OSIRIS

Optical, Spectroscopic, and Infrared Remote Imaging System

Osiris Experiment Data Record and Software Interface Specification (EDR/SIS)

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Document Change Record

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1a	12/12-2004	all	First draft
1b	28/2-2005	page 11	Added PRODUCT_VERSION_ID to label description
2a	1/11-2006	all	Major rewrite of introductory sections Geometry related PDS labels modified Added PDS group describing the calibration pipeline header additions
2b	3/5-2007		Add definition of PROCESSING_ID Changed the definition of FILTER_NUMBER and COMMANDED_ FILTER_NUMBER Changed the definition of FILTER_NAME and COMMANDED_ FILTER_NAME Changed the description of the X_START, X_END, Y_START, Y_END labels
3a	13/5-2009	all	Added description of new PA_IMAGE/OL_IMAGE/PB_IMAGE/QUALITY _MAP_IMAGE and SIGMA_MAP_IMAGE objects Deleted the PROCESSING_ID group
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3d	11/5-2010	91	Added better description of the quality map
3e	22/6-2010	38	Added new Non PDS label SSMM_TIME
3f	8/11-2010	38,41	Added better description of the START_TIME label Added LIGHT_SOURCE_PHASE_ANGLE to geometry labels
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3h	2/12-2010		Updated the example PDS label Removed TARGET_LIST label again (PVV problems)
3i	28/1-2011		Marked LOST packets as Non PDS
3j	8/3-2011		Cleaned up definition of ENCODING
3k	4/4-2011		Removed SHUTTER_FIT values

Content

1 Acronyms

ASCII	American Standard Code for Information Interchange
ADC	Analog Digital Converter
CRB	CCD Readout Board
CCD	Charge Coupled Device
DDS	Data Distribution System
DPU	Data Processing Unit
DSP	Digital Signal Processor
EDR	Experiment Data Record
ESA	European Space Agency
HK	House Keeping data
IAA	Instituto de Astrofísica de Andalucía
IDA	Institut fuer Datentechnik und Kommunikationsnetze
INTA	Instituto Nacional de Técnica Aeroespacial
LAM	Laboratoire d'Astrophysique de Marseille
MCB	Motor Controller Board
MLI	Multi Layer Insulation
MPS	Max Planck Institut für Sonnensystemforschung
NAC	Narrow Angle Camera
ODL	Object Description Language
OIOR	Orbiter Instrument Operational Request
OSIRIS	Optical, Spectroscopic, and Infrared Remote Imaging System
PCM	Power Converter Module
PDS	Planetary Data Systems
RDR	Reduced Data Record
RSSD	Research and Scientific Support Department (ESA)
RO	Rosetta Orbiter
PSA	Planetary Science Archive
SPICE	Spacecraft, Planet, Instrument, C-matrix, Event kernels
SIS	Software Interface Specification
SPIHT	Set Partitioning in Hierarchical Trees (Wavelet compression algorithm)
SSMM	Solid State Mass Memory (Rosetta spacecraft storage device)
TBC	To Be Considered
TBD	To Be Determined
TMI	TeleMetry Image
UPD	University of Pardua
UPM	Universidad Politécnica de Madrid
WAC	Wide Angle Camera

2 General aspects

2.1 Scope

This document describes in detail the OSIRIS data product PDS data label.

2.2 Introduction

The purpose of this Data Product Software Interface Specification (SIS) is to provide consumers of OSIRIS Camera Experiment Data Record (EDR) and Reduced Data Record (RDR) data products with a detailed description of the products and how they are generated, including data sources and destinations. The SIS is intended for the planetary science scientific community who will analyze the data.

3 Instrument Overview

The OSIRIS instrument was provided by the OSIRIS consortium led by the principal investigator Dr. Horst Uwe Keller at the Max Planck Institut für Sonnensystemforschung.

The OSIRIS consortium has the following members:

MPS	Overall responsibility and project management, system engineering, interfaces, Focal Plane Assemblies, CCDs and Readout Boards, HK Boards, integration &qualification of E-Boxes, harnesses, system integration, high level software, NAC & WAC system calibration, QA, mission operations
LAM	NAC telescope, camera integration and qualification WAC optical bench, camera
UPD	Integration and qualification, shutter mechanisms and shutter electronics, Front Door Mechanisms (mechanisms for NAC and WAC)
IAA	Mechanism Controller Board
INTA	Filter Wheel Mechanisms, E-Box Power Converter Module, NAC & WAC CRB Power Converter Modules
RSSD	Data Processing Unit
IDA	Mass memory, low level software and data compression
DASP	NAC & WAC Filters
UPM	Thermal and structural analysis, NAC MLI, WAC FPA MLI

The OSIRIS camera system consists of a narrow angle camera (NAC) and a wide angle camera (WAC).

3.1 The narrow angle camera (NAC)

The NAC uses an off axis three mirror optical design. The off axis design was selected in order to minimize the strayligh reaching the CCD (The NAC has a proven stray light attenuation of better than 1.0e-9). The optical beam is reflected of the three mirrors (M1, M2 and M3) before passing through a double filter wheel, a mechanical shutter mechanism and an anti radiation plate (ARP) before reaching the CCD.

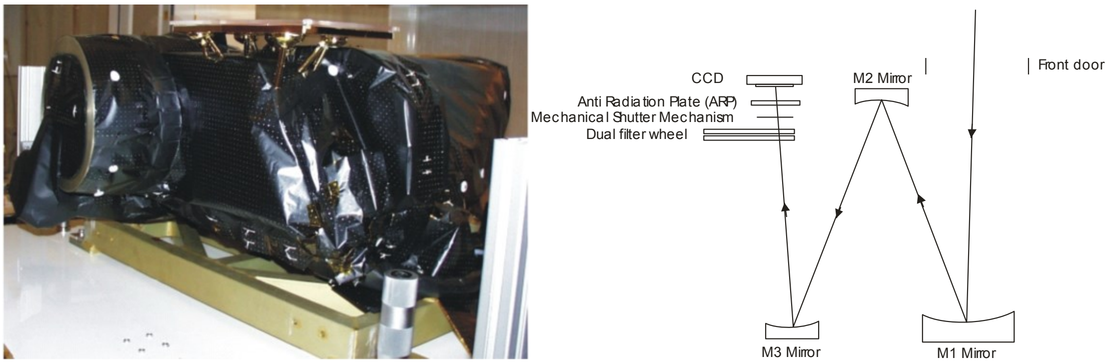


Figure 1 (right) The OSIRIS NAC flight unit in the lab. (left) The NAC Optical path

Optical design	3-mirror off-axis
Angular resolution	18.6 µrad px^{-1}
Focal length	717.4 mm
Mass	13.2 kg
Field of view	2.20 x 2.22°
F-number	8
Spatial scale from 100 km	1.86 m px^{-1}
Typical filter bandpass	40 nm
Wavelength range	250nm - 1000nm
Number of filters	12
Estimated detection threshold	18 mV

Table 1 Basic NAC parameters

The double filter wheels allow the NAC to place a refocusing plate together with an optical filter in the optical beam. The NAC is equipped with two types of refocusing plates allowing optimum focus at 4km and 1.2km respectively.

The NAC is equipped with the following optical filters:

Figure 2 The OSIRIS dual filter wheel mechanism

Name	Wavelength [nm]	Bandwidth [nm]	Peak [%]	Objective	Thickness centre [nm]	Wheel	Position	Encoder [DN]
FFP-UV	600	> 600	> 99	BBAR coated plate to allow use of wheel 2	4.41	1	1	14
FFP-IR	600	> 600	> 99	BBAR coated plate to allow use of wheel 1	5.15	2	1	14
Neutral	640	520	5.0	Neutral density filter	4.64	1	8	11
NFP-Vis	600	> 600	> 98	Refocusing lens for near-nucleus imaging, BBAR coated	4.18	1	3	4
Far-UV	269.3	53.6	37.8	Surface spectral reflectance	4.50	2	5	2
Near-UV	360.0	51.1	78.2	Surface spectral reflectance	4.68	2	6	7
Blue	480.7	74.9	74.6	Surface spectral reflectance	4.67	2	4	1
Green	535.7	62.4	75.8	Surface spectral reflectance	4.64	2	3	8
FFP-Vis	600	600	>90	Refocusing lens for near-nucleus imaging, BBAR coated	5.00	1	2	13
Orange	649.2	84.5	92.4	HMC orange filter; surface spectral reflectance	4.73	2	2	11
Hydra	701.2	22.1	87.4	Water of hydration band	4.72	2	7	4
Red	743.7	64.1	96.0	Surface spectral reflectance	4.68	2	8	13
Ortho	805.3	40.5	69.8	Orthopyroxene	4.69	1	5	2
Near-IR	882.1	65.9	78.4	Surface spectral reflectance	4.75	1	4	7
Fe2O3	931.9	34.9	81.6	Iron-bearing minerals	4.73	1	6	1
IR	989.3	38.2	78.1	IR Surface reflectance	4.74	1	7	8

Table 2 NAC Optical Filter

3.2 The wide angle camera (WAC)

The WAC uses an off axis two mirror optical design. The off axis design was selected in order to minimize the stray light reaching the CCD (The NAC has a proven stray light attenuation of better than 1.0e-8).
The optical beam is reflected of the two mirrors (M1 & M2)before passing through a double filter wheel, a mechanical shutter mechanism, an anti radiation plate (ARP) before reaching the CCD.

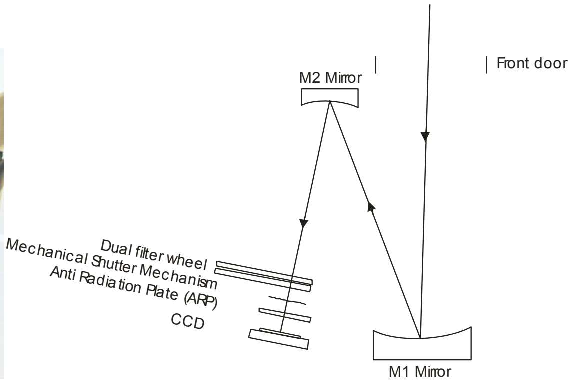


Figure 3 (left) The OSIRIS WAC flight unit in the lab. (right) The WAC Optical path

Optical design	2-mirror off-axis
Angular resolution	101 µrad px-1
Focal length	140(sag)/131(tan)
Mass	9.48 kg
Field of view	11.34 x 12.11°
F-number	5.6
Spatial scale from 100 km	10.1 m px-1
Typical filter bandpass	5 nm
Wavelength range	240nm - 720nm
Number of filters	14
Estimated detection threshold	13 mV

Table 3 Basic WAC parameters

The WAC camera does not have refocusing plates so the two WAC filter wheels each have a filter position with no filter mounted. So the typical WAC observation uses either the filter combination (empty + filter) or (filter + empty)

The WAC is equipped with the following optical filters:

Name	Wavelength [nm]	Bandwidth [nm]	Peak [%]	Objective	Thickness centre [nm]	Wheel	Position	Encoder [DN]
Empty				Empty position to allow the use of filter wheel 2		1	1	14
Empty				Empty position to allow the use of filter wheel 1		2	1	14
UV245	246.2	14.1	31.8	Continuum surface spectral reflectance	4.51	1	3	4
CS	259.0	5.6	29.8	CS gas emission	4.60	1	4	7
UV295	295.9	10.9	30.4	Continuum for OH	4.75	1	5	2
OH-WAC	309.7	4.1	26.0	OH emission from the vicinity of the nucleus	4.82	1	6	1
UV325	325.8	10.7	31.6	Continuum for OH surface spectral reflectance	4.85	1	7	8
NH	335.9	4.1	23.6	NH gas emission	4.86	1	8	11
UV375	375.6	9.8	57.3	Continuum for CN surface spectral reflectance	4.60	2	3	8
CN	388.4	5.2	37.4	CN gas emission	4.61	2	4	1
Green	537.2	63.2	76.8	Dust continuum	4.71	1	2	13
NH2	572.1	11.5	60.9	NH2 gas emission	4.74	2	5	2
Na	590.7	4.7	59.0	Sodium gas emission	4.75	2	6	7
VIS610	612.6	9.8	83.4	Continuum for OI surface spectral reflectance	4.65	2	8	13
OI	631.6	4.0	52.4	O (1D) gas emission for dissociation of H2O	4.66	2	7	4
R	629.8	156.8	95.7	Broadband filter for nucleus and asteroid detection (NAC redundancy)	4.67	2	2	11

Table 4 The WAC Optical Filters

3.3 The Mechanical Shutter Mechanism

Both the NAC and the WAC cameras are equipped with a mechanical shutter mechanism for controlling the exposure time. The shutter mechanism uses two blades to control the exposure. The first blade covers the CCD at the start of the exposure. when the exposure is started the first blade is accelerated to 1.3 m/s before the edge of the blade reaches the edge of the CCD. the blade edge then passes over the CCD at constant velocity before being decelerated to standstill after passing the far edge of the CCD. The end of the exposure is controlled by performing the same motion with a second blade that initially is outside the CCD surface.
The second blade motion starts after the exposure time has passed from the start of the first blade motion.
The full blade travel lasts 53ms. For exposure times shorter than 53 ms the blade motion of the two blades overlaps. In this case the exposure is controlled by a moving slit (same principle as a SLR camera).

During the blade motions the position is measured using a position encoder mounted on the drive shaft of the shutter motors.

The minimum allowed exposure time is 10 ms and accuracy of the exposure is better than 5 µs

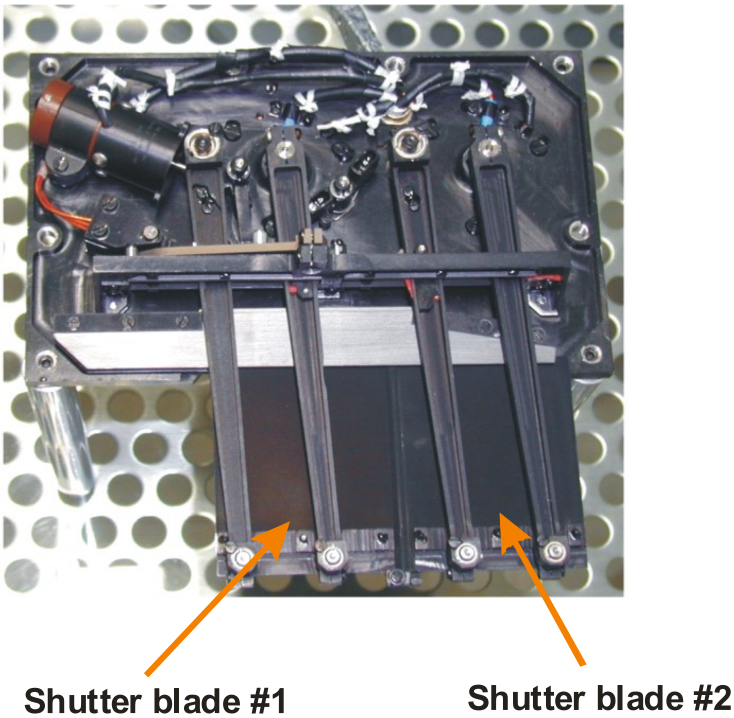


Figure 4 The OSIRIS mechanical shutter mechanism

3.4 The OSIRIS CCD

The OSIRIS camera system uses 2048x2048 pixel backside illuminated CCD's. The CCD's are equipped with anti reflection coatings optimized for the UV spectral range. The CCD's are equipped with shielded anti-blooming control. The CCD's are UV sensitive down to 240nm (50% QE) and IR sensitive up to 1000nm (6% QE). The system gain is set to ~3e- in normal operational mode. The readout electronics is using a dual 14 bit ADC configuration giving an effective 16 bit system. The CCD's uses two readout channels (channel A and B) which can be used in parallel for fast readout.

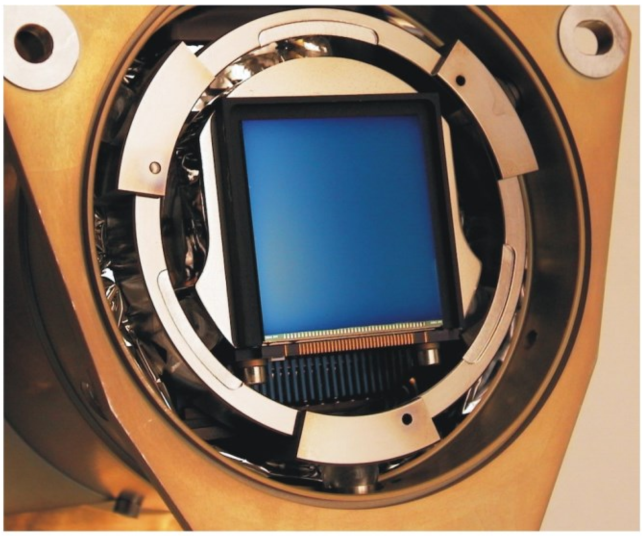


Figure 5 The OSIRIS CCD mounted in the focal plane assembly.

The CCD's can be read out using hardware windowing and hardware binning (1x1, 2x2, 4x4 and 8x8). The fastest readout of a 1x1 binned fullframe image is 3.4s. By using windowing and binning modes this time can be reduced to less than 1s.

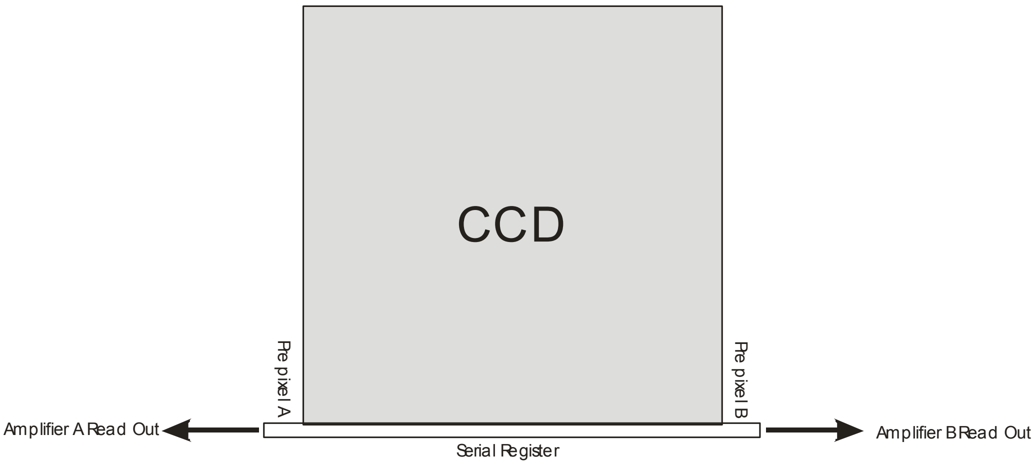


Figure 6 The OSIRIS CCD layout

OSIRIS CCD specification:

Item	Specification
Source detector type	E2V CCD42-40, non-MPP, backside illuminated, Hafnium oxide AR coated
Array size	Full frame, 2048 x 2048 pixels
Serial register size	50 + 2k + 50; 50 extra pixel at both ends 48 + 2k + 48 transmitted
Pixel size	13.5 um x 13.5 um
No. of outputs	2; either 1 sufficient
Overexposure	Shielded anti-blooming control
Operation modes	Clock dithering for dark current reduction for operations at > 220 K (optional), windowing, binning
Full well	> 100 000 e- px-1
System gain	~ 3 e- / DU
Readout noise (CCD)	< 7 e- rms
Dark charge generation	~0.6 e- s-1 px-1 @ 180 K ~200 e- s-1 px-1 @ 293 K - (with dithering)
QE	250 nm: 50 %, 400 nm: 60 %, 600 nm: 80 %, 800 nm: 60 %, 1000 nm: 6 %
Readout rate	1.3 Mpx s-1; 650 kpx s-1 per channel
Readout time (full frame)	3.4 s (2 channels)
Vertical clock rate	25 us per line
Operating temperature	160 K < T < 300 K

Table 5 The OSIRIS CCD parameters

4 Data Processing Overview

The OSIRIS EDR processing begins with the reconstruction of packetized telemetry data resident on the ESA DDS system by the IDA GSEOS (Gound Support Operating System) software system. The GSEOS system saves the image data as OSIRIS level 0 image files (TMI or PDS format depending on flight software version).
The OSIRIS level 0 images are then processed by a software application called tmi2pds used to calibrate the header information and to append various meta data like spacecraft position and orientation. The output is stored as OSIRIS level 1 (CODMAC level 2) PDS compliant image files (EDR's).
The EDR's are then processed by an IDL coded image processing pipeline used to generate OSIRIS level 2 (CODMAC level 3) files (RDR's).

The full data flow is illustrated in Figure 7 and the processing levels are defined in Table 6.

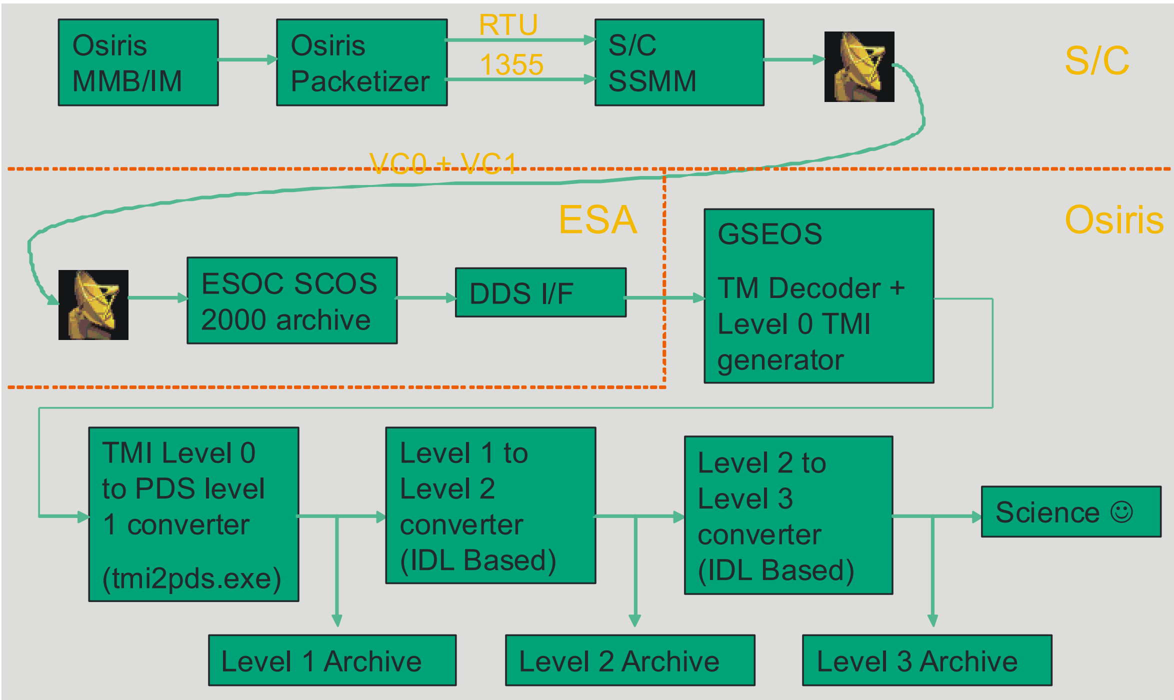


Figure 7 The OSIRIS data and processing flow (Please note that the data level referred to in the diagram is OSIRIS data levels = CODMAC data level -1.

OSIRIS Data Levels	CODMAC levels	Description
Packet Data	1	Telemetry data stream as received at the ground station, with science and engineering data embedded.
0		PDS or TMI formatted data files. Uncalibrated header and uncalibrated image data
1	2	PDS compliant data files with calibrated header data and uncalibrated image data
2	3	PDS compliant data files with calibrated header data and calibrated image data
3	4	PDS compliant data files with calibrated header data and calibrated image data optical distortion removed
4	5	PDS compliant data files with calibrated header data and calibrated image data optical distortion removed and image rotated to align image y-axis with galactic north.

Table 6 OSIRIS and CODMAC data levels

5 Data Storage

The OSIRIS images are stored as binary files with embedded PDS label. The file structure is as follows:

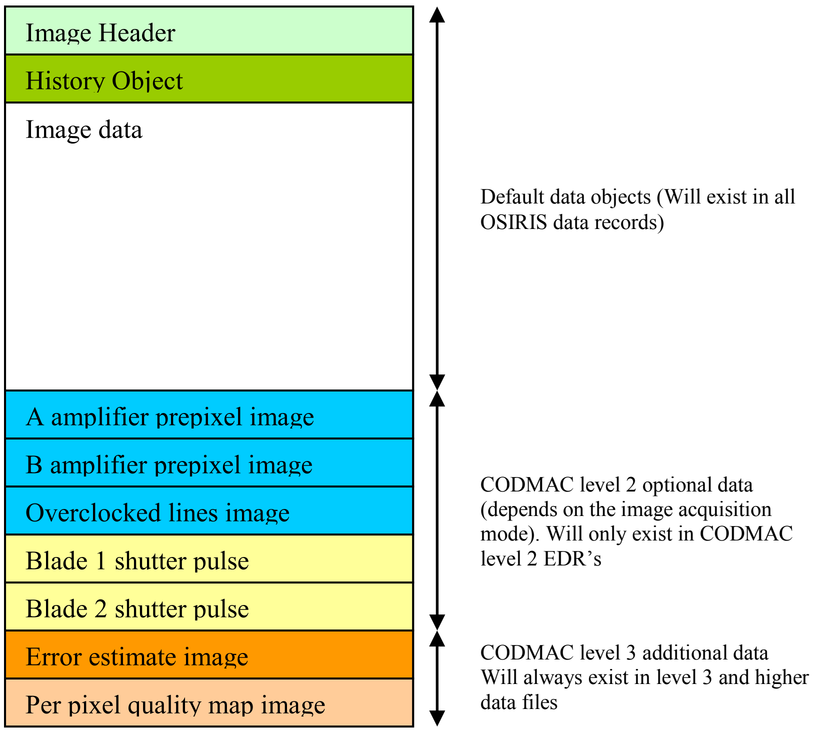


Figure 8 Layout of an OSIRIS data file

a. The image header is an embedded PDS label with associated ancillary information. The header contains object and pointer references to all other embedded objects.
b. The history object is an additional PDS label containing a PDS HISTORY object. The history object contains the processing information of all the processing software used in the telemetry pipeline.

c. The Image data contains the actual CCD image data from the exposure. The image data can be addressed using the primary IMAGE object.
d. The amplifier A pre pixel image data contains the image data from the pre pixel readout phase of the amplifier A chain of the CCD readout. The pre pixels are 48 elements in the serial register coupled to ground instead of the physical CCD. These pre pixels can be used to estimate the CCD bias level and readout noise level. The image data is mapped to the PA_IMAGE object. The image object only exists if the pre pixel data was transmitted to ground.
e. The amplifier B pre pixel image data contains the image data from the pre pixel readout phase of the amplifier B chain of the CCD readout. The pre pixels are 48 elements in the serial register coupled to ground instead of the physical CCD. These pre pixels can be used to estimate the CCD bias level and readout noise level. The image data is mapped to the PB_IMAGE object. The image object only exists if the pre pixel data was transmitted to ground.
f. The overclocking lines image contains image data acquired by continuing clocking out the CCD after all the physical pixels have been read. Reading out the CCD in this manner allows a measurement of the charge transfer efficiency along the column clocking direction. The over clocking lines data is mapped to the OL_IMAGE object. The image object only exists if over clocked line data was acquired during the image acquisition.
g. The Blade 1 shutter pulse object contains the raw timer data from the shutter mechanism motion encoder of the first shutter blade. This pulse data can be used to determine the position vs. time of the shutter blade during the exposure. His data can be used to improve the knowledge of the precise exposure time for each pixel in the image. The blade 1 shutter pulse data is stored in the BLADE1_PULSE_ARRAY array object. The object only exists if the shutter mechanism was used during the exposure and if the pulse data was down linked to ground.
h. The Blade 2 shutter pulse object contains the raw timer data from the shutter mechanism motion encoder of the second shutter blade. This pulse data can be used to determine the position vs. time of the shutter blade during the exposure. His data can be used to improve the knowledge of the precise exposure time for each pixel in the image. The blade 1 shutter pulse data is stored in the BLADE2_PULSE_ARRAY array object. The object only exists if the shutter mechanism was used during the exposure and if the pulse data was down linked to ground.
i. The error estimate image object is an image object with the same dimension as the primary image object. The image object contains the estimated standard deviation in % for each pixel based on the Poisson statistics of the exposure. The error estimate image is mapped to the SIGMA_MAP_IMAGE object. The object only exists in level 3 and higher data records.
j. The per pixels quality map image is a byte image with the same dimensions as the primary image object. The quality image contains a bit field giving a data quality estimate for each pixel in the image. General rule is the lower the value the better. 0 is quality data 255 is very bad quality data. Please note that the quality map only contains an estimate based on the CCD characteristics and the processing chain the image has passed through. A complete quality estimate should include a combination of the quality map and the sigma map. The per pixel quality map image is mapped to the QUALITY_MAP_IMAGE object. The object only exists in level 3 and higher data records.

The image data is stored using a PDS IMAGE object. The two Blade 1&2 shutter pulse array objects are optional and will only be generated if the relevant data has been transferred from the spacecraft.

Pixel with value 0 is used to indicate lost data (lost packets).

4.2.1 PDS Label

The OSIRIS EDRs and RDRs have an attached PDS label. A PDS label is object-oriented and describes the objects in the data file. The PDS label contains keywords for product identification. The label also contains descriptive information needed to interpret or process the data in the file.
PDS labels are written in Object Description Language (ODL) (see PDS v3.6 specification). PDS label statements have the form of "keyword = value". Each label statement is terminated with a carriage return character (ASCII 13) and a line feed character (ASCII 10) sequence to allow the label to be read by many operating systems.

Pointer statements with the following format are used to indicate the location of data objects in the file:

^object = location

where the carat character (^, also called a pointer) is followed by the name of the specific data object.

The location is the 1-based starting record number for the data object within the file.

4.2.1.1 PDS Image Object

An IMAGE object is a two-dimensional array of values, all of the same type, each of which is referred to as a *sample*. IMAGE objects are normally processed with special display tools to produce a visual representation of the samples by assigning brightness levels or display colors to the values. An IMAGE consists of a series of lines, each containing the same number of samples.
The required IMAGE keywords define the parameters for simple IMAGE objects:

- LINES is the number of lines in the image.
- LINE_SAMPLES is the number of samples in each line.
- SAMPLE_BITS is the number of bits in each individual sample.
- SAMPLE_TYPE defines the sample data type.

5.1 Onboard image processing and compression

The OSIRIS flight software has to capability to compress the image data before transmission to ground using a number of compression algorithms and filtering schemes.

OSIRIS implements a data segmentation scheme to decrease sensitivity to data loss during transmission. Each image is separated into segments with a maximum size of 512x512 pixels. Each of these blocks are processed and compressed individually.

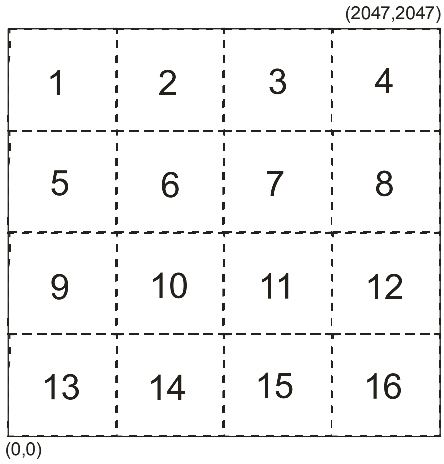


Figure 9 Example of the segmentation scheme used for an OSIRIS full frame image (2048x2048) (16 segments)

All information about compression and post processing is found in the SR_COMPRESSION group in the OSIRIS image headers. Each member of this group is a vector containing an entry for each image segment used to generate the final image. The segmentation boundaries can be found using the SEGMENT_[X,Y,W,H] members. The encoding algorithm can be found in the ENCODING member. The following encoding algorithms are supported:

NONE	- No Compression
SPIHT_D24	- SPIHT based compression used by the OSIRIS flight software prior to release 2.0
SPIHT_LIFT	- SPIHT compression with LIFT filtering
SPIHT_TAP	- SPIHT compression with TAP filtering
SQRT_16to8	- Square rooting followed by 16 to 8 bit reduction
PACK9BIT	- The image data has been compressed by chopping the data range at 9 bits (meaning discarding the upper 7 bits)

The effective compression ratio achieved by the encoder is stored in the COMPRESSION_RATIO member.

If the encoding step was performed without information loss then the LOSSLESS_FLAG member is TRUE else FALSE. Please note that LOSSLESS_FLAG only refers to the encoding step. LOSSLESS_FLAG can be TRUE even is a lossy filtering step has been performed.

OSIRIS can also perform a pixel averaging step. The pixel averaging box size can be found in the PIXEL_AVERAGING_WIDTH and PIXEL_AVERAGING_HEIGHT members.

To increase the quality of the SPIHT compressor OSIRIS also implements a number of pre processing filtering steps. The following filtering are possible:

1. A Gauss 5x5 convolution smooth filter
2. A Sqrt filtering step performing the transformation I_Out = sqrt(I * gain)

The type of gauss smooth filter used can be found in SMOOTH_FILTER_ID with the values:

'NONE':	No filtering
'CONVOL_KERNEL_1':	0.5 FWHM gauss filter
'CONVOL_KERNEL_2':	0.8 FWHM gauss filter
'CONVOL_KERNEL_3':	1.0 FWHM gauss filter

If the sqrt filter has been used the SQRT_FILTER_FLAG is set to TRUE and that gain used is written in SQRT_FILTER_GAIN.

6 File Naming Convention

6.1 The OSIRIS archive filename convention

The OSIRIS image files as archived in the project internal archive (please note NOT the PDS archive) use the following filename convention:

CCC_YYYY-MM-DDTHH.MM.SS.UUUZ_FFLI_NNNNNNNNNN_FAB.IMG

Field	Description
CCC	eitherNAC (narrow angle camera) or WAC (wide angle camera)
YYYY	is the year of acquisition
MM	is the month of acquisition
DD	is the day of acquisition
T	is the letter T (stands for "Time")
HH	is the hour of acquisition
MM	is the minute of acquisition
SS	is the second of acquisition
UUU	is the milli-second of acquisition
FF	is the image file type: the following filetypes are possible: ID Image Data (Normal images) TH Thumbnail version of the image (Highly compression version transmitted immidiately) PA Amplifier A pre pixels (calibration data) PB Amplifier B pre pixels (calibration data) OL Overclocked lines (calibration data)
L	is the OSIRIS processing level of the image
I	is the instance id if the image (multiple transmissions of an image will be reflected in this number incrementing)
NNNNNNNNNN	Ten digit user defined image ID number (Specified by the user when writing the command timeline)
F	is the letter F (stands for "Filter")
A	is the position index of the filter wheel #1
B	is the position index of the filter wheel #2
.IMG	File extension

Table 7 OSIRIS PDS data file filename elements

Example:

NAC_2003-10-16T13.50.05.012Z_ID21_0000000001_F82.img

Is a NAC image acquired at 2003-10-16T13:50:05.012 UTC
The file contains CCD image data (image type ID) with raw image data (level 1) and the image represents the 2nd transmission of the image data. The image was acquired using the filter combination (8,2). The image ID is 1. The time is the start time of the exposure.

Note! The filename contains an approximate time of acquisition. This time value is only used to uniquely identify the image and should not be used for any calculation needing high precision. The time value in the filename has not been corrected for onboard clock drift and leap seconds. The best possible knowledge about the time of acquisition can be found in the header label START_TIME

6.2 The PDS archive filename convention

The OSIRIS image files as archived in the PDS use the following filename convention:

CYYYYMMDDTHHMMSSUUUFFLIFAB.IMG

Field	Description
C	either N NAC (narrow angle camera) or W WAC (wide angle camera)
YYYY	is the year of acquisition
MM	is the month of acquisition
DD	is the day of acquisition
T	is the letter T (stands for "Time")
HH	is the hour of acquisition
MM	is the minute of acquisition
SS	is the second of acquisition
UUU	is the milli-second of acquisition
FF	is the image file type: the following file types are possible: ID Image Data (Normal images) TH Thumbnail version of the image (Highly compressed version transmitted immediately) PA Amplifier A pre pixels (calibration data) PB Amplifier B pre pixels (calibration data) OL Overclocked lines (calibration data)
L	is the CODMAC processing level of the image
I	is the instance id if the image (multiple transmissions of an image will be reflected in this number incrementing)
F	is the letter F (stands for "Filter")
A	is the position index of the filter wheel #1
B	is the position index of the filter wheel #2
.IMG	File extension

Table 8 OSIRIS PDS data file filename elements

Example:

W20040923T071606570ID12F12.img

Is a WAC image acquired at 2004-09-23 at 07:16:06.657 UTC
The file contains CCD image data (image type ID) with raw image data (level 1) and the image represents the 2nd transmission of the image data. The image was acquired using the filter combination (1,2) = Hole+Red for the WAC.

Note! The filename contains an approximate time of acquisition. This time value is only used to uniquely identify the image and should not be used for any calculation needing high precision. The time value in the filename has not been corrected for onboard clock drift and leap seconds. The best possible knowledge about the time of acquisition can be found in the header label START_TIME

7 Coordinate Systems

There are a number of coordinate system relevant to the interpretation of OSIRIS data. The se coordinate system can be separated into two groups: a. pixel coordinate systems referring directly to the CCD and b. inertial coordinate systems referring to the spacecraft and viewing geometry.

7.1 CCD coordinate frames

The following four CCD frames are defined for the OSIRIS NAC CCD:

7.1.1 NAC_AMPLIFIER_A_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the A amplifier electrical chain. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

7.1.2 NAC_AMPLIFIER_B_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the B amplifier electrical chain. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

7.1.3 NAC_AMPLIFIER_BOTH_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the both amplifier electrical chains in parralel. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

The NAC_AMPLIFIER_BOTH_ELECTRICAL frame is identical to the NAC_AMPLIFIER_A_ELECTRICAL frame.

7.1.4 NAC_CCD_REFERENCE

The NAC_CCD_REFERENCE frame is the coordinate frame relevant to all CODMAC 2 to 3 PDS image files.

The NAC_CCD_REFERENCE frame is identical to the NAC_AMPLIFIER_A_ELECTRICAL frame.

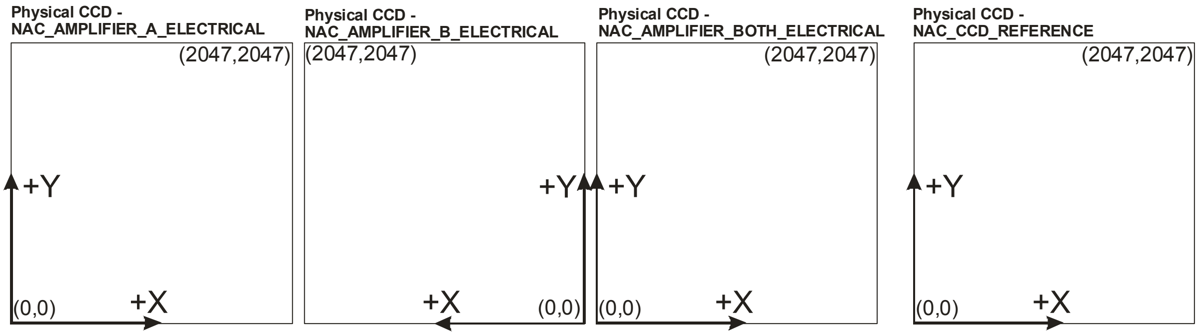


Figure 10 The NAC CCD frames

The following four CCD frames are defined for the OSIRIS WAC CCD:

7.1.5 WAC_AMPLIFIER_A_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the A amplifier electrical chain. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

7.1.6 WAC_AMPLIFIER_B_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the B amplifier electrical chain. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

7.1.7 WAC_AMPLIFIER_BOTH_ELECTRICAL

Pixel (0,0) is the first physical CCD pixel that reaches the ADC when using the both amplifier electrical chains in parralel. The X-axis corresponds to the CCD horizontal direction and the Y-axis corresponds to the CCD vertical direction (positive away from the serial register)

The NAC_AMPLIFIER_BOTH_ELECTRICAL frame is identical to the NAC_AMPLIFIER_A_ELECTRICAL frame.

7.1.8 WAC_CCD_REFERENCE

The WAC_CCD_REFERENCE frame is the coordinate frame relevant to all CODMAC 2 to 3 PDS image files.

The WAC_CCD_REFERENCE frame is identical to the WAC_AMPLIFIER_A_ELECTRICAL frame.

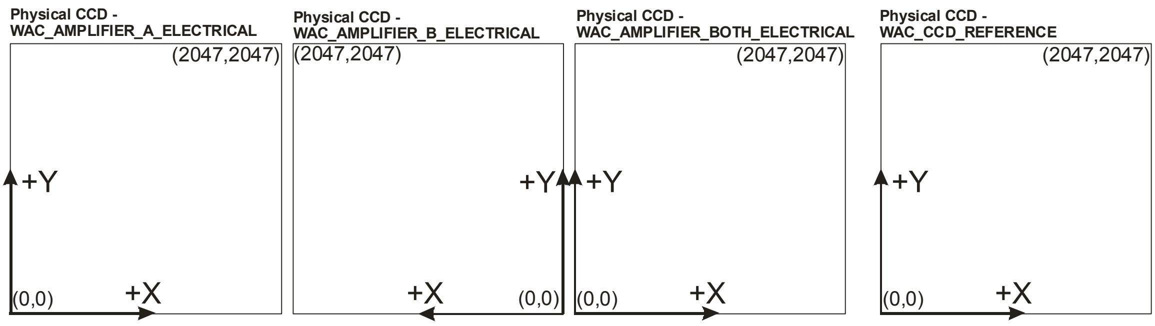


Figure 11 The WAC CCD frames

The WAC_CCD_REFERENCE frame +X is approximately equal to NAC_CCD_REFERENCE frame –X.

7.2 Inertial Coordinate Frames

7.2.1 Earth mean equator and equinox of J2000 (EME J2000)

International astronomical inertial reference frame (epoch J2000)

7.2.2 The Rosetta spacecraft coordinate frame:

The Rosetta spacecraft coordinate frame (S/C-COORDS) is defined with the +Z axis orthogonal to the instrument panel (average pointing of remote sensing instruments). The +Y axis is oriented along the solar panels and the +X is orthogonal to the high gain antenna mounting panel. The Rosetta spacecraft coordinate frame can be addressing in the SPICE system using the coordinate frame alias "ROS_SPACECRAFT".

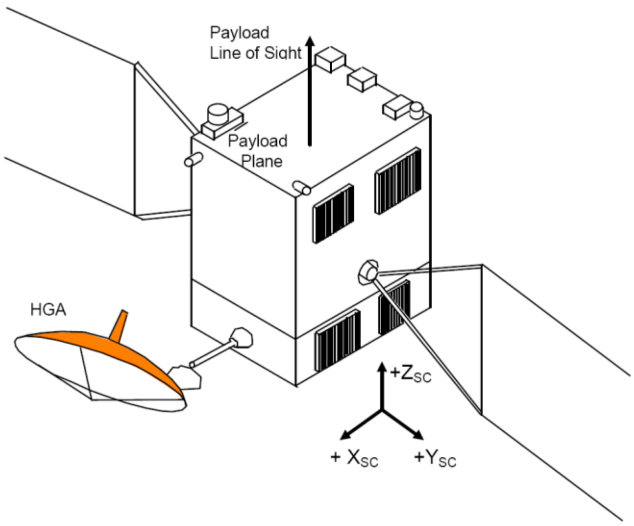


Figure 12 The Rosetta spacecraft coordinate frame (S/C-COORDS) definition

7.2.3 Camera Frames:

7.2.3.1 NAC_CAMERA_FRAME:

The NAC_CAMERA_FRAME is defined with origin at the center of the entrance aperture of the NAC camera with the +X axis along the image horizontal axis and the +Y axis along the vertical image direction. The +Z axis is defined as the right hand coordinate system defined by +X and +Y. Please note that for the NAC the +Z axis points in the opposite direction of the viewing direction.

The exact transformation can be found using the CAMERA_COORDINATE_SYSTEM label group in NAC images.

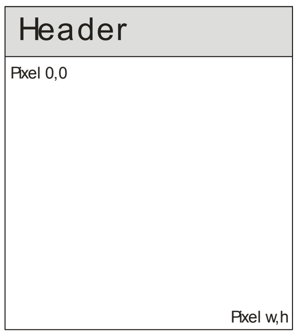
7.2.3.2 WAC_CAMERA_FRAME:

The WAC_CAMERA_FRAME is defined with origin at the center of the entrance aperture of the NAC camera with the +X axis along the image horizontal axis and the +Y axis along the vertical image direction. The +Z axis is defined as the right hand coordinate system defined by +X and +Y. Please note that for the WAC the +Z axis is pointed in the same direction as the boresight viewing direction.

The exact transformation can be found using the CAMERA_COORDINATE_SYSTEM label group in WAC images.

7.3 Displaying the OSIRIS images

The OSIRIS images are stored using the following format



This structure means that the image (as is typical for PDS images) needs to be vertically flipped to be correctly displayed on a typical computer screen.

On top of this the images from the narrow angle camera requires a horizontal flip to be shown with in the same geometry as the wide angle camera images.

To summarize:

OSINAC images: flip horizontally + flip vertically
OSIWAC images: flip vertically

Using these transformations the x-image axis is roughly aligned with the spacecraft y axis and the y-image axis is roughly aligned with the spacecraft x-axis.

8 The OSIRIS EDR and RDR PDS Labels

8.1 System Labels

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
PDS_VERSION_ID			Label		PDS version identifier	Fixed
LABEL_REVISION_NOTE			String		PDS label set version	Fixed
RECORD_TYPE			Label		PDS System Label	Fixed
RECORD_BYTES			Integer		Number of bytes in a record block	Image converter
FILE_RECORDS			Integer		Number of records in the file	Image converter
LABEL_RECORDS			Integer		Number of records in the PDS label header	Image converter
FILE_NAME			String		Original filename	Image Converter
^IMAGE			Pointer		Offset of the image data within the file (in records)	Image Converter
^BLADE1_PULSE_ARRAY			Pointer		Offset of the shutter blade 1 position encoder data within the file (in records) Note: This field only exists if blade 1 shutter pulse data exists in the data	Image Converter
^BLADE2_PULSE_ARRAY			Pointer		Offset of the shutter blade 2 position encoder data within the file (in records)	Image Converter

					Note: This field only exists if blade 2 shutter pulse data exists in the data	
SOFTWARE_DESC			String		Description of the software that generated the PDS file	Image converter
SOFTWARE_NAME			String		Filename of the image converter	Image converter
SOFTWARE_VERSION_ID			String		Version of the image converter	Image converter
SOFTWARE_RELEASE_DATE			String		Release date of the image converter	Image converter

8.2 Mission Identification

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
INSTRUMENT_HOST_ID			String		ID of the instrument host	Fixed
INSTRUMENT_HOST_NAME			String		Name of mission	Fixed
MISSION_ID			String		ID of mission	Fixed
MISSION_NAME			String		Name of mission	Fixed
MISSION_PHASE_NAME			String		Name of overall mission phase	Image converter

8.3 Instrument and image Identification

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
INSTRUMENT_ID			String		ID of the instrument Either OSINAC or OSIWAC	TM
INSTRUMENT_NAME			String		Description of instrument	TM/Fixed
INSTRUMENT_TYPE			String		Short description of the instrument	TM/Fixed
DETECTOR_DESC			String		Description of the detector system	Fixed
DETECTOR_PIXEL_WIDTH			Float	um	Width of a single pixel	Fixed
DETECTOR_PIXEL_HEIGHT			Float	um	Height of a single pixel	Fixed
DETECTOR_TYPE			String		Type of detector	Fixed
DETECTOR_ID			String		ID of detector	TM/Fixed
DETECTOR_TEMPERATURE			Float	K	Temperature of the CCD detector in Kelvin	TM
ELEVATION_FOV			Float	deg	Full Field of view of the instrument in elevation in degrees	Fixed
AZIMUTH_FOV			Float	deg	Full Field of view of the instrument in azimuth in degrees	Fixed
TELESCOPE_RESOLUTION			Float	rad	IFOV of instrument in rad	Fixed
TELESCOPE_F_NUMBER			Float		Telescope F number	Fixed

TELESCOPE_FOCAL_LENGTH			Float	m	Telescope focal length	Fixed
IMAGE_ID			Integer		User defined image ID number	TM
PROCESSING_ID		ROSETTA	Integer		The OSIRIS DPU has the capability to make multiple transfers of the same set of images data (The image can for example be first transferred as a highly compressed thumbnail image for quick look purposes followed later by a transfer of the same pixel data as a less compressed version). The value of the processing_id will be unique for each transfer)	TM
IMAGE_OBSERVATION_TYPE			String		Type of observation: ***REGULAR*** for normal observations ***BIAS*** for 0 sec dark exposures ***DARK*** for > 0 sec dark exposures	TM
EXPOSURE_TYPE			String		Type of exposure: ***AUTO*** for auto exposures ***MANUAL*** for manual exposures	TM
PRODUCT_ID			String		ID of EDR	Image converter
PRODUCT_TYPE			String		ID of data product EDR for level 2 data RDR for > level 2 data	Fixed

PRODUCT_VERSION_ID			String		Release version of product	Image Converter
PRODUCER_INSTITUTION_NAME			String		Name of the institution that produced the data product	Fixed
PRODUCER_FULL_NAME			String		Name of person that generated the data product	Fixed
PRODUCER_ID			String		ID of institution that generated the data product	Fixed
MEDIUM_TYPE					The medium_type element identifies the physical storage medium for a data volume.	Fixed
PUBLICATION_DATE			Date		The publication_date element provides the date when a published item, such as a document or a compact disc, was issued.	Fixed
VOLUME_FORMAT			Sting		The volume_format element identifies the logical format used in writing a data volume, such as ANSI, TAR, or BACKUP for tape volumes and ISO-9660, HIGH-SIERRA, for CD-ROM volumes.	Fixed
VOLUME_ID			String		The volume_id element provides a unique identifier for a data volume	Fixed
VOLUME_NAME			String		The volume_name element contains the name of a data volume. In most cases the	Fixed

					volume_name is more specific than the volume_set_name.	
VOLUME_SERIES_NAME			String		The volume_series_name element provides a full, formal name that describes a broad categorization of data products or data sets related to a planetary body or a research campaign (e.g. International Halley Watch). A volume series consists of one or more volume sets that represent data from one or more missions or campaigns.	Fixed
VOLUME_SET_NAME			String		The volume_set_name element provides the full, formal name of one or more data volumes containing a single data set or a collection of related data sets. Volume sets are normally considered as a single orderable entity.	Fixed
VOLUME_SET_ID			String		The volume_set_id element identifies a data volume or a set of volumes. Volume sets are normally considered as a single orderable entity.	Fixed
VOLUME_VERSION_ID			String		The volume_version_id element indentifies the version of a data volume.	Fixed

					All original volumes should use a volume_version_id of 'Version 1'. Versions are used when data products are remade due to errors or limitations in the original volumes (test volumes, for example), and the new version makes the previous volume obsolete. Enhancements or revisions to data products which constitute alternate data products should be assigned a unique volume id, not a new version id.	
VOLUMES			String		The volumes element provides the number of physical data volumes contained in a volume set.	Fixed
DATA_SET_ID			String		ID of the PDS dataset to which the data product belongs	Fixed
DATA_SET_NAME			String		Description of the dataset to which the data product belongs	Fixed
PROCESSING_LEVEL_ID			Integer		Processing level: 0: Raw TM 1: Uncalibrated header + raw image data 2: Calibrated header + raw image data 3: Calibrated header + calibrated image data 4: Calibrated header +	Image converter

					geometrically corrected image data	
PROCESSING_LEVEL_DESC			String		Description of the processing level	Image converter
DATA_QUALITY_ID			Integer		The data_quality_id element provides a numeric key which identifies the quality of data available for a particular time period. The data_quality_id scheme is unique to a given instrument and is described by the associated data_quality_desc element. Note that the field exists in the OSIRIS labels but will always contain the value 0 So do not use! The real quality estimate is located in the QUALITY_MAP_IMAGE objects residing in the reduced data records	
DATA_QUALTITY_DESC			String		The data_quality_desc element describes the data quality which is associated with a particular data_quality_id value. The various values of	

					data_quality_id and data_quality_desc are instrument dependent.	

8.4 Sequence identification Group

Please not that the following labels only exists in data files in the internal OSIRIS archive not in the PDS archive because the labels are not PDS compliant. In PDS archived images these labels are found in the history object!

Label	***Group***	***Namespace***	***Datatype***	***Unit***	***Description***	***Source***
ORFA_SUBMISSION_ID	Non PDS		integer		Each sequence formally delivered for uplink to the spacecraft contains is assigned an identification numver (The ORFA submission index) This label contains this release index Please note that this field does not exists in the PDS archive label	Telemetry + ground database
COMMAND_INDEX	Non PDS		integer		Each command within a sequence has a unique identification index. This label contains this index Please note that this field does not exists in the PDS archive label	Telemetry + ground database
COMMAND_IMAGE_INDEX	Non PDS		integer		An OSIRIS telecommand can generate more than one image. The first image acquired by a given telecommand will have the index 0, the next one 1 and so forth. Please note that this field does not exists in the PDS	Telemetry + ground database

					archive label	
ACTIVITY_NAME	Non PDS		string		Each mission phase is composed of several activities. Activities can for example be a checkout phase or a science activity like the Mars Swing-by closest approach. The activity name contains a short descriptive name of the activity within which the image was acquired. An example could be "PC8" or "Mars-Swing-By" Please note that this field does not exists in the PDS archive label	Telemetry + ground database
ACTIVITY_TYPE	Non PDS		string		The activity type field contains a short descriptive string of the type of activity performed: Values can for example be: "SCIENCE" "CHECKOUT" "ACTIVE_CHECKOUT" "IFSW_UPDATE" … Please note that this field does not exists in the PDS archive label	Telemetry + ground database
OBSERVATION_DESCRIPTION	Non PDS		string		Each activity can be	Telemetry + ground

					composed of several observations. For example the Mars Swing By activity can be composed of a stellar calibration observation, a Mars observation at closest approach, a Phobos observation and so forth. Each observation is coupled to a specific operational request and to a specific command sequence (OIOR) The observation description field contains a short human readable description of the observation Please note that this field does not exists in the PDS archive label	database
OBSERVATION_NAME	Non PDS		string		Each activity can be composed of several observations. For example the Mars Swing By activity can be composed of a stellar calibration observation, a Mars observation at closest approach, a Phobos observation and so forth. Each observation is coupled to a specific operational request and to a specific command sequence (OIOR) Each request has a specific ID	Telemetry + ground database

					string assigned during the planning phase. The observation name contains this ID string. The string will usually have the format "SR_XXX" where XXX is a number or refence. Please note that this field does not exists in the PDS archive label	
OIOR_FILENAME	Non PDS		string		Each observation is commanded using a so called OIOR command sequence file. The OIOR_FILENAME contains the filename of the command sequence used to generate the image Please note that this field does not exists in the PDS archive label	Telemetry + ground database
PLANNING_PHASE	Non PDS		string		OSIRIS is planned in cycles cappled planning phases. Each planning phase has an identification number. The PLANNING_PHASE field contains this ID number Please note that this field does not exists in the PDS archive label	Telemetry + ground database

8.5 Time Identification

Label	Group	Namespace	Datatype	Unit	Description	Source
PRODUCT_CREATION_TIME			Time	UTC	Time when the data product was generated in UTC	Image converter
START_TIME			Time	UTC	Start of the exposure in UTC Please note that the value stored in START_TIME is the most precise time known at the time of file generation. The START_TIME has been corrected for on board clock drift and leap seconds	TM/SPICE
STOP_TIME			Time	UTC	Start of image readout in UTC	TM/SPICE
SPACECRAFT_CLOCK_START_COUNT			SCLK	S/C clock count	Start of the exposure in raw spacecraft clock count Format: <reset>/<high count>:<low count>	TM
SPACECRAFT_CLOCK_STOP_COUNT			SCLK	S/C clock count	Start of image readout in raw spacecraft clock count Format: <reset>/<high count>:<low count>	TM
SSMM_TIME	Non PDS		Time	UTC	Contains the time the images data was transferred over the internal data link between the OSIRIS instrument and the spacecraft storage file (The Solid State Mass Memory (SSMM))	TM

					Please note that this field does not exists in the PDS archive label	
EPHEMERIS_START_TIME	Non PDS		float	s	Contains the number of seconds from the start of the J2000 epoch corrected for leap seconds. Please note that this field does not exists in the PDS archive label	

8.6 Observation geometry

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
TARGET_NAME			String		Name of the observation target	SPICE
TARGET_TYPE			String		Type of target. On of the following values: TEST_POINTING STAR MOON PLANET COMET ASTEROID NEBULA …	
SC_SUN_POSITION_VECTOR			3-vector	km	Vector from the S/C to the sun (X,Y,Z) in J2000 The vector is light-time corrected	
SPACECRAFT_SOLAR_DISTANCE			Float	km	Spacecraft distance from the Sun	SPICE
SOLAR_ELONGATION			Float	deg	The solar elongation angle (angle between a vection from the S/C to the sun, and the S/C +Z axis)	SPICE
RIGHT_ASCENSION			Float	deg	The right ascension of the S/C +Z axis specified in J2000 with coordinate system center in the S/C	SPICE
DECLINATION			Float	deg	The declination of the S/C +Z axis specified in J2000 with coordinate system center in the S/C	SPICE

ROLL_ANGLE	Non PDS (Not PDS compliant)		Float	deg	The roll angle of the spacecraft in J2000 at the time the image was acquired Please note that this field does not exists in the PDS archive label	SPICE
LIGHT_SOURCE_PHASE_ANGLE			Float	deg	The light source phase angle element provides a measure of the relationship between the spacecraft viewing position and the light source. Light source phase angle is defined as the angle between a vector from the intercept point to the light source and a vector from the intercept point to the spacecraft.	SPICE
NORTH_AZIMUTH			Float	deg	The north_azimuth element provides the value of the angle between a line from the image center to the north pole and a reference line in the image plane. The reference line is a horizontal line from the image center to the middle right edge of the image. This angle increases in a clockwise direction.	SPICE
SC_TARGET_POSITION_VECTOR			Float 3 vector	None or km	If solar system object this field contains the vector from the S/C to the target object in km. The vector is light-time corrected If stellar target object this	SPICE

					field contains a unit vector towards the target object	
TARGET_CENTER_DISTANCE			Float	km	Distance to the target object. (only valid for solar system objects)	SPICE
SPACECRAFT_ALTITUDE			float	km	The height of the spacecraft over the surface of an extended target object. For example at Mars the center distance gives the distance to the center of Mars while the altitude is the distance to the surface of Mars.	
SUB_SPACECRAFT_LATITUDE			float	deg	With the spacecraft flying over an extended object a vector can be drawn from the center og the planet to the spacecraft. This vector intersects the target surface at a specific latitude and longitude in the given IAU_XXX rotating coordinate system of the target. This field contains the latitude	
SUB_SPACECRAFT_LONGITUDE			float	deg	With the spacecraft flying over an extended object a vector can be drawn from the center og the planet to the spacecraft. This vector intersects the target surface at a specific latitude and	

					longitude in the given IAU_XXX rotating coordinate system of the target. This field contains the longitude	
COORDINATE_SYSTEM_NAME	SC_COORDINATE_SYSTEM				Name of the coordinate system Always: “S/C-COORDS”	Fixed
ORIGIN_OFFSET_VECTOR	SC_COORDINATE_SYSTEM		3-vector	km	Offset vector from J2000 origin to the origin of the rosetta spacecraft coordinate system Meaning the vector in J2000 from the origin of the J2000 coordinate system to the origin of the S/C coordinate system.	SPICE
ORIGIN_ROTATION_QUATERNION	SC_COORDINATE_SYSTEM		4-vector		Rotation quaternion for transforming from J2000 to the Rosetta spacecraft coordinate system The quaternion is stored using the ESA quaternion convention which is [nx sin(a/2), ny sin(a/2), nz sin(a/2), cos(a/2)] To use the quaternion in the SPICE system the vector needs to be transformed to [q3, q0, q1, q2]	SPICE

QUATERNION_DESC	SC_COORDINATE_SYSTEM				Description of the quaternion	Fixed
REFERENCE_COORD_SYSTEM_NAME	SC_COORDINATE_SYSTEM				Name of the reference coordinate system. Always EME J2000	Fixed
COORDINATE_SYSTEM_NAME	CAMERA_COORDINATE_SYSTEM				Name of the coordinate system Either: NAC_CAMERA_FRAME Or WAC_CAMERA_FRAME	TM
ORIGIN_OFFSET_VECTOR	CAMERA_COORDINATE_SYSTEM		3-vector	km	Offset vector from S/C-COORDS origin to the origin of the camera frame Meaning a vector in the space craft coordinate system from the origin of the space craft coordinate system to the origin of the camera coordinate system.	SPICE
ORIGIN_ROTATION_QUATERNION	CAMERA_COORDINATE_SYSTEM		4-vector		Rotation quaternion for transforming from S/C-COORDS to the camera frame. The quaternion is stored using the ESA quaternion convention which is [nx sin(a/2), ny sin(a/2), nz sin(a/2), cos(a/2)] To use the quaternion in the SPICE system the vector needs to be transformed to	SPICE

					[q3, q0, q1, q2]	
QUATERNION_DESC	CAMERA_COORDINATE_SYSTEM				Description of the quaternion	Fixed
REFERENCE_COORD_SYSTEM_NAME	CAMERA_COORDINATE_SYSTEM				Name of the reference coordinate system (always S/C-COORDS)	Fixed
SPICE_FILE_NAME			String vector		List of the spice kernels used to generate the geometry information in the label. The order of the list is identical to the loading order into SPICE	SPICE

8.7 Display geometry

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
LINE_DISPLAY_DIRECTION			Label		The LINE_DISPLAY_DIRECTION element is the preferred orientation of lines within an image viewing on a display device. The default is DOWN, meaning samples are viewed from top to bottom on the display. Allowed values: DOWN, LEFT, RIGHT, UP	SPICE
SAMPLE_DISPLAY_DIRECTION			Label		The SAMPLE_DISPLAY_DIRECTION element is the preferred orientation of samples within a line for viewing on a display device. The default is RIGHT, meaning samples are	Fixed

					viewed from left to right on the display. Allowed values: DOWN, LEFT, RIGHT, UP	

8.8 Status Flags Group

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
SHUTTER_FOUND_IN_ERROR_FLAG	SR_STATUS_FLAGS	ROSETTA	Label		TRUE if the shutter mechanism had to be reset before executing the exposure else FALSE	TM
SHUTTER_PRE_INIT_FAILED_FLAG	SR_STATUS_FLAGS	ROSETTA	Label		TRUE if the pre initiation of the shutter mechanism failed else FALSE	TM
ERROR_RECOVERY_FAILED_FLAG	SR_STATUS_FLAGS	ROSETTA	Label		TRUE if error recovery of the shutter mechanism failed else FALSE	TM
EXPOSURE_STATUS_ID	SR_STATUS_FLAGS	ROSETTA	Label		SUCCESS if no problems were detected during the exposure FAILURE if an error occurred	TM

8.9 Mechanism Status Group

Label	Group	Namespace	Datatype	Unit	Description	Source
FILTER_NUMBER	SR_MECHANISM_STATUS		Integer		OSIRIS is equipped with a dual filter wheel for doing multispectral imaging. The filter number contains the index of the filter combination that was in the optical beam when the image was acquired. The index is coded as a two digit number (AB) where A is the filter index of the first filter wheel and B is the index of the second filter wheel (for example 12 would mean wheel 1 at index 1 and wheel two at index 2)	TM
FILTER_NAME	SR_MECHANISM_STATUS		String		Names of the two commanded filters in the optical path. The name is coded as <name of filter in wheel 1>_<name of filter in wheel 2> (for example Empty_Red)	TM
FRONT_DOOR_STATUS_ID	SR_MECHANISM_STATUS	ROSETTA	Label		OSIRIS is equipped with a front door that blocks the optical beam into the camera when the camera is switched off.	

					This field tells if the front door was open or closed when the image was acquired. (Please note that many image are actually acquired with the door closed since the interior of the door acts as a calibration target for the camera) Possible values: ***OPEN*** ***CLOSED*** ***LOCKED*** ***UNKNOWN***	

8.10 Image Acquisition Options Group

Label	Group	Namespace	Datatype	Unit	Description	Source
SCIENCE_DATA_LINK	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has two data link to the spacecraft. The HIGHSPEED link is a multi megabit per second IEEE 1355 link used for normal transfer of image data to the spacecraft. Additionally there is a low speed link (the RTU link) normally used for housekeeping acquisition and event data. Image data can also be transferred through this low speed link Possible values: ***HIGHSPEED*** ***RTU*** ***BOTH*** ***NONE***	TM
DATA_ROUTING_ID	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has a number of data telemetry queues for managing the order of downlink. The data routing field contains the ID of the queue used to acquire the image ***IMAGEMEM*** ***QUEUE1*** ***QUEUE2*** ***QUEUE3*** ***QUEUE4*** ***QUEUE5*** ***PLAINFILE*** ***STORED***	TM
EXPOSURE_DURATION	SR_ACQUIRE_OPTIONS		Float	s	This field contains the exposure time used to acquired the image	TM

COMMANDED_FILTER_NUMBER	SR_ACQUIRE_OPTIONS	ROSETTA	Integer		OSIRIS has a dual filter wheel in the optical beam. This field contains the index of the filter combination. The index is coded as a two digit number (AB) where A is the filter index of the first filter wheel and B is the index of the second filter wheel (for example 12 would mean wheel 1 at index 1 and wheel two at index 2)	TM
COMMANDED_FILTER_NAME	SR_ACQUIRE_OPTIONS	ROSETTA	String		Names of the two commanded filters in the optical path. The name is coded as <name of filter in wheel 1>_<name of filter in wheel 2> (for example Empty_Red)	TM
GRAYSCALE_TESTMODE_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		The OSIRIS CCD readout electronics has a test mode where the electronics transmits a synthetic grayscale test pattern. This test pattern can be used to diagnose problems with the communication links inside OSIRIS This field is a Boolean telling if the image were acquired using this test mode. TRUE FALSE	TM
HARDWARE_BINNING_ID	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can bit data two ways: 1. in a software pixel averaging mode and 2. using a hardware driven binning mode. The hardware binning id specifies what hardware mode were used. The following modes are possible ***1x1: Each input pixel becomes an***	TM

					output pixel ***2x2: Each 2x2 input block becomes an output pixel*** ***4x4: Each 4x4 input block becomes an output pixel*** ***8x8: Each 8x8 input block becomes an output pixel*** Please note that the hardware binning mode has an influence on the effective exposure time: 1x1 -> time 2x2 -> 4 x time 4x4 -> 16 x time 8x8 -> 64 x time	
AMPLIFIER_ID	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can clock the CCD out using three methods: A: The data is clocked left in the horizontal direction and passed throught the A amplifier chain B: The data is clocked right in the horizontal direction and passed throught the B amplifier chain BOTH: Where the left half of the CCD is clocked through the A channel and the right half of the CCD is clocked through the B channel. This field specifies what amplifier chains were used: ***A*** ***B*** ***BOTH***	TM
GAIN_ID	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can be operated with two fixed	TM

					amplifier gain settings (LOW and HIGH) This field tells what gain setting was used to acquire the image ***LOW*** ***HIGH***	
ADC_ID	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has a 16 bit digital converter that is actually composed of two 14 bit analog to digital converters working in series. OSIRIS can be operated in three ADC mode: ***LOW : only the low 14 bit ADC is used*** ***HIGH: only the high 14 bit ADC is used*** ***TANDEM: Both low and hight ADC is used to build the final 16 data number***	TM
OVERCLOCKING_LINES_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has an operation mode where the CCD ready keep clocking for an additional number of lines after having clocked out all the physical pixels of the CCD. The mode allows calibration of the charge transfer efficiency of the CCD in the vertical clocking direction. This field is a boolean telling if this operational mode was used. ***TRUE*** ***FALSE***	TM
OVERCLOCKING_PIXELS_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has an operation mode where the CCD ready keep clocking for an	TM

					additional number of pixels after having clocked out all the physical pixels of the CCD. The mode allows calibration of the charge transfer efficiency of the CCD in the horizontal clocking direction. This field is a boolean telling if this operational mode was used. ***TRUE*** ***FALSE***	
CCD_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can be configured to skip the readout of the CCD when acquiring an image. This field is a boolean telling if the CCD data was actually read out. ***TRUE*** ***FALSE***	TM
ADC_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can be configured to either keep the analog to digital converters (ADC) powered always or to only power the ADC when an image is acquired. This field is a boolean telling if the ADC were kept powered (the default). ***TRUE*** ***FALSE***	TM
BLADE1_PULSES_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can be configured to retrive or discard shutter pulse data during operations of the mechanical shutter mechanism.	TM

					This field is a boolean telling if shutter pulses were acquired for the first blade of the shutter. ***TRUE*** ***FALSE***	
BLADE2_PULSES_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can be configured to retrive or discard shutter pulse data during operations of the mechanical shutter mechanism. This field is a boolean telling if shutter pulses were acquired for the second blade of the shutter. ***TRUE*** ***FALSE***	TM
BULBMODE_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has an operational mode for acquiring very long exposures. In this mode the exposure is commanded to start followed by another command to stop the exposure. This mode is only used for exposures longer than 2^23 milliseconds. This field is a boolean telling if the this operational mode was used: ***TRUE*** ***FALSE***	TM
FRAMETRANSFER_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has an emergency fallback failsafe mode for acquiring images in case the mechanical shutter would fail during the mission.	TM

					This field is a boolean telling if the this operational mode was used: ***TRUE*** ***FALSE***	
WINDOWING_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can acquire images using a software windowing mode or a hardware windowing mode. (Meaning reading out only a small part of the full CCD surface) This field is a boolean telling if the hardware windowing mode was used during the exposure ***TRUE*** ***FALSE***	TM
SHUTTER_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS is equipped with a mechanical shutter mechanism . This field is a boolean telling if the mechanical shutter was operated during the exposure. ***TRUE*** ***FALSE***	TM
DITHERING_ENABLED_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		At high CCD temperature OSIRIS can be operated in a special noise reduction mode (called clock dithering) This field is a boolean telling if the this operational mode was used: ***TRUE*** ***FALSE***	TM

CRB_DUMP_MODE	SR_ACQUIRE_OPTIONS	ROSETTA	Integer		Internal CRB configuration	TM
CRB_PULSE_MODE	SR_ACQUIRE_OPTIONS	ROSETTA	Integer		Internal CRB configuration	TM
SUBFRAME_COORDINATE_ID	SR_ACQUIRE_OPTIONS	ROSETTA	String		What subframe coordinate system is used in the X_START, X_END, Y_START, Y_END tags? ***OPTICAL*** ***ELECTRICAL***	Fixed
X_START	SR_ACQUIRE_OPTIONS	ROSETTA	Integer	pixels	First column of the hardware sub frame used to acquire the image. Note this value is specified in ELECTRICAL CCD coordinates Please note that the coordinate value given reflects the configuration used to actually acquire the image from the hardware. The value cannot be used for determining the sub frame of the image data in the image file since downstream processing can change the effective sub frame. For this purpose please use the FIRST_LINE_SAMPLE field in the IMAGE object	TM
X_END	SR_ACQUIRE_OPTIONS	ROSETTA	Integer	pixels	Last column (inclusive) of the hardware sub frame used to acquire the image. Note this value is specified in ELECTRICAL CCD coordinates Please note that the coordinate value	TM

					given reflects the configuration used to actually acquire the image from the hardware. The value cannot be used for determining the sub frame of the image data in the image file since downstream processing can change the effective sub frame. For this purpose please use the FIRST_LINE_SAMPLE + LINES fields in the IMAGE object	
Y_START	SR_ACQUIRE_OPTIONS	ROSETTA	Integer	pixels	First row of the hardware sub frame used to acquire the image. Note this value is specified in ELECTRICAL CCD coordinates Please note that the coordinate value given reflects the configuration used to actually acquire the image from the hardware. The value cannot be used for determining the sub frame of the image data in the image file since downstream processing can change the effective sub frame. For this purpose please use the FIRST_LINE field in the IMAGE object	TM
Y_END	SR_ACQUIRE_OPTIONS	ROSETTA	Integer	pixels	Last row (inclusive) of the hardware sub frame used to acquire the image. Note this value is specified in ELECTRICAL CCD coordinates Please note that the coordinate value given reflects the configuration used to	TM

					actually acquire the image from the hardware. The value cannot be used for determining the sub frame of the image data in the image file since downstream processing can change the effective sub frame. For this purpose please use the FIRST_LINE + LINES fields in the IMAGE object	
SHUTTER_PRETRIGGER_DURATION	SR_ACQUIRE_OPTIONS	ROSETTA	Float	s	The time between the end of the shutter motion and the start of the CCD readout.	TM
CRB_TO_PCM_SYNC_MODE	SR_ACQUIRE_OPTIONS	ROSETTA	Integer		Internal CRB configuration parameter (synchronization between the CRB and the CRB power converter)	TM
AUTOEXPOSURE_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		The OSIRIS flight software has the option of having the camera try to optimize the best exposure time for the scene being imaged. This field is a boolean telling if the this operational mode was used: ***TRUE*** ***FALSE***	TM
LOWPOWER_MODE_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS can acquire image using a special low power mode (used during the eatly comet detection phase of the mission where the spacecraft has no power margin) This field is a boolean telling if the this operational mode was used:	TM

					TRUE ***FALSE***	
DUAL_EXPOSURE_FLAG	SR_ACQUIRE_OPTIONS	ROSETTA	Label		OSIRIS has an operation mode where the narrow angle camera and the wide angle camera can be commanded to acquire image synchronized to within a few milliseconds This field is a boolean telling if the this operational mode was used: ***TRUE*** ***FALSE***	TM

8.11 Mechanical Shutter Configuration Group

Label	***Group***	***Namespace***	***Datatype***	***Unit***	***Description***	***Source***
PROFILE_ID	SR_SHUTTER_CONFIG	ROSETTA	Integer		Timestamp in seconds since epoch 2000 when the shutter mechanism power profile was generated	TM
CONTROL_MASK	SR_SHUTTER_CONFIG	ROSETTA	Hex Integer		Raw control byte used to drive the shutter electronics	TM
TESTMODE_FLAG	SR_SHUTTER_CONFIG	ROSETTA	Label		The shutter can be operated using a special test mode where the number of transmitted pulse data points is only limited by time. When this mode is switched OFF the shutter will always deliver a maximum of 440 pulse points per shutter blade. Was the shutter test mode enabled? ***TRUE***	TM

					FALSE	
ZEROPULSE_FLAG	SR_SHUTTER_CONFIG	ROSETTA	Label		The zero position encoder is a hall sensor located at a known position relative to the edge of the CCD. When the zero pulse flag is enabled the shutter electronics only starts to transmit pulse data after the shutter blade has passed this encode. The field is a Boolean telling is the zero pulse was enable during the exposure ***TRUE*** ***FALSE***	TM
LOCKING_ENCODER_FLAG	SR_SHUTTER_CONFIG	ROSETTA	Label		The shutter mechanism has a mechanical latch that catches the shutter blade #1 and keeps the shutter open for long exposure times. The shutter mechanism has a hall sensor for detecting hat the blade #1 was actually caught by the latch mechanism This sensor can be enabled or disabled: The field is a Boolean that is TRUE is the sensor was enabled. ***TRUE*** ***FALSE***	TM
CHARGEMODE_ID	SR_SHUTTER_CONFIG	ROSETTA	Label		The shutter mechanism is driven using two motors. The motors draws power from a bank of capasitors that buffers the large power consumption needed during the short time of the actual blade motion.	TM

					This capacitor bank can be recharged using four different mode: ***OFF:*** ***No recharge*** ***SLOW: 32 s to recharge*** ***NORMAL: 1s to recharge*** ***FAST: 0.5 s to recharge***	

8.12 Mechanical Shutter Status Group

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
STATUS_MASK	SR_SHUTTER_STATUS	ROSETTA	Hex Integer		Raw status value as returned from the CRB	TM
ERROR_TYPE_ID	SR_SHUTTER_STATUS	ROSETTA	Label		What error occurred (if any) during the exposure? ***NONE*** ***LOCKING_ERROR_A*** ***MEMORY_ERROR_B*** ***UNLOCKING_ERROR_C*** ***SHE_RESET_ERROR_D***	TM

8.13 Image Compression Group

The image compression group contains information about the data compression and pre processing performed on the transmitted image. All labels are vectors of length N where N is the number of image segments used to transmit the image.

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
LOST_PACKETS	SR_COMPRESSION Non PDS (Not PDS compliant)	ROSETTA	Integer vector	packets	Number of lost packets for each image segment	TM
SEGMENT_X	SR_COMPRESSION	ROSETTA	Integer vector		First column in each image segment (zero indexed)	TM
SEGMENT_Y	SR_COMPRESSION	ROSETTA	Integer vector		First row in each image segment (zero indexed)	TM
SEGMENT_W	SR_COMPRESSION	ROSETTA	Integer vector		Width of each image segment	TM
SEGMENT_H	SR_COMPRESSION	ROSETTA	Integer vector		Height of each image segment	TM
ENCODING	SR_COMPRESSION	ROSETTA	Label vector		Name of the compression algorithm used to compress the image Valid values: "NONE": No encoding "SPIHT_D24": SPIHT wavelet based compression used by the OSIRIS flight software before release v2.0 "SPIHT_TAP": SPIHT wavelet based compression using TAP filtering (lossy) "SPIHT_LIFT": SPIHT wavelet based compression using LIFT filtering (normally lossless) "SQRT_16to8": Sqrt based 16 to 8 bit scaling "PACK9BIT": A compression where the data numbers are simply truncated at 9 bit thus discarding the high 7 bits.	TM
COMPRESSION_RATIO	SR_COMPRESSION	ROSETTA	Float vector		The effective compression ratio obtained by the image encoder. Example value 16 means 16:1 compression.	TM

LOSSLESS_FLAG	SR_COMPRESSION	ROSETTA	Label vector		A flag indicating if the performed compression was lossless Either: TRUE lossless compression FALSE lossy compression	TM
SPIHT_PYRAMID_LEVELS	SR_COMPRESSION	ROSETTA	Integer vector		Number of pyramid levels used by the SPIHT compressor NA for other encodings than SPIHT	TM
SPIHT_THRESHOLD_BITS	SR_COMPRESSION	ROSETTA	Integer vector		Number of threshold bits used by the SPIHT compressor NA for other encodings than SPIHT	TM
SPIHT_MEAN	SR_COMPRESSION	ROSETTA	Integer vector		Mean value used by the SPIHT compressor NA for other encodings than SPIHT	TM
SPIHT_MEAN_SHIFT	SR_COMPRESSION	ROSETTA	Integer vector		Mean shift value used by the SPIHT compressor NA for other encodings than SPIHT	TM
SPIHT_WAVE_LEVELS	SR_COMPRESSION	ROSETTA	Integer vector		Number of wave levels used by the SPIHT compressor NA for other encodings than SPIHT	TM
PIXEL_AVERAGING_WIDTH	SR_COMPRESSION	ROSETTA	Integer vector		The OSIRIS flight software allows the image to be averaged in blocks to reduce the data volume before transmission to ground. The pixel averaging width specified the box width used by the processing pipeline 1 means 1xN pixel averaging 2 means 2xN pixel averaging And so forth	TM

PIXEL_AVERAGING_HEIGHT	SR_COMPRESSION	ROSETTA	Integer vector		The OSIRIS flight software allows the image to be averaged in blocks to reduce the data volume before transmission to ground. The pixel averaging height specified the box height used by the processing pipeline 1 means Nx1 pixel averaging 2 means Nx2 pixel averaging And so forth	TM
SMOOTH_FILTER_ID	SR_COMPRESSION	ROSETTA	Label vector		The OSIRIS flight software gives the option of passing the image data through a 5x5 convolution filter before passing the image data through the image compressor. Possible values: NONE: No filtering CONVOL_KERNEL_1: 0.5 FWHM gauss filter CONVOL_KERNEL_2: 0.8 FWHM gauss filter CONVOL_KERNEL_3 1.0 FWHM gauss filter	TM
SQRT_FILTER_FLAG	SR_COMPRESSION	ROSETTA	Label vector		The OSIRIS flight software gives the option of transforming the images using the equation: Filtered DN = sqrt(image DN * gain) This flag indicating if the sqrt filter has been applied by the flight software Possible Values: TRUE FALSE	TM

SQRT_GAIN	SR_COMPRESSION	ROSETTA	Float vector		If SQRT_FILTER_FLAG is TRUE then SQRT_GAIN contains the gain factor used by the filter. (see SQRT_FILTER_FLAG)	TM

8.14 Hardware Identification Group

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
DATA_PROCESSING_UNIT_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the data processing unit ***EM*** ***QM*** ***FM*** ***FS***	TM
POWER_CONVERTER_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the main power converter ***EM*** ***QM*** ***FM*** ***FS***	TM
MOTOR_CONTROLLER_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the motor controller unit ***EM*** ***QM*** ***FM*** ***FS***	TM
NAC_CCD_READOUT_BOX_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the NAC CCD Readout Box (CRB) ***EM*** ***QM*** ***FM*** ***FS***	TM

WAC_CCD_READOUT_BOX_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the WAC CCD Readout Box (CRB) ***EM*** ***QM*** ***FM*** ***FS***	TM
NAC_CAMERA_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the NAC Camera/Focal plane hardware ***EM*** ***QM*** ***FM*** ***FS***	TM
WAC_CAMERA_ID	SR_HARDWARE_CONFIG	ROSETTA	Label		Hardware ID of the WAC Camera/Focal plane hardware ***EM*** ***QM*** ***FM*** ***FS***	TM

8.15 Operation Heater Group

Label	***Group***	***Namespace***	***Datatype***	***Unit***	***Description***	***Source***
CCD_HEATER_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the CCD operation heater	TM
NAC_MAIN_FDM_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the main NAC front door operational heater	TM
NAC_RED_FDM_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the redundant NAC front door operational heater	TM

NAC_MAIN_PPE_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the main PPE structure operational heater.	TM
NAC_RED_PPE_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the redundant PPE structure operational heater.	TM
WAC_MAIN_STR1_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the main WAC structure #1 operational heater	TM
WAC_RED_STR1_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the redundant WAC structure #1 operational heater	TM
WAC_MAIN_STR2_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the main WAC structure #2 operational heater	TM
WAC_RED_STR2_POWER	SR_HEATER_STATUS	ROSETTA	Float	W	Power used by the redundant WAC structure #2 operational heater	TM

8.16 Power Switch Group

Contains the state of the various power switches inside OSIRIS.

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
WAC_SHUTFAILSAFEEXEC_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC shutter failsafe execution switch switched on? ***ON*** ***OFF***	TM
NAC_SHUTFAILSAFEEXEC_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC shutter failsafe execution switch switched on? ***ON*** ***OFF***	TM
WAC_DOORFAILSAFEEXEC_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC door failsafe execution switch switched on? ***ON*** ***OFF***	TM
NAC_DOORFAILSAFEEXEC_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC door failsafe execution switch switched on? ***ON*** ***OFF***	TM
PCM_PASSCTRLACTIVE_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the PCM passive controller switch switched on? ***ON*** ***OFF***	TM
WAC_SHUTFAILSAFE_ENAB_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC shutter failsafe enable switch switched on?	TM

					ON ***OFF***	
WAC_SHUTTERPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC shutter electronics switch switched on? ***ON*** ***OFF***	TM
WAC_CCDANNEALHEATER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC CCD annealing heater switch switched on? ***ON*** ***OFF***	TM
WAC_CRB_PRIMEPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC primary CRB power switch switched on? ***ON*** ***OFF***	TM
NAC_SHUTFAILSAFE_ENAB_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC shutter failsafe enabling switch switched on? ***ON*** ***OFF***	TM
NAC_SHUTTERPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC shutter electronics power switch switched on? ***ON*** ***OFF***	TM
NAC_CCDANNEALHEATER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC CCD annealing heater switch switched on? ***ON*** ***OFF***	TM

NAC_CRB_PRIMEPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC primary CRB power switch switched on? ***ON*** ***OFF***	TM
WAC_STRUCTUREHEATER_R_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC redundant structure heater switch switched on? ***ON*** ***OFF***	TM
WAC_STRUCTUREHEATER_M_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC main structure heater switch switched on? ***ON*** ***OFF***	TM
WAC_RED_CALLAMP_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC redundant calibration lamp switch switched on? ***ON*** ***OFF***	TM
WAC_MAIN_CALLAMP_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC main calibration lamp switch switched on? ***ON*** ***OFF***	TM
WAC_DOORFAILSAFE_ENAB_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the WAC door failsafe enable switch switched on? ***ON*** ***OFF***	TM
NAC_IFPLATEHEATER_R_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC redundant IFP (PPE) heater switch switched on?	TM

					ON ***OFF***	
NAC_IFPLATEHEATER_M_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC main IFP (PPE) heater switch switched on? ***ON*** ***OFF***	TM
NAC_RED_CALLAMP_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC redundant calibration lamp switch switched on? ***ON*** ***OFF***	TM
NAC_MAIN_CALLAMP_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC main calibration lamp switch switched on? ***ON*** ***OFF***	TM
NAC_DOORFAILSAFE_ENAB_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the NAC door failsafe enable switch switched on? ***ON*** ***OFF***	TM
MCB_RED_MOTORPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the redundant MCB motor power switch switched on? ***ON*** ***OFF***	TM
MCB_MAIN_MOTORPOWER_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		Is the main MCB motor power switch switched on? ***ON*** ***OFF***	TM

MCB_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		What is the MCB power mode? The MCB is the motor controller board which is also used to readout all the analog housekeeping channels. Possible values: ***MAIN: Main MCB active*** ***REDUNANT: Redundant MCB active*** ***OF: MCB powered OFF***	TM
PRIMARY_POWER_RAIL_FLAG	SR_SWITCH_STATUS	ROSETTA	Label		What primary power rail has been selected (primary spacecraft power switch) ***MAIN*** ***REDUNDANT***	TM

8.17 Currents and Voltages Group

Contains current and voltage measurements of the various power rails used by OSIRIS

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
V_28_MAIN	SR_POWER_STATUS	ROSETTA	Float	V	Voltage of the main 28 V power rail	TM
V_28_REDUNDANT	SR_POWER_STATUS	ROSETTA	Float	V	Voltage of the redundant 28 V power rail	TM
V_5	SR_POWER_STATUS	ROSETTA	Float	V	Main power converter 5V rail voltage	TM
V_3	SR_POWER_STATUS	ROSETTA	Float	V	Main power converter 3V rail voltage	TM
V_15	SR_POWER_STATUS	ROSETTA	Float	V	Main power converter 15V rail voltage	TM
V_M15	SR_POWER_STATUS	ROSETTA	Float	V	Main power converter -15V rail voltage	TM
V_NAC_REFERENCE	SR_POWER_STATUS	ROSETTA	Float	V	NAC reference voltage	TM
V_WAC_REFERENCE	SR_POWER_STATUS	ROSETTA	Float	V	WAC reference voltage	TM
CAMERA_V_24	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter 24V rail voltage	TM
CAMERA_V_8	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter 8V rail voltage	TM
CAMERA_V_M12	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter -12V rail voltage	TM
CAMERA_V_5_ANALOG	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter 5V analog rail voltage	TM
CAMERA_V_5_DIGITAL	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter 5V digital rail voltage	TM
CAMERA_V_M5	SR_POWER_STATUS	ROSETTA	Float	V	Camera CRB power converter -5V rail voltage	TM

I_28_MAIN	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the main 28 V power rail	TM
I_28_REDUNDANT	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the redundant 28 V power rail	TM
I_5	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the main power converter 5V rail	TM
I_3	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the main power converter 3V rail	TM
I_15	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the main power converter 15V rail	TM
I_M15	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the main power converter -15V rail	TM
CAMERA_I_24	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the camera CRB power converter 24V rail	TM
CAMERA_I_8	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the camera CRB power converter 8V rail	TM
CAMERA_I_M12	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the Camera CRB power converter -12V rail	TM
CAMERA_I_5_ANALOG	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the camera CRB power converter 5V analog rail	TM
CAMERA_I_5_DIGITAL	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the camera CRB power converter 5V digital rail	TM
CAMERA_I_M5	SR_POWER_STATUS	ROSETTA	Float	mA	Current measurement of the camera CRB power converter -5V rail	TM

8.18 Temperatures Group

Contains temperature measurements of various parts of the OSIRIS instrument

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
T_MAIN_PCM	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of the Main power converter electronics board	TM
T_REDUNDANT_PCM	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of the Redundant power converter electronics board	TM
T_WAC_STRUCTURE_MAIN_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC structure temperature sensor #1 (main)	TM
T_WAC_STRUCTURE_REDUNDANT_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC structure temperature sensor #1 (redundant)	TM
T_WAC_STRUCTURE_MAIN_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC structure temperature sensor #2 (main)	TM
T_WAC_STRUCTURE_REDUNDANT_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC structure temperature sensor #2 (redundant)	TM
T_WAC3	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC mirror temperature sensor #3	TM
T_WAC4	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC mirror temperature sensor #4	TM
T_WAC_WHEEL_MOTOR_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC filter wheel #1 motor temperature sensor	TM
T_WAC_WHEEL_MOTOR_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC filter wheel #2 motor temperature sensor	TM
T_WAC_DOOR_MOTOR	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC filter front door motor temperature sensor	TM
T_NAC_CCD_VIA_MCB	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	NAC CCD temperature as read By the MCB HK board	TM

T_WAC_CCD_VIA_MCB	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	WAC CCD temperature as read By the MCB HK board	TM
T_NAC_WHEEL_MOTOR_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	NAC filter wheel #1 motor temperature sensor	TM
T_NAC_WHEEL_MOTOR_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	NAC filter wheel #2 motor temperature sensor	TM
T_NAC_DOOR_MOTOR	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	NAC filter front door motor temperature sensor	TM
T_NAC_DOOR_IF_MAIN	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC front door interface plate (main)	TM
T_NAC_MIRROR_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC M2 mirror	TM
T_NAC_PPE_IF_REDUNDANT	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC PPE interface plate (mounting plate for filter wheel, shutter and focal plane) (redundant)	TM
T_NAC_DOOR_IF_REDUNDANT	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC front door interface plate (redundant)	TM
T_NAC_PPE_IF_MAIN	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC PPE interface plate (mounting plate for filter wheel, shutter and focal plane) (main)	TM
T_NAC_MIRROR_1_AND_3	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of NAC M1 and M3 mirror mounting plate	TM
T_DSP_MAIN	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of main DSP (processing unit)	TM
T_DSP_REDUNDANT	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of redundant DSP (processing unit)	TM

T_BOARD_CONTROLLER	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of motor controller controller board	TM
T_BOARD_DRIVER	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of motor controller driver state	
CAMERA_TCCD	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	CCD Temperature as read out by the CRB electronics	TM
CAMERA_T_SENSORHEAD	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of the CCD sensor head electronics board	TM
CAMERA_T_ADC_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of ADC #1	TM
CAMERA_T_ADC_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of ADC #2	TM
CAMERA_T_SHUTTER_MOTOR_1	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of shutter motor #1	TM
CAMERA_T_SHUTTER_MOTOR_2	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of shutter motor #2	TM
CAMERA_T_POWER_CONVERTER	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of CRB electronics power converter module	TM
CAMERA_T_DOSIMETER	SR_TEMPERATURE_STATUS	ROSETTA	Float	K	Temperature of dosimeter	TM

8.19 Radiation Environment Group

Label	Group	Namespace	Datatype	Unit	Description	Source
CAMERA_DOSIS	SR_RADIATION_STATUS	ROSETTA	Float	rad	Total radiation dosis measured by the radiation MOSFET	TM
SREM_PROTONS_GT_20MEV	SR_RADIATION_STATUS	ROSETTA	Float	DN	SREM dosis of >20MeV protons	TM
SREM_PROTONS_50_TO_70MEV	SR_RADIATION_STATUS	ROSETTA	Float	DN	SREM dosis of 50-70 MeV protons	TM
SREM_ELECTRONS_LT_2MEV	SR_RADIATION_STATUS	ROSETTA	Float	DN	SREM dosi of < 2 MeV electrons	TM

9 PDS Objects

9.1 The HISTORY Object

The HISTORY object is an attached secondary PDS label with additional information about the processing history if the image. The history object data can be extracted from the PDS label via the ^HISTORY pointer specifying the offset of the history label. The history label is terminated using an END statement (same as a normal PDS label). The history object contains a single object called HISTORY with a varying number of sub fields defined by the various processing steps.
For detailed information about the meaning of the various history fields please see the processing software source code.

A typical history object could look like:

```
OBJECT                                      = HISTORY
    /* Information about the CODMAC level 1 to COSMAC level 2 processing pipeline */
    GROUP                                       = TMI2PDS
        TIME                                        = "2009-05-12T12:28:59.921Z"
        INPUT_FILE                                  = "\\osi-storage\archive\data\spacecraft\pfm\flight\*"
        OUTPUT_FILE                                 = "\\osi-storage\archive\uplink"
        OUTPUT_DIR                                  = "c:\temp\pds_work"
        PDS_DB                                      = "\\osi-storage\archive_admin\Database\ArchivingDatabase"
        SPICE_DB                                    = "\\osi-storage\archive\Database\Kernels"
        UPLINK_DB                                   = "\\osi-storage\archive\uplink"
        REPROCESS                                   = FALSE
        DETECT_FDM_STATE                            = FALSE
        FORCE_TARGET_UNKNOWN                        = TRUE
        CORRECT_FILENAME                            = TRUE
        RECURSIVE                                   = FALSE
        USE_ADS                                     = TRUE
        BUILDING                                    = PDS_ARCHIVE
        BUILD_JPEG                                  = FALSE
        BUILD_THUMBNAILS                            = FALSE
        CODMAC                                      = TRUE
        IMPORT_RIS_ARCHIVE                          = TRUE
        USE_REVISION_CONTROL                        = FALSE
        USE_SHORT_FILENAME                          = TRUE
        SKIP_SHM_ERRORS                             = TRUE
```

```
        RESTRICT_TO_MISSION_PHASE                 = AST1
        USING_INSTRUMENT_ID                       = "OSINAC"
        USING_INSTRUMENT_NAME                     = "OSIRIS - NARROW ANGLE CAMERA"
    END_GROUP                                 = TMI2PDS
      OBJECT                                    = LEVEL2_PIPELINE
          ADC_OFFSET_CORRECTION_FLAG                = TRUE
          ADC_OFFSET_CORRECTION_VERSION             = "V1.1"
          COHERENT_NOISE_CORRECTION_FLAG            = TRUE
          COHERENT_NOISE_CORRECTION_VERSION         = "V1.0"
          FRAME_SEPERATOR_VERSION                   = "V1.0"
          BIAS_LEVEL                                = 232.195
          BIAS_CORRECTION_FLAG                      = TRUE
          BIAS_CORRECTION_VERSION                   = "V2.1"
          POISSON_NOISE_VERSION                     = "1.0"
          MK_QUALITY_MAP_VERSION                    = "1.0"
          EXPOSURETIME_CORRECTION_FLAG              = TRUE
          EXPOSURETIME_CORRECTION_VERSION           = "V1.2"
          DARK_CURRENT_CORRECTION_FLAG              = TRUE
          DARK_CURRENT_CORRECTION_VERSION           = "V1.2"
          BAD_PIXEL_REPLACEMENT_FLAG                = TRUE
          BAD_PIXEL_REPLACEMENT_VERSION             = "V1.0"
          FLATFIELD_CORRECTION_FLAG                 = TRUE
          FLATFIELD_CORRECTION_VERSION              = "V1.1"
          ABSCAL_FACTOR                             = 1.20000e+008
          ABSOLUTE_CALIBRATION_FLAG                 = TRUE
          ABSOLUTE_CALIBRATION_VERSION              = "V1.0"
          CALIBRATION_DATAFILES                     = ("NAC_FM_ADC_V1_27062005.TXT", "NAC_FM_BIAS_V5_20080905.txt",
      "NAC_FM_Dark_V3_16072005.img",         "NAC_FM_BPIX_V1_01072005.txt",         "NAC_FM_FLAT-22_V1_28062005.img",
      "NAC_FM_AbsCal_V2_02122005.txt")
          PIPELINE_MASTER_VERSION                   = "1.4"
      END_OBJECT                                = LEVEL2_PIPELINE
END_GROUP                                 = HISTORY
END
```

9.2 Shutter Blade 1 position encoder Object

Embedded binary object containing the position encoder pulse data for the shutter blade #1. The data is reached using the data pointer ^BLADE1_PULSE_ARRAY. Note this object only exists in the PDS header if shutter pulse data for blade 1 has been downlinked. The BLADE1_PULSE_ARRAY object only exists in the EDR label.

Label	***Object***	***Datatype***	***Description***
NAME	BLADE1_PULSE_ARRAY	String	Short description of the object
DESCRIPTION	BLADE1_PULSE_ARRAY	String	Description of the object
INTERCHANGE_FORMAT	BLADE1_PULSE_ARRAY	Label	Interchange format Always: BINARY
AXES	BLADE1_PULSE_ARRAY	Integer	Number of data axes (always 1)
AXIS_ITEMS	BLADE1_PULSE_ARRAY	Integer	Number of data elements in array
NAME	BLADE1_PULSE_ARRAY.ELEMENT	Label	Name of single data elements (Always “COUNT”)
DATA_TYPE	BLADE1_PULSE_ARRAY.ELEMENT	Label	Datatype of shutter pulse data array (Always LSB_UNSIGNED_INTEGER)
BYTES	BLADE1_PULSE_ARRAY.ELEMENT	Integer	Number of bytes per pulse sample (Always 4)

9.3 Shutter Blade 2 position encoder Object

Embedded binary object containing the position encoder pulse data for the shutter blade #2. The data is reached using the data pointer ^BLADE2_PULSE_ARRAY. Note this object only exists in the PDS header if shutter pulse data for blade 1 has been downlinked. The BLADE1_PULSE_ARRAY object only exists in the EDR label.

Label	***Object***	***Datatype***	***Description***
NAME	BLADE2_PULSE_ARRAY	String	Short description of the object
DESCRIPTION	BLADE2_PULSE_ARRAY	String	Description of the object
INTERCHANGE_FORMAT	BLADE2_PULSE_ARRAY	Label	Interchange format Always: BINARY
AXES	BLADE2_PULSE_ARRAY	Integer	Number of data axes (always 1)
AXIS_ITEMS	BLADE2_PULSE_ARRAY	Integer	Number of data elements in array
NAME	BLADE2_PULSE_ARRAY.ELEMENT	Label	Name of single data elements (Always “COUNT”)
DATA_TYPE	BLADE2_PULSE_ARRAY.ELEMENT	Label	Datatype of shutter pulse data array (Always LSB_UNSIGNED_INTEGER)
BYTES	BLADE2_PULSE_ARRAY.ELEMENT	Integer	Number of bytes per pulse sample (Always 4)

9.4 The IMAGE Object

(required object)

The image object contains the image data from the physical CCD surface (the actual image acquired during the exposure)

Label	*Object*	*Datatype*	*Description*
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type Normally: LSB_UNSIGNED_INTEGER for level 1 data
SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image
DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image

MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

9.5 The PA_IMAGE Object

(optional object)

The OSIRIS CCD has an operation mode where the CCD first clocks out 48 pixels connected to ground before actually clocking out the real image data (the pre pixels). The pre pixels can be acquired from both the A and B amplifier chains. If data was acquired from the A amplifier chain the pre pixel image data will be found in the PA_IMAGE object.

Label	***Object***	***Datatype***	***Description***
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type Normally: LSB_UNSIGNED_INTEGER for level 1 data

SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image
DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image
MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

9.6 The PB_IMAGE Object

(optional object)

The OSIRIS CCD has an operation mode where the CCD first clocks out 48 pixels connected to ground before actually clocking out the real image data (the pre pixels). The pre pixels can be acquired from both the A and B amplifier chains. If data was acquired from the B amplifier chain the pre pixel image data will be found in the PB_IMAGE object.

Label	***Object***	***Datatype***	***Description***
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data

			Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type Normally: LSB_UNSIGNED_INTEGER for level 1 data
SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image
DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image
MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

9.7 The OL_IMAGE Object

(optional object)

The OSIRIS CCD has an operation mode where the CCD keep clocking lines after the last physical CCD line has been read. This allows calibration of the charge transfer efficiency in the vertical clocking direction. If data was acquired using this mode then the image data will be found in the OL_IMAGE object.

Label	***Object***	***Datatype***	***Description***
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type Normally: LSB_UNSIGNED_INTEGER for level 1 data
SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image

DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image
MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

9.8 The SIGMA_MAP_IMAGE Object

(required for CODMAC level 3 and higher)

RDR data records with calibrated image data contains an additional image object called the sigma map image. The sigma map image contains an error estimate in % for each pixel in the image data. The error estimate currently just contains the Poisson error.

Label	***Object***	***Datatype***	***Description***
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type

			Normally: LSB_UNSIGNED_INTEGER for level 1 data
SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image
DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image
MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

9.9 The QUALITY_MAP_IMAGE Object

(required for CODMAC level 3 and higher)

An RDR data record with calibrated image data contains an additional image object called the quality map image. The quality map image contains a quality estimate for each pixel in the image.

The QUALITY_MAP_IMAGE is an 8-bit image with the same dimension as the image itself and contains a quality estimate of each pixel. The quality map exists for data level 3 and higher. The quality estimate values stored in the quality map are generated by setting a given bit to value 1 for specific effects. If more effect is present in the data several different bits can be set.

The following value a possible:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Value	128	64	32	16	8	4	2	1
Effect	BAD	SAT	DIM	WARM	LOSSY	NLIN	CONV	SQRT

BAD: Pixel is marked as bad (garbage data!)
SAT: Pixel was saturated during the exposure (garbage data!)
DIM: Pixel is marked as dim (low sensitivity – probably garbage data!)
WARM: Pixel is marked as warm (increased and slightly varying ensitivity) – use with caution
LOSSY: Pixel has seen lossy image compression
NLIN: Pixel was expososed into the non linear DN range of the CCD
CONV: Pixel has seen gauss convolution filtering as part of the image compression
SQRT: Pixel has seen sqrt filtering as part of the image compression

The general rule for the quality map is that low absolute values means good data and high absolute values mean suspect data.

Label	***Object***	***Datatype***	***Description***
INTERCHANGE_FORMAT	IMAGE	Label	The interchange format of the image data Always: BINARY
LINE_SAMPLES	IMAGE	Integer	Width of the image in pixels
LINES	IMAGE	Integer	Height of the image in pixels
BANDS	IMAGE	Integer	Number of image planes Always 1
SAMPLE_TYPE	IMAGE	Label	The binary storage data type Normally: LSB_UNSIGNED_INTEGER for level 1 data

SAMPLE_BITS	IMAGE	Integer	Number of bits per pixel Normally: 16 for level 1 data
SAMPLE_BIT_MASK	IMAGE	Bin Integer	Bitmask indicating significant bits
UNIT	IMAGE	String	Data unit of the image data Level2: DN Level3 – N: $Wm^{-2}sr^{-1}nm^{-1}$
DERIVED_MINIMUM	IMAGE	Integer/Float	Minimum data value in image
DERIVED_MAXIMUM	IMAGE	Integer/Float	Maximum data value in image
MEAN	IMAGE	Integer/Float	Mean data value of image data
FIRST_LINE	IMAGE	Integer	First row of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.
FIRST_LINE_SAMPLE	IMAGE	Integer	First column of subframe in OPTICAL CCD coordinates Please not that this value is 1 indexed! Not 0 indexed.

Appendix 1 – Example OSIRIS Label

```
PDS_VERSION_ID                  = PDS3
LABEL_REVISION_NOTE             = "V5.2 Dec 2 2010 SFH"

/* FILE CHARACTERISTICS */

RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 512
FILE_RECORDS                    = 4150
LABEL_RECORDS                   = 41
FILE_NAME                       = "W20100710T154116488ID20F71.IMG"
PROCESSING_HISTORY_TEXT         = "Level 1 PDS file created - tmi2pds 2010-12-02"

/* POINTERS TO DATA OBJECTS */

^HISTORY                        = 42
^IMAGE                          = 55
^BLADE1_PULSE_ARRAY             = 47
^BLADE2_PULSE_ARRAY             = 51

/* SOFTWARE */

SOFTWARE_DESC                   = "Osiris level 1 PDS file generator"
SOFTWARE_NAME                   = "tmi2pds.exe"
SOFTWARE_VERSION_ID             = "V3.0.0.10"
SOFTWARE_RELEASE_DATE           = 2010-12-02

/* MISSION IDENTIFICATION */

INSTRUMENT_HOST_ID              = "RO"
INSTRUMENT_HOST_NAME            = "ROSETTA-ORBITER"
MISSION_ID                      = "ROSETTA"
MISSION_NAME                    = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME              = "LUTETIA FLY-BY"
```

```
/* INSTRUMENT DESCRIPTION */

INSTRUMENT_ID                    = "OSIWAC"
INSTRUMENT_NAME                  = "OSIRIS - WIDE ANGLE CAMERA"
INSTRUMENT_TYPE                  = "FRAME CCD REFLECTING TELESCOPE"
DETECTOR_DESC                    = "2048x2048 PIXELS BACKLIT FRAME CCD DETECTOR"
DETECTOR_PIXEL_WIDTH             = 13.500000 <MICRON>
DETECTOR_PIXEL_HEIGHT            = 13.500000 <MICRON>
DETECTOR_TYPE                    = "SI CCD"
DETECTOR_ID                      = "EEV-242"
DETECTOR_TEMPERATURE             = 173.506946 <K>
ELEVATION_FOV                    = 12.000000 <DEGREES>
AZIMUTH_FOV                      = 12.100000 <DEGREES>
TELESCOPE_RESOLUTION             = 0.000101 <RAD>
TELESCOPE_F_NUMBER               = 5.600000
TELESCOPE_FOCAL_LENGTH           = 0.132000 <m>

/* IMAGE IDENTIFICATION */

IMAGE_ID                         = "281129003"
IMAGE_OBSERVATION_TYPE           = "REGULAR"
EXPOSURE_TYPE                    = "MANUAL"
PRODUCT_ID                       = "W20100710T154116488ID20F71"
PRODUCT_TYPE                     = EDR
PRODUCT_VERSION_ID               = "1"
PRODUCER_INSTITUTION_NAME        = "Max Planck Institute for Solar System Research"
PRODUCER_FULL_NAME               = "STUBBE F. HVIID"
PRODUCER_ID                      = "MPS"
MEDIUM_TYPE                      = "ELECTRONIC"
PUBLICATION_DATE                 = 2010-12-02
DATA_SET_ID                      = "RO-A-OSIWAC-2-AST2-LUTETIA_FLY-BY-V1.0"
DATA_SET_NAME                    = "ROSETTA-ORBITER LUTETIA FLY-BY OSIWAC 2 EDR data"
PROCESSING_LEVEL_ID              = "2"
PROCESSING_LEVEL_DESC            = "Raw image data with calibrated header information"
DATA_QUALITY_ID                  = "0"
```

```
DATA_QUALITY_DESC                 = "Note always 0. Please see the QUALITY_MAP_IMAGE object for quality information"

/* TIME IDENTIFICATION */

PRODUCT_CREATION_TIME             = 2010-12-02T10:49:10.570
START_TIME                        = 2010-07-10T15:41:35.447
STOP_TIME                         = 2010-07-10T15:41:37.867
SPACECRAFT_CLOCK_START_COUNT      = "1/237397254:31984"
SPACECRAFT_CLOCK_STOP_COUNT       = "1/237397254:35984"

/* GEOMETRY */

/*
           The values of the keywords SC_SUN_POSITION_VECTOR SC_TARGET_POSITION_VECTOR and SC_TARGET_VELOCITY_VECTOR
are related to the Earth Mean Equator J2000 reference frame.
           The values of SUB_SPACECRAFT_LATITUDE and  SUB_SPACECRAFT_LONGITUDE are northern latitude and eastern
longitude in the  standard planetocentric IAU_<TARGET_NAME> frame.
           All values are computed for the time t= START_TIME.
           Distances are given in <km> velocities in <km/s>, Angles in <deg>.
  */

SC_SUN_POSITION_VECTOR            = (401053125.269162 <km>, 68120031.651990 <km>, 7034033.981704 <km>)
SPACECRAFT_SOLAR_DISTANCE         = 406857991.975685 <km>
SOLAR_ELONGATION                  = 144.121598 <deg>
RIGHT_ASCENSION                   = 225.011181 <deg>
DECLINATION                       = -7.698864 <deg>
NORTH_AZIMUTH                     = 12.145057 <deg>
TARGET_NAME                       = "21 LUTETIA"
TARGET_TYPE                       = "ASTEROID"
TARGET_LIST                       = ()
LIGHT_SOURCE_PHASE_ANGLE          = 35.555844 <deg>
SC_TARGET_POSITION_VECTOR         = (-3068.723366 <km>, -3035.282570 <km>, -581.238849 <km>)
SC_TARGET_VELOCITY_VECTOR         = (14.986834 <km/s>, -0.313231 <km/s>, -0.386874 <km/s>)
TARGET_CENTER_DISTANCE            = 4355.208603 <km>
SUB_SPACECRAFT_LATITUDE           = NULL
SUB_SPACECRAFT_LONGITUDE          = NULL
```

```
SPACECRAFT_ALTITUDE              = 4308.090810 <km>

/* COORDINATE SYSTEMS */

GROUP                            = SC_COORDINATE_SYSTEM
  COORDINATE_SYSTEM_NAME           = "S/C-COORDS"
  ORIGIN_OFFSET_VECTOR             = (-401036033.706764 <km>, -68117127.862892 <km>, -7033733.851129 <km>)
  ORIGIN_ROTATION_QUATERNION       = (0.300457, 0.585442, -0.716851, 0.230450)
  QUATERNION_DESC                    = "J2000 to Rosetta Coordinate System quaternion [nx sin(a/2), ny sin(a/2), nz
sin(a/2), cos(a/2)]"
  REFERENCE_COORD_SYSTEM_NAME      = "EME J2000"
END_GROUP                        = SC_COORDINATE_SYSTEM

GROUP                            = CAMERA_COORDINATE_SYSTEM
  COORDINATE_SYSTEM_NAME           = "WAC_CAMERA_FRAME"
  ORIGIN_OFFSET_VECTOR             = (-0.001050 <km>, 0.000232 <km>, 0.002114 <km>)
  ORIGIN_ROTATION_QUATERNION       = (-0.707101, 0.707105, -0.002821, -0.001714)
  QUATERNION_DESC                  = "Rosetta Coordinate System to camera coordinate system quaternion [nx sin(a/2),
ny sin(a/2), nz sin(a/2), cos(a/2)]"
  REFERENCE_COORD_SYSTEM_NAME      = "S/C-COORDS"
END_GROUP                        = CAMERA_COORDINATE_SYSTEM

SPICE_FILE_NAME                            =  ("NAIF0009.TLS",  "ROS_101110_STEP.TSC",  "ATNR_P040302093352_00114.BC",
"ORHR_______________00109.BSP", "PCK00009.TPC", "ROS_V17.TF",
                                   "mar033_2000-2025.bsp",         "DE405.BSP",          "2867_STEINS_2004_2016.BSP",
"21_LUTETIA_2004_2016.BSP", "Tempel1-9p-39.bsp", "ORHO_______________00077.BSP",
                                   "ORHS_______________00109.BSP",   "ORHW_______________00016.BSP",   "C2001Q4.bsp",
"C2002T7.bsp", "TEMPEL1-9P-DI-P.BSP", "P2010A2.bsp",
                                   "Vesta-2004-2015.bsp", "C2004Q2.bsp")

/* DISPLAY INFORMATION */

SAMPLE_DISPLAY_DIRECTION         = RIGHT
LINE_DISPLAY_DIRECTION           = DOWN

/* STATUS FLAGS */
```

```
GROUP                             = SR_STATUS_FLAGS
  ROSETTA:SHUTTER_FOUND_IN_ERROR_FLAG      = FALSE
  ROSETTA:SHUTTER_PRE_INIT_FAILED_FLAG     = FALSE
  ROSETTA:ERROR_RECOVERY_FAILED_FLAG       = FALSE
  ROSETTA:EXPOSURE_STATUS_ID               = SUCCESS
END_GROUP                         = SR_STATUS_FLAGS

/* MECHANISM STATUS FLAGS */

GROUP                             = SR_MECHANISM_STATUS
  FILTER_NUMBER                     = "71"
  FILTER_NAME                       = "UV325_Empty"
  ROSETTA:FRONT_DOOR_STATUS_ID             = OPEN
END_GROUP                         = SR_MECHANISM_STATUS

/* IMAGE ACQUISITION OPTIONS */

GROUP                             = SR_ACQUIRE_OPTIONS
  ROSETTA:SCIENCE_DATA_LINK                = HIGHSPEED
  ROSETTA:DATA_ROUTING_ID                  = QUEUE1
  EXPOSURE_DURATION                 = 2.420000 <s>
  ROSETTA:COMMANDED_FILTER_NUMBER          = "71"
  ROSETTA:COMMANDED_FILTER_NAME            = "UV325_Empty"
  ROSETTA:GRAYSCALE_TESTMODE_FLAG          = FALSE
  ROSETTA:HARDWARE_BINNING_ID              = '1x1'
  ROSETTA:AMPLIFIER_ID                     = B
  ROSETTA:GAIN_ID                          = HIGH
  ROSETTA:ADC_ID                           = TANDEM
  ROSETTA:OVERCLOCKING_LINES_FLAG          = FALSE
  ROSETTA:OVERCLOCKING_PIXELS_FLAG         = FALSE
  ROSETTA:CCD_ENABLED_FLAG                 = TRUE
  ROSETTA:ADC_ENABLED_FLAG                 = TRUE
  ROSETTA:BLADE1_PULSES_ENABLED_FLAG       = TRUE
  ROSETTA:BLADE2_PULSES_ENABLED_FLAG       = TRUE
  ROSETTA:BULBMODE_ENABLED_FLAG            = FALSE
```

```
  ROSETTA:FRAMETRANSFER_ENABLED_FLAG       = FALSE
  ROSETTA:WINDOWING_ENABLED_FLAG           = TRUE
  ROSETTA:SHUTTER_ENABLED_FLAG             = TRUE
  ROSETTA:DITHERING_ENABLED_FLAG           = FALSE
  ROSETTA:CRB_DUMP_MODE                    = 0
  ROSETTA:CRB_PULSE_MODE                   = 0
  ROSETTA:SUBFRAME_COORDINATE_ID           = ELECTRICAL
  NOTE                             = "Do not use X_START, X_END, Y_START, Y_END for subframe determination"
  ROSETTA:X_START                          = 496
  ROSETTA:X_END                            = 1520
  ROSETTA:Y_START                          = 432
  ROSETTA:Y_END                            = 1456
  ROSETTA:SHUTTER_PRETRIGGER_DURATION      = 0.065000 <s>
  ROSETTA:CRB_TO_PCM_SYNC_MODE             = 17
  ROSETTA:AUTOEXPOSURE_FLAG                = FALSE
  ROSETTA:LOWPOWER_MODE_FLAG               = FALSE
  ROSETTA:DUAL_EXPOSURE_FLAG               = FALSE
END_GROUP                        = SR_ACQUIRE_OPTIONS

/* SHUTTER CONFIG */

GROUP                            = SR_SHUTTER_CONFIG
  ROSETTA:PROFILE_ID                       = "4294967295"
  ROSETTA:CONTROL_MASK                     = 16#3a#
  ROSETTA:TESTMODE_FLAG                    = TRUE
  ROSETTA:ZEROPULSE_FLAG                   = TRUE
END_GROUP                        = SR_SHUTTER_CONFIG

/* SHUTTER STATUS */

GROUP                            = SR_SHUTTER_STATUS
  ROSETTA:STATUS_MASK                      = 16#6000600#
  ROSETTA:ERROR_TYPE_ID                    = NONE
  ROSETTA:BLADE1_FIT_SLOPE                 = NULL
  ROSETTA:BLADE1_FIT_OFFSET                = NULL
  ROSETTA:BLADE1_FIT_STDDEV                = NULL
```

```
  ROSETTA:BLADE1_FIT_START                 = NULL
  ROSETTA:BLADE2_FIT_SLOPE                 = NULL
  ROSETTA:BLADE2_FIT_OFFSET                = NULL
  ROSETTA:BLADE2_FIT_STDDEV                = NULL
  ROSETTA:BLADE2_FIT_START                 = NULL
END_GROUP                         = SR_SHUTTER_STATUS

/* DATA COMPRESSION AND SEGMENTATION */

GROUP                             = SR_COMPRESSION
  ROSETTA:SEGMENT_X                        = (0, 512, 0, 512)
  ROSETTA:SEGMENT_Y                        = (0, 0, 512, 512)
  ROSETTA:SEGMENT_W                        = (512, 512, 512, 512)
  ROSETTA:SEGMENT_H                        = (512, 512, 512, 512)
  ROSETTA:ENCODING                         = (NONE, NONE, NONE, NONE)
  ROSETTA:COMPRESSION_RATIO                = (1.000000, 1.000000, 1.000000, 1.000000)
  ROSETTA:LOSSLESS_FLAG                    = (TRUE, TRUE, TRUE, TRUE)
  ROSETTA:SPIHT_PYRAMID_LEVELS             = (4294967293, 4294967293, 4294967293, 4294967293)
  ROSETTA:SPIHT_MEAN                       = (4294967293, 4294967293, 4294967293, 4294967293)
  ROSETTA:SPIHT_MEAN_SHIFT                 = (4294967293, 4294967293, 4294967293, 4294967293)
  ROSETTA:SPIHT_WAVE_LEVELS                = (4294967293, 4294967293, 4294967293, 4294967293)
  PIXEL_AVERAGING_WIDTH           = (1, 1, 1, 1)
  PIXEL_AVERAGING_HEIGHT          = (1, 1, 1, 1)
  ROSETTA:SMOOTH_FILTER_ID                 = (NONE, NONE, NONE, NONE)
  ROSETTA:SQRT_FILTER_FLAG                 = (FALSE, FALSE, FALSE, FALSE)
END_GROUP                         = SR_COMPRESSION

/* SUBSYSTEM HARDWARE IDENTIFICATION */

GROUP                             = SR_HARDWARE_CONFIG
  ROSETTA:DATA_PROCESSING_UNIT_ID          = FS
  ROSETTA:POWER_CONVERTER_ID               = FS
  ROSETTA:MOTOR_CONTROLLER_ID              = FS
  ROSETTA:NAC_CCD_READOUT_BOX_ID           = FM
  ROSETTA:WAC_CCD_READOUT_BOX_ID           = FM
  ROSETTA:NAC_CAMERA_ID                    = FM
```

```
  ROSETTA:WAC_CAMERA_ID                    = FM
END_GROUP                         = SR_HARDWARE_CONFIG

/* SYSTEM HEATER STATUS */

GROUP                             = SR_HEATER_STATUS
  ROSETTA:CCD_HEATER_POWER                 = 0.000000 <W>
  ROSETTA:NAC_MAIN_FDM_POWER               = 3.988600 <W>
  ROSETTA:NAC_RED_FDM_POWER                = 0.000000 <W>
  ROSETTA:NAC_MAIN_PPE_POWER               = 1.709400 <W>
  ROSETTA:NAC_RED_PPE_POWER                = 0.000000 <W>
  ROSETTA:WAC_MAIN_STR1_POWER              = 1.758240 <W>
  ROSETTA:WAC_RED_STR1_POWER               = 0.000000 <W>
  ROSETTA:WAC_MAIN_STR2_POWER              = 3.125760 <W>
  ROSETTA:WAC_RED_STR2_POWER               = 0.000000 <W>
END_GROUP                         = SR_HEATER_STATUS

/* POWER CONVERTER SWITCH STATUS */

GROUP                             = SR_SWITCH_STATUS
  ROSETTA:WAC_SHUTFAILSAFEEXEC_FLAG        = OFF
  ROSETTA:NAC_SHUTFAILSAFEEXEC_FLAG        = OFF
  ROSETTA:WAC_DOORFAILSAFEEXEC_FLAG        = OFF
  ROSETTA:NAC_DOORFAILSAFEEXEC_FLAG        = OFF
  ROSETTA:PCM_PASSCTRLACTIVE_FLAG          = OFF
  ROSETTA:WAC_SHUTFAILSAFE_ENAB_FLAG       = OFF
  ROSETTA:WAC_SHUTTERPOWER_FLAG            = ON
  ROSETTA:WAC_CCDANNEALHEATER_FLAG         = OFF
  ROSETTA:WAC_CRB_PRIMEPOWER_FLAG          = ON
  ROSETTA:NAC_SHUTFAILSAFE_ENAB_FLAG       = OFF
  ROSETTA:NAC_SHUTTERPOWER_FLAG            = ON
  ROSETTA:NAC_CCDANNEALHEATER_FLAG         = OFF
  ROSETTA:NAC_CRB_PRIMEPOWER_FLAG          = ON
  ROSETTA:WAC_STRUCTUREHEATER_R_FLAG       = OFF
  ROSETTA:WAC_STRUCTUREHEATER_M_FLAG       = OFF
  ROSETTA:WAC_RED_CALLAMP_FLAG             = OFF
```

```
  ROSETTA:WAC_MAIN_CALLAMP_FLAG            = OFF
  ROSETTA:WAC_DOORFAILSAFE_ENAB_FLAG       = OFF
  ROSETTA:NAC_IFPLATEHEATER_R_FLAG         = OFF
  ROSETTA:NAC_IFPLATEHEATER_M_FLAG         = OFF
  ROSETTA:NAC_RED_CALLAMP_FLAG             = OFF
  ROSETTA:NAC_MAIN_CALLAMP_FLAG            = OFF
  ROSETTA:NAC_DOORFAILSAFE_ENAB_FLAG       = OFF
  ROSETTA:MCB_RED_MOTORPOWER_FLAG          = OFF
  ROSETTA:MCB_MAIN_MOTORPOWER_FLAG         = ON
  ROSETTA:MCB_FLAG                         = MAIN
  ROSETTA:PRIMARY_POWER_RAIL_FLAG          = MAIN
END_GROUP                          = SR_SWITCH_STATUS

/* POWER SYSTEM STATUS */

GROUP                              = SR_POWER_STATUS
  ROSETTA:V_28_MAIN                        = 28.445000 <V>
  ROSETTA:V_28_REDUNDANT                   = 3.290000 <V>
  ROSETTA:V_5                              = 5.220000 <V>
  ROSETTA:V_3                              = 3.420000 <V>
  ROSETTA:V_15                             = 14.960000 <V>
  ROSETTA:V_M15                            = -14.960000 <V>
  ROSETTA:V_NAC_REFERENCE                  = -9.892000 <V>
  ROSETTA:V_WAC_REFERENCE                  = -9.956000 <V>
  ROSETTA:CAMERA_V_24                      = 25.403917 <V>
  ROSETTA:CAMERA_V_8                       = 8.385758 <V>
  ROSETTA:CAMERA_V_M12                     = -12.380590 <V>
  ROSETTA:CAMERA_V_5_ANALOG                = 5.367149 <V>
  ROSETTA:CAMERA_V_5_DIGITAL               = 5.274897 <V>
  ROSETTA:CAMERA_V_M5                      = -5.333306 <V>
  ROSETTA:I_28_MAIN                        = 1842.280000 <mA>
  ROSETTA:I_28_REDUNDANT                   = 0.000000 <mA>
  ROSETTA:I_5                              = 2058.680000 <mA>
  ROSETTA:I_3                              = 135.670000 <mA>
  ROSETTA:I_15                             = 48.380000 <mA>
  ROSETTA:I_M15                            = 41.170000 <mA>
```

```
  ROSETTA:CAMERA_I_24                     = 14.658805 <mA>
  ROSETTA:CAMERA_I_8                      = 12.273659 <mA>
  ROSETTA:CAMERA_I_M12                    = 71.962013 <mA>
  ROSETTA:CAMERA_I_5_ANALOG               = 102.924325 <mA>
  ROSETTA:CAMERA_I_5_DIGITAL              = 122.486374 <mA>
  ROSETTA:CAMERA_I_M5                     = 64.224957 <mA>
END_GROUP                       = SR_POWER_STATUS

/* TEMPERATURE STATUS */

GROUP                           = SR_TEMPERATURE_STATUS
  ROSETTA:T_MAIN_PCM                      = 299.343000 <K>
  ROSETTA:T_REDUNDANT_PCM                 = 294.951000 <K>
  ROSETTA:T_WAC_STRUCTURE_MAIN_1          = 284.933454 <K>
  ROSETTA:T_WAC_STRUCTURE_REDUNDANT_1     = 285.695172 <K>
  ROSETTA:T_WAC_STRUCTURE_MAIN_2          = 285.187360 <K>
  ROSETTA:T_WAC_STRUCTURE_REDUNDANT_2     = 285.441266 <K>
  ROSETTA:T_WAC3                          = 288.488138 <K>
  ROSETTA:T_WAC4                          = 286.202984 <K>
  ROSETTA:T_WAC_WHEEL_MOTOR_1             = 283.156112 <K>
  ROSETTA:T_WAC_WHEEL_MOTOR_2             = 284.933454 <K>
  ROSETTA:T_WAC_DOOR_MOTOR                = 281.378770 <K>
  ROSETTA:T_NAC_CCD_VIA_MCB               = 202.414004 <K>
  ROSETTA:T_WAC_CCD_VIA_MCB               = 178.800746 <K>
  ROSETTA:T_NAC_WHEEL_MOTOR_1             = 255.480358 <K>
  ROSETTA:T_NAC_WHEEL_MOTOR_2             = 256.242076 <K>
  ROSETTA:T_NAC_DOOR_MOTOR                = 252.433486 <K>
  ROSETTA:T_NAC_DOOR_IF_MAIN              = 247.863178 <K>
  ROSETTA:T_NAC_MIRROR_2                  = 222.980390 <K>
  ROSETTA:T_NAC_PPE_IF_REDUNDANT          = 255.226452 <K>
  ROSETTA:T_NAC_DOOR_IF_REDUNDANT         = 247.863178 <K>
  ROSETTA:T_NAC_PPE_IF_MAIN               = 255.226452 <K>
  ROSETTA:T_NAC_MIRROR_1_AND_3            = 222.218672 <K>
  ROSETTA:T_DSP_MAIN                      = 305.753746 <K>
  ROSETTA:T_DSP_REDUNDANT                 = 295.597506 <K>
  ROSETTA:T_BOARD_CONTROLLER              = 299.406096 <K>
```

```
  ROSETTA:T_BOARD_DRIVER                    = 297.374848 <K>
  ROSETTA:CAMERA_TCCD                       = 173.506946 <K>
  ROSETTA:CAMERA_T_SENSORHEAD               = 289.254578 <K>
  ROSETTA:CAMERA_T_ADC_1                    = 296.572658 <K>
  ROSETTA:CAMERA_T_ADC_2                    = 297.844610 <K>
  ROSETTA:CAMERA_T_SHUTTER_MOTOR_1          = 283.452386 <K>
  ROSETTA:CAMERA_T_SHUTTER_MOTOR_2          = 283.992530 <K>
  ROSETTA:CAMERA_T_POWER_CONVERTER          = 318.927650 <K>
  ROSETTA:CAMERA_T_DOSIMETER                = 291.763634 <K>
END_GROUP                         = SR_TEMPERATURE_STATUS

/* RADIATION ENVIRONMENT */

GROUP                             = SR_RADIATION_STATUS
  ROSETTA:CAMERA_DOSIS                      = 458.066882 <rad>
  ROSETTA:SREM_PROTONS_GT_20MEV             = 177
  ROSETTA:SREM_PROTONS_50_TO_70MEV          = 3
  ROSETTA:SREM_ELECTRONS_LT_2MEV            = NULL
END_GROUP                         = SR_RADIATION_STATUS

OBJECT                            = BLADE1_PULSE_ARRAY
  INTERCHANGE_FORMAT                = BINARY
  NAME                              = "Shutter Blade 1 pulse data"
  DESCRIPTION                       = "Raw 2.1 MHz Position encoder timer data for shutter blade 1"
  AXES                              = 1
  AXIS_ITEMS                        = 440
  OBJECT                            = ELEMENT
    DATA_TYPE                         = LSB_UNSIGNED_INTEGER
    BYTES                             = 4
    NAME                              = "COUNT"
  END_OBJECT                        = ELEMENT

END_OBJECT                        = BLADE1_PULSE_ARRAY

OBJECT                            = BLADE2_PULSE_ARRAY
  INTERCHANGE_FORMAT                = BINARY
```

```
  NAME                            = "Shutter Blade 2 pulse data"
  DESCRIPTION                     = "Raw 2.1 MHz Position encoder timer data for shutter blade 2"
  AXES                            = 1
  AXIS_ITEMS                      = 440
  OBJECT                          = ELEMENT
    DATA_TYPE                       = LSB_UNSIGNED_INTEGER
    BYTES                           = 4
    NAME                            = "COUNT"
  END_OBJECT                      = ELEMENT

END_OBJECT                      = BLADE2_PULSE_ARRAY

OBJECT                          = IMAGE
  BANDS                           = 1
  FIRST_LINE                      = 433
  FIRST_LINE_SAMPLE               = 529
  INTERCHANGE_FORMAT              = BINARY
  LINES                           = 1024
  LINE_SAMPLES                    = 1024
  SAMPLE_BITS                     = 16
  SAMPLE_TYPE                     = LSB_UNSIGNED_INTEGER
  DERIVED_MINIMUM                 = 247.000000
  DERIVED_MAXIMUM                 = 10357.000000
  MEAN                            = 841.232027
END_OBJECT                      = IMAGE

END
```

Appendix 2 – Example OSIRIS History Label

```
OBJECT                                = HISTORY
  GROUP                                 = TMI2PDS
    COMMAND_IMAGE_INDEX                   = 3
    ORFA_SUBMISSION_ID                    = "281"
    ACTIVITY_NAME                         = "21-Lutetia FlyBy"
    ACTIVITY_TYPE                         = "SCIENCE"
    OBSERVATION_DESCRIPTION               = "LUTETIA: Closest Approach"
    OBSERVATION_NAME                      = "SR 05"
    OIOR_FILENAME                         = "OIOR_PI7RSO_D_0018_SR_05____00281.itl"
    PLANNING_PHASE                        = "0018"
    TIME                                  = 2010-12-02T10:49:10.622
    INPUT_FILE_ARG                        = "\\osi-storage\archive\data\spacecraft\pfm\flight\*"
    INPUT_FILE             = "\\osi-storage\archive\data\spacecraft\pfm\flight\LutetiaFlyBy_2010\pds\level0\WAC_2010-
07-10T15.41.16.488Z_ID00_1251276003_F71.img"
    OUTPUT_FILE                           = "<DEFAULT>"
    OUTPUT_DIR                            = "."
    PDS_DB                                = "\\osi-storage\archive_admin\Database\ArchivingDatabase"
    SPICE_DB                              = "\\osi-storage\archive\Database\Kernels"
    UPLINK_DB                             = "\\osi-storage\archive\uplink"
    REPROCESS                             = FALSE
    DETECT_FDM_STATE                      = TRUE
    FORCE_TARGET_UNKNOWN                  = FALSE
    CORRECT_FILENAME                      = TRUE
    RECURSIVE                             = TRUE
    USE_ADS                               = TRUE
    ARCHIVE_TYPE                          = PDS_ARCHIVE
    BUILD_JPEG                            = FALSE
    BUILD_THUMBNAILS                      = FALSE
    CODMAC                                = TRUE
    IMPORT_RIS_ARCHIVE                    = TRUE
    USE_REVISION_CONTROL                  = FALSE
    USE_SHORT_FILENAME                    = TRUE
```

```
    SKIP_SHM_ERRORS                  = TRUE
    RESTRICT_TO_MISSION_PHASE        = "AST2"
    USING_INSTRUMENT_ID              = "OSIWAC"
    USING_INSTRUMENT_NAME            = "OSIRIS - WIDE ANGLE CAMERA"
  END_GROUP                        = TMI2PDS

END_OBJECT                       = HISTORY

END
```