PDS\_VERSION\_ID = PDS3

LABEL\_REVISION\_NOTE = "2009-09-10 RS: J. Oschlisniok"

RECORD\_TYPE = STREAM

OBJECT = DATA\_SET

DATA\_SET\_ID = "RO-X-RSI-1/2/3-PRL-1010-V1.0"

OBJECT = DATA\_SET\_INFORMATION

DATA\_SET\_NAME = "ROSETTA-ORBITER CHECK RSI 1/2/3

PRELANDING 1010 V1.0"

DATA\_SET\_COLLECTION\_MEMBER\_FLG = "N"

DATA\_OBJECT\_TYPE = TABLE

START\_TIME = 2014-03-30T17:43:54.500

STOP\_TIME = 2014-03-30T19:54:52.000

DATA\_SET\_RELEASE\_DATE = 2015-11-18

PRODUCER\_FULL\_NAME = "MARTIN PAETZOLD"

DETAILED\_CATALOG\_FLAG = "N"

ARCHIVE\_STATUS = "ARCHIVED"

ABSTRACT\_DESC = "This is a Rosetta Radio Science

data set, collected during the

PRELANDING phase 2014-01-21 to

2014-11-18.

It is a Commissioning

measurement and covers the time

2014-03-30T17:43:54.500 to

2014-03-30T19:54:52.000."

CITATION\_DESC = "M. Paetzold,

ROSETTA-ORBITER CHECK RSI 1/2/3

PRELANDING 1010 V1.0,

RO-X-RSI-1/2/3-PRL-1010-V1.0,

ESA Planetary Science Archive and

NASA Planetary Data System,

2015."

DATA\_SET\_TERSE\_DESC = "This is a ROS RSI Commissioning

measurement covering the time

2014-03-30T17:43:54.500 to

2014-03-30T19:54:52.000."

DATA\_SET\_DESC = "

Data Set Overview

================

The Rosetta (RO) Radio Science (RSI) Data Archive is a

time-ordered collection of raw and partially processed data

collected during the Rosetta Mission to Churymov-Gerasimenko.

For more information on the proposed see the RSI User Manual

[RSIUSERMANUAL2004] in the DOCUMENT/RSI\_DOC folder.

This is a Commissioning measurement covering the time

2014-03-30T17:43:54.500 to 2014-03-30T19:54:52.000.

This data set was collected during the Rosetta Mission Prelanding

Phase (PRL) - on route to comet Churymov-Gerasimenko.

For more information about RSI measurements see INST.CAT or the

RSI User Manual [RSIUSERMANUAL2004].

Mission Phase Definition

========================

Mission phase abbreviations are defined in CATALOG/MISSION.CAT and

DOCUMENT/ESA\_DOC/RO\_EST\_TN\_3372.PDF.

Data files

==========

Data files are:

The tracking files from Deep Space Network (DSN) and from

the Intermediate Frequency Modulation System (IFMS) used by

the ESA ground station New Norcia. Level 1A to level 2 data

are archived. The predicted and reconstructed Doppler and

range files Geometry files.

All Level 1A binary data files will have the file name

extension eee = .DAT

IFMS Level 1A ASCII data files will have the file name

extension eee = .RAW

Level 1B and 2 tabulated ASCII data files will have the file

name extension eee = .TAB

Binary data files will have the file name extension .DAT

Data levels

----------

It should be noted that these data levels which are also used

in the file names and data directories are PSA data levels

whereas in the PDS label files CODMAC levels are used.

PSA data level | CODMAC level

-----------------------------

1A | 1

1B | 2

2 | 3

Data Set Identifier

-------------------

The 'DATA\_SET\_ID' is a unique alphanumeric identifier for

the data sets.

It looks something like:

XX-Y-ZZZ-U-VVV-NNNN-WWW

Acronym | Description | Example

--------------------------------------------------------

XX | Instrument Host ID | RO

--------------------------------------------------------

Y | Target ID | C (for Comet) or X for

| | others like for example

| | the sun during solar

| | conjunction measurements

--------------------------------------------------------

ZZZ | Instrument ID | RSI

--------------------------------------------------------

U | Data level (here | 1/2/3 (Data set

| CODMAC levels are used) | contains raw, edited

| | and calibrated data)

---------------------------------------------------------

VVV | RSI mission phase | CR1

---------------------------------------------------------

NNNN | 4 digit sequence number | 0123

| which is identical to |

| the Radio Science |

| VOLUME\_ID |

---------------------------------------------------------

WWW | Version number | V1.0

RSI data were originally archived as volumes rather than data

sets. However, ESA PSA does not use volume but data set.

To avoid confusion it was specified that one RSI data volume

is equal one data set. Thus the data set was also assigned a

4 digit sequence number which is identical to the one used in

the Radio Science VOLUME\_ID. If the data\_set\_id is known it is

automatically specified on which volume the data set is found.

VOLUME\_ID

---------

The VOLUME\_ID is a unique alphanumeric identifier for volume.

The VOLUME\_ID provides a unique identifier for a single

RSI data volume, including a complete measurement

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

volume set, the remaining digits define the range of volumes

in the volume set. For Mars Express the first digit is not

defined after the kind of measurement (see below for Rosetta

and VEX), but after the Mission phase.

0000: Commissioning

1000: Occultation

2000: Gravity

3000: Solar Conjunction

4000: Bistatic Radar

5000: Passive/Active Checkouts

6000: Swing-bys/Fly-bys

7000: Cometary Coma Observations

It looks something like:

XXXXX-ZZZZ

Acronym | Description | Example

----------------------------------------------------------

XXXXX | Instrument Host and Instrument ID | RORSI

----------------------------------------------------------

ZZZZ | 4 digit sequence number | 0123

Important note: the here defined ESA PSA Volume\_Id is not identical

with the Radio Science Volume\_Id. The Radio Science Volume\_Id is a

number which is incremented measurement by measurement, independent

what kind of measurement was conducted. The Radio Science Volume\_Id

belonging to one single measurement can be find in the Logbook, loca-

ted in the folder DOCUMENT/RSI\_DOC.

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 Ancillary files (event files, attitude files,

ESOC orbit files, products, SPICE files)

.TXT Information (text) files

File naming convention

======================

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.

The new PDS compliant file name will be the following:

rggttttlll\_sss\_yydddhhmm\_qq.eee

Acronym | Description | Examples

=============================================================

r | space craft name abbreviation | R

| R = Rosetta |

| M = Mars Express |

| V = Venus Express |

-------------------------------------------------------------

gg | Ground station ID: | 43

| |

| 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 |

| |

| DSN complex Canberra: |

| --------------------- |

| 34 = 34 m BWG (beam waveguide) |

| 40 = complex |

| 43 = 70 m |

| 45 = 34 m HEF (high efficiency) |

| |

| ESA Cebreros antenna: |

| --------------------- |

| 62 = 35 m |

| |

| DSN complex Goldstone: |

| ---------------------- |

| 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 |

| |

| ESA Kourou antenna: |

| ------------------- |

| 75 = 15 m |

| |

| DSN complex Madrid: |

| ------------------- |

| 54 = 34 m BWG |

| 55 = 34 m BWG |

| 63 = 70 m |

| 65 = 34 m HEF |

| 60 = complex |

| |

| ESA New Norcia antenna: |

| ----------------------- |

| 32 = 35 m |

-------------------------------------------------------------

tttt | data source identifier: | TNF0

| |

| Level 1A and 1B: |

| ---------------- |

| ODF0 = ODF closed loop |

| TNF0 = TNF closed loop (L1A) |

| T000-T017 = TNF closed loop (L1B) |

| ICL1 = IFMS 1 closed 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 ESOC DDS |

| DSN0 = ancillary files from DSN |

| SUE0= ancillary and information files |

| coming from Stanford University |

| center for radar astronomy |

| |

| Level 2: |

| ------- |

| UNBW = predicted and reconstructed |

| Doppler and range files |

| ICL1 = IFMS 1 closed loop |

| ICL2 = IFMS 2 closed-loop |

| ICL3 = IFMS RS closed-loop |

| ODF0 = DSN ODF closed loop file |

| T000-T017 = 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) |

| RSRL = 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 |

| GEOM = geometry file |

| |

--------|------------------------------------------|--------

lll | Data archiving level | L1A

| L1A = Level 1A |

| L1B = Level 1B |

| L02 = Level 2 |

| L03 = Level 3 |

--------|------------------------------------------|--------

sss | data type |

| |

| IFMS data files level 1A: |

| ------------------------- |

| 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 file |

| AG1 AGC 1 files |

| AG2 AGC 2 files |

| RCX X-Band range equip. calibration |

| RCS S-Band range equip. calibration |

| |

| DSN data files level 1A: |

| ------------------------- |

| ODF original orbit files (closed loop) |

| RSR radio science receiver open-loop file|

| TNF file (closed loop) |

| |

| ESOC ancillary data level 1A: |

| ----------------------------- |

| ATR attitude file, reconstructed |

| EVT orbit event file |

| OHC orbit file, heliocentric cruise |

| OMO orbit file, marscentric, operational |

| |

| DSN Calibration files level 1A: |

| ------------------------------- |

| TRO DSN tropospheric calibration model |

| MET DSN meteorological file |

| ION DSN ionospheric calibration model |

| BCL SUE Bistatic radar temperature |

| calibration |

| |

| DSN ancillary data level 1A: |

| ----------------------------- |

| 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 |

| |

| DSN Browse Plots level 1A: |

| -------------------------- |

| BRO bistatic radar 4-panel plots (browse)|

| |

| IFMS data files level 1B: |

| ------------------------- |

| 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 |

| |

| DSN ODF data files level 1B: |

| ----------------------------- |

| 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 |

| |

| DSN calibration data level 1B: |

| ----------------------------- |

| MET meteorological file |

| |

| IFMS data level 2: |

| ----------------- |

| D1X uncalibrated Doppler 1 X-Band |

| D1S uncalibrated Doppler 1 S-Band |

| D2X uncalibrated Doppler 2 X-Band |

| D2S uncalibrated Doppler 2 S-Band |

| RGX uncalibrated X-Band range |

| RGS uncalibrated S-Band range |

| RCX X-Band range equip. calibration |

| RCS S-Band range equip. calibration |

| |

| IFMS Browse plots level 2 |

| ------------------------- |

| 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 |

| |

| DSN level 2 data: |

| ----------------- |

| DPX calibrated Doppler X-band |

| DPS calibrated Doppler 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 |

| |

| DSN level 2 calibration data: |

| ---------------------------- |

| SRF Surface Reflection Filter Files |

| |

| orbit files level 2: |

| -------------------- |

| PTW Doppler & range prediction two-way |

| PON Doppler & range prediction on |

| RTW reconstructed Doppler & range orbit |

| file two-way |

| RON reconstructed Doppler & range orbit |

| file one-way |

| LOC heliocentric state vector file |

| |

| Constellation file Level 2: |

| --------------------------- |

| MAR Mars constellation file |

| VEN Venus constellation file |

| P67 Churyumov-Gerasimenko |

| constellation file |

| |

| SPICE kernel files level 2: |

| --------------------------- |

| BSP binary spacecraft/location |

| kernel file |

| FRM frame kernel file |

| ORB orbit numbering file |

| PBC predicted attitude kernel file |

| PCK planetary constant kernel |

| SCK space craft clock kernel |

| TLS leap second kernel file |

| |

| Science data level 3: |

| --------------------- |

| SCP solar corona science |

--------|------------------------------------------|--------

yy | Year | 04

--------|------------------------------------------|--------

ddd | Day of year | 153

--------|------------------------------------------|--------

hhmm | Sample hour, minute start time | 1135

| For IFMS files this is the ESOC |

| reference time tag which usually |

| coincides with the first sample time. |

| For IFMS Ranging files however this is |

| not true. Here the reference time tag |

| is two-way light time before the first |

| actual measurement. |

--------|------------------------------------------|--------

qq | Sequence or version number | 01

--------|------------------------------------------|--------

eee | .DAT binary files (Level 1A) | .RAW

| .TAB ASCII table data file |

| .AUX ancillary file |

| .CFG IFMS configuration file (Level 1B) |

| .LBL PDS label files |

| .TXT information files |

| .RAW ASCII data files (Level 1A) |

| .LOG Processing log files (Level 2) |

Processing (DSN)

================

TNF's are screened for 'bad' data points by the JPL Radio Metric

Data Conditioning Team (RMDCT) before the files are processed to

ODF's. The TNF's included in this archive, however, are the pre-

screened versions.

The open-loop (RSR) data in the archive have been assembled from

individual records (packets) into files. They have not

otherwise been processed.

The Level 2 radio occultation data have been processed as

follows.

The RSR samples were digitally filtered to reduce bandwidth;

in the process they were also converted from 16-bit I and

16-bit Q complex integer samples to 64-bit I and 64-bit Q

double precision complex floating point samples. The complex

floating point samples were Fourier transformed and estimates

made of the carrier amplitude and frequency and their uncer-

tainties.

The reconstructed spacecraft trajectory, planetary epheme-

redes, records of uplink and downlink tuning, and other data

were used to calculate the expected carrier frequency at the

receiving antenna.

The Level 2 products are tables of the observed amplitude, its

uncertainty, the observed frequency, its uncertainty, and the

difference between the observed and the expected frequency as

a function of time. Separate tables have been created for

each RSR.

The Level 2 bistatic radar spectra (SPC) have been processed as

follows.

The RSR samples were converted from 16-bit I and 16-bit Q

complex integer samples to 64-bit I and 64-bit Q double

precision complex floating point samples. In the process they

were digitally corrected for non-uniform spectral response of

the receiving system. This was done by computing spectra from

series of time samples and dividing each spectrum by the

square root of a power spectrum computed from many minutes of

noise. The amplitude of the samples was then adjusted so that

power spectra in each receiver channel would have an amplitude

proportional to kTsysB where k is Boltzmann's constant, Tsys

is the receiver system temperature in Kelvin, and B is the

width of one frequency bin (spectral resolution) in the power

spectrum.

Then the power spectra (e.g., XR\*conj(XR)) and cross spectra

(e.g., XR\*conj(XL)) were computed.

Processing (IFMS)

================

For information about the processing of IFMS data please see in

the DOCUMENT folder.

Structure of DATA Directory

===========================

Please note that the following description lists all possible

subfolders. If however there is no data to fill some of these

folders they will not be generated.

|-DATA

| |-LEVEL1A

| | |-CLOSED\_LOOP

| | | |-DSN

| | | | |-ODF Orbit Data Files

| | | | |-Tracking and Navigation Files

| | | |

| | | |-IFMS

| | | |-AG1 Auto Gain Control 1 data files

| | | |-AG2 Auto Gain Control 2 data files

| | | |-DP1 Doppler 1 data files

| | | |-DP2 Doppler 2 data files

| | | |-RNG Ranging data files

| | |

| | |-OPEN\_LOOP

| | | |-DSN

| | | | |-RSR Radio-Science Receiver data files

| | | |

| | |-IFMS

| | |-AG1 Auto Gain Control 1 data files

| | |-AG2 Auto Gain Control 2 data files

| | |-DP1 Doppler 1 data files

| | |-DP2 Doppler 2 data files

| | |-RNG Ranging data files

| |

| |-LEVEL1B

| | |-CLOSED\_LOOP

| | | |-DSN

| | | | |-ODF Orbit Data Files

| | | |

| | | |- IFMS

| | | | |- AG1 Auto Gain Control 1 data files

| | | | |- AG2 Auto Gain Control 2 data files

| | | | |- DP1 Doppler 1 data files

| | | | |- DP2 Doppler 2 data files

| | | | |- RNG Ranging data files

| | |

| | |- OPEN\_LOOP

| | | |-IFMS

| | | | |-AG1 Auto Gain Control 1 data files

| | | | |-AG2 Auto Gain Control 2 data files

| | | | |-DP1 Doppler 1 data files

| | | | |-DP2 Doppler 2 data files

| | | | |-RNG Ranging data files

| |

| |-LEVEL2

| | |- CLOSED\_LOOP

| | | |- DSN

| | | | |-ODF Orbit Data Files

| | | |

| | | |- IFMS

| | | | |-DP1 Doppler 1 data files

| | | | |-DP2 Doppler 2 data files

| | | | |-RNG Ranging data files

| | |

| | |- OPEN\_LOOP

| | | |-DSN

| | | | |-BSR Bistatic radar power spectra

| | | | |-SRG Bistatic radar surface reflection

| | | | | geometry file

| | | | |-DPX Doppler X-Band files

| | | | |-DPS Doppler S-Band files

| | | |

| | | |-IFMS

| | | | |-DP1 Doppler 1 data files

| | | | |-DP2 Doppler 2 data files

| | | | |-RNG Ranging data files

Files in the DATA Directory

---------------------------

Files in the DATA directory are:

Data Level 1A:

--------------

Level 1A data are incoming raw tracking data files obtained

either from ESA IFMS or DSN. All incoming data files will be

renamed after the file naming convention format defined in

section 5.1 of the RSI File Naming Convention document

[RSIFNC2004] and get a minimal detached label file .LBL. The

original file name of the incoming tracking data files will be

stored in the according label file as SOURCE\_PRODUCT\_ID. These

files have the file extension .RAW if ASCII and .DAT if binary

files.

TNF's are screened for 'bad' data points by the JPL Radio Metric

Data Conditioning Team (RMDCT) before the files are processed to

ODF's. The TNF's included in this archive, however, are the pre-

screened versions.

Tracking and Navigation Files (TNF Directory)

---------------------------------------------

TNF's became available within a few hours of the completion of

a Rosetta pass.

Orbit Data Files

----------------

ODF's were typically issued daily throughout the RO mission

with weekend data being consolidated into a single file on

Monday. Typical ODF's have sizes 15-50 kB.

Sample rates typically are 1/sec or 1/(60 sec).

Radio Science Receiver Files (RSR Directory)

--------------------------------------------

Each RSR generated a stream of packets which could be

assembled into files of arbitrary length. It was decided,

after some experimentation, that files containing about 300 MB

were the largest that could be easily manipulated in the

analysis computers available in 2003. With a small number of

exceptions, this is the largest file size that will be found

in the RSR directory.

The open-loop (RSR) data in the archive have been assembled from

individual records (packets) into files. They have not other-

wise been processed.

IFMS Data Level 1B:

-------------------

Level 1B files are created from level 1A (raw tracking data) as

edited ASCII formatted file.

Three files are generated for each ESA IFMS Level 1A data file:

Level 1B IFMS data file (extension .TAB)

Level 1B IFMS configuration file (extension .CFG)

Level 1B IFMS label file (extension .LBL)

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

of the .CFG file.

Up to eight files are generated for each DSN ODF Level 1A file:

Level 1B ODF Doppler S-Band data file + label file

Level 1B ODF Doppler X-Band data file + label file

Level 1B ODF Ranging S-Band data file + label file

Level 1B ODF Ranging X-Band data file + label file

Cologne is processing IFMS and ODF data, Stanford University

processes RSR data up to level 2 and forwards raw and processed

data to Cologne for archiving. However, for RSR there will be no

level 1B files.

Data Level 2:

-------------

Level 2 data are calibrated data after further processing. The

file format is in ASCII. This data level can be used for further

scientific interpretation. The keyword OBSERVATION\_TYPE in the

Level 2 data labels indicates which kind of measurement was

done. Keyword values are: Occultation, Target Gravity, Global

Gravity, Solar Conjunction, Bistatic Radar, Commissioning and

Steins/Lutetia Flyby. Commissioning measurements were carried

out on several days during the cruise phases. These are

measurements where the equipment on board the spacecraft and on

the ground station was tested.

IFMS Level 2 input files:

-------------------------

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 continuous 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

----------------------------------------------------------

Example:

R32ICL1L02\_D1X\_040931103\_00.TAB

is a level 2 Doppler 1 X-Band file

in R32ICL1L02\_D1X\_040931103\_00.LBL

the following SOURCE\_PRODUCT\_ID is given:

SOURCE\_PRODUCT\_ID = {NN11\_ROSE\_2004\_093\_OP\_D1\_110358\_0000,

NN11\_ROSE\_2004\_093\_OP\_D1\_110358\_0001,

NN11\_ROSE\_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:

R32ICL1L1A\_D1X\_040931103\_00.RAW

R32ICL1L1A\_D1X\_040931103\_01.RAW

R32ICL1L1A\_D1X\_040931103\_02.RAW

and the corresponding label files give the

source\_product\_id as:

in the R32ICL1L1A\_D1X\_040931103\_00.LBL file the

source\_product\_id is given as:

SOURCE\_PRODUCT\_ID = NN11\_ROSE\_2004\_093\_OP\_D1\_110358\_0000

in the R32ICL1L1A\_D1X\_040931103\_01.LBL file the

source\_product\_id is given as:

SOURCE\_PRODUCT\_ID = NN11\_ROSE\_2004\_093\_OP\_D1\_110358\_0001

in the R32ICL1L1A\_D1X\_040931103\_02.LBL file the

source\_product\_id is given as:

SOURCE\_PRODUCT\_ID = NN11\_ROSE\_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

----------------------------------------------------------

Other inputs for Doppler and Ranging files:

-------------------------------------------

predicted orbit file (see EXTRAS/ANCILLARY/UNI\_BW)

Meteorological file (see CALIB/CLOSED\_LOOP/IFMS/MET)

AGC file (see DATA/1A or 1B/CLOSED\_LOOP/AGC1 or AGC2)

Spacecraft orbit SPICE kernels (see EXTRAS/ANCILLARY/SPICE

can also be downloaded from

ftp://ssols01.esac.esa.int/pub/data/SPICE/ROSETTA/kernels)

Calibration Documentation:

--------------------------

For documentation about Doppler and Ranging Calibration

please see in DOCUMENT/RSI\_DOC/ROS\_RSI\_IGM\_DS\_3118 and

ROS\_RSI\_IGM\_DS\_3119.

For differential Doppler:

-------------------------

If the processed level 2 file is for example Doppler 1

X-Band then information from IFMS raw Doppler 1 S-Band

files which cover approximately the same time were used

for processing as well.

For Doppler 1 S-Band information from IFMS raw Doppler 1

X-Band files were used.

Doppler 2 files were processed accordingly.

In most cases on IFMS1 and IFMS2 X-Band data were

recorded:

The corresponding raw files' names start with NN11\_ or

NN12\_. S-Band data were in most cases recorded at IFMS3.

The corresponding raw files' names start with NN13\_.

If for some reason this configuration was changed this is

indicated either at the beginning of this description or

at the end in the anomaly report.

For Ranging in addition are used:

---------------------------------

Range calibration file (see CALIB/CLOSED\_LOOP/IFMS/RCL)

Klobuchar coefficients for Earth-Ionosphere calibration

(can be downloaded from this site:

http://www.aiub.unibe.ch/download/CODE/)

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 differen-

tial Doppler cannot be computed and was set to -999.999999

in the output file.

The level 2 ranging files contain 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.

IFMS Level 2 output files:

--------------------------

Level 2 IFMS data file (extension .TAB)

Level 2 IFMS label file (extension .LBL)

Level 2 IFMS log file (extension .LOG).

The log files can be found in

/EXTRAS/ANCILLARY/RSI/LOGFILES and contain information

about the level 2 Doppler and Ranging data processing.

ODF Level 2 input files:

------------------------

ODF Level 1B files

Doppler and Range prediction file

or

Orbit reconstructed file

Media calibration files

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 -999.999999.

The level 2 ranging file contains the observed Two-Way-

Light-Time (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.

Other inputs for Doppler and Ranging files:

-------------------------------------------

Predicted orbit file (see EXTRAS/ANCILLARY/UNI\_BW)

Meteorological file (see CALIB/CLOSED\_LOOP/ODF/MET)

Spacecraft orbit SPICE kernels (see EXTRAS/ANCILLARY/SPICE

can also be downloaded from:

ftp://ssols01.esac.esa.int/pub/data/SPICE/ROSETTA/kernels)

RSR Level 2 data:

-----------------

There are four types of 'calibrated' data in the data set;

each is described briefly below.

Surface Reflection Filter Files

-------------------------------

SRF files contain power spectra derived from noise measure-

ments when the radio system was stable and there were no

spacecraft signals in the passband. SRF's were derived sepa-

rately 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. SRF's were ASCII PDS SPECTRUM objects with

attached labels.

Level 2 Neutral Atmosphere Files

--------------------------------

L2N files were the calibrated output of partial processing of

RSR data collected for radio occultations. They were ASCII

tables of frequencies and amplitudes in physically meaningful

units. Separate L2N files were derived for each receiver

channel. The Level 2 radio occultation data have been

processed as follows:

The RSR samples were digitally filtered to reduce bandwidth;

in the process they were also converted from 16-bit I and

16-bit Q complex integer samples to 64-bit I and 64-bit Q

double precision complex floating point samples. The complex

floating point samples were Fourier transformed and estimates

made of the carrier amplitude and frequency and their

uncertainties.

The reconstructed spacecraft trajectory, planetary epheme-

redes, records of uplink and downlink tuning, and other data

were used to calculate the expected carrier frequency at the

receiving antenna.

The Level 2 products are tables of the observed amplitude, its

uncertainty, the observed frequency, its uncertainty, and the

difference between the observed and the expected frequency as

a function of time. Separate tables have been created for

each RSR.

Bistatic Radar Spectra

------------------------------

SPC files were the calibrated output of partial processing of

RSR data collected for bistatic radar. They were ASCII tables

of power and cross-voltage spectra. All spectra for a single

observation were collected in a single ASCII file.

The Level 2 bistatic radar spectra (BSR) have been processed

as follows:

The RSR samples were converted from 16-bit I and 16-bit Q

complex integer samples to 64-bit I and 64-bit Q double

precision complex floating point samples. In the process they

were digitally corrected for non-uniform spectral response of

the receiving system. This was done by computing spectra from

series of time samples and dividing each spectrum by the

square root of a power spectrum computed from many minutes of

noise. The amplitude of the samples was then adjusted so that

power spectra in each receiver channel would have an amplitude

proportional to kTsysB where k is Boltzmann's constant, Tsys

is the receiver system temperature in Kelvin, and B is the

width of one frequency bin (spectral resolution) in the power

spectrum.

Then the power spectra (e.g., XR\*conj(XR)) and cross spectra

(e.g., XR\*conj(XL)) were computed.

Structure of CALIB Directory

============================

Please note that the following description lists all possible

subfolders. If however there is no data to fill some of these

folders they will not be generated.

|-CALIB

| |-CALINFO.TXT text description of the directory contents

| |

| |-CLOSED\_LOOP

| | |-DSN Closed-loop calibration data of the DSN ground

| | | stations

| | |-IFMS

| | | |-RCL Range Calibration data files

| | | |-DCL Doppler Calibration data files

| | | |-MET Meteo data files

| |

| |-OPEN\_LOOP

| | |-DSN

| | | |-BCAL System temperature calibration files

| | | |-ION Ionospheric Calibration files

| | | |-MET Meteo data files

| | | |-TRO Tropospheric Calibration files

| | | |-SRF Surface Reflection Filter Files

| | |

| | |-IFMS

| | | |-RCL Range Calibration data files

| | | |-DCL Doppler Calibration data files

| | | |-MET Meteo data files

| |

| |-UPLINK\_FREQ\_CORRECT

Only present if the uplink frequency

in one of the .RAW files was

identified as wrong. The Folder

includes files which indicate the

wrong and corrected uplink frequency

and their corresponding files.

Files in the CALIB Directory

----------------------------

Files in the CALIB directory are:

Calibration data files have in principle the same structure as

normal data files. But they do not contain scientific data but

rather reflect the behaviour of the system. These kind of data

is typically recorded at New Norcia once for every tracking

before the real measurement took place. For example: range

calibration data contain the equipment propagation delay

measurements before the tracking pass.

Note: If the uplink frequency in one of the .RAW files was

identified as wrong the folder UPLINK\_FREQ\_CORRECT will be

generated. It tells the user which files were affected and where

to find the corrected Level 2 data files.

Closed loop IFMS Calib data level 1A:

-------------------------------------

These Level 1A data are incoming raw tracking data files

obtained from ESA IFMS. All incoming data files will be renamed

after the file naming convention format defined in section 5.1

of the RSI File Naming Convention document [RSIFNC2004] and

get a minimal detached label file .LBL. The original file name

of the incoming tracking data files will be stored in the

according label file as SOURCE\_PRODUCT\_ID. These files have the

file extension .RAW.

Closed loop IFMS Calib data level 1B:

-------------------------------------

IFMS Calib level 1B files are processed from level 1A (raw

tracking data) into an edited ASCII formatted file.

Three files are generated for each ESA IFMS Level 1A data file:

Level 1B IFMS data file (extension .TAB)

Level 1B IFMS configuration file (extension .CFG)

Level 1B IFMS label file (extension .LBL)

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

of the .CFG file.

DSN METEO Files (MET directory)

-------------------------------

DSN METEO files were produced by the Tracking System

Analytic Calibration (TSAC) Group at JPL. Files give weather

calibration information for DSN complexes. These are ASCII

files of variable length records. Each record is delimited

by an ASCII line-feed <LF> (ASCII 10). METEO files were

typically released weekly and contain all weather data for the

complex since 1 January. Each METEO file is accompanied by a

PDS label. The files grow at the rate of approximately 90 kB

per month.

DSN Ionosphere Calibration Files (ION Directory)

------------------------------------------------

Ionosphere Calibration files were produced by the Tracking

System Analytic Calibration (TSAC) Group at JPL. They docu-

mented and predicted Earth ionospheric conditions. Global

Ionosphere Map (GIM) software created daily maps from Global

Positioning System (GPS) data. Each day, a final map was

created for the UT day three days previously and a preliminary

map was created for the UT day immediately before.

Also created were predict maps a couple times a week by

averaging recent 'normal' days. Then the software evaluated the

maps at the spacecraft line-of-sight and fitted the results to

a normalized polynomial versus time over each spacecraft pass.

This was done for all three modes: final, preliminary, and

predict. Then the software selected the best available cali-

bration for each pass (in priority order final > preliminary >

predict). An operator ran a plotting program to view all of

the calibrations and overrode the default selections where

desired. The mapping technique is described by

[MANNUCCIETAL1998].

They are ASCII files of variable length records. Each record is

delimited by an ASCII carriage-return line-feed pair <CR><LF>

(ASCII 13 followed by ASCII 10). ION files were usually

released at one week intervals to cover a single month; only

final files covering a full month are included in this archive.

Each ION file is accompanied by a PDS minimal label. Typical

file sizes are approximately 50 kB.

Troposphere Calibration Files (TRO Directory)

---------------------------------------------

Troposphere Calibration files were produced by the Tracking

System Analytic Calibration (TSAC) Group at JPL. They docu-

mented and predicted Earth tropospheric conditions and were

based on measurements made using Global Positioning System

(GPS) satellites. These are ASCII files of variable length

records. Each record is delimited by an ASCII line-feed <LF>

(ASCII 10).

Surface Reflection Filter Files (SRF Directory)

-----------------------------------------------

SRF files contain power spectra derived from noise measure-

ments when the radio system was stable and there were no

spacecraft signals in the passband. SRF's were derived sepa-

rately 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 inter-

changeable. SRF's were ASCII PDS SPECTRUM objects with

attached labels.

System Temperature Calibration Files (BCAL directory)

-----------------------------------------------------

This table contains system temperature calibration results

from Rosetta (RO) bistatic radar experiments. 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 Log is produced by the Stanford University Element

(SUE) of the Rosetta Radio Science Team under the direction of

R.A. Simpson.

Browse Files (BROWSE Directory)

===============================

Browse files may be composite PostScript files summarizing

quick-look processing of raw RSR data. In that case each file

has a name: rggttttL1A\_BRO\_yydddhhmm\_00.AUX. Each file has a

JPEG version with the same file name but extension .LBL. Both

files are accompanied by a single detached label of the same

file name but extension .LBL. Each PostScript file is sized to

fit on a single 8-1/2x11 inch page. Each landscape format page

includes four panels showing a histogram of raw data (12-bit)

samples (upper left), one-minute average power spectra derived

from the raw samples (upper right), one-second averages of raw

sample power versus time (lower left), and an extract of the

first few lines of the source RSR PDS label (lower right).

BRO files may be helpful in quickly scanning data to determine

which files are suitable for closer study.

IFMS Browse plot files are only available as JPEG files.

These plots are generated in order to check data quality of

IFMS Level 2 closed-loop data. 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.

Geometry information - Coordinate System

========================================

The geometry items SC\_SUN\_POSITION\_VECTOR, SC\_TARGET\_POSITION\_

VECTOR and SC\_TARGET\_VELOCITY\_VECTOR provided in the label of the

data products are calculated from the spacecraft to the sun center

expressed in J2000 reference frame, corrected for light time and

stellar abberation.

SUB\_SPACECRAFT\_LATITUDE, SUB\_SPACECRAFT\_LONGITUDE are given in the

PLANETOCENTRIC coordinate system. These parameters are computed

for the time given in POSITION\_TIME. Distances are given in km,

angles in degrees.

More information can be found in the geometry\_index file under

INDEX/. Documentation is available in the RSI document folder.

Ancillary Data

==============

An extensive set of ancillary files is needed for proper

analysis and interpretation of the radio data. These are

organized in parallel directories and stored approximately

chronologically. When a file type is not represented on an

electronic volume, the corresponding directory has been omitted.

Files in the EXTRAS/ANCILLARY Directory

---------------------------------------

Files in the EXTRAS/ANCILLARY directory are:

ESOC: Relevant DDS files to describe the observation geometry

SPICE: Relevant SPICE Kernels to describe the observation geo-

metry

UNI\_BW: Relevant PREDICT files from the Uni BW Munich

RSI: Level 2 processing log files

SUE: Ancillary files coming from Stanford University

|-SPICE:

Spice Kernels were produced by the RO Flight Dynamics

Team, converted to IEEE binary format, and then distri-

buted by the JPL Navigation and Ancillary Information

Facility (NAIF). For more information on NAIF and SPICE

see http://pds-naif.jpl.nasa.gov/

The original Spice Kernels were merged with the JPL DE405

planetary ephemeris and the ephemeredes of Phobos and

Deimos for the same time interval.

DSN: Ancillary files provided by Deep Space Network

|-EOP: Earth Orientation Parameter Files

| Earth Orientation Parameter files were produced by the

| Time and Earth Motion Precision Observation (TEMPO)

| Group at JPL. They documented and predicted Earth rota-

| tion (rate and axis). These are ASCII files of variable

| length records. Each record is delimited by an ASCII

| line-feed <LF> (ASCII 10).

| There are both 'long' and 'short' versions. The long

| file covered past motion since about 1962 and a predic-

| tion for about three months into the future; these files

| have typical sizes of 1 MB.

| The short file covered the most recent nine months of

| past motion and a prediction for three months into the

| future; these files are typically 30 kB. Each EOP file

| is accompanied by a PDS minimal label.

|

|-OPT: Orbit Propagation and Timing Geometry File

| Orbit Propagation and Time Generation files contain

| estimates of event timing (e.g., equator crossings) that

| depend on precise knowledge of the spacecraft orbit.

| These are ASCII files of variable length records. Each

| record is delimited by an ASCII carriage-return <CR>

| (ASCII 13) line-feed <LF> (ASCII 10) pair. File names

| have the form ydddeeeC.OPT where the file name compo-

| nents are the same as for BCK files (above).

| Each OPT file is accompanied by a PDS minimal label with

| file name ydddeeeC.LBL. Typical files are based on

| reconstructed spacecraft trajectories, cover a month of

| operation, and have sizes less than 500 kB.

|

|-LIT: Light Time File

| Light Time files give radio propagation time from the

| spacecraft to Earth as a function of time. These are

| ASCII files of fixed length records. Each record is

| delimited by an ASCII carriage-return line-feed pair.

| File names have the form ydddeeeC.LIT where the file

| name components are the same as for DKF files. An LIT

| file may cover more than 365 days; so eee may be a year

| or more after yddd. Each LIT file is accompanied by a

| PDS label. Typical file sizes are less than 1 MB.

Software

========

Software for parsing, reducing, and analyzing data such as

these has been developed at University of Cologne and Stanford

University.

Because such software must usually operate at the bit-level and

is written for a narrow range of platforms, it is not suitable

for general distribution. No software is included with this

archival data set.

Documents

=========

The DOCUMENT directory contains the files that provide documen-

tation and supplementary information to assist in understanding

and using the data products on the volume.

The files evolved as the mission progressed; users should refer to the

files on the most recent (highest numbered) archive volume for the

most up-to-date information.

The below mentioned documents represent the maximum of available docu-

ments, but need not to be present for every measurement. For IFMS

(NNO) measurements, please refer mainly to RSI\_DOC, for DSN measure-

ments to DSN\_DOC.

Structure of the DOCUMENT directory:

DOCUMENT

|

|- DOCINFO.TXT Specifies the content of

| the document directory

|- RSI\_DOC

| |

| |- M32ESOCL1B\_RCL\_021202\_00.PDF Group delay stability

| | .ASC specification and

| | measurements at New Norcia.

| |

| |- M32ESOCL1B\_RCL\_030522\_00.PDF Range calibrations at New

| | .ASC Norcia and Kourou.

| |

| |- M32UNBWL1B\_RCL\_030801\_00.PDF Transponder group veloci-

| | .ASC ties (in German, .ASC in

| | English).

| |

| |- ROS\_RSI\_IGM\_IS\_3079.PDF RSI Data Archive Plan.

| | ROS\_RSI\_IGM\_IS\_3079.ASC

| |

| |- ROS\_RSI\_IGM\_IS\_3087.PDF RSI File Naming Convention

| | ROS\_RSI\_IGM\_IS\_3087.ASC

| |

| |- ROS\_RSI\_IGM\_MA\_3081.PDF RSI User Manual.

| |

| |- ROS\_OPS\_LOGBOOK\_04.PDF Status of all planned

| | radio science operations

| | in year 2004 (later 05,06)

| |

| |- ROS\_RSI\_IGM\_LI\_3116.PDF List of RSI Team members.

| |

| |- ROS\_RSI\_IGM\_DS\_3118.PDF IFMS Doppler Processing and

| | Calibration Software

| | Documentation: Level 1A to

| | Level 2.

| |

| |- ROS\_RSI\_IGM\_DS\_3119.PDF IFMS Ranging Processing and

| | Calibration Software

| | Documentation: Level 1A to

| | Level 2.

| |

| |- ROS\_RSI\_IGM\_DS\_3121.PDF Radio Science Predicted

| | and Reconstructed Orbit and

| | Planetary Constellation

| | Data: Specifications

| |

| |- ROS\_RSI\_IGM\_DS\_3126.PDF Radio Science Geometry and

| Position Index Software

| Design Specifications

| |

| |- ROS\_RSI\_IGM\_DS\_3127.PDF ODF Processing and

| | Calibration Software: Level

| | 1a to Level 1b Software

| | Design Specifications

|

|- ESA\_DOC

| |

| |- IFMS\_OCCFTP.PDF Documentation of IFMS data

| | format.

| |

| |- RO\_ESC\_ID\_5003\_FDSICD.PDF File format description of

| | ESOC Flight Dynamics files

| | (ancillary files).

| |

| |- RO\_ESC\_IF\_5003\_APPENDIX\_C.PDF Documentation of DDS confi-

| | guration.

| |

| |- RO\_ESC\_IF\_5003\_APPENDIX\_I.PDF Definition of XML-schema

| | for the data delivery

| | interface.

| |

| |- RO\_ESC\_IF\_5003\_APPENDIX\_H.PDF Description of content of

| | ESOC Flight Dynamics files

| | (ancillary files).

| |

| |- RO\_ESC\_IF\_5003.PDF Data delivery interface

| | document.

| |

| |- RO\_EST\_IF\_5010.PDF Specifications of operatio-

| | nal interfaces and proce-

| | dures

| |

| |- SOP\_RSSD\_TN\_010.PDF Planetary Science Data

| | Archive Technical Note Geo-

| | metry and Position Informa-

| | tion

| |

| |- RO\_EST\_TN\_3372.PDF Rosetta Archive Conventions

|

|

|- DSN\_DOC

| |

| |-DSN\_DESIGN\_HB.PDF/.ASC

| | Technical information and near future configurations of

| | NASA Deep Space Network

| |

| |-DSN\_ODF\_TRK\_2\_18.PDF

| | Documentation of Tracking System Interfaces and Orbit Data

| | File Interface

| |

| |-HGA\_CALA.ASC

| | High Gain Antenna calibration

| |

| |-HGA\_SBDA.PDF

| | S-band antenna patterns

| |

| |-HGA\_XBDA.PDF

| | X-band antenna patterns

| |

| |-JPL\_D\_16765\_RSR.PDF

| | Documentation of RSR data format

| |

| |-LIT\_SIS.HTM

| | Software Interface Specification: Light Time File

| |

| |-M00DSN0L1A\_DKF\_yydddhhmm\_vv.TXT (optional)

| | DSN Keyword File derived from SOE file and models of

| | activities supported by the DSN

| |

| |-M00DSN0L1A\_SOE\_yydddhhmm\_vv.TXT (optional)

| | Sequence of Events file

| |

| |-MggDSN0L1A\_NMC\_\_yydddhhmm\_vv.TXT (optional)

| | Network Monitor and Control Logfile

| |

| |-M43SUE0L1A\_MFT\_\_yydddhhmm\_vv.TXT (optional)

| | Rosetta Manifest file

| |

| |-MEDIASIS.HTM

| | Media Calibration data: formats and contents

| |

| |-MON0158.ASC/.DOC/.PDF (optional)

| | Definition of format and distribution of the real-time,

| | mission monitor data

| |

| |-NMC\_SIS.TXT

| | Contents of Network Monitor and Control Log.

| |

| |-OCCLOGnn.TAB

| | Summary information of RSI radio science tests and

| | experiments. nn represents the sequence number.

| |

| |-OPTG\_SIS.TXT

| | Software Interface Specification for the Orbit Propagation

| | and Timing Geometry (OPTG) file.

| |

| |-Ryddd.ASC/.DOC/.PDF (optional)

| | Set of notes describing tests before and during radio

| | science tests or operations or the progress of an

| | experiment itself. y represents the year, ddd the DOY.

| |

| |-JPEG

| | Zip-folder with 4 sets of 24 jpeg-files, each from a

| | different receiver, showing circularly polarized received

| | power spectra averaged over 60 seconds. FILENAME:

| | Rydddbca.jpg with y:year, ddd:doy, b:X- or S-band, c: Left

| | or Right-Hand circulation, a:alphabetic numbering for each

| | plot of 60s.

| |

| |-SRX.TXT (optional)

| | Software Interface Specification for Surface Reflection

| | investigation files.

| |

| |-SUE\_DMP.ASC/.DOC

| | Data Management Plan

| |

| |-TNF\_SIS.TXT

| | Deep Space Mission System External Interface Specification

| |

| |-TRK\_2\_21.TXT

| | Software Interface Specification

| |

| |-TRK\_2\_23.TXT / DSN\_MEDIA\_CAL\_TRK\_2\_23.PDF

| | Specification of DSN media calibration data.

| |

| |-TRK\_2\_24.TXT / DSN\_WEA\_FORMAT\_TRK\_2\_24.PDF

| | Specification of DSN weather file.

The documents are either in PDF-Format or are text files in ASCII with

variable length of characters per line. Each line is delimited with a

carriage-return (ASCII 13) line-feed (ASCII 10) pair.

Media/Format

============

The archival data is copied to electronic media.

More general description of radio science data

==============================================

Closed-loop and Open-loop data:

================================

There are in principle two different ways to record radio

science data: Open-loop and closed-loop data.

The CLOSED-LOOP system used a phase-lock loop in the receiver to

track the downlink signal, reporting both amplitude and fre-

quency at rates typically of 1-10 times per second.

In the OPEN-LOOP system, the signal was simply converted to a

baseband frequency range; the entire passband was sampled and

recorded for later processing. Typical open-loop sampling rates

for MEX were 2000 complex samples per second.

CLOSED-LOOP data are efficient for characterizing slowly

changing signals; OPEN-LOOP data (because of their much higher

volume) are usually used when the signal is very dynamic - such

as during an occultation or bistatic radar measurement.

The data set includes four primary data types with respect to

the two different ground station systems. These systems are on

the one hand the ESA ground station in New Norcia, Australia

(NNO) and the NASA Deep Space Network (DSN).

CLOSED-LOOP data types:

|

|- ESA: Intermediate Frequency Modulation System (IFMS)

| Closed-Loop (CL)

|

| In this data set file names of data recorded at the

| New Norcia IFMS closed loop system start with the

| string 'R32\_ICL'

|

| IFMS CL consists of Doppler and Ranging data at

| selected sample rates. The sample rate is usually

| 1/s.

| The only exception are occultation data where the

| sample rate should be 10/s to get a good enough

| vertical resolution of the atmosphere.

| Ranging are only recorded for gravity measurements.

|

| Thus the IFMS closed loop has three recording

| systems IFMS 1, IFMS 2 and IFMS 3

| The standard\_data\_product\_id in the data label

| specifies on which system the data was recorded.

|

| RSI measurements are usually done in TWO-WAY

| configuration: that is an uplink signal goes up

| (This is usually X-Band but the uplink signal can

| also be S-Band) and the ground station receives a

| dual frequency simultaneous and coherent downlink

| signal.

|

| IFMS 1 is configured for the uplink signal. It

| receives X-Band downlink if uplink was X-Band and

| S-Band downlink if uplink was S-Band.

| IFMS 2 acts at backup.

| IFMS 3 records the second downlink signal. This is

| usually S-Band. But can also be X-Band when the

| uplink was S-Band.

|

| IFMS 1 D1 is fixed to a sample rate of 1/s

| IFMS 1 D2 is on fixed to a sample rate of 1/10s

|

| In addition each Doppler recording system has also

| two Doppler channels which can record simultaneous-

| ly and act as an additional backup system.

| Therefore for each IFMS system there should be at a

| given time two Doppler files and two Auto Gain

| Control files recorded. The file names of these

| data contain the string '\_D1' or '\_D2' for Doppler

| and '\_G1' or '\_G2' for Auto Gain control files and

| they will be on different subfolders within the

| data directory. See further down the description of

| the DATA Directory.

|

| For these data files only X-Band ranging was

| possible. Ranging data was nominally recorded on

| IFMS1.

|

|- DSN:

|-Tracking and Navigation File (TNF)

|

| The Tracking and Navigation File (TNF) is the primary out-

| put from the DSN closed-loop receiver system. These are

| large files, accumulating at the rate of approximately 3

| megabytes (MB) per hour of antenna operation. The files

| comprise nearly 20 block types, each designed to carry

| data of interest to a particular navigation, telecommuni-

| cations, or science community.

| The blocks are described by TNF\_SIS.TXT in the

| DOCUMENT/DSN\_DOC directory. Fields include:

| Uplink and downlink antenna numbers

| Spacecraft number

| Equipment identifiers, status flags, and calibration

| values

| Time tags and frequency bands

| Transmitted and received phase and frequency

| Transmitted and received ranging information

| Noise levels, signal-to-noise ratios, and uncertain-

| ties

|

|-Orbit Data Files (ODF)

|

| For many applications the TNF is too cumbersome. The ODF

| is an edited and partially processed version of the TNF.

| It is a smaller file, often issued in daily increments of

| about 0.2 MB. It contains the most important information

| (range and Doppler)

| needed by spacecraft navigators and investigators

| interested in determining gravitational fields of bodies

| such as Mars. Each ODF is accompanied by a full PDS label

| which describes both the content and format of the

| associated file. ODF data fields include:

| Narrowband spacecraft VLBI, Doppler mode (cycles)

| Narrowband spacecraft VLBI, phase mode (cycles)

| Narrowband quasar VLBI, Doppler mode (cycles)

| Narrowband quasar VLBI, phase mode (cycles)

| Wideband spacecraft VLBI (nanoseconds)

| Wideband quasar VLBI (nanoseconds)

| One-way Doppler (Hertz)

| Two-way Doppler (Hertz)

| Three-way Doppler (Hertz)

| One-way total count phase (cycles)

| Two-way total count phase (cycles)

| Three-way total count phase (cycles)

| PRA planetary operational discrete spectrum range (range

| units)

| SRA planetary operational discrete spectrum range (range

| units)

| RE(GSTDN) range (nanoseconds)

| Azimuth angle (degrees)

| Elevation angle (degrees)

| Hour angle (degrees)

| Declination angle (degrees)

|

| For more information please refer to document

| [DSN\_ODF\_TRK-2-18] in the DOCUMENT/DSN\_DOC folder.

Open- Loop data types:

|

|-ESA: Intermediate Frequency Modulation System (IFMS) Open-Loop

| (OL)

|

| During the commissioning phase the IFMS Open-Loop

| recording system was not implemented, yet.

|

|-DSN: Radio- Science Receiver (RSR)

|

| The Radio Science Receiver (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 in one second records

| in real time. In near real time the one second records

| are partitioned and formatted into a sequence of RSR

| Standard Format Data Units (SFDUs) which are

| transmitted to the Advanced Multi-Mission Operations

| System (AMMOS) at the Jet Propulsion Laboratory (JPL).

| Included in each RSR SFDU are the ancillary data

| necessary to reconstruct the signal represented by the

| recorded data samples.

|

| Each SFDU is defined here as a single row in a

| PDS TABLE object; later SFDUs are later rows. The

| first fields in each row contain the ancillary data

| (time tags and frequency estimates, for example) that

| applied while the samples at the end of the record

| were being collected. The object definitions below

| explain where the fields are and what the contents

| represent.

|

| Analysis of variations in the amplitude, frequency,

| and phase of the recorded signals provides information

| on the ring structure, atmospheric density, magnetic

| field, and charged particle environment of planets

| which occult the spacecraft. Variations in the

| recorded signal can also be used for detection of

| gravitational waves.

|

| DSN open-loop receivers sample a narrow part of the micro-

| wave spectrum near the spacecraft transmitting frequency.

| For radio occultation tests, two RSR's were used - one

| each for X-RCP and S-RCP with output sampled at rates of

| 2000 (complex; 16-bit I, 16-bit Q).

| The data were examined for compliance with data acquisi-

| tion procedures and to measure the frequency/stability of

| the radiolink. Four RSR's (X-RCP, S-RCP, X-LCP, and S-LCP)

| each sample at a rate of 25000 (complex; 16-bit I,

| 16-bit Q) to test bistatic radar data acquisition.

|

| Header information accompanying each RSR record included:

|

| Date and time of the first data sample

| Sample rate and channel assignments

| Receiver local oscillator phase and frequency

| Attenuator settings

| RMS voltages at several stages in the receiving chain

|

|

| For more information please refer to document

| [JPL\_D-16765\_RSR] in the DOCUMENT/DSN\_DOC folder.

"

CONFIDENCE\_LEVEL\_NOTE = "

Overview

========

Data in this archival data set have been processed as part of

health monitoring activities of the RSI Radio Science Team.

In general, this is a good data set.

Review

======

This archival data set was reviewed by the RSI Radio Science

Team prior to submission to the Planetary Science Archive (PSA).

Prior to creation of the final version of the archival data

set, key elements of the archive were distributed for

preliminary review. These included electronic versions of

example PDS labels, CATALOG files, and Software Interface

Specifications. These materials were distributed to PDS

personnel, the experiment investigator, and others,

as appropriate.

ODR files on the electronic media were checked using Stanford

parsing and reduction software to ensure that they were both

complete and accurate replicas of the data contained in the

original files.

Data Coverage and Quality

=========================

The table below lists the individual volumes created to date and

(very briefly) their respective contents.

RSI VOLUME ID VOLUME\_ID Start Date Measurement

------------- ---------- ---------- -------------

RORSI\_0001 RORSI\_0001 2004-03-26 Commissioning

RORSI\_0002 RORSI\_0002 2004-03-27 Commissioning

RORSI\_0003 RORSI\_0003 2004-03-28 Commissioning

RORSI\_0004 RORSI\_0004 2004-03-29 Commissioning

RORSI\_0005 RORSI\_0005 2004-05-02 Commissioning

RORSI\_0006 RORSI\_0006 2004-05-03 Commissioning

RORSI\_0007 RORSI\_0007 2004-05-04 Commissioning

RORSI\_0008 RORSI\_0008 2004-05-05 Commissioning

RORSI\_0009 RORSI\_0009 2004-05-06 Commissioning

RORSI\_0010 RORSI\_0010 2004-09-11 Commissioning

RORSI\_0011 RORSI\_0011 2004-10-09 Commissioning

RORSI\_0012 RORSI\_5001 2005-04-06 Checkout

RORSI\_0013 RORSI\_5002 2005-04-06 Checkout

RORSI\_0014 RORSI\_5003 2005-09-29 Checkout

RORSI\_0015 RORSI\_3001 2006-03-02 Solar Conjunction

RORSI\_0016 RORSI\_3021 2006-03-15 Solar Conjunction

RORSI\_0017 RORSI\_3007 2006-03-16 Solar Conjunction

RORSI\_0018 RORSI\_3002 2006-03-22 Solar Conjunction

RORSI\_0019 RORSI\_3003 2006-03-23 Solar Conjunction

RORSI\_0020 RORSI\_3004 2006-03-24 Solar Conjunction

RORSI\_0021 RORSI\_3005 2006-03-28 Solar Conjunction

RORSI\_0022 RORSI\_3006 2006-03-29 Solar Conjunction

RORSI\_0023 RORSI\_3008 2006-03-30 Solar Conjunction

RORSI\_0024 RORSI\_3009 2006-03-31 Solar Conjunction

RORSI\_0025 RORSI\_3010 2006-04-01 Solar Conjunction

RORSI\_0026 RORSI\_3011 2006-04-04 Solar Conjunction

RORSI\_0027 RORSI\_3024 2006-04-05 Solar Conjunction

RORSI\_0028 RORSI\_3012 2006-04-06 Solar Conjunction

RORSI\_0029 RORSI\_3013 2006-04-07 Solar Conjunction

RORSI\_0030 RORSI\_3014 2006-04-08 Solar Conjunction

RORSI\_0031 RORSI\_3015 2006-04-10 Solar Conjunction

RORSI\_0032 RORSI\_3025 2006-04-15 Solar Conjunction

RORSI\_0033 RORSI\_3026 2006-04-16 Solar Conjunction

RORSI\_0034 RORSI\_3027 2006-04-17 Solar Conjunction

RORSI\_0035 RORSI\_3036 2006-04-18 Solar Conjunction

RORSI\_0036 RORSI\_3029 2006-04-19 Solar Conjunction

RORSI\_0037 RORSI\_3016 2006-04-20 Solar Conjunction

RORSI\_0038 RORSI\_3030 2006-04-21 Solar Conjunction

RORSI\_0039 RORSI\_3031 2006-04-22 Solar Conjunction

RORSI\_0040 RORSI\_3017 2006-04-23 Solar Conjunction

RORSI\_0041 RORSI\_3018 2006-04-24 Solar Conjunction

RORSI\_0042 RORSI\_3032 2006-04-25 Solar Conjunction

RORSI\_0043 RORSI\_3019 2006-04-26 Solar Conjunction

RORSI\_0044 RORSI\_3020 2006-04-27 Solar Conjunction

RORSI\_0045 RORSI\_3037 2006-04-28 Solar Conjunction

RORSI\_0046 RORSI\_3022 2006-04-29 Solar Conjunction

RORSI\_0047 RORSI\_3038 2006-05-02 Solar Conjunction

RORSI\_0048 RORSI\_3039 2006-05-03 Solar Conjunction

RORSI\_0049 RORSI\_3023 2006-05-04 Solar Conjunction

RORSI\_0050 RORSI\_3040 2006-05-09 Solar Conjunction

RORSI\_0051 RORSI\_3041 2006-05-10 Solar Conjunction

RORSI\_0052 RORSI\_5004 2006-08-22 Checkout

RORSI\_0053 RORSI\_5005 2006-11-22 Checkout

RORSI\_0060 RORSI\_5006 2007-05-15 Checkout

RORSI\_0061 RORSI\_5007 2007-10-10 Checkout

RORSI\_0063 RORSI\_5008 2008-01-03 Checkout

RORSI\_0064 RORSI\_5009 2008-11-04 Checkout

RORSI\_0120 RORSI\_3033 2006-11-04 Solar Conjunction

RORSI\_0120 RORSI\_6001 2010-07-10 Lutetia

RORSI\_0121 RORSI\_3028 2006-04-12 Solar Conjunction

RORSI\_0122 RORSI\_3034 2006-04-13 Solar Conjunction

RORSI\_0123 RORSI\_3035 2006-04-13 Solar Conjunction

RORSI\_1010 RORSI\_0012 2014-03-30 Commissioning

Radio Science Validation Process

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Several Quick-Look-plots of the retrieved data are generated

during processing to Level 2. These plots are investigated to

validate the measurement. Possible decisions are then to deliver

the data to the official PSA Archive, to archive the data only

internally or regard the measurement as failed.

The following section gives a short description of the

Quick-Look-Plots and their meaning for the validation process.

The plots can be found in the BROWSE folder. For more details

refer to BROWINFO.TXT, also located in this folder. For the

respective terms refer to the document

MEX-MRS-IGM-DS-3035/ROS-RSI-IGM-DS-3118/VEX-VRA-IGM-IS-3011

(Doppler Processing and Calibration Software) in the DOCUMENT

folder of this dataset.

Residuals

---------

The residual (frequencyobserved - frequencypredicted) should

fluctuate around 0 Hz with a maximum fluctuation range of

approximately 0.1 HZ. Steps, peaks or a gradient in the residual

should be investigated to decide if the data can be used. But it

depends on the individual measurement, if the data set is

severely influenced by such data problems, and on the

experienced user if he accepts the data. The time measuring

device at the IFMS ground station may produce so-called

cycle-slips which can be seen in the observed frequency. This

results in huge peaks in the residuals and the data can not be

used, if the number of cycle-slips is too large.

AGC

---

The noise level of the data and the associated signal level

(AGC) is dependent on the distance between the spacecraft and

the Earth. For X-Band we usually have values of about

-50/-70 dBm, for S-Band of about -70/-80 dBm. The fluctuation

range should not exceed 1 dBm. If there is a high noise-level

or the signal level is extremely low, the ground station

receiver might have been unlocked or the spacecraft operated

in a non-coherent mode. No gradient or peaks should be visible

in the data. Steps can be seen if telemetry is switched on/off,

but this is not a sign for a measurement error. In case of VEX

occultations both, ingress and egress phases, can occur in one

plot. A drop of about 40 dB representing the occultation then

appears in the middle of the time interval.

Differential Doppler

--------------------

The data should fluctuate around 0 Hz with a maximum fluctuation

range of 0.1 Hz, depending on the distance between spacecraft

and Earth. The Differential Doppler is important in solar corona

sounding measurements especially.

Calibration

-----------

Occultation

Calibration is done for occultation measurements using a

Klobuchar model for the Earth ionosphere. Besides, Meteo-files

derived at the groundstation are used for the tropospheric

correction. The calibration data should show a smooth curve with

small values without any steps.

Gravity

Until begin of 2007 calibration of gravity measurements is done

using the Differential Doppler data. This calibration step

corrects the effects induced by the interplanetary plasma.

This can only be done if two downlink frequencies have been

recorded. The Meteo-files derived at the groundstation are used

for the tropospheric correction. If the Differential Doppler

noise is too high, Earth ionosphere calibration is done via the

Klobuchar-Coefficients. The calibration data should then show a

smooth curve of small values without any steps. If the

Differential Doppler is used, the high frequency plasma noise

superposes the calibration curve. The overall appearance depends

on the observation geometry. Since begin of 2007 calibration is

always done using the Klobuchar model for Earth ionosphere. The

Meteo-files derived at the groundstation are used for the

tropospheric correction. The calibration data should show a

smooth curve without steps and small values.

Solar Conjunction

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Calibration is done for Solar Conjunction measurements with

Klobuchar-Coefficients for the Earth Ionosphere. The Meteo-files

derived at the groundstation are used for the tropospheric

correction. The calibration data should show a smooth curve with

small values without any steps.

Other Notes

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Most notably it was discovered that the incoming Doppler data

from ESA and thus level 1A and level 1B Doppler data may contain

a wrong uplink frequency. This problem was identified during

processing and corrected for level 2 data. If this problem

occurred the folder UPLINK\_FREQ\_CORRECT will be generated in the

CALIB directory containing information which raw files were

effected and where to find the corrected data.

It was discovered that for IFMS the file naming convention of

AGC raw files was crossed since beginning of the Mars Express

mission.

In fact AGC1 refers to D2 and AG2 refers to D1 and not the other

way around as it should be. Consequently the AGC files were

swapped during the whole processing.

Please note, that for the New Norcia ground station (NNO) the

ESA station number is 74 wheras the DSN station number is 32.

This number is used in the labels and most documents. Some ESA

documents and especially orbit prediction files may use the

ESA station number.

Because of some problems with documentation on the U.S. side,

the navigation people are using 83 for Cebreros rather than 62,

the official station id; so you may see either number depending

on the source of the file.

On 15.8.2007 the PI of Radio Science moved to another institute.

Old institute: Institut fuer Geophysik und Meteorologie an der

Universitaet zu Koeln.

New instiute: Rheinisches Institut fuer Umweltforschung,

Abteilung Planetenforschung

Quality of data was affected by anomalous conditions.

Examples include:

Open-Loop Data Anomalies

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Closed-Loop Data Anomalies

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RORSI\_1010: Measurement several times stopped and restarted;

uplink frequency corrected for IFMS3.

Limitations

===========

The limitations in this data set follow from the quality of

the execution, which is described above under Data Coverage

and Quality.

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

CHDO Compressed Header Data Object

CVP Commissioning

DDS Data Distribution System

DSMS Deep Space Mission System

DSN Deep Space Network

ESA European Space Agency

ENT/EXT Extended Mission

ESOC European Space Operations Centre

G/S Ground Station

HEF High Efficiency ground station (DSN)

IFMS Intermediate Frequency Modulation System

JPL Jet Propulsion Laboratory

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

PRM Prime Mission

RO Rosetta Orbiter

RSI Radio Science Investigation

RSR Radio Science Receiver

S/C Spacecraft

SFDU Standard Formatted Data Unit

TNF Tracking and Navigation File

ULS Ulysses

UniBw Universitaet der Bundeswehr in Muenchen

"

END\_OBJECT = DATA\_SET\_INFORMATION

OBJECT = DATA\_SET\_TARGET

TARGET\_NAME = CHECKOUT

END\_OBJECT = DATA\_SET\_TARGET

OBJECT = DATA\_SET\_HOST

INSTRUMENT\_HOST\_ID = RO

INSTRUMENT\_ID = RSI

END\_OBJECT = DATA\_SET\_HOST

OBJECT = DATA\_SET\_MISSION

MISSION\_NAME = "INTERNATIONAL ROSETTA MISSION"

END\_OBJECT = DATA\_SET\_MISSION

OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

REFERENCE\_KEY\_ID = "RSIUSERMANUAL2004"

END\_OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

REFERENCE\_KEY\_ID = "RSIFNC2004"

END\_OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

REFERENCE\_KEY\_ID = "JPLD-16765"

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REFERENCE\_KEY\_ID = "DSNTRK-2-18"

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OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

REFERENCE\_KEY\_ID = "MANNUCCIETAL1998"

END\_OBJECT = DATA\_SET\_REFERENCE\_INFORMATION

END\_OBJECT = DATA\_SET

END