Rosetta
Mars Express
Venus Express

MaRS/ RSI/ VeRa

Radio Science File Naming Convention
And
Radio Science File Formats

Issue:	**12**
Revision:	**14**
Date:	**30.05.2016**
Document:	**MEX-MRS-IGM-IS-3016**
	ROS-RSI-IGM-IS-3087
	VEX-VRA-IGM-IS-3009

Prepared by

Thomas Andert

Approved by

Martin Pätzold (MaRS/RSI Principal Investigator, VeRa Co-Investigator)

Page left free

Document Change Record

Issue	Rev	Sec	Date	Changes	Name
2.0	0.0	2	02.11.2002	Section 2 inserted	T.A.
		3		Section 3 inserted	
		4-7		Number of sections shifted	
		5		5.1.2.3 inserted	
		6		6.1.1.3.1 modified	
		All		Reviewed	
2.0	1.0	2	12.02.2003	Figure 2.1 updated	T.A.
		3		Section 3 edited	
		4		Table 4.1 and 4.2 edited	
		5		Section 5.1.2.2 inserted	
		6		Section 6.1.2 inserted	
2.0	2	All	22.05.2003	Some editing	mpa
3.0	0.0	All	04.06.03	Complete update	T.A.
4.0	0	All	08.07.2003	Complete revision	mpa
4	1	8.1 4.1 6.1	15.07.2003	Change of orbit predict file extension Change of RSR level 1a extension; predict file extensions Description of DSN file format	mpa
4	2	All 8.1 9.1	16.07.2003	All ATDF and ODR format descriptions removed New predict file formats Range calibration file format	mpa
4	3	4.2 5	20.07.2003	Introduction of descriptive files Old section 5 becomes new section 7	mpa
4	4	4.1 6.2.2	22.07.2003	New level 2 file types Changed Doppler output file format Changed file name format	mpa
4	5	6.2.2	30.07.2003	Changed Doppler output file format changed ranging output format	mpa
5	0	all	01.08.2003	after Stanford review	mpa

5	1	All	17.08.2003	DSS station numbers New file name formats TNF level 1b extensions After discussion CGN/Stan/JPL/ESA	mpa
5	2	all	19.08.2003	New file name format	mpa
5	3	4.1 6.2.2	25.08.2003	New L02 file types in Table 4-1 Introducing L02 Doppler output files for X-band and S-band each	mpa
5	4		26.08.2003	New L02 ranging file formats for X-band and S-band each	mpa
5	5	All 4.1 3.1.4 6.1.2 6.2.2	15.09.2003	Some editing New extensions for binary and ASCII files New Volume ID New formats for X- and S-band calibrated Doppler files Level 2, after discussion with VD and JPB	mpa
5	6	4.1 5.2.1.2 7.3 8.4 8.5 8.6	17.09.2003	Adding information about ancillary files	mpa
6	0	All 3.1.3 9 11 12	19.09.2003	RS comments included Document reorganized Volume name specified Calibration section expanded SPICE information included Example IFMS configuration file in Appendix	mpa
6	1	4.1 8.1 8.2	24.11.2003	New range data type identifier in Table 4.1 Tables updated Tables updated	mpa
6	2	2 4.1 6 7.3	29.11.2003	New Figures 2.1 and 2.2 New ODF file name definitions Table 4.1 TNF description replaced by ODF throughout section 6 New section 7.3	mpa
6	3	5.2.1 7.4.1 7.4.2 8.4 8.5	2.12.2003	Section 5.2.1.2.1.1 inserted Tables updated Tables updated Tables updated Tables updated Tables updated	B.S.
6	4	8.5.1	15.12.2003	Update file name	B.S.

6	5	4.1 7.3.1 8.1.1 9.2	03.02.2004	Update Table 4.1 New data type identifier New section New section New section	mpa
6	6	All 3.2 3.3 4.1 5 5.1 6.1 6.1.3.1 6.1.3.2 6.2 12.2	11.02.2004	Editing and correcting typos Table 3.4 updated Table 3.5 updated Table 4.1 updated Explaining text introduced Section corrected and revised Updated Table 6.5 and 6.6 corrected revised revised Tables 6.12 and 6.13 corrected New section; example labels	mpa
6	7	4.1 8.3 10.1	12.02.2004	Table 4.1 updated Section deleted Section reworked and revised	mpa
6	8	3.2 3.3 4.1 5.1.2.3 6.1.1.3 6.2.2 6.3 7.6 – 7.8 9.5 9.6 2	17.02.2004	Table 3.4 revised Table 3.5 revised Table 4.1 revised; data types added Section revised Tables revised ODF Header File deleted Level 2 tables revised Table 6.9 revised Sections added Section added Section added Figur 2.1 updated	mpa T.A.
6	9	12	18.2.2004	Appendix with Example PDS labels added	mf
6	10	12	15.03.2004	New section 12	mpa
6	11	beginning All 1.3 3.2.1 6.1.1.3.1 6.1.1.3.2 7.1.2.2 13.2.1.2	18.03.2004	Axel Hagermann deleted from distribution list some editing section updated Table 3.4: data level in data_set_id description changed from PSA-level to CODMAC-level; footnote inserted Level 1b file name corrected Table 6-2, 6-3, 6-4 updated Table 7-1 product_type replaced by standard_data_product_id and definition values for instrument_id updated Section updated	LC

		13.2.3.1 13.2.3.2 7.1.2.2 3.2.1	 22.3.2004	Section updated Section updated Table 7-1 Mission phase name inserted and updated Table 3-4: data description part updated	
6	12	11	23.3.2004	SPICE kernel names updated	CS
6	13	4.1 5.1.2.4 6.1.3.2.2	06.04.2004	Table 4.1 new data types introduced for covering BSR ancillary data from DSN/Stanford New section for BRO data Section updated	mpa
6	14	4.1 6.2.1.3.2. 6.2.1.3.2.1 6.2.1.6.1. 6.2.2.2. 6.2.2.3.2.1 13.2. 9.4.1 7.2.1. 6.1.1.3.2.1 6.2.1.3.2.1 6.2.1.3.2.2 6.2.1.3.2.4 6.2.2.3.2.1 6.2.2.3.2.2 9.1.2. 9.2.3. 9.3.2. 10.1.3. 6.2.1.3.2.2 6.2.2.2 6.2.1.3.1.2 6.2.1.3.2. 7.2.1 5.2.1.1.3. 6.2.1.3.2.7 6.2.1.3.1. 9.3. 9.3.1.	12.07.2004	Table 4.1 updated with new Doppler names D1X,D1S,D1X,D2S instead of DP1,DP2 and for level 1a&1b and calibration file names updated: C1S,C1X,C2X,C2S inserted updated with new Doppler file names Meteo file name updated .TAB instead of .AUX as ending calibration file names updated C1X,C1S,C2X,C2S instead of DP1,DP2; RNG,AG1,AG2 deleted from table MJD time format updated to 12:00 01.01.2000 RNG replaced by RGX, RGS updated with new Doppler, Ranging and Calibration file names New section added New section added Description extended New section “IFMS □oppler calibration file” added	LC

		9.3.2. 9.4.		Description extended	
7	0	4.1 5.2 6.1 6.2 8.4 & 8.5 11	25.08.2004	Table 4.1 updated Section 5.2 updated 5.2.1.1.9 deleted Tables in 6.1 updated Section 6.2 updated Section 8.4 and 8.5 file names corrected Section 11 updated	mpa et al.
7	1	3	31.08.2004	Revision of section 3	mpa
7	2	3	6.9.2004	Volumes and Datasets Organization, Formats and Name Specification Reintroduced in Section 3	mf
7	3	3.2.1 3.2.2 3.2.4.2. 7.1.2.2. 8.3. 12 13.2.3 All	13.9.2004	Data_set_id updated Data_set_id updated Description of volume CD updated New keyword added processing_level_id 8.3. section deleted New section Labels and tables updated Update of time description in tables	LC
8	0	7.3.1.1 7.3.2.1 10	14.09.04	file name updated file name updated file name updated	bs
8	1	All	15.09.2004	Some editing	mpa
9	0	6.5	16.09.2004	Update tables 6.5 and 6.6	mpa
9	1	3.2.1.1. 3.2.1.2. 3.2.2.1 3.2.3.1 3.2.4.2 3.2.5 3.2.5.1 6 6.1.1.3.2. 7 8 9.2.3. 9.3.2. 9.4.2. 10.1.3.	20.09.2004	added radio science missione phase description new section added: Dataset name Table 3.4 updated section updated. Definition of volume_id clarified volume_set_name defined Figure 3.2: description of figure updated New section: Volume series New section: Volume series name Tables 6.5 – 6.8, Tables 6.11-6.14 time description updated Subsections 1-4 time description updated Table 7.1 updated Tables 8.1-8.4 time description updated time description updated Table 10.2 time description updated	LC
9	2	4.1 9.6	22.09.2004	Table 4.1 updated New section 9.6	Mpa

9	3	6	23.09.2004	Tables 6.6 and 6.7 edited Tables 6.1 – 6.4 updated New Table 6.5 included	mpa
9	4	6 7 8 9 10 12.1.2 12.2.3 13.3.3	29.09.2004	Tables 6.1 – 6.9 updated Tables 6.11 – 6.15 updated Table 7-1 keyword original_product_id replaced by source_product_id Tables 8.1- 8.4 updated sections 9.2.3, 9.3.2, 9.4.2, 9.6.2 updated Table 10-2 updated Description of ephemeris time corrected Replaced old example labels by new ones	LC
9	5	6	08.10.2004	Update of tables 6.6 and 6.7	mpa
9	6	4.1 6 6.1.1.3.1 9.5 11	22.10.2004	Update Table 4.1 Revised tables 6.1 – 6.5 Update tables 6.6 and 6.7 after discussions with GLT and RAS. Tables 6.8 and 6.9 revised ODF L1A and L1B file names updated DSN METEO file updated Update of SPICE file names	mpa
9	7	6	24.10.2004	Correction of Tables 6.6 and 6.7	mpa
10	1	4 6 7	27.10.2004	Update of Table 4.1. Inserted new file ending .RAW Section 4.2 file extension .RAW added Section 6.2.1.3.1. file extension .RAW added Update of Table 7.1 updated value for producer_id	LC
10	2	3	08.11.2004	Mission phases updated	CS
10	3	9.9	23.11.2004	Section about wrong uplink frequency added	CS
10	4	3.2	29.11.2004	Data_set_id and Data_set_name changed VOLUME_NAME updated	LC
10	5	6	01.12.2004	Tables section 6 updated	mpa
10	6	6 13	14.12.2004	Tables section 6 updated and new example labels added	CS
10	7	?	?	RNG tables	mf?
10	8	6.2.2.3 7.1	20.12.2004	Text about merging in Level02 data added. Table 7.1 updated, observation_type added.	Cs
10	9	6.2.2.3 13.2	21.12.2004	Text about merging changed. Chapter about Example labels deleted. New file MEX-MRS-IGM-IS-3016_APP_A.TXT created with example labels.	CS

10	10	3.2.3.2 6.2.2.3.2	13.1.2004	Own section for Volume Version Id added; Section about log-files (Level 2 processing) added. Example table added about the connection of level 2 und 1a data (because of raw-filename in source_product_id)	CS
10	11	8.4.1. 4 7.3.2.1.	19.1.2004	Update of Mars centric Orbit file description Table 4.1. description of date in file name updated New MaRS compliant file name for EVTM files updated	LC
10	12	9	28.01.2005	UPLINK_FREQ_CORRECT section updated	CS
10	13	4 6.1.1.3.1. 7.1 7.4.1. 7.6. 7.8.	21.02.2005	Table 4.1. description of DSN level 2 Doppler files corrected: DPS and DPX instead of D1X and D2X Added SUE0 in data source identifier Added .LOG as file ending for Log files Description of DSN Ranging file names corrected: RGX and RGS instead of RNX and RNS. Table 7.1. description of SUE added added ENB files as example Titel corrected to DSN Network Monitor and Control File Added section 7.8. about the Earth Orientation file	LC
10	14	All 6	13.03.2005	Some editing Tables 6.1 – 6.4 corrected Tables 6.8 and 6.9 corrected	mpa
10	15	4.1. 9 11.1.	13.04.2005	updated file naming, added manifest files Complete make over of section, devision between DSN and IFMS calibration files, added GNC files Added description of modified Spice Kernels	LC
10	16	4.1. 9.1.	18.04.2005	Added description of SRF files (Surface Reflection Filer Files)	LC
10	17	4.1. 5.1. 9	08.07.2005	Added description of BCL files (Bistatic radar calibration log files), LIT (Light time files), OPT (Orbit propagation and timing files), removed GNC files, added source description of level 2 solar conjunction files RSRC and RSLC instead of RSR0 Updated refenrences, remeoved GNC files removed GNC files	LC

		9.2.6.		Added description of Bistatic radar log files (BCL)	
10	18	8.3 8.4 8.5	11.07.2005	Updated for Mars Express Updated for Mars Express Created section for Rosetta ancillary orbit files	CW
10	19	3 11.1.2 11.1.3	08.08.2005	Section 3 inserted File name identifier updated (UNBW replaced with GEOM) Table 11.2 updated	T.A.
10	20	5.3	11.08.2005	Data source identifier for Level 2 DSN RSR open loop file containing data with left circular polarization changed	CW
11	1	5 7.2.2.3.3.	13.12.2005	Include IFMS Browse Plots (updated table 5.1) Added new section IFMS Browse Plots (Level 2)	LC
11	2	11.1.2 11.1.3	31.01.2006	Planetary Constellation Geometry updated	AM
12	1	8.1.2.2. 4.2.1.1.	3.02.2006	PDS label file header updated Data_set_id updated with instrument_host_id RO instead of ROS for Rosetta and update of mission phases	LC
12	2	4.2.1.1	4.5.2006	Mission phases for Rosetta updated	CS
12	3	.2.1.1	17.5.2006	observation type changed	CS
12	4	4.2.1.1. 5.5. 8.1.2.2.	7.8.2006	inserted X as possible target id (i.e. sun or checkout) Inserted ODFX and ODFS as possible values added SUN as possible target name	LC
12	5	9.5.1	24.04.2007	File name description updated	CW
12	6	all	19.07.2007	Institute affiliation changed from IGM (Institute for Geophysics & Meteorology, University Clogne) to RIU (Rhenish Institute of Environmental Research, Planetary Science)	LC
12	7	4 8.1.2.	24.09.2007	Update to volume keywords for Rosetta Update of keywords in Label header	LC
12	8	All	22.01.2008	Overall review and update where necessary	CS
12	9	4.2.	23.11.2009	Updated volume_id and data_set_id section to keep it consistent with higher sience data file naming convention	LC
12	10	4	07.10.2009	Table 4-1 updated Table 4-2 updated	JO

				Table 4-3 updated Table 4-4 updated	
12	11	4.2.4.2	13.10.2010	New values for the keyword VOLUME_SET_NAME for Venus Express added	JO
12	12	4.2.1.2	30.11.2010	Table 4-3 updated	JO
12	13	4.2.1.2 8.1.2.2	24.06.2011	Table 4-3 updated Table 8-1 updated	JO
12	14	4.1.2 4.2.3 6.2 11	30.05.2016	Figure 4-1 modified Section modified Table 6-1 updated Section ‘Geometry files’ removed	JO

DISTRIBUTION LIST

Destination	Number of copies
MaRS/RSI/VeRa Team:	
Martin Pätzold	1
Silvia Tellmann	
Christina Stanzel	1
Thomas Andert	1
Markus Fels	1
Ludmila Carone	1
Len Tyler	1
Richard Simpson	1
Dave Hinson	1
Jörg Selle	1
Bernd Häusler	1
Véronique Dehant	1
Jean-Pierre Barriot	1

ACRONYMS

AAS	Atmosphere Analysis Software
AGC	Automatic Gain Control
AMMOS	Advanced Multi-Mission Operations System
ATDF	Archival Tracking Data Files
ADC	Analog to Digital Converter
BWG	Beam Wave Guide ground station (DSN)
CALI	calibration file
CEB	Cebreros
CHDO	Compressed Header Data Object
DDS	Data Distribution System
DSMS	Deep Space Mission System
DSN	Deep Space Network
ESA	European Space Agency
ESOC	European Space Operations Centre
G/S	Ground Station
HEF	High Efficiancy ground station (DSN)
IFMS	Intermediate Frequency Modulation System
IGM	Institute for Geophysics and Meteorology, University of Cologne
JPL	Jet Propulsion Labatory
MAL	Malargüe
MEX	Mars Express
MGS	Mars Global Surveyor
NEA	NEAR
NNO	New Norcia Station (Perth)
ODF	Orbit Data File
ODR	Original Data Record
PDS	Planetary Data System
RIU	Rhenish Institute for Enviromental Research at the University of Cologne
ROS	Rosetta
RSI	Radio Science Investigation
RSR	Radio Science Receiver
S/C	Spacecraft
SFDU	Standard Formatted Data Unit
SUE	Stanford University, Center for Radar Astronomy
TNF	Tracking and Navigation File
ULS	Ulysses
UniBw	Universität der Bundeswehr UniBw

Contents

page intentionally left free

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

The Radio Science Investigations (RSI) experiment on board of ESA's mission Rosetta, Mars Express and Venus Express will use the S/C radio system to perform their experiments. Data from the tracking ground stations will be collected and pre-processed at RIU Cologne. This Document describes the different kinds of data files, their formats and naming conventions, which will be generated during the operational phase of both missions Mars Express and Rosetta.

1.2 DOCUMENT OVERVIEW

Section 2 shows the data flow of the tracking and processed data files
Section 3 defines volume and dataset name conventions of the data media for data archiving and distribution to PDS
Section 4 defines the general file naming convention of data files and label files of the different data archiving levels
Section 5 defines the file name convention and the formats of the raw data files used by Rosetta RSI and MaRS of level 1a
Section 6 defines the file name convention and the formats of the data files used by Rosetta RSI and MaRS up to level 2
Section 7 defines the formats and and file names of the descriptive files
Section 8 defines the file names and formats of the predicted and reconstructed orbit files, both from UniBw and ESOC
Section 9 defines the file names and formats of the calibration files from ESOC and DSN concerning ranging and media calibrations.
Section 10 defines file names and formats of geometries
Section 11 defines old and MaRS generated file names of files related to SPICE
Section 12 is an Appendix

1.3 REFERENCED DOCUMENTS

The following documents are referenced in the MaRS FOM, and may be referred to if more information is needed.

	document Number	Title
1	IFMS_OCCFTP.PDF	IFMS-to-OCC interface
2	MEX-MRS-IGM-MA-3017	IFMS-Read-Program-Manual
3	ROS-RSI-IGM-MA-3113 MEX-MRS-IGM-MA-3026	RSR-Read-Program-Manual
4	820-013, 0159-Science	Radio Science Receiver Standard Formatted Data Unit
5	deleted	
6	deleted	
7	820-013, TRK-2-34	Deep Space Mission System (DSMS) Tracking System Data Archival Format
8	MEX-MRS-IGM-DS-3031	Solar Corona Analysis Software; Requirement Spec.
9	MEX-ESC-IF-5003	DDID Appendix H
10	MEX-MRS-IGM-IS-3019/ ROS-RSI-IGM-IS-3079/ VEX-VRA-IGM-IS-3007	Rosetta/Mars Express/Venus Express Archive Generation, Validation and Transfer Plan
11	ME-ESC-IF-5014	Configuration Control Document FTS Configuration
12	820-013 TRK 2-18	ODF
13		Media Calibration etc.
14		PDS document Zender
15		SPICE documentation
16	MEX-MRS-IGM-DS-3037/ ROS-RSI-IGM-DS-3127/ VEX-VRA-IGM-DS-5008	ODF Level 1a to Level 1b Software Design Specifications
17	JPL D-7669, Part 2	PDS Standards Reference

2 DATA FLOW

The raw tracking data files from DSN ground stations will be delivered through JPL and Stanford and processed at the RIU as shown in Figure 2-1. The raw tracking data files from the ESA ground stations will be delivered through ESOC and processed at the RIU as shown in Figure 2-2.

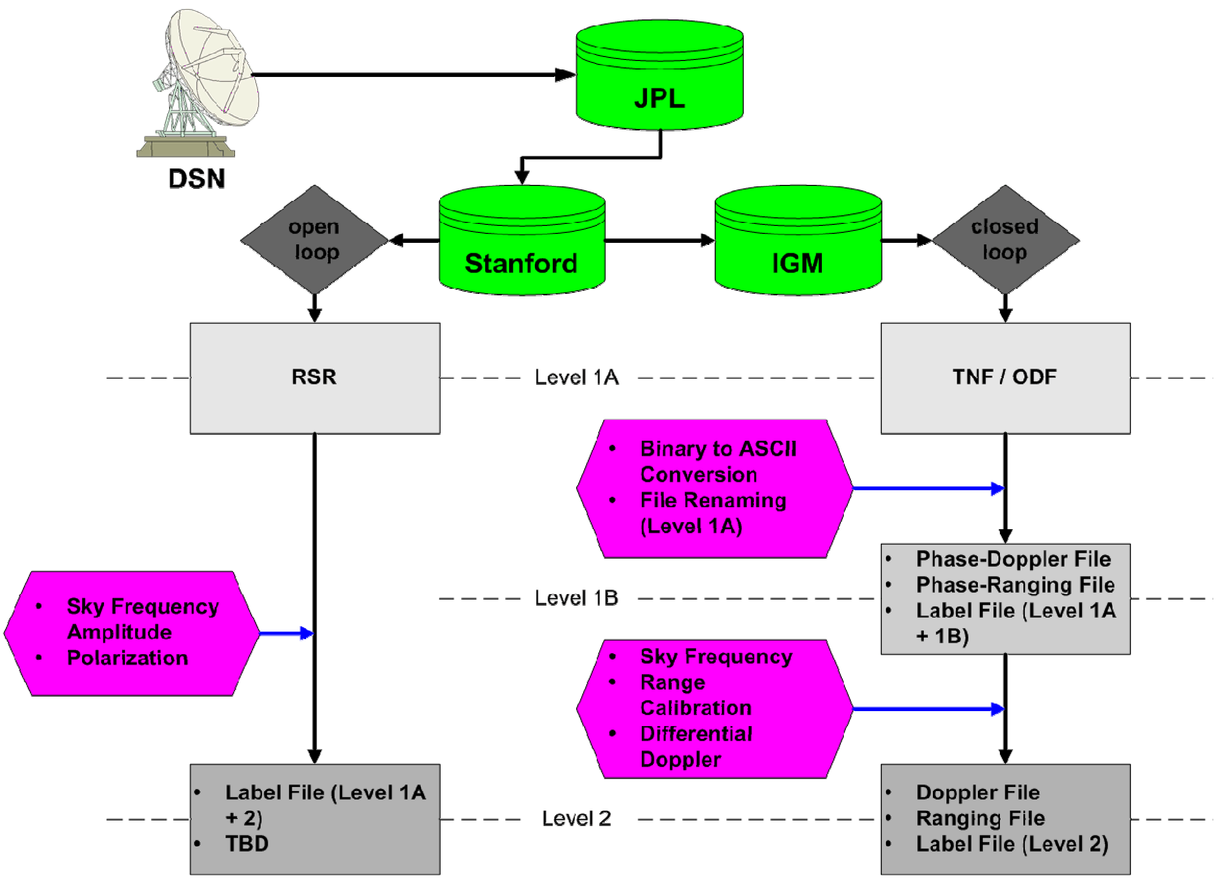

Figure 2-1: Data flow from the DSN stations.

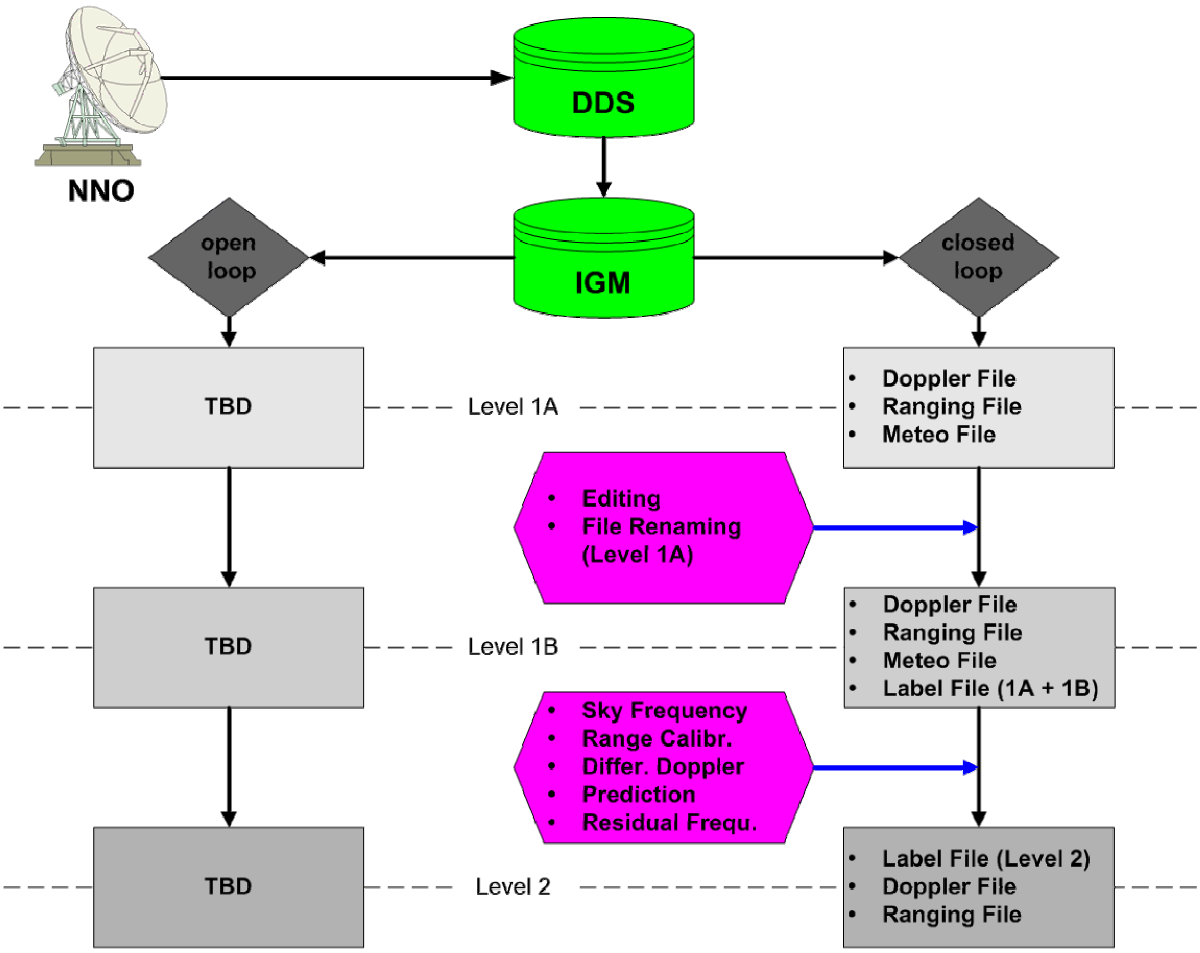

Figure 2-2: Data flow from ESA´s NNO station.

3 USED CONSTANTS

DEF-3010: ASTRONOMICAL UNIT (AU)

1 AU = 149,597,870 kilometers

Reference: Strauss, B., Highsmith, D., Mars Exploration Rover Project Planetary Constants and Models, Jet Propulsion Laboratory, Interoffice Memorandum, IOM 312/015-02, 2002

DEF-3015: SOLAR RADIUS (R_o)

1 R_o = 696,000 km

DEF-3020: SPEED OF LIGHT

c = 299,792,458 m/s

DEF-3025: PHYSICAL CONSTANTS

Constant		Value	SI units
Electron charge	e	$1.6022\ 10^{-19}$	A s
Electron mass	m_e	$9.1094\ 10^{-31}$	kg
Electric field constant	ε_0	$8.8542\ 10^{-12}$	$s^4\ A^2\ m^{-3}\ kg^{-1}$
Plasma constant	$\frac{1}{2}\frac{1}{4\pi^2}\frac{e^2}{m_e\varepsilon_0}$	40.30924	$m^3\ s^{-2}$

DEF-3030: CARRIER FREQUENCIES FOR MARS EXPRESS, VENUS EXPRESS AND ROSETTA

frequency band	uplink	downlink
S-band	2114.676 MHz	2296.482 MHz
X-band	7116.936 MHz	8420.432 MHz

Actual transmitted frequencies (up and downlink) may vary according to expected Doppler shift (approx. 10 – 100 kHz).

DEF-3031: Transponder constants and ratios

frequency band uplink	**transponder ratios downlink/uplink**	
	S-band	**X-band**
S-band	240/221	880/221
X-band	240/749	880/749

4 MARS, RSI AND VERA VOLUMES AND DATASETS ORGANIZATIONS, FORMATS AND NAME SPECIFICATIONS

4.1 DEFINITIONS AND GENERAL CONCEPT

4.1.1 <u>Definitions</u>

4.1.1.1 Data Product
A labeled grouping of data resulting from a scientific observation. Examples of data products include spectrum tables, and time series tables. A data product is a component of a data set.

4.1.1.2 Data Set
The accumulation of data products, secondary data, software, and documentation, that completely document and support the use of those data products. A data set is part of a data set collection.

4.1.1.3 Data Set Collection
A data set collection consists of data sets that are related by observation type, discipline, target, or time, and therefore are treated as a unit, archived and distributed as a group (set) for a specific scientific objective and analysis.

4.1.1.4 Volume
A physical unit used to store or distribute data products (e.g. a CD_ROM or DVD disk) which contain directories and files. The directories and files include documentation, software, calibration and geometry information as well as the actual science data. A volume is part of a volume set.

4.1.1.5 Volume Set
A volume set consists of one or more data volumes containing a single data set or collection of related data sets. In certain cases, the volume set can consists of only one volume.

4.1.2 Data- and Volume Set Organization

The general concept for the MaRS, RSI and VeRa Data- and Volume Set Design is shown in Figure 4-1.

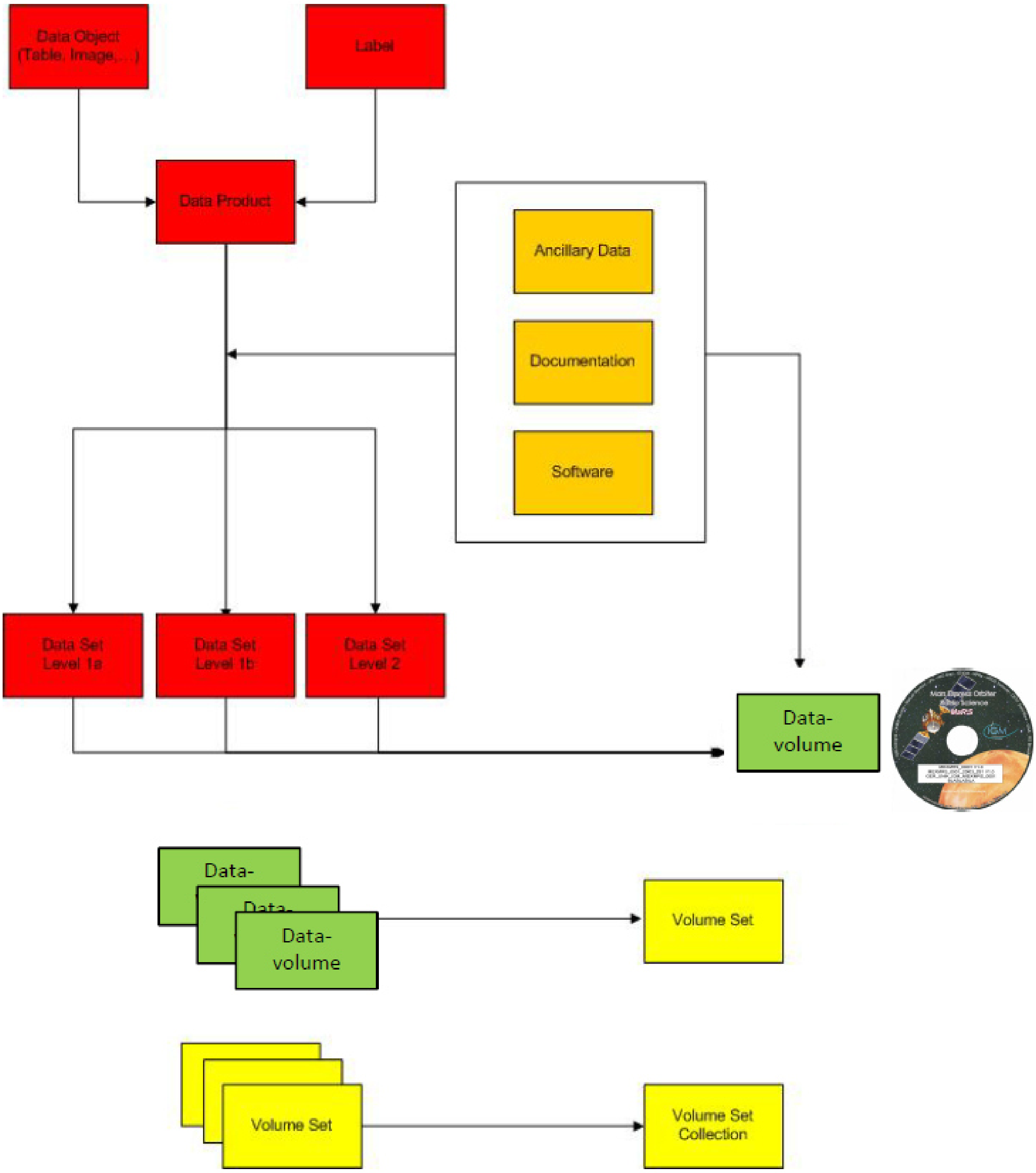

Figure 4-1: Data Set Collection, Data Sets and Data Products

4.2 VOLUME AND DATASET NAME SPECIFICATION

4.2.1 Dataset

4.2.1.1 Dataset ID

The Data Set ID is a unique alphanumeric identifier for the MaRS, VeRa and RSI data products. One data set corresponds to one physical data volume and both have a four digit sequence number. See Table 4-1 for more information.

XXX-Y-ZZZ-U-VVV-NNNN-WWW

Acronym	Description	Example
XXX	Instrument Host ID	MEX RO VEX
Y	Target ID	M (Mars) V (Venus) C (Comet Churyumov-Gerasimenko) L (asteroid Lutetia) S (asteroid Steins) X (for others i.e. Sun)
ZZZ	Instrument ID	MRS RSI VRA
U	Data level[1] (CODMAC Level)	1 raw data/ESOC/DDS 2 edited raw data 3 calibrated data 5 derived/scientific data 1/2/3 (Data set contains raw and calibrated DATA)
VVV	mission phases for level 1/2/3 (MaRS mission phases deviate from the official MEX mission phases see below)	MCO Mission Commissioning CR1 cruise first part PRM prime mission NMP nominal mission phase EXT1 extended mission 1
NNNN	A 4 digit sequence number which is identical to the Radio Science VOLUME_ID	0123
WWW	Version number	V1.0

Table 4-1: Dataset ID

[1] In the keyword DATA_SET_ID the CODMAC-levels are used instead of PSA-level. In all other file names and documents we keep PSA-level.

Examples:

MEX-M-MRS-1/2/3-PRM-1144-V1.0
RO-C-RSI-1/2/3-PRL-0099-V2.0
VEX-V-VRA-1/2/3-NMP-0124-V1.0

It should be noted that the MaRS mission phase names used in the data_set_id **do not** correspond to the mission phase names as defined from ESA for Mars Express. However, since the radio science team tries to archive data for Mars Express as well as for Venus Express and Rosetta, it was granted the use of spacecraft-independent mission phase names which can be used for all three missions. Nevertheless, for Venus Express the ESA-defined mission phases will be used.

For the mission_phases definition see **Table 4-2**.

Acronym	Description	Timespan
	For Mars Express	
NEV	Near Earth Verification	2003-06-02 at 00:00:00 UTC to 2003-07-31 at 23:59:59 UTC
CR1	Cruise 1	2003-08-01 at 00:00:00 UTC to 2003-12-25 at 23:59:59 UTC
MCO	Mission Commissioning	2003-12-26 at 00:00:00 UTC to 2004-06-30 at 23:59:59 UTC
PRM	Prime Mission	2004-07-01 at 00:00:00 UTC to 2005-12-31 at 23:59:59 UTC
EXT1	Extended Mission 1	2006-01-01 at 00:00:00 UTC to 2007-09-30 at 23:59:59 UTC
EXT2	Extended Mission 2	2007-10-01 at 00:00:00 UTC to 2009-12-31 at 23:59:59 UTC
EXT3	Extended Mission 3	2010-01-01 at 00:00:00 UTC to 2012-12-31 at 23:59:59 UTC
EXT4	Extended Mission 4	2013-01-01 at 00:00:00 UTC to 2014-12-31 at 23:59:59 UTC
EXT5	Extended Mission 5	2015-01-01 at 00:00:00 UTC to 2016-12-31 at 23:59:59 UTC
	For Venus Express	
NMP	Nominal Mission Phase	2005-11-09 to 2007-10-02
EXT1	Extended Mission 1	2007-10-03 to 2009-05-30
EXT2	Extended Mission 2	2009-05-31 to 2010-08-21
EXT3	Extended Mission 3	2010-08-22 to 2012-12-31
EXT4	Extended Mission 4	2013-01-01 to 2015

Table 4-2: Mission phase description

The mission phases and their abbreviations for Venus Express will be used in the DATA_SET_ID and DATA_SET_NAME. In the data labels, however, the value of the keyword MISSION_PHASE_NAME is fixed and have other definitions, belonging to defined subphases. These subphases can be found in the MISSION.CAT (CATALOG folder of the Venus Express dataset) or in the MISSION_PHASE.TAB document (DOCUMENT/ESA_DOC folder).

Rosetta mission phase definitions can be found in RO_EST_TN_3372.PDF in the DOCUMENT/ESA_DOC directory.

For higher science data products data_set_id please refer to the higher science file naming convention document MEX-MRS-RIU-IS-3050.

4.2.1.2 Dataset Name

The dataset name is the full name of the dataset already identifiable by a dataset id. Dataset names shall be at most 60 characters in length and must be in upper case. See Table 4-3 for more information.

Description	Example
Instrument Host Name	MARS EXPRESS ROSETTA ORBITER VENUS EXPRESS
Target name	MARS VENUS 67P (for Comet Churyumov-Gerasimenko) CHECK (commissioning Rosetta) LUTETIA STEINS SKY (commissioning VEX) PHOBOS
Instrument id	MRS RSI VRA
data processing level number in CODMAC level	1/2/3 5
Data description: mission phases for level 1/2/3: (MaRS misson phases can deviate from the MEX official phase names. See above) For higher science data: Measurement type	MISSION COMMISSIONING CRUISE 1 PRIME MISSION NMP EXTENDED MISSION OCCULTATION
A 4 digit sequence number	0123
Version number	V1.0

Table 4-3: Dataset name

In order to not exceed 60 characters for the Dataset name during the Venus Express nominal mission phase, the abbreviation ‘NMP’ will be used for the mission phase within the Dataset name instead of ‘NOMINAL MISSION PHASE’.

Examples:

MARS EXPRESS MARS MRS 1/2/3 MISSION COMISSIONING 0123 V1.0
VENUS EXPRESS VENUS VRA 1/2/3 NMP 0099 V2.0
ROSETTA ORBITER 67P RSI 1/2/3 CRUISE 1 1144 V3.0

4.2.2 Dataset Collection

4.2.2.1 Dataset Collection ID

The data set collection ID element is a unique alphanumeric identifier for a collection of related data sets or data products. The data set collection is treated as a single unit, whose components are selected according to a specific scientific purpose. Components are related by observation type, discipline, target, time, or other classifications. See Table 4-4 for more information.

XXX_Y_ZZZ_U_VVV_IIIIIIIII_TTT

Acronym	Description	Example
XXX	Instrument Host ID	MEX RO VEX
Y	Target ID	M (Mars) V (Venus) C (Comet 67P/Churyumov-Gerasimenko tbc) L (asteroid Lutetia tbc) S (asteroid Steins tbc)
ZZZ	Instrument ID	MRS RSI VRA
U	Data Level In the keyword DATA_COLLECTION_ID the CODMAC-levels are used instead of PSA-level. In all other file names and documents we keep PSA-level.	1 (Raw data) 2 (Edited raw data) 3 (Calibrated data) 5 (Higher Science Data) 1/2/3 (Data set contains raw, edited and calibrated data)
VVV	Data Description (Acronym)	MCO commissioning CR1 cruise first part PRM prime mission EXT extended mission
IIIIIIIII	Data Description (Detailed)	ROCC Occulation Profiles GRAV Gravity Data RANG Apocenter Ranging BSR Bistatic Radar Spectra PHOBOS Phobos Flyby SUPCON superior solar conjunction INFCON inferior solar conjunction
TTT	Version Number	V1.0

Table 4-4: Dataset Collection ID

Examples:

MEX-M-MRS-5-PRM-ROCC-V1.0
RO-C-RSI-5-MCO-GRAV-V2.0
VEX-V-VRA-5-MCO-BSR-V1.0

4.2.3 Volume

4.2.3.1 Volume ID

The Volume ID is a unique identifier for a single MaRS, RSI or VeRa data volume, including a complete measurement. Two kinds of Volume ID's are used, the ESA and RSI Volume ID:

ESA PSA Volume-ID:

The Volume ID is formed using a mission identifier, an instrument identifier of 3 characters, followed by an underscore character, followed by a 4 digit sequence number. In the 4-digit number, the first one represents the kind of measurement, the remaining digits define the range of volumes in the volume set.

The first digit of the 4-digit sequence number:
0: Commissioning
1: Occultation
2: Gravity
3: Solar Conjunction
4: Bistatic Radar
5: Passive/Active Checkouts
6: Swing-bys/Fly-bys
7: Cometary Coma Observations
9: Higher Science data

The Volume-ID looks like:

XXXXXX_UZZZ

Acronym	Description	Example
XXXXXX	Missionhost and Instrument ID	MEXMRS RORSI VEXVRA
ZZZZ	4 digit sequence number	3050

Table 4-5: Volume ID

Examples:

MEXMRS_3050
RORSI_3050
VEXVRA_3050

RSI Volume-ID:

The Radio Science Volume ID is a number which is incremented measurement by measurement, independent what kind of measurement was conducted. The RSI Volume ID is used within the DATA_SET_ID. The Radio Science Volume ID can be found in the logbook located in DOCUMENT/RSI_DOC.

4.2.3.2 Volume Version ID

There can be several version of the same volume, if for example the archiving software changed during the archiving process or errors occurred during the initial production. This is indicated by the Volume Version ID, a string, which consists of a ‘V’ for Version followed by a sequence number indicating the revision number.

VV.V

Acronym	Description	Example
VV.V	Volume Version ID	V1.0

Table 4-6: Volume Version Id

If a volume is redone because of errors in the initial production or because of a change in the archiving software during the archiving process, the volume ID remains the same, and the Volume Version ID will be incremented.

4.2.3.3 Volume Name

The VOLUME NAME (formatted according to Table 4-7) contains the name of the physical data volume.

xxxxxx_zzzz_yyyy_ddd_vv.v

Acronym	Description	Example
xxxxxx	Missionhost and Instrument ID	MEXMRS RORSI VEXVRA
zzzz	4-digit number of the ESA PSA Volume-ID	3050
yyyy	Year of the measurement	2008
ddd	Day of year of the measurement	180
vv.v	Volume Version ID	V1.0

Table 4-7: Volume name definition

Examples:

MEXMRS_3050_2008_180_V1.0
RORSI_3050_2008_180_V1.0
VEXVRA_3050_2008_180_V1.0

4.2.4 Volume Set

A volume set consists of a number of volumes.

4.2.4.1 Volume Set ID

The VOLUME SET ID identifies a data volume or a set of volumes. Volume sets are considered as a single orderable entity. VOLUME SET ID shall be at most 60 characters in length, must be in upper case and separated by underscores. See Table 4-8 for more information.

XXX_YYYY_ZZZ_WWW_UVVV

Acronym	Description	Example
XXX	Abbreviation of the country of origin	GER USA
YYYY	The government branch	UNIK NASA
ZZZ	Discipline within branch	RIU (new, since 15.8.2007) IGM (old)
[W…]	Mission and Instrument ID	MEXMRS RORSI VEXVRA
UVVV	A 4 digit sequence identifier The “U” digit is be used to represent the volume set Only MEX: U = 0 commissioning / cruise = 1 flybys = 2 prime missions = 3 extended missions the trailing “V”s are wildcards that represent the range of volumes in the set and are set to X as long as the number of volumes per set are not fixed For measurements taken after 1.1.2006 the first digit U represents the measurement type.	0099

Table 4-8: Volume Set ID

Examples:

GER_UNIK_IGM_MEXMRS_0099
USA_NASA_JPL_MEXMRS_0098

4.2.4.2 Volume Set Name

The VOLUME SET NAME provides the full, formal name of a group of data volumes containing a data set or a collection of related data sets. Volume set names shall be at most 60 characters in length and must be in upper case. Volume sets are considered as a single orderable entity. In certain cases, the volume set name can be the same as the volume name, such as when the volume set consists of only one volume.

Spacecraft	Example
Mars Express	MEX: RADIO SCIENCE OCCULTATION MEX: RADIO SCIENCE GLOBAL GRAVITY MEX: RADIO SCIENCE TARGET GRAVITY MEX: RADIO SCIENCE SOLAR CONJUNCTION MEX: RADIO SCIENCE PHOBOS FLYBY MEX: RADIO SCIENCE BISTATIC RADAR
Venus Express	VEX: RADIO SCIENCE OCCULTATION VEX: RADIO SCIENCE TARGET GRAVITY VEX: RADIO SCIENCE SOLAR CONJUNCTION
Rosetta	RO: RADIO SCIENCE COMMISSIONING

Table 4-9: Volume Set Name

Examples:

MEX: RADIO SCIENCE OCCULTATION
MEX: RADIO SCIENCE GLOBAL GRAVITY

Both the VOLUME SET ID and the VOLUME SET NAME are printed on the CD-ROM or DVD label (Figure 4-2).

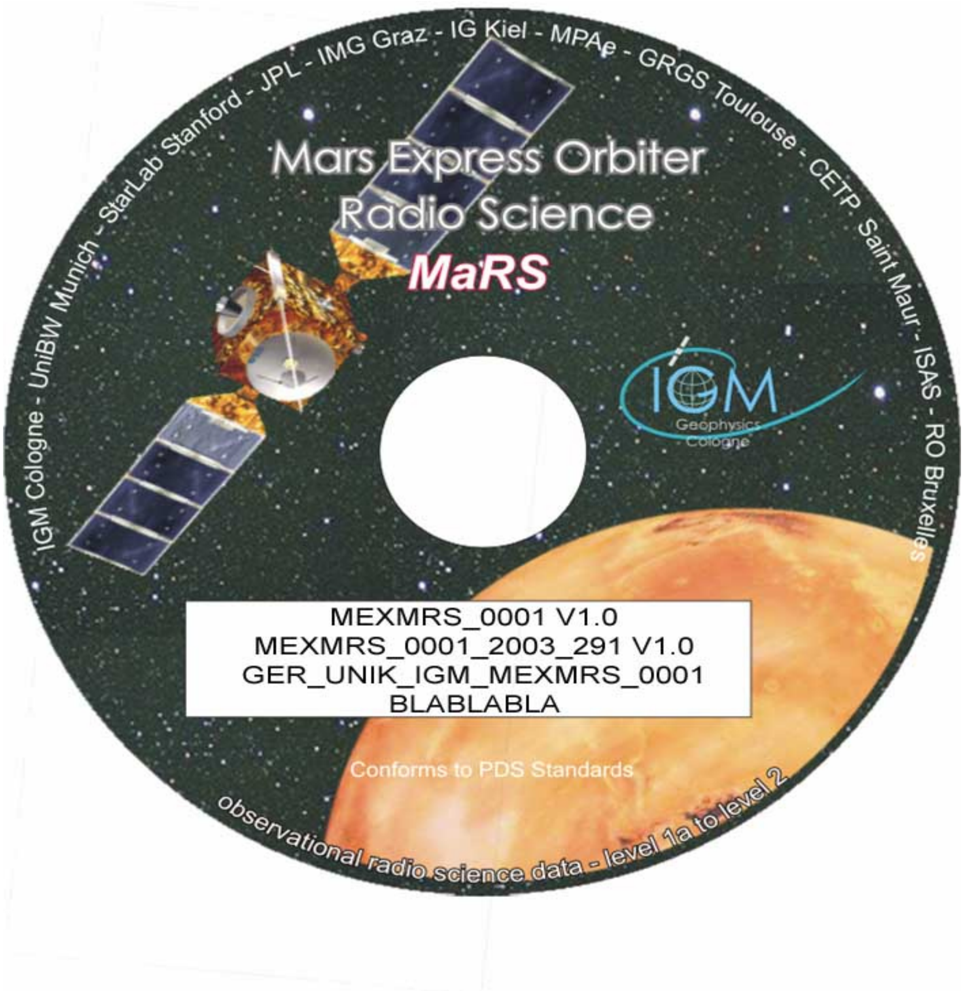

Figure 4-2: Example of a physical archive data volume (CD-ROM or DVD) with appropriate designations printed on the volume label sticker. On the sticker is printed: line 1: Volume_id + Volume_Version_ID, line 2: Volume_name, line 3: Volume_set_id, Line 4:Volume_set_name.

4.2.5 Volume Series

A volume series consists of one or more volume sets that represent data from one or more missions or campaigns.

4.2.5.1 Volume Series Name

The volume_series_name element provides a full, formal name that describes a broad categorization of data products or data sets related to a planetary body or a research campaign. See Table 4-10 for details.

Spacecraft	Example
Mars Express	MISSION TO MARS
Venus Express	MISSION TO VENUS
Rosetta	MISSION TO SMALL BODIES

Table 4-10: Volume Series Name

Examples:

MISSION TO MARS
MISSION TO VENUS
MISSION TO SMALL BODIES

5 GENERAL FILE NAMING CONVENTION

5.1 FILE NAME FORMAT

All incoming data files will be renamed and all processed data files will be named after the following file naming convention format. The original file name of the incoming tracking data files will be stored in the according label file as *source_product_id*. See Table 5-1 for more information.

rggttttlll_sss_yydddhhmm_qq.eee

5.2 DATA FILES

Data files are:

- The DSN and IFMS radio tracking files from Level 1a to level 2
- The predicted and reconstructed Doppler and range files
- Geometry files

All Level 1a binary data files will have the extension *eee = DAT*.
Level 1a to level 2 tabulated ASCII data files will have the extension *eee = TAB* with the exception of IFMS level 1a files which will have the extension *eee = RAW*.

5.3 DESCRIPTIVE FILES

Descriptive files contain information in order to support the processing and analysis of data files. The following file types are defined as descriptive files with extension *eee =*

- *.LBL PDS label files
- *.CFG IFMS configuration
- *.AUX Anxiliary files (event files, attitude files, ESOC orbit files, UniBw products, SPICE files)
- *.TXT Information (text) files
- *.LOG Log files (see section 7.2.2.3.2)

Acronym	Description	Examples
r	Spacecraft (Raumsonde) name R = Rosetta M = Mars Express V = Venus Express	M
gg	Ground station ID: 00 = valid for all ground stations, various ground stations or independent of ground station or not feasible to appoint to a specific ground station or complex <u>DSN complex 40 Canberra</u> 34 = 34 m BWG 40 = complex 43 = 70 m 45 = 34 m HEF <u>ESA New Norcia antenna</u> 32 = 35 m <u>ESA Cebreros antenna:</u> 62 = 35 m <u>ESA Malargüe antenna:</u> 84 = 35 m <u>DSN complex 10 Goldstone:</u> 10 = complex 14 = 70 m 15 = 34 m HEF 24 = 34 m BWG 25 = 34 m BWG 26 = 34 m BWG 27 = 34 m HSBWG <u>ESA Kourou antenna</u> 75 = 15 m <u>DSN complex 60 Madrid:</u> 54 = 34 m BWG 55 = 34 m BWG 60 = complex 63 = 70 m 65 = 34 m HEF	43
tttt	data source identifier <u>Level 1a and 1b</u> ODF0 = ODF closed loop with sample rate 1/min ODFX = ODF closed loop X-band file with sample rate 1/sec. ODFS = ODF closed loop S-band file with sample rate 1/sec. TNF0 = TNF closed-loop (L1a)	TNF0

	T000 – T017 = TNF closed-loop (L1b) ICL1 = IFMS 1closed loop ICL2 = IFMS 2 closed-loop ICL3 = IFMS RS closed-loop IOL3 = IFMS RS open loop R1Az = RSR block 1A open loop R1Bz = RSR block 1B open loop R2Az = RSR block 2A open loop R2Bz = RSR block 2B open loop R3Az = RSR block 3A open loop R3Bz = RSR block 3B open loop z = 1...4 subchannel number ESOC = ancillary files from the ESOC DDS DSN0 = ancillary files from the DSN SUE0= ancillary and information files coming from Stanford University center for radar astronomy Level 2 UNBW = predicted and reconstructed Doppler & range orbit files ICL1 = IFMS 1closed loop ICL2 = IFMS 2 closed-loop ICL3 = IFMS RS closed-loop ODF0 = DSN ODF closed-loop file with sample rate 1/min ODFX = ODF closed loop X-band file with sample rate 1/sec. ODFS = ODF closed loop S-band file with sample rate 1/sec. T000 – T017 = DSN TNF closed-loop file RSR0 = DSN RSR open-loop file RSRC = DSN RSR open loop file containing data with right circular polarization (only solar conjunction measurement) RSLC = DSN RSR open loop file containing data with left circular polarization (only solar conjunction measurement) NAIF = JPL or ESTEC SPICE kernels SUE0= ancillary, information and calibration files coming from Stanford University center for radar astronomy	
lll	Data archiving level L1A = Level 1A L1B = Level 1B	L1a

	L02 = Level 2 L03 = Level 3	
sss	data type <u>IFMS Data files level 1A:</u> D1X uncalibrated Doppler 1 X-band D1S uncalibrated Doppler 1 S-band D2X uncalibrated Doppler 2 X-band D2S uncalibrated Doppler 2 S-band C1X Doppler 1 X-band equip. calibration C1S Doppler 1 S-band equip. calibration C2X Doppler 2 X-band equip. calibration C2S Doppler 2 S-band equip. calibration RGX uncalibrated X-band range RGS uncalibrated S-band range MET meteo AG1 AGC 1 AG2 AGC 2 RCS S-band range equip. calibration RCX X-band range equip. calibration <u>DSN data files level 1A:</u> ODF original orbit files (closed-loop) RSR radio science receiver open-loop files TNF TNF file (closed-loop) <u>DSN calibration files level 1A:</u> TRO DSN tropospheric calibration model MET DSN meterological file ION DSN ionospheric calibration model BCL SUE Bistatic radar temperature calibration <u>ESOC ancillary data, Level 1A:</u> ATR attitude file, reconstructed EVT orbit event file OHC orbit file, heliocentric, cruise OMO orbit file, Marscentric, operational <u>DSN ancillary data, Level 1A:</u> DKF DSN Keyword File MON DSN monitor data NMC DSN Network Monitor and Control file SOE DSN Sequence of Events EOP DSN earth orientation parameter file ENB SUE Experimenter Notebook MFT SUE Manifest files	

	LIT DSN Light time file HEA DSN Data collection list OPT DSN Orbit and timing geometry file <u>DSN Browse plots level 1A</u> BRO Radio Science quick look 4-panel plot set (browse plots) <u>IFMS data files level 1B:</u> D1X uncalibrated Doppler 1 X-band D1S uncalibrated Doppler 1 S-band D2X uncalibrated Doppler 2 X-band D2S uncalibrated Doppler 2 S-band C1X Doppler 1 X-band equip.calibration C1S Doppler 1 S-band equip.calibration C2X Doppler 2 X-band equip.calibration C2S Doppler 2 S-band equip.calibration RGX uncalibrated X-band range RGS uncalibrated S-band range MET meteo AG1 AGC 1 AG2 AGC 2 RCX X-band range equip. calibration RCS S-band range equip. calibration <u>DSN ODF data files level 1B:</u> DPS S-band Doppler DPX X-band Doppler RGS uncalibrated S-band ranging file RGX uncalibrated X-band ranging file RMP uplink frequency ramp rate file <u>DSN calibration files level 1B:</u> MET meteorological file <u>IFMS data level 2:</u> D1X calibrated Doppler 1 X-band D1S calibrated Doppler 1 S-band D2X calibrated Doppler 2 X-band D2S calibrated Doppler 2 S-band RGS calibrated S-band ranging file RGX calibrated X-band ranging file RCS S-band range calibration file RCX X-band range calibration file <u>IFMS Browse plots level 2</u> B1X Quick look plots of calibrated Doppler 1	

	X-band B1S Quick look plots of calibrated Doppler 1 S-band B2X Quick look plots of calibrated Doppler 2 X-band B2S Quick look plots of calibrated Doppler 2 S-band <u>DSN level 2 data</u> DPX calibrated Doppler 1 X-band DPS calibrated Doppler 1 S-band RGS calibrated S-band ranging file RGX calibrated X-band ranging file BSR bistatic radar power spectra SRG bistatic radar surface reflection geometry file <u>DSN level 2 calibration files</u> SRF Surface Reflection Filter files <u>Orbit files level 2</u> PTW Doppler & range prediction two-way PON Doppler & range prediction one-way RTW reconstructed Doppler & range orbit file two-way RON reconstructed Doppler & range orbit file one-way LOC heliocentric state vector file <u>Constellation file Level 2:</u> MAR Mars constellation file VEN Venus constellation file P67 Churyumov-Gerasimenko constellation file <u>SPICE kernel files level 2:</u> BSP binary spacecraft/location kernel file FRM frame kernel file ORB orbit numbering file PBC predicted attitude kernel file PCK planetary constant kernel SCK spacecraft clock kernel TLS leap second kernel file <u>Science data level 3:</u> SCP solar conjunction science	
yy	Year	04

ddd	Day of the year	153
hhmm	Sample hour , minute (Start time or ESOC reference time tag)[2]	1135
qq	Sequence or version number	01
eee	.DAT binary data files (Level 1a) .TAB ASCII data files .AUX ancillary files .CFG IFMS configuration files (Level 1b) .LBL PDS label files .TXT information files .RAW ASCII data files (Level 1a) .LOG Processing log files (Level 2)	

Table 5-1: Data file naming convention

[2] Please note that this is the reference time tag for IFMS files. This is the time at which the first file of a sequence of files has started. For IFMS ranging files this does not coincide with the first sample time since ESOC starts the ranging files a two-way light time before the first true measurement.

page intentionally left free

6 RAW TRACKING DATA FILES (LEVEL 1A)

All incoming data files will be renamed and all processed data files will be named after the file naming convention format defined in section 5.1. The original file name of the incoming tracking data files will be stored in the according label file as *original_product_id*.

6.1 DEEP SPACE NETWORK TRACKING DATA

6.1.1 File names of incoming level 1a DSN raw data files

The file names of the incoming Deep Space Network (DSN) tracking data files level 1a are not specified:

Abbreviation	description
ODF	Closed-loop ODF level 1a file
TNF	Closed-loop Tracking Navigation File (TNF) Level 1a
RSR	Open-loop RSR level 1a file

6.1.2 File formats of incoming Level 1a DSN raw data files

6.1.2.1 ODF Level 1a

The structure of binary ODF is described in the NASA document

820-13, Rev B; TRK-2-18 ODF Orbit data File

and in the IGM documents

MEX-MRS-IGM-DS-3037 **ROS-RSI-IGM-DS-3127** **VEX-VRA-IGM-DS-5008** **DSN ODF (Orbit Data File) Processing Software:** **Level 1a to Level 1b** **Software Design Specifications**

6.1.2.2 RSR Level 1a

The RSR is a computer controlled open loop receiver that digitally records a spacecraft signal through the use of an analog to digital converter (ADC) and up to four digital filter sub-channels. The digital samples from each sub-channel are stored to disk at regular intervals in real time. In near real time the records are partitioned and formatted into a sequence of RSR SFDUs which are transmitted to JPL's Advanced Multi-Mission Operations System (AMMOS). Included in each RSR SFDU is the ancillary data necessary to reconstruct the signal represented by the recorded data samples in that SFDU.
The structure of RSR's is described in the NASA document

JPL_D-16765_RSR.PDF Radio Science Receiver Standard Formatted Data Unit (SFDU)

And in the IGM documents

ROS-RSI-IGM-MA-3113-RSR-Read-Program-Manual MEX-MRS-IGM-MA-3026 RSR-Read-Program-Manual

The physical layout of the RSR SFDU is divided into five sections: the SFDU label, the header aggregation CHDO label, the primary header CHDO, the secondary header CHDO, and the data CHDO. The primary header CHDO and the secondary header CHDO together constitute the value field of the header aggregation CHDO; the header aggregation CHDO and the data CHDO together constitute the value field of the RSR SFDU.
The length of the RSR SFDU (in 8-bit bytes) is designated as *N* in this module. In general, the length of all items in the RSR SFDU are fixed, except for the data CHDO. The length of the data CHDO is variable and is determined by the sample rate and sample size of the recorded data. The length of the data CHDO is designated as *M* in this module. In any case, the total length of the RSR SFDU is easily ascertained from the length attribute in the SFDU label (total SFDU length *N* = SFDU length attribute + 20).

6.1.2.3 Incoming calibration files from the DSN

6.1.2.3.1 DSN meteorological calibration file

The file name and format of the DSN meteo calibration file is described in section 10.2.1.

6.1.2.3.2 DSN tropospheric calibration model file

The DSN tropospheric calibration file describes a model of the Earth troposphere at the antenna site. The file name and format is described in section 10.2.3

6.1.2.3.3 DSN ionospheric calibration model file

The DSN tropospheric calibration file describes a model of the Earth ionosphere at the antenna site. The file name and format is described in section 10.2.4

6.1.2.4 Incoming ancillary files from the DSN

6.1.2.4.1 DSN monitor files

The file name and format of the DSN monitor file is described in section 8.5

6.1.2.4.2 DSN Network Monitor and Control files

The file name and format of the DSN Network Monitoring Control file is described in section 8.6

6.1.2.4.3 DSN Sequence of Events file

The file name and format of the DSN Sequence of Events file is described in section 8.7

6.1.2.4.4 SPICE kernels

The file name and formats of the SPICE kernel files is described in section 11.

6.1.2.5 RSR Level 1a Browse Data Plots

In order to check data quality of RSR Level 1a open-loop data, Stanford University is producing a 4-panel plot. These plots are Postscript files. These plots are also available as JPG files.

The source identifier *tttt* is set according to the relevant RSR receiver channel and subchannel (see Table 5-1), the data level *lll=L1A* and the data type identifier is *sss=BRO* for browse data.

for Postscript files:
rggttttL1A_BRO_yydddhhmm_00.AUX
for JPG files:
rggttttL1A_BRO_yydddhhmm_00.JPG

6.2 ESA STATIONS (LEVEL 1A)

6.2.1 File names of incoming Level 1a IFMS files

6.2.1.1 IFMS Level 1a incoming raw data files

6.2.1.1.1 IFMS raw data file name format

The nominal length of a filename of the IFMS is 31 characters, and increases only in the case that more than 9999 sequence IDs are needed, or in the case of raw (uncorrected) ranging data (more information in the referenced document IFMS_OCCFTP.PDF). In that case, the IFMS expands the sequence IDs length, or add a filename extension, as needed. Level 1a files will be renamed according to the file name format defined in section 5.1.

gggg_ssss_ddd_ii_tt_hhmmss_kkkk

Acronym	Description	Example
gggg	Ground station ID NN = New Norcia NN11 = IFMS-1 NN12 = IFMS-2 NN13 = IFMS-RS CB = Cebreros CB11 = IFMS1 CB12 = IFMS2 CB13 = IFMS3 MG = Malargüe MG11 = IFMS1 MG12 = IFMS2 MG13 = IFMS3	NN11
ssss	Spacecraft ID MEX1 = Mars Express ROSE = Rosetta	MEX1
ddd	Day of year	108
ii	Data kind identifier OP = operational TS = test CL = calibration (range) RO = radio science (old)	OP
tt	Type of Data D1 = Doppler 1 D2 = Doppler 2 ME = Meteo RG = Ranging G1 = AGC 1	

	G2 = AGC 2	
hhmmss	hh = hours mm = minutes ss = seconds	145513
kkkk	Data-set sequence identification	0001

Table 6-1: File name convention for Raw IFMS-files

6.2.1.1.2 IFMS raw data file format

The structure of the IFMS tracking data files are described in the ESA document

IFMS_OCCFTP.PDF Issue/Revision No: 10.5.0 IFMS-to-OCC Interface Control Document

6.2.1.1.3 Level 1a file name format

Since the IFMS raw data file names are not PDS compliant, a new file name is created and is formatted according to section 5.1 with the data archiving level set to *lll = L1a*. It replaces the original file name which is stored in the accompanying PDS label file. The extension is set to *eee = TAB* (see also 7.2.1.3.1). The file content remains unchanged.

6.2.1.2 Incoming ancillary files from ESOC DDS

6.2.1.2.1 ESOC DDS file name convention

6.2.1.2.1.1 Conventions

The following conventions have been adopted in the rest of this document:

1. RMx is used where a file can be sent to either RMA or RMB
2. MMx is used where a file can be sent to either MMA or MMB
3. FDx is used where a file can be sent to either FDL or FDR

The incoming ESOC ancillary data file names follow the following format :

ffff_sssddd_Dwxyymmddhhmmss_vvvvv.eee

Placeholder	description
ffff	File type identifier ORHM = orbit file heliocentric Mars Express ORMM = orbit file marscentric Mars Express ORMF = orbit file marscentric frozen orbit ORHR = orbit file heliocentric Rosetta ATNM = attitude file nominal Mars Express ATNR = attitude file nominal Rosetta EVTM = event file Mars Express EVTF = event file frozen orbit (Mars Express) VILM = visibility file Lander Mars Express OASW = orbit and attitude data access software
sss	Data source identifier FDx = ESOC Flight Dynamics PST = ESTEC Project Science Team Mars Express (for SPICE files)
ddd	Data destination identifier MMx = Mars Express Mission System (DDS) PIX = PI Teams (for SPICE files from PST)
D	Data file
w	format identifier B = binary data A = ASCII data
x	Data type identifier _ = (underscore) orbit data P = predicted attitude data R = reconstructed attitude data
yymmddhhmmss	Start time of data in file Except for orbit files where the time stamp is replaced by Twelve (12) underscores
vvvvv	Version number
eee	Extension MEX = Mars Express

Table 6-2: ESOC ancillary data file names

6.2.1.2.2 S/C attitude file, reconstructed

The reconstructed spacecraft attitude file for a specified time interval is described in section 8.3.1.

6.2.1.2.3 Orbit event file

An ASCII file containing information about events will be provided. For each event one line of information is given. The events occur in ascending order in time. The highest version number represents the most recent issue of that file. The file name and file format is described in section 8.3.2.

6.2.1.2.4 S/C orbit file during cruise, heliocentric

The spacecraft cruise orbit file is described in section 9.3

6.2.1.2.5 S/C orbit file during mission, Marscentric

The spacecraft Marscentric orbit file is described in section 9.4

6.2.1.2.6 SPICE kernels

The file name and formats of the SPICE kernel files is described in section 11.

7 PROCESSED TRACKING DATA (LEVEL 1B AND 2)

7.1 DEEP SPACE NETWORK

7.1.1 Closed-loop ODF Level 1b products

7.1.1.1 Specifications Document

The processing of ODF Level 1a to Level 1b products is specified in the IGM documents

MEX-MRS-IGM-DS-3037 ROS-RSI-IGM-DS-3127 VEX-VRA-IGM-DS-5008 DSN ODF (Orbit Data File) Processing Software: Level 1a to Level 1b Software Design Specifications

7.1.1.2 Input file

The input files for the processing software are:

- The ODF level 1a file

7.1.1.2.1 ODF level 1a file

The original ODF files have file names and formats according to section 6.1.1 and 6.1.2..

7.1.1.3 Output Level 1b products

7.1.1.3.1 File name formats

A new file name is created and is formatted according to section 5.1 with the data archiving level set to *lll = L1A*. It replaces the original file name which is stored in the accompanying label file. The extension is set to *eee = TAB*.
A DSN ODF file contains usually data covering several days and from different ground stations. Therefore, a general apointement to a specific ground station cannot be done and *gg=00*.
The processed data file names of level 1b are formatted according section 5.1 with the archiving level set to *lll = L1b* and *eee = TAB.*
The sequence number *qq* is not used for all DSN file types of level 1a and level 1b and is set *qq = 00*.

- For the Doppler data *sss = DPS or DPX*
- For the range data *sss = RGS or RGX*
- For the uplink frequency ramp rate data *sss = RMP*
- For the modified meteorological file *sss = MET*

New level 1a file name:

r00ODF0L1A_sss_yydddhhmm_00.DAT

Level 1b file name:

r00ODF0L1B_sss_yydddhhmm_00.TAB

7.1.1.3.2 Data file formats for Level 1b ODF files

7.1.1.3.2.1 File format of S-band Doppler

Column	Format	Description	Unit	Resolution
1		Sample number		
2		Time in ISO format		
3		Time in fractions of day of year	Days	10^{-10}
4		Ephemeris time since 01.01.2000	Sec	μsec
5	I2	Spacecraft ID		
6	I2	DSN station ID		
7	I1	1 = One-way 2 = two-way		
8	I1	Uplink frequency flag 0 = one-way 1 = S-band 2 = X-band 3 = Ka-band		
9	I1	Downlink frequency flag 1 = S-band 2 = X-band 3 = Ka-band		
10	I1	Data validity indicator 0 = data invalid 1 = data valid		
11		Observed S-band Doppler	Hz	nHz

Table 7-1: File format of S-band Level 1b Doppler file

7.1.1.3.2.2 File format of X-band Doppler

Column	Format	Description	Unit	Resolution
1		Sample number		
2		Time in ISO format		
3		Time in fractions of day of year	Days	10^{-9}
4		Ephemeris time since 01.01.2000	Sec	μsec
5	I2	Spacecraft ID		
6	I2	DSN station ID		
7	I1	1 = One-way 2 = two-way		
8	I1	Uplink frequency flag 0 = one-way 1 = S-band 2 = X-band 3 = Ka-band		
9	I1	Downlink frequency flag 1 = S-band 2 = X-band 3 = Ka-band		
10	I1	Data validity indicator 0 = data invalid 1 = data valid		
11		Observed X-band Doppler	Hz	nHz

Table 7-2: File format of Level 1b X-band Doppler

7.1.1.3.2.3 File format of S-band ranging

Column	Format	Description	Unit	Resolution
1		Sample number		
2		Time in ISO format		
3		Time in fractions of day of year	Days	10^{-9}
4		Ephemeris time since 01.01.2000	Sec	μsec
5	I2	Spacecraft ID		
6	I2	DSN station ID		
7	I1	1 = One-way 2 = two-way		
8	I1	Uplink frequency flag 0 = one-way 1 = S-band 2 = X-band 3 = Ka-band		
9	I1	Downlink frequency flag 1 = S-band 2 = X-band 3 = Ka-band		
10	I1	Data validity indicator 0 = data invalid 1 = data valid		
11	I2	Data type (item 10)		
12		Observed S-band range	Range units or nsec	
13		Item 18 plus item 19		
14		Item 20		
15		Item 21		
16		Item 22		

Table 7-3: File format of Level 1b S-band ranging

7.1.1.3.2.4 File format of X-band ranging

Column	Format	Description	Unit	Resolution
1		Sample number		
2		Time in ISO format		
3		Time in fractions of day of year	Days	10^{-9}
4		Ephemeris time since 01.01.2000	Sec	μsec
5	I2	Spacecraft ID		
6	I2	DSN station ID		
7	I1	1 = One-way 2 = two-way		
8	I1	Uplink frequency flag 0 = one-way 1 = S-band 2 = X-band 3 = Ka-band		
9	I1	Downlink frequency flag 1 = S-band 2 = X-band 3 = Ka-band		
10	I1	Data validity indicator 0 = data invalid 1 = data valid		
11	I2	Data type (item 10)		
12		Observed X-band range	Range units or nsec	
13		Item 18 plus item 19		
14		Item 20		
15		Item 21		
16		Item 22		

Table 7-4: File format of level 1b X-band ranging

7.1.1.3.2.5 File format of the uplink ramp rate file

Column	Format	Description	Unit	Resolution
1		Sample number		
2		Ramp start time Time in ISO format		
3		Ramp start time Time in fractions of day of year	Day	10^{-9}
4		Ramp start time Ephemeris time since 01.01.2000	second	μsec
5		Ramp stop time Time in ISO format		
6		Ramp stop time Time in fractions of day of year	Day	10^{-9}
7		Ramp stop time Ephemeris time since 01.01.2000	second	μsec
8		DSN Station ID		
9		Ramp Rate	Hertz/s	10^{-6} Hz/s
10		Ramp Start Frequency	Hertz	10^{-6} Hz

Table 7-5: File format of uplink ramp rate file

7.1.2 Closed-loop ODF Level 2 products

7.1.2.1 Specifications document

The processing of the ODF Level 1b to Level 2 data is specified in the IGM document

MEX-MRS-IGM-DS-3038 **ROS-RSI-IGM-DS-3128** **VEX-VRA-IGM-DS-5009** **DSN ODF (Orbit Data File) Calibration Software:** **Doppler Level 1b to Level 2** **Software Design Specifications**

MEX-MRS-IGM-DS-3043 **ROS-RSI-IGM-DS-3129** **VEX-VRA-IGM-DS-5010** **DSN ODF (Orbit Data File) Calibration Software:** **Ranging Level 1b to Level 2** **Software Design Specifications**

7.1.2.2 Input file

The input files are:
- The ODF level 1b files
- The Doppler and range prediction file (PTW or PON)
  Or
- The Orbit reconstructed file (RTW or RON)
- Media calibration files

7.1.2.2.1 The orbit prediction file PTW or PON
The content and format of the predict file is described in section 9.1.

7.1.2.2.2 The orbit reconstructed file RTW or RON
The content and format of the reconstructed orbit file is described in section 9.2.

7.1.2.3 ODF Level 2 products

7.1.2.3.1 ODF file name formats Level 2

The file names of the ODF output level 2 files are formatted according to section 5.1 with the archiving level identifier set to *lll = L02* and the file type set to *sss = DPX* or *DPS* for X-band or S-band Doppler, respectively, or *sss = RGX* or *RGS* for calibrated X-band or S-band ranging files, respectively. The data source identifier is *ttt = ODF0*

rggODF0L02_sss_yydddhhmm_00.TAB

7.1.2.3.2 ODF file formats Level 2

7.1.2.3.2.1 Calibrated Doppler files DPX and DPS

The calibrated Doppler files contain observed IFMS Doppler expressed as X-band Doppler or S-band Doppler, residual and detrended X-band or S-band Doppler (computed using the predict file), the detrended differential Doppler. If only one single frequency was used, the differential Doppler will be set to zero. The formats are shown in Table 7-6 and Table 7-7.

column	description	unit	resolution
1	Sample number		
2	Ground received time *as UTC in ISO format*		
3	Ground received time *as UTC in fractions of day of year starting with the first day of the year the data was recorded at 00:00.000*	day	10^{-10} day
4	Ground received time *as elapsed terrestrial barycentric dynamic time (TDB) time since noon of the first calendar day of year 2000 (12:00 1 January 2000 TDB)*	second	10^{-6} sec
5	Distance *Propagation experiments: approximate value of the closest approach of a downlink geometric ray path to the center of the reference body (Sun, planet, minor object). When two-way, the value is approximate average of uplink and downlink rays* *Gravity observations: geometric distance of the s/c from the center of mass of referenced body*	kilometer	10^{-3} m
6	Transmit frequency ramp reference time *UTC in ISO format* *The time (t0) at which the transmitted frequency would have been f_0 using the coefficients f_0 (column 7) and df (column 8). At any time t within the interval when those coefficients are valid, the transmitted frequency f_t may be calculated from* $$f_t = f_0 + df \cdot (t - t_0)$$ *For DSN two-way measurements:* *f_t is the uplink frequency of the ground transmitter; the f_t photon will reach the receiver one RTLT later.* *For DSN one-way measurements:* *f_t is the downlink frequency of the spacecraft transmitter; the f_t photon will reach the receiver OWLT later. In both cases, f_0 and df may change; but f_t is always continuous, and changes in the coefficients occur only on integer seconds.* *For IFMS measurements:* $$f_t = f_0$$ *because df=0.*		
7	Transmit frequency corresponding to time in	Hertz	10^{-6} Hz

	column 6 *<u>Two-way coherent modes:</u>* *Uplink frequency of ground station* *S-band order of 2100 MHZ* *X-band order of 7100 MHz* *<u>One-way mode:</u>* *S/C transmission frequency* *X-band order of 8400 MHz* *S-band order of 2300 MHz*		
8	Uplink frequency ramp rate *<u>DSN two-way coherent:</u>* *Time derivative of uplink frequency in column 7* *<u>DSN one-way downlink mode:</u>* *Value of spacecraft frequency drift, if known and/or meaningful; -99999.999999* *<u>IFMS measurements:</u>* *Ramp rate is always zero; df=0*	Hertz/sec	10^{-6} Hz/sec
9	Observed X-band antenna frequency *Frequency of the signal at the terminals of the receiving antenna structure at UTC TIME columns 2 to 4 (t_r). Set to -9999999999.999999 for missing or corrupted data.*	Hertz	10^{-6} Hz
10	Predicted X-band antenna frequency *Based on the ESOC reconstructed orbit file or SPICE kernels* *Expected frequency of the signal at the terminals of the receiving antenna structure at UTC TIME in columns 2 to 4 (t_r). The calculation includes geometrical effects (relative positions and motions of ground station and spacecraft, including Earth rotation and light time adjustments), tuning of both the transmitter and receiver and a model-based correction for one- or two-way (as appropriate) propagation through the Earth's atmosphere.*	Hertz	10^{-6} Hz
11	Correction of Earth atmosphere propagation *Correction term for the propagation of the signal in the Earth atmosphere, based on meteorological data observed at the ground station site (MET-files)*	Hertz	10^{-6} Hz
12	Residual calibrated X-band frequency shift *column 9 minus 10*	Hertz	10^{-6} Hz
13	Received signal level *<u>Closed-loop data:</u>* *Signal level from AGC in decibels relative to one milliwatt (dBm).* *<u>Open-loop (RSR):</u>*	dBm / dB	0.1 dB

	Signal level in decibels (dB) relative to an arbitrary reference.		
14	Differential Doppler $$f_S - \frac{3}{11} f_X$$ *Where f_S and f_X are the received S-band and X-band frequencies* *If* BAND_NAME = X *(from the label file),* f_X *comes from column 9 in this table and* f_S *comes from column 9 in the file identified by* SOURCE_ID *(from the label file).* *If* BAND_NAME = S *(from the label file),* f_S *comes from column 9 in this table and* f_X *comes from column 9 in the file identified by* SOURCE_ID *(from the label file).* *if either band is not available, this column is set "-99999.999"*	Hertz	10^{-6} Hz
15	standard deviation of the observed antenna frequency X-band in column 9 (open-loop only) *for closed-loop this value is set "-99999.999"*	Hertz	10^{-6} Hz
16	Received X-band signal quality (open-loop only) *Ratio of observed received signal strength to the statistical standard deviation of the measurement, column 15 devided by column 19* *For closed-loop this is value is set "-999.9"*	dB	0.1 dB
17	standard deviation of received signal level at X-band (open-loop) *A statistical measure of the error in determining SIGNAL LEVEL (column 15) based on fit of a data spectrum to a sinc function. Uses the same arbitrary scale factor as column 15; units of dB.* *for closed-loop this is set "-999.9"*	dB	0.1 dB

Table 7-6: Format of the level 2 X-band Doppler file.

column	description	unit	resolution
1	Sample number		
2	Ground received time *as UTC in ISO format*		
3	Ground received time *as UTC in fractions of day of year starting with the first day of the year the data was recorded at 00:00.000*	day	10^{-10} day
4	Ground received time *as elapsed terrestrial barycentric dynamic time (TDB) time since noon of the first calendar day of year 2000 (12:00 1 January 2000 TDB)*	second	10^{-6} sec
5	Distance *<u>Propagation experiments:</u> approximate value of the closest approach of a downlink geometric ray path to the center of the reference body (Sun, planet, minor object). When two-way, the value is approximate average of uplink and downlink rays* *<u>Gravity observations:</u> geometric distance of the s/c from the center of mass of referenced body*	kilometer	10^{-3} m
6	Transmit frequency ramp reference time *UTC in ISO format* *The time (t0) at which the transmitted frequency would have been f_0 using the coefficients f_0 (column 7) and df (column 8). At any time t within the interval when those coefficients are valid, the transmitted frequency f_t may be calculated from* $f_t = f_0 + df \cdot (t - t_0)$ *<u>For DSN two-way measurements:</u>* *f_t is the uplink frequency of the ground transmitter; the f_t photon will reach the receiver one RTLT later.* *<u>For DSN one-way measurements</u>:* *f_t is the downlink frequency of the spacecraft transmitter; the f_t photon will reach the receiver OWLT later. In both cases, f_0 and df may change; but f_t is always continuous, and changes in the coefficients occur only on integer seconds.* *<u>For IFMS measurements:</u>* $f_t = f_0$ *because df=0.*		
7	Transmitted frequency corresponding to time in	Hertz	10^{-6} Hz

	column 6 *<u>Two-way coherent modes:</u>* *Uplink frequency of ground station* *S-band order of 2100 MHZ* *X-band order of 7100 MHz* *<u>One-way mode:</u>* *S/C transmission frequency* *X-band order of 8400 MHz* *S-band order of 2300 MHz*		
8	Uplink frequency ramp rate *<u>DSN two-way coherent:</u>* *Time derivative of uplink frequency in column 7* *<u>DSN one-way downlink mode:</u>* *Value of spacecraft frequency drift, if known and/or meaningful; -99999.999999* *<u>IFMS measurements:</u>* *Ramp rate is always zero; df=0*	Hertz/sec	10^{-6} Hz/sec
9	Observed S-band antenna frequency *Frequency of the signal at the terminals of the receiving antenna structure at UTC TIME columns 2 to 4 (t_r). Set to -9999999999.999999 for missing or corrupted data.*	Hertz	10^{-6} Hz
10	Predicted S-band antenna frequency *Based on the ESOC reconstructed orbit file or SPICE kernels* *Expected frequency of the signal at the terminals of the receiving antenna structure at UTC TIME in columns 2 to 4 (t_r). The calculation includes geometrical effects (relative positions and motions of ground station and spacecraft, including Earth rotation and light time adjustments), tuning of both the transmitter and receiver and a model-based correction for one- or two-way (as appropriate) propagation through the Earth's atmosphere.*	Hertz	10^{-6} Hz
11	Correction of Earth atmosphere propagation *Correction term for the propagation of the signal in the Earth atmosphere and ionosphere, based on meteorological data observed at the ground station site (MET-files)*	Hertz	10^{-6} Hz
12	Residual calibrated X-band frequency shift *column 9 minus 10*	Hertz	10^{-6} Hz
13	Received S-band signal level *<u>Closed-loop data:</u>* *Signal level from AGC in decibels relative*	dBm / dB	0.1 dB

	to one milliwatt (dBm). *Open-loop (RSR):* *Signal level in decibels (dB) relative to an arbitrary reference.*		
14	Differential Doppler $f_S - \frac{3}{11} f_X$ *Where f_S and f_X are the received S-band and X-band frequencies* *If* BAND_NAME = X *(from the label file),* f_X *comes from column 9 in this table and* f_S *comes from column 9 in the file identified by* SOURCE_ID *(from the label file).* *If* BAND_NAME = S *(from the label file),* f_S *comes from column 9 in this table and* f_X *comes from column 9 in the file identified by* SOURCE_ID *(from the label file).* *if either band is not available, this column is set "-99999.999"*	Hertz	10^{-6} Hz
15	standard deviation of the observed antenna frequency S-band in column 9 (open-loop only) *for closed-loop this value is set "-99999.999"*	Hertz	10^{-6} Hz
16	Received S-band signal quality (open-loop only) *Ratio of observed received signal strength to the statistical standard deviation of the measurement, column 15 devided by column 19* *For closed-loop this is value is set "-999.9"*	dB	0.1 dB
17	standard deviation of received signal level at S-band (open-loop) *A statistical measure of the error in determining SIGNAL LEVEL (column 15) based on fit of a data spectrum to a sinc function. Uses the same arbitrary scale factor as column 15; units of dB.* *for closed-loop this is set "-999.9"*	dB	0.1 dB

Table 7-7: format of the level 2 S-band Doppler file.

7.1.2.3.2.2 Calibrated ranging files RGX and RGS

The level 2 ranging file contains the observed TWLT at X-band or S-band, the calibrated TWLT at X-band or S-band, the TWLT delay at X-band or S-band and the differential TWLT. If only one frequency was used, the differential TWLT is set to -99999.9. The formats are shown in Table 7-8 and Table 7-9.

column	description	unit	resolution
1	Sample number		
2	Ground received time *as UTC in ISO format*		
3	Ground received time *as UTC in fractions of day of year starting with the first day of the year the data was recorded at 00:00.000*	day	10^{-10} day
4	Ground received time *as elapsed terrestrial barycentric dynamic time (TDB) time since noon of the first calendar day of year 2000 (12:00 1 January 2000 TDB)*	second	10^{-6} sec
5	Distance *<u>Propagation experiments:</u> approximate value of the closest approach of a downlink geometric ray path to the center of the reference body (Sun, planet, minor object). When two-way, the value is approximate average of uplink and downlink rays* *<u>Gravity observations:</u> geometric distance of the s/c from the center of mass of referenced body*	kilometer	10^{-3} m
6	Observed TWLT X-band	second	0.1 nsec
7	calibrated TWLT X-band *corrected for the propagation in the Earth atmosphere, ionospshere and interplanetary plasma propagation*	second	0.1 nsec
8	TWLT delay X-band *Signal Round-Trip delay, modulo the maximum code ambiguity*	second	0.1 nsec
9	Differential TWLT *Computed from the S-band and X-band calibrated range in column 6* $\tau_S - \tau_X$ *If neither S-band or X-band is available the value is set to -99999.9*	second	0.1 nsec
10	X-band Range Calibration G/S Equipment Delay	second	0.1 nsec
11	X-band Range predict	second	0.1 nsec
12	X-band Range residual	second	0.1 nsec
13	X-band AGC Carrier level	DBM	0.1 DBM

Table 7-8: format of the level 2 X-band calibrated ranging file

column	description	unit	resolution
1	Sample number		
2	Ground received time *as UTC in ISO format*		
3	Ground received time *as UTC in fractions of day of year starting with the first day of the year the data was recorded at 00:00.000*	day	10^{-10} day
4	Ground received time *as elapsed terrestrial barycentric dynamic time (TDB) time since noon of the first calendar day of year 2000 (12:00 1 January 2000 TDB)*	second	10^{-6} sec
5	Distance *<u>Propagation experiments:</u> approximate value of the closest approach of a downlink geometric ray path to the center of the reference body (Sun, planet, minor object). When two-way, the value is approximate average of uplink and downlink rays* *<u>Gravity observations:</u> geometric distance of the s/c from the center of mass of referenced body*	kilometer	10^{-3} m
6	Observed TWLT S-band	second	0.1 nsec
7	calibrated TWLT S-band *corrected for the propagation in the Earth atmosphere, ionospshere and interplanetary plasma propagation*	second	0.1 nsec
8	TWLT delay S-band *Signal Round-Trip delay, modulo the maximum code ambiguity*	second	0.1 nsec
9	Differential TWLT *Computed from the S-band and X-band calibrated range in column 6* $\tau_S - \tau_X$ *If neither S-band or X-band is available the value is set to -99999.9*	second	0.1 nsec
10	S-band Range Calibration G/S Equipment Delay	second	0.1 nsec
11	S-band Range predict	second	0.1 nsec
12	S-band Range residual	second	0.1 nsec
13	S-band AGC Carrier level	DBM	0.1 DBM

Table 7-9: format of the level 2 S-band calibrated ranging file

7.1.3 Open-loop RSR Level 2

7.1.3.1 Specification Document

tbd

7.1.3.2 Open-loop RSR Level 2 products

7.1.3.2.1 Open-loop Doppler file products Level 2

7.1.3.2.1.1 Open-loop Doppler File name format

The file names of the Doppler RSR level 2 products are formatted according to section 4.1 with the archiving level identifier set to *lll = L02* and the file type set to *sss = DPS or DPX*. The data source identifier is set to *tttt = RSR0* for Occulation measurements and *tttt = RSRC* or *tttt = RSLC* for right circular polarized or left circular polarized solar conjunction measurements.

for occultation measurments
rggRSR0L02_sss_yydddhhmm_00.TAB
for solar conjunction measurements:
rggRSRCL02_sss_yydddhhmm_00.TAB
and
rggRSLCL02_sss_yydddhhmm_00.TAB

7.1.3.2.1.2 Open-loop Doppler File formats

See Table 7-6 and Table 7-7.

7.1.3.2.2 Bistatic Radar products

7.1.3.2.2.1 File name format

The file names of the bistatic radar RSR level 2 products are formatted according to section 5.1 with the archiving level identifier set to *lll = L02* and the file type set to *sss = BSR or SRG*, for the power spectra and the surface reflection geometry file, respectively. The data source identifier is *tttt = RSR0.*

Bistatic Radar power spectra:

rggRSR0L02_BSR_yydddhhmm_00.TAB

The associated surface reflection geometry file:

rggRSR0L02_SRG_yydddhhmm_00.TAB

7.1.3.2.2.2 Bistatic Radar products level 2: Power Spectra

The BSR spectra contain as a function of spectral frequency the power of the right-handed circular polarized (RCP) and the left-handed circular polarized (LCP) signals at X-band and S-band, and the real and imaginary components of the RCP and LCP cross spectra again at both frequency bands.
If the polarization information for a frequency band is not available, then the respective columns contain zeros.

Column	Description	Unit	Resolution/ format
1	Spectrum number		I3
2	Center time of spectrum	spm	microseconds
3	Number of sample in spectrum		I5
4	Spectral frequency	Hz	
5	X-band RCP power	W	1x,E12.5
6	X-band LCP power	W	1x,E12.5
7	S-band RCP power	W	1x,E12.5
8	S-band LCP power	W	1x,E12.5
9	X-band RCP/LCP cross spectral power real component	W	1x,E12.5
10	X-band RCP/LCP cross spectral power imaginary component	W	1x,E12.5
11	S-band RCP/LCP cross spectral power real component	W	1x,E12.5
12	S-band RCP/LCP cross spectral power imaginary component	W	1x,E12.5

Table 7-10: BSR spectra file format

7.1.3.2.2.3 Bistatic Radar products level 2: Surface Reflection Geometry (SRG) File

Please refer to the document SRX.TXT in the folder DOCUMENT/DSN_DOC, which is available for a Bistatic Radar measurement.

7.2 ESA STATIONS (LEVEL 1B AND LEVEL 2)

7.2.1 Closed-loop IFMS level 1b products

7.2.1.1 Specifications document

The processing of the IFMS Level 1a to Level 1b data is specified in the document

MEX-MRS-IGM-MA-3017 Issue 1.0 **IFMS-Read-Program** **User Manual**

7.2.1.2 Input files

The input files are:

- The incoming IFMS level 1a files

7.2.1.2.1 IFMS level 1a files

The original IFMS files have file names and formats according to section 6.2.1.

7.2.1.3 Output IFMS Level 1b products

7.2.1.3.1 File name formats

Since the incoming raw IFMS files are not PDS compliant, for each file a new file name is created and is formatted according to section 5.1 with the data archiving level set to *lll = L1A* and file ending set to *.eee = .RAW* . It replaces the original file name which is stored in the accompanying label file. The data source identifier is set to *tttt = ICL1, ICL2, ICL3* or *IOL3.*

New level 1a file name:

rggttttL1A_sss_yydddhhmm_qq.RAW

PDS label file names level 1a:

rggttttL1A_sss_yydddhhmm_qq.LBL

The processed data file names of level 1b are formatted according section 5.1 with the archiving level identifier set to *lll = L1B*. For each Level 1a data file three files are generated:

Level 1b data file name:

rggttttL1B_sss_yydddhhmm_qq.TAB

IFMS configuration file name level 1b:

rggttttL1B_sss_yydddhhmm_qq.CFG

PDS label file names level 1b:

rggttttL1B_sss_yydddhhmm_qq.LBL

The label file contains the description of the *.TAB* as well as of the *.CFG* file.

7.2.1.3.2 Data file formats

The program will produce up to fifteen different level 1b data files along with their respective label files according to PDS standards. The data files contain Doppler data, ranging data, meteorological data and AGC data. The file type identifier *sss* is set to:

D1S *D2S* *RGS* *AG1* *RCS* *C1S* *C2S*
D1X *D2X* *RGX* *AG2* *RCX* *C2X* *C2X*
MET

Furthermore, IFMS configuration files are created which contain the actual configuration of the respective IFMS (*tttt = ICL1, ICL2, ICL3* or *IOL3*). The extension of the configuration files are *eee = CFG*, they describe data files of file type *sss*.

7.2.1.3.2.1 The Doppler Files D1S, D1X, D2S, D2X

The program will read the information of the level 1a Doppler files and will produce Doppler files of level 1b containing data described in Table 7-11.

Column	description	Unit
1	sample number	
2	Ground received time as UTC in ISO format	
3	Ground received time as UTC in fractions of day of year starting with the first day of the year the data was recorded in at 00:00.000	day
4	Ground received time in Ephemeris time beginning at J2000 (12 h 1 January 2000 TBD)	second
5	Interval count	
6	Unwrapped phase	cycle
7	Spurious carrier	(Flag 0 or 1)
8	Delta delay	second

Table 7-11: Format of IFMS level 1b doppler files

7.2.1.3.2.2 The Ranging Files RGX, RGS

The program will read the information of the level 1a ranging file and will produce a level 1b ranging file containing data described in Table 7-12.

Column	description	Unit
1	Sample number	
2	Ground received time as UTC in ISO format	
3	Ground reveived time as UTC in fractions of day of year starting with the first day of the year the data was recorded in at 00:00.000	day
4	Ground received time as Ephemeris time beginning at J2000 (12 h 1 January 2000 TBD)	second
5	Delay	second
6	Current Code	(Number 0..24)
7	Ambiguity Done	(Flag 0 or 1)
8	Spurious Carrier	(Flag 0 or 1)
9	Spurious Tone	(Flag 0 or 1)
10	Previous Correlation	(Flag 0 or 1)
11	Estimated Doppler Effect or more precisely: minus relative velocity of s/c over c	
12	DSP – Status	(Flag 0 or 1)
13	DSP – Integrated Tone	dB
14	DSP – Integrated Code	
15	DSP – Phase Error	cycle
16	DSP Toneloop SNR	dB
17	DSP Modulation Index	rad

Table 7-12: format of the IFMS level 1b ranging files

7.2.1.3.2.3 The Meteorological File MET

The program will read the information of the level 1a meteorological file and will produce a level 1b meteorological file for Earth atmosphere calibration. See section 10.1.4 for file name and file format description.

7.2.1.3.2.4 The AGC files AG1 and AG2

The program will read the information of the level 1a AGC files and will produce the level 1b AGC files containing data described in Table 7-13:.

Colum	**Description**	**Unit**
1	Sample number	N/A
2	Ground received time as UTC in ISO format	
3	UTC sample time in fractions of day of year starting with the first day of the year the data was recorded in at 00:00.000	day
4	Ephemeris time beginning at J2000 (12 h 1 January 2000 TDB)	second
5	Carrier Level	dBm
6	Polarisation Angle of received carrier signal	cycle

Table 7-13: Format of IFMS level 1b AGC files

7.2.1.3.2.5 The range calibration file RCX or RCS

See section 10.1.1

7.2.1.3.2.6 The configuration files CFG

See section 8.2

7.2.1.3.2.7 The doppler calibration files C1X, C1S, C2X, C2S

See section 10.1.3

7.2.2 Closed-loop IFMS level 2 products

7.2.2.1 Specifications document

The IFMS level 2 processing is specified in the documents

MEX-MRS-IGM-DS-3035
ROS-RSI-IGM-DS-3118
VEX-VRA-IGM-DS-3011
IFMS Doppler Processing and Calibration Software: Level 1a to Level 2

MEX-MRS-IGM-DS-3036
ROS-RSI-IGM-DS-3119
VEX-VRA-IGM-DS-3012
IFMS Ranging Processing and Calibration Software: Level 1a to Level 2

7.2.2.2 Input files

The input files are:

- The IFMS level 1a files (D1S,D1X, D2S,D2X, RGX,RGS)
- The orbit reconstructed file (RWT or RON)
- The range calibration file (RCX or RCS)
- Meteorological file
- AGC file
- Klobuchar coefficients for Earth ionosphere calibration
- Spacecraft orbit SPICE kernels

7.2.2.2.1 The orbit reconstructed file RTW or RON

The content and format of the predict file is described in section 9.

7.2.2.2.2 The range calibration file RCX or RCS

The content and format of the range calibration file RCX and RCS is described in section 10

7.2.2.3 Output IFMS Level 2 products

There may be several Doppler 1 X-Band files in level 1a which will be merged on level 2. The same is true for all other Doppler file type and Ranging X and S-Band files. Only files with continous sequenced numbers (the file names are the same only the sequence number varies for these files) are merged together. Otherwise a new Level 02 data file is created (merging data files with a new sequence of files).

The level 2 source_product_id however gives the RAW IFMS file names since the raw files are used for processing. But the content of the IFMS raw files are identical to the corresponding level 1a IFMS files in one data set, only the file name is different. And the source_product_id of the level 1a files gives the original raw IFMS files. In addition the level 1A files have almost the same file name as the corresponding level 2 files. The corresponding level 1A files can be found in
DATA/LEVEL1A/CLOSED_LOOP/IFMS/DP1 for Doppler 1 files
DATA/LEVEL1A/CLOSED_LOOP/IFMS/DP2 for Doppler 2 files
DATA/LEVEL1A/CLOSED_LOOP/IFMS/RNG for Ranging files

```
M32ICL1L02_D1X_040931103_00.TAB          is a level 2 Doppler 1 X-Band file


in M32ICL1L02_D1X_040931103_00.LBL       the following SOURCE_PRODUCT_ID is given:

SOURCE_PRODUCT_ID =  {"NN11_MEX1_2004_093_OP_D1_110358_0000",
                      "NN11_MEX1_2004_093_OP_D1_110358_0001",
                      "NN11_MEX1_2004_093_OP_D1_110358_0002"}

which are the raw IFMS files. The corresponding Level 1A files can be found in
DATA/LEVEL1A/CLOSED_LOOP/IFMS/DP1

Their names are:
M32ICL1L1A_D1X_040931103_00.RAW
M32ICL1L1A_D1X_040931103_01.RAW
M32ICL1L1A_D1X_040931103_02.RAW

and the corresponding label files give the source_product_id as:

in the M32ICL1L1A_D1X_040931103_00.LBL file the source_product_id is given as:
SOURCE_PRODUCT_ID  =  "NN11_MEX1_2004_093_OP_D1_110358_0000"

in the M32ICL1L1A_D1X_040931103_01.LBL file the source_product_id is given as:
SOURCE_PRODUCT_ID  =  "NN11_MEX1_2004_093_OP_D1_110358_0001"

in the M32ICL1L1A_D1X_040931103_02.LBL file the source_product_id is given as:
SOURCE_PRODUCT_ID  =  "NN11_MEX1_2004_093_OP_D1_110358_0002"
```

Note that in this example the three level 1A files were merged to one level 2 files.
The file names of the level 1a files are almost identical to the level 2 file name with three differences:

- L1A instead of L02 in the file name which tells the user that these are level 1A and level 2 files.
- The two digit-sequence number at the end of the file can be different.
- The level 1A files have file extension .RAW whereas level 2 files have file extension .TAB

Table 7-14: Example of the connection of Level 2 and 1a files.

7.2.2.3.1 File name formats

The file names of the IFMS output level 2 files are formatted according to section 5.1 with the archiving level identifier set to *lll = L02* and the file source identifier set to *tttt = ICL1 or ICL2 or ICL3* for the IFMS 1, 2 or 3, respectively. The file type is set to *sss = D1X or D2X* for X-band Doppler or *sss = D1S or D2S* for S-band Doppler, respectively, or *sss* = *RGX* or *RGS* for calibrated X-band or S-band ranging files, respectively.

r32ICL1L02_sss_yydddhhmm_qq.TAB

7.2.2.3.2 Log-Files

Additionally a log-file is produced which contains information about the Level 2 processing of Doppler or Ranging data. These log-files are stored in EXTRAS/ANCILLARY/MRS/LOGFILES or RSI/LOGFILES or VRA/LOGFILES. The name of the files are the same like the Level 2 data files except for the sequence number *qq* and the extension. The sequence number is started with *00* and will be incremented by every new processing of the data. The extensions will be .LOG

r32ICL1L02_sss_yydddhhmm_qq.LOG

```
MEX

GLOBAL GRAVITY

FLAGS FROM PROCESS_OPTIONS FILE:
--------------------------------
F    Differential Range ON
T    Processing with UniBW Predict
F    Processing with AGC
T    Processing with CGIM
T    Processing with RCL
F    Processing with MET
F    Additional file for frequency correction
F    One-Way Mode
F    Active table is containing the correct frequency data

NUMBER OF INPUT FILES:
----------------------
04    Number of RGX files
00    Number of RGS files
00    Number of AGX files
00    Number of AGS files
00    Number of MET files

FILES USED FOR PROCESSING:
--------------------------
```

```
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\NN11_MEX1_2004_30
0_OP_RG_235105_0000.raw
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\NN11_MEX1_2004_30
0_OP_RG_235105_0001.raw
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\NN11_MEX1_2004_30
0_OP_RG_235105_0002.raw
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\NN11_MEX1_2004_30
0_OP_RG_235105_0003.raw
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\NN11_MEX1_2004_30
0_CL_RG_202229_0000.raw
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\predict_300.txt
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\CGIM3000.04N\CGIM
3000.04N

FILES CREATED DURING PROCESSING:
--------------------------------
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\M32ICL1L02_RGX_04
3002351_00.TAB
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\M32ICL1L02_RGX_04
3002351_00.LBL
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\M32ICL1L02_RCX_04
3002022_00.TAB
Z:\ddswork\process_data\Soft_RNG_L2\data\mars_express\300\M32ICL1L02_RCX_04
3002022_00.LBL

CONFIGURATION INFO:
--------------------
UPLINK-FREQUENCY X-BAND:     7166758739.9976720809936523
DOWNLINK-FREQUENCY X-BAND:   8420223886.7796421051025391
SAMPLE-INTERVAL X-BAND:      1.000
TRANSPONDER-RATIO X-BAND:    880/749

PROCESSING INFO:
----------------
PRODUCER ID:       fels
NO DIFFERENTIAL RANGE
PLASMA-CORRECTION DONE WITH KLOBUCHAR-MODEL

ERRORS:
-------
                    No Errors during processing
```

Table 7-15: Example log-file of Ranging Level 2 processing for MEX.

7.2.2.3.3 IFMS Browse Plots (Level 2)

In order to check data quality of IFMS Level 2 closed-loop data, quick look quality JPEG plots are produced. The name of the files are the same like the Level 2 data files except for the data type identifier which is set as *sss=B1X,B1S,B2X,B2S* if the source of the plots is a Doppler 1 X-Band, Doppler 1 S-Band, Doppler 2 X-Band or Doppler 2 S-Band file, and the extension will be .JPG

r32ttttL02_sss_yydddhhmm_qq.JPG

7.2.2.3.4 Data file formats Level 2

7.2.2.3.4.1 Calibrated Doppler files D1X, D1S, D2X, D2S

The calibrated Doppler files contain observed IFMS sky frequency, X-band Doppler and S-band Doppler frequency shift, residual (computed using the predict file), and the differential Doppler. If only a single downlink frequency was used, a differential Doppler cannot be computed and was set to zero in the output file. The formats are shown in 7-6 and Table 7-7.

7.2.2.3.4.2 Calibrated ranging files RGX and RGS

The level 2 ranging file contains the observed TWLT at X-band or S-band, the calibrated TWLT at X-band or S-band, the TWLT delay at X-band or S-band and the differential TWLT. If only one frequency was used, the differential TWLT is set to -99999.9. The formats are shown in Table 7-8 and Table 7-9.

8 FORMAT OF DESCRIPTIVE FILES

8.1 PDS LABEL FILES

8.1.1 File name

The extension is set to *eee* = *LBL*.

rggttttlll_sss_yydddhhmm_qq.LBL

8.1.2 File Format

All label files consist of a header and a description part of the format of the data file.

8.1.2.1 Header of label files

The header of a label file contains general information about the data file like PDS version id, record type and so on. See Table 8-1 for a detailed description.

8.1.2.2 Description part of label files

The description part of a label file contains information about the format and the data in every column of the according data file.

Line	Name	Description
1	Pds_version_id	Version number of the PDS standard document
2	Data_set_id	Identifier for data set or data product
3	DATA_SET_NAME	Long Identifier for the data set
4	MISSION_ID	Mission name abbreviation
5	MISSION_NAME	Mission name (long)
6	MISSION_PHASE_NAME	Mission phase, see MISSION.CAT for description
7	Processing_level_id	Identifier of a set of data according to the CODMAC standard
8	PRODUCT_TYPE	data processing type: UDR,EDR,RDR
9	Target_name	Identifies a target: MARS VENUS 67P / CHURYUMOV-GERASIMENKO (1969 R1) SUN PHOBOS
10	TARGET_TYPE	PLANET N/A COMET SUN SATELLITE
11	Observation_Type	Mode of the executed measurement. Possible values are: Commissioning, Occultation, Target Gravity,

		Global Gravity, Solar Conjunction, Bistatic Radar, Phobos Gravity
12	Instrument_host_name	Full name of the host on which an instrument is based MARS EXPRESS VENUS EXPRESS ROSETTA-ORBITER
13	instrument_host_id	The instrument_host_id element provides a unique identifier for the host where an instrument is located. This host can be either an earth base or a spacecraft MEX VEX RO
14	Instrument_name	Full name of an instrument MARS EXPRESS ORBITER RADIO SCIENCE VENUS EXPRESS RADIO SCIENCE ROSETTA RADIO SCIENCE INVESTIGATIONS
15	INSTRUMENT_TYPE	RADIO SCIENCE
16	Instrument_id	Acronym which identifies the instrument MRS VRA RSI
17	Producer_id	Name for the producer of the dataset IFMS_ESA/NNO DSN RIU_COLOGNE JPL SUE (Stanford University Center for Radar Astronomy)
18	PRODUCER_FULL_NAME	MARTIN PAETZOLD
19	PRODUCER_INSTITUTION_NAME	RHEINISCHES INSTITUT FUER UMWELTFORSCHUNG
20	DSN_station_number	DSN station number
21	Product_creation_time	UTC system format time when a product was created
22	Spacecraft_clock_start_count	N/A
23	Spacecraft_clock_stop_count	N/A
24	Standard_data_product_id	Type of a data product within a data set TNF ODF RSR IFMS1, IFMS2, IFMS3
25	SC_SUN_POSITION_VE	for example:

	CTOR	(-140336628.815, -17453983.182, -7072874.318) Only on level 2 available
26	SC_TARGET_POSITION_VECTOR	N/A Only on level 2 available
27	SC_TARGET_VELOCITY_VECTOR	N/A Only on level 2 available
28	SPACECRAFT_ALTITUDE	N/A Only on level 2 available
29	SUB_SPACECRAFT_LATITUDE	N/A Only on level 2 available
30	SUB_SPACECRAFT_LONGITUDE	N/A Only on level 2 available
31	POSITION_TIME	the Geometry Epoch which is the time associated with the central point of an observation sample. Usually the first sample given in the according DATA-file is taken. Only on level 2 available
32	DATA_QUALITY_DESC	N/A
33	DATA_QUALITY_ID	N/A
34	instrument_mode_id	ONED, TWOD_X
35	instrument_mode_desc	ONE-WAY DUAL-FREQUENCY X&S-Band D/L TWO-WAY DUAL-FREQUENCY X-BAND U/L X&S-Band D/L
36	SPACECRAFT_POINTING_MODE	EARTH NADIR SPECULAR
37	SPACECRAFT_POINTING_MODE_DESC	^MEX_POINTING_MODE_DESC.TXT (or ROS or VEX), in folder DOCUMENT/ESA_DOC
38	Product_id	Permanent, unique identifier of the data product usually the filename of the data file which is described by this label
39	Source_product_id	The source_product_id data element identifies a product used as input to create a new product.
40	Software_name	Name of data processing software (Not available in level 1a)
41	DESCRIPTION	Short description of data file

Table 8-1: Description of the header of label files

8.2 IFMS CONFIGURATION FILES

The configuration files contain the configuration or Active Table of each recording IFMS for each data type.

8.2.1 File name

The file type description is set to *sss* of the to be described IFMS data file and the extension is *eee = CFG.*

r32ttttL1B_sss_yydddhhmm_qq.CFG

sss	Description
D1S	uncalibrated Doppler 1 data file S-band
D1X	uncalibrated Doppler 1 data file X-band
D2S	uncalibrated Doppler 2 data file S-band
D2X	uncalibrated Doppler 2 data file X-band
C1S	Doppler 1 calibration data file S-band
C1X	Doppler 1 calibration data file X-band
C2S	Doppler 2 calibration data file S-band
C2X	Doppler 2 calibration data file X-band
MET	Meteo file
RGS	uncalibrated S-band range data file
RGX	uncalibrated X-band range data file
RCS	S-band range calibration data file
RCX	X-band range calibration data file

Table 8-2: Calibration file description

8.2.2 File format

All configuration files are of the same format. See Appendix 13.1 for details.

8.3 ESOC ANCILLIARY FILES

8.3.1 Spacecraft Attitude Data; reconstructed

8.3.1.1 File name

Original file name:

ATNM_FDxMMx_DARyymmddhhmmss_vvvvv.MEX

Where

	description
ATNM / ATNR / ATNV	Attitude file Acronym as described in [11]
FDxMMx / FDxRMx / FDxVMx	File source: ESOC Flight Dynamics (FDS) for the Mars Express Mission Control System (MMS) / for the Rosetta Mission Control System (RMS) / for the Venus Express Mission Control System (VMS)
D	Data
A	ASCII data
R	Reconstructed data
yymmddhhmmss	Date specifies start time of the data in the file
vvvvv	Version number
MEX / ROS / VEX	Mars Express / Rosetta / Venus Express file

New Radio Science and PDS compliant file name:

r00ESOCL1A_ATR_yydddhhmm_vv.AUX

The data source identifier is set to *tttt = ESOC*, the data type identifier is set to *sss = ATR* for reconstructed attitude data. The sequence number is equal to the version number of the original file name. The extension is set to *eee = AUX*.

8.3.1.2 File format

The file format is described in the DDID Appendix H [referenced document 9]. A copy of the latest DDID Appendix H can be found on the most recent Data Archive Volumes. The structure of the Data Archive Volume is described in [10].

8.3.2 <u>Spacecraft orbit Event File</u>

8.3.2.1 File name

Original file name:

EVTM_FDxMMx_DA______________vvvvv.MEX

Where

	description
EVTM / EVTR / EVTV	Event file Acronym as described in [11]
FDxMMx / FDxRMx / FDxVMx	File source: ESOC Flight Dynamics (FDS) for the Mars Express Mission Control System (MMS) / for the Rosetta Mission Control System (RMS) / for the Venus Express Mission Control System (VMS)
D	Data
A	ASCII data
_	Blank (underscore)
____________	12x underscore no specific start date given
_vvvvv	Version number
MEX/ROS/VEX	Mars Express/Rosetta/Venus Express file

New Radio Science and PDS compliant file name:

r00ESOCL1A_EVT_yydddhhmm_vv.AUX

The data source identifier is set to *tttt = ESOC*, the data type identifier is set to *sss = EVT* for reconstructed attitude data. The sequence numbers are set to *vv=00.* The extension is set to *eee = AUX*. The event files are updated incrementally.
<u>The time information in the Radio Science file name will be set to the last time the event file contains.</u>

8.3.2.2 File format

The file format is described in the DDID Appendix H [referenced document 9]. A copy of the latest DDID Appendix H can be found on the most recent Data Archive Volumes. The structure of the Data Archive Volume is described in [10].

8.4 INFORMATION FILES

Information files contain collected information in plain ASCII (e.g. letters, emails, tables, notes, etc.) with regard to the respective data file to support analysis and interpretation.

8.4.1 File name

The extension is set to *eee = TXT*

rggttttL1B_sss_yydddhhmm_qq.TXT

examples are:

- The Experimenter Notebook file where file type description is set to *sss=ENB* which contains emails with configuration information about the measurement.
- The manifest files where file type description is set to *sss=MFT* which lists all data processed for a measurement with orginal and Radio Science compliant file name.
- The Data Collection list where file type description is set to *sss=HEA* . The file lists collected data.

8.4.2 File format

Plain ASCII text.

8.5 DSN MONITOR FILE

8.5.1 Specification document

none

8.5.2 File name

The file type description is set to *sss=MON, the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

rggDSN0L1A_MON_yydddhhmm_qq.TXT

8.5.3 File format

none; ASCII file

8.6 DSN NETWORK MONITOR AND CONTROL FILE

8.6.1 Specification document

none

8.6.2 File name

The file type description is set to *sss=NMC, the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

rggDSN0L1A_NMC_yydddhhmm_qq.TXT

8.6.3 File format

none; ASCII file

8.7 DSN SEQUENCE OF EVENTS FILE

8.7.1 Specification document

none

8.7.2 File name

The file type description is set to *sss=SOE, the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

rggDSN0L1A_SOE_yydddhhmm_qq.TXT

8.7.3 File format

None; ASCII file

8.8 DSN EARTH ORIENTATION PARAMETER FILE

8.8.1 Specification document

TRK_2_21.TXT

8.8.2 File name

The file type description is set to *sss=EOP the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

r00DSN0L1A_EOP_yydddhhmm_qq.TXT

8.8.3 File format

The Earth Orientation Parameters (EOP) file is generated by the Time and Earth Motion Precision Observation group at the NASA Jet Propulsion Laboratory. It is an ASCII file with several header records followed by a table with many records giving Earth orientation parameters:

column	description	unit
1	Modified Julian date	n/a
2	X coordinate of polar motion	milliarcseconds
3	Y coordinate of polar motion	milliarcseconds
4	TAI-UT1 or TAI-UT1R	n/a
5	TAI-UTC	seconds
6	nutation correction dPsi	milliarcseconds
7	nutation correction dEps	milliarcseconds

8.9 DSN LIGHT TIME FILE

8.9.1 Specification document

LIT_SIS.HTM

8.9.2 File name

The file type description is set to *sss=LIT the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

r00DSN0L1A_LIT_yydddhhmm_qq.TXT

8.9.3 File format

The Light Time (LIT) file was generated at the NASA Jet Propulsion Laboratory to facilitate JPL/DSN support of the mission. It was derived from materials provided by the project. The LIT is an ASCII file having several header records followed by a table with light time values.

column	description	unit
1	Date and time at the spacecraft (yy-fff/hh:mm:ss format) in UTC	n/a
2	downlink light time (spacecraft to DSN station)	seconds
3	uplink light time (DSN station to spacecraft)	seconds
4	station number (03=generic)	n/a
5	line number (starting from 1)	n/a

8.10 DSN ORBIT PROPAGATION AND TIMING GEOMETRY FILE

8.10.1 Specification document

OPTG_SIS.TXT

8.10.2 File name

The file type description is set to *sss=OPT the data source identifier is ttt=DSN0* and the extension is *eee=TXT.*

rggDSN0L1A_OPT_yydddhhmm_qq.TXT

8.10.3 File format

The Orbit Propagation and Timing Geometry (OPT) file was generated at the NASA Jet Propulsion Laboratory to facilitate JPL/DSN support of the project. It was derived from materials provided by the Project. The OPT is an ASCII file having several header records followed by a table of time-ordered orbit events (equator crossings, occultations, eclipses, periapsis times, etc.).

column	description	unit
1	event title (e.g., PERIAP for periapsis passage)	n/a
2	body name (e.g., MARS)	n/a
3	spacecraft ephemeris time of event (yyyy-dddThh:mm:ss.fff format)	n/a
4	Julian date	n/a
5	ET-UTC	n/a
6	orbit number	n/a
7	time from periapsis (sDDDDDThh:mm:ss.fff format)	n/a
8	Sun-Earth-probe angle	degrees

9 ORBIT FILES

9.1 DOPPLER AND RANGE PREDICTION FILE

9.1.1 Specification document

MEX-MRS-IGM-DS-3039
ROS-RSI-IGM-DS-3121
VEX-VRA-IGM-DS-3012
Radio Science Predicted and Reconstructed Orbit Data: Specifications

The Doppler and range predict file is provided by UniBwM and contains predicted Doppler and range for a given time span for one-way and two-way data.

9.1.2 File name

The predict file name is formatted according to section 4.1 by setting the archiving level to *lll = L02* and the file type to *sss = PTW* or *sss = PON* for two-way or one-way data, respectively. The file source is set to *tttt = UNBW*. The predict file is always relative to a given ground station (topocentric).

rggUNBWL02_sss_yydddhhmm_qq.TAB

9.1.3 File format

9.1.3.1 Two-way Doppler and range predict files

column	description	unit	resolution
1	sample number		
2	year (t_{TWRD})		
3	UTC Time stamp in ISO format (t_{TWRD})		
4	UTC Time in Fractions of DOY (t_{TWRD})	days	10^{-7} days
5	Ephemeris Time since J2000 (12 h 1 January 2000 TBD) (t_{TWRD})	days	Integer
6	TWUL Doppler $\frac{v_{LOS,UL}}{c}$		10^{-14}
7	TWDL Doppler $\frac{v_{LOS,DL}}{c}$		10^{-14}
8	TWUL Doppler $\frac{v_{LOS,UL}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}
9	TWDL Doppler $\frac{v_{LOS,DL}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}

10	TW geom. range ($r_{SC}(t_{TWE}) - r_{GS}(t_{TWE})$)	km	0.1 km
11	TW range ($(r_{SC}(t_{TWRU})-r_{GS}(t_{TWE}))+((r_{GS}(t_{TWRD})-r_{SC}(t_{TWRU}))$)	km	0.1 km
12	DLLT (t_{TWRU}- t_{TWRD})	seconds	nsec
13	TWLT (t_{TWE} -t_{TWRD})	seconds	nsec

Table 9-1: Two-way Doppler and range prediction file format

9.1.3.2 One-way Doppler and range predict files

column	description	unit	resolution
1	sample number		
2	Year (t_{OWR})		
3	UTC Time stamp in ISO format (t_{TWRD})		
4	UTC Time in Fractions of DOY (t_{TWRD})	days	10^{-7} days
5	Ephemeris Time since J2000 (12 h 1 January 2000 TBD) (t_{TWRD})	days	Integer
6	OW geom. range ($r_{SC}(t_{OWE}) - r_{GS}(t_{OWE})$)		
7	One-Way Doppler $\frac{v_{LOS}}{c}$		10^{-14}
8	One-Way Doppler $\frac{v_{LOS}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}
9	OWLT ($t_{OWR} – t_{OWE}$)	seconds	nsec

Table 9-2: One-way Doppler and range prediction file format

<u>Nomenclature:</u>

OW one way link
TW two way link
UL uplink
DL downlink
c speed of light (c = 299,792,458 m/s)
LT Light time
v_{LOS} relative velocity between ground station and S/C (in the line of sight)
$r_{SC}(t)$ Position of S/C at time t
$r_{GS}(t)$ Position of ground station at time t

t_{OWE} Time at emission of signal at S/C (one-way calculation)
t_{OWR} Time at reception of signal at ground station (one-way calculation)

t_{TWE} Time at emission of signal at ground station (two-way calculation)
t_{TWRU} Time at reception of signal at S/C (two-way calculation - uplink)
t_{TWRD} Time at reception of signal at ground station (two-way calculation - downlink)

9.2 RECONSTRUCTED DOPPLER & RANGE ORBIT FILE

The Doppler and range reconstructed orbit file is provided by UniBwM and contains post-observation reconstructed Doppler and range for a given time span for one-way and two-way data.

9.2.1 File name

The orbit file name is formatted according to section 5.1 by setting the archiving level to *lll = L02* and the file type to *sss = RTW* or *sss = RON* for two-way or one-way data, respectively. The file type is set to *ttt* = *ORB*. The predict file is always relative to a given ground station (topocentric).

rggUNBWL02_sss_yydddhhmm_qq.TAB

9.2.2 File format

9.2.2.1 Two-way Doppler and range reconstructed orbit files

column	description	unit	resolution
1	sample number		
2	year (t_{TWRD})		
3	UTC Time stamp in ISO format (t_{TWRD})		
4	UTC Time in Fractions of DOY (t_{TWRD})	days	10^{-7} days
5	Ephemeris Time since J2000 (12 h 1 January 2000 TBD) (t_{TWRD})	days	Integer
6	TWUL Doppler $\frac{v_{LOS,UL}}{c}$		10^{-14}
7	TWDL Doppler $\frac{v_{LOS,DL}}{c}$		10^{-14}
8	TWUL Doppler $\frac{v_{LOS,UL}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}
9	TWDL Doppler $\frac{v_{LOS,DL}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}
10	TW geom. range ($r_{SC}(t_{TWE})$ - $r_{GS}(t_{TWE})$)	km	0.1 km
11	TW range ($(r_{SC}(t_{TWRU})-r_{GS}(t_{TWE}))+((r_{GS}(t_{TWRD})-r_{SC}(t_{TWRU}))$)	km	0.1 km
12	DLLT ($t_{TWRU}- t_{TWRD}$)	seconds	nsec
13	TWLT ($t_{TWE} -t_{TWRD}$)	seconds	nsec

Table 9-3: File format description of Two-way Doppler reconstructed files.

9.2.2.2 One-way Doppler and range reconstructed orbit files

column	description	unit	resolution
1	sample number		
2	Year (t_{OWR})		
3	UTC Time stamp in ISO format (t_{TWRD})		
4	UTC Time in Fractions of DOY (t_{TWRD})	days	10^{-7} days
5	Ephemeris Time since J2000 (12 h 1 January 2000 TBD) (t_{TWRD})	days	Integer
6	OW geom. range ($r_{SC}(t_{OWE})$ - $r_{GS}(t_{OWE})$)		
7	One-Way Doppler $\frac{v_{LOS}}{c}$		10^{-14}
8	One-Way Doppler $\frac{v_{LOS}}{c}$ considering gravity fields degree and order l,m <= 10		10^{-14}
9	OWLT (t_{OWR} – t_{OWE})	seconds	nsec

Table 9-4: One-way Doppler and range prediction file format

<u>Nomenclature:</u>

OW	one way link
TW	two way link
UL	uplink
DL	downlink
c	speed of light (c = 299,792,458 m/s)
LT	Light time
v_{LOS}	relative velocity between ground station and S/C (in the line of sight)
$r_{SC}(t)$	Position of S/C at time t
$r_{GS}(t)$	Position of ground station at time t
t_{OWE}	Time at emission of signal at S/C (one-way calculation)
t_{OWR}	Time at reception of signal at ground station (one-way calculation)
t_{TWE}	Time at emission of signal at ground station (two-way calculation)
t_{TWRU}	Time at reception of signal at S/C (two-way calculation - uplink)
t_{TWRD}	Time at reception of signal at ground station (two-way calculation - downlink)

9.3 SPACECRAFT HELIOCENTRIC CRUISE ORBIT FILE

9.3.1 File name

Original file name:

ORHM_FDxMMx_DA_____________vvvvv.MEX

Where

	description
ORHM / ORHR / ORHV	Mars Express/Rosetta/Venus Express orbit, cruise, heliocentric Acronym as described in [11]
FDxMMx / FDxRMx / FDxVMx	File source: ESOC Flight Dynamics (FDS) for the Mars Express/Rosetta/Venus Express Mission Control System (MMS)
D	Data
A	ASCII data
_	Blank (underscore)
____________	12x blank (underscore) no specific time or time range given
_vvvvv	Version number
MEX / ROS / VEX	Mars Express/Rosetta/Venus Express file

New radio science and PDS compliant file name:

r00ESOCL1A_OHC_yydddhhmm_vv.AUX

The data source identifier is set to *tttt = ESOC*, the data type identifier is set to *sss = OHC* for the heliocentric cruise orbit file. The sequence number is equal to the version number of the original file name. The extension is set to *eee = AUX*.

9.3.2 File format

The file format is described in the DDID Appendix H [referenced document 9]. A copy of the latest DDID Appendix H can be found on the most recent Data Archive Volumes. The structure of the Data Archive Volume is described in [10].

9.4 SPACECRAFT MARSCENTRIC/VENUSCENTRIC ORBIT FILE

9.4.1 File name

Original file name:

ORMM_FDxMMx_DA_yymmddhhmmss_vvvvv.MEX

Where

	description
ORMM / ORMR / ORVV	Mars Express / Rosetta orbit, operational, Marscentric; Venus Express Venuscentric Acronym as described in [11]
FDxMMx / FDxRMx / FDxVMx	File source: ESOC Flight Dynamics (FDS) for the Mars Express Mission Control System (MMS) / for the Rosetta Mission Control System (RMS) / Venus Express (VMS)
D	Data
A	ASCII data
_	Blank (underscore)
yymmddhhmmss	Date specifies start time of the data in the file
_vvvvv	Version number
MEX / ROS / VEX	Mars Express/Rosetta/Venus Express file

New Radio Science and PDS compliant file name:

r00ESOCL1A_OMO_yydddhhmm_vv.AUX

The data source identifier is set to *tttt = ESOC*, the data type identifier is set to *sss = OMO/OVO* for the marscentric/venuscentric operational orbit file. The sequence number is not equal to the version number of the original file name. Instead they get a new chronological sequence number. *OMO/OVO* files always cover a month of orbit data and get frequently updated. Therefor the first file from ESOC that covers a specific file gets after renaming the sequence number _00 and when an updated *OMO/OVO* is received the new file will get the same file name as the first file but the sequence number is increased by one and so on. Utimately only the files with the higest version numbers will be archived since these contain the latest orbit information. The extension is set to *eee = AUX*.

9.4.2 File format

The file format is described in the DDID Appendix H [referenced document 9]. A copy of the latest DDID Appendix H can be found on the most recent Data Archive Volumes. The structure of the Data Archive Volume is described in [10].

9.5 ROSETTA ORBIT FILES

9.5.1 File name

Original file name:

cccc_FDxRMx_DA ____________vvvvv.ROS

Where

	description
cccc	Data type identifier
FDxRMx	File source: ESOC Flight Dynamics (FDS) for the Rosetta Mission Control System (RMS)
D	Data
A	ASCII data
_	Blank (underscore)
____________	12x blank (underscore) no specific time or time range given
_vvvvv	Version number
ROS	Rosetta file

New RSI and PDS compliant file name:

R00ESOCL1A_sss_yydddhhmm_vv.AUX

The data source identifier is set to *tttt = ESOC.*
The time stamp *yydddhhmm* is the start time of the file.
The sequence number is not equal to the version number of the original file name. Instead they get a new chronological sequence number starting by 00 for the first available file. When an updated file is received the new file will get a by one increased sequence number. Utimately only the files with the higest version numbers will be archived since these contain the latest orbit information.
The extension is set to *eee = AUX*.

The data type identifier is set from cccc to sss:

Orginal (cccc)	New(sss)	description
ORER	OER	Earth centric 1. flyby / Rosetta
ORFR	OFR	Earth centric 2. flyby / Rosetta
ORGR	OGR	Earth centric 3. flyby / Rosetta
ORMR	OMR	Mars centric / Rosetta
ORHR	OHR	Heliocentric / Rosetta
ORHO	OHO	Heliocentric / 1. flyby asteroid
ORHS	OHS	Heliocentric / 2.flyby asteroid
ORHW	OHW	Heliocentric / Churyumov-Gerasimenko
ORPR	OPR	Medium term planning / Rosetta
ORWR	OWR	comet centric / Rosetta

9.5.2 File format

The file format is described in the DDID Appendix H [referenced document 9]. A copy of the latest DDID Appendix H can be found on the most recent Data Archive Volumes. The structure of the Data Archive Volume is described in [10].

10 CALIBRATION FILES

10.1 IFMS CALIBRATION FILES

10.1.1 IFMS Range Calibration level 1b

The IFMS range calibration file is taken before or after the NNO, CEB or MAL tracking pass and contains the range delay within the IFMS ground station equipment.

10.1.1.1 File name

The range calibration file name is formatted according to section 5.1 by setting the archiving level to *lll = L1B* , the file type to *sss = RCX* or *RCS*, the file type is set to *tltt = ICL1* or *ICL2,* depending on the uplinking IFMS and the ground station is *gg = 32, 62 or 84*.

rggttttL1B_sss_yydddhhmm_qq.TAB

10.1.1.2 File format

The file content and file format for the range calibration file is identical to the regular range file as described in section 7.2.1.3.2.2.

10.1.2 IFMS Range Calibration level 2

10.1.2.1 Specification document

MEX-MRS-IGM-DS-3036
ROS-RSI-IGM-DS-3119
VEX-VRA-IGM-DS-3012
IFMS Ranging Processing and Calibration Software: Level 1a to Level 2
Software Design Specifications

The range calibration file Level 2 contains the measured equipment delay, the average value and the 1-sigma rms value. The difference to the Level 1b file is the resolved ambiguity of the measured range delay.

10.1.2.2 File name

The range calibration file name is formatted according to section 5.1 by setting the archiving level to *lll = L02* , the file type to *sss = RCX* or *RCS*, the file type is set to *tltt = ICL1* or *ICL2,* depending on the uplinking IFMS and the ground station is *gg = 32, 62 or 84*.

rggttttL02_sss_yydddhhmm_qq.TAB

10.1.2.3 File format

column	description	unit	resolution
1	Sample number		
2	Ground received time as UTC in ISO format		
3	Ground received time as UTC in fractions of day of year starting with the first day of the year the data was recorded in at 00:00.000	day	10^{-7} day
4	Ground received time as Ephemeris time beginning at J2000 (12 h 1 January 2000 TDB)	second	Second
5	Mean average value of equipment propagation delay	second	nsec
6	equipment propagation delay	second	nsec
7	Root Mean Square of equipment propagation delay	second	nsec

10.1.3 IFMS Doppler Calibration Files

The IFMS doppler calibration file is taken before or after the NNO, CEB or MAL tracking pass at the same time as the IFMS ranging calibration file.

10.1.3.1 File name

The doppler calibration file name is formatted according to section 5.1 by setting the archiving level to *lll = L1B* , the file type to *sss = C1X* or *C2X or C1S or C2S*, the file type is set to *tltt* = *ICL1* or *ICL2,* depending on the uplinking IFMS and the ground station is *gg = 32, 62 or 84*.

rggttttL1B_sss_yydddhhmm_qq.TAB

10.1.3.2 File format

The file content and file format for the doppler calibration file is identical to the regular doppler file as described in section 7.2.1.3.2.1.

Column	description	Unit
1	sample number	
2	Ground received time as UTC in ISO format	
3	Ground received time as UTC in fractions of day of year starting with the first day of the year the data was recorded in at 00:00.000	day
4	Ground received time as Ephemeris time beginning at J2000 (12 h 1 January 2000 TDB)	second
5	Interval count	
6	Unwrapped phase	cycle
7	Spurious carrier	
8	Delta delay	second

10.1.4 IFMS meteorological calibration

The meteorological file is the Level 1b IFMS output and describes the temperature, atmospheric pressure and humidity at the ground station site. The file is accompagnied by the IFMS configuration file **.CFG* (see Appendix 13.1 for content). Since the meteorological information is stored independently from doppler and ranging measurements, these files usually do not start and stop at the same time as a Doppler or range data file. That means that sometimes the meteorological data applicable for a Doppler or range data file has to be extracted from two files.

10.1.4.1 File name format

The file name of the meteorological file is formatted according to section 5.1 by setting the archiving level to *lll = L1B* , the file type to *sss = MET*, the file type is set to *tltt = ICL1* or *ICL2,* depending on the uplinking IFMS and the ground station is
gg = 32, 62, 84.

rggttttL1B_MET_yydddhhmm_qq.TAB

10.1.4.2 File format

Column	description	Unit
1	Sample number	
2	UTC Time in ISO format	
3	UTC Time in DOY and fractions of day	day
4	Ephemeris time since J2000 (12 h 1 January 2000 TDB)	second
5	Humidity	%
6	Pressure	HectoPascal
7	Temperature	° C

10.1.5 Corrected Uplink Frequency

The wrong uplink frequency is sometimes provided in the IFMS Level 1a Doppler Raw-Files coming from ESOC. The correct frequency will be calculated and corrected in Level 2 data files. The Level 1a file including the wrong frequency, the appropriate Level 2 file including the correct frequency, the wrong and correct frequency and the source file from which the correct frequency was derived are provided for each occurrence of this error in the folder UPLINK_FREQ_CORRECT in the CALIB directory.

UPLINK_FREQ_CORRECT_GGnn_Dd.TAB

Acronym	Description	Example
GG	NNO, CEB, MAL	NN
nn	IFMS 1, 2 or 3	11 12 13
d	Doppler channel 1 or 2	1 2

Table 10-1: File Naming Convention of the files indicating wrong and false uplink frequency and their corresponding source files.

There will be no UPLINK_FREQ_CORRECT folder if all uplink frequencies in the Level 1a IFMS Doppler files are correct.

10.2 DSN CALIBRATION FILES

10.2.1 DSN METEO Calibration File

10.2.1.1 Specification document:

TRK_2_24.TXT

10.2.1.2 File name format

This file presents meteorological data as a function of time at the location of the DSN ground station complexes. *gg = 10, 40, 60* is set for the ground station complex

rggDSN0L1A_MET_yydddhhmm_qq.AUX

10.2.1.3 File format

The file has a header line:

DATE: yymmdd DOY: ddd DSS gg

And six columns with meteorological information for every 30 minutes

column	description	unit
1	time	hhmm
2	dew point temperature	degree Celsius
3	temperature	degree Celsius
4	pressure	mbar
5	H2O partial pressure	mbar
6	relative humidity	%

The format repeats itself for each day of the year.

10.2.2 DSN modified METEO Calibration File

The DSN meteorological calibration was modified to match the format of the IFMS meteorological calibration file in order to be able to reuse existing software modules for the ODF processing at the L1B data level. One file for each ground station complex was created.

10.2.2.1 File name format

This file presents meteorological data as a function of time at the location of one DSN ground station complex by setting *gg = ground station complex.*

rggDSN0L1B_MET_yydddhhmm_qq.TAB

10.2.2.2 File format

Column	description	Unit
1	Sample number	
2	UTC time in ISO format	
3	UTC time in DOY and fractions of day	day
4	Ephemeris time since J2000 (12 h 1 January 2000 TDB)	second
5	Humidity	%
6	Pressure	hecto Pascal
7	Temperature	° C

10.2.3 DSN Tropospheric Calibration File

10.2.3.1 Specification Document

TRK_2_23.TXT

10.2.3.2 File name format

This file presents a model of the Earth troposphere at the location of a DSN ground station antenna.

rggDSN0L1A_TRO_yydddhhmm_qq.AUX

10.2.3.3 File format

Ascii file

10.2.4 DSN Ionospheric Calibration File

10.2.4.1 Specification Document

TRK_2_23.TXT

10.2.4.2 File name format

This file presents a model of the Earth ionosphere at the location of a DSN ground station antenna.

rggDSN0L1A_ION_yydddhhmm_qq.AUX

10.2.4.3 File format

Ascii file

10.2.5 Surface Reflection Filter Files

Surface Reflection Filter files (SRF) contain power spectra derived from noise measurements when the radio system was stable and there were no spacecraft signals in the passband. SRF's were derived separately for each receiver channel; but the fact that the spectral characteristics of each receiver depended almost entirely on digital signal processing meant that there was little practical difference among channels when sampling rates (output bandwidths) were the same and the SRF's were interchangeable. These are calibration files associated with bistatic radar measurements.

10.2.5.1 File name format

GNC's are ASCII files having names of the form

rggSUE0L02_SRF_yydddhhmm_qq.TAB

10.2.5.2 File format

SRF's are ASCII PDS SPECTRUM objects with attached labels.

10.2.6 Bistatic Radar Calibration Log Files

Bistatic radar calibration log files (BCL) contain system temperature calibration results. For each receiver channel the table includes the best estimate of system temperature with the antenna pointed to zenith (either pre- or post-cal, or a combination of both), the associated noise diode temperature, and the system temperature at the mid-point of the bistatic (surface) observation. In general there is one set of four rows for each experiment - one for each receiver channel (X-band and S-band, right- and left-circular polarization). The table is cumulative, growing by four rows for each new observation. The Bistatic Radar Calibration files are produced by the Stanford University Element (SUE) under the direction of R.A. Simpson.

10.2.6.1 File name format

BCLs are ASCII files having names of the form

rggSUE0L1A_BCL_yydddhhmm_qq.TAB

Since these files are cumulative the first file from Stanford gets after renaming the sequence number _00 and when an updated *BCL* – usually after a new bistatic radar measurement - is received the new file will get the same file name as the first file but the sequence number is increased by one and so on. Utimately only the files with the higest version numbers will be archived since these contain the latest information. The extension is set to *eee = TAB*

10.2.6.2 File format

BCLSs are ASCII tabels with dettached labels.

column	description	unit
1	Antenna number	n/a
2	Receiver channel and polarization. Possible values are: XR: X-Band; right circular XL: X-Band; left circular SR: S-Band; right circular SL: S-Band; left circular	n/a
3	Zenith time in UTC; ZENITH_TIME is usually an average time for the interval over which the values were obtained, typically a few tens of minutes. in some cases pre-calibration and post-calibration values were both used, in which case the interval covers several hours.	n/a
4	System temperature with the antenna pointed to zenith by comparing powers from an ambient load and sky	Kelvin
5	Noise diode temperature. The effective temperature of the calibration noise diode obtained by comparing its additive power against the value in Column 4 with the antenna pointing to zenith	Kelvin
6	BSR time in UTC; The time of the bistatic radar measurement. - Typically the center time for an interval of about 20 minutes to which the value in Column 7 applies.	n/a
7	System temperature at the center of the observing interval during which bistatic radar surface surface echoes were being received.	Kelvin

Page intentionally left free

11 SPICE

11.1 INTRODUCTION

11.1.1 Spice files

The NAIF group at JPL will produce SPICE files from the mission orbit files generated by ESOC. The SPICE files relevant for the respective Radio Science data will be copied on the archive CD-ROM volume. They are also available from the following file servers:

At ESTEC:

ftp://gorilla.estec.esa.int/pub/projects/MEX/data/spice
/VenusExpress/
/rosetta/

at JPL:

ftp://naif.jpl.nasa.gov/pub/naif/MEX
/VEX
/ROSETTA

Available SPICE files:

1. SPK spacecraft orbit kernel file
2. EK ephemeris kernel file for the planets
3. CK C-matrix instrument attitude kernel file
4. TLS leap second kernel file
5. FK frame kernel file
6. IK instrument kernel file
7. ORBNUM orbit numbering kernel file
8. PCK planetary constant kernel file
9. SCLK spacecraft clock kernel file

11.1.2 File handling and description

The documentation of the SPICE subroutines and the use of the kernels is described in [15] and can be retrieved from

ftp://naif.jpl.nasa.gov/pub/naif/toolkit_docs/Tutorials/pdf/

11.1.3 Modified Spice Kernels

RSR files are accompanied by modified spice kernels were the original NAIF SPICE kernels are combined with the JPL DE405 and Phobos/Deimos ephemerides. For information regarding these files see:

http://ssd.jpl.nasa.gov

11.2 SPK ORBIT KERNEL FILE

11.2.1 File name

ESTEC original file name:

AAAA______________vvvvv.BSP

Where

	description
aaaa	ORMM = spacecraft orbit, operational, marscentric ORMF = spacecraft orbit, marscentric, long term planning ORHM = spacecraft orbit, cruise, heliocentric, Mars Express Acronym as described in [11]
______________	14 underscores
vvvvv	Version number
BSP	Binary SP file

The letter M in the filenames is replaced by V for Venus (also then Venus centric). For Rosetta see section 9.5.1 and the values for aaaa.

11.3 EK EPHEMERIS KERNEL FILE

There are no ephermeris kernels for the three missions Mars Express, Rosetta and Venus Express.

11.4 CK C-MATRIX INSTRUMENT ATTITUDE FILE

11.4.1 File name

ESTEC original file name:

ATNM_Pyymmddhhmmss_vvvvv.BC

Where

	description
ATNM	Predicted / reconstituted attitude Acronym as described in [11]
P	P = predicted
yymmddhhmmss	Time stamp
vvvvv	Version number
BC	Binary CK file

11.5 TLS LEAP SECOND KERNEL FILE

11.5.1 File name

JPL/NAIF original file name:

NAIFvvvv.TLS

currently the most actual leap second file.

Where

	description
vvvv	Version number (currently 0008)

11.6 FK FRAME KERNEL FILE

11.6.1 Frame Kernel File name

There are five actual JPL/NAIF frame kernel files with the original file names:

Original file name	description
EARTH_TOPO_yymmdd.TF	Frame kernel file for all DSN ground stations. This kernel was released on yy-mm-dd.
NEW_NORCIA_TOPO.TF	Frame kernel file for the 35-m station in New Norcia (NNO). An read.me file is available. A location SPK file is available under the old file name *NEW_NORCIA.BSP* and described in 11.6.2
EARTHFIXEDIAU.TF	SPICE reference frame mapped to EARTH_IAU
EARTHFIXEDITRF93.TF	SPICE reference frame mapped to IRTF 1993
MEX_V08.TF ROS_V12.TF VEX_V06.TF	Mars Express / Rosetta / Venus Express spacecraft frame kernel
RSSD0001.TF	FK kernel defining a number of mission independent frames that could be used by any of the users of any of the ESA planetary missions

11.6.2 Location Kernel file name

The following location kernels are available:

Original NAIF file name	description
NEW_NORCIA.BSP	A location SPK file for the 35-m New Norcia station

11.7 IK INSTRUMENT KERNEL FILE

11.7.1 File name

There is no Instrument Kernel for the Radio Science experiment.

11.8 ORBNUM ORBIT NUMBERING FILE

11.8.1 File name

ESTEC original file name:

ORMF______________vvvvv.ORB
ORMM_MERGED_vvvvv.ORB

Where

	description
ORMF/ORVF ORMM/ORVV	s/c orbit, marscentric/venuscentric, Long Term Planning Aconym as described in [11] s/c orbit, operational, marscentric/venuscentric
______________	14 underscores (for ORMF/ORVF)
MERGED	For ORMM/ORVV
vvvvv	Version number the highest version number presents the most actual file
ORB	Orbit numbering file

11.9 PCK PLANETARY CONSTANT FILE

11.9.1 File name

NAIF original file name	description
DE403-MASSES.TPC	Contains the masses for the sun and planetary barycentres.
EARTH_[sdat]_[edat]_[pdat].BPC	PCK file containing the orientation of the Earth as a function of time for the interval [sdat] to [edat]. From [pdat] the information contained in the file corresponds to predicted data.
PCK00008.TPC	Contains the size, shape, radii and orientation constants for planets, satellites, Sun and some asteroids.
Mars Express	
MARS_IAU2000_V0.TPC	Mars planetary constant file (including satellites)
Rosetta	
ROS_LUTETIA_LC1_V02.TPC	Asteroid Lutetia file, according to lightcurves Pole solution #1 (Reference see below)
ROS_LUTETIA_LC2_V02.TPC	Asteroid Lutetia file, according to lightcurves Pole solution #2 (Reference see below)
ROS_LUTETIA_R1_V02.TPC	Asteroid Lutetia file, according to Radar Pole solution #1 (Reference see below)
ROS_LUTETIA_R2_V02.TPC	Asteroid Lutetia file, according to Radar Pole solution #2 (Reference see below)
ROS_STEINS_V02.TPC	Asteroid Steins file
Venus Express	
tbd	

Reference: "The Rosetta Asteroid Targets", M. A. Barucci, Padova. 31 Jan 2006

11.10 SCLK SPACECRAFT CLOCK KERNEL FILE

11.10.1 File name

NAIF original file name:

MEX_yymmdd_STEP.TSC

Where

	description
MEX_yymmdd_STEP.TSC ROS_yymmdd_STEP.TSC VEX_yymmdd_STEP.TSC	This file is a SPICE spacecraft clock (SCLK) kernel containing information required for MEX/Rosetta/VEX spacecraft on-board clock to UTC conversion. The most actual file will be provided
yymmdd	Is the start time of the clock kernel

Page left free

12 TIME STANDARDS AND FORMATS

12.1 TIME STANDARDS

MaRS, RSI and VeRa data products make use of different Time and Reference systems. For our data processing and archiving the most important Time Systems are:

1. Coordinated Universal Time (UTC)
2. Ephemeris Time (ET)

The scientific success of a Radio Science Experiment depends critically on a common understanding about the conventions for the reference and time systems. The following sections give an overview of the time standards necessary to understand the above mentioned Time Systems and to convert to other common Time Systems. It should be noted that radio science data are generated and recorded at ground stations. Thus the times given in the data and label files are ground station and not onboard time.

Note: In some equations the letters h, m, s or d are used. They refer to hour, minute, second or day of the corresponding value.

12.1.1 Coordinated Universal Time (UTC)

Coordinated Universal Time (UTC) is obtained from atomic clocks running at the same rate as TT (see section 12.1.3.3) or TAI (see section 12.1.3.2). The UTC time scale is always within 0.7 seconds of UT1 (see section 12.1.3.5). By the use of leap seconds, care is taken to ensure that this difference is never exceeded. However, because of the introduction of the leap seconds it becomes clear that this time scale is not steady.
The International Earth Rotation Service (IERS) can add leap seconds and is normally doing this at the end of June or December of each year if necessary. The actual UTC can only be determined for a previous point in time but predictions for the future are published by the IERS. This fact should be noted when future missions are planned on the base of the UTC time standard.
UTC can be obtained by the difference of the predicted value DUT1 or the past value ΔUT between UT1 and UTC published in the IERS Bulletin A (http://maia.usno.navy.mil/) which contains previous leap seconds and predictions:

$$\mathrm{UTC} = \mathrm{UT1} - \mathrm{DUT1} \quad \text{or} \quad \mathrm{UTC} = \mathrm{UT} - \Delta\mathrm{UT}$$

This relation is needed to obtain UT1 (UT) from UTC.

12.1.2 Dynamical Time Scale T_{eph} for the JPL DE405 Ephemeris

In a general relativistic framework, time is not an absolute quantity but depends on the location and motion of a clock. Therefor unlike UTC T_{eph} is not based on the rotation of the earth around its axis. T_{eph} refers to the center of mass of the solar system and is the independent variable of *barycentric planetary ephemerides*. It should be noted that during the years 1984 – 2003 the time scale of ephemerides referred to the barycenter of the solar system was the relativistic time scale Barycentric Dynamic Time TDB (see section 12.1.3.1).
From 2004 onwards this time scale for the JPL DE405 ephemeris will be replaced by T_{eph}. For practical purposes the length of the ephemeris second can be taken as equal to the length of the TDB second. T_{eph} is approximately equal to TDB, but not exactly. On the other hand, T_{eph} is mathematically and physically equivalent to the newly-defined TCB (see section 12.1.3.7), differing from it by only an offset and a constant rate. Within the accuracy required by MaRS, RSI and VeRa we use: T_{eph} ~ TDB.
T_{eph} is then defined as seconds past J2000, with J2000 being 12 h 1 January TDB.

12.1.3 Other Time Standards

12.1.3.1 Barycentric Dynamic Time (TDB)

Since the differences compared to TT are fairly small, the corrections can be determined by the following approximation :

$$\mathrm{TDB} = \mathrm{TT} + 0.001658 \cdot \sin \mathrm{g} + 0.000014 \cdot \sin(2\mathrm{g}) \quad [\mathrm{s}]$$

with g being the mean anomaly of the Earth in its orbit given by

$$\mathrm{g} = 357.53 + 0.9856003 \cdot \left(\mathrm{JD}\left(\mathrm{UT1}\right) - 2451545.0\right) \quad [\mathrm{deg}]$$

12.1.3.2 International Atomic Time (TAI)

TAI provides the practical realization of a uniform time scale based on atomic clocks. This time is measured at the surface of the Earth. Since this time scale is a steady one, it differs from UTC by an integral number of leap seconds introduced up the current point in time:

$$\mathrm{TAI} = \mathrm{UTC} + \mathrm{LS}$$

where LS is the number of leap seconds. The unit of TAI is the SI second.

12.1.3.3 Terrestrial Dynamic Time (TT)

Terrestial Time (TT) – formerly Terrestrial Dynamical Time (TDT) - is to be understood as time measured on the geoid. It has conceptionally a uniform time scale. TT is the independent variable of *geocentric ephemerides*. TT replaced Ephemeris Time (ET) in 1984. The difference between TT and the atomic time scale (TAI) is a constant value of 32.184 seconds:

$$\mathrm{TT} = \mathrm{TAI} + 32.184$$

One therefore obtains also the relationship:

$$\mathrm{UTC} = \mathrm{TT} - 32.184 - \mathrm{LS}$$

TT does not take into account relativistic corrections. It is used as an independent argument of geocentric ephemeris.

12.1.3.4 GMT (UT)

Time is traditionally measured in days of 86400 SI seconds. Each day has 24 hours counted from 0^h at midnight. The motion of the real sun was replaced by the concept of a fictitious mean sun that moves uniformly in right ascension defining the Greenwich Mean Time (GMT) or Universal Time (UT). Greenwich Mean Sidereal Time (GMST), however, is the Greenwich hour angle of the vernal equinox, i. e. it denotes the angle between mean vernal equinox of date and the Greenwich meridian.
The mean vernal equinox is based on a reference system which takes into account the secular effects, i.e. the precession of the Earth´s equator but not periodic effects such as the nutation of the Earth´s axis.
In terms of SI seconds, the length of a sidereal day (i. e. the Earth’s spin period) amounts $23^h\ 56^m\ 4^s.091 \pm 0^s.005$ (corresponding to a factor 1/1.00273790935) making it about four minutes shorter than a 24^h solar day. Hence, sidereal time and mean solar time have different “rates”.

12.1.3.5 Universal Time (UT1)

Universal Time UT1 is the presently adopted realization of a mean solar time scale (constant average length of a solar day of 24 hours) with UT1 = UT. As a result, the length of one second of UT1 is not constant because of the apparent motion of the sun and the rotation of the Earth. UT1 is therefore defined as a function of sidereal time.

For any particular day, 0 h UT1 is defined as the instant at which Greenwich Mean Sidereal Time (GMST) has the value:

$$\mathrm{GMST}\left(0^h\,\mathrm{UT1}\right) = 24110^s.54841 + 8640184^s.812866 \cdot T_o + 0^s.093104 \cdot T_o^2 - 0^s.0000062 \cdot T_o^3$$

For an arbitrary time of the day, the expression may be generalized to obtain the Greenwich hour angle GHA by multiplying this time with the factor 1.00273790935, adding this result to GMST and convert it into degrees (if so desired)

$$\mathrm{GMST}\ \left(\mathrm{UT1}\right) = 24110^s.54841 + 8640184^s.812866\mathrm{T_o} + 1.00273790935\mathrm{UT1} + 0^s.093104\mathrm{T}^2\ - 0^s.0000062 \cdot T^3$$

where T is the time in Julian centuries since the 1st of January 2000, 12 h, i.e. 2000 Jan. 1.5 :

$$\mathrm{T} = \frac{\mathrm{JD(UT1)} - 2451545}{36525}$$

and JD is the Julian Date.

Ecliptic and Earth equator at 2000 Jan 1.5 define the *J2000 system*.

The most useful relation for computer software is one that uses only JD (UT1):

$$GMST(°) = 280.46061837 + 360.98564736629 \cdot \left(JD - 2451545.0\right) + + 0.000387933T^2 - T^3 / 38710000$$

The difference between UT1 and TT or TAI (atomic clock time, to be explained below) can only be determined retrospectively. This difference is announced by the International Earth Rotation Service (IERS) and is handled in practice by the implementation of leap seconds (maximum of two in one year).

The above formulae contain implicitly the Earth's mean angular rotation $\omega_\oplus$ in degrees per second [3.15].

$$\omega_\oplus\left(rad / s\right) = \left\{1.002737909350795 + 5.9006 \cdot 10^{-11} T - 5.9 \cdot 10^{-15} T^2\right\} \cdot \frac{2\pi}{86400s}$$

12.1.3.6 Geocentric Coordinate Time (TCG)

Geocentric Coordinate Time TCG represents the time coordinate of a four dimensional reference system and differs from TT by a constant scale factor yielding the relation

$$TCG = TT + L_G \cdot \left(JD - 2443144.5\right) \cdot 86400\ s$$

$L_G = 6.9692903 * 10^{-10}$

For practical reasons this equation can also be put into the following relation:

TCG = TT + 2.2 s/cy * (year-1977.0)

cy = century

12.1.3.7 Barycentric Coordinate Time (TCB)

The Barycentric Coordinate Time TCB has been introduced to describe the motion of solar system objects in a non rotating relativistic frame centered at the solar system barycenter. TCB and TCG exhibit a rate difference which depends on the gravitational potential of the Sun at the mean Earth-Sun distance 1 AU and the Earth´s orbital velocity. The accumulated TCB-TT time difference amounts to roughly 11 s around epoch J2000.

$$TCB = TCG + L_C \cdot \left(JD - 2443144.5\right) \cdot 86400\ s + P$$

(Mc Carthy 1996) and

$$\begin{aligned} \mathrm{P} \approx & +0^{s}.0016568 \cdot \sin\left(35999^{\circ}.37T + 357^{\circ}.5\right) \\ & + 0^{s}.0000224 \cdot \sin\left(32964^{\circ}.5T + 246^{\circ}\right) \\ & + 0^{s}.0000138 \cdot \sin\left(71998^{\circ}.7T + 355^{\circ}\right) \\ & + 0^{s}.0000048 \cdot \sin\left(3034^{\circ}.9T + 25^{\circ}\right) \\ & + 0^{s}.0000047 \cdot \sin\left(34777^{\circ}.3T + 230^{\circ}\right) \\ T = & \left(JD - 2451545.0\right) / 36525 \end{aligned} \tag{3.16}$$

$L_c = 1.4808268457\ 10^{-8}$

The largest contribution is given by the first term. When neglecting the other terms we can approximate P by:

$P = 0.001658^{s} \sin(g) + 0.000014^{s} \sin(2g)$

12.1.3.8 Julian Date (JD)

In astronomical computations, a continuous day count is used which avoids the usage of a calendar. The Julian Date (JD) is the number of days since noon January 1, 4712 BC including fractions of the day.

12.1.3.9 Modified Julian Date (MJD)

Since the JD has become such a large number, the Modified Julian Date was introduced for convenience. JD was reset at November 17th 1858 which leads to the following equation :

$$\mathrm{MJD} = \mathrm{JD} - 2400000.5^{d}$$

Note that the count for MJD starts at midnight.

12.2 TIME FORMATS

12.2.1 ISO Time Format

In our data and label files we use UTC time to measure the time the data were recorded at the ground station in the PDS compliant ISO/DIS 8601 standard format CCYY-MM-DDTHH:MM:SS.sss. (Example: 2004-06-21T025208.000 corresponds to the date 21.6.2004 and the time of day 2:52:08.000).

12.2.2 Time in Fractions of Days of Year

This is the UTC time in the format fraction of days of year starting with the first day of year the data was recorded at 00:00.000 UTC. (Example: 2003-07-01T18:03:02.000 in ISO format corresponds to 182.752106 in fraction of days since the 1st July was the 182th day of the year 2003.) This format is only used in the data files.

12.2.3 Ephemeris Time Format

Ephemeris time is given in seconds starting with the 1st January 2000 at 12:00:00.000 TDB (see also section 12.1.2).

13 APPENDIX

13.1 IFMS CONFIGURATION FILE EXPLANATION

line	abbreviation	possible value	description
1	station_id	NN12	
2	spacecraft_id	MEX1	
3	data_set_kind	OP	
4	dap_type	D1	
5	ref_time_tag	20030702.001055.000	
6	first_sample_time	20030702.002114.000	
7	last_sample_time	20030702.021414.000	
8	requestor_id	STC	
9	requested_id	1	
10	why_opend	Conf_Changed	
11	total_samples	6781	
12	sample_period	1.	
13	internal_reference	No	
14	uplink_carrier_230	Yes	
15	actual_carrier_indic	3067833783.	
16	actual_tone_indic	-	
17	epd_source	0	
18	rg_data_corrected	No	
19	sequence_id	3	
20	LogMaxEv	N/A in input Data	Maximum number of logged events
21	LogDebugMode	N/A in input Data	Select `Debug` logging level
22	Dsp_MetPresent	N/A in input Data	Meteorological Unit present
23	Dsp_UlmPresent	N/A in input Data	Up-Link Modulator present
24	Dsp_Cf1Present	N/A in input Data	Common Front End #1 present
25	Dsp_Cf2Present	N/A in input Data	Common Front End #1 present
26	Dsp_DcePresent	N/A in input Data	Diversity Combination Estimator present and GDSP
27	Dsp_RgdPresent	N/A in input Data	Ranging Demodulator present and GDSP
28	Dsp_RcdPresent	N/A in input Data	Remnant Carrier Demodulator present and GDSP
29	Dsp_ScdPresent	N/A in input Data	Suppressed Carrier Demodulator present and GDSP
30	Dsp_TcdsPresent	N/A in input Data	Telemetry Channel Decoder System present and GDSP
31	UlmCarFrSel	"230MHz"	Up-Link Modulator Carrier Output Frequency

32	UlmCarFrOffs	0	Up-Link Modulator Carrier Output Frequency Offset
33	UlmCarNomLvl	4	Up-Link Modulator Carrier Nominal output level
34	UlmCarTstOut	No	Up-Link Modulator Carrier Test output selection
35	UlmCarTstLvl	0.0	Up-Link Modulator Carrier Test output attenuation
36	UlmCarSpecInv	No	
37	UlmSwpDelStF	0	Up-Link Modulator Carrier Sweep: Delta Start Frequency
38	UlmSwpDelSpF	0	Up-Link Modulator Carrier Sweep: Delta Stop Frequency
39	UlmSwpRate	1	Up-Link Modulator Carrier Sweep: sweep rate
40	UlmSwpAccFact	1	Up-Link Modulator Carrier Sweep: acceleration factor
41	UlmPrior	No	Up-Link Modulator Carrier modulation TC priority selection
42	UlmTcSrc	"TCE1"	Up-Link Modulator TC data source
43	UlmTcDataCoding	"NRZ-L"	Up-Link Modulator TC data coding
44	UlmTcTceMode	"Normal"	Up-Link Modulator TC TCE mode
45	UlmTcModIdx_Ana	0.0000	Up-Link Modulator TC modulation index for analogue source
46	UlmTcModIdx_Dig	1.000	Up-Link Modulator TC modulation index for digital source
47	UlmTcMod	"PM on sub-carrier"	Up-Link Modulator TC modulation mode
48	UlmTcRCBRateN	1	Up-Link Modulator TC bit-rate numerator in RC modes (1=>integer mode)
49	UlmTcRCBRateD	8	Up-Link Modulator TC bit-rate denominator in RC modes
50	UlmTcSCBRateP	100.00	Up-Link Modulator TC P-channel bit-rate in SC modes
51	UlmTcSCBRateQ	100.00	Up-Link Modulator TC Q-channel bit-rate (U-QPSK only)
52	UlmTcUnbalRatio	-15.0	Up-Link Modulator TC modulation unbalance ratio (U-

			QPSK only)
53	UlmTcSqWavSubc	No	Up-Link Modulator TC square-wave subcarrier selection (RC only)
54	UlmTcRCBRateSel	No	Up-Link Modulator TC irrational bit-rate selection for RC modes
55	UlmTcRCIrrBRate	2000.00	Up-Link Modulator TC irrational bit-rate for RC modes
56	UlmTcSubF	16000	Up-Link Modulator TC sub-carrier frequency
57	UlmRampTime	0.00	Up-Link Modulator TC & Tone modulation index ramp time (0=> no ramp)
58	UlmTestPat	N/A in input Data	Up-Link Modulator Test bit pattern selection
59	Cf1Input	N/A in input Data	Common Front End 1 Input selection
60	CfeAgcCst	N/A in input Data	Common Front End 1&2 AGC Time Constant
61	CfeAgcHead	N/A in input Data	Common Front End 1&2 AGC Head room
62	Cf1AGain	N/A in input Data	Common Front End 1 Channel A gain (used if CfeAgcCst is 0)
63	Cf1BGain	N/A in input Data	Common Front End 1 Channel B gain (used if CfeAgcCst is 0)
64	Cf1Dither	N/A in input Data	Common Front End 1 Dither noise enabled
65	Cf2Input	N/A in input Data	Common Front End 2 Input selection
66	Cf2AGain	N/A in input Data	Common Front End 2 Channel A gain (used if CfeAgcCst is 0)
67	Cf2BGain	N/A in input Data	Common Front End 2 Channel B gain (used if CfeAgcCst is 0)
68	Cf2Dither	N/A in input Data	Common Front End 2 Dither noise enabled
69	DceFreqPlan	N/A in input Data	Diversity Combination Estimator Frequency plan selection
70	DceInput	N/A in input Data	Diversity Combination Estimator Input selection
71	DceExpCN0Avail	N/A in input Data	Diversity Combination Estimator Expected C/No available
72	DceExpCN0	N/A in input Data	Diversity Combination Estimator Expected C/No

73	DceCFrUnc	N/A in input Data	Diversity Combination Estimator Carrier frequency uncertainty
74	DceCFrRateUnc	N/A in input Data	Diversity Combination Estimator Carrier frequency rate uncertainty
75	DceCAcqMode	N/A in input Data	Diversity Combination Estimator Acquisition Mode (SC: sweep, RC: FFT1)
76	DceUseAcq	N/A in input Data	Diversity Combination Estimator Use acquisition for initial phase estimate
77	DceCorrBw	N/A in input Data	Diversity Combination Estimator Correlation bandwidth
78	DceEstMode	N/A in input Data	Diversity Combination Estimator mode
79	DceAngPreSt	N/A in input Data	Diversity Combination Estimator Polarisation angle rate pre-steer
80	DceModRemov	N/A in input Data	Diversity Combination Estimator Modulation removal
81	DceFftCentre	N/A in input Data	Diversity Combination Estimator slow FFT: centre frequency
82	DceFftSpan	N/A in input Data	Diversity Combination Estimator slow FFT: span ratio (actual span is 17.5 MHz / N)
83	DceAna_0	N/A in input Data	Diversity Combination Estimator Analogue driver
84	DceAna_1	N/A in input Data	Diversity Combination Estimator Complex analogue source
85	DceAna_2	N/A in input Data	Diversity Combination Estimator Real analogue source
86	RgdSpecInv	No	Ranging Demodulator Spectrum inversion
87	RgdUplkConv	6936988810	Ranging Demodulator Up-link carrier conversion
88	RgdCoherTrs	Yes	Ranging Demodulator Coherent transponder
89	RgdTR1	880	Ranging Demodulator Spacecraft coherent transponder ration numerator
90	RgdTR2	749	Ranging Demodulator

			Spacecraft coherent transponder ration denominator
91	RgdDnlkCF	8420429800	Ranging Demodulator Spacecraft non-coherent down-link carrier frequency
92	RgdDnlkConv	8350165420	Ranging Demodulator Down-link carrier conversion
93	RgdPolarisation	"Combined"	
94	RgdPhEst	0.00	Ranging Demodulator Manual phase estimate
95	RgdPostProc	1	Ranging Demodulator Post-processing
96	RgdExpCN0Avail	Yes	Ranging Demodulator Expected C/No available
97	RgdExpCN0	46	Ranging Demodulator Expected C/No
98	RgdCFrUnc	1000000	Ranging Demodulator Carrier frequency uncertain
99	RgdCFrRateUnc	1000	Ranging Demodulator Carrier frequency rate uncertain
100	RgdCAcqMode	"FFT2"	Ranging Demodulator Carrier acquisition
101	RgdUseAcq	Yes	Ranging Demodulator Use acquisition for initial phase estimate
102	RgdCLpNoBw	300.0	Ranging Demodulator Carrier loop noise bandwidth (2BL)
103	RgdCLpOrder	2	Ranging Demodulator Carrier loop order
104	RgdCLpPhEst	"RCD"	Ranging Demodulator Carrier loop phase estimator
105	RgdCLp_ChgDel	"STEP"	Ranging Demodulator Carrier loop – Change delay
106	RgdTLpBw	1.260	Ranging Demodulator Tone loop bandwidth
107	RgdTLPreSt	Yes	Ranging Demodulator Tone loop Doppler presteering enable
108	RgdTLp_ChgDel	"STEP"	Ranging Demodulator Tone loop – Change delay
109	RgdAna_0	N/A in input Data	Ranging Demodulator Analogue driver
110	RgdAna_1	N/A in input Data	Ranging Demodulator Complex analogue source

111	RgdAna_2	N/A in input Data	Ranging Demodulator Real analogue source
112	RcdSpecInv	No	Remnant Carrier Demodulator Spectrum inversion
113	RcdUplkConv	6936988810	Remnant Carrier Demodulator Up-link carrier conversion
114	RcdCoherTrs	Yes	Remnant Carrier Demodulator Coherent transponder
115	RcdTR1	880	Remnant Carrier Demodulator Spacecraft coherent transponder ratio numerator
116	RcdTR2	749	Remnant Carrier Demodulator Spacecraft coherent transponder ratio denominator
117	RcdDnlkCF	8420429800	Remnant Carrier Demodulator Spacecraft non-coherent down-link carrier frequency
118	RcdDnlkConv	8350165420	Remnant Carrier Demodulator Down-link carrier conversion
119	RcdPolarisation	"Combined"	
120	RcdPhEst	0.00	Remnant Carrier Demodulator Manual phase estimate
121	RcdPostProc	1	Remnant Carrier Demodulator Post-processing
122	RcdExpCN0Avail	Yes	Remnant Carrier Demodulator Expected C/No available
123	RcdExpCN0	46	Remnant Carrier Demodulator Expected C/No
124	RcdCFrUnc	1000000	Remnant Carrier Demodulator Carrier frequency uncertainty
125	RcdCFrRateUnc	1000	Remnant Carrier Demodulator Carrier frequency rate uncertainty
126	RcdCAcqMode	"FFT2"	Remnant Carrier Demodulator acquisition mode (FFT1 recommended)
127	RcdUseAcq	Yes	Remnant Carrier Demodulator Use acquisition for initial phase estimate
128	RcdCLpNoBw	100.0	Remnant Carrier Demodulator Carrier loop noise bandwidth (2BL)
129	RcdCLpOrder	2	Remnant Carrier Demodulator Carrier loop order
130	RcdCLpPhEst	"RCD"	Remnant Carrier Demodulator Carrier loop phase estimator

131	RcdCLp_ChgDel	"STEP"	Remnant Carrier Demodulator Carrier loop – Change delay
132	RcdTLpBw	0.00010	Remnant Carrier Demodulator Timing loop bandwidth (2BL)
133	RcdTLpOrder	2	Remnant Carrier Demodulator Timing loop order
134	RcdTLpPhEst	"DD"	Remnant Carrier Demodulator Clock loop estimator
135	RcdTLp_ChgDel	"STEP"	Remnant Carrier Demodulator Timing loop – Change delay
136	RcdSCLpFreq	0	Remnant Carrier Demodulator Subcarrier loop nominal subcarrier frequency
137	RcdSCLpPreSt	No	Remnant Carrier Demodulator Subcarrier loop Subcarrier loop enable pre-steering
138	RcdSCLpBw	0.00010	Remnant Carrier Demodulator Subcarrier loop bandwidth
139	RcdSCLpModInd	1.10	Remnant Carrier Demodulator Subcarrier loop expected modulation index
140	RcdSCLpPhEst	"Decision directed"	Remnant Carrier Demodulator Subcarrier loop phase est. Mode (NDA if Es/No<-2dB)
141	RcdSCLpAcq	"None"	Remnant Carrier Demodulator Subcarrier loop acquisition strategy
142	RcdSCLpBitNum	1	Remnant Carrier Demodulator Subcarrier loop bit clock numerator
143	RcdSCLpBitDen	1	Remnant Carrier Demodulator Subcarrier loop bit clock denominator
144	RcdSCLpSqWavSc	Yes	Remnant Carrier Demodulator Subcarrier loop square wave subcarrier
145	RcdSCLpSRateUsed	Yes	Remnant Carrier Demodulator Subcarrier loop symbol rate used
146	RcdSCLpSRate	419430.40	Remnant Carrier Demodulator Subcarrier loop symbol rate
147	RcdSCLpDecodMode	"NRZ-L"	Remnant Carrier Demodulator Subcarrier loop decoding mode
148	RcdSCLp_ChgDel	"STEP"	Remnant Carrier Demodulator Subcarrier loop – Change delay

149	RcdAna_0	N/A in input Data	Remnant Carrier Demodulator Analogue driver
150	RcdAna_1	N/A in input Data	Remnant Carrier Demodulator Complex analogue source
151	RcdAna_2	N/A in input Data	Remnant Carrier Demodulator Real analogue source
152	ScdSpecInv	No	Suppressed Carrier Demodulator Spectrum inversion
153	ScdUplkConv	1000000000	Suppressed Carrier Demodulator Up-link carrier conversion
154	ScdCoherTrs	No	Suppressed Carrier Demodulator Coherent transponder
155	ScdTR1	1	Suppressed Carrier Demodulator Spacecraft coherent transponder ratio numerator
156	ScdTR2	1	Suppressed Carrier Demodulator Spacecraft coherent transponder ratio denominator
157	ScdDnlkCF	1000000000	Suppressed Carrier Demodulator Spacecraft non-coherent down-link carrier freq.
158	ScdDnlkConv	1000000000	Suppressed Carrier Demodulator Down-link carrier conversion
159	ScdPolarisation	"X"	
160	ScdPhEst	0.00	Suppressed Carrier Demodulator Manual phase estimate
161	ScdPostProc	1	Suppressed Carrier Demodulator Post.processing
162	ScdExpCN0Avail	No	Suppressed Carrier Demodulator Expected C/No available
163	ScdExpCN0	6	Suppressed Carrier Demodulator Expected C/No
164	ScdCFrUnc	0	Suppressed Carrier Demodulator Carrier frequency uncertainty
165	ScdCFrRateUnc	0	Suppressed Carrier Demodulator Carrier frequency

			rate uncertainty
166	ScdCAcqMode	"Sweep"	Suppressed Carrier Demodulator Carrier acquisition mode (Sweep recommended)
167	ScdUseAcq	No	Suppressed Carrier Demodulator Use acquisition for initial phase estimate
168	ScdCLpNoBw	0.1	Suppressed Carrier Demodulator Carrier loop Noise bandwidth (2BL)
169	ScdCLpOrder	1	Suppressed Carrier Demodulator Carrier loop order
170	ScdCLpPhEst	"RCD"	Suppressed Carrier Demodulator Carrier loop phase estimator
171	ScdCLp_ChgDel	"STEP"	Suppressed Carrier Demodulator Carrier loop – Change delay
172	ScdTLpBw	0.00001	Suppressed Carrier Demodulator Timing loop bandwidth (2BL)
173	ScdTLpOrder	1	Suppressed Carrier Demodulator Timing loop order
174	ScdTLpPhEst	"DD"	Suppressed Carrier Demodulator Clock loop estimator
175	ScdTLp_ChgDel	"STEP"	Suppressed Carrier Demodulator Timing loop – Change delay
176	ScdModFormat	"off"	Suppressed Carrier Demodulator Modulation format
177	ScdModPRate	100	Suppressed Carrier Demodulator Modulation P symbol rate
178	ScdModQRate	100	Suppressed Carrier Demodulator Modulation Q symbol rate (only for U-QPSK)
179	ScdModExpBalAv	No	Suppressed Carrier Demodulator Modulation expected balance ratio available
180	ScdModExpBal	1.0	Suppressed Carrier Demodulator Modulation expected balance ratio

181	ScdModIChCoding	"NRZ-L"	Suppressed Carrier Demodulator Modulation I Channel Coding
182	ScdModQChCoding	"NRZ-L"	Suppressed Carrier Demodulator Modulation Q Channel Coding
183	ScdMchPulse	No	Suppressed Carrier Demodulator match filter: pulse shaped selection
184	ScdMchCosine	No	Suppressed Carrier Demodulator match filter: root raise cosine selection
185	ScdMchExcBw	20	Suppressed Carrier Demodulator match filter: excess bandwidth
186	ScdAna_0	N/A in input Data	Suppressed Carrier Demodulator Analogue driver
187	ScdAna_1	N/A in input Data	Suppressed Carrier Demodulator Complex analogue source
188	ScdAna_2	N/A in input Data	Suppressed Carrier Demodulator Real analogue source
189	D1Dur	72000	Doppler 1 Data Acquisition Process: default duration
190	D1SplPer	"1"	D1 Data Acquisition Process: sampling period
191	D1MaxDs	10000	Doppler 1 Data Acquisition Process: maximum samples per data-set
192	D1DSetKind	"OP"	Doppler 1 Data Acquisition Process: data-set kind (2 characters used)
193	D1Source	"RGD"	Doppler 1 Data Acquisition Process: source
194	D2Dur	72000	Doppler 2 Data Acquisition Process: default duration
195	D2SplPer	"1"	Doppler 2 Data Acquisition Process: sampling period
196	D2MaxDs	10000	Doppler 2 Data Acquisition Process: maximum samples per data-set
197	D2DSetKind	"OP"	Doppler 2 Data Acquisition Process: data-set kind (2 characters used)
198	D2Source	"RCD"	Doppler 2 Data Acquisition

			Process: source
199	G1Dur	72000	AGC 1 Data Acquisition Process: default duration
200	G1SplPer	1.0	AGC 1 Data Acquisition Process: sampling period
201	G1MaxDs	10000	AGC 1 Data Acquisition Process: maximum samples per data-set
202	G1DSetKind	"OP"	AGC 1 Data Acquisition Process: data-set kind (2 characters used)
203	G1Source	"RCD"	AGC 1 Data Acquisition Process: source
204	G2Dur	72000	AGC 2 Data Acquisition Process: default duration
205	G2SplPer	1.0	AGC 2 Data Acquisition Process: sampling period
206	G2MaxDs	10000	AGC 2 Data Acquisition Process: maximum samples per data-set
207	G2DSetKind	"OP"	AGC 2 Data Acquisition Process: data-set kind (2 characters used)
208	G2Source	"RGD"	AGC 2 Data Acquisition Process: source
209	MeDur	72000	Meteo Data Acquisition Process: default duration
210	MeSplPer	60	Meteo Data Acquisition Process: sampling period
211	MeMaxDs	10000	Meteo Data Acquisition Process: maximum samples per data-set
212	MeDSetKind	"OP"	Meteo Data Acquisition Process: data-set kind (2 characters used)
213	RgDur	72000	Ranging Data Acquisition Process: default duration
214	RgSplPer	1	Ranging Data Acquisition Process: sampling period
215	RgMaxDs	10000	Ranging Data Acquisition Process: maximum samples per data-set
216	RgDSetKind	"OP"	Ranging Data Acquisition Process: data-set kind (2 characters used)
217	RgToneF	1061683.200	Ranging Data Acquisition

			Process: nominal tone frequency
218	RgToneTxModInd	0.7	Ranging Data Acquisition Process: transmitted tone modulation index
219	RgToneRxModInd	0.2	Ranging Data Acquisition Process: expected received tone modulation index
220	RgToneInteg	1.0	Ranging Data Acquisition Process: tone integration time
221	RgToneSettl	1.0	Ranging Data Acquisition Process: tone settling time
222	RgCodeModInd	"High&Low"	Ranging Data Acquisition Process: code modulation index
223	RgCodeMax	14	Ranging Data Acquisition Process: maximum code length
224	RgCodeInteg	0.5	Ranging Data Acquisition Process: code integration time
225	RgCodeRestart	Yes	Ranging Data Acquisition Process: code sequence immediate restart
226	RgCodeRepet	No	Ranging Data Acquisition Process: repetitive code sequence
227	Epd	13.33	Expected propagation delay
228	EpdDer	0.000020099	Expected propagation delay derivative
229	EpdTime	"19700101.000000.000"	Time of given Epd
230	StationId	"NN12"	Station identifier (4 characters used)
231	MissionId	"MEX1"	Mission identifier (8 characters used)
232	SpacecraftId	"MEX1"	Spacecraft identifier (4 characters used)
233	AdsdAct	N/A in input Data	Data-set deletion: enabled
234	AdsdDelay	N/A in input Data	Data-set deletion: Delay between runs
235	AdsdMaxAge	N/A in input Data	Data-set deletion: maximum age for data-sets
236	AdsdPercen	N/A in input Data	Data-set deletion: maximum percentage used
237	AdsdMaxSupLog	N/A in input Data	Data-set handling: maximum support log entries

238	NESim_Duration	N/A in input Data	Near-Earth Simulation: Duration (around Zenith)
239	NESim_Height	N/A in input Data	Near-Earth Simulation: Spacecraft altitude
240	NESim_Speed	N/A in input Data	Near-Earth Simulation: Spacecraft speed
241	NESim_CoherMode	N/A in input Data	Near-Earth Simulation: Coherent mode
242	DSSim_Duration	N/A in input Data	Deep-Space Simulation: Duration
243	DSSim_RefTime	N/A in input Data	Deep-Space Simulation: Reference time
244	DSSim_Offset	N/A in input Data	Deep-Space Simulation: Frequency offset (at RefTime)
245	DSSim_DpRate	N/A in input Data	Deep-Space Simulation: Doppler rate
246	DSSim_EarthPhase	N/A in input Data	Deep-Space Simulation: Earth rotation phase (at RefTime)
247	DSSim_EarthPer	N/A in input Data	Deep-Space Simulation: Earth rotation period
248	DSSim_EarthAmp	N/A in input Data	Deep-Space Simulation: Earth rotation freq. Amplitude
249	DCal_MeasL	N/A in input Data	Delay calibration: Left-Hand circular measurement
250	DCal_MeasR	N/A in input Data	Delay calibration: Right-Hand circular measurement
251	DCal_CorrL	N/A in input Data	Delay calibration: Left-Hand circular correction
252	DCal_CorrR	N/A in input Data	Delay calibration: Right-Hand circular correction
253	DCal_Calib	N/A in input Data	Delay calibration: Delay Calibration
254	StatLat	N/A in input Data	Station latitude
255	StatLong	N/A in input Data	Station longitude
256	StatHeight	N/A in input Data	Station height
257	EarthMeanRadius	N/A in input Data	Doppler Prediction: Mean radius of earth model
258	EarthInvFlatCoef	N/A in input Data	Doppler Prediction: Inverse flattening coef. of earth model
259	DpPredDur	N/A in input Data	Doppler Prediction: Default duration