Juno
JIRAM

JIRAM Standard Product
Data Record and Archive Volume
Software Interface Specification

Version 7.5
June 30, 2022

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1 INTRODUCTION

This software interface specification (SIS) describes the format and content of the JIRAM Planetary Data System (PDS) data archive. It includes descriptions of the Standard Data Products and associated metadata, and the volume archive format, content, and generation pipeline.

1.1 *DISTRIBUTION LIST*

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Table 1: Distribution list

1.2 *DOCUMENT CHANGE LOG*

Change	Date	Affected portion
Initial template	01/15/2010	All
JIRAM EDR data File Structure	09/22/2011	$ 6.1 pag. 39
Relationships to Other Interfaces	09/22/2011	$ 1.7 pag. 12
SIS Content Overview	09/22/2011	$ 1.8 pag 12
All sections	03/13/2012	
All sections	06/25/2013	
Coordinate Systems	07/08/2013	$6.1.3 pag 41
Appendix 10.1, 10.2, 10.8	07/08/2013	
Data Flow	07/08/2013	$ 3.2 pag 23
Cover	07/08/2013	
Inserted Appendix 10.10	08/19/2013	
Label Science and HK Data	08/19/2013	$ 3.3.1; Figure 9
naming convention (Auxiliary Files)	08/19/2013	$ 5.7.1
Data Set Name for Luna Observation	08/19/2013	Table 9
CALIB Directory	08/27/2014	Table 17
10.1 EDR Label data IMAGE	08/27/2014	
10.2 EDR Label data SPECTRUM	09/09/2014	

$7.3PDS Label	09/09/2014	Figure 14: JIRAM keywords sections
10.3 EDR-RDR PDS Label Keywords	09/09/2014	Inserted Keyword : TARGET_PIXELS
$7.4Local Keywords - Image (L Band & M band)	09/09/2014	Inserted new paragraph
10.3 EDR-RDR PDS Label Keywords	09/09/2014	
$6.7 DATA directory Contents and Naming Convention	20/03/2017	Table 20
$4.2 RDR Data Production Pipeline IMG	21/06/2021	Changed the spectral radiance in band radiance
All sections	*05/01/2022*	*Some editorial changes*
$7.1.3 Coordinate Systems	*05/01/2022*	*Longitude is in degrees positive east*
table 5	*11/04/2022*	*Updated the parameter pixel IFOV*
All document	*30/06/2022*	

Table 2: Document change log

1.3 *TBD ITEMS*

Table 3 lists items that are not yet finalized.

Item	Section(s)	Page(s)

Table 3: List of TBD items

1.4 *ABBREVIATIONS*

Abbreviation	Meaning
ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
CD-ROM	Compact Disc – Read-Only Memory
CDR	Calibrated Data Record
CFDP	CCSDS File Delivery Protocol
CK	C-matrix Kernel (NAIF orientation data)
CODMAC	Committee on Data Management and Computation
CRC	Cyclic Redundancy Check
DAP	Data Analysis Product
DDR	Derived Data Record
DMAS	Data Management and Storage
DVD	Digital Versatile Disc
DVD-R	DVD - Recordable media
E&PO	Educational and Public Outreach
EDR	Experiment Data Record
EGSE	Electrical Ground Support Equipment
SPDR	Standard Product (Experiment and Pipeline) Data Record

FEI	File Exchange Interface
FOV	Field of View
FTP	File Transfer Protocol
GB	Gigabyte(s)
GCR	Galactic Cosmic Ray
GSFC	Goddard Space Flight Center
HK	Housekeeping
HSSL	High Speed Serial Link
HTML	Hypertext Markup Language
ICD	Interface Control Document
IMG	Image
IOT	Instrument Operations Team
ISO	International Standards Organization
JADE	Jovian Auroral Plasma Distributions Experiment
JEDI	Jupiter Energetic Particle Detector Instrument
JIRAM	Jupiter InfraRed Auroral Mapper
JPL	Jet Propulsion Laboratory
JSC	Johnson Spaceflight Center
JSOC	Juno Science Operations Center
LET	Lineal Energy Transport
LSSL	Low Speed Serial Link
MAG	Magnetometer Instrument
MB	Megabyte(s)
MOS	Mission Operations System
MWR	Microwave Radiometer Instrument
NAIF	Navigation and Ancillary Information Facility (JPL)
NASA	National Aeronautics and Space Administration
NSSDC	National Space Science Data Center
ODL	Object Description Language
PCK	Planetary Cartographic and Physical Constants Kernel (NAIF)
PDS	Planetary Data System
PPI	Planetary Plasma Interactions Node (PDS)
RDR	Reduced Data Records
RSSG	Radio Science System Group
SCET	Spacecraft Event Time
SCLK	Spacecraft Clock
SIS	Software Interface Specification
SPE	Spectrometer
SPICE	Spacecraft, Planet, Instrument, C-matrix, and Events (NAIF data format)
SPWG	Science Planning Working Group
SPK	SPICE (ephemeris) Kernel (NAIF)
SwRI	Southwest Research Institute
TBC	To Be Confirmed

TBD	To Be Determined
TEP	Tissue Equivalent Plastic
UVS	Ultraviolet Spectrometer Instrument
V-EGA	Venus-Earth Gravity Assist

Table 4: Abbreviations and their meaning

1.5 *GLOSSARY*

Archive – An archive consists of one or more data sets along with all the documentation and ancillary information needed to understand and use the data. An archive is a logical construct independent of the medium on which it is stored.

Archive Volume – A volume is a unit of media on which data products are stored; e.g. one DVD-R. An *archive volume* is a volume containing all or part of an archive; i.e. data products plus documentation and ancillary files.

Archive Volume Set – When an archive spans multiple volumes, they are called an *archive volume set*. Usually the documentation and some ancillary files are repeated on each volume of the set, so that a single volume can be used alone.

Catalog Information – High-level descriptive information about a data set (e.g. mission description, spacecraft description, instrument description), expressed in Object Description Language (ODL), which is suitable for loading into a PDS catalog.

Data Product – A labeled grouping of data resulting from a scientific observation, usually stored in one file. A product label identifies, describes, and defines the structure of the data. An example of a data product is a planetary image, a spectral table, or a time series table.

Data Set – A data set is an accumulation of data products together with supporting documentation and ancillary files.

Experiment Data Record – An accumulation of raw output data from a science instrument, in chronological order, with duplicate records removed, together with supporting documentation and ancillary files.

Pipeline Data Record – An accumulation of calibrated data from a science instrument, derived from experiment data records, together with supporting documentation, calibration data, and ancillary files.

Standard Data Product – A data product generated in a predefined way using well-understood procedures and processed in "pipeline" fashion. Data products that are generated in a non-standard way are sometimes called *special data products*.

1.6 *JUNO MISSION OVERVIEW*

The launch period for Juno opens on 5 August 2011 and extends for 21 days until 26 August. The spacecraft uses a ΔV-EGA trajectory consisting of a deep space manoeuvre on 12 September 2012 followed by an Earth gravity assist on 9 October 2013 at an altitude of 500 km. Jupiter arrival is on 5 July 2016 using a 107-day capture orbit prior to commencing operations for a 1-(Earth) year

long prime mission comprising 32 high inclination, high eccentricity orbits of Jupiter. The orbit is polar with a periapses altitude of 4500 km and a semi major axis of 19.91 RJ giving an orbital period of 10.9725 days. The primary science is acquired for approximately 6 hours centered on each periapses although fields and particles data are acquired at low rates for the remaining apoapsis portion of each orbit. Currently, 5 of the first 7 periapses are dedicated to microwave radiometry of Jupiter's deep atmosphere with the remaining orbits dedicated to gravity measurements to determine the structure of Jupiter's interior. All orbits will include fields and particles measurements of the planet's auroral regions. Juno is spin stabilized with a rotation rate of 1 – 3 revolutions per minute (RPM). For the radiometry orbits the spin axis is precisely perpendicular to the orbit plane so that the radiometer fields of view pass through the nadir. For gravity passes, the spin axis is aligned to the Earth direction, allowing for Doppler measurements through the periapsis portion of the orbit. The orbit plane is initially very close to perpendicular to the Sun-Jupiter line and evolves over the 1-year mission. Data acquired during the periapsis passes are recorded and played back over the subsequent apoapsis portion of the orbit.

Juno's instrument complement includes Gravity Science using the X and Ka bands to determine the structure of Jupiter's interior; vector fluxgate magnetometer (MAG) to study the magnetic dynamo and interior of Jupiter as well as to explore the polar magnetosphere; and a microwave radiometer (MWR) experiment covering 6 wavelengths between 1.3 and 50 cm to perform deep atmospheric sounding and composition measurements. The instrument complement also includes a suite of fields and particle instruments to study the polar magnetosphere and Jupiter's aurora. This suite includes an energetic particle detector (JEDI), a Jovian auroral (plasma) distributions experiment (JADE), a radio and plasma wave instrument (Waves), an ultraviolet spectrometer (UVS), and a Jupiter infrared auroral mapping instrument (JIRAM). The JunoCam is a camera included for education and public outreach. While this is not a science instrument, we plan to capture the data and archive them in the PDS along with the other mission data. Appendix C includes Lead Co-Is and archivists for each instrument, along with the associated PDS Discipline Node.

1.7 *RELATIONSHIPS TO OTHER INTERFACES*

Raw data in PDS format are generated by the EGSE and PDS Converter; any changes in these tools in the generation process would necessarily affect this document. Any future reprocessing of the data, for whatever reason, even if the labels are not affected, must be taken into account and described in this document.

1.8 *SIS CONTENT OVERVIEW*

- Section 2 describes the JIRAM instrument.
- Section 3 describes the data sets, data flow, and validation.
- Section 4 describes the archive volumes generation
- Section 6 describes the structure of the archive volumes and contents of each file.
- Section 6 describes the structure of the EDR products.
- Section 7 describes the structure of the RDR products.

1.9 *SCOPE OF THIS DOCUMENT*

The specifications in this SIS apply to all JIRAM Standard Data Record products submitted for archive to the Planetary Data System (PDS), for all phases of the Juno mission. Some sections of this document describe parts of the JIRAM archive and archiving process that are managed by the PDS archive team. These sections have been provided for completeness of information and are not maintained by the JIRAM team.

1.10 *APPLICABLE DOCUMENTS*

[AD01] ISO 9660-1988, Information Processing—Volume and File Structure of CD-ROM for Information Exchange, 04/15/1988.

[AD02] Planetary Data System Archive Preparation Guide, Version 1.1, JPL D-31224, 08/29/2006.

[AD03] Planetary Data System Standards Reference, JPL D-7669, Part 2, Version 3.8, 02/27/2009.

[AD04] Planetary Science Data Dictionary Document, Planetary Data System, JPL D-7116, Version 1r65, 02/2007.

[AD05] Juno Mission Operations Concept Document, JPL D-35531, Version Preliminary, 04/30/2007.

[AD06] Juno Science Data Management and Archive Plan, Version Final, JPL D-34032, 08/26/2009.

[AD07] ICD - Science Operations center (SOC) and PDS Athmosheres NODE/PPI , Version 2,06/18/2013.

1.11 *AUDIENCE*

This document is useful to those wishing to understand the format and content of the JIRAM PDS data product archive collection. Typically, these individuals would include scientists, data analysts, or software engineers.

2 JIRAM INSTRUMENT DESCRIPTION

JIRAM is equipped with a single telescope that accommodates both an infrared camera and a spectrometer to facilitate a large observational flexibility in obtaining simultaneous images in the L and M bands with the spectral radiance over the central zone of the images. Moreover, JIRAM will be able to perform spectral imaging of the planet in the 2.0-5.0 μm interval of wavelengths with a spectral resolution better than 10 nm. Instrument design, modes, and observation strategy will be optimized for operations on-board a spinning satellite in polar orbit around Jupiter. The JIRAM heritage comes from Italian-made, visual-infrared imaging spectrometers dedicated to planetary exploration, such as VIMS-V on Cassini, VIRTIS on Rosetta and Venus Express, and VIR-MS on the Dawn mission.

JIRAM combines two data channels in one instrument: the **imager** and the **spectrometer**, which are housed in the same optical subsystem (fig. 1). The instrument is composed of the Optical Head (OH) and the Main Electronic (ME). The ME contains the electronics to drive the Focal Plane Arrays (FPAs) and compensating mirror, and perform the acquisition and conversion of the science and housekeeping data. It also manages the operation of the two channels, gathers data and housekeeping information from them, stores the data, performs data compression, and interfaces the instrument with the spacecraft.

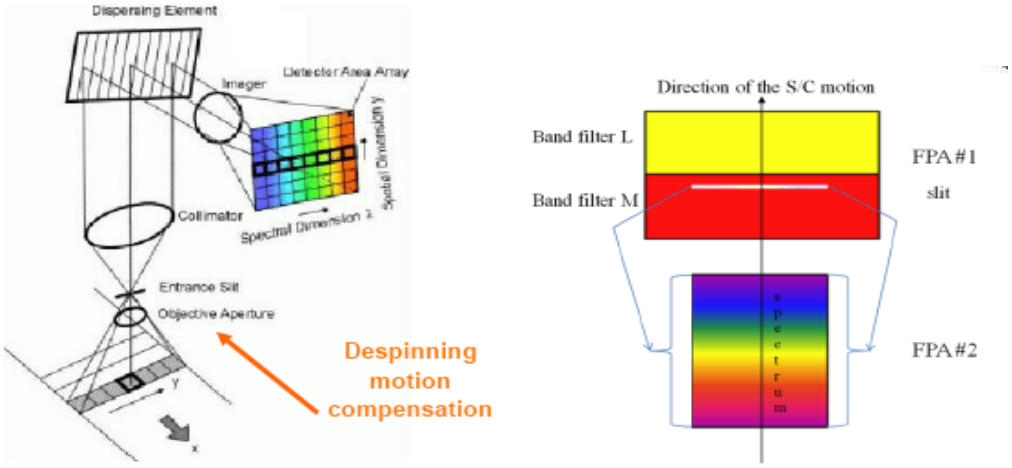
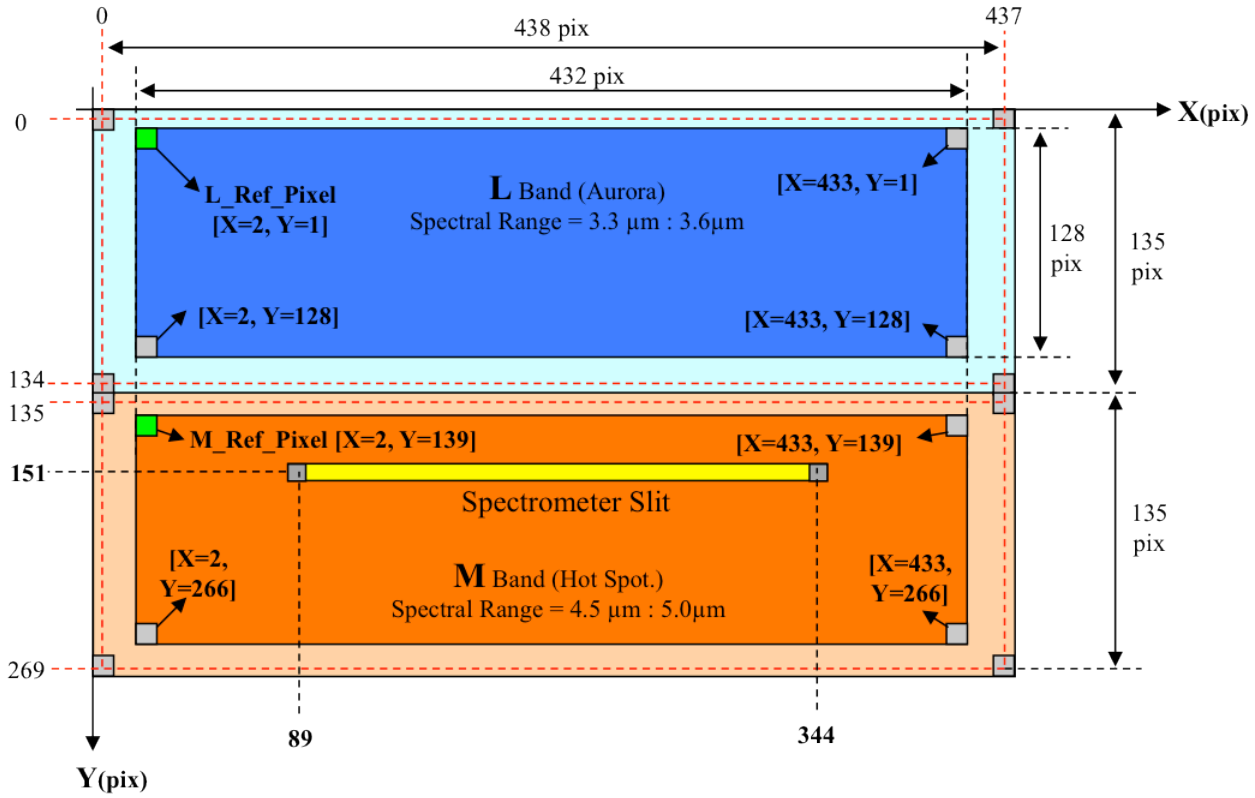


Figure 1: The two focal planes

2.1 *DETECTORS*

JIRAM IMG and SPE channels use two HgCdTe focal planes with a CMOS multiplexer having the same characteristics: 270 × 438 pixels, 38 µm pixel pitch, 2 millions e- full-well capacity. A reduced window of pixels equal to 256 ×336 for the SPE and 256 × 432 for the IMG is used. Detectors are passively cooled down to 80-90K through a thermal harness connected to an external radiator. Focal planes are housed in two separate mechanical structures which allow to

1. Maintain the correct alignment w.r.t. the optical design;
2. Thermally isolate w.r.t the instrument housing;
3. Hold the order sorting filters on the SPE and the L and M filters on the IMG.



Matrix pixels filter L

Active Matrix pixels filter L

Matrix pixels filter M

Active Matrix pixels filter M

Figure 2: The Image focal planes

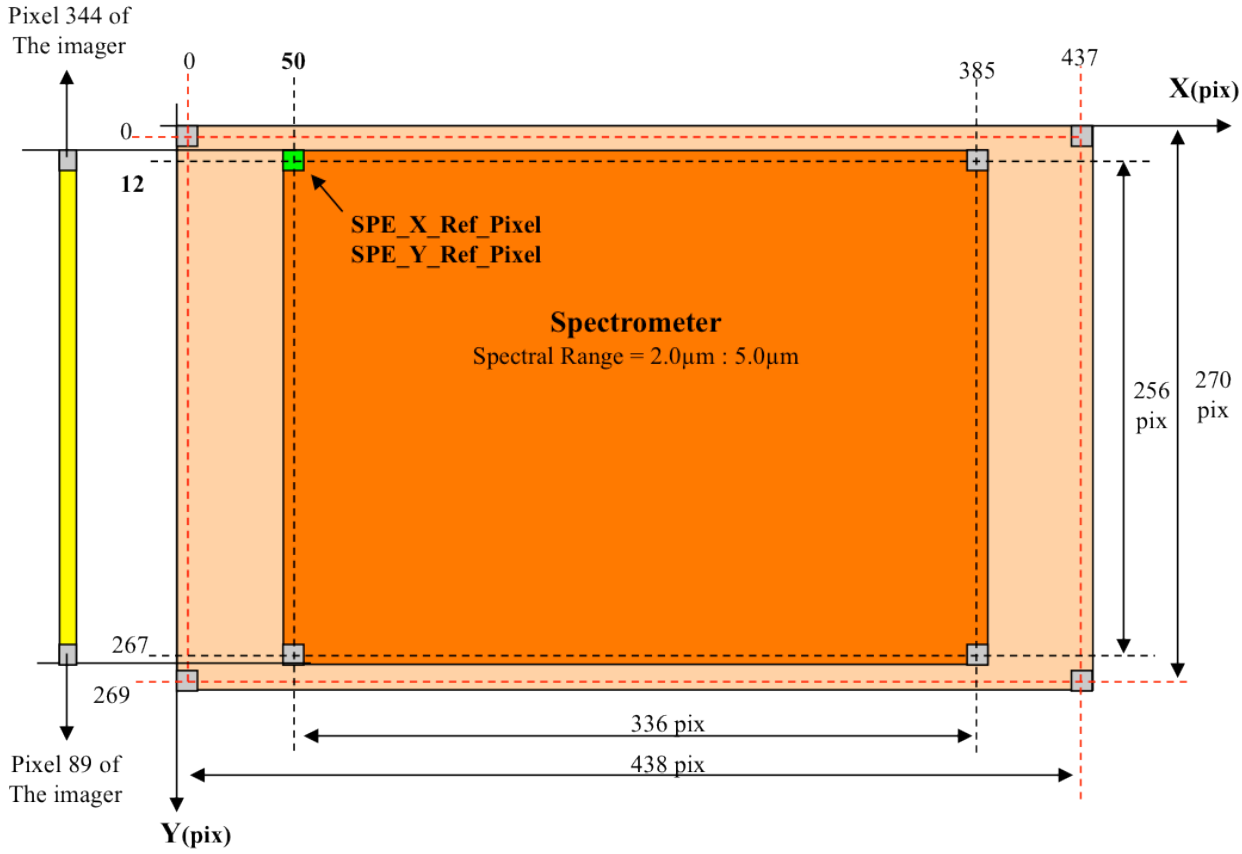


Figure 3: The Spectrometer focal plane

2.2 *SCIENCE OBJECTIVES*

The Jovian InfraRed Auroral Mapper (JIRAM) will explore the dynamics and the chemistry of Jovian auroral regions by high contrast imaging and spectroscopy. It will also analyze the Jovian hot spots to determine their vertical structure and infer possible mechanisms for their formation. JIRAM will sound the Jovian meteorological layer to map moist convection and determine water abundance and other constituents at depths that correspond to several bars pressure.

2.3 *ELECTRONICS*

JIRAM combines 2 data channels in one instrument: the imager and the spectrometer, which are housed in the same optical subsystem. The instrument is composed of the Optical Head (OH) and the Main Electronic (ME). The ME contains the electronics to drive the FPAs and compensating mirror and to perform the acquisition and conversion of the science and housekeeping data. The single ME box contains the Digital Processing Unit, the proximity (detector driver and readout board), the main (CPU board) electronics, the power supply, and the limited angle de spinning mechanism driver board. A general block diagram of JIRAM is shown in Fig. 3.

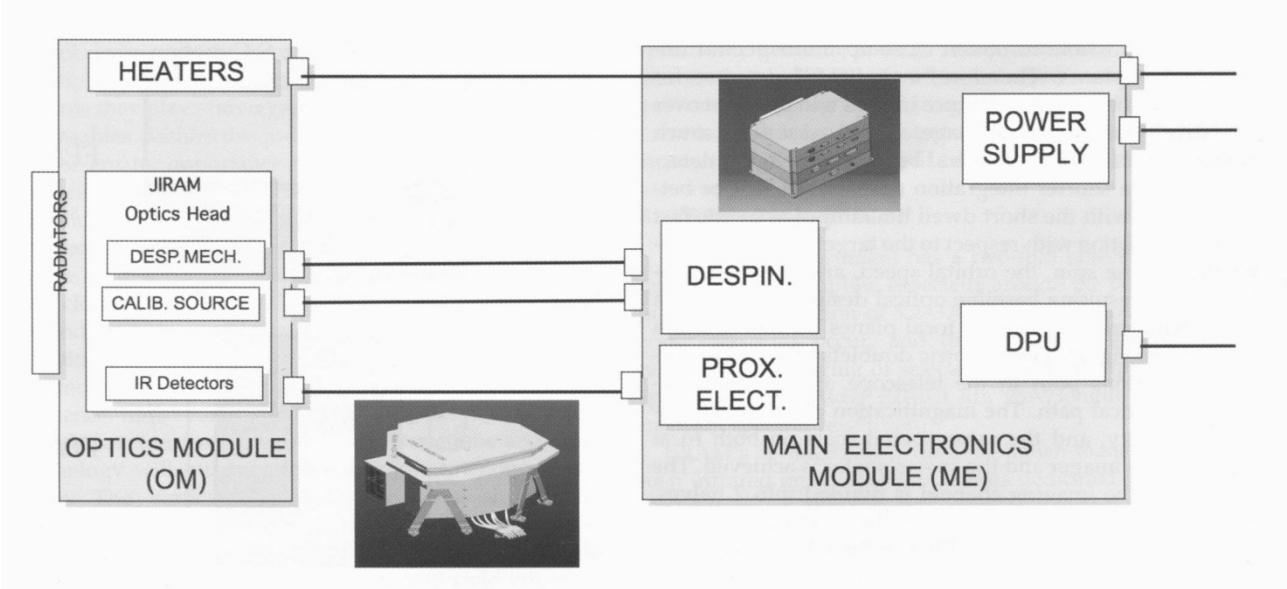


Figure 4:General block diagram of JIRAM.
The electronic box contains the proximity and main electronics.
Calib. Source, calibration source; Desp. Mech, de-spinning mechanism; DPU, Digital Processing Unit; Prox. Elect, proximity electronics.

2.4 *MEASURED PARAMETERS*

The overall design of JIRAM has been driven by the necessity to have an instrument with the smallest possible volume and, consequently, mass, without degrading its performance. Table 5 shows the main characteristic of the instrument.

Parameter	*Unit*	*Value /Description*
Telescope F#		3.7
Equivalent aperture diameter	mm	44
Pixel IFOV	µrad	240
Spectral range	µm	2-5
Average spectral dispersion	nm / pix	9
Detector technology	-	HgCdTe + CMOS mux
Array formats	#	Imager: 256x432; Spectrometer: 256x336
Pixel size	µm	38x38
Image channel dimensions (FOV)	°	3.5x6.0
Spectroscopic channel dimensions (slit FOV)	°	0.0143x3.5
Peak quantum efficiency	%	>50
Full well capacity	e^-	2x10^6
Operating temperature	K	<100
Auroral filter wavelengths	µm	3.48 fwhm <0.28
Hot-spot filter wavelengths	µm	4.8 fwhm <0.5
Power consumption	W	<15
Approximate instrument mass (overall)	Kg	<13
Approximate Optical Head volume	m^3	3.8x10^-2
Approximate Electronics volume	m^3	9x10^-3

Table 5: Jiram parameters

2.5 *OPERATIONAL MODES*

JIRAM FSW manages different operations, organised for operating modes as follows:
PROM SW modes

- Initialisation mode (INI)
- SW Maintenance mode (SWM)
- Safe mode (SAF)
- Stand-by mode (STB)
- Science mode (SCI)
- Calibration mode (CAL)

The operative modes and the related transitions are reported in Figure 5

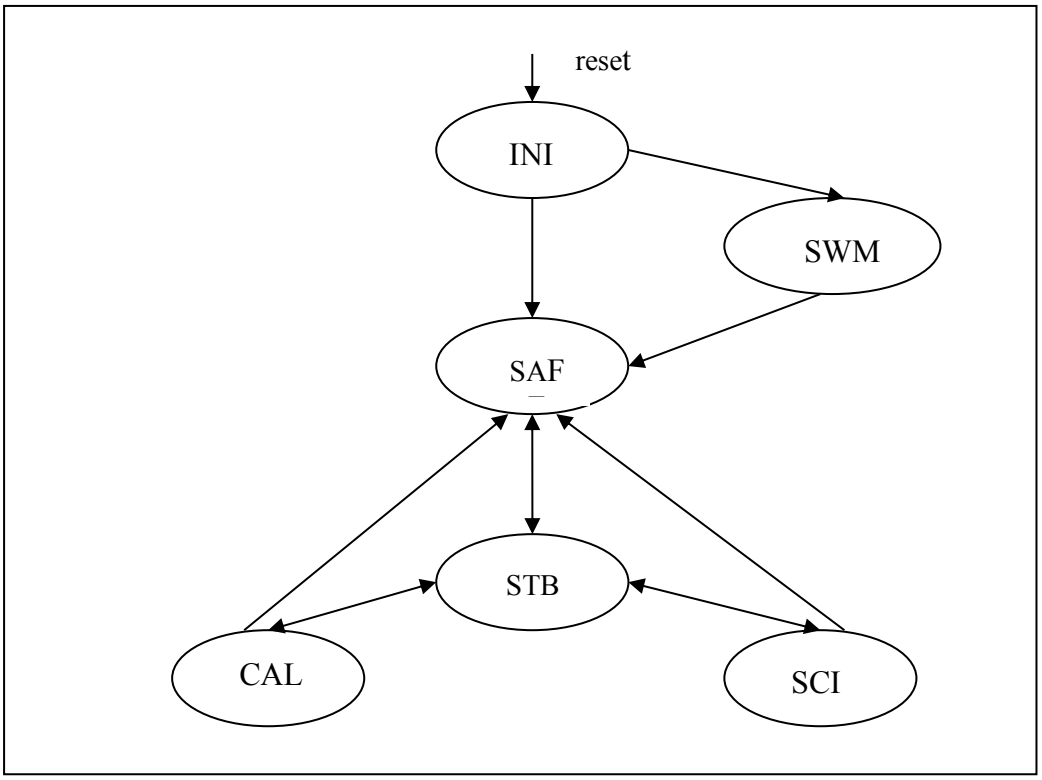


Figure 5: JIRAM FSW modes

2.5.1 INITIALIZATION MODE (INI)

At the start-up (or after any reset), the instrument executes the INI mode, where all the preliminary operations necessary for the nominal working (HW and SW initialisation, memory checks, etc.) are executed (Primary Boot). At the end of the Primary Boot the instrument is able to check TC and send TM via the LSSL. The Secondary Boot is performed after the reception of the proper TC.

2.5.2 SW MAINTENANCE MODE (SWM)

The SWM mode is commanded from INI to allow the direct access to the on board RAM and EEPROM memories which can be modified and checked to allow SW patching and parameters modification.

2.5.3 SAFE MODE (SAF)

The SAF mode is commanded from SWM or INI mode after the successfully loading of the EEPROM SW (Secondary Boot). The IR detectors are Off. This mode can be entered (commanded or autonomously) by all the EEPROM. This mode can be accessed by all the modes.

2.5.4 STAND-BY MODE (STB)

The STB mode is commanded from SAF. In this mode the detectors are on to allow thermal stabilization. The instrument is ready to receive command to set and select the operative modes (SCI, CAL). The mode is autonomously entered at the end of each acquisition sequence.

2.5.5 SCIENCE MODE (SCI)

In the SCI mode the instrument performs a Science Session according to the parameters received in STB. The main tasks are: NADIR acquisition time evaluation based on SC Dynamics, IR commanding, data pre-processing, data compression, data packetization and transmission via HSSL\LSSL to SC, de-spinning mirror motor command to compensate the SC rotation. Several sub-modes are selectable to combine the capabilities of the two IR detectors (the first for images, the second for spectra).
Simulated sub-modes are implemented too (I0S0 60 00). Data from the S/C are trasmitted in sub-frames. Each detector full active areas is split into 6 sub-frames.

MODE	HEX MODE - SUBMODE	SUBMODE	Number of pixels stored for IMG	Number of pixels stored for SPE	Number of Sub-Frames
SCI	60 01	I0S1	NO IMG	256 LINES x 336 SAMPLES	IMG = 0 SPE=6
SCI	60 02	I0S2	NO IMG	64 LINES x 336 SAMPLES	IMG = 0 SPE=3
SCI	60 03	I0S3	NO IMG	16 LINES x 336 SAMPLES	IMG = 0 SPE=3
SCI	60 11	I1S1	256 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 6 SPE=6
SCI	60 12	I1S2	256 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 6 SPE=3
SCI	60 13	I1S3	256 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 6 SPE=3
SCI	60 21	I2S1	128 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 3 SPE=6
SCI	60 22	I2S2	128 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 3 SPE=3
SCI	60 23	I2S3	128 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 3 SPE=3
SCI	60 31	I3S1	128 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 3 SPE=6
SCI	60 32	I3S2	128 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 3 SPE=3
SCI	60 33	I3S3	128 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 3 SPE=3
SCI	60 10	I1S0	256 LINES x 432 SAMPLES	NO SPE	IMG = 6 SPE=0
SCI	60 20	I2S0	128 LINES x 432 SAMPLES	NO SPE	IMG = 3 SPE=0
SCI	60 30	I3S0	128 LINES x 432 SAMPLES	NO SPE	IMG = 3 SPE=0

Table 6: JIRAM Science Operative Mode – submode

2.5.6 CALIBRATION MODE (CAL)

In the CAL mode the instrument performs the Calibration Sequence. The calibration sources are on. The mirror motor is commanded to a fix position.

MODE	HEX MODE - SUBMODE	SUBMODE	Number of pixels stored for IMG	Number of pixels stored for SPE	Number of Sub-Frames
CAL	50 01	I0S1	NO IMG	256 LINES x 336 SAMPLES	IMG = 0 SPE=6
CAL	50 02	I0S2	NO IMG	64 LINES x 336 SAMPLES	IMG = 0 SPE=3
CAL	50 03	I0S3	NO IMG	16 LINES x 336 SAMPLES	IMG = 0 SPE=3
CAL	50 11	I1S1	256 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 6 SPE=6
CAL	50 12	I1S2	256 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 6 SPE=3
CAL	5013	I1S3	256 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 6 SPE=3
CAL	50 21	I2S1	128 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 3 SPE=6
CAL	50 22	I2S2	128 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 3 SPE=3
CAL	50 23	I2S3	128 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 3 SPE=3
CAL	50 31	I3S1	128 LINES x 432 SAMPLES	256 LINES x 336 SAMPLES	IMG = 3 SPE=6
CAL	50 32	I3S2	128 LINES x 432 SAMPLES	64 LINES x 336 SAMPLES	IMG = 3 SPE=3
CAL	50 33	I3S3	128 LINES x 432 SAMPLES	16 LINES x 336 SAMPLES	IMG = 3 SPE=3
CAL	50 10	I1S0	256 LINES x 432 SAMPLES	NO SPE	IMG = 6 SPE=0
CAL	50 20	I2S0	128 LINES x 432 SAMPLES	NO SPE	IMG = 3 SPE=0
CAL	50 30	I3S0	128 LINES x 432 SAMPLES	NO SPE	IMG = 3 SPE=0

Table 7: JIRAM Calibration Operative Mode - submode

3 DATA SET OVERVIEW

3.1 *DATA SETS*

Currently, two levels of processing are foreseen for JIRAM data (see table 8):

- Level 1b (EDR): telemetry data that have been cleaned and merged, time ordered and instrument modes. Data are in scientifically useful form, but still uncalibrated.
- Level 2 (RDR): Level 1b with calibration and corrections applied to yield data in scientific units.

Standard Data Product ID	ID	NASA Level	COD MAC	Product Format
Raw IR images versus time	IMG_EDR		2	Binary 16 bits
Raw IR spectral image versus time	SPE_EDR		2	Binary 16 bits
IR Calibration images versus time	IMG_RDR		3	Binary 32 bits
IR Calibration spectral versus time	SPE_RDR		3	Binary 32 bits

Table 8: JIRAM Products

The Data Sets are homogeneous in terms of the processing level of the data and the resulting list of data sets is provided in the table below.

Data Set	Data Set Name	Data Set ID
2	JUNO JUPITER JIRAM EXPERIMENT DATA RECORD V1.0	JNO-J-JIRAM-2-EDR-V1.0
3	JUNO JUPITER JIRAM REDUCED DATA RECORD V1.0	JNO-J-JIRAM-3-RDR-V1.0

For Luna fly by:

Data Set	Data Set Name	Data Set ID
2	JUNO MOON JIRAM EXPERIMENT DATA RECORD V1.0	JNO-L-JIRAM-2-EDR-V1.0
3	JUNO MOON JIRAM REDUCED DATA RECORD V1.0	JNO-L-JIRAM-3-RDR-V1.0

Table 9: JIRAM DATA SETs and Data Set ID's

3.2 *DATA FLOW*

Data organized in submodes, as described in tables 6 and 7, are not compressed. Compression on the data is possible to reduce the data volume. Lossy compression is possible on imager data; the images can be reduced to JPEG format. The lossy compression reduces the images' data volume of a factor 6. Lossless compression can be applied to spectra. The lossless compression would produce a compression of a variable factor that depends on the datum itself. The factor is about 1.5 on average. The Juno Data Management and Storage (DMAS) will receive packets and CCSDS File Delivery Protocol (CFDP) products from the Deep Space Network (DSN) and place these on the Project data repository system. The DMAS will provide the initial processing of the raw telemetry data bringing it to Committee on Data Management and Computation (CODMAC) Level 2 science data, comprising bested and de-overlapped data. At this point compressed data are not decompressed. The JIRAM Instrument Operations Team (IOT) will retrieve the CODMAC Level 2 data from the DMAS using FEI services and ancillary data from the JPL Mission Support Area (MSA) via Juno Science Operations Center (JSOC). Decompression of compressed data and any necessary restructuring of the data will be carried out by the IOT. The JIRAM Science Investigation Team will verify the content and the format will be validated. The resulting decompressed, restructured CODMAC Level 2 data will constitute the lowest level of data to be archived with the PDS. JSOC will coordinate the validation of the edited (CODMAC Level 2) data archive volumes created by the IOT. JSOC development and operations will be carried out at SwRI, in coordination with the MOS at JPL. The JSOC will also receive and organize higher-level data products that are developed by the Science Investigation Team based on the Level 2 data and ancillary data and return these to the JSOC. JSOC will support archiving the CODMAC Level 2 data by building archive volumes and verifying the format of the volumes and included data and metadata. Higher-level data set archives will be coordinated through the JSOC. The Science Investigation Team will be responsible for ensuring that the metadata and documentation included with these data sets are complete and accurate. This means that both JSOC and the Science Investigation Team will need to work closely with the PDS. This coordination will be fostered via the Data Archive Working Group.
A comprehensive description of the Juno Mission System is provided in the Juno Mission Operations Concept. A data flow diagram for the downlink process is shown in Fig. 6.

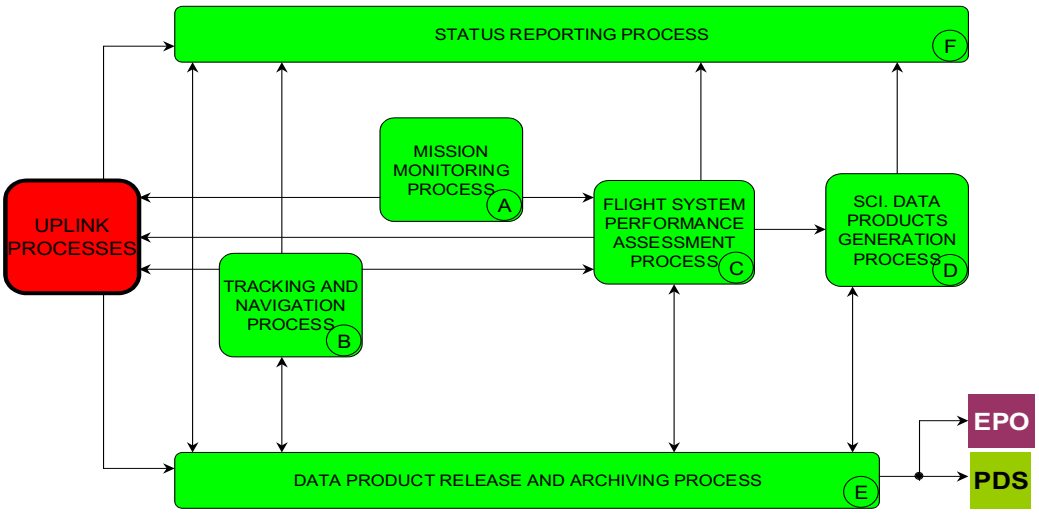


Figure 6: Juno Downlink Processes Context Diagram.

3.3 *DOWNLINK DATA AND PROCESSING DATA*

The downlink procedures involve JIRAM Science and Engineering Telemetries, as well as JUNO spacecraft housekeeping telemetries and SPICE kernels products. JIRAM is able to transfer the collected data to the spacecraft through two dedicated buses: HSSL and LSSL. Depending on the selected BUS, data products are respectively retrieved by the File Exchange Interface (FEI) for HSSL and RAMPAGE for LSSL.

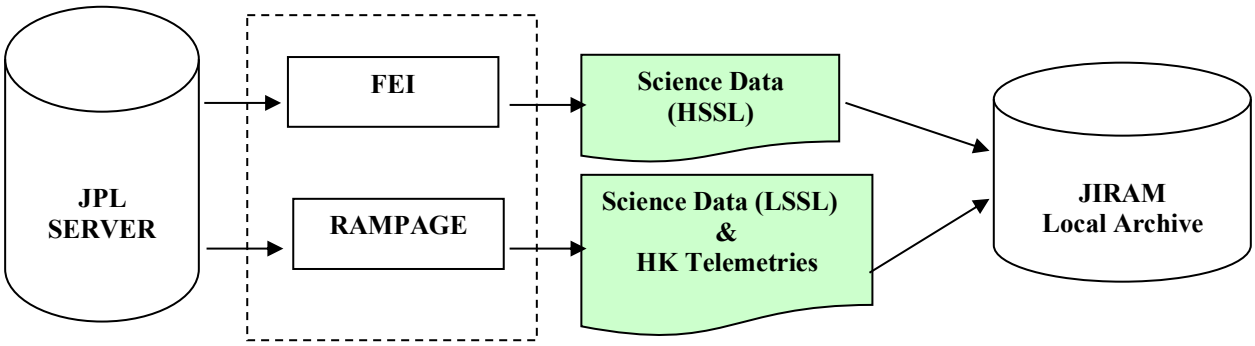


Figure 7: Jiram downlink

The data are then fed into the EGSE, located at IAPS-INAF in Rome, and transformed into CODMAC Level 2 data with a detached PDS label.

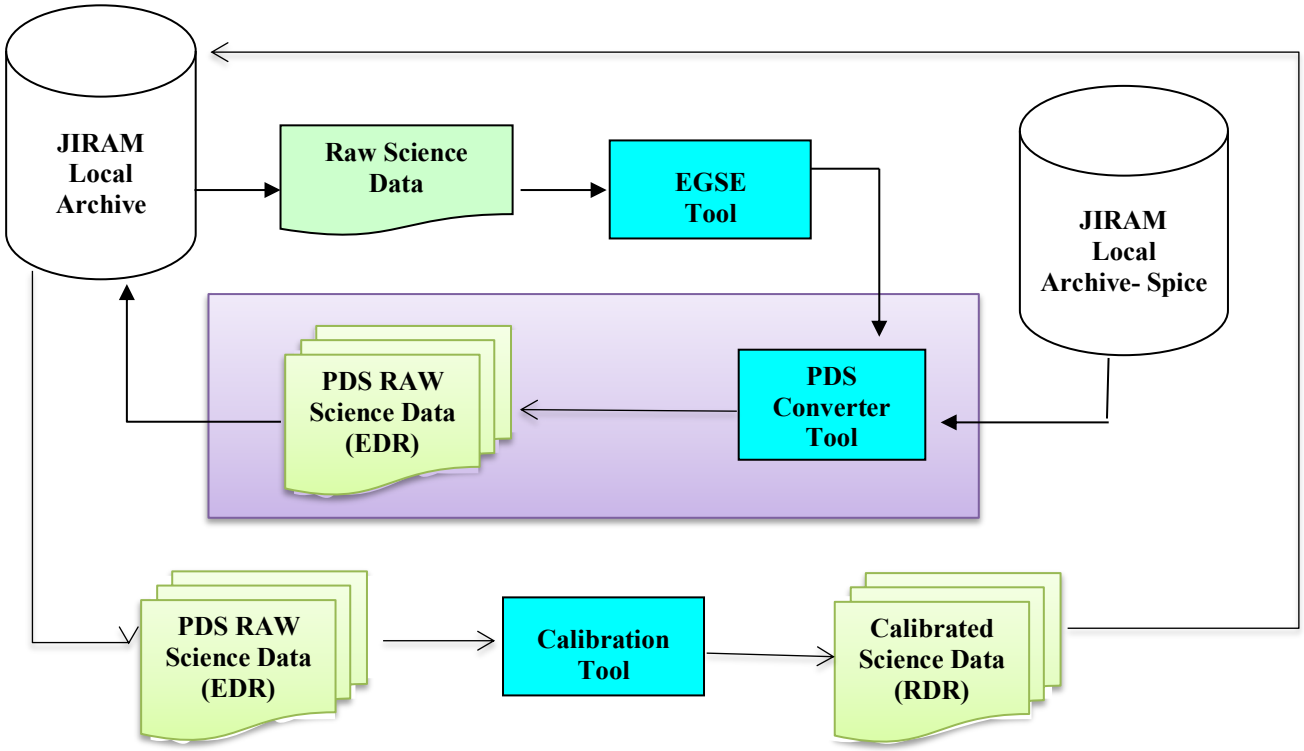


Figure 8: Jiram processing data.

3.3.1 EDR DATA PRODUCTION

Each Data Product will consist of four files (see Figure 9):

- A binary file containing the scientific telemetry of the instrument.
- A detached ASCII label file describing the content of the data product. Such label is written according to standards defined by the Planetary Data System (PDS), and lists parameters describing both the observation in which data were acquired and the structure of the files in which data are stored and parameters extracted from instrument and spacecraft housekeeping telemetry.
- A binary file containing housekeeping telemetry of the product
- A detached ASCII label file describing the content of the housekeeping telemetry.

The information reported in the HK file is listed in Appendix 10.4.

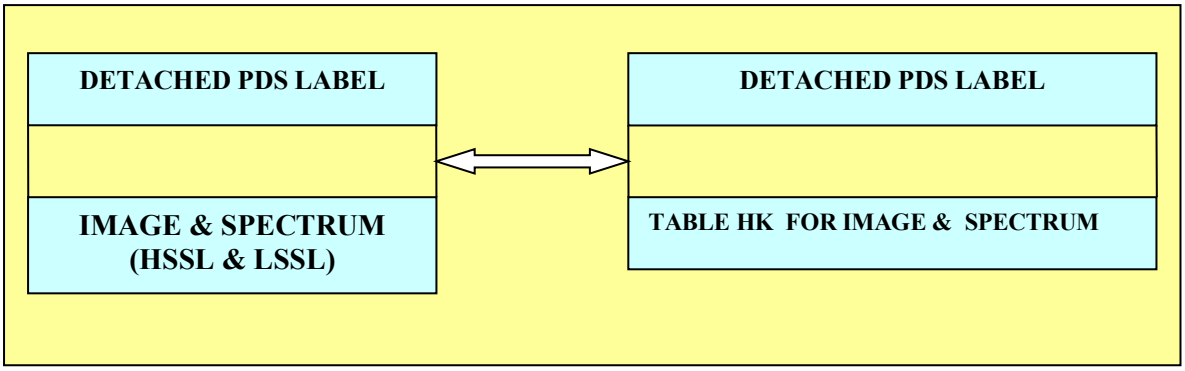


Figure 9: Structure of a JIRAM EDR data product

For each Data Set JIRAM team will deliver a spreadsheet containing auxiliary information. In each spreadsheet all products are ordered by acquisition time. This file will give an overview on the data set acquisition.
The labels permit the contents of most of the products to be browsed by PDS software, *NASAView*, etc.

3.3.2 FILE DATA STRUCTURE

JIRAM data consist of two parts: the first contains ancillary data produced by instrument and used to interpret scientific data, the second is science data.
The scientific products are spectra or images that are downloaded form the S/C in data packets or sub-frames. Packets are then recombined by IOT in image or a number of spectra as function of the used submode. In the Table 10 the number of scientific products (spectra or images) and number of packets, in which the active areas of the detector are split for downlink, are reported.

SCI_I0_S1 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 256 lines	1 spectra – 6 packets

SCI_I0_S2 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 64 lines	1 spectra – 3 packets

SCI_I0_S3 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 16 lines	1 spectra – 3 packets

SCI_I1_S1 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	1 image – 6 packets
Spectrometer	336 sample x 256 lines	1 spectra – 6 packets

SCI_I1_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	1 image – 6 packets
Spectrometer	336 sample x 64 lines	1 spectra – 3 packets

SCI_I1_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	1 image – 6 packets

Spectrometer	336 sample x 16 lines	1 spectra – 3 packets

SCI_I2_S1 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 256 lines	1 spectra – 6 packets

SCI_I2_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 64 lines	1 spectra – 3 packets

SCI_I2_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 16 lines	1 spectra – 3 packets

SCI_I3_S1 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 256 lines	1 spectra – 6 packets

SCI_I3_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 64 lines	1 spectra – 3 packets

SCI_I3_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets
Spectrometer	336 sample x 16 lines	1 spectra – 3 packets

SCI_I1_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	1 image – 6 packets

SCI_I2_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets

SCI_I3_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	1 image – 3 packets

Table 10: JIRAM SCI Products

The calibration procedure provides a standard sequence of 6 measurements described in Table 11. The specific the meaning of the steps is the following:
1 - the detectors look at the internal calibration unit where the calibration sources are in the off state, the integration time is fixed;
2 – the detector is acquired with an integration time virtually equal to 0 (actually 20 μs);
3 – one of the calibration source is turned on and powered with a previously defined current, integration time is as in step 1;
4 - the same calibration source is turned on and powered with a previously defined current but higher than in step 3 to produce a different level of signal, integration time is as in step 1;
5 – same of step 1;
6 – same of step 2.

Calibration Cycle:

Step	Phase
#1	Internal Background
#2	Readout Noise
#3a	Cal Source Stabilization
#3b	Cal Source Gain 1
#4a	Cal Source Stabilization
#4b	Cal Source Gain 2
#5	Internal background
#6	Readout noise

Table 11: JIRAM Calibration cycle

CAL_I0_S1 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 256 lines	6 spectra – 6 packets per spectrum

CAL_I0_S2 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 64 lines	6 spectra – 3 packets per spectrum

CAL_I0_S3 (16 bits) - n_acquisition = 1		
Spectrometer	336 sample x 16 lines	6 spectra – 3 packets per spectrum

CAL_I1_S1 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	6 images – 6 packets per image
Spectrometer	336 sample x 256 lines	6 spectra – 6 packets per spectrum

CAL_I1_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	6 images – 6 packets per image
Spectrometer	336 sample x 64 lines	6 spectra – 3 packets per spectrum

CAL_I1_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	6 images – 6 packets per image
Spectrometer	336 sample x 16 lines	6 spectra – 3 packets per spectrum

CAL_I2_S1 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images – 3 packets per image
Spectrometer	336 sample x 256 lines	6 spectra – 6 packets per spectrum

CAL_I2_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images -3 packets per image
Spectrometer	336 sample x 64 lines	6 spectra- 3 packets per spectrum

CAL_I2_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images– 3 packets per image
Spectrometer	336 sample x 16 lines	6 spectra – 3 packets per spectrum

CAL_I3_S1 (16 bits) - n_acquisition = 1

Imager	432 sample x 128 lines	6 images – 3 packets per image
Spectrometer	336 sample x 256 lines	6 spectra – 3 packets for image

CAL_I3_S2 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images – 3 packets per image
Spectrometer	336 sample x 64 lines	6 spectra – 3 packets per spectrum

CAL_I3_S3 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images – 3 packets per image
Spectrometer	336 sample x 16 lines	6 spectra – 3 packets per spectrum

CAL_I1_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 256 lines	6 images – 6 packets per image

CAL_I2_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images – 3 packets per image

CAL_I3_S0 (16 bits) - n_acquisition = 1		
Imager	432 sample x 128 lines	6 images – 3 packets per image

Table 12: JIRAM CAL Products

4 CALIBRATION PIPELINE

The RDR Data Product consist of a file that contains a PDS binary TABLE object for spectrometer and binary IMAGE object with detached label describing its structure. Data product files are named according to the convention defined in Section 5.7.1. The files contain the instrument data having a RAW identical structure (see Figure 12). The RDR is 32 bits data, the binary files are all fixed-length records, stored in most-significant-byte-first (big-endian) format.

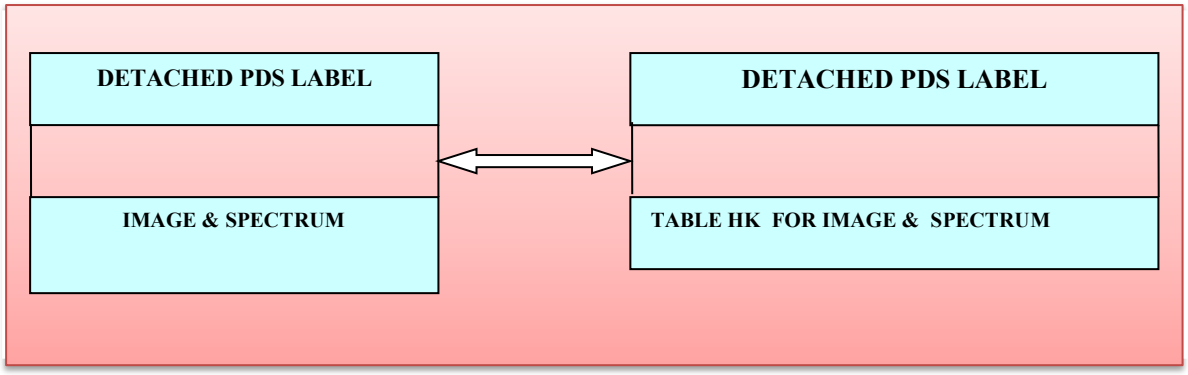


Figure 10: Structure of a JIRAM RDR data product

4.1 *RDR-SPE DATA PRODUCTION PIPELINE*

JIRAM-SPE flight data shall be processed using a dedicated calibration pipeline. The principal task of this pipeline is to convert raw signal data, expressed in DN/s, into physical units of spectral radiance, in W/(m^2 µm sterad).
The instrumental signal can be expressed as:

$$DN(\lambda, t_{exp}, T, k_y) = \eta(\lambda) k_y t_{exp} \theta^2 S(\lambda, T) \frac{\lambda}{hc} \delta\lambda \frac{\pi D^2}{4} \quad (1)$$

- $\eta(\lambda)$ is the global quantum efficiency of the instrument,
- k_y the spatial binning parameter,
- D the telescope's pupil diameter,
- θ the FOV,
- $\delta\lambda$ the spectral sampling
- t_{exp} the integration time of the observation.
- h = 6.62618 · 10−34 Js^{-1} Planck constant
- c = 2.99792458 · 108 ms^{-1} speed of light in vacuum.
- λ = wavelength.
- $S(\lambda, T)$ spectral radiance

The responsivity R includes all the instrument-dependent terms shown in eq. 1. The responsivity is typically measured on the center of the FOV in correspondence of the spatial pixel (sample) s*=128 for each band, b.
At this point the Instrument Transfer Function, ITF(b, s) can be determined, allowing us to retrieve the response across the whole focal plane by applying the flat-field FF

$$FF(b,s) = \frac{DN(b,s)}{DN(b,s^*)} \tag{2}$$

to the responsivity R (eq.3)

$$R(b,s^*) = \frac{DN(b,s^*,T)}{BB(b,T)\cdot t_{exp}} \tag{3}$$

where

- DN(b, s*,T) is the signal (corrected for dark and background) measured on band b, sample s*=128 with temperature T;
- BB(b, T) is the spectral radiance emitted by the blackbody at temperature T and t_{exp} is the instrumental integration time (in s).

$$ITF(b,s) = FF(b,s)\cdot R(b,s^*) \tag{4}$$

The target's spectral radiance, S, in W/(m^2 µm sterad), measured at wavelength λ and spatial position s along the slit's direction, is equal to:

$$S(\lambda,s) = \frac{DN(b,s)}{ITF(b,s)\cdot t_{exp}} \tag{5}$$

The conversion from the instrumental bands, b, to wavelengths, λ, is done using the spectral calibration law

$$\lambda_c(n) = \lambda_0 + SSI\cdot n \tag{6}$$

Where:

- λ_0 is the sample central wavelength measured on the first sensitive band on the frame
- SSI is the average spectral sampling interval. Both these quantities are retrieved from several fine spectral scans.

with parameters λ_0=1993.2749 nm and SSI=8.9908290 nm/band for the slit's center; the correspondence between the spatial position of samples, s, on the frame and the geometric position of the resulting target's image is possible thanks to the geometric calibration parameters.

4.2 *RDR DATA PRODUCTION PIPELINE IMG*

The calibration pipeline of the imager is the procedure to convert raw flight data, expressed in [DN/s], into the correspondent band radiance expressed in [W/(m^2 sterad)]. It must be noted that the unit of calibrated data is not spectral radiance but band radiance, and the conversion can be done by assuming the band width of each filter.

Considering the two bands of the IMG, L and M bands, and the corresponding spectral range (λ_1,λ_2) of the pass band filters, the generic acquisition in Digital Number (DN) of the IMG can be described by the equation

$$DN(\lambda_1,\lambda_2,t_{\exp},T_t,k_y)=\eta(\lambda_1,\lambda_2)k_y t_{\exp}\theta^2 S(\lambda_1,\lambda_2,T)\frac{\Delta\lambda}{hc}\frac{\pi D^2}{4} \quad (7)$$

where

- $\eta(\lambda_1,\lambda_2)$ is the global quantum efficiency of the instrument in the spectral range (λ_1,λ_2)
- k_y is the spatial binning parameter
- t_{exp} is the exposure time of the observation
- θ is the FOV
- $S(\lambda_1,\lambda_2,T)$ is the target band radiance at a given temperature T
- $\Delta\lambda$ is the spectral range of the considered band M or L
- D is the telescope's pupil diameter

To retrieve the target's band radiance $S(\lambda_1,\lambda_2,T)$ in [W/(m^2 sterad)]] acquired during the in flight JIRAM operations is necessary to apply the following equation

$$S(\lambda_1,\lambda_2,T)=\frac{DN(\lambda_1,\lambda_2,t_{\exp},T)-BG(\lambda_1,\lambda_2,t_{\exp})}{t_{\exp}\cdot ITF_{RAD_IMG(\lambda_1,\lambda_2)}} \quad (8)$$

where

- (λ_1,λ_2) is the spectral range corresponding to the L band (λ_1=3320 nm , λ_2=3600 nm) or to the M band (λ_1=4537,5 nm, λ_2=5035 nm).
- $DN(\lambda_1,\lambda_2,t_{exp},T)$ is the signal of the target at a given temperature T acquired by the imager in the M or L band.
- t_{exp} is the exposition time of the acquisition corrected for the "read time" of 20 nsec.
- $BG(\lambda_1,\lambda_2,t_{exp})$ is the Back Ground Signal acquired in the M or L band at the same exposition time.
- $ITF_{RAD_IMG(\lambda1,\lambda2)}$ is the instrument transfer function for the radiative calibration.

4.3 *DATA VALIDATION*

Validation of data is performed at different levels of detail and using different procedures. A dedicated tool, called EGSE, exists in the JIRAM ground segment software to verify the completeness of data received from the spacecraft. Finally, scientific validation of the data takes place during the validation period as JIRAM Co-I's perform their scientific analysis and examine in detail the content of each data product.

4.4 *ARCHIVE SCHEDULE*

ID	Data Set	CODMAC level	Time
J1	Raw IR Images versus time	2	4 months after acquisition
J2	Raw spectral image versus time	2	4 months after acquisition
J3	IR calibrated images versus time	3	4 months after acquisition
J4	IR calibrated spectral	3	4 months after acquisition

Table 13: JIRAM Archive Schedule

5 ARCHIVE VOLUME GENERATION

The JIRAM Standard Data Record archive collection is produced by the JIRAM IOT in cooperation with the JSOC, and with the support of the PDS Planetary Atmospheres Node at New Mexico State University (NMSU). The archive volume creation process described in this section sets out the roles and responsibilities of both these groups. The assignment of tasks has been agreed by both parties, and codified in [AD06]. Archived data received by the Atmospheres Node from the JIRAM team will be made electronically available to PDS users as soon as practicable but no later than as laid out in Table 13.

5.1 *DATA PRODUCTION AND TRANSFER METHODS*

The instrument operations team (IOT) produces the individual data files and the associated PDS labels for each of the standard data products defined in the data product SISs. Data files will contain all data of the appropriate type for the time interval contained in the data product. The products are formatted in image like files containing L-band and /or M.band images or a number of spectra depending on the used acquisition submode (see tables 6,7,10 and 12). Data products will be transferred via secure FTP to the JSOC. Upon receipt at the JSOC, the data files and their corresponding labels will be checked for consistency and compliance with the PDS standards. Files and labels that pass this check will be placed in directories that mirror the archive organization. The JSOC will return a positive or negative acknowledgement via email to the IOT. Upon receipt of a negative acknowledgement, the IOT will diagnose and correct the errors and resubmit the data.

The JSOC transfers data products to the PDS discipline node. Data products will be compressed and transferred via secure FTP to the PDS node. Each data transfer is logged. Upon notification of the data transfer, the PDS node decompresses the transfer and compares its contents against the transfer information. Each data file is validated against the MD5 checksum contained the corresponding detached label. The PDS node will post a positive or negative acknowledgement of the data receipt. If the acknowledgement is positive, no further action is required on the part of JSOC. If the acknowledgement is negative, the transfer is repeated after diagnosis and correction of the cause of the transfer error.

5.2 *VOLUME CREATION*

The PDS node collects the data files and labels provided by the JSOC team onto archive volumes. Each archive volume contains all instrument data available for the time interval covered by the archive volume. Once all of the data files, labels, and ancillary data files are organized onto an archive volume, the PDS node adds all of the PDS required files (AAREADME, INDEX, ERRATA, etc.) and produces the physical media.

5.3 *VOLUME VALIDATION METHODS*

Validation of the instrument data archive is completed in two phases. The first phase is performed by the PDS node and consists of reviewing a sample, pathfinder data set for compliance with the PDS standards. The instrument team will submit a set of data files following the procedure of section 3.2. Upon receipt, the PDS node will confirm the structure of the files and labels. Once the sample data is validated, PDS will develop software to validate subsequent data volumes in an automated fashion.

The second phase of the validation consists of a peer review to ensure usability and completeness. The peer review panel will consist of members of the instrument team, the PDS Atmospheres Bode and Engineering Node of the PDS, and at least two outside scientists actively working in the field. The PDS personnel will be responsible for validating that the archive volume(s) are fully compliant with PDS standards. The instrument team and outside science reviewers will be responsible for verifying the content of the data set, the completeness of the documentation, and the usability of the data in its archive format. Any deficiencies in the archive volume will be recorded as liens against the product by the review panel. After all liens placed against the product or the product generation software is resolved, automated production and validation can begin.

Once automated production begins, the data file content will be spot checked by members of the instrument team. The data will be used by team members to perform their analysis. Any discrepancies in the data noted during these activities will be investigated. If the discrepancy is a data error, the response will depend on the source of the error. If the error is in the software producing the data product, the error will be corrected and the data products affected will be reproduced. If there is a correctable error in a data file, the file will be replaced. If an error in a data file is uncorrectable, the error will be described in the cumulative errata file included on each volume in the volume set. The structure of data files and labels will be spot checked by the PDS discipline node for compliance with PDS standards and this SIS.

6 ARCHIVE VOLUME CONTENTS

This section describes the contents of the JIRAM standard product archive collection volumes, including the file names, file contents, file types, and the organizations responsible for providing the files. The complete directory structure is shown in *Figure 11 -12*.

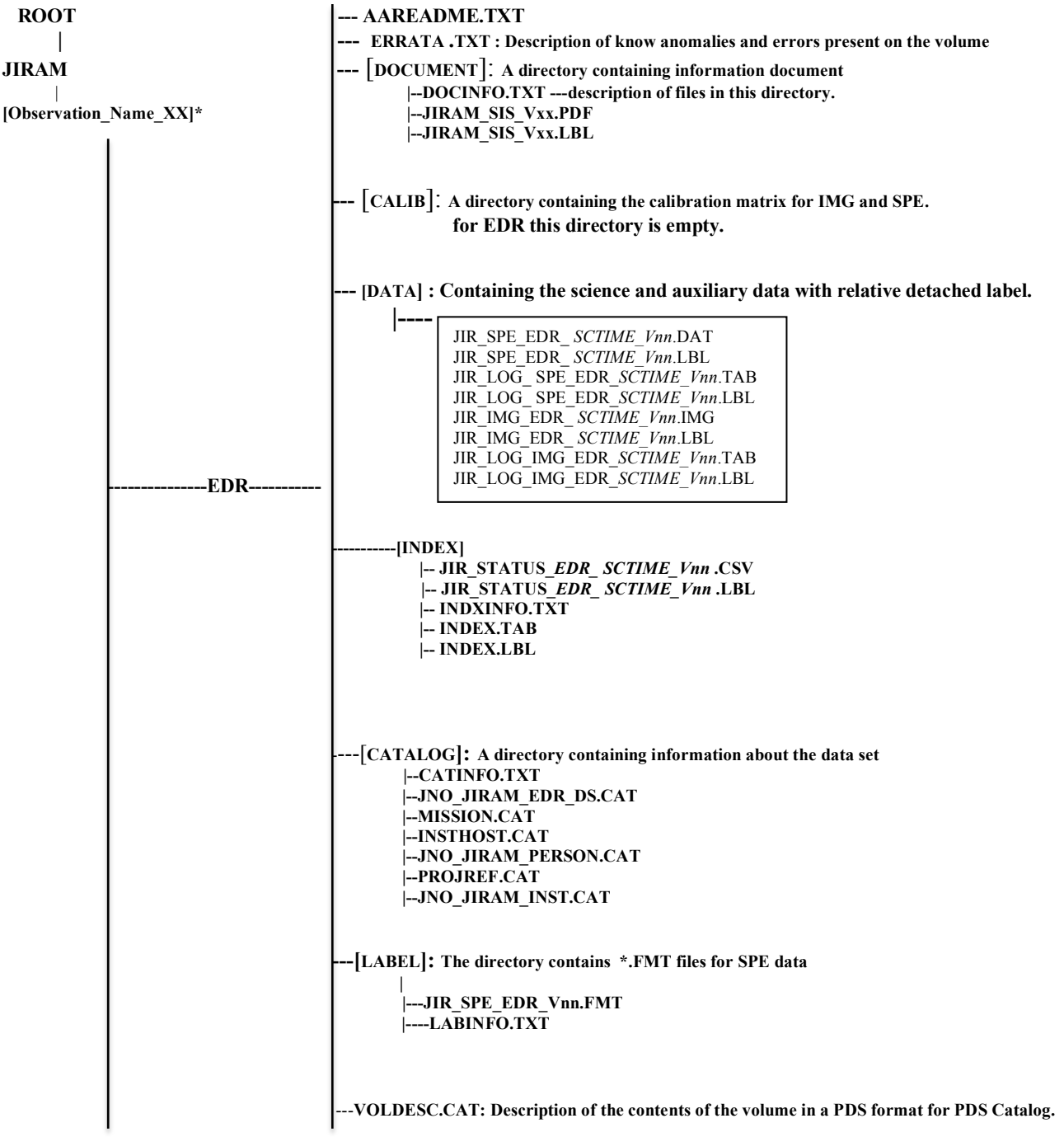


Figure 11: Archive volume directory structure EDR

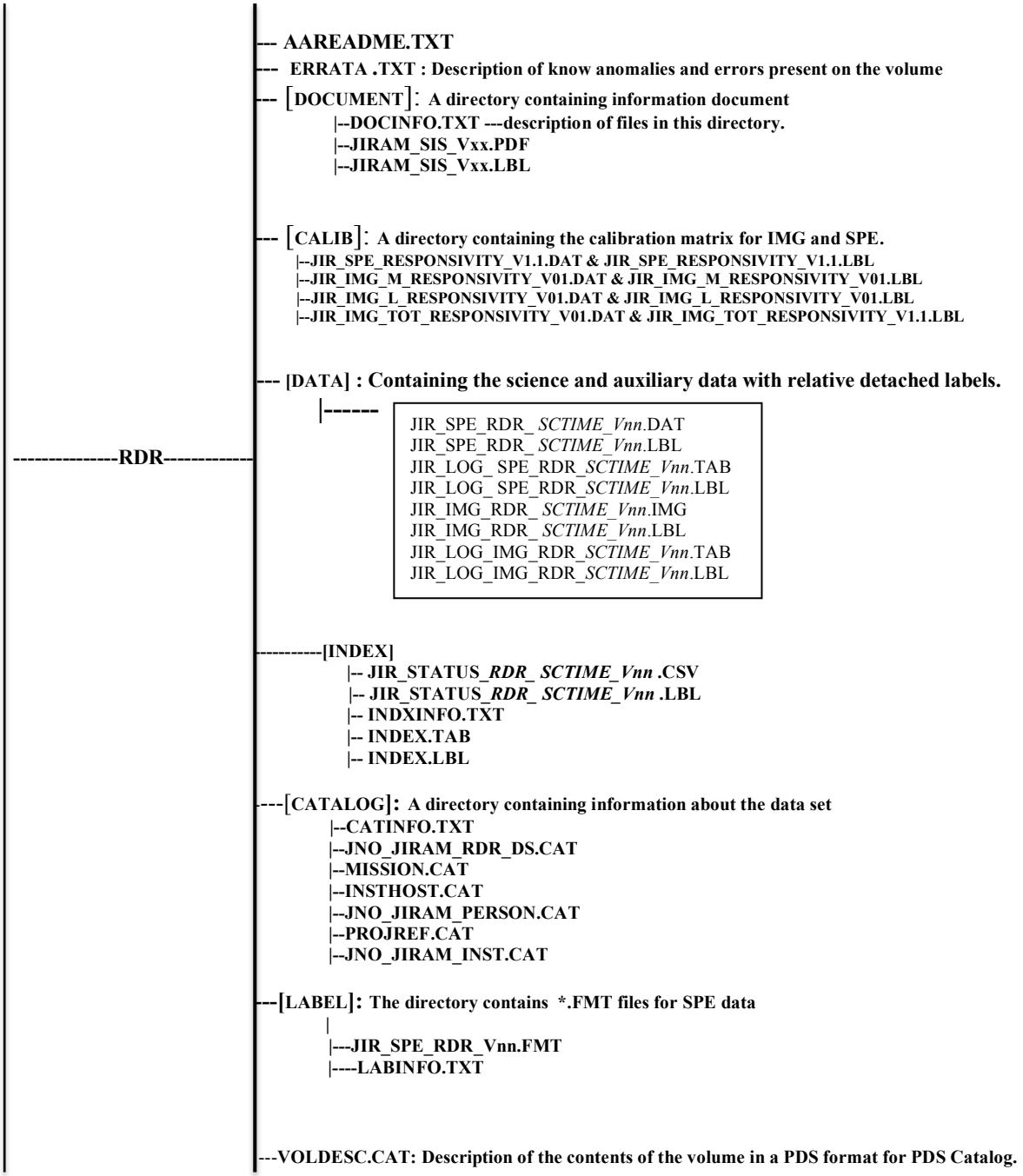


Figure 12: Archive volume directory structure RDR

6.1 *ROOT DIRECTORY CONTENTS*

The files listed in Table 14 are contained in the (top-level) root directory, and are produced by the JIRAM team in consultation with the Atmospheres node of the PDS. All of these files are required by the PDS volume organization standards.

File Name	File Contents	Provided By
AAREADME.TXT	This file completely describes the Volume organization and contents (PDS label attached).	PDS node
ERRATA.TXT	A cumulative listing of comments and updates concerning all Standard Data Products on all Volumes in the Volume set published to date.	PDS node and IOT
VOLDESC.CAT	A description of the contents of this Volume in a PDS format readable by both humans and computers.	PDS node

Table 14: Root directory contents

6.2 *INDEX DIRECTORY CONTENTS*

The following files are contained in the index directory and are produced by the PDS discipline node. The INDEX.TAB file contains a listing of all data products on the archive volume. In addition, there is a cumulative index file (CUMINDEX.TAB) that lists all data products in the archive volume set to date. The index and index information (INDXINFO.TXT) files are required by the PDS volume standards. The index tables include both required and optional columns. The cumulative index file is also a PDS requirement; however, this file is not reproduced on each data volume. An online and web accessible cumulative index file is maintained at the PDS discipline node while archive volumes are being produced. Only the last archive volume in the volume series will contain a cumulative index file.

File Name	File Contents	Provided By
INDXINFO.TXT	A description of the contents of this directory	PDS node
INDEX.TAB	A table listing all Data Products on this Volume	PDS node
INDEX.LBL	A PDS detached label that describes INDEX.TAB	PDS node
JIR_STATUS_*LLL*_ *SCTIME_Vnn* .CSV JIR_STATUS_*LLL*_ *SCTIME_Vnn* .LBL	Auxiliary Data	IOT

Table 15: INDEX directory contents

6.3 *DOCUMENT DIRECTORY*

The document directory contains documentation that is considered to be either necessary or simply useful for users to understand the archive data set. These documents are not necessarily appropriate for inclusion in the PDS catalog. The following files are contained in the DOCUMENT directory:

File Name	File Contents	Provided By
DOCINFO.TXT	A description of the contents of this directory	PDS node
JIRAM_SIS_7.1.PDF	The Archive Volume SIS (this document) in ASCII format	IOT, PDS node
JIRAM_SIS_7.1.LBL	A PDS detached label that describes JIRAM_SIS_7.1.PDF	PDS node

Table 16: DOCUMENT directory contents

6.4 *CALIB DIRECTORY*

The calibration directory contains the available versions of calibration files for SPE and for IMG; each file has an associated detached label. The calibration directory contains a file named CALINFO.TXT that is an ASCII text description of the CALIB directory contents. The contents of this directory are described in Table 17.

File Name (nn = version).	File Contents	Provided By
CALINFO.TXT	Brief description of directory contents and naming conventions.	PDS node
JIR_SPE_RESPONSIVITY_V*nn*.DAT	Responsivity matrix, in (DN*m^2*micron*sterad)/(W*s) units, for Spectrum calibration. samples = 336 lines = 256	IOT
JIR_SPE_RESPONSIVITY_V*nn*.LBL		IOT
JIR_IMG_L_RESPONSIVITY_V*nn*.DAT	Responsivity matrix for Image band L, in (DN*m^2*micron*sterad)/(W*s) units. samples = 432 lines = 128	IOT
JIR_IMG_L_RESPONSIVITY_V*nn*.LBL		IOT
JIR_IMG_M_RESPONSIVITY_V*nn*.DAT	Responsivity matrix for Image band M, in (DN*m^2*micron*sterad)/(W*s) units. samples = 432 lines = 128	IOT
JIR_IMG_M_RESPONSIVITY_V*nn*.LBL		IOT
JIR_IMG_TOT_RESPONSIVITY_V*nn*.DAT	Responsivity matrix for Image band M, in (DN*m^2*micron*sterad)/(W*s) units. samples = 432 lines = 256	IOT
JIR_IMG_TOT_RESPONSIVITY_V*nn*.LBL		IOT

Table 17: Calibration directory contents

6.5 *LABEL DIRECTORY*

This directory contains files referred to by ^STRUCTURE pointers included in labels of files in the DATA subdirectory. The content of these files is the description in ODL language of PDS Data Objects contained in Data Product files themselves. These files have a ".FMT" extension, and are named "JIR_SPE_***lll***_Vnn.FMT" where

- ***lll*** indicates the processing level, either EDR or RDR.
- ***nn*** version

File Name	File Contents	Provided By
JIR_SPE_*lll*_Vnn.FMT	Brief description of directory contents and naming conventions.	IOT
LABINFO.TXT	Brief description of directory contents	

Table 18: Label directory contents

6.6 *CATALOG DIRECTORY*

The completed PDS catalog files in the catalog directory provide a top-level understanding of the Juno mission and its data products.

Each file in the catalog directory contains an individual PDS catalog object. These objects provide a top-level understanding of the Juno mission, the instrument and its data products. The instrument team, and the CATINFO.TXT will provide the data set catalog files by the PDS discipline node.

File Name	File Contents	Provided By
CATINFO.TXT	A description of the contents of this directory	PDS node
JNO_JIRAM_xDR_DS.CAT	PDS Data Set catalog description of appropriate to the data set .	IOT
INSTHOST.CAT	PDS instrument host (spacecraft) catalog description of the Juno spacecraft	Juno Project
JNO_JIRAM_INST.CAT	PDS instrument catalog description of the instrument	IOT
MISSION.CAT	PDS mission catalog description of the Juno mission	Juno Project
JNO_JIRAM_PERSON.CAT	PDS personnel catalog description of instrument Team members and other persons involved with generation of Data Products	IOT
PROJREF.CAT	Juno related references mentioned in other *.CAT files.	Juno Project

Table 19: CATALOG directory contents

6.7 *DATA DIRECTORY CONTENTS AND NAMING CONVENTIONS*

The data directory contains the data products generated by the JIRAM team. The data directory will be divided into subdirectories <observation>, each containing data collected over one "Activity Periods". The naming convention for subdirectory is:

Mission Phase Names	Orbit number	The subdirectories name <Observation>
INNER CRUISE 3	N/A	MOON_<YY> Where YY indicates the version
CAPTURE ORBIT	N/A	JM00XX
SCIENCE ORBITS	1, 2, 3, 4, 5, 6, 7, 8…	ORBIT_<XX> Where XX indicates the orbit number

Table 20: CATALOG data directory

Every subdirectory beneath the data directory contains a file named INFO.TXT that is an ASCII text description of the directory contents. Every file in the data path of an Archive Volume must be described by a PDS label. All labels will be detached, having the same root name as the file they describe with the suffix ".LBL". The format description is included in a file (.FMT) that is referenced by a pointer within each PDS label file.

The data directory contains the science data with label and HK data with label.

File Name	File Contents	Provided By
JIR_*SSS_LLL_* SCTIME_Vnn.EXT JIR_*SSS_LLL_* SCTIME_Vnn.LBL	**Science Data**	**IOT**
JIR_LOG_*SSS_LLL*_SCTIME_Vnn.TAB JIR_LOG_*SSS_LLL*_SCTIME_Vnn.LBL	**HK Data**	**IOT**

Table 21: DATA directory contents

6.7.1 FILE NAMING CONVENTIONS

JIRAM combines 2 data channels in one instrument: the IMAGER and SPECTROMETER. The data are named according to the suffix indicating the channel and the acquisition time. The naming convention is the following:

<table>
<tr><th>Product</th><th>File Name</th><th>Description</th></tr>
<tr><td colspan="2">SCIENCE DATA & HOUSEKEEPING DATA
JIR_SSS_LLL_ SCTIME_Vnn.EXT
JIR_SSS_LLL_ SCTIME_Vnn.LBL
JIR_LOG_SSS_LLL_SCTIME_Vnn.TAB
JIR_LOG_SSS_LLL_SCTIME_Vnn.LBL</td><td rowspan="2">SSS: indicates the sensor, IMG or SPE for imager and spectrometer respectively.
LLL: indicates the processing level, either EDR or RDR.
SCTIME: is yyyydddThhmmss
• yyyy = year
• ddd = doy
• hh = hours
• mm = minutes
• ss = seconds
nn : version
EXT: The file extension
➢ IMG for image
➢ DAT for spectrum</td></tr>
<tr><td>AUXILIARY DATA</td><td>JIR_STATUS_LLL_ SCTIME_Vnn.CSV
JIR_STATUS_LLL_ SCTIME_Vnn.LBL</td></tr>
</table>

Table 22: Naming Conventions

6.8 *EXTRAS DIRECTORY*

The EXTRAS directory contains files that are helpful, but are not required to interpret the INSTRUMENT data. Files in the EXTRAS directory are exempt from labeling requirements. Subdirectories are used to organize the items into groups of related files. The EXTRAS directory, if present must contain the EXTRAINFO.TXT file that identifies the function or purpose of each file in the directory.

6.9 *SOFTWARE DIRECTORY*

The optional SOFTWARE directory contains software libraries, utilities or applications required for accessing the data.

7 EDR DATA PRODUCT FORMAT DESCRIPTION

This section describes the format of the Level 1 data files.

7.1 *TIME STANDARDS*

7.1.1 START_TIME AND STOP_TIME FORMATION

The PDS formation rule for dates and time in UTC is: YYYY-MM-DDThh:mm:ss.fff with

- YYYY year (0000-9999)
- MM month (01-12)
- DD day of month (01-31)
- T date/time separator
- hh hour (00-23)
- mm minute (00-59)
- ss second (00-59)
- fff fractions of second (000-999) (restricted to 3 digits)

7.1.2 SC_CLOCK_START_COUNT AND SC_CLOCK_STOP_COUNT

The SC_CLOCK*COUNTS represents the on-board time counters (OBT) of the spacecraft and instrument computers. This OBT counter is given in the headers of the experiment telemetry source packets. It contains the data acquisition start time as 32 bit of unit seconds followed by 16 bit of fractional seconds. Thus the OBT is represented as a two integer numbers separated by a colon, the first of which represents the integer part of the clock count, and the second of which represents the fractional second part of the clock count. A reset of the spacecraft clock is represented by an integer number followed by a slash, e.g. “1/” or “2/”.

7.1.3 COORDINATE SYSTEMS

All computations are performed in the planetographic system and using positive eastward longitudes in the range 0°-360° (longitude increasing with increasing local solar time as the planet rotates). The geographic frame is the one used in the SPICE kernels, and defined in the IAU 2000 system.

7.2 *JIRAM EDR DATA FILE STRUCTURE*

The JIRAM Image focal plane is 438x270 pixels and we consider only 432x256 pixels. The JIRAM Spectrometer focal plane is 256x336 pixels.
Scientific telemetries arrive with a header containing information necessary for the further processing and analysis of the data. The precise content of the header depends on the detector and link (LSSL or HSSL). Tables detailing this information are shown in Appendix 10.6 and 10.7 This information is transferred in the log files, with corresponding detached labels.

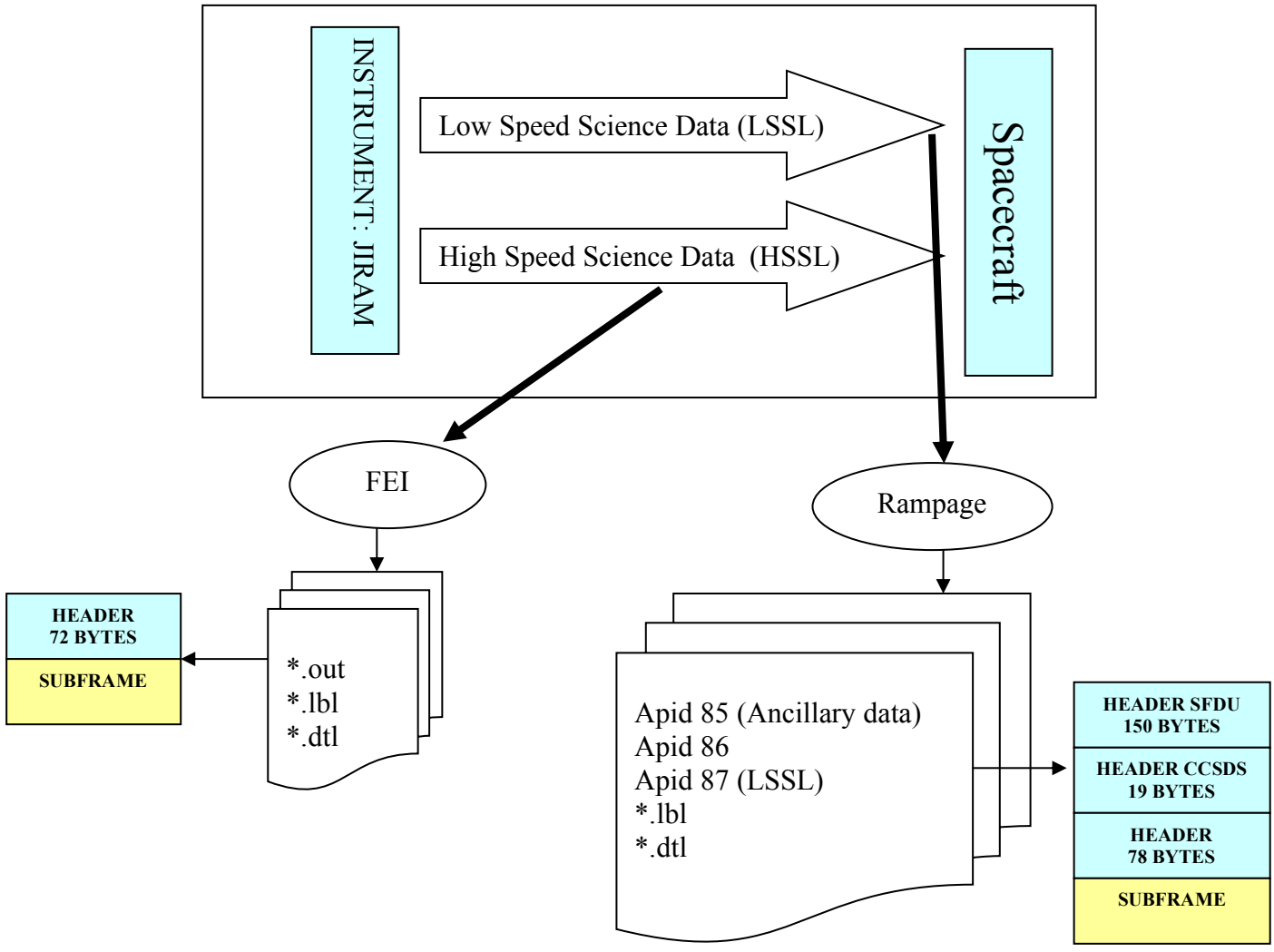


Figure 13: JIRAM Raw Science Data Product Pack

- HSSL

The subframe must be a multiple of 32 bits long, if the compression creates a subframe not a multiple of 32 bits, the FSW (flight software) shall append a padding (from 0 to 3 bytes) at the end of the message. If the subframe is uncompressed, it has a maximum size of 18432 pixels. Each pixel (or compressed data block) is mapped on 16 bits (standard signed integer). This is the superior limit for a subframe size. In this case, since each subframe has a even number of 16-bits pixels, the padding is not necessary. JIRAM produces a file *.out for each subframe.

- LSSL

The subframe is uncompressed, it has a maximum size of 18432 pixels. Each pixel (or compressed data block) is mapped on 16 bits (standard signed integer).

Binary files are all fixed-length records, stored in most-significant-byte-first (big-endian) format.

7.3 *PDS LABELS*

All data files in the JIRAM Standard Product Archive Collection have associated detached PDS labels. These label files are named using the same prefix as the data file together with an LBL extension. All spaces and tabulations in the labels are encoded with ASCII character 32 (space). All labels lines are 80 long, including the EOL marker encoded as ASCII 13-10 (CR-LF).

The keywords are grouped in functional sections.

- Identification Data elements.
- Mission description parameters.
- Instrument description parameters.
- Geometry Information
  - Celestial Geometry
  - Solar Geometry
  - Coordinate System
  - Geometry in “JUPITER_FIXED” coordinates from SPICE.
  - Illumination.
  - Channel parameters
    - ✓ Image filter M parameters
    - ✓ Image filter L parameters
    - ✓ Spectrum parameters
- Instrument status
- Pointers and Description of the PDS object

Following the label details for different operative mode:

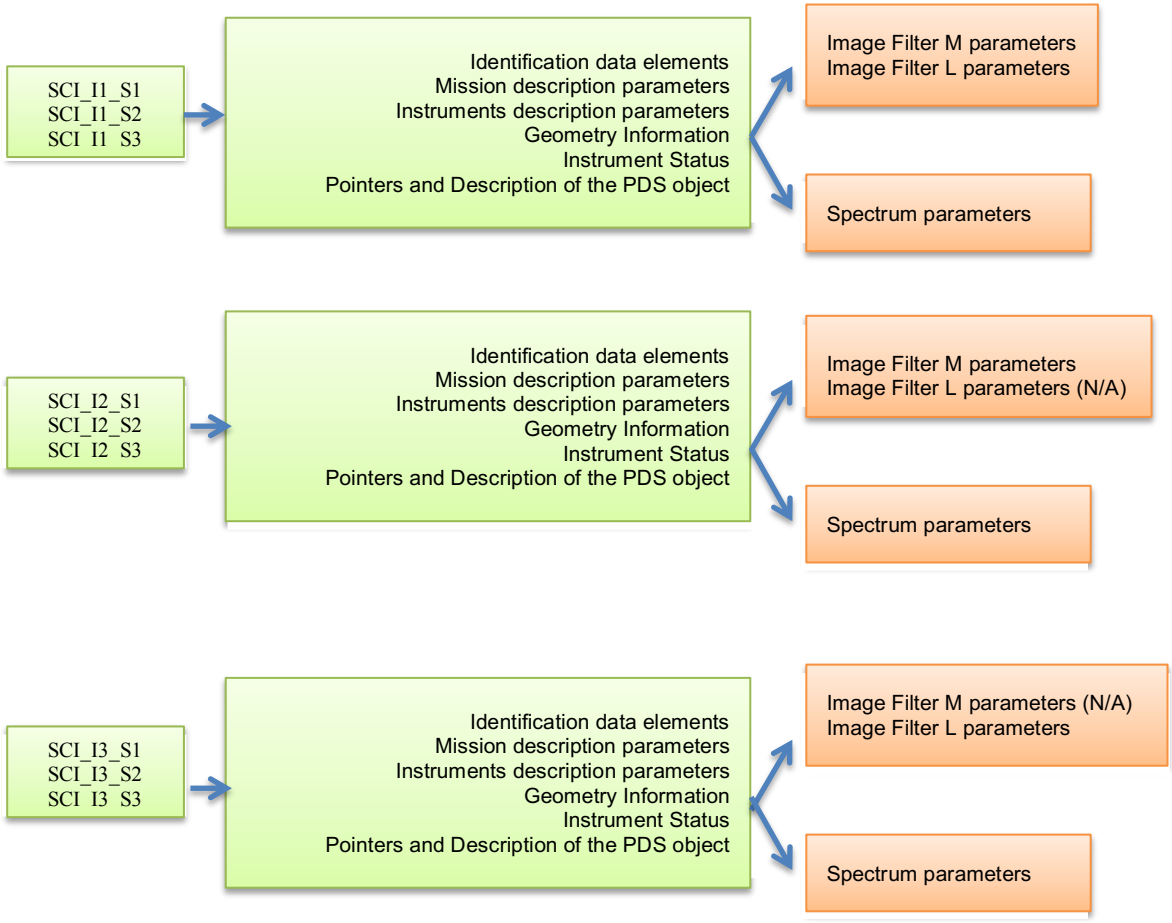


Figure 14: JIRAM keywords sections

Examples of actual labels are provided in Appendix 10.1, 10.2 , 10.10 e 10.11. More details about keywords in the labels can be found in Appendix 10.3.

8 RDR DATA PRODUCT DESIGN

The RDR Data Product consist of a file that contains a PDS binary TABLE object for spectrometer and binary IMAGE object with detached label describing its structure. Data product files are named according to the convention defined in Section 5.7.1. The files contain the instrument data having a RAW identical structure (see Figure 12). The RDR is 32 bits data

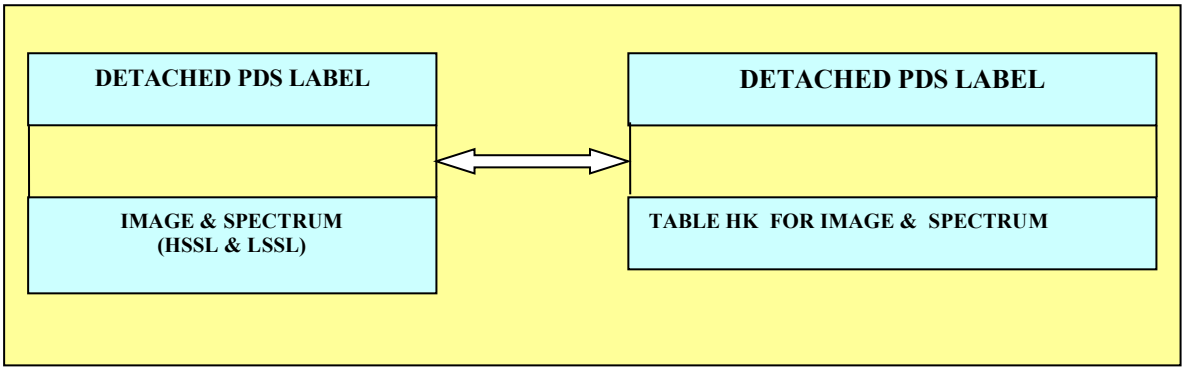


Figure 15: Structure of a JIRAM RDR data product

9 SUPPORT STAFF AND COGNIZANT PERSONS

JIRAM team			
Name	**Address**	**Phone**	**Email**
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Table 23: Archive collection support staff

10 APPENDIX

10.1 *EDR LABEL DATA IMAGE*

```
PDS_VERSION_ID                  = PDS3

/* Identification data elements */
DATA_SET_NAME                = "JUNO JUPITER JIRAM EXPERIMENT DATA
RECORD V1.0"
DATA_SET_ID                     = "JNO-J-JIRAM-2-EDR-V1.0"
PRODUCT_ID                      = JIR_IMG_EDR_2022012T094606_V01
PRODUCT_TYPE                    = EDR
PROCESSING_LEVEL_ID             = "2"
START_TIME                      = 2022-01-12T09:46:04.392
STOP_TIME                       = 2022-01-12T09:46:04.407
SPACECRAFT_CLOCK_START_COUNT    = "5/695253153:52101"
SPACECRAFT_CLOCK_STOP_COUNT     = "5/695253153:53084"
STANDARD_DATA_PRODUCT_ID        = "IMAGE"
PRODUCER_FULL_NAME              = "A.ADRIANI - R.NOSCHESE"
INSTITUTION_NAME                = "ISTITUTO NAZIONALE DI
ASTROFISICA"
PRODUCT_CREATION_TIME           = 2022-06-13T12:20:20.000
PRODUCT_VERSION_ID              = "01"
COMMAND_FILE_NAME               = "jm0390_JRMa.sasf"
SEQUENCE_NUMBER                 = 4
SEQUENCE_SAMPLES                = 6
MD5_CHECKSUM                    =
"05a03517b4cf9d225661e4d8e8db733b"

/* Mission description parameters */
INSTRUMENT_HOST_NAME            = "JUNO"
INSTRUMENT_HOST_ID              = "JNO"
MISSION_PHASE_NAME              = "SCIENCE ORBITS"

/* Instrument description parameters */
INSTRUMENT_NAME                 = "JOVIAN INFRARED AURORAL MAPPER"
INSTRUMENT_ID                   = "JIR"
INSTRUMENT_TYPE                 = "INFRARED IMAGING SPECTROMETER"
SOFTWARE_VERSION_ID             = ("EGSE_208", "PDS_EDR_V7")

ORBIT_NUMBER                    = 39
TARGET_NAME                     = "JUPITER"
TARGET_TYPE                     = "PLANET"
TARGET_PIXELS                   = 110592
JNO:TARGET_PRESENCE_FLAG        = "000001000010000"
```

```
/* Instrument status */
CHANNEL_ID                      = "1"           /* 0:SPECTRUM IR;
1:IMAGE */
FRAME_PARAMETER                 = (1 ,0 )
FRAME_PARAMETER_DESC            =
       ("FRAME_ACQUISITION_RATE","EXTERNAL_REPETITION_TIME")
EXPOSURE_DURATION               = 0.015 <second>
INSTRUMENT_MODE_ID              = SCI_I1_S1
INSTRUMENT_MODE_DESC            =
" SCI_I1_S1: Science, IMAGE(256x432) full acquisition, SPECTRUM
(256x336) High
Spatial and High spectral"

OBJECT                          = FILE
RECORD_TYPE                     = FIXED_LENGTH
FILE_RECORDS                    = 256
RECORD_BYTES                    = 864
FRAME_TYPE                      = "SCIENCE"
NOTE                            = " HSSL : High Speed Serial Link "
DATA_QUALITY_ID                 = "1"
DATA_QUALITY_DESC               = "0:INCOMPLETE; 1:COMPLETE"
^IMAGE                          =
"JIR_IMG_EDR_2022012T094606_V01.IMG"

/* Data Object pointers */
OBJECT                          = IMAGE
   LINES                        = 256
   LINE_SAMPLES                 = 432
   SAMPLE_TYPE                  = LSB_INTEGER
   SAMPLE_BITS                  = 16
   DESCRIPTION                   = "Binary Table listing containing
raw science
                        telemetry frame.
                        Each line containing information about
bands
                        (Bandpass L = 3320-3600 nm and M = 4537 -
5035 nm)."
END_OBJECT                       = IMAGE

SPICE_FILE_NAME                 =
{"juno_v09.tf",
"juno_jiram_v02.ti",
"juno_struct_v01.ti",
"naif0012.tls",
"pck00010.tpc",
"JNO_SCLKSCET.00130.tsc",
"de440s.bsp",
"juno_struct_v04.bsp",
"jup363.bsp",
"juno_rec_orbit.orb",
```

```
"spk_rec_211222_220204_220210.bsp",
"juno_sc_rec_220111_220112_v01.bc"}
END_OBJECT                    = FILE
END
```

10.2 *EDR LABEL DATA SPECTRUM*

```
PDS_VERSION_ID                = PDS3

/* Identification data elements */
DATA_SET_NAME              = "JUNO JUPITER JIRAM EXPERIMENT DATA
RECORD V1.0"
DATA_SET_ID                   = "JNO-J-JIRAM-2-EDR-V1.0"
PRODUCT_ID                    = JIR_SPE_EDR_2022012T093737_V01
PRODUCT_TYPE                  = EDR
PROCESSING_LEVEL_ID           = "2"
START_TIME                    = 2022-01-12T09:37:33.148
STOP_TIME                     = 2022-01-12T09:37:34.148
SPACECRAFT_CLOCK_START_COUNT  = "5/695252642:36044"
SPACECRAFT_CLOCK_STOP_COUNT   = "5/695252643:36044"
STANDARD_DATA_PRODUCT_ID      = "SPECTRAL"
PRODUCER_FULL_NAME            = "A.ADRIANI - R.NOSCHESE"
INSTITUTION_NAME              = "ISTITUTO NAZIONALE DI
ASTROFISICA"
PRODUCT_CREATION_TIME         = 2022-06-13T12:17:17.000
PRODUCT_VERSION_ID            = "01"
COMMAND_FILE_NAME             = "jm0390_JRMa.sasf"
SEQUENCE_NUMBER               = 4
SEQUENCE_SAMPLES              = 6
MD5_CHECKSUM                  =
"fda3ff58fee6050c3fff2fd57f2bf07b"

/* Mission description parameters */
INSTRUMENT_HOST_NAME          = "JUNO"
INSTRUMENT_HOST_ID            = "JNO"
MISSION_PHASE_NAME            = "SCIENCE ORBITS"

/* Instrument description parameters */
INSTRUMENT_NAME               = "JOVIAN INFRARED AURORAL MAPPER"
INSTRUMENT_ID                 = "JIR"
INSTRUMENT_TYPE               = "INFRARED IMAGING SPECTROMETER"
SOFTWARE_VERSION_ID           = ("EGSE_208", "PDS_EDR_V7")

ORBIT_NUMBER                  = 39
TARGET_NAME                   = "JUPITER"
TARGET_TYPE                   = "PLANET"
TARGET_PIXELS                 = 256
JNO:TARGET_PRESENCE_FLAG      = "100000000000000"
```

```
/* Instrument status */
CHANNEL_ID                      = "0"      /* 0:SPECTRUM IR;
1:IMAGE */
FRAME_PARAMETER                 = (1 ,0 )
FRAME_PARAMETER_DESC            =
       ("FRAME_ACQUISITION_RATE","EXTERNAL_REPETITION_TIME")
EXPOSURE_DURATION               = 1 <second>
INSTRUMENT_MODE_ID              = SCI_I1_S1
INSTRUMENT_MODE_DESC            =
" SCI_I1_S1: Science, IMAGE(256x432) full acquisition, SPECTRUM
(256x336) High
Spatial and High spectral"

OBJECT                          = FILE
RECORD_TYPE                     = FIXED_LENGTH
FILE_RECORDS                    = 256
RECORD_BYTES                    = 672
FRAME_TYPE                      = "SCIENCE"
NOTE                            = " HSSL : High Speed Serial Link "
DATA_QUALITY_ID                 = "1"
DATA_QUALITY_DESC               = "0:INCOMPLETE; 1:COMPLETE"
^TABLE                          =
"JIR_SPE_EDR_2022012T093737_V01.DAT"

/* Data Object pointers */
OBJECT                          = TABLE
   ROWS                         = 256
   ROW_BYTES                    = 512
   DESCRIPTION                  = "Binary Table listing containing
raw science
                                  telemetry frame.
                                  Each line containing information
about bands
                                  (range 2-5um)."
   INTERCHANGE_FORMAT           = BINARY
   ^STRUCTURE                   = "JIR_SPE_EDR_V02.FMT"
   COLUMNS                      = 336
END_OBJECT                      = TABLE

SPICE_FILE_NAME                 =
{"juno_v09.tf",
"juno_jiram_v02.ti",
"juno_struct_v01.ti",
"naif0012.tls",
"pck00010.tpc",
"JNO_SCLKSCET.00130.tsc",
"de440s.bsp",
"juno_struct_v04.bsp",
```

```
"jup363.bsp",
"juno_rec_orbit.orb",
"spk_rec_211222_220204_220210.bsp",
"juno_sc_rec_220111_220112_v01.bc"}
END_OBJECT                          = FILE
END
```

10.3 *EDR – RDR PDS LABEL KEYWORDS*

The following table lists in alphabetical order the keywords appearing in an EDR data product PDS label, together with an explanation of its meaning.

Keyword name	Definition	Type	Valid values
CHANNEL_ID	Detector used for the current subframe.	CHARACTER	0 = Spectrum IR 1 = Image IR
COLUMNS	Number of columns in each row of a data object.	INTEGER	336 = Spectrometer Science Data 432 = Imager Science DATA 36 = HouseKeeping 90 = Auxiliary Data
COMMAND_FILE_NAME	The command_file_name element provides the name of the file containing the commanded observation description for this product.	CHARACTER	For JIRAM this keyword gives the information about the name of the commanding file + ID of the request in the file itself.
DATA_QUALITY_DESC	Description of the data quality which is associated with a particular DATA_QUALITY_ID value.	CHARACTER	0:INCOMPLETE; 1:COMPLETE
DATA_QUALITY_ID	Numeric key which identifies the quality of data in the data product.	CHARACTER	0; 1
DATA_SET_ID	Unique alphanumeric identifier for a data set or a data product. The DATA_SET_ID value for a given data set or product is constructed according to flight project naming conventions.	CHARACTER	See Table.9
DATA_SET_NAME	provides the full name given to a data set or a data product. The data_set_name typically identifies the instrument that acquired the data, the target of that instrument, and the processing level of the data.	CHARACTER	See Table.9
EXPOSURE_DURATION	Describes the integration duration of each pixel.	FLOAT	
FILE_RECORDS	Number of physical file records.	INTEGER	
FRAME_PARAMETER	The FRAME_PARAMETER element defines the individual frame parameters of an instrument.	FLOAT	A three-valued array describing: “ACQUISITION_RATE”, “ACQUISITION_DURATION”, “BKG_ACQUISITION_RATE”
FRAME_PARAMETER_DESC	The FRAME_PARAMETER_DESC element describes the individual frame parameters listed in the element FRAME_PARAMETER.	CHARACTER	
FRAME_TYPE		CHARACTER	BACKGROUND, CAL_GAIN_1,CAL_GAIN_2,DARK, RN,SCIENCE,DOUBLE_SCI
^IMAGE	Pointer to the file containing the data IMAGE object.	CHARACTER	
INSTITUTION_NAME	Identidies the research center	CHARACTER	I”STITUTO NAZIONALE DI ASTROFISICA”
INSTRUMENT_HOST_ID	Unique identifier for the host where an instrument is located.	CHARACTER	“JNO”

INSTRUMENT_HOST_NAME	Full name of the host on which an instrument is based.	CHARACTER	“JUNO”
INSTRUMENT_ID	Abbreviated name or acronym which identifies an instrument.	CHARACTER	“JIR”
INTRUMENT_MODE_DESC	Description of the instrument mode which is identified by the INSTRUMENT_MODE_ID element.	CHARACTER	SCI_I0_S1: Science, no IMAGE, SPECTRUM (256x336) High Spatial and High Spectral SCI_I0_S2: Science, no IMAGE, SPECTRUM (64x336) Medium Spatial and High Spectral . SCI_I0_S3: Science, no IMAGE, SPECTRUM(16x336) Low Spatial and Hight Spectral. SCI_I1_S0: Science, IMAGE(256x432) full acquisition (L and M images), no SPECTRUM. SCI_I1_S1: Science, IMAGE(256x432) full acquisition (L and M images), SPECTRUM (256x336) High Spatial and High spectral. SCI_I1_S2: Science, IMAGE(256x432) full acquisition (L and M images), SPECTRUM (64x336) Medium Spatial and High spectral SCI_I1_S3: Science, IMAGE(256x432) full acquisition (L and M images),, SPECTRUM (16x336) Low Spatial and High spectral SCI_I2_S0: Science, IMAGE(128x432) M-Band, no SPECTRUM . SCI_I2_S1: Science, IMAGE(128x432) M-Band, SPECTRUM(256x336) High Spatial and High Spectral. SCI_I2_S2: Science, IMAGE(128x432) M-Band, SPECTRUM (64x336) Medium Spatial and High Spectral SCI_I2_S3: Science, IMAGE(128x432) M-Band, SPECTRUM (16x336) Low Spatial and High Spectral SCI_I3_S0: Science, IMAGE(128x432) L-Band, no SPECTRUM

			SCI_I3_S1: Science, IMAGE(128x432) L-Band, SPECTRUM (256x336) High Spatial and High Spectral SCI_I3_S2: Science, IMAGE(128x432) L-Band, SPECTRUM(64x336) Medium Spatial and Hogh Spectral SCI_I3_S3: Science, IMAGE(128x432) L-Band, SPECTRUM (16x336) Low Spatial and Hogh Spectral CAL_I0_S1: Calibration, no IMAGE, SPECTRUM (256x336) High Spatial and High Spectral CAL_I0_S2: Calibration, no IMAGE, SPECTRUM (64x336) Medium Spatial and High Spectral CAL_I0_S3: Calibration, no IMAGE, SPECTRUM(16x336) Low Spatial and very High Spectral CAL_I1_S0: Calibration, IMAGE(256x432) full acquisition (L and M images), no SPECTRUM CAL_I1_S1: Calibration, IMAGE(256x432) full acquisition (L and M images), SPECTRUM (256x336) High Spatial and High spectral CAL_I1_S2: Calibration, IMAGE(256x432) full acquisition (L and M images), SPECTRUM (64x336) Medium Spatial and High spectral CAL_I1_S3: Calibration, IMAGE(256x432) full acquisition (L and M images), SPECTRUM (16x336) Low Spatial and High spectral. CAL_I2_S0: Calibration, IMAGE(128x432) M-Band, no SPECTRUM CAL_I2_S1: Calibration, IMAGE(128x432) M-Band, SPECTRUM (256x336) High Spatial and High Spectral CAL_I2_S2: Calibration, IMAGE(128x432) M-Band, SPECTRUM (64x336) Medium Spatial and High Spectral

			CAL_I2_S3: Calibration, IMAGE(128x432) M-Band, SPECTRUM (16x336) Low Spatial and High Spectral CAL_I3_S0: Calibration, IMAGE(128x432) L-Band, no SPECTRUM CAL_ *I3*_S1: Calibration, IMAGE(128x432) L-Band, SPECTRUM (256x336) High Spatial and High Spectral CAL_I3_S2: Calibration, IMAGE(128x432) L-Band, SPECTRUM(64x336) Medium Spatial and High Spectral CAL *I3*S3: Calibration, IMAGE(128x432) L-Band, SPECTRUM (16x336) Low Spatial and High Spectral
INSTRUMENT_MODE_ID	The value of this keyword identifies the instrument mode. The valid values are the following mode.	CHARACTER	SCI_I0_S1 SCI_I0_S2 SCI_I0_S3 SCI_I1_S0 SCI_I1_S1 SCI_I1_S2 SCI_I1_S3 SCI_I2_S0 SCI_I2_S1 SCI_I2_S2 SCI_I2_S3 SCI_I3_S0 SCI_I3_S1 SCI_I3_S2 SCI_I3_S3 CAL_I0_S1 CAL_I0_S2 CAL_I0_S3 CAL_I1_S0 CAL_I1_S1 CAL_I1_S2 CAL_I1_S3 CAL_I2_S0 CAL_I2_S1 CAL_I2_S2 CAL_I2_S3 CAL_I3_S0 CAL_I3_S1 CAL_I3_S2 CAL_I3_S3
INSTRUMENT_NAME	Full name of an instrument.	CHARACTER	“JOVIAN INFRARED AURORAL MAPPER”
INSTRUMENT_TYPE	Type of an instrument.	CHARACTER	“INFRARED IMAGING SPECTROMETER”
INTERCHANGE_FORMAT	Manner in which data items are stored.	CHARACTER	
LINE_FIRST_PIXEL	This keyword gives the X coordinate of the first pixel.	INTEGER	

LINE_SAMPLES	Indicates the total number of data instances along the horizontal axis of an image.	INTEGER	
LINES	The total number of data instances along the vertical axis of an image.	INTEGER	
MISSION_PHASE_NAME	Commonly-used identifier of a mission phase.	CHARACTER	See Appendix: Mission Phase Names
MD5_CHECKSUM	It is a value of 128 bits that corresponds to a calculated checksum.	CHARACTER	
NOTE	Describe the used bus	CHARACTER	Value = “HSSL : High Speed Serial Link” “LSSL : Low Speed Serial Link “
ORBIT_NUMBER	The ORBIT_NUMBER element identifies the number of the orbital revolution of the spacecraft around a target body.	INTEGER	0 … 99999
PDS_VERSION_ID	Version number of the PDS standards documents that is valid when a data product label is created	STRING	PDS3
PROCESSING_LEVEL_ID	This data elemement identifies the processing level of a set of data according to the eight-level CODMAC standard	INTEGER	2,3
PRODUCER_FULL_NAME	This element provides the full name of the individual mainly responsible for the production of a data set.	STRING	“ A. ADRIANI – R. NOSCHESE”
PRODUCT_CREATION_TIME	Contains the date and time at which the PDS file was created in PDS time format.		
PRODUCER_INSTITUTION_NAME	Identifies the organization responsible for developing the data products.	STRING	“ISTITUTO NAZIONALE DI ASTROFISICA”
PRODUCT_ID	Permanent, unique identifier assigned to a data product by its producer.	STRING	For JIRAM , PRODUCT_ID is the file name without extension.
PRODUCT_TYPE	Type or category of a data product within a data set.	STRING	EDR RDR
PRODUCT_CREATION_TIME	This element defines the UTC system format time when a product was created.	TIME	Formation rule is : YYYY-MM-DDThh:mm:ss.fff
PRODUCT_VERSION_ID	Version of an individual product within a data set.	CHARACTER	
PRODUCT_VERSION_TYPE	Version of an individual data product that might appear in several incarnations.	CHARACTER	
RECORD_BYTES	Number of bytes in a physical file record, including record terminators and separators.	INTEGER	
RECORD_TYPE	Record format of a file.	CHARACTER	FIXED_LENGTH
ROWS	Number of rows in a data object.	INTEGER	
ROW_BYTES	Number of bytes in each data object row.	INTEGER	
SAMPLE_BITS	The sample_bits element indicates the stored number of bits, or units of binary information, contained in a line_sample value.	INTEGER	

SAMPLE_FIRST_PIXEL	This keyword gives the Y coordinate of the first pixel.	INTEGER	
SAMPLE_TYPE	Indicates the data storage representation of sample value	CHARACTER	LSB_INTEGER
SPACECRAFT_CLOCK_START_COUNT	Value of the spacecraft clock at the time of acquisition of the first Data Block in the Data Product	CHARACTER	Formation rule is: p/ccccccccc.fffff where p is increased after each resynchronization of the S/C clock, starting from 1
SPACECRAFT_CLOCK_STOP_COUNT	Value of the spacecraft clock at the time of acquisition of the last Data Block in the Data Product.	CHARACTER	Formation rule is: p/ccccccccc.fffff where p is increased after each resynchronization of the S/C clock, starting from 1
SOURCE_PRODUCT_ID	The source_product_id data element identifies a product as input to create a new product	CHARACTER	
SOFTWARE_VERSION_ID	Versions ID of software used to process this file.		{ “EGSE_<n>”, “PDS_EDR_<p>”, “PDS_RDR_<q>”}; <n>,<p>,<q> are the version numbers of software.
STANDARD_DATA_PRODUCT_ID	element is used to link a data product (file) to a standard data product	CHARACTER	Auxiliary, Spectral, Image
START_TIME	Date and time of acquisition of the Spectrum or IMAGE in UTC system format.	TIME	Formation rule is: YYYY-MM-DDThh:mm:ss.fff
STOP_TIME	Date and time of stop acquisition of the spectrum or image in UTC system format.	TIME	Formation rule is: YYYY-MM-DDThh:mm:ss.fff
SEQUENCE_NUMBER	The sequence_number element indicates a number designating the place occupied by an item in an ordered sequence.	INTEGER	
SEQUENCE_SAMPLES	The sequence_samples element specifies the number of samples in a given observation sequence.	INTEGER	
^STRUCTURE	This element identifies the name of a file located in the LABEL directory and containing the definition of the data object structure.	CHARACTER	The value is the name of the file located in the LABEL directory containing the definition of the data object structure, enclosed in quotes.
SPACE_FILE_NAME	Names of the SPICE files used in processing the data.	CHARACTER	Names of the SPICE kernels used in producing the geometry information in the data product.
SUB_SOLAR_LONGITUDE	The “sub_solar_longitude” element provides the longitude of the sub-solar point.	DEGREES	
^TABLE	Data objects are the actual data for which the structure and attributes are defined in a PDS label. Each data product file contains one data object. The PDS uses a pointer within the product labels to identify the file location for the object in a data product.	CHARACTER	In a detached label, the value is the name of the file containing the data product, enclosed in quotes
TARGET_NAME	Target of observation.	CHARACTER	MOON, JUPITER, GANYMEDE, CALLISTO,IO,EUROPA.
TARGET_PIXELS	The number of pixels in which the target appears	INTEGER	

TARGET_TYPE	Target type	CHARACTER	Planet, Asteroid, Star, Satellite

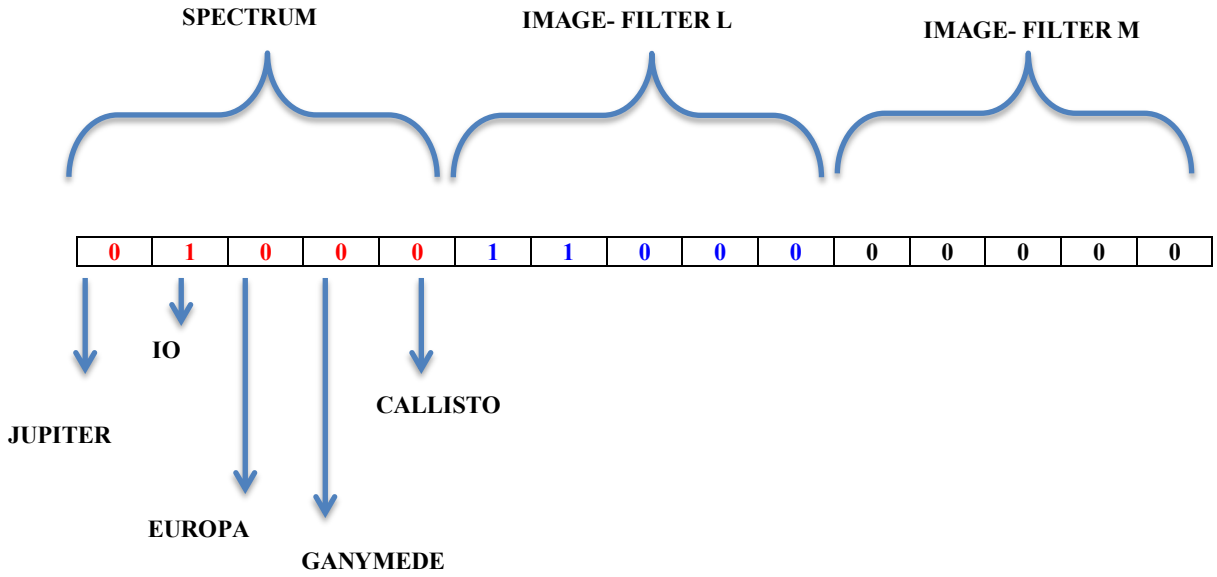
Table 24: Alphabetical list of keywords appearing in an EDR data product PDS label

10.4 *EDR-RDR JIRAM LOCAL KEYWORDS*

Keyword name	***Definition***	***Type***	***Valid values***
JNO:TARGET_PRESENCE_FLAG	It gives the information of the targets that we see in an observation. The target are:JUPITER, IO, EUROPA, GANYMEDE, CALLISTO.	CHARACTER	See Appendix:TARGET_PRESENCE_FLAG

Table 25: JIRAM Local keyword

10.5 *TARGET_PRESENCE_FLAG*



0 = The target is not in the JIRAM FOV
1 = The target is in the JIRAM FOV

In the “IMAGE. FILTER L” and “IMAGE. FILTER M” blocks it is valid the targets sequence, indicated for the “SPECTRUM":

{ 'JUPITER', 'IO', 'EUROPA', 'GANYMEDE','CALLISTO' }

10.6 *LEVEL 0 DATA RECORD FORMATS (LSSL)*

The files comprising JIRAM standard products have record formats that are specified in the PDS label files. This section shows the format component of PDS labels for each of the two types of Level 0 data file. The following tables list the housekeeping parameters.
For each word (first column) are listed: the type of telemetry packet from which it is extracted, the field and the word ordinal number in this packet, and the data field/HK name. The word is copied from the telemetry without any change. Fields identified as "SPARE" are empty.

Function	**This packet provides the SCI data via LSSL (not nominal)**			
DW (16 bits)	**Field**	**Size (bit)**	**Format**	**Description**
01	ID	16	Uint16	AAAA = HSSL link BBBB = LSSL link
02	LENGTH	16	Uint16	2324 Maximum size
03 04	SECONDS	32	Uint32	Datation of TM production time
05	SUBSECONDS	16	Uint16	Datation of TM production time, subsecond See 8.1 for description
06	COUNTER	16	Uint16	TM sequence counter
07 H	MODE	8	Uint8	Current Mode See Table 6
07 L	SUBMODE	8	Uint8	Current Submode See Table 6
	ACQ DATA			
08	ACQ_NUMBER	16	Uint16	Total number of acquisitions in the current session/sequence step Min=1; Max=65535
09	ACQ_COUNT	16	Uint16	Current acquisition number in the current session Min=1; Max= ACQ_NUMBER
10 H	ACQ_REPETITION	8	Uint8	Number of SC revolutions between two acquisitions Min=1; Max=255
10 L	ACQ_DURATION	8	Uint 8	Acquisition Cycle duration 0 = use SC Dynamics Else Min=27; Max=255;
11	SUBFRAME_NUMBER	16	Uint16	Total number of sub-frames for current acquisition phase Min=2; Max=6
12 bit 15-13	SUBFRAME_COUNT	3	Enum	Current sub-frame in the current acquisition Min=1; Max=6
12 bit 12	DATATION	1	Enum	0=external (nominal) 1=internal (recovery)
12 bit 11	WARN_DATATION_STEP	1	Enum	0= OK 1=Out of datation tolerance
12 bit 10	FRAME_ERROR_FLAG	1	Enum	Flag used to signal there was a timeout error during the acquistion 0=ACQ OK 1=ACQ ERROR
12 bit 9-7	ACQ_TYPE	3	Enum	Type of acquisition 0 = Science

				1 = Double Science Frame 1 2 = Double Science Frame 2 3 = Background 4= Dark 5= Readout noise
12 bit 6	CHANNEL_ID	1	Enum	Detector used for the current subframe 0 = Spectrum IR 1 = Image IR
12 bit 5-4	COMP_STATUS	2	Enum	Compression status of the current subframe 0 = Not compressed data 1 = Compressed data 2 = Not compressed data due to error
12 bit 3-2	SUBFRAME_TYPE	3	Enum	Type of subframe 0 = ImSubFrame = 128 x144 pixel 1 = SpSubFrameF = 128x112 pixel 2 = SpSubFrameM = 64x112 pixel 3 = SpSubFrameS = 16x112 pixel
12 bit 1-0	ROW_BACK_SUBTRACTION	2	Enum	RICE subtraction 0= Subtraction disabled 1= Background subtraction on 2= Reference row subtraction on
13 bit 15-12	START_NOISY_BITS	4	Uint4	It is the echo of SP_START_NOISY_BITS Set to 0 in case of compression error or not compressed data or JPG compression
13 bit 11-8	END_NOISY_BITS	4	Uint4	It is the echo of SP_END_NOISY_BITS Set to 0 in case of compression error or not compressed data or JPG compression
13 bit 7-4	CR_ROW	4	Uint4	Compression reference rows offset It is the echo of SP_CR_ROW Range 0..15 Not valid in case of not compressed data or JPG compression
13 bit 3-0	NOF_NOISY_BITS	4	Uint4	Number of used noisy bits Set to 0 in case of compression error or not compressed data or JPG compression
14	MAX_VAL_JPEG	16	Uint16	Max value for the pixel in JPEG compression. Not used in RICE.
15	MIN_VAL_JPEG	16	Uint16	Min value for the pixel in JPEG compression. Not used in RICE
16	TEXPO	16	Uint 16	Expo time for the used detector Min=0; Max=65535 ;Res=0.2msec ;
17	TDELAY	16	Uint 16	Delay time for the used detector Min=0 ;Max=65535; Res=0.2msec ;
	SCI DATA AND HK			
18 19	SECONDS	32	Uint32	Datation of science and HK acquisition time (when the command of start acquisition is sent to the internal IF), second See 8.1 for the description
20	SUBSECONDS	16	Uint16	Datation of science and HK acquisition time (when the command of start acquisition is sent to the internal IF),, subsecond See 8.1 for the description
21	NADIR_OFFSET	16	Iint16	Nadir offset angle related to the current frame , calculated by the sw (For example NADIR_OFFSET_1 +

				NADIR_DELTA) Min=0; Max=57343; Res=0.003138951 deg (optical) NB: Used with the sign bit in the word 26 (bit 0) to generate negative angles.
22 Bit 15-8	BKG_REPETITION	8	Uint8	Period of Background acquisition Min=0; Max=50 Cases: 1) If it is set to 0 every JIRAM acquisition is a science acquisition 2) If it is set to 1 every JIRAM acquisition is a background acquisition 3) If it is set to 2 JIRAM performs the sequence: background acquisition science acquisition background acquisition science acquisition 4) If it is set to 3 JIRAM performs the sequence: background acquisition science acquisition science acquisition background acquisition science acquisition science acquisition
22 Bit 7-6	EN_DIS_SUB	2	Enum	Background subtraction enabled 0=EN 1=DIS
22 Bit 5-3	BKG_RN	3	Enum	Type of background 0=BKG (Internal background, mirror in BKG position) 1=RN (readout noise, mirror in BOSIGHT position with Texpo=0) 2=DARK (External background, mirror in DARK position)
22 Bit 2-0	EN_DIS_DOU_SCI	3	Enum	0=EN 1=DIS
23H	WIN1_X	8	Uint8	X coordinates of the SPE win or IMG L band win Min=0 Max 255 Res:1IDN=1pixel
23L	WIN1_Y	8	Uint8	Y coordinates of the SPE win or IMG L band win Min=0 Max 255 Res:1IDN=1pixel
24H	WIN2_X	8	Uint8	X coordinates of the IMG M band win, 0 in the case of SPE Min=0 Max 255 Res:1IDN=1pixel
24L	WIN2_Y	8	Uint8	Y coordinates of the IMG M band win, 0 in the case of SPE Min=0 Max 255 Res:1IDN=1pixel
25	DET_TEMP	16	Uint16	Temperature for the used detector Min=0; Max=16383; Res: 1DN=TBD K
26 bit 15-13	STATUS_DET	3	Enum	Detector status 0=OFF 1=ON 2=AUTO 3=NA

26 bit 12	STATUS_GAIN	1	Enum	Gain status for the detector 0=LOW 1=HIGH
26 bit 11	M_STATUS_LOOP_ERROR_FLAG	1	Enum	Motor control loop error flag 0=OK 1=ERROR
26 bit 10	M_STATUS_MOTOR_MODE	1	Enum	Despinning mode, acquired from FPA 0=POINT 1=DE-SPIN
26 bit 9	M_STATUS_MOTOR_POWER	1	Enum	Motor power status 0=Motor power off 1=Motor power on
26 bit 8	M_STATUS_ON_OFF	1	Enum	Motor status 0=Motor off 1=Motor on
26L Bit 7-1	Spare	7		
26 Bit 0	NADIR_OFFSET_SIGN	16	Uint	Field used to generate negative angles of Nadir Offset. Used with the word 21. 0= positive or 0 1=negative
27	S_TELESCOPE_MIRROR_TEMP	16	Uint16	Telescope mirror temperature Min=0; Max=16383;
28	S_SLIT_TEMP	16	Uint16	Slit temperature Min=0; Max=16383;
29	S_SC_IF_TEMP	16	Uint16	Interface with the S/C temperature Min=0; Max=16383;
30	S_COLD_RADIATOR_TEMP	16	Uint16	Cold radiator temperature Min=0; Max=16383;
31	S_ SPECTROMETER_MIRROR_TEMP	16	Uint16	S_ SPECTROMETER_MIRROR_TEMP
32	M_MOTOR_TS	16	Uint16	Motor temperature Min=0; Max=16383;
33	M_CAL_SOURCE_TEMP	16	Uint16	Lamp 1 (main) temperature Min=0; Max=16383;
34	M_DIFFUSER_CAL_TEMP	16	Uint16	Calibration diffuser temperature Min=0; Max=16383;
35	M_MOTOR_START_POS	16	Uint16	Motor pointing or despin start position Min=0 (-12.85714286 opt.deg); Max=8190 (12.85086496 opt.deg); Res: 0.003138951 deg (optical)
	CAL DATA			
36 bit 15-14	Lamp_ID	2	Enum	Calibration Source ID
36 bit 13 -8	Lamp_gain_current_1	6	Enum	Gain current Min=0; Max=15 0=TBD mA 1=TBD mA . 15=TBDmA
36 Bit 7-2	Lamp_gain_current_2	6		Gain current for the redundant lamp Min=0 ; Max=15 Res : See RD3 It's a valid field only for the steps 3-4 of the CAL mode. It's a don't care field if in SCI mode and during the steps 1-2 and 5-6 of the CAL mode.
36 bit 1-0	Spare	2		
	SUBFRAME DATA			

37	SUBFRAME_TOTAL_CHUNKS	16	Uint16	Total number of chunks for this subframe
38	SUBFRAME_CURRENT_CHUNK	16	Uint16	Number of current chunk for the current subframe

*Table 26: **HK LSSL**.*

10.7 *LEVEL 0 DATA RECORD FORMATS (HSSL)*

Function	This packet provides the SCI and CAL data via HSSL (nominal)			
DW (16 bits)	**Field**	**Size (bit)**	**Format**	**Description**
01	ID	16	Uint16	AAAA = HSSL link BBBB = LSSL link
02	LENGTH	16	Uint16	36932 (Maximum size)
03 04	SECONDS	32	Uint32	Datation of TM production time, second See 8.1 for description
05	SUBSECONDS	16	Uint16	Datation of TM production time, subsecond See 8.1 for description
06	COUNTER	16	Uint16	TM sequence counter
07 H	MODE	8	Uint8	Current Mode See Table 6
07 L	SUBMODE	8	Uint8	Current Submode See Table 6
	ACQ DATA			
08	ACQ_NUMBER	16	Uint16	Total number of acquisitions in the current session/sequence step Min=1; Max=65535
09	ACQ_COUNT	16	Uint16	Current acquisition number in the current session Min=1; Max= ACQ_NUMBER
10 H	ACQ_REPETITION	8	Uint8	Number of SC revolutions between two acquisitions Min=1; Max=255
10 L	ACQ_DURATION	8	Uint 8	Acquisition Cycle duration 0 = use SC Dynamics Else Min=27; Max=255;
11	SUBFRAME_NUMBER	16	Uint16	Total number of sub-frames for current acquisition phase Min=2; Max=6
12 bit 15-13	SUBFRAME_COUNT	3	Enum	Current sub-frame in the current acquisition Min=1; Max=6
12 bit 12	DATATION	1	Enum	0=external (nominal) 1=internal (recovery)
12 bit 11	WARN_DATATION_STEP	1	Enum	0= OK 1=Out of datation tolerance (same of ERROR #30, see table 8.3.3)
12 bit 10	FRAME_ERROR_FLAG	1	Enum	Flag used to signal there was a timeout error during the acquisition 0=ACQ OK 1=ACQ ERROR
12 bit 9-7	ACQ_TYPE	3	Enum	Type of acquisition 0 = Science 1 = Double Science Frame 1 2 = Double Science Frame 2 3 = Background 4= Dark 5= Readout noise 6= Calibration frame
12 bit 6	CHANNEL_ID	1	Enum	Detector used for the current subframe 0 = Spectrum IR 1 = Image IR

12 bit 5-4	COMP_STATUS	2	Enum	Compression status of the current subframe 0 = Not compressed data 1 = Compressed data 2 = Not compressed data due to error
12 bit 3-2	SUBFRAME_TYPE	3	Enum	Type of subframe 0 = ImSubFrame = 128 x144 pixel 1 = SpSubFrameF = 128x112 pixel 2 = SpSubFrameM = 64x112 pixel 3 = SpSubFrameS = 16x112 pixel
12 bit 1-0	ROW_BACK_SUBTRACTION	2	Enum	RICE subtraction 0= Subtraction disabled 1= Background subtraction on 2= Reference row subtraction on
13 bit 15-12	START_NOISY_BITS	4	Uint4	It is the echo of SP_START_NOISY_BITS Set to 0 in case of compression error or not compressed data or JPG compression
13 bit 11-8	END_NOISY_BITS	4	Uint4	It is the echo of SP_END_NOISY_BITS Set to 0 in case of compression error or not compressed data or JPG compression
13 bit 7-4	CR_ROW	4	Uint4	Compression reference rows offset It is the echo of SP_CR_ROW Range 0..15 Not valid in case of not compressed data or JPG compression
13 bit 3-0	NOF_NOISY_BITS	4	Uint4	Number of used noisy bits Set to 0 in case of compression error or not compressed data or JPG compression
14	MIN_PIXEL_JPEG	16	Uint16	Max value for the pixel in JPEG compression. Not used in RICE
15	MAX_PIXEL_JPEG	16	Uint16	Min value for the pixel in JPEG compression. Not used in RICE
16	TEXPO	16	Uint 16	Expo time for the used detector Min=0; Max=65535 ;Res=0.2msec ;
17	TDELAY	16	Uint 16	Delay time for the used detector Min=0 ;Max=65535; Res=0.2msec ;
	SCI DATA AND HK			
18 19	SECONDS	32	Uint32	Datation of science and HK acquisition time (when the command of start acquisition is sent to the internal IF), second See 8.1 for the description
20	SUBSECONDS	16	Uint16	Datation of science and HK acquisition time (when the command of start acquisition is sent to the internal IF), subsecond See 8.1 for the description
21	NADIR_OFFSET	16	Iint16	Nadir offset angle (Deg/100) related to the current frame , calculated by the sw (For example NADIR_OFFSET_1 + NADIR_DELTA)
22 Bit 15-8	BKG_REPETITION	8	Uint8	Period of Background acquisition Min=0; Max=50
22 Bit 7-6	EN_DIS_SUB	2	Enum	Background subtraction enabled 0=EN 1=DIS

22 Bit 5-3	BKG_RN	3	Enum	Type of background 0=BKG 1=RN 2=DARK
22 Bit 2-0	EN_DIS_DOU_SCI	3	Enum	0=EN 1=DIS
23H	WIN1_X	8	Uint8	X coordinates of the SPE win or IMG L band win Min=0 Max 255 Res:1IDN=1pixel
23L	WIN1_Y	8	Uint8	Y coordinates of the SPE win or IMG L band win Min=0 Max 255 Res:1IDN=1pixel
24H	WIN2_X	8	Uint8	X coordinates of the IMG M band win, 0 in the case of SPE Min=0 Max 255 Res:1IDN=1pixel
24L	WIN2_Y	8	Uint8	Y coordinates of the IMG M band win, 0 in the case of SPE Min=0 Max 255 Res:1IDN=1pixel
25	DET_TEMP	16	Uint16	Temperature for the used detector Min=0; Max=16383; Res: 1DN=TBD K
26 bit 15-13	STATUS_DET	3	Enum	Detector status 0=OFF 1=ON 2=AUTO 3=TBD
26 bit 12	STATUS_GAIN	1	Enum	Gain status for the detector 0=LOW 1=HIGH
26 bit 11	M_STATUS_LOOP_ERROR_FLAG	1	Enum	Motor control loop error flag 0=OK 1=ERROR
26 bit 10	M_STATUS_MOTOR_MODE	1	Enum	Despinning mode, acquired from FPA 0=POINT 1=DE-SPIN
26 bit 9	M_STATUS_MOTOR_POWER	1	Enum	Motor power status 0=Motor power off 1=Motor power on
26 bit 8	M_STATUS_ON_OFF	1	Enum	Motor status 0=Motor off 1=Motor on
26	Spare	7		
27	S_TELESCOPE_MIRROR_TEMP	16	Uint16	Telescope mirror temperature Min=0; Max=16383;
28	S_SLIT_TEMP	16	Uint16	Slit temperature Min=0; Max=16383;
29	S_SC_IF_TEMP	16	Uint16	Interface with the S/C temperature Min=0; Max=16383;
30	S_COLD_RADIATOR_TEMP	16	Uint16	Cold radiator temperature Min=0; Max=16383;
31	S_SPECTROMETER_MIRROR_TEMP	16	Uint16	Spectrometer mirror temperature Min=0; Max=16383;
32	M_MOTOR_TS	16	Uint16	Motor temperature Min=0; Max=16383;
33	M_CAL_SOURCE_TEMP	16	Uint16	Lamp 1 (main) temperature Min=0; Max=16383;
34	M_DIFFUSER_CAL_TEMP	16	Uint16	Calibration diffuser temperature Min=0; Max=16383;

35	M_MOTOR_START_POS	16	Uint16	Motor point/despin start position Min=0 (-12.85714286 opt. deg); Max =16380 (12.85086496 opt. deg) ; Res: 0.00156948 deg (optical)
	CAL DATA			
36 bit 15-14	Lamp_ID	2	Enum	Calibration Source ID 0=Main ON 1=Redundant ON 2=Both ON
36 Bit 13 -8	Lamp_gain_current_1	6	Enum	Gain current for the main lamp. Min=0; Max=15 See RD3 It's a valid field only for the steps 3-4 of the CAL mode. It's a don't care field if in SCI mode and during the steps 1-2 and 5-6 of the CAL mode.
36 bit 7-2	Lamp_gain_current_2	6	Enum	Gain current for the redundant lamp. Min=0; Max=15 See RD3 It's a valid field only for the steps 3-4 of the CAL mode. It's a don't care field if in SCI mode and during the steps 1-2 and 5-6 of the CAL mode.
36 bit 1-0	Spare	2		

*Table 27: **HK HSSL**.*

10.8 *JIRAM MODE-SUBMODE AND DATA VOLUME*

Mode	Sub mode	MODE SUBMODE hex	Frame I (Pixel)	Frame S (Pixel)	Sub Frame I	Sub Frame S	HSSL Data Volume uncomp (Mbits)	I comp factor	S comp factor	HSSL Science Data Volume comp min (Mbits)	HSSL Science Data Volume comp max (Mbits)	LSSL HK Data Volume (Mbits)
INI	None	10 00	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,026
SWM	None	20 00	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,026
SAF	None	30 00	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,026
STB	None	40 00	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,026
CAL	I1-S1	50 11	110592	86016	6	6	18,91	6	1,3-1,5	8,16	7,31	0,026
CAL	I2-S2	50 22	55296	21504	3	3	7,39	6	1,3-1,5	2,49	2,28	0,026
CAL	I3-S3	50 33	55296	5376	3	3	5,84	6	1,3-1,5	1,30	1,25	0,026
SCI	I0-S1	60 01	0	86016	0	6	1,38	6	1,3-1,5	1,06	0,92	0,026
SCI	I0-S2	60 02	0	21504	0	3	0,34	6	1,3-1,5	0,27	0,23	0,026
SCI	I0-S3	60 03	0	5376	0	3	0,08	6	1,3-1,5	0,68	0,06	0,026
SCI	I1-S0	60 10	110592	0	6	0	1,77	6	1,3-1,5	0,3	0,3	0,026
SCI	I1-S1	60 11	110592	86016	6	6	3,15	6	1,3-1,5	1,36	1,22	0,026
SCI	I1-S2	60 12	110592	21504	6	3	2,12	6	1,3-1,5	0,56	0,53	0,026
SCI	I1-S3	60 13	110592	5376	6	3	1,86	6	1,3-1,5	0,37	0,36	0,026
SCI	I2-S0	60 20	55296	0	3	0	0,88	6	1,3-1,5	0,15	0,15	0,026
SCI	I2-S1	60 21	55296	86016	3	6	2,26	6	1,3-1,5	1,21	1,07	0,026
SCI	I2-S2	60 22	55296	21504	3	3	1,23	6	1,3-1,5	0,41	0,38	0,026
SCI	I2-S3	60 23	55296	5376	3	3	0,97	6	1,3-1,5	0,22	0,21	0,026
SCI	I3-S0	60 30	55296	0	3	0	0,88	6	1,3-1,5	0,15	0,15	0,026
SCI	I3-S1	60 31	55296	86016	3	6	2,27	6	1,3-1,5	1,21	1,07	0,026
SCI	I3-S2	60 32	55296	21504	3	3	1,23	6	1,3-1,5	0,42	0,38	0,026
SCI	I3-S3	60 33	55296	5376	3	3	0,97	6	1,3-1,5	0,22	0,21	0,026

Table 28: JIRAM Mode Submode and Data Volume

10.9 *JIRAM AUXILIARY DATA FILE*

Field Name	Type	Description	Applicable Modes
FILE_NAME	CHARACTER	Science file Name	SCI, CAL
COMMAND_FILE_NAME	CHARACTER	Command file name	SCI, CAL
MODE	CHARACTER	Operative Mode	SCI, CAL
SCLK	20		SCI, CAL
ET	20		SCI, CAL
GeometryEpoch	20		SCI, CAL
FRAME_TYPE	CHARACTER	Type of acquisition 0-Science 1-Double Science Frame 1 2-Double Science frame 2 3-Background 4-Dark 5-Readout noise	SCI
ACQ_NUMBER	INTEGER	Total number acquisition	SCI, CAL
ACQ_COUNT	INTEGER	Current acquisition number in the current session	SCI, CAL
ACQ_REPETITION	INTEGER	Numbers of SC revolutions between two acquisitions. (Min= 1 – Max = 255);	SCI
ACQ_DURATION	INTEGER	Acquisition Cycle duration (Min= 27 – Max = 255); 0=use SC Dynamics.	SCI, CAL
ACQ_TYPE	CHARACTER	Type of acquisition: Science, Double SCience Frame 1, Double SCience Frame 2, Background (Internal background), Dark (External background), Readout noise, Calibration frame.	SCI, CAL
LAMP	CHARACTER	Lamp: Lamp_1 Lamp_2 Both_lamp	CAL
BKG_REPETITION	INTEGER	Period of Background acquisition	SCI
LAMP_GAIN_CURRENT_1	NTEGER	GAIN current for main lamp	CAL
LAMP_GAIN_CURRENT_2	NTEGER	GAIN current for main lamp	CAL
DETECTORS	CHARACTER	Detector: Spectrum IR Image IR	SCI, CAL
STATUS_GAIN	CHARACTER	Gain status for the detector 0=LOW 1=HIGH	SCI, CAL
LINK	CHARACTER	Link: HSSL LSSL	SCI
COMP_STATUS	CHARACTER	Compression status of the current subframe: 0-Not compressed data, 1-Compressed data, 2-Not compressed data due to error	SCI, CAL
EN_DIS_SUB	CHARACTER	Background subtraction enabled -BC_SUBTRACTION_EN disabled-BC_SUBTRACTION_DIS	SCI, CAL

BKG_RN	CHARACTER	Type of background: BKG (Internal background, mirror in BKG position) RN (readout noise, mirror in BOSIGHT position with Texpo=0) DARK (External background, mirror in DARK position)	SCI
STATUS_DET	CHARACTER	Detector status 0=OFF 1=ON 2=AUTO 3=TBD	SCI, CAL
TEXPO	INTEGER	Expo Time for the used detector.	SCI, CAL
TDELAY	INTEGER	Delay Time for the used detector.	SCI, CAL
NADIR_OFFSET	NTEGER	Nadir offset angle related to the current frame.	SCI
DET_TEMP	FLOAT	Temperature in °K for the used detector	SCI, CAL
S_TELESCOPE_MIRROR_TEMP	FLOAT	Telescope mirror temperature in °K	SCI, CAL
S_SLIT_TEMP	FLOAT	Slit temperature in °K	SCI, CAL
S_SC_IF_TEMP	FLOAT	Interface with the S/C temperature in °K	SCI, CAL
S_COLD_RADIATOR_TEMP	FLOAT	Cold radiator temperature in °K	SCI, CAL
S_SPECTROMETER_MIRROR_TEMP	FLOAT	Spectrometer mirror temperature in °K	SCI, CAL
M_MOTOR_TS	FLOAT	Motor temperature in °K	SCI, CAL
M_CAL_SOURCE_TEMP	FLOAT	Lamp_1 (main) temperature in °K	SCI, CAL
M_DIFFUSER_CAL_TEMP	FLOAT	Calibration temperature in °K	SCI, CAL

Table 29: JIRAM Auxiliary fields

10.10 *RDR LABEL DATA IMG*

```
PDS_VERSION_ID                  = PDS3

/* Dataset and Product Information */
DATA_SET_NAME                   = "JUNO JUPITER JIRAM REDUCED DATA RECORD V1.0"
DATA_SET_ID                     = "JNO-J-JIRAM-3-RDR-V1.0"
PRODUCT_ID                      = JIR_IMG_RDR_2022012T092203_V01
PRODUCT_TYPE                    = RDR
PROCESSING_LEVEL_ID             = "3"
START_TIME                      = 2022-01-12T09:22:01.269
STOP_TIME                       = 2022-01-12T09:22:01.284
SPACECRAFT_CLOCK_START_COUNT    = "5/695251710:43909"
SPACECRAFT_CLOCK_STOP_COUNT     = "5/695251710:44892"
STANDARD_DATA_PRODUCT_ID        = "IMAGE"
PRODUCER_FULL_NAME              = "A.ADRIANI - R.NOSCHESE"
INSTITUTION_NAME                = "ISTITUTO NAZIONALE DI ASTROFISICA"
PRODUCT_CREATION_TIME           = 2022-06-23T12:52:52.000
PRODUCT_VERSION_ID              = "01"
SEQUENCE_NUMBER                 = 5
SEQUENCE_SAMPLES                = 6
MD5_CHECKSUM                    = "bf45be80619ee2f7feebbd652cc6fa78"

/* Mission description parameters */
INSTRUMENT_HOST_NAME            = "JUNO"
INSTRUMENT_HOST_ID              = "JNO"
COMMAND_FILE_NAME               = "jm0390_JRMa.sasf"
MISSION_PHASE_NAME              = "SCIENCE ORBITS"

/* Instrument description parameters */
INSTRUMENT_NAME                 = "JOVIAN INFRARED AURORAL MAPPER"
INSTRUMENT_ID                   = "JIR"
INSTRUMENT_TYPE                 = "INFRARED IMAGING SPECTROMETER"
SOFTWARE_VERSION_ID             = ("EGSE_208", "PDS_RDR_v10")

ORBIT_NUMBER                    = 39
TARGET_NAME                     = "JUPITER"
TARGET_TYPE                     = "PLANET"
TARGET_PIXELS                   = 110592
JNO:TARGET_PRESENCE_FLAG        = "000001000010000"

/* Instrument status */
CHANNEL_ID                      = "1"       /* 0:SPECTRUM IR; 1:IMAGE */
INSTRUMENT_MODE_ID              = SCI_I1_S1
INSTRUMENT_MODE_DESC            =
" SCI_I1_S1: Science, IMAGE(256x432) full acquisition, SPECTRUM (256x336) High
Spatial and High spectral"

OBJECT                          = FILE
   RECORD_TYPE                  = FIXED_LENGTH
   FILE_RECORDS                 = 256
   RECORD_BYTES                 = 1728
   FRAME_TYPE                   = "SCIENCE"
   DATA_QUALITY_ID              = "1"
   DATA_QUALITY_DESC            = "0:INCOMPLETE; 1:COMPLETE"
   UNIT                         = "W/(m^2*sr)"
^IMAGE                          = "JIR_IMG_RDR_2022012T092203_V01.IMG"

/* Data Object pointers */
OBJECT                        = IMAGE
```

```
   LINES                        = 256
   LINE_SAMPLES                 = 432
   SAMPLE_TYPE                  = IEEE_REAL
   SAMPLE_BITS                  = 32
END_OBJECT                      = IMAGE

OBJECT                          = HISTORY
   CALIBRATION_SOURCE_ID        = "JIR_IMG_TOT_RESPONSIVITY_V02.DAT"
   SOURCE_PRODUCT_ID            = "JIR_IMG_EDR_2022012T092203_V01.IMG"
   NOTE                         = " SUBTRACTION BACKGROUND ON BOARD ENABLED "
END_OBJECT                      = HISTORY

SPICE_FILE_NAME                  =
{"juno_v09.tf",
"juno_jiram_v02.ti",
"juno_struct_v01.ti",
"naif0012.tls",
"pck00010.tpc",
"JNO_SCLKSCET.00130.tsc",
"de440s.bsp",
"juno_struct_v04.bsp",
"jup363.bsp",
"juno_rec_orbit.orb",
"spk_rec_211222_220204_220210.bsp",
"juno_sc_rec_220111_220112_v01.bc"}
END_OBJECT                       = FILE
END
```

10.11 *RDR LABEL DATA SPE*

```
PDS_VERSION_ID                  = PDS3

/* Identification data elements */
DATA_SET_NAME                   = "JUNO JUPITER JIRAM REDUCED DATA RECORD V1.0"
DATA_SET_ID                     = "JNO-J-JIRAM-3-RDR-V1.0"
PRODUCT_ID                      = JIR_SPE_RDR_2022012T092205_V01
PRODUCT_TYPE                    = RDR
PROCESSING_LEVEL_ID             = "3"
START_TIME                      = 2022-01-12T09:22:01.269
STOP_TIME                       = 2022-01-12T09:22:02.269
SPACECRAFT_CLOCK_START_COUNT    = "5/695251710:43909"
SPACECRAFT_CLOCK_STOP_COUNT     = "5/695251711:43909"
STANDARD_DATA_PRODUCT_ID        = "SPECTRAL"
PRODUCER_FULL_NAME              = "A.ADRIANI - R.NOSCHESE"
INSTITUTION_NAME                = "ISTITUTO NAZIONALE DI ASTROFISICA"
PRODUCT_CREATION_TIME           = 2022-06-23T12:52:52.000
PRODUCT_VERSION_ID              = "01"
SEQUENCE_NUMBER                 = 5
SEQUENCE_SAMPLES                = 6
MD5_CHECKSUM                    = "6abfe70281766f09ba0bd135772952f9"

/* Mission description parameters */
INSTRUMENT_HOST_NAME            = "JUNO"
INSTRUMENT_HOST_ID              = "JNO"
COMMAND_FILE_NAME               = "jm0390_JRMa.sasf"
MISSION_PHASE_NAME              = "SCIENCE ORBITS"

/* Instrument description parameters */
INSTRUMENT_NAME                 = "JOVIAN INFRARED AURORAL MAPPER"
INSTRUMENT_ID                   = "JIR"
INSTRUMENT_TYPE                 = "INFRARED IMAGING SPECTROMETER"
SOFTWARE_VERSION_ID             = ("EGSE_208", "PDS_RDR_v10")

ORBIT_NUMBER                    = 39
TARGET_NAME                     = "JUPITER"
TARGET_TYPE                     = "PLANET"
TARGET_PIXELS                   = 256
JNO:TARGET_PRESENCE_FLAG        = "100000000000000"

OBJECT                          = FILE
  RECORD_TYPE                   = FIXED_LENGTH
  FILE_RECORDS                  = 256
  RECORD_BYTES                  = 1344
  FRAME_TYPE                    = "SCIENCE"
  DATA_QUALITY_ID               = "1"
  DATA_QUALITY_DESC             = "0:INCOMPLETE; 1:COMPLETE"
  UNIT                          = "W/(m^2*sr*micron)"
^TABLE                          = "JIR_SPE_RDR_2022012T092205_V01.DAT"

OBJECT                         = HISTORY
  CALIBRATION_SOURCE_ID        = "JIR_SPE_RESPONSIVITY_V02.DAT"
  SOURCE_PRODUCT_ID            = "JIR_SPE_EDR_2022012T092205_V01.DAT"
  NOTE                         = " SUBTRACTION BACKGROUND ON BOARD ENABLED "
END_OBJECT                     = HISTORY
/*  Data Object pointers */

OBJECT                         = TABLE
```

```
  ROWS                          = 256
  ROW_BYTES                     = 1344
  INTERCHANGE_FORMAT            = BINARY
  ^STRUCTURE                    = "JIR_SPE_RDR_V02.FMT"
  COLUMNS                       = 336
END_OBJECT                      = TABLE

SPICE_FILE_NAME                  =
{"juno_v09.tf",
"juno_jiram_v02.ti",
"juno_struct_v01.ti",
"naif0012.tls",
"pck00010.tpc",
"JNO_SCLKSCET.00130.tsc",
"de440s.bsp",
"juno_struct_v04.bsp",
"jup363.bsp",
"juno_rec_orbit.orb",
"spk_rec_211222_220204_220210.bsp",
"juno_sc_rec_220111_220112_v01.bc"}
END_OBJECT                       = FILE
END
```

10.12 *MISSION PHASE NAMES*

The following are the Juno Project's official names for the various phases of the mission.

Mission Phase Names	*Start Time*	*Stop Time*
LAUNCH	2011-08-05	2011-08-08
INNER CRUISE 1	2011-09-01	2011-10-10
INNER CRUISE 2	2011-10-10	2013-05-28
INNER CRUISE 3	2013-05-28	2013-11-05
QUIET CRUISE	2013-11-05	2016-01-05
JUPITER APPROACH	2016-01-05	2016-06-30
JUPITER ORBIT INSERTION	2016-06-30	2016-07-05
CAPTURE ORBIT	2016-07-05	2016-10-19
PERIOD REDUCTION MANEUVER	2016-10-19	2016-10-20
ORBITS 1-2	2016-10-20	2016-11-09
SCIENCE ORBITS	2016-11-09	2017-10-11
DEORBIT	2017-10-11	2017-10-16

10.13 *LABEL AUXILIARY DATA (EDR AND RDR)*

```
PDS_VERSION_ID                  = PDS3
/* Identification data elements */
DATA_SET_NAME                = "JUNO JUPITER JIRAM EXPERIMENT DATA RECORD V1.0"
DATA_SET_ID                     = "JNO-J-JIRAM-2-EDR-V1.0"
PRODUCT_ID                      = "JIR_LOG_IMG_EDR_2022012T094206_V01"
PRODUCT_VERSION_ID              = "01"
SOURCE_PRODUCT_ID               = "JIR_IMG_EDR_2022012T094206_V01.IMG"
PRODUCT_TYPE                    = " ENGINEERING_DATA "

START_TIME                      = 2022-01-12T09:42:04.100
STOP_TIME                       = 2022-01-12T09:42:04.115
SPACECRAFT_CLOCK_START_COUNT    = "5/695252913:32899"
SPACECRAFT_CLOCK_STOP_COUNT     = "5/695252913:33882"

INSTRUMENT_NAME                 = "JOVIAN INFRARED AURORAL MAPPER"
INSTRUMENT_ID                   = "JIR"
INSTRUMENT_HOST_NAME            = "JUNO"
INSTRUMENT_HOST_ID              = "JNO"

PRODUCT_CREATION_TIME           = 2022-06-13T12:19:19.000
PROCESSING_LEVEL_ID             = "2"
RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 72
FILE_RECORDS                    = 1
STANDARD_DATA_PRODUCT_ID        = "AUXILIARY"
ORBIT_NUMBER                    = 39
TARGET_NAME                     = "JUPITER"
TARGET_TYPE                     = "PLANET"
MISSION_PHASE_NAME              = "SCIENCE ORBITS"
COMMAND_FILE_NAME               = "jm0390_JRMa.sasf"
MD5_CHECKSUM                    = "3662b08b3e6c3912471b1661d2de0600"
^TABLE                          = "JIR_LOG_IMG_EDR_2022012T094206_V01.TAB"

OBJECT                         = TABLE
  ROWS                         = 1
  ROW_BYTES                    = 72
  COLUMNS                      = 38
  INTERCHANGE_FORMAT           = BINARY
  DESCRIPTION                  = "Binary Table listing parameter extracted
                                  from instrument housekeeping telemetry.
                                  This table is associated to a binary file
                                  containing instrument science telemetry."

  OBJECT                       = COLUMN
    NAME                       = "PACKET IDENTIFICATION"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 1
    BYTES                      = 2
    START_BYTE                 = 1
    DESCRIPTION                = "Location-independent name of the file
                                  containing the current frame"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "LENGTH"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
```

```
    COLUMN_NUMBER              = 2
    BYTES                      = 2
    START_BYTE                 = 3
    DESCRIPTION                = "36936 (Maximum size)"
  END_OBJECT                   = COLUMN

  OBJECT                      = COLUMN
    NAME                      = "SECONDS"
    DATA_TYPE                 = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER             = 3
    BYTES                     = 4
    START_BYTE                = 5
    DESCRIPTION               = "Datation of TM production time"
    ITEMS                     = 2
    ITEM_BYTES                = 2
  END_OBJECT                  = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "SUBSECONDS"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 4
    BYTES                      = 2
    START_BYTE                 = 9
    DESCRIPTION                = "Datation of TM production time, subsecond"
  END_OBJECT                   = COLUMN

OBJECT                         = COLUMN
    NAME                       = "COUNTER"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 5
    BYTES                      = 2
    START_BYTE                 = 11
    DESCRIPTION                = "TM sequence counter"
  END_OBJECT                   = COLUMN

   OBJECT                      = COLUMN
    NAME                       = "SUBMODE "
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 6
    BYTES                      = 1
    START_BYTE                 = 13
    DESCRIPTION                = "Current Mode"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "MODE"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 7
    BYTES                      = 1
    START_BYTE                 = 14
    DESCRIPTION                = "Current Mode"
  END_OBJECT                   = COLUMN


  OBJECT                       = COLUMN
    NAME                       = "ACQ_NUMBER"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 8
    BYTES                      = 2
    START_BYTE                 = 15
```

```
    DESCRIPTION                = "Total number of acquisitions
       in the current session/sequence step Min=1;Max=65535"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "ACQ_COUNT"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 9
    BYTES                      = 2
    START_BYTE                 = 17
    DESCRIPTION                = "Current acquisition number
         in the current session Min=1; Max= ACQ_NUMBER"
  END_OBJECT                   = COLUMN

 OBJECT                        = COLUMN
    NAME                       = "ACQ_DURATION"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 10
    BYTES                      = 1
    START_BYTE                 = 19
    DESCRIPTION                = "Acquisition Cycle duration  0 = use SC
              Dynamics else Min=27; Max=255"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "ACQ_REPETITION"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 11
    BYTES                      = 1
    START_BYTE                 = 20
    DESCRIPTION                = "Number of SC revolutions between two
                                   acquisitions Min=1; Max=255"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "SUBFRAME_NUMBER"
    DATA_TYPE                  = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER              = 12
    BYTES                      = 2
    START_BYTE                 = 21
    DESCRIPTION                = "Total number of  sub-frames
          for current acquisition phase  Min=2; Max=6"
  END_OBJECT                   = COLUMN

  OBJECT                       = COLUMN
    NAME                       = "SUBFRAME"
    DATA_TYPE                  = LSB_BIT_STRING
    COLUMN_NUMBER              = 13
    BYTES                      = 2
    START_BYTE                 = 23

       OBJECT                        = BIT_COLUMN
         NAME                        = "SUBFRAME_COUNT"
         BIT_DATA_TYPE               = UNSIGNED_INTEGER
         BITS                        = 3
         START_BIT                   = 1
         DESCRIPTION                 = "Current sub-frame
         in the current acquisition Min=1; Max=6"
       END_OBJECT                    = BIT_COLUMN
```

```
OBJECT                        = BIT_COLUMN
  NAME                        = "DATATION"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 1
  START_BIT                   = 4
  DESCRIPTION                 = "Current sub-frame
   in the current acquisition Min=1; Max=6"
END_OBJECT                    = BIT_COLUMN

OBJECT                        = BIT_COLUMN
  NAME                        = "WARN_DATATION_STEP"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 1
  START_BIT                   = 5
 DESCRIPTION                 = "0= OK
             1=Out of datation tolerance"
END_OBJECT                    = BIT_COLUMN

OBJECT                        = BIT_COLUMN
  NAME                        = "FRAME_ERROR_FLAG"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 1
  START_BIT                   = 6
  DESCRIPTION                 = "Flag used to signal
 there was a timeout error  during the acquisition
   0 = ACQ OK
   1 = ACQ ERROR"
END_OBJECT                    = BIT_COLUMN

OBJECT                        = BIT_COLUMN
  NAME                        = "ACQ_TYPE"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 3
  START_BIT                   = 7
  DESCRIPTION                 = "Type of acquisition
   0 = Science
   1 = Double Science Frame 1
   2 = Double Science Frame 2
   3 = Background
   4 = Dark
   5 = Readout noise"
END_OBJECT                    = BIT_COLUMN

OBJECT                        = BIT_COLUMN
  NAME                        = "CHANNEL_ID"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 1
  START_BIT                   = 10
  DESCRIPTION                 = "Detector used for
    the current subframe
        0 = Spectrum IR
        1 = Image IR"
END_OBJECT                     = BIT_COLUMN

OBJECT                        = BIT_COLUMN
  NAME                        = "COMP_STATUS"
  BIT_DATA_TYPE               = UNSIGNED_INTEGER
  BITS                        = 2
  START_BIT                   = 11
  DESCRIPTION                 = "Compression status
```

```
          of the current subframe
                 0 = Not compressed data
                 1 = Compressed data
                 2 = Not compressed data due to error"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                        = BIT_COLUMN
        NAME                        = "SUBFRAME_TYPE"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 2
        START_BIT                   = 13
        DESCRIPTION                 = "Type of subframe
             0 = ImSubFrame  = 128 x144 pixel
             1 = SpSubFrameF = 128x112 pixel
             2 = SpSubFrameM = 64x112 pixel
             3 = SpSubFrameS = 16x112 pixel"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                        = BIT_COLUMN
        NAME                        = "ROW_BACK_SUBTRACTION"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 2
        START_BIT                   = 15
        DESCRIPTION                 = "RICE subtraction
               0 = Subtraction disabled
               1 = Background subtraction on
               2 = Reference row  subtraction on"
      END_OBJECT                    = BIT_COLUMN

  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "NOISY"
    DATA_TYPE                   = LSB_BIT_STRING
    COLUMN_NUMBER               = 14
    BYTES                       = 2
    START_BYTE                  = 25

      OBJECT                        = BIT_COLUMN
        NAME                        = "START_NOISY_BITS"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 4
        START_BIT                   = 1
        DESCRIPTION                 = "It is the echo
        of SP_START_NOISY_BITS set to 0 in case of compression
        error or not compressed data or JPG compression"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                         = BIT_COLUMN
         NAME                        = "END_NOISY_BITS"
         BIT_DATA_TYPE               = UNSIGNED_INTEGER
         BITS                        = 4
         START_BIT                   = 5
         DESCRIPTION                 = "It is the echo
          of SP_END_NOISY_BITS set to 0 in case of compression
          error or not compressed data or JPG compression"
       END_OBJECT                    = BIT_COLUMN

       OBJECT                        = BIT_COLUMN
         NAME                        = "CR_ROW"
```

```
          BIT_DATA_TYPE             = UNSIGNED_INTEGER
          BITS                      = 4
          START_BIT                 = 9
          DESCRIPTION               = "Compression reference
          rows offset It is the echo of  SP_CR_ROW Range 0..15
          Not valid in case of not compressed data or JPG compression "
        END_OBJECT                  = BIT_COLUMN

        OBJECT                      = BIT_COLUMN
          NAME                      = "NOF_NOISY_BITS"
          BIT_DATA_TYPE             = UNSIGNED_INTEGER
          BITS                      = 4
          START_BIT                 = 13
          DESCRIPTION               = "Number of used
          noisy bits, set to 0 in case of compression
          error or not compressed data or JPG compression"
        END_OBJECT                  = BIT_COLUMN

  END_OBJECT                  = COLUMN

  OBJECT                      = COLUMN
    NAME                      = "MIN_PIXEL_JPEG"
    DATA_TYPE                 = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER             = 15
    BYTES                     = 2
    START_BYTE                = 27
    DESCRIPTION               = "Min value for the pixel in JPEG
        compression. Not used in RICE"
  END_OBJECT                  = COLUMN

  OBJECT                      = COLUMN
    NAME                      = "MAX_PIXEL_JPEG"
    DATA_TYPE                 = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER             = 16
    BYTES                     = 2
    START_BYTE                = 29
    DESCRIPTION               = "Max value for the pixel in JPEG
              compression. Not used in RICE"
  END_OBJECT                  = COLUMN

OBJECT                        = COLUMN
    NAME                      = "TEXPO"
    DATA_TYPE                 = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER             = 17
    BYTES                     = 2
    START_BYTE                = 31
    DESCRIPTION               = "Expo time for the used detector
                          Min=0;
                          Max=65535 ;
                          Res=0.2msec;"
  END_OBJECT                  = COLUMN

 OBJECT                       = COLUMN
    NAME                      = "TDELAY"
    DATA_TYPE                 = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER             = 18
    BYTES                     = 2
    START_BYTE                = 33
    DESCRIPTION               = "Delay time for the used detector
                    Min = 0 ;
```

```
                    Max = 65535;
                    Res = 0.2msec ;"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "SECONDS"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 19
    BYTES                       = 4
    START_BYTE                  = 35
    DESCRIPTION                 = "Datation of science and HK acquisition time
  (when the command of start acquisition is sent to the internal IF), second"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "SUBSECONDS"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 20
    BYTES                       = 2
    START_BYTE                  = 39
    DESCRIPTION                 = "Datation of science and HK acquisition time
(when the command of start acquisition is sent to the internal IF) subseconds"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "NADIR_OFFSET"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 21
    BYTES                       = 2
    START_BYTE                  = 41
    DESCRIPTION                 = "Nadir offset angle (Deg/100) related
      to the current frame , calculated by the sw
    (For example NADIR_OFFSET_1 + NADIR_DELTA)"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "BACKGROUND"
    DATA_TYPE                   = LSB_BIT_STRING
    COLUMN_NUMBER               = 22
    BYTES                       = 2
    START_BYTE                  = 43

      OBJECT                        = BIT_COLUMN
        NAME                        = "BKG_REPETITION"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 8
        START_BIT                   = 1
        DESCRIPTION                 = "Period of Background
          acquisition
                  Min = 0;
                  Max = 50"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                        = BIT_COLUMN
        NAME                        = "EN_DIS_SUB"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 2
        START_BIT                   = 9
        DESCRIPTION                 = "Background subtraction
        enabled
```

```
                          0 = EN
                          1 = DIS"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                        = BIT_COLUMN
        NAME                        = "BKG_RN"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 3
        START_BIT                   = 11
        DESCRIPTION                 = "Type of background
                    0=BKG
                    1=RN
                    2=DARK"
      END_OBJECT                    = BIT_COLUMN

      OBJECT                        = BIT_COLUMN
        NAME                        = "EN_DIS_DOU_SCI"
        BIT_DATA_TYPE               = UNSIGNED_INTEGER
        BITS                        = 3
        START_BIT                   = 14
        DESCRIPTION                 = "
                              0 : EN
                              1 : DIS"
      END_OBJECT                    = BIT_COLUMN

END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
   NAME                        = "WIN1_X"
   DATA_TYPE                   = LSB_UNSIGNED_INTEGER
   COLUMN_NUMBER               = 23
   BYTES                       = 1
   START_BYTE                  = 45
   DESCRIPTION                 = "X coordinates of the SPE win or IMG L band
  Win Min=0 Max 255 Res:1IDN=1pixel"
 END_OBJECT                    = COLUMN

 OBJECT                        = COLUMN
   NAME                        = "WIN1_Y"
   DATA_TYPE                   = LSB_UNSIGNED_INTEGER
   COLUMN_NUMBER               = 24
   BYTES                       = 1
   START_BYTE                  = 46
   DESCRIPTION                 = "Y coordinates of the SPE win or
 IMG L band win Min=0 Max 255 Res:1IDN=1pixel"
 END_OBJECT                    = COLUMN

 OBJECT                        = COLUMN
   NAME                        = "WIN2_X"
   DATA_TYPE                   = LSB_UNSIGNED_INTEGER
   COLUMN_NUMBER               = 25
   BYTES                       = 1
   START_BYTE                  = 47
   DESCRIPTION                 = "X coordinates of the IMG M band win, 0
    in the case of SPE Min=0 Max 255 Res:1IDN=1pixel"
 END_OBJECT                    = COLUMN

 OBJECT                        = COLUMN
   NAME                        = "WIN2_Y"
   DATA_TYPE                   = LSB_UNSIGNED_INTEGER
```

```
  COLUMN_NUMBER              = 26
  BYTES                      = 1
  START_BYTE                 = 48
  DESCRIPTION                = "Y coordinates of the IMG M band win, 0
       in the case of SPE Min=0 Max 255 Res:1IDN=1pixel"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
  NAME                       = "DET_TEMP"
  DATA_TYPE                  = LSB_UNSIGNED_INTEGER
  COLUMN_NUMBER              = 27
  BYTES                      = 2
  START_BYTE                 = 49
  DESCRIPTION                = "Temperature for the used detector
              Min=0; Max=16383; Res: 1DN=TBD K"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
  NAME                       = "STATUS"
  DATA_TYPE                  =  LSB_BIT_STRING
  COLUMN_NUMBER              = 28
  BYTES                      = 2
  START_BYTE                 = 51

     OBJECT                        = BIT_COLUMN
       NAME                        = "STATUS_DET"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
       BITS                        = 3
       START_BIT                   = 1
       DESCRIPTION                 = "Detector status
                       0 = OFF
                       1 = ON
                       2 = AUTO
                       3 = NA"
     END_OBJECT                    = BIT_COLUMN

     OBJECT                        = BIT_COLUMN
       NAME                        = "STATUS_GAIN"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
       BITS                        = 1
       START_BIT                   = 4
       DESCRIPTION                 = "Gain status
       for the detector
                         0 = LOW
                         1 = HIGH"
     END_OBJECT                    = BIT_COLUMN


     OBJECT                          = BIT_COLUMN
       NAME                        = "M_STATUS_LOOP_ERROR_FLAG"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
       BITS                        = 1
       START_BIT                   = 5
       DESCRIPTION                 = "Motor control loop
       error flag
                   0 = OK
                   1 = ERROR"
     END_OBJECT                    = BIT_COLUMN

     OBJECT                        = BIT_COLUMN
```

```
    NAME                        = "M_STATUS_MOTOR_MODE"
    BIT_DATA_TYPE               = UNSIGNED_INTEGER
    BITS                        = 1
    START_BIT                   = 6
    DESCRIPTION                 = "Despinning mode,
    acquired from FPA
                0 = POINT
                1 = DE-SPIN"
  END_OBJECT                    = BIT_COLUMN

  OBJECT                        = BIT_COLUMN
    NAME                        = "M_STATUS_MOTOR_POWER"
    BIT_DATA_TYPE               = UNSIGNED_INTEGER
    BITS                        = 1
    START_BIT                   = 7
    DESCRIPTION                 = "Motor power status
                    0 = Motor power off
                    1 = Motor power on"
  END_OBJECT                    = BIT_COLUMN

  OBJECT                        = BIT_COLUMN
    NAME                        = "M_STATUS_ON_OFF"
    BIT_DATA_TYPE               = UNSIGNED_INTEGER
    BITS                        = 1
    START_BIT                   = 8
    DESCRIPTION                 = "Motor status
              0 = Motor off
              1 = Motor on"
  END_OBJECT                    = BIT_COLUMN

  OBJECT                        = BIT_COLUMN
    NAME                        = "SPARE"
    BIT_DATA_TYPE               = UNSIGNED_INTEGER
    BITS                        = 7
    START_BIT                   = 9
    DESCRIPTION                 = "SPARE"

  END_OBJECT                    = BIT_COLUMN

  OBJECT                        = BIT_COLUMN
    NAME                        = "NADIR_OFFSET_SIGN"
    BIT_DATA_TYPE               = UNSIGNED_INTEGER
    BITS                        = 1
    START_BIT                   = 15
    DESCRIPTION                 = "UTC system format
    time corresponding to the SPACECRAFT ELAPSED TIME count"
  END_OBJECT                    = BIT_COLUMN

END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "S_TELESCOPE_MIRROR_TEMP"
  DATA_TYPE                     = LSB_UNSIGNED_INTEGER
  COLUMN_NUMBER                 = 29
  BYTES                         = 2
  START_BYTE                    = 53
  DESCRIPTION                   = "Telescope mirror temperature
            Min=0; Max=16383; Res: See RD3"
END_OBJECT                      = COLUMN
```

```
  OBJECT                        = COLUMN
    NAME                        = "S_SLIT_TEMP"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 30
    BYTES                       = 2
    START_BYTE                  = 55
    DESCRIPTION                 = "Slit temperature
                  Min=0; Max=16383; Res: 1DN=TBD K"
  END_OBJECT                    = COLUMN

OBJECT                         = COLUMN
    NAME                        = "S_SC_IF_TEMP"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 31
    BYTES                       = 2
    START_BYTE                  = 57
    DESCRIPTION                 = "Interface with the S/C temperature
                        Min=0; Max=16383; Res: 1DN=TBD K"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "S_COLD_RADIATOR_TEMP"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 32
    BYTES                       = 2
    START_BYTE                  = 59
    DESCRIPTION                 = "Cold radiator temperature
                Min=0; Max=16383; Res: 1DN=TBD K"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "S_SPECTROMETER_MIRROR_TEMP"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 33
    BYTES                       = 2
    START_BYTE                  = 61
    DESCRIPTION                 = "Spectrometer mirror temperature
             Min=0; Max=16383; Res: See RD3"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "M_MOTOR_TS"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 34
    BYTES                       = 2
    START_BYTE                  = 63
    DESCRIPTION                 = "Motor temperature
              Min=0; Max=16383; Res: 1DN=TBD K"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "M_CAL_SOURCE_TEMP"
    DATA_TYPE                   = LSB_UNSIGNED_INTEGER
    COLUMN_NUMBER               = 35
    BYTES                       = 2
    START_BYTE                  = 65
    DESCRIPTION                 = "Lamp 1 (main) temperature
             Min=0; Max=16383; Res: 1DN=TBD K"
  END_OBJECT                    = COLUMN
```

```
OBJECT                       = COLUMN
  NAME                       = "M_DIFFUSER_CAL_TEMP"
  DATA_TYPE                  = LSB_UNSIGNED_INTEGER
  COLUMN_NUMBER              = 36
  BYTES                      = 2
  START_BYTE                 = 67
  DESCRIPTION                = "Calibration diffuser temperature
                  Min=0; Max=16383; Res: 1DN=TBD K"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
  NAME                       = "M_MOTOR_START_POS"
  DATA_TYPE                  = LSB_UNSIGNED_INTEGER
  COLUMN_NUMBER              = 37
  BYTES                      = 2
  START_BYTE                 = 69
  DESCRIPTION                = "Motor point/despin start position
               Min = 0 (-12.85714286 opt. deg);
               Max = 16380 (12.85086496 opt. deg) ;
             Res: 0.00156948 deg (optical)"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
  NAME                       = "LAMP"
  DATA_TYPE                  =  LSB_BIT_STRING
  COLUMN_NUMBER              = 38
  BYTES                      = 2
  START_BYTE                 = 71

     OBJECT                        = BIT_COLUMN
       NAME                        = "LAMP_ID"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
       BITS                        = 2
       START_BIT                   = 1
       DESCRIPTION                 = "Calibration Source ID
                 0=Main ON
                 1=Redundant ON
                 2=Both ON
This is the echo of the TC_CALIBRATION devoted filed.
It is a do not care COLUMN              if in SCI mode."
     END_OBJECT                    = BIT_COLUMN

     OBJECT                        = BIT_COLUMN
       NAME                        = "LAMP_GAIN_CURRENT_1"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
       BITS                        = 6
       START_BIT                   = 3
       DESCRIPTION                 = "Gain current
       for the main lamp.
       Min=0; Max=15
       It is a valid filed only for the steps 3-4 of
       the CAL mode.
       It is a do not care COLUMN if in SCI mode and
       during the steps 1-2 and 5-6 of the CAL mode."
     END_OBJECT                    = BIT_COLUMN

     OBJECT                        = BIT_COLUMN
       NAME                        = "LAMP_GAIN_CURRENT_2"
       BIT_DATA_TYPE               = UNSIGNED_INTEGER
```

```
      BITS                        = 6
      START_BIT                   = 9
      DESCRIPTION                 = "Gain current for the redundant lamp.
           Min=0; Max=15
      It is a valid filed only for the steps 3-4 of
      the CAL mode.
      It is a do not care COLUMN if in SCI mode and
      during the steps 1-2 and 5-6 of the CAL mode."
    END_OBJECT                    = BIT_COLUMN

    OBJECT                        = BIT_COLUMN
      NAME                        = "SPARE"
      BIT_DATA_TYPE               = UNSIGNED_INTEGER
      COLUMN_NUMBER               = 2
      BITS                        = 2
      START_BIT                   = 15
      DESCRIPTION                 = "SPARE"
    END_OBJECT                    = BIT_COLUMN


END_OBJECT                    = COLUMN

END_OBJECT                    = TABLE
END
```