OSIRIS

Optical, Spectroscopic, and Infrared Remote Imaging System

Rosetta-OSIRIS To Planetary Science Archive Interface Control Document

RO-RIS-MPAE-ID-015

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Document Change Record

Iss./Rev.	Date	Pages affected	Description
Draft	4 Nov. 2003	All	First draft
1a	29 Aug 2005	All	Fleshed out
1b	24 Jan 2006	All	Added science objectives General cleaning
2a	2 Nov 2006	All	Major cleaning and reorganization of document Added dataset overview covering the period until Comet encounter Changed the PDS file naming convention to be PDS compliant Simplified the data directory structure Moved most of the actual PDS label information to the EDR/SIS document.
3a	14/5-2009	All	Added data set ID's separated between NAC and WAC
3c	2/12-2010	All	Synchronized the EAICD with the actual archive generation process (several minor points) Added description of new EXTRAS directory used to store the BROWSE HTML files, thumbnail images and activity log
3d	28/1-2011		Added missing BROWSE directory description Corrected mistakes in the data set ID description Corrected various spelling errors
3e	3/3-2011	26	Change CAL description to reflect the non-zip based implementation required by the PDS
3f	20 Oct 2015	1,2,9,26	Added explanation on the extent of the calibration database Updated PI and creator of the data

4-	16/01/2017	All	Now uses OSIRIS document template Updated various figures & tables Updated Acronym list Removed "Scientific objectives" Updated Data Handling Process Updated Instrument Overview section for NAC & WAC Removed "Data Set and Data Product Overview" Updated The CALIB directory • Removed ADC, FILTERS, MIRRORS, QE, SHUTTER, SOLARFLUX sections • Added BADPIXELS, EXPOSURE sections • Descriptions of all CALIB sections have been updated Removed "Reference Systems" Removed "PDS Object and Keyword Definitions" Added OSIRIS Ancillary Data PDS Labels
4a	28/04/2017	Sect. 1.5, Sect. 3.4, Sect. 4, Sect. 5.1	Updated versions of reference documents Added Sec 4: The OSIRIS Science Data (.fts and .jpg) Detached Labels Added description of DATA_VERSION_ID Removed INSTRUMENT_NAME from ancillary labels Added description of BROWSE and .FTS data to Sect. 3.4 Section 4.2: added note in MEAN and STANDARD_DEVIATION: “this label is present only in CODMAC level 2 images.

Table of contents

1 General aspects

1.1 Scope

This document describes the data flow of the OSIRIS instrument on the Rosetta mission from the S/C until the insertion into the PSA for ESA. It includes information on how data were processed, formatted, labelled and uniquely identified. The document discusses general naming schemes for data volumes, data sets, data and label files. Standards used to generate the product are explained. Software that may be used to access the product is explained further on.

The design of the data set structure and the data product is given. Examples of these are given in the appendix.

1.2 Introduction

The purpose of this EAICD (Experimenter to (Science) Archive Interface Control Document) is twofold. First, it provides users of the OSIRIS instrument with detailed description of the product and a description of how it was generated, including data sources and destinations. Secondly, it is the official interface between the OSIRIS instrument team and the PSA archiving authority.

1.3 Archiving Authorities

The Planetary Data System Standard is used as archiving standard by:

- NASA for U.S. planetary missions, implemented by PDS
- ESA for European planetary missions, implemented by the Research and Scientific Support Department (RSSD) of ESA

ESA implements an online science archive, the PSA, to support and ease data ingestion to offer additional services to the scientific user community and science operations teams as e.g. search queries that allow searches across instruments, missions and scientific disciplines several data delivery options as direct download of data products, linked files and data sets ftp download of data products, linked files and data sets

The PSA aims for online ingestion of logical archive volumes and will offer the creation of physical archive volumes on request.

1.4 Intended Readership

The staff of the archiving authority (Planetary Science Archive, ESA, RSSD, design team) and any potential user of OSIRIS data.

1.5 Reference Documents

no.	document name	document number, Iss./Rev.
RD1	Planetary Data System Preparation Workbook, February 1, 1995	Version 3.1, JPL, D-7669, Part1
RD2	Planetary Data System Standards Reference, June 1, 1999	Version 3.3, JPL, D-7669, Part 2
RD3	OSIRIS Experiment Data Record and Software Interface Specification (EDR/SIS)	RO-RIS-MPAE-ID-018, 4/d
RD4	OSIRIS Experiment Data Record and Software Interface Specification (EDR/SIS) for JPEG Thumbnails	RO-RIS-MPAE-ID-021, 1/b

1.6 Contact Names and Addresses

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2 Acronyms and Abbreviations

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 für 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	Università di Padova
UPM	Universidad Politécnica de Madrid
WAC	Wide Angle Camera

3 Overview of Instrument Design, Data Handling Process and Product Generation

3.1 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 camera system consists of a Narrow Angle Camera (NAC) and a Wide Angle Camera (WAC).

3.1.1 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 straylight reaching the CCD (the NAC has a proven stray light attenuation of better than 10^{-9}). The optical beam is reflected by 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: (left) The OSIRIS NAC flight unit in the lab. (right) The NAC Optical path

3.1.2 The Wide Angle Camera

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 WAC has a proven stray light attenuation of better than 10^{-8}).

The optical beam is reflected by the two mirrors (M1 & M2) before passing through a double filter wheel, a mechanical shutter mechanism, and an anti-radiation plate (ARP) before reaching the CCD.

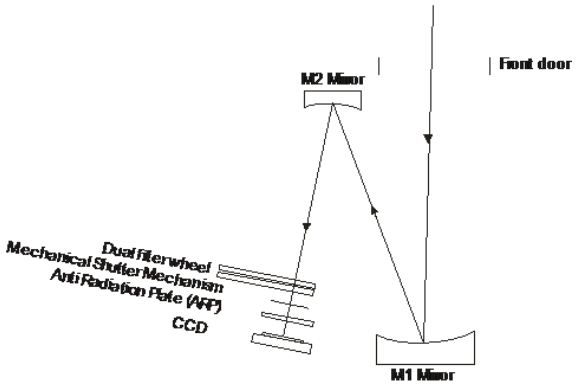

Figure 2: (left) The OSIRIS WAC flight unit in the lab. (right) The WAC Optical path

More detailed information about the design of the cameras, the filter wheels, the mechanical shutter mechanism and the CCD can be found in:

Keller, H. U. et al. OSIRIS -- The Scientific Camera System Onboard Rosetta, *Space Science Reviews*. 2007. **128**. 433-506.

3.2 Data Handling Process

OSIRIS EDR processing is overseen by OsiDRONE. OsiDRONE runs several processes, which handle the actual data processing. Each of these processes can be run independently as needed, but in general operational use, they are controlled by OsiDRONE. OsiDRONE is scheduled to automatically run four times a day, in addition to being run manually if required. The following steps are performed when processing a data set, with output logs generated for each step.

3.2.1 HERMES

HERMES downloads the raw telemetry data via the DDS interface from ESA, and saves the data to the OSIRIS TLM archive.

3.2.2 OsiTRAP

OsiTRAP generates both the OSIRIS level 0 (raw data & header) images and OSIRIS level 1 (raw data & calibrated header) images, which are then stored in the OSIRIS Primary Archive.

3.2.3 GETTY

GETTY determines where each image from the primary archive should be copied, and copies them to the correct location within the OSIRIS Secondary Archive.

3.2.4 OsiCALLIOPE

OsiCALLIOPE calibrates the OSIRIS level 1 images, creating OSIRIS level 2 and level 3 images, with these images being stored in the OSIRIS Secondary Archive.

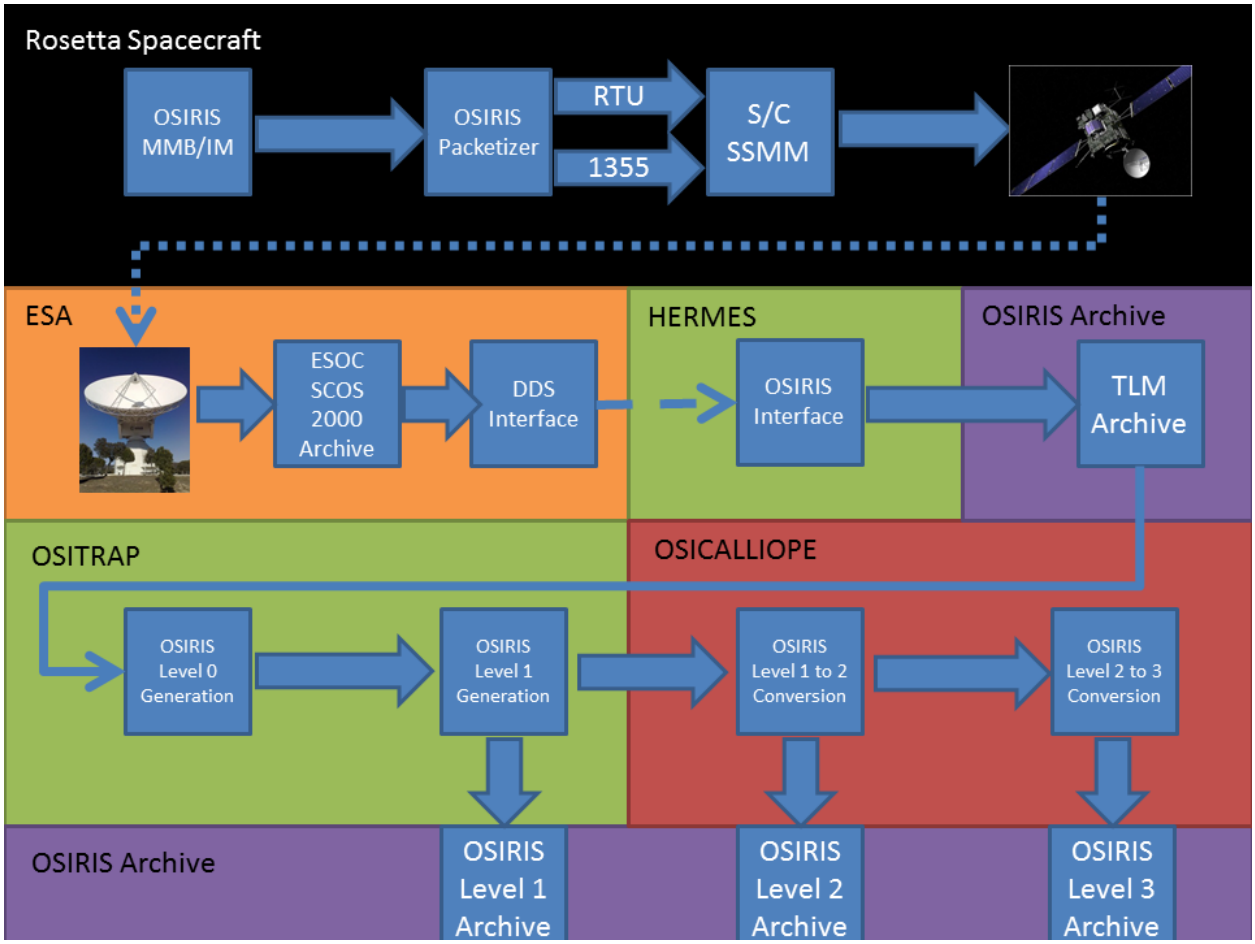

Figure 3: The OSIRIS data and processing flow

With the generation of products for the OSIRIS archive, further tools are used in order to deliver these data products, along with supporting ancillary information, to the PSA Archive.

3.2.5 pds2Legacy

pds2Legacy generates additional formats as required, derived from the PDS products; for example, JPEG and FITS.

3.2.6 TIMGAD

TIMGAD packages the data products, along with supporting ancillary information (see "Overview of Data Products"), creating a data package for the CODMAC level being delivered. This data package is then uploaded to the PSA Archive.

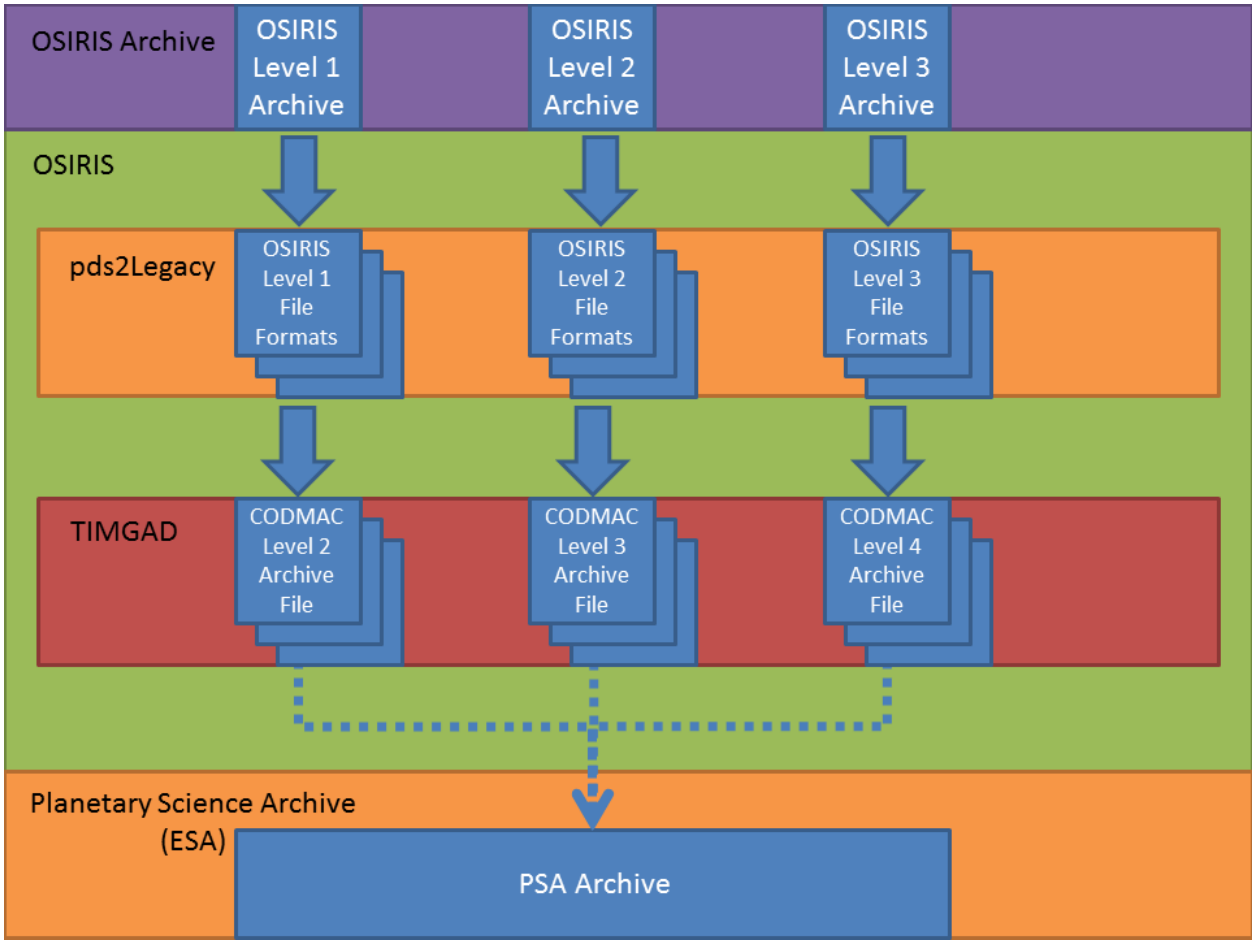

Figure 4: The data and processing flow from the OSIRIS Archive, to the PSA Archive

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 radiometrically calibrated image data
3	4	PDS compliant data files with calibrated header data and radiometrically calibrated & geometric distortion corrected image data

Table 1: OSIRIS and CODMAC data levels

3.3 Overview of Data Products

For details on the OSIRIS EDR and RDR PDS labels please see the OSIRIS EDR/SIS document included in the dataset documentation folder.

3.3.1 Instrument Calibrations

OSIRIS is archiving calibrated data (CODMAC level 3). The database used by the software to generate the calibrated data is included in the archived dataset structure. Moreover, routines in the programming language IDL are included, provide an interface to read and modify the images.

CALIB/DATABASE/	Folder containing a database of calibration information
EXTRAS/SOFTWARE/FWPDSLIB.ZIP	containing an IDL (Interactive Data Language) software library for manipulating PDS images

3.4 Data Set Organization

The OSIRIS flight data sets are organized using the subdirectories recommended by the PDS standards:

- BROWSE
- CALIB
- CATALOG
- DATA
- DOCUMENT
- EXTRAS

3.4.1 The BROWSE directory

The BROWSE directory contains thumbnail versions in JPEG format for all the images stored in the DATA directory of the dataset. The images are stored using the same organization as used for the DATA directory with the images stored in <year>_<month> sub folders. Each file comprises a detached PDS label with content defined in Sect. 4.

Details of the thumbnail files including size, compression, and orientation are described in RD4.

3.4.2 The DATA directory

The data directory contains the actual OSIRIS EDR and RDR data files. The DATA directory contains a list of sub directories. Each of these subdirectories will contain all data acquired within a calendar month. The directories are named:

YYYY-MM

Example: 2006-12 will contain all data acquired in the month of December 2006.

The data is stored in PDS compatible format (.IMG) as well as in the fits file format (.FTS). Fits files comprises a detached PDS label with content defined in Sect. 4.

3.4.3 The CALIB directory

The CALIB directory provides various calibration parameters for OSIRIS. These parameters are used by the OSIRIS calibration pipeline, OsiCALLIOPE.

The CALIB folder contains the various database information required to calibrate OSIRIS images. The information provided is stored in a format readable by the OSIRIS calibration pipeline software. All information is readable using either a text editor (ASCII format) or a standard PDS data file reader (PDS image data and PDS table data).

Given that the calibration database is considered a single product even if it can be used separately to calibrate images from the NAC and the WAC; it is delivered in its entirety on the NAC and WAC datasets.

The calibration database has the following structure:

CALIB/		
	ABSCAL	Folder containing the DN/s to W/m2/sr/nm for various optical filter combinations.
	BADPIXELS	Folder containing a list of bad pixels on the CCDs and their correction method.
	BIAS	Folder containing the bias offsets for the various operational modes of OSIRIS.
	DISTORTION	Folder containing the optical distortion model parameters for the cameras.
	EXPOSURE	Folder containing data for shutter flight and thus exposure time correction.
	FLATFIELDS	Folder containing the flatfields for the various filter combinations

3.4.3.1 ABSCAL

Contains files with the format <camera>_<model>_ABSCAL_V<version>.TXT

The data files contain the detached PDS label description of the file, followed by the data from the Delta Calibration (May 2014).

The data contains <tag>=<value> lists with the format:

ABS_CAL_<filter>: [(DN/s)/(W/m2/nm/sr)] for <filter>

ABS_CER_<filter>: Error in [(DN/s)/(W/m2/nm/sr)]

ABS_RWL_<filter>: The reference (central) wavelength

ABS_SFX_<filter>: The Solar flux @ reference wavelength

3.4.3.2 BADPIXELS

Contains files with the format <camera>_<model>_BAD_PIXEL_ V<version>.TXT

The data files contain the detached PDS label description of the file, followed by the data from inflight calibration.

The data contains <tag>=<value> lists with the format:

PIXEL = (COLUMN, ROW, CORRECTION): for a single bad pixel

COLUMN = (COLUMN, ROW, CORRECTION): for a bad column or cluster

AREA_R = (COLUMN, ROW, WIDTH, HEIGHT, CORRECTION): for a rectangular area

3.4.3.3 BIAS

Contains files with the format <camera>_<model>_BIAS_V<version>.TXT

The data files contain the detached PDS label description of the file, followed by the data from the Delta Calibration (May 2014) and regular inflight BIAS observations.

Contains the BIAS offset added to the images by the readout electronics for various readout configurations, in the format:

BIAS_Wn_Bn_Xn_Snn: where X is A for single channel or D for dual channel

DNDT_Wn_Bn_Xn_Snn: temperature dependency, where X is A for single channel or D for dual channel

SDEV_Wn_Bn_Xn_Snn: standard deviation, where X is A for single channel or D for dual channel

3.4.3.4 DISTORTION

Contains files with the format <camera>_<model>_DISTORTION_V<version>.TXT

The data files contain the detached PDS label description of the file, followed by the data, in the format:

DIST_a_METHOD/DIST_a_NPARS: the method and number of parameters used for the calculation, where a is X or Y

DIST_a_PARnn: a parameter used in the calculation, where a is X or Y, and nn is the parameter number

3.4.3.5 EXPOSURE

Contains files with the format <camera>_<model>_EXPOSURE_<suffix>_V<version>.TXT

<suffix> is either BAL (for correction of data acquired following the mission start) or a date (for correction of data acquired after the date).

The data files contain the detached PDS label description of the file, followed by the data itself. The data contains <tag>=<value> lists with the format:

ROW_nnnn: where nnnn is the row number and the value is the exposure time for the row, in seconds

3.4.3.6 FLATFIELDS

Contains the flatfield required to calibration OSIRIS images.

The folder contains files with the names:

<camera>_<model>_FLAT<type>_<filter number>_V<version>.IMG

<type> can be “HI” for high frequency flatfield images or omitted for low frequency flatfield images.

The data files are stored in a data format that can be read with a PDS image reader.

3.4.4 The CATALOG directory

The CATALOG directory contains the catalogue files required by the PDS standard.

DATASET.CAT	Description of the dataset
INSTHOST.CAT	Description of the Rosetta orbiter spacecraft
MISSION.CAT	Description of the Rosetta mission
OSIRIS.CAT	Description of the OSIRIS instrument
PERSONNEL.CAT	Contact information
REFERENCE.CAT	References
TARGETS.CAT	Description of the target object observed in the dataset
SOFTWARE.CAT	Description of the included software packages

3.4.5 The DOCUMENT directory

The Document directory contains supporting documentation for the data set. The documents are organized in sub directories. Each subdirectory contains multiple versions of the same document. An ASCII version of the document is always available (PDS requirement) but an ADOBE PDF version is typically also available.

[CALIB]	One document that describes the calibration process (OSIRIS_CAL_PIPELINE_V<version>.PDF) and several documents that describe the database.
[EAICD]	Archive interface control document (this document)
[OSIRIS_SSR]	A Space Science Review paper by Keller et al. (2007), describing the OSIRIS cameras in detail
[SIS]	The OSIRIS EDR/SIS document (detailed PDS label description)

3.4.6 The EXTRAS directory

The EXTRAS directory contains a subdirectory SOFTWARE. This folder is used to store the software that can be used to read and modify the OSIRIS images. All routines are written in the programming language IDL (Interactive Data Language) and zipped into FWPDSLIB.ZIP, which contains a readme file explaining how to use the routines.

3.5 Data File Naming Conventions and Product IDs

3.5.1 File Naming Convention

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

CYYYYMMDDTHHMMSSUUUFFLIFAB.XXX

Field	Description
C	Either: N (Narrow Angle Camera) **OR** W (Wide Angle Camera)
YYYY	The year of acquisition
MM	The month of acquisition
DD	The day of acquisition
T	The letter T (stands for "Time")
HH	The hour of acquisition
MM	The minute of acquisition
SS	The second of acquisition
UUU	The millisecond of acquisition
FF	The image file type: ID: Image Data (normal images) TH: Thumbnail version PA: Amplifier A pre pixels (calibration data) PB: Amplifier B pre pixels (calibration data) OL: Overclocked lines (calibration data)
L	The CODMAC processing level of the image
I	The instance id if the image (multiple transmissions of an image will be reflected in this number incrementing)
F	The letter F (stands for "Filter")
A	The position index of the filter wheel #1
B	The position index of the filter wheel #2
.XXX	The file extension (e.g. .IMG, .FTS, .JPG…)

Table 2: OSIRIS PDS data file filename elements

Example:

W20040923T071606570ID12F12.IMG

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 3rd transmission of the image data. The image was acquired using the filter combination (1, 2), and is in PDS format.

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 on-board clock drift and leap seconds.

The best possible knowledge about the time of acquisition can be found in the header label START_TIME.

3.5.2 The Dataset ID

The OSIRIS DATA_SET_ID follows the following convention:

DATA_SET_ID = RO-<target id>-OSIRIS-<CODMAC level>-<mission phase abbreviation>-<description>-<version>

Field	Description
RO-	The letters "RO-"
<target ID>	A single letter code for the target type observed. (See Table 5 of RO-EST-TN-3372_1_- for full list) A subset is: E = Earth M = Mars C = Comet A = Asteroid
-	The letter "-"
<Instrument>	Either OSINAC or OSIWAC
-	The letter "-"
<CODMAC level>	The CODMAC data level of the dataset
-	The letter "-"
<mission phase ID>	One of the words: CVP, EAR1, CR2, MARS, CR3, EAR2, CR4A, AST1, CR4B, EAR3, CR5, AST2, RVM1, CR6, RVM2
-	The letter "-"
<mission phase name>	One of the words: COMMISSIONING, EARTHSWINGBY1, CRUISE2, MARSSWINGBY, CRUISE3, EARTHSWINGBY2, CRUISE4A, STEINSFLYBY, CRUISE4B, EARTHSWINGBY3, CRUISE5, LUTETIAFLYBY, RENDEZVOUSMANOEUVRE1, CRUISE6, RENDEZVOUSMANOEUVRE2
<version>	The release version using the form: V<release>.<submission> Example. V1.1 means release 1 submission 1 The release number only increments if a dataset is resubmitted and made public. The submission number refers to deliveries of the same dataset from OSIRIS to the PSA (for example as part of the review process)

Example: RO-M-OSINAC-1-MARS-MARSSWINGBY-V1.0

3.6 Standards Used in Data Product Generation

3.6.1 PDS Standards

The OSIRIS archive is based on the PDS v3.6 specifications.

3.6.2 Time Standards

3.6.2.1 SCLK Time fields

SLCK time fields are specified using the following convention:

<reset number>/<time counter high value>:<time counter low value>

- <time counter high value> is approximately the number of seconds since Jan 1 2003
- <time counter low value> is counted in 1/65536 second ticks

Example: 1/37673377:42320

3.6.2.2 Calendar Time Fields

All time fields follow the ANSI time definition:

YYYY-MM-DDTHH:MM:SS.mmm

Where:

- YYYY is the year in 4 digits
- MM is the month in 2 digits
- DD is the day of month in 2 digits
- HH is the hour in 2 digits
- MM is the minute in 2 digits
- SS is the second in 2 digits
- mmm is millisecond

All time fields are given in UTC.

Please see the OSIRIS EDR/SIS for more detailed information on the organization of the OSIRIS data files and the detailed definition of the OSIRIS PDS labels. The EDR/SIS can be found in the Document folder of the dataset in the SIS subfolder.

4 The OSIRIS Science Data (.fts and .jpg) Detached Labels

4.1 Mandatory labels

These labels should appear in all science data detached labels.

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
PDS_VERSION_ID			Label		PDS version identifier.	Fixed
LABEL_REVISION_NOTE			String		PDS label set version. This value represents the version of this document.	Data producer
RECORD_TYPE			Label		PDS System Label. For ASCII data files, this will be STREAM. For PDS data, this will be FIXED_LENGTH.	Data producer
RECORD_BYTES			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of bytes in a record block. Mandatory if RECORD_TYPE= IXED_LENGTH.	Data producer
FILE_RECORDS			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of records in the file. Mandatory if RECORD_TYPE=FIXED_LENGTH.	Data producer
LABEL_RECORDS			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of records in the PDS label header. Mandatory if RECORD_TYPE=FIXED_LENGTH.	Data producer
FILE_NAME			String		Original filename.	Source file
SOURCE_PRODUCT_ID			String		Filename of the original image used to generate this product.	Source file
PRODUCT_ID			String		Internal name of the data file.	Data producer
INSTRUMENT_NAME			String		Name of the instrument.	Data producer

INSTRUMENT_HOST_NAME			String		Name of mission.	Fixed
PRODUCT_CREATION_TIME			Time	UTC	Time when the data product was generated in UTC.	Data producer
MISSION_PHASE_NAME			String		Name of overall mission phase.	Source file
START_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.	Source file
STOP_TIME					Start of image readout in UTC.	Source file
TARGET_NAME			String		Name of the observation target, PSA-compliant. Refer to TARGETS.CAT for a complete list of targets.	Source file
IMAGE_OBSERVATION_TYPE			String		Type of observation: ***REGULAR*** for normal observations ***BIAS*** for 0 sec dark exposures ***DARK*** for > 0 sec dark exposures	Source file
DATA_SET_ID			String		ID of the PDS dataset to which the data product belongs.	Source file
DATA_SET_NAME			String		Description of the dataset to which the data product belongs.	Source file
INTERCHANGE_FORMAT	IMAGE		Label		The interchange format of the image data. Always: **BINARY**	
LINES	IMAGE		Integer		Height of the image in pixels.	
LINE_SAMPLES	IMAGE		Integer		Width of the image in pixels.	

FIRST_LINE	IMAGE		Integer		First row of subframe in OPTICAL CCD coordinates. Please note that this value is 1 indexed! Not 0 indexed.	
FIRST_LINE_SAMPLE	IMAGE		Integer		First column of subframe in OPTICAL CCD coordinates. Please note that this value is 1 indexed! Not 0 indexed.	
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	
BANDS	IMAGE		Integer		Number of image planes. Always: **1**	

4.2 Optional labels

These labels are optional, in that they are not applicable to all science data.

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
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. Note: this label is present only in CODMAC level 2 images.	

STANDARD_DEVIATION	IMAGE		Integer/Float		Standard deviation value of image data. Note: this label is present only in CODMAC level 2 images.	
SAMPLE_DISPLAY_DIRECTION	IMAGE		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 viewed from left to right on the display. Allowed values: **DOWN**, **LEFT**, **RIGHT**, **UP**	
LINE_DISPLAY_DIRECTION	IMAGE		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**	

4.3 Example Detached Label

```
PDS_VERSION_ID                          = PDS3
LABEL_REVISION_NOTE                     = "RO-RIS-MPAE-ID-015 4/a"

/* FILE CHARACTERISTICS */

RECORD_TYPE                             = FIXED_LENGTH
RECORD_BYTES                            = 1
FILE_RECORDS                            = 8395200
LABEL_RECORDS                           = 2457
FILE_NAME                               = "N20140324T030357573ID20F22.LBL"

/* POINTERS TO DATA OBJECTS */

^IMAGE                                  = "N20140324T030357573ID20F22.FTS"

/*   MANDATORY FIELDS   */

PRODUCT_ID                              = "N20140324T030357573ID20F22.FTS"
SOURCE_PRODUCT_ID                       = "N20140324T030357573ID20F22.IMG"
INSTRUMENT_NAME                         = "OSIRIS - NARROW ANGLE CAMERA"
INSTRUMENT_HOST_NAME                    = "ROSETTA-ORBITER"
PRODUCT_CREATION_TIME                   = 2017-04-27T08:36:25.000
MISSION_PHASE_NAME                      = "COMET ESCORT 1"
```

```
START_TIME                              = 2014-03-24T03:05:01.817
STOP_TIME                               = 2014-03-24T03:06:01.817
TARGET_NAME                             = "67P/CHURYUMOV-GERASIMENKO 1 (1969 R1)"
IMAGE_OBSERVATION_TYPE                  = "REGULAR"
DATA_SET_ID                             = "RO-C-OSINAC-2-ESC1-67PCHURYUMOV-S39-V1.0"
DATA_SET_NAME                           = "ROSETTA-ORBITER COMET ESCORT OSINAC 2 EDR STP 039 V1.0"
OBJECT                                  = IMAGE
    INTERCHANGE_FORMAT                  = BINARY
    LINE_SAMPLES                        = 2048
    LINES                               = 2048
    BANDS                               = 1
    SAMPLE_TYPE                         = LSB_UNSIGNED_INTEGER
    SAMPLE_BITS                         = 16
    DERIVED_MINIMUM                     = 198
    DERIVED_MAXIMUM                     = 56908
    MEAN                                = 239
    STANDARD_DEVIATION                  = 236
    LINE_DISPLAY_DIRECTION              = DOWN
    SAMPLE_DISPLAY_DIRECTION            = LEFT
    FIRST_LINE                          = 1
    FIRST_LINE_SAMPLE                   = 1
END_OBJECT                              = IMAGE
```

END

5 The OSIRIS Ancillary Data PDS Labels

5.1 Mandatory Labels

These labels should appear in all ancillary data products.

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. For ASCII data files, this will be STREAM. For PDS data, this will be FIXED_LENGTH.	Data producer
FILE_NAME			String		Original filename.	Source file
PRODUCT_ID			String		Internal name of the data file.	Data producer
PRODUCT_CREATION_TIME			Time	UTC	Time when the data product was generated in UTC.	Data producer
INSTRUMENT_HOST_NAME			String		Name of mission.	Fixed
START_VALID_PERIOD	ROSETTA		Time	UTC	Start of the mission period to which the data can be applied.	Data producer
START_VALID_PERIOD_SCLK	ROSETTA		SCLK	S/C clock count	Start of the mission period to which the data can be applied, in S/C seconds.	Data producer
END_VALID_PERIOD	ROSETTA		Time	UTC	End of the mission period to which the data can be applied.	Data producer
END_VALID_PERIOD_SCLK	ROSETTA		SCLK	S/C clock count	End of the mission period to which the data can be applied, in S/C seconds.	Data producer

5.2 Optional Labels

These labels are optional, in that they are not applicable to all ancillary data products.

Label	*Group*	*Namespace*	*Datatype*	*Unit*	*Description*	*Source*
DATA_VERSION_ID			String		The version of the data, specified as the unique document number and issue, which describes the acquisition of the data.	Data producer
RECORD_BYTES			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of bytes in a record block. Mandatory if RECORD_TYPE= IXED_LENGTH.	Data producer
FILE_RECORDS			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of records in the file. Mandatory if RECORD_TYPE=FIXED_LENGTH.	Data producer
LABEL_RECORDS			Integer		If RECORD_TYPE is FIXED_LENGTH, this is the number of records in the PDS label header. Mandatory if RECORD_TYPE=FIXED_LENGTH.	Data producer
DESCRIPTION			String		Text description of the data product.	Data producer
NOTE			String		A note relevant for users of the data product.	Data producer
PROCESSING_HISTORY_TEXT			String		Text describing any processing required to produce the data product.	Data producer

FILTER_NUMBER			Integer		OSIRIS is equipped with a dual filter wheel for doing multispectral imaging. The filter number contains the index of the filter combination of the flatfield image. 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).	Data producer
SOFTWARE_DESC			String		Description of the software that generated the data file.	Data producer
SOFTWARE_LICENSE_TYPE			String		Brief copyright notice.	Data producer
SOFTWARE_ID			String		Data producer project name.	Data producer
SOFTWARE_NAME			String		Filename of the data producer.	Data producer
SOFTWARE_VERSION_ID			String		Version of the data producer.	Data producer
^OBJECT_NAME			Pointer		Offset of additional data within the file (in records; if attached label) or pointer to filename (if detached label).	Data producer

5.3 Pointer to Data or File

One or more object pointers are following the standard PDS header, which come in the format:

```
^OBJECT_NAME = "Filename"
```

where OBJECT_NAME is a short reference name referred to in the OBJECT definition(s), which follow the pointer definition(s). An OBJECT is then defined in the following manner:

```
OBJECT      = OBJECT_NAME
  INTERCHANGE_FORMAT = <INTERCHANGE_FORMAT>
  DOCUMENT_FORMAT    = <DOCUMENT_FORMAT>
  DOCUMENT_TOPIC_TYPE = <DATA PRODUCT DESCRIPTION>
```

```
  DOCUMENT_NAME = <DOCUMENT_NAME>
  PUBLICATION_DATE   = <PUBLICATION_DATE>
  PRODUCT_CREATION_TIME = <CREATION_TIME>
END_OBJECT  = OBJECT_NAME
```

Value	*Description*
INTERCHANGE_FORMAT	This is the data format of the file. In the case of PDF documents, or PDS images, this will be BINARY. For text files, this will be ASCII.
DOCUMENT_FORMAT	This is the format of the document itself. For example, for a PDF document, this will be PDF, and for a text file, it will be TEXT.
DATA PRODUCT DESCRIPTION	This should contain a description of the data contained within the file.
DOCUMENT_NAME	This should contain the name of the document.
PUBLICATION_DATE	This will be present for data which has been published, for example in the case of a scientific publication.
CREATION_TIME	Time when the data product was generated in UTC.

5.4 Example Header

```
PDS_VERSION_ID                  = PDS3
LABEL_REVISION_NOTE             = "RO-RIS-MPAE-ID-015 4/-"

RECORD_TYPE                     = STREAM
FILE_NAME                       = "NAC_FM_ABSCAL_V01.TXT"
PRODUCT_ID                      = "NAC_FM_ABSCAL"

DATA_VERSION_ID                 = "RO-RIS-MPAE-TN-074 1/-"
PRODUCT_CREATION_TIME           = 2017-02-20

INSTRUMENT_HOST_NAME            = "ROSETTA-ORBITER"
INSTRUMENT_NAME                 = "OSIRIS - NARROW ANGLE CAMERA"

ROSETTA:START_VALID_PERIOD      = 2004-03-02T00:00:00
ROSETTA:START_VALID_PERIOD_SCLK = "1/131500772.00000"
ROSETTA:END_VALID_PERIOD        = 2016-09-30T23:59:59
ROSETTA:END_VALID_PERIOD_SCLK   = "1/528595079.00000"
```

```
DESCRIPTION                    = "Absolute calibration scaling parameters for various
                                  filter combination for the NAC FM camera:
                                  The data is stored in the following formats:
                                  ABS_CAL_<filter> : [(DN/s)/(W/m2/nm/sr)] for <filter>
                                  ABS_CER_<filter> : Error in [(DN/s)/(W/m2/nm/sr)]
                                  ABS_RWL_<filter> : The the reference (central) wavelength
                                  ABS_SFX_<filter> : The Solar flux @ reference wavelength"

OBJECT      = NAC_FM_ABSCAL
  INTERCHANGE_FORMAT  = ASCII
  DOCUMENT_FORMAT     = TEXT
  DOCUMENT_TOPIC_TYPE = "SENSOR CALIBRATION"
  DOCUMENT_NAME       = "NAC_FM_ABSCAL_V01.TXT"
  PUBLICATION_DATE    = 2017-02-20
END_OBJECT  = NAC_FM_ABSCAL

END
```