HISUI
Level1 Product File Format Description

Version 1.0

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Japan Space Systems

<u>Level-1 Product File Format Description</u>

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* 'HS' means Hyper Spectral sensor.

1. Output Products

The nomenclature of the output products is shown in the Table1-1. These products are preserved in the subdirectries shown below:

HSHL1*A_LatiLongi_YYYYMMDDhhmmss_ZZZZNNEEiinntt_B*
(Meanings of characters in Italic style are described in Table1-1)

Table 1-1 Nomenclature of output files

HSHL1*A_LatiLongi_YYYYMMDDhhmmss_ZZZZNNEEiinntt_**.ext*		
symbol	value	description
A	A/R/G	distinction of L1A/R/G
Lati	N900～S900	center latitude of the scene (90.0 north to 90.0 south)
Longi	W1800～E1800	center longitude of the scene (180.0 wet to 180.0 east)
YYYYMMDDhhmmss		time when the scene center was observed (A.D. Year, Month, Day, Hour, minute, second in UTC)
ZZZZNNEEiinntt		time when L1 product was processed (A.D. Year, Month, Day, Hour, minute, second in UTC)
**	V	VNIR (only L1A/R)
	S	SWIR (only L1A/R)
	QA	QA data file
	QA_DM	QA data (Dead Pixel correction flag) file
	QA_IM	QA data (Bad Pixel interpolation flag) file
	DEM	DEM file
	B	Ancillary data file (each band)
	L	Ancillary data file (each line)
	1/2/3	Browse image file of L1G
ext	tif	Image file,QA data file, DEM file
	csv	Ancillary file
	txt	Metafile
	jpg	Browse data file

The output files, which varies depending on processing levels and operation modes, are listed in Table 1-2.

Table 1-2 Output products list

L1A/R HSHL1[AR]_*LatiLongi_YYYYMMDDhhmmss_ZZZZNNEEiinntt* _*B**.ext*		L1G HSHL1G_*LatiLongi_YYYYMMDDhhmmss_ZZZZNNEEiinntt* _*B**.ext*	
VNIR image file	_V.tif	Image file	.tif
SWIR image file	_S.tif		
VNIR QA data file (output only in L1R)	_VQA.tif	QA data file	_QA.tif
SWIR QA data file (output only in L1R)	_SQA.tif		
VNIR QA data (Dead Pixel correction flag) file (output only in L1R)	_VQA_DM.tif	QA data (Dead pixel correction flag) file	_QA_DM.tif
SWIR QA data (Dead Pixel correction flag) file (output only in L1R)	_SQA_DM.tif		
VNIR QA data (Bad pixel interpolation flag) file (output only in L1R)	_VQA_IM.tif	QA data (Bad pixel interpolation flag) file	_QA_IM.tif
SWIR QA data (Bad pixel interpolation flag) file (output only in L1R)	_SQA_IM.tif		
Metadata file	.txt	Metadata file	.txt
Ancillary data file (each line)	_L.csv		
Ancillary data file (each band)	_B.csv	Ancillary data file (each band)	_B.csv
Radiometric DB file	Note 1		
Geometric DB file	Note 1		
		DEM data file (Note 2)	_DEM.tif
		Browse data file (Blue-Green-Red) (Note 3)	_1.jpg
		Browse data file (Red-NIR-SWIR) (Note 3)	_2.jpg
		Browse data file (SWIR-SWIR-SWIR) (Note 3)	_3.jpg

Note 1 These follow the nomenclature of Radiometric / Geometric DB file.

- Parameter definition of HISUI Radiometric DB (2020/07/01)
- HISUI Geometric DB file plan (2018/10/10)

Note 2 DEM data file is not output when system geometric correction is selected as the 3D measurement method.

Note 3 The wavelength of Browse image depends on processing parameters.

1.1. L1A data

L1A data is generated by scene-cutting and/or shifting L0 data. It is composed of the four elements listed below. Browse data is not output.

(1) Image data

Image data is generated by scene-cutting and/or shifting L0B data which is input by each strip and separated files. The amount of scene-cutting and shifting, and line numbers of overlapping area are set arbitrarily in parameter file. The format is BigTIFF.

(2) Ancillary data

Ancillary data is generated for each band (e.g. reflectance conversion coefficient of Hyper spectral sensor). It is generated for each lines of L1A/R image (e.g. observation time, sensor temperature). The format is CSV.

(3) Metadata

Metadata is ancillary data except for (2) (e.g. specification of the image). The format is plane text.

(4) Radiometric DB, Geometric DB

These are generated by copying Radiometric DB and Geometric DB used in L1A/R process.

1.2. L1R data

L1R data is generated by applying radiometric correction to L1A data. It is composed of the five elements listed below. Browse data is not output.

(1) Image data

Image data is generated by applying radiometric correction to L1A image data. The format is BigTIFF.

(2) QA data

QA data is quality data including applying or not applying of Dead Pixel correction, Bad Pixel interpolation and Gain correction, and the result of Cloud Detection. It includes the flag plane which shows the pixels applied Dead Pixel correction and Bad pixel interpolation for each band. The format is BigTIFF.

(3) Ancillary data

Ancillary data is generated for each band (e.g. reflectance conversion coefficient of Hyper spectral sensor). It is generated for each lines of L1A/R image (e.g. observation time, sensor temperature). The format is CSV.

(4) Metadata

Metadata is ancillary data except for (3) (e.g. specification of the image). The format is plane text.

(5) Radiometric DB, Geometric DB

These are generated by copying Radiometric DB and Geometric DB used in L1A/R process.

1.3. L1G data

L1G data is generated by map-projecting L1R data. It is composed of the six elements listed below.

(1) Image data

Image data is generated by map-projecting L1R image data applying 3D measurement of each pixel. The format is BigGeoTIFF.

(2) QA data

QA data is quality data including applying or not applying of Dead Pixel correction, Bad Pixel interpolation, Gain correction and image matching results, and the result of Cloud Detection. It includes the flag plane which shows the pixels applied Dead Pixel correction and Bad pixel interpolation for each band. It is map-projected as (1) Image data. The format is BigGeoTIFF.

(3) DEM data

Digital elevation model which is map-projected as (1) Image data. The elevation is measured from geoid surface. The format is BigGeoTIFF.

(4) Ancillary data

Ancillary data is generated for each band (e.g. reflectance conversion coefficient of Hyper spectral sensor). The format is CSV.

(5) Metadata

Metadata is ancillary data except for (5) (e.g. specification of the image). The format is plane text.

(6) Browse data

Browse data is the image data intended to check whether the scene includes the target or not, and to assess temporally varying scene coverage (e.g. cloud, vegetation, water and ice / snow). The format is jpeg.

2. Description of the format

Detailed format of each product shown in Chapter 1 are shown below:

2.1. Image data

(1) BigTIFF

Image data before being map-projected is output in BigTIFF format of little endian. BigTIFF is the extended format of TIFF Revision 6.0. It can treat up to 2^{30} GB data beyond the limitation of TIFF file size of 4GB.

TIFF tags and set values are listed in Table 2-1.

Table 2-1 TIFF tags set values

TIFF tag	description	set value
ImageWidth	width of image	The number of columns in the image, which is set depending on the image.
ImageLength	height of image	The number of rows in the image, which is set depending on the image.
BitsPerSample	the number of bits per component.	16 (image data, QA data, DEM) 1 (flag plane of QA data)
Compression	compression scheme	No compression
Photometric	the color space of the image data	min-is-black grayscale image: 0 is imaged as black
SamplesPerPixel	the number of bands	The number of bands of the data, which is set depending on the image. It is bigger than 1 except for QA data and DEM data.
PlanarConfig	How the components of each pixel are stored.	single image plane (=BIP: Band Interleaved by Pixel)
TileWidth	The tile width in pixels*	16
TileLength	The tile length (height) in pixels*	16
SampleFormat	Specifies how to interpret each data sample in a pixel	Image data, QA data : unsigned integer (1) DEM data : signed integer (2) Flag plane of QA data : undefined (4)

* An image data is preserved by being separated into tiles.

(2) BigGeoTIFF

  Map-projected image data is output in BigGeoTIFF format which is added geographic information to (1) BigTIFF format of little endian.

  TIFF tags and set values added in BigGeoTIFF are listed in Table 2-2, GeoTIFF keys which depends on map-projection method are listed in Table 2-3.

Table 2-2 TIFF tags (GeoTIFF) set values

TIFF	description	set value
PixelScale	map resolution	depend on the image
TiePoints	Tie point (map coordinate of upper-most and left-most pixel)	depend on the image

Table 2-3 GeoTIFF keys set values

GeoTIFF key	map-projection	set value
GTModelTypeGeoKey	Geographic latitude-longitude System	ModelTypeGeographic
	UTM、PS	ModelTypeProjected
GTRasterTypeGeoKey	common	RasterPixelIsPoint
GeographicTypeGeoKey	common	GCS_WGS_84
GeogLinearUnitsGeoKey	common	Linear_Meter
GeogAngularUnitsGeoKey	common	Angular_Degree
ProjLinearUnitsGeoKey	UTM、PS	Linear_Meter
ProjectedCSTypeGeoKey	UTM	PCS_WGS84_UTM_zone_ *(Zone number)*
	PS	WGS84_ANTARCTIC_POLAR_STEREOGRAPHIC ／WGS84_ARCTIC_POLAR_STEREOGRAPHIC
ProjNatOriginLatGeoKey	PS	-71.0／71.0
ProjCoordTransGeoKey	PS	ProjCoordTransGeoKey
ProjFalseEastingGeoKey	PS	0.0
ProjFalseNorthingGeoKey	PS	0.0
ProjStraightVertPoleLongGeoKey	PS	Longitude at Straight Vertical Pole. For polar stereographic set by L1 processing parameters.

2.2. QA data

QA data is 2 bytes unsigned integer and the flag plane of QA data (Dead Pixel correction flag and Bad Pixel interpolation flag) is 1 bit data. It is output in BigTIFF or BigGeoTIFF format as image data.

Description of QA data is shown in Table 2-4.

Table 2-4 Description of QA data

No	item	bit positon	valid bit *1		value
			L1R	L1G	
1	field of view	0	-	o	0 = within field of view 1 = outside of field of view
2	VNIR image matching	1	-	o	0 = not applied results of image matching
3	SWIR image matching	2	-	o	1 = applied results of image matching
4	VNIR Dead Pixel correction	3	o	o	0 = not corrected 1 = including Dead Pixel corrected band(s) *2
5	SWIR Dead Pixel correction	4	o	o	
6	VNIR interpolated pixel	5	o	o	0 = not interpolated 1 = including Bad Pixel interpolated band(s) *2
7	SWR interpolated pixel	6	o	o	
8	Reserved	7	-	-	0 fixed
9	Gain correction	8	o	o	0 = not corrected 1 = including gain corrected band(s) *2
10	Snow & Ice area	9-10	o	o	00 = not Snow & Ice 01 = judged as Snow & Ice by Snow & Ice MAP 10 = judged as Snow & Ice by HS observation data 11 = judged as Snow & Ice by Snow & Ice MAP and HS observation data
11	water area	11-12	-	o	00 = Land 01 = Sea 10 = Inland water (big river) 11 = Inland water (lake)
12	Cirrus	13	o	o	0 = not Cirrus 1 = Cirrus
13	cloud	14-15	o	o	00 = impossible to judge 01 = Clear 10 = Ambiguous 11 = Cloud

*1 o : QA bit is valid.

  - : QA bit is invalid (0 fixed).

*2 It can be checked by the flag plane of QA data, to which band correction and/or interpolation was applied .

2.3. DEM data

DEM data is 2 bytes signed integer data. It is output in BigGeoTIFF format as image data. The definition of the pixel value is shown below:

- Elevation form WGS84/EGM96 geoid surface
- 1m/DN
- '-9999' means that the pixel is outside of the filed of view.

2.4. Ancillary data

Band information ancillary data and line information ancillary data are output in CSV format.

Examples of line information ancillary data is shown below. Output items are listed in Table 2-5.

format	
# Epoch Time 2014-01-07T12:34.567890Z	observation time of the first line
LineNo, ElapsedTimeSec, DetectorTemperatureCelsius, ChassisTemperatureCelsius, ... 1, 0.000000, 1.1234, 2.1234e5, ... 2, 0.000001, 1.1234, 2.1234e5, ...	CSV data

Examples of Band / HR band / channel information ancillary data are shown below. Output items are listed in Table 2-6.

format	
BandNo※, CenterWavelengthNanometer, FullWidthAtHalfMaximumNanometer, SolarIrradiance, ... a, 0.1234, 1.1234, 2.1234e5, ... b, 0.1234, 1.1234, 2.1234e5, ...	CSV data （VNIR）
184, 0.1234, 1.1234, 2.1234e5, ... 185, 0.1234, 1.1234, 2.1234e5, ...	CSV data （SWIR）

* BandNo is a, b, c, ..., 1, 2, 3, ..., 56, 57, w, x, y, z, 58, 59, ..., 184, 185.

Table 2-5 Item list of Band / HR band / channel information ancillary data

Region	No.	Item Name	Keyword	Format	HS L1 output * A	HS L1 output * R	HS L1 output * G	Note
	1	ID of Band / HR Band / Channel	###No 　### isBand, HRband, Channel	%s	o	o	o	Band IDs of observed wavelength range are expressed by digits. Band IDs of insensible bands are expressed by small character alphabets.
	2	Filter Center Wavelength (nm)	CenterWavelengthNanometer	%.4f	o	o	o	output in Normal Observation or Smile correction in CAL/HR mode.
	3	FWHM (nm)	FullWidthAtHalfMaximumNanometer	%.4f	o	o	o	Only Normal Observation for L1A.
	4	Solar Irradiance Model value (W/m2/micron)	SolarIrradianceWatt/Meter2/Micron	%.4e	o	o	o	
	5	Reflectance Multi	ReflectanceMulti	%.6e		o	o	output in Normal Observation or Smile correction in CAL/HR mode.
	6	Reflectance Add	ReflectanceAdd	%.6f		o	o	
	7	Reflectance Maximum (ND)	ReflectanceMaximum	%.4e		o	o	calculate from DNMaximum using ReflectanceMulti and ReflectanceAdd.
	8	Reflectance Minimum (ND)	ReflectanceMinimum	%.4e		o	o	output in Normal Observation or Smile correction in CAL/HR mode.
	9	Scene Maximum (DN)	SceneMaximumDN	%d	o	o	o	calculate using pixels which value are between Maximum and Minimum DNs.
	10	Scene Minimum (DN)	SceneMinimumDN	%d	o	o	o	calculate using pixels which value are between Maximum and Minimum DNs.
	11	Scene Average (DN)	SceneAverageDN	%.2f	o	o	o	calculate using pixels which value are between Maximum and Minimum DNs.
	12	Scene Standard Deviation (DN)	SceneStandardDeviationDN	%.2f	o	o	o	calculate using pixels which value are between Maximum and Minimum DNs.
	13	Bad Pixel Counts	BadPixelCounts	%d	o	o	o	
	14	Interpolated Bad Pixel Counts	InterpolatedBadPixelCounts	%d		o	o	
	15	Saturated Pixel Counts	SaturatedPixelCounts	%d	o	o	o	

* o means 'output', vacant means 'not output'.

Table 2-6 Item list of line information ancillary data

Region	No.	Item Name	Keyword	Format	HS L1 output *			Note
					A	R	G	
	1	Elapsed Time (sec)	ElapsedTimeSec	%.6f	o	o		Elapsed seconds from the first line.
	2	MDP-GPS time difference (sec)	MdpGpsTimeDifferenceSec	%.6f	o	o		
	3	Detector Temperature (Celsius)	DetectorTemperatureCelsiusVNIR DetectorTemperatureCelsiusSWIR	%f	o	o		Interpolated value used for the correction of each line.
	4	Grating Temperature (Celsius)	GratingTemperatureCelsius	%f	o	o		Interpolated value used for the correction of each line.
	5	Error Information	ErrorInformationVNIR ErrorInformationSWIR	%s	o	o		Error information described in L0B line information file. The for mat is identical to L0B line informationfile.
	6	Sensor Position (WGS84) (m)	SensorPositionWGS84XMeter SensorPositionWGS84YMeter SensorPositionWGS84ZMeter	%f	o	o		
	7	Attitude Transformation Matrix from sensor system to WGS84	TransformationMatrix11SensorToWGS84 TransformationMatrix12SensorToWGS84 TransformationMatrix13SensorToWGS84 TransformationMatrix21SensorToWGS84 TransformationMatrix22SensorToWGS84 TransformationMatrix23SensorToWGS84 TransformationMatrix31SensorToWGS84 TransformationMatrix32SensorToWGS84 TransformationMatrix33SensorToWGS84	%f	o	o		
	8	Roll correction (radian)	RollCorrectionRadian	%.6f	o	o		

* o means 'output', vacant means 'not output'.

2.5. Metadata

Metadata file is output in plane text format. In the metadata file, Data are described as 'keyword = value'.

An example is shown below. The line starting with '#' is comment line. Output items are listed in Table 2-7.

```
#################### Product information ####################
ProductID              = "HSML1G_N25E121_20130705022331_20140102123456"
ProductVersion         = "1"
ProcessingDate         = 2014-01-02T12:34:56Z
ProducerID             = "National Institute of Advanced Industrial Science and Technology"
ProcessorName          = "HISUI_L1_MULTI"
ProcessorVersion       = "0.0.0"
ProcessingLevel        = "L1G"
...
```

Table 2-7 Metadata list

(1/9)

Region	No.	Item Name	Keyword	Format	HS L1 output * A	HS L1 output * R	HS L1 output * G	Note
Product	1	Product ID	ProductID	%s	o	o	o	
	2	Product Version	ProductVersion	%s	o	o	o	
	3	Processing Date (UTC : up to seconds)	ProcessingDate	%s	o	o	o	output in ISO 8601 format (YYYY-MM-DDThh : mm : ssZ).
	4	Producer ID	ProducerID	%s	o	o	o	"Japan Space Systems"
	5	Processor Name	ProcessorName	%s	o	o	o	"HISUI_L1_HYPER"
	6	Processor Version	ProcessorVersion	%s	o	o	o	
	7	Processing Level	ProcessingLevel	%s	o	o	o	"L1A", "L1R" or "L1G"
	8	Mission Name	MissionName	%s	o	o	o	"HISUI"
	9	Spacecraft Name	SpacecraftName	%s	o	o	o	"ISS/Kibo"
	10	Instrument Name	InstrumentName	%s	o	o	o	"HISUI-HS"
	11	Revolution Number	RevolutionNumber	%d	o	o	o	
	12	Path Number	PathNo	%d				"N/A" in case time designated scene cut was applied.
	13	Row Number	RowNo	%.2f	o	o	o	
	14	Acquisition Station ID	AcquisitionStation[1-N]	%s	o	o	o	as much as the number of L0B.
	15	Scene Center Time	SceneCenterTime	%s	o	o	o	output in ISO 8601 format (YYYY-MM-DDThh : mm : ss.ssssssZ). "Scene Center" means – When Path & Row is designated : the passage time of scene center. – When the start time is designated : average of the start time and end time.
	16	L0B DataID	L0BDataID[1-N]	%s	o	o	o	as much as the number of L0B.
	17	Metadata File Name	MetadataFileName	%s	o	o	o	
	18	Image Data File Name	L1A/R : ###FileName ### is Normal Observation : VNIR, SWIR CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : ImageFileName	%s	o	o	o	
	19	QA Data File Name	L1R : ###QAFileName ### is Normal Observation : VNIR, SWIR CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : QAFileName	%s		o	o	
	20	QA Data (Dead Pixel Correction Flag) File Name	L1R : ###QADeadPixelMapFileName ### is Normal Observation : VNIR, SWIR CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : QADeadPixelMapFileName	%s		o	o	output in case of Normal Observation or binning for CAL/HR mode.
	21	QA Data (Bad Pixel Interpolation Flag) File Name	L1R : ###QAInterpolatedPixelMapFileName ### is Normal Observation : VNIR, SWIR CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : QAInterpolatedPixelMapFileName	%s		o	o	output in case of Normal Observation or binning for CAL/HR mode.

Table 2-7

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Region	No.	Item Name	Keyword	Format	HS L1 output * A	R	G	Note
Product	22	Ancillary Data File Name	− Band ／ HR Band ／ Channel Information 　Normal Observation : BandAncillaryDataFileName 　CAL／HR : HRbandAncillaryDataFileName 　　　　　ChannelAncillaryDataFileName − L1A/R Line Information 　Normal Observation/HR : LineAncillaryDataFileName 　CAL : ###LineAncillaryDataFileName 　### is Blue, Green, Red, NIR, SWIR1, SWIR2	%s	o	o	o	
	23	Elevation File Name	ElevationFileName	%s			o	″N/A″ in case system geometric correction.
	24	Acquisition Type	AcquisitionType	%s	o	o	o	Normal Observation : ″Normal″ HR Mode : ″High Resolution″ CAL Mode : ″Calibration″
	25	Target Object	TargetObject	%s	o	o	o	″Earth″, ″Moon″, ″Deep Space″, ″Lamp″ etc.
	26	Instrument Description	InstrumentDescription	%s	o	o	o	
	27	Sensor Status	VNIRStatus, SWIRStatus	%s	o	o	o	″On″ or ″Off″
	28	Number of Bands / HR Bands / Channels	L1A/R : ###NumberOfBands 　### is 　Normal Observation : VNIR, SWIR 　CAL/HR : Blue, Green, Red, NIR, 　　　　　SWIR1, SWIR2 L1G : NumberOfBands	%d	o	o	o	
	29	Registration Base Band	RegistrationBaseBand	%s	o	o	o	″VNIR″ or ″SWIR″
	30	Line Exposure Duration (microsecond)	Normal Observation/HR : LineExposureDurationMicrosecond CAL : ###LineExposureDurationMicrosecond ### is VNIR, SWIR	%d	o	o	o	
	31	First Line Observation Time (UTC : up to microsecond)	FirstLineObservationTime	%s	o	o	o	output in ISO 8601 format (YYYY-MM-DDThh : mm : ss.ssssssZ).
	32	Last Line Observation Time (UTC : up to microsecond)	LastLineObservationTime	%s	o	o	o	output in ISO 8601 format (YYYY-MM-DDThh : mm : ss.ssssssZ).
	33	Sampling Interval (microsecond)	Normal Observation/HR : SamplingIntervalMicrosecond CAL : ###SamplingIntervalMicrosecond ### is VNIR, SWIR	%d	o	o	o	
	34	Orbit Direction	OrbitDirection	%s	o	o	o	″Descend″ or ″Ascend″
	35	Attitude Data Quality	AttitudeQuality	%.6f	o	o	o	Maximum standard deviation of attitude determination error in the scene
	36	Orbit Data Quality	OrbitQuality	%.6f	o	o	o	Maximum standard deviation of orbit determination error in the scene
	37	Attitude and Orbit determination mode	AttitudeOrbitDeterminationMode	%s	o	o	o	″HISUI″ or ″ISS″
Scene	38	Latitude and Longitude of four corners of FOV (deg)	###Observation− 　UpperLeftSystemGeoLatitudeDegree 　UpperLeftSystemGeoLongitudeDegree 　UpperRightSystemGeoLatitudeDegree 　UpperRightSystemGeoLongitudeDegree 　LowerLeftSystemGeoLatitudeDegree 　LowerLeftSystemGeoLongitudeDegree 　LowerRightSystemGeoLatitudeDegree 　LowerRightSystemGeoLongitudeDegree ### is 　Normal Observation : VNIR, SWIR 　CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2	%.6f	o	o		The numbers of elements are : 　Normal Observation, HR Mode : VNIR(1)+SWIR(1)=2 　CAL Mode : VNIR(4)+SWIR(2)=6 ″N/A″ in case the Earth was not observed.
	39	Latitude and Longitude of the Center of FOV (deg)	###Observation− 　CenterSystemGeoLatitudeDegree 　CenterSystemGeoLongitudeDegree ### is 　Normal Observation : VNIR, SWIR 　CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2	%.6f	o	o	o	The numbers of elements are : 　Normal Observation, HR Mode : VNIR(1)+SWIR(1)=2 　CAL Mode : VNIR(4)+SWIR(2)=6 ″N/A″ in case the Earth was not observed.

Table 2-7
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Region	No.	Item Name	Keyword	Format	A	R	G	Note
Scene	40	Local Solar Time	LocalSolarTime	%s	o	o	o	hh : mm : ss "N/A" in case the Earth was not observed.
	41	Earth Sun Distance（AU）	EarthSunDistanceAU	%.7f	o	o	o	
	42	Illumination Elevation Angle（deg）	IlluminationElevationAngleDegree	%.6f	o	o	o	Angle from the tangential plane of the reference ellipsoid. "N/A" in case the Earth was not observed.
	43	Illumination Azimuth Angle（deg）	IlluminationAzimuthAngleDegree	%.6f	o	o	o	"N/A" in case the Earth was not observed.
	44	Spacecraft Elevation Angle（deg）	SpacecraftElevationAngleDegree	%.6f	o	o	o	Angle from the tangential plane of the reference ellipsoid. "N/A" in case the Earth was not observed.
	45	Spacecraft Azimuth Angle（deg）	SpacecraftAzimuthAngleDegree	%.6f	o	o	o	"N/A" in case the Earth was not observed.
	46	Incidence, Emission, Phase Angles（deg）	IncidenceAngleDegree EmissionAngleDegree PhaseAngleDegree	%.6f	o	o	o	Incidence Angle and Emission Angle are the angle from the normal line of the reference ellipsoid. "N/A" in case the Earth was not observed.
	47	Detector Temperature (Celsius)	DetectorTemperatureCelsiusVNIR DetectorTemperatureCelsiusSWIR	%f	o	o	o	Interpolated value of the scene center.
	48	Grating Temperature (Celsius)	GratingTemperatureCelsius	%f	o	o	o	Interpolated value of the scene center.
	49	Cloud Cover (%)	CloudCoverPercentage	%d		o	o	Calculating the cloud cover assuming that the cloud pixels and Ambiguous pixels set in the parameter file are cloud.
	50	Cloud Detect Line Offset	CloudDetectLineOffset	%d		o		
	51	Cloud Detect Sample Offset	CloudDetectSampleOffset	%d		o		
	52	Bad Pixel (%)	BadPixelPercentageVNIR BadPixelPercentageSWIR	%f	o	o	o	
	53	Bad Pixel Counts	BadPixelCountsVNIR BadPixelCountsSWIR	%d	o	o	o	
	54	Interpolated Bad Pixel (%)	InterpolatedBadPixelPercentageVNIR InterpolatedBadPixelPercentageSWIR	%f		o	o	
	55	Interpolated Bad Pixel Counts	InterpolatedBadPixelCountsVNIR InterpolatedBadPixelCountsSWIR	%d		o	o	
	56	Saturated Pixel (%)	SaturatedPixelPercentageVNIR SaturatedPixelPercentageSWIR	%f	o	o	o	
	57	Saturated Pixel Counts	SaturatedPixelCountsVNIR SaturatedPixelCountsSWIR	%d	o	o	o	
Image File	58	Image File Format	ImageFileFormat	%s	o	o	o	"Big TIFF", "Big TIFF Multiband" or "Big GeoTIFF Multiband"
	59	Band Arrangement	BandArrangement	%s	o	o	o	"Band Interleaved by Pixel"
	60	Lines	L1A/R : ###Lines 　### is 　Normal Observation : VNIR, SWIR 　CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : ImageLines	%d	o	o	o	
	61	Samples per Line	L1A/R : ###Samples 　### is 　Normal Observation : VNIR, SWIR 　CAL/HR : Blue, Green, Red, NIR, SWIR1, SWIR2 L1G : ImageSamples	%d	o	o	o	
	62	Designated Fill Pixel Counts	DesignatedFillPixelCounts	%d			o	Designated fill pixel counts for one band.

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Region	No.	Item Name	Keyword	Format	A	R	G	Note
Image File	63	Sample Type	SampleType	%s	o	o	o	"LSB Integer"
	64	Sample Bits	SampleBits	%d	o	o	o	16
	65	Radiance Multi	RadianceMultiVNIR RadianceMultiSWIR	%.6e		o	o	
	66	Radiance Add	RadianceAddVNIR RadianceAddSWIR	%.6f		o	o	
	67	Reflectance Unit	ReflectanceUnit	%s		o	o	"ND"
	68	Radiance Unit	RadianceUnit	%s		o	o	"W/m2/micron/sr"
Radiance Correction	69	Radiometric Parameter DB File Name	RadiometricParameterFileName	%s	o	o	o	
	70	Solar Irradiance Model Name	SolarIrradianceModelName	%s	o	o	o	
	71	Irradiance Unit	IrradianceUnit	%s	o	o	o	"W/m2/micron"
	72	Radiance Maximum (W/m2/micron/sr)	RadianceMaximumVNIR RadianceMaximumSWIR	%.4e		o	o	calculate from DNMaximum using RadianceMulti and RadianceAdd.
	73	Radiance Minimum (W/m2/micron/sr)	RadianceMinimumVNIR RadianceMinimumSWIR	%.4e		o	o	calculate from DNMinimum using RadianceMulti and RadianceAdd.
	74	Maximum Valid DN	DNMaximum	%d	o	o	o	L1A : 4094 L1R,L1G : 65534
	75	Minimum Valid DN	DNMinimum	%d	o	o	o	L1A : 0 L1R,L1G : 2
	76	Bad Pixel DN	BadPixelDN	%d	o	o	o	L1A : 9999 L1R,L1G : 1
	77	Saturated Pixel DN	SaturatedPixelDN	%d	o	o	o	L1A : 4095 L1R,L1G : 65535
	78	Black Line Calibration	BlackLineCalibration	%s		o	o	"On" or "Off"
	79	Onboard Radio Calibration	OnboardRadioCalibration	%s		o	o	"On" or "Off". Not output in Normal Observation Mode.
	80	Other 1 Calibration	Other1Calibration	%s		o	o	"On" or "Off". Not output in Normal Observation Mode.
	81	Onboard Smile Calibration with binning	OnboardSmileCalibration	%s		o	o	"On" or "Off". Not output in Normal Observation Mode.
	82	Ground Smile Calibration without binning	GroundSmileCalibration	%s		o	o	"On" or "Off". Not output in Normal Observation Mode.
	83	Dead Pixel Calibration	DeadPixelCalibration	%s		o	o	"On" or "Off"
	84	Dark Calibration	DarkCalibration	%s		o	o	"On" or "Off"
	85	Gain Calibration	GainCalibration	%s		o	o	"On" or "Off"
	86	Other 2 Calibration	Other2Calibration	%s		o	o	"On" or "Off"
	87	Aging Degradation Calibration	AgingDegradationCalibration	%s		o	o	"On" or "Off"
	88	Bad Pixel Interpolation	BadPixelInterpolation	%s		o	o	"On" or "Off"
Geometric Correctin	89	Orbit Data Type	OrbitDataType	%s	o	o	o	"ISS"
	90	Geometric DB File Name	GeometricParameterFileName	%s	o	o	o	
	91	Geometry Calculation Method	GeometryCalculationMethod	%s			o	System Geometric Correction : "Systematic Geometry" Intersection of LOS and DEM : "DEM" Stereo 3D measurement : "Stereo+DEM"
	92	Elevation Source	ElevationSource	%s			o	"ASTER GDEM V3" "N/A" in case System Geometric Correction.
	93	Keystone Correction	KeystoneCorrection	%s			o	"On" or "Off"

Table 2-7

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Region	No.	Item Name	Keyword	Format	HS L1 output * A	R	G	Note

Geometric Correctin	94	Image Matching Applied Pixel Counts	###ImageMatchingAppliedPixelCounts
			### is
			  Normal Observation : VNIR, SWIR
			  HR : Blue, Green, Red, NIR, SWIR1, SWIR2
				%d			o	Pixel counts in the not map-projected image (= L1A/R).
								″N/A″ except for Stereo 3D, LOS-DEM intersection + Image Matching.

	95	Along Track Disparity (pixel)
		(Maximum, minimum, average, standard deviation)
			###AlongTrackDisparity-
			  MaximumPixel
			  MinimumPixel
			  AveragePixel
			  StandardDeviationPixel
			### is
			  Normal Observation : VNIR, SWIR
			  HR : Blue, Green, Red, NIR, SWIR1, SWIR2
				%f			o	

	96	Cross Track Disparity (pixel)
		(Maximum, minimum, average, standard deviation)
			###CrossTrackDisparity-
			  MaximumPixel
			  MinimumPixel
			  AveragePixel
			  StandardDeviationPixel
			### is
			  Normal Observation : VNIR, SWIR
			  HR : Blue, Green, Red, NIR, SWIR1, SWIR2
				%f			o	″N/A″ except for Stereo 3D, LOS-DEM intersection + Image Matching.

	97	Normalized Cross Correlation
		(Maximum, minimum, average, standard deviation)
			###NormalizedCrossCorrelation-
			  Maximum
			  Minimum
			  Average
			  StandardDeviation
			### is
			  Normal Observation : VNIR, SWIR
			  HR : Blue, Green, Red, NIR, SWIR1, SWIR2
				%f			o	

	98	Image Matching Geometric Correction Result	MatchingGeocorrectionResult	%s			o	″corrected″ in case correction was executed, ″uncorrected″ in case correction was not executed.
Map Projection	99	Map Projection	MapProjection	%s			o	″UTM″, ″LATLON″ or ″PS″
	100	Reference Datum	ReferenceDatum	%s			o	″WGS84″
	101	Reference Ellipsoid	ReferenceEllipsoid	%s			o	″WGS84″
	102	Map Orientation	MapOrientation	%s			o	(except for PS)″North Up″
	103	Map Standard Latitude (deg)	MapStandardLatitudeDegree	%.6f			o	(except for UTM)
	104	Map Standard Longitude (deg)	MapStandardLongitudeDegree	%.6f			o	(except for UTM)
	105	Map True Scale Latitude (deg)	MapTrueScaleLatitudeDegree	%.6f			o	(only PS)71 or -71
	106	UTM Zone	UTMZone	%d			o	(only UTM) Northern hemisphere : Plus, Southern hemisphere : minus.
	107	Positive Longitude Direction	PositiveLongitudeDirection	%s			o	″East″
	108	Grid Cell Size (m)	GridCellSizeMeter	%.2f			o	

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Region	No.	Item Name	Keyword	Format	HS L1 output *			Note
					A	R	G	
Map Projection	109	Latitude of the four corners of FOV (deg)	ObservationUpperLeftLatitudeDegree ObservationUpperRightLatitudeDegree ObservationLowerLeftLatitudeDegree ObservationLowerRightLatitudeDegree	%.6f			o	The Up/Down and Right/Left correspond with L1A/R.
	110	Longitude of the four corners of FOV (deg)	ObservationUpperLeftLongitudeDegree ObservationUpperRightLongitudeDegree ObservationLowerLeftLongitudeDegree ObservationLowerRightLongitudeDegree	%.6f			o	
	111	Latitude of four corners of Map image (deg)	MapUpperLeftLatitudeDegree MapUpperRightLatitudeDegree MapLowerLeftLatitudeDegree MapLowerRightLatitudeDegree	%.6f			o	including outside of FOV.
	112	Longitude of four corners of Map image (deg)	MapUpperLeftLongitudeDegree MapUpperRightLongitudeDegree MapLowerLeftLongitudeDegree MapLowerRightLongitudeDegree	%.6f			o	including outside of FOV.
	113	Line Projection Offset (m)	LineProjectionOffsetMeter	%.2f			o	
	114	Sample Projection Offset (m)	SampleProjectionOffsetMeter	%.2f			o	
	115	Resampling Method	ResamplingOption	%s			o	"Nearest Neighbor", "Bi-Linear" or "Cubic Convolution"
Browse Image	116	Browse Image Lines	Browse[1-3]ImageLines	%d			o	
	117	Browse Image Samples	Browse[1-3]ImageSamples	%d			o	
	118	Browse Image File Name	Browse[1-3]ImageFileName	%s			o	
	119	Browse Image File Size	Browse[1-3]ImageFileSize	%d			o	
	120	Browse Image Creation Time	Browse[1-3]ImageCreationTime	%s			o	
Geometric Accuracy	121	Fitting Method for MDP Time Correction	MDPTimeCorrectionFittingMethod	%s	O	O	O	"Linear", "Mean" or "Defalt Value"
	122	Fitting Method for Roll Correction	RollCorrectionFittingMethod	%s	O	O	O	"Linear", "Mean" or "Defalt Value"
	123	Strip Scene Count	StripSceneCount	%d	O	O	O	
	124	Fitting Scene Count	FittingSceneCount	%d	O	O	O	
	125	Fitting Scene Count without Outliers	FittingSceneCountWithoutOutliers	%d	O	O	O	
	126	MDP Time Correction Fitting Result (Slope, intercept)	MDPTimeCorrectionFitting- 　　Slope 　　InterceptSecond	%.6e	O	O	O	
	127	MDP Time Correction (sec) (Average, default value)	MDPTimeCorrection 　　Average 　　DefaultValue	%.6e	O	O	O	

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Table 2-7

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Region	No.	Item Name	Keyword	Format	HS L1 output *			Note
					A	R	G	
Geometric Accuracy	128	MDP Time Correction Regression Residual (sec) (Maximum, minimum, average, standard deviation)	MDPTimeCorrectionRegressionResidual− MaximumSecond MinimumSecond AverageSecond StandardDeviationSecond	%.6e	○	○	○	
	129	Strip MDP Time Correction (sec) (Maximum, minimum)	StripMDPTimeCorrection− MaximumSecond MinimumSecond	%.6e	○	○	○	
	130	Fitting MDP TIme Correction (sec) (Maximum, minimum)	FittingMDPTimeCorrection− MaximumSecond MinimumSecond	%.6e	○	○	○	
	131	Fitting MDP TIme Correction without Outliers (sec) (Maximum, minimum)	FittingMDPTimeCorrectionWithoutOutliers MaximumSecond MinimumSecond	%.6e	○	○	○	
	132	Roll Correction Fitting Result (Slope, intercept)	RollCorrectionFitting− SlopeRadianPerSecond InterceptRadian	%.6e	○	○	○	
	133	Roll Correction (radian) (Average, default value)	RollCorrection Average DefaultValue	%.6e	○	○	○	
	134	Roll Correction Regression Residual (radian) (Maximum, minimum, average, standard deviation)	RollCorrectionRegressionResidual− MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	135	Strip Roll Correction Regression Residual (radian) (Maximum, minimum, average, standard deviation)	StripRollCorrection− MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	136	Strip Pitch Correction Regression Residual (radian) (Maximum, minimum, average, standard deviation)	StripPitchCorrection− MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	137	Strip Yaw Correction Regression Residual (radian) (Maximum, minimum, average, standard deviation)	StripYawCorrection− MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	

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Region	No.	Item Name	Keyword	Format	HS L1 output *			Note
					A	R	G	
Geometric Accuracy	138	Strip Z Correction Regression Residual（m） (Maximum, minimum, average, standard deviation)	StripZCorrection－ MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e	○	○	○	
	139	Fitting Roll Correction Regression Residual（radian） (Maximum, minimum, average, standard deviation)	FittingRollCorrection－ MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	140	Fitting Pitch Correction Regression Residual（radian） (Maximum, minimum, average, standard deviation)	FittingPitchCorrection－ MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	141	Fitting Yaw Correction Regression Residual（radian） (Maximum, minimum, average, standard deviation)	FittingYawCorrection－ MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.6e	○	○	○	
	142	Fitting Z Correction Regression Residual（m） (Maximum, minimum, average, standard deviation)	FittingZCorrection－ MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e	○	○	○	
	143	Fitting Roll Correction Regression Residual without Outliers（radian） (Maximum, minimum, average, standard deviation)	FittingRollCorrectionWithoutOutliers－ MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.7e	○	○	○	
	144	Fitting Pitch Correction Regression Residual without Outliers（radian） (Maximum, minimum, average, standard deviation)	FittingPitchCorrectionWithoutOutliers－ MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.8e	○	○	○	

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Region	No.	Item Name	Keyword	Format	HS L1 output * A	R	G	Note
Geometric Accuracy	145	Fitting Yaw Correction Regression Residual without Outliers (radian) (Maximum, minimum, average, standard deviation)	FittingYawCorrectionWithoutOutliers- MaximumRadian MinimumRadian AverageRadian StandardDeviationRadian	%.9e	○	○	○	
	146	Fitting Z Correction Regression Residual without Outliers (m) (Maximum, minimum, average, standard deviation)	FittingZCorrectionWithoutOutliers- MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.10e	○	○	○	
	147	Scene Count under Pitch Correction Threshold	PitchCorrectionUnderThresholdSceneCount	%d	○	○	○	
	148	Geometric correction Reference File Name	GeocorrectionReferenceFileName	%s			○	
	149	Matching Valid Pixel Count between L1G and Geometric correction Reference Image	GeocorrectionValidPixelCount	%d			○	Valid″ means that the correlation coefficient is greater than or equal to 0.5 and disparity is within searching area.
	150	Correlation coefficient between L1G and Geometric correction Reference Image (Maximum, minimum, average, standard deviation)	GeocorrectionCorrelation- Maximum Minimum Average StandardDeviation	%.6e			○	
	151	Along Track Disparity between L1G and Geometric correction Reference Image (m) (Maximum, minimum, average, standard deviation)	GeocorrectionAlongTrackDisparity- MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e			○	
	152	Cross Track Disparity between L1G and Geometric correction Reference Image (m) (Maximum, minimum, average, standard deviation)	GeocorrectionCrossTrackDisparity- MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e			○	
	153	Matching Valid Pixel Count between representative bands of VNIR and SWIR	VNIR-SWIRRegistrationMatchingValidPixelCount	%d			○	Valid″ means that the correlation coefficient is greater than or equal to 0.5 and disparity is within searching area.
	154	Correlation coefficient between representative bands of VNIR and SWIR (Maximum, minimum, average, standard deviation)	VNIR-SWIRRegistrationMatchingCorrelation- Maximum Minimum Average StandardDeviation	%.6e			○	
	155	Along Track Disparity between representative bands of VNIR and SWIR (m) (Maximum, minimum, average, standard deviation)	VNIR-SWIRRegistrationMatchingAlongTrackDisparity- MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e			○	
	156	Cross Track Disparity between representative bands of VNIR and SWIR (m) (Maximum, minimum, average, standard deviation)	VNIR-SWIRRegistrationMatchingCrossTrackDisparity- MaximumMeter MinimumMeter AverageMeter StandardDeviationMeter	%.6e			○	

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*1 o means 'output', vacant means 'not output'.

*2 [1-n] in keywords means that value between 1 and n is substituted. e.g. Browse{1-3] means Browse1, Browse2 and Browse3.

*3 Double quotation marks ["] are attached to strings (%s) parameters except for UTC.