

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**

**In Situ Key Parameters**

**PDS Archive**

**Software Interface Specification**

**Rev. 5.2**

**Oct 16, 2019**

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# 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.

## Distribution List

Table 1: Distribution list

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## 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 |

## TBD Items

Table 3: List of TBD items

| **Item** | **Section(s)** | **Page(s)** |
| --- | --- | --- |
|  |  |  |
|  |  |  |

## 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) |
| 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) |
| 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 |

## 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.

## 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/km3). 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/km3 (~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.

### 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.

### 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.

### 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.

## 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.

## 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.

## 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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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).

## 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.

# 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.

# 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 |

## 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 |
| 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+ |

## 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.

## 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.

**Bundle**

**Collection A**

**Basic Product A1**

**Basic Product A2**

**Basic Product A3**

**Basic Product A*N***

**…**

**Collection B**

**Basic Product B1**

**Basic Product B2**

**Basic Product B3**

**Basic Product B*N***

**…**

**Collection C**

**Basic Product C1**

**Basic Product C2**

**Basic Product C3**

**Basic Product C*N***

**…**

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.

### 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. |

## 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 |

## 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.

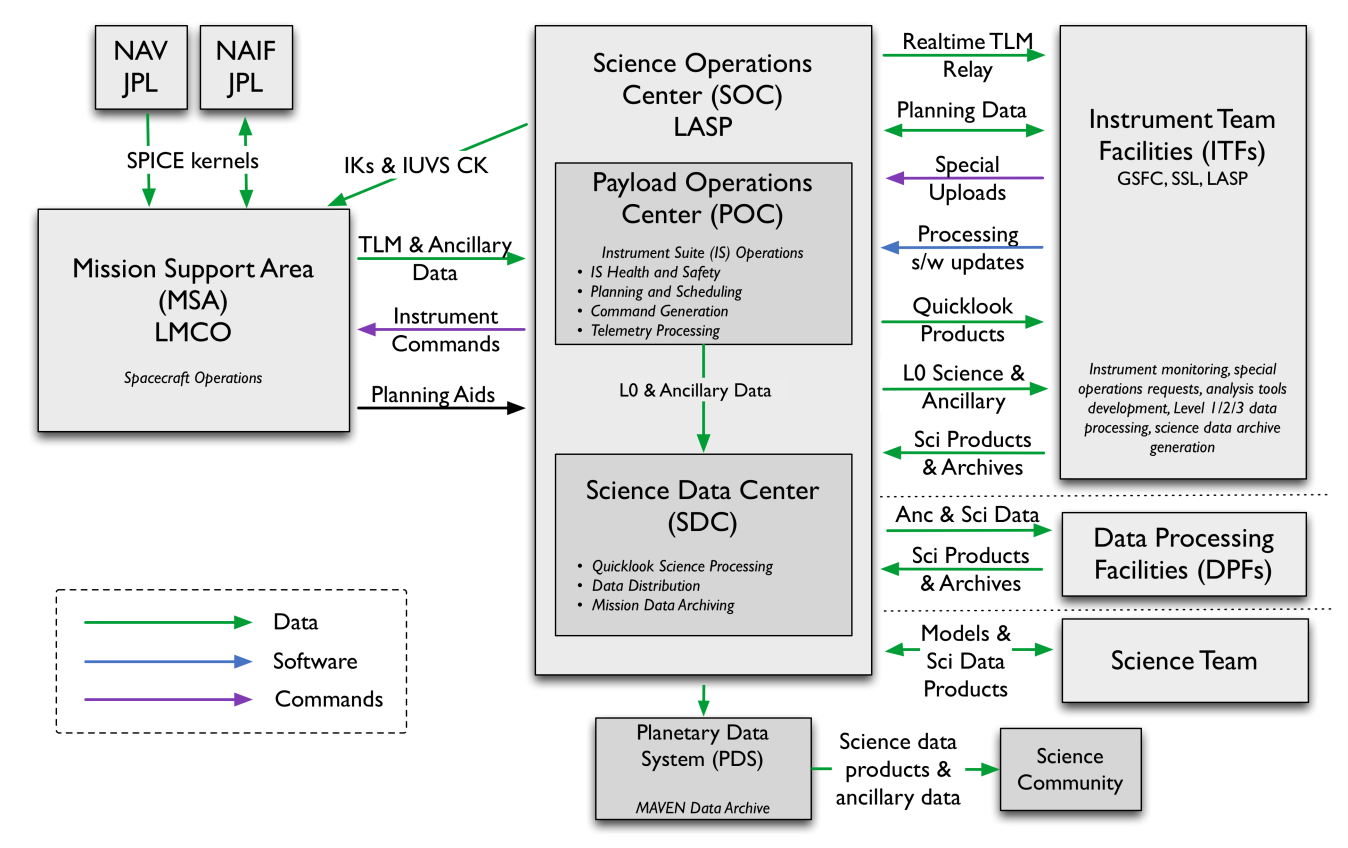


Figure 2: MAVEN Ground Data System responsibilities and data flow. Note that this figure includes portions of the MAVEN GDS which are not directly connected with archiving, and are therefore not described in Section 3.5 above.

# 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.

## 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.

### 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.

## 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.

### 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.

## 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.

## 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.

## 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.

MAVEN insitu KP ITF

Deep Archive (NSSDC)

PDS Planetary Plasma Interactions (PDS-PPI) Node

Peer Review

Committee

PDS-PPI Node Mirror Site

Data Users

PDS-PPI Public Web Pages

Review Data

Validation Report

Archive Delivery

Delivery Receipt

Backup Copy

Archive Assurance

Validated Data

# 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.

## 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.

### 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.

### 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.

## 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.

### 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 |

#### 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.

#### 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.

# 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.

## Data File Formats

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

### 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/m2) |
| 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/m2) |
| 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/m2) |
| 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 ), 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 ), 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/(cm2-s-ster). |
| Quality | 436 | 16 | SWEA: Statistical uncertainty (1 ), 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/(cm2-s-ster). |
| Quality | 468 | 16 | SWEA: Statistical uncertainty (1 ), 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/(cm2-s-ster). |
| Quality | 500 | 16 | SWEA: Statistical uncertainty (1 ), 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/(cm2-s-ster). |
| Quality | 532 | 16 | SWEA: Statistical uncertainty (1 ), 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/(cm2-s-ster). |
| Quality | 564 | 16 | SWEA: Statistical uncertainty (1 ), 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/(cm2-s-ster). |
| Quality | 596 | 16 | SWEA: Statistical uncertainty (1 ), 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: O2+ 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: O2+ 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 |
|  |  |  |  |
| O2+ Flow Velocity MAVEN\_APP X | 1044 | 16 | STATIC: O2+ 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 |
|  |  |  |  |
| O2+ Flow Velocity MAVEN\_APP Y | 1076 | 16 | STATIC: O2+ 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 |
|  |  |  |  |
| O2+ Flow Velocity MAVEN\_APP Z | 1108 | 16 | STATIC: O2+ 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: O2+ 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: O2+ 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: O2+ 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/(cm2-s-ster). |
| Uncertainty | 1604 | 16 | SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1636 | 16 | SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1668 | 16 | SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1700 | 16 | SEP: Standard uncertainty in ion energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1732 | 16 | SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1764 | 16 | SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1796 | 16 | SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm2-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/(cm2-s-ster). |
| Uncertainty | 1828 | 16 | SEP: Standard uncertainty in electron energy flux based on Poisson statistics, in units of eV/(cm2-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](http://en.wikipedia.org/wiki/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.

## Document Product File Formats

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

## 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.

### 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).

## 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.

### 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.

### 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.

### 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.

1. 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 |

1. 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 |

1. 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>

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<Modification\_Detail>

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<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>

<Modification\_Detail>

<modification\_date>2017-05-23</modification\_date>

<version\_id>10.0</version\_id>

<description>

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.

</description>

</Modification\_Detail>

<Modification\_Detail>

<modification\_date>2017-03-10</modification\_date>

<version\_id>9.0</version\_id>

<description>

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.

</description>

</Modification\_Detail>

<Modification\_Detail>

<modification\_date>2017-01-11</modification\_date>

<version\_id>8.0</version\_id>

<description>

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.

</description>

</Modification\_Detail>

<Modification\_Detail>

<modification\_date>2016-12-07</modification\_date>

<version\_id>7.0</version\_id>

<description>

MAVEN Release 7. This version includes a full redelivery of the in situ

KP data. These data replace all earlier versions of the data.

</description>

</Modification\_Detail>

<Modification\_Detail>

<modification\_date>2016-12-07</modification\_date>

<version\_id>6.1</version\_id>

<description>

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.

</description>

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<Modification\_Detail>

<modification\_date>2016-08-15</modification\_date>

<version\_id>6.0</version\_id>

<description>

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\_reference>

<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\_reference>

<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>

1. Sample Collection Product Label

This section provides a sample collection 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"?>

<?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\_identifier>

<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\_reference>

<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\_reference>

<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>

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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.

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1. Sample Data Product Labels

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

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xmlns:mvn="http://pds.nasa.gov/pds4/mission/mvn/v1"

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http://pds.nasa.gov/pds4/pds/v1/PDS4\_PDS\_1400.xsd

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<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.

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<name>STATIC:Dominant pickup ion characteristic direction MSO Z</name>

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<name>STATIC:Dominant pickup ion characteristic angular width</name>

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<name>STATIC:Dominant pickup ion characteristic angular width counts</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 1-F</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 1-F uncertainty</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 1-R</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 2-F</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 2-F uncertainty</name>

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<name>SEP:Ion Flux (30-1000 keV), FOV 2-R uncertainty</name>

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<name>SEP:Look direction 1-F MSO X</name>

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<name>MAG:Magnetic Field MSO X quality</name>

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<name>MAG:Magnetic Field MSO Y</name>

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<name>MAG:Magnetic Field MSO Y quality</name>

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<name>MAG:Magnetic Field RMS Deviation</name>

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<name>SPICE:Spacecraft attitude GEO Y</name>

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<name>SPICE:Spacecraft attitude MSO Z</name>

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<name>SPICE:APP Attitude GEO Y</name>

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<name>SPICE:Mars-Sun distance</name>

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1. 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.

* 1. Transfer Package Directory Structure

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

* 1. 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.).