# GOSAT-2/TANSO-FTS-2
# Level 1 Product Description Document

Rev.NC July, 2019

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Japan Aerospace Exploration Agency

| Rev. | Date | Revision Contents | Remark |
|---|---|---|---|
| NC | July,2019 | First Edition | |
| A | October,2020 | ・ 3.5.6. SolarGeometry group<br>Added the description about the new dataset on the solar direction in the satellite coordinate.<br><br>・ 3.5.13. ScanMirror group<br>Added the description about the new group, ScanMirror.<br><br>5. Format Details<br>・ Table 5-2 the format details of SWIR/TIR file (HDF5)<br>・/SoundingData<br>Added the following dataset to the ILSF calibration product.<br>・WavenumberInfo_HiRes<br>・RawSpectrum_HiRes<br><br>・/QualityInfo<br>Added the following dataset to the ILSF calibration product.<br>・interferogramAC<br><br>・/SolarGeometry<br>Added the following dataset about the solar direction in the satellite coordinate.<br>・solarSatBetaAngle<br>・solarSatEtaAngle<br>・solarSatDistance<br><br>・/ScanMirror<br>Added new group, ScanMirror. | |

GOSAT-2/TANSO-FTS-2 Level 1 Data Description Document

Contents

# 1. Introduction

## 1.1. Outline

The GOSAT-2 mission is aimed at continuing and advancing GOSAT mission and continuously providing useful information that contributes to environmental decision making for global warming.

GOSAT-2 project is promoted under the cooperation between the Ministry of the Environment (MOE), the Japan Aerospace Exploration Agency (JAXA) and the National Institute for Environmental Studies (NIES).

JAXA implements Level 1 processing of GOSAT-2 data. The Level 1 products based on the observation data of GOSAT-2 is processed in the GOSAT-2 Mission Operations System.

This document describes the format of TANSO-FTS-2 Level 1 following products generated in the GOSAT-2 Mission Operations System.

- Level 1A product
- Level 1B product
- Level 1A calibration product
- Level 1B calibration product

TANSO-FTS-2 Level 1 products are stored in HDF5 (Hierarchical Data Format Version 5). They are produced with HDF5 library.

## 1.2. Baseline Documents

Following documents are the baseline for the design of products:

(1) HDF5
- HDF5 Reference Manual (Release 1.8.18)
- HDF5 User's Guide(Release 1.8.18)

(2) Engineering Specification Document (ESPC)
- ESPC for global earth observation data processing system (for GOSAT-2), in Japanese
- Definition of GOSAT-2 Level 1 Products

# 2. Overview of products

## 2.1. Definition of processing level

Processing of TANSO-FTS-2 level 1 is defined as follows:

Level 1A processing:

Level 1A products are raw interferogram data sampled at equal distance.

Level 1B processing:

Level 1B products are complex spectrum data generated by interferogram data sampled at equal distance and applied radiometric correction, phase correction, Fourier transformation, etc.

FTS-2 also equips a high-resolution monitoring camera (CAM) to check the FOV of FTS-2. Level 1A and Level 1B products contains CAM data.

Table 2.1-1 shows definitions of TANSO-FTS-2 products.

Table 2.1-2 shows correspondence table of product between observation mode and band.

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**Table 2.1-1 Definition of TANSO-FTS-2 products (1/4)**

| Type | Definition | Operation Mode | Appended information |
|---|---|---|---|
| Level 1A | Level 1A products contain interferogram data observed by FTS-2, together with geometric information of observation points and various telemetry. In addition, CAM data near the observation time are also stored.<br><br>Every scene, the following 4 files are produced . In night observation, product usually contains 3 files because SWIR doesn't observe and SWIR file is not produced.<br>・ Common file<br>Common information for SWIR/TIR including CAM data.<br>・ SWIR file<br>Information for SWIR is stored. (Interferogram, etc.)<br>In case SWIR is not observed (in night), SWIR file is not generated.<br>・ TIR file<br>Information for TIR is stored. (Interferogram, etc.)<br>・ L1 processing result file<br>Quality information, geometric information of representative point and etc. are stored as XML format. | ・ Observation Mode 1 (day/night)<br>Observation Mode 2<br>・ Target Mode<br>(Target Mode/Sunglint) | ・ Observation ID<br>・ Observation time<br>・ Satellite position and velocity (ECI, ECR) and attitude at the observation time<br>・ Geometric information at the observation point<br>・ Sun and Moon position at the observation point (ECI, ECR)<br>・ Sunglint flag<br>・ Quality flag<br>・ Land/Ocean flag<br>・ Viewing vector<br>・ CAM data near the observation time. |

**Table 2.1-1 Definition of TANSO-FTS-2 products (2/4)**

| Type | Definition | Operation Mode | Appended information |
|---|---|---|---|
| Level 1A Calibration | Same as Level 1A.<br>In case of dark calibration, solar irradiance calibration, instrumentline shape function calibration and lunar calibration, TIR doesn't observe and TIR file is not generated. | ・ Observation Mode 1 (Blackbody calibration)<br>・ Observation Mode 1 (Deep space calibration)<br>・ Observation Mode 2 (Blackbody calibration)<br>・ Observation Mode 2 (Deep space calibration)<br>・ Calibration Mode (Dark calibration)<br>・ Calibration Mode (Solar irradiance calibration)<br>・ Calibration Mode (Instrument line shape function calibration)<br>・ Calibration Mode (Lunar calibration) | Same as Level 1A.<br>The information about earth surface (for example geometric information of observation point, etc.) and CAM data are not stored. |

**Table 2.1-1 Definition of TANSO-FTS-2 products (3/4)**

| Type | Definition | Operation Mode | Appended information |
|---|---|---|---|
| Level 1B | Level 1B products contains spectrum data, which are generated by Fourier transformation and other corrections to raw interferogram data in L1A. The sampled CAM data near the observation time are also stored.<br>Every scene the following 4 files are produced. In night observation, product contains 3 files because SWIR and CAM are observed only during daytime.<br>・ Common file<br>Common information for SWIR/TIR including CAM data.<br>・ SWIR file<br>Information for SWIR is stored. (Spectrum data of SWIR, etc.)<br>・ TIR file<br>Information for TIR is stored. (Spectrum data of TIR, etc.)<br>・ L1 processing result file<br>Quality information, geometric information of representative point and etc. are stored as XML format.<br><br>SWIR file contains spectrum($V/cm^{-1}$) before sensitivity correction and spectrum($W/cm^2/str/com^{-1}$) after sensitivity correction spectrum($W/cm^2/str/cm$-1). TIR files contains spectrum ($W/cm^2/str/cm$-1) after sensitivity correction using backbody and deep space calibration data and spectrum($W/cm^2/str/cm^{-1}$) after correction of finite field of view. | Same as Level 1A | ・ Observation ID<br>・ Observation time<br>・ Satellite position and velocity (ECI, ECR) and attitude at the observation time<br>・ Latitude and longitude at the observation point<br>・ Sun and Moon position at the observation point (ECI, ECR)<br>・ Sunglint flag<br>・ Quality flag<br>・ Land/Ocean flag<br>・ Viewing vector<br>・ CAM data near the observation time.<br>・ Granule ID used for calculation |

**Table 2.1-1 Definition of TANSO-FTS-2 products (4/4)**

| Type | Definition | Operation Mode | Appended information |
|---|---|---|---|
| Level 1B Calibration | Same as Level 1B.<br>In case of dark calibration and solar irradiance calibration, instrument line shape function calibration and lunar calibration, TIR doesn't observe and TIR file is not generated. | Same as Level 1A calibration | Same as Level 1B<br>But the information about earth surface (for example geometric information of observation point, etc.) and CAM data are not stored. |
| CAM data | One scene product of CAM data with full resolution is stored. Each CAM data is jpeg and summarize them into a file with ZIP. | ・ Observation Mode 1 (day/night)<br>Observation Mode 2<br>・ Target Mode<br>(Target Mode/ Sunglint) | — |

**Table 2.1-2 Correspondence table between product and mode/band**

| | | TANSO-FTS-2 Operation mode | Stored Band | |
|---|---|---|---|---|
| | | | SWIR(*1) | TIR (*2) |
| TANSO-FTS-2 L1A Product | Observation mode (day) | Observation ,mode (day) | ○ | ○ |
| | Observation mode (night) | Observation mode (night) | | ○ |
| TANSO-FTS-2 L1A Calibration Product | Solar irradiance calibration | Solar irradiance calibration mode | ○ | |
| | Blackbody calibration | Blackbody calibration mode | ○ | ○ |
| | Deep space calibration | Deep space calibration mode | ○ | ○ |
| | Instrument line shape function calibration | Instrument line shape function calibration mode | ○ | |
| | Dark calibration | Dark calibration mode | ○ | |
| | Lunar calibration | Lunar calibration mode | ○ | |
| TANSO-FTS-2 L1B Product | Observation mode (day) | Observation mode (day) | ○ | ○ |
| | Observation mode (night) | Observation mode (night) | | ○ |
| TANSO-FTS-2 L1B Calibration Product | Solar irradiance calibration | Solar irradiance calibration mode | ○ | |
| | Blackbody calibration | Blackbody calibration mode | ○ | ○ |
| | Deep space calibration | Deep space calibration mode | ○ | ○ |
| | Instrument line shape function calibration | Instrument line shape function calibration mode | ○ | |
| | Dark calibration | Dark calibration mode | ○ | |
| | Lunar calibration | Lunar calibration mode | ○ | |

*1 SWIR : B1P/B1S/B2P/B2S/B3P/B3S

*2 TIR : B4, B5

## 2.2. Unit of products

Unit of Level 1A/1B products are described below.

(1) For observation mode (day/night) product, one scene data is defined as 1/4 data of one satellite revolution from ascending node as Figure 2.2-1.

① From ascending node (*A*) to the end of night observation(*B*)
(North side during night observation)

② From the start of day observation(*B*) to descending node (*C*)
(North side during day observation)

③From descending node (C) to the end of day observation(*D*)
(South side during day observation)

④ From the start of night observation(*D*) to next ascending node (*A*)
(South side during night observation)

Note: The position of *B* and *D depends on* season.

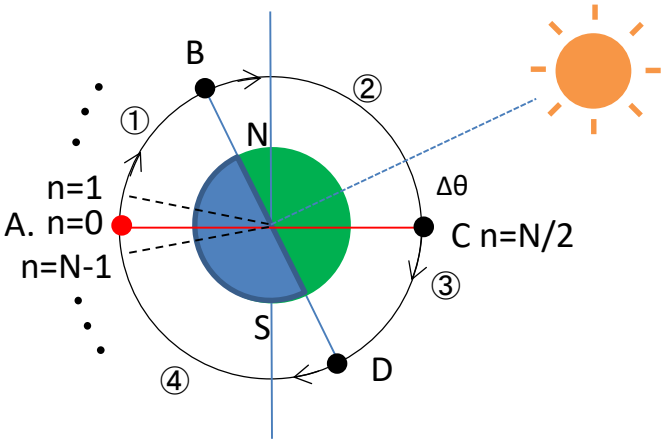


**Figure 2.2-1 Unit of Level 1A/1B products and FTS-2 observation mode in a scene**

(2) Calibration data, such as Solar irradiance calibration, Blackbody and the other calibration mode in the same path are collected every same calibration mode and stored the calibration product file. If the calibration keeps the same mode across the ascending node, the calibration data will be stored the separated product files.

(3) The Common file and SWIR/TIR file are produced for both of Observation mode and Calibration mode. However, SWIR data are observed only during the daytime, SWIR file is not produced during the nighttime.

(4) Regarding an interferogram data or spectrum data for a soundings, all the samples of the data must be connected and stored in a same product file and not be separated. It is the same for both observation mode and calibration mode.

(5) In Observation mode, the one set of CAM data which are confirmed the observation point of each scene is stored as a zip file. Each CAM data save an image using JPEG format.

(6) In Calibration mode, the one set of CAM data which are confirmed the observation point of each calibration product is stored as a zip file. Each CAM data save as image using JPEG format.

2.3. Data Contents

Basic observation modes of TANSO-FTS-2 are shown in Table 2.3-1.In nominal observation mode, TANSO-FTS-2 observes with short wavelength infrared (SWIR B1-B3) and thermal infrared (TIR B4, B5) during the daytime on earth surface. However, during the nighttime on earth surface, TANSO-FTS-2 observes with only thermal infrared.

**Table 2.3-1 Basic observation modes of TANSO-FTS-2**

| Operation Mode | | | Description |
|---|---|---|---|
| Observation Mode 1 | | day | SWIR and TIR observations are operated.<br>Blackbody and Deep space calibration are operated. |
| | | night | TIR observations are operated.<br>Blackbody and Deep space calibration are operated. |
| Observation Mode 2 | | | In the situation that the power supply level of the satellite becomes lower and the satellite cannot keep observation mode 1, the observation continues under the condition that a part of function of TANSO-FTS-2 is suspended depending on the power level. |
| Target Mode | | Sunglint observation | Observation over the command specified point is executed. |
| | | Specific point observation | Observation over the command specified point is executed. “Specific points” here means validation sites, the sky above ground-based observation points, or big cities, etc. |
| Calibration Mode | Lunar Calibration | | SWIR lunar observations are executed more than once a year, as needed.<br>Lunar calibration is executed by moving GOSAT-2 satellite using pointing mechanism so as that FTS-2 FOV points to the moon.. |
| | Solar irradiance calibration | | Performs solar irradiance calibration is executed by the sensor pointing to the solar diffusion reflector for every orbit. |
| | Instrument line shape function calibration | | Performs calibration on the Instrument line shape function by irradiating laser light. The instrument line shape calibration is performed by irradiating light of the semiconductor laser on sensors. |
| | Dark calibration | | Performs calibration of the offset level of SWIR during nighttime |
| | Electrical calibration | | Performs calibration of signal processing after the analogue-signal processing system by inputting a reference voltage signal. |

Data contents for each processing level and mode are given in Table 2.3-2.

**Table 2.3-2 Contents of TANSO-FTS-2 L1 Products (1/2)**

| Processing level | Operation Mode | Observation band | Data Size (for one exposure) | Note |
|---|---|---|---|---|
| 1A | Observation Mode 1 (day) | SWIR(Band1-3)<br>TIR(Band4,5) | B1 :188458～188926 samples<br>B2 :94229～94463 samples | Nominal observation mode during daytime. |
| | Observation Mode 1(night) | TIR | B3 :78524～78719samples<br>B4-5:39262～39360<br>32bit single floating point/sample for each | Nominal observation mode during nighttime.<br>During the nighttime on earth surface, SWIR data (Band 1-3) are not generated. |
| | Observation Mode 2 | SWIR<br>TIR | ibid | |
| 1A Calibration | Calibration mode (Solar irradiance calibration) | SWIR | ibid | |
| | Observation mode 1 (Blackbody Calibration) | SWIR,TIR | ibid | |
| | Observation mode 1(Deep space calibration) | SWIR,TIR | ibid | |
| | Calibration mode(Instrument line shape function calibration) | SWIR | ibid | |
| | Calibration mode(Dark Calibration) | SWIR | ibid | |
| | Calibration mode(Lunar Calibration) | SWIR | ibid | |

**Table 2.3-2 Contents of TANSO-FTS-2 L1 Products (2/2)**

| Processing level | Operation Mode | Observation band | Data Size (for one exposure) | Note |
|---|---|---|---|---|
| 1B | Observation Mode 1 (day) | SWIR<br>TIR | SWIR band:<br>Wavenumber within the significant wavenumber range×2 (Real part & Imaginary part)×e (spectrum before and after sensitivity correction)<br><br>TIR band:<br>Wavenumber within the significant wavenumber range×2 (Real part & Imaginary part)×e (spectrum after sensitivity correction and finite FOV correction)<br>Store spectrum within the significant wavenumber range. Spectrum consists of both real and imaginary part and is stored with 32 bit single floating point for each. | |
| | Observation Mode 1(night) | TIR | | |
| | Observation Mode 2 | SWIR<br>TIR | | |
| 1B<br>Calibration | Calibration mode<br>(Solar irradiance calibration) | SWIR | SWIR band for each:<br>Wavenumber within the significant wavenumber range×2 (Real part & Imaginary part) (spectrum before sensitivity correction)<br><br>TIR band for each:<br>Wavenumber within the significant wavenumber range×2 (Real part & Imaginary part)<br>(spectrum before sensitivity correction)<br><br>Store spectrum within the significant wavenumber range. Spectrum consists of both real and imaginary part and is stored with 32 bit single floating point for each. | |
| | Observation mode 1<br>(Blackbody Calibration) | SWIR | | |
| | Observation mode1<br>(Deep space calibration) | SWIR,TIR | | |
| | Calibration mode(Instrument line shape function calibration) | SWIR | | |
| | Calibration mode( Dark Calibration) | SWIR | | |
| | Calibration mode<br>(Lunar Calibration) | SWIR | | |

# 3. Product Format

## 3.1. File name convention

### 3.1.1. File name convention of TANSO-FTS-2 L1 (HDF5 format)

Table 3.1-1 shows the file name convention of TANSO-FTS-2 L1A products.

**Table 3.1-1 File name convention of TANSO-FTS-2 L1A products**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | O | S | A | T | 2 | T | F | T | S | 2 | Y | Y | Y | Y | M | M | D | D | H | H | m | m | P | P | P | S | S | _ | L | L | B | R | C | 0 | 0 | O | O | O | O | A | A | A | B | B | B | . | h | 5 |

Convention for each item.is shown below

- Satellite Name：GOSAT2 (Fixed)
- Sensor Name：TANSO-FTS2: TFTS2 (Fixed)
- Observation time at first observation point of scene (year・month・day・hour・minute)：YYYYMMDDHHmm (UT)
- Path No.：PPP(001-089)
- Scene No.：00(Fixed)
- Processing Level：LL
  - FTS-2 level 1A：1A
  - FTS-2 level 1B：1B
- Band：B
  - Common file：C
  - SWIR file：S
  - TIR file：T
- Orbit data used for processing：R
  - Using predicted orbit data：P
  - Using GPS or determined orbit data：D
- Correction coefficients used for processing：C
  - Using nominal coefficients：N
  - Using updated coefficients：U
- Reserved：00
- Operation Mode： OOOO
  - Observation Mode (day)：OB1D
  - Observation Mode (night)：OB1N
  - Observation Mode (day, not full bands)：OB2D
  - Observation Mode (night, not full bands)：OB2N
  - Solar irradiance calibration mode：SCAL
  - Blackbody Calibration mode：BCAL
  - Deep space calibration mode：DCAL
  - Instrument line shape function calibration mode：ILSF
  - Dark calibration mode：NCAL
  - Electrical calibration mode：ECAL (L1A/L1B products are not generated.)
  - Lunar calibration mode：LCAL
  - Undecimated mode: TEST (L1A/L1B products are not generated.)
  - Scanner Bearing: LUBE (L1A/L1B products are not generated.)
- Algorithm Version：AAA (000-999)
- Parameter Version：BBB (000-999)
- Extension：h5 (Fixed)

3.1.2. Definition of the file name of CAM data

FTS-2 is the optical instrument with Fourier transform type and observes radiation from a point on earth's surface every 4.65sec. The moving mirror in this instrument scans with a constant duration (4.024sec) and then within the residual time of 0.65 sec, the pointing axis moves to next observation point.

Before scan of this instrument starts, the monitoring camera (CAM) captures the image near the observation point. And from the captured image, the area with fine weather is identified and it serves to "intelligent pointing" which is the function to adjust focus onto the observation point. And after adjusting, CAM captures images again around the observation time.

Table 3.1-2 shows the file name convention of CAM data.

**Table 3.1-2 File name convention of CAM data file (zip file)**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | O | S | A | T | 2 | T | F | T | S | 2 | Y | Y | Y | Y | M | M | D | D | H | H | m | m | P | P | P | S | S | _ | C | A | M | . | z | i | p |

Convention for each item is shown below.

- Satellite Name：GOSAT2 (Fixed)
- Sensor Name：TANSO-FTS2: TFTS2 (Fixed)
- Observation time of first observation point scene (year・month・day・hour・minute)：YYYYMMDDHHmm (UT)
- Path No.：PPP (001-089)
- Scene No.：00 (Fixed)
- Monitoring camera to check the FOV of FTS-2：CAM (Fixed)
- Extension：zip (Fixed)

Table 3.1-3 shows the file name convention of JPEG in zip files.

**Table 3.1-3 File name convention of individual CAM data (given as jpeg file)**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | O | S | A | T | 2 | T | F | T | S | 2 | Y | Y | Y | Y | M | M | D | D | H | H | m | m | s | s | f | f | f | _ | C | A | M | P | P | P | S | S | I | I | I | I | N | N | . | j | p | g |

The following defines each item.

- Satellite Name：GOSAT2 (Fixed)
- Sensor Name：TANSO-FTS2: TFTS2 (Fixed)
- Observation time at CAM data (year・month・day・hour・minute・second・millisecond)：YYYYMMDDHHmmssfff (UT)
- Monitoring camera to check the FOV of FTS-2：CAM (Fixed)
- Path No.：PPP (001-089)
- Scene No.：SS ( Calibration mode data is 00, observation mode data is 01 to 04)
- Observation point ID：IIII (0000-1245)
- Sequence number of every image of observation point：NN (01-99)
- Extension：jpeg (Fixed)

3.1.3. The file name convention of processing result (XML format)

Table 3.1-4 shows the file name convention of TANSO-FTS-2 L1 processing result.

**Table 3.1-4 File name convention of TANSO-FTS-2 L1 processing result**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | O | S | A | T | 2 | T | F | T | S | 2 | Y | Y | Y | Y | M | M | D | D | H | H | m | m | P | P | P | S | S | _ | L | L | B | R | C | 0 | 0 | O | O | O | O | A | A | A | B | B | B | . | x | m | l |

Convention for each item is shown below.

- Satellite Name：GOSAT2 (Fixed)
- Sensor Name：TANSO-FTS2: TFTS2 (Fixed)
- Observation time of first observation point scene (year・month・day・hour・minute) : YYYYMMDDHHmm (UT)
- Path No.：PPP (001-089)
- Scene No.： SS(Calibration mode data is 00, observation mode data is 01 to 04 )
- Processing Level：LL
  FTS-2 level 1A：1A
  FTS-2 level 1B：1B
- Band：B
  “C”(Fixed)
- Orbit data used for processing：R
  Using predicted orbit data：P
  Using GPS or determined orbit data：D
- Correction coefficients used for processing：C
  Using nominal coefficients：N
  Using updated coefficients：U
- Reserved：00
- Operation Mode：OOOO
  Observation Mode (day)：OB1D
  Observation Mode (night)：OB1N
  Observation Mode (day, not full bands)：OB2D
  Observation Mode (night, not full bands)：OB2N
  Solar irradiance calibration mode：SCAL
  Blackbody Calibration mode：BCAL
  Deep space calibration mode：DCAL
  Instrument line shape function calibration mode：ILSF
  Dark calibration mode：NCAL
  Electrical calibration mode：ECAL (L1A/L1B products are not generated.)
  Lunar calibration mode：LCAL
  Undecimated mode: TEST (L1A/L1B products are not generated.)
  Scanner Bearing: LUBE (L1A/L1B products are not generated.)
- Algorithm Version：AAA (000-999)
- Parameter Version：BBB (000-999)
- Extension：XML(Fixed)

## 3.2. Dataset Structure

TANSO-FTS-2 L1 product consists of Common file (consists of common information between SWIR/TIR bands including CAM data near the observation time), SWIR file (consists of interferogram, spectrum and specific information of SWIR bands) and TIR file (consists of interferogram, spectrum and specific information of TIR bands).

Common file contains metadata, orbit and attitude data, ephemeris data (sun and moon), housekeeping telemetry data such as temperature, status of instruments.

SWIR/TIR file consist of metadata, information at each observation point (latitude, longitude and etc.), interferogram (in the case of L1A product) and spectrum (in the case of L1B product).

In addition, one scene CAM product is stored as a zip file which is the summarized file of some CAM data. Each CAM data is saved as image using JPEG format with original size.

The SWIR bands and CAM data are observed during only daytime on earth surface. Thus, the nighttime observation produces only Common and TIR file, SWIR file is not produced.

Dataset structure of TANSO-FTS-2 L1A and L1B product are shown in Table 3.2-1 and 3.2-2, respectively.

**Table 3.2-1 Dataset Structure of TANSO-FTS-2 Level 1A Product (1/2)**

| File | Group | Name |
|---|---|---|
| Common file | Metadata | Items below are stored as explanation of product type, contents, etc.<br>・Granule ID<br>・Observation Mode<br>・Date of product creation<br>・Processing Level<br>・Processing Algorithm/Parameter version<br>・Start and end time of observation<br>・Quality information |
| | SpacecraftTimeError | Parameters for spacecraft time error correction are stored. |
| | SiderealTimeInfo | Parameters for calculating Greenwich sidereal time are stored. |
| | TransMatrixInfo | Transform matrix which convert from J2000.0 to TOD and ECR in consideration of polar motion are stored. |
| | OnboardOrbitData | Onboard orbit data is stored. |
| | KinematicOrbitDataPredicted | Predicted kinematic orbit data is stored. |
| | KinematicOrbitDataDetermined | Determined kinematic orbit data is stored. |
| | AttitudeData | Onboard attitude data is stored. |
| | SolarEphemeris | Solar position and velocity data are stored. |
| | LunarEphemeris | Lunar position and velocity data are stored. |
| | CAMData | CAM data is stored. |
| | TemperatureTelemetry_FTS2 | Temperature telemetry of FTS-2 is stored. |
| | HK_Telemetry_FTS2 | Housekeeping telemetry of FTS-2 is stored. |
| | Telemetry_FTS2_1Hz | 1Hz telemetry of FTS-2 is stored (RotaryArmSpeed and etc.). |
| | Telemetry_FTS2_100Hz | 100Hz telemetry of FTS-2 is stored.(CT/AT angle and etc.). |
| | Telemetry_CAM | Telemetry of CAM is stored. |

**Table 3.2-1 Dataset Structure of TANSO-FTS-2 Level 1A Product (2/2)**

| File | Group | Name |
|---|---|---|
| SWIR/TIR file | Metadata | Items below are stored as explanation of product type, contents, etc.<br>・ Granule ID<br>・ Observation Mode<br>・ Date of product creation<br>・ Processing Level<br>・ Processing Algorithm/Parameter version<br>・ Start and end time of observation |
| | SoundingAttribute | SoundingID, observation time and etc. are stored as information at each observation point. |
| | QualityInfo | Items below are stored as quality information at each observation point.<br>・ Quality Flag<br>・ Data Valid/Invalid Flag<br>・ Missing Flag<br>・ Spike Flag |
| | ProcessingParameters | Parameters used for processing are stored. |
| | SatelliteGeometry | Satellite position, velocity and attitude at each observation point are stored. |
| | SolarGeometry | Solar position and velocity at each observation point are stored. |
| | LunarGeometry | Lunar position and velocity at each observation point are stored. |
| | SoundingGeometry | Latitude/Longitude, sunglint flag and etc. at each observation point are stored. |
| | PointingGeometry | CT/AT angle and view vector at each observation time are stored. |
| | SoundingData | Items below are stored :<br>・ Number of data points<br>・ Interferogram data sampled at equal distance |

**Table 3.2-2 Dataset Structure of TANSO-FTS-2 Level 1B Product (1/2)**

| File | Group | Name |
|---|---|---|
| Common file | Metadata | Items below are stored as explanation of product type, contents, etc.<br>・Granule ID<br>・Observation Mode<br>・Date of product creation・Processing Level<br>・Processing Algorithm/Parameter version<br>・Start and end time of observation<br>・Quality information |
| | SpacecraftTimeError | Parameters for spacecraft time error correction are stored. |
| | SiderealTimeInfo | Parameters for calculating Greenwich sidereal time are stored. |
| | TransMatrixInfo | Transform matrix which converts from J2000.0 to TOD and ECR in consideration of polar motion are stored. |
| | OnboardOrbitData | Onboard orbit data is stored. |
| | KinematicOrbitDataPredicted | Predicted kinematic orbit data is stored. |
| | KinematicOrbitDataDertemined | Determined kinematic orbit data is stored. |
| | AttitudeData | Onboard attitude data is stored. |
| | SolarEphemeris | Solar position and velocity data are stored. |
| | LularEphemeris | Lunar position and velocity data are stored. |
| | CAMData | CAM data are stored. |
| | TemperatureTelemetry_FTS2 | Temperature telemetry of FTS-2 is stored. |
| | HK_Telemetry_FTS2 | Housekeeping telemetry of FTS-2 is stored. |
| | Telemerty FTS2 1Hz | 1 Hz telemetry of FTS-2 is stored. (Rotary ArmSpeed and etc) |
| | Telemetry_FTS2_100Hz | 100Hz telemetry of FTS-2 is stored (CT/AT angle and etc.). |
| | Telemetry_CAM | Telemetry of CAM is stored. |
| SWIR/TIR file | Metadata | Items below are stored as explanation of product type, contents, etc.<br>・ Granule ID<br>・ Observation Mode<br>・ Date of product creation<br>・ Processing Level<br>・ Processing Algorithm/Parameter version<br>・ Start and end time of observation |
| | SoundingAttribute | SoundingID, observation time and etc. are stored as information at each observation point. |
| | QualityInfo | Items below are stored as quality information at each observation point.<br>・ soundingQualityFlag<br>・ dataInvalidFlag<br>・ missingFlag<br>・ spikeFlag |

**Table 3.2-2 Dataset Structure of TANSO-FTS-2 Level 1B Product (2/2)**

| File | Group | Name |
|---|---|---|
| SWIR/TIR file | ProcessingParameters | Parameters used for processing are stored. |
| | SatelliteGeometry | Satellite position, velocity and attitude at each observation point are stored. |
| | SolarGeometry | Solar position and velocity at each observation point are stored. |
| | LunarGeometry | Lunar position and velocity at each observation point are stored. |
| | SoundingGeometry | Latitude/Longitude, sunglint flag and etc. at each observation point are stored. |
| | PointingGeometry | CT/AT angle and view vector at each observation time are stored. |
| | SoundingData | Items below are stored.<br>・ Number of data points<br>・ Start/End of wavenumber<br>・ Spectrum data<br><br>SWIR file contains the spectrum before sensitivity correction ($V/cm^{-1}$) and the spectrum after sensitivity correction ($W/cm^2/str/cm^{-1}$).<br>TIR file contains the spectrum after sensitivity correction using blackbody and deep space data ($W/cm^2/str/cm^{-1}$) and the spectrum after finite FOV correction ($W/cm^2/str/cm^{-1}$). |
| | SolarCalibrationData | Reflectance and gain coefficient for each polarization calculated by Solar irradiance calibration mode data are stored. |

3.3. Notes for definition of data group

(1) Definition of data type

Table 3.3-1 describes the definition of data type stored in TANSO-FTS-2 L1A and L1B products.

**Table 3.3-1 Definition of data type**

| HDF5 type | Data type |
|---|---|
| H5T_STRING | more than 1 byte string |
| H5T_STD_I8LE | signed 1byte integer |
| H5T_STD_U8LE | unsigned 1byte integer |
| H5T_STD_I16LE | signed 2byte integer |
| H5T_STD_U16LE | unsigned 2byte integer |
| H5T_STD_I32LE | signed 4byte integer |
| H5T_STD_U32LE | unsigned 4byte integer |
| H5T_IEEE_F32LE | signed 4byte float |
| H5T_IEEE_F64LE | signed 8byte double |

(2) Expression of time

UTC date is expressed as “YYYY-MM-DDThh:mm:ss.ffffffZ” with string data. “YYYY-MM-DD” means year, month and day. “hh:mm”means hour and minute. “ss.ffffffZ” means second with microsecond accuracy.

Spacecraft time is defined as follows:

$$\text{Spacecraft Time (s)} = \text{GPS Time (s)} - 1{,}041{,}033{,}615\text{(s)},$$

where GPS Time (s) is total seconds from 00:00:00 UTC, Jan 6, 1980.

(3) Definition of coordinates

Table 3.3-2 describes the definition of coordinates used for dataset.

**Table 3.3-2 Definition of coordinates**

| Name | Abbreviated name | The origin/Axis | Definition | |
|---|---|---|---|---|
| Inertial coordinate system (J2000.0 coordinate ) | $\Phi_I$ | The origin:$O_I$ | Earth centered | EPOCH 2000/01/01 12:00:00 TT(Earth time) |
| | | $X_I$ | Direction of mean vernal equinox of EPOCH | |
| | | $Y_I$ | $Z_I \times X_I$ | |
| | | $Z_I$ | Vertical direction of mean equatorial plain of EPOCH (Direction of the north pole is +) | |
| Coordinate Reference Systems in Orbit | $\Phi_R$ | The origin:$O_R$ | Ascending node | |
| | | $X_R$ | Coincide with ascending node of orbit coordinate | |
| | | $Y_R$ | | |
| | | $Z_R$ | | |
| Orbit coordinate | $\Phi_O$ | The origin:Oo | Center of the mass of satellite | Defined by orbit model of AOCE inInertial coordinate system. |
| | | $X_O$ | $Y_O \times Z_O$ | |
| | | $Y_O$ | Opposite direction of vector of orbit plane | |
| | | $Z_O$ | Direction of center of the earth | |
| Coordinate Reference Systems in STT (Reference point for determination of satellite attitude ) | $\Phi_{SST1}$ | The origin:$O_{STT1}$ | Reference mirror in STT | Defined after early operations phase on orbit |
| | | $X_{STT1}$ | Roll axis in orbit | |
| | | $Y_{STT1}$ | Pitch axis in orbit | |
| | | $Z_{STT1}$ | Yaw axis in orbit | |
| Satellite coordinate | $\Phi_B$ | The origin:$O_B$ | Center of the mass of satellite | Coincide with the orbit coordinate except for attitude error |
| | | $X_B$ | Parallel to each axis of coordinate reference systems in STT | |
| | | $Y_B$ | | |
| | | $Z_B$ | | |
| FTS-2 optical coordinate | $\Phi_{FTS-2}$ | The origin:$O_{FTS-2}$ | Transform matrix to convert Satellite coordinate $\Phi_B$ from FTS-2 optical coordinate is provided as AlignmentMatrix of ProcessingParameters group in SWIR/TIR file. The origin is same as satellite coordinate. | |
| | | $X_{FTS-2}$ | | |
| | | $Y_{FTS-2}$ | | |
| | | $Z_{FTS-2}$ | | |
| Satellite-fixed coordinate | $\Phi_S$ | The origin:$O_S$ | Intersection point of center line of and satellite separation plain | |
| | | $X_S$ | Roll axis in machine | |
| | | $Y_S$ | Pitch axis in machine | |
| | | $Z_S$ | Yaw axis in machine | |
| Earth-fixed coordinate | $\Phi_{WGS84}$ | The origin:$O_{WGS84}$ | the gravity center of the earth | GPSR gives absolute position and absolute velocity on this corrdinate |
| | | $X_{WGS84}$ | Coincide with X axis which is defined byBIH for calculation of earth rotation paramerter | |
| | | $Y_{WGS84}$ | $Z_{WGS84} \times X_{WGS84}$ | |
| | | $Z_{WGS84}$ | Parallel to Z axis which is defined byBIH for calculation of earth rotation paramerter. Z axis is the direction of CTP. | |
| TOD coordinate | $\Phi_{TOD}$ | The origin:$O_{TOD}$ | Earth centered | Inertial coordinate system (J2000.0 coordinate)$\Phi$ I with taking into precession and nutation. |
| | | $X_{TOD}$ | Direction of vernal equinox at the present time | |
| | | $Y_{TOD}$ | $Z_{TOD} \times X_{TOD}$ | |
| | | $Z_{TOD}$ | Vertical direction of equatorial plain at the present time (Direction of the north pole is +) | |

(4) Definition of latitude/longitude

Unless otherwise specifically noted, latitude and longitude in this document means geographic latitude and longitude.

3.4. Definition of common file

3.4.1. Metadata group

Each dataset under Metadata describes product type, contents, others which are corresponding to this product file.

Metadata group in common file contains productQualityFlag. productQualityFlag refers to missingFlag defined in QualityInfo group (refer 3.5.3) for each observation point and evaluates the quality of this product in four levels (Good, Fair, Poor and NG).

The evaluation Good means missingFlag for all observation points are no missing data.

Fair/Poor/NG is determined by the threshold value defined in this system. When productQualityFlag is “NG”, product isn’t provided to users.

3.4.2. SpacecraftTimeError group

SpacecraftTimeError group contains the information to correct the gap between satellite time and the ground station time. If the status of time system is normal, this correction is not required.

Formula to correct the time gap is as follows:

Spacecraft time (after correction)

＝periodCount * {spacecraft time(before correction) – refCount} + groundTime

3.4.3. SiderealTimeInfo group

SiderealTimeInfo group contains information of Greenwich sidereal time. Using this information, TOD can be converted to pseudo earth-fixed coordinates (out of consideration of polar motion).

Using Greenwich sidereal time $\theta_{g0}$ at the baseline time $t_0$ and Deviation of Greenwich sidereal time, $\dot{\theta}_g$ Greenwich sidereal time $\theta_g$ at the arbitrary time $t$ is expressed as follows:

$$\theta_g = \theta_{g0} + \dot{\theta}_g \times (t - t_0) \qquad \text{Eq. 3.4.3-1}$$

Transform matrix conversion from TOD to pseudo earth-fixed coordinate $\mathbf{M}_{\mathbf{TOD\text{-}PECR}}$ is as follows:

$$\mathbf{M}_{\mathbf{TOD-PECR}} = \begin{pmatrix} \cos\theta_g & \sin\theta_g & 0 \\ -\sin\theta_g & \cos\theta_g & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad \text{Eq. 3.4.3-2}$$

3.4.4. Definition of TransMatrixInfo data group

TransMatrixInfo data group contains PN matrix which can convert from J2000.0 coordinates to TOD coordinates and XY matrix which can convert from pseudo-earth fixed coordinate (without considering polar motion of the earth ) to ECR coordinates.

Data interval is 60 sec. But, in case of the leap second, data interval is 61 sec.

3.4.5. OnboardOrbitData group

OnboardOrbitData group contains onboard orbit data (expressed in ECR coordinates) and orbit data converted to TOD coordinates from onboard orbit data.

Data interval is 1 sec. But in case of data missing, there will be some gap in data interval.

The Conversion method from position vector $\mathbf{P_{ECR}}$ and velocity vector $\mathbf{V_{ECR}}$ of onboard in ECR to position vector $\mathbf{P_{TOD}}$ and velocity vector $\mathbf{V_{TOD}}$ in TOD is described below.

First, $\mathbf{P_{ECR}}$ and $\mathbf{V_{ECR}}$ convert to position vector and velocity vector in pseudo earth-fixed coordinates (not corresponding polar motion) using XY matrix:

$$\mathbf{P_{PECR}} = \mathbf{XY}^t \times \mathbf{P_{ECR}} \qquad \text{Eq. 3.4.5-1}$$

$$\mathbf{V_{PECR}} = \mathbf{XY}^t \times \mathbf{V_{ECR}} \qquad \text{Eq. 3.4.5-2}$$

The superscript *t* denotes transpose. Since XY matrix is unitary, transpose of it is the same as its inversion.

Next, $\mathbf{P_{PECR}}$ and $\mathbf{V_{PECR}}$ convert to $\mathbf{P_{TOD}}$ and $\mathbf{V_{TOD}}$ using Greenwich sidereal time $\theta_g$ and Deviation of Greenwich sidereal time $d\theta_g/dt$:

$$\mathbf{P_{TOD}} = \begin{pmatrix} \cos(-\theta_g) & \sin(-\theta_g) & 0 \\ -\sin(-\theta_g) & \cos(-\theta_g) & 0 \\ 0 & 0 & 1 \end{pmatrix} \times \mathbf{P_{PECR}} \qquad \text{Eq. 3.4.5-3}$$

$$\mathbf{V_{TOD}} = \begin{pmatrix} \cos(-\theta_g) & \sin(-\theta_g) & 0 \\ -\sin(-\theta_g) & \cos(-\theta_g) & 0 \\ 0 & 0 & 1 \end{pmatrix} \times \left[ \mathbf{V_{PECR}} + \begin{pmatrix} 0 \\ 0 \\ \dot{\theta}_g \end{pmatrix} \otimes \mathbf{P_{PECR}} \right] \qquad \text{Eq. 3.4.5-4}$$

Here $\otimes$ means outer product of vector.

3.4.6. KinematicOrbitDataPredicted group

KinematicOrbitDataPredicted group contains predicted kinematic orbit data in ECR and TOD coordinates, this data is distributed from the kinematic orbit system.

In all cases (includes the leap second is inserted), data interval is 60 sec.

3.4.7. KinematicOrbitDataDetermined group

KinematicOrbitDataDetermined group contains determined kinematic orbit data in ECR and TOD coordinates, this data is distributed from the kinematic orbit system.

In all cases (includes the leap second is inserted), data interval is 60 sec.

3.4.8. AttitudeData group

AttitudeData group contains onboard attitude data and yaw steering flag which shows yaw steering

operation status.

The data interval is not constant. But, in case of data missing, there will be some gap in data interval.

Attitude data is given in quaternion $Q=(q_0,q_1,q_2,q_3)$ in J2000.0. $q_0$ is scalar component and $(q_1,q_2,q_3)$ are vector components.

Interpolation is needed to determine attitude data at the given time.

Transform matrix $\mathbf{M}_{\mathbf{J2000\text{-}body}}$ which convert satellite coordinates from J2000.0 coordinates is expressed as follows:

$$\mathbf{M}_{\mathbf{J2000\text{-}body}} = \begin{pmatrix} q_0^2+q_1^2-q_2^2-q_3^2 & 2(q_1q_2+q_0q_3) & 2(q_1q_3-q_0q_2) \\ 2(q_1q_2-q_0q_3) & q_0^2-q_1^2+q_2^2-q_3^2 & 2(q_2q_3+q_0q_1) \\ 2(q_1q_3+q_0q_2) & 2(q_2q_3-q_0q_1) & q_0^2-q_1^2-q_2^2+q_3^2 \end{pmatrix} \qquad \text{Eq. 3.4.8-1}$$

Transform matrix $\mathbf{M}_{\mathbf{body\text{-}J2000}}$ which converts J2000.0 coordinates from satellite coordinates is transpose matrix of $\mathbf{M}_{\mathbf{J2000\text{-}body}}$. $\mathbf{M}_{\mathbf{body\text{-}J2000}}$ is expressed as follows (The superscript *t* denotes transpose):

$$\mathbf{M}_{\mathbf{body-J2000}} = \left(\mathbf{M}_{\mathbf{J2000\text{-}body}}\right)^t = \begin{pmatrix} q_0^2+q_1^2-q_2^2-q_3^2 & 2(q_1q_2-q_0q_3) & 2(q_1q_3+q_0q_2) \\ 2(q_1q_2+q_0q_3) & q_0^2-q_1^2+q_2^2-q_3^2 & 2(q_2q_3-q_0q_1) \\ 2(q_1q_3-q_0q_2) & 2(q_2q_3+q_0q_1) & q_0^2-q_1^2-q_2^2+q_3^2 \end{pmatrix}$$

Eq. 3.4.8-2

3.4.9. SolarEphemeris group

SolarEphemeris group contains the kinematic solar position and velocity data in ECR and TOD coordinates distributed from kinematic orbit system. In all cases (includes the leap second is inserted), data interval is always 60 sec.

Solar position and velocity data are true position and velocity at the time. The light propagation time from sun to earth is not taken in account. However, time data has been recorded since about 10 minutes before start of observation. Thus, solar position and velocity data with taking account of light propagation time can be calculated.

3.4.10. LunarEphemeris group

LunarEphemeris group contains true kinematic lunar position and velocity data in ECR and TOD coordinates distributed from kinematic orbit system. In all cases (includes the leap second is inserted), data interval is always 60 sec.

### 3.4.11. CAMData group

CAMData group contains CAM data which is color image taken near the observation time. Usually, CAM data is one image per one observation point. A CAM data is stored every observation except missing data.

Observation time, latitude/longitude and etc are also stored with CAM Data group.

CAM image itself is stored in CAM Image subgroup. File name of CAM image is ”image_CAM_NNNN” ,NNNN is observation point ID(0000 to 1245). CAM image is stored as HDF5Image(H5IM) format which can be displayed with color image in HDFView.

### 3.4.12. TemperatureTelemetry_FTS2 group

TemperatureTelemetry_FTS2 group contains temperature telemetry of FTS-2. The evaluation result on the range of temperature is stored for each data

These data in this group are mainly used for check of sensor condition.

### 3.4.13. HK_Telemetry_FTS2 group

HK_Telemetry_FTS2 group contains housekeeping telemetry other than temperature which is mainly used for check of sensor status.

### 3.4.14. Telemetry_FTS2_1Hz group

Telemetry_FTS2_1Hz contains information of RotaryArmSpeed and etc. with 1Hz (1 sec cycles).

These data are mainly used for check of sensor condition.

### 3.4.15. Telemetry_FTS2_100Hz group

Telemetry_FTS2_100Hz contains information of CT/AT angle and etc. with 100Hz (0.01 sec cycles).

These data are mainly used for check of sensor condition.

### 3.4.16. Telemetry_CAM group

Telemetry_CAM group contains telemetry of CAM.

These data are mainly used for check of sensor condition.

## 3.5. Definition of SWIR/TIR file

### 3.5.1. Metadata group

Each dataset under Metadata describes product type, contents, others which are corresponding to the product file.

### 3.5.2. SoundingAttribute group

SoundingAttribute group contains number of soundings (numSoundings), soundingID, observation time (observationTime), and etc. Note that the number of soundings is a “planned” number. There are the planned number data in the product. If the observation point is not observed as planned or data loss occurs, the data corresponding to the point which is not observed or data loss is filled with the invalid values and flags in QualityInfo group are set to “NG”.

observationTime is expressed as follows:

observationTime =Start time of sample window + 2.012 sec

### 3.5.3. QualityInfo group

QualityInfo group contains following items as quality information at each observation point data.

- dataInvalidFlag
- IMC_StabilityFlag
- missingFlag
- saturationFlag
- spikeFlag
- scanStabilityFlag
- Fringe Count Error (L1B only）
- dcLevelFlag (L1B only）
- Simplified SNR(Signal to Noise Ratio) (L1B only）

In L1B, interferogramQualityFlag (normal/abnormal) and spectrumQualityFlag (normal/abnormal) are stored.

interferogramQualityFlag is judged comprehensively by above flags.

spectrumQualityFlag is judged based on data out bands of each spectrum.

In addition, soundingQualityFlag which evaluates quality of product in four levels (Good, Fair, Poor, NG) for each observation point is stored.

When productQualityFlag is Good, all quality checks are normal. Fair/Poor/NG is determined by the threshold value setting in this system.

### 3.5.4. ProcessingParameters group

ProcessingParameters group contains important parameters used in processing for each observation point.

- Non-linear correction coefficients for interferogram
- Alignment conversion matrix (convert satellite coordinate from FTS-2 optical coordinate)
- ApodizationFunction used for finite FOV correction.

### 3.5.5. SatelliteGeometry group

SatelliteGeometry group contains satellite position/velocity (in ECR and TOD), attitude and transformation matrix (satToECR_Matrix). The transform matrix can convert to ECR (WGS84)

coordinate from satellite coordinate.

Satellite position and velocity at the observation time are nominally calculated from interpolation processing using onboard orbit data. In that case that onboard data is short (for example, data missing or near edge of scene), satellite position and velocity are calculated from interpolation processing using predicted or determined orbit data, the extrapolation is never used. The type of orbit data used in interpolation at each observation point is stored in satOrbitPrecision group.

Satellite attitude is stored as quaternion in J2000.0 and roll, pitch and yaw angles. Definition and usage of quaternion are the same as Chapter 3.4.8. Roll, pitch, and yaw angles are calculated by using quaternion, etc. The algorithm is shown later.

Satellite attitude is calculated using onboard attitude data. In case onboard data is not enough to interpolate (for example data loss or near edge of scene), satellite attitude is calculated from extrapolation. Flag shows using either interpolation or extrapolation is stored in satAttInterpolationMethodFlag group

Transformation matrix (satToECR_Matrix) can transform coordinate from satellite coordinate to ECR (WGS84) directly. The matrix contains all coordinate transformation from satellite coordinate to J2000, J2000 to TOD which considers precession and nutation of the earth, and TOD to ECR (WGS84) which considers the earth rotation and polar motion. Usage of this matrix shows in Chapter 4.

The calculation of roll, pitch and yaw angles are described below.

The first step is to make a transform matrix from orbit coordinate to TOD by using $\mathbf{p}_{\mathbf{TOD}}$ satellite position and $\mathbf{v}_{\mathbf{TOD}}$ velocity vectors in TOD.

$$\mathbf{E}_{\text{orbit-TOD}} = \begin{pmatrix} E_{11} & E_{12} & E_{13} \\ E_{21} & E_{22} & E_{23} \\ E_{31} & E_{32} & E_{33} \end{pmatrix} \qquad \text{Eq. 3.5.5-1}$$

Each element of the matrix is defined as follows:

$$\mathbf{E}_{\mathbf{z}} = \begin{pmatrix} E_{13} \\ E_{23} \\ E_{33} \end{pmatrix} = -\frac{\mathbf{p}_{\mathbf{TOD}}}{|\mathbf{p}_{\mathbf{TOD}}|} \qquad \text{Eq. 3.5.5-2}$$

$$\mathbf{E}_{\mathrm{y}} = \begin{pmatrix} E_{12} \\ E_{22} \\ E_{32} \end{pmatrix} = -\frac{\mathbf{p}_{\mathbf{TOD}} \otimes \mathbf{v}_{\mathbf{TOD}}}{|\mathbf{p}_{\mathbf{TOD}} \otimes \mathbf{v}_{\mathbf{TOD}}|} \qquad \text{Eq. 3.5.5-3}$$

$$\mathbf{E}_{\mathrm{x}} = \begin{pmatrix} E_{11} \\ E_{21} \\ E_{31} \end{pmatrix} = \mathbf{E}_{\mathrm{y}} \otimes \mathbf{E}_{\mathrm{z}} \qquad \text{Eq. 3.5.5-4}$$

Here $\otimes$ means outer product of vector.

Next step is to make a transform matrix from orbit coordinate to satellite body $\mathbf{M}_{\mathbf{orbit\text{-}body}}$ by using the above matrix, $\mathbf{E}_{\mathbf{orbit\text{-}TOD}}$, quaternion $\mathrm{Q} = (q_0, q_1, q_2, q_3)$, and PN matrix which converts from J2000.0 to TOD coordinates,

$$\mathbf{M}_{\text{orbit–body}} = \mathbf{M}_{\text{J2000-body}} \times \mathbf{PN}^{t} \times \mathbf{E}_{\text{orbit-TOD}} \qquad \text{Eq. 3.5.5-5}$$

where the superscript *t* denotes transpose and $\mathbf{M}_{\mathbf{J2000\text{-}body}}$ is defined by Eq. 3.4.8-1. The superscript t denotes transpose. The above formula denotes a set of coordinate conversion matrices, $\mathbf{E}_{\mathbf{orbit\text{-}TOD}}$ is the matrix converting from orbit to TOD coordinates, $\mathbf{PN}^{t}$ is converting from TOD to J2000.0 coordinates, and then $\mathbf{M}_{\mathbf{J2000\text{-}body}}$ is converting from J2000.0 to satellite coordinate.

Then angles around x,y,z axes are expressed roll $\varphi$, pitch $\theta$ and yaw $\psi$ respectively and the coordinate can convert from orbit to satellite coordinate by rotating around each axis in order of z, y, x.

The conversion matrix $\mathbf{M}_{\mathbf{J2000\text{-}body}}$ from orbit to satellite coordinate can be defined by roll $\varphi$, pitch $\theta$ and yaw $\phi$, shown below, the equation 3.5.8.-6.

$$\begin{aligned}
\mathbf{M}_{\text{orbit–body}} &= \begin{pmatrix} M_{11} & M_{12} & M_{13} \\ M_{21} & M_{22} & M_{23} \\ M_{31} & M_{32} & M_{33} \end{pmatrix} \\
&= \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\varphi & \sin\varphi \\ 0 & -\sin\varphi & \cos\varphi \end{pmatrix} \begin{pmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{pmatrix} \begin{pmatrix} \cos\psi & \sin\psi & 0 \\ -\sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{pmatrix} \\
&= \begin{pmatrix} \cos\theta\cos\psi & \cos\theta\sin\psi & -\sin\theta \\ \sin\varphi\sin\theta\cos\psi - \cos\varphi\sin\psi & \sin\varphi\sin\theta\sin\psi + \cos\varphi\cos\psi & \sin\varphi\cos\theta \\ \cos\varphi\sin\theta\cos\psi + \sin\varphi\sin\psi & \cos\varphi\sin\theta\sin\psi - \sin\varphi\cos\psi & \cos\varphi\cos\theta \end{pmatrix}
\end{aligned} \qquad \text{Eq. 3.5.5-6}$$

By equating Eq. 3.5.5-5 and Eq. 3.5.5-6, roll $\varphi$, pitch $\theta$ and yaw $\psi$ can be obtained as follows:

$$\begin{aligned}
\varphi &= \operatorname{atan2}(M_{23}, M_{33}) \\
\theta &= \operatorname{asin}(-M_{13}) \\
\psi &= \operatorname{atan2}(M_{12}, M_{11})
\end{aligned} \qquad \text{Eq. 3.5.5-7}$$

The definition of atan2 is shown in Eq.4-16.

3.5.6. SolarGeometry group

SolarGeometry group contains apparent solar position and velocity (in ECR and TOD) at observation time. The values take account of light propagation time from sun to earth (8 minutes 19 seconds/ fixed value/ specified by parameters).

When $\mathbf{E}_{sol} = (\mathbf{e}_x, \mathbf{e}_y, \mathbf{e}_z)$ is the unit vector of the solar direction in the satellite coordinate at the observation time, the solar direction is described as following angles.

$$\begin{aligned}
\beta &= -\text{atan2}(\mathbf{e}_y, \mathbf{e}_x) \\
\eta &= -\text{atan2}(\mathbf{e}_z, \mathbf{e}_x)
\end{aligned} \qquad \text{Eq. 3.5.6-1}$$

3.5.7. LunarGeometry group

LunarGeometry group contains true lunar position and velocity (in ECR and TOD) at observation time.

3.5.8. SoundingGeometry group

SoundingGeometry group contains latitude/longitude at each observation point, land type flag, sunglint flag, satellite zenith and azimuth angle, solar zenith and azimuth angle, distance from the observation point to sun, scattering angle and lunar to satellite to solar angle.

In this group, calculation of the values related solar position (for example, solar zenith angle, etc.) is used by the apparent position in taking account of light propagation time from sun to earth (fixed value).

The land/ocean flag (landType) is stored under exposureAttribute indicates whether the FTS-2 footprint is land or water (ocean/lake/river) using grid data. Grid data is the basic map generated using GSHHG (A Global Self-consistent, Hierarchical, High-resolutionGeography Database)

If the footprint is fully covered by land, the flag is defined as land (0). If the footprint is fully covered by water, the flag is defined as water (1). For the other cases, it is defined as mixed (2).

This flag is valid only within the range of -85 to +85 degrees in latitude. If, the observation point outside this latitudinal range, the flag is defined the outside of judge (3).

The sunglint flag indicates whether each exposure is sunglint area. Sunglint occurs when the sun locates the direction which the view vector from satellite reflects to on the surface. The bright patch can be observed in the data, and this phenomenon occurs depending on the relation between the sun and the satellite.

The sunglint flag is set when the following conditions are satisfied:

- Solar zenith angle is less than 90 degrees.
- Solar zenith angle is almost equal to satellite zenith angle, that is,

  $| \text{viewZenith} - \text{solarZenith} | \leqq \varepsilon 1$,

  where $\varepsilon 1$ is a processing parameter.
- Difference of solar and satellite azimuth angles is almost 180 degrees, that is,

  $|\text{wrap}(\text{viewAzimuth} - \text{solarAzimuth}) - 180| \leqq \varepsilon 2$,

  where wrap( $\theta$ ) is wrapping function of angle $\theta$ within 0 to 360 degrees, and
  $\varepsilon 2$ is an error parameter.

The angle between specular reflection vector and satellite view vector is stored as specular_viewVector_angle.

The Definition of sensor and solar zenith/azimuth angle, lunar tosatellite to solar angle, scattering angle and the angle between specular reflection vector and satellite view vector are described below.

(1) The Definition of sensor and solar zenith/azimuth angle (Refer Figure 3.5.8-1)

When geographic latitude/longitude is $\lambda / \varphi$ in observation point $\mathbf{p_{obs}}=(p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$, unit vector of zenith direction **z**, unit vector of north direction **n** and unit vector of east direction **e** are expressed as follows:

$$\mathbf{z} = \begin{pmatrix} \cos\varphi\cos\lambda \\ \cos\varphi\sin\lambda \\ \sin\varphi \end{pmatrix} \qquad \text{Eq. 3.5.8-1}$$

$$\mathbf{n} = \begin{pmatrix} -\sin\varphi\cos\lambda \\ -\sin\varphi\sin\lambda \\ \cos\varphi \end{pmatrix} \qquad \text{Eq. 3.5.8-2}$$

$$\mathbf{e} = \begin{pmatrix} -\sin\lambda \\ \cos\lambda \\ 0 \end{pmatrix} \qquad \text{Eq. 3.5.8-3}$$

Using satellite or solar position vector in ECR $\mathbf{p}_{\mathbf{ECR}}$, zenith angle $\theta_z$ and azimuth angle $\varphi_{Az}$ are expressed as follows:

$$\theta_z = \operatorname{acos}\left(\frac{(\mathbf{p}_{\mathbf{ECR}} - \mathbf{p}_{\mathbf{obs}}) \cdot \mathbf{z}}{|\mathbf{p}_{\mathbf{ECR}} - \mathbf{p}_{\mathbf{obs}}|}\right) \qquad \text{Eq. 3.5.8-4}$$

$$\varphi_{Az} = \operatorname{atan2}\left((\mathbf{p}_{\mathbf{ECR}} - \mathbf{p}_{\mathbf{obs}}) \cdot \mathbf{e},\quad (\mathbf{p}_{\mathbf{ECR}} - \mathbf{p}_{\mathbf{obs}}) \cdot \mathbf{n}\right) \qquad \text{Eq. 3.5.8-5}$$

($\mathbf{p}_{\mathbf{ECR}}$ - $\mathbf{p}_{\mathbf{obs}}$) is direction to sun from observation point or satellite.

The azimuth angle $\varphi_{Az}$ is defined from 0 to $2\pi$ [rad] (0 to 360[deg]). If $\varphi_{Az}$ is negative value at Eq.3.5.8-5 add $2\pi$ to $\varphi_{Az}$. For definition of atan2 function, please refer to Eq.4-16.

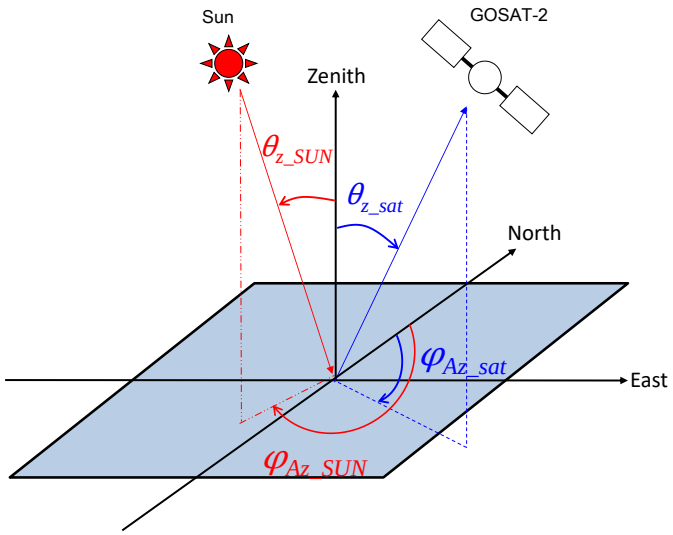


**Figure 3.5.8 -1 Sensor and solar zenith/azimuth angle**

(2) The Definition of angle between lunar to satellite vector and solar to satellite vector (Figure 3.5.8-2)

Using sensor position vector $\mathbf{p}_{\mathbf{sat}}$, solar position vector $\mathbf{p}_{\mathbf{SUN}}$ and lunar position vector $\mathbf{p}_{\mathbf{MOON}}$, the angle between lunar-satellite vector and solar-satellite vector $\theta_{el}$ is expressed as follows:

$$\theta_{el} = \operatorname{acos}\left(\frac{(\mathbf{p}_{\mathbf{MOON}} - \mathbf{p}_{\mathbf{sat}}) \cdot (\mathbf{p}_{\mathbf{SUN}} - \mathbf{p}_{\mathbf{sat}})}{|\mathbf{p}_{\mathbf{MOON}} - \mathbf{p}_{\mathbf{sat}}||\mathbf{p}_{\mathbf{SUN}} - \mathbf{p}_{\mathbf{sat}}|}\right) \qquad \text{Eq. 3.5.8-6}$$

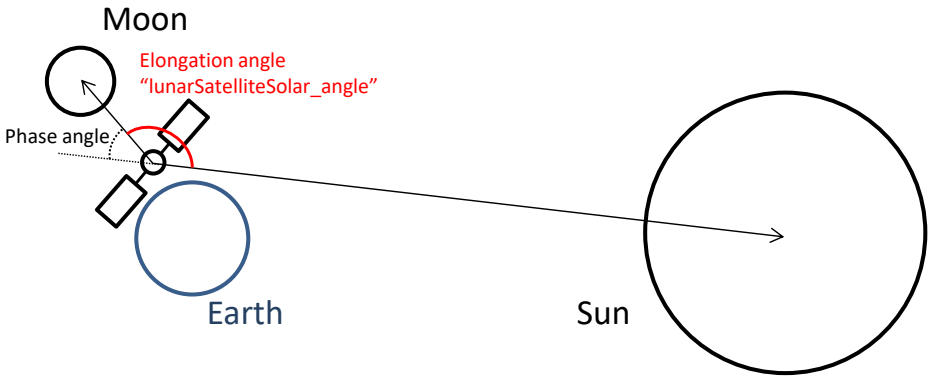


**Figure 3.5.8-2 Angle between lunar-satellite vector and solar-satellite vector.**

(3) The Definition of scattering angle (Figure 3.5.8-3)

The scattering angle is defined as angle between the directions of scattered light and incoming light.

When the scatted light progresses to the same direction of incident light（$\varphi_{SCAT}$=0 degree）, the scatter is called the forward scatter and when it progresses to the opposite direction（$\varphi_{SCAT}$=180 degree）, it is called the backward scatter. The definition is as follows.

$$\varphi_{SCAT} = \mathrm{acos}(\Phi_{SCAT}) \qquad \text{Eq. 3.5.8-7}$$

$\Phi_{SCAT}$ is defined by below Eq. 3.5.8-8. $\theta_{z\_sat}$ and etc. are defined by (1) and Figure 3.5.8-1.

$$\begin{aligned}\Phi_{SCAT} = &-\sin\theta_{z\_SUN}\sin\varphi_{Az\_SUN}\sin\theta_{z\_sat}\sin\varphi_{Az\_sat} \\ &-\sin\theta_{z\_SUN}\cos\varphi_{Az\_SUN}\sin\theta_{z\_sat}\cos\varphi_{Az\_sat} \\ &-\cos\theta_{z\_SUN}\cos\theta_{z\_sat}\end{aligned} \qquad \text{Eq. 3.5.8-8}$$

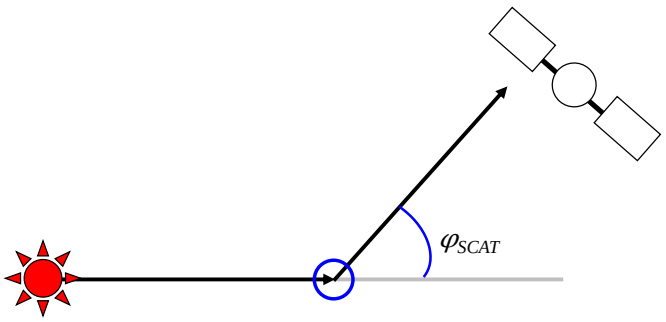


**Figure 3.5.8-3 Definition of Scattering angle**

(4) The angle between specular reflection vector and satellite view vector (Figure 3.5.8-4)

The angle between specular reflection vector and satellite view vector $\varphi_{SPEC}$ is defined by the following equation.

$$\varphi_{SPEC} = \mathrm{acos}(\Phi_{SPEC}) \qquad \text{Eq. 3.5.8-9}$$

$\Phi_{SPEC}$ is defined by Eq. 3.5.8-10. $\theta_{z\_sat}$ and etc. are defined by (1) and Figure 3.5.8-1.

$$\begin{aligned}\Phi_{SPEC} = &-\sin\theta_{z\_SUN}\sin\varphi_{Az\_SUN}\sin\theta_{z\_sat}\sin\varphi_{Az\_sat} \\ &-\sin\theta_{z\_SUN}\cos\varphi_{Az\_SUN}\sin\theta_{z\_sat}\cos\varphi_{Az\_sat} \\ &+\cos\theta_{z\_SUN}\cos\theta_{z\_sat}\end{aligned} \qquad \text{Eq. 3.5.8-10}$$

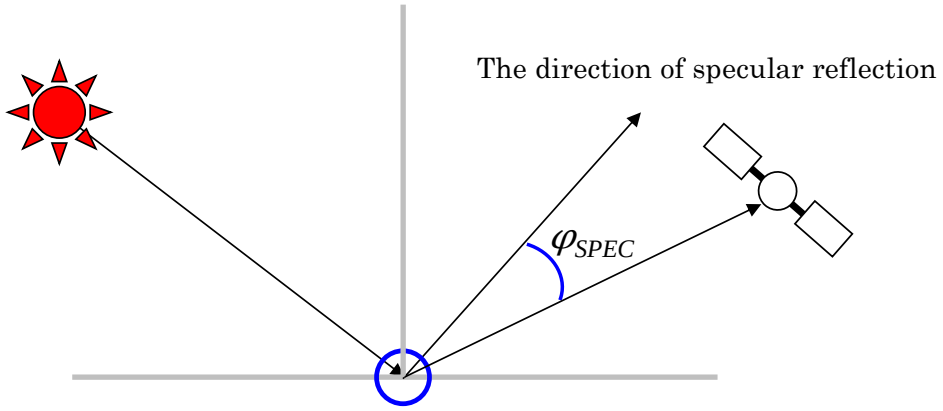


**Figure 3.5.8-4 Definition of angle between specular reflection vector and satellite view vector**

3.5.9. PointingGeometry group

PointingGeometry group contains the gimbal driving angle (pointingAT : AT angle, pointingCT : CT angle) and view vector of center of FOV(viewVector/ satellite coordinate) , the angle between AT direction and the view vector (viewVectorAT), the angle between CT direction and the view vector(viewVectorCT) at the observation time. The method to calculate these angles are described in section 4.

3.5.10. SoundingData group (L1A)

SoundingData group in L1A contains interferogram data sampled at equal distance for each observation point and band.

The optical path distance for sample *i* can be calculated by folloing equation.

$$d(i) = \begin{cases} (i - beginFringe) \times deltaOPD & (scanDirection = FWD) \\ (beginFringe - i) \times deltaOPD & (scanDirection = BWD) \end{cases} \qquad \text{Eq. 3.5.10-1}$$

The *i* is the index of samples (*i = 0,1,…, numFringes-1*). The *d(i)* is the optical path distance corresponding to index *i* . The beginFringe is the maximum signal position of interferogram. The deltaOPD is interval of distance. Both beginFringe and deltaOPD are stored in SoundingData group. The scanDirection can be obtained in SoundingAttribute group.

3.5.11. SoundingData group (L1B)

SoundingData group in L1B contains complex spectrum data for each observation point and band. Types of spectrum are described below.

- Before sensitivity correction spectrum (V/cm$^{-1}$) (SWIR file only)
- After sensitivity correction spectrum (W/cm$^2$/str/cm$^{-1}$) (SWIR/TIR file)
- Finite FOV correction spectrum (W/cm$^2$/str/cm$^{-1}$) (TIR file only)

Sensitivity correction spectrum in TIR is calculated using blackbody and deep space data.

In addition, the following spectrum data are stored as quality check.

- Low-frequency components before applying sensitivity correction spectrum ($V/cm^{-1}$) (SWIR only)
- Low-frequency components after applying sensitivity correction spectrum ($W/cm^2/str/cm^{-1}$) (TIR only)

Table 3.5.11-1 shows the spectrum to be stored.

Table3.5.11-1 Stored spectrum

| | | Observation mode | | | | Calibration mode | | |
|---|---|---|---|---|---|---|---|---|
| | | Night (OB1N,OB2N) | Day (OB1D,OB2D) | | Night Calibration (Ncal) | Blackbody cal (Bcal) Deep space cal (Dcal) Solor irradaiance cal (Scal) | | Lunar cal (Lcal) Instrument line shape function cal (ILSF) |
| | | TIR | SWIR | TIR | SWIR | SWIR | TIR | SWIR |
| Spectrum before sensitivity correction (V/cm-1) | /SoundingData/RawSpecturm/band1P | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band1S | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band2P | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band2S | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band3P | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band3S | | ○ | | ○ | ○ | | ○ |
| | /SoundingData/RawSpecturm/band4 | | | | | | ○ | |
| | /SoundingData/RawSpecturm/band5 | | | | | | ○ | |
| | /SoundingData/RawSpecturm_outband/band1P | | ○ | | ○ | | | ○ |
| | /SoundingData/RawSpecturm_outband/band1S | | ○ | | ○ | | | ○ |
| | /SoundingData/RawSpecturm_outband/band2P | | ○ | | ○ | | | ○ |
| | /SoundingData/RawSpecturm_outband/band2S | | ○ | | ○ | | | ○ |
| | /SoundingData/RawSpecturm_outband/band3P | | ○ | | ○ | | | ○ |
| | /SoundingData/RawSpecturm_outband/band3S | | ○ | | ○ | | | ○ |
| Spectrum after sensitivity correction (W/cm2/str/cm-1) | /SoundingData/Radiance/band1P | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band1S | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band2P | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band2S | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band3P | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band3S | | ○ | | ○ | | | |
| | /SoundingData/Radiance/band4 | ○ | | ○ | | | | |
| | /SoundingData/Radiance/band5 | ○ | | ○ | | | | |
| | /SoundingData/Radiance_outband/band4 | ○ | | ○ | | | | |
| | /SoundingData/Radiance_outband/band5 | ○ | | ○ | | | | |
| Spectrum after finite FOV correction (W/cm2/str/cm-1) | /SoundingData/Radiance_finiteFOVcorr/band4 | ○ | | ○ | | | | |
| | /SoundingData/Radiance_finiteFOVcorr/band5 | ○ | | ○ | | | | |

### 3.5.12. SolarCalibrationData group

SolarCalibrationData group contains reflectance for each polarization which is calculated using solar irradiance calibration mode data, and gain value.

### 3.5.13. ScanMirror group

ScanMirror group contains the scan mirror's temperature and mirror reflectivity for each polarization at the observation time.

## 4. Geometric conversion

Setting of viewing vector, coordinate conversion to ECR coordinate and calculation of observation point are described below.

(1) Definition of view vector in FTS-2 optical coordinate

Figure4-1 shows the sensor view vector in FTS-2 optical coordinate.

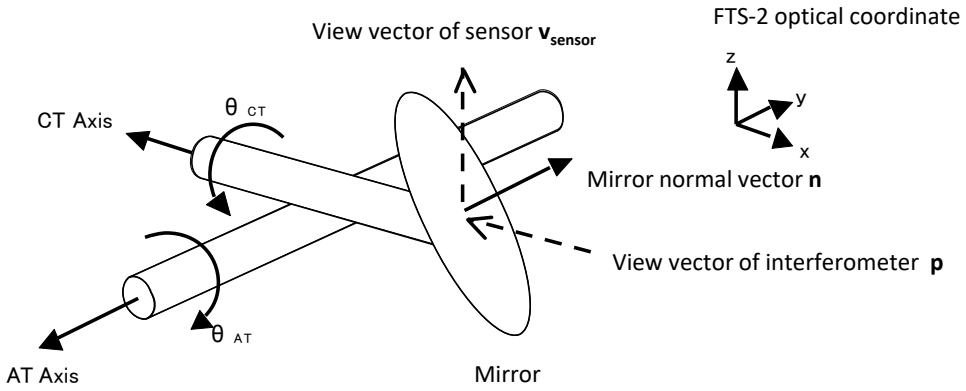


Figure4-1 View vector in FTS-2 optical coordinate

The sensor view vector $\mathbf{v}_{sensor}$ is calculated by below Eq.4-1.

$$\mathbf{v}_{sensor} = \mathbf{p} - 2(\mathbf{p} \bullet \mathbf{n})\mathbf{n} \qquad \text{Eq. 4-1}$$

Where **n** is mirror normal vector in FTS-2 defined as follows:

$$\mathbf{n} = \begin{pmatrix} \cos\theta_{AT} & 0 & \sin\theta_{AT} \\ 0 & 1 & 0 \\ -\sin\theta_{AT} & 0 & \cos\theta_{AT} \end{pmatrix} \times \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_{CT} & -\sin\theta_{CT} \\ 0 & \sin\theta_{CT} & \cos\theta_{CT} \end{pmatrix} \times \begin{pmatrix} \frac{1}{\sqrt{2}} \\ 0 \\ \frac{1}{\sqrt{2}} \end{pmatrix} \qquad \text{Eq. 4-2}$$

$\theta_{CT}$ (pointingCT) is a motor rotation angle around the CT axis and $\theta_{AT}$ (pointingAT) is a motor rotation angle around AT axis. They are stored in PointingGeometry group.

**p** is the view vector of the interferometer. For the center of the field of view (FOV), **p** = [-1, 0, 0]$^t$ . For the view vector for limit direction of FOV, **p** = [-cos($\theta_{FOV}$/2), sin($\theta_{FOV}$/2)cos($\theta_r$), sin($\theta_{FOV}$/2)sin($\theta_r$)]$^t$ . $\theta_{FOV}$ is the view angle (15.8 mrad at the maximum), and $\theta_r$ is the angle around the center of FOV (0 to 360 degrees).

The definition of the angle of view vector, $\varphi_{AT}$(viewAngleAT) of AT direction (in x-z plane) and $\varphi_{CT}$(viewAngleCT) of CT direction (in y-z plane), are described in the note of the following section.

(2) Conversion from FTS-2 optical coordinate to satellite coordinate

Conversion from view vector in FTS-2 optical coordinate $\mathbf{v}_{sensor}$ to satellite coordinate $\mathbf{v}_{body}$ is expressed as follows:

$$\mathbf{v}_{body} = \mathbf{M}_{sensor-body} \times \mathbf{v}_{sensor} \qquad \text{Eq. 4-3}$$

$\mathbf{M}_{sensor\text{-}body}$ is coordinate transformation matrix convert from FTS-2 optical coordinate to satellite coordinate and stored in AlignmentMatrix of ProcessingParameters group.(See Chapter 3.5.4)

(3) Conversion from satellite coordinate to ECR coordinate

Using transformation matrix (satToECR_Matrix) $\mathbf{M}_{body\text{-}ECR}$ which is stored in SatelliteGeometry group, conversion from view vector in satellite coordinate $\mathbf{v}_{body}$ to view vector in ECR(WGS84) $\mathbf{v}_{ECR}$ is expressed as follows:

$$\mathbf{v}_{ECR} = \mathbf{M}_{body-ECR} \times \mathbf{v}_{body} \qquad \text{Eq. 4-4}$$

$\mathbf{v}_{ECR}$ can also be calculated by following process(4) to (7) without using $\mathbf{M}_{body\text{-}ECR}$. The process transforms coordinates, satellite coordinate, J2000.0, TOD consists of pseudo earth-fixed (the coordinate without considering the polar motion of the earth) and ECR sequentially.

(4) Conversion from satellite coordinate to J2000.0 coordinate

Conversion from view vector in satellite coordinate $\mathbf{v}_{body}$ to view vector in J2000.0 coordinate $\mathbf{v}_{J2000}$ is expressed as follows:

$$\mathbf{v}_{J2000} = \mathbf{M}_{body-J2000} \times \mathbf{v}_{body} \qquad \text{Eq. 4-5}$$

$\mathbf{M}_{body\text{-}J2000}$ is coordinate transformation matrix converting from satellite coordinate to J2000.0 coordinate using satellite attitude data (quaternion) which is stored in AttitudeData group of Common file (see Chapter 3.4.8).

(5) Conversion from J2000.0 coordinate to TOD coordinate

Using PN matrix which is stored in TransMatrixInfo group of Common file, conversion from view vector in J2000.0 coordinate $\mathbf{v}_{J2000}$ to view vector in TOD coordinate $\mathbf{v}_{TOD}$ is expressed as follows:

$$\mathbf{v}_{TOD} = \mathbf{PN} \times \mathbf{v}_{J2000} \qquad \text{Eq. 4-6}$$

(6) Conversion from TOD coordinate to pseudo earth-fixed coordinate

Conversion from view vector in TOD coordinates $\mathbf{v}_{TOD}$ to view vector in pseudo earth-fixed coordinate (without considering the polar motion of the earth) $\mathbf{v}_{PECR}$ is expressed as follows:

$$\mathbf{v}_{PECR} = \mathbf{M}_{TOD-PECR} \times \mathbf{v}_{TOD} \qquad \text{Eq. 4-7}$$

$\mathbf{M}_{TOD\text{-}PECR}$ is coordinate transformation matrix converting from TOD coordinate to pseudo earth-fixed coordinate and calculated using Greenwich sidereal time SiderealTimeInfo group of Common file (see Chapter 3.4.3).

(7) Conversion from pseudo earth-fixed coordinate to ECR coordinate

Using XY matrix is stored in TransMatrixInfo group of Common file, conversion from view vector in pseudo earth-fixed coordinate (without considering polar motion) $\mathbf{v}_{PECR}$ to view vector

in ECR $\mathbf{v_{ECR}}$is expressed as follows:

$$\mathbf{v_{ECR}} = \mathbf{XY} \times \mathbf{v_{PECR}} \qquad \text{Eq. 4-8}$$

(8) Calculation of observation point on the earth ellipsoid

Using view vector in ECR coordinate $\mathbf{v_{ECR}}=(v_x, v_y, v_z,)^t$ (the superscript *t* denotes transpose), sensor position vector $\mathbf{p_{sat}}=(p_{sat\_x}, p_{sat\_y}, p_{sat\_z})^t$ and observation point vector on the earth ellipsoid $\mathbf{p_{obs}}=(p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$, observation point is expressed as follows:

$$\begin{pmatrix} p_{obs\_x} \\ p_{obs\_y} \\ p_{obs\_z} \end{pmatrix} = \begin{pmatrix} p_{sat\_x} \\ p_{sat\_y} \\ p_{sat\_z} \end{pmatrix} + k \begin{pmatrix} v_x \\ v_y \\ v_z \end{pmatrix} \qquad \text{Eq. 4-9}$$

*k* is intermediate variable.

When the equatorial radius and polar radius on the earth ellipsoid is *Re* and *Rp*, $\mathbf{p_{obs}}=(p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$ satisfies the following relational expression:

$$\frac{p_{obs\_x}^2 + p_{obs\_y}^2}{R_e^2} + \frac{p_{obs\_z}^2}{R_p^2} = 1 \qquad \text{Eq. 4-10}$$

Assigning Eq.4-9 to Eq.4-10, quadratic equation for *k* is obtained as follows:

$$ak^2 + 2bk + c = 0$$
$$where \qquad \text{Eq. 4-11}$$
$$\begin{cases} a = R_p^2\left(v_x^2 + v_y^2\right) + R_e^2 v_z^2 \\ b = R_p^2\left(p_{sat\_x} v_x + p_{sat\_y} v_y\right) + R_e^2\, p_{sat\_z} v_z \\ c = R_p^2\left(p_{sat\_x}^2 + p_{sat\_y}^2\right) + R_e^2\, p_{sat\_z}^2 - R_e^2 R_p^2 \end{cases}$$

Then, Eq. 4-11 solved for *k*.

$$k = \frac{-b - \sqrt{b^2 - ac}}{a} \qquad \text{Eq. 4-12}$$

In case $b^2-ac < 0$ and $k < 0$, observation point is outside of earth surface.

Assigning *k* to Eq.4-9, observation point vector $\mathbf{p_{obs}}=(p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$ can be calculated.

Figure 4-2 shows each vector.

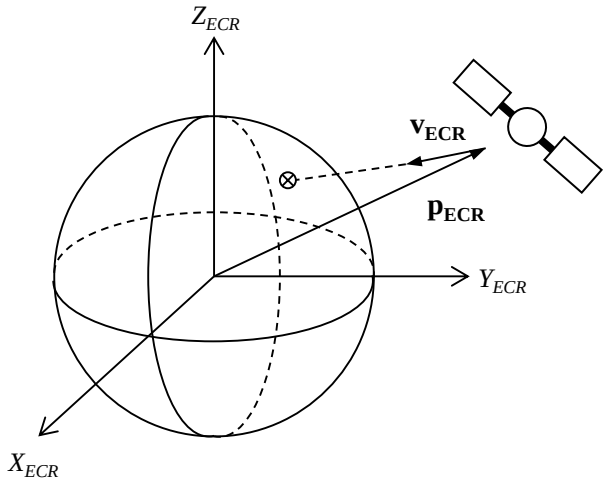


**Figure 4-2 Calculation of observation point**

(9) Calculation of geographic latitude/longitude

Geographic longitude $\lambda$ corresponding observation point vector of the earth ellipsoid $\mathbf{p}_{\mathbf{obs}}=(p_{obs\_x}, p_{obs\_y}, p_{obs\_z})^t$ is expressed as follows:

$$\lambda = \operatorname{atan2}(p_{obs\_y}, p_{obs\_x}) \qquad \text{Eq. 4-13}$$

Using geocentric latitude $\psi$, geographic latitude $\varphi$ is expressed as follows:

$$\psi = \operatorname{asin}\left(\frac{p_{obs\_z}}{\sqrt{p_{obs\_x}^2 + p_{obs\_y}^2 + p_{obs\_z}^2}}\right) \qquad \text{Eq. 4-14}$$

$$\varphi = \operatorname{atan2}\left(\sin\psi,\ \frac{R_p^2}{R_e^2}\cos\psi\right) \qquad \text{Eq. 4-15}$$

Definition of atan2 function is described below.

$$\operatorname{atan2}(y,x) = \begin{cases} \tan^{-1}\left(\dfrac{y}{x}\right) & (x>0) \\ \tan^{-1}\left(\dfrac{y}{x}\right)+\pi & (x<0, y\geq 0) \\ \tan^{-1}\left(\dfrac{y}{x}\right)-\pi & (x<0, y<0) \\ \dfrac{\pi}{2} & (x=0, y>0) \\ -\dfrac{\pi}{2} & (x=0, y<0) \\ \textit{undefined} & x=0, y=0 \end{cases} \qquad \text{Eq. 4-16}$$

Note: Calculating angles of AT direction and CT direction of view vector in FTS-2 coordinate.

In the view vector calculated by Eq4-1, how to calculate the angle of AT direction (x-z plane) $\varphi_{AT}$(viewAngleAT) and the angle of CT direction (y-z plane) $\varphi_{CT}$(viewAngleCT) is described

below.

From Eq4-2, the mirror normal vector is calculated from the following,

$$\mathbf{n} = \begin{pmatrix} \cos\theta_{AT} & 0 & \sin\theta_{AT} \\ 0 & 1 & 0 \\ -\sin\theta_{AT} & 0 & \cos\theta_{AT} \end{pmatrix} \times \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_{CT} & -\sin\theta_{CT} \\ 0 & \sin\theta_{CT} & \cos\theta_{CT} \end{pmatrix} \times \begin{pmatrix} \frac{1}{\sqrt{2}} \\ 0 \\ \frac{1}{\sqrt{2}} \end{pmatrix}$$

$$= \frac{1}{\sqrt{2}} \begin{pmatrix} \cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT} \\ -\sin\theta_{CT} \\ -\sin\theta_{AT} + \cos\theta_{AT}\cos\theta_{CT} \end{pmatrix}$$

Eq.4-17

Eq.4-17 and the pointing direction of interferogram p = [-1,0,0]t, Eq.4-1 is calculated as the followings.

$$\mathbf{v}_{\mathbf{sensor}} = \mathbf{p} - 2(\mathbf{p}\cdot\mathbf{n})\mathbf{n} = \begin{pmatrix} -1 \\ 0 \\ 0 \end{pmatrix} + \left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right) \begin{pmatrix} \cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT} \\ -\sin\theta_{CT} \\ -\sin\theta_{AT} + \cos\theta_{AT}\cos\theta_{CT} \end{pmatrix}$$

$$= \begin{pmatrix} -1 + \left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right)^2 \\ -\sin\theta_{CT}\left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right) \\ \left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right)\left(-\sin\theta_{AT} + \cos\theta_{AT}\cos\theta_{CT}\right) \end{pmatrix}$$

Eq.4-18

From Eq.4-18, the angle of AT direction (the angle in x-z plane)$\varphi_{AT}$ and the angle of CT direction (the angle of y-z plane) of view vector is calculated as follows:

$$\varphi_{AT} = \operatorname{atan2}\left(-1 + \left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right)^2, \left(\cos\theta_{AT} + \sin\theta_{AT}\cos\theta_{CT}\right)\left(-\sin\theta_{AT} + \cos\theta_{AT}\cos\theta_{CT}\right)\right)$$

Eq. 4-19

$$\varphi_{CT} = \operatorname{atan2}\left(-\sin\theta_{CT}, \left(-\sin\theta_{AT} + \cos\theta_{AT}\cos\theta_{CT}\right)\right)$$

Eq. 4-20

## 5. Format Details

The details of product (HDF5) format are described below. Table 5-1 shows the format details of Common file (HDF5) and Table 5-2 shows the format details of SWIR/TIR file (HDF5).

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(1/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| Metadata | L1A,L1B | | | | | | | | | |
| granuleID | L1A,L1B | 1 | 1 | H5T_STRING | File Identifier (Granule ID) | Granule ID(47bytes, the last 1 byte is a null terminated string)<br>・ Satellite Name : GOSAT2 (Fixed)<br>・ Sensor Name : TANSO-FTS-2: TFTS2 (Fixed)<br>・ The first observation point of this scene<br>(UT:year・month・day・hour・minute) : YYYYMMDDHHmm<br>・ Path No. : PPP(001-089)<br>・ Scene No. : 00-04(Fixed)<br>(Calibration Mode : 00, operation mode : 01-04)<br>・ Processing Level : 1A,1B<br>・ Band : C(Fixed)<br>・ Orbit data used for processing : R<br>Using predicted orbit data : P<br>Using GPS or determined orbit data : D<br>・ Correction coefficients used for processing : C<br>Using nominal coefficients : N<br>Using updated coefficients : U<br>・ Reserved : 00<br>・ Operation Mode : 0000<br>OB1D:Observation Mode (day)<br>OB1N:Observation Mode (night)<br>OB2D:Observation Mode (day/Except for full observation)<br>OB2N:Observation Mode (night/Except for full observation)<br>OBUD:Undecimated Mode (day)<br>OBUN:Undecimated Mode (night)<br>SCAL:Solar irradiance calibration mode<br>BCAL : Blackbody Calibration mode<br>DCAL : Deep space calibration mode<br>ILSF : Instrument function calibration mode<br>NCAL: Dark calibration mode<br>ECAL: Electrical calibration mode<br>LCAL : Lunar calibration mode<br>TEST: TEST Calibration<br>LUBE: Scanner bearing mode<br>・ Algorithm Version : AAA(000-999)<br>・ Parameter Version : BBB(000-999) | - | - | - | The time at the first observation point is the oldest observation start time in this product. |
| operationMode | L1A,L1B | 1 | 1 | H5T_STRING | Operation mode | "OB1D":Observation Mode (day)<br>"OB1N":Observation Mode (night)<br>"OB2D":Observation Mode (day/Except for full observation)<br>"OB2N":Observation Mode (night/Except for full observation)<br>"OBUD":Undecimated Mode (day)<br>"OBUN":Undecimated Mode (night)<br>"SCAL":Solar irradiance calibration mode<br>"BCAL" : Blackbody Calibration mode<br>"DCAL" : Deep space calibration mode<br>"ILSF" : Instrument function calibration mode<br>"NCAL": Dark calibration mode<br>"ECAL": Electrical calibration mode<br>"LCAL : Lunar calibration mode<br>"TEST": TEST calibration mode<br>"LUBE": Scanner bearing mode<br>(5bytes, the last 1 byte is a null terminated string) | - | - | - | |
| processingDate | L1A,L1B | 1 | 1 | H5T_STRING | Processing date | Date of product creation (UTC)<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28 bytes, the last 1 byte is a null terminated string) | UTC | - | - | The time at the job start of producing product is stored. |
| startDateSWIR | L1A,L1B | 1 | 1 | H5T_STRING | Start date of SWIR data of scene | Start date of SWIR data of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ (28 bytes, the last 1 byte is a null terminated string)<br>If there is no SWIR data, "-" is filled, and 2 bytes, the last 1 byte is a null terminated string | UTC | - | "-" | The oldest start time of SWIR observation is stored. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(2/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| endDateSWIR | L1A,L1B | 1 | 1 | H5T_STRING | End date of SWIR data of scene | End date of SWIR data of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ (28 bytes, the last 1 byte is a null terminated string.)<br>If there is no SWIR data, "-" is filled, and 2 bytes, the last 1 byte is a null terminated string. | UTC | - | "-" | The latest start time of SWIR observation is stored. |
| startDateTIR | L1A,L1B | 1 | 1 | H5T_STRING | Start date of TIR data of scene | Start date of TIR data of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ (28 bytes, the last 1 byte is a null terminated string.)<br>If there is no TIR data,"-" is filled, and 2 bytes, the last 1 byte is a null terminated string. | UTC | - | "-" | The oldest start time of TIR observation is stored. |
| endDateTIR | L1A,L1B | 1 | 1 | H5T_STRING | End date of TIR data of scene | End date of TIR data of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ(28 bytes, the last 1 byte is a null terminated string.)<br>If there is no TIR data,"-" is filled, and 2 bytes, the last 1 byte is a null terminated string. | UTC | - | "-" | The latest start time of TIR observation is stored. |
| geodeticDatum | L1A,L1B | 1 | 1 | H5T_STRING | Geodetic datum | "WGS84( WGS84":Reference Ellipsoid Model/Frame of Reference<br>(14 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| satelliteName | L1A,L1B | 1 | 1 | H5T_STRING | Satellite Name | "GOSAT-2" : Greenhouse gases Observing SATellite-2<br>(8 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| sensorName | L1A,L1B | 1 | 1 | H5T_STRING | Sensor Name | "TANSO-FTS-2" : Fourier Transform Spectrometer-2<br>(12 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| processingLevel | L1A,L1B | 1 | 1 | H5T_STRING | Processing Level | "L1A" : Level 1A<br>"L1B" : Level 1B<br>(4 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| algorithmVersion | L1A,L1B | 1 | 1 | H5T_STRING | Algorithm Version | Algorithm version number to produce this product<br>(4 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| parameterVersion | L1A,L1B | 1 | 1 | H5T_STRING | ParameterVersion | Parameter version number to produce this product<br>(4 bytes, the last 1 byte is a null terminated string) | - | - | - | |
| processingFacility | L1A,L1B | 1 | 1 | H5T_STRING | Processing facility name | "G2MDP" : Mission Operations System Data Processing<br>"JSS" : JAXA Super computer System<br>"EORC" : Earth Observation Research Center<br>(the size is the length of string above plus 1byte) | - | - | - | |
| contact_01 | L1A,L1B | 1 | 1 | H5T_STRING | Organization Name1 | "Japan Aerospace Exploration Agency (JAXA)"<br>(42bytes, the last 1 byte is a null terminated string) | - | - | - | |
| contact_02 | L1A,L1B | 1 | 1 | H5T_STRING | Organization Name2 | "National Institute for Environmental Studies (NIES)"<br>(52bytes, the last 1 byte is a null terminated string) | - | - | - | |
| email | L1A,L1B | 1 | 1 | H5T_STRING | e-mail address | e-mail address<br>(the size is the length of string above plus 1byte) | - | - | - | |
| releaseVersion | L1A,L1B | 1 | 1 | H5T_STRING | Release version | Product release version<br>(the size is the length of string above plus 1byte) | - | - | - | |
| granuleIDSWIR | L1A,L1B | 1 | 1 | H5T_STRING | Granule ID of SWIR file | Granule ID for SWIR product file.<br>(47bytes, the last 1 byte is a null terminated string)<br>If there are no SWIR data in the scene, the granule ID is empty string. (The string terminator 1bytesonly) | - | - | "" | - |
| granuleIDTIR | L1A,L1B | 1 | 1 | H5T_STRING | Granule ID of TIR file | Granule ID for TIR product file.<br>(47bytes, the last 1 byte is a null terminated string)<br>If there are no TIR data in the scene, the granule ID is empty string. (The string terminator 1bytesonly) | - | - | "" | - |
| granuleIDL1A | L1B | 1 | 1 | H5T_STRING | Granule ID of L1A | Granule ID of L1A.<br>(47bytes, the last 1 byte is a null terminated string) | - | - | - | - |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (3/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| productQualityFlag | L1A,L1B | 1 | 1 | H5T_STRING | Product quality flag | Four level quality flag of this product as follows:<br>"Good", "Fair", "Poor", "NG"<br>(the size is the length of string above plus 1byte) | - | - | - | When productQualityFlag is "NG", product isn't provided to user. |
| SpacecraftTimeError (Spacecraft time error information) | L1A,L1B | | | | | | | | | |
| numDiffInfo | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of Time Difference Information Records | Number of Time Difference Information Records.<br>(When Time System is GPS, 0 is set.)<br>The items in this group are used when two time systems between the interior time system of satellite and that of the ground station are interchanged.<br><br>*ground time = (ground reference time) + (satellite counter period) * (satellite counter)<br><br>*satellite counter = (ground time) - (ground reference time in second) + (satellite time reference counter) | - | - | 0 | |
| startDate | L1A,L1B | 1 | numDiffInfo | H5T_STRING | Start date | The start time at the first record of Time Difference information Record in this path.<br>There is no dataset if numDiffInfo is 0.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string x numDiffInfo) | UTC | - | - | There is no dataset if numDiffInfo is 0. |
| endDate | L1A,L1B | 1 | numDiffInfo | H5T_STRING | End date | The end time at the last record of Time Difference information Record in this path.<br>There is no dataset if numDiffInfo is 0.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string x numDiffInfo) | UTC | - | - | There is no dataset if numDiffInfo is 0. |
| groundTime | L1A,L1B | 1 | numDiffInfo | H5T_STRING | Ground Reference Time | Ground Reference Time.<br>There is no dataset if numDiffInfo is 0.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string x numDiffInfo) | UTC | - | - | There is no dataset if numDiffInfo is 0. |
| refCount | L1A,L1B | 1 | numDiffInfo | H5T_STD_I32LE | Satellite Reference Time | Satellite Reference Time.<br>There is no dataset if numDiffInfo is 0. | sec | - | - | There is no dataset if numDiffInfo is 0. |
| periodCount | L1A,L1B | 1 | numDiffInfo | H5T_IEEE_F64LE | Satellite Counter Period | Satellite Counter Period.<br>Time duration corresponding to 1 count during the valid data range.<br>There is no dataset if numDiffInfo is 0. | sec | 10 | - | There is no dataset if numDiffInfo is 0. |
| SiderealTimeInfo | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of Greenwich sidereal time parameters | Number of parameters to calculate Greenwich sidereal time is stored. | - | - | 0 | |
| t0 | L1A,L1B | 1 | numData | H5T_STRING | t0(UTC) | Reference time t0 is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string)<br>Using t0, $\theta$g, and $\theta$g_dot, Greenwich sidereal time $\theta$g is expressed as follows:<br>$\theta g = \theta g0 + \theta g\_dot * (t - t0)$ | UTC | - | - | There is no dataset if numData is 0. |
| t0_ContinuousTime | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | t0 (seconds) | Total seconds since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| thetaG0 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | $\theta$g0 | Greenwich sidereal angle at the reference time $\theta$g0.<br>$0 \leqq \theta g0 < 360$ | deg | 10 | - | There is no dataset if numData is 0. |
| thetaGDot | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | $\theta$g_dot | Time derivative of Greenwich sidereal angle ~~time~~ $\theta$g_dot is stored. | deg/sec | 10 | - | There is no dataset if numData is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (4/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| TransMatrixInfo | L1A,L1B | | | | | | | | | |
| numMatrix | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of Coordinate Transformation Matrix | Number of coordinate transformation matrix. | - | - | 0 | |
| date | L1A,L1B | 1 | numMatrix | H5T_STRING | Date corresponding PN and XY matrix(UTC) | Date and time at PN and XY matrix (UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28 bytes, the last 1 byte is a null terminated stringxnumMatrix) | UTC | - | - | There is no dataset if numMatrix is 0. |
| date_ContinuousTime | L1A,L1B | 1 | numMatrix | H5T_IEEE_F64LE | Date corresponding PN and XY matrix(seconds) | Total seconds at PN, XY since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numMatrix is 0. |
| pnMatrix | L1A,L1B | 2 | numMatrix,9 | H5T_IEEE_F64LE | PN Matrix | The values of matrix PN are stored in the following order:<br>(0, 1, 2)<br>(3, 4, 5)<br>(6, 7, 8).<br><br>PN is the conversion matrix expression polar precess and nutation of earth and is used to convert ECI(J2000) coordinate to ECI(TOD). | - | 10 | - | There is no dataset if numMatrix is 0. |
| xyMatrix | L1A,L1B | 2 | numMatrix,9 | H5T_IEEE_F64LE | XY Matrix | The values of matrix XY are stored in the following order:<br>(0, 1, 2)<br>(3, 4, 5)<br>(6, 7, 8).<br><br>XY matrix is the conversion matrix from pseudo earth-fixed coordinates without considering polar motion of earth to ECR(WGS84) coordinate. | - | 10 | - | There is no dataset if numMatrix is 0. |
| OnboardOrbitData | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of onboard orbit data | Number of onboard orbit data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of onboard orbit data (UTC) | Start date of onboard orbit data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of onboard orbit data (seconds) | Total seconds of start date of onboard orbit data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of onboard orbit data | The elapsed seconds from the start date of onboard orbit data. | sec | 10 | - | There is no dataset if numData is 0. |
| posECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECR) | Satellite Position Vector in ECR is stored.<br>(x,y,z) ECR(WGS84) | km | 10 | - | There is no dataset if numData is 0. |
| velECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECR) | Satellite Velocity Vector in ECR is stored.<br>(u,v,w) ECR(WGS84) | km/s | 10 | - | There is no dataset if numData is 0. |
| posECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECI) | Satellite Position Vector in ECI is stored.<br>(x,y,z) ECI(TOD) | km | 10 | - | There is no dataset if numData is 0. |
| velECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECI) | Satellite Velocity Vector in ECI is stored.<br>(u,v,w) ECI(TOD) | km/s | 10 | - | There is no dataset if numData is 0. |
| KinematicOrbitDataPredicted (From Kinematic orbit data system in JAXA) | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of predicted kinematic orbit data | Number of predicted kinematic orbit data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of predicted kinematic orbit data (UTC) | Start date of predicted kinematic orbit data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of predicted kinematic orbit data (seconds) | Total seconds of reference time of predicted kinematic orbit data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (5/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of predicted kinematic orbit data | The elapsed seconds from start date of predicted kinematic orbit data. | sec | 10 | - | There is no dataset if numData is 0. |
| posECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECR) | Satellite Position Vector in ECR is stored.<br>(x,y,z) ECR(WGS84) | km | 10 | - | There is no dataset if numData is 0. |
| velECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECR) | Satellite Velocity Vector in ECR is stored.<br>(u,v,w) ECR(WGS84) | km/s | 10 | - | There is no dataset if numData is 0. |
| posECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECI) | Satellite Position Vector in ECI is stored.<br>(x,y,z) ECI(TOD) | km | 10 | - | There is no dataset if numData is 0. |
| velECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECI) | Satellite Velocity Vector in ECI is stored.<br>(u,v,w) ECI(TOD) | km/s | 10 | - | There is no dataset if numData is 0. |
| KinematicOrbitDataDetermined (From Kinematic orbit data system) | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of determined kinematic orbit data | Number of determined kinematic orbit data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of determined kinematic orbit data (UTC) | Start date of determined kinematic orbit data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of Determined kinematic orbit data(seconds) | Total seconds of start date of determined kinematice orbit data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of determined kinematic orbit data | The elapsed seconds from start date of determined kinematic orbit data. | sec | 10 | - | There is no dataset if numData is 0. |
| posECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECR) | Satellite Position Vector in ECR is stored.<br>(x,y,z) ECR(WGS84) | km | 10 | - | There is no dataset if numData is 0. |
| velECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECR) | Satellite Velocity Vector in ECR is stored.<br>(u,v,w) ECR(WGS84) | km/s | 10 | - | There is no dataset if numData is 0. |
| posECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECI) | Satellite Position Vector in ECI is stored.<br>(x,y,z) ECI(TOD) | km | 10 | - | There is no dataset if numData is 0. |
| velECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECI) | Satellite Velocity Vector in ECI is stored.<br>(u,v,w) ECI(TOD) | km/s | 10 | - | There is no dataset if numData is 0. |
| AttitudeData | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of attitude data | Number of attitude data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of attitude data (UTC) | Start date of attitude data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of attitude data (seconds) | Total seconds of reference time of attitude data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of attitude data | The elapsed seconds from start date of attitude data. | sec | 10 | - | There is no dataset if numData is 0. |
| satAttQuaternion | L1A,L1B | 2 | numData,4 | H5T_IEEE_F64LE | Satellite Attitude Quaternion | Quaternion (satellite-fixed coordinates at ECI(J2000)) is stored.<br>q0 is scalar data.<br>q1,q2 and q3 are i, j, and k respectively. | - | 10 | - | There is no dataset if numData is 0. |
| yawSteeringFlag | L1A,L1B | 1 | numData | H5T_STD_I8LE | Yaw steering flag | Yaw steering flag indicates the executing condition of yaw steering.<br>0: Not execute<br>1: Execute | - | - | - | There is no dataset if numData is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (6/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| aoceStatusFlag | L1A,L1B | 1 | numData | H5T_STD_I8LE | AOCE status flag | AOCE status flag which indicates the followings is stored.<br>3:Pointing to the moon<br>Otherwise:Not pointing to the moon | - | - | - | There is no dataset if numData is 0. |
| SolarEphemeris | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of data | Number of solar ephemeris data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of solar ephemeris data (UTC) | Start date of solar ephemeris data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of solar ephemeris data (seconds) | Total seconds of start date of solar ephemeris data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from Start time start date of solar ephemeris data | The elapsed seconds from start date of solar ephemeris data. | sec | 10 | - | There is no dataset if numData is 0. |
| posECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Solar Position Vector(ECR) | Solar Position Vector in ECR is stored.<br>(x,y,z) ECR(WGS84) | km | 10 | - | There is no dataset if numData is 0. |
| velECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Solar Velocity Vector(ECR) | Solar Velocity Vector in ECR is stored.<br>(u,v,w) ECR(WGS84) | km/s | 10 | - | There is no dataset if numData is 0. |
| posECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Solar Position Vector(ECI) | Solar Position Vector in ECI is stored.<br>(x,y,z) ECI(TOD) | km | 10 | - | There is no dataset if numData is 0. |
| velECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Solar Velocity Vector(ECI) | Solar Velocity Vector in ECI is stored.<br>(u,v,w) ECI(TOD) | km/s | 10 | - | There is no dataset if numData is 0. |
| LunarEphemeris | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of data | Number of lunar ephemeris data is stored. | - | - | 0 | |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of lunar ephemeris data (UTC) | Start date of lunar ephemeris data (UTC) is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of lunar ephemeris data (seconds) | Total seconds of start date of lunar ephemeris data since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of lunar ephemeris data | The elapsed seconds from start date of lunar ephemeris data. | sec | 10 | - | There is no dataset if numData is 0. |
| posECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Lunar Position Vector(ECR) | Lunar Position Vector in ECR is stored.<br>(x,y,z) ECR(WGS84) | km | 10 | - | There is no dataset if numData is 0. |
| velECR | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Lunar Velocity Vector(ECR) | Lunar Velocity Vector in ECR is stored.<br>(u,v,w) ECR(WGS84) | km/s | 10 | - | There is no dataset if numData is 0. |
| posECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Lunar Position Vector(ECI) | Lunar Position Vector in ECI is stored.<br>(x,y,z) ECI(TOD) | km | 10 | - | There is no dataset if numData is 0. |
| velECI | L1A,L1B | 2 | numData,3 | H5T_IEEE_F64LE | Lunar Velocity Vector(ECI) | Lunar Velocity Vector in ECI is stored.<br>(u,v,w) ECI(TOD) | km/s | 10 | - | There is no dataset if numData is 0. |
| CAMData | L1A,L1B | | | | | | | | | |
| numImages_CAM | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of CAM data | Number of CAM data is stored. | - | - | 0 | |
| soundingID | L1A,L1B | 1 | numImages_CAM | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numImages_CAM is 0. |
| soundingUniqueID | L1A,L1B | 1 | numImages_CAM | H5T_STRING | sounding unique ID | Sounding unique ID is stored in following format.<br>YYYYMMDD_AAA_NNNN<br>YYYYMMDD : Observation date<br>AAA : Path No.<br>NNNN : Sounding ID(0-1245)<br><br>(18bytes, the last 1 byte is a null terminated string x numimages_CAM) | - | - | - | There is no dataset if numImages_CAM is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(7/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| numPixels_CAM | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of pixels of CAM data | Number of pixels of CAM data is stored. | - | - | - | There is no dataset if numImages_CAM is 0. |
| numLines_CAM | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of lines of CAM data | Number of lines of CAM data is stored. | - | - | - | There is no dataset if numImages_CAM is 0. |
| time_CAM | L1A,L1B | 1 | numImages_CAM | H5T_STRING | Observation time of CAM data (UTC) | Observation time of CAM data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated stringxnumImage_CAM) | UTC | - | - | There is no dataset if numImages_CAM is 0. |
| time_CAM_ContinuousTime | L1A,L1B | 1 | numImages_CAM | H5T_IEEE_F64LE | Observation time of CAM data (total seconds) | Total seconds of observation of CAM since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numImages_CAM is 0. |
| intelligentPointing_Flag | L1A,L1B | 1 | numImages_CAM | H5T_STD_I8LE | Intelligent pointing flag | Intelligent pointing flag is stored.<br>0: Not execute<br>1: Execute | - | - | - | There is no dataset if numImages_CAM is 0. |
| latitude | L1A,L1B | 1 | numImages_CAM | H5T_IEEE_F64LE | Latitude at CAM observation time | Latitude of observation point at CAM observation time is stored.<br>-90 ≤latitude≤90 | deg | 10 | -999 | There is no dataset if numImages_CAM is 0. |
| longitude | L1A,L1B | 1 | numImages_CAM | H5T_IEEE_F64LE | Longitude at CAM observation time | Longitude of observation point at CAM observation time is stored.<br>-180<longitude≤180 | deg | 10 | -999 | There is no dataset if numImages_CAM is 0. |
| satPos_ECR | L1A,L1B | 2 | numImages_CAM ,3 | H5T_IEEE_F64LE | Satellite position (ECR(WGS84)) | Satellite position in ECR(WGS84) at CAM observation time is stored.<br>satPos_ECR[numImage_CAM][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numImages_CAM is 0. |
| satVel_ECR | L1A,L1B | 2 | numImages_CAM ,3 | H5T_IEEE_F64LE | Satellite velocity (ECR(WGS84)) | Satellite velocity in ECR(WGS84) at CAM observation time is stored.<br>satVel_ECR[numImages_CAM][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numImages_CAM is 0. |
| satPos_ECI | L1A,L1B | 2 | numImages_CAM ,3 | H5T_IEEE_F64LE | Satellite position (ECI(TOD)) | Satellite position in ECI(TOD) at CAM observation time is stored.<br>satPos_ECI[numImages_CAM][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numImages_CAM is 0. |
| satVel_ECI | L1A,L1B | 2 | numImages_CAM ,3 | H5T_IEEE_F64LE | Satellite velocity (ECI(TOD)) | Satellite velocity in ECI(TOD) at CAM observation time is stored.<br>satVel_ECI[numImages_CAM][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numImages_CAM is 0. |
| satAtt | L1A,L1B | 2 | numImages_CAM ,4 | H5T_IEEE_F64LE | Satellite attitude (Satellite coordinate in ECI(J2000)) | Satellite attitude data at CAM observation time is stored as quaternion at ECI(J2000).<br>1st dimension [numImages_CAM] shows observation point and 2nd dimension shows satellite attitude quaternion in order of q0, q1, q2, q3.<br><br>satAtt[numImages_CAM][b]<br>b=0:q0<br>b=1:q1<br>b=2:q2<br>b=3:q3<br>(q0 is scalar component and q1, q2, and q3 are i, j, and k, respectively.) | - | 10 | (0,0,0,0) | There is no dataset if numImages_CAM is 0. |
| viewVector | L1A,L1B | 2 | numImages_CAM ,3 | H5T_IEEE_F64LE | Viewing vector | Viewing vector in the satellite coordinate at CAM observation time is stored.<br>viewVector[numImages_CAM][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | - | 10 | (0,0,0) | There is no dataset if numImages_CAM is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (8/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| CAM_Image | L1A,L1B | | | | | | | | | |
| image_CAM_NNNN | L1A,L1B | 3 | numLines_CAM, numPixels_CAM ,3 | H5T_STD_U8LE | CAM image data | CAM image data of soundingID[0] - soundingID[numImages_CAM - 1] is stored.<br>NNNN is the sounding ID(0000-1245) for each observation point. | - | - | - | Stored with HDF5 IMAGE(H5IM) style.<br>The attribute of data is set below.<br>CLASS = IMAGE<br>IMAGE_SUBCLASS = IMAGE_TRUECOLOR<br>IMAGE_VERSION = 1.2<br>INTERLACE_MODE = INTERLACE_PIXEL<br><br>There is no dataset if numImages_CAM is 0. |
| TemperatureTelemetry_FTS2 (Temperature telemetry of each observation of FTS-2) | L1A,L1B | | | | | | | | | |
| numSoundings | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of soundings | Number of soundings of temperature telemetry is stored. | - | - | 0 | Number of planned soundings is stored regardless actual observation. |
| soundingID | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numSoundings is 0. |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of data (UTC) | Start date of data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of data (seconds) | Total seconds since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| time | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Elapse time from start date of data | The elapsed seconds from start date of data. | sec | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanMirrorTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Scan mirror temperature | Scan mirror temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanMirrorTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of scan mirror temperature | Quality flag of scan mirror temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(9/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| ICT_Temp1 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Blackbody temperature #1 | Blackbody temperature #1 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ICT_Temp1Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of Blackbody temperature #1 | Quality flag of Blackbody temperature #1 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ICT_Temp2 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Blackbody temperature #2 | Blackbody temperature #2 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is stored in the case of loss or non-acquisition of data. |
| ICT_Temp2Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of Blackbody temperature #2 | Quality flag of Blackbody temperature #2 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ICT_Temp3 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Blackbody temperature #3 | Blackbody temperature #3 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ICT_Temp3Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of Blackbody temperature #3 | Quality flag of Blackbody temperature #3 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| HK_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | HK temperature | HK temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| HK_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of HK temperature | Quality flag of HK temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| 150V_CONV_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | 150V_CONV temperature | 150V_CONV temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(10/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| 150V_CONV_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of 150V_CONV temperature | Quality flag of 150V_CONV temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| DIGITAL_PS_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | DIGITAL_PS temperature | DIGITAL_PS temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| DIGITAL_PS_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of DIGITAL_PS temperature | Quality flag of DIGITAL_PS temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| QUIET_PS_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | QUIET_PS temperature | QUIET_PS temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| QUIET_PS_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of QUIET_PS temperature | Quality flag of QUIET_PS temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| DVR_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | DVR_PS temperature | DVR_PS temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| DVR_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of DVR_PS temperature | Quality flag of DVR_PS temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SP_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SP temperature | SP temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SP_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SP temperature | Quality flag of SP temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. Data lack) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SMD_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SMD temperature | SMD temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SMD_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SMD temperature | Quality flag of SMD temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(11/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| CCT_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | CCT temperature | CCT temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| CCT_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of CCT temperature | Quality flag of CCT temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IC_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | IC temperature | IC temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IC_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of IC temperature | Quality flag of IC temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SDP_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SDP temperature | SDP temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SDP_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SDP temperature | Quality flag of SDP temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SCT_TEMP1 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SCT_TEMP1 | SCT_TEMP1 is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SCT_TEMP1Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SCT1 TEMP1 | Quality flag of SCT_TEMP1 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SCT_TEMP2 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SCT_TEMP2 | SCT_TEMP2 is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SCT_TEMP2Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SCT TEMP2 | Quality flag of SCT_TEMP2 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. Data lack) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| AT_MOTOR_STRUCT_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | AT_MOTOR_STRUCT temperature | AT_MOTOR_STRUCT temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(12/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| AT_MOTOR_STRUCT_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of AT_MOTOR_STRUCT temperature | Quality flag of AT_MOTOR_STRUCT temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILS_STRUCT_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | ILS_STRUCT temperature | ILS_STRUCT temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILS_STRUCT_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of ILS_STRUCT temperature | Quality flag of ILS_STRUCT temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. Data lack) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FOV_CAM_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | FOV_CAM temperature | FOV_CAM temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FOV_CAM_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of FOV_CAM temperature | Quality flag of FOV_CAM temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| TELE_TEMP1 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | TELE1 temperature | TELE1 temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| TELE_TEMP1Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of TELE1 temperature | Quality flag of TELE1 temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP1 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SPA_TEMP1 | SPA_TEMP1 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP1Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SPA_TEMP1 | Quality flag of SPA_TEMP1 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP2 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SPA_TEMP2 | SPA_TEMP2 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP2Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SPA_TEMP2 | Quality flag of SPA_TEMP2 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(13/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| SPA_TEMP3 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SPA_TEMP3 | SPA_TEMP3 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP3Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SPA_TEMP3 | Quality flag of SPA_TEMP3 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP4 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SPA_TEMP4 | SPA_TEMP4 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SPA_TEMP4Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SPA_TEMP4 | Quality flag of SPA_TEMP4 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| COOLER_PLATE_TEMP1 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | COOLER_PLATE_TEMP1 | COOLER_PLATE_TEMP1 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| COOLER_PLATE_TEMP1Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of COOLER_PLATE_TEMP1 | Quality flag of COOLER_PLATE_TEMP1 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| COOLER_PLATE_TEMP2 | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | COOLER_PLATE_TEMP2 | COOLER_PLATE_TEMP2 is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| COOLER_PLATE_TEMP2Quality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of COOLER_PLATE_TEMP2 | Quality flag of COOLER_PLATE_TEMP2 is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. Data lack) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE1_OUTGAS_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE1_OUTGAS_TEMP | STAGE1_OUTGAS_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE1_OUTGAS_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE1_OUTGAS_TEMP | Quality flag of STAGE1_OUTGAS_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE3_OUTGAS_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE3_OUTGAS_TEMP | STAGE3_OUTGAS_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(14/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| STAGE3_OUTGAS_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE3_OUTGAS_TEMP | Quality flag of STAGE3_OUTGAS_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE4_OUTGAS_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE4_OUTGAS_TEMP | STAGE4_OUTGAS_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE4_OUTGAS_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE4_OUTGAS_TEMP | Quality flag of STAGE4_OUTGAS_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE1_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE1_TEMP | STAGE1_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE1_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE1_TEMP | Quality flag of STAGE1_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. Data lack) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE2_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE2_TEMP | STAGE2_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE2_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE2_TEMP | Quality flag of STAGE2_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE3_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE3_TEMP | STAGE3_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE3_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE3_TEMP | Quality flag of STAGE3_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE4_TEMP | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | STAGE4_TEMP | STAGE4_TEMP is stored | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| STAGE4_TEMPQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of STAGE4_TEMP | Quality flag of STAGE4_TEMP is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(15/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| IOA_plus_X_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | IOA+X_Struct temperature | IOA+X_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IOA_plus_X_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of IOA+X_Struct temperature | Quality flag of IOA+X_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IOA_plus_Z_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | IOA+Z_Struct temperature | IOA+Z_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IOA_plus_Z_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of IOA+Z_Struct temperature | Quality flag of IOA+Z_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_minus_Z_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SSA-Z_Struct temperature | SSA-Z_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_minus_Z_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SSA-Z_Struct temperature | Quality flag of SSA-Z_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_minus_X_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SSA-X_Struct temperature | SSA-X_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_minus_X_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SSA-X_Struct temperature | Quality flag of SSA-X_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_plus_Y_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SSA+Y_Struct temperature | SSA+Y_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_plus_Y_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SSA+Y_Struct temperature | Quality flag of SSA+Y_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SSA_minus_Y_Struct_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SSA-Y_Struct temperature | SSA-Y_Struct temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(16/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| SSA_minus_Y_Struct_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SSA-Y_Struct temperature | Quality flag of SSA-Y_Struct temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SDP_PRT_CalResistorTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | SDP_PRT_CalResistor temperature | SDP_PRT_CalResistor temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SDP_PRT_CalResistorTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of SDP_PRT_CalResistor temperature | Quality flag of SDP_PRT_CalResistor temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| PCC_TEC_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | PCS_TEC temperature | PCS_TEC temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| PCC_TEC_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of PCS_TEC temperature | Quality flag of PCS_TEC temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILST_LD1_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | ILST_LD1 temperature | ILST_LD1 temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILST_LD1_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of ILST_LD1 temperature | Quality flag of ILST_LD1 temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILST_LD2_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | ILST_LD2 temperature | ILST_LD2 temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILST_LD2_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of ILST_LD2 temperature | Quality flag of ILST_LD2 temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| laserTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Laser temperature | Laser temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| laserTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of Laser temperature | Quality flag of laser temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| beamsplitterTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Beam splitter temperature | Beam splitter temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| beamsplitterTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of beam splitter temperature | Quality flag of beam splitter temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(17/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| interferometerInterfaceTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Interferometer interface temperature | Interferometer interface temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| interferometerInterfaceTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of interferometer interface temperature | Quality flag of interferometer interface temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FTS_C_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | FTS-C temperature | FTS-C(FTS2 interferometer module - Control Box) temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FTS_C_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of FTS-C temperature | Quality flag of FTS-C temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FTS_A_Temp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | FTS-A temperature | FTS-A(FTS2 interferometer module - Analog Box) temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FTS_A_TempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of FTS-A temperature | Quality flag of FTS-A temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| actuatorTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | actuator temperature | Actuator temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| actuatorTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of actuator temperature | Quality flag of actuator temperature is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>2 : Not determined (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| HK_Telemetry_FTS2 (Telemetry of each observation of FTS-2 except for temperature telemetry) | L1A,L1B | | | | | | | | | |
| numSoundings | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of soundings | Number of soundings is stored. | - | - | 0 | Number of planned soundings is stored regardless actual observation. |
| soundingID | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numSoundings is 0. |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of data (UTC) | Start date of data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(18/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of data (seconds) | Total seconds of start time of telemetry since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| time | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Elapse time from start date of data | The elapsed seconds from start date of data. | sec | 10 | -9999 | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| masterSlaveFlag | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Master/Slave flag | Master/Slave flag is stored.<br>0: Slave<br>1: Master<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| sensorMode | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Sensor Mode | Sensor mode from observation mode is stored.<br>0 : Normal Observation<br>1: Solar Cal (SCT) (Solar irradiance calibration mode)<br>2: ILS CAL (ILST) (Instrument function calibration mode)<br>3: Infrared CAL (ICT) (Blackbody Calibration mode)<br>4: Park (Observation at Park)<br>5: Nadir (Observation at Nadir)<br>6: Space View CAL (Deep space calibration mode)<br>7: Luna. CAL #1 (0deg)<br>8: Luna. CAL #2 (+20deg)<br>9: Luna. CAL #1 (-20deg)<br>10: Test Space<br>11: Test ECT<br>12: Test Pattern<br>13: ECAL Data Collect (Electrical calibration mode)<br>14: CT+ Lube Cycle (Bearing lubrication : CT+94deg)<br>15: CT- Lube Cycle (Bearing lubrication : CT+129deg)<br>16: AT+ Lube Cycle (Bearing lubrication : AT+34deg)<br>17: AT- Lube Cycle (Bearing lubrication : AT-31deg)<br>-128: No observation | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IP_Request | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | IP request flag | IP request flag is stored.<br>0: Interigent pointing was disabled. (IP="No")<br>1: Interigent pointing was enabled. (IP="Yes")<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| XYZ_Before_IP | L1A,L1B | 1 | numSoundings, 3 | H5T_IEEE_F64LE | Observation point before intelligent pointing | Observation point before intelligent pointing(ECR(WGS84))is stored.<br>XYZ_BeforeIP[numSoundings][b]<br><br>b=0:X<br>b=1:Y<br>b=2:Z | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| XYZ_After_IP | L1A,L1B | 1 | numSoundings, 3 | H5T_IEEE_F64LE | Observation point after intelligent pointing | Observation point after intelligent pointing(ECR(WGS84))is stored.<br>XYZ_BeforeIP[numSoundings][b]<br><br>b=0:X<br>b=1:Y<br>b=2:Z | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| priority | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Priority | Priority is stored.<br>0: Regular priority<br>1: High priority<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(19/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| pathNumber | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Path No. | Path No. (number from observation table: 0-14) is stored. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| undecimatedFlag | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Undecimated flag | Undecimated flag is stored<br>0: Decimated mode (nominal)<br>1: Undecimated mode (observation for the specific single band)<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| Filtered_Unfiltered | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I8LE | Filtered/Unfiltered flag | Flag of Filtered/Unfiltered is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5.<br>0: Unfiltered<br>1: Filtered<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanDirection | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Scan direction | Scan direction is stored.<br>0: Backward<br>1: Forward<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| turnaroundDuration | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Turn around duration | Turn around duration is stored. | sec | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| metrologyMode | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Metrology mode | Metrology mode (1bit) is stored.<br>0: Metrology laser used for servo and sampling<br>1: Open-loop scan and time based samples<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ZPD_MIN_Value | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I16LE | ZPD_MIN_Value | ZPD_MIN_Value (14bits) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -32768 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ZPD_MAX_Value | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I16LE | ZPD_MAX_Value | ZPD_MAX_Value (14bits) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -32768 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ZPD_MIN_MetrologyCounts | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I32LE | ZPD_MIN_MetrologyCounts | ZPD_MIN_MetrologyCounts (20bits) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(20/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| ZPD_MAX_MetrologyCounts | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I32LE | ZPD_MAX_MetrologyCounts | ZPD_MAX_MetrologyCounts (20bits) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ZPD_Offset | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | ZPD offset | ZPD offset (16bits) is stored. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ZPD_Calibration | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | ZPD Calibration | ZPD Calibration is stored.<br>0: Fringe count not calibrated.<br>1: Fringe count calibrated to mechanical bumpers. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| fringeSignal_ACLevel | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Fringe Signal AC Level | Fringe Signal AC Level is stored. | V | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| fringeSignal_DCLevel | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Fringe Signal DC Level | Fringe Signal DC Level is stored. | V | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| dephaseSignal_ACLevel | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Dephase Signal AC Level | Dephase Signal AC Level is stored. | V | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| dephaseSignal_DCLevel | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Dephase Signal DC Level | Dephase Signal DC Level is stored. | V | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| PGA_Setting | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I8LE | PGA setting | PGA setting (4bit:0～15) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| sensorGain | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I8LE | Sensor gain | Sensor gain is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. Gain is 16th steps. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| DC_ClampSetting | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I16LE | DC clamp setting | DC clamp setting (12bit) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5. | - | - | -32768 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ILS_ON_OFF | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | ILS ON/OFF flag | ILS ON/OFF flag is stored.<br>0: Laser #1 & #2 OFF<br>1: Laser #1 ON & Laser #2 OFF<br>2: Laser #1 OFF & Laser #2 ON<br>3: Laser #1 & #2 ON<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(21/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| SCT_ON_OFF | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | SCT ON/OFF flag | SCT ON/OFF flag is stored.<br>0: OFF (diffuser pannel is covered)<br>1: ON - Routine (front side sied of the diffuser pannel is exposed)<br>2: ON - Reference (back side reverse sied of the diffuser pannel is exposed)<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| Dither_E_N | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I8LE | Dither (enable or disable) | Dither setting (enable or disable) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5.<br>0:disable<br>1:enable<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| modulatorOperatingMode | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Modulator operating mode | Modulator operating mode is stored. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set |
| PCC_TEC_Setpoint | L1A,L1B | 1 | numSoundings | H5T_STD_I16LE | PCC_TEC_Setpoint | PCS_TEC_Setpoint (14bit) is stored. | - | - | -32768 | There is no dataset if numSoundings is 0.<br>The invalid value is set |
| SMD_FaultRegister | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | SMD Fault Register | SMD Fault Register (26bit) is stored. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set |
| SMD_StatusRegister | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | SMD Status Register | SMD Status Register (27bit) is stored. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set |
| BandData_E_D | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I8LE | Band Data (enable or disable) | Band Data setting (enable or disable) is stored for each band in order of 1P, 1S, 2P, 2S, 3P, 3S, 4 and 5.<br>0: Disable<br>1: Enable<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| slew | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Slew flag | Slew flag is stored.<br>0: No Slew. During turn around, finish to ready for next observation during turnaround.<br>1: Slew. During turn around and operation of observation, finish to ready for next observation during turnaround and observation operating time (4.024sec).<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| endOfTable | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | End of Table | The flag that means the end of table is stored.<br>0: Not the end of table<br>1: The end of table<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanDuration | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Scan duration | Scan duration is stored.<br>2(Fixed): 4.024s | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| countsToIstSample | L1A,L1B | 2 | numSoundings, 8 | H5T_STD_I32LE | Counts to 1st sample | For each observation points, counts(32bits) to the first equal-timing sample for each bands in order of 1P,1S,2P,2S,3P,3S,4 and 5. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| Telemetry_FTS2_1Hz (Telemetry of FTS-2 1Hz) | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | number of data | Number of data is stored. | - | - | 0 | |
| soundingID | L1A,L1B | 1 | numData | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numData is 0. |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of data (UTC) | Start date of data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(22/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of data (seconds) | Total seconds of the first point of this telemetry since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numSoundings is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of data | Elapse time from start date of data is stored. | sec | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed0 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 0 | Rotary Arm Speed 0 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed1 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 1 | Rotary Arm Speed 1 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed2 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 2 | Rotary Arm Speed 2 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed3 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 3 | Rotary Arm Speed 3 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed4 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 4 | Rotary Arm Speed 4 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed5 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 5 | Rotary Arm Speed 5 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed6 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 6 | Rotary Arm Speed 6 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| rotaryArmSpeed7 | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Rotary Arm Speed 7 | Rotary Arm Speed 7 is stored. | kHz | 10 | - | There is no dataset if numData is 0. |
| Telemetry_FTS2_100Hz (Telemetry of FTS-2 100Hz) | L1A,L1B | | | | | | | | | |
| numData | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of soundings | Number of soundings is stored. | - | - | 0 | |
| soundingID | L1A,L1B | 1 | numData | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numData is 0. |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of data (UTC) | Start date of data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | There is no dataset if numData is 0. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of data (seconds) | Total seconds of the first point of this telemetry since 23:59:59 UTC, Dec 31, 2012. | sec | - | - | There is no dataset if numData is 0. |
| time | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | Elapse time from start date of data | The elapsed seconds from start date of data. | sec | 10 | - | There is no dataset if numData is 0. |
| CT_CommandedAngle | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | CT-Angle(Command) | CT command angle (planned) is stored. | deg | 10 | - | There is no dataset if numData is 0. |
| AT_CommandedAngle | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | AT Angle(Command) | At command angle (planned) is stored. | deg | 10 | - | There is no dataset if numData is 0. |
| CT_MeasuredAngle | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | CT angle (measured) | The motor driving angle around CT axis is stored.<br>-180.0 ＜ CT_MesuredAngle[numData] ≦ 180.0 | deg | 10 | - | There is no dataset if numData is 0. |
| CT_MeasuredAngleQuality | L1A,L1B | 1 | numData | H5T_STD_I8LE | Quality flag of CT angle (measured) | Quality flag of CT angle (measured) is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>it becomes abnormal when it exceeds the range below (range when the motor can be physically driven).<br>-129.2 ≦ CT_MesuredAngle[numData] ≦ 94.7 | - | - | - | There is no dataset if numData is 0. |
| AT_MeasuredAngle | L1A,L1B | 1 | numData | H5T_IEEE_F64LE | AT angle (measured) | The motor driving angle around AT axis is stored. The motor can drive with the range below.<br>-180.0 ＜ AT_MesuredAngle[numData] ≦ 180.0 | deg | 10 | - | There is no dataset if numData is 0. |
| AT_MeasuredAngleQuality | L1A,L1B | 1 | numData | H5T_STD_I8LE | Quality flag of AT angle (measured) | Quality flag of AT angle (measured) is stored.<br>0 : Normal<br>1 : Abnormal (outside the acceptable range)<br>it becomes abnormal when it exceeds the range below (range when the motor can be physically driven).<br>-31.6 ≦ AT_MesuredAngle[numData] ≦ 35.0 | - | - | - | There is no dataset if numData is 0. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5) (23/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| Telemetry_CAM (Telemetry of each observation of CAM) | L1A,L1B | | | | | | | | | |
| numSoundings | L1A,L1B | 1 | 1 | H5T_STD_I32LE | Number of soundings | Number of soundings is stored. | - | - | 0 | Number of planned soundings is stored regardless actual observation. |
| soundingID | L1A,L1B | 1 | numSoundings | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numSoundings is 0. |
| startDate | L1A,L1B | 1 | 1 | H5T_STRING | Start date of data (UTC) | Start date of data is stored.<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string)<br>If data is invalid, "-" is set. (2 bytes, the last 1 byte is a null terminated string) | UTC | - | "-" | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| startDate_ContinuousTime | L1A,L1B | 1 | 1 | H5T_IEEE_F64LE | Start date of data (seconds) | Total seconds of the first point of this telemetry of since 23:59:59 UTC, Dec 31, 2012. | sec | - | 0 | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| time | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Elapse time from start date of data | The elapsed seconds from start date of data. | sec | 10 | -9999 | There is no dataset if numSoundings is 0.<br>Start date of the valid data is stored. |
| FOV_Camera_VideoMode | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | CAM 5fps mode flag | CAM 5fps mode flag is stored.<br>0: No action<br>1: VIDEO for 10sec mode<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FOV_Camera_Reset | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | CAM reset flag | CAM reset flag is stored.<br>0: No action<br>1: Execute Issue Camera reset<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FOV_Camera_ON_OFF | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | CAM ON/OFF flag | CAM ON/OFF flag is stored.<br>0: FOV-CAM and DVR power off<br>1: FOV-CAM and DVR power on<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| CLS_E_D | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Enable/Disable setting of CLS | Enable/Disable setting of CLS is stored.<br>0: Disable<br>1: Enable<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| Image_ID | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Image ID | Image ID (32bit) is stored. | - | - | -1 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ImageSize | L1A,L1B | 1 | numSoundings | H5T_STD_U32LE | Image size | Image size (32bit) is stored. | Byte | - | 0 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| CameraTemp | L1A,L1B | 1 | numSoundings | H5T_IEEE_F64LE | Camera temperature | Camera temperature is stored. | K | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-1 Dataset definition of FTS-2 L1A/L1B common file (HDF5)(24/24)

| Group Path/Dataset Name | L1A/L1B | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimension | Size | | | | | | | |
| CameraTempQuality | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | Quality flag of camera temperature | Quality flag of camera temperature is stored.<br>0：Normal<br>1：Abnormal (outside the acceptable range)<br>-128: Invalid (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| FTS_C_ID | L1A,L1B | 1 | numSoundings | H5T_STD_I8LE | FTS-C ID | FTS-C ID (1bit:0,1) is stored.<br>0：Primary<br>1：Secondary | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| XYZ_Before_IP | L1A,L1B | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Observation point before intelligent pointing | Observation point before intelligent pointing (ECR(WGS84)) is stored.<br>XYZ_BeforeIP[numSoundings][b]<br><br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| XYZ_After_IP | L1A,L1B | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Observation point after intelligent pointing | Observation point after intelligent pointing (ECR(WGS84)) is stored.<br>XYZ_AfterIP[numSoundings][b]<br><br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (1/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| Metadata | L1A, L1B | SWIR, TIR | OBS, CAL | | | | | | | | | |
| granuleID | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | File Identifier (Granule ID) | Granule ID (47bytes, the last 1 byte is a null terminated string )<br>・ Satellite Name : GOSAT2 (Fixed)<br>・ Sensor Name : TANSO-FTS2: TFTS2 (Fixed)<br>・ Start Time of Observation<br>(year・month・day・hour・minute) : YYYYMMDDHHmm<br>・ Path No. : PPP(001-089)<br>・ Scene No. : 00～04<br>(Calibration Mode : 00, ・ Operation mode : 01～04)<br>・ Processing Level : 1A, 1B<br>・ Band : B<br>SWIR : S<br>TIR : T<br>・ Orbit data used for processing : R<br>Using predicted orbit data : P<br>Using GPS or determined orbit data : D<br>・ Correction coefficients used for processing : C<br>Using nominal coefficients : N<br>Using updated coefficients : U<br>・ Reserved : 00<br>・ Operation Mode : 0000<br>OB1D:Observation Mode (day)<br>OB1N:Observation Mode (night)<br>OB2D:Observation Mode (day/Except for full observation)<br>OB2N:Observation Mode (night/Except for full observation)<br>OBUD:Undecimated Mode (day)<br>OBUN:Undecimated Mode (night)<br>SCAL:Solar irradiance calibration mode<br>BCAL : Blackbody Calibration mode<br>DCAL : Deep space calibration mode<br>ILSF : Instrument function calibration mode<br>NCAL: Dark calibration mode<br>ECAL: Electrical calibration mode<br>LCAL : Lunar calibration mode<br>TEST: Undecimated calibration mode<br>LUBE: Scanner bearing mode<br>・ Algorithm Version : AAA(000-999)<br>・ Parameter Version : BBB(000-999) | - | - | - | The observation time(UT) at the start observation point is the oldest time in this scene. |
| operationMode | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Operation Mode | "OB1D":Observation Mode (day)<br>"OB1N":Observation Mode (night)<br>"OB2D":Observation Mode (day/Except for full observation)<br>"OB2N":Observation Mode (night/Except for full observation)<br>"OBUD":Undecimated Mode (day)<br>"OBUN":Undecimated Mode (night)<br>"SCAL":Solar irradiance calibration mode<br>"BCAL" : Blackbody Calibration mode<br>"DCAL" : Deep space calibration mode<br>"ILSF" : Instrument function calibration mode<br>"NCAL": Dark calibration mode<br>"ECAL": Electrical calibration mode<br>"LCAL" : Lunar calibration mode<br>"TEST": Undecimated mode<br>"LUBE": Scanner bearing mode<br>(5bytes, the last 1 byte is a null terminated string) | - | - | - | |
| processingDate | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Processing date | Date of product creation (UTC)<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | Time when creation job started is stored. |
| startDate | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Start date of data of scene | Start date of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | Stores the oldest observation start time among the scenes when "QualityInfo/missingFlag" is "0:Normal" in more than one band. |
| endDate | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | End date of data of scene | End date of scene(UTC).<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string) | UTC | - | - | Stores the latest observation start time among the scenes when "QualityInfo/missingFlag" is "0:Normal" in more than one band. |
| geodeticDatum | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Geodetic datum | "WGS84/ WGS84":Reference Ellipsoid Model/Frame of Reference (Fixed)<br>(14bytes, the last 1 byte is a null terminated string) | - | - | - | |
| satelliteName | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Satellite Name | "GOSAT-2" : Greenhouse gases Observing SATellite-2 (Fixed)<br>(8bytes, the last 1 byte is a null terminated string) | - | - | - | |
| sensorName | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Sensor Name | "TANSO-FTS-2" : Fourier Transform Spectrometer-2 (Fixed)<br>(12bytes, the last 1 byte is a null terminated string) | - | - | - | |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (2/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| processingLevel | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Processing Level | "L1A" : Level 1A<br>"L1B" : Level 1B<br>(4bytes, the last 1 byte is a null terminated string) | - | - | - | |
| algorithmVersion | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Algorithm Version | Algorithm version is stored.<br>(4bytes, the last 1 byte is a null terminated string) | - | - | - | |
| parameterVersion | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | ParameterVersion | Parameter version is stored.<br>(4bytes, the last 1 byte is a null terminated string) | - | - | - | |
| granuleIDCommon | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | File Identifier (Granule ID) of common file | Granule ID of common file is stored<br>(47bytes, the last 1 byte is a null terminated string) | - | - | - | |
| granuleIDL1A | L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | File Identifier (Granule ID) of L1A SWIR/TIR file | Granule ID of L1A SWIR/TIR file is stored<br>(47bytes, the last 1 byte is a null terminated string) | - | - | - | |
| processingFacility | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STRING | Processing facility name | "G2MDP" : Mission Operations System Data Processing<br>"JSS" : JAXA Super computer System<br>"EORC" : Earth Observation Research Center<br>(the size is the string length above plus the terminator 1byte) | - | - | - | |
| SoundingAttribute | L1A, L1B | SWIR, TIR | OBS, CAL | | | | | | | | | |
| numSoundings | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STD_I32LE | Number of data | Number of observation data is stored. | - | - | 0 | Number of planned soundings is stored regardless actual observation. |
| soundingID | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STD_I32LE | sounding ID | Sounding ID (0-1245) is stored. | - | - | - | There is no dataset if numSoundings is 0. |
| soundingUniqueID | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STRING | sounding unique ID | Sounding unique ID through the operational term is stored<br>(18bytes, the last 1 byte is a null terminated string x numSoundings)<br>YYYYMMDD_AAA_NNNN<br><br>YYYYMMDD : Observation date<br>AAA : Path No.<br>NNNN : Sounding ID (0-1245) | - | - | - | There is no dataset if numSoundings is 0. |
| numBands | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | 1 | H5T_STD_I32LE | Number of bands | Number of bands is stored. | - | - | - | |
| detailedOperationMode | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STRING | Detailed operation mode | Detailed operation mode is stored.<br>(5bytes, the last 1 byte is a null terminated string x numSoundings)<br>"OB1D": Observation Mode (day/All data are observed by decimated mode.)<br>"OB1N": Observation Mode (night/All data are observed by decimated mode.)<br>"OB2D": Observation Mode except for full-observation<br>(day/All data are observed by decimated mode.Specific bands are not observed.)<br>"OB2N": Observation Mode except for full-observation<br>(night/All data are observed by decimated mode.Specific bands are not observed.)<br>"OBUD": Undecimated Mode (day/Only specific band data are observed)<br>"OBUN": Undecimated Mode (night/Only specific band data are observed)<br>"SUNG": Sunglint observation<br>"SPPT": Specific point observation<br>"SCAL": Solar irradiance calibration mode<br>"BCAL": Blackbody Calibration mode<br>"DCAL": Deep space calibration mode<br>"ILSF": Instrument function calibration mode<br>"NCAL": Dark calibration mode<br>"ECAL": Electrical calibration mode<br>"LCAL": Lunar calibration mode<br>"TEST": Undecimated calibration mode (TBD)<br>"LUBE": Scanner bearing mode | - | - | - | The detailed observation mode is derived from observation plan because this item cannot derived from the downlinked data when sensor observes the sunglint or specific area.<br>There is no dataset if numSoundings is 0. |
| observationRequestID | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STRING | Observation request ID | Observation request ID is stored.<br>(28bytes, the last 1 byte is a null terminated string x numSoundings )<br>"XKYYYYMMDDaaaannnn_mmmmmmm"<br>X: Request from (J:JAXA, N:NIES, I:internal)<br>K: Kind of request(F:routine, T:temporary)<br>YYYYMMDD: created date of observation of request<br>aaaaa: observation code(e.g. "FT206")<br>nnnn: observation request Number (0000～9999)<br>mmmmmmm: observation request Branch number (0000000～9999999) | - | - | - | There is no dataset if numSoundings is 0. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (3/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| observationTime | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STRING | Observation time | Observation time at of observation point is stored.<br>Observation time is expressed as follows:<br><br>observationTime = (The start time of sample window) + 2.012 sec<br>Time format : YYYY-MM-DDThh:mm:ss.ffffffZ<br>(28bytes, the last 1 byte is a null terminated string x numSoundings)<br>If invalid, "-" (2 bytes, the last 1 byte is a null terminated string ) is stored. | UTC | - | "-" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| observationTime_ContinuousTime | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Observation time (total seconds) | Total seconds at the observation time since 23:59:59 UTC, Dec 31, 2012. | sec | - | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanDirection | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STRING | Scan direction | Scan direction of observation point is stored.<br>"FWD" : Forward<br>"BWD" : Backward<br>"-" : Invalid (ex. data loss)<br><br>(the size is the string length above plus the terminator 1byte x numSoundings) | - | - | "-" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| IP_Request | L1A,L1B | SWIR,TIR | OBS | 1 | numSoundings | H5T_STD_I8LE | IP request flag | IP request flag is stored.<br>0: Not execute the intelligent pointing. ( IP=""NO"")<br>1: Execute the intelligent pointing (IP=""Yes"")<br>-128: Invalid due to data loss and so no. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| targetPosition_BeforeIP_ECR | L1A,L1B | SWIR,TIR | OBS | 2 | numSoundings,3 | H5T_IEEE_F64LE | Observation point before Intelligent pointing | Observation point( ECR(WGS84)) is stored before executing intelligent pointing.<br>targetPosition_BeforeIP_ECR[numSoundings][b]<br>(The value is aquired from FTS-2 telemetry, which is stored in /HK_Telemetry_FTS2/XYZ_Before_IP, the common product file.)<br><br>b=0: X component<br>b=1: Y component<br>b=2: Z component | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| targetPosition_AfterIP_ECR | L1A,L1B | SWIR,TIR | OBS | 2 | numSoundings,3 | H5T_IEEE_F64LE | Obeservation point after intelligent pointing | Observation point( ECR(WGS84)) is stored after executing intelligent pointing.<br>targetPosition_AfterIP_ECR[numSoundings][b]<br>(The value is calculated from satellite position, attitude and view angle.)<br><br>b=0: X component<br>b=1: Y component<br>b=2: Z component | m | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| diffTargetPosition | L1A,L1B | SWIR,TIR | OBS | 1 | numSoundings | H5T_IEEE_F64LE | Distance between before/after Intelligent pointing. | The distance between observation points before/after executing intelligent pointing. | m | 10 | -1 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| QualityInfo | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| soundingQualityFlag | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STRING | Quality flag of each observation point | Quality of each observation point on a four level scale as follows:<br>"Good", "Fair", "Poor", "NG"<br>(the size is the string length above plus the terminator 1byte x numSoundings) | - | - | "NG" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| dataInvalidFlag | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STD_I8LE | Data invalid flag | The flag which indcates if the observation is "valid". The observation is invalid when the yaw steering is OFF or just after yaw steering had been changed from OFF to ON because the pointing to the observation point is not available.<br><br>0 : Valid<br>1 : Invalid<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (4/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| IMC_StabilityFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STD_I8LE | IMC stability flag | IMC stability flag is stored.<br>0 : Stable<br>1 : Not stable<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| missingFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | Missing data flag | Missing data flag is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case.<br>0 : Normal (No data loss)<br>1 : Data loss<br>9 : No observation plan (No interferogram for the sounding) | - | - | 1 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| saturationFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | Saturation flag | Interferogram saturation flag is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case.<br>0 : DN saturation detection=Normal<br>1 : DN saturation detection=Saturation<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| spikeFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | Spike flag | Spike flag is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case. The found spikes have been removed by spike correction method.<br><br>0 : Normal (no spike)<br>1 : With spike<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| scanStabilityFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STD_I8LE | Scan stability flag | Scan stability flag is stored.<br>0 : Stable<br>1 : Not stable<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| interferogramAC | L1A, L1B | SWIR | CAL(ILSF) | 2 | numSoundings, numBands | H5T_IEEE_F64LE | Interferogram AC voltage | Interferogram AC voltage is stored for each band.<br>The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case. | V | 10 | -9999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| fringeCountError | L1B only | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I32LE | Fringe count error (FCE) | The difference between maximum signal position and ZPD is stored for each band. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case. | - | - | -2147483648 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| fringeCountErrorQualityFlag | L1B only | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | Fringe count error (FCE) quality flag | Quality flag determined by FCE is stored for each band. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case.<br>0 : Normal<br>1 : Abnormal<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| dcLevelFlag | L1B only | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | DC level flag | DC level quality flag is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case.<br>0 : Normal<br>1 : Abnormal<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SNR | L1B only | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_IEEE_F64LE | Simplified SNR | Simplified calculated SNR is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case. | - | 10 | -1 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SNRQualityFlag | L1B only | SWIR, TIR | OBS, CAL | 2 | numSoundings, numBands | H5T_STD_I8LE | SNR quality flag | Quality flag determined by SNR is stored. The order is 1P, 1S, 2P, 2S, 3P, 3S in SWIR case and 4, 5 in TIR case.<br>0 : Normal<br>1 : Abnormal<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (5/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| interferogramQualityFlag | L1B only | SWIR,TIR | OBS,CAL | 2 | numSoundings,numBands | H5T_STD_I8LE | Interferogram quality flag | Interferogram quality flag is stored. The flag indicates the total quality consists of saturationFlag, scanStabilityFlag, fringeCountError, dcLevelFlag. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case.<br>0 : Normal<br>1 : Abnormal<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| spectrumQualityFlag | L1B only | SWIR,TIR | OBS,CAL | 2 | numSoundings,numBands | H5T_STD_I8LE | Spectrum quality flag | Spectrum quality flag is stored. The quality is judged based on outband data.The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case.<br>0 : Normal<br>1 : Abnormal<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| cloud | L1A,L1B | SWIR,TIR | OBS | 1 | numSoundings | H5T_IEEE_F64LE | Colud index | The value calculated from FOV camera data and indicates how many percent the view area was covered by cloud.<br>0≦ cloud ≦ 1<br>(0 : no cloud, 1: all of the view area was covered by cloud) | - | - | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| ProcessingParameters | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| degreeOfNonLinearPolynomial | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | 1 | H5T_STD_I32LE | Degree of non-linear polynomial | Degree of non-linear polynomial for correction of interferogram is stored (3 is Fixed). | - | - | - | |
| nonLinearCoeff | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | degreeOfNonLinearPolynomial+1, numBands | H5T_IEEE_F64LE | Non-linear correction coefficient | Non-linear correction coefficient for interferogram is stored in order of degree, band.<br>Degree are stored in order of 0-th coefficient, 1-st ....<br>The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | 10 | - | |
| alignmentMatrix | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | 9 | H5T_IEEE_F64LE | Alignment matrix | Coordinate transformation matrix convert from FTS-2 optical axis coordinate to satellite-fixed coordinate are stored in the following order:<br>(0, 1, 2)<br>(3, 4, 5)<br>(6, 7, 8) | - | 10 | - | |
| sensorGain | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,numBands | H5T_STD_I8LE | Gain | Gain (4bit;0-15) for each bands are stored. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| apodizationFunction | L1B | TIR | OBS only | 1 | 1 | H5T_STRING | Apodization function | Apodization function type used for finite FOV correction is stored.<br>"Box-car" : Box-car<br>"Norton-Beer (weak)" : Norton-Beer (weak)<br>"Norton-Beer (medium)" : Norton-Beer (medium)<br>"Norton-Beer (strong)" : Norton-Beer (strong)<br>"Gaussian": Gaussian function<br>(the size is the string length above plus the terminator 1byte ) | - | - | - | |
| numCalibrations | L1B | SWIR,TIR | OBS,CAL(Solar CAL) | 1 | 1 | H5T_STD_I8LE | Number of calibration product | The number of calibration products used in processing is stored. | - | - | 0 | |
| calibrationGranuleID | L1B | SWIR,TIR | OBS,CAL(Solar CAL) | 1 | numCalibrations | H5T_STRING | Granule ID of calibration product | The granule IDs of calibration products used in processing is stored.<br>(calibrationGranuleId[numCalibrations])<br>( 47bytes, the last 1 byte is a null terminated string ) | - | - | - | There is no dataset if numCalibrations is 0. |
| calibrationSoundingUniqueID_DCAL | L1B | TIR | OBS | 2 | numSoundings, numBands | H5T_STRING | DCAL sounding unique ID | The applied DCAL sounding unique ID is stored<br>(18bytes, the last 1 byte is a null terminated string x numSoundings)<br>YYYYMMDD_AAA_NNNN<br><br>YYYYMMDD:Observation date<br>AAA:Path No.<br>NNNN:Sounding ID (0-1245) | - | - | "_" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| calibrationSoundingUniqueID_BCAL | L1B | SWIR,TIR | OBS,CAL(Solar CAL) | 2 | numSoundings, numBands | H5T_STRING | BCAL sounding unique ID | The applied BCAL sounding unique ID through the operational term is stored<br>(18bytes, the last 1 byte is a null terminated string x numSoundings)<br>YYYYMMDD_AAA_NNNN<br><br>YYYYMMDD:Observation date<br>AAA:Path No.<br>NNNN:Sounding ID (0-1245) | - | - | "_" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SatelliteGeometry | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (6/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| satPos_ECR | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECR(WGS84)) | Satellite position in ECR(WGS84) at observation time is stored.<br>satPos_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satVel_ECR | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECR(WGS84)) | Satellite velocity in ECR(WGS84) at observation time is stored.<br>satVel_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satPos_ECI | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Satellite Position Vector(ECI(TOD)) | Satellite position in ECI(TOD) at observation time is stored.<br>satPos_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satVel_ECI | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Satellite Velocity Vector(ECI(TOD)) | Satellite velocity in ECI(TOD) at observation time is stored.<br>satVel_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satArgLat | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Argument of latitude | Argument of latitude at observation time is stored.<br>(0≤satArgLat<360) | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satOrbitPrecision | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STRING | Precision of satellite orbit data | Orbit data type for satPos_ECR/ECI, satVel_ECR/ECI is stored.<br>"OnBoard":Onboard orbit data<br>"Predicted":Predicted orbit data<br>"Determined":Determined orbit data<br>"-": Invalid (ex. data loss)<br>(the size is the string length above plus the terminator 1byte x numSoundings) | - | - | "-" | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satAtt | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,4 | H5T_IEEE_F64LE | Satellite attitude (Satellite coordinate in ECI(J2000)) | Satellite attitude quaternion data at observation time is stored as quaternion in ECI(J2000). 1st dimension shows observation point and 2nd dimension shows satellite attitude quaternion in order of q0,q1,q2,q3.<br>satAtt[numSoundings][b]<br>b=0:q0<br>b=1:q1<br>b=2:q2<br>b=3:q3<br>(q0 is scalar component and q1, q2, and q3 are i, j, and k, respectively.) | - | 10 | (0,0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satAtt_RPY | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Satellite Attitude Roll/Pitch/Yaw | Satellite attitude,roll,pitch and yaw angles at observation time is stored.<br>satAtt_RPY[numSoundings][b]<br>b=0:roll<br>b=1:pitch<br>b=2:yaw | deg | 10 | (-999,-999,-999) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| yawSteeringFlag | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STD_I8LE | Yaw steering flag | Yaw steering flag indicates the execution of yaw steering.<br>yawSteeringFlag[numSoundings]<br>0: Not execute(OFF)<br>1: Execute(ON)<br>2: Invalid (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satAttInterpolationMethodFlag | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STD_I8LE | Satellite attitude interpolation method flag | Interpolation method for calculating satellite attitude is stored.<br>0 : Interpolation<br>1 : Extrapolation<br>2: Invalid (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (7/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| satAttInterpolationQualityFlag | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_STD_I8LE | Satellite attitude Interpolation quality flag | Interpolation quality of calculating satellite attitude is stored.<br>0 : Good (The interval of source data for interpolation is fine sufficiently. Thus, interpolation value is high accuracy.)<br>1 : Poor (The interval of source data for interpolation is rough. Thus, interpolation value is low accuracy.)<br>2: Invalid (ex. data loss) | - | - | 2 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| satToECR_Matrix | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 9 | H5T_IEEE_F64LE | Coordinate transformation matrix from satellite-fixed to ECR(WGS84) | Coordinate transformation matrix converting from satellite-fixed coordinate to ECR(WGS84) are stored in the following order:<br>(0, 1, 2)<br>(3, 4, 5)<br>(6, 7, 8) | - | 10 | (0,0,0,<br>0,0,0,<br>0,0,0 ) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SolarGeometry | L1A, L1B | SWIR, TIR | OBS, CAL | | | | | | | | | |
| solarPos_ECR | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Apparent solar position at the observation time (ECR(WGS84)) | Apparent solar position in ECR(WGS84) at observation time is stored.<br>solarPos_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarVel_ECR | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Apparent solar velocity at the observation time (ECR(WGS84)) | Apparent solar velocity in ECR(WGS84) at observation time is stored.<br>solarPos_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarPos_ECI | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Apparent solar position at the observation time (ECI(TOD)) | Apparent solar position in ECI(TOD) at observation time is stored.<br>solarPos_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarVel_ECI | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 3 | H5T_IEEE_F64LE | Apparent solar velocity at the observation time (ECI(TOD)) | Apparent solar velocity in ECI(TOD) at observation time is stored.<br>solarPos_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarSatBetaAngle | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_IEEE_F64LE | Solar beta angle (satellite coordinate XY plane) | The angle of the solar position in satellite coordinate XY plane is stored.<br>$-180 < \text{solarSatBetaAngle} \leq 180$ | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarSatEtaAngle | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_IEEE_F64LE | Solar eta angle (satellite coordinate ZX plane) | The angle of the solar position in satellite coordinate ZX plane is stored.<br>$-180 < \text{solarSatEtaAngle} \leq 180$ | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarSatDistance | L1A, L1B | SWIR, TIR | OBS, CAL | 1 | numSoundings | H5T_IEEE_F64LE | Distance between satellite and Sun | Distance from the sun to the satellite at the observation time is stored. | AU | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| LunarGeometry | L1A, L1B | SWIR, TIR | OBS, CAL | | | | | | | | | |
| lunarPos_ECR | L1A, L1B | SWIR, TIR | OBS, CAL | 2 | numSoundings, 3 | H5T_IEEE_F64LE | True lunar position at the observation time (ECR(WGS84)) | True lunar position in ECR(WGS84) at observation time is stored.<br>lunarPos_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (8/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| lunarVel_ECR | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | True lunar velocity at the observation time (ECR(WGS84)) | True lunar velocity in ECR(WGS84) at observation time is stored.<br>lunarPos_ECR[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| lunarPos_ECI | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | True lunar position at the observation time (ECI(TOD)) | True lunar position in ECI(TOD) at observation time is stored.<br>lunarPos_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| lunarVel_ECI | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | True lunar velocity at the observation time (ECI(TOD)) | True lunar velocity in ECI(TOD) at observation time is stored.<br>lunarPos_ECI[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | km/s | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SoundingGeometry | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| latitude | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Latitude at the observation point | latitude of observation point is stored.<br>-90 ≤ latitude ≤ 90 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| longitude | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Longitude at the observation point | Longitude of observation points stored.<br>-180 < longitude ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| viewZenith | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Sensor view zenith angle | Sensor (satellite) zenith angle at observation point is stored.<br>0 ≤ viewZenith < 90 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| viewAzimuth | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Sensor view azimuth angle | Sensor (satellite) azimuth angle at observation point is stored.<br>0 ≤ viewAzimuth < 360 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarDistance | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Distance between observation point and Sun | Distance from the sun to observation point at observation time is stored.<br>solarDistance[numSoundings] | AU | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarZenith | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Solar zenith angle at the observation point | Solar zenith angle seeing from observation point at obervation time is stored.<br>0 ≤ solarZenith ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| solarAzimuth | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Solar azimuth angle at the observation point | Solar azimuth angle seeing from observation point at observation time is stored.<br>0 ≤ solarAzimuth < 360 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| lunarSatelliteSolar_angle | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Angle between lunar-satellite vector and solar-satellite vector | Angle between lunar-satellite vector and solar-satellite vector from satellite is stored.<br>0 ≤ lunarSatelliteSolar_angle ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (9/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| scatteringAngle | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | Scattering angle | Scattering angle at observation point is stored.<br>0 ≤ scatteringAngle ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| landType | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_STD_I8LE | Land/Ocean Flag | The flag of land/ocean identification for the observation point is stored.<br>landType[numSoundings]<br>0 : Land<br>1 : Water (ocean/lake/river)<br>2 : Mixed<br>3 : Outside of judge (polar area)<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| sunglintFlag | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_STD_I8LE | Sunglint flag | The flag indicates whether each exposure is contaminated by sunglint observation or not is stored.<br>This flag is valid for any landType.<br>sunglintFlag[numSoundings]<br>0:Not sunglint<br>1:Sunglint<br>-128: Invalid (ex. data loss) | - | - | -128 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| specular_viewVector_angle | L1A,L1B | SWIR,TIR | OBS only | 1 | numSoundings | H5T_IEEE_F64LE | The angle between specular reflection vector and view vector | The angle between specular reflection vector and view vector at observation time is stored.<br>0 ≤ specular_viewVector_angle ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| PointingGeometry | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| pointingAT | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Motor andgle around AT axis | The motor rotation angle around AT axis at observation time is stored. The possible range of motor is below.<br>-180.0 ＜ pointingAT[numSoundings] ≦ 180.0<br>Refer to /QualityInfo/IMC_StabilityFlag for stability of motor rotation angle. | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| pointingCT | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Motor angle around CT axis | The motor rotation angle around CT axis at observation time is stored. The possible range of motor is below.<br>-180.0 ＜ pointingCT[numSoundings] ≦ 180.0<br>Refer to /QualityInfo/IMC_StabilityFlag for stability of motor rotation angle. | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| viewAngleAT | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Angle between viewing vector and AT direction | The angle of view vector in AT direction is stored.<br>-180 < viewAngleAT ≤ 180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| viewAngleCT | L1A,L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | Angle between viewing vector and CT direction | The angle of view vector in CT direction is stored.<br>-180 < viewAngleCT ≤ 180 | - | 10 | -999 | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| viewVector | L1A,L1B | SWIR,TIR | OBS,CAL | 2 | numSoundings,3 | H5T_IEEE_F64LE | Viewing vector | Viewing vector in the satellite coordinate at observation time is stored.<br>viewVector[numSoundings][b]<br>b=0:X-component<br>b=1:Y-component<br>b=2:Z-component | - | 10 | (0,0,0) | There is no dataset if numSoundings is 0.<br>The invalid value is set in the case of data loss or it is not observed according to request. |
| SoundingData | L1A,L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| FringeInfo | L1A only | SWIR,TIR | OBS,CAL | | | | | This dataset is only for L1A. | | | | |
| numFringes | L1A only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_STD_I32LE | Number of interferogram data | Number of interferogram data is stored. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | - | - | |
| beginFringe | L1A only | SWIR,TIR | OBS,CAL | 2 | numBands,numSoundings | H5T_STD_I32LE | Maximum signal position of interferogram | The maximum signal position of interferogram is stored.<br>The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | - | - | There is no dataset if numSoundings is 0. |
| deltaOPD | L1A only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Interval of interferogram | Delta OPD (optical path difference) is stored. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. The value means sampling interval for interferogram. | cm | 10 | - | |
| Interferogram | L1A only | SWIR,TIR | OBS,CAL | | | | | This dataset is only for L1A. | | | - | |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (10/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band1P | L1A only | SWIR only | OBS,CAL | 2 | numFringes[0],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1A only | SWIR only | OBS,CAL | 2 | numFringes[1],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1A only | SWIR only | OBS,CAL | 2 | numFringes[2],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1A only | SWIR only | OBS,CAL | 2 | numFringes[3],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3P | L1A only | SWIR only | OBS,CAL | 2 | numFringes[4],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1A only | SWIR only | OBS,CAL | 2 | numFringes[5],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band4 | L1A only | TIR only | OBS,CAL | 2 | numFringes[0],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5 | L1A only | TIR only | OBS,CAL | 2 | numFringes[1],numSoundings | H5T_IEEE_F32LE | Interferogram data | Interferogram data is stored in order of interval, sounding. | V | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |
| WavenumberInfo | L1B only | SWIR,TIR | OBS,CAL | | | | | This dataset is only for L1B. | | | | |
| numWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_STD_I32LE | Number of spectrum data | Number of spectrum data is stored for each band. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | | | |
| numWN_outband | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_STD_I32LE | Number of spectrum data (in low frequency) | Number of spectrum data in low frequency is stored for each band.The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | - | | The value is zero for SCAL, BCAL, DCAL because SoundingData/ RawSpectrum contains all samples and no outband data. |
| beginWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Beginning wavenumber of spectrum data | Beginning wavenumber of spectrum data is stored for each band.The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | cm-1 | 10 | | |
| beginWN_outband | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Beginning wavenumber of spectrum data (in low frequency) | Beginning wavenumber of spectrum data in low frequency is stored for each band.The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | cm-1 | 10 | | |
| deltaWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Interval of wavenumber of spectrum data | Interval of wavenumber of spectrum data is stored.It is the same way in low frequency. | cm-1 | 10 | | |
| RawSpectrum | L1B only | SWIR only | OBS,CAL | | | | | This dataset is only for SWIR file of L1B. | | | | |
| band1P | L1B only | SWIR only | OBS,CAL | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values. Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0. The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (11/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band1S | L1B only | SWIR only | OBS,CAL | 3 | numWN[1],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | OBS,CAL | 3 | numWN[2],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | OBS,CAL | 3 | numWN[3],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3P | L1B only | SWIR only | OBS,CAL | 3 | numWN[4],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1B only | SWIR only | OBS,CAL | 3 | numWN[5],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band4 | L1B only | TIR only | CAL only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5 | L1B only | TIR only | CAL only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction | Spectrum data before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| Radiance | L1B only | SWIR,TIR | OBS only | | | | | This dataset is only for L1B. | | | | |
| band1P | L1B only | SWIR only | OBS only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B only | SWIR only | OBS only | 3 | numWN[1],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | OBS only | 3 | numWN[2],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | OBS only | 3 | numWN[3],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (12/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band3P | L1B only | SWIR only | OBS only | 3 | numWN[4],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1B only | SWIR only | OBS only | 3 | numWN[5],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band4 | L1B only | TIR only | OBS only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5 | L1B only | TIR only | OBS only | 3 | numWN[1],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction | Spectrum data after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| Radiance_finiteFOVcorr | L1B only | TIR only | OBS only | | | | | This dataset is only for TIR file of L1B. | | | | |
| band4 | L1B only | TIR only | OBS only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after finite FOV correction | Spectrum data after finite FOV correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5 | L1B only | TIR only | OBS only | 3 | numWN[1],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after finite FOV correction | Spectrum data after finite FOV correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| RawSpectrum_outband | L1B only | SWIR only | OBS,CAL | | | | | This dataset is only for SWIR file of L1B. | | | | |
| band1P | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[0],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[1],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[2],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[3],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3P | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[4],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (13/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band3S | L1B only | SWIR only | OBS,CAL | 3 | numWN_outband[5],numSoundin,2 | H5T_IEEE_F32LE | Spectrum data before sensitivity correction (in low frequency) | Spectrum data in low frequency before sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | V/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| Radiance_outband | L1B only | TIR only | OBS,CAL | | | | | This dataset is only for TIR file of L1B in observation mode. | | | | |
| band4 | L1B only | TIR only | OBS,CAL | 3 | numWN_outband[0],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction (in low frequency) | Spectrum data in low frequency after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5 | L1B only | TIR only | OBS,CAL | 3 | numWN_outband[1],numSoundings,2 | H5T_IEEE_F32LE | Spectrum data after sensitivity correction (in low frequency) | Spectrum data in low frequency after sensitivity correction is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part. | W/cm2/str/cm-1 | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| WavenumberInfo_HiRes | L1B only | SWIR only | CAL(ILSF) | | | | | This dataset is only for L1B and instrument function calibration mode. | | | | |
| numWN | L1B only | SWIR only | CAL(ILSF) | 1 | 4 | H5T_STD_I32LE | Number of ILSF high resolution spectrum | Number of ILSF high resolution spectrum is stored for each band. The order is 1P,1S,2P,2S. | - | - | - | |
| beginWN | L1B only | SWIR only | CAL(ILSF) | 1 | 4 | H5T_IEEE_F64LE | Beginning wavenumber of ILSF high resolution spectrum | Beginning wavenumber of ILSF high resolution spectrum is stored for each band. The order is 1P,1S,2P,2S. | cm-1 | 10 | - | |
| deltaWN | L1B only | SWIR only | CAL(ILSF) | 1 | 4 | H5T_IEEE_F64LE | Interval of wavenumber of ILSF high resolution spectrum | Interval of wavenumber of ILSF high resolution spectrum is stored. | cm-1 | 10 | - | |
| RawSpectrum_HiRes | L1B only | SWIR only | CAL(ILSF) | | | | | This dataset is only for L1B and instrument function calibration mode. | | | | |
| band1P | L1B only | SWIR only | CAL(ILSF) | 2 | numWN[0],numSoundings | H5T_IEEE_F64LE | ILSF high resolution spectrum data | Real part of upsampled spectrum is stored in order of wave number, sounding. | V/cm-1 | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B only | SWIR only | CAL(ILSF) | 2 | numWN[1],numSoundings | H5T_IEEE_F64LE | ILSF high resolution spectrum data | Real part of upsampled spectrum is stored in order of wave number, sounding. | V/cm-1 | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | CAL(ILSF) | 2 | numWN[2],numSoundings | H5T_IEEE_F64LE | ILSF high resolution spectrum data | Real part of upsampled spectrum is stored in order of wave number, sounding. | V/cm-1 | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | CAL(ILSF) | 2 | numWN[3],numSoundings | H5T_IEEE_F64LE | ILSF high resolution spectrum data | Real part of upsampled spectrum is stored in order of wave number, sounding. | V/cm-1 | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| SolarCalibrationData | L1B only | SWIR only | Solar CAL only | | | | | | | | | |
| WavenumberInfo | L1B only | SWIR only | Solar CAL only | | | | | This dataset is only for L1B in solar calibration mode. | | | | |
| numWN | L1B only | SWIR only | Solar CAL only | 1 | numBands | H5T_STD_I32LE | Number of gain coefficient | Number of gain coefficient is stored for each ban.The order is 1P,1S,2P,2S,3P,3S. | - | | | |
| beginWN | L1B only | SWIR only | Solar CAL only | 1 | numBands | H5T_IEEE_F64LE | Beginning wavenumber of spectrum data | Beginning wavenumber of gain coefficient is stored for each band.The order is 1P,1S,2P,2S,3P,3S. | cm-1 | 10 | | |
| deltaWN | L1B only | SWIR only | Solar CAL only | 1 | numBands | H5T_IEEE_F64LE | Interval of wavenumber of spectrum data | Interval of wavenumber of gain coefficient is stored.<br>In low frequency, interval of wavenumber is the same way. | cm-1 | 10 | - | |
| SCTGeometry | L1B only | SWIR only | Solar CAL only | | | | | | | | | |
| diffuserSolarZenith | L1B only | SWIR only | Solar CAL only | 1 | numSoundings | H5T_IEEE_F64LE | Diffuser-Solar Position (Zenith) | Solar zenith angle from point of diffuser view at the observation time.<br>0≦diffuserSolarZenith≦180 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (14/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| diffuserSolarAzimuth | L1B only | SWIR only | Solar CAL only | 1 | numSoundings | H5T_IEEE_F64LE | Diffuser-Solar Position (Azimuth) | Solar azimuth angle from point of diffuser view at the observation time.<br>0≦diffuserSolarAzimuth＜360 | deg | 10 | -999 | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| Reflectivity | L1B only | SWIR only | Solar CAL only | | | | | This group is exist in Solar irradiance calibration mode L1B product only. | | | | |
| band1P | L1B only | SWIR only | Solar CAL only | 2 | numWN[0],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 1P) | Reflectivity of polarization 1P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B only | SWIR only | Solar CAL only | 2 | numWN[1],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 1S) | Reflectivity of polarization 1S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | Solar CAL only | 2 | numWN[2],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 2P) | Reflectivity of polarization 2P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | Solar CAL only | 2 | numWN[3],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 2S) | Reflectivity of polarization 2S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3P | L1B only | SWIR only | Solar CAL only | 2 | numWN[4],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 3P) | Reflectivity of polarization 3P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1B only | SWIR only | Solar CAL only | 2 | numWN[5],numSoundings | H5T_IEEE_F64LE | Reflectivity (Polarization 3S) | Reflectivity of polarization 3S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| GainCoefficients | L1B only | SWIR only | Solar CAL only | | | | | This dataset is only for L1B in solar calibration mode. | | | | |
| band1P | L1B only | SWIR only | Solar CAL only | 3 | numWN[0],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 1P calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B only | SWIR only | Solar CAL only | 3 | numWN[1],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 1S calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection. | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B only | SWIR only | Solar CAL only | 3 | numWN[2],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 2P calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection. | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B only | SWIR only | Solar CAL only | 3 | numWN[3],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 2S calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection. | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (15/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band3P | L1B only | SWIR only | Solar CAL only | 3 | numWN[4],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 3P calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection. | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1B only | SWIR only | Solar CAL only | 3 | numWN[5],numSoundings,2 | H5T_IEEE_F32LE | Gain coefficient | Gain coefficient of band 3S calculated from solar calibration mode data is stored in order of wave number, sounding, complex values.<br>Complex values are stored in order of real part, imaginary part.<br>The scan direction refers to /SoundingAttribute/scanDirection. | - | 5 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| ScanMirror | L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| WavenumberInfo | L1B only | SWIR,TIR | OBS,CAL | | | | | This dataset is only for L1B. | | | | |
| numWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_STD_I32LE | Number of reflectivity data | Number of reflectivity data is stored for each band. The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | - | | | |
| beginWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Beginning wavenumber of reflectivity data | Beginning wavenumber of reflectivity data is stored for each band.The order is 1P,1S,2P,2S,3P,3S in SWIR case and 4,5 in TIR case. | cm-1 | 10 | | |
| deltaWN | L1B only | SWIR,TIR | OBS,CAL | 1 | numBands | H5T_IEEE_F64LE | Interval of wavenumber of reflectivity data | Interval of wavenumber of reflectivity data is stored.It is the same way in low frequency. | cm-1 | 10 | | |
| Reflectivity | L1B | SWIR,TIR | OBS,CAL | | | | | | | | | |
| band1P | L1B | SWIR only | OBS,CAL | 2 | numWN[0],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 1P) | Reflectivity of polarization 1P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band1S | L1B | SWIR only | OBS,CAL | 2 | numWN[1],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 1S) | Reflectivity of polarization 1S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2P | L1B | SWIR only | OBS,CAL | 2 | numWN[2],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 2P) | Reflectivity of polarization 2P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band2S | L1B | SWIR only | OBS,CAL | 2 | numWN[3],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 2S) | Reflectivity of polarization 2S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3P | L1B | SWIR only | OBS,CAL | 2 | numWN[4],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 3P) | Reflectivity of polarization 3P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band3S | L1B | SWIR only | OBS,CAL | 2 | numWN[5],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 3S) | Reflectivity of polarization 3S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band4P | L1B | TIR only | OBS,CAL | 2 | numWN[0],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 4P) | Reflectivity of polarization 4P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band4S | L1B | TIR only | OBS,CAL | 2 | numWN[0],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 4S) | Reflectivity of polarization 4S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |

Table 5-2 Dataset definition of FTS-2 L1A/L1B SWIR/TIR file (HDF5) (16/16)

| Group Path/Dataset Name | L1A/L1B | SWIR/TIR | Observation/ Calibration mode | Data size | | Data Type | Dataset Name | Explanation (Format) | Unit | Significant digit | Invalid Value | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimension | Size | | | | | | | |
| band5P | L1B | TIR only | OBS,CAL | 2 | numWN[1],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 5P) | Reflectivity of polarization 5P is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| band5S | L1B | TIR only | OBS,CAL | 2 | numWN[1],numSoundings | H5T_IEEE_F32LE | Reflectivity (Polarization 5S) | Reflectivity of polarization 5S is stored in order of wave number, sounding. | - | 10 | - | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| scanMirrorTemp | L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_IEEE_F64LE | ScanMirror tempurature | ScanMirror tempurature is stored. | K | | -9999 | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |
| scanMirrorTempQuality | L1B | SWIR,TIR | OBS,CAL | 1 | numSoundings | H5T_STD_I8LE | ScanMirror tempurature quality flag | ScanMirror tempurature quality flag is stored.<br>0 : Normal<br>1 : Abnormal(outside the acceptable range)<br>2: Quality is unknown due to data loss and so on | - | - | 2 | There is no dataset if numSoundings is 0.<br>The data is filled by zero in the case of data loss or it is not observed according to request. |