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MAPPING OF ROSETTA PDS3 RPC DATASETS TO CDF ISTP COMPLIANT FILES

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APPROVAL

Mapping of Rosetta PDS3 RPC datasets to CDF ISTP Compliant files	
Issue 1	**Revision** 1
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CHANGE LOG

Reason for change	**Issue**	**Revision**	**Date**
Initial version	1	0	07/09/2018

CHANGE RECORD

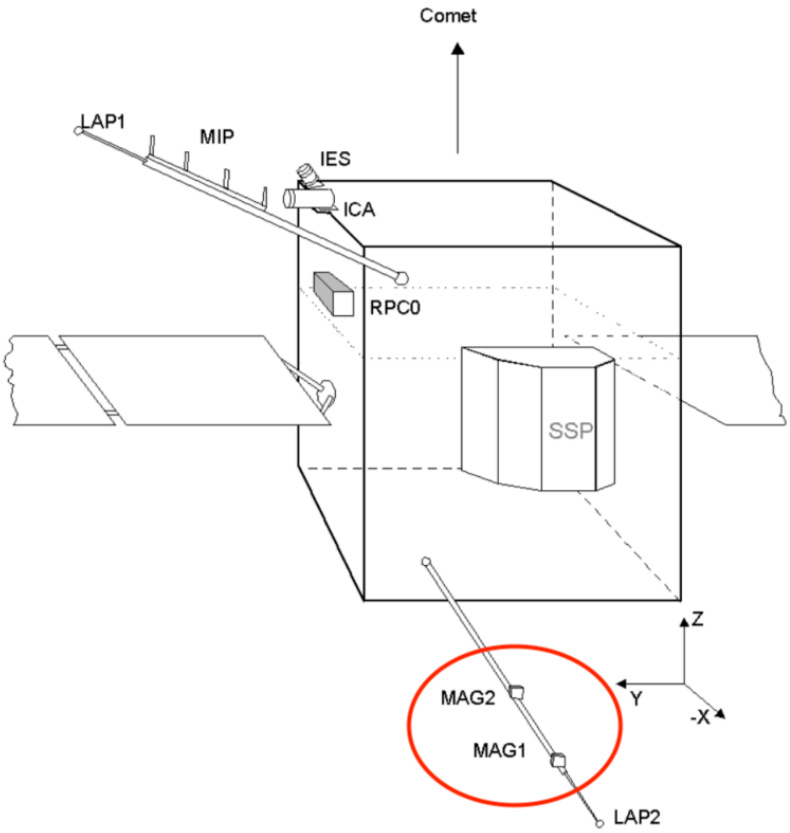
Issue 1	**Revision** 1		
Reason for change	**Date**	**Pages**	**Paragraphs**
Updated version	10/09/2019	All	Full RPCMAG TN revised (related to the availability of all RPCMAG datasets in version 9)

Table of contents:

The purpose of this document is to detail the mapping of RPCMAG PDS3 datasets into CDF/ISTP compliant files. This conversion is performed by the ESA SPace dAta foRmat TrAnslator (SPARTA) software. This technical note assumes that the reader is familiar with the PDS3 and CDF/ISTP formats. Otherwise, the reader is invited to explore first the following links
https://pds.jpl.nasa.gov/tools/standards-reference.shtml
https://cdf.gsfc.nasa.gov/

As underlined by (Glassmeier et al., 2007), RPCMAG aims to measure the magnetic field in the interaction region of the solar wind plasma with comet 67P/Churyumov-Gerasimenko. It consists of a system of two ultra-light (about 28 g each) triaxial fluxgate magnetometer sensors, mounted close to the tip of the 1.5 m long spacecraft boom and 15 cm closer to the s/c on the same boom. Two magnetometer sensors are required to determine the influence of the rather complex spacecraft magnetic field on the actual measurements, and for redundancy purposes. The measurement range of each sensor is ±16,384 nT with quantization steps of 31 pT. The magnetometer sensors are operated with a time resolution of up to 0.05 s, corresponding to a bandwidth of 0-10 Hz. This performance allows detailed analyses of magnetic field variations in the cometary environment. RPC-MAG furthermore is designed to study possible remnant magnetic fields of the nucleus, measurements which have been done in close cooperation with the ROSETTA lander magnetometer experiment ROMAP .

Glassmeier, KH., Richter, I., Diedrich, A. et al., RPC-MAG the fluxgate magnetometer in the ROSETTA plasma consortium, Space Sci. Rev., 128: 649, 2007; https://doi.org/10.1007/s11214-006-9114-x



1. RPCMAG PDS3 DATASETS CONVERTED BY SPARTA

Three levels of the RPCMAG PDS3 datasets have been delivered by the RPCMAG team to the ESA Planetary Science Archive (PSA)

Level 2: 20 raw datasets
Level 3: 20 calibrated datasets, of subtypes A, B, C
Level 4: 20 resampled (calibrated) datasets, of subtypes F, G, H, K, L

As of 10 September 2019, PSA provide all these datasets in version 9.0, expected to be the final release.

Each of these datasets contain different sub-levels of the data corresponding to different coordinate systems and sometimes corrections/cleaning of the data. All these (sub) level types are explained below.

The RPCMAP PI team considers the following datasets as the most scientifically relevant
- CLC, best time resolution calibrated data in celestial coordinates
- CLG, averaged CLC data
- CLH, reaction wheel disturbance eliminated CLC- OB data in Burst mode (when available)

Furthermore, the CLB and CLF data in spacecraft coordinates are also considered to be useful.

SPARTA converts all PDS3 Level 3 datasets of type B and C and PDS3 Level 4 of type F, G, H. PDS3 Level 2 (raw data) are not converted by SPARTA as only calibrated datasets are converted.

1.1 RPCMAG Level 3 datasets

Level 3 datasets contain calibrated magnetic field vector data and quality flags with the highest time resolution from in the inboard and outboard sensors.

- **LEVEL_A** provide magnetic field data in instrument coordinates, sensor temperatures as well as housekeeping data.
- **LEVEL_B** contain magnetic field data in spacecraft coordinates and sensor temperatures. S/C generated noise and residual field are not taken into account.
- **LEVEL_C** provide magnetic field data in J2000 celestial body coordinate system. Nominal s/c position and attitude have been considered during the evaluation. Spacecraft generated noise and residual fields are not taken into account. Data also contain spacecraft positions.

1.2 RPCMAG Level 4 datasets

Level 4 datasets contain resampled data, which are derived from Level 3 (calibrated) datasets by averaging to a specified time period, e.g. 1 second or 1 minute, sometimes correcting specific disturbance sources by application of special filters. This leads to

- **LEVEL_F** are calibrated data in spacecraft coordinates. Derived from LEVEL_B or LEVEL_K data. Spacecraft generated noise and residual fields are not taken into account. Data averaged. Different modes are taken into account if necessary.
- **LEVEL_G** are calibrated data in J2000 celestial body coordinate system. Derived from LEVEL_C or LEVEL_L. Spacecraft position and attitude have been considered during the evaluation. Spacecraft generated noise and residual fields are not taken into account. Data contain s/c positions as well. Data averaged. Different modes are taken into account if necessary.
- **LEVEL_H** data are derived from LEVEL_C outboard sensor in burst mode. A filter algorithm has been applied to get rid of the noise produced by ROSETTA's reaction

wheels. Nominal S/C position and attitude have been considered during the evaluation. Residual fields are not taken into account. Data contain s/c positions as well. Data are not averaged but resampled due to filter algorithm in frequency domain.

Each RPCMAG PDS3 level 4 dataset does not contain all of levels of data mentioned above. Please find below what they contain in more details as of 20 November 2018 in PSA

Rosetta mission phase (dataset acronym)	Start	Stop	RESAMPLED data levels	Dataset version on PSA
Cruise Phase (CVP)	2004-03-17	2004-10-14	F, G, H	9
Earth Flyby (EAR1)	2005-03-01	2005-03-29	F, G, H	9
Solar wind (CR2)	2005-06-16	2006-07-08	F, G	9
Mars Flyby (MARS)	2006-08-29	2007-05-22	F, G, H	9
Earth Flyby (EAR2)	2007-09-28	2007-09-29	F, G	9
Earth Flyby (EAR2)	2007-11-07	2007-11-20	F, G, H	9
Earth Flyby (EAR3)	2008-01-07	2008-01-08	F, G, H	9
Cruise Phase (CR4A)	2008-07-19	2008-07-26	F, G, H	9
Asteroid Steins (AST1)	2008-09-01	2008-09-10	F, G, H	9
Cruise Phase (CR4B)	2009-01-31	2009-02-01	F, G	9
Earth Flyby (EAR3)	2009-10-01	2009-10-02	F, G	9
Earth Flyby (EAR3)	2009-11-09	2009-11-17	F, G, H	9
Cruise Phase (CR5)	2010-02-24	2010-04-27	F, G, H	9
Asteroid Lutetia (AST2)	2010-07-07	2010-07-13	F, G, H	9
Solar wind (RVM1)	2010-12-06	2010-12-06	F, G	9
Solar wind (PRL)	2014-03-24	2014-11-21	F, G, H	9
Comet phase (ESC1, ESC2, ESC3, ESC4, EXT1, EXT2, EXT3)	2014-11-22	2016-09-30	F, G, H	9

2. MAPPING OF THE RPCMAG PDS3 DATA CONTENT

2.1 Level B

The DATA folder contains up to four types of data files per day

RPCMAGYYMMDD_CLB_OB_M2.TAB
RPCMAGYYMMDD_CLB_IB_M2.TAB
RPCMAGYYMMDD_CLB_OB_M3.TAB
RPCMAGYYMMDD_CLB_IB_M3.TAB

where

IB is an acronym for InBoard sensor
OB is an acronym OutBoard sensor
M2 relates to different time resolution (1s for OB, not fixed for IB)
M3 relates to different time resolution (0.05 s for OB, 1s for IB)

The content of each column is described in its related metadata file (so called label file, or LBL)

For files of type RPCMAGYYMMDD_CLB_OB_M2 or RPCMAGYYMMDD_CLB_OB_M3

PDS3 COLUMN NAME	**PDS3 description**
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, OB SENSOR
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, OB SENSOR
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, OB SENSOR
T_OB	TEMPERATURE OF RPCMAG OB SENSOR
QUALITY_FLAGS	These flags describe the quality of the magnetic field data. The quality is coded in a 8 byte string. Each character can have the following values: VALUE: MEANING: x property described by flag is still unknown 0 no disturbance, good quality 1..9 specific disturbance/problems, see below Description of the specific flags: FLAG-STRING FLAG DESCRIPTION 87654321 ::::::::------ 1 IMPACT OF REACTION WHEELS ::::::: x = impact not assessed ::::::: 0 = no disturbance ::::::: 1 = disturbance eliminated during data analysis ::::::: 2 = disturbance elimination failed ::::::: 3 = data disturbed ::::::: :::::::------- 2 IMPACT OF LANDER HEATER CURRENTS: ::::::: x = impact not assessed ::::::: 0 = no disturbance ::::::: 1 = disturbance eliminated during data analysis

	:::::: 2 = disturbance elimination failed :::::: 3 = data disturbed :::::: ::::::-------- 3 BOOM DEPLOYMENT: ::::: 0 = boom deployed ::::: 1 = boom stowed ::::: 2 = boom deployment ongoing. Data only valid in ::::: instrument coordinates ::::: 3 = pyros fired for boom release ::::: :::::--------- 4 OFFSET/RESIDUAL-FIELD RELATED EFFECTS: :::: x = offset/residual-field issues not assessed :::: 0 = no offset/residual-field problems :::: 1 = offset/residual-field behavior not clear :::: 2 = offset drifts, sensor not in thermal :::: equilibrium thus temperature model N/A :::: 3 = offset/residual-field drifts, reason unknown :::: 4 = /residual-field jump detected, reason unknown :::: ::::---------- 5 CORRELATION BETWEEN IB AND OB SENSOR ::: x = correlation not assessed ::: 0 = perfect correlation ::: 1 = good correlation ::: 2 = poor correlation ::: 3 = IB and OB show different long term behavior ::: :::---------- 6 OTHER IMPACTS DECREASING THE QUALITY :: x = no assessment :: 0 = no other problems detected :: 1 = TBD :: 2 = TBD :: 3 = TBD :: 4 = data disturbed by pulses originated in s/c :: 5 = data disturbed by AC signal originated in s/c :: 6 = data noisy due to power on failure :: 7 = data not calculatable due to thermistor failure :: 8 = sensor saturated due to huge external field :: 9 = sensor saturated, instrument power on sequence failed :: ::---------- 7 TBD : x = no assessment :---------- 8 TBD : x = no assessment

For files of type RPCMAGYYMMDD_CLB_IB_M2.LBL
or RPCMAGYYMMDD_CLB_IB_M3.LBL, only the following variables are different OB will be replaced by IB in the variable names and description

2.2 Level C

The DATA folder contains two types of data files per day
RPCMAGYYMMDD_CLC_OB_M2.TAB
RPCMAGYYMMDD_CLC_IB_M2.TAB
RPCMAGYYMMDD_CLC_OB_M3.TAB
RPCMAGYYMMDD_CLC_IB_M3.TAB

where
IB relates to InBoard sensor
OB relates to OutBoard sensor
M2 to different time resolution (1s for OB, not fixed for IB)
M3 relates to different time resolution (0.05 s for OB, 1s for IB)

The content of each column is described in its related label file

For files of type RPCMAGYYMMDD_CLC_OB_M2.LBL
or RPCMAGYYMMDD_CLC_OB_M2.LBL

PDS3 COLUMN NAME	PDS3 description
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
POSITION_X	SPACECRAFT POSITION, X COMPONENT, 67P/C-G_CSEQ
POSITION_Y	SPACECRAFT POSITION, Y COMPONENT, 67P/C-G_CSEQ
POSITION_Z	SPACECRAFT POSITION, Z COMPONENT, 67P/C-G_CSEQ
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, OB SENSOR, 67P/C-G_CSEQ
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, OB SENSOR, 67P/C-G_CSEQ
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, OB SENSOR, 67P/C-G_CSEQ
QUALITY_FLAGS	Same as level B

For files of type RPCMAGYYMMDD_CLC_IB_M2.LBL
or RPCMAGYYMMDD_CLC_IB_M3.LBL, differences are

PDS3 COLUMN NAME	PDS3 description
BX_IB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, IB SENSOR, 67P/C-G_CSEQ
BY_IB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, IB SENSOR, 67P/C-G_CSEQ
BZ_IB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE, CORRECTED DATA, IB SENSOR, 67P/C-G_CSEQ

2.3 Level F

The DATA folder contains four types of data files per day
RPCMAGYYMMDD_CLF_OB_A1.TAB
RPCMAGYYMMDD_CLF_OB_A60.TAB
RPCMAGYYMMDD_CLF_IB_A1.TAB
RPCMAGYYMMDD_CLF_IB_A60.TAB

where
IB relates to InBoard sensor
OB relates to OutBoard sensor
A60 to 1 minute resolution
A1 to 1 s resolution

The content of each column is described in its related metadata label file
For files of type RPCMAGYYMMDD_CLF_OB_A1.LBL.

PDS3 COLUMN NAME	PDS3 description
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 1S_AVERAGE-OB SENSOR
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 1S_AVERAGE-OB SENSOR
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 1S_AVERAGE-OB SENSOR
T_OB	TEMPERATURE OF RPCMAG OB SENSOR
QUALITY_FLAGS	Same as level B

For files of type RPCMAGYYMMDD_CLF_OB_A60.LBL, differences are

PDS3 COLUMN NAME	PDS3 description
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 60S_AVERAGE-OB SENSOR
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 60S_AVERAGE-OB SENSOR
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 60S_AVERAGE-OB SENSOR

For files of type RPCMAGYYMMDD_CLF_IB_A1.LBL
or RPCMAGYYMMDD_CLF_IB_A60.LBL

IB replaces OB

2.4 Level G

The DATA folder contains four types of data files per day
RPCMAGYYMMDD_CLG_OB_A1.TAB
RPCMAGYYMMDD_CLG_IB_A1.TAB

where IB relates to InBoard sensor, OB to OutBoard sensor, A60 to 1 minute resolution and A1 to 1 s resolution

The content of each column is described in its related metadata file (so called label file), as follows for files of type RPCMAGYYMMDD_CLG_OB_A1.LBL.

PDS3 COLUMN NAME	PDS3 description
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
POSITION_X	SPACECRAFT POSITION, X COMPONENT, S/C-COORDS
POSITION_Y	SPACECRAFT POSITION, Y COMPONENT, S/C-COORDS
POSITION_Z	SPACECRAFT POSITION, Z COMPONENT, S/C-COORDS
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-OB SENSOR, S/C-COORDS
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-OB SENSOR, S/C-COORDS
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-OB SENSOR, S/C-COORDS
QUALITY_FLAGS	Same as level B

For files of type RPCMAGYYMMDD_CLF_IB_A1.LBL

PDS3 COLUMN NAME	PDS3 description
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
POSITION_X	SPACECRAFT POSITION, X COMPONENT, S/C-COORDS
POSITION_Y	SPACECRAFT POSITION, Y COMPONENT, S/C-COORDS
POSITION_Z	SPACECRAFT POSITION, Z COMPONENT, S/C-COORDS
BX_IB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-IB SENSOR, S/C-COORDS
BY_IB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-IB SENSOR, S/C-COORDS
BZ_IB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE CORRECTED DATA, 1S_AVERAGE-IB SENSOR, S/C-COORDS
QUALITY_FLAGS	Same as level B

2.5 Level H

The DATA folder contains up to 6 types of data files per day
RPCMAGYYMMDD_CLH_OB_M2.TAB
RPCMAGYYMMDD_CLH_OB_M3.TAB
RPCMAGYYMMDD_CLH_OB_M4.TAB
RPCMAGYYMMDD_CLH_IB_M2.TAB

where
IB relates to InBoard sensor
OB relates to OutBoard sensor
M2, M3 and M4 to different time resolutions (1s, 0.05 s, 0.2 s)

The content of each column is described in its related metadata file (so called label file)

For files of type RPCMAGYYMMDD_CLH_OB_MX.LBL where MX is either M2, M3 or M4

PDS3 COLUMN NAME	PDS3 description
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
POSITION_X	SPACECRAFT POSITION, X COMPONENT, ECLIPJ2000
POSITION_Y	SPACECRAFT POSITION, Y COMPONENT, ECLIPJ2000
POSITION_Z	SPACECRAFT POSITION, Z COMPONENT, ECLIPJ2000
BX_OB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, OB SENSOR, ECLIPJ2000
BY_OB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, OB SENSOR, ECLIPJ2000
BZ_OB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, OB SENSOR, ECLIPJ2000
QUALITY_FLAGS	Same as level B

For files of type RPCMAGYYMMDD_CLH_IB_MX.LBL where MX is either M2, M3 or M4, same as above except the magnetic field components

PDS3 COLUMN NAME	PDS3 description
BX_IB	MAGNETIC FIELD X COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, IB SENSOR, ECLIPJ2000
BY_IB	MAGNETIC FIELD Y COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, IB SENSOR, ECLIPJ2000
BZ_IB	MAGNETIC FIELD Z COMPONENT, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, IB SENSOR, ECLIPJ2000

3. MAPPING OF THE RPCMAG PDS3 METADATA CONTENT

3.1 RPCMAG CDF global attributes

RPCMAG CDF global attributes are described in the following sub-sections

1. CDF ISTP required global attributes (RPCMAG)
2. Mapping of the PDS3 keywords (RPCMAG)
3. Mapping of the PDS3 CATALOG files (RPCMAG)
4. Mapping of the PDS3 DOCUMENT and CALIB files (RPCMAG)

3.1.1 CDF ISTP required global attributes (RPCMAG)

In this section, the CDF global attributes of a Level F dataset are described in details. The global attributes of any other RPCMAG level 3 or level 4 dataset is converted in a similar way by SPARTA. For a CDF file to be ISTP compliant, a number of global attributes are compulsory (in bold) while others are recommended (in italic). For RPCMAG, level 4, level F, OutBoard (OB) sensor at 1s resolution, measured on 20160929, here is how they are defined. These global attributes are listed at the top of the global attributes' list contained in the converted file named Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf.

Project: {'ROSETTA'}
Discipline: {'Space Physics>Interplanetary Studies'}
Source_name: {'ROSETTA>International Rosetta mission'}
Data_type: see Data_type global attribute sub-section
Descriptor: {'RPCMAG>Rosetta Plasma Consortium fluxgate MAGnetometer'}
Data_version: {'9.0'}
TEXT: see TEXT global attribute subsection
Logical_file_id: {'Rosetta_RPCMAG_clf_ob_a1_20160929_V9.0'}
Logical_source: {'rosetta_rpcmag_clf_ob_a1'}
Logical_source_description: {'This dataset contains [..] '}
PI_name: {'Prof. Dr. Karl-Heinz Glassmeier'}
PI_affiliation: {'Technische Universitaet Braunschweig - Institute For Geophysics And Extraterrestrial Physics'}
Instrument_type: {'Magnetic Fields (space)'}
Mission_group: {'Rosetta'}
Generated_by: {'Dr. Ingo Richter for the RPCMAG team, converted to CDF by SPARTA'}
Generation_date: {'20171106'}
File_naming_convention: {'source_descriptor_datatype_yyyyMMdd'}

Please note that Logical_file_id and logical_source depends on the PDS3 dataset and the type of file

- to be adapted to the level version (B, C, F, G, H), i.e. clb, clc, clf, clg or clh
- to be adapted to the time resolution/mode, i.e. either a1 or a60 for level versions F and G or M2, M3 or M4 for versions B, C and H

PI_affiliation is mapped from PDS3 keyword PRODUCER_INSTITUTION_NAME

Data_type global attribute

last part of data_type description is mapped from PDS3 keyword INSTRUMENT_MODE_DESC in the LBL file of the dataset

Data_type for B version shall read

Data_type: {'CLB_OB_M2>Codmac Level H, OutBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}
Data_type: {'CLB_OB_M3>Codmac Level H, OutBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}

Data_type: {'CLB_IB_M2>Codmac Level H, InBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLB_IB_M3>Codmac Level H, InBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}

M2 corresponds to a time resolution of 0.05s M3 to 1s when operated in primary normal mode

Data_type for C version shall read

Data_type: {'CLC_OB_M2>Codmac Level H, OutBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLC_OB_M3>Codmac Level H, OutBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}**Data_type:** {'CLC_IB_M2>Codmac Level H, InBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLC_IB_M3>Codmac Level H, InBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}

M2 corresponds to a time resolution of 0.05s M3 to 1s when operated in primary normal mode

Data_type for F version shall read

Data_type: {'CLF_OB_A1>Codmac Level F, OutBoard sensor, 1s averages'}

Data_type: {'CLF_OB_A60>Codmac Level F, OutBoard sensor, 60s averages'}

Data_type: {'CLF_IB_A1>Codmac Level F, InBoard sensor, 1s averages'}

Data_type: {'CLF_IB_A60>Codmac Level F, InBoard sensor, 60s averages'}

Data_type for G version shall read

Data_type: {'CLG_OB_A1>Codmac Level G, OutBoard sensor, 1s averages'}

Data_type: {'CLG_OB_A60>Codmac Level G, OutBoard sensor, 60s averages'}

Data_type: {'CLG_IB_A1>Codmac Level G, InBoard sensor, 1s averages'}

Data_type: {'CLG_IB_A60>Codmac Level G, InBoard sensor, 60s averages'}

Data_type for H version shall read

Data_type: {'CLH_OB_M2>Codmac Level H, OutBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLH_OB_M3>Codmac Level H, OutBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}

Data_type: {'CLH_OB_M4>Codmac Level H, OutBoard sensor, MEDIUM MODE: 160 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLH_IB_M2>Codmac Level H, InBoard sensor, NORMAL MODE: 32 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

Data_type: {'CLH_IB_M3>Codmac Level H, InBoard sensor, BURST MODE: 320 PRIMARY & 16 SECONDARY VECTORS PER 16 SECONDS'}

Data_type: {'CLH_IB_M4>Codmac Level H, InBoard sensor, MEDIUM MODE: 160 PRIMARY & 1 SECONDARY VECTORS PER 32 SECONDS'}

M2 corresponds to a time resolution of 0.05s M3 to 1s and M4 to 0.2s

The last part of the data type global attribute is a direct mapping of the INSTRUMENT_MODE_DESC PDS3 keyword.

TEXT global attribute

The RPCMAG TEXT global attribute shall always read as follows

Instrument reference paper:
Glassmeier, K.H., Richter, I., Diedrich, A., Musmann, G., Auster, U., Motschmann, U., Balogh, A., Carr,
C., Cupido, E., Coates, A., Rother, M., Schwingenschuh, K., Szegoe, K., Tsurutani, B., RPC-MAG The Fluxgate Magnetometer in the ROSETTA Plasma Consortium, Space Sci. Rev., 128, 649-670, 2007

For more information
Rosetta mission overview - See Rosetta_Mission_cat global attribute
Rosetta spacecraft overview - See Rosetta_Insthost_cat global attribute
Rosetta targets overview - See Rosetta_target_cat global attribute
Rosetta references listing - See Rosetta_ref_cat global attribute
RPCMAG instrument overview - See RPCMAG_inst_cat global attribute
RPCMAG software overview - See RPCMAG_software_cat global attribute
RPCMAG personnel contacts - See RPCMAG_pers_cat global attribute
RPCMAG dataset overview - See Dataset_cat global attribute
RPCMAG dataset quality flags overview - See Quality_flags_description global attribute

Those attributes are located at the bottom of the global attributes list.
The content of these attributes is mapped from the original PDS3 catalog files.

DOCUMENTATION
A number of documents describing how the instrument was operated, calibrated and tips on how data shall be interpreted are available at ftp://psa.esac.esa.int/pub/mirror/INTERNATIONAL-ROSETTA-MISSION/RPCMAG/RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0/DOCUMENT/

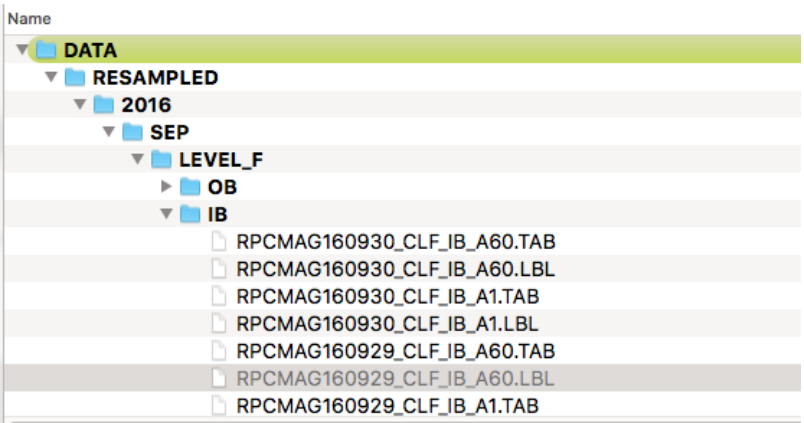
CALIBRATION
A number of products describing the instrument calibration are available at ftp://psa.esac.esa.int/pub/mirror/INTERNATIONAL-ROSETTA-MISSION/RPCMAG/RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0/CALIB/

3.1.2 Mapping of PDS3 keywords to CDF global attributes

For each of the TAB data file, a label file is provided (same filename with LBL extension). The top tier of such an LBL file is displayed in Figure 14.

Each of this file provides

- a list of PDS3 keywords and their associated values (including SPICE information),
    - The PDS3 keywords list has been mapped into the Global attributes of the CDF file. The mapping has been done exactly in the same order as they are listed in the label file, and listed after the CDF ISTP global attributes. The first PDS3 mapped keyword of this list is simply PDS_VERSION_ID = PDS3. "Pds_" has been added at the beginning of each PDS3 mapped keyword to make the distinction, see Figure 15.
- an ordered list of the variables corresponding to the data columns in the TAB files,
    - This list is mapped to the *Variables* of the CDF file while their related metadata such as Unit or description is stored in the *VariableAttributes* of the CDF file.
- an extensive description of the quality flags.
    - The quality flags description has been added as a separate global attribute named Quality_flags_description. A reference to this global attribute is also present in the CATDESC variable attribute of the QUALITY_FLAGS variable.




```
PDS_VERSION_ID                  = PDS3
LABEL_REVISION_NOTE             = "V1.0"
RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 90
FILE_RECORDS                    = 1438
DATA_SET_ID                     = "RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0"
DATA_SET_NAME = "ROSETTA-ORBITER 67P RPCMAG 4 EXT3 RESAMPLED V6.0"
PRODUCT_ID                      = "RPCMAG160929_CLF_IB_A60"
PRODUCT_CREATION_TIME           = 2016-11-30T14:35:00
PRODUCT_TYPE                    = "REFDR"
MISSION_ID                      = "ROSETTA"
MISSION_NAME                    = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME              = "ROSETTA EXTENSION 3"
OBSERVATION_TYPE                = "N/A"
INSTRUMENT_HOST_ID              = "RO"
INSTRUMENT_HOST_NAME            = "ROSETTA-ORBITER"
INSTRUMENT_ID                   = "RPCMAG"
INSTRUMENT_NAME = "ROSETTA PLASMA CONSORTIUM - FLUXGATE MAGNETOMETER"
INSTRUMENT_TYPE                 = "MAGNETOMETER"
INSTRUMENT_MODE_ID              = "AVERAGED"
INSTRUMENT_MODE_DESC            = "60 S AVERAGES"
TARGET_NAME                     = "67P/CHURYUMOV-GERASIMENKO 1 (1969 R1)"
TARGET_TYPE                     = "COMET"
START_TIME                      = 2016-09-29T00:01:29.427
STOP_TIME                       = 2016-09-29T23:58:29.427
SPACECRAFT_CLOCK_START_COUNT    = "1/433727999.60731"
SPACECRAFT_CLOCK_STOP_COUNT     = "1/433814219.60731"

START_JULIAN_DATE_VALUE         = 2457660.5010350351
STOP_JULIAN_DATE_VALUE          = 2457661.4989517019
SC_SUN_POSITION_VECTOR          = ( 537347421.18, 193790968.09, -35564807.47)
SC_TARGET_POSITION_VECTOR       = (       -20.42,        -0.14,       -11.45)
SC_TARGET_VELOCITY_VECTOR       = (         0.00,        -0.00,        -0.00)
SPACECRAFT_ALTITUDE             =           21.311
SUB_SPACECRAFT_LATITUDE         =  -18.736
SUB_SPACECRAFT_LONGITUDE        =  175.856
SPICE_FILE_NAME                 = {"PREHIB\ATNR_P040302093352_00127.BC",
                                   "PREHIB\ORER_____________00031.BSP",
                                   "PREHIB\ORFR_____________00067.BSP",
                                   "PREHIB\ORGR_____________00096.BSP",
                                   "PREHIB\ORHR_____________00122.BSP",
                                   "PREHIB\ORMR_____________00052.BSP",
                                   "PREHIB\ORHO_____________00077.BSP",
                                   "ROS_SA_2004_V0001.BC",
                                   "ROS_SA_2005_V0001.BC",
                                   "ROS_SA_2006_V0001.BC",
                                   "ROS_SA_2007_V0001.BC",
                                   "ROS_SA_2008_V0038.BC",
                                   "ROS_SA_2009_V0054.BC",
                                   "ROS_SA_2010_V0052.BC",
                                   "ROS_SA_2011_V0013.BC",
                                   "ROS_SA_2014_V0047.BC",
                                   "ROS_SA_2015_V0042.BC",
                                   "ROS_SA_2016_V0041.BC",
                                   "ROS_HGA_2008_V0018.BC",
                                   "ROS_HGA_2009_V0051.BC"
```

Figure 14. Top tier of the RPCMAG160929_CLF_IB_A60.LBL file of RPCMAG related to the description of the data.

List of PDS3 keywords converted to global attributes, displayed within Matlab

```
>> info=spdfcdfinfo('Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf');
>> info.GlobalAttributes
ans =
  struct with fields:

                        Project: {'ROSETTA'}
                     Discipline: {'Space Physics>Interplanetary Studies'}
                    Source_name: {'ROSETTA>International Rosetta mission'}
                      Data_type: {'CLF_OB_A1>Codmac Level F, OutBoard sensor, 1 s averages'}
                     Descriptor: {'RPCMAG>Rosetta Plasma Consortium fluxgate MAGnetometer'}
                   Data_version: {'6.0'}
                           TEXT: {25×1 cell}
                  Logical_file_id: {'Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0'}
                   Logical_source: {'rosetta_rpcmag_clf_ob_a1'}
         Logical_source_description: {6×1 cell}
                        PI_name: {'Prof. Dr. Karl-Heinz Glassmeier'}
                  PI_affiliation: {'Technische Universitaet  Braunschweig - Institute For Geophysics And Extraterrestrial Physics'}
                 Instrument_type: {'Magnetic Fields (space)'}
                   Mission_group: {'Rosetta'}
                 Time_resolution: {'1 s'}
                    Generated_by: {'Dr. Ingo Richter for the RPCMAG team, converted to CDF by the ESA SPARTA software'}
                 Generation_date: {'20180607'}
              File naming convention: {'source_descriptor_datatype_yyyyMMdd'}
                  Pds_version_id: {'PDS3'}
           Pds_label_revision_note: {'V1.0'}
                  Pds_record_type: {'FIXED_LENGTH'}
                 Pds_record_bytes: {'90'}
                 Pds_file_records: {'86357'}
                  Pds_data_set_id: {'RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0'}
                Pds_data_set_name: {'ROSETTA-ORBITER 67P RPCMAG 4 EXT3 RESAMPLED V6.0'}
                   Pds_product_id: {'RPCMAG160929_CLF_OB_A1'}
        Pds_product_creation_time: {'2016-11-30T14:35:00'}
                  Pds_product_type: {'REFDR'}
                    Pds_mission_id: {'ROSETTA'}
                  Pds_mission_name: {'INTERNATIONAL ROSETTA MISSION'}
            Pds_mission_phase_name: {'ROSETTA EXTENSION 3'}
              Pds_observation_type: {'N/A'}
            Pds_instrument_host_id: {'RO'}
          Pds_instrument_host_name: {'ROSETTA-ORBITER'}
                 Pds_instrument_id: {'RPCMAG'}
               Pds_instrument_name: {'ROSETTA PLASMA CONSORTIUM - FLUXGATE MAGNETOMETER'}
            Pds_instrument_mode_id: {'AVERAGED'}
          Pds_instrument_mode_desc: {'1 S AVERAGES'}
                  Pds_target_name: {'67P/CHURYUMOV-GERASIMENKO 1 (1969 R1)'}
                  Pds_target_type: {'COMET'}
                   Pds_start_time: {'2016-09-29T00:00:36.177'}
                    Pds_stop_time: {'2016-09-29T23:59:52.177'}
Pds_spacecraft_clock_start_count: {'1/433727946.61579'}
 Pds_spacecraft_clock_stop_count: {'1/433814302.61579'}
      Pds_start_julian_date_value: {'2457660.5004187156'}
       Pds_stop_julian_date_value: {'2457661.4999094564'}
       Pds_sc_sun_position_vector: {3×1 cell}
    Pds_sc_target_position_vector: {3×1 cell}
    Pds_sc_target_velocity_vector: {3×1 cell}
          Pds_spacecraft_altitude: {'21.311'}
     Pds_sub_spacecraft_latitude: {'-18.716'}
    Pds_sub_spacecraft_longitude: {'176.132'}
             Pds_spice_file_name: {59×1 cell}
                 Pds_producer_id: {'RPC_MAG_TEAM'}
            Pds_producer_full_name: {'INGO RICHTER'}
    Pds_producer_institution_name: {'IGEP-TU-BRAUNSCHWEIG'}
             Pds_data_quality_id: {'N/A'}
           Pds_data_quality_desc: {'ONLY 'GOOD' RAW DATA HAVE BEEN PROCESSED AND STORED'}
          Pds_processing_level_id: {'4'}
                 Pds_description: {5×1 cell}
   Pds_flight_software_version_id: {'FIL:V1.0'}
    Pds_platform_or_mounting_desc: {'MAGNETOMETER_BOOM: DEPLOYED'}
                       Pds_note: {21×1 cell}
              Rosetta_mission_cat: {2270×1 cell}
             Rosetta_insthost_cat: {2161×1 cell}
               Rosetta_target_cat: {1509×1 cell}
                  Rosetta_ref_cat: {1618×1 cell}
                  RPCMAG_inst_cat: {1121×1 cell}
              RPCMAG_software_cat: {6×1 cell}
                  RPCMAG_pers_cat: {50×1 cell}
                      Dataset_cat: {219×1 cell}
        Quality_flags_description: {68×1 cell}
                 Software_version: {'SPARTA DEVELOPMENT'}
```

CDF ISTP required and recommended Global attributes

PDS3 data label file keywords mapped to CDF Global

ROSETTA_MISSION.CAT
ROSETTA_INSTHOST.CAT
ROSETTA_TARGET.CAT
ROSETTA_REF.CAT
RPCMAG_INST.CAT
RPCMAG_SOFTWARE.CAT
RPCMAG_PERS.CAT
DATASET.CAT
Quality flags desc from LBL

Figure 15. Listing of all global attributes of an RPCMAG CDF ISTP compliant file converted by SPARTA

This list of global attributes can also be visualized and edited by the NASA CDFedit tool software, see below

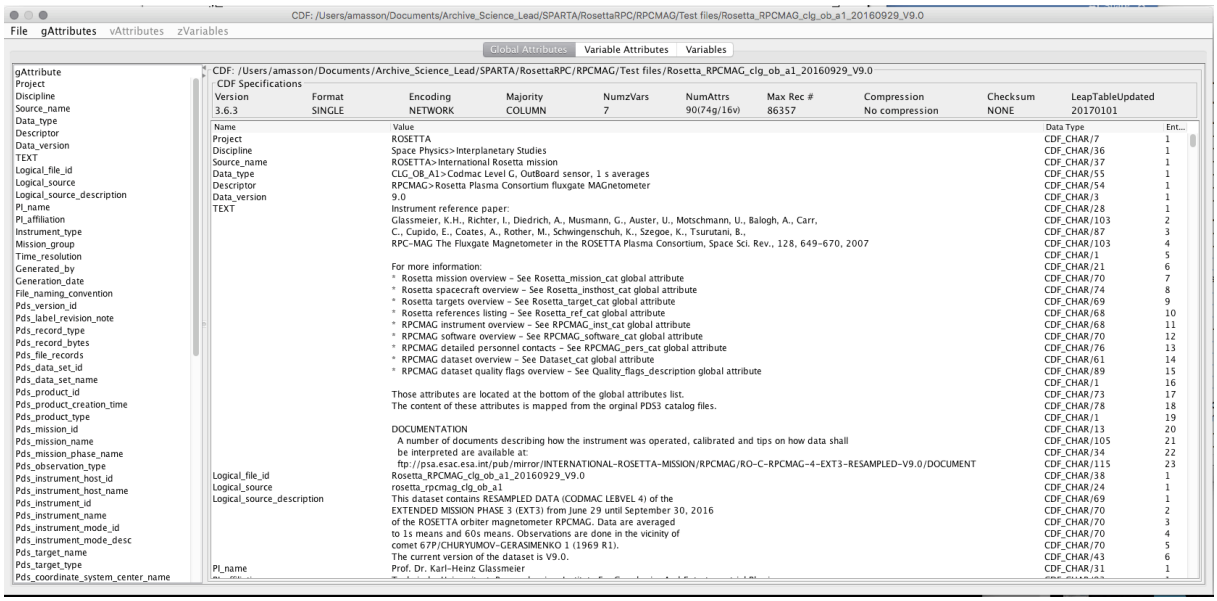


Figure 16. Visualization of the global attributes of a CDF file converted by SPARTA with NASA CDFedit tool. Please note the CDF/ISTP required global attribute TEXT, which describes the experiment related to the file.

3.1.3 Mapping of PDS3 CATALOG files to CDF global attributes

A folder named CATALOG is contained in the PDS3 dataset entitled RO-C-RPCMAG-4-EXT3_RESAMPLED-V6.0. It is composed of 8 files, see below

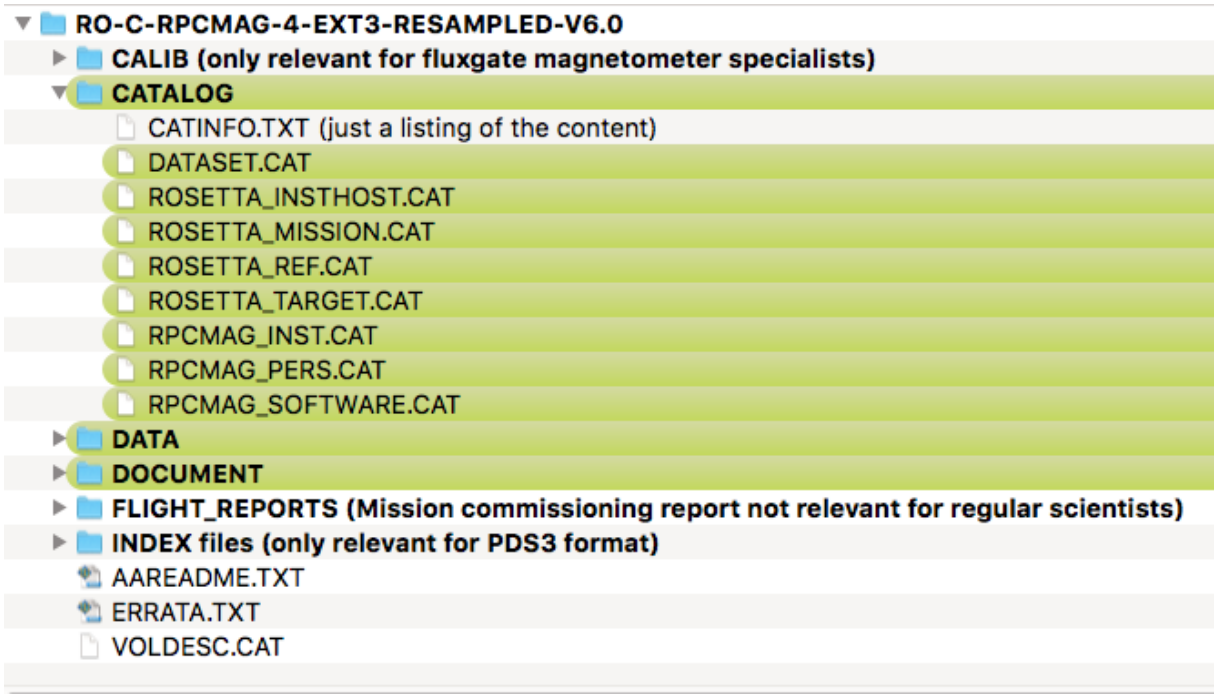


Figure 17. Content of the CATALOG folder of the RPCMAG PDS3 dataset RO-C-RPCMAG-4-EXT3_RESAMPLED-V6.0.

The content of each of these eight files has been mapped to eight global variables in the CDF file. These variables have been named with the PDS CATALOG filenames, as follows

PDS3 Catalog files CDF/ISTP global attributes

ROSETTA_MISSION.CAT -----> Rosetta_mission_cat
ROSETTA_INSTHOST.CAT-----> Rosetta_insthost_cat
ROSETTA_TARGET.CAT -----> Rosetta_target_cat
ROSETTA_REF.CAT -----> Rosetta_ref_cat
RPCMAG_INST.CAT -----> RPCMAG_inst_cat
RPCMAG_SOFTWARE.CAT -----> RPCMAG_software_cat
RPCMAG_PERS.CAT -----> RPCMAG_pers_cat
DATASET.CAT -----> Dataset_cat

These global attributes are located at the bottom of the global attributes list.

This mapping is detailed in the mandatory ISTP global attribute TEXT (see 7th global attribute from the top of the global attributes' list in Figure 16). This attribute is a "*text description of the experiment whose data is included in the CDF. A reference to a journal article(s) or to a World Wide Web page describing the experiment is essential, and constitutes the minimum requirement. [...]*" according to its NASA definition.

For the example treated here, this global attribute reads (using Matlab)

>> info.GlobalAttributes.TEXT

Instrument reference paper:
Glassmeier, K.H., Richter, I., Diedrich, A., Musmann, G., Auster, U., Motschmann, U., Balogh, A., Carr,
C., Cupido, E., Coates, A., Rother, M., Schwingenschuh, K., Szegoe, K., Tsurutani, B., RPC-MAG The Fluxgate Magnetometer in the ROSETTA Plasma Consortium, Space Sci. Rev., 128, 649-670, 2007

For more information
Rosetta mission overview - See Rosetta_Mission_cat global attribute
Rosetta spacecraft overview - See Rosetta_Insthost_cat global attribute
Rosetta targets overview - See Rosetta_target_cat global attribute
Rosetta references listing - See Rosetta_ref_cat global attribute
RPCMAG instrument overview - See RPCMAG_inst_cat global attribute
RPCMAG software overview - See RPCMAG_software_cat global attribute
RPCMAG personnel contacts - See RPCMAG_pers_cat global attribute
RPCMAG dataset overview - See Dataset_cat global attribute
RPCMAG dataset quality flags overview - See Quality_flags_description global attribute
Those attributes are located at the bottom of the global attributes list.
The content of these attributes is mapped from the original PDS3 catalog files.

DOCUMENTATION

A number of documents describing how the instrument was operated, calibrated and tips on how data shall be interpreted are available at ftp://psa.esac.esa.int/pub/mirror/INTERNATIONAL-ROSETTA-MISSION/RPCMAG/RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0/DOCUMENT/

A number of products describing the instrument calibration are available at ftp://psa.esac.esa.int/pub/mirror/INTERNATIONAL-ROSETTA-MISSION/RPCMAG/RO-C-RPCMAG-4-EXT3-RESAMPLED-V6.0/CALIB/

3.1.4 Mapping of the PDS3 DOCUMENT and CALIB files (RPCMAG)

3.1.4.1 Reference to PDS3 DOCUMENT directory

A folder named DOCUMENT is contained in the RPCMAG PDS3 dataset level 3 and 4 converted by SPARTA. It contains the following subfolders

- CALIBRATION
- FLIGHT_REPORTS
- INTERFERENCE

+ five documents with their related label files

- RPC MAG logbook(LOGBOOK_YYDDMM_YYDDMM.ASC)
- RPCMAG EAICD (RO_IGEP_TR0009_MAC_EAICD.PDF)
- RPCMAG user guide (RO_IGEP_TR0074_MAC_USERGUIDE.PDF)
- RPCMAG instrument (RPCMAP_INSTRUMENT.PDF)
- RPC user guide (RPC_USER_guide.PDF)

A reference to this directory with a direct ftp link is mentioned in the TEXT global attribute about this set of documents (see previous subsection).

3.1.4.2 Reference to PDS3 CALIB directory

A directory named CALIB is contained in every RPCMAG level 3 and 4 PDS3 dataset converted by SPARTA. The CALIB directory contains all necessary information to generate calibrated magnetic field values from the Inboard (IB) and the Outboard (OB) sensor. As an example, for the dataset RO-C-RPCMAG-4-EXT3_RESAMPLED-V6.0, this directory is composed of 126 files and enables to understand the calibration of the magnetic field measurement, changes of reference frames etc... This information is relevant mostly for fluxgate magnetometer specialists.

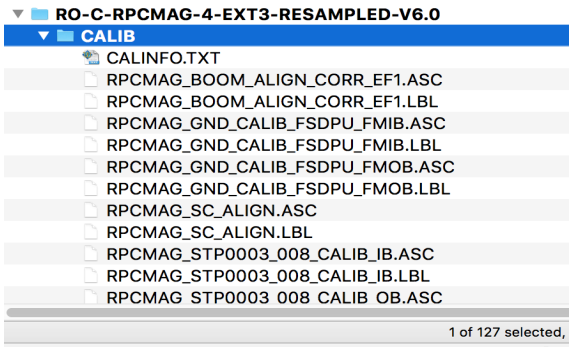


Figure 20. Content of the CALIB folder of the PDS3 dataset RO-C-RPCMAG-4-EXT3_RESAMPLED-V6.0.

A reference to this directory with a direct ftp link is mentioned in the TEXT global attribute about this set of documents (see previous subsection).

3.1.5 Mapping of the quality flags (RPCMAG)

The quality flags available in any LBL file is static, hence its content is stored as the last before last global variable and named Quality_flags_description.

3.2 CDF variable attributes

To be ISTP compliant, the following variable attributes are compulsory (in bold) or recommended

FIELDNAM for all variables
CATDESC for all variables
VAR_TYPE for all variables (CDF specific)
UNITS for data and support data
FORMAT for all variables not using FORM_PTR
FILLVAL for data, Record Varying (RV) support_data, and RV metadata
VALIDMIN for data and RV support_data
VALIDMAX for data and RV support_data **DEPEND_0** for data, RV support_data, and RV metadata
DISPLAY_TYPE for data
LABLAXIS for data of type image, scalar time series and 1D spectrogram
LABL_PTR_1 for vectors

Additional variable attributes are recommended
TIME_BASE (recommended for time variables) or optional like SI_CONVERSION
All these variable attributes are explained in more detailed in section 6. The values of these variable attributes have been mapped from the PDS3 LBL files. The variable attributes' values are detailed below.

3.2.1 Level B

The magnetic field data are stored in the original PDS3 TAB files per component (e.g. for the outboard sensor Bx_OB, By_OB, Bz_OB). When files are converted to CDF files by SPARTA, the magnetic field is stored as a vector in one variable instead, the third variable, named B_OB for outboard sensor or B_IB for inboard sensor. In this case, a variable LABEL_B_OB (resp. LABEL_B_IB) of type metadata is recommended by NASA SPDF ISTP guidelines to label the values Bx, By, Bz.

These variable attributes are the same for M2 and M3 files.

CDF variable names	FIELDNAM
TIME_UTC	TIME_UTC
TIME_OBT	SpacecraftOnBoard clock Time
B_OB	Magnetic Field Vector
T_OB	Sensor Temperature
QUALITY_FLAGS	QUALITY_FLAGS
LABEL_B_OB	LABEL_B_OB

CDF variable names	CATDESC
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
B_OB	MAGNETIC FIELD VECTOR, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, OB SENSOR

T_OB	TEMPERATURE OF RPCMAG OB SENSOR
QUALITY_FLAGS	See Quality_flags_description global attribute
LABEL_B_OB	Labels of the vector B_OB

CDF variable names	VAR_TYPE	UNITS	SI_CONVERSION	TIME_BASE	FORMAT
TIME_UTC	support_data	ps	1.0e-12>s	0AD	A27
TIME_OBT	support_data	s	1.0>s		F15.5
B_OB	data	nT	1.0e-9>T		F9.2
T_OB	data	K	1.0>K		F6.2
QUALITY_FLAGS	data				A11
LABEL_B_OB	metadata				A3

CDF variable names	FILLVAL	VALIDMIN	VALIDMAX	DEPEND_0	UNIT
TIME_UTC	31-Dec-9999 23:59:59.999	On the fly	On the fly		
TIME_OBT	-1.0e-31	On the fly	On the fly	TIME_UTC	
B_OB	-1.0e-31	-16384	16384.0	TIME_UTC	NANOTESLA
T_OB	-1.0e-31	113.15	393.15	TIME_UTC	KELVIN
QUALITY_FLAGS				TIME_UTC	
LABEL_B_OB					

CDF variable names	DISPLAY_TYPE	LABEL_PTR_1	LABLAXIS
TIME_UTC			UTC
TIME_OBT			Onboard Time
B_OB	time_series	LABEL_B_OB	B (OB sensor)
T_OB	time_series		Temp. (OB sensor)
QUALITY_FLAGS	no_plot		
LABEL_B_OB			[Bx, By, Bz]

3.2.2 Level C

The magnetic field data are stored in the original PDS3 TAB files per component (e.g. for the outboard sensor Bx_OB, By_OB, Bz_OB). When files are converted to CDF files by SPARTA, the magnetic field is stored as a vector in one variable instead, the third variable, named B_OB for outboard sensor or B_IB for inboard sensor. In this case, a variable LABEL_B_OB (resp. LABEL_B_IB) of type metadata is recommended by NASA SPDF ISTP guidelines to label the values Bx, By, Bz. Hence the variable attributes for files of type.

These variable attributes are the same for M2 and M3 files.

Rosetta_RPCMAG_clc_ob_M2_YYMMDD_V6.0.cdf reads

CDF variable names	FIELDNAM
TIME_UTC	TIME_UTC
TIME_OBT	SpacecraftOnBoard clock Time
POSITION	Rosetta orbiter position
B_OB	Magnetic Field Vector
QUALITY_FLAGS	QUALITY_FLAGS
LABEL_B_OB	LABEL_B_OB
LABEL_POSITION	LABEL_POSITION

CDF variable names	CATDESC
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
POSITION	SPACECRAFT POSITION VECTOR, 67P/C-G_CSEQ comet-centred solar equatorial (CSEQ) coordinate system
B_OB	MAGNETIC FIELD VECTOR, CALIBRATED, TEMPERATURE, CORRECTED DATA, OB SENSOR, 67P/C-G_CSEQ
QUALITY_FLAGS	See Quality_flags_description global attribute
LABEL_B_OB	Labels of the vector B_OB
LABEL_POSITION	Labels of the vector POSITION

CDF variable names	VAR_TYPE	UNITS	SI_CONVERSION	TIME_BASE	FORMAT
TIME_UTC	support_data	ps	1.0e-12>s	0AD	A26
TIME_OBT	support_data	s	1.0>s		F15.5
POSITION	data	km	1.0e3>m		F13.2
B_OB	data	nT	1.0e-9>T		F9.2
QUALITY_FLAGS	data				A11
LABEL_B_OB	metadata				A3
LABEL_POSITION	metadata				A3

CDF variable names	FILLVAL	VALIDMIN	VALIDMAX	DEPEND_0	UNIT

TIME_UTC	31-Dec-9999 23:59:59.999	On the fly	On the fly		
TIME_OBT	-1.0e-31	On the fly	On the fly	TIME_UTC	
POSITION	-1.0e-31	0	9e8	TIME_UTC	KILOMETER
B_OB	-1.0e-31	-16384	16384.0	TIME_UTC	NANOTESLA
QUALITY_FLAGS				TIME_UTC	
LABEL_B_OB					
LABEL_POSITION					

CDF variable names	DISPLAY_TYPE	LABEL_PTR_1	LABLAXIS	FRAME
TIME_UTC			UTC	
TIME_OBT			Onboard Time	
POSITION	time_series		Position	vector>ECLIPJ2000
B_OB	time_series	LABEL_B_OB	B	vector>ECLIPJ2000
QUALITY_FLAGS	no_plot			
LABEL_B_OB			[Bx, By, Bz]	
LABEL_POSITION			[X, Y, Z]	

3.2.3 Level F

The magnetic field data are stored in the original PDS3 TAB files per component (e.g. for the outboard sensor Bx_OB, By_OB, Bz_OB). When files are converted to CDF files by SPARTA, the magnetic field is stored as a vector in one variable instead, the third variable, named B_OB for outboard sensor or B_IB for inboard sensor. In this case, a variable LABEL_B_OB (resp. LABEL_B_IB) of type metadata is recommended by NASA SPDF ISTP guidelines to label the values Bx, By, Bz. Hence the variable attributes for files of type

Rosetta_RPCMAG_clf_ob_a1_YYMMDD_V6.0.cdf reads

CDF variable names	**FIELDNAM**
TIME_UTC	TIME_UTC
TIME_OBT	SpacecraftOnBoard clock Time
B_OB	Magnetic Field Vector
T_OB	Sensor Temperature
QUALITY_FLAGS	QUALITY_FLAGS
LABEL_B_OB	LABEL_B_OB

CDF variable names	**CATDESC**
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF

TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
B_OB	MAGNETIC FIELD VECTOR, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 1S_AVERAGE-OB SENSOR
T_OB	TEMPERATURE OF RPCMAG OB SENSOR
QUALITY_FLAGS	See Quality_flags_description global attribute
LABEL_B_OB	Labels of the vector B_OB

CDF variable names	VAR_TYPE	UNITS	SI_CONVERSION	TIME_BASE	FORMAT
TIME_UTC	support_data	ps	1.0e-12>s	0AD	A27
TIME_OBT	support_data	s	1.0>s		F15.5
B_OB	data	nT	1.0e-9>T		F9.2
T_OB	data	K	1.0>K		F6.2
QUALITY_FLAGS	data				A11
LABEL_B_OB	metadata				A3

CDF variable names	FILLVAL	VALIDMIN	VALIDMAX	DEPEND_0	UNIT
TIME_UTC	31-Dec-9999 23:59:59.999	On the fly	On the fly		
TIME_OBT	-1.0e-31	On the fly	On the fly	TIME_UTC	
B_OB	-1.0e-31	-16384	16384.0	TIME_UTC	NANOTESLA
T_OB	-1.0e-31	113.15	393.15	TIME_UTC	KELVIN
QUALITY_FLAGS				TIME_UTC	
LABEL_B_OB					

CDF variable names	DISPLAY_TYPE	LABEL_PTR_1	LABLAXIS
TIME_UTC			UTC
TIME_OBT			Onboard Time
B_OB	time_series	LABEL_B_OB	B (OB sensor)
T_OB	time_series		Temp. (OB sensor)
QUALITY_FLAGS	no_plot		
LABEL_B_OB			[Bx, By, Bz]

3.2.4 Level G

The magnetic field data are stored per component (e.g. for the outboard sensor Bx_OB, By_OB, Bz_OB). When files are converted to CDF files by SPARTA, the magnetic field is stored as a vector in one variable, the third variable, named B_OB for outboard sensor or B_IB for inboard sensor. In this case, a variable LABEL_B_OB (resp. LABEL_B_IB) of type

metadata is recommended by NASA SPDF ISTP guidelines to label the values Bx, By, Bz. Hence the variable attributes for files of type

Rosetta_RPCMAG_clg_ob_a1_YYMMDD_V6.0.cdf reads

CDF variable names	FIELDNAM
TIME_UTC	TIME_UTC
TIME_OBT	SpacecraftOnBoard clock Time
B_OB	Magnetic Field Vector
POSITION	Rosetta orbiter position
QUALITY_FLAGS	QUALITY_FLAGS
LABEL_B_OB	LABEL_B_OB
LABEL_POSITION	LABEL_POSITION

CDF variable names	CATDESC
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
B_OB	MAGNETIC FIELD VECTOR, CALIBRATED, TEMPERATURE CORRECTED DATA, S/C-COORDINATES, 1S_AVERAGE-OB SENSOR
POSITION	SPACECRAFT POSITION VECTOR, S/C-COORDS
QUALITY_FLAGS	See Quality_flags_description global attribute
LABEL_B_OB	Labels of the vector B_OB
LABEL_POSITION	Labels of the vector POSITION

CDF variable names	VAR_TYPE	UNITS	SI_CONVERSION	TIME_BASE	FORMAT
TIME_UTC	support_data	ps	1.0e-12>s	0AD	A26
TIME_OBT	support_data	s	1.0>s		F15.5
B_OB	data	nT	1.0e-9>T		F9.2
POSITION	data	km	1.0e3>m		F13.2
QUALITY_FLAGS	data				A11
LABEL_B_OB	metadata				A3
LABEL_POSITION	metadata				A3

CDF variable names	FILLVAL	VALIDMIN	VALIDMAX	DEPEND_0	UNIT
TIME_UTC	31-Dec-9999 23:59:59.999	On the fly	On the fly		
TIME_OBT	-1.0e-31	On the fly	On the fly	TIME_UTC	
B_OB	-1.0e-31	-16384	16384.0	TIME_UTC	NANOTESLA

POSITION	-1.0e-31	0	9e8	TIME_UTC	KILOMETER
QUALITY_FLAGS				TIME_UTC	
LABEL_B_OB					
LABEL_POSITION					

CDF variable names	DISPLAY_TYPE	LABEL_PTR_1	LABLAXIS	FRAME
TIME_UTC			UTC	
TIME_OBT			Onboard Time	
B_OB	time_series	LABEL_B_OB	B	vector>ECLIPJ2000
POSITION	time_series		Position	vector>ECLIPJ2000
QUALITY_FLAGS	no_plot			
LABEL_B_OB			[Bx, By, Bz]	
LABEL_POSITION			[X, Y, Z]	

3.2.5 Level H

The magnetic field data are stored per component (e.g. for the outboard sensor Bx_OB, By_OB, Bz_OB). When files are converted to CDF files by SPARTA, the magnetic field is stored as a vector in one variable, the third variable, named B_OB for outboard sensor or B_IB for inboard sensor. In this case, a variable LABEL_B_OB (resp. LABEL_B_IB) of type metadata is recommended by NASA SPDF ISTP guidelines to label the values Bx, By, Bz. Hence the variable attributes for files of type

Rosetta_RPCMAG_clh_ob_M2_YYMMDD_V6.0.cdf reads

CDF variable names	FIELDNAM
TIME_UTC	TIME_UTC
TIME_OBT	SpacecraftOnBoard clock Time
B_OB	Magnetic Field Vector
POSITION	Rosetta orbiter position
QUALITY_FLAGS	QUALITY FLAGS
LABEL_B_OB	LABEL_B_OB
LABEL_POSITION	LABEL_POSITION

CDF variable names	CATDESC
TIME_UTC	UTC TIME OF OBSERVATION: YYYY-MM-DDTHH:MM:SS.FFFFFF
TIME_OBT	S/C CLOCK AT OBSERVATION TIME,SECONDS SINCE 00:00 AT 1.1.2003: SSSSSSSSS.FFFFF
B_OB	MAGNETIC FIELD VECTOR, CALIBRATED, TEMPERATURE AND REACTION WHEEL AND LAP DISTURBANCE CORRECTED DATA, OB SENSOR, ECLIPJ2000

POSITION	SPACECRAFT POSITION VECTOR, ECLIPJ2000
QUALITY_FLAGS	See Quality_flags_description global attribute
LABEL_B_OB	Labels of the vector B_OB
LABEL_POSITION	Labels of the vector POSITION

CDF variable names	VAR_TYPE	UNITS	SI_CONVERSION	TIME_BASE	FORMAT
TIME_UTC	support_data	ps	1.0e-12>s	0AD	A26
TIME_OBT	support_data	s	1.0>s		F15.5
B_OB	data	nT	1.0e-9>T		F9.2
POSITION	data	km	1.0e3>m		F9.2
QUALITY_FLAGS	data				A11
LABEL_B_OB	metadata				A3
LABEL_POSITION	metadata				A3

CDF variable names	FILLVAL	VALIDMIN	VALIDMAX	DEPEND_0	UNIT
TIME_UTC	31-Dec-9999 23:59:59.999	On the fly	On the fly		
TIME_OBT	-1.0e-31	On the fly	On the fly	TIME_UTC	
B_OB	-1.0e-31	-16384	16384.0	TIME_UTC	NANOTESLA
POSITION	-1.0e-31	0	9e8	TIME_UTC	KILOMETER
QUALITY_FLAGS				TIME_UTC	
LABEL_B_OB					
LABEL_POSITION					

CDF variable names	DISPLAY_TYPE	LABEL_PTR_1	LABLAXIS	FRAME
TIME_UTC			UTC	
TIME_OBT			Onboard Time	
B_OB	time_series	LABEL_B_OB	B	vector>ECLIPJ2000
POSITION	time_series	LABEL_POSITION	Position	vector>ECLIPJ2000
QUALITY_FLAGS	no_plot			
LABEL_B_OB			B	
LABEL_POSITION			POSITION	

4. LOADING AND PLOTTING A DC MAGNETIC FIELD VECTOR FROM A CDF FILE

4.1 Loading and plotting a DC magnetic field vector from a RPCMAG CDF file

This section details how to load and display DC magnetic field vector from the CDF file Rosetta_RPCIES_l3elc_flux_20160930_V1.0.cdf converted by SPARTA in Matlab and IDL. The following NASA ISTP compliant CDF routines for Matlab and IDL must be installed and are available at

https://spdf.sci.gsfc.nasa.gov/pub/software/cdf/dist/cdf37_0/matlab/
https://spdf.sci.gsfc.nasa.gov/pub/software/cdf/dist/cdf37_0/idl/

These routines are available for all major platforms. They are necessary as for instance in MATLAB, variable attributes are not allowed to be of type EPOCH16 and are not read by the native functions *cdfinfo.m* and *cdfread.m*.

4.2 Matlab

The following NASA ISTP compliant CDF routines for Matlab must be installed and is available at

https://spdf.sci.gsfc.nasa.gov/pub/software/cdf/dist/cdf37_0/matlab/

These routines are available for all major platforms. They are necessary as for instance in MATLAB, variable attributes are not allowed to be of type EPOCH16 and are not read by the native functions *cdfinfo.m* and *cdfread.m*.

Make sure the NASA library (cdf370_patch-64 on 64bits Mac for instance) is in your path

```
>> info=spdfcdfinfo('Rosetta_RPCMAG_clf_ib_a60_20160929_V6.0.cdf');
>> info.Variables
ans =
  6×12 cell array
    'TIME_UTC'          [1×2 double]    [1438]    'epoch16'    'T/'     'Full'    'None'    [1438]     [1×2 double]     [1×2 double]     [1×2 double]     [1×2 double]
    'TIME_OBT'          [1×2 double]    [1438]    'double'     'T/'     'Full'    'None'    [1438]    [-1.0000e+30]    [-1.0000e+31]    [4.3373e+08]    [4.3381e+08]
    'B_IB'              [1×2 double]    [1438]    'double'     'T/T'    'Full'    'None'    [1438]    [-1.0000e+30]    [-1.0000e+31]    [    -16384]    [     16384]
    'T_IB'              [1×2 double]    [1438]    'double'     'T/'     'Full'    'None'    [1438]    [-1.0000e+30]    [-1.0000e+31]    [  113.1500]    [  393.1500]
    'QUALITY_FLAGS'     [1×2 double]    [1438]    'char'       'T/'     'Full'    'None'    [1438]    '        '                [0]              [0]              [0]
    'LABEL_B_IB'        [1×2 double]    [   1]    'char'       'F/T'    'Full'    'None'    [   1]    '  '                     [0]              [0]              [0]
>> data=spdfcdfread('Rosetta_RPCMAG_clf_ib_a60_20160929_V6.0.cdf')
data =
  1×6 cell array
    [1438×1 double]    [1438×1 double]    [1438×3 double]    [1438×1 double]    [1438×8 char]    [3×2 char]
>>  B_IB=data{3}; whos B_IB
  Name          Size              Bytes  Class     Attributes

  B_IB      1438x3             34512  double              |

>>
```

Figure 21. Extraction of the variable names and their content from a SPARTA ISTP compliant CDF file in Matlab using the NASA Matlab routines designed to read ISTP compliant CDF file version 3.6.4

The only difference with the PDS3 TAB file is the following. The magnetic field is stored as a vector in one variable (the third variable B_IB is indeed described as [1438x3 double], corresponding to 1483 time steps). In the PDS3 TAB file, the data are stored per component (Bx_IB, By_IB, Bz_IB). A variable LABEL_B_IB of type metadata has been added with values Bx Inboard, By Inboard, Bz Inboard as recommended by NASA SPDF ISTP guidelines https://spdf.gsfc.nasa.gov/istp_guide/variables.html - Metadata_eg1

Please note that by using the *spdfcdfinfo* routine and *info.Variables*, the last two columns correspond to the validmin and validmax VariableAttributes values extracted from the RPCMAG documentation.

By copy pasting the simple list of Matlab command presented below, Matlab will first load the metadata and the data stored in the file Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf

then display these data (see Figure 22) using some of the metadata stored in the global and variable attributes. These RPCMAG data were originally stored in the PDS3 file RPCMAG160929_CLF_OB_A1.TAB, converted with its relevant metadata information by SPARTA.

```
>> info=spdfcdfinfo('Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf');
>> data=spdfcdfread('Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf');
>> info.Variables
ans =
6×12 cell array
Columns 1 through 9
'TIME_UTC' [1×2 double] [86357] 'epoch16' 'T/' 'Full' 'None' [86357] [1×2 double]
'TIME_OBT' [1×2 double] [86357] 'double' 'T/' 'Full' 'None' [86357] [-1.0000e+30]
'B_OB' [1×2 double] [86357] 'double' 'T/T' 'Full' 'None' [86357] [-1.0000e+30]
'T_OB' [1×2 double] [86357] 'double' 'T/' 'Full' 'None' [86357] [-1.0000e+30]
'QUALITY_FLAGS' [1×2 double] [86357] 'char' 'T/' 'Full' 'None' [86357] ' '
'LABEL_B_OB' [1×2 double] [ 1] 'char' 'F/T' 'Full' 'None' [ 1] ' '
Columns 10 through 12
[1×2 double] [1×2 double] [1×2 double]
[-1.0000e+31] [4.3373e+08] [4.3381e+08]
[-1.0000e+31] [ -16384] [ 16384]
[-1.0000e+31] [ 113.1500] [ 393.1500]
[] [] []
[] [] []
>> time=data{1};B=data{3};labels=data{6};
>> plot(time,B);datetick('x','HH:MM')
>> info.VariableAttributes.UNITS
ans =
6×2 cell array
'TIME_UTC' 'ps'
'TIME_OBT' 's'
'B_OB' 'nT'
'T_OB' 'K'
'QUALITY_FLAGS' ' '
'LABEL_B_OB' ' '
>> xlabel('HH:MM [UTC]');ylabel(info.VariableAttributes.UNITS{9});
>> title([char(info.GlobalAttributes.Pds_instrument_id),' from
',char(info.GlobalAttributes.Pds_start_time)]);
>> xlabel('HH:MM [UTC]');ylabel(info.VariableAttributes.UNITS{9});
```

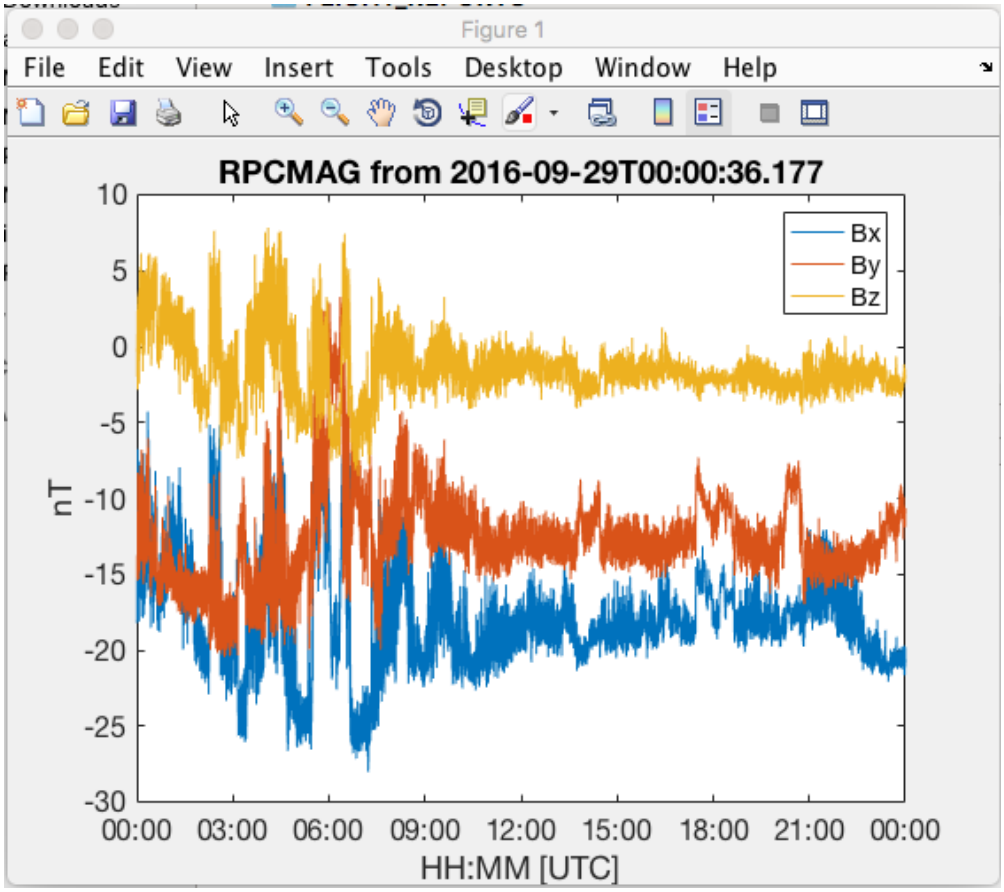


Figure 22. RPCMAG data plotted in Matlab using an ISTP compliant CDF file converted by SPARTA.

Similarly, for RPCMAG CLG type of file

```
info=spdfcdfinfo('Rosetta_RPCMAG_clg_ob_a1_20101206_V3.0.cdf');
data=spdfcdfread('Rosetta_RPCMAG_clg_ob_a1_20101206_V3.0.cdf');
time=data{1};B=data{4};labels=data{6};
plot(time,B);datetick('x','HH:MM')
xlabel('HH:MM [UTC]');ylabel(info.VariableAttributes.UNITS{11});
title([char(info.GlobalAttributes.Pds_instrument_id),' from
',char(info.GlobalAttributes.Pds_start_time)])
legend(labels)
```

4.3 IDL

To read an RPCIES CDF file converted by SPARTA with IDL, a few libraries need to be installed

- Installation of CDF3.7: https://cdf.gsfc.nasa.gov/html/sw_and_docs.html
- Installation of NASA CDF IDL PATCH https://cdf.gsfc.nasa.gov/html/cdf_patch_for_idl.html
- Installation of NASA SPDF CDAWLIB https://spdf.gsfc.nasa.gov/CDAWlib.html

  For this installation, you need to edit compile_cdaweb.pro contained in the installed CDAWLIB folder to fit YOUR paths in the following two lines
  setenv,'LD_LIBRARY_PATH=/usr/local/exelis/idl85/bin/:/home/cdaweb/lib'
  setenv,'IDL_DLM_PATH=/usr/local/cdf37_0/lib'

Interest of CDAWLIB
While CDAWLIB is not absolutely necessary, the function READ_MYCDF is very handy to load the CDF file into an IDL structure. It was built to read from one to many variables from one to many CDF files, and returns all data and metadata for these variables in a single structure of the form:

structure_name.variable_name.attribute_name.value

Please find below blocks of IDL commands that can be simply be copy pasted in the IDL command window. Please do include a blank line at the end of each block for the last command to be executed.

1. First, setup the path to your data folder (just an example below)

```
my_data_folder='~/IDLWorkspace/Default'
```

2. Loading and plotting an RPCMAG CDF into an IDL data structure

```
cd,my_data_folder
@compile_cdaweb
@compile_IDLmakecdf
cdfilename=strarr(1)
cdfilename[0]='Rosetta_RPCMAG_clf_ob_a1_20160929_V6.0.cdf'
data=read_mycdf('',/all,cdfilename)
```

3. Content of an IDL data structure loaded with read_mycdf

```
IDL> help,/struct,data
** Structure <2e7f008>, 6 tags, length=7102880, data length=7102856, refs=1:
  TIME_UTC      STRUCT    -> <Anonymous> Array[1]
  TIME_OBT      STRUCT    -> <Anonymous> Array[1]
  B_OB          STRUCT    -> <Anonymous> Array[1]
  T_OB          STRUCT    -> <Anonymous> Array[1]
  QUALITY_FLAGS STRUCT    -> <Anonymous> Array[1]
  LABEL_B_OB    STRUCT    -> <Anonymous> Array[1]
```

Please note that all field names can also be listed with the command:

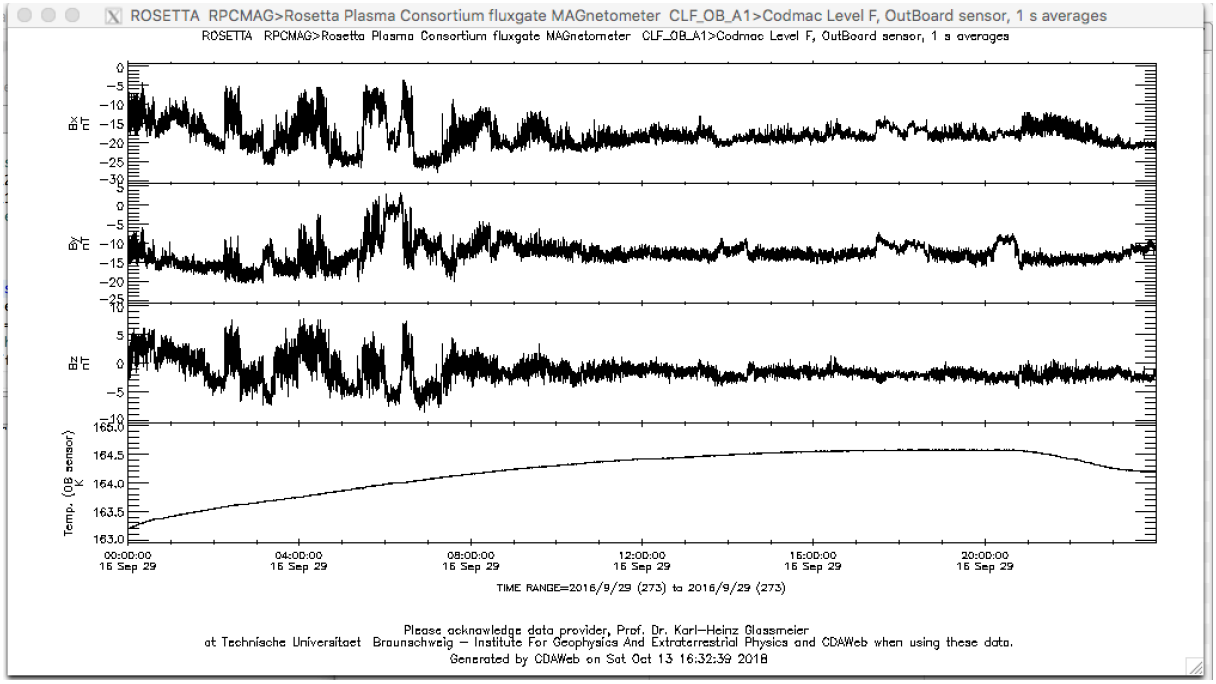
```
IDL>tag_names(data)
TIME_UTC
TIME_OBT
B_OB
T_OB
QUALITY_FLAGS
LABEL_B_OB
```

4. Plotting the data content with NASA CDAWLIB plotmaster routine
Tested with CDAWLIB version released in May 2018 and CDF 3.7 routines and IDL patch.

When the time resolution is of type EPOCH16 (ps precision), Plotmaster requires start and stop time

```
start='2016/09/29 00:00:00.00.000'
stop='2016/09/29 23:59:59.00.000'
plotmaster(data,xsize=1000,/AUTO, TSTART=start, TSTOP=stop)
```

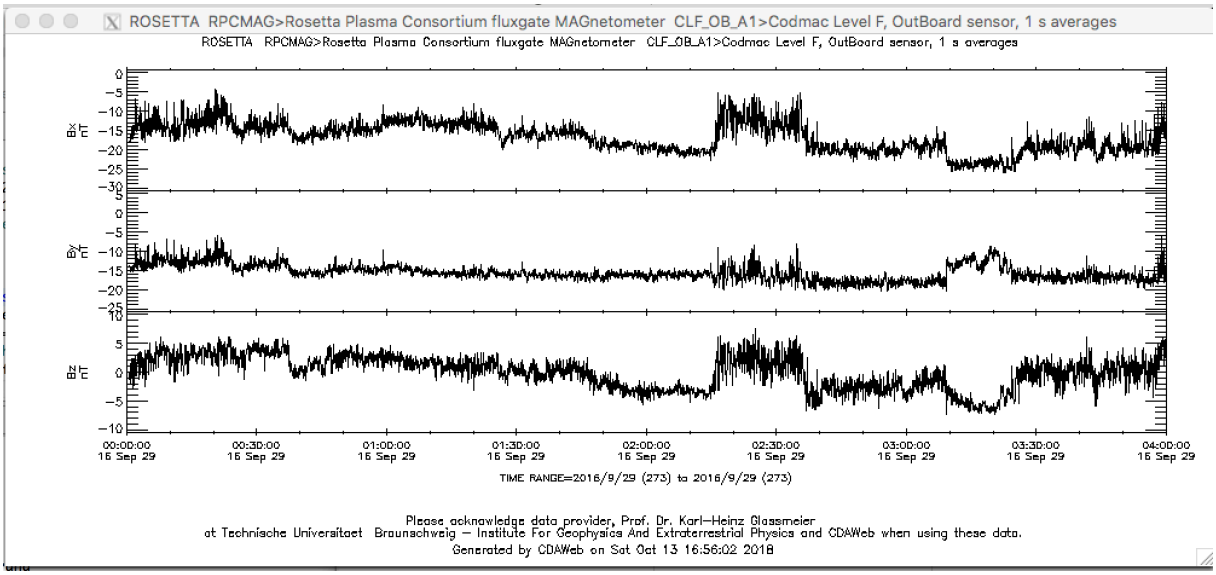
Plotmaster will then display the following figure where all metadata information is extracted automatically from the data structure



If you want to plot only a subset of the data, e.g. only the magnetic field vector components, and visualize only the first 4 hours

```
datasubset=read_mycdf('B_OB',cdfilename)
stop='2016/09/29 04:00:00.00.000'
plotmaster(datasubset,xsize=1000,/AUTO, TSTART=start, TSTOP=stop)
```

Plotmaster will then display the following figure where all metadata information is extracted automatically from the data structure



Other relevant IDL resources

Accessing CDAWeb Data from IDL: https://cdaweb.sci.gsfc.nasa.gov/WebServices/REST/CdasIdlLibrary.html

IDL CDF functions
description: http://www.harrisgeospatial.com/docs/cdf_varget.html#CDF_1744428779_1008632
SPDFgetdata.pro: https://cdaweb.sci.gsfc.nasa.gov/WebServices/REST/idl/public/spdfgetdata.html