SWEDISH INSTITUTE OF SPACE PHYSICS
Uppsala

ROSETTA RPC-LAP
to Planetary Science Archive
Interface Control Document

RO-IRFU-LAP-EAICD

Issue 1.11.3

20 November 2017

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Document History

Version	Date	Sections Changed	Notes
1.0	2003-08-19	New document	Initial draft
1.1	2005-08-04	All sections updated.	PDS Software and archive has matured
1.2	2005-11-24	Most sections updated.	Corrections in response to PSA team.
1.3	2006-01-27		Never issued.
1.4	2006-01-31	Minor corrections.	Corrections in response to PSA team.
1.5	2006-10-31	Numerous updates related to PDS review, mostly RID corrections.	PDS archive review.
1.6	2012-07-03	Almost all.	Complete update and revision of all text, taking RIDs from the Lutetia review into account. Geometry info added.
1.7	2012-10-10	Minor corrections.	Corrections in response to comments on previous version. Non-correspondence of filenames in EDITED and CALIBRATED described. More details on bias values and their calibration.
1.8	2012-01-30	2.2, 2.3, 2.5, 3.1.4	Editorial and typo correction in response to comments by PSA. All tables renumbered. Improved description of filenames in Section 3.1.4.
1.9	2013-08-13		Editorial changes in response to PSA review.
1.9.1	2015-02-23	1.9, 2.5, 4.3.1.5, 4.3.2.2-5	Updated contact names, addresses, a calibration detail (cubic fit), and renamed keywords, other minor edits.

1.9.2	2015-07-07	2.3, Table 2.3-1	Corrected the macro table graphics. Emphasized that the macro table is an example.
1.9.3	2015-09-01	0, 2.7, 4.1.4, 4.2.3, 5.3.2.3, Tables 3-1, 3-2	New specifications for geometry files.
1.10	2016-08-31	Most sections modified, in particular Sections 2 and 3 (new).	Changes in response to PSA & PDS review. Updates for new CALIBRATED data set format. Updated specification of geometry files, extended descriptions of in-flight data products and HK, added RPCLAP_CALIB_MEAS_EXCEPT.
1.10.1	2016-10-12	Section 3.5, 4.1.4, Table 8	Changes in response to PSA & PDS review. Added missing information on RPCLAP_CALIB_MEAS_EXCEPT. Product ID text as proper table. Mission-specific keywords cleaned up.
1.10.2	2016-12-14	Section 2.5, 3.1, 3.2.1	Described two additional offset calibrations and a related caveat. Moved tables within Section 3.1 to end of section.
1.10.3	2017-03-02	Section 2.5, 3.1	Calibration typo fixed (offsets between ADC16 and ADC20 data). Fixed broken internal references.
1.11	2017-08-24	Section 2.5, 2.6 (moved into 3.1.1), 3.1, 3.2.1, 3.3, 3.9, 5.3.1.5, 5.3.2.1.5	Rephrased language to not use “we” or “our” (all sections). Algorithm to select RPCLAP*yymmdd*_CALIB_MEAS corrected to mention RPCLAP_CALIB_MEAS_EXCEPT. Clarified calibration and updated new calibration procedures (8 kHz filter offsets, moving-average bug compensation, new ADC20 calib. factors). Removed unused ADC20 calib. factor PDS keywords. Added high/low-gain, truncated/non-truncated to summary of instrument settings. Added TSEQ coordinates to geometry files. Updated SPICE usage. Updated quality flags information.

1.11.1	2017-09-11	2.4, 2.5.1, 5.3.2, 2.5.5, 2.5.6.1, 3.2.1, 3.5, 4.4.3.2	Removed geometry files from EDITED. Moved geometry data product design. New algorithm and new supporting data product RPCLAP*yymmdd*_CALIB_COEFF for bias- and temperature-dependent current offset, replacing old data product RPCLAP_CALIB_MEAS_EXCEPT and all except one RPCLAP*yymmdd*_CALIB_MEAS. Updated P2 caveats.
1.11.2	2017-09-29	2.2, 2.5.7 (new), 2.5.8 (new), 3.1, 5.3.1.5	Added excluded LF samples, pseudocode to describe calibration, distinction coarse/fine sweeps, note on ADC20 average bug (last four bits).
1.11.3	2017-11-20	Changes in response to Review; 2.2, 2.5.1, 3.2.1, 4.1.4, Table 5-6, Fig. 2, Fig. 3 (prev.)	Transfer functions and time shift. Clarified product IDs and filenames with colors. Removed (old) Fig 3. Caveat for absence of way to detect saturation in CALIBRATED data.

CONTENTS

1 Introduction

1.1 Purpose and Scope

This document provides users of PSA/PDS data products from the Langmuir Probe instrument of the Rosetta Plasma Consortium (RPC-LAP) with a description of the data products and how they were generated. It is also the official interface between the LAP team and the archiving authority.

1.2 Archiving Authorities

1.2.1 Planetary Data System (PDS)

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

1.2.2 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 will offer the creation of physical archive volumes on request.

1.3 Contents

This document describes the data flow of the LAP instrument on the Rosetta mission from the s/c until the insertion into the PSA for ESA. It includes information on how data were processed, formatted, labeled and uniquely identified. The document discusses general naming schemes for data volumes, data sets, data and label files as well as fundamental features of the instrument. Standards used to generate the product are explained. The design of the data set structure and the data product is given, with some examples.

1.4 Intended Readership

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

1.5 Applicable Documents

AD1 Planetary Data System Standards Reference, February 27, 2009, Version 3.8, JPL D-7669, Part 2

AD2 ROSETTA Archive Generation, Validation and Transfer Plan, September 01, 2005, RO-EST-PL-5011

AD3 RO-RPC-UM, Rosetta Plasma Consortium: User´s Manual

AD4 RO-IGEP-TR-0016, RPC Archiving Guidelines

1.6 **Reference Documents**

RD1 RPC-LAP: The Rosetta Langmuir probe instrument. A. I. Eriksson, R. Boström, R. Gill, L. Åhlén, S.-E. Jansson, J.-E. Wahlslund, M. André, A. Mälkki, J. A. Holtet, B. Lybekk, A. Pedersen, L. G. Blomberg and the LAP team. *Space Science Reviews, 128*, 729-744, 2007. DOI:10.1007/s11214-006-9003-3.

RD2 RPC-LAP: The Langmuir probe instrument of the Rosetta plasma consortium. A. I. Eriksson, R. Gill, J.-E. Wahlund, M. André, A. Mälkki, B. Lybekk, A. Pedersen, J. A. Holtet, L. G. Blomberg and N. J. T. Edberg. In *Rosetta: ESA's Mission to the Origin of the Solar System*, editors R. Schulz, C. Alexander, H. Bönhardt and K.-H. Glassmeier. Springer, 2009.

RD3 RPC: The Rosetta Plasma Consortium. C. Carr, E. Cupido, C. G. Y. Lee, A. Balogh, T. Beek, J. L. Burch, C. N. Dunford, A. I. Eriksson, R. Gill, K. H. Glassmeier, R. Goldstein, D. Lagoutte, R. Lundin, K. Lundin, B. Lybekk, J. L. Michau, G. Musmann, H. Nilsson, C. Pollock, I. Richter and J. G. Trotignon. *Space Science Reviews, 128*, 629-647, 2007. DOI: 10.1007/s11214-006-9136-4.

RD4 RPC: The Rosetta Plasma Consortium. C. Carr, E. Cupido, C.G.Y. Lee, A. Balogh, T. Beek, J. L. Burch, C. N. Dunford, A. I. Eriksson, R. Gill, K.-H. Glassmeier, R. Goldstein, D. Lagoutte, R. Lundin, K. Lundin, B. Lybekk, J. L. Michau, G. Musmann, H. Nilsson, C. Pollock, I. Richter and J. G. Trotignon. In *Rosetta: ESA's Mission to the Origin of the Solar System*, editors R. Schulz, C. Alexander, H. Bönhardt and K.-H. Glassmeier. Springer, 2009.

RD5 RPC-MIP: The Mutual Impedance Probe of the Rosetta Plasma Consortium. J.-G. Trotignon, J.-L. Michau, D. Lagoutte, M. Chabassière, G. Chalumeau, F. Colin, P. M. E. Décréau, J. Geiswiller, P. Gille, R. Grard, T. Hachemi, M. Hamelin, A. Eriksson, H. Laakso, J.P. Lebreton, C. Mazelle, O. Randriamboarison, W. Schmidt, A. Smit, U. Telljohann and P. Zamora. *Space Science Reviews, 128*, 713-728, 2007. DOI: 10.1007/s11214-006-9005-1.

RD6 N.J.T. Edberg, A.I. Eriksson, U. Auster, S. Barabash, A.Bößwetter, C.M. Carr, S.W.H. Cowley, E. Cupido, M. Fränz, K.-H. Glassmeier, R. Goldstein, M. Lester, R. Lundin, R. Modolo, H. Nilsson, I. Richter, M. Samara, J.G. Trotignon, 'Simultaneous measurements of the Martian plasma environment by Rosetta and Mars Express', Planet. Space Sci., 57, 1085-1096, 2008. doi:10.1016/j.pss.2008.10.016

1.7 Relationships to Other Interfaces

This document is the top level document for LAP PDS-compliant PSA archiving.

1.8 Acronyms and Abbreviations

ADC	Analog-to-Digital Converter
ADC16	The 16-bit ADC. One on each probe.
ADC20	The 20-bit ADC. One on each probe.
AQP	Acquisition Period
bps	Bits per second
BM	Burst rate TM mode
DAC	Digital-to-Analog Converter
DDS	Data Disposition System
DVAL	Data Validation Tool (software)
E	Current bias (E-field measurement), mode of a LAP probe
EAICD	Experiment to Archive Interface Control Document
ESA	European Space Agency
ESOC	European Space Operations Centre
GSE	Ground Support Equipment
HGA	High-Gain Antenna
ICA	Ion Composition Analyzer (other RPC instrument)
HK	Housekeeping
IC	Imperial College, London
IES	Ion and Electron Sensor (other RPC instrument)
IRFU	Swedish Institute of Space Physics, Uppsala branch (Institutet för rymdfysik (IRF), Uppsala)
LAP	Langmuir Probe instrument
LDL	Long Debye Length (mode of the MIP instrument)
LM	Low rate TM mode
MAG	Fluxgate magnetometer (other RPC instrument)
MIP	Mutual Impedance Probe (other RPC instrument)
N	Voltage bias (deNsity measurement), mode of a LAP probe
NM	Normal rate TM mode

P1	LAP probe 1
P2	LAP probe 2
PDS	Planetary Data System
PIU	Plasma Interface Unit (RPC central unit)
PSA	Planetary Science Archive (ESA)
PVV	PSA Volume Verifier
RPC	Rosetta Plasma Consortium
s/c	Spacecraft
SDL	Short Debye Length (normal mode of MIP instrument)
SSP	Surface Science Package (the Philae lander)
TM	Telemetry.
TM units	The units of the digital values sent to DACs (set bias), and received from ADCs (measurements).
Vps	Probe-to-spacecraft voltage

1.9 Contact Names and Addresses

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2 Overview of Instrument Design, Data Handling and Product Generation

2.1 RPC and LAP

RPC, the Rosetta Plasma Consortium, is a set of instruments on the Rosetta orbiter for investigation of plasma properties and electromagnetic fields. RPC is described in RD3 and RD4. The Langmuir probe (LAP) instrument is one of these instruments, and is referred to as RPC-LAP or LAP in the rest of this document.

2.2 The LAP instrument

This section gives a very brief introduction to the LAP instrument, and is recommended reading for any user of any LAP data product. For more complete information, refer to the two published instrument descriptions, RD1 and RD2.

LAP uses two spherical sensors of 2.5 cm radius, mounted on 15 cm “stubs,” which, in turn, are attached to the ends of the spacecraft booms by a “foot” (see picture on document cover page). Probe 1 is mounted on the “upper” spacecraft boom, also carrying the RPC-MIP antenna (RD5). This boom, which is 2.24 m in length from hinge to probe, is protruding from the spacecraft at an angle of 45° to the nominal comet direction (the *z* axis in Figure 1; see also Table 1). By pointing to the comet, probe 1 will get access to a plasma flow from the comet as undisturbed as possible by any spacecraft sheath or wakes, without interfering with the field of view of other instruments. Probe 2 is mounted on the “lower” boom, 1.62 m in length, which also carries the RPC-MAG sensors. The distance between the probes is 5.00 m, and the probe separation in the nominal comet direction (z axis) is 4.55 m.

	x (m)	*y* (m)	*z* (m)
Probe 1	−1.19	2.43	3.88
Hinge 1	−1.19	0.85	2.30
Probe 2	−2.48	0.78	−0.65
Hinge 2	−1.19	0.65	0.30

Table 1. Positions in the spacecraft coordinate system, indicated in Figure 1, for the LAP probes and for the hinges at the boom roots. [After AD3]

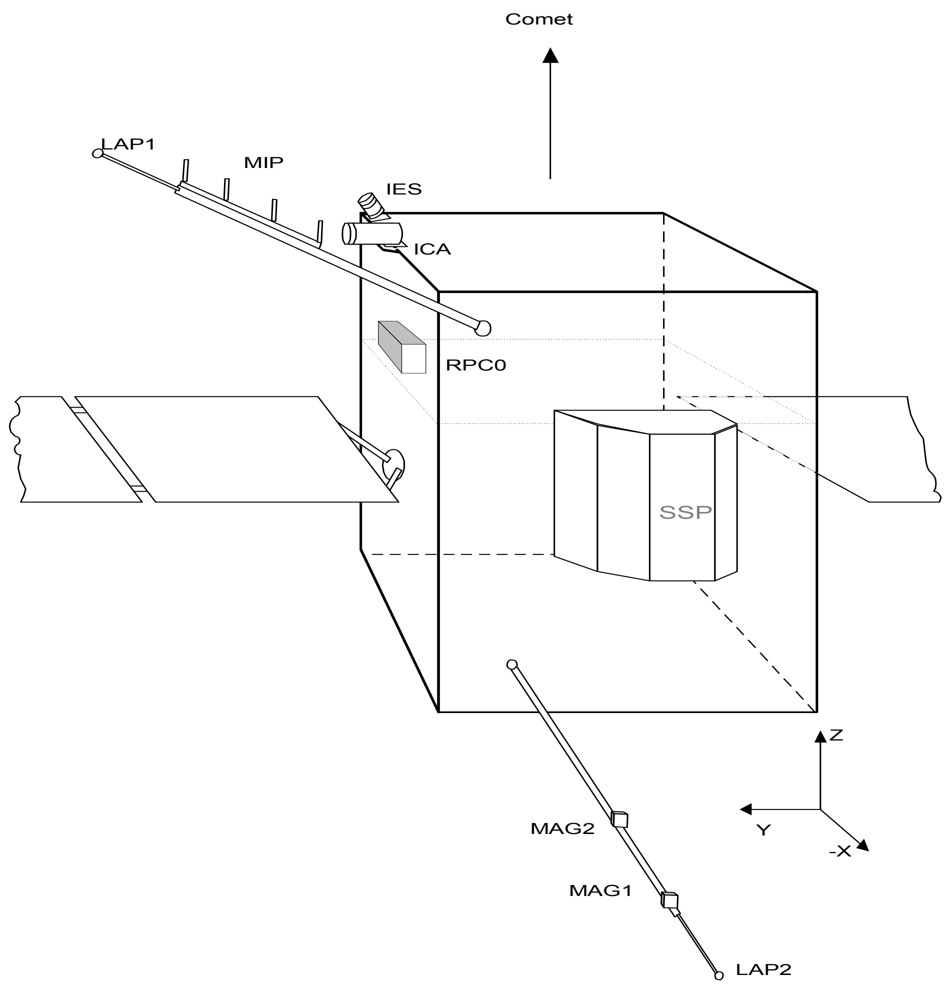

Figure 1. The mounting of the LAP sensors, LAP1 and LAP2, and other RPC units on the Rosetta spacecraft. RPC-0 is the common electronics box, also housing the LAP electronics boards. The direction of the s/c coordinate axes are indicated: the origin of the s/c coordinate system is at the center of the –Z surface (bottom surface in this sketch). SSP is the Philae lander, not part of RPC. [From RD3]

This document uses the designations P1 and P2 for the two LAP probes, though other schemes can be found in the literature and documentation: LAP1 and LAP2 (as in Figure 1), RPC-3.1 and RPC-3.2, probe 1 and probe 1, S1 and S2, and so forth.

The probes can be independently operated in any of two *bias modes*:

- A *bias voltage* can be applied to the probe, in which case the basic measured quantity is the current flowing from the probe to the plasma. In general, this current is denoted as Ip, with I1 and I2 referring to the specific currents from the two probes. This bias mode is denoted N (for deNsity mode) or (in the EDITED archive data filenames) D.

- A *bias current* (including zero, corresponding to floating probes) can be applied to the probe. In this case, the basic quantity measured is the voltage of the probe with respect to the spacecraft, denoted Vps in general, with V1 and V2 denoting the specific signal from each probe. This bias mode is denoted E (for Electric field mode).

Probe P2 may also be used by the RPC-MIP instrument for use in its LDL (Long Debye-Length) mode [RD5]. In this case, LAP can only take data from P1. To indicate how the probes are operated, it is convenient to group the P1 and P2 bias modes together. For example, “NE” then indicates that P1 is in voltage bias mode (N) and P2 in current bias mode (E), while “E-“ indicates that P1 is in current bias mode (E) and P2 is not used by LAP because it is being handed over to MIP for LDL operations.

In general, voltage bias is most useful in dense plasmas for determining the prime LAP science parameters of plasma density, electron temperature, plasma flow speed, and the density fluctuation spectrum, while the bias current is applied to get measurements of spacecraft potential and electric (wave) fields. In tenuous plasmas, the density is better obtained from the spacecraft potential. The limit between “dense” and “tenuous” is not absolute but set by the currents flowing to an object at zero potential with respect to the surrounding plasma: “dense” means that the random thermal electron current dominates, “tenuous” that the photoemission current dominates. Hence, the dense-tenuous density limit depends on the photoemission current, which is proportional to the solar UV flux. The limit density therefore follows a $1/r^2$ relation with distance from the sun, and also varies with temporal solar UV intensity variations. In general, the limit varies between at a few hundred cm^{-3} at Earth orbit to a few tens cm^{-3} in the outer part of the Rosetta operational range of solar distances.

The bias applied on a probe can either be set to a constant value or, in the case of bias voltage, "swept", i.e. varied in steps over some range of voltage. LAP also has the possibility to apply a square-wave voltage of up to a few kHz to either probe and observe the resulting signal on the other probe.

Each probe has its own electronics, and can thus be operated independently of the other probe, regarding biasing as well as sampling. To each probe is attached two analog-to-digital converters (ADCs): one 20-bit ADC (ADC20), operating at 57.8 samples/s and denoted L or LF (for low frequency sampling), and one 16-bit ADC (ADC16), operating at 18 750 samples/s and denoted H or HF (for high frequency sampling).

Data are low-pass filtered by one of three different filters before sampling, cutting (3 dB damping point) at 20 Hz for L sampling and at either 4 kHz or 8 kHz for H sampling. The filter characteristics are shown in Figure 2, and are also available in the files containing the string FRQ in the CALIB directory, see Section 4.4.3.2. The filters were designed for high phase linearity in the pass band, resulting in the flat group delays displayed in Panels (c) and (d) of Figure 2.

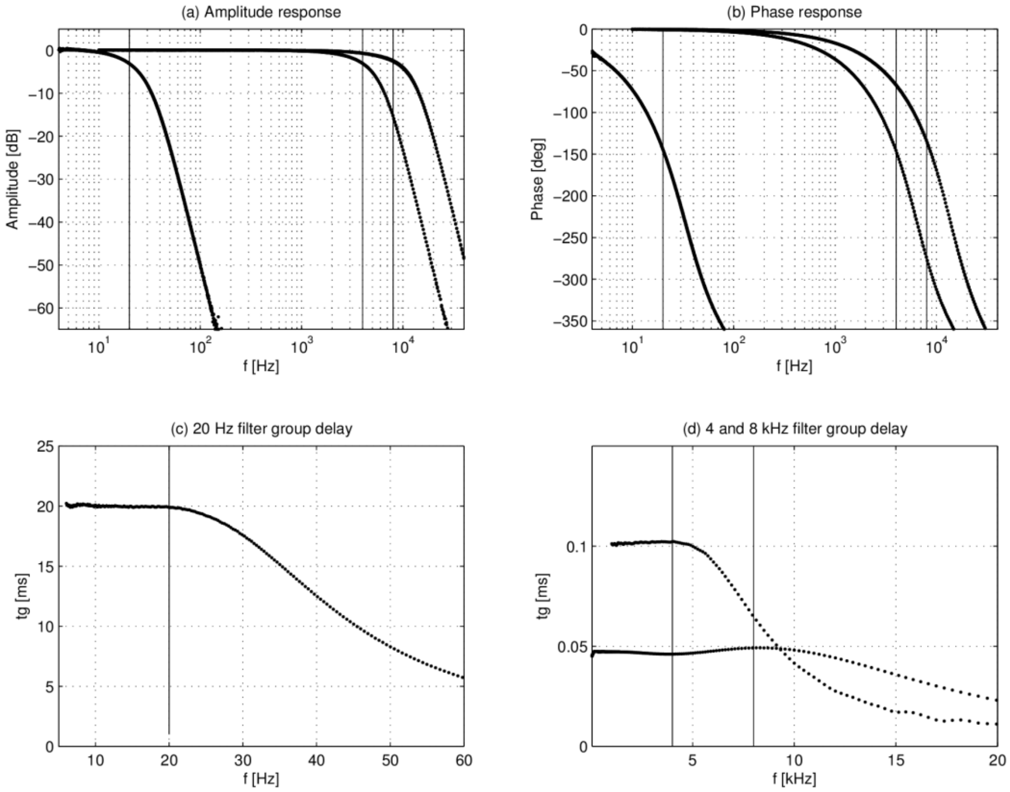

Figure 2. (a) Amplitude and (b) phase response of the LAP instrument, showing the roll-off of the three anti-aliasing filters, as measured in laboratory tests of the flight hardware. Data for P1 and P2 are plotted on top of each other but the probes are identical to the limit of the plot resolution and can therefore not be distinguished. (c) LAP2 group delay times for the 20 Hz, and (d) 4 kHz and 8 kHz filters, calculated from the P2 data in (b), showing the very low distortion in the pass bands. Vertical lines indicate nominal corner frequencies.

A variety of different measurements can be produced by this arrangement, producing different data types. The basic data types are listed below: however, it should be noted that the LAP flight s/w is very flexible, and functions can be defined for construction of other data types not listed here.

- *Fix-bias time series.* With the probes at constant bias (current or voltage), the time series, at some (almost) constant sampling frequency, from both or any of the probes, or derived time series like their sum or their average, can be transmitted.
- *Bias sweeps.* The bias voltage can be varied during a brief interval, known as a sweep. While the samples acquired still constitutes a time series, the basic assumption is that the plasma does not vary during the short sweep, and the sweep is treated as a set of instantaneous and simultaneous samples acquired at different bias. A sweep consists of at least one sequence of monotonously increasing or decreasing bias voltages, possibly followed by another sequence of monotonously decreasing or increasing (i.e. opposite direction) of bias voltages. Sweeps can be either “coarse” (low-resolution bias) or fine (high-resolution bias). See RD1, page 738.

Data can be transmitted to the PIU and further to the spacecraft systems at three different data rates or telemetry modes:

- *Low TM mode (LM):* 1.6 bps. Not used for regular science operations.
- *Normal TM mode (NM):* 62.5 bps. Most common mode for science operations.
- *Burst TM mode (BM):* 2253 bps. Used for shorter intervals when RPC TM allocation so allows.

2.3 LAP Operational Modes - Macros

This section describes the LAP operational mode concept. A general knowledge of these is necessary for at least users of LAP EDITED and CALIBRATED data sets, and could be of interest also to users of future DERIVED data sets.

As described above, and in more detail in RD1 and RD2, the LAP probes can be used in different bias and sampling modes. Such settings are combined in instrument macros, which are command sequences stored in the LAP flash memory (RD1, RD2).

The basic time unit for LAP operations is the spacecraft data acquisition period (AQP) of 32 s. A macro specifies the LAP operations over an integer number of AQPs, with indefinite repetition. When the instrument is commanded to run a certain macro, it thus repeats the sequence of operations specified in the macro until commanded to stop or to change macro. A macro can therefore be said to define an operational mode of LAP.

A macro can contain any LAP command. In practice, macro instructions include the following:

- Bias settings for each probe
- Sweep setup
- Number of samples to acquire from each of the ADCs (beginning at the start of the AQP)
- Onboard data reduction: digital filtering, downsampling, and subtraction or addition of two signals.
- Possible idle wait for a number of AQPs (to keep telemetry within bounds)
- Telemetry mode (LM, NM, or BM)

Each macro is identified by a macro ID, which is stored in the data so that the instrument setup is always well known. A macro ID is fundamentally a sequence of three hexadecimal digits, e.g. 0x506, although digits outside the range 0-9 have rarely been used.

The document DOCUMENTS/RO-IRFU-LAPMAC-*yymmdd*.PDF contains a human-friendly summary of the types of measurements made by the various science macros used in the current mission phase. As new macros can be uploaded, the macros actually in use may be different for each phase of the mission. Table 2 shows an example of such a summary.

The term “macro block” is defined as the uninterrupted period of time when a given macro runs with the exception that for practical reasons, macro blocks never run over midnight. Therefore, if the same macro runs continuously over midnight (once), it will still count as two separate macro blocks. A macro block is therefore a natural period of time for analyzing science data products.

2.3.1 Example macro explained

To understand the macro table, Table 2, take as an example macro 0x506, which can be run at Normal telemetry rate. From the table, one can see that when this macro is running, both LAP probes are in bias voltage mode (NN), with a constant bias of +10 V when not sweeping. One can also see that the data sampled by the instrument in this mode are:

- Both probe currents I1 and I2 are available continuously at a time resolution of about 2.2 s (0.45 samples/s). These signals are conveniently denoted as I1L and I2L, the L signifying that the low frequency ADCs (ADC20) are used. Had the probes been in current bias mode, the signals had been voltages denoted V1L and V2L. This continuous sampling is not exactly continuous: the sampling is always reset at the beginning of each AQP, and there may also be one or a few samples missing at the end of an AQP. Despite this, it covers almost all the entire AQP, and is available in every AQP, and hence is at least quasi-continuous. These data are produced by the two ADC20s at 57.8 samples/s, and are then downsampled by a factor of 128. This downsampling is always by some power of two, so for a macro where the table says continuous data at 0.9 samples/s, the exact number is 57.8/64 samples/s.

- Every 5th AQP (every 160 s = 5 * 32 s/AQP), 96 samples are taken simultaneously on both probes at full time resolution by the two ADC16s (18.750 kHz). These signals are denoted I1H and I2H, with H signifying high frequency, and are referred to as HF snapshots. In macros where the probes are in current bias mode, the HF signals are voltage samples denoted by V1H and V2H. In this particular macro, they cover 5.12 ms (96/18750 s), and can thus be used to study wave activity between 0.2 and 8 kHz (where the low-pass filter sets in, see Figure 2). In some macros (e.g. 0x700), digitally computed differences between the probes rather than individual signals are stored.
- Both probes bias voltages are swept between -12 and +12 V every 5th AQP (every 160 s, not the same AQPs as in which the HF snapshots are taken), in steps of 0.5 V. Sweeps are only available in bias voltage mode.

In the LAP EDITED data sets, one file is saved for each record. This means that for this macro, there is for every AQP two data files containing I1L and I2L. For every 5th AQP, there are two additional data files containing I1H and I2H. Also every 5th AQP, there are also two files containing I1S and I2S data. The number of files produced per AQP can thus differ. In CALIBRATED data sets, data are combined to longer time series which are more convenient to work with.

LAP Macro Table

Date: 120828

Macro ID	0x104	0x212	0x503	0x504	0x505	0x506	0x600	0x604	0x700	0x701	0x702	0x703	0x704	0x705	0x706	0x803	0x804	0x807
Notes	Calibration	Use 0x506			Use 0x506		Use 0x506		Use 0x503	Use 0x503	Use 0x503			Use 0x503	Use 0x504		Use 0x807	
Purpose	Calibration	Swp, HF	Vs, HF	Vs, HF	N, HF, swp	N, HF, swps	Swp, HF	N, HF, swps	Vs, HF	Vs, HF	Vs, HF	LDL, Vs, HF	DL, Vs, wave	Vs, HF	Vs, HF	LDL, N, HF	LDL, N, HF	DL, N, HF, swp
TM rate	NM	NM	NM	BM	NM	NM	NM	BM	NM	NM	NM	NM	BM	NM	BM	NM	BM	BM
Bias mode	NN	NN	EE	EE	NN	NN	NN	NN	EE	EE	EE	E-	E-	EE	EE	N-	N-	N-
Fix bias P1	.	0 V	-8 nA	-8 nA	+10 V	+10 V	+20 V	+20 V	-17 nA	-17 nA	+1 nA	-30 nA	-29 nA	-29 nA	-29 nA	+10 V	+10 V	+10 V
Fix bias P2	.	0 V	+3 nA	+3 nA	+10 V	+10 V	+20 V	+20 V	-17 nA	+1 nA	-17 nA	MIP	MIP	+3 nA	+3 nA	MIP	MIP	MIP
Continuous data (ADC20)																		
Sampled data	.	.	V1, V2	V1, V2	I1, I2	I1, I2	.	I1, I2	V1, V2	V1, V2	V1, V2	V1	V1	V1, V2	V1, V2	I1	I1	I1
fsamp [Hz]	.	.	0.9	57.8	0.45	0.45	.	28.9	0.9	0.9	0.9	1.8	57.8	0.9	57.8	1.8	57.8	57.8
Wave snapshots (ADC16)																		
Sampled data	.	I1, I2	V1	V1, V2	I1, I2	I1, I2	I1, I2	I1, I2	V1-V2	V1-V2	V1-V2	V1	V1	V1-V2	V1-V2	I1	I1	I1
fsamp [Hz]	.	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750	18750
Samples	.	256	272	432	96	96	256	1840	160	160	160	160	2416	272	2624	160	2416	4080
Cadency [AQPs]	.	8	5	1	5	5	8	3	3	3	3	3	1	5	3	3	1	2
Cadency [s]	.	256	160	32	160	160	256	96	96	96	96	96	32	160	96	96	32	64
Sweeps (ADC16)																		
Probes	Open	P1, P2	.	.	P1, P2	P1, P2	P1, P2	P1, P2	.	.	.	.	.	.	.	.	.	P1
Cadency [AQPs]	8	8	.	.	5	5	8	3	.	.	.	.	.	.	.	.	.	2
Cadency [s]	256	256	.	.	160	160	256	96	.	.	.	.	.	.	.	.	.	64
Range [V]	[-30, +30]	[-30,+15]	.	.	[-18, +18]	[-12, +12]	[-30, +20]	[-30, +20]	.	.	.	.	.	.	.	.	.	[-30, +30]
Step [V]	0.25	1	.	.	0.75	0.5	0.25?	0.25	.	.	.	.	.	.	.	.	.	0.25
First upload			PC8	PC8	PC12	PC12			PC4	PC4	PC4	PC6	PC6	PC6	PC6	PC10	PC10	PC12

Field colour indicates use:
Green: prefered non-LDL science macros
Orange: prefered LDL science macros
Yellow: maintenance, diagnostics, etc
Grey: superseded science macros

Text colour indicatess telemetry mode:
Black: Normal Mode
Blue: Burst Mode

Table 2. Example LAP science macros. LAP science macros uploaded June 2010. Text color indicates normal mode (NM, black) or burst mode (BM, blue) data rate. Background color indicates operational status: Pale green and orange are useful science macros without or with LDL, yellow calibration macros, and grey older science macros. The file DOCUMENTS/RO-IRFU-LAPMAC-*yymmdd*.PDF contains the table relevant for the current mission phase.

2.4 LAP Archive Data

This section describes the general structure of the LAP archive. It should be of interest to any user of this archive.

In conformance to PDS standards, LAP data are archived at three levels: EDITED, CALIBRATED and DERIVED. For LAP, these correspond to decommutated uncalibrated raw data in TM units (EDITED), data corrected for instrumental offsets and converted to engineering units (V and A; CALIBRATED), and final physical output parameters in physical units (V, cm-3, eV etc.; DERIVED), respectively.

In more detail:

- EDITED data:
    - Edited science data – the science data stream converted to human and PDS readable format, but still in telemetry units and with no calibrations or corrections applied. One science packet of data from the s/c is converted to one or more files of data in the edited data set, each packet containing the data from one specific measurement. Data files from onboard calibrations are included. The edited science data files are supplied mainly for long term archiving and reference purposes, and are not intended or suitable for regular scientific use.
    - HK data – the HK data stream converted to human and PDS readable format, one file for each LAP HK packet. These data are supplied for long term archiving and reference purposes only, and are not intended or suitable for regular scientific use. The edited HK data files are only archived together with the edited science data files.
- CALIBRATED data:
    - Calibrated science data -- the science data stream converted to engineering units (volt and ampere), calibrated and corrected for known offsets and errors. Every type of data is separately collected into a longer time series spanning a macro block (a continuous run of a given macro but still splitting at midnight). Data from pure calibration macros (in particular macro 0x104) are not included since they cannot be used to calibrate themselves. The CALIBRATED data as such are of high quality, but there is no attempt for correction of e.g. attitude-dependent spacecraft-plasma interaction effects (wakes, photoemission, etc.), and scientific interpretation of the data requires great caution.

  - Sweep descriptions – Information on step biases and time between steps valid for all sweeps on a given probe within a given macro block.
  - Block files – One table per day listing the macro blocks: macro number and their respective time coverages.
  - Geometry data files – one file per day containing position and attitude information at 32 s intervals throughout the day. The geometry files are archived with the calibrated science data files.
- DERIVED data – science data converted to the basic measurement units of volts and amperes, and further to Vps, plasma density, temperature, flow speed, electric field, or any other parameters that can be derived. One file for each derived parameter results from each uninterrupted period of operation of a certain macro, though files are split as to not cross day boundaries. **No DERIVED data sets are yet available.**

2.5 Calibration process

This section is included for reference and should only be of relevant for users interested in how to derive CALIBRATED data from EDITED data.

The measured EDITED data (current or voltage) are based on the direct output of the analog-to-digital converters (ADCs), and spans the range -32,768 to 32,767 (ADC16 data, and ADC20 data truncated to 16 bits) and -524,288 to 524,287 (non-truncated ADC20 data), with 0 representing approximately zero volt or ampere measured by the ADCs.

Saturation, i.e. the analog input to the ADCs being outside of the permitted range, is represented by the ADCs as the minimum digital value, both in the case of positive and negative saturation.

The probe current, both in the form of the bias current in E mode and the measured current in N mode, is by standard convention taken to be positive when flowing from the probe to the plasma. However, to follow the actual settings of the digital-to-analog converters, the bias current values have the opposite sign in the EDITED archive, so that -128 corresponds to a nominal bias current of +44 nA (with conventional sign choice) in the CALIBRATED archive, and +127 to -44 nA. Bias voltages range from -128 to 127 in EDITED, with the same sign as in CALIBRATED. Exact calibration factors are found in the calibration files (see below).

The data in the CALIBRATED data sets have been calibrated using the contents of the CALIB directory and files mentioned below are contained in that directory (see Section 4.4.3.2). Note that the CALIB directory also includes files with the instrument frequency response measured on ground (transfer functions; See Section 4.4.3.2) and that these are not used at present, but are included only for reference as vital instrument information.

The following sections describe the steps needed to produce CALIBRATED data from EDITED data.

2.5.1 *Frequency response and time shift*

All analog signals run through analog low-pass filters before sampling as described in Section 2.2. The filters are designed for high phase linearity in the pass band, yielding frequency independent delays to the signals. To compensate for this delay, the timestamp of every calibrated ADC20 sample is decreased by 20 ms in level 3 (EDITED) and higher archive levels to ensure consistency with RPC-MAG (50 ms time resolution), which is the only other instrument on Rosetta with comparable time resolution. For ADC16 samples (4 and 8 kHz filters), *no adjustment* for the corresponding 0.1 and 0.05 ms group delays has been applied at any archive level.

2.5.2 *Obtaining bias voltages and bias currents.*

Bias voltages and bias currents are not routinely measured onboard. Their digital values are synthetically generated from knowledge of the commanded bias, after which they are converted to engineering units (volts and amperes) using the calibration tables contained in the files RPCLAP030101_CALIB_VBIAS.TAB and RPCLAP030101_CALIB_IBIAS.TAB, determined on ground. While there is no routine measurement of the biases onboard, it is possible to measure the current resulting from a given voltage bias applied over a 5.1 MOhm resistor (e.g. via macro 0x105) for occasional verification of the instrument integrity and consistency.

2.5.3 *Compensating for jump in the ADC16 output*

The measured ADC16 values are non-linear due to an unintended jump between -1 and 0 TM units. Therefore, 2.5 TM units is added to all non-negative ADC16 samples before further calibration, i.e. *before* multiplying with a calibration factor to obtain a value in ampere or volt. It is implicit that this correction is made for ADC16 TM data elsewhere in this chapter.

2.5.4 *Compensating for ADC20 moving-average bug in flight s/w*

There is a flight s/w bug associated with moving average. The moving-average feature is only implemented for ADC20 data and this bug therefore only concerns such data. The bug consists of that the flight s/w mistakenly calculates moving averages $\bar{x}$ as

$$\bar{x} = \frac{(\sum_{i=1}^{N} x_i)+z}{N}, \text{ when } N \neq 1$$

where x_i are the real samples (in TM units), z is an unknown sample (in TM units), and N is the originally intended (i.e. commanded) number of samples per average, as specified in the LAP-specific PDS label keyword LAP_P1P2_ADC20_MA_LENGTH. Note that a value of $N = 1$ is equivalent to the moving average function being disabled, which means that the bug is not triggered. When the bug is triggered, we compensate for the bug by multiplying the data, in TM units, by $N/(N+1)$. It is implicit that this correction is made for ADC20 TM data elsewhere in this chapter

Note that this bug does not clash with the jump in ADC16 values, Subsection 2.5.3, since that concerns another ADC.

2.5.5 *Convert measured values in TM units to volt and ampere*

Currents and voltages measured by the ADCs in TM units, but corrected for the effects in Subsections 2.5.3 and 2.5.4, are converted to ampere and volt by multiplying them with the appropriate calibration factors.

For ADC16 data, the calibration factors C_{ADC16} are identical on P1 and P2 and were obtained from pre-flight ground tests. They are listed in Table 3.

ADC16 calibration factor, C_{ADC16}	***Value***
E-field	1.22072175E-3
Density, low gain	6.10360876E-9
Density, high gain	3.05180438E-10

Table 3. Calibration factors for ADC16 data (identical values for both probes).

For ADC20 data, the corresponding calibration factor values $C_{\mathrm{ADC20},i}$ can be obtained with

$$C_{\mathrm{ADC20},i} = C_{\mathrm{ADC16}} * k_{\mathrm{trunc}} * R_i$$

where k_{trunc} is 1 for truncated data and 16 for non-truncated data, R_i is a near-unity ADC ratio calibration value, and i = probe. The ADC ratio calibration values R_i are listed in Table 4 and were obtained in a one-time in-flight calibration on 2015-05-28 which compared the behavior of the ADC16s and ADC20s.

Probe	ADC ratio calibration value, R_i
P1	1.0030
P2	1.0046
Table 4. Near-unity ADC ratio calibration values needed to derive ADC20 calibration factors from ADC16 calibration factors.	

Whether a data product contains ADC16 or ADC20 data can be determined from filenames and product IDs. Whether density mode or E-field mode is used can be determined from filenames, product IDs, and from LAP-specific label keywords LAP_P1_BIAS_MODE and LAP_P2_BIAS_MODE. Whether low gain or high gain is used can be determined from the LAP-specific label keywords LAP_P1_STRATEGY_OR_RANGE and LAP_P2_STRATEGY_OR_RANGE. Whether or not ADC20 data has been truncated to 16 bits onboard the spacecraft can be determined from the LAP-specific label keywords ROSETTA:LAP_P1P2_ADC20_STATUS. See Subsections 4.1.4 and 5.3.1.5.

2.5.6 Adding and subtracting offsets

In addition to the above, there are known offsets which, depending on bias and type of data, need to be added/subtracted from the measured currents and voltages produced above (in ampere or volt). These offsets are described below.

2.5.6.1 Temperature- and bias-dependent current offsets (density mode)

Current measurements (i.e. only density mode) are sensitive to inevitable bias-dependent offsets due to small leakage currents in the instrument which add to the current before it is measured. These offsets also vary with time and temperature and are therefore measured repeatedly. The following steps are taken to find and apply such offsets to data.

1) **Measuring bias-dependent current offsets:** The offsets were measured regularly during the mission by running macro 0x104 on the order of once per week. In this macro the probes are physically disconnected from the probes by opening a relay. The non-zero current that still arises is then measured (ADC16, 4 kHz filter) for every possible voltage-bias setting and for each probe, and originates from the instrument electronics themselves.
2) **Analyzing the measured offsets and producing tables of coefficients:** The LAP team has analyzed these measured offsets to produce tables of coefficients p_i, q_i, r_i, and s_i for each probe i (see below), as they change over time, but with a much higher time resolution (every 32 s) than that of the actually measurements of the offsets. These tables are stored in the

RPCLAP*yymmdd*_CALIB_COEFF data products. To produce these tables of coefficients, the LAP team has analyzed how the measured offsets vary over time and how they correlate with instrument temperatures over time etc. Note that these tables themselves might be updated in future versions of data sets as the team's understanding of the behavior of these offsets improves. Only the tables of coefficients that have actually been used to produce a particular data set are included in that data set.

3) **Calculating and removing the offsets:** For any given sample, we use the timestamp of the first sample of that same data product in the same AQP. That timestamp is in turn used for looking up the relevant coefficients for the relevant probe(s) (two probes for P3 data, i.e. differential measurements). Coefficients are interpolated over time between the tabulated values. The offset value which is subtracted from each current sample is

$$I_{\text{offset},i} = p_i \cdot \left(V_{\text{bias},i} - s_i\right)^3 + q_i \cdot \left(V_{\text{bias},i} - s_i\right) + r_i$$

where $V_{\text{bias},i}$ is probe voltage bias (in TM units), and i = probe. $I_{\text{offset},i}$ is expressed in ADC16 TM units, but including the correction for the ADC jump, Subsection 2.5.3, and are generally not integers. Thus, to subtract the offset from a sample in engineering units (A), one must multiply the above offset with the relevant ADC16 calibration factor (low/high gain), also for ADC20 data.

2.5.6.2 Offsets between ADC16 data and ADC20 data

In theory, the ADC16 and ADC20 for a given probe convert the same *intermediate* analog signal, *internal* to the LAP electronic circuitry, to TM units. In practice, there is an offset between the two. To compensate for this, the following values are added to all ADC20 data:

Probe 1: -77.9601

Probe 2: -84.8991

Probe 1-Probe 2 (diff. measurements): -77.9601 + 84.8991 = 6.9390

The above values are expressed in ADC16 TM units and are thus multiplied with the relevant ADC16 calibration factors (select density/E field mode, high/low gain as for the current sample; but *not* ADC20 factors) to convert them to engineering units (ampere, volt) before they are added to ADC20 data. The values were obtained in a one-time in-flight calibration on 2015-05-28.

2.5.6.3 Offsets between 4 kHz and 8 kHz filter data (ADC16)

There are offsets between data measured using the 4 kHz filter and data measured using the 8 kHz filter. Therefore, this offset applies to both density mode and E-field mode, but only to ADC16 data, since only the ADC16s are connected to the 4 and 8 kHz filters. To compensate for this we add the following to all 8 kHz-filter data (both measured currents and measured voltages):

Probe 1: 1.4

Probe 2: 25.35

Probe 1-Probe 2 (diff. measurements): 1.4-25.35 = -23.95

The above values are expressed in ADC16 TM units and one should thus multiply with the relevant ADC16 calibration factors (density/E field, high/low gain as for the sample) to produce the values in engineering units (ampere, volt).

2.5.7 *Excluding LF samples during sweeps*

LF samples which are taken during sweeps are in reality taken with the sweep bias, not the commanded fix-bias. The relevant sweep bias to match with such a LF sample is also ambiguous due to the ADC20 20 Hz low-pass filter. Therefore, LF samples that occur during, or just after, a sweep are kept in edited data sets but are eliminated from other data sets. HF samples cannot be taken during a sweep since they use the same ADC as sweeps (ADC16).

2.5.8 *Pseudocode describing calibration process*

The pseudocode below summarizes most of the calibration described in the previous sections for P1 and P2 data (not P3 data), but without actual numeric values.

```
%=============================================================
% Definitions of terms
% --------------------
% TM units =          "Telemetry" units, digital values both
%                     returned from ADCs in telemetry (TM),
%                     and sent in telecommands (TC) to DACs.
%                     EDITED dataset contain data in TM units.
% Engineering units = Decimal values representing values in
%                     ampere or volt. CALIBRATED datasets
%                     contain data in engineering units.
%
% Variable naming conventions
% ---------------------------
% adc    = ADC; Analogue-to-Digital Converter
% ci     = Calibration info, i.e. various calibration
%          constants, calibration tables, calibration
%          functions.
% meas   = Measured value (samples; as opposed to bias).
% ed     = Edited value
% cal    = Calibrated value
% factor = Something that should be multiplied with a
%          measured value.
% offset = Something that should be SUBTRACTED from a
```

```
%          measured value.
%==============================================================

%==============================================================
% Derive truncation factor to compensate for ADC20 data being
% truncated from 20 bits to 16 bits.
%==============================================================
if isAdc20 && isAdc20Truncated ; adc20TruncationFactor = 16;
else                             adc20TruncationFactor =  1;
end

%======================================================
% Derive factor to compensate for moving average bug
%======================================================
if isAdc20 && (LAP_P1P2_ADC20_MA_LENGTH ~= 1)
    adc20MovingAverageTmFactor = ...
        LAP_P1P2_ADC20_MA_LENGTH / (LAP_P1P2_ADC20_MA_LENGTH + 1);
else
    adc20MovingAverageTmFactor = 1;
end

%==============================================================
% Set conversion factors
% ----------------------
% Multiplicative factors to convert
% measured TM units (not bias) --> engineering units, with or
% without considering various additional effects, and always
% without considering offsets.
%
% adc16Factor
%     Current ideal conversion factor for
%     ADC16 TM measurements --> engineering units.
% adc20Factor
%     Current ideal conversion factor for
%     ADC20 TM measurements --> engineering units.
% adcMeasFactor
%     (temporary variable) Conversion factor for the ADC that
%     is actually used for sampling, compensated for
%     small non-ideal differences between ADCs (ADC16 or
%     ADC20; no truncation factor, no moving average-bug
%     factor).
% combinedMeasFactor
%     Total current conversion factor for
%     TM --> enginering units, for ANY measured value,
%     compensating for various effects.
%==============================================================
if isDensity
    if usesHighGain
        adc16Factor = ci.LAP_CURRENT_CAL_16B_G1;
        adc20Factor = ci.LAP_CURRENT_CAL_16B_G1 / 16.0;
    else
        adc16Factor = ci.LAP_CURRENT_CAL_16B_G0_05;
        adc20Factor = ci.LAP_CURRENT_CAL_16B_G0_05 / 16.0;
    end
else
```

```
    adc16Factor = ci.LAP_VOLTAGE_CAL_16B;
    adc20Factor = ci.LAP_VOLTAGE_CAL_16B / 16.0;
end

% Compensate for
% (1) that the ADC20s are not exactly (only approximately)
% a factor 16 more sensitive than ADC16s, and
% (2) small differences between approximately identical ADCs.
if     probeNbr == 1; adcRatio = ci.ADC_RATIO_P1;
elseif probeNbr == 2: adcRatio = ci.ADC_RATIO_P2;
else   error('This code can only handle P1 & P2.')
end
adc20Factor = adc20Factor * adcRatio;

if isAdc16 ; adcMeasFactor = adc16Factor;
else         adcMeasFactor = adc20Factor;
end
combinedMeasFactor = adcMeasFactor ...
    * adc20TruncationFactor ...
    * adc20MovingAverageTmFactor;

%============================================================
% Set total measurement offset = Value to be SUBTRACTED from
% measured values, in engineering/calibrated units.
%============================================================
calMeasOffset = 0;
if isDensity
    % Offset in measured current due to setting the bias
    % voltage (there is no analogue for E-field mode).
    % BVDCO = Bias Voltage-Dependent Current Offset
    calMeasOffset = calMeasOffset ...
        + ci.bvdcoFunc(probeNbr, edVoltage) * adc16Factor;
end
if isAdc16 && usesFilter8kHz
    % Offset due to difference between the 4 kHz and 8 kHz
    % low-pass filters.
    calMeasOffset = calMeasOffset ...
        + (ci.KHZ8_Px_OFFSET_ADC16TM(probeNbr) * adc16Factor);
end
if isAdc20
    % Offset due to difference between ADC16 and ADC20 data.
    calMeasOffset = calMeasOffset ...
        + ci.ADC20_Px_OFFSET_ADC16TM(probeNbr) * adc16Factor;
end

%============================================================
% Modify edCurrent, edVoltage
% --------------------------
% Compensate for an unintended jump in the ADC16
% analogue-to-digital conversion between -1 TM units and 0 TM
% units. Subtract offset for non-negative values. (The
% correction is defined as the subtraction of a negative
% number to be consistent with the sign convention for other
% calibration offsets.)
%============================================================
```

```
if isAdc16
    if isDensity
        i = (edCurrent >= 0);
        edCurrent(i) = edCurrent(i) ...
            - ci.ADC16_NONNEGATIVE_OFFSET_ADC16TM;
    else
        i = (edVoltage >= 0);
        edVoltage(i) = edVoltage(i) ...
            - ci.ADC16_NONNEGATIVE_OFFSET_ADC16TM;
    end
end

%==============================================================
% Final conversion ~TM units-->engineering units
% ---------------------------------------------
% ci.biasVoltageCalibFunc, biasVoltageCalibFunc = Functions
% for looking up calibrated BIAS value in table.
%==============================================================
if isDensity
    calCurrent = edCurrent * combinedMeasFactor - calMeasOffset;
    calVoltage = ci.biasVoltageCalibFunc(probeNbr, edVoltage);
else
    calCurrent = ci.biasCurrentCalibFunc(probeNbr, edCurrent);
    calVoltage = edVoltage * combinedMeasFactor - calMeasOffset;
end

%==============================================================
% Adjust LF timestamps for group delay
% ------------------------------------
% OBT = Spacecraft clock as a number (not string), i.e. with
% true decimals, and no reset count. Approximate seconds.
%==============================================================
if isAdc20
    calObt = edObt - ci.ADC20_GROUP_DELAY_S;
    calUtc = obt2Utc(calObt, ci);
else
    calUtc = edUtc;
    calObt = edObt;
end
```

3 Overview of Data Products

This section describes the organization of the LAP data products. The descriptions of science data products (Section 3.1), caveats (Section 3.2), documentation (Section 3.7) should be of interest to any user of the archived LAP data. **The regular user should only be interested in the CALIBRATED-level data sets**, and eventually in the DERIVED-level data sets. Note that there is as of yet no DERIVED-level data set.

The regular user should also be aware of the **important caveats relating science data which can be found in Section 3.2**.

The time interval covered by a particular data set can be found in the CATALOG/DATASET.CAT file.

3.1 Science Data Products

To understand and classify the types of LAP science data available one must consider that every LAP science data product is based on data acquired using a certain combination of instrument options (settings). For a single data product, many of these options can be set independently of each other, but not necessarily in all combinations, and not all permitted combinations are useful.

The list below summarizes the most important options which can be combined to produce different types of science data products. Each item lists mutually exclusive options where exactly one option under every item is always used for a single data product (recursively). "Data" here refers to the measured sample values in any one edited or calibrated science data product. Multiple such data products can cover the same time interval.

- Data is always acquired from either
  - **P1**,
  - **P2**, or
  - "**P3**" = The (onboard) calculated value of P1 minus P2 (difference measurement). (Seldom used)
- Data is always acquired in either
  - **density mode** (bias voltage; measures current), or
  - **E-field mode** (bias current; measures voltage)
- Data is always acquired in either of two bias modes:
  - **Sweep bias** (with measurements via ADC16), i.e. bias rapidly sweeping over voltages (never currents) within a short period of time. This is thus only applicable to density mode. Sweeps come in two forms:
    - **Coarse sweeps**
    - **Fine sweeps**, with a higher bias step resolution. (seldom used). The LAP team deems this data to be *unusable* and it is therefore only available in edited.
  - **Fix bias**, which is always acquired in one of the two forms below:

- **LF**, i.e. low frequency samplings (and using ADC20 for measurements) which for the most of the time are quasi-continuous, or
- **HF**, i.e. short high-frequency snapshots (and using ADC16 for measurements)

For a more advanced user, it may also be important to be aware of some more technical settings, e.g. for understanding the calibration. Similar to the list above, each item lists mutually exclusive options, where exactly one option under every item is always used (recursively). These options are *generally* not associated with any particular data products.

- Data from a given probe is always acquired through either of the two ADCs connected to that particular probe. The two ADCs are:
  - **ADC20** (20-bit), with a physical low-pass filter with a cutoff at 20 Hz. ADC20 samples in TM units are always either
    - **full 20-bit values**, or
    - **16-bit values**, truncated (onboard) from 20-bit values
  - **ADC16** (16-bit samples), with a physical low-pass filter with a cutoff at either of the two options below:
    - **4 kHz**, or
    - **8 kHz**
- All density mode data (measured currents) is acquired using either
  - **high-gain** (the great majority of data), or
  - **low-gain**

Filenames and product IDs can be used to determine most of these settings. (Note: LF/HF can be determined indirectly from the EDITED filenames via ADC+fix bias.). See Section 4.1.4. The remaining, and more technical and obscure settings, can be determined from mission-specific PDS keywords found in the data product label files, see Section 5.3.1.5.

The exact science data products which are actually available within a macro block depends on the LAP macro (see Section 2.3). The macro which produced a particular data product can be derived from the value of the PDS keyword INSTRUMENT_MODE_ID in the data product label files, see Section 5.3.1.5. This is however only necessary for EDITED, since CALIBRATED data products contain the macro ID in the filename. The file DOCUMENTS/RO-IRFU-LAPMAC-*yymmdd*.PDF contains a human reader-friendly table over what the science macros relevant for the current mission phase do.

In the EDITED archives, each file includes data covering up to 32 seconds of time (one AQP). Therefore, a large number of files may need to be opened for studies of longer time intervals of EDITED data.

For EDITED and CALIBRATED data, the LAP data sets contain the data products in Table 5 and Table 6, all of them stored in table (.TAB) files and described in label (.LBL) files. Note that probe, data type etc. is specified in the data filenames and product IDs and that they are explained further in Section 4.1.4.

EDITED Science Data Products			
Data type	***Columns***		***Product ID***
	Number of columns	***Column data***	
(1) Time series (fix bias; LF/HF), or (2) sweep	1	UTC time	**RPCLAP***YYMMDD_AAAa_bcdefg***S** ("*e*" = probe = 1 or 2)
	1	OBT time	
	1	Current; bias or measured	
	1	Voltage; bias or measured	
Difference measurements, E-field	1	UTC time	**RPCLAP***YYMMDD_AAAa_b***E***d***3***fg***S**
	1	OBT time	
	2	Current bias, P1 and P2	
	1	Measured voltage difference, P1 minus P2	
Difference measurements, Density mode	1	UTC time	**RPCLAP***YYMMDD_AAAa_b***D***d***3***fg***S**
	1	OBT time	
	1	Measured current difference, P1 minus P2	
	2	Voltage bias, P1 and P2	

Table 5. LAP data products in the EDITED data sets. Product ID in our data sets are equal to filenames without suffix. Black boldface characters are static, while red, italicized letters are variables. The complete filenaming and product ID convention as well as the meaning of red, italicized letters (variables) can be found in Section 4.1.4.

CALIBRATED Science Data Products			
Data type	***Columns***		***Product ID***
	Number of columns	***Column data***	
Time series (fix bias; LF/HF)	1	UTC time	**LAP**_*YYMMDD*_*hhmmss*_*iii*_*jek* ("*e*" = probe = 1 or 2)
	1	OBT time	
	1	Current; bias or measured	
	1	Voltage; bias or measured	
	1	Quality	
Time series, difference measurements, E-field (fix bias, HF)	1	UTC time	**LAP**_*YYMMDD*_*hhmmss*_*iii*_**V3H**
	1	OBT time	
	2	Current bias, P1 and P2	
	1	Measured voltage difference, P1 minus P2	
	1	Quality	
Time series, difference measurements, Density mode (fix bias, HF)	1	UTC time	**LAP**_*YYMMDD*_*hhmmss*_*iii*_**I3H**
	1	OBT time	
	1	Measured current difference, P1 minus P2	
	2	Voltage bias, P1 and P2	
	1	Quality	
Sweep data	1	Start UTC time	**LAP**_*YYMMDD*_*hhmmss*_*iii*_**I***e***S** ("*e*" = probe = 1 or 2)
	1	Stop UTC time	
	1	Start OBT time	
	1	Stop OBT time	
	1	Quality	
	N (varies)	Measured currents for every step of a sweep	

Sweep descriptions (step biases and time between steps)	1	Step time (seconds since beginning of sweep)	**LAP_***YYMMDD_hhmmss_iii*_**B***e***S** (”*e*” = probe = 1 or 2)
	1	Step bias	
Block list	1	UTC start time	**LAP_***YYMMDD*_**000000_BLKLIST**
	1	UTC stop time	
	1	Macro ID	

Table 6. LAP data products in CALIBRATED data sets. Product ID in our data sets are equal to filenames without suffix. Black boldface characters are static, while red, italicized letters are variables. The complete filenaming and product ID convention as well as the meaning of red, italicized letters (variables) can be found in Section 4.1.4. Combinations I3L (difference measurement, density mode, LF) and V3L (difference measurement, E-field mode, LF) are conceivable but have never been used and are therefore not represented.

Sweep descriptions (calibrated) are needed to understand the biases and times of measurement for sweeps. They are given once per probe and macro block since they are identical for all sweeps for a given macro. Block lists contain the macros that have been run during a given day and when. Calibrated science data products (but not block lists) cover an entire macro block.

3.1.1 Data Quality Flag and Quality Factor

The EDITED and CALIBRATED data sets just present the output of the instrument, and are as such of high quality. There is therefore no attempt to assign a detailed quality assessment of these data. The LBL files contain a placeholder quality indicator DATA_QUALITY_ID always set to 1. Further use of this flag is expected only for the DERIVED data set.

Some data products in the CALIBRATED data set contains columns with a quality factor ranging from 000 (best quality) to 999 (worst), based on assessment of the rotation of the spacecraft during measurement, possible perturbation effects from other instruments (LDL), low sample size, etc. Each detrimental quality effect is an integer additive component to the total quality factor of each data point. The quality factor flag is constructed so that each value can only be reached by a unique combination of factors detrimental to the quality of the data. See Table 7. Note that the quality flag does not contain any information on saturation (yet).

Quality factor event description	***Additive effect***
LDL disturbance (MIP in LDL mode)	+40
Bias change near measurement	+20
SAA rotation of more than 0.01° during sweep	+10
Low sample size / zero padding	+2
Poor model fit in analysis (DERIVED)	+1

Table 7. Values added to the quality factor to signify different quality-related conditions. Note that the given numbers are decimal, not hexadecimal (sic!).

3.2 Caveats When Interpreting Science Data

This section lists technical details which are important for regular LAP data users to be aware of:

3.2.1 General

- **After hibernation**, LAP probe 2 (P2) showed strong signs of contamination, to some extent visible all through the mission. Clear signs of this include that the current to P2 is always lower than to P1 at similar bias voltage, and sweeps in both directions (available from macro 0x204) showing hysteresis effects. To avoid problems, **avoid using probe 2 measurements at positive bias potential, whether in sweeps or at fixed bias**. Measurements of negative currents are usually good, due to the higher probe sheath resistance, and so are also voltage measurements with the probe floating, as no current then flows through the probe surface, but caution is recommended.
- **From May 2016 to end of mission**, LAP probe 2 (P2) occasionally exhibits very strong and intermittent currents when at negative bias voltage. These are not yet well understood, and are therefore not considered to be reliable plasma measurements.
- **Saturated data** means that the pre-ADC signal is outside the range of the ADC. It can thus not be properly represented digitally and should not be used. Saturation on either the positive or negative side is represented by the ADCs as the maximum *negative* value that the corresponding ADC can output. Note however, that for data using onboard-averaging (only available for ADC20 data), saturated samples may have been combined with non-saturated samples, meaning that the resulting average, which was transmitted back to Earth, may be inaccurate and without there being a way to absolutely determine from TM whether saturated samples influence the result.

- EDITED data: Saturation is (for non-onboard averaged data) represented as -32,768 in 16-bit data (ADC16 data, and truncated ADC20 data), and as -524,288 in 20-bit data (non-truncated ADC20 data). See Section 2.5.
- CALIBRATED data: **There is currently no good way for the user to identify saturated data**. Saturation is (for non-onboard averaged data) represented as the greatest negative value, e.g. approximately -40 V in E mode data, but due to the nature of the LAP calibration process (Section 2.5), e.g. the conditional subtraction of various offsets, it is non-trivial for the user to determine with absolute certainty what is and is not saturated data. The LAP team plans to have *future* CALIBRATED data sets explicitly signal saturation in the quality flag referred to in Table 6 and Table 7.

- **Fix bias values included in the files are not measured but reconstructed from the instrument command log**, calibrations, and the known characteristics of the instrument modes (macros). When the fix bias value on any of the probes is changed by telecommand, the bias step will be seen in the data files at the time of telecommand execution. **The bias setting actually takes effect 2-3 seconds later**, as can be seen in data. In addition, in certain plasmas the time constant for charging a probe when in current bias mode (E field mode) can be so long that there is a further delay before the bias has settled. Users should thus take care when interpreting data close to a bias setting. This only applies to measurements at fixed bias; the bias voltage in sweeps has correct timing. See also Section 2.5.
- **There is obvious interference from the MIP instrument when using its LDL mode** (e.g. when running macros 0x801 or 0x807). This affects mainly the data sampled at kHz frequencies at fixed bias and in sweeps. Outliers are removed from sweep data to compensate for this. For the fix bias snapshots at 18.75 kHz sampling frequency, this mostly affects the first samples in a record, but can in longer records sometimes be seen also further into the record. In sweeps from e.g. macro 0x807, MIP interference can be detected as spikes where one or two samples deviate from their neighbors. Some MIP interference may occur also outside of LDL operations, as might of course interference from other sources. LDL mode (on/off) is determined by the macro running and is therefore the same during every run of any particular macro. Therefore the LDL mode can be detected through the macro number and the macro table in the DOCUMENT directory. The column MIPLAP (not LDLMODE) in HK (Table 9) can also be used to detect the LDL mode. Each step in a calibrated sweep only contains one average of multiple measured currents made on that sweep step (identical bias voltage). Outlier within a sweep step are removed before the average is made, and only if all measurements on a sweep step are outliers will the average for that step be removed.

- The **transfer functions are not used for calibration** (apart from adjusting timestamps for delay), but are provided for reference, see Section 2.5.
- **The time series of coefficients used to derive bias-dependent current offsets** has been derived from the LAP team's manual analysis of in-flight calibration measurements, instrument temperatures etc. These tables may therefore be updated in future versions of data sets as the team's understanding of the behavior of these offsets improves. See Section 2.5.6.1.

3.2.2 Fix-bias measurements

- For probe-to-spacecraft potential (Vps) time series: this is a commonly used proxy for the plasma density in tenuous plasmas. However, because the perturbations from the solar panels, the wake formed behind the s/c and solar panels in the solar wind, and the photoelectron cloud around the spacecraft are all sensitive to the probe location, **Vps can be used as a density proxy only during intervals of constant pointing**. See the paper by Edberg et al (RD6) for an example of how Vps may be used as a plasma density proxy. Perturbations from wake and photoemission have been studied by Sjogren (report available at http://www.space.irfu.se/exjobb/2009_alex_sjogren/).

3.2.3 Sweep measurements

- **Probe bias sweeps are sensitive to the spacecraft pointing** for the same reasons that fix-bias time measurements are. However, for all sweeps obtained prior to the comet phase, except some acquired in Earth's plasmasphere, the ion contribution to the data is so low that the photoemission saturation current can be obtained at all angles for which the probe is sunlit. Note however that the probe may be partially shadowed by its supporting rod (the stub), and that surface inhomogeneities may cause the photoemission to vary also with the pointing.
- For all sweeps obtained before coming close to the nucleus in September 2014, and for some parts also later on, the dominating contributions to the probe current are probe photoemission (at negative bias voltage) and collection of photoelectrons emitted by the spacecraft and solar panels (at positive bias voltage). Hence, probe sweep data can be interpreted in terms of local plasma parameters only in the Earth's plasmasphere. The main reasons for occasionally running such sweeps in other environments, e.g. the solar wind and the Earth's magnetosphere, are to gather data for investigation of spacecraft-plasma-probe interactions and to monitor probe photoemission.

3.3 Geometry Data Products

The geometry data are all produced by using the SPICE toolkit with kernels for Rosetta provided and updated by ESA. These data include the most important parameters for understanding the LAP measurements and are provided once every 32 seconds (once per AQP). The position is provided in target-centered solar orbital coordinates (TSO), and target-centered solar equatorial coordinates (TSEQ). At 67P, Mars and Earth, TSO is identical to cometocentric solar orbital (CSO), Mars-centric orbital (MSO) and geocentric solar ecliptic (GSE) coordinates, respectively. Similarly, at 67P, TSEQ is identical to cometocentric solar equatorial coordinates (CSEQ).

In TSO:

- X_TSO points towards the sun.
- Z_TSO is along the normal of the target (67P, Mars, Earth) orbit around the sun (the angular momentum vector).
- Y_TSO completes the right hand triad (X,Y,Z).

In TSEQ:

- X_TSEQ points towards the sun (identical to X_TSEQ).
- Z_TSEQ is the Sun’s axis of rotation, projected onto the plane perpendicular to X_TSEQ.
- Y_TSEQ completes the right hand triad (X,Y,Z).

The latitude and longitude are given in target-centered geographic coordinates, rotating with the target. For Rosetta at 67P, this is the Cheops system.

The solar zenith angle (SZA), commonly also known as the s/c phase angle, is the angle sun-target-Rosetta (0 deg. at the subsolar point, 90 deg. at the terminator).

The solar aspect and elevation angles are provided for describing the positions of the LAP probes w.r.t. the solar direction, and thereby regulates their illumination which is important to know since this controls the probes’ emission of photoelectrons. To intuitively and visually understand these angles, consider the spacecraft coordinate system in Figure 1. The solar panels are nominally held perpendicular to the direction of the sun, meaning it stays in the s/c XZ plane. The illumination of the probes thus depends on one angle alone, which is taken to be the angle from the s/c

Z axis to the solar direction, counted as increasing from zero when the sun moves from +Z towards +X in the s/c frame. This defines the solar aspect angle (SAA). It is complemented by the solar elevation angle (SEA), which nominally is zero but attains positive (negative) values if the sun moves out of the s/c XZ plane toward the s/c +Y (-Y) axis. For the nominal case of SEA = 0, the probe illumination is given by SAA as:

-179 deg. < SAA < 18 deg.	Both probes sunlit
18 deg. < SAA < 82 deg.	P1 sunlit; P2 in shadow behind s/c body
82 deg. < SAA < 107 deg.	P1 sunlit; P2 possibly in shadow behind the high-gain antenna (HGA) depending on how the HGA is turned.
107 deg. < SAA < 131 deg.	Both probes sunlit
131 deg. < SAA < 181 deg.	P1 in shadow behind solar array; P2 sunlit

The target aspect and elevation angles (TAA and TEA) are similar except for referring to the target body instead of the sun. They are useful mainly at the comet in the case of TEA = 0 (i.e. the nucleus in the s/c XZ plane), as similar TAA intervals as for SAA above will indicate if the probes are exposed to or in the wake of a nominal radial outward plasma flow from the nucleus (corresponding to the sunlit and shadowed cases for SAA). This is information is very much more approximate than the rather exact solar illumination and should be used only as a rough indication, because of the often non-radial plasma flow as well as by the fact that there is no guarantee the solar array normal will be along the flow direction -- in fact, it is mostly perpendicular to that direction.

Column	Name	Description
1	TIME_UTC	UTC time
2	OBT_TIME	OBT time
3	X_TSO	Target-centric solar orbital coordinates (TSO) [km]
4	Y_TSO	
5	Z_TSO	
6	X_TSEQ	Target-centric solar equatorial coordinates (TSEQ) [km]
7	Y_TSEQ	
8	Z_TSEQ	
9	LATITUDE	Spacecraft latitude in target coordinates [deg.]
10	LONGITUDE	Spacecraft longitude in target coordinates [deg.]
11	SZA	Solar zenith angle (SZA) [deg.], a.k.a. phase angle the angle between the spacecraft and the Sun as seen from the target
12	SAA	Solar aspect angle (SAA) [deg.], longitude of the Sun in the spacecraft coordinate system, counted positive from +Z toward +X
13	TAA	Target aspect angle (TAA) [deg.], longitude of the target in the spacecraft coordinate system, counted positive from +Z toward +X
14	SEA	Solar elevation angle (SEA) [deg.], latitude of the Sun in the spacecraft coordinate system, counted positive above the XZ plane toward +Y
15	TEA	Target elevation angle (TEA) [deg.], latitude of the target in the spacecraft coordinate system, counted positive above the XZ plane toward +Y

Table 8. LAP geometry file content.

3.4 Housekeeping Data Products

The HK parameters, only present in the EDITED archive, should not be of interest to normal science users since they do not provide any information not already present in the description of the macro. They are listed and described above for completeness. They are used for monitoring instrument operation and have no scientific interest on their own.

Column	Name	Description and values
1	UTC_TIME	Generation time of HK packet (UT).
2	OBT_TIME	Generation time of HK packet (s/c clock counter)

Column	***Name***	***Description and values***
3	PMAC	Currently programming macro (nonzero only during upload of instrument macros)
4	EMAC	Currently executing macro (indicates number within bank of last started macro)
5	WATCHD	Watchdog status (usually ENABLED, DISABLED only when uploading new macros)
6	PROMEN	PROM and flash memory status (usually DISABLED, ENABLED only at boot time and when uploading new macros)
7	OSC	Using oscillator (using oscillator 0 or 1)
8	LDLMODE	LDL mode and phase (this refers to an old LDL implementation not used in main mission, therefore always NONE)
9	TEMP	Temperature sensor status (usually DISABLED, ENABLED only when booting up)
10	CDRIV2	Range P2 bias (+-32 or +-1.3 V; usually +-32)
11	CDRIV1	Range P1 bias (+-32 or +-1.3 V; usually +-32)
12	E2D216	ADC 16 P2 mode (E-FIELD or DENSITY)
13	E1D116	ADC 16 P1 mode (E-FIELD or DENSITY)
14	E2D120	ADC 20 P2 mode (E-FIELD or DENSITY)
15	E1D120	ADC 20 P1 mode (E-FIELD or DENSITY)
16	CNTRE2	P2 feedback (E-FIELD or DENSITY)
17	CNTRE1	P1 feedback (E-FIELD or DENSITY)
18	MIPLAP	Instrument using probe 2 (LAP or MIP)
19	BTSTRP	Internal bootstrap status (usually ENABLED, rarely DISABLED)
20	F2122	P2 connected to: RX=analog input (usual), TX=transmitter (very rare)
21	F22ED	P2 bias mode (DENSITY or E-FIELD)
22	F22EDDEDC	P2 density range or E-field strategy (for DENSITY, G1.0 or G.05 gives high or the rarely used low gain; for E-FIELD, BIAS or FLOAT specifies if a bias current is applied or the probe is floating)
23	F1121	P1 connected to: RX=analog input (usual), TX=transmitter (very rare)
24	F11ED	P1 bias mode (DENSITY or E-FIELD)
25	F11EDDEDC	P1 density range or E-field strategy (for DENSITY, G1.0 or G.05 gives high or the rarely used low gain; for E-FIELD, BIAS or FLOAT specifies if a bias current is applied or the probe is floating)
26	CALIBRATIONA	Flash checksum at reboot, then most significant byte of macro identifier.
27	CALIBRATIONB	Flash checksum at reboot, then least significant byte of macro identifier.
28	TMP12	Uncalibrated temperature, valid if TEMP is ENABLED and P2 in E-FIELD.
29	SWVERSION	Software version (15 in main mission).

Column	Name	Description and values
Table 9. LAP HK parameters.		

3.5 Instrument Calibration Data Products

Ground calibration data as well as in-flight calibrations are used and included in the archive. The following calibration products are included in the CALIB directory of the LAP archives:

In flight	*Product ID*
Coefficients used to derive current offsets as a function of probe, bias voltage, and time (density mode).	**RPCLAP***YYMMDD***_CALIB_COEFF**

On ground (pre-flight)	*Product ID*
Current biases and measured laboratory values.	**RPCLAP***YYMMDD***_CALIB_IBIAS**
Voltage biases and measured laboratory values.	**RPCLAP***YYMMDD***_CALIB_VBIAS**
Fine bias voltage settings and measured laboratory values.	**RPCLAP***YYMMDD***_CALIB_FINE**
Transfer function probe 1, Density mode	**RPCLAP***YYMMDD***_CALIB_FRQ_D_P1**
Transfer function probe 2, Density mode	**RPCLAP***YYMMDD***_CALIB_FRQ_D_P2**
Transfer function probe 1, E-field mode	**RPCLAP***YYMMDD***_CALIB_FRQ_E_P1**
Transfer function probe 2, E-field mode	**RPCLAP***YYMMDD***_CALIB_FRQ_E_P2**
Voltage bias-dependent current offsets in TM units, both probes. Effectively single ground measurement of what **RPCLAP***YYMMDD***_CALIB_COEFF** represents in flight.	**RPCLAP***030101***_CALIB_MEAS**

As mentioned in Section 2.5, the transfer functions are currently not used in the production of calibrated or edited data sets, but are provided for reference. All other products are used in producing the calibrated data sets. *YYMMDD* is the date on which the corresponding calibration was made.

3.6 Software

There is no software included with the archive.

3.7 Documentation

Relevant documentation is archived in the DOCUMENT directory of each data set (see detailed description in Section 4.4.3.5).

3.8 Derived and other Data Products

There is as yet no DERIVED level data included in the archive.

3.9 Ancillary Data Usage

All geometry files, as well as all conversions between spacecraft clock and UTC throughout the data sets, have been made using SPICE and SPICE kernels provided by the ESA SPICE Service.

4 Archive Format and Content

This section should be of interest as a reference to any user directly accessing the LAP archive.

4.1 Format and Conventions

4.1.1 Deliveries and Archive Volume Format

The LAP team use conventions defined as in the RO-EST-PL-5011_2_Rosetta_Archive_GVT_Plan, and conventions defined by the RPC team. For instance, the data directory naming conventions as in section 4.1.3 are RPC consistent. One Data Set corresponds to one Volume.

4.1.2 Data Set ID Formation

Example:

RO-C-RPCLAP-3-ESC2-Description-V1.0

RO	= INSTRUMENT_HOST_ID
C	= TARGET_ID
RPCLAP	= INSTRUMENT_ID
3	= Data processing level (DPL) number
ESC2	= Mission phase abbreviation

Description can be EDITED, CALIB, CALIB2, or DERIVED thus essentially displaying in words the same information as the processing level.

One data set will be produced for each processing level:

Edited data = 2, Calibrated data = 3.

Within each data set TARGET_NAME and TARGET_TYPE is used to identify the current target.

4.1.3 Data Directory Naming Convention

Data files are stored in one directory per day, organized as shown in Figure **3**.

```
DATA_SET_ROOT
|
_________________________...
|       |           |
DATA    DOCUMENT    ...
|
_________________________
|         |             |
EDITED    CALIBRATED    DERIVED
|
___________________________...
|       |       |       |
2004    2005    2006    ....
|
__________________________...
|     |     |     |     |
JAN   FEB   MAR   APR   ...
|
__________________________...
|     |     |     |     |
D01   D02   D03   D04   ...
```

Figure 3. Data directory structure.

4.1.4 Filenaming and Product ID Convention

This is the LAP product ID and filenaming convention for files in the DATA directory. Filenames are identical to the corresponding product ID plus the relevant filename suffix. We thus only explicitly state the filenaming conventions here.

For science data files, the filename contains some information on the type of data which should make it possible to often avoid having to parse the corresponding PDS label file to distinguish between different types of data.

(Edited) science data	**RPCLAP***YYMMDD*_*AAAa*_*bcdefghxx*.*ext*
(Calibrated) science data or sweep descriptions	**LAP_***YYMMDD*_*hhmmss*_*iii*_*jek*.*ext*
(Calibrated) block list	**LAP_***YYMMDD***_000000_BLKLIST.***ext*
(Edited) housekeeping	**RPCLAP***YYMMDD*_*AAA***_H.***ext*
Geometry	**RPCLAP***YYMMDD*_*L***_GEOM.***ext*

In the above product IDs, black, boldface characters are static, and red italicized characters are variables which are described in Table 10.

Code	Meaning	Values
YYMMDD	Date	
hhmmss	Time of day	
AAA	Alphanumeric counter resetting to zero at the beginning of every day. Might sometimes skip values (increment more than one step) for technical reasons.	Three-digit alphanumeric counter running through the numbers 0 to 9 and then the letters A to Z, i.e. from 000 to ZZZ.
a	Indicates which ADC the data comes from	S = 16-bit ADC T = 20-bit ADC
b	Archiving level	R = Edited Raw (for historical reasons)
c	Instrument mode	E = E-Field (voltage measurements and current bias) D = Density (current measurements and voltage bias)
d	Bias mode	B = Fix-bias S = Sweeping
e	Sensor (probe)	1 = Probe 1 2 = Probe 2 3 = Derived from both probe 1 and 2.
f	Analog filters applied to the data sampled by the 16-bit ADCs. Note that this number (4 or 8) will be present also in the filename of data sampled with the 20-bit ADCs, which always use the analog filter cutting at 20 Hz. For more information on filters, see Section 2.2.	8 = 8 kHz 4 = 4 kHz
g	Telemetry rate	M = Minimum N = Normal B = Burst
h	For science data this character is always an “S”.	S
iii	Macro number.	Three hexadecimal digits.
j	Type of data.	I = Measured current V = Measured voltage B = Sweep description
k	Type of measurement.	L = Low frequency (fix bias; ADC20)

		H = High frequency (fix bias; ADC16) S = Sweep (always ADC16)
x	For contingency. Not present if not needed.	
L	Archiving level	2 = EDITED 3 = CALIBRATED
H	Non-changing identifier "H" to indicate housekeeping files. EDITED only	H
.ext	File extension	.LBL = PDS label file .TAB = Text file with data
Table 10. The meaning of the variables (red, italicized) in the descriptions of filenames and product IDs.		

4.2 Standards Used in Data Product Generation

4.2.1 PDS Standards

LAP data sets comply with PDS version 3, and should follow version 3.6 of the PDS standard reference.

4.2.2 Time Standards

Time references in the LAP PDS archive are UTC and spacecraft clock. UTC time is displayed in the PDS CCYY-MM-DDThh:mm:ss.sss format. Conversion from spacecraft clock to UTC is done using SPICE and SPICE kernels provided by the ESA SPICE Service.

4.2.3 Reference Systems

The geometry files provide spacecraft positions in the target-centered solar orbital coordinate system. For Rosetta at comet 67P, the data sets use the Cheops system. The spacecraft pointing is described using angles which are defined using the Sun, the target, and the s/c coordinate axes, which are briefly described in Figure 1.

4.3 *Data Validation*

All data is checked with PSA's DVAL-NG or DatasetValidator before delivery.

4.3.1 EDITED

Data are automatically scanned for internal consistency when processed into edited format.

4.3.2 CALIBRATED

Data are visually scanned for noting obvious problems. Comparative investigations may be undertaken. Particularly noteworthy features are documented in the DATASET.CAT file in the CATALOG directory of each archive.

4.3.3 DERIVED

There are currently no derived-level data in the LAP archive.

4.4 **Content**

4.4.1 Volume Set

According to Section 19.4 in AD1.

4.4.2 Data Set

The data set naming convention follows principles similar to those for the DATA_SET_ID, Section 4.1.2.

DATA_SET_NAME="ROSETTA-ORBITER <TARGET> RPCLAP <LEVELNUM> <MPHASE> <LEVELWORD> V<X>"

The variable fields here are:

<TARGET>	= Target name, i.e. LUTETIA.
<LEVELNUM>	= Data processing level numbers (e.g. 2 for EDITED).
<MPHASE>	= Mission phase abbreviation, example AST1.
<LEVELWORD>	= Data processing level in text (e.g. CALIB for calibrated or EDITED for edited data).
<X>	= Archive version number, e.g. 2.0.

One data set will be used for each processing level and mission phase. The data set name fits in the full length thus 60 characters.

4.4.3 Directories

4.4.3.1 Root Directory

Contents:

AAREADME.TXT
CALIB
CATALOG
DATA
DOCUMENT
INDEX
VOLDESC.CAT

See section 5.1 for more detail.

4.4.3.2 Calibration Directory

The directory CALIB contains calibration files, described in Section 3.5.

Example listing of CALIB directory:

Filename	**Comment**
CALINFO.TXT	Information on directory contents
RPCLAP030101_CALIB_FINE.LBL RPCLAP030101_CALIB_FINE.TAB	Ground calibration of fine sweep voltage bias.
RPCLAP030101_CALIB_FRQ_D_P1.LBL RPCLAP030101_CALIB_FRQ_D_P1.TXT	Ground calibration, frequency response (transfer function) for P1 in voltage bias mode.
RPCLAP030101_CALIB_FRQ_D_P2.LBL RPCLAP030101_CALIB_FRQ_D_P2.TXT	Ground calibration, frequency response (transfer function) for P2 in voltage bias mode.
RPCLAP030101_CALIB_FRQ_E_P1.LBL RPCLAP030101_CALIB_FRQ_E_P1.TXT	Ground calibration, frequency response (transfer function) for P1 in current bias mode.
RPCLAP030101_CALIB_FRQ_E_P2.LBL RPCLAP030101_CALIB_FRQ_E_P2.TXT	Ground calibration, frequency response (transfer function) for P2 in current bias mode.
RPCLAP030101_CALIB_IBIAS.LBL RPCLAP030101_CALIB_IBIAS.TAB	Ground calibration of current bias.
RPCLAP030101_CALIB_MEAS.LBL RPCLAP030101_CALIB_MEAS.TAB	Ground calibration of voltage bias-dependent current offsets, both probes.
RPCLAP030101_CALIB_VBIAS.LBL RPCLAP030101_CALIB_VBIAS.TAB	Ground calibration of voltage bias.
RPCLAP*yymmdd*_CALIB_COEFF.LBL RPCLAP*yymmdd*_CALIB_COEFF.TAB	Coefficients representing voltage bias-dependent, temperature-dependent current offsets evolving over time.

4.4.3.3 Catalog Directory

Contents:

Filename	**Description**

CATINFO.TXT	This file contains a list of all catalog files located in the CATALOG directory, with brief descriptions (as this table).
DATASET.CAT	Description of the data in the present Data Set, including caveats and the time interval covered by the data set.
ROSETTA_INSTHOST.CAT	ROSETTA spacecraft information. File provided by ESA.
ROSETTA_MSN.CAT	ROSETTA Mission information. File provided by ESA.
RPCLAP_INST.CAT	LAP instrument description.
RPCLAP_PERS.CAT	LAP key people with contact details.
RPCLAP_REF.CAT	Catalog of relevant publications. File provided by ESA.
RPCLAP_SOFTWARE.CAT	Software catalog file (only containing the information that there is no s/w).

4.4.3.4 Index Directory

Contents:

INDXINFO.TXT
INDEX.LBL
INDEX.TAB

This directory contains the index files generated by the ESA S/W PVV.

4.4.3.5 Document Directory

This directory contains relevant LAP documentation as described below.

The FLIGHT REPORTS subdirectory contains LAP operations reports from the relevant mission phase (and may contain reports for other mission phases as well). These reports summarize the commanding, data taking, anomalies and outcomes of each operation. Note that one mission phase may include several operations, documented in separate reports (for example, EAR2 includes not only the operations around the 2nd Earth swing-by, but also a payload checkout activity).

LAP PDS Document Directory Contents	
Document	**Description**
DOCINFO.TXT	Describes directory contents

ERIKSSON2007A.LBL ERIKSSON2007A.PDF	Instrument description, label file and document as PDF: A. I. Eriksson, R. Boström, R. Gill, L. Åhlén, S.-E. Jansson, J.-E. Wahlund, M. André, A. Mälkki, J. A. Holtet, B. Lybekk, A. Pedersen, L. G. Blomberg and the LAP team, RPC-LAP: The Rosetta Langmuir probe instrument, *Space Sci. Rev.*, 128, 729-744, 2007, doi:10.1007/s11214-006-9003-3
ERIKSSON2008A.LBL ERIKSSON2008A.PDF	Instrument description, label file and document as PDF: A. I. Eriksson, R. Gill, J.-E. Wahlund, M. André, A. Mälkki, B. Lybekk, A. Pedersen, J. A. Holtet, L. G. Blomberg and N. J. T. Edberg, RPC-LAP: The Langmuir probe instrument of the Rosetta Plasma Consortium, in *Rosetta: ESA's mission to the origin of the solar system*, eds. R. Schulz, C. Alexander, H. Boehnhardt and K.-H. Glassmeier, pp. 435-447, Springer, 2009, ISBN: 978-0-387-77517-3.
RO-IRFU-LAP-EAICD-*ver*.LBL RO-IRFU-LAP-EAICD-*ver*.PDF	EAICD (this document) as PDF, with label file (ver = version number)
RO-IRFU-LAPMAC-*yymmdd*.LBL RO-IRFU-LAPMAC-*yymmdd*.PDF	Description of the LAP macros referred to by INSTRUMENT_MODE_ID, in PDF format, with label file. This replaces the outdated LAPMPF document present in previous releases. The date *yymmdd* is a version identifier.

4.4.3.6 Data Directory

See Section 4.1.3 for overall structure, Sections 4.1.4 and 3.1 for data products in the data directory and Section 5.3.2 for detailed examples of data product design.

5 Detailed Interface Specifications

5.1 Structure and Organization Overview

The contents of the directories in an EDITED or CALIBRATED Data Set are discussed in Section 4. The general organization of the archive can be seen from the following example for the data set of CALIBRATED data from the Lutetia flyby:

```
DATASET_ROOT
  |-CALIB
  |-CATALOG
  |-DATA
  |---CALIBRATED
  |-----2010
  |-------JUL
  |---------D07
  |---------D08
  |---------D09
  |---------D10
  |---------D11
  |---------D12
  |---------D13
  |-DOCUMENT
  |---FLIGHT_REPORTS
  |-INDEX
```

For the contents of these directories, please see Section 4.4.

5.2 Data Sets, Definition and Content

Please see Section 0.

5.3 Data Product Design

5.3.1 General Issues

5.3.1.1 File Characteristics Data Elements

Data are stored in ASCII files with the extension ".TAB". The associated label file, describing the data file in detail, has the same name but with the extension ".LBL" instead.

5.3.1.2 Data Object Pointers Identification Data Elements

The only pointer which is used is the pointer from the *.LBL file to the *.TAB file.

5.3.1.3 Instrument and Detector Descriptive Data Elements

Please see Sections 2.2 and 2.3.

5.3.1.4 Data Object Definition

All data are stored in *.TAB files. Their structure is defined in the OBJECT Table definition within the *.LBL files. Each data definition block has a DESCRIPTION which explains the meaning of the assigned data column exactly.

5.3.1.5 Mission-Specific Keywords

The LAP data sets use some LAP specific keywords in the label files, as illustrated by the following examples:

ROSETTA:LAP_TM_RATE = “BURST”
ROSETTA:LAP_P1_SWEEP_START_BIAS = "0x00c0"

The instrument-specific keywords used are tabulated in Table 11 below. Most of them regard instrument internal settings and are mostly present for completeness: see the instrument descriptions in the DOCUMENTS archive for understanding of their meaning. Note that Hex word means values from 0x0000 to 0xffff, though they are stored as character strings. **Note that all values in Table 11 are DATA_TYPE = CHARACTER and are enclosed in quotes in the label file.** The valid string values are separated by a colon (“:”) in Table 11, thus the colon is not part of the values themselves. Also note that the maximum character string length does not include counting quotes, null terminators, line feeds or carriage returns.

Rosetta LAP-specific label keywords	***Valid values separated by colon***	***Maximum character string length***	***Description***
LAP_BOOTSTRAP	ON:OFF	3	Bootstrapping on or off
LAP_CURRENT_CAL_16B_G0_05	*Ascii real string*	14	Convert TM to [A] ADC16’s gain 0.05

LAP_CURRENT_CAL_16B_G1	*Ascii real string*	14	Convert TM to [A] ADC16's gain 1
LAP_FEEDBACK_P1, LAP_FEEDBACK_P2	DENSITY:E-FIELD	7	E-Field or Density feedback relay probe 1 or 2
LAP_IBIAS1, LAP_IBIAS2	*Hex word string*	*6*	Fix current bias sensor 1 or 2
LAP_P1_ADC16, LAP_P2_ADC16	DENSITY:E-FIELD	7	ADC16 probe 1 or 2 E-Field or Density mode
LAP_P1_ADC16_DIG_FILT_CUTOFF, LAP_P2_ADC16_DIG_FILT_CUTOFF	4688 Hz:2344 Hz:1172 Hz:586 Hz	7	Digital filter used on probe 1 or 2
LAP_P1_ADC16_DIG_FILT_STATUS, LAP_P2_ADC16_DIG_FILT_STATUS	DISABLED:ENABLED	8	Digital filter on or off on probe 1 or 2
LAP_P1_ADC16_DOWNSAMPLE, LAP_P2_ADC16_DOWNSAMPLE	*Hex word string*	*6*	Data sensor 1 or 2 downsampled *n* times
LAP_P1_ADC16_FILTER, LAP_P2_ADC16_FILTER	4 KHz:8 KHz	5	Analog filter used
LAP_P1_ADC20, LAP_P2_ADC20	DENSITY:E-FIELD	7	ADC20 probe 1 or 2, E-Field or Density mode
LAP_P1_BIAS_MODE, LAP_P2_BIAS_MODE	E-FIELD:DENSITY	7	Probe 1 or 2 bias mode
LAP_P1_DENSITY_FIX_DURATION, LAP_P2_DENSITY_FIX_DURATION	*Hex word string*	*6*	Duration in samples of fix density bias data sensor 1 or 2
LAP_P1_EFIELD_FIX_DURATION, LAP_P2_EFIELD_FIX_DURATION	*Hex word string*	*6*	Duration in samples of fix E-field bias data sensor 1 or 2
LAP_P1_FINE_SWEEP_OFFSET, LAP_P2_FINE_SWEEP_OFFSET	*Hex word string*	*6*	Probe 1 or 2 fine sweep bias offset
LAP_P1_INITIAL_SWEEP_SMPLS, LAP_P2_INITIAL_SWEEP_SMPLS	*Hex word string*	*6*	Initial samples before a sweep starts on probe 1 and 2 respectively
LAP_P1_RANGE_DENS_BIAS,	+5:+32	3	Density bias range probe 1 or 2

LAP_P2_RANGE_DENS _BIAS			
LAP_P1_RX_OR_TX, LAP_P2_RX_OR_TX	ANALOG INPUT:TRANSMI TTER	12	Connected to transmitter or not
LAP_P1_STRATEGY_O R_RANGE, LAP_P2_STRATEGY_O R_RANGE	BIAS:FLOAT:GAI N 0.05:GAIN 1	9	E-Field strategy or density gain probe 1 or 2
LAP_P1_SWEEP_FOR MAT, LAP_P2_SWEEP_FOR MAT	UP:DOWN:DOW N UP:UP DOWN	7	Sweeping direction on probe 1 and 2 respectively
LAP_P1_SWEEP_PLAT EAU_DURATION, LAP_P2_SWEEP_PLAT EAU_DURATION	*Hex word string*	*6*	Samples on a plateau on probe 1 and 2 respectively
LAP_P1_SWEEP_RES OLUTION, LAP_P2_SWEEP_RES OLUTION	COARSE:FINE	6	Sweeping resolution on probe 1 and 2 respectively
LAP_P1_SWEEP_STAR T_BIAS, LAP_P2_SWEEP_STAR T_BIAS	*Hex word string*	*6*	Sweep start bias on probe 1 and 2 respectively
LAP_P1_SWEEP_STEP _HEIGHT, LAP_P2_SWEEP_STEP _HEIGHT	*Hex word string*	*6*	Height of a bias step on probe 1 and 2 respectively
LAP_P1_SWEEP_STEP S, LAP_P2_SWEEP_STEP S	*Hex word string*	*6*	Number of bias steps in sweep on probe 1 and 2 respectively
LAP_P1P2_ADC20_DO WNSAMPLE	*Hex word string*	*6*	Downsampling *n* times on ADC20 data sensor 1 and 2
LAP_P1P2_ADC20_MA _LENGTH	*Hex word string*	*6*	Length of moving average used. Note: Due to a bug in the flight s/w, the 4 least significant bits (of 20) are set to zero when moving average is used.
LAP_P1P2_ADC20_STA TUS	EMPTY:P2T:P1T: P1T & P2T:P2F:P1T	9	Status: P1 = Sensor 1 P2 = Sensor 2

	P2F:P1F:P1F P2T:P1F & P2F		T = Truncated to 16 bit F = Full 20 bit
LAP_SWEEPING_P1, LAP_SWEEPING_P2	NO:YES	3	A sweep or time series
LAP_TM_RATE	NONE:MINIMUM: NORMAL:BURST	7	Telemetry rate
LAP_TRANSMITTER_AMPLITUDE	LTRO1:MTRO2:HTRO3:LTR1:MTR2:HTR3	5	Amplitude of transmitter signal full description. Not used up to now.
LAP_TRANSMITTER_FREQUENCY	*Hex word string*	*6*	Frequency of transmitter square wave in Hz. Not used up to now.
LAP_TRANSMITTER_STATUS	DISABLED:ENABLED	8	Transmitter on or off
LAP_VBIAS1, LAP_VBIAS2	*Hex word string*	*6*	Fix voltage bias sensor 1 or 2
LAP_VOLTAGE_CAL_16B	*Ascii real string*	14	Convert TM to [V] ADC16s

Table 11. LAP instrument-specific keywords. The table is sorted in alphabetical order of the first keyword in every cell of the left-most column.

The LAP team has also defined a set of instrument modes using the already existing keyword INSTRUMENT_MODE_ID and INSTRUMENT_MODE_DESC. Instrument modes are identified by the onboard macro producing the data (Section 2.3). The macro ID (MCID) is a hexadecimal number 0x0100 to 0x0A07 where the last digit cannot be higher than 7. The middle digit represents the version number of the macro, starting from 0.

5.3.2 Data Product Design

LAP data products are described in Section 3. The filenaming convention, identifying the data product, is given in Section 4.1.4.

All science data products in the EDITED data sets have the same structure: ASCII tables giving time in UTC, spacecraft clock time, probe current value (bias or measured), and probe voltage (measured or bias) for one of the probes. The one exception to this is the difference measurements sometimes taken between the probes: in these files, the bias of both probes are given, adding an extra column.

The detailed design of the science data products is provided here by displaying example label files for each of them. The fix bias products for the EDITED and CALIBRATED data sets are very similar: only the units, the lengths of the time series, and the filenaming conventions differ.

5.3.2.1 Edited Data Product Design

5.3.2.1.1 Edited Housekeeping Data Product Design

```
PDS_VERSION_ID = PDS3
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 208
FILE_RECORDS = 16
FILE_NAME = "RPCLAP100707_01J_H.LBL"
^TABLE = "RPCLAP100707_01J_H.TAB"
DATA_SET_ID = "RO-A-RPCLAP-2-AST2-EDITED-V1.1"
DATA_SET_NAME = "ROSETTA-ORBITER LUTETIA RPCLAP 2 AST2 EDITED V1.1"
DATA_QUALITY_ID = "1"
MISSION_ID = ROSETTA
MISSION_NAME = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME = "LUTETIA FLY-BY"
PRODUCER_INSTITUTION_NAME = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
PRODUCER_ID = EJ
PRODUCER_FULL_NAME = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE = "2015-02-25T19:31:28, V1.1: Erik P G
Johansson (IRFU); Seven renamed sweep keywords."
PRODUCT_ID = RPCLAP100707_01J_H
PRODUCT_TYPE = "EDR"
PRODUCT_CREATION_TIME = 2015-02-25T19:31:28
INSTRUMENT_HOST_ID = RO
INSTRUMENT_HOST_NAME = "ROSETTA-ORBITER"
INSTRUMENT_NAME = "ROSETTA PLASMA CONSORTIUM - LANGMUIR PROBE"
INSTRUMENT_ID = RPCLAP
INSTRUMENT_TYPE = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID = MCID0X0503
INSTRUMENT_MODE_DESC = "N/A"
TARGET_NAME = "21 LUTETIA"
TARGET_TYPE = "ASTEROID"
PROCESSING_LEVEL_ID = "N"
START_TIME = 2010-07-07T23:51:23.596
STOP_TIME = 2010-07-07T23:59:23.596
SPACECRAFT_CLOCK_START_COUNT = "1/0237167442.42944"
SPACECRAFT_CLOCK_STOP_COUNT = "1/0237167922.42944"
DESCRIPTION = "LAP HK Data, Each line is a separate HK packet sent
every 32s"
OBJECT = TABLE
INTERCHANGE_FORMAT = ASCII
ROWS = 16
COLUMNS = 29
ROW_BYTES = 208
DESCRIPTION = "LAP HK Data table."
OBJECT = COLUMN
NAME = UTC_TIME
DATA_TYPE = TIME
START_BYTE = 1
```

```
BYTES = 26
DESCRIPTION = "UTC TIME"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = OBT_TIME
START_BYTE = 28
BYTES = 16
DATA_TYPE = ASCII_REAL
UNIT = SECONDS
FORMAT = "F16.6"
DESCRIPTION = "SPACE CRAFT ONBOARD TIME SSSSSSSSS.FFFFFF (TRUE
DECIMALPOINT)"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = PMAC
DATA_TYPE = ASCII_INTEGER
START_BYTE = 45
BYTES = 1
DESCRIPTION = "CURRENTLY PROGRAMMING MACRO"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = EMAC
DATA_TYPE = ASCII_INTEGER
START_BYTE = 47
BYTES = 1
DESCRIPTION = "CURRENTLY EXECUTING MACRO"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = WATCHD
DATA_TYPE = CHARACTER
START_BYTE = 49
BYTES = 8
DESCRIPTION = "WATCHDOG STATUS"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = PROMEN
DATA_TYPE = CHARACTER
START_BYTE = 58
BYTES = 8
DESCRIPTION = "PROM AND FLASH MEMORY STATUS"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = OSC
DATA_TYPE = ASCII_INTEGER
START_BYTE = 67
BYTES = 1
DESCRIPTION = "USING OSCILLATOR 0 or 1"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = LDLMODE
DATA_TYPE = CHARACTER
START_BYTE = 69
BYTES = 7
DESCRIPTION = "LDL MODE AND PHASE"
END_OBJECT = COLUMN
```

```
OBJECT = COLUMN
NAME = TEMP
DATA_TYPE = CHARACTER
START_BYTE = 77
BYTES = 8
DESCRIPTION = "TEMPERATURE SENS STATUS, VALID TEMPERATURE IF IN E-
FIELD MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CDRIV2
DATA_TYPE = CHARACTER
START_BYTE = 86
BYTES = 4
DESCRIPTION = "RANGE PROBE 2 BIAS "
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CDRIV1
DATA_TYPE = CHARACTER
START_BYTE = 91
BYTES = 4
DESCRIPTION = "RANGE PROBE 1 BIAS "
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = E2D216
DATA_TYPE = CHARACTER
START_BYTE = 96
BYTES = 7
DESCRIPTION = "ADC 16 PROBE 2 MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = E1D116
DATA_TYPE = CHARACTER
START_BYTE = 104
BYTES = 7
DESCRIPTION = "ADC 16 PROBE 1 MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = E2D120
DATA_TYPE = CHARACTER
START_BYTE = 112
BYTES = 7
DESCRIPTION = "ADC 20 PROBE 2 MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = E1D120
DATA_TYPE = CHARACTER
START_BYTE = 120
BYTES = 7
DESCRIPTION = "ADC 20 PROBE 1 MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CNTRE2
DATA_TYPE = CHARACTER
START_BYTE = 128
BYTES = 7
```

```
DESCRIPTION = "P2 FEEDBACK"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CNTRE1
DATA_TYPE = CHARACTER
START_BYTE = 136
BYTES = 7
DESCRIPTION = "P1 FEEDBACK"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = MIPLAP
DATA_TYPE = CHARACTER
START_BYTE = 144
BYTES = 3
DESCRIPTION = "INSTRUMENT USING PROBE 2"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = BTSTRP
DATA_TYPE = CHARACTER
START_BYTE = 148
BYTES = 8
DESCRIPTION = "INTERNAL BOOTSTRAP STATUS"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F2122
DATA_TYPE = CHARACTER
START_BYTE = 157
BYTES = 2
DESCRIPTION = "P2 CONNECTED TO, RX=ANALOG INPUT TX=TRANSMITTER"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F22ED
DATA_TYPE = CHARACTER
START_BYTE = 160
BYTES = 7
DESCRIPTION = "P2 BIAS MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F22EDDEDC
DATA_TYPE = CHARACTER
START_BYTE = 168
BYTES = 5
DESCRIPTION = "P2 DENSITY RANGE OR E-FIELD STRATEGY"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F1121
DATA_TYPE = CHARACTER
START_BYTE = 174
BYTES = 2
DESCRIPTION = "P1 CONNECTED TO, RX=ANALOG INPUT TX=TRANSMITTER"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F11ED
DATA_TYPE = CHARACTER
START_BYTE = 177
```

```
BYTES = 7
DESCRIPTION = "P1 BIAS MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = F11EDDEDC
DATA_TYPE = CHARACTER
START_BYTE = 185
BYTES = 5
DESCRIPTION = "P1 DENSITY RANGE OR E-FIELD STRATEGY"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CALIBRATIONA
DATA_TYPE = ASCII_INTEGER
START_BYTE = 191
BYTES = 3
DESCRIPTION = "FLASH CHECKSUM AT START, THEN FREE FOR OTHER USES"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = CALIBRATIONB
DATA_TYPE = ASCII_INTEGER
START_BYTE = 195
BYTES = 3
DESCRIPTION = "FLASH CHECKSUM AT START, THEN FREE FOR OTHER USES"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = TMP12
DATA_TYPE = ASCII_INTEGER
START_BYTE = 199
BYTES = 4
DESCRIPTION = "UNCALIBRATED TEMP, VALID IF TEMP IS ENABLED AND E-
FIELD MODE"
END_OBJECT = COLUMN
OBJECT = COLUMN
NAME = SWVERSION
DATA_TYPE = ASCII_INTEGER
START_BYTE = 205
BYTES = 2
DESCRIPTION = "SOFTWARE VERSION"
END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.1.2 Edited Time Series Data Product Design

```
PDS_VERSION_ID = PDS3
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 59
FILE_RECORDS = 28
FILE_NAME = "RPCLAP100707_0B6T_REB18NS.LBL"
^TABLE = "RPCLAP100707_0B6T_REB18NS.TAB"
DATA_SET_ID = "RO-A-RPCLAP-2-AST2-EDITED-V1.1"
DATA_SET_NAME = "ROSETTA-ORBITER LUTETIA RPCLAP 2 AST2 EDITED V1.1"
DATA_QUALITY_ID = "1"
```

```
MISSION_ID = ROSETTA
MISSION_NAME = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME = "LUTETIA FLY-BY"
PRODUCER_INSTITUTION_NAME = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
PRODUCER_ID = EJ
PRODUCER_FULL_NAME = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE = "2015-02-25T19:31:32, V1.1: Erik P G
Johansson (IRFU); Seven renamed sweep keywords."
PRODUCT_ID = "RPCLAP100707_0B6T_REB18NS"
PRODUCT_TYPE = "EDR"
PRODUCT_CREATION_TIME = 2015-02-25T19:31:32
INSTRUMENT_HOST_ID = RO
INSTRUMENT_HOST_NAME = "ROSETTA-ORBITER"
INSTRUMENT_NAME = "ROSETTA PLASMA CONSORTIUM - LANGMUIR PROBE"
INSTRUMENT_ID = RPCLAP
INSTRUMENT_TYPE = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID = MCID0X0503
INSTRUMENT_MODE_DESC = "EE Cont. 20 bit down 64, Every 160s 16 Bit
P1"
TARGET_NAME = "21 LUTETIA"
TARGET_TYPE = "ASTEROID"
PROCESSING_LEVEL_ID = "2"
START_TIME = 2010-07-07T23:59:23.596
STOP_TIME = 2010-07-07T23:59:52.396
SPACECRAFT_CLOCK_START_COUNT = "1/0237167922.42944"
SPACECRAFT_CLOCK_STOP_COUNT = "1/0237167951.29837"
DESCRIPTION = "E_P1P2INTRL_TRNC_20BIT_RAW_BIP"
ROSETTA:LAP_TM_RATE = "NORMAL"
ROSETTA:LAP_BOOTSTRAP = "ON"
ROSETTA:LAP_FEEDBACK_P2 = "E-FIELD"
ROSETTA:LAP_P2_ADC20 = "E-FIELD"
ROSETTA:LAP_P2_ADC16 = "E-FIELD"
ROSETTA:LAP_P2_RANGE_DENS_BIAS = "+-32"
ROSETTA:LAP_P2_STRATEGY_OR_RANGE = "BIAS"
ROSETTA:LAP_P2_RX_OR_TX = "ANALOG INPUT"
ROSETTA:LAP_P2_ADC16_FILTER = "8 KHz"
ROSETTA:LAP_IBIAS2 = "0x0077"
ROSETTA:LAP_P2_BIAS_MODE = "E-FIELD"
ROSETTA:LAP_FEEDBACK_P1 = "E-FIELD"
ROSETTA:LAP_P1_ADC20 = "E-FIELD"
ROSETTA:LAP_P1_ADC16 = "E-FIELD"
ROSETTA:LAP_P1_RANGE_DENS_BIAS = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE = "BIAS"
ROSETTA:LAP_P1_RX_OR_TX = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER = "8 KHz"
ROSETTA:LAP_IBIAS1 = "0x00d6"
ROSETTA:LAP_P1_BIAS_MODE = "E-FIELD"
ROSETTA:LAP_P1P2_ADC20_STATUS = "P1T & P2T"
ROSETTA:LAP_P1P2_ADC20_MA_LENGTH = "0x0040"
ROSETTA:LAP_P1P2_ADC20_DOWNSAMPLE = "0x0040"
OBJECT     = TABLE
INTERCHANGE_FORMAT = ASCII
ROWS               = 28
COLUMNS            = 4
```

```
ROW_BYTES           = 59
DESCRIPTION         = "E_P1P2INTRL_TRNC_20BIT_RAW_BIP"
OBJECT     = COLUMN
NAME        = UTC_TIME
DATA_TYPE   = TIME
START_BYTE  = 1
BYTES       = 26
DESCRIPTION = "UTC TIME"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = OBT_TIME
START_BYTE  = 28
BYTES       = 16
DATA_TYPE   = ASCII_REAL
UNIT        = SECONDS
FORMAT      = "F16.6"
DESCRIPTION = "SPACE CRAFT ONBOARD TIME SSSSSSSSS.FFFFFF (TRUE
DECIMALPOINT)"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1_CURRENT
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 45
BYTES       = 6
DESCRIPTION = "CURRENT BIAS"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1_VOLTAGE
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 52
BYTES       = 6
DESCRIPTION = "MEASURED VOLTAGE"
END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.1.3 Edited Sweep Data Product Design

```
PDS_VERSION_ID = PDS3
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 59
FILE_RECORDS = 200
FILE_NAME = "RPCLAP100707_05HS_RDS18NS.LBL"
^TABLE = "RPCLAP100707_05HS_RDS18NS.TAB"
DATA_SET_ID = "RO-A-RPCLAP-2-AST2-EDITED-V1.1"
DATA_SET_NAME = "ROSETTA-ORBITER LUTETIA RPCLAP 2 AST2 EDITED V1.1"
DATA_QUALITY_ID = "1"
MISSION_ID = ROSETTA
MISSION_NAME = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME = "LUTETIA FLY-BY"
PRODUCER_INSTITUTION_NAME = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
```

```
PRODUCER_ID = EJ
PRODUCER_FULL_NAME = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE = "2015-02-25T19:31:29, V1.1: Erik P G
Johansson (IRFU); Seven renamed sweep keywords."
PRODUCT_ID = "RPCLAP100707_05HS_RDS18NS"
PRODUCT_TYPE = "EDR"
PRODUCT_CREATION_TIME = 2015-02-25T19:31:29
INSTRUMENT_HOST_ID = RO
INSTRUMENT_HOST_NAME = "ROSETTA-ORBITER"
INSTRUMENT_NAME = "ROSETTA PLASMA CONSORTIUM - LANGMUIR PROBE"
INSTRUMENT_ID = RPCLAP
INSTRUMENT_TYPE = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID = MCID0X0600
INSTRUMENT_MODE_DESC = "As MCID0x212 but with 20 V bias and 8KHz
filters"
TARGET_NAME = "21 LUTETIA"
TARGET_TYPE = "ASTEROID"
PROCESSING_LEVEL_ID = "2"
START_TIME = 2010-07-07T20:20:43.595
STOP_TIME = 2010-07-07T20:20:44.981
SPACECRAFT_CLOCK_START_COUNT = "1/0237154802.42944"
SPACECRAFT_CLOCK_STOP_COUNT = "1/0237154804.2684"
DESCRIPTION = "D_SWEEP_P1_RAW_16BIT_BIP"
ROSETTA:LAP_P1_INITIAL_SWEEP_SMPLS = "0x0005"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE = "0x0080"
ROSETTA:LAP_TM_RATE = "NORMAL"
ROSETTA:LAP_BOOTSTRAP = "ON"
ROSETTA:LAP_FEEDBACK_P1 = "DENSITY"
ROSETTA:LAP_P1_ADC20 = "DENSITY"
ROSETTA:LAP_P1_ADC16 = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER = "8 KHz"
ROSETTA:LAP_SWEEPING_P1 = "YES"
ROSETTA:LAP_P1_FINE_SWEEP_OFFSET = "0x0000"
ROSETTA:LAP_P1_SWEEP_FORMAT = "DOWN"
ROSETTA:LAP_P1_SWEEP_RESOLUTION = "COARSE"
ROSETTA:LAP_P1_SWEEP_PLATEAU_DURATION = "0x0200"
ROSETTA:LAP_P1_SWEEP_STEPS = "0x0030"
ROSETTA:LAP_P1_SWEEP_STEP_HEIGHT = "0x0004"
ROSETTA:LAP_P1_SWEEP_START_BIAS = "0x00c0"
OBJECT     = TABLE
INTERCHANGE_FORMAT = ASCII
ROWS               = 200
COLUMNS            = 4
ROW_BYTES          = 59
DESCRIPTION        = "D_SWEEP_P1_RAW_16BIT_BIP"
OBJECT     = COLUMN
NAME        = UTC_TIME
DATA_TYPE   = TIME
START_BYTE  = 1
BYTES       = 26
DESCRIPTION = "UTC TIME"
END_OBJECT = COLUMN
```

```
OBJECT     = COLUMN
NAME        = OBT_TIME
START_BYTE  = 28
BYTES       = 16
DATA_TYPE   = ASCII_REAL
UNIT        = SECONDS
FORMAT      = "F16.6"
DESCRIPTION = "SPACE CRAFT ONBOARD TIME SSSSSSSSS.FFFFFF (TRUE
DECIMALPOINT)"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1_CURRENT
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 45
BYTES       = 6
DESCRIPTION = "MEASURED CURRENT"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1_VOLTAGE
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 52
BYTES       = 6
DESCRIPTION = "VOLTAGE BIAS"
END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.1.4 Edited Difference Measurements Data Product Design

```
PDS_VERSION_ID = PDS3
RECORD_TYPE = FIXED_LENGTH
RECORD_BYTES = 66
FILE_RECORDS = 272
FILE_NAME = "RPCLAP071107_29FS_REB38NS.LBL"
^TABLE = "RPCLAP071107_29FS_REB38NS.TAB"
DATA_SET_ID = "RO-E-RPCLAP-2-EAR2-EDITED-V0.5"
DATA_SET_NAME = "ROSETTA-ORBITER EARTH RPCLAP 2 EAR2 EDITED V0.5"
DATA_QUALITY_ID = "1"
MISSION_ID = ROSETTA
MISSION_NAME = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME = "EARTH SWING-BY 2"
PRODUCER_INSTITUTION_NAME = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
PRODUCER_ID = EJ
PRODUCER_FULL_NAME = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE = "2015-03-29: Erik P G Johansson (IRFU); Seven
renamed sweep keywords."
PRODUCT_ID = "RPCLAP071107_29FS_REB38NS"
PRODUCT_TYPE = "EDR"
PRODUCT_CREATION_TIME = 2016-04-07T07:52:43
INSTRUMENT_HOST_ID = RO
INSTRUMENT_HOST_NAME = "ROSETTA-ORBITER"
INSTRUMENT_NAME = "ROSETTA PLASMA CONSORTIUM - LANGMUIR PROBE"
```

```
INSTRUMENT_ID = RPCLAP
INSTRUMENT_TYPE = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID = MCID0X0705
INSTRUMENT_MODE_DESC = "E-Field,Cont. 20 Bit down 64, Every 160s 16
bit diff"
TARGET_NAME = "EARTH"
TARGET_TYPE = "PLANET"
PROCESSING_LEVEL_ID = "2"
START_TIME = 2007-11-07T23:58:02.875
STOP_TIME = 2007-11-07T23:58:02.890
SPACECRAFT_CLOCK_START_COUNT = "1/0153100650.1600"
SPACECRAFT_CLOCK_STOP_COUNT = "1/0153100650.2547"
DESCRIPTION = "E_DIFF_P1P2"
ROSETTA:LAP_P2_ADC16_DOWNSAMPLE = "0x0001"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE = "0x0001"
ROSETTA:LAP_TM_RATE = "NORMAL"
ROSETTA:LAP_BOOTSTRAP = "ON"
ROSETTA:LAP_FEEDBACK_P2 = "E-FIELD"
ROSETTA:LAP_P2_ADC20 = "E-FIELD"
ROSETTA:LAP_P2_ADC16 = "E-FIELD"
ROSETTA:LAP_P2_RANGE_DENS_BIAS = "+-32"
ROSETTA:LAP_P2_STRATEGY_OR_RANGE = "BIAS"
ROSETTA:LAP_P2_RX_OR_TX = "ANALOG INPUT"
ROSETTA:LAP_P2_ADC16_FILTER = "8 KHz"
ROSETTA:LAP_P2_EFIELD_FIX_DURATION = "0x0002"
ROSETTA:LAP_IBIAS2 = "0x0077"
ROSETTA:LAP_P2_BIAS_MODE = "E-FIELD"
ROSETTA:LAP_FEEDBACK_P1 = "E-FIELD"
ROSETTA:LAP_P1_ADC20 = "E-FIELD"
ROSETTA:LAP_P1_ADC16 = "E-FIELD"
ROSETTA:LAP_P1_RANGE_DENS_BIAS = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE = "BIAS"
ROSETTA:LAP_P1_RX_OR_TX = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER = "8 KHz"
ROSETTA:LAP_P1_EFIELD_FIX_DURATION = "0x0002"
ROSETTA:LAP_IBIAS1 = "0x00d6"
ROSETTA:LAP_P1_BIAS_MODE = "E-FIELD"
OBJECT     = TABLE
INTERCHANGE_FORMAT = ASCII
ROWS               = 272
COLUMNS            = 5
ROW_BYTES          = 66
DESCRIPTION        = "E_DIFF_P1P2"
OBJECT     = COLUMN
NAME         = UTC_TIME
DATA_TYPE    = TIME
START_BYTE   = 1
BYTES        = 26
DESCRIPTION = "UTC TIME"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME         = OBT_TIME
START_BYTE   = 28
BYTES        = 16
DATA_TYPE    = ASCII_REAL
```

```
UNIT        = SECONDS
FORMAT      = "F16.6"
DESCRIPTION = "SPACECRAFT ONBOARD TIME SSSSSSSSS.FFFFFF (TRUE
DECIMALPOINT)"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1_CURRENT
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 45
BYTES       = 6
DESCRIPTION = "CURRENT BIAS"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P2_CURRENT
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 52
BYTES       = 6
DESCRIPTION = "CURRENT BIAS"
END_OBJECT = COLUMN
OBJECT     = COLUMN
NAME        = P1-P2_VOLTAGE
DATA_TYPE   = ASCII_INTEGER
START_BYTE  = 59
BYTES       = 6
DESCRIPTION = "MEASURED VOLTAGE"
END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.2 Calibrated Data Product Designs

5.3.2.2.1 Calibrated LF Fix Bias Measurement Data Product Design

```
PDS_VERSION_ID                   = PDS3
RECORD_TYPE                      = FIXED_LENGTH
RECORD_BYTES                     = 83
FILE_RECORDS                     = 3883277
FILE_NAME                        =
"LAP_20150620_000208_807_I1L.LBL"
^TABLE                           =
"LAP_20150620_000208_807_I1L.TAB"
DATA_SET_ID                      = "RO-C-RPCLAP-3-ESC2-CALIB2-
V1.0"
DATA_SET_NAME                    = "ROSETTA-ORBITER 67P RPCLAP 3
ESC2 CALIB2 V1.0"
DATA_QUALITY_ID                  = "1"
MISSION_ID                       = ROSETTA
MISSION_NAME                     = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME               = "COMET ESCORT 2"
PRODUCER_INSTITUTION_NAME        = "SWEDISH INSTITUTE OF SPACE
PHYSICS, UPPSALA"
```

```
PRODUCER_ID                       = EJ
PRODUCER_FULL_NAME                = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE               = "2016-08-18, EJ, Initial
release"
PRODUCT_ID                        = "LAP_20150620_000208_807_I1L"
PRODUCT_TYPE                      = "RDR"
PRODUCT_CREATION_TIME             = 2016-08-30T12:01:44.975
INSTRUMENT_HOST_ID                = RO
INSTRUMENT_HOST_NAME              = "ROSETTA-ORBITER"
INSTRUMENT_NAME                   = "ROSETTA PLASMA CONSORTIUM -
LANGMUIR PROBE"
INSTRUMENT_ID                     = RPCLAP
INSTRUMENT_TYPE                   = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID                = MCID0X0807
INSTRUMENT_MODE_DESC              = "Density,Cont. 20 bit trun, LDL
BM, 16 bit and Sweep P1"
TARGET_NAME                       = "67P/CHURYUMOV-GERASIMENKO 1
(1969 R1)"
TARGET_TYPE                       = "COMET"
PROCESSING_LEVEL_ID               = "3"
START_TIME                        = 2015-06-20T00:02:08.596
STOP_TIME                         = 2015-06-20T23:59:27.714
SPACECRAFT_CLOCK_START_COUNT      = "1/0393379251.15680"
SPACECRAFT_CLOCK_STOP_COUNT       = "1/393465490.21576"
DESCRIPTION                       = "D_P1_TRNC_20_BIT_RAW_BIP"
ROSETTA:LAP_TM_RATE               = "BURST"
ROSETTA:LAP_BOOTSTRAP             = "ON"
ROSETTA:LAP_FEEDBACK_P1           = "DENSITY"
ROSETTA:LAP_P1_ADC20              = "DENSITY"
ROSETTA:LAP_P1_ADC16              = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS    = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE  = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX           = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER       = "8 KHz"
ROSETTA:LAP_VBIAS1                = "0x00a8"
ROSETTA:LAP_P1_BIAS_MODE          = "DENSITY"
ROSETTA:LAP_P1P2_ADC20_STATUS     = "P1T"
ROSETTA:LAP_P1P2_ADC20_MA_LENGTH  = "0x0001"
ROSETTA:LAP_P1P2_ADC20_DOWNSAMPLE = "0x0001"
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 3883277
    COLUMNS            = 5
    ROW_BYTES          = 83
    DESCRIPTION        = "D_P1_TRNC_20_BIT_RAW_BIP"
    OBJECT = COLUMN
        NAME        = UTC_TIME
        START_BYTE  = 1
        BYTES       = 26
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "UTC TIME"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = OBT_TIME
```

```
        START_BYTE  = 29
        BYTES       = 16
        DATA_TYPE   = ASCII_REAL
        UNIT        = "SECONDS"
        DESCRIPTION = "SPACECRAFT ONBOARD TIME SSSSSSSSS.FFFFFF
(TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P1_CURRENT
        START_BYTE  = 47
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "AMPERE"
        DESCRIPTION = "MEASURED CALIBRATED CURRENT"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P1_VOLTAGE
        START_BYTE  = 63
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "VOLT"
        DESCRIPTION = "CALIBRATED VOLTAGE BIAS"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = QUALITY
        START_BYTE  = 79
        BYTES       = 3
        DATA_TYPE   = ASCII_INTEGER
        UNIT        = "N/A"
        DESCRIPTION = "QUALITY FACTOR FROM 000 (best) to 999."
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.2.2 Calibrated HF Fix Bias Data Product Design

```
PDS_VERSION_ID                     = PDS3
RECORD_TYPE                        = FIXED_LENGTH
RECORD_BYTES                       = 83
FILE_RECORDS                       = 5495760
FILE_NAME                          =
"LAP_20150620_000208_807_I1H.LBL"
^TABLE                             =
"LAP_20150620_000208_807_I1H.TAB"
DATA_SET_ID                        = "RO-C-RPCLAP-3-ESC2-CALIB2-
V1.0"
DATA_SET_NAME                      = "ROSETTA-ORBITER 67P RPCLAP 3
ESC2 CALIB2 V1.0"
DATA_QUALITY_ID                    = "1"
MISSION_ID                         = ROSETTA
MISSION_NAME                       = "INTERNATIONAL ROSETTA
MISSION"
MISSION_PHASE_NAME                 = "COMET ESCORT 2"
```

```
PRODUCER_INSTITUTION_NAME           = "SWEDISH INSTITUTE OF SPACE
PHYSICS, UPPSALA"
PRODUCER_ID                         = EJ
PRODUCER_FULL_NAME                  = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE                 = "2016-08-18, EJ, Initial
release"
PRODUCT_ID                          = "LAP_20150620_000208_807_I1H"
PRODUCT_TYPE                        = "RDR"
PRODUCT_CREATION_TIME               = 2016-08-30T12:01:44.975
INSTRUMENT_HOST_ID                  = RO
INSTRUMENT_HOST_NAME                = "ROSETTA-ORBITER"
INSTRUMENT_NAME                     = "ROSETTA PLASMA CONSORTIUM -
LANGMUIR PROBE"
INSTRUMENT_ID                       = RPCLAP
INSTRUMENT_TYPE                     = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID                  = MCID0X0807
INSTRUMENT_MODE_DESC                = "Density,Cont. 20 bit trun,
LDL BM, 16 bit and Sweep P1"
TARGET_NAME                         = "67P/CHURYUMOV-GERASIMENKO 1
(1969 R1)"
TARGET_TYPE                         = "COMET"
PROCESSING_LEVEL_ID                 = "3"
START_TIME                          = 2015-06-20T00:02:40.596
STOP_TIME                           = 2015-06-20T23:58:24.842
SPACECRAFT_CLOCK_START_COUNT        = "1/0393379283.15680"
SPACECRAFT_CLOCK_STOP_COUNT         = "1/393465427.29937"
DESCRIPTION                         = "D_P1_RAW_16BIT"
ROSETTA:LAP_TM_RATE                 = "BURST"
ROSETTA:LAP_BOOTSTRAP               = "ON"
ROSETTA:LAP_FEEDBACK_P1             = "DENSITY"
ROSETTA:LAP_P1_ADC20                = "DENSITY"
ROSETTA:LAP_P1_ADC16                = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS      = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE    = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX             = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER         = "8 KHz"
ROSETTA:LAP_VBIAS1                  = "0x00a8"
ROSETTA:LAP_P1_BIAS_MODE            = "DENSITY"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE     = "0x0001"
ROSETTA:LAP_P1_DENSITY_FIX_DURATION = "0x0001"
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 5495760
    COLUMNS            = 5
    ROW_BYTES          = 83
    DESCRIPTION        = "D_P1_RAW_16BIT"
    OBJECT = COLUMN
        NAME        = UTC_TIME
        START_BYTE  = 1
        BYTES       = 26
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "UTC TIME"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
```

```
        NAME        = OBT_TIME
        START_BYTE  = 29
        BYTES       = 16
        DATA_TYPE   = ASCII_REAL
        UNIT        = "SECONDS"
        DESCRIPTION = "SPACECRAFT ONBOARD TIME SSSSSSSSS.FFFFFF
(TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P1_CURRENT
        START_BYTE  = 47
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "AMPERE"
        DESCRIPTION = "MEASURED CALIBRATED CURRENT"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P1_VOLTAGE
        START_BYTE  = 63
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "VOLT"
        DESCRIPTION = "CALIBRATED VOLTAGE BIAS"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = QUALITY
        START_BYTE  = 79
        BYTES       = 3
        DATA_TYPE   = ASCII_INTEGER
        UNIT        = "N/A"
        DESCRIPTION = "QUALITY FACTOR FROM 000 (best) to 999."
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.2.3 Calibrated Fix Bias Difference Measurement Data Product Design

```
PDS_VERSION_ID                    = PDS3
RECORD_TYPE                       = FIXED_LENGTH
RECORD_BYTES                      = 99
FILE_RECORDS                      = 2048
FILE_NAME                         =
"RPCLAP_20050304_173213_603_I3H.LBL"
^TABLE                            =
"RPCLAP_20050304_173213_603_I3H.TAB"
DATA_SET_ID                       = "RO-E-RPCLAP-5-EAR1-DERIV-
V0.5"
DATA_SET_NAME                     = "ROSETTA-ORBITER EARTH RPCLAP
5 EAR1 DERIV V0.5"
DATA_QUALITY_ID                   = "1"
MISSION_ID                        = ROSETTA
```

```
MISSION_NAME                        = "INTERNATIONAL ROSETTA
MISSION"
MISSION_PHASE_NAME                  = "EARTH SWING-BY 1"
PRODUCER_INSTITUTION_NAME           = "SWEDISH INSTITUTE OF SPACE
PHYSICS, UPPSALA"
PRODUCER_ID                         = EJ
PRODUCER_FULL_NAME                  = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE                 = "2015-02-27T12:00:00, EJ, 4th
draft"
PRODUCT_ID                          =
"RPCLAP_20050304_173213_603_I3H"
PRODUCT_TYPE                        = "DDR"
PRODUCT_CREATION_TIME               = 2016-08-02T19:59:47.579
INSTRUMENT_HOST_ID                  = RO
INSTRUMENT_HOST_NAME                = "ROSETTA-ORBITER"
INSTRUMENT_NAME                     = "ROSETTA PLASMA CONSORTIUM -
LANGMUIR PROBE"
INSTRUMENT_ID                       = RPCLAP
INSTRUMENT_TYPE                     = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID                  = MCID0X0603
INSTRUMENT_MODE_DESC                = "As MCID0x212 but with
difference measurments"
TARGET_NAME                         = "EARTH"
TARGET_TYPE                         = "PLANET"
PROCESSING_LEVEL_ID                 = "5"
START_TIME                          = 2005-03-04T17:32:13.417
STOP_TIME                           = 2005-03-04T17:55:09.430
SPACECRAFT_CLOCK_START_COUNT        = "1/0068578314.1600"
SPACECRAFT_CLOCK_STOP_COUNT         = "1/0068579690.2491"
DESCRIPTION                         = "D_DIFF_P1P2"
ROSETTA:LAP_TM_RATE                 = "NORMAL"
ROSETTA:LAP_BOOTSTRAP               = "ON"
ROSETTA:LAP_FEEDBACK_P1             = "DENSITY"
ROSETTA:LAP_P1_ADC20                = "DENSITY"
ROSETTA:LAP_P1_ADC16                = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS      = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE    = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX             = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER         = "8 KHz"
ROSETTA:LAP_VBIAS1                  = "0x00d0"
ROSETTA:LAP_P1_BIAS_MODE            = "DENSITY"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE     = "0x0001"
ROSETTA:LAP_P1_DENSITY_FIX_DURATION = "0x0100"
ROSETTA:LAP_FEEDBACK_P2             = "DENSITY"
ROSETTA:LAP_P2_ADC20                = "DENSITY"
ROSETTA:LAP_P2_ADC16                = "DENSITY"
ROSETTA:LAP_P2_RANGE_DENS_BIAS      = "+-32"
ROSETTA:LAP_P2_STRATEGY_OR_RANGE    = "GAIN 1"
ROSETTA:LAP_P2_RX_OR_TX             = "ANALOG INPUT"
ROSETTA:LAP_P2_ADC16_FILTER         = "8 KHz"
ROSETTA:LAP_VBIAS2                  = "0x00d0"
ROSETTA:LAP_P2_BIAS_MODE            = "DENSITY"
ROSETTA:LAP_P2_ADC16_DOWNSAMPLE     = "0x0001"
ROSETTA:LAP_P2_DENSITY_FIX_DURATION = "0x0100"
OBJECT = TABLE
```

```
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 2048
    COLUMNS            = 6
    ROW_BYTES          = 99
    DESCRIPTION        = "D_DIFF_P1P2"
    OBJECT = COLUMN
        NAME               = UTC_TIME
        START_BYTE         = 1
        BYTES              = 26
        DATA_TYPE          = TIME
        UNIT               = SECONDS
        DESCRIPTION        = "UTC TIME"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME               = OBT_TIME
        START_BYTE         = 29
        BYTES              = 16
        DATA_TYPE          = ASCII_REAL
        UNIT               = SECONDS
        DESCRIPTION        = "SPACECRAFT ONBOARD TIME
SSSSSSSSS.FFFFFF (TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME               = P1-P2_CURRENT
        START_BYTE         = 47
        BYTES              = 14
        DATA_TYPE          = ASCII_REAL
        UNIT               = AMPERE
        DESCRIPTION        = "MEASURED CALIBRATED CURRENT"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME               = P1_VOLTAGE
        START_BYTE         = 63
        BYTES              = 14
        DATA_TYPE          = ASCII_REAL
        UNIT               = VOLT
        DESCRIPTION        = "CALIBRATED VOLTAGE BIAS"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME               = P2_VOLTAGE
        START_BYTE         = 79
        BYTES              = 14
        DATA_TYPE          = ASCII_REAL
        UNIT               = VOLT
        DESCRIPTION        = "CALIBRATED VOLTAGE BIAS"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME               = QUALITY
        START_BYTE         = 95
        BYTES              = 3
        DATA_TYPE          = ASCII_REAL
        UNIT               = "N/A"
        DESCRIPTION        = "QUALITY FACTOR FROM 000 (best) to 999."
    END_OBJECT = COLUMN
END_OBJECT = TABLE
```

```
END
```

5.3.2.2.4 Calibrated Sweep Measurement Data Product Design

```
PDS_VERSION_ID                        = PDS3
RECORD_TYPE                           = FIXED_LENGTH
RECORD_BYTES                          = 3953
FILE_RECORDS                          = 1348
FILE_NAME                             =
"LAP_20150620_000208_807_I1S.LBL"
^TABLE                                =
"LAP_20150620_000208_807_I1S.TAB"
DATA_SET_ID                           = "RO-C-RPCLAP-3-ESC2-CALIB2-
V1.0"
DATA_SET_NAME                         = "ROSETTA-ORBITER 67P RPCLAP
3 ESC2 CALIB2 V1.0"
DATA_QUALITY_ID                       = "1"
MISSION_ID                            = ROSETTA
MISSION_NAME                          = "INTERNATIONAL ROSETTA
MISSION"
MISSION_PHASE_NAME                    = "COMET ESCORT 2"
PRODUCER_INSTITUTION_NAME             = "SWEDISH INSTITUTE OF SPACE
PHYSICS, UPPSALA"
PRODUCER_ID                           = EJ
PRODUCER_FULL_NAME                    = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE                   = "2016-08-18, EJ, Initial
release"
PRODUCT_ID                            =
"LAP_20150620_000208_807_I1S"
PRODUCT_TYPE                          = "RDR"
PRODUCT_CREATION_TIME                 = 2016-08-30T12:01:44.975
INSTRUMENT_HOST_ID                    = RO
INSTRUMENT_HOST_NAME                  = "ROSETTA-ORBITER"
INSTRUMENT_NAME                       = "ROSETTA PLASMA CONSORTIUM
- LANGMUIR PROBE"
INSTRUMENT_ID                         = RPCLAP
INSTRUMENT_TYPE                       = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID                    = MCID0X0807
INSTRUMENT_MODE_DESC                  = "Density,Cont. 20 bit trun,
LDL BM, 16 bit and Sweep P1"
TARGET_NAME                           = "67P/CHURYUMOV-GERASIMENKO
1 (1969 R1)"
TARGET_TYPE                           = "COMET"
PROCESSING_LEVEL_ID                   = "3"
START_TIME                            = 2015-06-20T00:02:08.596
STOP_TIME                             = 2015-06-20T23:59:03.253
SPACECRAFT_CLOCK_START_COUNT          = "1/0393379251.15680"
SPACECRAFT_CLOCK_STOP_COUNT           = "1/393465465.56881"
DESCRIPTION                           = "D_SWEEP_P1_RAW_16BIT_BIP"
ROSETTA:LAP_TM_RATE                   = "BURST"
ROSETTA:LAP_BOOTSTRAP                 = "ON"
ROSETTA:LAP_FEEDBACK_P1               = "DENSITY"
ROSETTA:LAP_P1_ADC20                  = "DENSITY"
```

```
ROSETTA:LAP_P1_ADC16                   = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS         = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE       = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX                = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER            = "8 KHz"
ROSETTA:LAP_P1_INITIAL_SWEEP_SMPLS     = "0x0005"
ROSETTA:LAP_P1_SWEEP_PLATEAU_DURATION = "0x0200"
ROSETTA:LAP_P1_SWEEP_STEPS             = "0x00f0"
ROSETTA:LAP_P1_SWEEP_START_BIAS        = "0x00f8"
ROSETTA:LAP_P1_SWEEP_FORMAT            = "DOWN"
ROSETTA:LAP_P1_SWEEP_RESOLUTION        = "COARSE"
ROSETTA:LAP_P1_SWEEP_STEP_HEIGHT       = "0x0001"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE        = "0x0080"
ROSETTA:LAP_SWEEPING_P1                = "YES"
ROSETTA:LAP_P1_FINE_SWEEP_OFFSET       = "0x0000"
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 1348
    COLUMNS            = 246
    ROW_BYTES          = 3953
    DESCRIPTION        = "D_SWEEP_P1_RAW_16BIT_BIP"
    OBJECT = COLUMN
        NAME        = START_TIME_UTC
        START_BYTE  = 1
        BYTES       = 26
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "START UTC TIME YYYY-MM-DD HH:MM:SS.FFFFFF"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = STOP_TIME_UTC
        START_BYTE  = 29
        BYTES       = 26
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "STOP UTC TIME YYYY-MM-DD HH:MM:SS.FFFFFF"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = START_TIME_OBT
        START_BYTE  = 57
        BYTES       = 16
        DATA_TYPE   = ASCII_REAL
        UNIT        = "SECONDS"
        DESCRIPTION = "START SPACECRAFT ONBOARD TIME
SSSSSSSSS.FFFFFF (TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = STOP_TIME_OBT
        START_BYTE  = 75
        BYTES       = 16
        DATA_TYPE   = ASCII_REAL
        UNIT        = "SECONDS"
        DESCRIPTION = "STOP SPACECRAFT ONBOARD TIME
SSSSSSSSS.FFFFFF (TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
```

```
    OBJECT = COLUMN
        NAME        = QUALITY
        START_BYTE  = 93
        BYTES       = 3
        DATA_TYPE   = ASCII_INTEGER
        UNIT        = "N/A"
        DESCRIPTION = "QUALITY FACTOR FROM 000 (best) to 999."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME             = P1_SWEEP_CURRENT
        START_BYTE       = 98
        BYTES            = 3854
        DATA_TYPE        = ASCII_REAL
        UNIT             = "AMPERE"
        ITEMS            = 241
        ITEM_BYTES       = 14
        ITEM_OFFSET      = 16
        DESCRIPTION      = "One current for each of the voltage
potential sweep steps described by
RPCLAP_20150620_000208_807_B1S.TAB. Each current is the average
over multiple measurements on a single potential step. A value of -
1.0e3 implies the absense of a value."
        MISSING_CONSTANT = -1.0e3
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.2.5 Calibrated Sweep Description Product Design

```
PDS_VERSION_ID                          = PDS3
RECORD_TYPE                             = FIXED_LENGTH
RECORD_BYTES                            = 32
FILE_RECORDS                            = 241
FILE_NAME                               =
"LAP_20150620_000208_807_B1S.LBL"
^TABLE                                  =
"LAP_20150620_000208_807_B1S.TAB"
DATA_SET_ID                             = "RO-C-RPCLAP-3-ESC2-CALIB2-
V1.0"
DATA_SET_NAME                           = "ROSETTA-ORBITER 67P RPCLAP
3 ESC2 CALIB2 V1.0"
DATA_QUALITY_ID                         = "1"
MISSION_ID                              = ROSETTA
MISSION_NAME                            = "INTERNATIONAL ROSETTA
MISSION"
MISSION_PHASE_NAME                      = "COMET ESCORT 2"
PRODUCER_INSTITUTION_NAME               = "SWEDISH INSTITUTE OF SPACE
PHYSICS, UPPSALA"
PRODUCER_ID                             = EJ
PRODUCER_FULL_NAME                      = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE                     = "2016-08-18, EJ, Initial
release"
```

```
PRODUCT_ID                              =
"LAP_20150620_000208_807_B1S"
PRODUCT_TYPE                            = "RDR"
PRODUCT_CREATION_TIME                   = 2016-08-30T12:01:44.975
INSTRUMENT_HOST_ID                      = RO
INSTRUMENT_HOST_NAME                    = "ROSETTA-ORBITER"
INSTRUMENT_NAME                         = "ROSETTA PLASMA CONSORTIUM
- LANGMUIR PROBE"
INSTRUMENT_ID                           = RPCLAP
INSTRUMENT_TYPE                         = "PLASMA INSTRUMENT"
INSTRUMENT_MODE_ID                      = MCID0X0807
INSTRUMENT_MODE_DESC                    = "Density,Cont. 20 bit trun,
LDL BM, 16 bit and Sweep P1"
TARGET_NAME                             = "67P/CHURYUMOV-GERASIMENKO
1 (1969 R1)"
TARGET_TYPE                             = "COMET"
PROCESSING_LEVEL_ID                     = "3"
START_TIME                              = 2015-06-20T00:02:08.596
STOP_TIME                               = 2015-06-20T23:59:03.253
SPACECRAFT_CLOCK_START_COUNT            = "1/0393379251.15680"
SPACECRAFT_CLOCK_STOP_COUNT             = "1/393465465.56881"
DESCRIPTION                             = "D_SWEEP_P1_RAW_16BIT_BIP"
ROSETTA:LAP_TM_RATE                     = "BURST"
ROSETTA:LAP_BOOTSTRAP                   = "ON"
ROSETTA:LAP_FEEDBACK_P1                 = "DENSITY"
ROSETTA:LAP_P1_ADC20                    = "DENSITY"
ROSETTA:LAP_P1_ADC16                    = "DENSITY"
ROSETTA:LAP_P1_RANGE_DENS_BIAS          = "+-32"
ROSETTA:LAP_P1_STRATEGY_OR_RANGE        = "GAIN 1"
ROSETTA:LAP_P1_RX_OR_TX                 = "ANALOG INPUT"
ROSETTA:LAP_P1_ADC16_FILTER             = "8 KHz"
ROSETTA:LAP_P1_INITIAL_SWEEP_SMPLS      = "0x0005"
ROSETTA:LAP_P1_SWEEP_PLATEAU_DURATION = "0x0200"
ROSETTA:LAP_P1_SWEEP_STEPS              = "0x00f0"
ROSETTA:LAP_P1_SWEEP_START_BIAS         = "0x00f8"
ROSETTA:LAP_P1_SWEEP_FORMAT             = "DOWN"
ROSETTA:LAP_P1_SWEEP_RESOLUTION         = "COARSE"
ROSETTA:LAP_P1_SWEEP_STEP_HEIGHT        = "0x0001"
ROSETTA:LAP_P1_ADC16_DOWNSAMPLE         = "0x0080"
ROSETTA:LAP_SWEEPING_P1                 = "YES"
ROSETTA:LAP_P1_FINE_SWEEP_OFFSET        = "0x0000"
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 241
    COLUMNS            = 2
    ROW_BYTES          = 32
    DESCRIPTION        = "D_SWEEP_P1_RAW_16BIT_BIP Sweep step bias
and time between each step"
    OBJECT = COLUMN
        NAME        = SWEEP_TIME
        START_BYTE  = 1
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "SECONDS"
```

```
        DESCRIPTION = "LAPSED TIME (S/C CLOCK TIME) FROM FIRST
SWEEP MEASUREMENT"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P1_VOLTAGE
        START_BYTE  = 17
        BYTES       = 14
        DATA_TYPE   = ASCII_REAL
        UNIT        = "VOLT"
        DESCRIPTION = "CALIBRATED VOLTAGE BIAS"
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.2.6 Calibrated Block List Data Product Design

```
PDS_VERSION_ID                = PDS3
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 55
FILE_RECORDS                  = 1
FILE_NAME                     = "LAP_20150620_000000_BLKLIST.LBL"
^TABLE                        = "LAP_20150620_000000_BLKLIST.TAB"
DATA_SET_ID                   = "RO-C-RPCLAP-3-ESC2-CALIB2-V1.0"
DATA_SET_NAME                 = "ROSETTA-ORBITER 67P RPCLAP 3 ESC2
CALIB2 V1.0"
DATA_QUALITY_ID               = "1"
MISSION_ID                    = ROSETTA
MISSION_NAME                  = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME            = "COMET ESCORT 2"
PRODUCER_INSTITUTION_NAME     = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
PRODUCER_ID                   = EJ
PRODUCER_FULL_NAME            = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE           = "2016-08-18, EJ, Initial release"
PRODUCT_ID                    = "LAP_20150620_000000_BLKLIST"
PRODUCT_TYPE                  = "RDR"
PRODUCT_CREATION_TIME         = 2016-08-30T12:01:44.975
INSTRUMENT_HOST_ID            = RO
INSTRUMENT_HOST_NAME          = "ROSETTA-ORBITER"
INSTRUMENT_NAME               = "ROSETTA PLASMA CONSORTIUM -
LANGMUIR PROBE"
INSTRUMENT_ID                 = RPCLAP
INSTRUMENT_TYPE               = "PLASMA INSTRUMENT"
TARGET_NAME                   = "67P/CHURYUMOV-GERASIMENKO 1 (1969
R1)"
TARGET_TYPE                   = "COMET"
PROCESSING_LEVEL_ID           = "3"
START_TIME                    = 2015-06-20T00:00:00.000
STOP_TIME                     = 2015-06-21T00:00:00.000
SPACECRAFT_CLOCK_START_COUNT  = "1/0393379122.42145"
SPACECRAFT_CLOCK_STOP_COUNT   = "1/0393465522.40266"
OBJECT = TABLE
```

```
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 1
    COLUMNS            = 3
    ROW_BYTES          = 55
    DESCRIPTION        = "BLOCKLIST DATA. START & STOP TIME OF
MACRO BLOCK AND MACRO ID."
    OBJECT = COLUMN
        NAME        = START_TIME_UTC
        START_BYTE  = 1
        BYTES       = 23
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "START TIME OF MACRO BLOCK YYYY-MM-DD
HH:MM:SS.sss"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = STOP_TIME_UTC
        START_BYTE  = 26
        BYTES       = 23
        DATA_TYPE   = TIME
        UNIT        = "SECONDS"
        DESCRIPTION = "LAST START TIME OF MACRO BLOCK FILE YYYY-MM-
DD HH:MM:SS.sss"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = MACRO_ID
        START_BYTE  = 51
        BYTES       = 3
        DATA_TYPE   = CHARACTER
        UNIT        = "N/A"
        DESCRIPTION = "HEXADECIMAL MACRO IDENTIFICATION NUMBER."
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.3 Geometry Data Product Design

```
PDS_VERSION_ID                = PDS3
RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 251
FILE_RECORDS                  = 2700
FILE_NAME                     = "RPCLAP160401_3_GEOM.LBL"
^TABLE                        = "RPCLAP160401_3_GEOM.TAB"
DATA_SET_ID                   = "RO-C-RPCLAP-3-EXT1-CALIB2-V1.0"
DATA_SET_NAME                   = "ROSETTA-ORBITER 67P RPCLAP 3 EXT1
CALIB2 V1.0"
MISSION_PHASE_NAME            = "ROSETTA EXTENSION 1"
PRODUCER_ID                   = EJ
PRODUCER_FULL_NAME            = "ERIK P G JOHANSSON"
LABEL_REVISION_NOTE           = "2017-07-13, EJ: Added X/Y/Z_TSEQ."
PRODUCT_ID                    = "RPCLAP160401_3_GEOM"
PRODUCT_TYPE                  = "RDR"
PRODUCT_CREATION_TIME         = 2017-09-05T19:42:21.478
INSTRUMENT_HOST_NAME          = "ROSETTA-ORBITER"
```

```
INSTRUMENT_NAME              = "ROSETTA PLASMA CONSORTIUM - LANGMUIR
PROBE"
INSTRUMENT_ID                = RPCLAP
TARGET_NAME                    = "67P/CHURYUMOV-GERASIMENKO 1 (1969
R1)"
TARGET_TYPE                  = "COMET"
PROCESSING_LEVEL_ID          = "3"
START_TIME                   = 2016-04-01T00:00:16.000
STOP_TIME                    = 2016-04-01T23:59:44.000
SPACECRAFT_CLOCK_START_COUNT = "1/0418089531.39491"
SPACECRAFT_CLOCK_STOP_COUNT  = "1/0418175899.37682"
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 2700
    COLUMNS            = 15
    ROW_BYTES          = 251
    DESCRIPTION           = "Geometry information for some of the
relative positions and orientations of the spacecraft, target, and
Sun."
    OBJECT = COLUMN
        NAME              = TIME_UTC
        START_BYTE        = 1
        BYTES             = 23
        DATA_TYPE         = TIME
        DESCRIPTION       = "UTC TIME YYYY-MM-DD HH:MM:SS.FFF"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = OBT_TIME
        START_BYTE        = 26
        BYTES             = 16
        DATA_TYPE         = ASCII_REAL
        DESCRIPTION      = "SPACECRAFT ONBOARD TIME SSSSSSSSS.FFFFFF
(TRUE DECIMALPOINT)"
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = X_TSO
        START_BYTE        = 44
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION     = "The spacecraft X coordinate in the target-
centric solar orbital coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = Y_TSO
        START_BYTE        = 60
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION     = "The spacecraft Y coordinate in the target-
centric solar orbital coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = Z_TSO
        START_BYTE        = 76
```

```
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION      = "The spacecraft Z coordinate in the target-
centric solar orbital coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = X_TSEQ
        START_BYTE        = 92
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION      = "The spacecraft X coordinate in the target-
centric solar equatorial coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = Y_TSEQ
        START_BYTE        = 108
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION      = "The spacecraft Y coordinate in the target-
centric solar equatorial coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = Z_TSEQ
        START_BYTE        = 124
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "KM"
        DESCRIPTION      = "The spacecraft Z coordinate in the target-
centric solar equatorial coordinate system."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = LATITUDE
        START_BYTE        = 140
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "DEGREES"
        DESCRIPTION       = "The spacecraft latitude on the target."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = LONGITUDE
        START_BYTE        = 156
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "DEGREES"
        DESCRIPTION       = "The spacecraft longitude on the target."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME              = SZA
        START_BYTE        = 172
        BYTES             = 14
        DATA_TYPE         = ASCII_REAL
        UNIT              = "DEGREES"
```

```
        DESCRIPTION       = "Solar zenith angle, the angle between
the spacecraft and the Sun as seen from the target."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME             = SAA
        START_BYTE       = 188
        BYTES            = 14
        DATA_TYPE        = ASCII_REAL
        UNIT             = "DEGREES"
        DESCRIPTION      = "Solar aspect angle, longitude of the Sun
in the spacecraft coordinate system, counted positive from +Z toward
+X."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME             = TAA
        START_BYTE       = 204
        BYTES            = 14
        DATA_TYPE        = ASCII_REAL
        UNIT             = "DEGREES"
        DESCRIPTION       = "Target aspect angle, longitude of the
target in the spacecraft coordinate system, counted positive from +Z
toward +X."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME             = SEA
        START_BYTE       = 220
        BYTES            = 14
        DATA_TYPE        = ASCII_REAL
        UNIT             = "DEGREES"
        DESCRIPTION       = "Solar elevation angle, latitude of the
Sun in the spacecraft coordinate system, counted positive above the
XZ plane toward +Y."
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME             = TEA
        START_BYTE       = 236
        BYTES            = 14
        DATA_TYPE        = ASCII_REAL
        UNIT             = "DEGREES"
        DESCRIPTION      = "Target elevation angle, latitude of the
target in the spacecraft coordinate system, counted positive above
the XZ plane toward +Y."
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```

5.3.2.4 Coefficients for deriving bias-dependent current calibration offsets

```
PDS_VERSION_ID               = PDS3
LABEL_REVISION_NOTE          = "2017-08-23, EJ: First version"
RECORD_TYPE                  = FIXED_LENGTH
RECORD_BYTES                 = 181
```

```
FILE_RECORDS                  = 2700
FILE_NAME                     = "RPCLAP160405_CALIB_COEFF.LBL"
^TABLE                        = "RPCLAP160405_CALIB_COEFF.TAB"
DATA_SET_ID                   = "RO-C-RPCLAP-3-EXT1-CALIB2-V1.0"
MISSION_ID                    = ROSETTA
MISSION_NAME                  = "INTERNATIONAL ROSETTA MISSION"
MISSION_PHASE_NAME            = "ROSETTA EXTENSION 1"
PRODUCER_INSTITUTION_NAME     = "SWEDISH INSTITUTE OF SPACE PHYSICS,
UPPSALA"
PRODUCER_ID                   = EJ
PRODUCER_FULL_NAME            = "ERIK P G JOHANSSON"
PRODUCT_ID                    = "RPCLAP160405_CALIB_COEFF"
PRODUCT_CREATION_TIME         = 2017-08-31T12:31:30
INSTRUMENT_HOST_ID            = RO
INSTRUMENT_HOST_NAME          = "ROSETTA-ORBITER"
INSTRUMENT_NAME               = "ROSETTA PLASMA CONSORTIUM -
LANGMUIR PROBE"
INSTRUMENT_ID                 = RPCLAP
INSTRUMENT_TYPE               = "PLASMA INSTRUMENT"
START_TIME                    = 2016-04-05T00:00:00.000
SPACECRAFT_CLOCK_START_COUNT = "1/0418435115.32251"
STOP_TIME                     = 2016-04-06T00:00:00.000
SPACECRAFT_CLOCK_STOP_COUNT  = "1/0418521515.30441"
DESCRIPTION                   = "COEFFICIENTS FOR CALCULATING BIAS-
DEPENDENT CURRENT OFFSETS OVER TIME."
OBJECT = TABLE
    INTERCHANGE_FORMAT = ASCII
    ROWS               = 2700
    COLUMNS            = 10
    ROW_BYTES          = 181
    DESCRIPTION        = "COEFFICIENTS FOR CALCULATING BIAS-
DEPENDENT CURRENT OFFSETS."
    OBJECT = COLUMN
        NAME        = UTC_TIME
        DATA_TYPE   = TIME
        DESCRIPTION = "UTC TIME"
        START_BYTE  = 1
        BYTES       = 19
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = SPACECRAFT_CLOCK
        DATA_TYPE   = CHARACTER
        DESCRIPTION = "SPACECRAFT CLOCK"
        START_BYTE  = 22
        BYTES       = 18
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P_P1
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "P COEFFICIENT FOR PROBE 1"
        START_BYTE  = 42
        BYTES       = 14
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = Q_P1
```

```
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "Q COEFFICIENT FOR PROBE 1"
        START_BYTE  = 58
        BYTES       = 16
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = R_P1
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "R COEFFICIENT FOR PROBE 1"
        START_BYTE  = 76
        BYTES       = 16
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = S_P1
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "S COEFFICIENT FOR PROBE 1"
        START_BYTE  = 94
        BYTES       = 16
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = P_P2
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "P COEFFICIENT FOR PROBE 2"
        START_BYTE  = 112
        BYTES       = 14
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = Q_P2
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "Q COEFFICIENT FOR PROBE 2"
        START_BYTE  = 128
        BYTES       = 16
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = R_P2
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "R COEFFICIENT FOR PROBE 2"
        START_BYTE  = 146
        BYTES       = 16
    END_OBJECT = COLUMN
    OBJECT = COLUMN
        NAME        = S_P2
        DATA_TYPE   = ASCII_REAL
        DESCRIPTION = "S COEFFICIENT FOR PROBE 2"
        START_BYTE  = 164
        BYTES       = 16
    END_OBJECT = COLUMN
END_OBJECT = TABLE
END
```