Mars Atmosphere and Volatile Evolution (MAVEN) Mission

In Situ Instruments

Key Parameters

PDS Archive

Software Interface Specification

Rev. 5.2

Oct 16, 2019

Prepared by

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MAVEN

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1 Introduction

This software interface specification (SIS) describes the format and content of the Key Parameter (KP) Planetary Data System (PDS) data archive. It includes descriptions of the data products and associated metadata, and the archive format, content, and generation pipeline.

1.1 Distribution List

Table 1: Distribution list

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1.2 Document Change Log

Table 2: Document change log

Version	Change	Date	Affected portion
0.0	Initial template (based upon MAVEN SIS Template, ver. 0.3)	2014-Feb-03	All
0.1	First draft	2014-March 5	All
0.2	Second draft	2014-March 18	All
1.0	Third draft	2014-March 25	Sections 1,5,6, and Appendix B
1.1	Fourth draft	2014-April 7	Table 13
1.2	Fifth draft	2014-April 22	Section 5.2.1.1, added a few sentences regarding LPW cadence
2.0	Changes and corrections suggested by reviewers.	2015-March	All
2.1	Added NGIMS quality columns (previous quality columns now titled precision)	2015-June	Table 13
5.1	Final peer review lien resolution.	2019-March	
5.2	Clarified unused columns, per final peer review.	2019-October	Table 13, NGIMS NO (3 columns) and SWEA Electron Spectrum Shape Parameter Quality

1.3 TBD Items

Table 3: List of TBD items

Item	Section(s)	Page(s)

1.4 Abbreviations

Table 4: Abbreviations and their meaning

Abbreviation	Meaning
APID	Application Identifier
ASCII	American Standard Code for Information Interchange
Atmos	PDS Atmospheres Node (NMSU, Las Cruces, NM)
CCSDS	Consultative Committee for Space Data Systems
CDR	Calibrated Data Record
CFDP	CCSDS File Delivery Protocol
CK	C-matrix Kernel (NAIF orientation data)
CODMAC	Committee on Data Management, Archiving, and Computing
CRC	Cyclic Redundancy Check
CU	University of Colorado (Boulder, CO)
DAP	Data Analysis Product
DDR	Derived Data Record
DMAS	Data Management and Storage
DPF	Data Processing Facility
E&PO	Education and Public Outreach
EDR	Experiment Data Record
EUV	Extreme Ultraviolet; also used for the EUV Monitor, part of LPW (SSL)
FEI	File Exchange Interface
FOV	Field of View
FTP	File Transfer Protocol
GB	Gigabyte(s)
GSFC	Goddard Space Flight Center (Greenbelt, MD)

Abbreviation	Meaning
HK	Housekeeping
HTML	Hypertext Markup Language
ICD	Interface Control Document
IM	Information Model
ISO	International Standards Organization
ITF	Instrument Team Facility
IUVS	Imaging Ultraviolet Spectrograph (LASP)
JPL	Jet Propulsion Laboratory (Pasadena, CA)
LASP	Laboratory for Atmosphere and Space Physics (CU)
LID	Logical Identifier
LIDVID	Versioned Logical Identifer
LPW	Langmuir Probe and Waves instrument (SSL)
MAG	Magnetometer instrument (GSFC)
MAVEN	Mars Atmosphere and Volatile EvolutioN
MB	Megabyte(s)
MD5	Message-Digest Algorithm 5
MOI	Mars Orbit Insertion
MOS	Mission Operations System
MSA	Mission Support Area
NAIF	Navigation and Ancillary Information Facility (JPL)
NASA	National Aeronautics and Space Administration
NGIMS	Neutral Gas and Ion Mass Spectrometer (GSFC)
NMSU	New Mexico State University (Las Cruces, NM)
NSSDC	National Space Science Data Center (GSFC)
PCK	Planetary Constants Kernel (NAIF)
PDS	Planetary Data System
PDS4	Planetary Data System Version 4
PF	Particles and Fields (instruments)
PPI	PDS Planetary Plasma Interactions Node (UCLA)
RS	Remote Sensing (instruments)

Abbreviation	Meaning
SCET	Spacecraft Event Time
SCLK	Spacecraft Clock
SDC	Science Data Center (LASP)
SDWG	Science Data Working Group
SEP	Solar Energetic Particle instrument (SSL)
SIS	Software Interface Specification
SOC	Science Operations Center (LASP)
SPE	Solar Particle Event
SPICE	Spacecraft, Planet, Instrument, C-matrix, and Events (NAIF data format)
SPK	Spacecraft and Planetary ephemeris Kernel (NAIF)
SSL	Space Sciences Laboratory (UCB)
STATIC	Supra-Thermal And Thermal Ion Composition instrument (SSL)
SWEA	Solar Wind Electron Analyzer (SSL)
SWIA	Solar Wind Ion Analyzer (SSL)
TBC	To Be Confirmed
TBD	To Be Determined
UCB	University of California, Berkeley
UCLA	University of California, Los Angeles
URN	Uniform Resource Name
UV	Ultraviolet
XML	eXtensible Markup Language

1.5 Glossary

Archive – A place in which public records or historical documents are preserved; also the material preserved – often used in plural. The term may be capitalized when referring to all of PDS holdings – the PDS Archive.

Basic Product – The simplest product in PDS4; one or more data objects (and their description objects), which constitute (typically) a single observation, document, etc. The only PDS4 products that are *not* basic products are collection and bundle products.

Bundle Product – A list of related collections. For example, a bundle could list a collection of raw data obtained by an instrument during its mission lifetime, a collection of the calibration products associated with the instrument, and a collection of all documentation relevant to the first two collections.

Class – The set of attributes (including a name and identifier) which describes an item defined in the PDS Information Model. A class is generic – a template from which individual items may be constructed.

Collection Product – A list of closely related basic products of a single type (e.g. observational data, browse, documents, etc.). A collection is itself a product (because it is simply a list, with its label), but it is not a *basic* product.

Data Object – A generic term for an object that is described by a description object. Data objects include both digital and non-digital objects.

Description Object – An object that describes another object. As appropriate, it will have structural and descriptive components. In PDS4 a 'description object' is a digital object – a string of bits with a predefined structure.

Digital Object – An object which consists of real electronically stored (digital) data.

Identifier – A unique character string by which a product, object, or other entity may be identified and located. Identifiers can be global, in which case they are unique across all of PDS (and its federation partners). A local identifier must be unique within a label.

Label – The aggregation of one or more description objects such that the aggregation describes a single PDS product. In the PDS4 implementation, labels are constructed using XML.

Logical Identifier (**LID**) – An identifier which identifies the set of all versions of a product.

Versioned Logical Identifier (LIDVID) – The concatenation of a logical identifier with a version identifier, providing a unique identifier for each version of product.

Manifest - A list of contents.

Metadata – Data about data – for example, a 'description object' contains information (metadata) about an 'object.'

Non-Digital Object – An object which does not consist of digital data. Non-digital objects include both physical objects like instruments, spacecraft, and planets, and non-physical objects like missions, and institutions. Non-digital objects are labeled in PDS in order to define a unique identifier (LID) by which they may be referenced across the system.

Object – A single instance of a class defined in the PDS Information Model.

PDS Information Model – The set of rules governing the structure and content of PDS metadata. While the Information Model (IM) has been implemented in XML for PDS4, the model itself is implementation independent.

Product – One or more tagged objects (digital, non-digital, or both) grouped together and having a single PDS-unique identifier. In the PDS4 implementation, the descriptions are combined into a single XML label. Although it may be possible to locate individual objects within PDS (and to find specific bit strings within digital objects), PDS4 defines ‘products’ to be the smallest granular unit of addressable data within its complete holdings.

Tagged Object – An entity categorized by the PDS Information Model, and described by a PDS label.

Registry – A data base that provides services for sharing content and metadata.

Repository – A place, room, or container where something is deposited or stored (often for safety).

XML – eXtensible Markup Language.

XML schema – The definition of an XML document, specifying required and optional XML elements, their order, and parent-child relationships.

1.6 MAVEN Mission Overview

The MAVEN spacecraft launched on an Atlas V on November 18, 2013. After a ten-month ballistic cruise phase, Mars orbit insertion occurred on September 21, 2014. Following a 5-week transition phase, the spacecraft began to orbit Mars at a 75° inclination, with a 4.5 hour period and periapsis altitude of 140-170 km (density corridor of 0.05-0.15 kg/km^3). Over a one-Earth-year period, periapsis precesses over a wide range of latitude and local time, while MAVEN obtains detailed measurements of the upper atmosphere, ionosphere, planetary corona, solar wind, interplanetary/Mars magnetic fields, solar EUV and solar energetic particles, thus defining the interactions between the Sun and Mars. MAVEN is exploring down to the homopause during a series of five 5-day “deep dip” campaigns for which periapsis is lowered to an atmospheric density of 2 kg/km^3 (~125 km altitude) in order to sample the transition from the collisional lower atmosphere to the collisionless upper atmosphere. These five campaigns are interspersed thoughout the mission to sample the subsolar region, the dawn and dusk terminators, the anti-solar region, and the north pole.

1.6.1 Mission Objectives

The primary science objectives of the MAVEN project is to provide a comprehensive picture of the present state of the upper atmosphere and ionosphere of Mars and the processes controlling them and to determine how loss of volatiles to outer space in the present epoch varies with changing solar conditions. Knowing how these processes respond to the Sun’s energy inputs will enable scientists, for the first time, to reliably project processes backward in time to study atmosphere and volatile evolution. MAVEN will deliver definitive answers to high-priority science questions about atmospheric loss (including water) to space that will greatly enhance our understanding of the climate history of Mars. Measurements made by MAVEN will allow us to determine the role that escape to space has played in the evolution of the Mars atmosphere, an essential component of the quest to "follow the water" on Mars. MAVEN will accomplish this by achieving science objectives that answer three key science questions:

- What is the current state of the upper atmosphere and what processes control it?
- What is the escape rate at the present epoch and how does it relate to the controlling processes?
- What has the total loss to space been through time?

MAVEN will achieve these objectives by measuring the structure, composition, and variability of the Martian upper atmosphere, and it will separate the roles of different loss mechanisms for both neutrals and ions. MAVEN will sample all relevant regions of the Martian atmosphere/ionosphere system—from the termination of the well-mixed portion of the atmosphere (the "homopause"), through the diffusive region and main ionosphere layer, up into the collisionless exosphere, and through the magnetosphere and into the solar wind and downstream tail of the planet where loss of neutrals and ionization occurs to space—at all relevant latitudes and local solar times. To allow a meaningful projection of escape back in time, measurements of escaping species will be made simultaneously with measurements of the energy drivers and the controlling magnetic field over a range of solar conditions. Together with measurements of the isotope ratios of major species, which constrain the net loss to space over time, this approach will allow thorough identification of the role that atmospheric escape plays today and to extrapolate to earlier epochs.

1.6.2 Payload

MAVEN uses the following science instruments to measure the Martian upper atmospheric and ionospheric properties, the magnetic field environment, the solar wind, and solar radiation and particle inputs:

- NGIMS Package:
  - Neutral Gas and Ion Mass Spectrometer (NGIMS) measures the composition, isotope ratios, and scale heights of thermal ions and neutrals.
- RS Package:
  - Imaging Ultraviolet Spectrograph (IUVS) remotely measures UV spectra in four modes: limb scans, planetary mapping, coronal mapping and stellar occultations. These measurements provide the global composition, isotope ratios, and structure of the upper atmosphere, ionosphere, and corona.
- PF Package:
  - Supra-Thermal and Thermal Ion Composition (STATIC) instrument measures the velocity distributions and mass composition of thermal and suprathermal ions from below escape energy to pickup ion energies.
  - Solar Energetic Particle (SEP) instrument measures the energy spectrum and angular distribution of solar energetic electrons (30 keV – 1 MeV) and ions (30 keV – 12 MeV).
  - Solar Wind Ion Analyzer (SWIA) measures solar wind and magnetosheath ion density, temperature, and bulk flow velocity. These measurements are used to determine the charge exchange rate and the solar wind dynamic pressure.

- Solar Wind Electron Analyzer (SWEA) measures energy and angular distributions of 5 eV to 5 keV solar wind, magnetosheath, and auroral electrons, as well as ionospheric photoelectrons. These measurements are used to constrain the plasma environment, magnetic field topology and electron impact ionization rate.
- Langmuir Probe and Waves (LPW) instrument measures the electron density and temperature and electric field in the Mars environment. The instrument includes an EUV Monitor that measures the EUV input into Mars atmosphere in three broadband energy channels.
- Magnetometer (MAG) measures the vector magnetic field in all regions traversed by MAVEN in its orbit.

1.6.3 In Situ Key Parameter File

The in situ key parameter files contain data for 235 parameters selected by the instrument leads and other MAVEN scientists. These data consist of values derived from L2 data provided by the in situ instruments (PF and NGIMS packages), as well as ephemeris data from SPICE kernels.

1.7 SIS Content Overview

Section 2 describes the in situ instruments. Section 3 gives an overview of data organization and data flow. Section 4 describes data archive generation, delivery, and validation. Section 5 describes the archive structure and archive production responsibilities. Section 6 describes the file formats used in the archive, including the data product record structures. Individuals involved with generating the archive volumes are listed in Appendix A. Appendix B contains a description of the MAVEN science data file naming conventions. Appendix C, Appendix D, and Appendix E contain sample PDS product labels. Appendix F describes Key Parameter archive product PDS deliveries formats and conventions.

1.8 Scope of this document

The specifications in this SIS apply to all Key Parameter products submitted for archive to the Planetary Data System (PDS), for all phases of the MAVEN mission. This document includes descriptions of archive products that are produced by both the Key Parameter team and by PDS.

1.9 Applicable Documents

[1] Planetary Data System Data Provider's Handbook, Version 1.4.1, February 23, 2016.

[2] Planetary Data System Standards Reference, Version 1.4.0, September 22, 2015.

[3] PDS4 Data Dictionary, – Abridged, Version 1.4.0.0, 30 March 2015.

[4] Planetary Data System (PDS) PDS4 Information Model Specification, Version 1.4.0.0.

[5] Mars Atmosphere and Volatile Evolution (MAVEN) Science Data Management Plan, Rev. C, doc. no.MAVEN-SOPS-PLAN-0068.

[6] Archive of MAVEN CDF in PDS4, Version 3, T. King and J. Mafi, March 13, 2014.

[7] Jakosky, B.M., Lin, R.P., Grebowsky, J.M. et al., The Mars Atmosphere and Volatile Evolution (MAVEN) Mission, Space Sci Rev (2015) 195: 3. https://doi.org/10.1007/s11214-015-0139-x.

[8] Mitchell, D.L., Mazelle, C., Sauvaud, JA. et al., The MAVEN Solar Wind Electron Analyzer, Space Sci Rev (2016) 200: 495. https://doi.org/10.1007/s11214-015-0232-1.

[9] Halekas, J.S., Taylor, E.R., Dalton, G. et al., The Solar Wind Ion Analyzer for MAVEN, Space Sci Rev (2015) 195: 125. https://doi.org/10.1007/s11214-013-0029-z.

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[12] Connerney, J.E.P., Espley, J., Lawton, P. et al., The MAVEN Magnetic Field Investigation, Space Sci Rev (2015) 195: 257. https://doi.org/10.1007/s11214-015-0169-4.

[13] Andersson, L., Ergun, R.E., Delory, G.T. et al., The Langmuir Probe and Waves (LPW) Instrument for MAVEN, Space Sci Rev (2015) 195: 173. https://doi.org/10.1007/s11214-015-0194-3.

[14] Eparvier, F.G., Chamberlin, P.C., Woods, T.N. et al., The Solar Extreme Ultraviolet Monitor for MAVEN, Space Sci Rev (2015) 195: 293. https://doi.org/10.1007/s11214-015-0195-2.

[15] Mahaffy, P.R., Benna, M., King, T. et al., The Neutral Gas and Ion Mass Spectrometer on the Mars Atmosphere and Volatile Evolution Mission, Space Sci Rev (2015) 195: 49. https://doi.org/10.1007/s11214-014-0091-1.

[16] SWEA SIS, Mitchell, D., (urn:nasa:pds:maven.swea.calibrated:document:sis).

[17] SWIA SIS, Halekas, J., (urn:nasa:pds:maven.swia.calibrated:document:sis).

[18] STATIC SIS, McFadden, J., (urn:nasa:pds:maven.static.c:document:sis).

[19] SEP SIS, Larson, D., and Lillis, R., (urn:nasa:pds:maven.sep.calibrated:document:sis).

[20] MAG SIS, Connerney, J., and Espley, J., (urn:nasa:pds:maven.mag.calibrated:document:sis).

[21] LPW SIS, Andersson, L., (urn:nasa:pds:maven.lpw:document:sis).

[22] EUV SIS, Eparvier, F., (urn:nasa:pds:maven.euv:document:sis).

[23] NGIMS SIS, Benna, M., and Elrod, M., (urn:nasa:pds:maven_ngims:document:ngims_pds_sis).

1.10 Audience

This document serves both as a SIS and Interface Control Document (ICD). It describes both the archiving procedure and responsibilities, and data archive conventions and format. It is designed to be used both by the instrument teams in generating the archive, and by those wishing to understand the format and content of the Key Parameter PDS data product archive collection. Typically, these individuals would include scientists, data analysts, and software engineers.

2 Instrument Descriptions

The in situ KP files contain data from each of the in situ instruments onboard the MAVEN spacecraft, i.e. all instruments except the Imaging Ultraviolet Spectrograph (IUVS). Following is a list of the in situ instruments.

-- MAG: Magnetometer

-- LPW: Langmuir Probe and Waves

-- LPW-EUV: Langmuir Probe and Waves – Extreme Ultra-Violet

-- NGIMS: Neutral Gas and Ion Mass Spectrometer

-- SEP: Solar Energetic Particle Detector

-- STATIC: Supra-Thermal and Thermal Ion Composition

-- SWEA: Solar Wind Electron Analyzer

-- SWIA: Solar Wind Ion Analyzer

Full descriptions of all in situ instruments are contained within the SIS documents.

3 Data Overview

This section provides a high level description of archive organization under the PDS4 Information Model (IM) as well as the flow of the data from the spacecraft through delivery to PDS. Unless specified elsewhere in this document, the MAVEN Key Parameter archive conforms with version 1.1.0.1 of the PDS4 IM [4] and version 1.0 of the MAVEN mission schema. A list of the XML Schema and Schematron documents associated with this archive are provided in Table 5 below.

Table 5: MAVEN Key Parameters Schema and Schematron

XML Document	Steward	Product LID
PDS Core Schema, v. 1.4.0.0	PDS	urn:nasa:pds:system_bundle:xml_schema:pds-xml_schema
PDS Core Schematron, v. 1.4.0.0	PDS	urn:nasa:pds:system_bundle:xml_schema:pds-xml_schema
MAVEN Mission Schema, v. 1.0.4.0	MAVEN	urn:nasa:pds:system_bundle:xml_schema:mvn-xml_schema
MAVEN Mission Schematron, v. 1.0.4.0	MAVEN	urn:nasa:pds:system_bundle:xml_schema:mvn-xml_schema

3.1 Data Processing Levels

A number of different systems may be used to describe data processing level. This document refers to data by their PDS4 processing level. Table 6 provides a description of these levels along with the equivalent designations used in other systems.

Table 6: Data processing level designations

PDS4 processing level	PDS4 processing level description	MAVEN Processing Level	CODMAC Level	NASA Level
Raw	Original data from an instrument. If compression, reformatting, packetization, or other translation has been applied to facilitate data transmission or storage, those processes are reversed so that the archived data are in a PDS approved archive format.	0	2	1A
Reduced	Data that have been processed beyond the raw stage but which are not yet entirely independent of the instrument.	1	2	1A
Calibrated	Data converted to physical units entirely independent of the instrument.	2	3	1B

PDS4 processing level	PDS4 processing level description	MAVEN Processing Level	CODMAC Level	NASA Level
Derived	Results that have been distilled from one or more calibrated data products (for example, maps, gravity or magnetic fields, or ring particle size distributions). Supplementary data, such as calibration tables or tables of viewing geometry, used to interpret observational data should also be classified as 'derived' data if not easily matched to one of the other three categories.	3+	4+	2+

3.2 Products

A PDS product consists of one or more digital and/or non-digital objects, and an accompanying PDS label file. Labeled digital objects are data products (i.e. electronically stored files). Labeled non-digital objects are physical and conceptual entities which have been described by a PDS label. PDS labels provide identification and description information for labeled objects. The PDS label defines a Logical Identifier (LID) by which any PDS labeled product is referenced throughout the system. In PDS4 labels are XML formatted ASCII files. More information on the formatting of PDS labels is provided in Section 6.3. More information on the usage of LIDs and the formation of MAVEN LIDs is provided in Section 5.1.

3.3 Product Organization

The highest level of organization for PDS archive is the bundle. A bundle is a list of one or more related collection products which may be of different types. A collection is a list of one or more related basic products which are all of the same type. Figure 1 below illustrates these relationships.

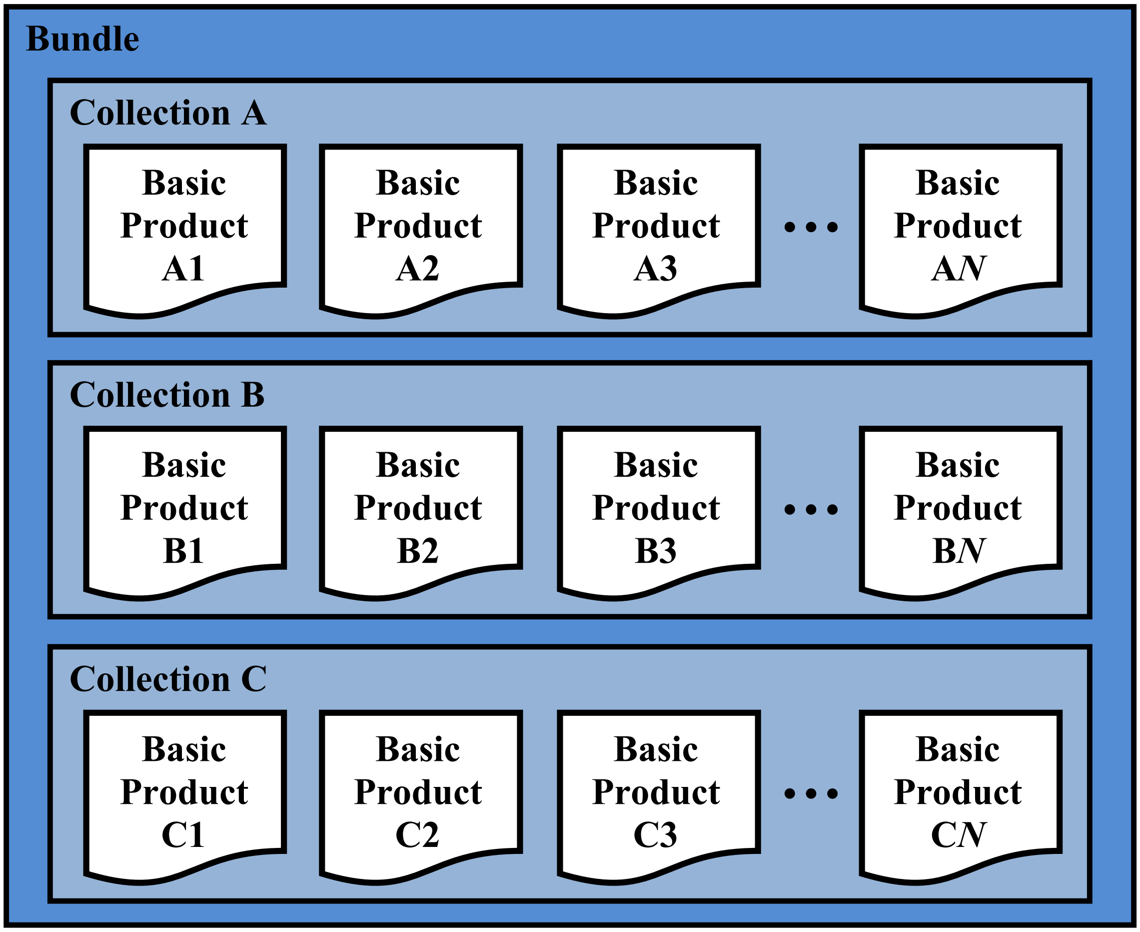

Figure 1: A graphical depiction of the relationship among bundles, collections, and basic products.

Bundles and collections are logical structures, not necessarily tied to any physical directory structure or organization. Bundle and collection membership is established by a member inventory list. Bundle member inventory lists are provided in the bundle product labels themselves. Collection member inventory lists are provided in separate collection inventory table files. Sample bundle and collection labels are provided in Appendix C and Appendix D, respectively.

3.3.1 Collection and Basic Product Types

Collections are limited to a single type of basic products. The types of archive collections that are defined in PDS4 are listed in Table 7.

Table 7: Collection Product Types

Collection Type	Description
Browse	Contains products intended for data characterization, search, and viewing, and not for scientific research or publication.
Calibration	Contains data and files necessary for the calibration of basic products.
Context	Contains products which provide for the unique identification of objects which form the context for scientific observations (*e.g.* spacecraft, observatories, instruments, targets, etc.).
Document	Contains electronic document products which are part of the PDS Archive.
Data	Contains scientific data products intended for research and publication.
SPICE	Contains NAIF SPICE kernels.
XML_Schema	Contains XML schemas and related products which may be used for generating and validating PDS4 labels.

3.4 Bundle Products

The Key Parameter data archive is organized into 1 bundle. A description of the bundle is provided in Table 8. A more detailed description of the contents and format of the bundle is provided in Section 5.2. In situ KP data will only be generated from level 2 data.

Table 8: Key Parameter Bundles

Bundle Logical Identifier	PDS4 Reduction Level	Description	Data Provider
urn:nasa:pds:maven.insitu.calibrated	2	ASCII files containing 235 columns consisting of ephemeris information as well as data from all MAVEN in situ instruments.	SSL, UC Berkeley

3.5 Data Flow

This section describes only those portions of the MAVEN data flow that are directly connected to archiving the in situ KP data. A full description of MAVEN data flow is provided in the MAVEN Science Data Management Plan [5].

The in situ KP data files will consist of ASCII files generated by the ITFs (and DPFs as applicable, as determined by the SDWG) as part of their data processing, and will be delivered to the SDC for access by the MAVEN team and eventual archiving at the PDS as with all other science data products.

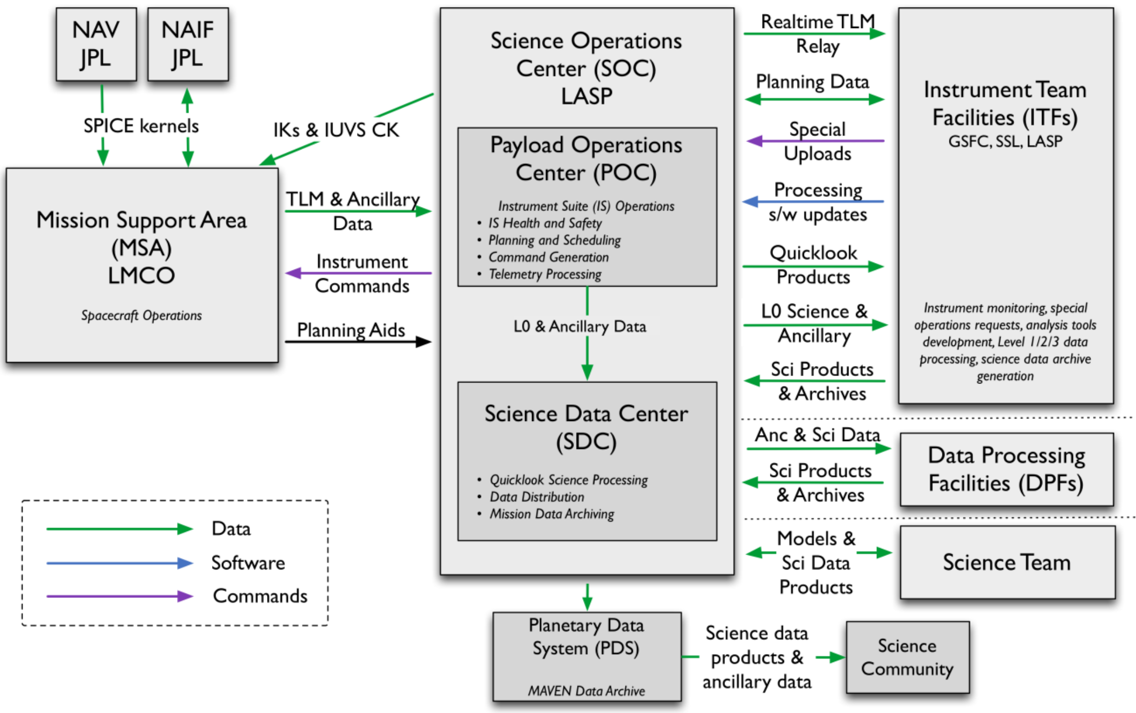

Figure 2: MAVEN Ground Data System responsibilities and data flow. Note that this figure includes portions of the MAVEN GDS which are not directly connected with archiving, and are therefore not described in Section 3.5 above.

4 Archive Generation

The Key Parameter archive products are produced by the Key Parameter team in cooperation with the SDC, and with the support of the PDS Planetary Plasma Interactions (PPI) Node at the University of California, Los Angeles (UCLA). The archive volume creation process described in this section sets out the roles and responsibilities of each of these groups. The assignment of tasks has been agreed upon by all parties. Archived data received by the PPI Node from the Key Parameter team are made available to PDS users electronically as soon as practicable but no later than two weeks after the delivery and validation of the data.

4.1 Data Processing and Production Pipeline

The following sections describe the process by which data products in the Key Parameter bundle listed in Table 8 are produced.

4.1.1 KP Data Production Pipeline

The Key Parameter data is generated directly and automatically from level 2 data (calibrated, in physical units). Descriptions of the data production pipelines for each of the in situ instruments are found in their respective SIS documents.

4.2 Data Validation

A routine has been created that runs automated checks for the data files (i.e. negative temperatures, Infinite values, etc.). Manual checks (visibly scanning the data) are performed as well.

Routine data deliveries to the PDS are validated at the PPI node to ensure that the delivery meets PDS standards, and that the data conform to the SIS as approved in the peer review. As long as there are no changes to the data product formats, or data production pipeline, no additional external review will be conducted.

4.2.1 PDS Peer Review

The PPI node conducted a full peer review of all of the data types that the Key Parameter team intends to archive. The review data consisted of fully formed bundles populated with candidate final versions of the data and other products and the associated metadata.

Table 9: MAVEN PDS review schedule

Date	Activity	Responsible Team
2014-Mar-24	Signed SIS deadline	ITF
2014-Apr-18	Sample data products due	ITF
2014-May through 2014-Aug	Preliminary PDS peer review (SIS, sample data files)	SDC
2015-June	Release #1: Data PDS peer review	PDS
2015-July	Release #1: Public release	PDS

Reviews will include a preliminary delivery of sample products for validation and comment by PDS PPI and Engineering node personnel. The data provider will then address the comments coming out of the preliminary review, and generate a full archive delivery to be used for the peer review.

Reviewers will include MAVEN Project and Key Parameter team representatives, researchers from outside of the MAVEN project, and PDS personnel from the Engineering and PPI nodes. Reviewers will examine the sample data products to determine whether the data meet the stated science objectives of the instrument and the needs of the scientific community and to verify that the accompanying metadata are accurate and complete. The peer review committee will identify any liens on the data that must be resolved before the data can be 'certified' by PDS, a process by which data are made public as minor errors are corrected.

In addition to verifying the validity of the review data, this review will be used to verify that the data production pipeline by which the archive products are generated is robust. Additional deliveries made using this same pipeline will be validated at the PPI node, but will not require additional external review.

As expertise with the instruments and data develops the Key Parameter team may decide that changes to the structure or content of its archive products are warranted. Any changes to the archive products or to the data production pipeline will require an additional round of review to verify that the revised products still meet the original scientific and archival requirements or whether those criteria have been appropriately modified. Whether subsequent reviews require external reviewers will be decided on a case-by-case basis and will depend upon the nature of the changes. A comprehensive record of modifications to the archive structure and content is kept in the Modification_History element of the collection and bundle products.

The instrument teams and other researchers are encouraged to archive additional Key Parameter products that cover specific observations or data-taking activities. The schedule and structure of any additional archives are not covered by this document and should be worked out with the PPI node.

4.3 Data Transfer Methods and Delivery Schedule

The SDC is responsible for delivering data products to the PDS for long-term archiving. While SSL is primarily responsible for the design and generation of Key Parameter archives, the archival process is managed by the SDC. The first PDS delivery will take place within 6 months of the start of science operations. Additional deliveries will occur every following 3 months and one final delivery will be made after the end of the mission. Science data are delivered to the PDS within 6 months of its collection. If it becomes necessary to reprocess data which have already been delivered to the archive, SSL will reprocess the data and deliver them to the SDC for inclusion in the next archive delivery. A summary of this schedule is provided in Table 10 below.

Table 10: Archive bundle delivery schedule

Bundle Logical Identifier	First Delivery to PDS	Delivery Schedule	Estimated Delivery Size
urn:nasa:pds:maven.insitu.calibrated	No later than 6 months after the start of science operations	Every 3 months	4 Gigabytes (43 MB/day * 90 days)

Each delivery will be organized into directory structures consistent with the archive design described in Section 5, and combined into a deliverable file(s) using file archive and compression software. When these files are unpacked at the PPI Node in the appropriate location, the constituent files will be organized into the archive structure.

Archive deliveries are made in the form of a "delivery package". Delivery packages include all of the data being transferred along with a transfer manifest, which helps to identify all of the products included in the delivery, and a checksum manifest which helps to insure that integrity of the data is maintained through the delivery. The format of these files is described in Section 6.4.

Data are transferred electronically (using the *ssh* protocol) from the SDC to an agreed upon location within the PPI file system. PPI will provide the SDC a user account for this purpose. Each delivery package is made in the form of a compressed *tar* or *zip* archive. Only those files that have changed since the last delivery are included. The PPI operator will decompress the data, and verify that the archive is complete using the transfer and MD5 checksum manifests that were included in the delivery package. Archive delivery status will be tracked using a system defined by the PPI node.

Following receipt of a data delivery, PPI will reorganize the data into its PDS archive structure within its online data system. PPI will also update any of the required files associated with a PDS archive as necessitated by the data reorganization. Newly delivered data are made available publicly through the PPI online system once accompanying labels and other documentation have been validated. It is anticipated that this validation process will require no more than fourteen working days from receipt of the data by PPI. However, the first few data deliveries may require more time for the PPI Node to process before the data are made publicly available.

The MAVEN prime mission begins approximately 5 weeks following MOI and lasts for 1 Earth-year. Table 10 shows the data delivery schedule for the entire mission.

4.4 Data Product and Archive Volume Size Estimates

Key Parameter data products consist of files that span 24 hours breaking at 0h UTC/SCET. Files vary in size depending on the telemetry rate and allocation.

4.5 Backups and duplicates

The PPI Node keeps three copies of each archive product. One copy is the primary online archive copy, another is an onsite backup copy, and the final copy is an off-site backup copy. Once the archive products are fully validated and approved for inclusion in the archive, copies of the products are sent to the National Space Science Data Center (NSSDC) for long-term archive in a NASA-approved deep-storage facility. The PPI Node may maintain additional copies of the archive products, either on or off-site as deemed necessary. The process for the dissemination and preservation of Key Parameter data is illustrated in Figure 3.

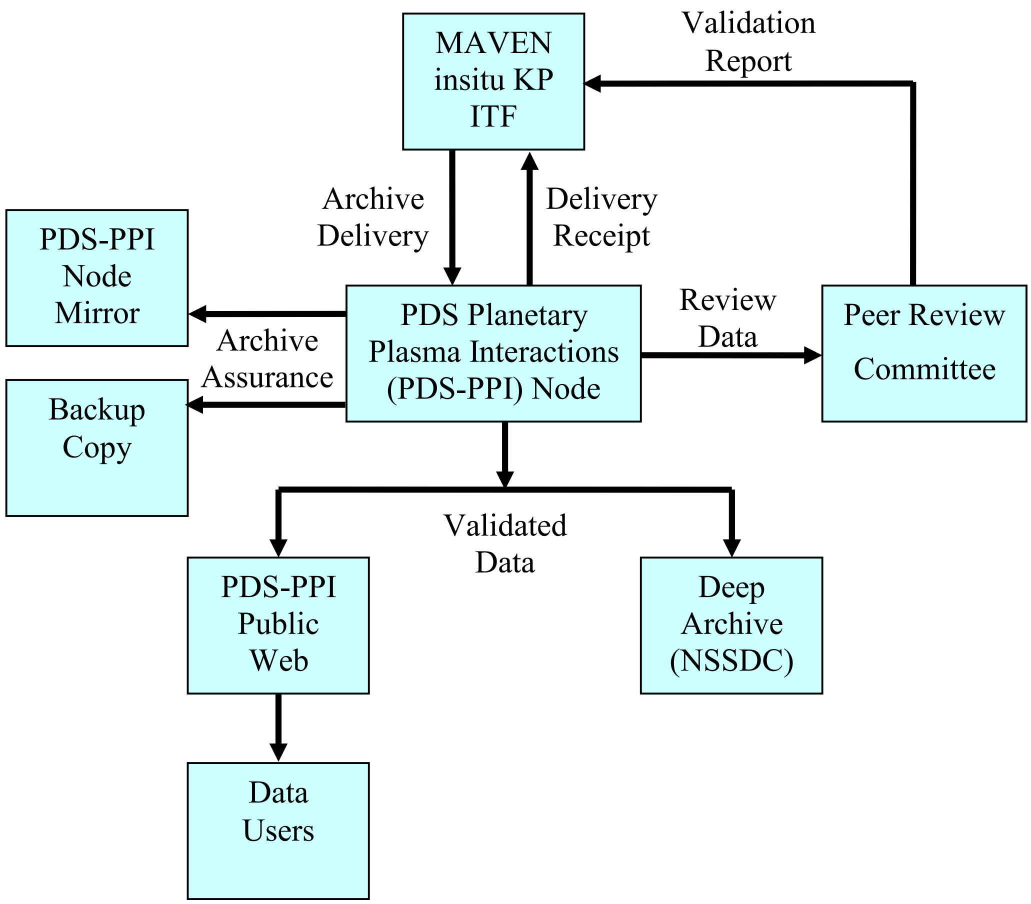

Figure 3: Duplication and dissemination of Key Parameter archive products at PDS/PPI.

5 Archive organization and naming

This section describes the basic organization of the Key Parameter bundle, and the naming conventions used for the product logical identifiers, and bundle, collection, and basic product filenames.

5.1 Logical Identifiers

Every product in PDS is assigned an identifier which allows it to be uniquely identified across the system. This identifier is referred to as a Logical Identifier or LID. A LIDVID (Versioned Logical Identifier) includes product version information, and allows different versions of a specific product to be referenced uniquely. A product's LID and VID are defined as separate attributes in the product label. LIDs and VIDs are assigned by the entity generating the labels and are formed according to the conventions described in sections 5.1.1 and 5.1.2 below. The uniqueness of a product's LIDVID may be verified using the PDS Registry and Harvest tools.

5.1.1 LID Formation

LIDs take the form of a Uniform Resource Name (URN). LIDs are restricted to ASCII lower case letters, digits, dash, underscore, and period. Colons are also used, but only to separate prescribed components of the LID. Within one of these prescribed components dash, underscore, or period are used as separators. LIDs are limited in length to 255 characters.

MAVEN Key Parameter LIDs are formed according to the following conventions:

- Bundle LIDs are formed by appending a bundle specific ID to the MAVEN [INST] base ID:

  urn:nasa:pds:maven.insitu.calibrated.<bundle ID>

  Since all PDS bundle LIDs are constructed this way, the combination of maven.kp.<bundle ID> must be unique across all products archived with the PDS.

  Collection LIDs are formed by appending a collection specific ID to the collection's parent bundle LID:

  urn:nasa:pds: maven.insitu.calibrated.<bundle ID>:<collection ID>

  Since the collection LID is based on the bundle LID, which is unique across PDS, the only additional condition is that the collection ID must be unique across the bundle. Collection IDs correspond to the collection type (e.g. "browse", "data", "document", etc.). Additional descriptive information may be appended to the collection type (e.g. "data-raw", "data-calibrated", etc.) to insure that multiple collections of the same type within a single bundle have unique LIDs.

- Basic product LIDs are formed by appending a product specific ID to the product's parent collection LID:

  urn:nasa:pds: maven.insitu.calibrated.<bundle ID>:<collection ID>:<product ID>

  Since the product LID is based on the collection LID, which is unique across PDS, the only additional condition is that the product ID must be unique across the collection.

A list of Key Parameter bundle LIDs is provided in Table 8. Collection LIDs are listed in Tables 11 and 12.

5.1.2 VID Formation

Product version ID's consist of major and minor components separated by a "." (M.n). Both components of the VID are integer values. The major component is initialized to a value of "1", and the minor component is initialized to a value of "0". The minor component resets to "0" when the major component is incremented.

5.2 Key Parameter Archive Contents

The Key Parameter archive includes the bundle listed in Table 8. The following sections describe the contents of this bundle in greater detail.

5.2.1 Key Parameter Bundle

The insitu.calibrated level 2 science.data bundle contains selected fully calibrated (L2) data from the Particles and Fields package and NGIMS, together with ephemeris information. These data are in physical units and are averaged/sampled at a uniform cadence.

Table 11: Key Parameter collections

Collection LID	Description
urn:nasa:pds:maven.insitu.calibrated:data.kp	Time-ordered table of Key Parameters from the in situ instruments on MAVEN: STATIC, SWIA, SWEA, SEP, LPW, EUV, MAG, NGIMS.
urn:nasa:pds:maven.insitu.calibrated:document	Documents related to the Insitu Calibrated KP bundle

5.2.1.1 insitu.calibrated:data.kp Data Collection

In situ instrument data is derived directly from Level 2 data. Ephemeris information is derived using SPICE libraries and kernels provided by MAVEN/NAV team and Lockheed-Martin. The file begins with header lines giving the titles, instrument, units, column number, output format, and notes for each parameter column. After these header lines, rows of data follow a 4-second cadence when MAVEN is at an altitude of less than 500 km, otherwise the time cadence is 8 seconds. The kp data for the MAG and EUV instruments are derived by *averaging* L2 data over the corresponding time interval; whereas for all other instruments the kp data are derived by *interpolating* the L2 data. An average is used for the MAG and EUV instruments due to their higher respective sampling frequencies of 32 Hz and 1 Hz. The kp time corresponds to the midpoint of the L2 interval over which data is averaged. The instruments often change modes/parameters depending on altitude and the columns of data are grouped by instrument. Most parameters have an associated Quality column that contains an uncertainty value or a quality of data value. Where data are not produced, NAN's are generated.

5.2.1.2 insitu.calibrated:document Document Collection

The Key Parameter insitu.calibrated:document document collection contains documents which are useful for understanding and using the insitu.calibrated:data.kp bundle. Table 12 contains a list of the documents included in this collection, along with the LID, and responsible group. Following this a brief description of each document is also provided.

Table 12: Key Parameter Calibrated Science Data Documents

Document Name	LID	Responsiblility
MAVEN Science Data Management Plan	urn:nasa:pds:maven:document:sdmp	MAVEN Project
MAVEN Mission Description	urn:nasa:pds:maven:document:mission.description	MAVEN Project
MAVEN Spacecraft Description	urn:nasa:pds:maven:document:spacecraft.description	MAVEN Project
MAVEN KP Archive SIS	urn:nasa:pds:maven.insitu.calibrated:document:SIS	KP Team
MAVEN EUV Archive SIS	urn:nasa:pds:maven:document.euv:sis	EUV Team
MAVEN LPW Archive SIS	urn:nasa:pds:maven.lpw:document:sis	LPW Team
MAVEN MAG Archive SIS	urn:nasa:pds:maven.mag:document:SIS	MAG Team
MAVEN NGIMS Archive SIS	urn:nasa:pds:maven.ngims:document:SIS	NGIMS Team
MAVEN SEP Archive SIS	urn:nasa:pds:maven.sep:document:SIS	SEP Team
MAVEN STATIC Archive SIS	urn:nasa:pds:maven.static:document:SIS	STATIC Team
MAVEN SWEA Archive SIS	urn:nasa:pds:maven.swea:document:SIS	SWEA Team
MAVEN SWIA Archive SIS	urn:nasa:pds:maven.swia:document:sis	SWIA Team
MAVEN EUV Software Description	urn:nasa:pds:maven:document.euv:process	EUV Team
MAVEN LPW Software Description	urn:nasa:pds:maven.lpw:document:process	LPW Team
MAVEN SEP Instrument Description	urn:nasa:pds:maven.sep:document:sep.instrument.description	SEP Team
MAVEN STATIC Instrument Paper	urn:nasa:pds:maven.static:document:STATIC_instrument_paper	STATIC Team
MAVEN SWEA Instrument Paper	urn:nasa:pds:maven.swea:document:swea.instpaper	SWEA Team
MAVEN SWIA Instrument Paper	urn:nasa:pds:maven.swia:document:instpaper	SWIA Team
MAVEN SEP Calibration Description	urn:nasa:pds:maven.sep.calibrated:document:calibration.description	SEP Team

MAVEN Science Data Management Plan – describes the data requirements for the MAVEN mission and the plan by which the MAVEN data system will meet those requirements

MAVEN Key Parameter Archive SIS – describes the format and content of the Key Parameter PDS data archive, including descriptions of the data products and associated metadata, and the archive format, content, and generation pipeline (this document)

MAVEN Mission Description – describes the MAVEN mission.

MAVEN Spacecraft Description – describes the MAVEN spacecraft.

EUV Instrument Description – describes the MAVEN Key Parameter instrument.

EUV Calibration Description – describes the algorithms and procedures used to apply the calibration performed on the data included in this bundle.

While responsibility for the individual documents varies, the document collection itself is managed by the PDS/PPI node.

6 Archive product formats

Data that comprise the Key Parameter archives are formatted in accordance with PDS specifications [see *Planetary Science Data Dictionary* [4], *PDS Data Provider's Handbook* [2], and *PDS Standards Reference* [3]. This section provides details on the formats used for each of the products included in the archive.

6.1 Data File Formats

This section describes the format and record structure of each of the data file types.

6.1.1 KP data file structure

KP data files will be archived as fixed width ASCII tables with ASCII headers. Each file is accompanied by a PDS label file (*.xml).

Table 13: Calibrated data file structure.

Field Name	Start Byte*	Bytes*	Description
TIME (UTC/SCET)	1	19	Four-second cadence when spacecraft altitude is less than 500 km, otherwise eight-second cadence. All parameters on uniform time grid established by SWEA/SWIA/STATIC/LPW
Electron Density	20	16	LPW - Derived from the LP sweep and when available the Plasma line. Units: cm^{-3}
Quality	36	16	LPW – minimum value
Quality	52	16	LPW – maximum value
Electron Temperature	68	16	LPW - Derived from the LP sweep. Units: Kelvin
Quality	84	16	LPW – minimum value
Quality	100	16	LPW – maximum value
Spacecraft Potential	116	16	LPW - Measured from the probe potentials. Units: Volt
Quality	132	16	LPW – minimum value
Quality	148	16	LPW – maximum value

E- Field Wave Power (2-215 Hz)	164	16	LPW - The integrated wave power over frequency range 2-215 Hz from the onboard calculated FFT. Units: $(V/m)^2/Hz$
Quality	180	16	LPW - Quality: Ranges from 0 to 100, where 100 is the highest confidence level. Use data with quality flag 50 or above.
E- Field Wave Power (256 Hz – 15.8 kHz)	196	16	LPW - The integrated wave power over frequency range 256 Hz – 15.8 kHz from the onboard calculated FFT. Units: $(V/m)^2/Hz$
Quality	212	16	LPW - Quality: Ranges from 0 to 100, where 100 is the highest confidence level. Use data with quality flag 50 or above.
E-Field Wave Power (24.6 kHz – 1.3 MHz)	228	16	LPW - The integrated wave power over frequency range 24.6 kHz – 1.3 MHz from the onboard calculated FFT. Units: $(V/m)^2/Hz$
Quality	244	16	LPW - Quality: Ranges from 0 to 100, where 100 is the highest confidence level. Use data with quality flag 50 or above.
EUV Irradiance (0.1-7.0 nm)	260	16	LPW-EUV: EUV irradiance in the 0.1-7.0 nm bandpass. Units: (W/m^2)
Quality	276	16	LPW-EUV: Data flag: 0=Good solar, 1=Occultation, 2=No pointing info, 3=Sun NOT fully In FOV, 4=Sun NOT In FOV, 5=Windowed, 6=Eclipse, 7=spare
EUV Irradiance (17-22 nm)	292	16	LPW-EUV: EUV irradiance in the 17-22 nm bandpass. Units: (W/m^2)
Quality	308	16	LPW-EUV: Data flag: 0=Good solar, 1=Occultation, 2=No pointing info, 3=Sun NOT fully In FOV, 4=Sun NOT In FOV, 5=Windowed, 6=Eclipse, 7=spare
EUV Irradiance (Lyman-alpha)	324	16	LPW-EUV: EUV irradiance in the Lyman-alpha bandpass. Units: (W/m^2)
Quality	340	16	LPW-EUV: Data flag: 0=Good solar, 1=Occultation, 2=No pointing info, 3=Sun NOT fully In FOV, 4=Sun NOT In FOV, 5=Windowed, 6=Eclipse, 7=spare

Solar Wind Electron Density	356	16	SWEA: Density of solar wind or magnetosheath electrons based on moments of the electron distribution after correcting for the spacecraft potential. (Thermal ionospheric electrons are below SWEA's energy range.) Units: (cm^{-3})
Quality	372	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Solar Wind Electron Temperature	388	16	SWEA: Temperature of solar wind or magnetosheath electrons based on moments of the electron distribution after correcting for the spacecraft potential. (Thermal ionospheric electrons are below SWEA's energy range.) Units: eV
Quality	404	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Electron Parallel Flux (5-100 eV)	420	16	SWEA: Electron energy flux from 5 eV to 100 eV for pitch angles from 0 to 90 degrees. Units: eV/(cm^2-s-ster).
Quality	436	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Electron Parallel Flux (100-500 eV)	452	16	SWEA: Electron energy flux from 100 eV to 500 eV for pitch angles from 0 to 90 degrees. Units: eV/(cm^2-s-ster).
Quality	468	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Electron Parallel Flux (500-1000 eV	484	16	SWEA: Electron energy flux from 500 eV to 1000 eV for pitch angles from 0 to 90 degrees. Units: eV/(cm^2-s-ster).
Quality	500	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Electron Anti-Parallel Flux (5-100 eV)	516	16	SWEA: Electron energy flux from 5 eV to 100 eV for pitch angles from 90 to 180 degrees. Units: eV/(cm^2-s-ster).
Quality	532	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.

Electron Anti-Parallel Flux (100-500 eV)	548	16	SWEA: Electron energy flux from 100 eV to 500 eV for pitch angles from 90 to 180 degrees. Units: eV/(cm^2-s-ster).
Quality	564	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
Electron Anti-Parallel Flux (500-1000 eV)	580	16	SWEA: Electron energy flux from 500 eV to 1000 eV for pitch angles from 90 to 180 degrees Units: eV/(cm^2-s-ster).
Quality	596	16	SWEA: Statistical uncertainty (1 σ), not including systematic error.
NOTE PERTAINING TO SWEA ELECTRON FLUX COLUMNS: *Level 2 MAG data are used to map pitch angle over SWEA's field of view with a resolution 16 times finer than the instrument's intrinsic angular resolution of ~20 degrees. The parallel (anti-parallel) flux is calculated by averaging solid angle bins that are entirely contained in the 0-90 degree (90-180 degree) range. Bins that straddle the 90-degree pitch angle boundary or are blocked by the spacecraft are excluded.*			
Electron Spectrum Shape Parameter	612	16	SWEA: An empirical parameter based on the spectral shape from 3 to 100 eV. Values <~ 1 indicate the spectrum is dominated by ionospheric photoelectrons. Values > 2 indicate the spectrum is dominated by, or has a significant contribution from, non-ionospheric electrons. Dimensionless
Quality	628	16	SWEA: Unused, all values set to NaN

NOTE PERTAINING TO SWEA ELECTRON SPECTRUM SHAPE PARAMETER: *To calculate the shape parameter we compare a measured energy spectrum to a template. The template is obtained from measured SWEA spectra in a region where the suprathermal population is dominated by ionospheric photoelectrons. Such regions often occur in sunlight near periapsis (~150-170 km altitude), and are identified by the presence of three features in the electron energy spectrum: (1) the He-II peak at ~23 eV, (2) the Al edge at ~60 eV, and (3) the oxygen Auger peak at ~500 eV. At higher energies the flux drops sharply to the instrument's background level, indicating a negligible contribution from electron populations of solar wind origin. The template spectrum is averaged over a time interval long enough to provide good statistics up to 500 eV.* *Since we are interested in comparing the spectral shape and not the overall flux level, we calculate the derivative dlog(Eflux)/dlog(E) and restrict the energy range from 3 to 100 eV. This range contains the He-II and Al-edge features, which, if present, can be observed well above background in a single 2-second integration.* *For each input energy spectrum, we calculate dlog(Eflux)/dlog(E), subtract the template, and sum the result from 3 to 100 eV to produce a single number. This shape parameter (P) can be interpreted as follows:* *P < 1 : The spectrum is dominated by ionospheric photoelectrons. The He-II and Al-edge features are clearly observed, and there is a negligible contribution from electrons of solar wind origin, which would tend to wash out the photoelectron features.* *1 < P < 2 : Photoelectrons are present, but there is a contribution from some other population(s) that wash out but don't completely obscure the photoelectron features.* *P > 2 : There is no evidence for photoelectrons. The spectrum is dominated by electrons of solar wind origin.* *These ranges are approximate. Typical values outside of the ionosphere are 2.5-3 in the upstream solar wind, 3-5 in the sheath, 2-3 in the magnetic pileup region (induced magnetosphere), and 2.5 in the tail.* *The template was obtained during a time when the spacecraft potential was small and negative, resulting in negligible energy shifts of the He-II and Al-edge features. Consequently, the shape parameter will not properly identify ionospheric photoelectrons when the spacecraft potential is large enough (magnitude > 4 Volts) to shift the He-II feature from its nominal energy. Spacecraft potentials up to -20 V can occur below ~300-km altitude on some periapsis passes, depending on spacecraft attitude and illumination.* *The shape parameter cannot be used to identify suprathermal electron voids, since the signal-to-noise ratio within the voids is too low to calculate dlog(Eflux)/dlog(E). During these times, the shape parameter is set to a fill value. However, suprathermal electron voids can be readily identified using 100-500-eV parallel and anti-parallel fluxes.*			
H+ Density	644	16	SWIA: Total ion density from SWIA onboard moment calculation, assuming 100% protons

Quality	660	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite
H+ Flow Velocity MSO X	676	16	SWIA: Bulk ion flow velocity X-component from SWIA onboard moment calculation, assuming 100% protons
Quality	692	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite
H+ Flow Velocity MSO Y	708	16	SWIA: Bulk ion flow velocity Y-component from SWIA onboard moment calculation, assuming 100% protons
Quality	724	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite
H+ Flow Velocity MSO Z	740	16	SWIA: Bulk ion flow velocity Z-component from SWIA onboard moment calculation, assuming 100% protons
Quality	756	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite
H+ Temperature	772	16	SWIA: Scalar ion temperature from SWIA onboard moment calculation, assuming 100% protons
Quality	788	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite
Solar Wind Dynamic Pressure	804	16	SWIA: Ion dynamic pressure computed on the SWIA ground from density and velocity moments, assuming 100% protons
Quality	820	16	SWIA: Quality flag (0 = bad, 1 = good) indicating whether the distribution is well-measured and decommutation parameters are definite

STATIC Quality Flag	836	16	Quality Flag bits. Valid=0, Flag=1 Bit 0 – test pulser on Bit 1 – diagnostic mode Bit 2 - dead time correction >2 flag Bit 3 – detector droop correction >2 flag Bit 4 – dead time correction not at event time Bit 5 – electrostatic attenuator problem Bit 6 – attenuator change during accumulation Bit 7 – mode change during accumulation Bit 8 – LPW interference with data Bit 9 – high background Bit 10 – no background subtraction array Bit 11 – missing spacecraft potential Bit 12 – inflight calibration incomplete Bit 13 – geometric factor problem Bit 14 – ion suppression problem Bit 15 – 0
H+ Density	852	16	STATIC: H^+ number density below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram and Conic modes.
Quality	868	16	STATIC: Number of counts in the measurement
O+ Density	884	16	STATIC: O^+ number density below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram or Conic mode.
Quality	900	16	STATIC: Number of counts in the measurement
O2+ Density	916	16	STATIC: O_2^+ number density below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram or Conic mode.
Quality	932	16	STATIC: Number of counts in the measurement
H+ Temperature	948	16	STATIC: H^+ RAM temperature below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram or Conic mode.

Quality	964	16	STATIC: Number of counts in the measurement
O+ Temperature	980	16	STATIC: O^+ RAM temperature below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram or Conic mode.
Quality	996	16	STATIC: Number of counts in the measurement
O2+ Temperature	1012	16	STATIC: O_2^+ RAM temperature below TBD km altitude determined from APID c6 (32 energy x 64 mass) while in Ram or Conic mode.
Quality	1028	16	STATIC: Number of counts in the measurement
O_2+ Flow Velocity MAVEN_APP X	1044	16	STATIC: O_2^+ MAVEN_APP X-component of velocity below TBD km altitude determined from APID c6 while in Ram or Conic mode.
Quality	1060	16	STATIC: Number of counts in the measurement
O_2+ Flow Velocity MAVEN_APP Y	1076	16	STATIC: O_2^+ MAVEN_APP Y-component of velocity below TBD km altitude determined from APID ca while in Ram or Conic mode.
Quality	1092	16	STATIC: Number of counts in the measurement
O_2+ Flow Velocity MAVEN_APP Z	1108	16	STATIC: O_2^+ MAVEN_APP Z-component of velocity below TBD km altitude determined from APID c8 while in Ram or Conic mode.
Quality	1124	16	STATIC: Number of counts in the measurement
O2+ Flow Velocity MSO X	1140	16	STATIC: O_2^+ MSO X-component of velocity below TBD km altitude while in Ram or Conic mode.
Quality	1156	16	STATIC: Number of counts in the measurement
O2+ Flow Velocity MSO Y	1172	16	STATIC: O_2^+ MSO Y-component of velocity below TBD km altitude while in Ram or Conic mode.

Quality	1188	16	STATIC: Number of counts in the measurement
O2+ Flow Velocity MSO Z	1204	16	STATIC: O_2^+ MSO Z-component of velocity below TBD km altitude while in Ram or Conic mode.
Quality	1220	16	STATIC: Number of counts in the measurement
STATIC CHARACTERISTIC COLUMNS (ENERGY, DIRECTION, ANGULAR WIDTH) ARE BASED ON THE PEAK FLUX.			
H+ Omni-Directional Flux	1236	16	STATIC: H^+ omni-directional flux above TBD km altitude determined from APID c6 while in Pickup and Eclipse mode.
H+ Characteristic Energy	1252	16	STATIC: H^+ omni-directional characteristic energy (energy flux / particle flux) above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
Quality	1268	16	STATIC: Number of counts in the measurement
He++ Omni-Directional Flux	1284	16	STATIC: He^{++} omni-directional flux above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
He++ Characteristic Energy	1300	16	STATIC: He^{++} omni-directional characteristic energy (energy flux / particle flux) above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
Quality	1316	16	STATIC: Number of counts in the measurement
O+ Omni-Directional Flux	1332	16	STATIC: O^+ omni-directional flux above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
O+ Characteristic Energy	1348	16	STATIC: O^+ omni-directional characteristic energy (energy flux / particle flux) above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
Quality	1364	16	STATIC: Number of counts in the measurement
O2+ Omni-Directional Flux	1380	16	STATIC: $O2^+$ omni-directional flux above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.

O2+ Characteristic Energy	1396	16	STATIC: $O2^{+}$ omni-directional characteristic energy (energy flux / particle flux) above TBD km altitude determined from APID c6 while in Pickup, Eclipse, and Protect mode.
Quality	1412	16	STATIC: Number of counts in the measurement
H+ Characteristic Direction MSO X	1428	16	STATIC: H^{+} MSO X-direction of flux above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
H+ Characteristic Direction MSO Y	1444	16	STATIC: H^{+} MSO Y-direction of flux above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
H+ Characteristic Direction MSO Z	1460	16	STATIC: H^{+} MSO Z-direction of flux above TBD km altitude determined from TBD APID while in Pickup, Eclipse, and Protect mode.
H+ Characteristic Angular Width	1476	16	STATIC: H^{+} flux angular width above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
Quality	1492	16	STATIC: Number of counts in the measurement
DOMINANT PICKUP ION IS BASED ON THE PEAK FLUX.			
Dominant Pickup Ion Characteristic Direction MSO X	1508	16	STATIC: Dominant pickup ion MSO X-direction of flux above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
Dominant Pickup Ion Characteristic Direction MSO Y	1524	16	STATIC: Dominant pickup ion MSO Y-direction of flux above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
Dominant Pickup Ion Characteristic Direction MSO Z	1540	16	STATIC: Dominant pickup ion MSO Z-direction of flux above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
Dominant Pickup Ion Characteristic Angular Width	1556	16	STATIC: Dominant pickup ion flux angular width above TBD km altitude determined from APID D0 AND CE while in Pickup, Eclipse, and Protect mode.
Quality	1572	16	STATIC: Number of counts in the measurement

Total Ion Flux (30 keV - 1 MeV) – 1 (FOV 1-Forward)	1588	16	SEP: Energy flux of ions in the 1-Forward field of view, integrated over the energy range 0.03-1.0 MeV, in units of eV/(cm^2-s-ster).
Uncertainty	1604	16	SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Ion Flux (30 keV - 1 MeV) – 2 (FOV 1-Reverse)	1620	16	SEP: Energy flux of ions in the 1-Reverse field of view, integrated over the energy range 0.03-1.0 MeV, in units of eV/(cm^2-s-ster).
Uncertainty	1636	16	SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Ion Flux (30 keV - 1 MeV) – 3 (FOV 2-Forward)	1652	16	SEP: Energy flux of ions in the 2-Forward field of view, integrated over the energy range 0.03-1.0 MeV, in units of eV/(cm^2-s-ster).
Uncertainty	1668	16	SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Ion Flux (30 keV - 1 MeV) – 4 (FOV 2-Reverse)	1684	16	SEP: Energy flux of ions in the 2-Reverse field of view, integrated over the energy range 0.03-1.0 MeV, in units of eV/(cm^2-s-ster).
Uncertainty	1700	16	SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Electron Flux (30 - 300 keV) – 1 (FOV 1-Forward)	1716	16	SEP: Energy flux of electrons in the 1-Forward field of view, integrated over the energy range 30-300 keV, in units of eV/(cm^2-s-ster).
Uncertainty	1732	16	SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Electron Flux (30 - 300 keV) – 2 (FOV 1-Reverse)	1748	16	SEP: Energy flux of electrons in the 1-Reverse field of view, integrated over the energy range 30-300 keV, in units of eV/(cm^2-s-ster).

Uncertainty	1764	16	SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Electron Flux (30 - 300 keV) – 3 (FOV 2-Forward)	1780	16	SEP: Energy flux of electrons in the 2-Forward field of view, integrated over the energy range 30-300 keV, in units of eV/(cm^2-s-ster).
Uncertainty	1796	16	SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Total Electron Flux (30 - 300 keV) – 4 (FOV 2-Reverse)	1812	16	SEP: Energy flux of electrons in the 2-Reverse field of view, integrated over the energy range 30-300 keV, in units of eV/(cm^2-s-ster).
Uncertainty	1828	16	SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm^2-s-ster).
Look Direction 1 MSO X	1844	16	SEP: X-component of the center of the 1-Forward field of view, i.e. x-component of the vector from the center of the SEP 1AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 1 MSO Y	1860	16	SEP: Y-component of the center of the 1-Forward field of view, i.e. y-component of the vector from the center of the SEP 1AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 1 MSO Z	1876	16	SEP: Z-component of the center of the 1-Forward field of view, i.e. z-component of the vector from the center of the SEP 1AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 2 MSO X	1892	16	SEP: X-component of the center of the 1-Reverse field of view, i.e. x-component of the vector from the center of the SEP 1AO detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 2 MSO Y	1908	16	SEP: Y-component of the center of the 1-Reverse field of view, i.e. y-component of the vector from the center of the SEP 1AO detector to the center of its aperture, in MSO coordinates (dimensionless)

Look Direction 2 MSO Z	1924	16	SEP: Z-component of the center of the 1-Reverse field of view, i.e. z-component of the vector from the center of the SEP 1AO detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 3 MSO X	1940	16	SEP: X-component of the center of the 2-Forward field of view, i.e. x-component of the vector from the center of the SEP 1AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 3 MSO Y	1956	16	SEP: Y-component of the center of the 2-Forward field of view, i.e. y-component of the vector from the center of the SEP 2AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 3 MSO Z	1972	16	SEP: Z-component of the center of the 2-Forward field of view, i.e. z-component of the vector from the center of the SEP 2AF detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 4 MSO X	1988	16	SEP: X-component of the center of the 2-Reverse field of view, i.e. x-component of the vector from the center of the SEP 2AO detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 4 MSO Y	2004	16	SEP: Y-component of the center of the 2-Reverse field of view, i.e. y-component of the vector from the center of the SEP 2AO detector to the center of its aperture, in MSO coordinates (dimensionless)
Look Direction 4 MSO Z	2020	16	SEP: Z-component of the center of the 2-Reverse field of view, i.e. z-component of the vector from the center of the SEP 2AO detector to the center of its aperture, in MSO coordinates (dimensionless)
Magnetic Field MSO X	2036	16	MAG: Magnetic field vector component in the X direction in MSO (sometimes called Sun-State) coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2052	16	MAG: Unused column per instrument lead.

Magnetic Field MSO Y	2068	16	MAG: Magnetic field vector component in the Y direction in MSO (sometimes called Sun-State) coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2084	16	MAG: Unused column per instrument lead.
Magnetic Field MSO Z	2100	16	MAG: Magnetic field vector component in the Z direction in MSO (sometimes called Sun-State) coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2116	16	MAG: Unused column per instrument lead.
Magnetic Field GEO X	2132	16	MAG: Magnetic field vector component in the X direction in GEO coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2148	16	MAG: Unused column per instrument lead.
Magnetic Field GEO Y	2164	16	MAG: Magnetic field vector component in the Y direction in GEO coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2180	16	MAG: Unused column per instrument lead.
Magnetic Field GEO Z	2196	16	MAG: Magnetic field vector component in the Z direction in GEO coordinates. Data is the mean across multiple samples if the instrument sampling rate is higher than standard KP data rate.
Quality	2212	16	MAG: Unused column per instrument lead.
Magnetic Field RMS	2228	16	MAG: Deviations from the mean magnitude of the magnetic field. Specifically, find the mean of the magnitude of the magnetic field vector(de-trended over the time interval with a 2nd order polynomial fit), subtract that mean from the measurements leaving the signed deviations, then add the squares of these deviations, divide by the number of measurements, and take the square root of the whole thing.

Quality	2244	16	MAG: Unused column per instrument lead.
He Density	2260	16	NGIMS: He abundance or upper limit (/cc)
Precision	2276	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2292	16	D = definitive, P = preliminary
O Density	2308	16	NGIMS: O abundance or upper limit (/cc)
Precision	2324	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2340	16	D = definitive, P = preliminary
CO Density	2356	16	NGIMS: CO abundance or upper limit (/cc)
Precision	2372	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2388	16	D = definitive, P = preliminary
N2 Density	2404	16	NGIMS: N2 abundance or upper limit (/cc)
Precision	2420	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2436	16	D = definitive, P = preliminary
NO Density	2452	16	NGIMS: Removed from data set by the NGIMS team, NO counts are too low to be separated from noise and therefore determined to be unreliable. All values set to NaN. (/cc)
Precision	2468	16	NGIMS: Removed from data set by the NGIMS team, all values set to NaN.
Quality	2484	16	Removed from data set by the NGIMS team, all values set to NaN.
Ar Density	2500	16	NGIMS: Ar abundance or upper limit (/cc)
Precision	2516	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2532	16	D = definitive, P = preliminary
CO2 Density	2548	16	NGIMS: CO2 abundance or upper limit (/cc)
Precision	2564	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2580	16	D = definitive, P = preliminary
O2+ Density	2596	16	NGIMS: O2+ abundance or upper limit (/cc)

Precision	2612	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2628	16	D = definitive, P = preliminary
CO2+ Density	2644	16	NGIMS: CO2+ abundance or upper limit (/cc)
Precision	2660	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2676	16	D = definitive, P = preliminary
NO+ Density	2692	16	NGIMS: NO+ abundance or upper limit (/cc)
Precision	2708	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2724	16	D = definitive, P = preliminary
O+ Density	2740	16	NGIMS: O+ abundance or upper limit (/cc)
Precision	2756	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2772	16	D = definitive, P = preliminary
CO+ and N2+ Density	2788	16	NGIMS: Mass 28 ion abundance or upper limit (/cc)
Precision	2804	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2820	16	D = definitive, P = preliminary
C+ Density	2836	16	NGIMS: C+ abundance or upper limit (/cc)
Precision	2852	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2868	16	D = definitive, P = preliminary
OH+ Density	2884	16	NGIMS: OH+ abundance or upper limit (/cc)
Precision	2900	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2916	16	D = definitive, P = preliminary
N+ Density	2932	16	NGIMS: N+ abundance or upper limit (/cc)
Precision	2948	16	NGIMS: % Error (1 sigma). If -1 the value is an upper limit.
Quality	2964	16	D = definitive, P = preliminary
			Ephemeris and pointing data (the following columns) are derived from the SPICE kernels.

Spacecraft GEO X	2980	16	X-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the IAU Mars planetocentric (geographic) coordinate system. **
Spacecraft GEO Y	2996	16	Y-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the IAU Mars planetocentric (geographic) coordinate system.**
Spacecraft GEO Z	3012	16	Z-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the IAU Mars planetocentric (geographic) coordinate system.**
Spacecraft MSO X	3028	16	X-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the MSO coordinate system.* **
Spacecraft MSO Y	3044	16	Y-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the MSO coordinate system.***
Spacecraft MSO Z	3060	16	Z-component of the vector from the center-of-mass of Mars to the center-of-mass of the spacecraft (km), in the MSO coordinate system.***
Spacecraft GEO Longitude	3076	16	Longitudinal component of MAVEN's location with respect to Mars.
Spacecraft GEO Latitude	3092	16	Latitudinal (areodetic) component of MAVEN's location with respect to IAU Mars ellipsoid, equatorial radius of 3396.2 km, polar radius of 3376.2 km.
Spacecraft Solar Zenith Angle	3108	16	Angle measured from MAVEN to the geometric center of the sun's disc, as described using a horizontal coordinate system.
Spacecraft Local Time	3124	16	Local solar time of spacecraft location with respect to Mars
Spacecraft Altitude Ellipsoid	3140	16	Areodetic altitude (km) of MAVEN's location with respect to IAU Mars ellipsoid, equatorial radius of 3396.2 km, polar radius of 3376.2 km
Spacecraft Attitude GEO X	3156	16	X-component of Mars-centered, body-fixed, geographic coordinates (GEO, same as IAU_MARS in SPICE)

Spacecraft Attitude GEO Y	3172	16	Y-component of Mars-centered, body-fixed, geographic coordinates (GEO, same as IAU_MARS in SPICE)
Spacecraft Attitude GEO Z	3188	16	Z-component of Mars-centered, body-fixed, geographic coordinates (GEO, same as IAU_MARS in SPICE)
Spacecraft Attitude MSO X	3204	16	X-component of Mars-centered Mars-Sun-Orbit coordinates (MSO, analogous to GSE coordinates at Earth)
Spacecraft Attitude MSO Y	3220	16	Y-component of Mars-centered Mars-Sun-Orbit coordinates (MSO, analogous to GSE coordinates at Earth)
Spacecraft Attitude MSO Z	3236	16	Z-component of Mars-centered Mars-Sun-Orbit coordinates (MSO, analogous to GSE coordinates at Earth)
APP Attitude GEO X	3252	16	X-component of pointing direction of Articulated Payload Platform in GEO coordinates
APP Attitude GEO Y	3268	16	Y-component of pointing direction of Articulated Payload Platform in GEO coordinates
APP Attitude GEO Z	3284	16	Z-component of pointing direction of Articulated Payload Platform in GEO coordinates
APP Attitude MSO X	3300	16	X-component of pointing direction of Articulated Payload Platform in MSO coordinates
APP Attitude MSO Y	3316	16	Y-component of pointing direction of Articulated Payload Platform in MSO coordinates
APP Attitude MSO Z	3332	16	Z-component of pointing direction of Articulated Payload Platform in MSO coordinates
Orbit Number	3348	16	Orbit 1 begins when MAVEN first reaches inbound altitude of 1000 km, increments each time MAVEN reaches geometric periapsis
Inbound/Outbound Flag	3364	16	Inbound ('I') is from geometric apoapsis to next geometric periapsis in time, outbound ('O') is the reverse
Mars Season (Ls)	3380	16	Martian solar longitude (deg)
Mars-Sun Distance	3396	16	Distance from Mars to the Sun (AU)
Subsolar Point GEO Longitude	3412	16	GEO longitude of the sub-solar point
Subsolar Point GEO Latitude	3428	16	GEO latitude of the sub-solar point
Sub-Mars Point on the Sun, Longitude	3444	16	Solar longitude of the center of the Sun, as seen from Mars

Sub-Mars Point on the Sun, Latitude	3460	16	Solar latitude of the center of the Sun, as seen from Mars
Rotation Matrix 1: Row 1, Column 1	3476	16	Element [1,1] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 1, Column 2	3492	16	Element [1,2] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 1, Column 3	3508	16	Element [1,3] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 2, Column 1	3524	16	Element [2,1] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 2, Column 2	3540	16	Element [2,2] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 2, Column 3	3556	16	Element [2,3] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 3, Column 1	3572	16	Element [3,1] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 3, Column 2	3588	16	Element [3,2] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 1: Row 3, Column 3	3604	16	Element [3,3] of matrix for transformation from IAU Mars coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 1, Column 1	3620	16	Element [1,1] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 1, Column 2	3636	16	Element [1,2] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 1, Column 3	3652	16	Element [1,3] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 2, Column 1	3668	16	Element [2,1] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 2, Column 2	3684	16	Element [2,2] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 2, Column 3	3700	16	Element [2,3] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system

Rotation Matrix 2: Row 3, Column 1	3716	16	Element [3,1] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 3, Column 2	3732	16	Element [3,2] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system
Rotation Matrix 2: Row 3, Column 3	3748	16	Element [3,3] of matrix for transformation from MAVEN spacecraft coordinate system to MAVEN MSO coordinate system

*For the ASCII Key Parameter file, each character/space is equivalent to one byte.

**The IAU Mars coordinate system is an orthogonal, right-handed coordinate system fixed to the body of Mars, the z-axis is aligned with Mars' rotation axis.

***The MSO (Mars-Solar-Orbital) coordinate system is defined as follows: the x-direction is from the center-of-mass of Mars to the center-of mass of the Sun, the y-direction is opposite to Mars' orbital velocity, the z-direction completes the right-handed system and is approximately parallel to the z-direction of the ecliptic.

6.2 Document Product File Formats

Documents are provided in ASCII text and PDF-A formats.

6.3 PDS Labels

PDS labels are ASCII text files written, in the eXtensible Markup Language (XML). All product labels are detached from the digital files (if any) containing the data objects they describe (except Product_Bundle). There is one label for every product. Each product, however, may contain one or more data objects. The data objects of a given product may all reside in a single file, or they may be stored in multiple separate files. PDS4 label files must end with the file extension ".xml".

The structure of PDS label files is governed by the XML documents described in Section 6.3.1.

6.3.1 XML Documents

For the MAVEN mission PDS labels will conform to the PDS master schema based upon the 1.1.0.1 version of the PDS Information Model for structure, and the 1.1.0.1 version of the PDS schematron for content. By use of an XML editor these documents may be used to validate the structure and content of the product labels.

The PDS master schema and schematron documents are produced, managed, and supplied to MAVEN by the PDS. In addition to these documents, the MAVEN mission has produced additional XML documents which govern the products in this archive. These documents contain attribute and parameter definitions specific to the MAVEN mission. A list of the XML documents associated with this archive is included in this document in the XML_Schema collection section for each bundle.

Examples of PDS labels required for the Key Parameter archive are shown in Appendix C (bundle products), Appendix D (collection products), and Appendix E (basic products).

6.4 Delivery Package

Data transfers, whether from data providers to PDS or from PDS to data users or to the deep archive, are accomplished using delivery packages. Delivery packages include the following required elements:

1. The package which consists of a compressed bundle of the products being transferred.
2. A transfer manifest which maps each product's LIDVID to the physical location of the product label in the package after decompression.
3. A checksum manifest which lists the MD5 checksum of each file included in the package after decompression.

Key Parameter archive delivery packages (including the transfer and checksum manifests) for delivery to PDS are produced at the MAVEN SDC.

6.4.1 The Package

The directory structure used in for the delivery package is described in the Appendix in Section F.1. Delivery packages are compressed using zip and are transferred electronically using the ssh protocol.

6.4.2 Transfer Manifest

The "transfer manifest" is a file provided with each transfer to, from, or within PDS. The transfer manifest is external to the delivery package. It contains an entry for each label file in the package, and maps the product LIDVID to the file specification name for the associated product's label file. Details of the structure of the transfer manifest are provided in Section **Error! Reference source not found.**.

The transfer manifest is external to the delivery package, and is not an archive product. As a result, it does not require a PDS label.

6.4.3 Checksum Manifest

The checksum manifest contains an MD5 checksum for every file included as part of the delivery package. This includes both the PDS product labels and the files containing the digital objects which they describe. The format used for a checksum manifest is the standard output generated by the md5deep utility. Details of the structure of the checksum manifest are provided in section F.2.

The checksum manifest is external to the delivery package, and is not an archive product. As a result, it does not require a PDS label.

Appendix A Support staff and cognizant persons

Table 14: Archive support staff

Key Parameter team			
Name	**Address**	**Phone**	**Email**
Patrick Dunn	Space Sciences Laboratory, 7 Gauss Way, University of California, Berkeley, CA 94720	510-502-0257	pdunn@ssl.berkeley.edu

UCLA			
Name	**Address**	**Phone**	**Email**
Dr. Steven Joy PPI Operations Manager	IGPP, University of California 405 Hilgard Avenue Los Angeles, CA 90095-1567 USA	+001 310 825 3506	sjoy@igpp.ucla.edu
Mr. Joseph Mafi PPI Data Engineer	IGPP, University of California 405 Hilgard Avenue Los Angeles, CA 90095-1567 USA	+001 310 206 6073	jmafi@igpp.ucla.edu

Appendix B Naming conventions for MAVEN science data files

This section describes the naming convention used for the MAVEN mission science data files.

Raw (MAVEN Level 0):

mvn_<inst>_<grouping>_l0_< yyyy><mm><dd>_v<xx>.dat

Level 1, 2, 3+:

mvn_<inst>_<level>_<descriptor>_<yyyy><mm><dd>T<hh><mm><ss>_v<xx>_r<yy>.<ext>

In Situ KP:

mvn_kp_insitu_<yyyy><mm><dd>_v<xx>_r<yy>.tab

Code	**Description**
<inst>	3-letter instrument ID
<grouping>	Three-letter code: options are all, svy, and arc for all data, survey data, and archive data respectively. Primarily for PF to divide their survey and archive data at Level 0.
<yyyy>	4-digit year
<mm>	2-digit month, *e.g.* 01, 12
<dd>	2-digit day of month, *e.g.* 02, 31
<hh>	2-digit hour, separated from the date by T. OPTIONAL.
<mm>	2-digit minute. OPTIONAL.
<ss>	2-digit second. OPTIONAL.
v<xx>	2-digit software version: which version of the software was used to create this data product?
r<yy>	2-digit data version: is this a new version of a previous file, though the same software version was used for both? (Likely to be used in the case of retransmits to fill in data gaps)
<descriptor>	A description of the data. Defined by the creator of the dataset. There are no underscores in the value.
.<ext>	File type extension: .fits, .txt, .cdf, .png, .tab
<level>	A code indicating the MAVEN processing level of the data (valid values: l1, l2, l3)

Instrument name	**<instrument>**
IUVS	iuv
NGIMS	ngi
LPW	lpw
MAG	mag
SEP	sep
SWIA	swi
SWEA	swe
STATIC	sta

Appendix C Sample Bundle Product Label

This section provides a sample bundle product label.


```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-model href="http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.sch"
    schematypens="http://purl.oclc.org/dsdl/schematron"?>
<Product_Bundle
    xmlns="http://pds.nasa.gov/pds4/pds/v1"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="
    http://pds.nasa.gov/pds4/pds/v1
    http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.xsd
    ">
    <Identification_Area>

<logical_identifier>urn:nasa:pds:maven.insitu.calibrated</logical_identifier>
        <version_id>17.0</version_id>
        <title>MAVEN Insitu Key Parameters Data Bundle</title>
        <information_model_version>1.4.0.0</information_model_version>
        <product_class>Product_Bundle</product_class>
        <Citation_Information>
            <publication_year>2018</publication_year>
            <description>
                The insitu.calibrated level 2 science.data bundle contains
selected fully
                calibrated (L2) data from the Particles and Fields package
and NGIMS, together
                with ephemeris information. These data are in physical units
and are
                averaged/sampled at a uniform cadence. In situ instrument
data is derived
                directly from Level 2 data. Ephemeris information is derived
using SPICE
                libraries and kernels provided by MAVEN/NAV team and
Lockheed-Martin.
            </description>
        </Citation_Information>
        <Modification_History>
            <Modification_Detail>
                <modification_date>2018-11-27</modification_date>
                <version_id>17.0</version_id>
                <description>
                    MAVEN Release 15, redelivery 1 (2018-11-15). This version
includes a full
                    redelivery of the in situ KP data, together with some new
files.
                    Data coverage is 2014-03-18 to 2018-08-14.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2018-11-13</modification_date>
                <version_id>16.0</version_id>
                <description>
                    MAVEN Release 15 (2018-11-15). This version includes a
full redelivery of the
```

```
                    in situ KP data. Data coverage is 2014-09-21 to 2018-05-
14.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2018-08-23</modification_date>
                <version_id>15.0</version_id>
                <description>
                    MAVEN Release 14 (2018-08-15). This version includes a
full redelivery of the
                    in situ KP data. Data coverage is 2014-09-21 to 2018-05-
14.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2018-05-15</modification_date>
                <version_id>14.0</version_id>
                <description>
                    MAVEN Release 13 (2018-05-15). This version includes a
full redelivery of
                    the in situ KP data. Data coverage is 2014-09-21 to 2018-
02-14. A new version
                    of the archive SIS, and intial version of the Data File
Version Log are also
                    ncluded.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2018-02-21</modification_date>
                <version_id>13.0</version_id>
                <description>
                    MAVEN Release 12 (2018-02-15). This version includes a
full redelivery of
                    the in situ KP data. Data coverage is 2014-09-21 to 2017-
11-14.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2017-12-07</modification_date>
                <version_id>12.0</version_id>
                <description>
                    MAVEN Release 11 (2017-11-15). This version includes a
full redelivery of
                    the in situ KP data.  Data coverage is 2014-09-21 to
2017-08-14.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2017-08-27</modification_date>
                <version_id>11.0</version_id>
                <description>
                    MAVEN Release 10 (2017-08-15). This version includes a
full redelivery of
                    the in situ KP data.  Data coverage is 2014-09-21 to
2017-05-14.
                </description>
            </Modification_Detail>
```

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            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2017-05-23&lt;/modification_date&gt;
                &lt;version_id&gt;10.0&lt;/version_id&gt;
                &lt;description&gt;
                    MAVEN Release 9 (2017-05-15). This version includes a
full redelivery of
                    the in situ KP data.  Data coverage is 2014-09-21 to
2017-02-14.
                &lt;/description&gt;
            &lt;/Modification_Detail&gt;
            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2017-03-10&lt;/modification_date&gt;
                &lt;version_id&gt;9.0&lt;/version_id&gt;
                &lt;description&gt;
                    MAVEN Release 8 (2017-02-15). This version includes a
full redelivery of
                    the in situ  KP data generated using update science input
data. Data
                    coverage is 2014-09-21 to 2016-11-14.
                &lt;/description&gt;
            &lt;/Modification_Detail&gt;
            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2017-01-11&lt;/modification_date&gt;
                &lt;version_id&gt;8.0&lt;/version_id&gt;
                &lt;description&gt;
                    MAVEN Release 7, redelivery 1. This version includes a
full redelivery
                    of the in situ KP data.  These data replace the previous
delivery of
                    Release 7 and all earlier versions of the data.
                &lt;/description&gt;
            &lt;/Modification_Detail&gt;
            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2016-12-07&lt;/modification_date&gt;
                &lt;version_id&gt;7.0&lt;/version_id&gt;
                &lt;description&gt;
                    MAVEN Release 7. This version includes a full redelivery
of the in situ
                    KP data.  These data replace all earlier versions of the
data.
                &lt;/description&gt;
            &lt;/Modification_Detail&gt;
            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2016-12-07&lt;/modification_date&gt;
                &lt;version_id&gt;6.1&lt;/version_id&gt;
                &lt;description&gt;
                    MAVEN Release 6, redelivery 1. This version includes a
full redelivery
                    of the in situ KP data generated using an updated
routine.  These data
                    replace all earlier versions of the data.
                &lt;/description&gt;
            &lt;/Modification_Detail&gt;
            &lt;Modification_Detail&gt;
                &lt;modification_date&gt;2016-08-15&lt;/modification_date&gt;
                &lt;version_id&gt;6.0&lt;/version_id&gt;
                &lt;description&gt;
```

```
                    MAVEN Release 6. This version includes a full redelivery
of the in situ
                    KP data generated using updated science input data.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2016-05-19</modification_date>
                <version_id>5.0</version_id>
                <description>
                    MAVEN Release 5. This version includes a full redelivery
of the in situ
                    KP data generated using updated science input data.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2016-03-14</modification_date>
                <version_id>4.0</version_id>
                <description>
                    MAVEN Release 4. This version includes a full redelivery
of the in situ
                    KP data generated using updated science input data.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2015-11-19</modification_date>
                <version_id>3.0</version_id>
                <description>
                    MAVEN Release 3. This version includes a full redelivery
of the in situ
                    KP data generated using updated science input data, and a
correction
                    to the Articulated Payload Platform (APP) pointing.
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2015-08-24</modification_date>
                <version_id>2.1</version_id>
                <description>
                    MAVEN Release 2
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2015-08-19</modification_date>
                <version_id>2.0</version_id>
                <description>
                    MAVEN Release 2
                </description>
            </Modification_Detail>
            <Modification_Detail>
                <modification_date>2015-07-13</modification_date>
                <version_id>1.0</version_id>
                <description>
                    MAVEN Release 1
                </description>
            </Modification_Detail>
        </Modification_History>
    </Identification_Area>
```

```
    <Context_Area>
        <Time_Coordinates>
            <start_date_time>2014-03-18T00:00:00Z</start_date_time>
            <stop_date_time>2018-08-14T23:59:52Z</stop_date_time>
        </Time_Coordinates>
        <Investigation_Area>
            <name>Mars Atmosphere and Volatile EvolutioN Mission</name>
            <type>Mission</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:investigation:mission.maven</lid_referenc
e>
                <reference_type>bundle_to_investigation</reference_type>
            </Internal_Reference>
        </Investigation_Area>
        <Observing_System>
            <Observing_System_Component>
                <name>MAVEN</name>
                <type>Spacecraft</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument_host:spacecraft.maven</lid_ref
erence>
                    <reference_type>is_instrument_host</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Extreme Ultraviolet Monitor</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:euv.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Langmuir Probe and Waves Instrument</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:lpw.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Magnetometer</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:mag.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Neutral Gas and Ion Mass Spectrometer</name>
                <type>Instrument</type>
                <Internal_Reference>
```

```
<lid_reference>urn:nasa:pds:context:instrument:ngims.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Solar Energetic Particle Experiment</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:sep.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Supra-Thermal and Thermal Ion Composition</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:static.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Solar Wind Electron Analyzer</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:swea.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
            <Observing_System_Component>
                <name>Solar Wind Ion Analyzer</name>
                <type>Instrument</type>
                <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:swia.maven</lid_reference>
                    <reference_type>is_instrument</reference_type>
                </Internal_Reference>
            </Observing_System_Component>
        </Observing_System>

    </Context_Area>
    <Reference_List>

    </Reference_List>
    <Bundle>
        <bundle_type>Archive</bundle_type>
        <description>
            This file contains a brief overview of the MAVEN Insitu Key
Parameters data bundle.
        </description>
    </Bundle>
    <File_Area_Text>
        <File>
            <file_name>readme_maven_insitu_key_parameter_17.0.txt</file_name>
```

```
            <local_identifier>Readme</local_identifier>
            <creation_date_time>2018-11-27T17:57:19</creation_date_time>
            <md5_checksum>980d2d06fafed93cce70508614cb6918</md5_checksum>
            <comment>
                This file contains a brief overview of the MAVEN Insitu Key
Parameters data bundle.
            </comment>
        </File>
        <Stream_Text>
            <name>readme_maven_insitu_key_parameter_17.0.txt</name>
            <local_identifier>Readme</local_identifier>
            <offset unit="byte">0</offset>
            <object_length unit="byte">8136</object_length>
            <parsing_standard_id>7-Bit ASCII Text</parsing_standard_id>
            <description>
                This file contains a brief overview of the MAVEN Insitu Key
Parameters data bundle.
            </description>
            <record_delimiter>Carriage-Return Line-Feed</record_delimiter>
        </Stream_Text>
    </File_Area_Text>
    <Bundle_Member_Entry>

<lidvid_reference>urn:nasa:pds:maven.insitu.calibrated:data.kp::16.0</lidvid_
reference>
        <member_status>Primary</member_status>
        <reference_type>bundle_has_data_collection</reference_type>
    </Bundle_Member_Entry>
    <Bundle_Member_Entry>

<lidvid_reference>urn:nasa:pds:maven.insitu.calibrated:document::1.2</lidvid_
reference>
        <member_status>Primary</member_status>
        <reference_type>bundle_has_document_collection</reference_type>
    </Bundle_Member_Entry>
</Product_Bundle>
```

Appendix D Sample Collection Product Label

This section provides a sample collection product label.


```xml
<?xml version="1.0" encoding="UTF-8"?>
<?xml-model href="http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
<?xml-model href="http://pds.nasa.gov/pds4/mission/mvn/v1/PDS4_MVN_1030.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
<Product_Collection
   xmlns="http://pds.nasa.gov/pds4/pds/v1"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:mvn="http://pds.nasa.gov/pds4/mission/mvn/v1"
   xsi:schemaLocation="
      http://pds.nasa.gov/pds4/pds/v1
      http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.xsd

      http://pds.nasa.gov/pds4/mission/mvn/v1
      http://pds.nasa.gov/pds4/mission/mvn/v1/PDS4_MVN_1030.xsd
    ">
   <Identification_Area>

<logical_identifier>urn:nasa:pds:maven.insitu.calibrated:data.kp</logical_ide
ntifier>
      <version_id>16.0</version_id>
      <title>MAVEN Insitu Key Parameters Data Collection</title>
      <information_model_version>1.4.0.0</information_model_version>
      <product_class>Product_Collection</product_class>
      <Citation_Information>
         <publication_year>2018</publication_year>
         <description>
            Key Parameters from the in situ instruments on MAVEN: NGIMS, EUV,
LPW, MAG, SEP, STATIC, SWEA, and SWIA. Instrument data is derived directly
from Level 2 data. Ephemeris information is derived using SPICE libraries and
kernels provided by MAVEN/NAV team and Lockheed-Martin.
         </description>
      </Citation_Information>
      <Modification_History>
         <Modification_Detail>
            <modification_date>2018-11-27</modification_date>
            <version_id>17.0</version_id>
            <description>MAVEN Release 15</description>
         </Modification_Detail>
      </Modification_History>
   </Identification_Area>
   <Context_Area>
      <Time_Coordinates>
         <start_date_time>2014-03-18T00:00:00Z</start_date_time>
         <stop_date_time>2018-08-14T23:59:52Z</stop_date_time>
      </Time_Coordinates>
      <Primary_Result_Summary>
         <purpose>Science</purpose>
         <processing_level>Calibrated</processing_level>
      </Primary_Result_Summary>
      <Investigation_Area>
         <name>Mars Atmosphere and Volatile EvolutioN Mission</name>
         <type>Mission</type>
```

```
        <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:investigation:mission.maven</lid_referenc
e>
            <reference_type>collection_to_investigation</reference_type>
        </Internal_Reference>
      </Investigation_Area>
      <Observing_System>
        <Observing_System_Component>
          <name>MAVEN</name>
          <type>Spacecraft</type>
          <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:instrument_host:spacecraft.maven</lid_ref
erence>
              <reference_type>is_instrument_host</reference_type>
          </Internal_Reference>
        </Observing_System_Component>
        <Observing_System_Component>
          <name>Extreme Ultraviolet Monitor</name>
          <type>Instrument</type>
          <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:instrument:euv.maven</lid_reference>
              <reference_type>is_instrument</reference_type>
          </Internal_Reference>
        </Observing_System_Component>
        <Observing_System_Component>
          <name>Langmuir Probe and Waves Instrument</name>
          <type>Instrument</type>
          <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:instrument:lpw.maven</lid_reference>
              <reference_type>is_instrument</reference_type>
          </Internal_Reference>
        </Observing_System_Component>
        <Observing_System_Component>
          <name>Magnetometer</name>
          <type>Instrument</type>
          <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:instrument:mag.maven</lid_reference>
              <reference_type>is_instrument</reference_type>
          </Internal_Reference>
        </Observing_System_Component>
        <Observing_System_Component>
          <name>Neutral Gas and Ion Mass Spectrometer</name>
          <type>Instrument</type>
          <Internal_Reference>
 
<lid_reference>urn:nasa:pds:context:instrument:ngims.maven</lid_reference>
              <reference_type>is_instrument</reference_type>
          </Internal_Reference>
        </Observing_System_Component>
        <Observing_System_Component>
          <name>Solar Energetic Particle Experiment</name>
          <type>Instrument</type>
```

```
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:sep.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
         <Observing_System_Component>
            <name>Supra-Thermal and Thermal Ion Composition</name>
            <type>Instrument</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:static.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
         <Observing_System_Component>
            <name>Solar Wind Electron Analyzer</name>
            <type>Instrument</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:swea.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
         <Observing_System_Component>
            <name>Solar Wind Ion Analyzer</name>
            <type>Instrument</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:swia.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
      </Observing_System>
      <Target_Identification>
         <name>Mars</name>
         <type>Planet</type>
         <Internal_Reference>

<lid_reference>urn:nasa:pds:context:target:planet.mars</lid_reference>
            <reference_type>collection_to_target</reference_type>
         </Internal_Reference>
      </Target_Identification>
      <Mission_Area>
         <MAVEN xmlns="http://pds.nasa.gov/pds4/mission/mvn/v1">
            <mission_phase_name>Mars Orbital Insertion</mission_phase_name>
            <mission_phase_name>Transition</mission_phase_name>
            <mission_phase_name>Prime Mission</mission_phase_name>
            <mission_phase_name>EM-1</mission_phase_name>
            <mission_phase_name>EM-2</mission_phase_name>
         </MAVEN>
      </Mission_Area>
   </Context_Area>
   <Reference_List>

   </Reference_List>
   <Collection>
```

```
      <collection_type>Data</collection_type>
      <description>
         Key Parameters from the in situ instruments on MAVEN: NGIMS, EUV,
LPW, MAG, SEP, STATIC, SWEA, and SWIA. Instrument data is derived directly
from Level 2 data. Ephemeris information is derived using SPICE libraries and
kernels provided by MAVEN/NAV team and Lockheed-Martin.
      </description>
   </Collection>
   <File_Area_Inventory>
      <File>
         <file_name>collection_data_l2_insitu_kp_17.0.csv</file_name>
         <creation_date_time>2018-11-27T17:05:58</creation_date_time>
         <file_size unit="byte">118114</file_size>
         <md5_checksum>b6551bf373f9b816969b1497f9db83bd</md5_checksum>
      </File>
      <Inventory>
         <offset unit="byte">0</offset>
         <parsing_standard_id>PDS DSV 1</parsing_standard_id>
         <records>1545</records>
         <record_delimiter>Carriage-Return Line-Feed</record_delimiter>
         <field_delimiter>Comma</field_delimiter>
         <Record_Delimited>
            <fields>2</fields>
            <groups>0</groups>
            <maximum_record_length unit="byte">257</maximum_record_length>
            <Field_Delimited>
               <name>Member_Status</name>
               <field_number>1</field_number>
               <data_type>ASCII_String</data_type>
               <maximum_field_length unit="byte">1</maximum_field_length>
            </Field_Delimited>
            <Field_Delimited>
               <name>LIDVID_LID</name>
               <field_number>2</field_number>
               <data_type>ASCII_LIDVID_LID</data_type>
               <maximum_field_length unit="byte">255</maximum_field_length>
            </Field_Delimited>
         </Record_Delimited>
         <reference_type>inventory_has_member_product</reference_type>
      </Inventory>
   </File_Area_Inventory>
</Product_Collection>
```

Appendix E Sample Data Product Labels

This section provides sample product labels for the various data types described in this document.


```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-model href="http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
<?xml-model href="http://pds.nasa.gov/pds4/mission/mvn/v1/PDS4_MVN_1040.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
<Product_Observational
   xmlns="http://pds.nasa.gov/pds4/pds/v1"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:mvn="http://pds.nasa.gov/pds4/mission/mvn/v1"
   xsi:schemaLocation="
      http://pds.nasa.gov/pds4/pds/v1
      http://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1400.xsd

      http://pds.nasa.gov/pds4/mission/mvn/v1
      http://pds.nasa.gov/pds4/mission/mvn/v1/PDS4_MVN_1040.xsd
 ">
   <Identification_Area>

<logical_identifier>urn:nasa:pds:maven.insitu.calibrated:data.kp:mvn_kp_insit
u_20180202</logical_identifier>
      <version_id>4.0</version_id>
      <title>MAVEN Insitu Key Parameters</title>
      <information_model_version>1.4.0.0</information_model_version>
      <product_class>Product_Observational</product_class>
      <Citation_Information>
         <editor_list>Dunn, P. A.</editor_list>
         <publication_year>2018</publication_year>
         <description>
             Key parameters data for the MAVEN in situ instruments (NGIMS,
EUV, LPW, MAG, SEP, STATIC, SWEA, and SWIA) for the date 2018-02-02.
         </description>
      </Citation_Information>
      <Modification_History>
         <Modification_Detail>
            <modification_date>2018-11-17</modification_date>
            <version_id>4.0</version_id>
            <description>
               Redelivered version
            </description>
         </Modification_Detail>
      </Modification_History>
   </Identification_Area>
   <Observation_Area>
      <Time_Coordinates>
         <start_date_time>2018-02-02T00:00:00Z</start_date_time>
         <stop_date_time>2018-02-02T23:59:52Z</stop_date_time>
      </Time_Coordinates>
      <Primary_Result_Summary>
         <purpose>Science</purpose>
         <processing_level>Calibrated</processing_level>
      </Primary_Result_Summary>
      <Investigation_Area>
```

```
         <name>Mars Atmosphere and Volatile EvolutioN Mission</name>
         <type>Mission</type>
         <Internal_Reference>

<lid_reference>urn:nasa:pds:context:investigation:mission.maven</lid_referenc
e>
            <reference_type>data_to_investigation</reference_type>
         </Internal_Reference>
      </Investigation_Area>
      <Observing_System>
         <Observing_System_Component>
            <name>MAVEN</name>
            <type>Spacecraft</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument_host:spacecraft.maven</lid_ref
erence>
               <reference_type>is_instrument_host</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
         <Observing_System_Component>
            <name>Extreme Ultraviolet Monitor</name>
            <type>Instrument</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:euv.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
         </Observing_System_Component>
         <Observing_System_Component>
            <name>Langmuir Probe and Waves Instrument</name>
            <type>Instrument</type>
            <Internal_Reference>

<lid_reference>urn:nasa:pds:context:instrument:lpw.maven</lid_reference>
               <reference_type>is_instrument</reference_type>
            </Internal_Reference>
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Appendix F PDS Delivery Package Manifest File Record Structures

The delivery package includes two manifest files: a transfer manifest, and MD5 checksum manifest. When delivered as part of a data delivery, these two files are not PDS archive products, and do not require PDS labels files. The format of each of these files is described below.

F.1 Transfer Package Directory Structure

Zip file directory structure follows that used by the MAVEN SDC.

F.2 Checksum Manifest Record Structure

The checksum manifest consists of two fields: a 32 character hexadecimal (using lowercase letters) MD5, and a file specification from the root directory of the unzipped delivery package to every file included in the package. The file specification uses forward slashes ("/") as path delimiters. The two fields are separated by two spaces. Manifest records may be of variable length. This is the standard output format for a variety of MD5 checksum tools (*e.g*. md5deep, etc.).