9	0	400	[K]	4-byte float	4 x 9 x 221 x nscan	4	nchan1	npix1	nscan

(18) RFIFlag (2-byte integer, array size: nfreq1 x npix1 x nscan)

Radio Frequency Interference (RFI) Flag. The flag is set to non-zero if the pixel is contaminated by

RFI according to certain filters. Current values are:

- 0 Not affected by RFI.
- 1 Affected by RFI with X-cal filter.
- 2 Affected by RFI with RSS filter.
- 3-7 Spare
- 9999 Missing

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.1. S1 (Swath)

Table 1.2-22 RFIFlag Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	RFIFlag	-9999.9	0	7	-	2-byte integer	2 x 5 x 221 x nscan	2	nfreq1	npix1	nscan

1.2.2.2 S2 (Swath)

(1) S2_SwathHeader (Metadata)

S2_SwathHeader contains metadata for swaths.

Table 1.2-23 S2_SwathHeader Group

Metadata Element	Estimated Size (bytes)	Description
NumberScansInSet	50	The scans read by TKreadScan are a "set". For single swath data, one scan is read so NumberScansInSet=1. For multiple swath data, one TKreadScan may read more than one scan. For example, for SSM/I data one TKreadScan reads one low frequency scan and two high frequency scans. Therefore NumberScansInSet=1 for the low frequency swath and NumberScansInSet=2 for the high frequency swath.
MaximumNumberScansTotal	50	The maximum allowed number of total scans in this swath. Total scans = overlap scans before granule + scans in granule + overlap scans after granule.
NumberScansBeforeGranule	50	The number of overlap scans before the first scan of the granule in this swath.
NumberScansGranule	50	The number of scans in the granule in this swath.
NumberScansAfterGranule	50	The number of overlap scans after the last scan of the granule in this swath.
NumberPixels	50	The number of IFOV in each scan in this swath.
ScanType	50	The type of scan in this swath. Values are: "CROSSTRACK" and "CONICAL"

(2) ScanTime (Group in S2)

Year (2-byte integer, array size: nscan)

4-digit year, e.g., 1998. Values range from 1950 to 2100 years. Special values are defined as:

-9999 Missing value

Month (1-byte integer, array size: nscan)

Month of the year. Values range from 1 to 12 months. Special values are defined as:

-99 Missing value

DayOfMonth (1-byte integer, array size: nscan)

Day of the month. Values range from 1 to 31 days. Special values are defined as:

-99 Missing value

Hour (1-byte integer, array size: nscan)

UTC hour of the day. Values range from 0 to 23 hours. Special values are defined as:

-99 Missing value

Minute (1-byte integer, array size: nscan)

Minute of the hour. Values range from 0 to 59 minutes. Special values are defined as:

-99 Missing value

Second (1-byte integer, array size: nscan)

Second of the minute. Values range from 0 to 60 s. Special values are defined as:

-99 Missing value

MilliSecond (2-byte integer, array size: nscan)

Thousandths of the second. Values range from 0 to 999 ms. Special values are defined as:

-9999 Missing value

DayOfYear (2-byte integer, array size: nscan)

Day of the year. Values range from 1 to 366 days. Special values are defined as:

-9999 Missing value

SecondOfDay (8-byte float, array size: nscan)

A time associated with the scan. scanTime sec is expressed as the UTC seconds of the day. Values range from 0 to 86400 s. Special values are defined as:

-9999.9 Missing value

Table 1.2-24 ScanTime Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Year	-9999	1950	2100	[year]	2-byte integer	2 x nscan	2	nscan	1	1
2	Month	-99	1	12	[month]	1-byte integer	1 x nscan	1	nscan	1	1
3	DayOfMonth	-99	1	31	[day]	1-byte integer	1 x nscan	1	nscan	1	1
4	Hour	-99	0	23	[hour]	1-byte integer	1 x nscan	1	nscan	1	1
5	Minute	-99	0	59	[minute]	1-byte integer	1 x nscan	1	nscan	1	1
6	Second	-99	0	60	[s]	1-byte integer	1 x nscan	1	nscan	1	1
7	MilliSecond	-9999	0	999	[ms]	2-byte integer	2 x nscan	2	nscan	1	1
8	DayOfYear	-9999	1	366	[day]	2-byte integer	2 x nscan	2	nscan	1	1
9	SecondOfDay	-9999.9	0	86400	[s]	8-byte float	8 x nscan	8	nscan	1	1

(3) Latitude(4-byte float, array size: npix2 x nscan)

The earth latitude of the center of the IFOV at the altitude of the earth ellipsoid. Latitude is positive north, negative south. Values range from -90 to 90 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-25 Latitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Latitude	-9999.9	-90	90	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(4) Longitude (4-byte float, array size: npix2 x nscan)

The earth longitude of the center of the IFOV at the altitude of the earth ellipsoid. Longitude is positive east, negative west. A point on the 180th meridian has the value -180 degrees. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-26 Longitude Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	Longitude	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(5) scanStatus (Group in S2)

dataQuality (1-byte integer, array size: nscan)

A summary of data quality in the scan. Unless this is 0 (normal), the scan data is meaningless to

higher precipitation processing. Bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0, the unsigned integer value is 2^{**i}).

Bit Meaning if bit = 1

- 0 missing
- 5 geoError is not zero
- 6 modeStatus is not zero

missing (1-byte integer, array size: nscan)

Indicates whether information is contained in the scan data. The values are:

Bit Meaning if bit = 1

- 0 Scan is missing
- 1 Science telemetry packet missing
- 2 Science telemetry segment withing packet missing
- 3 Science telemetry other missing
- 4 Housekeeping (HK) telemetry packet missing
- 5 Spare (always 0)
- 6 Spare (always 0)
- 7 Spare (always 0)

modeStatus (1-byte integer, array size: nscan)

A summary of status modes. If all status modes are routine, all bits in modeStatus = 0. Routine means that scan data has been measured in the normal operational situation as far as the status modes are concerned. modeStatus does not assess geolocation quality. modeStatus is broken into 8 bit flags. Each bit = 0 if the status is routine but the bit = 1 if the status is not routine. Bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0, the unsigned integer value is 2^{**i}). The non-routine situations follow:

Bit Meaning if bit = 1

- 0 Spare (always 0)
- 1 SCorientation not 0 or 180
- 2 pointingStatus not 0
- 3 Spare (always 0)
- 4 Non-routine operationalMode
- 5 Spare (always 0)
- 6 Spare (always 0)
- 7 Spare (always 0)

geoError (2-byte integer, array size: nscan)

A summary of geolocation errors in the scan. geoError is used to set a bit in dataQuality. A zero integer value of geoError indicates 'good' geolocation. A non-zero value broken down into the bit flags below indicates the specified reason, where bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0 the unsigned integer value is 2^{**i}). Bits 0, 4, 5, 8 and 9 are per pixel error flags. If the number of bad pixels (for any of the reasons specified by these flags) is greater than the threshold then bit 7 = 1 and each of these flags is set to 1 if any pixel is bad for that reason. At launch this threshold is zero, so data is flagged if any pixel is bad. If the number of bad pixels is less than or equal to the threshold then bit 7 = 0 and all of these flags are also 0.

Bit Meaning if bit = 1

- 0 Latitude limit exceeded for viewed pixel locations
- 1 Negative scan time, invalid input
- 2 Error getting spacecraft attitude at scan mid-time
- 3 Error getting spacecraft ephemeris at scan mid-time
- 4 Invalid input non-unit ray vector for any pixel
- 5 Ray misses Earth for any pixel with normal pointing
- 6 Nadir calculation error for subsatellite position

- 7 Pixel count with geolocation error over threshold
- 8 Error in getting spacecraft attitude for any pixel
- 9 Error in getting spacecraft ephemeris for any pixel
- 10 Spare (always 0)
- 11 Spare (always 0)
- 12 Spare (always 0)
- 13 Spare (always 0)
- 14 Spare (always 0)
- 15 Spare (always 0)

geoWarning (2-byte integer, array size: nscan)

A summary of geolocation warnings in the scan. geoWarning does not set a bit in dataQuality. Warnings indicate unusual conditions. These conditions do not indicate bad geolocation but are flagged as a warning that further review of the data may be useful. A zero integer value indicates usual geolocation. A non-zero value broken down into the following bit flags indicates the following, where bit 0 is the least significant bit (i.e., if bit $i = 1$ and other bits = 0 the unsigned integer value is 2^{**i}):

Bit Meaning if bit = 1

- 0 Ephemeris Gap Interpolated
- 1 Attitude Gap Interpolated
- 2 Attitude jump/discontinuity
- 3 Attitude out of range
- 4 Anomalous Time Step
- 5 GHA not calculated due to error
- 6 SunData (Group) not calculated due to error
- 7 Failure to calculate Sun in inertial coordinates
- 8 Fallback to GES ephemeris
- 9 Fallback to GEONS ephemeris
- 10 Fallback to PVT ephemeris
- 11 Fallback to OBP ephemeris
- 12 Spare (always 0)
- 13 Spare (always 0)
- 14 Spare (always 0)
- 15 Spare (always 0)

SCorientation (2-byte integer, array size: nscan)

The positive angle of the spacecraft vector (v) from the satellite forward direction of motion, measured clockwise facing down. We define v in the same direction as the spacecraft axis +X, which is also the center of the GMI scan. If SCorientation is not 0 or 180, a bit is set to 1 in modeStatus.

Value Meaning

- 0 +X forward (yaw 0)
- 180 -X forward (yaw 180)
- 8000 Non-nominal pointing
- 9999 Missing

pointingStatus (2-byte integer, array size: nscan)

pointingStatus is provided by the geo Toolkit. A value of zero means the pointing is good. Non-zero values indicate non-nominal pointing. If pointingStatus is non-zero, a bit in modeStatus is set to 1.

Value Meaning

- 0 Nominal pointing in Mission Science Mode
- 1 GPS point solution stale and PVT ephemeris used
- 2 GEONS solution stale and GEONS ephemeris used
- 8000 Non-nominal mission science orientation

-9999 Missing

acsModeMidScan (1-byte integer, array size: nscan)

acsModeMidScan is provided by the geo Toolkit as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

- 0 LAUNCH
- 1 RATENULL
- 2 SUNPOINT
- 3 GSPM (Gyro-less Sun Point)
- 4 MSM (Mission Science Mode)
- 5 SLEW
- 6 DELTAH
- 7 DELTAV
- 99 UNKNOWN -- ACS mode unavailable

targetSelectionMidScan (1-byte integer, array size: nscan)

targetSelectionMidScan is provided by the geo Toolkit as taken from Attitude Control System telemetry and is provided in this format for information only.

Value Meaning

- 0 S/C Z axis nadir, +X in flight direction
- 1 Flight Z axis nadir, +X in flight direction
- 2 S/C Z axis nadir, -X in flight direction
- 3 Flight Z axis nadir, -X in flight direction
- 4 +90 yaw for DPR antenna pattern calibration
- 5 -90 yaw for DPR antenna pattern calibration
- 99 Missing

operationalMode (1-byte integer, array size: nscan)

Status of the GMI instrument.

Bit Meaning if bit = 1

- 0 Receiver status (0=ON, 1=OFF)
- 1 Spinup Status (0=ON, 1=OFF)

FractionalGranuleNumber (8-byte float, array size: nscan)

The floating point granule number. The granule begins at the Southern-most point of the spacecraft's trajectory. For example, FractionalGranuleNumber = 10.5 means the spacecraft is halfway through granule 10 and starting the descending half of the granule. Values range from 0 to 100000. Special values are defined as:

-9999.9 Missing value

Table 1.2-27 scanStatus Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	dataQuality	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
2	missing	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
3	modeSatus	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
4	geoError	-	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
5	geoWarning	-	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
6	SCorientation	-9999	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1
7	pointingStatus	-9999	-	-	-	2-byte integer	2 x nscan	2	nscan	1	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.2. S2 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
8	acsModeMidScan	-99	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
9	targetSelectionMidScan	-99	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
10	operationalMode	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
11	FractionalGranuleNumber	-9999.9	-	-	-	8-byte float	8 x nscan	8	nscan	1	1

(6) sampleHeader (Group in S2)

blanking (1-byte integer, array size: nscan)

Value of 0 = Table 0 used for hot and cold samples,

No blanking

Value of 1 = Table 1 used for hot and cold samples,

Blanking on both sides

Value of 2 = Table 2 used for hot and cold samples,

Blanking on begin side

Value of 3 = Table 3 used for hot and cold samples,

Blanking on end side

earthViewFirstSample (2-byte integer, array size: nscan)

Sample number of the first earth view. Values range from 0 to 512. Special values are defined as:

-9999 Missing value

sampleNumber (2-byte integer, array size: nsamt x nchan2 x nscan)

Number of valid samples in scan. Values range from 0 to 512. Special values are defined as:

-9999 Missing value

tachSeconds (4-byte unsigned integer, array size: ntach x nscan)

Tachometer seconds. Special values are defined as:

0 Missing value

tachMicroSeconds (2-byte unsigned integer, array size: ntach x nscan)

Tachometer microseconds. Special values are defined as:

0 Missing value

Table 1.2-28 sampleHeader Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	blanking	-	-	-	-	1-byte integer	1 x nscan	1	nscan	1	1
2	earthViewFirstSample	-9999	0	512	-	2-byte integer	2 x nscan	2	nscan	1	1
3	sampleNumber	-9999	0	512	-	2-byte integer	2 x 4 x 4 x nscan	2	nsamt	nchan2	nscan
4	tachSeconds	0	-	-	-	4-byte unsigned int	4 x 32 x nscan	4	ntach	nscan	1
5	tachMicroSeconds	0	-	-	-	2-byte unsigned int	4 x 32 x nscan	2	ntach	nscan	1

(7) navigation (Group in S2)

scPos (4-byte float, array size: XYZ x nscan)

The position vector(m) of the spacecraft in Earth-Centered Earth Fixed (ECEF) Coordinates at the Scan mid-Time (i.e., time at the middle pixel/IFOV of the active scan period). Values range from -10000000 to 10000000 m. Special values are defined as:

-9999.9 Missing value

scVel (4-byte float, array size: XYZ x nscan)

The velocity vector (ms^{-1}) of the spacecraft in ECEF Coordinates at the Scan mid-Time. Values range from -10000000 to 10000000 m/s. Special values are defined as:

-9999.9 Missing value

scLat (4-byte float, array size: nscan)

The geodetic latitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -70 to 70 degrees. Special values are defined as:

-9999.9 Missing value

scLon (4-byte float, array size: nscan)

The geodetic longitude (decimal degrees) of the spacecraft at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAlt (4-byte float, array size: nscan)

The altitude (m) of the spacecraft above the Earth Ellipsoid at the Scan mid-Time. Values range from 350000 to 500000 m. Special values are defined as:

-9999.9 Missing value

dprAlt (4-byte float, array size: nscan)

The altitude (m) of the spacecraft above the Earth Ellipsoid at the Scan mid-Time from DPR science telemetry. This is empty in non-DPR products. Values range from 350000 to 500000 m. Special values are defined as:

-9999.9 Missing value

scAttRollGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Orbital Coordinates to the spacecraft body coordinates. Orbital Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geocentric nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Note this is geocentric, not geodetic, referenced, so that pitch and roll will have twice orbital frequency components due to the onboard control system following the oblate geodetic Earth horizon. Note also that the yaw value will show an orbital frequency component relative to the Earth fixed ground track due to the Earth rotation relative to inertial coordinates. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttPitchGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler pitch angle (degrees) at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttYawGeoc (4-byte float, array size: nscan)

The geocentric satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees. Special values are defined as:

-9999.9 Missing value

scAttRollGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler roll angle (degrees) at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Geodetic Coordinates to the spacecraft body coordinates. Geodetic Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geodetic nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttPitchGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler pitch angle (degrees) at the Scan mid-Time. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

scAttYawGeod (4-byte float, array size: nscan)

The geodetic satellite attitude Euler yaw angle (degrees) at the Scan mid-Time. Values range from -135 to 225 degrees. Special values are defined as:

-9999.9 Missing value

greenHourAng (4-byte float, array size: nscan)

The rotation angle (degrees) from Geocentric Inertial Coordinates to Earth Fixed Coordinates. Values range from 0 to 360 degrees. Special values are defined as:

-9999.9 Missing value

timeMidScan (8-byte float, array size: nscan)

The Scan mid-Time in GPS Atomic time, namely the seconds since 0000 UTC, 6 Jan 1980. timeMidScan is used as the reference time for the scPos and scVel values. Values range from 0 to 10000000000 s. Special values are defined as:

-9999.9 Missing value

timeMidScanOffset (8-byte float, array size: nscan)

Offset from the secondary header packet time to the timeMidScan. Values range from 0 to 100 s. Special values are defined as:

-9999.9 Missing value

Table 1.2-29 navigation Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	scPos	-9999.9	-10000000	10000000	[m]	4-byte float	4 x 3 x nscan	4	XYZ	nscan	1
2	scVel	-9999.9	-10000000	10000000	[ms ⁻¹]	4-byte float	4 x 3 x nscan	4	XYZ	nscan	1
3	scLat	-9999.9	-70	70	[decimal degree]	4-byte float	4 x nscan	4	nacan	1	1
4	scLon	-9999.9	-180	180	[decimal degree]	4-byte float	4 x nscan	4	nacan	1	1
5	scAlt	-9999.9	350000	500000	[m]	4-byte float	4 x nscan	4	nacan	1	1
6	dprAlt	-9999.9	350000	500000	[m]	4-byte float	4 x nscan	4	nacan	1	1
7	scAttRollGeoc	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
8	scAttPitchGeoc	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
9	scAttYawGeoc	-9999.9	-135	225	[degree]	4-byte float	4 x nscan	4	nacan	1	1
10	scAttRollGeod	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
11	scAttPitchGeod	-9999.9	-180	180	[degree]	4-byte float	4 x nscan	4	nacan	1	1
12	scAttYawGeod	-9999.9	-135	225	[degree]	4-byte float	4 x nscan	4	nacan	1	1
13	greenHourAng	-9999.9	0	360	[degree]	4-byte float	4 x nscan	4	nacan	1	1
14	timeMidScan	-9999.9	0	10000000000	-	8-byte float	8 x nscan	8	nacan	1	1
15	timeMidScanOffset	-9999.9	0	100	-	8-byte float	8 x nscan	8	nacan	1	1

(8) calibration (Group in S2)

hotLoadTemp (4-byte float, array size: nchan2 x nscan)

The mean physical temperature for the temperature sensors attached to the hot load. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

coldSkyTemp (4-byte float, array size: nchan2 x nscan)

The mean cold sky temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

onOrbitNonLinearity (4-byte float, array size: nchan2 x nscan)

The on Orbit Non-Linearity. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

derivedNonLinearity (4-byte float, array size: nchan2 x nscan)

The derived Non-Linearity. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

meanHotLoadCount (2-byte unsigned integer, array size: nchan2 x nscan)

The mean Hot Load Count. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanHotLoadCntnDiode (2-byte unsigned integer, array size: nchan2 x nscan)

The mean Hot Load Count Plus Noise Diode. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanColdSkyCount (2-byte unsigned integer, array size: nchan2 x nscan)

The mean Cold Sky Count. Values range from 0 to 15. Special values are defined as:

65535 Missing value

meanColdSkyCntnDiode (2-byte unsigned integer, array size: nchan2 x nscan)

The mean Cold Sky Count Plus Noise Diode. Values range from 0 to 15. Special values are defined as:

65535 Missing value

diodeCoupledTemp (4-byte float, array size: nchan2 x nscan)

The diode Coupled Temp. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

gain (4-byte float, array size: LNL x nchan2 x nscan)

Automatic gain control. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

offset (4-byte float, array size: LNL x nchan2 x nscan)

Offset. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

nonLinearGain (4-byte float, array size: nchan2 x nscan)

The nonlinear gain. Special values are defined as:

-9999.9 Missing value

calibrationQCflag (2-byte integer, array size: nscan)

calibrationQCflag. Values range from 0 to 15. Special values are defined as:

-9999 Missing value

diodeFlag (2-byte integer, array size: nscan)

Diode flag. If diodeFlag = 1, use LoadPlusDiodeReading If diodeFlag = 0, use LoadReading

Values range from 0 to 1 counts. Special values are defined as:

-9999 Missing value

receiverTemp (4-byte float, array size: nchan2 x nscan)

The receiver temperature. Special values are defined as:

-9999.9 Missing value

receiverGain (4-byte float, array size: nchan2 x nscan)

The receiver gain. Special values are defined as:

-9999.9 Missing value

Table 1.2-30 calibraion Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	hotLoadTemp	-9999.9	0	400	[K]	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
2	coldSkyTemp	-9999.9	0	400	[K]	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
3	onOrbitNonLinearty	-9999.9	0	400	[K]	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
4	derivedNonLinearity	-9999.9	0	400	[K]	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
5	meanHotLoatCount	65535	0	15	-	2-byte unsigned int	4 x 4 x nscan	2	nchan2	nscan	1
6	meanHotLoadCntnDiode	65535	0	15	-	2-byte unsigned int	4 x 4 x nscan	2	nchan2	nscan	1
7	meanColdSkyCount	65535	0	15	-	2-byte unsigned int	4 x 4 x nscan	2	nchan2	nscan	1
8	diodeCoupledTemp	-9999.9	0	400	[K]	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
9	Gain	-9999.9	0	400	[K]	4-byte float	4 x 2 x 4 x nscan	4	LNL	nchan2	nscan
10	offset	-9999.9	0	400	[K]	4-byte float	4 x 2 x 4 x nscan	4	LNL	nchan2	nscan
11	nonLinearGain	-9999.9	-	-	-	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
12	calibrationQCflag	-9999	0	15	-	2-byte integer	2 x nscan	2	nscan	1	1
13	diodeFlag	-9999	0	1	-	2-byte integer	2 x nscan	2	nscan	1	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.2. S2 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
14	receiverTemp	-9999.9	-	-	-	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1
15	receiverGain	-9999.9	-	-	-	4-byte float	4 x 4 x nscan	4	nchan2	nscan	1

(9) moonVectorInstFrame (4-byte float, array size: GMlxyz x nscan)

The x, y, z components of the moon vector in the GMI instrument coordinate system. Values are in counts. Special values are defined as:

-9999.9 Missing value

Table 1.2-31 moonVectorInstFrame Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	moonVectorInstFrame	-9999.9	-	-	-	4-byte float	4 x 3 x nscan	4	GMlxyz	nscan	1

(10) CalCounts (Group in S2)

hotLoadThermisterTemp (4-byte float, array size: ntherm x nchan2 x nscan)

Hot Load Thermister Temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

hotLoadReading (2-byte unsigned integer, array size: nhots2 x nchan2 x nscan)

Hot Load Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

coldLoadReading (2-byte unsigned integer, array size: ncolds2 x nchan2 x nscan)

Cold Load Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

hotLoadnDiodeReading (2-byte unsigned integer, array size: nhots2 x nchan2 x nscan)

Hot Load Plus Diode Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

coldLoadnDiodeReading (2-byte unsigned integer, array size: ncolds2 x nchan2 x nscan)

Cold Load Plus Diode Reading. Values range from 0 to 15 counts. Special values are defined as:

0 Missing value

Table 1.2-32 calCounts Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	hotLoadThemisterTep	-9999.9	0	400	[K]	4-byte float	4 x 11 x 4 x nscan	4	ntherm	nchan2	nscan
2	hotLoadReading	0	0	15	-	2-byte unsigned int	2 x 65 x 4 x nscan	2	nhots2	nchan2	nscan
3	coldLoadReading	0	0	15	-	2-byte unsigned int	2 x 85 x 4 x nscan	2	ncolds2	nchan2	nscan
4	hotloadnDiodeReading	0	0	15	-	2-byte unsigned int	2 x 65 x 4 x nscan	2	nhots2	nchan2	nscan
5	coldloadnDiodeReading	0	0	15	-	2-byte unsigned int	2 x 85 x 4 x nscan	2	ncolds2	nchan2	nscan

(11) sunData (Group in S2)

solarBetaAngle (4-byte float, array size: nscan)

Sun direction elevation from the orbit plane, positive toward orbit normal which is given by the cross product of the spacecraft position and velocity vectors. Values range from -89.0 to 89.0

degrees. Special values are defined as:

-9999.9 Missing value

phaseFromOrbitMidnight (4-byte float, array size: nscan)

Phase angle of the Sun direction around the orbit plane, with zero phase in the direction of the Earth center from the spacecraft and positive toward the spacecraft velocity direction so the phase increases with time. Zero phase occurs at local orbit midnight, 90 degrees occurs with the spacecraft over the Earth's dawn terminator, 180 degrees occurs at local orbit noon, and -90 degrees occurs with the spacecraft over the Earth's dusk terminator. Values range from -180.0 to 180.0 degrees. Special values are defined as:

-9999.9 Missing value

sunEarthSeparation (4-byte float, array size: nscan)

The separation angle between the Sun and Earth directions from the spacecraft. Values range from 0 to 180.0 degrees. Special values are defined as:

-9999.9 Missing value

earthAngularRadius (4-byte float, array size: nscan)

The angle between the center of the Earth and the horizon edge. The sun is above the Earth horizon when the sunEarthSeparation is greater than the earthAngularRadius. Values range from 69.0 to 80.0 degrees. Special values are defined as:

-9999.9 Missing value

phaseOfEclipseExit (4-byte float, array size: nscan)

The estimated phaseFromOrbitMidnight where the spacecraft leaves the Earth shadow, based on the instantaneous solarBetaAngle and earthAngularRadius. Values range from 0.0 to 80.0 degrees. Special values are defined as:

-9999.9 Missing value

orbitRate (4-byte float, array size: nscan)

The instantaneous angular rate of the spacecraft around the orbit. Values range from 0.064 to 0.07 degrees/s. Special values are defined as:

-9999.9 Missing value

timeSinceEclipseEntry (4-byte float, array size: nscan)

The estimated duration in seconds since the last entry into the Earth's shadow. Values range from 0 to 5600.0 s. Special values are defined as:

-9999.9 Missing value

sunVectorInBodyFrame (4-byte float, array size: 3 x nscan)

The unit sun vector direction in the TMI instrument body coordinate frame, defined such that +Z is nominally toward the Earth and gives the instrument spin axis, and data is collected nominally centered about the +X direction. Values range from 0 to 1.0. Special values are defined as:

-9999.9 Missing value

Table 1.2-33 sunData Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarBetaAngle	-9999.9	-89.0	89.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
2	phaseFromOrbitMidnight	-9999.9	-180.0	180.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
3	sunEarthSeparation	-9999.9	0	180.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
4	earthAngularRadius	-9999.9	69.0	80.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1

1.2. Contents of objects in each Group

1.2.2. Data Group

1.2.2.2. S2 (Swath)

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
5	phaseOfEclipseExit	-9999.9	0.0	80.0	[degree]	4-byte float	4 x nscan	4	nscan	1	1
6	orbitRate	-9999.9	0.064	0.07	[degree/s]	4-byte float	4 x nscan	4	nscan	1	1
7	timeSinceEclipseEntry	-9999.9	0	5600.0	[s]	4-byte float	4 x nscan	4	nscan	1	1
8	sunVectorInBodyFrame	-9999.9	0	1.0	-	4-byte float	4 x 3 x nscan	4	3	nscan	1

(12) incidenceAngle (4-byte float, array size: npix2 x nscan)

The angle at the center of the IFOV between the antenna boresight vector and the zenith vector normal to the Earth Ellipsoid. Also known as Satellite Zenith Angle. Values range from 0 to 90 degrees.

Special values are defined as:

-9999.9 Missing value

Table 1.2-34 incidenceAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	incidenceAngle	-9999.9	0	90	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(13) satAzimuthAngle (4-byte float, array size: npix2 x nscan)

The angle clockwise looking down between the local pixel geodetic north and the direction to the satellite. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-35 solarAzimuthAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarAzimuthAngle	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(14) solarZenAngle (4-byte float, array size: npix2 x nscan)

The angle between the local pixel geodetic zenith and the direction to the sun. Values range from 0 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-36 solarZenAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	solarZenAngle	-9999.9	0	180	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(15) solarAzimuthAngle (4-byte float, array size: npix2 x nscan)

The angle clockwise looking down between the local pixel geodetic north and the direction to the sun. Values range from -180 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-37 satAzimuthAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	satAzimuthAngle	-9999.9	-180	180	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(16) sunGlintAngle (4-byte float, array size: npix2 x nscan)

Conceptually, the angle between the sun and the instrument view direction as reflected off the Earth's surface. More specifically, define a Sun Vector from the viewed pixel location on the earth ellipsoid-model surface to the sun. Also define an Inverse Satellite Vector from the pixel to the satellite. Then reflect the Inverse Satellite Vector off the earth's surface at the pixel location to form the Reflected Satellite View Vector. sunGlintAngle is the angular separation between the Reflected Satellite View Vector and the Sun Vector. When sunGlintAngle is zero, the instrument views the center of the specular (mirror-like) sun reflection. Values range from 0 to 180 degrees. Special values are defined as:

-9999.9 Missing value

Table 1.2-38 sunGlintAngle Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	sunGlintAngle	-9999.9	0	180	[degree]	4-byte float	4 x 221 x nscan	4	npix2	nscan	1

(17) Tb (4-byte float, array size: nchan2 x npix2 x nscan)

Earth view brightness temperature. Values range from 0 to 400 K. Special values are defined as:

-9999.9 Missing value

Table 1.2-39 Tb Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	tb	-9999.9	0	400	[K]	4-byte float	4 x 4 x 221 x nscan	4	nchan2	npix2	nscan

(18) RFIFlag (2-byte integer, array size: nfreq2 x npix2 x nscan)

Radio Frequency Interference (RFI) Flag. The flag is set to non-zero if the pixel is contaminated by RFI according to certain filters. Current values are:

- 0 Not affected by RFI.
- 1 Affected by RFI with X-cal filter.
- 2 Affected by RFI with RSS filter.
- 3-7 Spare
- 9999 Missing

Table 1.2-40 RFIFlag Elements

No.	Element	Missing	Min	Max	unit	type	Data size (byte)	type	array		
1	RFIFlag	-9999.9	0	7	-	2-byte integer	4 x 2 x 221 x nscan	2	nfreq2	npix2	nscan

Index

A

acsModeMidScan..... 19, 34

B

blanking 20, 35

C

calCounts..... 25
CalCounts..... 40
calibration 23, 38
calibrationQCflag..... 24, 39
coldLoadnDiodeReading 25, 40
coldLoadReading 25, 40
coldSkyTemp 23, 38

D

dataQuality..... 17, 31
DayOfMonth..... 15, 30
DayOfYear 16, 31
derivedNonLinearity 23, 38
diodeCoupledTemp..... 24, 38
diodeFlag..... 24, 39
dprAlt 21, 36

E

earthAngularRadius 26, 41
earthViewFirstSample..... 20, 35

F

FileHeader..... 12
FileInfo..... 14
FractionalGranuleNumber..... 19, 34

G

gain..... 24, 39
geoError 17, 32
geoWarning 18, 33
greenHourAng..... 22, 37

H

hotLoadnDiodeReading 25, 40
hotLoadReading 25, 40

hotLoadTemp..... 23, 38
hotLoadThermisterTemp 25, 40
Hour 15, 30

I

incidenceAngle 27, 42
InputRecord 13

L

Latitude 16, 31
Longitude 16, 31

M

meanColdSkyCntnDiode 24, 38
meanColdSkyCount 23, 38
meanHotLoadCntnDiode 23, 38
meanHotLoadCount 23, 38
MilliSecond..... 16, 30
Minute..... 15, 30
missing 17, 32
modeStatus..... 17, 32
Month..... 15, 30
moonVectorInstFrame 25, 40

N

navigation..... 21, 35
NavigationRecord 13
nonLinearGain 24, 39

O

offset 24, 39
onOrbitNonLinearity..... 23, 38
operationalMode 19, 34
orbitRate..... 26, 41

P

phaseFromOrbitMidnight 26, 41
phaseOfEclipseExit..... 26, 41
pointingStatus 18, 33

R

receiverGain..... 24, 39
receiverTemp 24, 39

RFIFlag 28, 43

S

S1 15
S1_SwathHeader 15
S2 30
S2_SwathHeader 30
sampleHeader 20, 35
sampleNumber 20, 35
satAzimuthAngle 27, 42
scAlt 21, 36
scanStatus 17, 31
ScanTime 15, 30
scAttPitchGeoc 21, 36
scAttPitchGeod 22, 37
scAttRollGeoc 21, 36
scAttRollGeod 22, 36
scAttYawGeoc 22, 36
scAttYawGeod 22, 37
scLat 21, 36
scLon 21, 36
SCorientation 18, 33
scPos 21, 35

scVel 21, 36
Second 15, 30
SecondOfDay 16, 31
solarAzimuthAngle 28, 42
solarBetaAngle 26, 40
solarZenAngle 27, 42
sunData 26, 40
sunEarthSeparation 26, 41
sunGlintAngle 28, 43
sunVectorInBodyFrame 27, 41

T

tachMicroSeconds 20, 35
tachSeconds 20, 35
targetSelectionMidScan 19, 34
Tb 28, 43
timeMidScan 22, 37
timeMidScanOffset 22, 37
timeSinceEclipseEntry 26, 41

Y

Year 15, 30