European Space Agency
Research and Science Support Department
Planetary Missions Division

Rosetta - ROMAP

To Planetary Science Archive Interface Control Document

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RO-ROL-ROMAP-EAICD

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Distribution List

Recipient	Organisation

Change Log

Date	Sections Changed	Reasons for Change
23 December 2010	Creation of Issue 1 Revision 0	Delivery of Issue 1.0 to PSA after peer review
01/07/2015	Updated: -2.4.5 In-Flight data products -2.4.8 Ancillary Data Usage -3.2.3 Reference systems -3.3.2 SPM Quality parameter -4.2 Datasets, Definition and Content Added: -3.2.2.2.5 Spacecraft Clock Count in PDS Labels Deleted: -3.4.3.4.2 Geometric Index File -References to SPM derived data	Delivery of Issue 1.1 updated for the Comet phase
08/01/2016	Updated: 2.4.5. Inflight data products 3.1.4. Filenaming Conventions 3.2.3. Reference Frames	Comet related reference frames are added
14/07/2016	Updated: The orientation of the SPM sensor channels has been added in Chapter 2.2.1. Instrument Status description added in Chapter 2.2.2. It has been pointed out in chapters 3.1.1., 3.3.1., 3.4.2., and 4.3.7. that the data cleaning process is irreversible and therefore those data are classified as "derived"	RIDS

TBD ITEMS

Section	Description

Table Of Contents

1 Introduction

1.1 Purpose and Scope

The purpose of this EAICD (Experimenter to Planetary Science Archive Interface Control Document) is two fold. First it provides users of the ROMAP instrument with detailed description of the product and a description of how it was generated, including data sources and destinations. Secondly, it is the official interface document between ROMAP and Planetary Science Archive (PSA) of ESA.

1.2 Archiving Authorities

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

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

ESA's *Planetary Science Archive* (PSA)
ESA implements an online science archive, the PSA

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

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

1.3 Contents

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

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

1.4 Intended Readership

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

1.5 Applicable Documents

AD 1. Planetary Data System Preparation Workbook, February 17, 1995, Version 3.1, JPL, D-7669, Part1
AD 2. Planetary Data System Standards Reference, August 1, 2003, Version 3.6, JPL, D-7669, Part 2
AD 3. Rosetta Archive Generation, Validation and Transfer Plan, January 10, 2006, Issue 2, Rev. 3, RO-EST-PL-5011
AD 4. ROSETTA Archive Conventions RO-EST-TN-3372 Issue 7, Rev. 9, 06 April 2015
AD 5. ROSETTA-RPC-MAG To Planetary Science Archive Interface Control Document EAICD RO-IGEP-TR0009 Issue 2.1
AD 6. ROMAP Electronics FM2 ADP, RO-LRO-DP-300002-UA, Issue 1, Revision 0, 16/05/2001
AD 7. ROMAP Boom & Sensor FM2 ADP, RO-LRO-DP-300003-UA, Issue 1, Revision 1, 16/07/.2001
AD 8. ROMAP Instrument Calibration Report FM2, RO-LRO-TR-300010-WM, Issue 1, Rev. 1, 15/11/2000
AD 9. CDMS Command and Data Management System - Subsystem Specification RO-LCD-SP-3101 29/08/2001, Issue 3, Rev. 5
AD 10. CDMS Command and Data Management System - Operation Manual RO-LCD-SW-3402 12/02/2001, Issue 1, Rev. 2
AD 11. Rosetta Time handling RO-EST-TN-3165, issue 1 rev 0, February 9, 2004
AD 12. DDID- Data Delivery Interface Document RO-ESC-IF-5003 Issue B6 23/10/2003

1.6 Acronyms and Abbreviations

CDMS	Command and Data Management System
CEM	Channel Electron Multiplier
CFF	Comet Fixed Frame
CNES	Centre National d'Etudes Spatiales
CODMAC	Committee On Data Management, Archiving, and Computation
COSAC	Cometary Sampling And Composition
CSEQ	Body-Centered Solar EQuatorial Frame
DDS	Data Delivery System (ESOC server)
DECW	Data Error Control Word
EAICD	Experiment Archive Interface Control Document
EGSE	Electronic Ground Support Equipment
ESA	European Space Agency
ESOC	European Space Operation Center
ESTEC	European Space Research and Technology Center
ESS	Electrical Support System
FM	Flight Model
FPGA	Field-Programmable Gate Array
GRM	Ground Reference Model
HK	Housekeeping
IWF	Institut für Weltraumforschung (IWF) in Graz
LOBT	Lander On Board Time
MPS	Max-Planck-Institut für Sonnensystemforschung
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
OBDH	On Board Data Handling
OOBT	Orbiter On Board Time
OBT	On Board Time
PDS	Planetary Data System
PECW	Packet Error Control Word
PI	Principal Investigator
PID	Process Identifier
PSA	Planetary Science Archive
PVV	PSA Volume Verifier

QM	Qualification Model
RF	Radio Frequency
ROMAP	Rosetta Magnetometer and Plasma Monitor
SC	Science
S/C	Spacecraft
SCET	Spacecraft Event Time
SFDU	Standard Formatted Data Unit
SONC	Science Operations and Navigation Center(CNES-Toulouse)
TBC	To Be Confirmed
TBD	To Be Defined
TC	Telecommand
UTC	Universal Time Coordinated

1.7 Contact Names and Addresses

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2 Overview of Scientific Objectives, Instrument Design, Data Handling Process and Product Generation

Main scientific goals of ROMAP are (1) long term measurements on the surface to study the cometary activity as function of the distance from the Sun and (2) magnetic measurements during the descent phase of the Lander to investigate the structure of the remnant magnetization of the nucleus.

The ROMAP sensors (fluxgate magnetometer, electrostatic analyser and Faraday cup) measure the magnetic field from 0 to 32Hz, ions up to 8.0 keV and electrons up to 4.2 keV. High integration level of sensors and electronics. That is the basic for a combined field/plasma measurement instrument with less than 1 Watt power consumption and 1 kg mass. Additional two pressure sensors are included in the ROMAP sensor arrangement. The sensors are moved from COSAC to ROMAP to optimise long term operation of pressure sensors. Data of both pressure sensors are transmitted within the housekeeping frame and are handled / archived as housekeeping values

2.1 Scientific Objectives

The Magnetometer (MAG) and the Simple Plasma Monitor (SPM) are the two experiments of the Small Instrument Package ROMAP, which complement the plasma packages onboard the ROSETTA Orbiter. Both instruments deliver data about the comet / solar wind interaction and the cometary activity as function of the distance from the sun and the onset of the diamagnetic cavity formation. The SPM sensor is able to determine the major solar wind parameters like density, speed, temperature, and flow direction. The Magnetometer sensor is able to determine the magnetic field vector.
Based on camera data from the flybys of the VEGA/GIOTTO spacecrafts at comet p/Halley in 1986, it was found that only a small part of the nucleus is active. As a consequence, new models about the internal structure of the nucleus were developed, in which the heat conductivity of the surface material is a key parameter. Up to the present, however, there are no direct measurements. On the background of such models, the gas production rate Q of the target comet p/Wirtanen was calculated as function of its radial distance to the Sun [Fuselier 1995; Kührt 1995]. Whereas the predictions of both models for perihelion distances are almost identical, they significantly differ for greater distances. For R=3.5AU, for example, there is a discrepancy of about four orders of magnitude: $Q=10^{23}$ s^{-1} according to Fuselier's model and $Q=10^{27}$ s^{-1} from Kührt. This great discrepancy is an example, which demonstrates the large uncertainties about the internal structure of the nucleus.
To date, most of the studies of comet-solar wind interaction address a well-developed cometary atmosphere. During the last decade, however, it has become apparent from both observation and theory that even weakly outgassing (or weakly magnetized) bodies may act as obstacles to the solar wind, creating effects that spacecraft magnetometers can resolve. As a result of bi-ion fluid simulations of the solar wind interaction with a weakly outgassing comet (Bogdanov et al. 1995), for example, one can distinguish between three main interaction regimes ordered with increasing neutral gas production rate Q. For $Q<10^{25}$ s^{-1} the cometary activity is negligible and the body behaves like an asteroid. In the range 10^{25} s^{-1} < Q < 10^{27} s^{-1} effects become important that cannot be explained in the framework of classical one-fluid MHD theory since the characteristic scale lengths are smaller than the heavy ion gyro-radius. There is no bow shock, only Mach cone-like structures, and the heavy ion fluid flows along a cycloidal orbit accompanied by a small-scale structuring (heavy ion bunching). This structuring is sensitive to the parameters involved (Alfven Mach number, plasma beta, production rate). In the range 10^{27} s^{-1} <Q one is confronted with a well-developed cometary atmosphere as, for example, found at p/Grigg-Skjellerup, p/Giacobini-Zinner and p/Halley. Characteristic features are the formation of a diamagnetic cavity in the immediate vicinity of the nucleus, a cometopause (ion composition boundary) and a bow shock.
For the formation of a magnetic cavity around the nucleus, from which the solar wind is excluded, a rough estimate can be derived. According to the momentum flux balance of solar wind and purely cometary plasma at the interface, the cavity radius is given by

$R_{cavity}=\frac{\mu\sigma Q}{4\pi n_{sw} v_{sw}^2}$ (σ ionisation rate, μ mass ratio cometary ions to protons, n_{sw} solar wind density, v_{sw} solar wind velocity; see also Haerendel 1987). A cavity with a radius of 10km (as a reasonable lower limit) requires a production rate $Q=5\times10^{27}$ s^{-1}, which appears to be a threshold value for the existence of a cavity.
After landing, magnetometer and plasma monitor shall operate in a common mode (surface mode). Aim is to measure during a full cometary rotation period (8h). If the operation time is limited for energy reasons operation during a full cometary day (4h) is planed. The measurement shall be repeated in regular intervals (e.g. each 4 days) to monitor the plasma evolution with closer distance to Sun. Measurements have to be done synchronously with RPC onboard the orbiter.

For the first time ever, the ROSETTA mission provides magnetic field measurements at very low distances from a cometary nucleus in a situation where the cometary activity is not yet fully developed. If the nucleus is not protected by an atmosphere produced by outgassing, the solar wind interacts directly with the intrinsic field and one can expect a situation similar to that observed at GALILEO's flyby at the asteroids Gaspra and Ida. Whereas the closest approach at these flybys was of the order of 1000 km, the situation here is much better because the surface field can be measured directly, practically not affected by the solar wind. In addition, during the approach to the nucleus, the probe can measure the variation of the magnetic field with distance and thus one should be able to clearly identify the type of the possible remnant magnetization.

Magnetometer data from GALILEO's flyby at the two asteroids Gaspra and Ida [Kivelson et al. 1993] together with model calculations [Baumgärtel et al. 1994, Kivelson et al. 1995a,b] have been interpreted in terms of an intrinsic magnetization of these bodies. It is generally assumed that this is remnant magnetization due to magnetic minerals such as iron-nickel, magnetite, and pyrrhotite, which were magnetized by relatively strong magnetic fields in the early solar nebula [e.g., Sugiura and Strangway 1988]. In the case of a generic relationship between asteroids and comets as to their refractory components, the magnetism of cometary nuclei could be caused by material exhibiting a natural remnant magnetization (NRM) in much the same way. Whether or not such material is present in cometary nuclei is still under debate.
Both, experimental results (mass spectrometry of particles escaped from p/Halley) and theoretical models point out primary magnetic minerals and possibly secondary magnetic material as well. One should expect the more pristine bright cometary regions to be characterized by rather primary magnetic material whereas the dark fractionated regions should be enriched by secondary magnetic material. More specifically, the following magnetic minerals/materials are being considered: $Fe_3 O_4$ (magnetite), Fe-Ni (metal) and $(Fe,Ni)_{0.9} S$ (pyrrhotite) as major carriers in the light regions and magnetite and a Fe-S-Ni-Si-O-rich phase in the dark regions. This is probably the main carrier of the NRM in bulk samples of C1-chondrites.

The growth of fractal aggregates from collisions between small dust grains is generally accepted to be the first step in the formation of planetesimals and cometesimals in the early solar system. Until now, the grain-grain interactions considered within this scenario were of mechanical and electrostatic nature only. If magnetized material were present at this stage, as is suggested by meteoritic and asteroidal evidence, magnetic interactions between dust particles should be taken into account as well. It has been shown experimentally [Nuth et al. 1994] and numerically [Nübold and Glassmeier 1999, 2000] that magnetized grains tend to build elongated structures of low fractal dimension and non-vanishing magnetic moment (see Figure 1). In case of enough magnetic material is available, this process may lead to centimetre or even metre sized magnetic structures, which ROMAP might be able to detect. Remnant magnetization of primitive objects such as comets could thus be called “accretional remanence”.

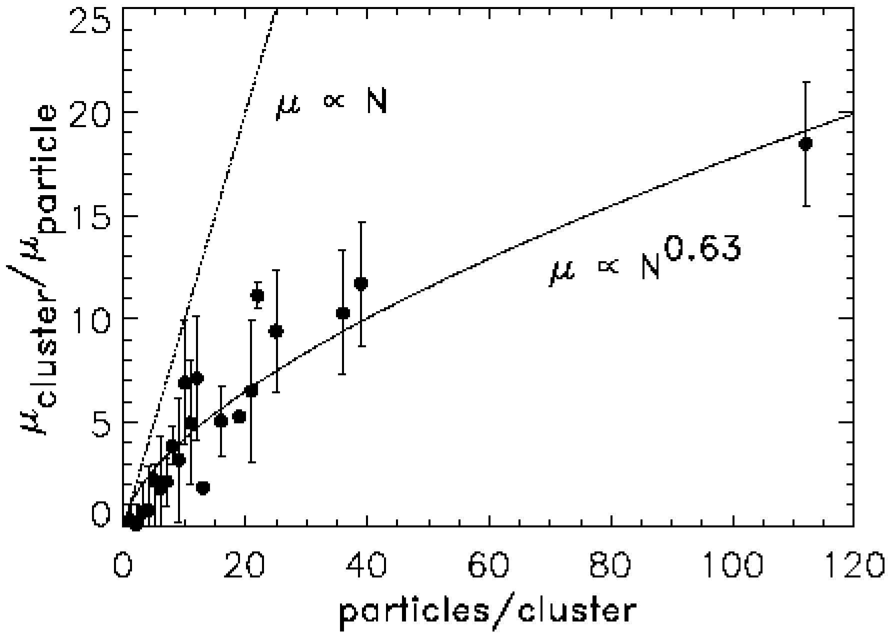

Figure 1 . Accretional remanence of growing magnetic dust aggregates in a numerical simulation [Nübold and Glassmeier, 2000].

2.2 Instrument Design

The ROMAP hardware consists of a combined magnetic field (MAG) and plasma (SPM) sensor mounted on a small boom, the near sensor electronics, a high-voltage generator (HV-part) and a small DPU (controller).

2.2.1 ROMAP Sensors

The magnetic field is measured with a vector compensated ringcore fluxgate magnetometer designed by the TU-Braunschweig and manufactured by the MPE Garching. The sensor consists of two ringcores (crossed in to each other) as well as pick-up coils and Helmholtz coils for each sensor axis. The coil system design without mechanical support allows the compensation of the external field on the ringcore position with high homogeneity and low weight (the overall sensor weight is 30g). Dynamic feedback fields as well as offset fields up to 2000nT can be generated in order to compensate Lander and/or Orbiter DC stray fields. The determination of Lander and Orbiter offsets could be done during the cruise phase using non compressible waves in the solar wind [Hedgecock 1975]. Parallel measurements of Lander and Orbiter magnetometer during Lander eject, descent and during measurement campaigns on the cometary surface gives an additional input for the inflight calibration.
The main part of the SPM-sensor is a hemispherical electrostatic analyzer with two channeltrons (CEM's) for ions measurement and one for electrons measurement. The entry of the ion channels is equipped with deflection plates to realize the spatial resolution. Despite the small size of the sensor, the sensitivity and resolution of the instrument are high and its field of view wide (appr. 100 degree). The E/q-range extends from 0 to 8 kV. Using CEMs in counting mode the electrostatic analyzer measures electron and ion distribution in a wide energy range. Hemispherical deflection plates analyze the energy in 32 or 64 steps. All major plasma parameters as bulk velocity, density and isotropic temperature of electrons and protons can be derived.
A retarding-grid Faraday cup sensor is implemented to measure currents due to fluxes of low energy charged particles on a collector plate. The Faraday cup measures the „reduced“ velocity distribution of the plasma due

to its inherent integration over velocities contained in a plane of differential thickness perpendicular to the axis of the sensor. Because the sensor is not differential in angle, the Faraday cup requires relatively low data rates. But for a given orientation it provides differential information in velocity space only along a direction perpendicular to the retarding grid [Lazarus et al. 1993].

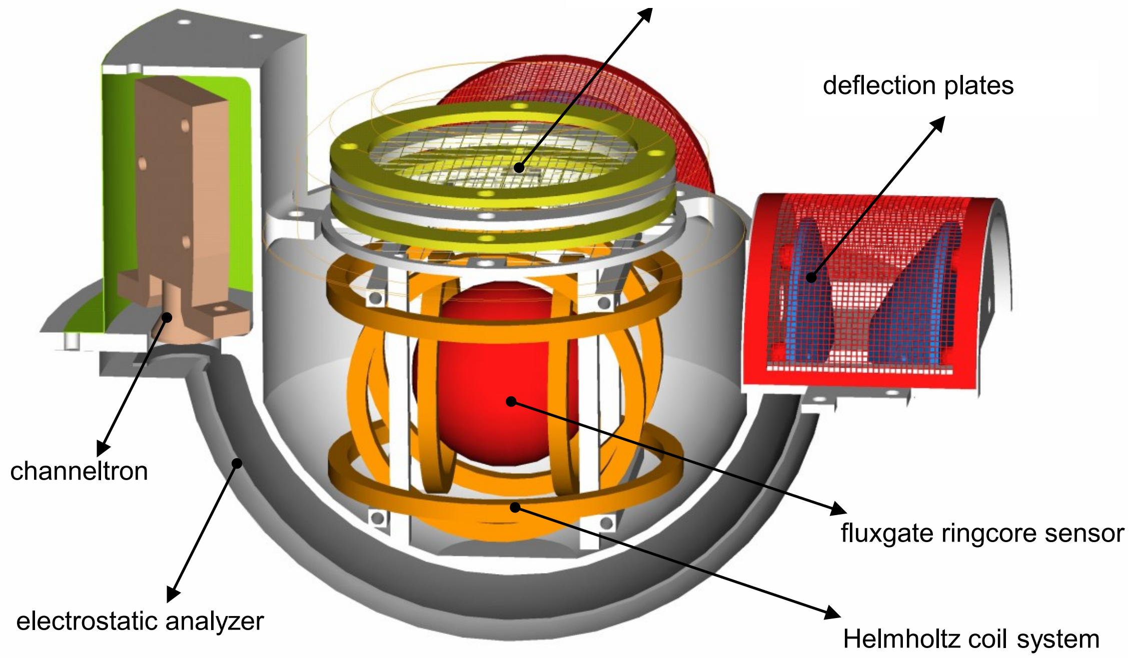

Figure 2 ROMAP MAG and SPM sensors compartment.

SPM sensor and fluxgate sensor integrated within one spherical sensor head. Figure 2 shows the sensor compartment. The sensor head is mounted on a 60 cm boom which is fixed with a hinge on the upper edge of the Lander structure and with a launch lock on the Lander balcony. After opening the launch lock, the boom

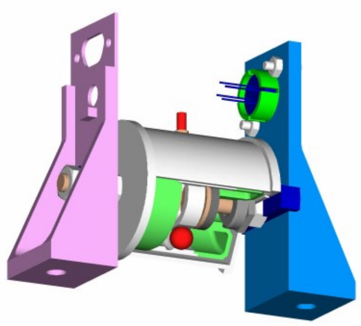

Figure 3 Pressure sensors

is deployed by two springs inside the hinge.

Two pressure sensors are selected to cover the whole pressure range from 10^{-8}mbar to 10^{1}mbar. For the range from 10^{-8}mbar to 10^{-3}mbar an ionising system (Penning) is deployed while for the range from 10^{-3}mbar to 10^{1}mbar a heat conduction sensor (Minipirani) is available. The pressure data are transmitted in the housekeeping frames. They are handled and archived as housekeeping and not as scientific values.
The combined magnetometer / SPM sensor is mounted on a 60 cm boom which is fixed with a hinge on the upper edge of the Lander structure and with a launch lock on the Lander balcony. After opening the launch lock, the boom is deployed by two springs inside the hinge. The SPM sensor, the Pressure sensors and all boom parts are designed by the MPS Lindau. The magnetometer sensor is provided by TU-BS.

The Boom and the related coordinate systems are shown in Figure 4a. In stowed position the opening angle is 19.6°. This angle opens to 90° with the deployment. The magnetometer coordinate system is identical with the ROMAP coordinate system. The alignment of the SPM Ion channels is shown in Figure 4b.

ROMAP sensor orientation

Coordinates (in Lander system) of rotation centre:

X:	186.82mm
Y:	-315.0mm
Z:	526.2mm

Sensor centre in stowed position:

X:	20.2mm
Y:	-315.0mm
Z:	58.7mm

Sensor centre in fully deployed position:

X:	-329.1mm
Y:	-315.0mm
Z:	526.2mm

Convertion of ROMAP system (R) in Lander System (L):

Stowed:

$$(L) = \begin{pmatrix} 0 & 0.336 & -0.942 \\ 1 & 0 & 0 \\ 0 & 0.942 & 0.336 \end{pmatrix} (R)$$

Deployed:

$$(L) = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} (R)$$

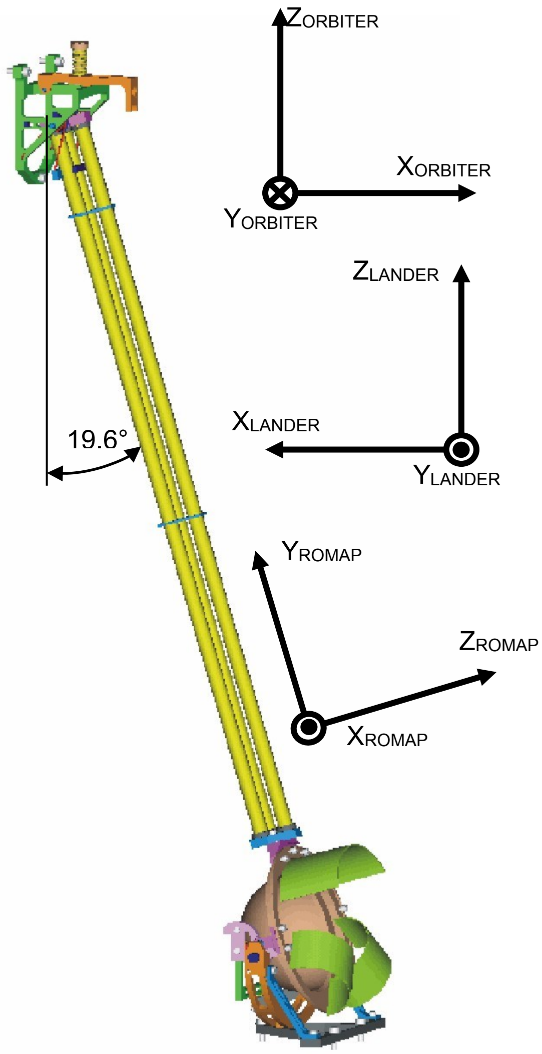

Figure 4a ROMAP MAG sensor orientation

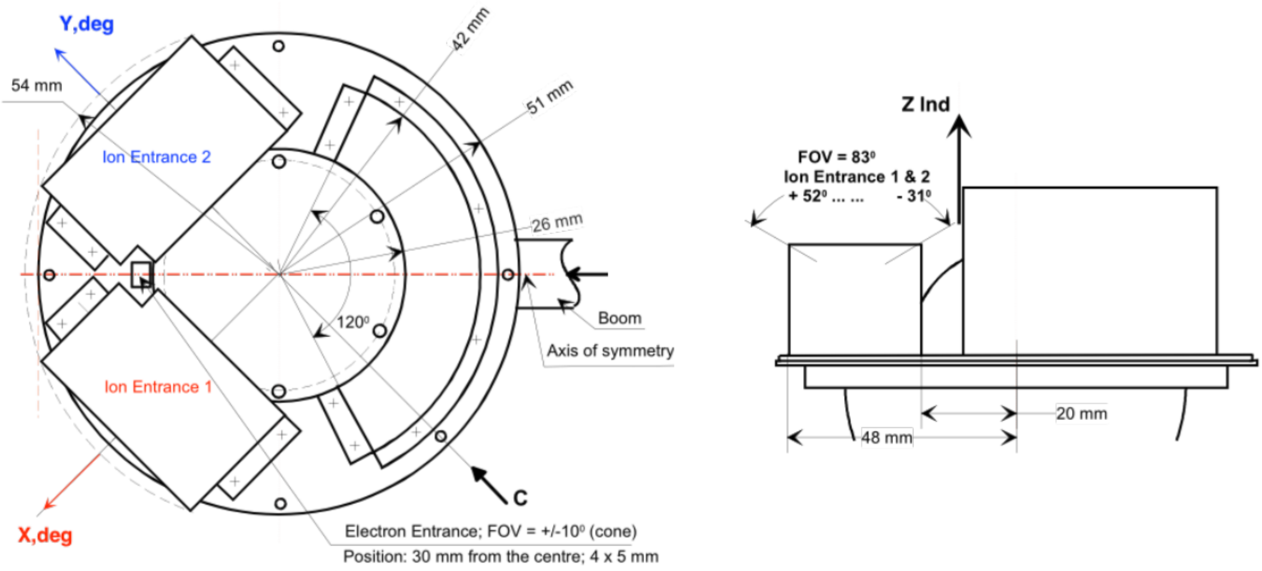

Figure 5b ROMAP SPM sensor orientation

2.2.2 ROMAP Electronics

The ROMAP electronics consists of two boards placed inside the common electronics box. The central part of the near sensor electronics on the first board is a FPGA which controls AD and DA-converters. The 16-bit AD converters are digitising science and housekeeping data from all three sensors. In the block diagram (Figure 6) this data flow is drawn with dotted lines.

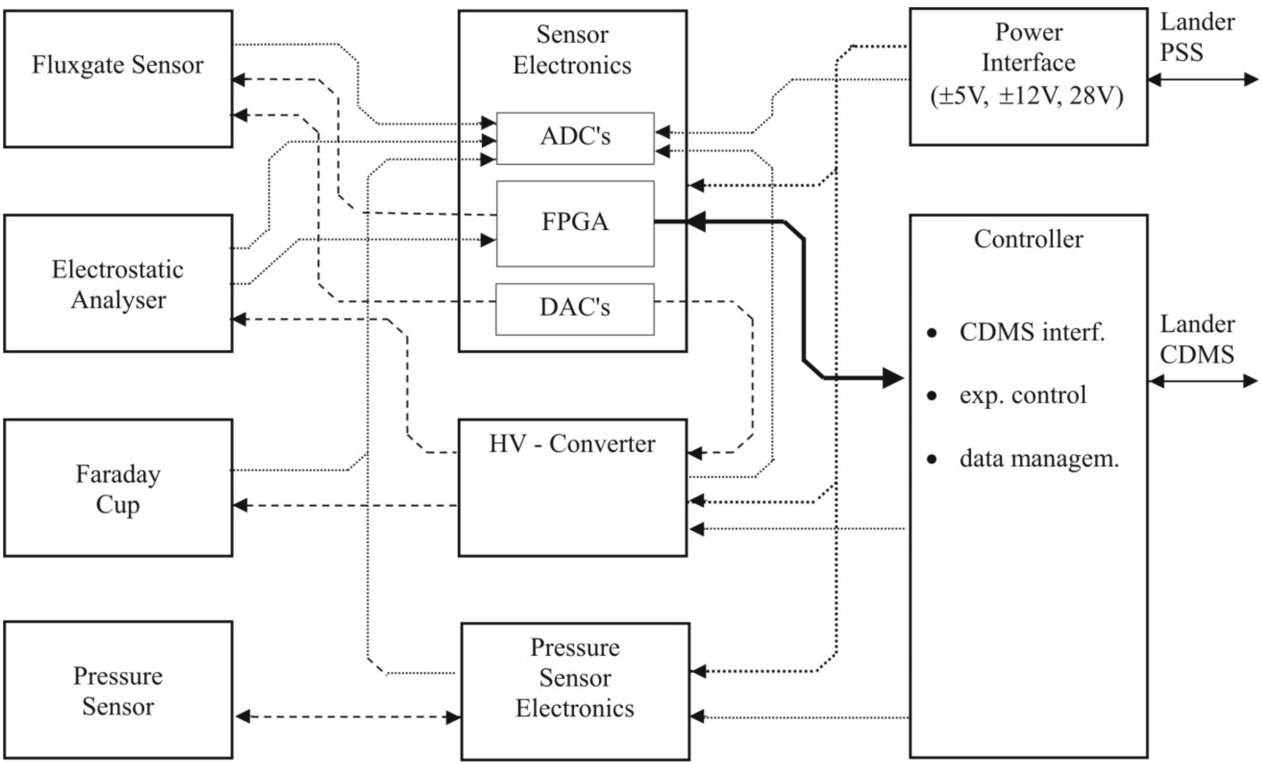

Figure 6 ROMAP electronics

Typical analogue parts of fluxgate magnetometers like filters or phase-sensitive integrators are substituted by fast digitalization of the sensor AC-signal and the following data processing in FPGA's (which overtakes the functions of the former analogue parts) [Auster et al. 1995]. In this way mass is saved without any loss of accuracy. The resolution is still restricted by sensor noise (less than 5pT/ √Hz at 1Hz) [Fornacon et al. 1999], not by electronics. Compensation fields for the magnetometer and high voltage steps for electrostatic analyser and Faraday cup are controlled via DA-converters (dashed lines). The near sensor electronics is developed by Magson GmbH Berlin The high voltage generator (developed by the KFKI) is in a separate shielded box on the front panel of the common electronics box..

The controller is located on the second ROMAP board. It controls MAG and SPM, stores their data output and implements the interface to the Lander Command and Data Management System (CDMS). It triggers the measurement cycle of the magnetometer, implements the digital magnetometer algorithm, controls the magnetometer feedback and generates data frames. For the SPM sensors the controller has implemented the counting logic for electrons and ions, samples Faraday cup data, generates SPM data frames, controls the high voltage parameters (energy, elevation), controls the channeltron HV-supply and computes the plasma parameters. In the parameter mode only the sums of the rows and columns of the sampled ion and ion-current arrays are transmitted. The controller is based on a RTX2010. Address decoder, reset logic, clock generators, control signals generator, watchdog logic and CDMS interface are integrated within a FPGA. Hard- and software are developed by the IWF Graz.
The instrument parameters and the required recourses are given in the following tables:

Instrument parameters:

type of sensor	***parameter***		***value***
Fluxgate Magnetometer	dynamic range		±2.000nT
	resolution		10pT
	sensor noise		<5pT/√Hz
	frequency range		0...32Hz
	offset drift		<0.1nT/°C
Electrostatic, Hemispherical Analyzer	channels	ions	2 CEM
		electrons	1 CEM
	energy range	ions	40 ... 8000eV
		electrons	0,35 ... 4200eV
	field of view	ions	100° x 100°
		electrons	10° x 60°
	energy steps		32 or 64, log. scaled
	max. count rate		10^6 counts/s
	exposition time		40 ... 1.000ms
Faraday cup	ion integral energy distribution		up to 2000 eV
	resolution (current mode)		$\pm 1.5\ 10^{-12}$ - $\pm 5.10^{-10}$ A
	field of view		140^0 x 140^0
	energy steps		16 steps
	entrance area		6 cm^2
Penning Sensor	range		10^{-8} – 10^{-3}mbar
	electric Field		10^6 V/m
	magnetic field		700 Gauss
Pirani Sensor	range		10^{-3} – 10 mbar
	bridge resistors		1kOhm

ROMAP Resources

recourses	***experiment part***	***requirements***	Σ
mass	MAG sensor	40g	
	SPM sensor	120g	
	Pressure sensor	110g	
	boom + hinge + cable	80g	
	launch lock	40g	
	pressure harness	50g	
	electronics in CEB (interface, analogue, controller, HV-box, connectors, frontplate)	360g	
	Pressure E-Box	130g	930g
power	sensor electronics	350...550mW	
	controller	180mW	
	penning electronics	100mW	
	pirani electronics	50mW	
	HV-part	200mW	<900mW
telemetry rate	surface mode MAG SPM	 70 bits/s 30 bits/s	80 bits/s
	slow mode MAG	70 bits/s	68 bits/s
	fast mode MAG	4400 bits/s	4369 bits/s

ROMAP Instrument Status:

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
descr.	IM1	IM0	R:P	PR	PE	RR	RE	CAL	P	F	R	I2	I1	CEM2	CEM1	CEM0

CEM2..0: CEM HV supply setting ("CEM_SUPPLY")
- 000: step 1
- 001: step 2
- 010: step 3
- 011: step 4
- 100: step 5

I1 ion channel 1 and ion current channel 1 on(1)/off(0)
I2 ion channel 2 and ion current channel 2 on(1)/off(0)
R raw data frames are generated on(1)/off(0)
F all rows/columns are transmitted in a raw data frame on(1)/off(0)
P parameter data frames are generated on(1)/off(0)
CAL SPM calibration (automatic increase of HV) active(1)/inactive(0)
RE Raw Data exposition time setting: Short(0)/Long(1)
RR Raw Data resolution setting: Low(0)/High(1)
PE Parameter Data exposition time setting: Short(0)/Long(1)
PR Parameter Data resolution setting: Low(0)/High(1)
R:P Raw Data : Parameter Data Cycles: 1:10(0)/1:20(1)
IM1, IM0 Instrument Mode identifier
- 00: Fast MAG Mode
- 01: Slow MAG Mode
- 10: Surface Mode

2.3 Data Handling Process

SONC is responsible for data preparation and TU-BS is responsible for the distribution to CoI's. The relevant contact information is provided in section 1.7.
The SONC is responsible for PDS ROMAP data sets generation and delivery to the PSA.

The ROMAP telemetry data are provided by the ESA DDS (Data Distribution Server). Following the operations plan the SONC pulls out archived packets (Science and HK) by direct request to the DDS via FTP and stores them into SONC database.
SONC also handles Auxiliary data (Attitude and Orbit files) pushed by the ESA DDS (data distribution system) server.

As soon as they are received, the Science and HK data raw packets are passed through data processing software. The SONC data processing system takes as input raw telemetry data (packets) and raw attitude and orbit files. The SPM raw data are decommutated into ions energy and angle distributions (currents and counts), Faraday cup current and electron energy distribution (counts) and preliminary calibrated. The magnetic field vectors in instrument frame are extracted, time stamped in UTC, converted to physical units (nT) and stored in the SONC database. These data are furthermore draft calibrated (offset, sensitivity and alignment calculation) and rotated into different coordinate systems (EMEJ2000, ECLIPJ2000, SM, GSM, GSE, MSO). The calibration can be performed with different sets of calibration data (alignment and sensitivity matrices and offset vectors) that are stored in the SONC data base. This allows the use of different calibrations for different time intervals. The calibrated data are not stored in the SONC database but produced on the fly from the raw data and a selected calibration set.

Consequently, the following data are immediately available through W3-SONC server (http://soncv2-rosetta.cnes.fr) and the authorized[1] users can get them for a selected time interval :

- Science (SC) and Housekeeping (HK) raw packets as binary files
- Preliminary calibrated magnetometer data (SONC level 1) in selectable coordinate systems as ASCII files
- Preliminary calibrated plasma monitor data (SONC level 1)
- Calibrated HK data as ASCII files

Moreover, the W3-SONC provides interactive plots of ROMAP science and housekeeping data.

After the proprietary period, the SONC team provides the raw data, preliminary calibrated data to the PSA team.

ROMAP-MAG Final calibration (SONC level 1_lab) has to be done by TU-BS using RPC data. Only some selected data intervals are provided to SONC and PDS during cruise.

The delivery format is described in this document.

2.4 Overview of Data Products

2.4.1 Pre-Flight Data Products

Preflight data are not subject of archiving. MAG as well as SPM data measured on ground are not representative due to environmental conditions (Earth field, stray fields, non vacuum): All relevant calibration results are summarized in the ADP.

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[1] The authorization is controlled by PI (TU-BS). At his request, SONC delivers a login/password to the authorized user.

2.4.2 Sub-System Tests

No sub-system test data are provided.

2.4.3 Instrument Calibrations

MAG : Only selected calibration data (interpretable with limited setup information) are archived.
SPM : Instrument calibration data are not archived.

The file ROMAP_CALIBRATION_DESC.TXT (located in the DOCUMENT directory) contains information about MAG and SPM calibration.

2.4.4 Other Files written during Calibration

No additional files are available.

2.4.5 In-Flight Data Products

The in-flight data correspond to all the on board data.
They can be produced during following mission phases :

Table 2-1 Mission phases

<table>
<tr><th rowspan="2">MISSION_PHASE_NAME</th><th rowspan="2">Abbreviation</th><th rowspan="2">Start Date (dd/mm/yyyy)</th><th rowspan="2">End Date (dd/mm/yyyy)</th><th colspan="2">ROMAP data (1)</th></tr>
<tr><th>MAG</th><th>SPM</th></tr>
<tr><td>Commissioning (part 1)</td><td>CVP1</td><td>05/03/2004</td><td>06/06/2004</td><td colspan="2">X</td></tr>
<tr><td>Cruise 1</td><td>CR1</td><td>07/06/2004</td><td>05/09/2004</td><td colspan="2"></td></tr>
<tr><td>Commissioning (part 2)</td><td>CVP2</td><td>06/09/2004</td><td>16/10/2004</td><td colspan="2">X</td></tr>
<tr><td>Earth Swing-by 1
(including PC#0)</td><td>EAR1</td><td>17/10/2004</td><td>04/04/2005</td><td>X</td><td></td></tr>
<tr><td>Cruise 2
(including PC#1,2)</td><td>CR2</td><td>05/04/2005</td><td>28/07/2006</td><td>X</td><td></td></tr>
<tr><td>Mars Swing-by
(including PC#3,4,5)</td><td>MARS</td><td>29/07/2006</td><td>28/05/2007</td><td colspan="2">X</td></tr>
<tr><td>Cruise 3</td><td>CR3</td><td>29/05/2007</td><td>12/09/2007</td><td colspan="2"></td></tr>
<tr><td>Earth Swing-by 2
(including PC#6,7)</td><td>EAR2</td><td>13/09/2007</td><td>27/01/2008</td><td>X</td><td></td></tr>
<tr><td>Cruise 4-1
(including PC#8)</td><td>CR4A</td><td>28/01/2008</td><td>03/08/2008</td><td colspan="2">X</td></tr>
<tr><td>Steins Flyby</td><td>AST1</td><td>04/08/2008</td><td>05/10/2008</td><td>X</td><td></td></tr>
<tr><td>Cruise 4-2
(including PC#9)</td><td>CR4B</td><td>06/10/2008</td><td>13/09/2009</td><td>X</td><td></td></tr>
<tr><td>Earth Swing-by 3
(including PC#10)</td><td>EAR3</td><td>14/09/2009</td><td>13/12/2009</td><td colspan="2">X</td></tr>
<tr><td>Cruise 5
(including PC#12)</td><td>CR5</td><td>14/12/2009</td><td>06/06/2010</td><td>X</td><td></td></tr>
<tr><td>Lutetia Flyby</td><td>AST2</td><td>07/06/2010</td><td>10/09/2010</td><td>X</td><td></td></tr>
<tr><td>RV Manoeuver 1
(including PC#13)</td><td>RVM1</td><td>11/09/2010</td><td>13/07/2011</td><td>X</td><td></td></tr>
<tr><td>Cruise 6</td><td>CR6</td><td>14/07/2011</td><td>22/01/2014</td><td colspan="2"></td></tr>
</table>

Post Hibernation Commissionning	PHC	09/04/2014	24/04/2014	**X**	**X**
Pre-delivery calibration Science	PDCS	25/04/2014	11/11/2014	**X**	

(1) The last column indicates if ROMAP data are available

After the release of the Lander, we distinguish four phases, characterized by:

- The Start and Stop dates need to be expressed in seconds
- The Lander has its own Auxiliary data

Separation/Descent/Landing	SDL	2014/11/12 08:35:02	2014/11/12 15:34:04	**X**	
Rebounds	RBD	2014/11/12 15:34:05	2014/11/12 17:30:20	**X**	**X**
First Science Sequence	FSS	2014/11/12 17:30:21	2014/11/15 01:00:00	**X**	**(X)**
Long Term Science	LTS	tbd	tbd	tbc	

Note that ROMAP data just before the separation (from 2014/11/12 03:35:05) will be included into SDL phase.

SDL / RBD:
These datasets are not fully calibrated yet and should not be used for scientific analysis. Strong rotational signatures are still present due to lander movement. Level 5 data will become available, as soon as reliable attitude information exists.

FSS:
Level 5 data are available. Please note that only level 5 data should be used for scientific analysis.

SPM
Please note, that the observations during RBD are influenced by lander rotation. After the second touchdown at 17:25 UTC only very few particles were detected, which was caused by the sensor hitting the comet surface. No data after this event (and FSS) should be used for science.

The data, both scientific and housekeeping, are listed in document AD 6.

Data products :

ROMAP-MAG

Edited (digital units) and draft calibrated data (in nT) are available for all mission phases. Calibrated data (in nT and cleaned from interferences) are available only for selected time intervals. The time intervals are selected when data from the Orbiter magnetometer (RPC-MAG) are available (see table Table 2-2 and §3.3.1). Only calibrated data are useful for scientific interpretation.

Edited (raw) data (in ADC units) provided by SONC
Science : UTC, OBT, BX, BY, BZ

Draft Calibrated Data (in physical units, draft aligned and very draft offset corrected), provided by SONC

Science_A (in Mag Coordinates) : UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_B (in Lander Coordinates): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_C (before release in S/C Coordinates): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_C (after release in CFF Coordinates) UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_D (before release in ECLIPJ2000): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_D (after release in CSEQ Coordinates) UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ

Final calibrated Data (in physical units, cleaned from offset and spacecraft disturbances), provided by IGeP (TU-BS)
Science_E (in Mag Coordinates) : UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_F (in Lander Coordinates): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_G (before release in S/C Coordinates): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_G (after release in CFF Coordinates) UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_H (before release in ECLIPJ2000): UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ
Science_H (after release in CSEQ Coordinates) UTC, OBT, POS_X, POS_Y, POS_Z, BX, BY, BZ

Mission phase	Start time (UTC)	Stop time (UTC)	Remarks
Mars swing-by	2007-02-25T01:28:04	2007-02-25T02:28:01	
Steins fly-by	2008-09-05T18:08:17	2008-09-05T19:08:16	ROMAP-MAG is switched into fast mode (64 Hz). However these data are reduced to 1Hz because correction has been derived from RPC-ROMAP comparison.
Post Hibernation Commissioning	2014-04-17T02:50:12	2014-04-17T05:39:11	
Pre-delivery calibration Science	2014-07-14T03:05:07 2014-09-08T00:50:05 2014-09-15T13:15:06 2014-09-25T05:50:06 2014-10-06T20:45:06 2014-10-16T21:15:06	2014-07-14T10:54:31 2014-09-08T06:10:30 2014-09-16T20:24:02 2014-09-25T11:10:00 2014-10-07T19:54:30 2014-10-17T08:24:00	
Separation/Descent/Landing	2014-11-12T08:56:30	2014-11-12T15:34:06	After boom deployment
Rebounds	2014-11-12T15:34:10	2014-11-12T17:30:21	

Table 2-2 Final calibrated ROMAP-MAG data time intervals

The centre of the ecliptic J2000 frame is chosen according to the mission phase. During the cruise, the centre is the Sun, except for the flybys of the Earth, Mars and asteroids where the centre is the Earth, or Mars or asteroids.
Although, additional to the S/C system, local systems might be preferred if solar wind interaction or remnant magnetization should be analysed, transformations in those systems are not foreseen for asteroid flybys. It could be done by user. Note, that ROMAP data are used primarily for correction of RPC data. This has been done in S/C system.
The center for different time intervals is given in Table 2-3. Only centers different from Sun are given in the table.

Start time (UTC)	Stop time (UTC)	ECLIP J2000 center
2005/03/01 01:00:09	2005/03/07 23:29:42	Earth
2007/11/07 01:30:18	2007/11/13 22:38:18	Earth
2007/11/13 22:38:18	2007/11/20 13:19:01	Earth
2007/02/24 01:01:08	2007/02/25 13:53:32	Mars

Table 2-3 The center of the ECLIP J2000 reference system for different time intervals

ROMAP-SPM

Edited data (in instrument coordinates)
The ROMAP electronics generates 2 types of data frames - Raw Data Frames and Parameter Data frames. The SPM data products are separated accordingly, in RAW and SPM files. The sampling procedure is the same for both modes. Only the way of transmitting the data differs.

In the **RAW mode**, the sampled data of one measurement cycle for the ion and ion-current channels are held in arrays (energy·elevation) in the ROMAP-Controller RAM.
After sampling for one measurement cycle is finished, data is packet into a specific amount of science data frames and transmitted via the CDMS interface.
For reducing the data amount, even and odd energies of both ion and ion-current channels can be transmitted alternating in consecutive Raw Data measurement cycles (at one measurement cycle the even energies of one ion channel and the odd energies of the other ion channel are transmitted and at the next measurement cycle vice versa). This is the default setting for SPM.
But also a full transmission of all energies can be selected. In this case for one cycle all data of one ion channel is transmitted and at the next cycle all of the other.

In the **PAR mode**, for reducing the amount of data to transmit, only the sums of the rows and columns of the sampled ion and ion-current arrays are transmitted. The sampling procedure is the same as for Raw Data transmission. The sums are computed when the sampling is finished.

Further details about ROMAP modes can be found in AD 6.

SC data products

For every science cycle:
UTC, OBT, Status of SPM (from HK parameters in SC data frame),
Raw Data
16 (for different angles) energy distributions (counts and current) for Ion1 and Ion2 sensors,
 1 energy distributions (current) for Faraday Cup sensors,
 1 energy distributions (counts) for Electron sensors
Parameter Data
 1 energy distributions (counts and current) for Ion1 and Ion2 sensors,
 1 angle distributions (counts and current) for Ion1 and Ion2 sensors,
 1 energy distributions (current) for Faraday Cup sensors,

1 energy distributions (counts) for Electron sensors

Calibrated data : the same as for SC data, but in physical units: energy - in keV, angle - deg, count - in sm2, current - in nA - all in accordance with calibration data.
Moreover for the calibrated data the orientation of sensors in ECLIPJ2000 coordinates is added for each distribution.

Derived data generated by SPM science group.

HK data products

Edited data (ADC counts)

16 housekeeping parameters: UTC, OBT, HK1, HK2, ..., HK16

Calibrated data (in physical units)

Same parameters as for edited data but in physical units: UTC, OBT, HK1, HK2, ..., HK16

2.4.6 Documentation

The documentation directory contains the following documents:

- ROMAP Electronics FM2 ADP, RO-LRO-DP-300002-UA, Issue 1, Revision 0, 16/05/2001
- EAICD (this document)
- ROMAP_CALIBRATION_DESC.TXT
- TIMELINE_ph.TXT, timeline Ascii file for phase ph
- TIMELINE_ph_DESC.TXT, description of the timeline file for phase ph
- TIMELINE_ph_obty.PNG, timeline Image file for phase ph and observation type obty

2.4.7 Derived and other Data Products

MAG : The final calibrated data are considered as CODMAC level 5 (derived product) since the correction procedure can not be described sufficiently and is not reproducible. It depends on detailed situation on board (temperatures, variable currents ...) and on availability of RPC data (for the detection of changing supply currents).

SPM : derived products are not generated

2.4.8 Ancillary Data Usage

The Lander Auxiliary Data on the comet (Position/Orientation/Illumination at any time + Comet models + Ancillary Data from the instruments) will be available in an ANCDR (Ancillary Data Record) whose definition is in progress, pending the Lander auxiliary data reconstruction.

3 Archive Format and Content

3.1 Format and Conventions

Data processing level number used in ROMAP naming scheme conforms to CODMAC norm :

2: Edited Data Corrected for telemetry errors and split or decommutated into a data set for a given instrument. Sometimes called Experimental Data Record. Data are also tagged with time and location of acquisition. Corresponds to NASA Level 0 data.

3: Calibrated Data Edited data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so edited data can be reconstructed. NASA Level 1A.

5: Derived Data Derived results, as maps, reports, graphics, etc. NASA Levels 2 through 5.

3.1.1 Deliveries and Archive Volume Format

A data set is delivered for each **simple mission phase.** Each data set contains **only one level data processing**. The ROMAP MAG and SPM data are archived in a separate data sets.

The list of simple mission phases is given in
.

A data set is level-stamped as below :

- Level 2 when it contains :
  - Uncalibrated SC or HK data (CODMAC level 2)

- Level 3 when it contains :
  - Preliminary calibrated SC or HK data (CODMAC level 3)

- Level 5 when it contains derived data (CODMAC level 5) which are in case of the magnetometer data which are finally calibrated and cleaned from spacecraft interferences. The cleaning proces is irreversible, therefor those data are classified as derived data.

In addition a data set contains :
- Documents (see chapter 3.4.3.9)

A new version of a data set is provided when :
- calibration information refining
- new data processing
- higher levels production.

3.1.2 Data Set ID Formation

DATA_SET_ID = <INSTRUMENT_HOST_ID>-<target id>-<INSTRUMENT_ID>-<data processing level number>-<mission phase abbreviation>-<description>-<version>

DATA_SET_NAME = <INSTRUMENT_HOST_NAME> <target name> <INSTRUMENT_ID> <data processing level number> <mission phase abbreviation> <description> <version>

Note: The description field is used to distinguish ROMAP-MAG and ROMAP-SPM datasets.

See appendix F (16.1.1, 16.1.2) of Archive Plan Issue 2/2.

Examples of DATA_SET_ID and DATA_SET_NAME for ROMAP-MAG data obtained in-flight during CVP:

DATA_SET_NAME = "ROSETTA-LANDER CAL ROMAP 3 CVP MAG V1.0"

DATA_SET_ID = "RL-CAL-ROMAP-3-CVP-MAG-V1.0"

3.1.3 Data Directory Naming Convention

See § 3.4.3.

3.1.4 Filenaming Convention

The following file **naming scheme** is used:

MAG file naming :
{**exp**}_{**datatype**}_{**begin of observation**}_{**length of observation**}.{**ext**}

- **exp** (3 character) = RHK (HK), MAG or SPM (SC)
- **datatype** (3 character) = XYZ
  - X = **G** for Ground, **F** for Flight
  - Y = **S** for Science Data, **H** for Housekeeping Data,
  - Z = Data processing level :
    2 for edited data (HK, SC)
    3 for calibrated data (HK)
    A for preliminary calibrated SC data, in physical units, draft aligned and very draft offset corrected, in MAG coordinates
    B for preliminary calibrated SC data, in physical units, draft aligned and very draft offset corrected, in Lander coordinates
    C for preliminary calibrated SC data, in physical units, draft aligned and very draft offset corrected, in S/C coordinates before Lander separation and in CFF frame after Lander separation
    D for preliminary calibrated SC data, in physical units, draft aligned and very draft offset corrected, in ECLIPJ2000 coordinates before Lander separation and CSEQ system after Lander separation
    E for final calibrated SC data, in physical units, cleaned from offset and spacecraft disturbances, in MAG coordinates
    F for final calibrated SC data, in physical units, cleaned from offset and spacecraft disturbances, in Lander coordinates
    G for final calibrated SC data, in physical units, cleaned from offset and spacecraft disturbances, , in S/C coordinates before Lander separation and in CFF frame after Lander separation
    H for final calibrated SC data, in physical units, cleaned from offset and spacecraft disturbances, in ECLIPJ2000 coordinates before Lander separation and CSEQ system after Lander separation
  - SPM :
    2 for edited data (HK, SC), in MAG coordinates

3 for calibrated data (HK, SC), in Lander coordinates
5 for derived data (SC), in Lander coordinates

- **begin of observation** (12 characters) = time of test or working session in UTC yymmddhhmmss:
  - yy = year
  - mm = month
  - dd = day
  - hh = hour
  - mm = minute
  - ss = second

- **length of observation** (5 characters) = duration of test or working session expressed in minutes. A file do not contain more than 10 day of data
  Two working sessions are separated by a gap greater than 100 seconds for MAG (SC), greater than 200 seconds for SPM (SC). A gap of 500 secondes is used for HK data.

- **ext** = extension of file. For ROMAP possible extensions are:
  - ROL for Raw Data containing HK and SC data mixed together (CODMAC level 1)
  - TAB for SC or HK Data (CODMAC level 2, 3 and 5)
  - LBL for label file associated to file .TAB

<u>SPM file naming</u> :

{exp}_{datatype}_{begin of observation}_{mode}.{ext}

- **exp** (3 or 4 characters)
  - SPM for LBL files (combined detached labels, one LBL file points to several TAB files),
  - SPME for electron TAB files,
  - SPMF for Faraday cup TAB files,
  - SPMP for Parameter mode TAB files,
  - SPMR for Raw mode TAB files

- **datatype** (3 character) = XYZ
  - X = **G** for Ground, **F** for Flight
  - Y = **S** for Science Data, **H** for Housekeeping Data,
  - Z = Data processing level :
    2 for edited data (HK, SC), in sensor coordinates
    3 for calibrated data (HK, SC), in Lander coordinates
    5 for derived data (SC), in Lander coordinates

- **begin of observation** (12 characters) = time of test or working session in UTC yymmddhhmmss:
  - yy = year
  - mm = month
  - dd = day
  - hh = hour
  - mm = minute
  - ss = second

- **mode** = data type for SPM files
  - for LBL files the possible values are:
    - RAW (Raw mode)
    - PAR (Parameter mode)

- For TAB files the possible values are :
  - CNA (counts-angle distribution)
  - CNE (counts-energy distribution)
  - CRA (current-angle distribution)
  - CRE (current-energy distribution)
  - CN (counts-energy-angle distribution)
  - CR (current-energy-angle distribution)

- **ext** = extension of file. For ROMAP possible extensions are:
  - ROL for Raw Data containing HK and SC data mixed together (CODMAC level 1)
  - TAB for SC or HK Data (CODMAC level 2, 3 and 5)
  - LBL for label file associated to file .TAB

Examples :

MAG_FSA_040603123400_01542.TAB
Data included in this file are ROMAP-MAG Science data recorded on flight on 03 June 2004 beginning at 12:34:00 (UTC) for a duration of 1542 minutes. They are preliminary calibrated, in MAG coordinates.

SPMP_FS2_141112173046_CNA.TAB
Data included in this file are ROMAP-SPM edited science data in parameter mode recorded on comet on 14 Nov 2014 beginning at 17:30:46 (UTC). The file contains ions counts-angle distribution.

RHK_FH3_040903121000_00800.TAB
Data included in this file are calibrated HK flight data recorded on 09 Sep 2004 beginning at 12:10:00 (UTC) for a duration of 800 minutes.

3.2 Standards Used in Data Product Generation

3.2.1 PDS Standards

The archive structure given in this document complies with PDS standard version 3.6.

3.2.2 Time Standards

3.2.2.1 Generalities

This paragraph gives a summary of the different existing formats in the Rosetta Ground segment, from their generation by the instruments to their availability at SONC :

- The Lander CDMS requires the scientific instruments to transmit the data by bursts of 8 or 64 bytes (4 or 32 16-bit words)

- When sufficient data are received, the CDMS builds packets containing 256 bytes of instrument data. The CDMS adds 18 bytes header (unit PID, sequence count, OOBT : Orbiter OBT, data type) and a 2 bytes checksum (DECW) and creates packets with a fixed length of 276 bytes[2]. For transmission between Lander and Orbiter, a 4 bytes synchro header and a 2 bytes trailing checksum (PECW) are added, increasing the packet size to 282 bytes. The extra bytes are removed by the ESS.

To comply with ESA requirements, the time registered in the CDMS packets is the **OOBT**. It is reconstituted from the LOBT, as shown in Figure 7:

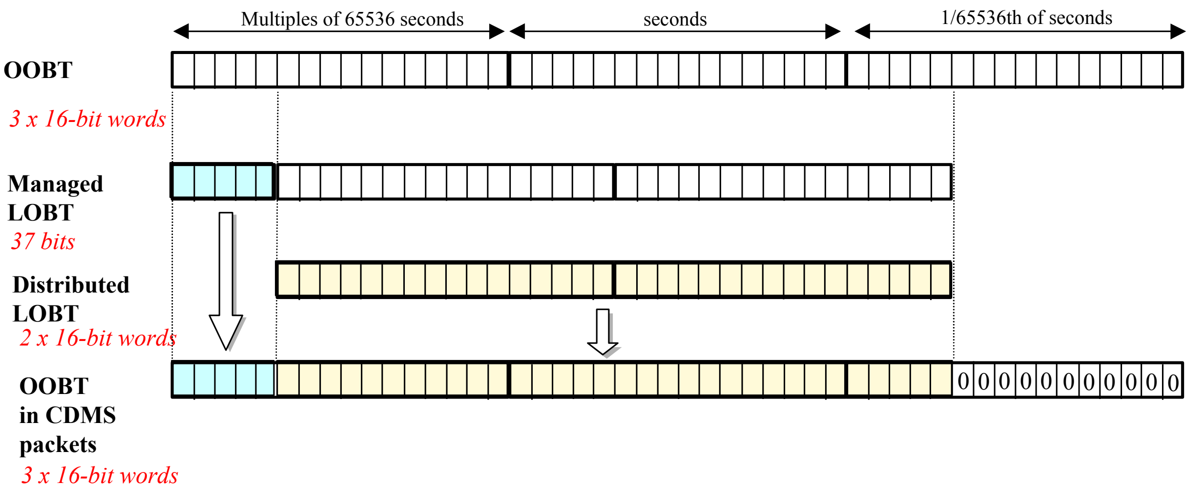

Figure 7 Reconstruction of on board time in CDMS packets

- The ESS groups together several packets and passes them to the Orbiter OBDH, which transmits them according to the Space/Ground interface. This part is transparent for the Lander ground segment.
- The data are delivered by the Rosetta Data Distribution System (DDS) to the SONC in SFDU format. A SFDU file is basically a collection of 276-byte packets interspersed with auxiliary information records. An 18 bytes SFDU header is added to the CDMS 276-byte packets. This header contains information added at the ground station (time correlated OBT, ground station id, virtual channel id, service channel, type of data, time quality)
- SONC processes the SFDU files to retrieve the 276-byte packets. This format is available in the SONC database.

[2] The Lander CDMS header and the headers of the telemetry source packets from the Orbiter instruments are quite similar. There is a difference in the data field header. The byte containing PUS version, checksum flag and spare fields is set to zero in the CDMS header. Besides the last byte of the OOBT is set to zero in the CDMS header. The CDMS header has an additional word (2 bytes) after the data field header named "FORMAT ID". This word is mainly used for HK data and it contains the HK scanning period and the SID (structure identification).

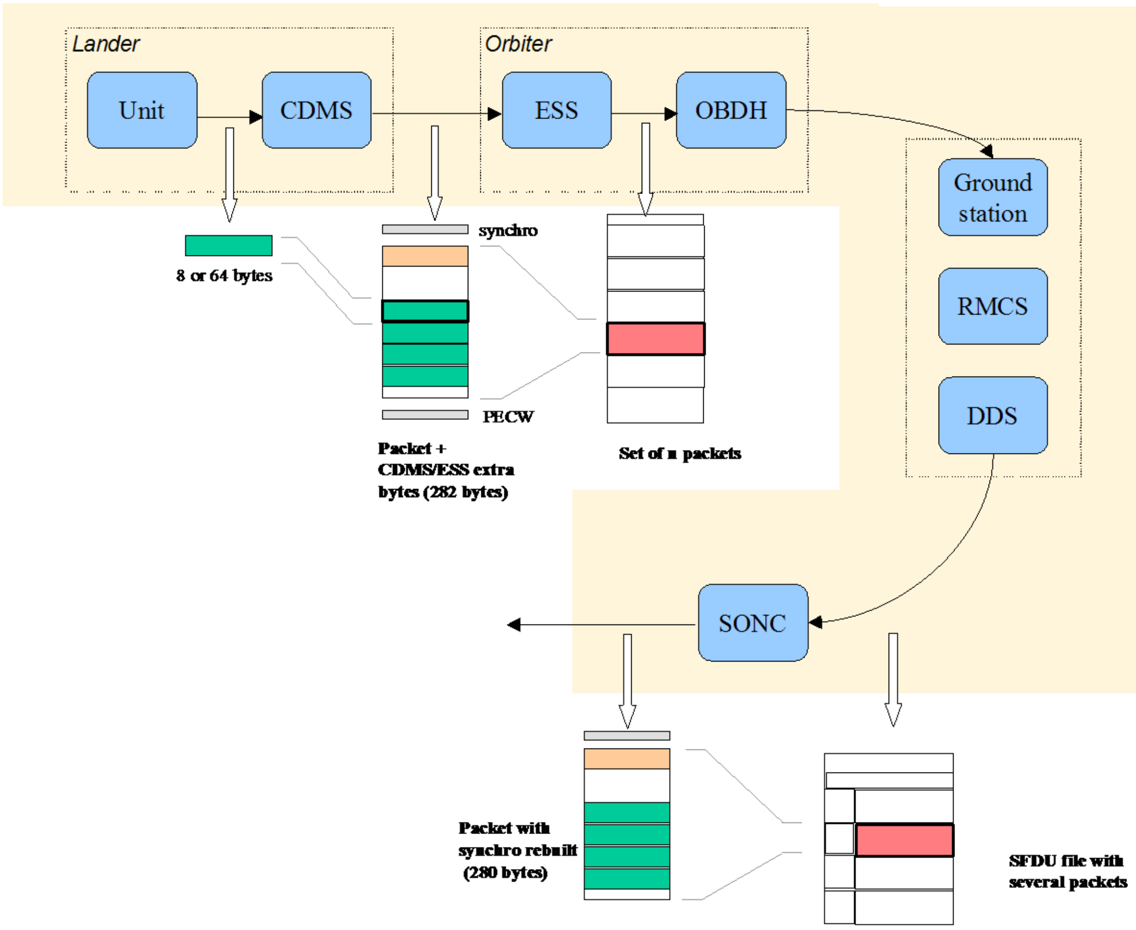

Figure 8 On board data flow

- Afterwards, SONC processes science raw packets in order to recompose the science measurement (e.g. an image, a spectrum, ...).

Figure 8 gives an overview of this data flow.

Only the following principles are applied:

- the packet wrapping is removed, and science frames that had to be split into several raw data packets are rebuilt. Basic error detection controls are applied, to recover from possible problems in the transmission chain.

- the Lander On-Board time (LOBT) (synchronised with OOBT) extracted from the packet, and corresponding UTC time coming from the SFDU header, are added.

- UTC time is calculated from the On-Board time taking into account the On-Board clock drift as following :
UTC (seconds since 01/01/1970) = LOBT(seconds) * Gradient + Offset (these coefficients are extracted from TCP packets delivered by DDS).
LOBT is either the LOBTextracted from CDMS header or the Experiment internal clock when it exists (CIVA, COSAC, PTOLEMY, ROMAP, ROLIS, SESAME). In the last case, it must be taken into account that the Internal clock (32 bits) resets all 4 years, 4 months, 3 days (first reset : 03/04/2007 10 :42 :07).

UTC time-stamped Science and HK data are available in the SONC database and used to generate PDS format.

3.2.2.2 ROMAP Time standards

The time standards used in the ROMAP data products are :
- the ROMAP on-board time,
- the Lander on-board time,
- the DDS header time correlated,
- the UTC.

3.2.2.2.1 The ROMAP On-Board Time

ROMAP puts a time stamp of the first vector in a science data frame (MAG) or of the beginning of a data collection cycle (SPM) into the frame header. The timing information for subsequent data in the frame can be computed with the time stamp as reference. Because the interval of the received OBT is too low, the ROMAP-Controller integrates a 16bit counter with 1/32s resolution that is reset when a new OBT is received. For getting accurate time stamps, the value of the internal counter is read and added to the last received OBT. Then the time is stored to the data frame.

3.2.2.2.2 The Lander On-Board Time (LOBT)

The instruments on board the spacecraft (Orbiter) generate telemetry source packets with an OOBT (orbiter on board time) time stamp in the header.
The OOBT written into the packet header specifies the time, when CDMS can complete a packet.

In terms of HK packets this is the time of the last HK word. Using the HK scanning rate, which is given in word #9 of the packet, one can calculate the OBT of every individual word in this packet. Note that this is only valid if packets with SID (word #9) 1 or 2 are generated. Packets with SID 4 and 5 are "snapshots", which means you can apply the packet OOBT for every word in this packet. SID 3 packets have to be analysed case by case.

In terms of SC packets this is the reception of the last 32 word block by CDMS, which also completes the SC packet. How often 32 word blocks are created (and sent) by the unit, and corresponding to this the delta time between each block, might be different for each unit. So, re-calculation of OOBT for SC words depends on this unit feature.

The Orbiter On-Board Time (OOBT) is a linear binary counter having a resolution of 1/65536 sec stored in 3 16-bit words.

The Lander On-Board Time (LOBT) is a linear binary counter having a resolution of 1/32 sec, kept in 37 bits. Only the 32 least significant bits are distributed to the instruments, in 2 16-bit words. The 5 most significant bits are supposed constant during most of the mission, they are available through a specific service.
The LOBT is derived from the Orbiter On-Board Time (OOBT) : the 11 least significant bits of the OOBT are discarded to obtain the LOBT, hence the reduced resolution. A re-synchronization between OOBT and LOBT is performed regularly (see AD 9).
The Lander is synchronized prior to Separation and during every RF link after landing. So, during descent and the First Science Sequence this should not be a problem, since LOBT is kept synchronized as long as the Lander is powered.

Technical details about sychronisation of Lander On-board Time can be found in § 2.3.2.6 of AD 9.

For a description of time handling in the Rosetta project see AD 11.
For a description of Lander on board time handling see AD 9 :
§ 2.3.2.6 Synchronisation and Adjustment of Lander On-board Time
§ 2.3.2.6.1 Absolute vs. relative time references
§ 2.3.2.6.2 On-board Time Failure Modes and Recovery Procedures

and AD 10 § 6. About Lander On-board Time.

3.2.2.2.3 The DDS header time correlated

The OOBT is converted to UTC (Coordinated Universal Time) by means of time correlation and included in the additional DDS packet header when the packets are distributed via the DDS server.
The **DDS header time correlated** (SCET field in the DDS header) is the UTC of the start of measurement derived from the OOBT by time correlation.

Its format is the Sun Modified Julian Time (MJT) i.e. two 32 bit integers. The first (MSB) contains the number of seconds since 00:00:00 on 1st January 1970 and the second (LSB) integer the number of micro-seconds from seconds in the first field.

Time correlation is described in AD 12 § 18.1.2.1.

3.2.2.2.4 The UTC (Coordinated Universal Time)

The **UTC** used as time stamp for SC and HK ROMAP data products (from level 2 to level 3) is calculated from the experiment on-board time taking into account the drift and reset clock.

3.2.2.2.5 Spacecraft Clock Count in PDS Labels

The PDS keywords SPACECRAFT_CLOCK_START_COUNT and SPACECRAFT_CLOCK_STOP_COUNT refer to LOBT.
The LOBT is represented in the following format:
SPACECRAFT_CLOCK_START/STOP_COUNT = "<reset number>/<unit seconds>.<fractional seconds>"
The unit seconds and the fractional seconds are separated by the full stop character. **Note that this is not a decimal point.** The fractional seconds are expressed as multiples of 2^{-5} = 0,03125. seconds and count from 0 to 2^{5} -1 = 31. E.g. in SPACECRAFT_CLOCK_START_COUNT = "3/356281394.21" the 21 fractional seconds correspond to 21 × 2^{-5} = 0.65625 decimal seconds.
The reset number is an integer starting at 1, i.e. "1/" means LOBT = 0 at 2003-01-01T00:00:00 UTC.

3.2.3 *Reference Systems*

The reference systems used for ROMAP data products are either hardware related or systems related to solar system bodies.

Instrument coordinates (defined by the feedback system of the magnetometer sensor), Rosetta Lander coordinates and Rosetta Orbiter coordinates (S/C system) are used as hardware related reference systems.

After Lander separation the CFF system (Comet Fixed Frame), a body-centered coordinate systems is used instead of the S/C system. The positive Z-axis of the CFF system is pointing along the cometary rotation axis, and the X-axis is in the equatorial plane, parallel to the longest axis of the nucleus, in the direction of the small lobe of the nucleus. The Y-axis completes the right-handed system; the X-axis prime meridian is through the CHEOPS boulder.

For cruise phases the ECLIPJ2000 is used. (Ecliptic coordinates based upon the J2000 frame, i.e. the Earth mean equator and dynamical equinox of J2000). The X-axis is aligned with the cross product of the north-pointing vectors normal to the Earth's mean equator and mean orbital plane of J2000 epoch. The Z-axis is aligned with the second of these normal vectors. The Y axis is the cross product of the Z and X axes.

After Lander separation the CSEQ system (Body-centered Solar Equatorial) is used instead of the ECLIPJ2000 frame. This frame is defined as a two-vector style dynamic frame as follows: +X axis is the position of the Sun relative to the body; it's the primary vector and points from the body to the Sun; +Z axis is the component of the Sun's north pole of date orthogonal to the +X axis; +Y axis completes the right-handed reference frame; The origin of this frame is the body's center of mass.

3.3 Data Validation

The ROMAP data products are delivered to PSA by SONC. All the levels SC and HK data produced by SONC are validated by ROMAP PIs. These data are also distributed via the W3-SONC server and used by all the experiment team.

3.3.1 *MAG quality parameter*

Magnetometer quality parameter are given draft calibrated (CODMAC level 2) and final calibrated data (CODMAC level 3). Five levels are defined as follow.

- Level 0: absolute error less than 1nT
- Level 1: absolute error less than 5nT
- Level 2: absolute error less than 10nT
- Level 3: absolute error less than 100nT
- Level 4: absolute error exceed 100nT

Draft calibrated data are processed from edited data by linear transformation using a default calibration matrix and a preliminary offset (averaged value). As long the Lander is not released the data are disturbed by an offset drift due to changing balcony temperatures (temperature coefficient of compensation magnet) and the magnetic field caused by the supply current of the Lander (GND loop due to electrical contact between orbiter and lander structure). Especially the dependency on supply current can be in the order of several hundred nT (1mA corresponds to about 1nT) and leads sometimes to saturation of the magnetic field measurement. Therefore for most of the intervals in which the lander is active (AFT's) are draft calibrated data are level 4 data. Some quite intervals can be archived as level 3 data.

Final calibrated data are processed by draft calibrated data by applying a manually generated correction function. Drifts are related to TCU temperature measurements, signatures of changing supply currents are detected by comparison of RPC-MAG and Romap data. This part of the procedure can not be automated. It is done for selected intervals and only the calibrated data and not procedure and correction function are subject of archiving. Therefore the final calibrated data are classified as derived data (CODMAC level 5). Expected quality levels are 0-2.

3.3.2 SPM quality parameter

Three data quality levels are defined for SPM. We keep however four levels (with level 2 not used) in order to have the same scheme for quality definition as for MAG data, i.e. quality ID goes from level 0 – best quality to level 4 - worst quality.

- Level 0: data quality is perfect, that means counts doesn't depends on high voltage level
- Level 1: data are scientifically of interest, but calibration could be wrong due to too low high voltage level (degradation of channeltrons might be the reason)
- Level 2: data are scientifically of interest, but field of view is unknown due to Philae motion
- Level 3: data are scientifically wrong e.g. because sensor is directed to orbiter (all times during cruise) but technologically usable
- Level 4: data are scientifically and technologically wrong

3.4 Content

3.4.1 Volume Set

One volume corresponds to one data set. The possible values of VOLUME keywords can be found in AD 4. The volume keyword values for the Mars mission phase are given in the following example.

```
VOLUME_NAME                 = "ROMAP MAG RAW DATA FOR
                               THE MARS SWING-BY"
VOLUME_SERIES_NAME          = "ROSETTA SCIENCE ARCHIVE"
VOLUME_SET_ID               = "DE_TUBS_IGEP_RLMAG_10XX"
VOLUME_SET_NAME             = "ROSETTA ROMAP MAG DATA"
VOLUME_ID                   = "RLMAG2_1023"
VOLUME_VERSION_ID           = "VERSION 1"
VOLUME_FORMAT               = "ISO-9660"
MEDIUM_TYPE                 = "ONLINE"
VOLUMES                     =  35
PUBLICATION_DATE            = 2009-06-29
DESCRIPTION                 = " This volume contains data
                                and supporting documentation
                                from the Rosetta Mars swing by
                    mission phase "
```

3.4.2 Data Set

The ROMAP data are archived in as many Data Sets as simple mission phase and level data processing. The MAG and SPM data are archived in a separate data sets

Name element	Data Set ID	Data Set Name

INSTRUMENT_HOST_ID / INSTRUMENT_HOST_NAME	RL (Rosetta Lander)	ROSETTA-LANDER
Target id / target name	See AD 4	AD 4
INSTRUMENT_NAME	ROSETTA LANDER MAGNETOMETER AND PLASMA MONITOR	
INSTRUMENT_ID	ROMAP	
Data processing level number	* Level 2 contains non converted data (ADC units) * Level 3 contains preliminary calibrated data * Level 5 contains calibrated data from which all interference signatures have been removed. Those are derived data because the cleaning algorithm is done manually and too sophisticate for being reproducible. <u>Remark</u>: Level 2 and preliminary level 3 data are delivered directly after the end of the proprietary period. Level 5 data are delivered when ready Only level 5 data are usable for scientific interpretation.	
mission phase abbreviation	See	
description	N/A	N/A.
version	The first version of a data set is V1.0	

The archive contains 5 types of data sets.

- two for Level 2 data (edited data) :

DATA_SET_ID = "RL>-<*target name*>-ROMAP-2>-<*mission phase abbreviation*>-<MAG>-*Vx.x*"
DATA_SET_ID = "RL>-<*target name*>-ROMAP-2>-<*mission phase abbreviation*>-<SPM>-*Vx.x*"

- two for Level 3 data (preliminary and final calibrated data) :

DATA_SET_ID = "RL>-<*target name*>-ROMAP-3>-<*mission phase abbreviation*>-<MAG>-*Vx.x*"
DATA_SET_ID = "RL>-<*target name*>-ROMAP-3>-<*mission phase abbreviation*>-<SPM>-*Vx.x*"

- one for Level 5 data (derived data) :

DATA_SET_ID = "RL>-<*target name*>-ROMAP-5>-<*mission phase abbreviation*>-<SPM>-*Vx.x*"

3.4.3 Directories

The organisation (directories) of each dataset type is shown below.

Level 2 datasets :

```
                          |-AAREADME.TXT
                          |-CATALOG-
                          |            |--SC (Level 2 SC data files)
                          |-DATA------|
|-root directory--------- |            |--HK (Level 2 HK data files)
                          |-DOCUMENT-
                          |-INDEX-
                          |-LABEL-
                          |-VOLDESC.CAT
```

Level 3 datasets :

```
                         |-AAREADME.TXT
                         |-CATALOG-
                         |           |--SC_PRELIMINARY (MAG A,B,C,D)
                         |-DATA---- |
|-root directory--------- |           |--HK (Level 3 HK data files)
                         |
                         |-DOCUMENT-
                         |-INDEX-
                         |-LABEL-
                         |-VOLDESC.CAT
```

Level 5 datasets :

```
                         |-AAREADME.TXT
                         |-CATALOG-
                         |           |--SC_FINAL (MAG E,F,G,H)
                         |-DATA-----|
                         |           |--HK (Level 3 HK data files)
|-root directory--------- |
                         |
                         |-DOCUMENT-
                         |-INDEX-
                         |-LABEL-
                         |-VOLDESC.CAT
```

Remark : The name of Root Directory is the DATA_SET_ID.

3.4.3.1 Root Directory

The root directory contains the following files

File Name	Contents
AAREADME.TXT	Volume content and format information
VOLDESC.CAT	A description of the contents of this volume in PDS format readable by both humans and computers

The name of the root directory is the data set ID.

3.4.3.2 Calibration Directory

Calibration information can be found in the file ROMAP_CALIBRATION_DESC.TXT located in the DOCUMENT directory.

3.4.3.3 Catalog Directory

The catalog directory provides a top level understanding of the mission, spacecraft, instruments and data sets.The catalog directory contains the following files:

File Name	Contents
CATINFO.TXT	A description of the contents of the catalogue directory
DATASET.CAT	Data set information
INST.CAT	Instrument information
INSTHOST.CAT	Instrument host (spacecraft) information
MISSION.CAT	Mission information
PERSON.CAT	PDS personnel catalogue information about the instrument team responsible for generating the data products. There is one file for each instrument team providing data to this data set.
REF.CAT	Full citations for references mentioned in any and all of the catalogue files, or in any associated label files
SOFTWARE.CAT	Information about the software included in the SOFTWARE directory

3.4.3.4 Index Directory

The index directory contains the indices for all data products on the data set. The following files are included in the index directory:

File Name	Contents
INDEX.LBL	PDS label for the volume index file, INDEX.TAB
INDEX.TAB	Volume index in tabular format
INDXINFO.TXT	A description of the contents of the Index Directory

3.4.3.5 Geometry Directory

There is no geometry directory.

3.4.3.6 Software Directory

There is no software directory.

3.4.3.7 Gazetter Directory

There is no Gazetter directory.

3.4.3.8 Label Directory

The label directory contains include files (.FMT files with label definitions) referenced by data files on the data set. The following files are included in the index directory:

File Name	Contents
LABINFO.TXT	A description of the contents of this directory (.FMT files)
ROMAP_RAWHK.FMT	Edited (raw) HK data
ROMAP_CALHK.FMT	Calibrated HK data
ROMAP_MAG_RAWSC.FMT	Edited (raw) Science data

ROMAP_MAG_CALSCA.FMT	Draft Calibrated Data, Instrument coordinates
ROMAP_MAG_CALSCB.FMT	Draft Calibrated Data, Lander coordinates
ROMAP_MAG_CALSCC.FMT	Draft Calibrated Data, Orbiter coordinates
ROMAP_MAG_CALSCD.FMT	Draft Calibrated Data, ECLIP J2000 coordinates
ROMAP_MAG_CALSCE.FMT	Final Calibrated Data, Instrument coordinates
ROMAP_MAG_CALSCF.FMT	Final Calibrated Data, Lander coordinates
ROMAP_MAG_CALSCG.FMT	Final Calibrated Data, Orbiter coordinates
ROMAP_MAG_CALSCH.FMT	Final Calibrated Data, ECLIP J2000 coordinates
ROMAP_SPM_RAW_ION_CN.FMT	**raw** mode Ion spectrum definition (counts-energy-angle distribution, channels 1 or 2) ; Level 2
ROMAP_SPM_RAW_ION_CR.FMT	**raw** mode Ion spectrum definition (current-energy- angle), (channels 1 or 2) ; Level 2
ROMAP_SPM_PAR_ION_CNE.FMT	**parameter** mode Ion spectrum definition (counts-energy distribution), (channels 1 or 2) ; Level 2
ROMAP_SPM_PAR_ION_CRE.FMT	**parameter** mode Ion spectrum definition (current-energy distribution), (channels 1 or 2) ; Level 2
ROMAP_SPM_PAR_ION_CNA.FMT	**parameter** mode Ion spectrum definition (counts-angle distribution), (channels 1 or 2) ; Level 2
ROMAP_SPM_PAR_ION_CRA.FMT	**parameter** mode Ion spectrum definition (current-angle), (channels 1 or 2) ; Level 2
ROMAP_SPM_FC.FMT	Faraday cup current-energy distribution ; Level 2
ROMAP_SPM_ELEC.FMT	Electron spectrum (count-energy distribution) Level 2
ROMAP_SPM_RAWC_ION_CN.FMT	**raw** mode Ion spectrum definition (counts-energy-angle distribution), (channels 1 or 2) ; Level 3
ROMAP_SPM_RAWC_ION_CR.FMT	**raw** mode Ion spectrum definition (current-energy-angle), (channels 1 or 2) ; Level 3
ROMAP_SPM_PARC_ICNT_CNE.FMT	**parameter** mode Ion spectrum definition (counts-energy distribution), (channels 1 or 2) ; Level 3
ROMAP_SPM_PARC_ION_CRE.FMT	**parameter** mode Ion spectrum definition (current-energy distribution), (channels 1 or 2) ; Level 3angles)
ROMAP_SPM_PARC_ION_CNA.FMT	**parameter** mode Ion spectrum definition (counts-angle distribution), (channels 1 or 2) ; Level 3
ROMAP_SPM_PARC_ION_CRA.FMT	**parameter** mode Ion spectrum definition (current-angle), (channels 1 or 2) ; Level 3
ROMAP_SPM_FCC.FMT	Faraday cup current-energy distribution ; Level 3
ROMAP_SPM_ELECC.FMT	Electron spectrum (count-energy distribution) Level 3

3.4.3.9 Document Directory

This directory contains documentation to help the user to understand and use the archive data. The following files are contained in the document directory:

File Name	Contents
DOCINFO.TXT	A description of the contents of this directory
RO-LRO-DP-300002-UA.PDF	ROMAP FM2 ADP
RO-LRO-DP-300002-UA.LBL	PDS label for file RO-LRO-DP-300002-UA
EAICD_ROMAP.PDF	This document
EAICD_ROMAP.LBL	PDS label for file EAICD_ROMAP.PDF
ROMAP_CALIBRATION_DESC.TXT	Description of the calibration of MAG and SPM
ROMAP_CALIBRATION_DESC.LBL	PDS label for ROMAP_CALIBRATION_DESC.TXT
RL_ROMAP_LOGBOOK.TXT	Listing ROMAP operations
RL_ROMAP_LOGBOOK.LBL	PDS label for RL_ROMAP_LOGBOOK.TXT
TIMELINE_SDL_RBD_FSS.TXT	Timeline Ascii file with the PDS label attached for mission phases SDL (Separation Descent and Landing), RBD (Rebounds) and FSS (First science Sequence)
TIMELINE_SDL_RBD_FSS_DESC.TXT	Description of the timeline file for mission phases SDL, RBD and FSS
TIMELINE_SDL_RBD_FSS_1.PNG	Timeline Image file of Philae activities performed during SDL, RBD and FSS mission phases
TIMELINE_SDL_RBD_FSS_2.PNG	Timeline of Philae instruments data availability SDL, RBD and FSS mission phases
TIMELINE_SDL_RBD_FSS.LBL	PDS label for files TIMELINE_SDL_RBD_FSS_1.PNG and TIMELINE_SDL_RBD_FSS_2.PNG

3.4.3.10 Data Directory

The structure and naming scheme of the data directory is described in chapter 3.4.3.

4 Detailed Interface Specifications

4.1 Structure and Organization Overview

The ROMAP MAG and SPM data are archived in a separate data sets on the basis mission phase relative to the production of the data. The ROMAP MAG DATA directory contains subdirectories with preliminary and final calibrated data.

4.2 Data Sets, Definition and Content

The following table gives the definition of the name and id of the ROMAP data sets :

Data Set ID	Data Set Name
RL-CAL-ROMAP-2-CVP-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 CVP MAG V1.0
RL-CAL-ROMAP-2-CR2-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 CR2 MAG V1.0
RL-CAL-ROMAP-2-CR4A-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 CR4A MAG V1.0
RL-CAL-ROMAP-2-CR4B-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 CR4B MAG V1.0
RL-CAL-ROMAP-2-CR5-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 CR5 MAG V1.0
RL-CAL-ROMAP-2-RVM1-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 RVM1 MAG V1.0
RL-CAL-ROMAP-2-RVM2-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 2 RVM2 MAG V1.0
RL-CAL-ROMAP-3-CR2-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 CR2 MAG V1.0
RL-CAL-ROMAP-3-CR4A-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 CR4A MAG V1.0

RL-CAL-ROMAP-3-CR4B-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 CR4B MAG V1.0
RL-CAL-ROMAP-3-CR5-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 CR5 MAG V1.0
RL-CAL-ROMAP-3-RVM1-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 RVM1 MAG V1.0
RL-CAL-ROMAP-3-RVM2-MAG-V1.0	ROSETTA-LANDER CAL ROMAP 3 RVM2 MAG V1.0
RL-E-ROMAP-2-EAR1-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 2 EAR1 MAG V1.0
RL-E-ROMAP-2-EAR2-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 2 EAR2 MAG V1.0
RL-E-ROMAP-2-EAR3-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 2 EAR3 MAG V1.0
RL-E-ROMAP-3-EAR1-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 3 EAR1 MAG V1.0
RL-E-ROMAP-3-EAR2-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 3 EAR2 MAG V1.0
RL-E-ROMAP-3-EAR3-MAG-V1.0	ROSETTA-LANDER EARTH ROMAP 3 EAR3 MAG V1.0
RL-M-ROMAP-2-MARS-MAG-V1.0	ROSETTA-LANDER MARS ROMAP 2 MARS MAG V1.0
RL-M-ROMAP-3-MARS-MAG-V1.0	ROSETTA-LANDER MARS ROMAP 3 MARS MAG V1.0
RL-M-ROMAP-5-MARS-MAG-V1.0	ROSETTA-LANDER MARS ROMAP 5 MARS MAG V1.0
RL-A-ROMAP-2-AST1-MAG-V1.0	ROSETTA-LANDER STEINS ROMAP 2 AST1 MAG V1.0
RL-A-ROMAP-3-AST1-MAG-V1.0	ROSETTA-LANDER STEINS ROMAP 3 AST1 MAG V1.0
RL-A-ROMAP-5-AST1-MAG-V1.0	ROSETTA-LANDER STEINS ROMAP 5 AST1 MAG V1.0
RL-A-ROMAP-2-AST2-MAG-V1.0	ROSETTA-LANDER LUTETIA ROMAP 2 AST2 MAG V1.0
RL-A-ROMAP-3-AST2-MAG-V1.0	ROSETTA-LANDER LUTETIA ROMAP 3 AST2 MAG V1.0

RL-CAL-ROMAP-2-PHC-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 2 PHC MAG V1.0
RL-CAL-ROMAP-2-PDCS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 2 PDCS MAG V1.0
RL-C-ROMAP-2-SDL-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 2 SDL MAG V1.0
RL-C-ROMAP-2-RBD-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 2 RBD MAG V1.0
RL-C-ROMAP-2-FSS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 2 FSS MAG V1.0
RL-CAL-ROMAP-3-PHC-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 3 PHC MAG V1.0
RL-CAL-ROMAP-3-PDCS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 3 PDCS MAG V1.0
RL-C-ROMAP-3-SDL-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 3 SDL MAG V1.0
RL-C-ROMAP-3-RBD-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 3 RBD MAG V1.0
RL-C-ROMAP-3-FSS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 3 FSS MAG V1.0
RL-CAL-ROMAP-5-PHC-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 5 PHC MAG V1.0
RL-CAL-ROMAP-5-PDCS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 5 PDCS MAG V1.0
RL-C-ROMAP-5-SDL-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 5 SDL MAG V1.0
RL-C-ROMAP-5-RBD-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 5 RBD MAG V1.0
RL-C-ROMAP-5-FSS-MAG-V1.0	ROSETTA-LANDER 67P ROMAP 5 FSS MAG V1.0
RL-CAL-ROMAP-2-CVP-SPM-V1.0	ROSETTA-LANDER CAL ROMAP 2 CVP SPM V1.0
RL-CAL-ROMAP-2-CR4A-SPM-V1.0	ROSETTA-LANDER CAL ROMAP 2 CR4A SPM V1.0
RL-CAL-ROMAP-2-RVM2-SPM-V1.0	ROSETTA-LANDER CAL ROMAP 3 RVM2 SPM V1.0
RL-CAL-ROMAP-3-CR4A-SPM-V1.0	ROSETTA-LANDER CAL ROMAP 3 CR4A SPM V1.0
RL-CAL-ROMAP-3-RVM2-SPM-V1.0	ROSETTA-LANDER CAL ROMAP 3 RVM2 SPM V1.0
RL-E-ROMAP-2-EAR3-SPM-V1.0	ROSETTA-LANDER EARTH ROMAP 2 EAR3 SPM V1.0
RL-E-ROMAP-3-EAR3-SPM-V1.0	ROSETTA-LANDER EARTH ROMAP 3 EAR3 SPM V1.0
RL-M-ROMAP-2-MARS-SPM-V1.0	ROSETTA-LANDER MARS ROMAP 2 MARS SPM V1.0
RL-M-ROMAP-3-MARS-SPM-V1.0	ROSETTA-LANDER MARS ROMAP 3 MARS SPM V1.0
RL-CAL-ROMAP-2-PHC-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 2 PHC SPM V1.0
RL-CAL-ROMAP-2-PDCS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 2 PDCS SPM V1.0
RL-C-ROMAP-2-SDL-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 2 SDL SPM V1.0
RL-C-ROMAP-2-RBD-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 2 RBD SPM V1.0
RL-C-ROMAP-2-FSS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 2 FSS SPM V1.0
RL-CAL-ROMAP-3-PHC-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 3 PHC SPM V1.0
RL-CAL-ROMAP-3-PDCS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 3 PDCS SPM V1.0
RL-C-ROMAP-3-SDL-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 3 SDL SPM V1.0
RL-C-ROMAP-3-RBD-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 3 RBD SPM V1.0
RL-C-ROMAP-3-FSS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 3 FSS SPM V1.0
RL-CAL-ROMAP-5-PHC-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 5 PHC SPM V1.0

RL-CAL-ROMAP-5-PDCS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 5 PDCS SPM V1.0
RL-C-ROMAP-5-SDL-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 5 SDL SPM V1.0
RL-C-ROMAP-5-RBD-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 5 RBD SPM V1.0
RL-C-ROMAP-5-FSS-SPM-V1.0	ROSETTA-LANDER 67P ROMAP 5 FSS SPM V1.0

The contents of the ROMAP data sets is as follows:

RL-CAL-ROMAP-x-CVP-xxx-Vx.x contains data from commisioning (2004)
RL-CAL-ROMAP-x-CRx-xxx-Vx.x contains data from cruise phases 1 to 6 (2004-2014)
RL-E-ROMAP-x-EARx-xxx-Vx.x contains data from the 3 Earth swing-by (03/2005, 11/2007, 11/2009)
RL-M-ROMAP-x-MARS-xxx-Vx.x contains data from the Mars swing-by (02/2007)
RL-A-ROMAP-x-AST1-xxx-Vx.x contains data from asteroid Steins fly by (2008)
RL-A-ROMAP-x-AST2-xxx-Vx.x contains data from asteroid Lutetia fly by (2010)
RL-C-ROMAP-x-SDL-xxx-Vx.x contains data from SDL comet phase (11/2014).

4.3 Data Product Design

The following types of data products are defined for ROMAP:

- Magnetometer data products: edited data (CODMAC level 2) in ADC units, preliminary calibrated data (CODMAC level 3) and final calibrated data (CODMAC level 5).
- Simple plasma monitor data products: edited data (CODMAC level 2), preliminary calibrated and final calibrated (CODMAC level 3).
- Housekeeping data. The HK data are common for MAG and SPM and include the pressure values.

All ROMAP data products have PDS detached labels.

4.3.1 Magnetometer Science Edited Data Product Design (Level 2)

A ROMAP edited Science file contains magnetic field vectors time stamped in UTC and ROMAP on board time.

4.3.1.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP MAG edited science data (level 2) are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES
FILE_RECORDS
LABEL_RECORDS
```

4.3.1.2 Data Object Pointers Identification Data Elements

The ROMAP SC edited data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.1.3 Instrument and Detector Descriptive Data Elements

The following data identification elements provide additional information about the ROMAP-MAG data products.

```
INSTRUMENT_HOST_NAME       = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID         = RL
INSTRUMENT_ID              = ROMAP
INSTRUMENT_NAME            = "ROSETTA LANDER  MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE            = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                              "FARADAY CUP"}
DETECTOR_ID               = MAG
```

```
INSTRUMENT_MODE_ID        = "N/A"
INSTRUMENT_MODE_DESC      = "N/A"
```

4.3.1.4 Data Object Definition

Each TAB file contains a five columns table with the raw magnetic field in Instrument frame and in ADC units: UTC, OBT, Bx, By, Bz.

```
OBJECT                     = TABLE
  NAME                     = "ROMAP_MAG_RAWSC_TABLE"
  INTERCHANGE_FORMAT       = ASCII
  ROWS                     =
  COLUMNS                  = 5
  ROW_BYTES                = 65
  ^STRUCTURE               = "ROMAP_MAG_RAWSC.FMT"
END_OBJECT                 = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_RAWSC.FMT as follows:

```
/*  Contents of format file  "ROMAP_MAG_RAWSC.FMT"  (Edited Science data)  */

OBJECT                 = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the magnetic field vector in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "OBT"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 25
    BYTES              = 15
    UNIT               = SECOND
    FORMAT             = "F15.5"
    DESCRIPTION        = "ROMAP 4 bytes counter representing the measurement
                          time synchronized with Lander On Board Time.
                          The time resolution is 0.03125 s"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "BX"
    DATA_TYPE          = ASCII_INTEGER
    START_BYTE         = 41
    BYTES              = 7
    FORMAT             = "I7"
    UNIT               = "ADC_COUNTS"
    DESCRIPTION        = "Magnetic field X component,
                         Uncalibrated raw data in instrument coordinates"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "BY"
    DATA_TYPE          = ASCII_INTEGER
    START_BYTE         = 49
    BYTES              = 7
    FORMAT             = "I7"
    UNIT               = "ADC_COUNTS"
    DESCRIPTION        = "Magnetic field Y component,
                         Uncalibrated raw data in instrument coordinates"
END_OBJECT           = COLUMN
```

```
OBJECT                = COLUMN
    NAME                = "BZ"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 57
    BYTES               = 7
    FORMAT              = "I7"
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "Magnetic field Z component,
                          Uncalibrated raw data in instrument coordinates"
END_OBJECT            = COLUMN
```

4.3.1.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

4.3.2 Simple Plasma Monitor Science Edited Data Product Design (Level 2)

A ROMAP SPM edited science file contains data for several measurement cycles.

One cycle contains the following data (in raw or parameter modes):

<u>Raw mode</u>
SPM header:
- UTC,
- OBT,
- Status of SPM (from HK parameters in SC data frame)

16 (for different angles) energy distributions (counts and current) for Ion1 and Ion2 sensors,
1 energy distribution (current) for Faraday Cup sensors,
1 energy distribution (counts) for Electron sensors

<u>Parameter mode</u>
SPM header (same as for raw mode)
1 energy distribution (counts and currents) for Ion1 and Ion2 sensors,
1 angle distributions (counts and currents) for Ion1 and Ion2 sensors,
1 energy distribution (current) for Faraday Cup sensors (same format as for raw mode),
1 energy distribution (counts) for Electron sensors (same format as for raw mode)

Each measurement cycle is described by a "combined detached label" (.LBL) containing pointers to corresponding data files (.TAB).

Examples:

<u>Raw mode:</u>
SPM_FS2_041007004354_RAW.LBL
    SPMR_FS2_041007004354_CN.TAB (ion energy-angle distribution, counts)
    SPMR_FS2_041007004354_CR.TAB (ion energy-angle distribution, current)
    SPMF_FS2_041007004354.TAB (Faraday cup energy distribution, current)
    SPME_FS2_041007004354.TAB (electron energy distribution, counts)

<u>Param mode:</u>
SPM_FS2_040514013124_PAR.LBL
    SPMP_FS2_040514013124_CNA.TAB (ion angle distribution, counts)
    SPMP_FS2_040514013124_CNE.TAB (ion energy distribution, counts)
    SPMP_FS2_040514013124_CRA.TAB (ion angle distribution, current)
    SPMP_FS2_040514013124_CRE.TAB (ion energy distribution, current)
    SPMF_FS2_040514013124.TAB (Faraday cup energy distribution, current)
    SPME_FS2_040514013124.TAB (electron energy distribution, counts)

The table objects corresponding to the distributions are detailed in the following paragraphs.

4.3.2.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP SPM edited science data (level 2) are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES
FILE_RECORDS
LABEL_RECORDS
```

4.3.2.2 Data Object Pointers Identification Data Elements

The ROMAP SPM SC edited data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.2.3 Instrument and Detector Descriptive Data Elements

The following data identification elements provide additional information about the ROMAP-SPM data products.

```
INSTRUMENT_HOST_NAME      = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID        = RL
INSTRUMENT_ID             = ROMAP
INSTRUMENT_NAME           = "ROSETTA LANDER MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE           = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                               "FARADAY CUP"}
DETECTOR_ID              = SPM
INSTRUMENT_MODE_ID        = "N/A"
INSTRUMENT_MODE_DESC      = "N/A"
```

4.3.2.4 Data Object Definition

Each TAB file contains a header describing the Instrument status and the energy and angle distributions.

4.3.2.4.1 Ion spectrum definition (counts-energy-angle distribution), raw mode (channels 1 or 2)

```
  OBJECT                        = ROMAP_SPM_RAW_ION_CN_TABLE
      NAME                      = ROMAP_SPM_RAW_ION_CN
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 256
      ^STRUCTURE                = "ROMAP_SPM_RAW_ION_CN.FMT"
      COLUMNS                   = 28
      ROW_BYTES                 = 232
  END_OBJECT                    = ROMAP_SPM_RAW_ION_CN_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_RAW_ION_CN.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_RAW_ION_CN.FMT"      */
/*                Ion spectrum definition      (Level 3)                 */
/*       (I1CNT or I2CNT),    raw mode (channels 1 or 2)                 */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement       */
/* ************************************************************ */

OBJECT                   = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
```

```
 END_OBJECT              = COLUMN

OBJECT                 = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "MODE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 42
    BYTES                = 9
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM mode:
                            raw or parameter"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "EXPOSITION_TIME"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 54
    BYTES                = 5
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM exposition time setting:
                            short or long"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "CALIBRATION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 62
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM calibration status:
                            active or inactive"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "CEM_SUPPLY"
    DATA_TYPE            = ASCII_INTEGER
    START_BYTE           = 72
    BYTES                = 1
    FORMAT               = "I1"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM CEM supply setting:
                            step number from 1 to 5"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "RESOLUTION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 75
    BYTES                = 4
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM resolution setting:
                            low or high"
```

```
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "ION_CHANNEL"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 82
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Ion channel status:
                             Both_off
                             Ion1
                             Ion2
                             Both_on"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "EVEN_ODD"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 93
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Indicates whether all energies
                           are transmitted (64 for full resolution and
                           32 for low resolution) or even/odd energies
                           alternatively. Takes the values:
                             even_odd or full"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 103
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Z_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 117
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Z component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I2_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 124
```

```
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                             detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                             detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
                             detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 166
    BYTES               = 6
```

```
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 173
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 180
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

/* *********************************************************** */
/* Add index and type columns                                  */
/*      Index column : measurement number                      */
/*      Type  column : measurement type (I1CNT or I2CNT)       */
/* *********************************************************** */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 187
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 194
    BYTES               = 5
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement type (I1CNT or I2CNT)"
END_OBJECT            = COLUMN

/* ********************************************************* */

OBJECT                = COLUMN
   NAME                 = "ENERGY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 201
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = "ELECTRONVOLT"
    DESCRIPTION         = "Energy step"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
```

```
    NAME                = "COUNTS_ELEVATION_1"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 209
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 1"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_2"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 218
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 2"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_3"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 227
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 3"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_4"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 236
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 4"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_5"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 245
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 5"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_6"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 254
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 6 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_7"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 263
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 7 "
```

```
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_8"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 272
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 8 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_9"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 281
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 9 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_10"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 290
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 10 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_11"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 299
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 11 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_12"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 308
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 12 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_13"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 317
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 13 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_14"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 326
    BYTES               = 8
```

```
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 14 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_15"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 335
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 15 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS_ELEVATION_16"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 344
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "counts for elevation step 16"
END_OBJECT              =  COLUMN
```

4.3.2.4.2 Ion spectrum definition (current-energy-angle), raw mode (channels 1 or 2)

```
  OBJECT                        = ROMAP_SPM_RAW_ION_CR_TABLE
      NAME                      = ROMAP_SPM_RAW_ION_CR
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 96
      ^STRUCTURE                = "ROMAP_SPM_RAW_ION_CR.FMT"
      COLUMNS                   = 28
      ROW_BYTES                 = 200
  END_OBJECT                    = ROMAP_SPM_RAW_ION_CR_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_RAW_ION_CR.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_RAW_ION_CR.FMT"         */
/*                Ion spectrum definition      (Level 2)                  */
/*       (I1CRT or I2CRT),    raw mode (channels 1 or 2)                  */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                   = COLUMN
    NAME                 = "UTC"
    DATA_TYPE            = TIME
    START_BYTE           = 1
    BYTES                = 23
    DESCRIPTION          = "This column represents the UTC
                            Of the SPM spectrum in PDS standard format
                            YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "OBT"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 25
    BYTES              = 15
    UNIT               = SECOND
    FORMAT             = "F15.5"
    DESCRIPTION        = "ROMAP 4 bytes counter representing the measurement
                          time synchronized with Lander On Board Time.
                          The time resolution is 0.03125 s"
```

```
END_OBJECT          = COLUMN

OBJECT               = COLUMN
    NAME             = "MODE"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 42
    BYTES            = 9
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM mode:
                        raw or parameter"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "EXPOSITION_TIME"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 54
    BYTES            = 5
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM exposition time setting:
                        short or long"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CALIBRATION"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 62
    BYTES            = 8
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM calibration status:
                        active or inactive"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CEM_SUPPLY"
    DATA_TYPE        = ASCII_INTEGER
    START_BYTE       = 72
    BYTES            = 1
    FORMAT           = "I1"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM CEM supply setting:
                        step number from 1 to 5"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "RESOLUTION"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 75
    BYTES            = 4
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM resolution setting:
                        low or high"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "ION_CHANNEL"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 82
    BYTES            = 8
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "Ion channel status:
                        Both_off
                        Ion1
```

```
                               Ion2
                               Both_on"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "EVEN_ODD"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 93
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Indicates whether all energies
                             are transmitted (64 for full resolution and
                             32 for low resolution) or even/odd energies
                             alternatively. Takes the values:
                               even_odd or full"
END_OBJECT                = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                        */
/*      Type  column : measurement type (CNT or CRT)             */
/* ************************************************************ */

OBJECT                  = COLUMN
    NAME                  = "INDEX"
    DATA_TYPE             = INTEGER
    START_BYTE            = 103
    BYTES                 = 5
    FORMAT                = "I5"
    UNIT                  = "N/A"
    DESCRIPTION           = "Measurement index"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "TYPE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 110
    BYTES                 = 5
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Measurement type (I1CRT or I2CRT)"
END_OBJECT              = COLUMN

/* ********************************************************** */

OBJECT                  = COLUMN
    NAME                  = "ENERGY_BIN"
    DATA_TYPE             = INTEGER
    START_BYTE            = 117
    BYTES                 = 2
    FORMAT                = "I2"
    UNIT                  = "N/A"
    DESCRIPTION           = "Energy bin number"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CURRENT_ELEVATION_1"
    DATA_TYPE             = INTEGER
    START_BYTE            = 120
    BYTES                 = 4
    FORMAT                = "I4"
    UNIT                  = "ADC_UNITS"
    DESCRIPTION           = "Current for elevation step 1"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
```

```
    NAME                = "CURRENT_ELEVATION_2"
    DATA_TYPE           = INTEGER
    START_BYTE          = 125
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 2"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_3"
    DATA_TYPE           = INTEGER
    START_BYTE          = 130
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 3"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_4"
    DATA_TYPE           = INTEGER
    START_BYTE          = 135
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 4"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_5"
    DATA_TYPE           = INTEGER
    START_BYTE          = 140
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 5"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_6"
    DATA_TYPE           = INTEGER
    START_BYTE          = 145
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 6 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_7"
    DATA_TYPE           = INTEGER
    START_BYTE          = 150
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 7 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_8"
    DATA_TYPE           = INTEGER
    START_BYTE          = 155
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 8 "
```

```
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_9"
    DATA_TYPE           = INTEGER
    START_BYTE          = 160
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 9 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_10"
    DATA_TYPE           = INTEGER
    START_BYTE          = 165
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 10 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_11"
    DATA_TYPE           = INTEGER
    START_BYTE          = 170
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 11 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_12"
    DATA_TYPE           = INTEGER
    START_BYTE          = 175
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 12 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_13"
    DATA_TYPE           = INTEGER
    START_BYTE          = 180
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 13 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_14"
    DATA_TYPE           = INTEGER
    START_BYTE          = 185
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 14 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_15"
    DATA_TYPE           = INTEGER
    START_BYTE          = 190
    BYTES               = 4
```

```
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 15 "
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CURRENT_ELEVATION_16"
    DATA_TYPE           = INTEGER
    START_BYTE          = 195
    BYTES               = 4
    FORMAT              = "I4"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Current for elevation step 16 "
END_OBJECT            = COLUMN
```

4.3.2.4.3 Ion spectrum definition (counts-energy distribution), parameter mode (channels 1 or 2)

```
  OBJECT                          = ROMAP_SPM_PAR_ION_CNE_TABLE
      NAME                        = ROMAP_SPM_PAR_ION_CNE
      INTERCHANGE_FORMAT          = ASCII
      ROWS                        = 192
      ^STRUCTURE                  = "ROMAP_SPM_PAR_ION_CNE.FMT"
      COLUMNS                     = 14
      ROW_BYTES                   = 148
  END_OBJECT                      = ROMAP_SPM_PAR_ION_CNE_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PAR_ION_CNE.FMT as follows:

```
/*              Contents of format file  " ROMAP_SPM_PAR_ION_CNE.FMT" */
/*                   Ion spectrum definition     (Level 2)             */
/*    (I1CNTE or I2CNTE), parameter mode (channels 1 or 2)             */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement       */
/* ************************************************************ */

OBJECT                  = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                = "MODE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 42
    BYTES               = 9
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM mode:
```

```
                                raw or parameter"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "EXPOSITION_TIME"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 54
    BYTES                     = 5
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "SPM exposition time setting:
                                short or long"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "CALIBRATION"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 62
    BYTES                     = 8
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "SPM calibration status:
                                active or inactive"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "CEM_SUPPLY"
    DATA_TYPE                 = ASCII_INTEGER
    START_BYTE                = 72
    BYTES                     = 1
    FORMAT                    = "I1"
    UNIT                      = "N/A"
    DESCRIPTION               = "SPM CEM supply setting:
                                step number from 1 to 5"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "RESOLUTION"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 75
    BYTES                     = 4
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "SPM resolution setting:
                                low or high"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "ION_CHANNEL"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 82
    BYTES                     = 8
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "Ion channel status:
                                Both_off
                                Ion1
                                Ion2
                                Both_on"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "EVEN_ODD"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 93
    BYTES                     = 8
    FORMAT                    = "N/A"
```

```
    UNIT                = "N/A"
    DESCRIPTION         = "Indicates whether all energies
                          are transmitted (64 for full resolution and
                          32 for low resolution) or even/odd energies
                          alternatively. Takes the values:
                            even_odd or full"
END_OBJECT              = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                        */
/*      Type  column : measurement type (I1CNTE or I2CNTE)       */
/* ************************************************************ */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 103
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 110
    BYTES               = 6
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement type (I1CNTE or I2CNTE)"
END_OBJECT            = COLUMN

/* ********************************************************** */

OBJECT                  = COLUMN
    NAME                = "ENERGY_BIN"
    DATA_TYPE           = INTEGER
    START_BYTE          = 118
    BYTES               = 2
    FORMAT              = "I2"
    UNIT                = "N/A"
    DESCRIPTION         = "Energy bin number"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "COUNTS"
    DATA_TYPE           = INTEGER
    START_BYTE          = 121
    BYTES               = 8
    FORMAT              = "I8"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Sum of counts for elevation steps 1 to 16"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "OVERFLOW FLAG"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 131
    BYTES               = 16
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "String of 16 characters ; each character corresponds
                            to an elevation step and may take one of the following
                            values :
                                      0 : No overflow
```

```
                                           1 : Overflow"
END_OBJECT              = COLUMN
```

4.3.2.4.4 Ion spectrum definition (current-energy distribution), parameter mode (channels 1 or 2)

```
  OBJECT                        = ROMAP_SPM_PAR_ION_CRE_TABLE
      NAME                      = ROMAP_SPM_PAR_ION_CRE
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 192
      ^STRUCTURE                = "ROMAP_SPM_PAR_ION_CRE.FMT"
      COLUMNS                   = 14
      ROW_BYTES                 = 145
  END_OBJECT                    = ROMAP_SPM_PAR_ION_CRE_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PAR_ION_CRE.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_PAR_ION_CRE.FMT"     */
/*                  Ion spectrum definition      (Level 2)               */
/*    (I1CRTE or I2CRTE), parameter mode (channels 1 or 2)               */


/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement       */
/* ************************************************************ */

OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                = "MODE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 42
    BYTES               = 9
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM mode:
                           raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "EXPOSITION_TIME"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 54
    BYTES               = 5
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM exposition time setting:
                           short or long"
```

```
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CALIBRATION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 62
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM calibration status:
                           active or inactive"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CEM_SUPPLY"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 72
    BYTES               = 1
    FORMAT              = "I1"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM CEM supply setting:
                           step number from 1 to 5"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                           low or high"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                           Both_off
                           Ion1
                           Ion2
                           Both_on"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "EVEN_ODD"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 93
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Indicates whether all energies
                         are transmitted (64 for full resolution and
                         32 for low resolution) or even/odd energies
                         alternatively. Takes the values:
                           even_odd or full"
END_OBJECT              = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                        */
/*      Type  column : measurement type (I1CRTE or I2CRTE)       */
```

```
/* ************************************************************ */

OBJECT                  = COLUMN
    NAME                 = "INDEX"
    DATA_TYPE            = INTEGER
    START_BYTE           = 103
    BYTES                = 5
    FORMAT               = "I5"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement index"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                 = "TYPE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 110
    BYTES                = 6
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement type (I1CRTE or I2CRTE)"
END_OBJECT              = COLUMN

/* ********************************************************** */

OBJECT                    = COLUMN
    NAME                 = "ENERGY_BIN"
    DATA_TYPE            = INTEGER
    START_BYTE           = 118
    BYTES                = 2
    FORMAT               = "I2"
    UNIT                 = "N/A"
    DESCRIPTION          = "Energy bin number"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                 = "CURRENT"
    DATA_TYPE            = INTEGER
    START_BYTE           = 121
    BYTES                = 5
    FORMAT               = "I5"
    UNIT                 = "ADC_UNITS"
    DESCRIPTION          = "Sum of currents for elevation steps 1 to 16"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                 = "OVERFLOW FLAG"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 128
    BYTES                = 16
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "String of 16 characters ; each character corresponds
                            to an elevation step and may take one of the following
                            values :
                                      0 : No overflow
                                      1 : Overflow"
END_OBJECT                = COLUMN
```

4.3.2.4.5 Ion spectrum definition (counts-angle distribution), parameter mode (channels 1 or 2)

```
  OBJECT                          = ROMAP_SPM_PAR_ION_CNA_TABLE
      NAME                        = ROMAP_SPM_PAR_ION_CNA
      INTERCHANGE_FORMAT          = ASCII
      ROWS                        = 96
      ^STRUCTURE                  = "ROMAP_SPM_PAR_ION_CNA.FMT"
      COLUMNS                     = 14
      ROW_BYTES                   = 196
  END_OBJECT                      = ROMAP_SPM_PAR_ION_CNA_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PAR_ION_CNA.FMT as follows:

```
/*              Contents of format file  " ROMAP_SPM_PAR_ION_CNA.FMT"  */
/*                   Ion spectrum definition     (Level 2)             */
/*    (I1CNTA or I2CNTA), parameter mode (channels 1 or 2)             */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT             = COLUMN

OBJECT                   = COLUMN
    NAME                 = "MODE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 42
    BYTES                = 9
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM mode:
                            raw or parameter"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "EXPOSITION_TIME"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 54
    BYTES                = 5
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM exposition time setting:
                            short or long"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CALIBRATION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 62
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM calibration status:
                            active or inactive"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
```

```
    NAME                = "CEM_SUPPLY"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 72
    BYTES               = 1
    FORMAT              = "I1"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM CEM supply setting:
                           step number from 1 to 5"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                           low or high"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                           Both_off
                           Ion1
                           Ion2
                           Both_on"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "EVEN_ODD"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 93
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Indicates whether all energies
                         are transmitted (64 for full resolution and
                         32 for low resolution) or even/odd energies
                         alternatively. Takes the values:
                           even_odd or full"
END_OBJECT              = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CNTA or I2CNTA)      */
/* ************************************************************ */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 103
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
```

```
    DATA_TYPE        = CHARACTER
    START_BYTE       = 110
    BYTES            = 6
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "Measurement type (I1CNTA or I2CNTA)"
END_OBJECT         = COLUMN

/* ********************************************************* */

OBJECT               = COLUMN
    NAME             = "ANGLE_BIN"
    DATA_TYPE        = INTEGER
    START_BYTE       = 118
    BYTES            = 2
    FORMAT           = "I2"
    UNIT             = "N/A"
    DESCRIPTION      = "Elevation step"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "COUNTS"
    DATA_TYPE        = INTEGER
    START_BYTE       = 121
    BYTES            = 8
    FORMAT           = "I8"
    UNIT             = "N/A"
    DESCRIPTION      = "Sum of counts for energy steps 0 to 31
                        Or 0 to 63"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "OVERFLOW FLAG"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 131
    BYTES            = 64
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "String of 64 characters ; each character corresponds
                        to a step of energy and may take one of the following
                        values :
                                  0 : No overflow
                                  1 : Overflow
                        In low resolution the 32 last characters are unused
                        and set to blank "
END_OBJECT           = COLUMN
```

4.3.2.4.6 Ion spectrum definition (current-angle), parameter mode (channels 1 or 2)

```
  OBJECT                       = ROMAP_SPM_PAR_ION_CRA_TABLE
      NAME                     = ROMAP_SPM_PAR_ION_CRA
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 96
      ^STRUCTURE               = "ROMAP_SPM_PAR_ION_CRA.FMT"
      COLUMNS                  = 14
      ROW_BYTES                = 194
  END_OBJECT                   = ROMAP_SPM_PAR_ION_CRA_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PAR_ION_CRA.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_PAR_ION_CRA.FMT"     */
/*                   Ion spectrum definition     (Level 2)               */
/*    (I1CRTA or I2CRTA), parameter mode (channels 1 or 2)               */

/* *********************************************************** */
/* Include the HEADER at the beginning of each measurement      */
/* *********************************************************** */
```

```
OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT             = COLUMN

OBJECT                   = COLUMN
    NAME                 = "MODE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 42
    BYTES                = 9
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM mode:
                            raw or parameter"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "EXPOSITION_TIME"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 54
    BYTES                = 5
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM exposition time setting:
                            short or long"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CALIBRATION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 62
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM calibration status:
                            active or inactive"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CEM_SUPPLY"
    DATA_TYPE            = ASCII_INTEGER
    START_BYTE           = 72
    BYTES                = 1
    FORMAT               = "I1"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM CEM supply setting:
                            step number from 1 to 5"
END_OBJECT               = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                            low or high"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                            Both_off
                            Ion1
                            Ion2
                            Both_on"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "EVEN_ODD"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 93
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Indicates whether all energies
                          are transmitted (64 for full resolution and
                          32 for low resolution) or even/odd energies
                          alternatively. Takes the values:
                            even_odd or full"
END_OBJECT              = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CRTA or I2CRTA)      */
/* ************************************************************ */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 103
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 110
    BYTES               = 6
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement type (I1CRTA or I2CRTA)"
END_OBJECT            = COLUMN

/* ********************************************************** */
```

```
OBJECT                  = COLUMN
    NAME                 = "ANGLE_BIN"
    DATA_TYPE            = INTEGER
    START_BYTE           = 118
    BYTES                = 2
    FORMAT               = "I2"
    UNIT                 = "N/A"
    DESCRIPTION          = "Elevation step number"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT"
    DATA_TYPE            = INTEGER
    START_BYTE           = 121
    BYTES                = 6
    FORMAT               = "I6"
    UNIT                 = "N/A"
    DESCRIPTION          = "Sum of currents for energy steps 0 to 31
                             Or 0 to 63"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OVERFLOW FLAG"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 129
    BYTES                = 64
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "String of 64 characters ; each character corresponds
                            to a step of energy and may take one of the following
                            values :
                                      0 : No overflow
                                      1 : Overflow
                            In low resolution the 32 last characters are unused
                            and set to blank "
END_OBJECT               = COLUMN
```

4.3.2.4.7 Faraday cup current-energy distribution

FC TABLE object for PAR mode

```
 OBJECT                        = ROMAP_SPM_PAR_FC_TABLE
      NAME                      = ROMAP_SPM_PAR_FC
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 54
      COLUMNS                   = 12
      ROW_BYTES                 = 119
      ^STRUCTURE                = "ROMAP_SPM_FC.FMT"
  END_OBJECT                    = ROMAP_SPM_PAR_FC_TABLE
```

FC TABLE object for RAW mode

```
  OBJECT                        = ROMAP_SPM_RAW_FC_TABLE
      NAME                      = ROMAP_SPM_RAW_FC
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 272
      COLUMNS                   = 12
      ROW_BYTES                 = 119
      ^STRUCTURE                = "ROMAP_SPM_FC.FMT"
  END_OBJECT                    = ROMAP_SPM_RAW_FC_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_FC.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_FC.FMT"                 */
/*    Faraday cup current-energy distribution   (Level 2)                   */

/* ********************************************************** */
/* Include the HEADER at the beginning of each measurement      */
/* ********************************************************** */

OBJECT                     = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                              Of the SPM spectrum in PDS standard format
                              YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT             = COLUMN

OBJECT                    = COLUMN
    NAME                  = "MODE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 42
    BYTES                 = 9
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM mode:
                             raw or parameter"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "EXPOSITION_TIME"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 54
    BYTES                 = 5
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM exposition time setting:
                             short or long"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "CALIBRATION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 62
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM calibration status:
                             active or inactive"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "CEM_SUPPLY"
    DATA_TYPE             = ASCII_INTEGER
    START_BYTE            = 72
```

```
    BYTES                = 1
    FORMAT               = "I1"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM CEM supply setting:
                            step number from 1 to 5"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "RESOLUTION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 75
    BYTES                = 4
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM resolution setting:
                            low or high"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "ION_CHANNEL"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 82
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Ion channel status:
                            Both_off
                            Ion1
                            Ion2
                            Both_on"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "EVEN_ODD"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 93
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Indicates whether all energies
                          are transmitted (64 for full resolution and
                          32 for low resolution) or even/odd energies
                          alternatively. Takes the values:
                            even_odd or full"
END_OBJECT               = COLUMN

/* ************************************************************ */
/* Add index column                                             */
/*      Index column : measurement number                       */
/* ************************************************************ */

OBJECT                 = COLUMN
    NAME                 = "INDEX"
    DATA_TYPE            = INTEGER
    START_BYTE           = 103
    BYTES                = 5
    FORMAT               = "I5"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement index"
END_OBJECT             = COLUMN

/* ********************************************************** */

OBJECT                   = COLUMN
    NAME                 = "ENERGY_BIN"
    DATA_TYPE            = INTEGER
    START_BYTE           = 109
```

```
    BYTES               = 2
    FORMAT              = "I2"
    UNIT                = "N/A"
    DESCRIPTION         = "Energy bin number"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CURRENT"
    DATA_TYPE           = INTEGER
    START_BYTE          = 112
    BYTES               = 6
    FORMAT              = "I6"
    UNIT                = "ADC_UNITS"
    DESCRIPTION         = "Faraday cup Current "
END_OBJECT              = COLUMN
```

4.3.2.4.8 Electron spectrum (count-energy distribution)

Electron spectrum TABLE object for PAR mode.

```
  OBJECT                       = ROMAP_SPM_PAR_ELEC_TABLE
      NAME                     = ROMAP_SPM_PAR_ELEC
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 96
      COLUMNS                  = 12
      ROW_BYTES                = 119
      ^STRUCTURE               = "ROMAP_SPM_ELEC.FMT"
  END_OBJECT                   = ROMAP_SPM_PAR_ELEC_TABLE
```

Electron spectrum TABLE object for RAW mode.

```
OBJECT                       = ROMAP_SPM_RAW_ELEC_TABLE
      NAME                     = ROMAP_SPM_RAW_ELEC
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 256
      COLUMNS                  = 12
      ROW_BYTES                = 119
      ^STRUCTURE               = "ROMAP_SPM_ELEC.FMT"
  END_OBJECT                   = ROMAP_SPM_RAW_ELEC_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_ELEC.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_ELEC.FMT"             */
/*         Electron spectrum (count-energy distribution) (Level 2)        */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the SPM spectrum in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT               = COLUMN

OBJECT                  = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
```

```
                              time synchronized with Lander On Board Time.
                              The time resolution is 0.03125 s"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "MODE"
    DATA_TYPE               = CHARACTER
    START_BYTE              = 42
    BYTES                   = 9
    FORMAT                  = "N/A"
    UNIT                    = "N/A"
    DESCRIPTION             = "SPM mode:
                               raw or parameter"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "EXPOSITION_TIME"
    DATA_TYPE               = CHARACTER
    START_BYTE              = 54
    BYTES                   = 5
    FORMAT                  = "N/A"
    UNIT                    = "N/A"
    DESCRIPTION             = "SPM exposition time setting:
                               short or long"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "CALIBRATION"
    DATA_TYPE               = CHARACTER
    START_BYTE              = 62
    BYTES                   = 8
    FORMAT                  = "N/A"
    UNIT                    = "N/A"
    DESCRIPTION             = "SPM calibration status:
                               active or inactive"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "CEM_SUPPLY"
    DATA_TYPE               = ASCII_INTEGER
    START_BYTE              = 72
    BYTES                   = 1
    FORMAT                  = "I1"
    UNIT                    = "N/A"
    DESCRIPTION             = "SPM CEM supply setting:
                               step number from 1 to 5"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "RESOLUTION"
    DATA_TYPE               = CHARACTER
    START_BYTE              = 75
    BYTES                   = 4
    FORMAT                  = "N/A"
    UNIT                    = "N/A"
    DESCRIPTION             = "SPM resolution setting:
                               low or high"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
    NAME                    = "ION_CHANNEL"
    DATA_TYPE               = CHARACTER
    START_BYTE              = 82
    BYTES                   = 8
    FORMAT                  = "N/A"
    UNIT                    = "N/A"
    DESCRIPTION             = "Ion channel status:
```

```
                               Both_off
                               Ion1
                               Ion2
                               Both_on"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
    NAME                     = "EVEN_ODD"
    DATA_TYPE                = CHARACTER
    START_BYTE               = 93
    BYTES                    = 8
    FORMAT                   = "N/A"
    UNIT                     = "N/A"
    DESCRIPTION              = "Indicates whether all energies
                             are transmitted (64 for full resolution and
                             32 for low resolution) or even/odd energies
                             alternatively. Takes the values:
                               even_odd or full"
END_OBJECT                   = COLUMN

/* ********************************************************** */
/* Add index column                                           */
/*      Index column : measurement number                      */
/* ********************************************************** */

OBJECT                     = COLUMN
    NAME                     = "INDEX"
    DATA_TYPE                = INTEGER
    START_BYTE               = 103
    BYTES                    = 5
    FORMAT                   = "I5"
    UNIT                     = "N/A"
    DESCRIPTION              = "Measurement index"
END_OBJECT                 = COLUMN

/* ********************************************************* */

OBJECT                       = COLUMN
    NAME                     = "ENERGY_BIN"
    DATA_TYPE                = INTEGER
    START_BYTE               = 109
    BYTES                    = 2
    FORMAT                   = "I2"
    UNIT                     = "N/A"
    DESCRIPTION              = "Energy bin number"
END_OBJECT                   = COLUMN

OBJECT                       = COLUMN
    NAME                     = "COUNTS"
    DATA_TYPE                = INTEGER
    START_BYTE               = 112
    BYTES                    = 6
    FORMAT                   = "I6"
    UNIT                     = "ADC_UNITS"
    DESCRIPTION              = "Electron counts"
END_OBJECT                   = COLUMN
```

4.3.2.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

4.3.3 Housekeeping Edited Data Product Design (Level 2)

4.3.3.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP HK edited data (level 2) are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES
FILE_RECORDS
LABEL_RECORDS
```

4.3.3.2 Data Object Pointers Identification Data Elements

The ROMAP HK edited data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.3.3 Instrument and Detector Descriptive Data Elements

```
INSTRUMENT_HOST_NAME        = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID          = RL
INSTRUMENT_ID               = ROMAP
INSTRUMENT_NAME             = "ROSETTA LANDER  MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE             = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                               "FARADAY CUP"}
INSTRUMENT_MODE_ID          = "N/A"
INSTRUMENT_MODE_DESC        = "N/A"
```

4.3.3.4 Data Object Definition

Each TAB file contains a 16 columns table with the uncalibrated HK data (ADC units).

```
OBJECT                     = TABLE
  NAME                     = "ROMAP_RAWHK_TABLE"
  INTERCHANGE_FORMAT       = ASCII
  ROWS                     =
  COLUMNS                  = 8
  ROW_BYTES                = 153
  ^STRUCTURE               = "ROMAP_RAWHK.FMT"
END_OBJECT                 = TABLE
```

The structure of the TABLE object is described in the file ROMAP_RAWHK.FMT as follows:

```
/*  Contents of format file  "ROMAP_RAWHK.FMT"  (Uncalibrated HK data)  */

OBJECT                  = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the HK parameters set in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "OBT"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 25
    BYTES              = 15
    UNIT               = SECOND
    FORMAT             = "F15.5"
    DESCRIPTION        = "ROMAP 4 bytes counter representing the measurement
                          time synchronized with Lander On Board Time.
                          The time resolution is 0.03125 s"
```

```
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CONTROLLER STATUS"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 42
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = " Controller Status Bits in Hexadecimal Format :

                           Bit                          Description

                           0        Status flag : Instrument Mode was loaded
                                                  at power-up from TC-Buffer
                           1        Status flag : MAG setting was loaded from
                                                  TC-Buffer
                           3        Error flag : read TC-Buffer error at power-up
                           4        Error flag : write BRAM error; cleared after
                                                  successfully writing BRAM
                           5        Error flag : TC-Buffer content error
                                                 (illegal checksum)
                           6        Error flag : SPM Ion 1 counter overflow occurred
                                                 (cleared after displaying SPM
                                                  overflow error flag in HK data)
                           7        Error flag : SPM Ion 2 counter overflow occurred
                                                 (cleared after displaying SPM
                                                  overflow errorflag in HK data)
                           8        Error flag : SPM Electron counter overflow
                                                 occurred (cleared after displaying
                                                 SPM overflow error flag in HK data)
                           9        Status flag : Penning pressure sensor on/off
                          10        Status flag : Pirani pressure sensor on/off
                          11        Status flag : DUMMY FPGA output on/off
                          12..13    Not used
                          14..15    Status flags: I0, I1 identify instrument mode

                            If one of the bits 0 .. 5 is set once, it stays active
                            until the instrument is switched off."
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "LAST RECEIVED TC (WORD 1)"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 49
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Last received TC (word 1) in Hexadecimal Format"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "LAST RECEIVED TC (WORD 2)"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 56
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Last received TC (word 2 )in Hexadecimal Format"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POWER CONSUMPTION"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 62
    BYTES               = 6
    FORMAT              = "I6"
```

```
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "Overall instrument power consumption
                           P = N * 76.3E-3 * 4 [mW]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "+5V CURRENT"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 69
    BYTES               = 6
    FORMAT              = "I6"
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "+5V current
                           I = N * 76.3E-3 * 0.5 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "-5V CURRENT"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 76
    BYTES               = 6
    FORMAT              = "I6"
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "-5V current
                           I = N * 76.3E-3 * 0.05 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "ELECTRONICS TEMPERATURE"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 83
    BYTES               = 6
    FORMAT              = "I6"
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "electronics temperature
                           T = (N * 76.3E-6 - 0.535) * 472.9 [°C]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "+28V CURRENT"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 90
    BYTES               = 6
    FORMAT              = "I6"
    UNIT                = "ADC_COUNTS"
    DESCRIPTION         = "+28V current
                           I = N * 76.3E-3 * 0.025 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "SPM HV STATUS 1"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 98
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM HV status 1 in Hexadecimal Format"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "SPM HV STATUS 2"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 105
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM HV status 2 in Hexadecimal Format"
```

```
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "SPM HV STATUS 3"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 112
    BYTES             = 4
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "SPM HV status 3 in Hexadecimal Format"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "SPM HV STATUS 4"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 119
    BYTES             = 4
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "SPM HV status 4 in Hexadecimal Format"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "PENNING PRESSURE"
    DATA_TYPE         = ASCII_INTEGER
    START_BYTE        = 125
    BYTES             = 6
    FORMAT            = "I6"
    UNIT              = "ADC_COUNTS"
    DESCRIPTION       = "Penning pressure"
END_OBJECT            = COLUMN


OBJECT                = COLUMN
    NAME              = "PIRANI PRESSURE"
    DATA_TYPE         = ASCII_INTEGER
    START_BYTE        = 132
    BYTES             = 6
    FORMAT            = "I6"
    UNIT              = "ADC_COUNTS"
    DESCRIPTION       = "Pirani pressure"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "PROM CHECKSUM"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 140
    BYTES             = 4
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "PROM checksum (computed at power-up)
                         in Hexadecimal Format"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "INSTRUMENT ERROR FLAGS"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 147
    BYTES             = 4
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = " Instrument Error Flags in Hexadecimal Format :

                       Bit                Description

                       0        Command overflow (a TC was received before the
                                                  former was processed)
```

```
                                1       CDMS illegal word count
                                2       CDMS message error
                                3       General CDMS receiving error
                                4       General CDMS transmission error
                                5       Wrong telecommand received
                                6       CDMS request overflow (a CDMS request occurs
                                                     before the former was processed)
                                7       Frame buffer overflow
                                8       MAG vector sampling overflow
                                9       CDMS error code word received
                               10       CDMS checksum error
                               11       checksum error in received CDMS SST word
                               12       SPM counter overflow
                               13       ADC sampling overflow
                               14       SPM transmission overflow
                               15       SPM setup error"
END_OBJECT                     = COLUMN
```

4.3.3.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

4.3.4 Magnetometer Science calibrated Data Product Design (Level 3)

There are two kinds of calibrated science data for the ROMAP MAG instrument, draft calibrated and final calibrated. The draft calibration refers to that data are in physical units (like nanoTesla), scaled, rotated into different coordinates and preliminary offsets subtracted. The different frames are Magnetometer, Lander, Orbiter and Ecliptic J2000. Level 3 contains draft calibrated MAG data.

4.3.4.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP MAG science calibrated data are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES   = 119
FILE_RECORDS
LABEL_RECORDS
```

4.3.4.2 Data Object Pointers Identification Data Elements

The ROMAP MAG SC calibrated data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.4.3 Instrument and Detector Descriptive Data Elements

The following data identification elements provide additional information about the ROMAP-MAG data products.

```
INSTRUMENT_HOST_NAME      = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID        = RL
INSTRUMENT_ID             = ROMAP
INSTRUMENT_NAME           = "ROSETTA LANDER  MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE           = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                               "FARADAY CUP"}
DETECTOR_ID               = MAG
INSTRUMENT_MODE_ID        = "N/A"
INSTRUMENT_MODE_DESC      = "N/A"
```

4.3.4.4 Data Object Definition

4.3.4.4.1 Level A data object definition (draft calibrated in instrument coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                    = TABLE
  NAME                    = "ROMAP_MAG_CALSCA_TABLE"
  INTERCHANGE_FORMAT      = ASCII
  ROWS                    =
  COLUMNS                 = 8
  ROW_BYTES               = 119
  ^STRUCTURE              = "ROMAP_MAG_CALSCA.FMT"
END_OBJECT                = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCA.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCA.FMT"           */
/*     Level A data object definition  :                                  */
/*    draft calibrated in instrument coordinates                          */


OBJECT                  = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the magnetic field vector in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT              = COLUMN

OBJECT                 = COLUMN
    NAME               = "OBT"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 25
    BYTES              = 15
    UNIT               = SECOND
    FORMAT             = "F15.5"
    DESCRIPTION        = "ROMAP 4 bytes counter representing the measurement
                          time synchronized with Lander On Board Time.
                          The time resolution is 0.03125 s"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "POS_X"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 41
    BYTES              = 16
    FORMAT             = "F16.3"
    UNIT               = KILOMETER
    DESCRIPTION        = "X component of the Spacecraft (Lander) position,
                          ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "POS_Y"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 58
    BYTES              = 16
    FORMAT             = "F16.3"
    UNIT               = KILOMETER
    DESCRIPTION        = "Y component of the Spacecraft (Lander) position,
                          ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN
```

```
OBJECT                   = COLUMN
    NAME                 = "POS_Z"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 75
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Z component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BX"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 92
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field X component,
                            draft calibrated, instrument coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BY"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 101
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field Y component,
                           draft calibrated, instrument coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BZ"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field Z component,
                           draft calibrated, instrument coordinates"
END_OBJECT               = COLUMN
```

4.3.4.4.2 Level B data object definition (draft calibrated in Lander coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                       = TABLE
  NAME                       = "ROMAP_MAG_CALSCB_TABLE"
  INTERCHANGE_FORMAT         = ASCII
  ROWS                       =
  COLUMNS                    = 8
  ROW_BYTES                  = 119
  ^STRUCTURE                 = "ROMAP_MAG_CALSCB.FMT"
END_OBJECT                   = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCB.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCB.FMT"           */
/*     Level B data object definition  :                                  */
/*     draft calibrated in Lander coordinates                             */


OBJECT                     = COLUMN
    NAME                   = "UTC"
```

```
    DATA_TYPE            = TIME
    START_BYTE           = 1
    BYTES                = 23
    DESCRIPTION          = "This column represents the UTC
                            Of the magnetic field vector in PDS standard format
                            YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_X"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 41
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "X component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Y"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 58
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Y component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Z"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 75
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Z component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BX"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 92
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field X component,
                            draft calibrated, Lander coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BY"
    DATA_TYPE            = ASCII_REAL
```

```
    START_BYTE        = 101
    BYTES             = 8
    FORMAT            = "F8.2"
    UNIT              = NANOTESLA
    DESCRIPTION       = "Magnetic field Y component,
                        draft calibrated, Lander coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "BZ"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 110
    BYTES             = 8
    FORMAT            = "F8.2"
    UNIT              = NANOTESLA
    DESCRIPTION       = "Magnetic field Z component,
                        draft calibrated, Lander coordinates"
END_OBJECT            = COLUMN
```

4.3.4.4.3 Level C data object definition (draft calibrated in Orbiter coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                    = TABLE
  NAME                    = "ROMAP_MAG_CALSCC_TABLE"
  INTERCHANGE_FORMAT      = ASCII
  ROWS                    =
  COLUMNS                 = 8
  ROW_BYTES               = 119
  ^STRUCTURE              = "ROMAP_MAG_CALSCC.FMT"
END_OBJECT                = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCC.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCC.FMT"           */
/*     Level C data object definition  :                                  */
/*     draft calibrated in Orbiter  coordinates                           */


OBJECT                  = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the magnetic field vector in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT              = COLUMN

OBJECT                = COLUMN
    NAME              = "OBT"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 25
    BYTES             = 15
    UNIT              = SECOND
    FORMAT            = "F15.5"
    DESCRIPTION       = "ROMAP 4 bytes counter representing the measurement
                         time synchronized with Lander On Board Time.
                         The time resolution is 0.03125 s"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME              = "POS_X"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 41
    BYTES             = 16
    FORMAT            = "F16.3"
```

```
    UNIT                 = KILOMETER
    DESCRIPTION          = "X component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Y"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 58
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Y component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Z"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 75
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Z component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BX"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 92
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field X component,
                            draft calibrated, Orbiter coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BY"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 101
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field Y component,
                           draft calibrated, Orbiter coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BZ"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = NANOTESLA
    DESCRIPTION          = "Magnetic field Z component,
                           draft calibrated, Orbiter coordinates"
END_OBJECT               = COLUMN
```

4.3.4.4.4 Level D data object definition (draft calibrated in ECLIP J2000 coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                        = TABLE
  NAME                        = "ROMAP_MAG_CALSCD_TABLE"
  INTERCHANGE_FORMAT          = ASCII
```

```
  ROWS                        =
  COLUMNS                     = 8
  ROW_BYTES                   = 119
  ^STRUCTURE                  = "ROMAP_MAG_CALSCD.FMT"
END_OBJECT                    = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCD.FMT as follows:

```
/*               Contents of format file  "ROMAP_MAG_CALSCD.FMT"           */
/*    Level D data object definition  :                                    */
/*    draft calibrated in ECLIP J2000 coordinates                          */


OBJECT                      = COLUMN
    NAME                    = "UTC"
    DATA_TYPE               = TIME
    START_BYTE              = 1
    BYTES                   = 23
    DESCRIPTION             = "This column represents the UTC
                               Of the magnetic field vector in PDS standard format
                               YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT                  = COLUMN

OBJECT                    = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "POS_X"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 41
    BYTES                 = 16
    FORMAT                = "F16.3"
    UNIT                  = KILOMETER
    DESCRIPTION           = "X component of the Spacecraft (Lander) position,
                             ECLIPJ2000 coordinates"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "POS_Y"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 58
    BYTES                 = 16
    FORMAT                = "F16.3"
    UNIT                  = KILOMETER
    DESCRIPTION           = "Y component of the Spacecraft (Lander) position,
                             ECLIPJ2000 coordinates"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                  = "POS_Z"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 75
    BYTES                 = 16
    FORMAT                = "F16.3"
    UNIT                  = KILOMETER
    DESCRIPTION           = "Z component of the Spacecraft (Lander) position,
                             ECLIPJ2000 coordinates"
END_OBJECT                = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                = "BX"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 92
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field X component,
                           draft calibrated, ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 101
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Y component,
                          draft calibrated, ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BZ"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 110
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Z component,
                          draft calibrated, ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN
```

4.3.4.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

4.3.5 Simple Plasma Monitor Science Draft Calibrated Data Product Design (Level 3)

We understand by draft calibrated data energy and angle distributions in $cm^{-2}s^{-1}$, ion currents in ADC units (signed 16 integers, no physical values since the CEM amplifications are not clear), Faraday cup currents in cm^{-2}, energy in eV and angle (elevation) in degrees. The energy tables and the correspondences between step numbers and energy and between step numbers and angle (elevation) is given in the following tables (Table 4-1, Table 4-2).

Step No	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ion1/2 (deg)	-52	-47	-41	-34	-27	-21	-16	-11	-6	0	5	10	15	20	25	31

Table 4-1 Correspondence between step number and elevation

Step No “64”	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Step No “32”		**0**		**1**		**2**		**3**		**4**		**5**
Ion1/2 (eV)	38.6	42.6	46.6	50.6	54.6	59.9	65.3	70.6	77.3	83.9	90.6	98.6
Electron (eV)	0.35	0.42	0.49	0.56	0.63	0.7	0.84	0.98	1.12	1.3	1.47	1.75

Step No “64”	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Step No “32”		**6**		**7**		**8**		**9**		**10**		**11**
Ion1/2 (eV)	107	117	127	138	150	163	178	194	211	230	250	271

Electron (eV)	2.03	2.38	2.74	3.16	3.72	4.28	4.98	5.82	6.73	7.79	9.05	10.5

Step No “64”	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
Step No “32”		**12**		**13**		**14**		**15**		**16**		**17**
Ion1/2 (eV)	295	321	350	381	414	450	490	533	580	640	700	760
Electron (eV)	12.3	14.2	16.5	19.2	22.3	25.9	30.1	34.9	41.0	47.4	54.7	63.1

Step No “64”	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
Step No “32”		**18**		**19**		**20**		**21**		**22**		**23**
Ion1/2 (eV)	820	900	980	1060	1160	1260	1360	1480	1620	1760	1920	2080
Electron (eV)	73.7	86.3	100	116	135	156	181	211	245	284	330	383

Step No “64”	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**
Step No “32”		**24**		**25**		**26**		**27**		**28**		**29**
Ion1/2 (eV)	2260	2460	2680	2920	3180	3460	3760	4080	4440	4820	5260	5720
Electron (eV)	445	517	600	695	810	937	1095	1274	1474	1716	1989	2316

Step No “64”	**60**	**61**	**62**	**63**
Step No “32”		**30**		**31**
Ion1/2 (eV)	6220	6760	7360	8000
Electron (eV)	2684	3115	3621	4210

Step No “64”	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Step No “32”		**0**		**1**		**2**		**3**		**4**
Far.Cup -“Ions” (eV)	10.7	12.7	15	17.6	20.8	24.6	29.2	34.6	40.8	48.6
Far.Cup -“Electrons” (eV)	1	2								

Step No “64”	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Step No “32”		**5**		**6**		**7**		**8**		**9**
Far.Cup -“Ions” (eV)	57.6	67.8	80.2	95.2	113	133	160	190	224	264

Step No “64”	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Step No “32”		**10**		**11**		**12**		**13**		**14**
Far.Cup -“Ions” (eV)	314	370	440	520	614	730	864	1020	1204	1430

Step No “64”	**30**	**31**
Step No “32”		**15**
Far.Cup -“Ions” (eV)	1690	2000

Table 4-2 Correspondence between step number and energy

The ROMAP SPM draft calibrated science files have a format similar to the edited (level 2) data, i.e; each file contains data from several measurement cycles. The level 3 files contain in addition detectors orientation in ECLIP J2000 frame.

One cycle contains the following data (in raw or parameter modes):

<u>Raw mode</u>

SPM header:
- UTC,
- OBT,
- Status of SPM (from HK parameters in SC data frame)
- Orientation of detectors in ECLIPJ2000 (see §2.2.1 for the orientation of sensors relative to S/C)

16 (for different angles) energy distributions ($cm^{-2}s^{-1}$ and current in nA) for Ion1 and Ion2 sensors,
1 energy distribution (current in nA) for Faraday Cup sensors,
1 energy distribution ($cm^{-2}s^{1}$) for Electron sensors

Parameter mode

SPM header (same as for raw mode)
1 energy distribution ($cm^{-2}s^{1}$ and currents in nA) for Ion1 and Ion2 sensors,
1 angle distributions ($cm^{-2}s^{1}$ and currents in nA) for Ion1 and Ion2 sensors,
1 energy distribution (current in nA) for Faraday Cup sensors (same format as raw mode),
1 energy distribution ($cm^{-2}s^{1}$) for Electron sensors (same format as raw mode)

The table objects corresponding to the distributions are detailed in the following paragraphs.

4.3.5.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP SPM draft calibrated science data (level 3) are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES
FILE_RECORDS
LABEL_RECORDS
```

4.3.5.2 Data Object Pointers Identification Data Elements

The ROMAP SPM SC draft calibrated data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.5.3 Instrument and Detector Descriptive Data Elements

The following data identification elements provide additional information about the ROMAP-SPM data products.

```
INSTRUMENT_HOST_NAME      = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID        = RL
INSTRUMENT_ID             = ROMAP
INSTRUMENT_NAME           = "ROSETTA LANDER MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE           = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                              "FARADAY CUP"}
DETECTOR_ID               = SPM
INSTRUMENT_MODE_ID        = "N/A"
INSTRUMENT_MODE_DESC      = "N/A"
```

4.3.5.4 Data Object Definition

Each TAB file contains a header describing the Instrument status and detectors orientation followed by the energy and angle distributions.

4.3.5.4.1 Ion spectrum definition (counts-energy-angle distribution), raw mode (channels 1 or 2)

```
  OBJECT                      = ROMAP_SPM_RAW_ION_CN_TABLE
      NAME                    = ROMAP_SPM_RAW_ION_CN
      INTERCHANGE_FORMAT      = ASCII
      ROWS                    = 32
      ^STRUCTURE              = "ROMAP_SPM_RAWC_ION_CN.FMT"
      COLUMNS                 = 40
      ROW_BYTES               = 401
  END_OBJECT                  = ROMAP_SPM_RAW_ION_CN_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_RAWC_ION_CN.FMT as follows:

```
/*               Contents of format file  "ROMAP_SPM_RAWC_ION_CN.FMT"     */
/*                 Ion spectrum definition       (Level 3)                */
/*         (I1CNT or I2CNT),    raw mode (channels 1 or 2)                */

/* *********************************************************** */
/* Include the HEADER at the beginning of each measurement     */
/* *********************************************************** */
```

```
OBJECT                    = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                              Of the SPM spectrum in PDS standard format
                              YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                  = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "MODE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 42
    BYTES                 = 9
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM mode:
                             raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EXPOSITION_TIME"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 54
    BYTES                 = 5
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM exposition time setting:
                             short or long"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CALIBRATION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 62
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM calibration status:
                             active or inactive"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CEM_SUPPLY"
    DATA_TYPE             = ASCII_INTEGER
    START_BYTE            = 72
    BYTES                 = 1
    FORMAT                = "I1"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM CEM supply setting:
                             step number from 1 to 5"
END_OBJECT              = COLUMN
```

```
OBJECT                 = COLUMN
    NAME                 = "RESOLUTION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 75
    BYTES                = 4
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM resolution setting:
                             low or high"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "ION_CHANNEL"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 82
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Ion channel status:
                             Both_off
                             Ion1
                             Ion2
                             Both_on"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "EVEN_ODD"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 93
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Indicates whether all energies
                           are transmitted (64 for full resolution and
                           32 for low resolution) or even/odd energies
                           alternatively. Takes the values:
                             even_odd or full"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 103
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Z_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 117
    BYTES                = 6
    FORMAT               = "F6.3"
```

```
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN
OBJECT                = COLUMN
    NAME                = "I2_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 124
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
```

```
                         detector in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "FC_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 166
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Faraday cup
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "FC_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 173
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Y component of unit vector aligned with Faraday cup
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "FC_Z_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 180
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Z component of unit vector aligned with Faraday cup
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                        */
/*      Type  column : measurement type (I1CNT or I2CNT)         */
/* ************************************************************ */

OBJECT                 = COLUMN
    NAME                 = "INDEX"
    DATA_TYPE            = INTEGER
    START_BYTE           = 187
   BYTES                = 5
    FORMAT               = "I5"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement index"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "TYPE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 194
    BYTES                = 5
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement type (I1CNT or I2CNT)"
END_OBJECT             = COLUMN

/* ********************************************************** */

OBJECT                 = COLUMN
    NAME                 = "ENERGY"
    DATA_TYPE            = ASCII_REAL
```

```
    START_BYTE         = 201
    BYTES              = 7
    FORMAT             = "F7.2"
    UNIT               = "ELECTRONVOLT"
    DESCRIPTION        = "Energy step"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_1"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 209
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 1"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_2"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 218
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 2"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_3"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 227
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 3"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_4"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 236
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 4"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_5"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 245
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 5"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME               = "COUNTS_ELEVATION_6"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 254
    BYTES              = 8
    FORMAT             = "F8.2"
    UNIT               = "CM**-2*S**-1"
    DESCRIPTION        = "counts for elevation step 6 "
END_OBJECT           = COLUMN
```

```
OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_7"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 263
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 7 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_8"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 272
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 8 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_9"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 281
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 9 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_10"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 290
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 10 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_11"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 299
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 11 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_12"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 308
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
    DESCRIPTION          = "counts for elevation step 12 "
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "COUNTS_ELEVATION_13"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 317
    BYTES                = 8
    FORMAT               = "F8.2"
    UNIT                 = "CM**-2*S**-1"
```

```
    DESCRIPTION       = "counts for elevation step 13 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME              = "COUNTS_ELEVATION_14"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 326
    BYTES             = 8
    FORMAT            = "F8.2"
    UNIT              = "CM**-2*S**-1"
    DESCRIPTION       = "counts for elevation step 14 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME              = "COUNTS_ELEVATION_15"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 335
    BYTES             = 8
    FORMAT            = "F8.2"
    UNIT              = "CM**-2*S**-1"
    DESCRIPTION       = "counts for elevation step 15 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME              = "COUNTS_ELEVATION_16"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 344
    BYTES             = 8
    FORMAT            = "F8.2"
    UNIT              = "CM**-2*S**-1"
    DESCRIPTION       = "counts for elevation step 16"
END_OBJECT           = COLUMN
```

4.3.5.4.2 Ion spectrum definition (current-energy-angle), raw mode (channels 1 or 2)

```
  OBJECT                        = ROMAP_SPM_RAW_ION_CR_TABLE
      NAME                      = ROMAP_SPM_RAW_ION_CR
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 32
      ^STRUCTURE                = "ROMAP_SPM_RAWC_ION_CR.FMT"
      COLUMNS                   = 40
      ROW_BYTES                 = 353
  END_OBJECT                    = ROMAP_SPM_RAW_ION_CR_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_RAWC_ION_CR.FMT as follows:

```
/*               Contents of format file  "ROMAP_SPM_RAWC_ION_CR.FMT"     */
/*                 Ion spectrum definition      (Level 3)                 */
/*         (I1CRT or I2CRT),    raw mode (channels 1 or 2)                */

/* ********************************************************** */
/* Include the HEADER at the beginning of each measurement    */
/* ********************************************************** */

OBJECT                 = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the SPM spectrum in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT             = COLUMN

OBJECT               = COLUMN
    NAME               = "OBT"
```

```
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 25
    BYTES            = 15
    UNIT             = SECOND
    FORMAT           = "F15.5"
    DESCRIPTION      = "ROMAP 4 bytes counter representing the measurement
                        time synchronized with Lander On Board Time.
                        The time resolution is 0.03125 s"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "MODE"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 42
    BYTES            = 9
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM mode:
                        raw or parameter"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "EXPOSITION_TIME"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 54
    BYTES            = 5
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM exposition time setting:
                        short or long"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "CALIBRATION"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 62
    BYTES            = 8
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM calibration status:
                        active or inactive"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "CEM_SUPPLY"
    DATA_TYPE        = ASCII_INTEGER
    START_BYTE       = 72
    BYTES            = 1
    FORMAT           = "I1"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM CEM supply setting:
                        step number from 1 to 5"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "RESOLUTION"
    DATA_TYPE        = CHARACTER
    START_BYTE       = 75
    BYTES            = 4
    FORMAT           = "N/A"
    UNIT             = "N/A"
    DESCRIPTION      = "SPM resolution setting:
                        low or high"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "ION_CHANNEL"
```

```
    DATA_TYPE          = CHARACTER
    START_BYTE         = 82
    BYTES              = 8
    FORMAT             = "N/A"
    UNIT               = "N/A"
    DESCRIPTION        = "Ion channel status:
                           Both_off
                           Ion1
                           Ion2
                           Both_on"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "EVEN_ODD"
    DATA_TYPE          = CHARACTER
    START_BYTE         = 93
    BYTES              = 8
    FORMAT             = "N/A"
    UNIT               = "N/A"
    DESCRIPTION        = "Indicates whether all energies
                         are transmitted (64 for full resolution and
                         32 for low resolution) or even/odd energies
                         alternatively. Takes the values:
                           even_odd or full"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "I1_X_ECLIPJ2000"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 103
    BYTES              = 6
    FORMAT             = "F6.3"
    UNIT               = "N/A"
    DESCRIPTION        = "X component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "I1_Y_ECLIPJ2000"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 110
    BYTES              = 6
    FORMAT             = "F6.3"
    UNIT               = "N/A"
    DESCRIPTION        = "Y component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "I1_Z_ECLIPJ2000"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 117
    BYTES              = 6
    FORMAT             = "F6.3"
    UNIT               = "N/A"
    DESCRIPTION        = "Z component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN
OBJECT                 = COLUMN
    NAME               = "I2_X_ECLIPJ2000"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 124
    BYTES              = 6
    FORMAT             = "F6.3"
    UNIT               = "N/A"
    DESCRIPTION        = "X component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
```

```
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 166
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN
```

```
OBJECT                 = COLUMN
    NAME                = "FC_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 173
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "FC_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 180
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CRT or I2CRT)        */
/* ************************************************************ */
OBJECT                 = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 187
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "TYPE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 194
    BYTES               = 5
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement type (I1CRT or I2CRT)"
END_OBJECT             = COLUMN

/* ********************************************************** */

OBJECT                  = COLUMN
    NAME                = "ENERGY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 201
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = "ELECTRONVOLT"
    DESCRIPTION         = "Energy step"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CURRENT_ELEVATION_1"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 209
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "MICROAMPERE"
```

```
    DESCRIPTION          = "Current for elevation step 1 (-31 deg)"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_2"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 216
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 2"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_3"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 223
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 3"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_4"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 230
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 4"
END_OBJECT               = COLUMN


OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_5"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 237
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 5"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_6"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 244
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 6 "
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_7"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 251
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Current for elevation step 7 "
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "CURRENT_ELEVATION_8"
```

```
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 258
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 8 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_9"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 265
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 9 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_10"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 272
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 10 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_11"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 279
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 11 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_12"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 286
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 12 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_13"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 293
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 13 "
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "CURRENT_ELEVATION_14"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 300
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "MICROAMPERE"
    DESCRIPTION      = "Current for elevation step 14 "
END_OBJECT           = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                = "CURRENT_ELEVATION_15"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 307
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "MICROAMPERE"
    DESCRIPTION         = "Current for elevation step 15 "
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "CURRENT_ELEVATION_16"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 314
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "MICROAMPERE"
    DESCRIPTION         = "Current for elevation step 16"
END_OBJECT              = COLUMN
```

4.3.5.4.3 Ion spectrum definition (counts-energy distribution), parameter mode (channels 1 or 2)

```
  OBJECT                       = ROMAP_SPM_PAR_ION_CNE_TABLE
      NAME                     = ROMAP_SPM_PAR_ION_CNE
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 640
      ^STRUCTURE               = "ROMAP_SPM_PARC_ION_CNE.FMT"
      COLUMNS                  = 26
      ROW_BYTES                = 240
  END_OBJECT                   = ROMAP_SPM_PAR_ION_CNE_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PARC_ION_CNE.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_PARC_ION_CNE.FMT"    */
/*                   Ion spectrum definition    (Level 3)                */
/*    (I1CNTE, I2CNTE), parameter mode (channels 1 or 2)                 */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                  = COLUMN
    NAME                 = "UTC"
    DATA_TYPE            = TIME
    START_BYTE           = 1
    BYTES                = 23
    DESCRIPTION          = "This column represents the UTC
                            Of the SPM spectrum in PDS standard format
                            YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT              = COLUMN

OBJECT                = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "MODE"
```

```
    DATA_TYPE           = CHARACTER
    START_BYTE          = 42
    BYTES               = 9
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM mode:
                           raw or parameter"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EXPOSITION_TIME"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 54
    BYTES               = 5
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM exposition time setting:
                           short or long"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CALIBRATION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 62
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM calibration status:
                           active or inactive"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CEM_SUPPLY"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 72
    BYTES               = 1
    FORMAT              = "I1"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM CEM supply setting:
                           step number from 1 to 5"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                           low or high"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                           Both_off
                           Ion1
                           Ion2
                           Both_on"
END_OBJECT            = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                  = "EVEN_ODD"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 93
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Indicates whether all energies
                           are transmitted (64 for full resolution and
                           32 for low resolution) or even/odd energies
                           alternatively. Takes the values:
                             even_odd or full"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 103
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 110
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Z_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 117
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Z component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I2_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 124
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I2_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 131
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
```

```
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "I2_Z_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 138
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Z component of unit vector aligned with Ion 2 detector
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "EL_X_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 145
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "X component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "EL_Y_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 152
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Y component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "EL_Z_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 159
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Z component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "FC_X_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 166
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "X component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "FC_Y_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 173
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Y component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN
```

```
OBJECT                = COLUMN
    NAME                = "FC_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 180
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Faraday cup
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CNTE, I2CNTE)        */
/* ************************************************************ */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 187
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 194
    BYTES               = 6
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement type (I1CNTE, I2CNTE)"
END_OBJECT            = COLUMN

/* ********************************************************** */

OBJECT                = COLUMN
    NAME                = "ENERGY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 202
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = "ELECTRONVOLT"
    DESCRIPTION         = "Energy step"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "COUNTS"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 210
    BYTES               = 10
    FORMAT              = "F10.2"
    UNIT                = "CM**-2*S**-1"
    DESCRIPTION         = "Sum of counts for elevation steps 1 to 16"
END_OBJECT            = COLUMN

OBJECT                  = COLUMN
    NAME                = "OVERFLOW FLAG"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 222
    BYTES               = 16
    FORMAT              = "N/A"
    UNIT                = "N/A"
```

```
    DESCRIPTION       = "String of 16 characters ; each character corresponds
                         to an elevation step and may take one of the following
                         values :
                                   0 : No overflow
                                   1 : Overflow"
END_OBJECT            = COLUMN
```

4.3.5.4.4 Ion spectrum definition (current-energy distribution), parameter mode (channels 1 or 2)

```
  OBJECT                       = ROMAP_SPM_PAR_ION_CRE_TABLE
      NAME                     = ROMAP_SPM_PAR_ION_CRE
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 640
      ^STRUCTURE               = "ROMAP_SPM_PARC_ION_CRE.FMT"
      COLUMNS                  = 26
      ROW_BYTES                = 237
  END_OBJECT                   = ROMAP_SPM_PAR_ION_CRE_TABLE
```

The structure of the TABLE object is described in the file ROMAP_ ROMAP_SPM_PARC_ION_CRE.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_PARC_ION_CRE.FMT"    */
/*                   Ion spectrum definition    (Level 3)                */
/*    (I1CRTE, I2CRTE), parameter mode (channels 1 or 2)                 */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                    = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                               Of the SPM spectrum in PDS standard format
                               YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                  = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "MODE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 42
    BYTES                 = 9
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM mode:
                             raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EXPOSITION_TIME"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 54
    BYTES                 = 5
```

```
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM exposition time setting:
                            short or long"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CALIBRATION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 62
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM calibration status:
                            active or inactive"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CEM_SUPPLY"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 72
    BYTES               = 1
    FORMAT              = "I1"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM CEM supply setting:
                            step number from 1 to 5"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                            low or high"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                            Both_off
                            Ion1
                            Ion2
                            Both_on"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EVEN_ODD"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 93
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Indicates whether all energies
                          are transmitted (64 for full resolution and
                          32 for low resolution) or even/odd energies
                          alternatively. Takes the values:
                            even_odd or full"
END_OBJECT            = COLUMN
```

```
OBJECT                 = COLUMN
    NAME                 = "I1_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 103
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Z_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 117
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Z component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN
OBJECT                 = COLUMN
    NAME                 = "I2_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 124
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I2_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 131
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Y component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I2_Z_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 138
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "Z component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "EL_X_ECLIPJ2000"
```

```
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 145
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "X component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "EL_Y_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 152
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Y component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "EL_Z_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 159
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Z component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "FC_X_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 166
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "X component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "FC_Y_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 173
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Y component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "FC_Z_ECLIPJ2000"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 180
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "N/A"
    DESCRIPTION       = "Z component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT          = COLUMN

/* ************************************************************** */
/* Add index and type columns                                      */
/*      Index column : measurement number                          */
```

```
/*      Type  column : measurement type (I1CRTE, I2CRTE)        */
/* ************************************************************ */

OBJECT                 = COLUMN
    NAME                 = "INDEX"
    DATA_TYPE            = INTEGER
    START_BYTE           = 187
    BYTES                = 5
    FORMAT               = "I5"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement index"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "TYPE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 194
    BYTES                = 6
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Measurement type (I1CRTE, I2CRTE)"
END_OBJECT             = COLUMN

/* ********************************************************** */

OBJECT                 = COLUMN
    NAME                 = "ENERGY"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 202
    BYTES                = 7
    FORMAT               = "F7.2"
    UNIT                 = "ELECTRONVOLT"
    DESCRIPTION          = "Energy bin number"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "CURRENT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 210
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "MICROAMPERE"
    DESCRIPTION          = "Sum of currents for elevation steps 1 to 16"
END_OBJECT             = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OVERFLOW FLAG"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 218
    BYTES                = 16
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "String of 16 characters ; each character corresponds
                             to an elevation step and may take one of the following
                             values :
                                       0 : No overflow
                                       1 : Overflow"
END_OBJECT               = COLUMN
```

4.3.5.4.5 Ion spectrum definition (counts-angle distribution), parameter mode (channels 1 or 2)

```
  OBJECT                        = ROMAP_SPM_PAR_ION_CNA_TABLE
      NAME                      = ROMAP_SPM_PAR_ION_CNA
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 320
      ^STRUCTURE                = "ROMAP_SPM_PARC_ION_CNA.FMT"
      COLUMNS                   = 26
```

```
      ROW_BYTES                = 288
  END_OBJECT                   = ROMAP_SPM_PAR_ION_CNA_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PARC_ION_CNA.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_PARC_ION_CNA.FMT"    */
/*                   Ion spectrum definition    (Level 3)                */
/*    (I1CNTA, I2CNTA), parameter mode (channels 1 or 2)                 */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */

OBJECT                    = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                              Of the SPM spectrum in PDS standard format
                              YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                  = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                 = "MODE"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 42
    BYTES                = 9
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM mode:
                            raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                 = "EXPOSITION_TIME"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 54
    BYTES                = 5
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM exposition time setting:
                            short or long"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                 = "CALIBRATION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 62
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM calibration status:
                            active or inactive"
END_OBJECT              = COLUMN
```

```
OBJECT                 = COLUMN
    NAME                 = "CEM_SUPPLY"
    DATA_TYPE            = ASCII_INTEGER
    START_BYTE           = 72
    BYTES                = 1
    FORMAT               = "I1"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM CEM supply setting:
                            step number from 1 to 5"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "RESOLUTION"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 75
    BYTES                = 4
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "SPM resolution setting:
                            low or high"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "ION_CHANNEL"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 82
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Ion channel status:
                            Both_off
                            Ion1
                            Ion2
                            Both_on"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "EVEN_ODD"
    DATA_TYPE            = CHARACTER
    START_BYTE           = 93
    BYTES                = 8
    FORMAT               = "N/A"
    UNIT                 = "N/A"
    DESCRIPTION          = "Indicates whether all energies
                          are transmitted (64 for full resolution and
                          32 for low resolution) or even/odd energies
                          alternatively. Takes the values:
                            even_odd or full"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_X_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 103
    BYTES                = 6
    FORMAT               = "F6.3"
    UNIT                 = "N/A"
    DESCRIPTION          = "X component of unit vector aligned with Ion 1 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                 = "I1_Y_ECLIPJ2000"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 110
    BYTES                = 6
```

```
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I1_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 117
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 124
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
```

```
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 166
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Faraday cup
                          in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 173
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Faraday cup
                          in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 180
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Faraday cup
                          in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CNTA or I2CNTA)      */
/* ************************************************************ */

OBJECT                = COLUMN
    NAME                = "INDEX"
    DATA_TYPE           = INTEGER
    START_BYTE          = 187
    BYTES               = 5
    FORMAT              = "I5"
    UNIT                = "N/A"
    DESCRIPTION         = "Measurement index"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "TYPE"
```

```
    DATA_TYPE         = CHARACTER
    START_BYTE        = 194
    BYTES             = 6
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "Measurement type (I1CNTA or I2CNTA)"
END_OBJECT          = COLUMN

/* ********************************************************** */

OBJECT              = COLUMN
    NAME              = "ANGLE "
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 202
    BYTES             = 7
    FORMAT            = "F7.2"
    UNIT              = "DEGREE"
    DESCRIPTION       = "Elevation step"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "COUNTS"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 210
    BYTES             = 10
    FORMAT            = "F10.2"
    UNIT              = "CM**-2*S**-1"
    DESCRIPTION       = "Sum of counts for energy steps 0 to 31
                         Or 0 to 63"
END_OBJECT          = COLUMN

OBJECT                = COLUMN
    NAME              = "OVERFLOW FLAG"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 222
    BYTES             = 64
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "String of 64 characters ; each character corresponds
                         to a step of energy and may take one of the following
                         values :
                                   0 : No overflow
                                   1 : Overflow
                         In low resolution the 32 last characters are unused
                         and set to blank "
END_OBJECT            = COLUMN
```

4.3.5.4.6 Ion spectrum definition (current-angle), parameter mode (channels 1 or 2)

```
  OBJECT                       = ROMAP_SPM_PAR_ION_CRA_TABLE
      NAME                     = ROMAP_SPM_PAR_ION_CRA
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 320
      ^STRUCTURE               = "ROMAP_SPM_PARC_ION_CRA.FMT"
      COLUMNS                  = 26
      ROW_BYTES                = 285
  END_OBJECT                   = ROMAP_SPM_PAR_ION_CRA_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_PARC_ION_CRA.FMT as follows:

```
/*               Contents of format file  "ROMAP_SPM_PARC_ION_CRA.FMT"    */
/*                    Ion spectrum definition     (Level 3)               */
/*     (I1CRTA, I2CRTA), parameter mode (channels 1 or 2)     */

/* ********************************************************** */
/* Include the HEADER at the beginning of each measurement      */
/* ********************************************************** */
```

```
OBJECT                    = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                               Of the SPM spectrum in PDS standard format
                               YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                  = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "MODE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 42
    BYTES                 = 9
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM mode:
                             raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EXPOSITION_TIME"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 54
    BYTES                 = 5
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM exposition time setting:
                             short or long"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CALIBRATION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 62
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM calibration status:
                             active or inactive"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CEM_SUPPLY"
    DATA_TYPE             = ASCII_INTEGER
    START_BYTE            = 72
    BYTES                 = 1
    FORMAT                = "I1"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM CEM supply setting:
                             step number from 1 to 5"
END_OBJECT              = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                  = "RESOLUTION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 75
    BYTES                 = 4
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM resolution setting:
                             low or high"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "ION_CHANNEL"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 82
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Ion channel status:
                             Both_off
                             Ion1
                             Ion2
                             Both_on"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EVEN_ODD"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 93
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Indicates whether all energies
                           are transmitted (64 for full resolution and
                           32 for low resolution) or even/odd energies
                           alternatively. Takes the values:
                             even_odd or full"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 103
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 110
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Z_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 117
    BYTES                 = 6
    FORMAT                = "F6.3"
```

```
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 1 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN
OBJECT                 = COLUMN
    NAME                = "I2_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 124
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                            in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                             detector in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                             detector in ECLIPJ2000 coordinates"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
```

```
                                  detector in ECLIPJ2000 coordinates"
END_OBJECT                 = COLUMN

OBJECT                     = COLUMN
    NAME                     = "FC_X_ECLIPJ2000"
    DATA_TYPE                = ASCII_REAL
    START_BYTE               = 166
    BYTES                    = 6
    FORMAT                   = "F6.3"
    UNIT                     = "N/A"
    DESCRIPTION              = "X component of unit vector aligned with Faraday cup
                                 in ECLIPJ2000 coordinates"
END_OBJECT                 = COLUMN

OBJECT                     = COLUMN
    NAME                     = "FC_Y_ECLIPJ2000"
    DATA_TYPE                = ASCII_REAL
    START_BYTE               = 173
    BYTES                    = 6
    FORMAT                   = "F6.3"
    UNIT                     = "N/A"
    DESCRIPTION              = "Y component of unit vector aligned with Faraday cup
                                 in ECLIPJ2000 coordinates"
END_OBJECT                 = COLUMN

OBJECT                     = COLUMN
    NAME                     = "FC_Z_ECLIPJ2000"
    DATA_TYPE                = ASCII_REAL
    START_BYTE               = 180
    BYTES                    = 6
    FORMAT                   = "F6.3"
    UNIT                     = "N/A"
    DESCRIPTION              = "Z component of unit vector aligned with Faraday cup
                                 in ECLIPJ2000 coordinates"
END_OBJECT                 = COLUMN

/* ************************************************************ */
/* Add index and type columns                                   */
/*      Index column : measurement number                       */
/*      Type  column : measurement type (I1CRTA, I2CRTA)        */
/* ************************************************************ */

OBJECT                     = COLUMN
    NAME                     = "INDEX"
    DATA_TYPE                = INTEGER
    START_BYTE               = 187
    BYTES                    = 5
    FORMAT                   = "I5"
    UNIT                     = "N/A"
    DESCRIPTION              = "Measurement index"
END_OBJECT                 = COLUMN

OBJECT                     = COLUMN
    NAME                     = "TYPE"
    DATA_TYPE                = CHARACTER
    START_BYTE               = 194
    BYTES                    = 6
    FORMAT                   = "N/A"
    UNIT                     = "N/A"
    DESCRIPTION              = "Measurement type (I1CRTA, I2CRTA)"
END_OBJECT                 = COLUMN

/* ********************************************************** */

OBJECT                     = COLUMN
    NAME                     = "ANGLE"
```

```
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 202
    BYTES             = 7
    FORMAT            = "F7.2"
    UNIT              = "DEGREE"
    DESCRIPTION       = "Elevation step"
END_OBJECT          = COLUMN

OBJECT              = COLUMN
    NAME              = "CURRENT"
    DATA_TYPE         = ASCII_REAL
    START_BYTE        = 210
    BYTES             = 6
    FORMAT            = "F6.3"
    UNIT              = "MICROAMPERE"
    DESCRIPTION       = "Sum of currents for energy steps 0 to 31
                         Or 0 to 63"
END_OBJECT          = COLUMN

OBJECT                = COLUMN
    NAME              = "OVERFLOW_FLAG"
    DATA_TYPE         = CHARACTER
    START_BYTE        = 218
    BYTES             = 64
    FORMAT            = "N/A"
    UNIT              = "N/A"
    DESCRIPTION       = "String of 64 characters ; each character corresponds
                         to a step of energy and may take one of the following
                         values :
                                   0 : No overflow
                                   1 : Overflow
                         In low resolution the 32 last characters are unused
                         and set to blank "
END_OBJECT            = COLUMN
```

4.3.5.4.7 Faraday cup current-energy distribution

FC TABLE object for PAR mode

```
  OBJECT                       = ROMAP_SPM_PAR_FC_TABLE
      NAME                     = ROMAP_SPM_PAR_FC
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 180
      COLUMNS                  = 24
      ROW_BYTES                = 212
      ^STRUCTURE               = "ROMAP_SPM_FCC.FMT"
  END_OBJECT                   = ROMAP_SPM_PAR_FC_TABLE
```

FC TABLE object for RAW mode

```
  OBJECT                       = ROMAP_SPM_RAW_FC_TABLE
      NAME                     = ROMAP_SPM_RAW_FC
      INTERCHANGE_FORMAT       = ASCII
      ROWS                     = 34
      COLUMNS                  = 24
      ROW_BYTES                = 212
      ^STRUCTURE               = "ROMAP_SPM_FCC.FMT"
  END_OBJECT                   = ROMAP_SPM_RAW_FC_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_FCC.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_FCC.FMT"              */
/*    Faraday cup current-energy distribution   (Level 3)                 */

/* ************************************************************ */
/* Include the HEADER at the beginning of each measurement      */
/* ************************************************************ */
```

```
OBJECT                    = COLUMN
    NAME                   = "UTC"
    DATA_TYPE              = TIME
    START_BYTE             = 1
    BYTES                  = 23
    DESCRIPTION            = "This column represents the UTC
                              Of the SPM spectrum in PDS standard format
                              YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT                = COLUMN

OBJECT                  = COLUMN
    NAME                  = "OBT"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 25
    BYTES                 = 15
    UNIT                  = SECOND
    FORMAT                = "F15.5"
    DESCRIPTION           = "ROMAP 4 bytes counter representing the measurement
                             time synchronized with Lander On Board Time.
                             The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "MODE"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 42
    BYTES                 = 9
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM mode:
                             raw or parameter"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EXPOSITION_TIME"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 54
    BYTES                 = 5
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM exposition time setting:
                             short or long"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CALIBRATION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 62
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM calibration status:
                             active or inactive"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "CEM_SUPPLY"
    DATA_TYPE             = ASCII_INTEGER
    START_BYTE            = 72
    BYTES                 = 1
    FORMAT                = "I1"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM CEM supply setting:
                             step number from 1 to 5"
END_OBJECT              = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                  = "RESOLUTION"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 75
    BYTES                 = 4
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "SPM resolution setting:
                              low or high"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "ION_CHANNEL"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 82
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Ion channel status:
                              Both_off
                              Ion1
                              Ion2
                              Both_on"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "EVEN_ODD"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 93
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Indicates whether all energies
                            are transmitted (64 for full resolution and
                            32 for low resolution) or even/odd energies
                            alternatively. Takes the values:
                              even_odd or full"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 103
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 1 detector
                              in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 110
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 1 detector
                              in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Z_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 117
    BYTES                 = 6
    FORMAT                = "F6.3"
```

```
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 1 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN
OBJECT                = COLUMN
    NAME                = "I2_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 124
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 131
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                           in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with electron
                            detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
```

```
                              detector in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "FC_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 166
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Faraday cup
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "FC_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 173
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Faraday cup
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "FC_Z_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 180
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Z component of unit vector aligned with Faraday cup
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

/* ************************************************************ */
/* Add index column                                             */
/*      Index column : measurement number                       */
/* ************************************************************ */

OBJECT                  = COLUMN
    NAME                  = "INDEX"
    DATA_TYPE             = INTEGER
    START_BYTE            = 187
    BYTES                 = 5
    FORMAT                = "I5"
    UNIT                  = "N/A"
    DESCRIPTION           = "Measurement index"
END_OBJECT              = COLUMN

/* ********************************************************** */

OBJECT                    = COLUMN
    NAME                    = "ENERGY"
    DATA_TYPE               = ASCII_REAL
    START_BYTE              = 193
    BYTES                   = 7
    FORMAT                  = "F7.2"
    UNIT                    = "ELECTRONVOLT"
    DESCRIPTION             = "Energy step"
END_OBJECT                = COLUMN

OBJECT                    = COLUMN
    NAME                    = "CURRENT"
    DATA_TYPE               = ASCII_REAL
    START_BYTE              = 201
```

```
    BYTES               = 10
    FORMAT              = "F10.2"
    UNIT                = "NANOAMPERE"
    DESCRIPTION         = "Faraday cup Current "
END_OBJECT              = COLUMN
```

4.3.5.4.8 Electron spectrum (count-energy distribution)

Electron spectrum TABLE object for PAR mode

```
  OBJECT                        = ROMAP_SPM_PAR_ELEC_TABLE
      NAME                      = ROMAP_SPM_PAR_ELEC
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 320
      COLUMNS                   = 24
      ROW_BYTES                 = 213
      ^STRUCTURE                = "ROMAP_SPM_ELECC.FMT"
  END_OBJECT                    = ROMAP_SPM_PAR_ELEC_TABLE
```

Electron spectrum TABLE object for RAW mode

```
  OBJECT                        = ROMAP_SPM_RAW_ELEC_TABLE
      NAME                      = ROMAP_SPM_RAW_ELEC
      INTERCHANGE_FORMAT        = ASCII
      ROWS                      = 32
      COLUMNS                   = 24
      ROW_BYTES                 = 210
      ^STRUCTURE                = "ROMAP_SPM_ELECC.FMT"
  END_OBJECT                    = ROMAP_SPM_RAW_ELEC_TABLE
```

The structure of the TABLE object is described in the file ROMAP_SPM_ELECC.FMT as follows:

```
/*              Contents of format file  "ROMAP_SPM_ELECC.FMT"            */
/*         Electron spectrum (count-energy distribution) (Level 3)        */

/* ********************************************************** */
/* Include the HEADER at the beginning of each measurement    */
/* ********************************************************** */


OBJECT                  = COLUMN
    NAME                 = "UTC"
    DATA_TYPE            = TIME
    START_BYTE           = 1
    BYTES                = 23
    DESCRIPTION          = "This column represents the UTC
                            Of the SPM spectrum in PDS standard format
                            YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT              = COLUMN

OBJECT                = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
```

```
    NAME                = "MODE"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 42
    BYTES               = 9
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM mode:
                           raw or parameter"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EXPOSITION_TIME"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 54
    BYTES               = 5
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM exposition time setting:
                           short or long"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CALIBRATION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 62
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM calibration status:
                           active or inactive"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "CEM_SUPPLY"
    DATA_TYPE           = ASCII_INTEGER
    START_BYTE          = 72
    BYTES               = 1
    FORMAT              = "I1"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM CEM supply setting:
                           step number from 1 to 5"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "RESOLUTION"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 75
    BYTES               = 4
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "SPM resolution setting:
                           low or high"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "ION_CHANNEL"
    DATA_TYPE           = CHARACTER
    START_BYTE          = 82
    BYTES               = 8
    FORMAT              = "N/A"
    UNIT                = "N/A"
    DESCRIPTION         = "Ion channel status:
                           Both_off
                           Ion1
                           Ion2
                           Both_on"
END_OBJECT            = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                  = "EVEN_ODD"
    DATA_TYPE             = CHARACTER
    START_BYTE            = 93
    BYTES                 = 8
    FORMAT                = "N/A"
    UNIT                  = "N/A"
    DESCRIPTION           = "Indicates whether all energies
                           are transmitted (64 for full resolution and
                           32 for low resolution) or even/odd energies
                           alternatively. Takes the values:
                             even_odd or full"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 103
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 110
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I1_Z_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 117
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Z component of unit vector aligned with Ion 1 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I2_X_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 124
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "X component of unit vector aligned with Ion 2 detector
                             in ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                  = "I2_Y_ECLIPJ2000"
    DATA_TYPE             = ASCII_REAL
    START_BYTE            = 131
    BYTES                 = 6
    FORMAT                = "F6.3"
    UNIT                  = "N/A"
    DESCRIPTION           = "Y component of unit vector aligned with Ion 2 detector
```

```
                         in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "I2_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 138
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with Ion 2 detector
                         in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 145
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 152
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"

   DESCRIPTION         = "Y component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "EL_Z_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 159
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Z component of unit vector aligned with electron
                          detector in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_X_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 166
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "X component of unit vector aligned with Faraday cup
                         in ECLIPJ2000 coordinates"
END_OBJECT            = COLUMN

OBJECT                = COLUMN
    NAME                = "FC_Y_ECLIPJ2000"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 173
    BYTES               = 6
    FORMAT              = "F6.3"
    UNIT                = "N/A"
    DESCRIPTION         = "Y component of unit vector aligned with Faraday cup
```

```
                        in ECLIPJ2000 coordinates"
END_OBJECT         = COLUMN

OBJECT             = COLUMN
    NAME             = "FC_Z_ECLIPJ2000"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 180
    BYTES            = 6
    FORMAT           = "F6.3"
    UNIT             = "N/A"
    DESCRIPTION      = "Z component of unit vector aligned with Faraday cup
                        in ECLIPJ2000 coordinates"
END_OBJECT         = COLUMN

/* ************************************************************ */
/* Add index column                                             */
/*      Index column : measurement number                       */
/* ************************************************************ */

OBJECT             = COLUMN
    NAME             = "INDEX"
    DATA_TYPE        = INTEGER
    START_BYTE       = 187
    BYTES            = 5
    FORMAT           = "I5"
    UNIT             = "N/A"
    DESCRIPTION      = "Measurement index"
END_OBJECT         = COLUMN

/* ********************************************************** */

OBJECT               = COLUMN
    NAME             = "ENERGY"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 193
    BYTES            = 7
    FORMAT           = "F7.2"
    UNIT             = "ELECTRONVOLT"
    DESCRIPTION      = "Energy step"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "COUNTS"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 201
    BYTES            = 8
    FORMAT           = "F8.2"
    UNIT             = "CM**-2*S**-1"
    DESCRIPTION      = "Electron counts"
END_OBJECT           = COLUMN
```

4.3.5.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

4.3.5.6 Mission Specific Keywords

There is no mission specific keywords for ROMAP.

4.3.6 Housekeeping Calibrated Data Product Design (Level 3)

4.3.6.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP HK calibrated data (level 3) are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES   = 168
FILE_RECORDS
LABEL_RECORDS
```

4.3.6.2 Data Object Pointers Identification Data Elements

The ROMAP HK calibrated data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.6.3 Instrument and Detector Descriptive Data Elements

```
INSTRUMENT_HOST_NAME       = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID         = RL
INSTRUMENT_ID              = ROMAP
INSTRUMENT_NAME            = "ROSETTA LANDER MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE            = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                               "FARADAY CUP"}
INSTRUMENT_MODE_ID         = "N/A"
INSTRUMENT_MODE_DESC       = "N/A"
```

4.3.6.4 Data Object Definition

Each TAB file contains a 18 columns table with the calibrated HK data (ADC units).

```
OBJECT                     = TABLE
  NAME                     = "ROMAP_CALHK_TABLE"
  INTERCHANGE_FORMAT       = ASCII
  ROWS                     =
  COLUMNS                  = 18
  ROW_BYTES                = 168
  ^STRUCTURE               = "ROMAP_CALHK.FMT"
END_OBJECT                 = TABLE
```

The structure of the TABLE object is described in the file ROMAP_CALHK.FMT as follows:

```
/*  Contents of format file  "ROMAP_CALHK.FMT"  (Calibrated HK data)  */

OBJECT                  = COLUMN
    NAME                = "UTC"
    DATA_TYPE           = TIME
    START_BYTE          = 1
    BYTES               = 23
    DESCRIPTION         = "This column represents the UTC
                           Of the HK parameters set in PDS standard format
                           YYYY-MM-DDThh:mm:ss.sss"
 END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "OBT"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 25
    BYTES              = 15
    UNIT               = SECOND
    FORMAT             = "F15.5"
    DESCRIPTION        = "ROMAP 4 bytes counter representing the measurement
                          time synchronized with Lander On Board Time.
```

```
                                The time resolution is 0.03125 s"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "CONTROLLER STATUS"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 42
    BYTES                     = 4
    FORMAT                    = "Hexadecimal Format"
    UNIT                      = "N/A"
    DESCRIPTION               = " Controller Status Bits :

                                Bit                        Description

                                 0       Status flag : Instrument Mode was loaded
                                                       at power-up from TC-Buffer
                                 1       Status flag : MAG setting was loaded from
                                                       TC-Buffer
                                 3       Error flag : read TC-Buffer error at power-up
                                 4       Error flag : write BRAM error; cleared after
                                                       successfully writing BRAM
                                 5       Error flag : TC-Buffer content error
                                                      (illegal checksum)
                                 6       Error flag : SPM Ion 1 counter overflow occurred
                                                      (cleared after displaying SPM
                                                       overflow error flag in HK data)
                                 7       Error flag : SPM Ion 2 counter overflow occurred
                                                      (cleared after displaying SPM
                                                       overflow errorflag in HK data)
                                 8       Error flag : SPM Electron counter overflow
                                                      occurred (cleared after displaying
                                                      SPM overflow error flag in HK data)
                                 9       Status flag : Penning pressure sensor on/off
                                10       Status flag : Pirani pressure sensor on/off
                                11       Status flag : DUMMY FPGA output on/off
                                12..13   Not used
                                14..15   Status flags: I0, I1 identify instrument mode

                                If one of the bits 0 .. 5 is set once, it stays active
                                until the instrument is switched off."
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "LAST RECEIVED TC (WORD 1)"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 49
    BYTES                     = 4
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "Last received TC (word 1)in Hexadecimal Format"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "LAST RECEIVED TC (WORD 2)"
    DATA_TYPE                 = CHARACTER
    START_BYTE                = 56
    BYTES                     = 4
    FORMAT                    = "N/A"
    UNIT                      = "N/A"
    DESCRIPTION               = "Last received TC (word 2 ) in Hexadecimal Format"
END_OBJECT                    = COLUMN

OBJECT                        = COLUMN
    NAME                      = "POWER CONSUMPTION"
    DATA_TYPE                 = ASCII_REAL
    START_BYTE                = 62
    BYTES                     = 8
```

```
    FORMAT              = "F8.2"
    UNIT                = MILLIWATT
    DESCRIPTION         = "Overall instrument power consumption
                           P = N * 76.3E-3 * 4 [mW]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "+5V CURRENT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 71
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = VOLT
    DESCRIPTION         = "+5V current
                           I = N * 76.3E-3 * 0.5 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "-5V CURRENT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 79
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = VOLT
    DESCRIPTION         = "-5V current
                           I = N * 76.3E-3 * 0.05 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "ELECTRONICS TEMPERATURE"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 87
    BYTES               = 6
    FORMAT              = "F6.2"
    UNIT                = KELVIN
    DESCRIPTION         = "electronics temperature
                           T = (N * 76.3E-6 - 0.535) * 472.9 [°C]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "+28V CURRENT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 94
    BYTES               = 7
    FORMAT              = "F7.2"
    UNIT                = MILLIAMPERE
    DESCRIPTION         = "+28V current
                           I = N * 76.3E-3 * 0.025 [mA]"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "SPM HV STATUS 1"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 102
    BYTES               = 5
    FORMAT              = "F5.2"
    UNIT                = VOLT
    DESCRIPTION         = "SPM HV status 1"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "SPM HV STATUS 2"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 108
    BYTES               = 8
    FORMAT              = "F8.4"
    UNIT                = VOLT
```

```
    DESCRIPTION        = "SPM HV status 2"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "SPM HV STATUS 3"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 117
    BYTES              = 8
    FORMAT             = "F8.4"
    UNIT               = VOLT
    DESCRIPTION        = "SPM HV status 3"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "SPM HV STATUS 4"
    DATA_TYPE          = ASCII_REAL
    START_BYTE         = 126
    BYTES              = 8
    FORMAT             = "F8.4"
    UNIT               = VOLT
    DESCRIPTION        = "SPM HV status 4"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "PENNING PRESSURE"
    DATA_TYPE          = ASCII_INTEGER
    START_BYTE         = 135
    BYTES              = 7
    FORMAT             = "I7"
    UNIT               = PASCAL
    DESCRIPTION        = "Penning pressure"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "PIRANI PRESSURE"
    DATA_TYPE          = ASCII_INTEGER
    START_BYTE         = 143
    BYTES              = 7
    FORMAT             = "I7"
    UNIT               = PASCAL
    DESCRIPTION        = "Pirani pressure"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "PROM CHECKSUM"
    DATA_TYPE          = CHARACTER
    START_BYTE         = 152
    BYTES              = 4
    FORMAT             = "N/A"
    UNIT               = "N/A"
    DESCRIPTION        = "PROM checksum (computed at power-up)
                          in Hexadecimal Format"
END_OBJECT             = COLUMN

OBJECT                 = COLUMN
    NAME               = "INSTRUMENT ERROR FLAGS"
    DATA_TYPE          = CHARACTER
    START_BYTE         = 159
    BYTES              = 4
    FORMAT             = "N/A"
    UNIT               = "N/A"
    DESCRIPTION        = " Instrument Error Flags in Hexadecimal Format :

                        Bit                Description

                        0       Command overflow (a TC was received before the
                                                  former was processed)
```

```
                                1       CDMS illegal word count
                                2       CDMS message error
                                3       General CDMS receiving error
                                4       General CDMS transmission error
                                5       Wrong telecommand received
                                6       CDMS request overflow (a CDMS request occurs
                                                     before the former was processed)
                                7       Frame buffer overflow
                                8       MAG vector sampling overflow
                                9       CDMS error code word received
                               10       CDMS checksum error
                               11       checksum error in received CDMS SST word
                               12       SPM counter overflow
                               13       ADC sampling overflow
                               14       SPM transmission overflow
                               15       SPM setup error"
END_OBJECT                     = COLUMN
```

4.3.7 Magnetometer Science calibrated Data Product Design (Level 5)

There are two kinds of calibrated science data for the ROMAP MAG instrument, draft calibrated and final calibrated. The level 5 contains final calibrated data. The calibration includes removal of spacecraft influence, of all kinds of AC disturbances and taking into account of temperature dependency of magnets. Only those data are suitable for scientific interpretation. Both data products (draft calibrated and calibrated) have the same format, i.e. the UTC, the OBT, the spacecraft position (X, Y, Z) and the magnetic field (Bx, By, Bz) in Instrument, Lander, Orbiter and ECLIP J2000 coordinates.

4.3.7.1 File Characteristics Data Elements

The PDS file characteristic data elements for ROMAP MAG science calibrated data are:

```
RECORD_TYPE    = FIXED_LENGTH
RECORD_BYTES   = 119
FILE_RECORDS
LABEL_RECORDS
```

4.3.7.2 Data Object Pointers Identification Data Elements

The ROMAP MAG SC calibrated data are organized as ASCII tables. The data object pointers (^TABLE) reference TAB files.

4.3.7.3 Instrument and Detector Descriptive Data Elements

The following data identification elements provide additional information about the ROMAP-MAG data products.

```
INSTRUMENT_HOST_NAME       = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID         = RL
INSTRUMENT_ID              = ROMAP
INSTRUMENT_NAME            = "ROSETTA LANDER  MAGNETOMETER AND PLASMA MONITOR"
INSTRUMENT_TYPE            = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                                "FARADAY CUP"}
DETECTOR_ID                = MAG
INSTRUMENT_MODE_ID         = "N/A"
INSTRUMENT_MODE_DESC       = "N/A"
```

4.3.7.4 Data Object Definition

4.3.7.4.1 Level E data object definition (calibrated in instrument coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                       = TABLE
  NAME                       = "ROMAP_MAG_CALSCE_TABLE"
  INTERCHANGE_FORMAT         = ASCII
  ROWS                       =
  COLUMNS                    = 8
  ROW_BYTES                  = 119
  ^STRUCTURE                 = "ROMAP_MAG_CALSCE.FMT"
END_OBJECT                   = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCE.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCE.FMT"            */
/*    Level E data object definition  :                                    */
/*    calibrated in instrument coordinates                                 */


OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the magnetic field vector in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT                = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_X"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 41
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "X component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Y"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 58
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Y component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Z"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 75
    BYTES                = 16
```

```
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "Z component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BX"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 92
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field X component,
                           calibrated, instrument coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 101
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Y component,
                          calibrated, instrument coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BZ"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 110
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Z component,
                          calibrated, instrument coordinates"
END_OBJECT              = COLUMN
```

4.3.7.4.2 Level F data object definition (calibrated in Lander coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                      = TABLE
  NAME                      = "ROMAP_MAG_CALSCF_TABLE"
  INTERCHANGE_FORMAT        = ASCII
  ROWS                      =
  COLUMNS                   = 8
  ROW_BYTES                 = 119
  ^STRUCTURE                = "ROMAP_MAG_CALSCF.FMT"
END_OBJECT                  = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCF.FMT as follows:

```
/*            Contents of format file  "ROMAP_MAG_CALSCF.FMT"           */
/*     Level F data object definition  :                                */
/*     calibrated in Lander coordinates                                 */


OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the magnetic field vector in PDS standard format
```

```
                          YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POS_X"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 41
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "X component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POS_Y"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 58
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "Y component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POS_Z"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 75
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "Z component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BX"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 92
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field X component,
                           calibrated, Lander coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 101
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Y component,
```

```
                          calibrated, Lander coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BZ"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 110
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Z component,
                          calibrated, Lander coordinates"
END_OBJECT              = COLUMN
```

4.3.7.4.3 Level G data object definition (calibrated in Orbiter coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                       = TABLE
  NAME                       = "ROMAP_MAG_CALSCG_TABLE"
  INTERCHANGE_FORMAT         = ASCII
  ROWS                       =
  COLUMNS                    = 8
  ROW_BYTES                  = 119
  ^STRUCTURE                 = "ROMAP_MAG_CALSCG.FMT"
END_OBJECT                   = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCG.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCG.FMT"           */
/*    Level F data object definition  :                                   */
/*    calibrated in Orbiter coordinates                                   */


OBJECT                   = COLUMN
    NAME                 = "UTC"
    DATA_TYPE            = TIME
    START_BYTE           = 1
    BYTES                = 23
    DESCRIPTION          = "This column represents the UTC
                            Of the magnetic field vector in PDS standard format
                            YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT               = COLUMN

OBJECT                  = COLUMN
    NAME                = "OBT"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 25
    BYTES               = 15
    UNIT                = SECOND
    FORMAT              = "F15.5"
    DESCRIPTION         = "ROMAP 4 bytes counter representing the measurement
                           time synchronized with Lander On Board Time.
                           The time resolution is 0.03125 s"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POS_X"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 41
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "X component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN
```

```
OBJECT                  = COLUMN
    NAME                = "POS_Y"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 58
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "Y component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "POS_Z"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 75
    BYTES               = 16
    FORMAT              = "F16.3"
    UNIT                = KILOMETER
    DESCRIPTION         = "Z component of the Spacecraft (Lander) position,
                           ECLIPJ2000 coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BX"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 92
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field X component,
                           calibrated, Orbiter coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BY"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 101
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Y component,
                          calibrated, Orbiter coordinates"
END_OBJECT              = COLUMN

OBJECT                  = COLUMN
    NAME                = "BZ"
    DATA_TYPE           = ASCII_REAL
    START_BYTE          = 110
    BYTES               = 8
    FORMAT              = "F8.2"
    UNIT                = NANOTESLA
    DESCRIPTION         = "Magnetic field Z component,
                          calibrated, Orbiter coordinates"
END_OBJECT              = COLUMN
```

4.3.7.4.4 Level H data object definition (calibrated in ECLIP J2000 coordinates)

Each TAB file contains an eight columns table with the magnetic field and the spacecraft position.

```
OBJECT                      = TABLE
  NAME                      = "ROMAP_MAG_CALSCH_TABLE"
  INTERCHANGE_FORMAT        = ASCII
  ROWS                      =
  COLUMNS                   = 8
  ROW_BYTES                 = 119
```

```
  ^STRUCTURE                 = "ROMAP_MAG_CALSCH.FMT"
END_OBJECT                   = TABLE
```

The structure of the TABLE object is described in the file ROMAP_MAG_CALSCH.FMT as follows:

```
/*              Contents of format file  "ROMAP_MAG_CALSCH.FMT"           */
/*    Level F data object definition  :                                   */
/*    calibrated in ECLIP J2000 coordinates                               */


OBJECT                    = COLUMN
    NAME                  = "UTC"
    DATA_TYPE             = TIME
    START_BYTE            = 1
    BYTES                 = 23
    DESCRIPTION           = "This column represents the UTC
                             Of the magnetic field vector in PDS standard format
                             YYYY-MM-DDThh:mm:ss.sss"
END_OBJECT                = COLUMN

OBJECT                   = COLUMN
    NAME                 = "OBT"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 25
    BYTES                = 15
    UNIT                 = SECOND
    FORMAT               = "F15.5"
    DESCRIPTION          = "ROMAP 4 bytes counter representing the measurement
                            time synchronized with Lander On Board Time.
                            The time resolution is 0.03125 s"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_X"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 41
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "X component of the Spacecraft (Lander) position,
                              ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Y"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 58
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Y component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "POS_Z"
    DATA_TYPE            = ASCII_REAL
    START_BYTE           = 75
    BYTES                = 16
    FORMAT               = "F16.3"
    UNIT                 = KILOMETER
    DESCRIPTION          = "Z component of the Spacecraft (Lander) position,
                            ECLIPJ2000 coordinates"
END_OBJECT               = COLUMN

OBJECT                   = COLUMN
    NAME                 = "BX"
```

```
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 92
    BYTES            = 8
    FORMAT           = "F8.2"
    UNIT             = NANOTESLA
    DESCRIPTION      = "Magnetic field X component,
                        calibrated, ECLIPJ2000 coordinates"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "BY"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 101
    BYTES            = 8
    FORMAT           = "F8.2"
    UNIT             = NANOTESLA
    DESCRIPTION      = "Magnetic field Y component,
                       calibrated, ECLIPJ2000 coordinates"
END_OBJECT           = COLUMN

OBJECT               = COLUMN
    NAME             = "BZ"
    DATA_TYPE        = ASCII_REAL
    START_BYTE       = 110
    BYTES            = 8
    FORMAT           = "F8.2"
    UNIT             = NANOTESLA
    DESCRIPTION      = "Magnetic field Z component,
                       calibrated, ECLIPJ2000 coordinates"
END_OBJECT           = COLUMN
```

4.3.7.5 Description of Instrument

The description of the instrument is done in above and as a brief overview in the INST.CAT catalog file.

5 Appendix: Available Software to read PDS files

The level 3 housekeeping and science PDS files can be read with the PDS table verifier tool “tbtool” and readpds (Small Bodies Node tool).

6 Appendix: Example of PDS detached label for ROMAP MAG level 2 data product

```
PDS_VERSION_ID                = PDS3

LABEL_REVISION_NOTE  = "2007-07-16, SONC, version 1.0"

/* PVV version 3.0 */
/*  Edited Science data   */

/* FILE CHARACTERISTIC DATA ELEMENTS */

RECORD_TYPE          = FIXED_LENGTH
FILE_RECORDS         = 18990
RECORD_BYTES         = 65
FILE_NAME            = "MAG_FS2_070225015459_00004.TAB"

/* DATA OBJECT POINTERS  */
```

```
^ROMAP_MAG_RAWSC_TABLE     = ("MAG_FS2_070225015459_00004.TAB",1 <BYTES>)

DATA_SET_ID          = "RL-CAL-ROMAP-2-MARS-MAG-V1.0"
DATA_SET_NAME        = "ROSETTA-LANDER MARS ROMAP 2 MARS MAG V1.0"
PRODUCT_ID           = "MAG_FS2_070225015459_00004"
PRODUCT_CREATION_TIME = 2008-03-17T10:20:01
MISSION_NAME          = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME   = "MARS SWING-BY"
MISSION_ID            = ROSETTA
INSTRUMENT_HOST_NAME = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID   = RL

PRODUCT_TYPE          = EDR
START_TIME            = 2007-02-25T01:54:59.194
STOP_TIME             = 2007-02-25T01:59:55.303
SPACECRAFT_CLOCK_START_COUNT = "1/130989270.09"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/130989566.12"

PRODUCER_ID           = "SONC"
PRODUCER_FULL_NAME    = "SCIENCE OPERATIONS AND NAVIGATION CENTER"
PRODUCER_INSTITUTION_NAME = "CNES"

INSTRUMENT_ID         = ROMAP
INSTRUMENT_NAME       = UNK
INSTRUMENT_TYPE       = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                          "FARADAY CUP"}
DETECTOR_ID           = MAG
DETECTOR_DESC         = "Magnetometer"

INSTRUMENT_MODE_ID    = "N/A"
INSTRUMENT_MODE_DESC = "N/A"
TARGET_NAME           = "MARS"
TARGET_TYPE           = "PLANET"

PROCESSING_LEVEL_ID = "2"
DATA_QUALITY_ID       = "-1"
DATA_QUALITY_DESC     = "-1 : NOT QUALIFIED"

/* GEOMETRY PARAMETERS */

/* SPACECRAFT LOCATION: Position <km> */
SC_SUN_POSITION_VECTOR = (  -18553289.9, 195616341.6,  90223877.3)
/* TARGET PARAMETERS: Position <km>, Velocity <km/s> */
SC_TARGET_POSITION_VECTOR = ( -153787159.6, 250943772.8, 114210041.1)
SC_TARGET_VELOCITY_VECTOR = (         -35.3,        -20.1,         -8.6)
/* SPACECRAFT POSITION WITH RESPECT TO CENTRAL BODY */
SPACECRAFT_ALTITUDE =   315694750.8 <km>
SUB_SPACECRAFT_LATITUDE =   -21.06 <deg>
SUB_SPACECRAFT_LONGITUDE =   122.76 <deg>
NOTE = "The values of the keywords SC_SUN_POSITION_VECTOR,
       SC_TARGET_POSITION_VECTOR and SC_TARGET_VELOCITY_VECTOR
       are related to the EMEJ2000 reference frame.
       The values of SUB_SPACECRAFT_LATITUDE and SUB_SPACECRAFT_LONGITUDE
       are northern latitude and eastern longitude in the standard
       planetocentric IAU_<TARGET_NAME> frame.
       All values are computed for the time = START_TIME.
       Distances are given in <km> velocities in <km/s>, Angles in <deg>"

/* DATA OBJECT DEFINITION  */

OBJECT                = ROMAP_MAG_RAWSC_TABLE
  NAME                = "ROMAP_MAG EDITED SCIENCE DATA"
  INTERCHANGE_FORMAT = ASCII
  ROWS                = 18990
  COLUMNS             = 5
  ROW_BYTES           = 65
```

```
  ^STRUCTURE           = "ROMAP_MAG_RAWSC.FMT"
END_OBJECT             = ROMAP_MAG_RAWSC_TABLE

END
```

7 Appendix: Example of PDS combined detached label for ROMAP SPM level 2 data product

```
PDS_VERSION_ID                = PDS3
LABEL_REVISION_NOTE  = "2009-03-16, SONC, version 1.0"
/* PVV version 3.0 */

/*              Edited Science data (Level 2)                   */

DATA_SET_ID             = "RL-CAL-ROMAP-2-CVP-SPM-V1.0"
DATA_SET_NAME           = "ROSETTA-LANDER CAL ROMAP 2 CVP SPM V1.0"
PRODUCT_ID              = "SPM_FS2_040514013124"
PRODUCT_CREATION_TIME = 2009-03-11T08:29:37
MISSION_NAME            = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME      = "COMMISSIONING"
MISSION_ID              = ROSETTA
INSTRUMENT_HOST_NAME    = "ROSETTA-LANDER"
INSTRUMENT_HOST_ID      = RL

PRODUCT_TYPE           = EDR
START_TIME             = 2004-05-14T01:31:24.815
STOP_TIME              = 2004-05-14T01:34:17.627
SPACECRAFT_CLOCK_START_COUNT = "031312529.93750"
SPACECRAFT_CLOCK_STOP_COUNT  = "042637969.93750"

PRODUCER_ID            = "SONC"
PRODUCER_FULL_NAME     = "SCIENCE OPERATIONS AND NAVIGATION CENTER"
PRODUCER_INSTITUTION_NAME = "CNES"

INSTRUMENT_ID          = ROMAP
INSTRUMENT_NAME        = "N/A"
INSTRUMENT_TYPE        = {"FLUXGATE MAGNETOMETER","ELECTROSTATIC ANALYZER",
                          "FARADAY CUP"}
DETECTOR_ID            = SPM
DETECTOR_DESC          = “Simple Plasma Monitor”

INSTRUMENT_MODE_ID     = "N/A"
INSTRUMENT_MODE_DESC = "N/A"
TARGET_NAME            = "CALIBRATION"
TARGET_TYPE            = "CALIBRATION"

PROCESSING_LEVEL_ID = “2”

DATA_QUALITY_ID = “-1”
DATA_QUALITY_DESC = "-1 : NOT QUALIFIED"

/* GEOMETRY PARAMETERS */

/* SPACECRAFT LOCATION: Position <km> */
SC_SUN_POSITION_VECTOR = (    58256145.8, 110046457.3,   46674031.2)
/* TARGET PARAMETERS: Position <km>, Velocity <km/s> */
SC_TARGET_POSITION_VECTOR = (“N/A”,”N/A”,”N/A”)
SC_TARGET_VELOCITY_VECTOR = (“N/A”,”N/A”,”N/A”)
/* SPACECRAFT POSITION WITH RESPECT TO CENTRAL BODY */
SPACECRAFT_ALTITUDE =    31680363.9 <km>
SUB_SPACECRAFT_LATITUDE =      3.08 <deg>
SUB_SPACECRAFT_LONGITUDE =    108.33 <deg>
NOTE = "The values of the keywords SC_SUN_POSITION_VECTOR,
       SC_TARGET_POSITION_VECTOR and SC_TARGET_VELOCITY_VECTOR
```

```
       are related to the EMEJ2000 reference frame.
       The values of SUB_SPACECRAFT_LATITUDE and SUB_SPACECRAFT_LONGITUDE
       are northern latitude and eastern longitude in the standard
       planetocentric IAU_<TARGET_NAME> frame.
       All values are computed for the time = START_TIME.
       Distances are given in <km> velocities in <km/s>, Angles in <deg>"

/* DATA OBJECT DEFINITION  */

OBJECT                      = FILE
  RECORD_TYPE               = FIXED_LENGTH
  FILE_RECORDS              = 96
  RECORD_BYTES              = 196
  ^ROMAP_SPM_PAR_ION_CNA_TABLE = "SPMP_FS2_040514013124_CNA.TAB"
  OBJECT                    = ROMAP_SPM_PAR_ION_CNA_TABLE
      NAME                  = ROMAP_SPM_PAR_ION_CNA
      INTERCHANGE_FORMAT    = ASCII
      ROWS                  = 96
      ^STRUCTURE            = "ROMAP_SPM_PAR_ION_CNA.FMT"
      COLUMNS               = 14
      ROW_BYTES             = 196
  END_OBJECT                = ROMAP_SPM_PAR_ION_CNA_TABLE
END_OBJECT                  = FILE

OBJECT                      = FILE
  RECORD_TYPE               = FIXED_LENGTH
  FILE_RECORDS              = 192
  RECORD_BYTES              = 148
  ^ROMAP_SPM_PAR_ION_CNE_TABLE = "SPMP_FS2_040514013124_CNE.TAB"
  OBJECT                    = ROMAP_SPM_PAR_ION_CNE_TABLE
      NAME                  = ROMAP_SPM_PAR_ION_CNE
      INTERCHANGE_FORMAT    = ASCII
      ROWS                  = 192
      ^STRUCTURE            = "ROMAP_SPM_PAR_ION_CNE.FMT"
      COLUMNS               = 14
      ROW_BYTES             = 148
  END_OBJECT                = ROMAP_SPM_PAR_ION_CNE_TABLE
END_OBJECT                  = FILE

OBJECT                      = FILE
  RECORD_TYPE               = FIXED_LENGTH
  FILE_RECORDS              = 96
  RECORD_BYTES              = 194
  ^ROMAP_SPM_PAR_ION_CRA_TABLE = "SPMP_FS2_040514013124_CRA.TAB"
  OBJECT                    = ROMAP_SPM_PAR_ION_CRA_TABLE
      NAME                  = ROMAP_SPM_PAR_ION_CRA
      INTERCHANGE_FORMAT    = ASCII
      ROWS                  = 96
      ^STRUCTURE            = "ROMAP_SPM_PAR_ION_CRA.FMT"
      COLUMNS               = 14
      ROW_BYTES             = 194
  END_OBJECT                = ROMAP_SPM_PAR_ION_CRA_TABLE
END_OBJECT                  = FILE

OBJECT                      = FILE
  RECORD_TYPE               = FIXED_LENGTH
  FILE_RECORDS              = 192
  RECORD_BYTES              = 145
  ^ROMAP_SPM_PAR_ION_CRE_TABLE = "SPMP_FS2_040514013124_CRE.TAB"
  OBJECT                    = ROMAP_SPM_PAR_ION_CRE_TABLE
      NAME                  = ROMAP_SPM_PAR_ION_CRE
      INTERCHANGE_FORMAT    = ASCII
      ROWS                  = 192
      ^STRUCTURE            = "ROMAP_SPM_PAR_ION_CRE.FMT"
      COLUMNS               = 14
      ROW_BYTES             = 145
  END_OBJECT                = ROMAP_SPM_PAR_ION_CRE_TABLE
```

```
END_OBJECT                   = FILE

OBJECT                       = FILE
  RECORD_TYPE                = FIXED_LENGTH
  FILE_RECORDS               = 54
  RECORD_BYTES               = 119
  ^ROMAP_SPM_PAR_FC_TABLE    = "SPMF_FS2_040514013124.TAB"
  OBJECT                     = ROMAP_SPM_PAR_FC_TABLE
      NAME                   = ROMAP_SPM_PAR_FC
      INTERCHANGE_FORMAT     = ASCII
      ROWS                   = 54
      COLUMNS                = 12
      ROW_BYTES              = 119
      ^STRUCTURE             = "ROMAP_SPM_FC.FMT"
  END_OBJECT                 = ROMAP_SPM_PAR_FC_TABLE
END_OBJECT                   = FILE

OBJECT                       = FILE
  RECORD_TYPE                = FIXED_LENGTH
  FILE_RECORDS               = 96
  RECORD_BYTES               = 119
  ^ROMAP_SPM_PAR_ELEC_TABLE  = "SPME_FS2_040514013124.TAB"
  OBJECT                     = ROMAP_SPM_PAR_ELEC_TABLE
      NAME                   = ROMAP_SPM_PAR_ELEC
      INTERCHANGE_FORMAT     = ASCII
      ROWS                   = 96
      COLUMNS                = 12
      ROW_BYTES              = 119
      ^STRUCTURE             = "ROMAP_SPM_ELEC.FMT"
  END_OBJECT                 = ROMAP_SPM_PAR_ELEC_TABLE
END_OBJECT                   = FILE

END
```

8 Appendix: Example of Directory Listing of Data Set RL-CAL-ROMAP-2-CVP-SPM-V1.0

```
|-AAREADME.TXT
|
|              |-CATINFO.TXT
|              |-DATASET.CAT
|              |-INST.CAT
|-CATALOG------|-INSTHOST.CAT
|              |-MISSION.CAT
|              |-PERSON.CAT
|              |-REF.CAT
|              |-SOFTWARE.CAT
|
|              |-HK-------|-RHK_FH2_040908120217_02155.LBL
|              |          |-RHK_FH2_040908120217_02155.TAB
|              |
|              |          |-SPME_FS2_040514013124.TAB
|              |          |-SPME_FS2_041007004354.TAB
|              |          |-SPME_FS2_041007004502.TAB
|              |          |-SPME_FS2_041009001317.TAB
|              |          |-SPME_FS2_041009001425.TAB
|              |          |-SPMF_FS2_040514013124.TAB
|              |          |-SPMF_FS2_041007004354.TAB
|              |          |-SPMF_FS2_041007004502.TAB
|              |          |-SPMF_FS2_041009001317.TAB
|              |          |-SPMF_FS2_041009001425.TAB
|              |          |-SPMP_FS2_040514013124_CNA.TAB
|              |          |-SPMP_FS2_040514013124_CNE.TAB
```

```
                               |              |          |-SPMP_FS2_040514013124_CRA.TAB
                               |              |          |-SPMP_FS2_040514013124_CRE.TAB
                               |-DATA---------|          |-SPMP_FS2_041007004502_CNA.TAB
                               |              |-SC-------|-SPMP_FS2_041007004502_CNE.TAB
                               |                         |-SPMP_FS2_041007004502_CRA.TAB
|-RL-CAL-ROMAP-2-CVP-SPM-V1.0-|                         |-SPMP_FS2_041007004502_CRE.TAB
                               |                         |-SPMP_FS2_041009001425_CNA.TAB
                               |                         |-SPMP_FS2_041009001425_CNE.TAB
                               |                         |-SPMP_FS2_041009001425_CRA.TAB
                               |                         |-SPMP_FS2_041009001425_CRE.TAB
                               |                         |-SPMR_FS2_041007004354_CN.TAB
                               |                         |-SPMR_FS2_041007004354_CR.TAB
                               |                         |-SPMR_FS2_041009001317_CN.TAB
                               |                         |-SPMR_FS2_041009001317_CR.TAB
                               |                         |-SPM_FS2_040514013124_PAR.LBL
                               |                         |-SPM_FS2_041007004354_RAW.LBL
                               |                         |-SPM_FS2_041007004502_PAR.LBL
                               |                         |-SPM_FS2_041009001317_RAW.LBL
                               |                         |-SPM_FS2_041009001425_PAR.LBL
                               |
                               |              |-DOCINFO.TXT
                               |              |-EAICD_ROMAP.DOC
                               |              |-EAICD_ROMAP.LBL
                               |              |-RO-LRO-DP-300002-UA.LBL
                               |              |-RO-LRO-DP-300002-UA.PDF
                               |              |-ROMAP_CALIBRATION_DESC.TXT
                               |-DOCUMENT-----|-ROMAP_CALIBRATION_DESC.LBL
                               |              |-TIMELINE_CVP.TXT
                               |              |-TIMELINE_CVP_DESC.TXT
                               |              |-TIMELINE_CVP_PART1.LBL
                               |              |-TIMELINE_CVP_PART1.PNG
                               |              |-TIMELINE_CVP_PART2.LBL
                               |              |-TIMELINE_CVP_PART2.PNG
                               |
                               |              |-INDXINFO.TXT
                               |-INDEX--------|-INDEX.LBL
                               |              |-INDEX.TAB
                               |
                               |              |-LABINFO.TXT
                               |              |-ROMAP_RAWHK.FMT
                               |              |-ROMAP_SPM_ELEC.FMT
                               |              |-ROMAP_SPM_FC.FMT
                               |-LABEL--------|-ROMAP_SPM_PAR_ION_CNA.FMT
                               |              |-ROMAP_SPM_PAR_ION_CNE.FMT
                               |              |-ROMAP_SPM_PAR_ION_CRA.FMT
                               |              |-ROMAP_SPM_PAR_ION_CRE.FMT
                               |              |-ROMAP_SPM_RAW_ION_CN.FMT
                               |              |-ROMAP_SPM_RAW_ION_CR.FMT
                               |-VOLDESC.CAT
```